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LEGAL AND POLICY GAPS IN NIGERIA'S RENEWABLE ENERGY FRAMEWORK: A CASE FOR WAVE AND TIDAL ENERGY

BABATUNDE PATRICK COKER

PhD **2025**

LEGAL AND POLICY GAPS IN NIGERIA'S RENEWABLE ENERGY FRAMEWORK: A CASE FOR WAVE AND TIDAL ENERGY

By

BABATUNDE PATRICK COKER

A thesis submitted in partial fulfilment of the

requirements of

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Abstract

Nigeria's wave and tidal energy resources remain underdeveloped, unlike other renewable energy resources such as bioenergy, hydropower, solar and wind, which have witnessed limited development. In essence, the research problem is how to justify the necessity for harnessing wave and tidal energy resources in Nigeria and ultimately provide a legal framework to integrate wave and tidal energy into Nigeria's overall renewable energy enactments. This thesis aimed to search for any gaps or inconsistencies in Nigeria's RE enactments and its governance strategy concerning wave and tidal energy. The objective of the thesis was to identify and critically analyse Nigeria's renewable energy enactments, related policies, and laws, with a specific focus on how they deal with wave and tidal energy. The research methodology and design utilised qualitative, doctrinal, and comparative approaches for desk-based data collection and data analysis of primary and secondary legal sources. The thesis also critically examined the enactments in Scotland, Canada (British Columbia and Nova Scotia), and South Korea for their best practices and lessons. This study found that Nigeria's current enactments did not specifically address wave and tidal energy resources, and, as a result, Nigeria's wave and tidal energy sector has not contributed towards electricity generation. Further, the study found gaps and inconsistencies within the renewable energy legal framework. Finally, this research highlighted lessons from jurisdictions with established ocean energy systems, specifically in wave and tidal energy. This research contributed to knowledge by filing the legislative and policy gaps of Nigeria's renewable energy sector. It also identified some critical gaps in both literature and law, and proposed a legal framework for integrating ocean energy into Nigeria's existing energy regime. This thesis laid a foundation for future academic, legal, and policy developments in Nigeria and similar coastal states in West Africa.

Keywords: Wave and tidal energy, Renewable Energy Resources, Climate, mitigation, Emission, Transition, Sustainable Development, Policy Nigeria, Scotland

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List of Abbreviations

AAD	Across Atlantic Development
AB	Aquabuoy
AEDPA	Alternative Energy Development Promotion Act
AfDB	African Development Bank
AFOLU	Agriculture, forestry and other land use
AMREP	Areas of Marine Renewable Energy Priority
AR	Allocation round
ASP	Administrative strike price
AWS	Archimedes Wave Swing
BC Hydro	British Columbia Hydro
BC	British Columbia
Bcf/d	billion cubic feet per day
BEIS	Business, Energy and Industrial Strategy
CALD	Council of Australian Law Deans
CCA	Climate Change Act
CCUS	Carbon Capture, Utilization, and Storage
CEA	Clean Energy Act
CER	Canada Energy Regulation
CfD	Contract for Difference
CHC	Canadian Hydraulics Centre
CHP	Combined Heat and Power
CIA	Canada's Impact Assessment Act 2019
CLM	Comparative Law Methodology
CMMEA	Conservation and Management of Marine Ecosystems Act
CNMP	Commercial Net-metering Program
CO2	Carbon dioxide
COMFIT	Community-oriented feed-in tariff
COP	Conference of the Parties
COVID 19	Corona Virus Disease 2019
CPI	Consumer Price Index

CSP	Concentrated solar power; kW = kilowatt
DARES	Distributed Access through Renewable Energy Scale-up
DECC	Department of Energy and Climate Change
DFO	Department of Fisheries
EA	Electricity Act (Amendment) 2024
EAO	Environmental Assessment Office
ECN	Energy Commission of Nigeria
ECN	Energy Commission of Nigeria
ECNA	Electricity Commission of Nigeria Act 1989
EEMP	Environmental Effects Monitoring Program
EGL2	Eastern Green Link 2
EIAA	Environmental Impact Assessment Act
EMEC	European Marine Energy Centre
EPSRA	Electric Power Sector Reform Act
ERBA	Energy and Regulatory Boards Act
ERCN	Electricity Regulatory Commission of Nigeria
ERGP	Economic Recovery Growth Plan
ESDPA	Electric Source Development Promotion Act 2016
EU	European Union
EUA	Electric Utility Act 2017
EURA	Energy Use Rationalization Act of 1979
FA	Finance Act
FALCGG	Framework Act on Low Carbon, Green Growth, 2010
FAST	Fundy Advanced Sensor Technology
FDI	Foreign Direct Investment
FGN	Federal Government of Nigeria
FiPs	feed-in Premiums
FITs	Feed in tariffs
FMSTIP	Federal Ministry of Science Innovation and Technology
FORCE	Fundy Ocean Research Centre for Energy
FRMA	Fishery Resources Management Act

G20	Group of Twenty
G7	Group of Seven
GEAPP	Global Energy Alliance for People and Planet
GENCOs	Generating Companies
GGA	Green Growth Act, 2010
GgCO2 eq.	Gigatons of CO2 warming equivalent
GHGs	Greenhouse Gases
GIZ	German Development Agency
GW	Gigawatts
GWEC	Global Wind Energy Council
HCA	Heat Control Act 1974
HPP	Hydroelectric Power Plant
HVDC	High Voltage DC Converter
ICEs	Internal Combustion Engines
ICREEE	Inter-Ministerial Committee on Renewable Energy and Energy Efficiency
IDA	International Development Association
IEA	International Energy Agency
IESA	Integrated Energy Supply Act
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
IRP	Integrated Resource Plan
ISO	Independent Systems Operator
KEPCO	Korea Electric Power Corporation
KMEMA	Korea Marine Environment Management Act.
KNA	Korean National Assembly
KORDI	Korea Ocean Research and Development Institute
KRISO	Korea Research Institute of Ships and Ocean Engineering
ktoe	Kilotons of Oil Equivalent
LCCC	Low Carbon Contract Company
LCOE	Levelized Cost of Energy

LDP	Legal data points
LRMC	Long Run Marginal Cost
LU	Land Use Act 1978
LULUCF	Land-Use Land Use, Change and forestry
MAEA	More Access to Energy Act
MaPP	Marine Plan Partnership for the North Pacific Coast
MEC	Marine Energy Council
mmb/d	million barrels per day
MOF	Ministry of Oceans and Fisheries
MOTIE	Ministry of Trade, Industry, and Energy
MREA	Marine Renewable Energy Area
MS LOT	Marine Scotland Licensing Operations Team
MSP	Marine Spatial Planning
MSTPA	Marine Science and Technology Promotion Act
MtCO2e	Metric tons of carbon dioxide equivalent
MW	Mega Watt
MWh	megawatt-hour
MYTO 1	Multi-Year Tariff Order 1
NAP	National Adaptation Plan
NASENI	National Agency for Science and Engineering Infrastructure
NASPA/CCN	National Adaptation Strategy and Plan of Action on Climate Change for Nigeria
NBET	Nigerian Bulk Electricity Trading Limited
NCCPRS	National Climate Change Policy and Response Strategy (2012)
NCERD	National Centre of Energy Research and Development
NCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NEP	National Energy Policy
NEP	Nigerian Electrification Project
NEP	National Energy Policy 2003
NEPA PLC	Nigeria Electricity Power Authority Public Liability Company

NEPA	National Electric Power Authority
NEPP	National Electric Power Policy 2001
NERC	Nigerian Electricity Regulatory Commission
NESCO	Nigerian Electricity Supply Corporation
NESCO	Nigeria Electricity Supply Company
NESI	Nigeria Energy Supply Industry
NESO	National Energy System Operator
NETA	New Electricity Trading Arrangements
NFFO	Non-Fossil Fuel Obligation
NIHSA	Nigeria Hydrological Services Agency
NIOMR	Nigerian Institute for Oceanography and Marine Research
NPGRE	National Policy and Guidelines on Renewable Electricity
NREAP	National Renewable Electricity Action Programme
NREAP	National Renewable Energy Action Plan
NREEEP	National Renewable Energy and Energy Efficiency Policy
NSGB	Nigerian Sovereign Green Bonds
NSMRE	Nova Scotia Marine Renewable Energy Act 2015
NSREP	Nova Scotia Renewable Energy Plan 2009
NSREPs	Nova Scotia's renewable Energy plans (2009 and 2015)
NSTIP	National Science Technology and Innovation Policy
OECD	Organization for Economic Co-operation and Development
OEP	Ocean Energy Policy 2011
OES	Ocean Energy Systems
OFGEM	Office of Gas and Electricity Markets
OSCOLA	Oxford University Standard for the Citation of Legal Authorities
OTEC	Ocean Thermal Energy Currents
OWC	Oscillating Water Column
OWEIP	Offshore Wind Environmental Improvement Package
PA	Petroleum Act 2021
PHCN	Power Holding Company of Nigeria

PV Solar	Photovoltaic Solar
PV/T	Photovoltaic-thermal
PWP	Pelamis Wave Power
R&D	Research and Development
RAP	Tidal Stream Energy
RE	Renewable Energy
REA	Rural Electrification Agency
REA	Renewable Energy Agency
REAP	Renewable Electricity Action Programme
REC	Renewable Energy Credits
REF	Renewable Energy Fund
REFIT	Regulations on Feed-In-Tariff
REMP	Renewable Energy Master plan
REMP	Renewable Energy Master Plan
REN21	Renewable Energy Policy Network for the 21st Century
REPG	Renewable Electricity Policy Guidelines
RES-E	Renewable Energy Sources – Electricity
RESIP	Rural Electrification Strategy, and Implementation Plan
RETs	Renewable Energy Technologies
REZ	Renewable Energy Zone
RIW	Remote Island Wind
RO	Renewables Obligation
RPS	Renewable Portfolio Standard
SCF	Standard Cubic Feet
SE4ALL	Sustainable Energy for All
SE4ALL-AA	Sustainable Energy for All Action Agenda
SEAs	Strategic Environmental Assessments
SERC	Sokoto Energy Research Centre
SHESTCO	Science Museum at Sheda Science and Technology Complex
SHP	Small-Scale Hydro Power
SNH	Scottish Natural Heritage

SREPP	Smart Renewables and Electrification Pathways Programme
SRIA	Strengthening Research Institutions in Africa
SROCs	Scottish Renewable Energy Obligations
SSEN	Scottish and Southern Electricity Network Transmission
TCF	trillion cubic feet
TETFund	Tertiary Education Trust Fund
TNUoS	Transmission Network Use of System
TWh	Terra Watt per hour
UNDP	United Nations Development Programme
UNESCO	United Nations Education Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNSDG	United Nations Sustainable Development Goals
USAID	United States Agency for International Development
WD	Wave Dragon
WEC	Wave Energy Converters
WTE	Wave and Tidal energy
$/MWh	Dollars/megawatt hour
£/MWh	Pound/megawatt hour

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Dedication

This thesis is dedicated to Late Pa James A O Coker and Odede Victoria Coker, nee Olusa; Awa Dabo, Tomiwa Coker, Late Dr. Abiodun Onadipe and Ebi Japhet. Thank you all for your prayers and support.

CHAPTER ONE - BACKGROUND AND OVERVIEW OF THE RESEARCH

1.1 Introduction

The need for countries to explore all potential sources of renewable energy cannot be overstressed because of the impact of fossil fuels on the environment and the consequent issues of energy security and climate change. To tackle these environmental and energy issues plaguing the world, the United Nations encourage countries to collaborate because the impact is global. Subsequently, the United Nations has enacted international instruments to encourage, guide, and propel countries on how to combat these global energy, climate, and environmental issues. For example, the 1987 Report, 'Our Common Future' by the United Nations Commission on Environment and Development, acknowledged the need for a global effort to protect the environment for the future because of the environmental problems caused by the persistent extraction and reliance on fossil fuels.[1] Additionally, international instruments such as the Rio Earth Summit of 1992,[2] the Kyoto Protocol of 1997,[3] the Copenhagen Accord of 2009,[4] the Doha Amendment of 2012,[5] and the Paris Agreement of 2015 all addressed the need for a global effort towards the protection of the climate and the environment. However, the Paris Agreement, which this research concentrates on, made a special case for countries to take actions for the mitigation and adaptation of climate change impacts,[6] which this researcher argues entails the increased development and use of all potential sources of renewable energy, not least facilitating energy transition.

---

[1] World Commission on Environment and Development, *Our Common Future: Brundtland Report 1987* (Oxford University Press, 1997).

[2] United Nations Sustainable Development Goals, 'United Nations Conference on Environment and Development (UNCED), Earth Summit (1992)', <https://sustainabledevelopment.un.org/milestones/unced >accessed 14 November 2024.

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[6] United Nations Climate Change, 'The Paris Agreement and Nationally Determined Contributions' <https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs> accessed 14 November 2024.

Furthermore, the accelerating pace of the energy transition necessitates a "revolutionary" approach to increase and achieve the net-zero target, which remains unachieved in many jurisdictions, including Nigeria.[7] This approach should encompass all nations to adequately address energy demands and prevent further deterioration of the climate crisis.[8] Wave and tidal energy are promising yet underexplored renewable energy resources that have the potential to significantly contribute to the world's future energy mix, particularly in light of the urgent need for sustainable energy solutions and the growing global concern over climate change.[9] The successful reduction of greenhouse gases (GHG) in this decade will determine whether we can limit the increase in global temperature to 1.5^{o}C or potentially 2^{o}C.[10] GHG reduction is crucial, particularly because the world's most vulnerable populations are already experiencing the destructive effects of climate change.[11]

Therefore, correcting these induced disasters such as fires, floods, or droughts should be a common priority. Consequently, the key to this correction effort is renewable energy. The International Renewable Energy Agency (IRENA), in its World Energy Transition Outlook 2023, aptly argues that electrification and efficiency propelled by renewable energy resources such as 'wave and tidal energy' are key transition drivers.[12] Accordingly, energy transition is one of the world's most pressing issues today. For instance, the global warming and climate change concerns addressed by the Paris Agreement encourage a transition from fossil fuels to renewable energy.[13] Ostensibly, 196 countries, including Nigeria, adopted the Paris Agreement—an international agreement—on December 12, 2015, to combat the climate change crisis.[14] Under the Paris Agreement, climate change is described as an increase in the

[7]David Toke, *Energy Revolutions Profiteering versus Democracy*) (Pluto Press 2024) ch 1.
[8] ibid.
[9] International Renewable Energy Agency, 'Renewable 2023 Global Status Report' REN21 (2023) <https://www.ren21.net/gsr-2023/modules/global_overview/> accessed 2 May 2024.
[10] International Renewable Energy Agency, 'World Energy Transition Outlook 2023: 1.5^{0}C Pathway' (2023) IRENA <https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/Jun/IRENA_World_energy_transitions_outlook_2023.pdf > accessed 12 November 2024.
[11] ibid.
[12] ibid.
[13] United Nations Sustainable Development Goals, 'What We'll be listening for at UNGA 76' (2021) SDG Knowledge Hub <http://sdg.iisd.org/commentary/policy-briefs/what-well-be-listening-for-at-unga-76/> accessed 12 November 2024.
[14] United Nations Climate Change, 'Paris Agreement: what is the Paris Agreement?'<https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement> accessed 7 November 2024.

global temperature to levels above 2°C or 1.5°C compared to pre-industrial levels.[15] In the Paris Agreement, countries committed to reducing global warming.[16] This underscores the crucial role of renewable energy in the energy sector, prompting annual gatherings of world leaders to underscore the need for collective action against climate change and to foster the advancement of all renewable energy sources and technology.[17]

For instance, at the time of writing, November 2024, countries are gathered in Baku, Azerbaijan, for COP29, deliberating on how to collectively act against climate change by cutting down emissions, with the UK's grand pledge of 81% emissions reduction by 2035.[18] While at COP 28 in Dubai, UAE, one of the highlights of the conference was the "*signalling of the beginning of the end for the fossil fuel era and laying the ground for a swift, just and equitable transition, underpinned by deep emission cuts and scaled-up finance"*.[19] In this light, COP 28 called on governments to fast-track the transition away from fossil fuel to renewables in their climate commitments.[20] Therefore, it is argued that issues of energy security and the environment remain a continuing global concern; hence, the need for countries to increase the use and development of environment-friendly (alternative to fossil fuels) sources of energy. However, to manage issues of energy security and to protect the environment, countries in line with the United Nations legal instruments must legislate on the need to cut emissions and the energy transition to renewables. This is why the current research finds that with the relevant legal framework, with evaluation and monitoring mechanisms, Nigeria, on its part, can explore all its potential sources of renewable energy, including support schemes, which promote the use and development of energy from renewable energy sources such as wave and tidal energy resources.

[15] Article 2 United Nations Framework Convention on Climate Change (Paris Agreement) 2015.
[16] Article 5 Paris Agreement.
[17] Patricia Espinosa, 'Four Keys to Success at COP26' (2021) United Nations Climate Change <https://unfccc.int/news/patricia-espinosa-outlines-the-four-keys-to-success-at-cop26> accessed 12 November 2024.
[18] Esme Stallard, 'PM describes 'ambitious' UK climate target' *BBC* (London, 12 November 2024) <https://www.bbc.co.uk/news/live/cly0qzxqzrmt?post=asset%3A027e3c3e-fbb1-453d-9256-cbc2a2ec1921#post> accessed 14 November 2024.
[19] United Nations Climate Change, 'COP 28: What Was Achieved and What Happens Next?' <https://unfccc.int/cop28/5-key-takeaways#end-of-fossil-fuels> accessed 7 May 2024.
[20] ibid

It is worth noting that Nigeria ratified the Paris Agreement in May 2017[21], thereby committing to cut its carbon emission unconditionally by 20% or conditionally by 47% with the support of international partners by 2030.[22] Therefore, Nigeria expresses its commitment to its Nationally Determined Contribution (NDC) and other targets set, including ending gas flaring by 2030.[23] Further, Nigeria revised its NDC in May 2021 to include clean cooking to convert from cooking fuels, for example, kerosene and charcoal, to cooking gas that is eco-friendly.[24] Thus, in May 2021, Nigeria submitted its NDC interim report to the United Nations Framework Convention on Climate Change (UNFCCC).[25] In addition to Nigeria's commitment to the Paris Agreement on Climate Change[26], Nigeria's position at COP28 was a combined advocacy for equitable climate finance, proactive planning for energy transition, and navigating the complexities of global climate politics.[27] As a result, Nigeria sought investments to decarbonise its energy sector while still seeking to utilise more gas resources.[28]

Still on its commitment to the Paris Agreement, on 18 November 2021, Nigeria signed the National Climate Change Bill into law, CCA.[29] This researcher believes that the CCA is likely to foster the success of Nigeria's NDC because the CCA embodies a legal framework that would facilitate the effective execution of Nigeria's NDC while also reaffirming Nigeria's commitment to the global climate agenda. However, having the law is one thing, but implementing it through existing infrastructure is another. Therefore, it remains to be seen whether the results will encourage energy transition,

[21] United Nations Climate Change, 'Nigeria' (2017) <https://unfccc.int/node/61130> accessed 8 November 2024.
[22] United Nations Framework Convention on Climate Change, 'Record of the facilitative sharing of views at the fifty-eight session of the Subsidiary Body for Implementation: Nigeria' (2023) Note by the Secretariat <Facilitative sharing of views record (unfccc.int)> accessed 2 May 2024.
[23] Federal Ministry of Environment, 'Submission of an Interim Report to the Updated Nationally Determined Contribution' (2021) <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nigeria%20First/NDC%20INTERIM%20REPORT%20SUBMISSION%20-%20NIGERIA.pdf> accessed 8 November 2024.
[24] ibid.
[25] ibid.
[26] The White House, 'President Biden Invites 40 World Leaders to Leaders' Summit on Climate' (2021) <https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/26/president-biden-invites-40-world-leaders-to-leaders-summit-on-climate/> accessed 12 November 2024.
[27] United Kingdom Nigeria Infrastructure Advisory Faculty, 'Nigeria and UKNIAF at COP 28' (2024) <https://ukniaf.ng/2024/02/14/nigeria-and-ukniaf-at-cop28/#:~:text=In%20this%20light%2C%20Nigeria's%20stance,complexities%20of%20global%20climate%20politics> accessed 14 June 2024.
[28] ibid.
[29] The Cable, 'Buhari signs Climate Change Bill into Law' (2021) <https://www.thecable.ng/breaking-buhari-signs-climate-change-bill-into-law> accessed 9 December 2021.

particularly the advancement of renewables through wave and tidal energy. Indeed, the CCA 2021 aligns with domesticating the Paris Agreement and adopting national legislation that addresses climate change issues. Nonetheless, Nigeria's approach to gas flaring must change because the World Bank's global gas flaring tracker report shows that Nigeria is one of the top seven countries in gas flaring.[30] This is why this researcher believes that it is crucial to recognise that fostering technological innovations plays a significant role in reducing Nigeria's reliance on fossil fuels. As a result, investments in technological advancement will facilitate the growth of wave and tidal energy, particularly as these technologies continue to evolve and remain comparatively costly.

On renewable energy resources, IRENA acknowledged that the sources of energy include geothermal, hydro-energy, bioenergy, solar, wind, and ocean energy.[31] Renewable energy is energy from inexhaustible sources and is acclaimed to be relatively clean, sustainable, and environmentally friendly when compared to fossil fuel-generated energies.[32] Thus, renewable energy remains the most viable alternative to fossil fuel energy, and the sources of renewable energy are inexhaustible, unlike fossil fuels.[33] Ocean energy sources provide significant advantages over other types of renewable energy sources. This research revealed that ocean technology exhibits high predictability, and the density of water concerning waves and tides indicates the potential for generating more energy.[34]

Also, according to IRENA Director General Francesco La Camera, 'Renewable energy from oceans has the potential to meet four times the global electricity demand of today, promote blue economy and bring socio-economic gains to some of the area's

[30] World Bank, 'Global Gas Flaring Track Report' (2021) <https://thedocs.worldbank.org/en/doc/1f7221545bf1b7c89b850dd85cb409b0-0400072021/original/WB-GGFR-Report-Design-05a.pdf> accessed 9 December 2021.
[31] International Renewable Energy Agency, 'Ocean Energy' <https://www.irena.org/ocean> accessed 9 December 2021.
[32] Columbo Emanuela, Stefano Bologna and Diego Masera, *Renewable Energy for sustainable development blending technology, finance, and policy in low income economies* (Cham Springer 2013) Pt 1.
[33] Lawrence Atsegbua and Sunday Dauda, *Beyond Fossil Fuels: Renewable Energy Law and Policy* (Fifers Lane 2019) pp 75 -82.
[34] United Nations Climate Change, 'Wave of the Future' (2021) < https://unfccc.int/blog/wave-of-the-future> accessed 12 December 2021.

most vulnerable to climate change.'[35] Consequently, this research shows that Nigeria is endowed with renewable energy resources, including wave and tidal energy resources. However, as of December 2024, Nigeria's wave and tidal energy remain undeveloped, unlike other renewable energy sources, including solar and hydro-energy.[36] Further, this research demonstrates that key factors contribute to the non-development of wave and tidal energy despite the abundance of ocean energy resources in Nigeria. Accordingly, factors identified in this research include a lack of legal framework and support schemes to promote the development of wave and tidal energy in Nigeria, irrespective of Nigeria's ocean energy resources. In all, it is crucial to support investment in wave and tidal energy, particularly when there is a clear and transparent support system in place for its development and use.

1.2 An Overview of Wave and Tidal Energy (WTE)

Wave and tidal energy are types of renewable ocean energy that utilise the natural motion of ocean waters to produce electricity.[37] As clean and sustainable energy sources, they possess considerable potential to mitigate global energy and climate issues, especially for coastal and island nations. The wind-induced surface motion of the sea generates wave energy.[38] Oscillating water columns, attenuators, and point absorbers are all technologies that have been developed to capture wave energy.[39] These devices are intended to convert the kinetic energy of waves into electrical power. In contrast, Tidal energy is produced by the predictable rise and fall of ocean tides, which are influenced by the gravitational interaction between the Earth, moon, and sun to generate electricity for public use.[40] It can be harnessed through the use of tidal stream turbines, tidal barrages, or tidal lagoons.[41] The hybrid wave-tidal

[35] International Renewable Energy Agency, 'IRENA and Ocean Energy Europe Partner to Drive Ocean Energy Industry' (2020) Press Release <https://www.irena.org/newsroom/pressreleases/2020/Dec/IRENA-and-Ocean-Energy-Europe-Partner-to-Drive-Ocean-Energy-Industry> accessed 12 December.
[36] David O Obada, Mamuda Muhammad, Bala Tajiri, Mkpe O Kekung, Simeon Abolade, Shittu B Akinpelu and Akinlolu Akande, 'A review of renewable energy in Nigeria for climate change mitigation' (2024) 9 CSCEE 10 <https://doi.org/10.1016/j.cscee.2024.100669 > accessed 27 February 2024.
[37] IRENA, 'Ocean energy', <https://www.irena.org/Energy-Transition/Technology/Ocean-energy> accessed 7 April 2025.
[38] ibid.
[39] EMEC, 'Wave devices', <https://www.emec.org.uk/marine-energy/wave-devices/> accessed 07 April 2025.
[40] Pacific Northwest National Laboratory, 'Tidal Energy', <https://www.pnnl.gov/projects/ocean-dynamics-modeling/tidal-energy> accessed 07 April 2025.
[41] National Geographic, Tidal Energy, <https://education.nationalgeographic.org/resource/tidal-energy/> accessed 07 April 2025.

energy conversion presents a potential solution to enhance output power and stability by leveraging their complementary characteristics.[42] Compared to other renewable energy sources, tidal energy is highly regarded for its exceptional predictability and dependability. Both wave and tidal energy are still in the early stages of commercial development, with most projects being pilot-scale or demonstration-based.[43] However, technological advancements and growing interest in clean energy transitions are driving increased research, investment, and policy attention globally.

Table 1: Summary of Turbine Designs & Estimated Technology Readiness Level (TRL)[44]

Turbine Design	Description	Estimated (TRL)
Horizontal Axis - Fixed	Like standard wind turbines, blades are fixed radially to a horizontal shaft. The turbine is attached to a module, which rests on the seabed.	8
Horizontal Axis - Floating	Turbines are of a similar design to fixed horizontal axis, but the module to which they are attached floats on the sea surface, and moored and anchored to the seabed.	7
Vertical Axis	The blades are vertical and parallel to the rotating shaft. Tidal flow through the blades causes the shaft to rotate irrespective of the flow direction.	5
Tidal Kite	A hydrodynamic wing ('kite') with an integral turbine is attached to the seabed or a floating platform via a cable.	6
Venturi/Opencentre	The turbine is contained in a duct, which concentrates the tidal flow, causing an increased velocity when it reaches the turbine.	7
Reciprocating Device/Oscillating Hydrofoil	A hydrofoil attached to an arm is moved up and down by tidal flows. Electricity is generated by this movement being transferred to a turbine.	5
Archimedes Screw/Spiral	A helical structure attached to a generator rotates as tidal flows pass through it.	6
Hybrid Wave-Tidal Energy Conversion	Presents a potential solution to enhance output power and stability by leveraging their complementary characteristics	

[42] Peihao Chen, Dawei Wu, 'A review of hybrid wave-tidal energy conversion technology', Ocean Engineering, Volume 303, 2024, <https://doi.org/10.1016/j.oceaneng.2024.117684.> accessed 07 April 2025.
[43] IRENA, 'Scaling Up Investments in Ocean Energy Technologies' 2023, <https://www.oceanenergy-europe.eu/wp-content/uploads/2023/03/IRENA_OEE_Scaling_up_investment_ocean_energy_2023.pdf> accessed 07 April 2025.
[44] Frazer-Nash Consultancy, Review of Technical Assumptions and Generation Costs Levelised Cost of Electricity from Tidal Stream Energy, May 2023, <https://assets.publishing.service.gov.uk/media/655372484ac0e1001277d819/tidal-lcoe-report.pdf> accessed 29 September 2024.

1.2.1 Distinguishing features of wave and tidal energy from other RE sources

Wave and tidal energy are unique among renewable energy sources due to their ocean origins, predictability, and technological challenges. These are some distinguishing features that make them different including:

- Source of energy. Wave Energy is harnessed from the surface motion of ocean waves, which are created by wind blowing over the sea. Tidal Energy is derived from the rise and fall of ocean tides, caused by the gravitational interaction between the earth, moon, and sun. Other renewables like solar and wind are atmospheric or terrestrial, and they rely on sunlight and air currents, respectively.
- Predictability: Tidal energy is highly predictable, as the tidal cycles follow consistent lunar patterns, making energy output easier to forecast. Wave energy is more variable than tides, but it is still more reliable than wind or solar energy in some coastal regions. Solar and wind are less predictable and more dependent on weather conditions and time of day.
- Energy Density: Ocean energy, especially tidal, is more energy-dense than solar or wind, meaning it can produce more power per unit area.
- Technology Maturity: Less mature wave and tidal energy technologies are still in the development or demonstration phase in many parts of the world. In contrast, solar PV and wind turbines are well-developed and widely deployed with declining costs.
- Location Specificity: Ocean-based wave and tidal systems can only be deployed in coastal or ocean environments with the right conditions. Solar and wind can be installed almost anywhere—rooftops, deserts, plains, offshore, etc.
- Environment Impact: Ocean energy can have site-specific environmental impacts, such as disruption of ocean habitats and changes in tidal flow and sediment transport. Other renewables, such as solar and wind, have their impacts but generally interact less with aquatic ecosystems.

1.2.2 Prospects in terms of energy generation.

In this context, oceans hold huge renewable energy reserves, particularly kinetic and potential energy, as the most extractable sources, produced from different ocean processes such as waves and tides.[45] It is reported that the estimated global theoretical wave energy potential is nearly 29,500 TWh/year, and the total tidal energy potential amounted to nearly 26,000 TWh/year.[46] Therefore, extracting these energy resources can help achieve net zero emission targets by 2050. This is important as future global demand for electricity is estimated to rise, for example, from ~23,000 TWh in 2015 to ~49,000 TWh in 2050. There is consensus that efficiently utilising wave, tidal, and current energy could help provide reliable electricity, particularly to small island developing states (SIDS), create socio-economic benefits, ensure a climate-friendly energy mix, and foster the emerging blue economy worldwide.[47]. Despite several benefits and vast resources, wave/tidal energy (together) contributed only 1.6 TWh (relative to approximately 23,000 TWh of electricity consumed) globally in 2020.[48]

1.2.3 Challenges facing Wave and Tidal Energy.

This minimal contribution to the global energy mix might be attributed to several challenges concerning materials and manufacturing, hydrodynamics, survivability and reliability, environmental resources, array configurations, power conversion and control systems, maritime safety, and socio-economic ramifications. Additionally, governance, grid connection, and infrastructure - for example, integrating wave and tidal energy into national electricity grids presents unique technical, infrastructural, and regulatory challenges. These include the remoteness of resource locations, variability in power output, limited transmission infrastructure, and the lack of grid codes tailored to ocean energy.[49]

[45] Danial Khojasteh, Abbas Shamsipour, Luofeng Huang, Sasan Tavakoli, Milad Haghani, Francois Flocard, Maryam Farzadkhoo, Gregorio Iglesias, Mark Hemer, Matthew Lewis, Simon Neill, Michael M. Bernitsas, William Glamore, A large-scale review of wave and tidal energy research over the last 20 years, Ocean Engineering, Volume 282, 2023, <https://doi.org/10.1016/j.oceaneng.2023.114995.> accessed 05 April 2025. Should this footnote be in green highlight or is it not new?
[46] ibid.
[47] ibid.
[48] ibid.
[49] ibid.

1.3 Research Statement

This research is based on the researcher's philosophical position[50] that Nigeria's laws and policies should promote and develop wave and tidal energy. In essence, the coastal states of Nigeria will benefit from wave and tidal-generated electricity, which will also increase access to clean and sustainable energy towards accomplishing the NDC targets. For example, Elieen Linklater, the Corporate Affairs Director of EMEC, asserted that wave and tidal energy have the potential to drive net-zero objectives, strengthen energy security, and foster green growth.[51] In this regard, Nigeria should learn lesson[52] from jurisdictions where tidal and wave energy are being explored to power homes. For example, in Scotland, where a huge tidal energy project is built to power about 175,000 homes.[53] While in Korea, the Korean Institute of Ocean Science and Technology (KIOST) established a Korean tidal energy centre site with a capacity of 4.5MW.[54] Further, for technological advancement, innovation, and transfer, Nigeria can partner with the European Marine Energy Centre (EMEC), the world's first and leading centre for developing and testing technologies that generate electricity by harnessing the power of waves and tidal streams in the sea.[55] For example, in July 2020, Korean authorities contracted the services of EMEC for its technological support.[56]

Another effort at harnessing wave and tidal energy resources was made by the Welsh Government in December 2021, which approved the construction of 35 million pounds for Morlais Menter Môn's tidal stream energy project.[57] Subsequently, the

[50] Mark NK Saunders, P Lewis and Adrian Thornhill, *Research Methods for Business Students* (8th edn, Pearson 2019) pp 130-131.
[51] Elieen Linklater, 'Tidal Power has potential to address energy challenges faced by Scottish Coastal Community' (EMEC, 4 November 2024) <https://www.emec.org.uk/tidal-power-has-potential-to-address-energy-challenges-faced-by-scottish-coastal-communities/> accessed 15 November 2024.
[52] Department for Business Energy & Industrial Strategy, Lessons Learnt from MeyGen Phase 1A Final Summary Report, <https://tethys-engineering.pnnl.gov/sites/default/files/publications/MeyGen-Lessons-Learnt-Full-Report.pdf> accessed 7 May 2024.
[53] TETHYS, MeyGen Tidal Energy Project, <https://tethys.pnnl.gov/project-sites/meygen-tidal-energy-project> accessed 7 May 2024.
[54] Adis Ajdin, 'EMEC gets onboard Korean tidal test site project' (*Offshore Energy*, 9 July 2020) <https://www.offshore-energy.biz/emec-gets-onboard-korean-tidal-test-site-project/> accessed 12 November 2024.
[55] EMEC, 'About' <https://www.emec.org.uk/about-us/> accessed 15 November 2024.
[56] Adis Ajdin, 'EMEC gets onboard Korean tidal test site project' (*Offshore Energy*, 9 July 2020) <https://www.offshore-energy.biz/emec-gets-onboard-korean-tidal-test-site-project/> accessed 12 December 2021.
[57] Cyfoeth Naturiol Cymru Natural Resources Wales, 'Marine licence issued by NRW for the Morlais tidal demonstration zone' (14 December 2021) <https://naturalresources.wales/about-us/news-and-

turbine project, covering the Crown-designated 35sq km of the seabed off the coast of Ynys Cybi, commenced in 2022. The Morlais tidal project is expected to generate about 240MW of electricity through tidal stream energy.[58] As of 2024, the landfall substation and the cabling to the grid connection are completed, and the first devices are expected to be deployed in 2026.[59] Certainly, the transition from fossil fuel to renewable energy is taking a more solid shape as more countries focus their attention on cleaner sources of energy. For example, Portugal has an ideal environment for wave energy generation, such as the Hiwave-5 project in Northern Portugal.[60] This project, which the European Union supports, is provided through the NORTE 2020 Programme operated by AICEP Portugal Global (Portuguese Trades and Investment Agency) and CCDR – N (Norte Portugal Regional Coordination and Development Commission).[61] The project aimed at bringing CorPowers wave Technology to a bankable product offering by 2026[62] by proving the survivability, performance, and economics of a grid-connected array of wave energy converters.[63] As of 2024, a five-stage approach to commercialisation of wave project that began with small prototype validation tests at tank test scale, a third scale system test, a half-scale device ocean deployment and stage 4.[64]

1.4 Research Question

The principal question this research seeks to answer is: how can we justify the necessity for the harnessing of wave and tidal energy resources in Nigeria and ultimately provide a legal framework to integrate wave and tidal energy into Nigeria's overall renewable energy enactments?

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events/news/marine-licence-issued-by-nrw-for-the-morlais-tidal-demonstration-zone/?lang=en> accessed 15 November 2024.

[58] ibid.

[59] Government renewables announcement, 'North Wales tidal energy scheme welcomes government renewables announcement' (*Menter Morlais*, 8 March 2024) <https://www.morlaisenergy.com/en/news/latest-news/government-renewables-announcement-2024-03-08> accessed 11 May 2024.

[60] TETHYS, 'CorPower Ocean HiWave-5 Project' <https://tethys.pnnl.gov/project-sites/corpower-ocean-hiwave-5-project> accessed 11 May 2024.

[61] Ocean Energy Europe, 'CorPower Secures €7.3 investment into Portuguese wave project' (*Ocean Energy Europe:* 2 February 2021) <https://www.oceanenergy-europe.eu/industry-news/corpower-secures-e7-3m-investment-into-portuguese-wave-project/> accessed 16 November 2024.

[62] ibid.

[63] ibid.

[64] Ocean Energy Europe, 'CorPower Ocean Announces wave energy breakthrough in Portuguese water' (*Ocean Energy Europe*: 29 February 2024 <https://www.oceanenergy-europe.eu/industry-news/corpower-ocean-announces-wave-energy-breakthrough-in-portuguese-waters/> accessed 16 November 2024.

1.5 Research Aim

This research aims to search for any gaps or inconsistencies in Nigeria's renewable energy enactments and its governance strategy concerning wave and tidal energy, thereby justifying the need for a legal framework that supports wave and tidal energy resources in Nigeria.

1.6 Research Objectives

- To identify and critically analyse Nigeria's renewable energy enactments with a specific focus on how it deals with wave and tidal energy.
- To identify and critically examine how related enactments, such as financial and technological acts, can promote the harnessing of wave and tidal energy in Nigeria.
- To critically evaluate what effects, if any, Nigeria's existing RE enactments have had on set targets, policies and programmes which support the energy mix.
- To evaluate RE enactments and policies from other jurisdictions with a focus on wave and tidal energy sources, including Scotland, Canada, South Korea and other countries. This will guide the most appropriate laws and policies to allow energy to be harvested from marine resources through a comparative study of other jurisdictions.
- Proposing a framework that will incorporate best practices and lessons from other jurisdictions into the governance of Nigeria's renewable energy legislation, specifically in wave and tidal energy.

1.7 Contribution to knowledge

This research makes a significant contribution to the field of energy law and policy by addressing the largely unexplored issue of integrating wave and tidal energy into Nigeria's renewable energy framework. While much of the existing literature and legal instruments in Nigeria focus primarily on solar, wind, and hydro sources, this thesis highlights the untapped potential of marine energy — specifically wave and tidal power — as a viable component of the country's renewable energy mix. Using a doctrinal and comparative methodology, the study critically examines the existing legal and regulatory gaps in Nigeria's energy sector, particularly the absence of any coherent legislative or policy structure for ocean energy. In doing so, it brings to light

the severe limitations in both legal coverage and technological preparedness that hinder the development of wave and tidal energy in Nigeria. The research further contributes to knowledge by drawing on comparative lessons from jurisdictions with advanced marine energy frameworks. These insights inform the development of a contextualised legal model for Nigeria that can guide the integration of wave and tidal energy into the country's broader renewable energy enactments. This model is not only new in the Nigerian context but also serves as a foundation for future legal reforms across similar jurisdictions in West Africa with untapped ocean energy resources. In summary, this thesis fills a critical gap in academic and legislative discourse by:

- Bringing attention to the neglect of wave and tidal energy in Nigeria's renewable energy narrative;
- Providing an original legal framework to support its integration;
- Offering a comparative legal analysis that grounds the recommendations in both global best practices and local realities.

This contribution lays the groundwork for future academic inquiry, policy development, and legal reform aimed at fostering a more inclusive and sustainable energy future for Nigeria.

1.8 Ethical Issues of the Research

The research employed doctrinal and desk-based approaches, which absolved it from the stringent ethical rigours typically associated with quantitative research. Nonetheless, the researcher was mindful of impending ethical constraints as prescribed by international academic standards as well as those within RGU protocols on research ethics. The researcher eschewed plagiarism and upheld academic transparency and accountability throughout the study. This research did not involve or relate to human subjects or animals, and it also did not involve any confidential information. In addition, the research impact is not harmful or has any cost implications. To sum up, the researcher has consistently and consciously examined all ethical issues, including those from Robert Gordon University and other libraries, to find ways to handle them.

1.9 Impact of the Research

The topic area of this research is relatively new in Nigeria, where there has not been much research on wave and tidal energy. Additionally, the West Africa sub-region, which includes Nigeria, boasts abundant ocean energy resources from the Atlantic Ocean. This research will have Legal and Regulatory Impact, Policy and Governance Relevance, Academic Contribution, environmental and Sustainable Development, Regional Influence, Economic and Social Impact.

- Legal and Regulatory Impact: Proposes a different legal framework for integrating wave and tidal energy into Nigeria's renewable energy legislation thereby filling a gap by providing relevant information on the RE development. Offers a practical legal guide for policymakers, regulators, and legislative drafters seeking to reform and expand Nigeria's energy laws.
- Policy and Governance Relevance. Supports evidence-based policymaking by highlighting regulatory gaps and proposing tailored legislative solutions. Encourages inter-agency collaboration and long-term energy planning inclusive of marine energy technologies.
- Academic Contribution. Fills a critical gap in the academic literature concerning Ocean renewable energy law in West Africa. Serves as a foundational resource for further legal, environmental, and policy research on wave and tidal energy in developing countries.
- Sustainable Development. Aligns with global sustainability goals, particularly: SDG 7 – Affordable and Clean Energy; SDG 13 – Climate Action. Promotes cleaner, low-carbon energy solutions that support climate resilience and energy transition.
- Regional Influence. Offers comparative insights and legal models that may inform energy reform efforts in other ECOWAS countries with similar marine potential.
- Economic and Social Impact. Opens avenues for green technology investment, innovation, and potential job creation in Nigeria's coastal areas. Contributes to long-term energy security and diversification of Nigeria's power sources. Further, instance, the research's evidence and outcomes will raise awareness

regarding formulating wave and tide energy policies and developing appropriate legislation. Further, investment in wave and tidal energy will promote business development and growth. Additionally, investing in wave and tidal energy will enhance awareness and knowledge about climate change and the transition from fossil fuels to wave and tidal energy and consequently reduce environmental challenges, particularly in the coastal areas of the Niger Delta.

CHAPTER TWO - RESEARCH METHODOLOGY AND LITERATURE REVIEW

2.1 Introduction

This chapter covers the literature review and the research methodology in detail, thereby laying the foundation for the whole thesis. Generally, the qualitative research methodology is the deliberate and systematic conduct of the study of the research process, beginning from the planning to reporting the outcomes of the research process. It entails a qualitative research method which involves data collection and analysis of primary and secondary legal sources, including legislation, journals, and peer-reviewed articles from industry practitioners. Primarily, the doctrinal legal research methodology entails initially identifying, locating, and reading the laws and policies, followed by interpreting and analysing the text. In other words, it includes elaborate steps to read, analyse, and link the first-hand data to the known body of law. In this light, this research studied laws and policies, including the search for gaps in the regulation of renewable energy in Nigeria, with a specific focus on wave and tidal energy resources.

Thereafter, the thesis discusses the details of the comparative law method. The comparative research methodology provided the tools to research the renewable energy laws, policies, and programmes of comparator jurisdictions, including British Columbia, Nova Scotia, Scotland, and South Korea. The research collected data from sources such as relevant international, regional, and national renewable energy legal frameworks, along with academic and peer-reviewed articles and journals. The desk-based research gathered relevant international, regional, and national laws and properly identified and described the research problem in an explanatory manner to ensure coherence and consistency of outcomes. Accordingly, this chapter covers a review of key literature, the research philosophy, research design, doctrinal research methodology, and comparative research methodology.

2.2 Literature Review

In this section, the researcher carried out a review of available literature in the subject area. However, it is worth noting that the development of wave and tidal energy is practically non-existent within Nigeria, not least a legal framework supporting its growth. Accordingly, research shows that publications on Nigeria's renewable energy resources only considered wind energy, solar energy, and biomass energy.[65] Empathically, in Nigeria, there is no book on wave and tidal energy resources, irrespective of Nigeria's ocean energy resources. As a result, the review in this section is done by reviewing available journal articles on Nigeria's renewable energy resources. Therefore, there is a paucity of scholarly literature on wave and tidal energy resources in Nigeria. Wave and tidal energy do not have any reported publications. Consequently, this has provided evidence of a lack of published literature on wave and tidal energy in Nigeria, which validates the need for the current research that aims to make a case for a renewable energy legal framework that considers wave and tidal energy resources.

In the developing world, many people live in energy poverty and yearn for access to energy, not least clean and sustainable energy. Renewable energy adoption has escalated on a global scale because of the transformative shift in power generation.[66] For instance, REN21 disclosed that renewable energy has witnessed a "surge" and doubling since 2020.[67] As a result, the renewable energy sector has experienced relentless advancements in technology, operational efficiency and cost competitiveness. The progressive growth that renewable energy has experienced is propelled by a combination of several factors, for example, technological development, innovation and financial support, which Hassan and others argued have been spearheaded by proactive government policies.[68] Nigeria has huge ocean energy potential of wave and tidal energy that, if harnessed, can provide electricity to rural

[65] B H Adedayo, S A Adio and B O Oboirien, 'Energy research in Nigeria: A bibliometric analysis' (2021) 34 ESR 100629 <https://doi.org/10.1016/j.esr.2021.100629> assessed 14 November 2024.
[66] Qusay Hassan, Sameer Algburi, Aws Zuhair Sameen, Tariq J Al-Musawi, Ali Khudhair Al-Jiboory, Hayder M Salman, Bashar Mahmood Ali and Marek Jaszczur, 'A comprehensive review of international renewable energy growth' (2024) Energy and Built Environment <https://doi.org/10.1016/j.enbenv.2023.12.002> accessed 21 February 2024.
[67] REN21, Renewables Now, Findings: Renewables 2024 Global Status Report Energy Supply, p 11, <https://www.ren21.net/wp-content/uploads/2019/05/GSR2024_supply_presentation.pdf> 16 October 2024.
[68] Hassan and others (n 66).

and urban Nigeria. To buttress this, an investigation revealed that the East and West coastal areas of Nigeria's Gulf of Guinea provide opportunities for the harvesting of ocean energy.[69] Thus, the need to create a balanced and transformative renewable energy legal framework underpinned by excellent research for the needed energy transition cannot be over-emphasised. For example, Nigeria's 2024 Electricity (Amendment) Act only passively mentioned wave and tidal energy without adequate provision for harnessing the resources relative to solar and wind energy. Accordingly, this legislation is further examined in chapter four of this research.

Brimmo and others, in a 2017 article titled "Sustainable energy development in Nigeria: Wind, hydropower, geothermal and nuclear", provide an in-depth review of the wind, hydropower, geothermal and nuclear energy options in Nigeria for the sustainable development of its power sector.[70] The authors also considered the potential, current developmental stages, and prospects of each of the energy conversion techniques in the Nigerian context are presented.[71] In addition, the study identified weaknesses in the available data for each considered renewable energy option such that the existing data is not sufficient to make definitive global assessments of the country's prospects in this sector.[72] Finally, the authors conclude that a countrywide resource mapping across all technologies is required for a reliable outlook of sustainable energy development in Nigeria.[73] However, although the authors were considering renewable energy resources and sustainable development in Nigeria's energy sector, the authors did not specifically acknowledge the relevance of wave and tidal energy resources to sustainable development, not least in the power sector. Nonetheless, this research in looking at Nigeria's renewable energy sector supports the relevance of developing all potential sources of renewable energy, including wave and tidal energy.

[69] L M Amoo, 'Techno-economic assessment of energy production potential from tidal streams in Nigeria' (2018) Volume 9 International Journal of Energy and Environment Engineering pp 81-91 <https://doi.org/10.1007/s40095-017-0256-2> accessed 17 October 2024.
[70] Ayoola T Brimmo, Ahmed Sodiq, Samuel Sofela and Isa Kolo, 'Sustainable energy development in Nigeria: Wind, hydropower, geothermal and nuclear' (2017) Volume 74 Renewable and Sustainable Energy Reviews pp 474-490 <https://www.sciencedirect.com/science/article/abs/pii/S1364032116309169 > accessed 16 November 2024.
[71] ibid.
[72] ibid.
[73] ibid.

Adelaja, in the article titled "Barriers to National Renewable Energy Policy Adoption: Insights from a Case Study of Nigeria", specifically mentioned wave and tidal energy resources as one of the rich energy sources in Nigeria.[74] However, while Adelaja discussed wave and tidal energy under "Hydro energy", he argued, "wave and tidal energy systems are not presently readily attainable due to technology and cost problems…" Thereafter, Adelaja did not consider wave and tidal energy as a viable source of energy, as well as Nigeria's latest renewable energy policy, which Adelaja helped to craft, did not address Wave and tidal energy resources. Adelaja's argument about wave and tidal and the evident neglect demonstrates that wave and tidal energy resources have been deliberately ignored in Nigeria. This confirms the position of this research and the argument that there is a gap that needs to be filled in Nigeria's renewable energy legal framework as it concerns wave and tidal energy.

Atsegbua and others, in the book titled *Beyond Fossil Fuels: Renewable Energy,* described the relevance of energy transition in Nigeria and the role of renewable energy sources, including the government's failure to develop renewable energy resources in Nigeria.[75] The authors identified failures, which include poor enforcement of renewable energy laws and policies.[76] Even though Atsegbua and others did not acknowledge Nigeria's ocean energy potential while assessing renewable energy sources in Nigeria, it is evident that their argument reinforces this researcher's thesis that there is a gap in the existing renewable energy legal framework in Nigeria. Onu, on the other hand, argued that Nigeria's renewable energy laws and policies did not make provisions for the development of wave and tidal energy.[77] According to Onu, "Unfortunately, Nigeria has failed to harness these abundant resources within her territorial waters to solve her energy problems and achieve her climate change

[74] Adesoji O Adelaja, 'Barriers to national renewable energy policy adoption: Insights from a case study of Nigeria' (2020) 30 ESR 100519 <https://doi.org/10.1016/j.esr.2020.100519.> accessed 16 November 2024.
[75] Atsegbua and Dauda (n 33).
[76] ibid.
[77] Kingsley Osinachi Onu, 'Mitigating the Effects of Climate Change through Marine Renewable Energy Development in Nigeria: Law, Issues and Prospects' (2021) African International Economic Law Network <https://www.afronomicslaw.org/category/analysis/mitigating-effects-climate-change-through-marine-renewable-energy-development> accessed 16 November 2024.

mitigation target under the Paris Climate Agreement, 2015."[78] Accordingly, both authors' positions were further reviewed in this research.

In 2013, Ukwuaba, in a paper 'Tidal Power Potentials in Nigeria: Investigative Study Of Port Harcourt Estuaries' asserted that a case study examining the characteristics of the coastal waves of Port Harcourt, with an emphasis on the feasibility of establishing a Tidal Power Station along the coastline, has already been conducted.[79] Ukwuaba unequivocally also contended that Nigeria possesses the potential to harness wave and tidal energy; however, he did not address the methods for implementation or the legal framework surrounding it. Furthermore, the researcher has not located any evidence indicating that the writer has engaged in additional studies related to wave and tidal energy. Accordingly, the arguments of these scholars align with the focus as reviewed in this research, which argues for the appropriate legal framework support for the development of tidal and wave energy in Nigeria. Inevitably, this implies that Nigeria needs the relevant renewable energy legal framework to support wave and energy development in Nigeria.

A 2015 investigation into Nigeria's tidal energy potential showed that Nigerian coastal states can generate ocean energy that can power rural and urban Nigeria if developed.[80] Thus, the article titled, 'Estimation of Tidal Power Potential of Nigeria Coastal Area' will be reviewed by this researcher because of the author's stance on Nigeria's tidal energy potential, and its development resonates with this current research, which aims to recommend relevant policies, programmes, and support schemes for the development of tidal and wave energy in Nigeria. Another study by Okoli and others further affirms the tidal energy potential of Nigerian coastal states and even indicates the precise location for a potential installation of the relevant technology for the generation of ocean energy.[81]

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[78] ibid.
[79] Lekan Bakare Foundation, 'The Emergence of Wave and Tidal Energy as an Alternative Source of Energy in Nigeria' (*Lekan Bakare:* 16 December 2022) <https://lekanbakarefoundation.org/News/the-emergence-of-wave-and-tidal-energy-as-an-alternative-source-of-energy-in-nigeria/> assessed 11 November 2024.
[80] Collins Nwakocha, Adekojo Waheed and Abayomi Layeni, 'Estimation of Tidal Power Potential of Nigeria Coastal Area' in Durai R T Prabhakara, Sandip A Kale and Kandasamy Prabakar (eds), *Renewable Energy and Sustainable Development* (2015) Nova Science Publishers ch 10.
[81] Chineike Okoli, Roland Uhunmwangho and Henry Nwogu, 'A Simulation of Model for Tidal Current Turbine' (2017) IEEE PES-IAS Power Africa <https://fardapaper.ir/mohavaha/uploads/2018/10/Fardapaper-A-Simulation-Model-for-Tidal-Energy-Extraction-in-Nigeria-Using-Tidal-Current-Turbine.pdf> accessed 12 December 2021.

Nigeria has implemented a range of programmes and policies aimed at enhancing the efficiency of its energy system. Renewable energy (RE) is a pivotal component of this transformative process. Nevertheless, the country's energy reforms in the realm of renewable energy encounter obstacles due to inefficient utilisation of renewable energy resources and the implementation of inadequate policies.[82] As a result, these obstacles contribute to the widening disparity between the demand for energy and its corresponding supply.[83] Gungah and others supported the necessity to evaluate the effectiveness, efficiency, equity, and institutional feasibility of Nigeria's legal and policy framework for renewable energy has been driven by this motivation.[84] Gungah and others' study contributes to the existing body of literature by employing a case study methodology to initiate enhancements in the efficacy and efficiency of the legal and policy framework about renewable energy in Nigeria. The findings of their study reveal a pressing need for the implementation of a synchronised and uniform legal intervention, which should be accompanied by the establishment of specific and time-constrained objectives, as well as a strong political commitment.[85]

Furthermore, considerable research has shown that Nigeria has wave energy potential, this is important and resonates with this current research because the researcher will also review international, regional, and national renewable energy legal frameworks to make a case for the fast-growing wave and tidal energy. For example, some scholars have suggested that Nigeria should harness its wave energy to generate electricity for areas lacking access to energy in Nigeria.[86] Kayode and Koya suggest the urgent development of wave energy because of the relevance of the lack of electricity suffered by the rural communities in Nigeria.[87] In 2023, a Report on Nigerian renewable Energy shows that in addition to solar and hydro, there is a significant demand for further information concerning the potential of renewable

[82] Aarti Gungah, Nnaemeka Vincent Emodi and Michael O Dioha, 'Improving Nigeria's renewable energy policy design: A case study approach' (2019) 130 EP 89-100 <https://doi.org/10.1016/j.enpol.2019.03.059> accessed 17 November 2024.
[83] ibid.
[84] ibid.
[85] ibid.
[86] Olakunle Kayode and Olufemi A Koya, 'Wave Energy Potential along the Gulf of Guinea Coast of Nigeria' (2019) 4 AEL 128-135 <https://aeletters.com/wp-content/uploads/2019/12/AEL00168.pdf> accessed 25 March 2025.
[87] ibid.

resources in the country, including wave and tidal energy resources.[88] According to the report by Nigeria Energy, the potential for geothermal, wave and tidal energy remains unquantified, and consequently, there are no plans to develop these renewable energy resources in Nigeria.[89]

Finally, in this thesis, the researcher also draws on the IRENA development studies, reports, and recommendations on the prospects of renewable energy development in Nigeria to make a case for wave and tidal energy.[90] Established in 2009, IRENA, as a leading global intergovernmental organisation, promotes energy transformation and serves as the principal platform for international cooperation, supports states in their energy transitions, and provides data and analyses on technological innovation, policy, finance and investment. As of 2024, Nigeria makes up one of IRENA's 169 countries that are member states of the United Nations and regional intergovernmental economic integration organisations. Mandatorily, IRENA members must be willing and able to act according to the objectives and activities laid down in their statute.[91] IRENA's reports have helped to keep the researcher abreast of current trends, improvements, and schemes concerning tidal and wave energy development because IRENA publishes yearly reviews of renewable energy prospects of countries. Thus, considering IRENA's review will help the researcher decipher appropriate ways and means to propose a guide to renewable energy laws and policies in Nigeria that will support the development of wave and tidal energy in Nigeria.

Additionally, the researcher also used data from REN21, another global body of renewable energy community of actors from science, government, non-governmental organisations and industry that provide up-to-date and peer-reviewed facts, figures and analysis of global developments in technology, policies and markets.[92] REN21's

[88] Nigeria Energy (NE23), 'Renewable Energy Roadmap Nigeria: Summary of key recommendations and findings' (*Nigeria Energy*: February 2023) <https://www.nigeria-energy.com/content/dam/markets/emea/nigeria-energy/en/2023/docs/NE23-NigeriaEnergyRoadmap-Report.pdf> accessed 22 September 2024.
[89] ibid.
[90] IRENA, 'About' <https://www.irena.org/About> accessed 20 May 2024.
[91] IRENA, Conference On The Establishment of the International Renewable Energy Agency, Statute of IRENA signed in Bonn, 26 January 2009, Bonn, World Conference Center <https://www.irena.org/-/media/Files/IRENA/Agency/About-IRENA/Preparatory-Commission/Founding-Conference/IRENA_FC_conference_report_26_01_2009.pdf?rev=a8b3f59c37084f8796c912fd57555e11> accessed 20 May 2024.
[92] REN21: Renewable Now! <https://www.ren21.net/about-us/who-we-are/> accessed 25 May 2024.

goal enables decision-makers to support and transition to renewable energy. Further, the facts gathered from REN21 have been useful to the researcher as the body offers a platform for diverse stakeholders to engage and collaborate to promote renewable energy with its tools, knowledge and culture of dialogue and debate.[93]

2.3 Research Methodology and Justification

2.3.1 Research Philosophy

Conceptually, the research philosophical method in doctrinal legal research provides more depth to the research.[94] These philosophical methods include argumentation analysis and construction through utilising the available literature, researchers' analysis of the argument in the literature and "reflective equilibrium" covering a submission of the position and arguments.[95] With an interpretive philosophical approach, this research enquires into existing legal texts, thereby understanding from within what law and policy gaps exist in Nigeria's legal framework.[96] Further, the researcher used inductive reasoning in this research, which is generally associated with qualitative methods of data collection and data analysis.[97] In order words, inductive research entails the process of identifying patterns through observation and formulating theories to explain those patterns by generating a series of hypotheses.[98] Generally, in this regard, an inductive reasoning approach will help to locate laws, principles, and theories from evidence collected, including international, regional, and national laws and policies, as well as journals and peer-reviewed papers.[99] Thoughtfully and clearly, the researcher synthesised existing legal concepts, values, and principles. In addition, the analysis of relevant literature aimed to reveal extant gaps and provide options towards convincing proof for the legal construct to transform Nigeria's renewable energy laws and policies, thereby

[93] ibid.
[94] Sanne Taekema and Wibren Van der Burg, 'Legal Philosophy as an Enrichment of Doctrinal Research Part I: Introducing Three Philosophical Methods' (2019) p 1, <https://repub.eur.nl/pub/123644/Repub_123644.pdf> accessed 17 November 2024.
[95] ibid 3.
[96] ibid.
[97] David Barrett and Ahtisham Younas, 'Induction, deduction and abduction' (2023) Vol 27(1) BMJ <https://ebn.bmj.com/content/27/1/6> accessed 17 June 2024.
[98] Business Research Methodology, Inductive Approach (Inductive Reasoning), <https://research-methodology.net/research-methodology/research-approach/inductive-approach-2/#_ftn4> accessed 17 June 2024.
[99] Sanne Taekema and Wibren Van der Burg (n 94)

supporting wave and tidal energy laws and policies.[100] In sum, the adopted research philosophy, which allows the researcher to take an informal perspective on law – authoritative legal sources and evidence, fits into the doctrinal legal research with sound, logically valid and defensible outcomes.

2.3.2 Research Design

The research design entails a process of gathering relevant facts and identifying and analysing the legal issues to find any gaps in Nigeria's renewable energy legal framework, specifically about wave and tidal energy. The research will study background materials such as textbooks, journals, and articles and locate primary sources, including legislation and official government websites, to synthesise the issues of Nigeria's wave and tidal energy and proffer outcomes for future policy formulation.

2.3.3 Doctrinal Research Methodology

In the past two decades, with significant changes in the research ecosystem in universities, more emphasis has been placed on group, interdisciplinary and empirical research, contrary to the older paradigm, particularly common in law faculties, of an individual legal researcher working alone.[101] In this respect, reports from studies, including the 1982 study of legal research and scholarship in Canada, Arthor's' Report, and the Australian Pearce Committee Report, agreed that doctrinal legal research was the most accepted methodology in the discipline of law.[102] For example, the Council of Australian Law Deans (CALD) standards refer to the necessity for students to achieve research methodology skills akin to the doctrinal. These skills include intellectual and practical skills required to research and analyse the law from primary sources to apply the findings of such research to solving legal problems and the ability to communicate these findings both orally and in writing.

[100] ibid.
[101] ibid.
[102] T Hutchinson and N Duncan, 'Defining and describing what we do: doctrinal legal research' (2012) 17(1) DLR 83-119 <https://www.austlii.edu.au/cgi-bin/viewdoc/au/journals/LegEdDig/2013/41.html#> accessed 16 June 2024.

Doctrine, by definition, is a synthesis of various rules, principles, norms, interpretive guidelines and values.[103] As with any social science research, the doctrinal research methodology is undertaken according to accepted discipline standards and rules. It requires an ability to achieve a high level of analysis and critique. However, this process is different from social scientific thought. Generally, doctrinal research focuses on legal principles generated by the courts and the legislature. It differs from other social science research because it involves the search for the specific rather than the general and 'the non-probabilistic nature of statements of law. In other words, before analysing the law, the researcher must first locate it. Even a mere description of the scope of such an exercise makes the breadth of the undertaking more apparent to the outsider. Having located this wealth of documents, the second step entails the use of deductive logic, inductive reasoning and analogy, which, appropriately, would constitute the second part of the doctrinal research methodology.[104]

Practically, the doctrinal method is a two-part process, which involves locating the sources of the law and then interpreting and analysing the text.[105] For example, laws are passed by parliament, and the words are written down. Subsequently, the law or rule is interpreted and analysed within a specific context that the outcome becomes 'contingent' or conditional on the expertise, views and methods of the individual researcher. In this research, the doctrine in question entails the renewable legal framework, concepts and principles of all types- laws, policies, statutes, and rules of Nigeria and comparator jurisdictions (British Columbia, Nova Scotia, Scotland and South Korea). This research explains, makes coherent or justifies, identifies gaps and proffer solutions. Inherently, doctrinal research is research into the law and legal concepts.

[103] ibid.
[104] ibid.
[105] ibid.

2.3.4 Comparative Research Methodology

Comparative research methodology denotes the study and research technique to investigate legal rules and procedures, not of one legal system in isolation, but in sync with the thorough examination of other regulations and policies from other jurisdictions.[106] Further, a comparative law methodology represents a research discipline employed to understand foreign law and culture.[107] According to Professor Grossfeld, the law operates with inherent culture[108] comprising "*invisible power*" such as geography, history, religion, morals, customs, philosophy, or ideology, et cetera.[109] In other words, the comparative law methodology engages sound methodical framework to provide insight and understanding of the law and embedded culture. Eberle argues that comparative law methodology and knowledge gathered can "illuminate" the inner workings of foreign legal systems.[110] Further, comparative law methodology is also the act of comparing the law of one country to the law of another, and the comparison can be broader, that is, covering more than law and more than written words.[111]

The comparative method chooses rational legal systems because of comparative facts about the alternatives or their reasons. In other words, A comparative fact describes how something is rather than how it is not, giving a relationship between two items in some respects; by contrast, being not worse than, not better than, not equal to, and neither better nor worse are not comparative relations and do not give rise to comparative facts.[112] The knowledge of other foreign legal systems will significantly improve the comparative research methodology,[113] not least where one of the ultimate purposes of the research entails seeking the improvements of Nigerian

[106] Bernhard Grossfield, 'Comparative Law as a Comprehensive Approach: A European Tribute to Professor Jack A. Hiller' (2000) 1(1) RJGLB 3 <https://scholarship.richmond.edu/global/vol1/iss1/2> assessed 22 July 2024.
[107] ibid.
[108] Gianmaria Ajani, 'By Chance and Prestige: Legal Transplants in Russia and Eastern Europe' (1995) 43 1 TAJCL 93–117 <https://doi.org/10.2307/840578.> accessed 17 Jan. 2024.
[109] Bernhard Grossfield, (n 106)
[110] Edward J Eberle, 'The Methodology of Comparative Law' (2011) 16(1) RWULR art 2 <http://docs.rwu.edu/rwu_LR/vol16/iss1/2> accessed 12 January 2024.
[111] ibid 52.
[112] ibid.
[113] Alan Watson, *Legal Transplants: An Approach to Comparative Law* (2nd edn, University of Georgia Press 1993) p 17.

renewable energy laws in respect of wave and tidal energy laws. Örücü lists the purposes of comparative research as aiding law reform and policy development, providing a tool of research to reach a universal theory of law, giving a critical perspective and aid to international law practice, facilitating global unification and harmonisation of rules, helping courts to fill gaps in the law and even working towards the furthering of world peace and tolerance.[114] Comparative academic legal research has more open-ended objectives and the enviable position of going about without being bound by an imperative result.

Therefore, the comparative research undertaken in this thesis aims to develop a critical understanding in two respects: first, concerning the legal systems compared – this represents the foreign legal jurisdictions examined and Nigeria's legal system; second, about the general knowledge of the law and the understanding of the law's context. The process of the choice of the legal system of the jurisdiction with which the researcher will compare involves several parameters, including selection of situations involving a historical relationship and neglecting those concerning only the inner connection, such as culture, tradition, and religion; historical relationship, namely borrowing and transmissibility of rules from one society or system to another; whenever a legal rule is transplanted from one jurisdiction to another, it is interesting to know whether it can be moved unaltered or to what extent it undergoes changes in its formulation.[115]

2.3.4.1 How Comparative Law Methodology Will Be Used in this Research

- The Theme of the Thesis

The theme of this thesis represents the central subject or core idea that the paper addresses. In other words, the theme is the main point or argument that the author seeks to convey and buttress through this research and critical analysis. Schlesinger describes the theme of a thesis as the thread that joins the several segments and arguments within the thesis.[116] In other words, the theme gives a clear focus, which aids the reader in understanding the primary object of the research and pilots the

[114] Erin Örücü and David Nelken, *Comparative Law: A Handbook* (1st edn, Bloomsbury 2012) p 480.
[115] Watson (n 113) 17.
[116] Rudolf B Schlesinger, *Comparative Law: Cases and Materials* (Brooklyn N Y Foundation Press 1950) pp 293-329.

organisation of the content of this paper. Essentially, the theme of this thesis focuses on the search for the extant gap(s) in Nigeria's renewable energy legal framework concerning wave and tidal energy resources. Alternatively stated, the thesis investigates key provisions of Nigeria's renewable energy laws and policies to identify gaps, especially concerning wave and tidal energy resources, to review and seek insight and knowledge from other jurisdictions. Specifically, this thesis evaluates the renewable energy legal framework of three jurisdictions, namely Canada (British Columbia and Nova Scotia), the United Kingdom (Scotland), and South Korea, focusing on their wave and tidal energy legal framework. Comparatively, lessons and best practices elicited formed the content and provisions of the proposed outline for Nigeria's proposed legal framework to promote the development of wave and tidal energy resources in Nigeria. Further, the proposed legal framework could contribute to the development and progress effectiveness of Nigeria's renewable energy legal framework in the present and future.

- Criteria of the Thesis

Fundamentally, the criteria of a thesis are standards and expectations established for what the author intends to achieve in the thesis. Thus, the criterion of the thesis provides the compass for the development and analysis of the thesis. For instance, this thesis strictly adhered to the Robert Gordon University (RGU) research guidelines and the OSCOLA footnote style that the Law School adopted. The criteria help to accomplish high academic research standards and to attain the objectives of the thesis.

- Criteria for the Comparative Law Analysis

In line with sub-section 2.3.4, specifically, this author critically analysed four comparators, including Canada's British Columbia and Nova Scotia, Scotland, and South Korea. In effect, the critical analysis entailed looking into the legal framework of these jurisdictions using the comparative law methodology. As discussed earlier, a comparative law methodology represents a research discipline employed to

understand foreign law and culture.[117] Conceptually, comparative law methodology establishes the basis to look out for similarities and differences in legal data.[118] For instance, one mass of legal data about wave and tidal energy resources can be reviewed in relationship to others, and they are evaluated based on similarities and differences that are aligned between "legal data points (LDP).[119] Therefore, the review is applied as a measure to understand the range and content of the LDP,[120] derived from three comparators' legal jurisdictions in Chapter 6, namely Scotland, British Columbia, Nova Scotia, and South Korea. In the assessment of the LDP, answers were proffered to some pertinent questions, such as what the substance of the legal data point is. How does LDP depart from the point of comparison? What is the nature of the divergences? What is revealed from the divergences and similarities? Consequently, the author reviewed the comparators' historical development and geography using both descriptive and evaluative skills that characterise the core skills of a comparativist as prescribed by Professor Grossfeld.[121] Both external (written laws and policies) and internal laws (invisible forces-geography, linguistics skills,[122] ideology, customs, morals, etc.)

- Description of the Guiding Rules of Comparative Law Methodology (CLM)

Eberle argued that CLM has four guiding rules, namely Rule 1: Acquiring the skills of a comparativist to evaluate the law, objectively and neutrally;[123] Rule 2: Evaluating external laws –written or stated;[124] Rule 3: Evaluating internal laws,[125] and Rule 4: Determining comparative observations.[126] Thus, the researcher argued that through a good understanding and application of these four rules of comparative law methodology as described by Eberle, the aims and objectives of this thesis would be accomplished. The author has adopted Eberle's CLM framework that guided the

[117] Grossfield (n 106).
[118] Eberle (n 110).
[119] John C Reitz, 'How to Do Comparative Law' (1998) 46 AJCL 617- 620 <https://studfile.net/preview/4367076/> accessed 17 November 2024.
[120] ibid.
[121] Grossfield (n 106).
[122] Mark Van Hoecke, 'Methodology of Comparative Legal Research' (*Law and Method,* 12 December 2015) <https://www.bjutijdschriften.nl/tijdschrift/lawandmethod/2015/12/RENM-D-14-00001> accessed 28 January 2024.
[123] Eberle (n 110).
[124] ibid.
[125] ibid.
[126] ibid.

comparative analysis of Scotland, Canada, and South Korea. What follows is a brief description of the above rules of comparative law methodology by Eberle. In summary, according to Rule 1, a comparativist should have an understanding that comparative law is not simply to compare words on paper but propelled and influenced by the culture of the jurisdictions under review.[127]

2.3.5 Choice of comparator jurisdictions – Nova Scotia, British Columbia, Scotland, and Korea

Comparativism can be formulated in terms of values or reasons. The values version of comparativism is a comparative fact about the evaluative merits of the options concerning matters in a well-formed choice situation, that is, in the virtue of which a choice is rational in that situation. The reasons version of comparativism entails comparative facts about the strengths of the reasons for and against the options concerning what matters in a well-formed choice situation, that is, in the virtue of which a choice is rational in the situation. A "well-formed choice situation" is one in which there is a determinate and small set of alternatives, each of which is capable of being chosen, something that matters in the choice—a "covering consideration(s)"—and a reasonably determinate set of background facts that are the circumstances in which a choice is to be made. The researcher adopts the values version of comparativism on the choice of alternative jurisdictions. Further, the researcher henceforth treats choice situations as involving only two alternatives of comparative fact that do the groundwork in relating only two options. In the comparative research undertaken for this thesis, the first alternative - legal frameworks in Nova Scotia, British Columbia, Scotland and South Korea are studied to support the development of Nigeria's wave and tidal energy legal reform.

Approaching law reform from a choice of models from selected legal systems involves a phenomenon described as legal transplants.[128] For example, Nigeria's legal system is like Scotland's mixed legal system of Common and Civil law systems.[129] English

[127]Edward J Eberle, 'The Method and Role of Comparative Law' (2009) 8(3) GSLR 451 <https://openscholarship.wustl.edu/cgi/viewcontent.cgi?article=1088&context=law_globalstudies> accessed 24 January 2024.
[128]Watson (n 113).
[129] Scotland.org.uk, 'The Differences Between the English and Scottish Law' <http://www.ltscotland.org.uk/the-differences-between-the-english-and-scottish-law/> accessed 11 October 2022.

law has heavily influenced the Nigerian legal system. This influence and legal transplants emanated from the British colonisation of Nigeria, while English law influence on Scotland came from the 1707 Union.[130] However, the English and the Scottish legal systems are different because the latter is more of a mixture of civil law and common law. In addition, Nigeria and Scotland's legal systems have similarities as the two systems adhere to the influences and traditions of continental law. Still, unlike Scotland, English laws asserted themselves on Nigeria's legal system. In addition, Nigeria and Scotland are geographically contiguous to enormous ocean resources where wave and tidal energy (WTE) can be sourced.

Scholars such as Örücü have argued about the disquiet nature of the mode of law reform of the terminology that depicts the conceptual framework.[131] It is asserted that law reform should emanate from within. Since a transplanted institution remains or continues to live /subsist on its old habitual and has been moved to a new place, the choice of the word 'transplant' is inappropriate.[132] However, variations of terminology have appeared in many works, and several new concepts have been developed to supplement, if not replace, 'legal transplant.'[133] As law moves, connects, disconnects, changes, and contributes to change, which forms one of the objects of the research, Örücü suggests that legal transplant is a process of transposition, tuning, and fitting.[134] A legal transplant means moving a person into a new territory with no comparative civilisation that takes its laws with it.[135] Currently, legal transplant is utilised as a generic term for all cross-border spread of laws. Transposition is the movement of legal institutions and ideas in trans-border, and transmigration is a natural phase in legal development.[136] For example, the transposition of Directive 2014/89/EU established a framework for maritime spatial planning into the Polish legal order.[137]

[130] Section 1 Union with England Act 1707.
[131] Örücü (n 114).
[132] ibid.
[133] ibid.
[134] Örücü (n 114).
[135] Watson (n 113).
[136] ibid ch 1.
[137] Tomasz Bąkowski and Justyna Nawrot, 'Transposition of the directive establishing a framework for maritime spatial planning into the polish legal order (main aspects and key solutions)' (2020) 117 MP <https://www.sciencedirect.com/science/article/abs/pii/S0308597X19303276> accessed 17 November 2024.

CHAPTER THREE - RENEWABLE ENERGY RESOURCES IN NIGERIA: PROBLEMS AND PROSPECTS

3.1 Introduction

Nigeria possesses abundant renewable energy resources and exhibits substantial potential for advancing renewable energy, fostering sustainable energy accessibility, economic expansion, and environmental preservation. To achieve the potential of renewable energy in Nigeria, it is essential to tackle the obstacles by implementing policy reforms, technological innovation, investing in infrastructure, and enhancing capacity building. In this Chapter, the thesis investigates Nigeria's renewable energy resources to demonstrate their prospect and problems to proffer some solutions that can correspondingly develop and enhance these energy potentials. However, this researcher argues that Nigeria's wave and tidal energy resources are yet to be exploited compared to solar, wind, biomass, and hydropower, which is further shown in this chapter. Accordingly, wave and tidal energy have been investigated to determine its potential and viability. In the end, the overall thesis shows an understanding of the impact of renewable energy sources on the energy mix of Nigeria, as well as the need for a legal framework that supports the harvesting of wave and tidal energy in Nigeria.

Hitherto, fossil fuels were being subsidised. However, on May 29 2023, the incoming Nigerian President Bola Tinubu announced, "fuel subsidy is gone", resolutely ending the fossil fuel subsidies regime in Nigeria.[138] While it may be too early to determine its effects on RE technologies, Usigbe argued that "without the subsidy, Nigeria could conserve more than 15 million tonnes of CO2 each year,"[139] and consequently, this researcher believes that saved income therefrom could be utilised for infrastructural development including wave and tidal energy.

[138] Leon Usigbe, 'Nigeria ends oil subsidy to invest savings in infrastructure development' (*United Nations,* 17 August 2023) <https://www.un.org/africarenewal/magazine/august-2023/nigeria-ends-oil-subsidy-invest-savings-infrastructure-development#:~:text=Without%20the%20subsidy%2C%20Nigeria%20could,the%20wake%20of%20drying%20resources> accessed 28 February 2024.
[139] ibid.

3.2 History and Background of Energy in Nigeria

Renewable energy has a rich history that can be traced back to ancient civilisations, which utilised the power of the sun, wind, and water for various purposes.[140] Nevertheless, the extensive utilisation of fossil fuels and the advent of the Industrial Revolution during the 18th and 19th centuries resulted in a decrease in the use of renewable energy. Consequently, in the 20th century, the environmental movement and concerns about fossil fuels' ecological impact revived interest in renewable energy.[141] When the oil crisis hit in the 1970s, energy independence and alternative energy sources became priorities. Global governments invested in renewable energy research. Nigeria's energy generation is derived from the burning of wood.[142] Nevertheless, it was utilised exclusively for domestic cooking. Concomitantly, in 1896, imported coal was initially employed; however, by 1909, coal was discovered in Nigeria, and it was first produced in 1916. However, Nigeria discovered oil in commercial quantities in 1956 and produced it in 1958, even though oil exploration began in 1901.[143] Subsequently, oil replaced coal as the primary energy source until 1969, when hydro energy was first developed. Energy consumption has been predominantly derived from hydroelectric sources.[144]

Nigeria's formal efforts to quest for electricity through generation began in 1896.[145] However, the first electricity supply company was established in 1929. Nearly half a century after, a national organisation backed by law was established in 1972 when all electricity-generating entities in Nigeria, including Niger Dam Authority, a hydropower station, were merged to become the National Electric Power Authority (NEPA). NEPA, a currently non-existent electricity monopoly, dominated the electricity generation, transmission, and distribution processes in Nigeria. Arguably, NEPA's record of performance in its 30 years of existence did not solve the prevailing energy poverty, essentially, because of ineffective operational management, poor

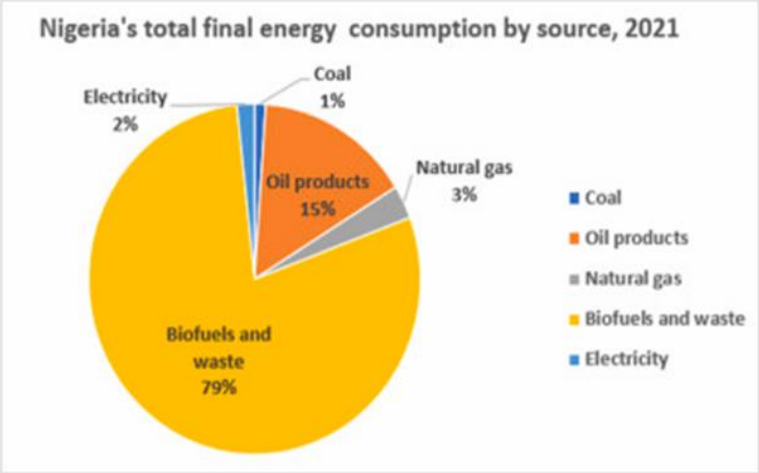
[140] DGB Group, 'The History and Future of Renewable Energy' (*DGB Group,* 23 January 2023) <https://www.green.earth/blog/the-history-and-future-of-renewable-energy> accessed 23 July 2024.
[141] ibid.
[142] Olayinka I Ogunsola, 'History of Energy Sources and Their-Utilization in Nigeria' (1990) 12 2 ER 181-198 <https://doi.org/10.1080/00908319008960198> assessed 23 July 2024
[143] ibid.
[144] ibid.
[145] Tunde Olaoye, Titilayo Ajilore, Kunle Akinluwada, Femi Omole, and Adelana Adetunji, 'Energy Crisis in Nigeria: Need for Renewable Energy Mix' (2016) 4(1) AJEEE 1-8 <http://pubs.sciepub.com/ajeee/4/1/1> accessed 19 November 2024.

maintenance culture,[146] ageing generating plants, and bureaucracy Consequently, in 2005, the Federal government of Nigeria enacted the Electric Power Sector Reform Act (EPSRA) 2005 after amending the electricity and NEPA laws, which were the prevailing laws as of 1998. EPSRA 2005 stripped NEPA PLC's monopoly on electricity.[147] Thus, the reform paved the way for an ambitious privatisation programme in Nigeria's energy sector. Consequently, NEPA Plc's name changed to the Power Holding Company of Nigeria (PHCN).

On 30 September 2013, following the privatisation process initiated by Nigeria's Goodluck Jonathan regime, PHCN ceased to exist. In its stead, the Nigerian Electricity Regulatory Commission (NERC) was established. The independent regulatory agency, as provided in the Electric Power Sector Reform Act of 2005, was tasked with monitoring and regulating the Nigerian electricity industry, issuing licences to market participants, and ensuring compliance with market rules and operating guidelines. The energy mix in Nigeria is a combination of traditional energy sourced from fossil fuels and renewable energy sources.[148] The vast majority of Nigeria's energy resources consist of crude oil, natural gas, tar sand, and coal.[149] Reportedly, Nigeria spends $25bn to import Oil and Gas every year for generating electricity and other uses in its economy.[150] Also, despite Nigeria's vast energy resources, according to the NERC, only about 7,500 megawatts (MW)[151] have been generated annually for a population of over 234 million.[152]

[146] Oludamilare Bode Adewuyi, Mark Kipngetich Kiptooa, Ayodeji Fisayo Afolayan, Theophilus Amaraac Oluwatobi Idowu Alawode and Tomonobu Senjyua, 'Challenges and prospects of Nigeria's sustainable energy transition with lessons from other countries' experiences' (2020) 6 ER 993 - 994 <https://doi.org/10.1016/j.egyr.2020.04.022.> accessed 18 November 2024
[147] Olaoye (n 145).
[148] Ayodele Oni, 'The Nigerian constitution, states and electricity regulation' *Business Day* (Nigeria, 10 April 2014) <https://businessday.ng/news/legal-business/article/the-nigerian-constitution-states-and-electricity-regulation/> assessed 18 November 2024.
[149] Udochukwu B Akuru, Ifeanyichukwu E Onukwube, Ogbonnaya I Okoro and Emeka S Obe, 'Towards 100% renewable energy in Nigeria' (2017) 71 RSER 943-947 <https://doi.org/10.1016/j.rser.2016.12.123.> accessed 20 February 2023
[150] Bunmi Aduloju, 'Shettima: $25bn spent on fuel importation every year, The Cable Nigeria' *The Cable* (Nigeria, 24 May 2024) <https://www.thecable.ng/shettima-25bn-spent-on-fuel-importation-every-year/> accessed 27 July 2024.
[151] C Ogbonnaya, C Abeykoon, U M Damo and A Turan 'The current and emerging renewable energy technologies for power generation in Nigeria: A review' (2019) 13 TSEP 100-390 <https://doi.org/10.1016/j.tsep.2019.100390.> accessed 27 April 2020.
[152] World Population Review, 'Nigeria Population 2024' (*World Population Review*, 19 November 2024) <https://worldpopulationreview.com/countries/nigeria> accessed 19 November 2024.

Figure 1 Nigeria's Total Energy Consumption[153]



Source: IEA, Energy Statistics Data Browser – Data Tools[155]

As of 2023, renewable energy accounted for 21% of the total electricity capacity in Nigeria.[154] Figure 1 represents Nigeria's power plants' total installed capacity, including public and private sector facilities. However, the amount of

Electricity delivered to end users is usually lower because of transmission and distribution losses and other factors such as fuel shortages and equipment breakdowns. To have a good understanding of Nigeria's Grid system, the centralised power generation system in the country, coupled with its weak grid infrastructure, presents significant challenges for the integration of renewable energy sources into the overall power framework. For instance, Nigeria has witnessed over 105 Grid collapses in 10 years.[156] This centralised power system facilitates the transmission of electricity across extensive distances, leading to approximately 20% losses in transmission. Furthermore, as of 2024, the transmission and distribution subsectors' capacities are less than the 12,500 MW installed generation capacity.[157]

Therefore, the transmission and distribution subsectors are incapable of accommodating the integration of renewable energy, regardless of the expansion of

[153] Obada and others (n 36).
[154] Statista, 'Renewable energy share in electricity capacity in Nigeria from 2011 to 2023' <https://www.statista.com/statistics/1278245/renewable-energy-share-of-electricity-capacity-in-nigeria/#:~:text=As%20of%202022%2C%20renewable%20energy,been%20keeping%20an%20upward%20trend> accessed 27 July 2024.
[155] Obada and others (n 36).
[156] Sami Tunji and Dare Olawin, 'Grid collapses 105 times in 10 years despite $1.4bn loans' *Punch Newspaper* (Nigeria, 21 October 2024) <https://punchng.com/grid-collapses-105-times-in-10-years-despite-1-4bn-loans/> accessed 21 October 2024.
[157] Nigerian Electricity Regulatory Commission (NERC), Electricity on Demand, Quarterly Report, Fourth Quarter 2022, <https://nerc.gov.ng/wp-content/uploads/2023/07/2022_Q4%20Report_Updated_310723.pdf> accessed 21 October 2024.

the current energy mix and capacities. Moreover, some renewable energy sources, such as wind and solar, have inherent fluctuations that make seamless integration into the grid difficult. These inefficiencies pose significant economic problems that could be partially resolved by adopting renewable energy technologies such as wave and tidal energy resources. Consequently, there is a significant shortfall in energy generation, transmission, and distribution. The installed capacity of grid-based systems is approximately 13 gigawatts; however, peak generation on the grid fluctuates, and hovers around 4.5 GW.[158] 86% of Nigeria's on-grid generation comes from natural gas power stations and large hydropower plants. Amadi and others argue that despite an increased commitment to developing and financing renewable energy production in Nigeria, little progress has been made in providing corresponding law and governance frameworks that can support the ambitious energy transition goals".[159]

3.3 Non-Wave and Tidal Renewable Energy Resources in Nigeria

The Energy Commission of Nigeria (ECN) has strategically projected the electricity demand and the sources that could be utilised to meet these demands by 2050.[160] As it were, the demand includes transport, industry, cooling and lighting, appliances, and cooking. Among the energy sources identified were nuclear, solar, wind, hydro energy, bioenergy, oil, coal, and gas. Wave and tidal energy are conspicuously absent. As a result of Nigeria's over 200 million population, the electricity demand exceeds 29 TWh in 2020. However, only about 36GWh was supplied.[161] Additionally, about 55% of the population had access to national grid generated electricity.[162] As of 2023, Nigeria's main source of electricity consumption is fossil fuels, specifically gas, which accounts for approximately 80% of the total national grid generated electricity, amounting to about 32.3 TWh. Moreover, Low-carbon sources make up a

[158] International Renewable Energy Agency, 'Renewable Energy Roadmap Nigeria' (*IRENA*, 2023) <www.irena.org/publications> accessed 23 February 2023.
[159] H N Amadi, M C Madu, O E Ojuka, and O N Igbogidi, 'Renewable Energy in Nigeria: Prospects and Challenges' (2024) 11(4) EJAET 51-60 <https://ejaet.com/PDF/11-4/EJAET-11-4-51-60.pdf> accessed 27 July 2024.
[160] Ogbonnaya (n 151).
[161] CEIC, 'Nigeria Electricity Consumption: Average per Hour' (*CEIC,* 2021) <https://www.ceicdata.com/en/nigeria/electricity-generation-and-consumption/electricity-consumption-average-per-hour> accessed 24 July 2024.
[162] Doris Dokua Sasu, 'Electricity in Nigeria - statistics & facts' (*Statista*, 21 December 2023) <https://www.statista.com/topics/9470/electricity-in-nigeria/#topicOverview> accessed 24 July 2024.

small portion, with hydropower representing 8.28 TWh and other low-carbon technologies contributing 8.35 TWh.[163] Nigeria's unreliable national power grid results in a widespread dependence on decentralized fossil fuel generators. Approximately 22 million small-scale generators function to alleviate grid instability, possessing a total capacity of 40 GW.[164] This dependency incurs an annual cost of $22 billion, resulting in substantial economic repercussions. About 4.5 million generators in Lagos State produce 39 million tonnes of CO_2 equivalent emissions each year.[165] The nation's grid-based electricity generation capacity is considerably surpassed by decentralized generation, underscoring the necessity for sustainable and dependable energy solutions. Considering the population of Nigeria, the per capita electricity consumption is considerably lower than the global average of 432 watts per person. The inadequate level of electricity generation can impede economic growth, curtail industrial activities, and constrain access to vital services, consequently impacting the overall quality of life. Also, these statistics emphasize the urgent necessity for energy solutions that are both sustainable and dependable in Nigeria.

3.3.1 Solar

Solar energy is gathered from the Sun's rays and converted to electricity.[166] Nigeria is endowed with huge solar energy resources because of its proximity to the equator, and this makes it an ideal location for solar power generation. The country sits on the western coast of Africa. Its vast territory stretches from the Gulf of Guinea on the Atlantic coast in the south to the Sahara Desert in the north, covering a total area of 923,768 square kilometres. Nigeria's solar irradiation is well-distributed and averages six hours per day in Nigeria.[167] The most prevalent application of solar energy is electricity generation, not least because solar technology is safe, environmentally

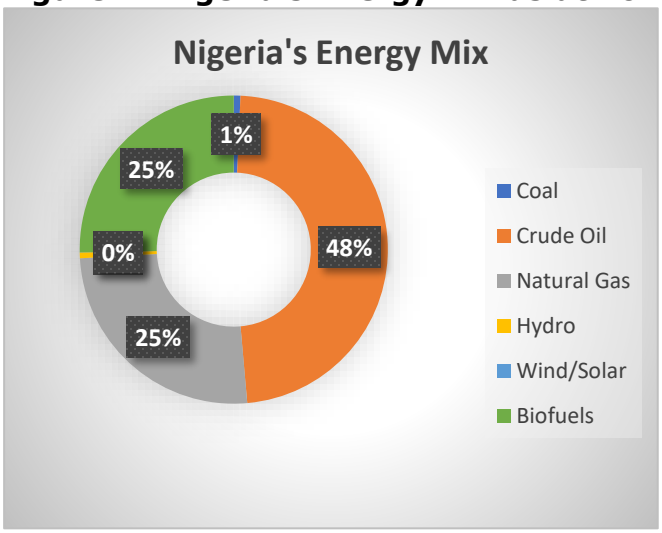
[163] LowCarbonPower, 'Electricity in Nigeria in 2023' (*LowCarbonPower,* 2023/2024) <https://lowcarbonpower.org/region/Nigeria> accessed 24 July 2024.
[164] Nathan Williams, Tunmise Raji, and Courage Ekoh, , Illuminating Nigeria: Blurring the Lines Between the Grid and Off-Grid Electricity, SFS, Georgetown Journal of International, Affairs 7 August 2024, <https://gjia.georgetown.edu/2024/08/07/illuminating-nigeria-blurring-the-lines-between-the-grid-and-off-grid-electricity/> accessed 25 March 2025
[165] Sustainable Energy for All, 'SEforALL study details fossil fuel generator usage in Lagos State to support transition planning and investment in clean energy', (SEforALL, 5 Oct 2024), <https://www.seforall.org/news/seforall-study-details-fossil-fuel-generator-usage-in-lagos-state-to-support-transition> accessed 25 March 2025.
[166] Bob Everett, 'Solar thermal energy' in Stephen Peake, (ed), *Renewable Energy, Power for Sustainable Future* (OUP 2018).
[167] Atsegbua and Dauda (n 33) 22.

friendly, and cost-effective relative to other energy technologies. Most of the major cities in Nigeria use solar energy for street lighting and remote electricity distribution.[168]

Three significant methods exist for converting solar energy into electricity: solar photovoltaic conversion, solar thermal conversion, and concentrated solar power conversion.[169] These technologies consist of devices that transform solar energy into a form of usable energy, including photovoltaic, the most widely used solar technology in Nigeria and the world.[170] This section of the paper will not discuss details of these technologies. However, wave and tidal energy resources' technology is described in section 2.3.5.1 to provide a good understanding.

Like all other renewable energy sources in Nigeria, solar potential is huge, but it is underexploited.[171]

Figure 2: Nigeria's Energy Mix as at 2023[172]



In comparison to its potential, solar energy's contribution to the nation's energy mix is still negligible. Nigeria's solar energy capacity increased from 15 MW in 2012 to approximately 33 MW in 2021. Correspondingly, in 2023, Nigeria's solar energy capacity reached 112 MW, marking a substantial growth of[173] compared to 2021. Nigeria's solar energy generated capacity, which has not been integrated into the national grid, is very low relative to fossil fuel-generated

[168] Chiemeka Onyeka Okoye, Onur Taylan and Derek K Baker, 'Solar energy potentials in strategically located cities in Nigeria: Review, resource assessment and PV System Design' (2016) 55 RSER 550-566 <https://doi.org/10.1016/j.rser.2015.10.154.> accessed 24 July 2024.
[169] Yusuf N Chanchangi, Flossie Adu, Aritra Ghosh, Senthilarasu Sundaram and Tapas K Mallick 'Nigeria's energy review: Focusing on solar energy potential and penetration' (2022) 25 EDS, 5755–5796 <https://link.springer.com/article/10.1007/s10668-022-02308-4> accessed 27 November 2022.
[170] Okoye (n 168).
[171] Nigeria Energy, 'Renewable Energy Roadmap Nigeria, Summary of key recommendations and findings' (2023) 6 NE <https://www.nigeria-energy.com/content/dam/markets/emea/nigeria-energy/en/2023/docs/NE23-NigeriaEnergyRoadmap-Report.pdf> accessed 24 July 2024.
[172] Obada and others (n 36).
[173] Sasu (n 162).

energy, which is being distributed in the country at present.[174] This low penetration can be attributed to component failure such as lack of qualified personnel, lack of infrastructure,[175] a lack of public awareness about solar energy,[176] technical difficulties including weak technological development,[177] un ambitious government policy, for example, the first target set for solar energy was 3%, and the following target is 6% to be achieved by 2030.[178]

Solar energy technologies are becoming more affordable as more households in the developed world adopt them,[179] and it is crucial for developing nations to adopt them as the majority of them are situated in regions with high solar radiation.[180] Several large solar farms have recently been commissioned in Nigeria; for example, 1MW in Ndufu-Alike Ikwo (AE-FUNAI) in Ebonyi State,[181] 7.1MW in Bayero University Kano;[182] and 1.2MW in Usman dam, Abuja.[183] In addition, several solar farm construction projects are currently underway, including 100MW in Sokoto, 50MW in Nasarawa State, 100 MW in Katsina State, 100 MW in Kaduna State, and 100 MW in Bauchi State.[184] Further, the five largest upcoming Solar PV power plants by capacity in Nigeria are[185]

[174] C G Ozoegwu, C A Mgbemene, and P A Ozor, 'The Status of Solar Energy Integration and Policy in Nigeria' Renew (2017) 70 RSER 457-471 <https://doi.org/10.1016/j.rser.2016.11.224> accessed 25 July 2024.
[175] Chanchangi and others (n 169).
[176] ibid.
[177] ibid.
[178] ibid 4.
[179] Shah Rukh Shakeel, Hassan Yousaf, Muhammad Irfan, Arto Rajala, Solar PV adoption at household level: Insights based on a systematic Literature Review (2023) 50 ESR <https://doi.org/10.1016/j.esr.2023.101178.> accessed 25 July 2024.
[180] Akeem T Otapo, Lateef A Saliu, Kazeem A Sodiq, Modiu A Mohammed and Nwinmene L Migah, 'Economic Advantage Of Solar Power System For Small Scale Uses In Nigeria' (2019) <https://www.researchgate.net/publication/358566076_ECONOMIC_ADVANTAGE_OF_SOLAR_POWER_SYSTEM_FOR_SMALL_SCALE_USES_IN_NIGERIA#:~:text=An%20average%20residence%20and%20small,energy%20obtainable%20from%20Ikeja%20Electricity> accessed 24 July 2024.
[181] Rural Electrification Agency, 'Buhari to commission 1 megawatt solar power plant, others in AE-FUNAI – Fashola' (*REA,* 2024) <https://rea.gov.ng/buhari-commission-1-megawatt-solar-power-plant-others-ae-funai-fashola/> accessed 19 January2023.
[182] Chanchangi and others (n 169).
[183] ibid.
[184] ibid.
[185] Power Technology, 'Top five solar PV plants in development in Nigeria' (*PowerTechnology,* 9 September 2024) <https://www.power-technology.com/data-insights/top-5-solar-pv-plants-in-development-in-nigeria/> accessed 25 July 2024.

- Argungu Solar PV Park, Jigawa Solar PV Park: The Argungu Solar PV Park is a 5,600MW solar PV power project situated in Kebbi, Nigeria. The project is currently in the announced stage. It is anticipated that the project will commence commercial operations in 2027.

- Jigawa Solar PV Park: Jigawa Solar PV Park is a 1,000MW solar PV power project located in Jigawa, Nigeria. It is anticipated that the project will be operational by 2025. The project is currently in the announced stage.

- Gezhouba Lagos Solar PV Park: The 360 MW Gezhouba Lagos Solar PV Park is situated in Lagos, Nigeria. It is under the ownership of Falcore Power and Energy. The Solar PV project is currently in the permitting phase. The project is anticipated to commence commercial operations in 2026. This project is being developed by Falcore Power and Energy.

- Lafia Solar PV Park. The Lafia Solar PV Park is a 350MW solar photovoltaic power project. Planned for Nasarawa, Nigeria. The project is currently in the permitting phase. Sun Africa, Sterling, and Wilson will be responsible for its development. The project is anticipated to be commissioned by 2026 following the completion of construction. The project is owned by Niger Delta Power.

- Gombe Solar PV Park: The Gombe Solar PV Park, a 270MW solar PV project, is anticipated to be operational by 2026. Sun Africa, Sterling, and Wilson are the entities responsible for its development. The project is currently in the permitting phase. The project is owned by Niger Delta Power. As of 2023, 112 MW of PV installations were reported.[186]

The ECN oversees efforts to harness Nigeria's solar potential. ECN is supported by the National Agency for Science and Engineering Infrastructure (NASENI). The ECN has these research institutes, namely,[187] the Sokoto Energy Research Centre

[186] Sasu (n 162).
[187] Abdullahi Abubakar Mas'ud a,n, Asan Vernyuy Wirba, Firdaus Muhammad-Sukki, Ibrahim Abubakar Mas'ud, Abu Bakar Munir and Norhidayah Md Yunus 'An assessment of renewable energy readiness in Africa: Case study'

(SERC),[188] the National Centre of Energy Research and Development (NCERD)[189] based at the University of Nigeria in Enugu, and the National Agency for Science and Engineering Infrastructure (NASENI) Solar Energy Ltd.[190]. Solar energy is used to power streetlights in several regions in northern Nigeria, for example, Sokoto. The research institutes, including SERC, have engaged in research efforts, and their findings have only just begun to be put into practice on a limited scale.[191]

3.3.2 Wind Energy

Wind energy, derived from onshore and offshore sources, uses a wind turbine to generate electricity. Historically, efforts to create electricity from wind energy, or wind energy conversion systems, started in the 19th century following the building of a range of wind energy devices. Globally, wind energy capacity increased to become commercial, viable, and profitable. Currently, the global wind power capacity has reached 837 GW, allowing the world to avoid over 1.2 billion tonnes of CO2 per year – the equivalent of South America's annual carbon emissions.[192] The global wind industry accomplished remarkable success in 2021, adding nearly 94 GW of capacity, trailing the record growth of 2020 by only 1.8%. Europe, Latin America, and Africa & the Middle East all had record-breaking years for new onshore installations, but the total onshore wind installations in 2021 were 18% lower than the previous year, recorded 110 GW).[193] Primarily, the slowing of onshore wind growth in the world's two largest wind power markets—China and the United States—was responsible for the decline.[194] China increased its wind capacity by 46.9 GW, followed by the United States (+14 GW).[195] In 2021, eleven additional nations increased their wind capacity

(2015) 51 Renewable and Sustainable Energy Reviews, 778, 784 <https://doi.org/10.1016/j.rser.2015.06.045.> accessed 26 November 2022.
[188] Sokoto Energy Research Centre (SERC), 'UDUS' <http://serc.org.ng/> accessed 24 November 2022.
[189] National Centre of Energy Research and Development (NCERD), <https://ncerd.com.ng/> accessed 24 November 2022.
[190] National Agency for Science and Engineering Infrastructure (NASENI), <https://naseni.org/about-us> accessed 24 November 2022.
[191] ibid.
[192] Global Wind Energy Council (GWEC), 'Global Wind Report 2022' <https://gwec.net/global-wind-report-2022/> accessed 5 December 2022.
[193] ibid.
[194] ibid.
[195] Moses Nosike, 'Solar Firm Powers Over two Million Nigerian Lives, Targets 30 Million by 2030' (*Vanguard Newspaper,* 28 December 2018) <https://www.vanguardngr.com/2018/12/solar-firm-powers-over-two-million-nigerian-lives-targets-30m-by-2030/> accessed 18 November 2024.

by more than 1 GW. Wind energy has recently become cost-competitive, and many see it as a valuable alternative for green energy initiatives.

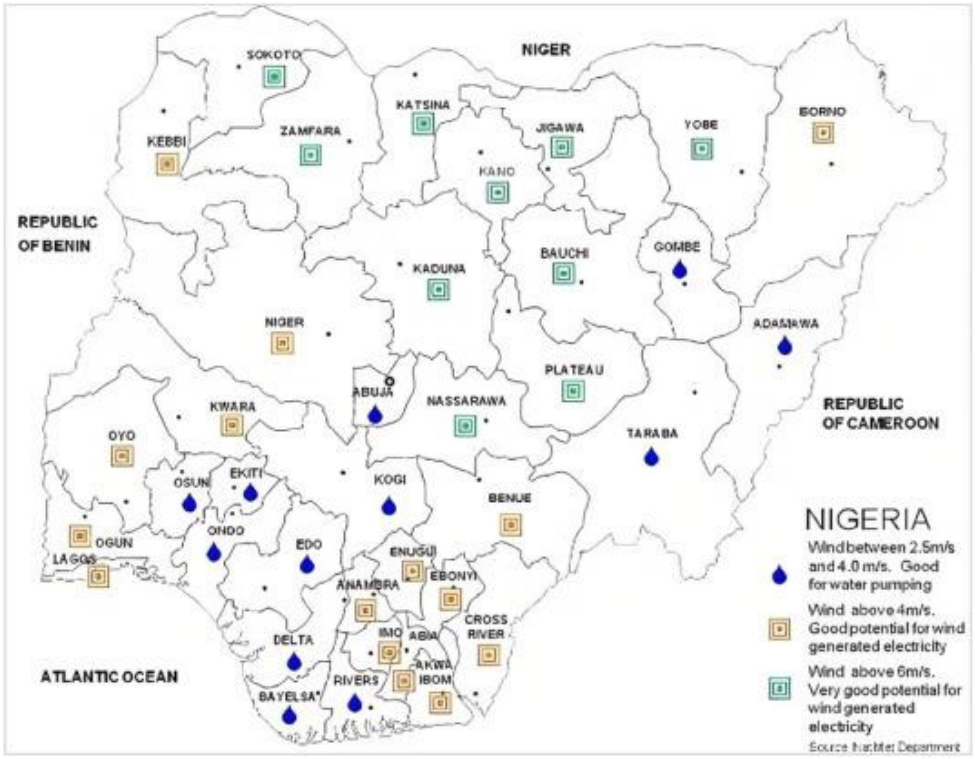
Wind technologies can be classified into two types: horizontal axis and vertical axis. Horizontal axis turbines are mostly of the axial flow variety; for example, the rotation axis is parallel to the wind direction. In contrast, while vertical axis turbines are typical of the "crossflow" variety, their rotation is perpendicular to the direction of the wind. The technical and engineering details of wind technology will not be discussed in this study as they are beyond the scope of this research. ind energy, installed onshore or offshore, presents positive and negative environmental challenges. The electricity production by wind turbines does not cause carbon dioxide emissions, pollutants that cause smog or acid rain, respiratory, cardiovascular, or dementia diseases or deaths, or pollutants that contaminate land, sea, or waterways.[196] In contrast, wind energy generates undesirable low-frequency noise,[197] virtual intrusions, electromagnetic interference,[198] aviation-related issues,[199] and impacts on wildlife, especially potential hazards to birds, and public attitudes and authority .[200] The worldwide wind power industry has almost doubled in size over the last decade, making it one of the most cost-competitive and resilient power sources.[201] In 2023, the wind industry worldwide set up a new capacity of 117GW, which is a remarkable 50% increase compared to 2022. This growth was observed in 54 countries across all continents, with Nigeria being one of them.[202] China and the US are the world's two major wind power markets, accounting for almost half of the world's total wind power capacity.[203]

Turning now to offshore wind, recent developments in wind farm technology involve an increasing emphasis on floating offshore wind farms located in deeper waters,

[196] Derek Taylor, 'Wind energy' in Stephen Peake (ed), *Renewable Energy Power for a Sustainable Future* (OUP 2018) 353 - 382.
[197] ibid 383.
[198] ibid 386.
[199] ibid 387.
[200] ibid 393.
[201] Piotr Bojek, 'IEA Wind Electricity' (*IEA 50,* 11 July 2023) <https://www.iea.org/reports/wind-electricity> accessed 05 December 2022.
[202] Alex Bath, 'Global Wind Report 2024' (*Global Wind Energy Council*, 2024) <https://gwec.net/global-wind-report-2024/> accessed 25 July 2024.
[203] ibid.

surpassing the proximity constraints of conventional fixed-bottom installations. In this regard, in 2019, 21.1 GW of offshore wind capacity was installed, which is three times as much as in 2020. Similarly, in 2023, operational offshore wind capacity increased to nearly 68 GW. This growth puts the world on track for up to around 233 GW of installed offshore wind capacity by 2030.[204] Additionally, the total investment in wind turbines worldwide reached $74.2 billion in 2023, with China being the leading contributor.[205] In Nigeria, wind technology is at its early stages of installation. Nigeria has abundant onshore and offshore wind energy resources, but its utilisation is practically minimal and not well developed.[206] Wind energy resources can be used to generate electricity; the government has generated various policy issues demonstrating the intention to generate electricity from wind.

Figure 3: Nigeria's Wind Potential Mapping[207]



[204], Breanne Gellatly, Tugce Sahin, and Roberta Donkin, '2024 Global Offshore Wind Report' (*ERM,* 22 April 2024) <https://www.erm.com/insights/2024-global-offshore-wind-report/> accessed 25 July 2024.
[205] ibid.
[206] Chinedu Ndigwe, 'Nigeria lags as global wind energy investment hits $74.2bn in 2022' (*BusinessDay* NG, 14 March 2023) <https://businessday.ng/energy/article/nigeria-lags-as-global-wind-energy-investment-hits-74-2bn-in-2022/> accessed 25 July 2024.
[207] O Kehinde, K O Babaremu, K V Akpanyung, E Remilekun, S T Oyedele and J Oluwafemi, 'Renewable Energy in Nigeria - A Review' (2018) 9 (10) 1085–1094 IJMET <https://eprints.federalpolyilaro.edu.ng/1290/1/Renewable%20Energy..pdf> accessed 20 September 2024.

Nigeria's first wind technology project was sited in Torankawa, Katsina State. The Nigerian government constructed a turnkey 37 wind turbines (Capacity 275 kW) 10 MW farm through the Federal Ministry of Energy. The contribution of Nigeria's wind power to the global wind capacity is limited and insignificant,[208] especially as the installed wind power is not operating at full capacity due to issues ranging from insecurity, underinvestment, and poor maintenance. However, this demonstrates the government's limited interest in wind technology development despite available policies, huge wind energy resources, and the current low cost of wind technology. According to the International Energy Agency, policy support continues to be the primary driver of wind deployment in most of the world. Auctions, feed-in-tariffs, Contracts for Difference, and renewable energy portfolio standards are among the policies that drive capacity growth. The focus should be on facilitating, allowing, and supporting the identification of available sites and reducing costs and development timelines. Wind energy development is covered by Nigeria's renewable energy enactments, including the latest Electricity (Amendment) Act 2024. Additionally, wind energy resources are also addressed by the Renewable Energy Master Plan 2005, National Renewable Energy and Energy Efficiency Policy 2015, Environmental Impact Assessment Act 1992, etc.

3.3.3 Hydro Energy

Hydroelectric projects, tidal power, and wave power, among others, can utilise water for the direct production of energy.[209] Nigeria uses only hydropower, not tidal and wave, to generate power.[210] Plainly, hydropower entails the movement of water from a higher to a lower elevation to produce hydroelectric power that operates efficiently. In other words, water flows from a higher level via a mechanism that converts the kinetic energy of the water into the kinetic energy of a rotor to generate electricity. The rotor is then connected to a generator that generates the required amount of power.

[208] ibid.
[209] Atsegbua and Dauda (n 33) 20.
[210] ibid.

Nigeria has a variety of water bodies that are appropriate to produce hydroelectricity. The Kainji Dam Hydroelectricity Power Station on the River Niger was the first hydroelectric facility to be constructed in Africa during the late 1950s and early 1960s. It has a maximum installed capacity of 750 megawatts. Currently, it is operating at a lower capacity than what was installed. If operational, both the Shiroro and Jebba dams have a 600-megawatt capacity. The Mambilla dam, on which construction is currently underway, will have a capacity of 2,600 megawatts when completed. In April 2007, the initial phase of the project was implemented. However, as of September 2024, the Mambila Dam project is uncompleted and belaboured by legal tussle.[211] To increase the amount of energy produced for the national grid, each of these dams will require renovation, modernisation, and improvement.

Nigeria has commissioned the first of four units at the 700MW Zungeru hydroelectric power plant (HPP). Consequently, the capacity of the Nigerian hydropower plants increases from 2.1 GW to 2.8 GW upon completion of the Zungeru HPP.[212] The Zungeru HPP is located on the Kaduna River, a left tributary of the largest river in West Africa, the Niger. The plant has a 233-meter-long, 101-meter-tall dam whose operation will facilitate the operation of a reservoir with a capacity of 10.4 billion cubic metres. The project costs $10 billion, with the Nigerian government contributing $2 billion and the China National Electrical Engineering Corporation contributing $8 billion. Once all four units are operational, the Zungeru hydropower plant will be capable of producing 2.64 TW/h of electricity annually, which is equivalent to 10% of Nigeria's electricity demand.[213]

According to the International Renewable Energy Agency, as of 2023, the installed capacity of Nigerian HPPs remained constant between 2011 and 2020 at 2.1 GW, and

[211] Festus Akanbi, 'Breaking the Stalemate over Mambilla Power Project' (*This Day*, March 2024) <https://www.thisdaylive.com/index.php/2024/03/03/breaking-the-stalemate-over-mambilla-power-project/> accessed 25 July 2024.
[212] Global Energy, 'The capacity of Nigeria's hydropower plants to increase by a third' (2022) <https://globalenergyprize.org/en/2022/04/07/the-capacity-of-nigerias-hydropower-plants-to-increase-by-a-third/> accessed 27 November 2022.
[213] Yunus Kemp, 'Nigeria: Hydroelectric adds 700MW to the national grid, (*ESI Africa*, 29 May 2023) <https://www.esi-africa.com/news/nigeria-hydroelectric-project-adds-700mw-to-national-grid/> accessed 23 September 2024.

in 2022 it increased to 2.2 gigawatts.[214] Explicitly, the country's largest hydropower plants are the Kainji HPP (760 MW) and Jebba HPP (578 MW) on the River Niger, as well as the Shiro HPP (600 MW) installed on the Kaduna River in 1990. When all four units of the Zungeru HPP are operational, it will be the second-largest hydroelectric power plant in Nigeria.[215] In addition to the hydropower earlier discussed, Nigeria has established micro hydropower plants to supply electricity to rural areas.[216] Due to the high price of gasoline in rural areas, many rural communities in Nigeria have turned to micro and macro hydropower to meet their energy needs. Small and mini hydro have gained momentum and traction in recent years because of their inherent advantages of smaller investment, shorter gestation period, grid-isolated power solution, and fewer social conflicts.[217]

3.3.4 Biomass Energy

Biomass is a renewable source of energy with an unlimited supply that can be utilised for heating or cooling, electricity generation, and transportation fuel.[218] In other words, biomass is a type of organic material derived from both plants and animals and biomass as an alternative source of energy is a sustainable, reliable, cost-efficient, environmentally friendly energy system that can employ local resources and networks for its production.[219] However, it is noteworthy that biomass has its issues and challenges, for instance, there is the possibility that it affects the biodiversity quality of the soil, air and water.[220] Further, biomass production sources, including forest or agricultural materials, are affected by external conditions of climate and

[214] Statista, 'Hydropower capacity in Nigeria 2011-2023' <https://www.statista.com/statistics/1278094/hydropower-capacity-in-nigeria/#:~:text=As%20of%202023%2C%20the%20hydropower,gigawatts%20and%202.2%20gigawatts%2C%20respectively> accessed 25 July 2024.
[215] Global Energy, 'The capacity of Nigeria's hydropower plants to increase by a third' (2022) <https://globalenergyprize.org/en/2022/04/07/the-capacity-of-nigerias-hydropower-plants-to-increase-by-a-third/> accessed 27 November 2022.
[216] Ugwu O Collins, Paul A Uzor and Charles Mbohwa, 'Small hydropower as a source of clean and local energy in Nigeria: Prospects and challenges' (2022) 10 Fuel Communications <https://doi.org/10.1016/j.jfueco.2021.100046> accessed 19 November 2024.
[217] ibid.
[218] IRENA, 'Solid Biomass Supply for Heat and Power', (*IRENA,* 2019), <https://www.irena.org/publications/2019/Jan/Solid-Biomass-Supply-for-Heat-and-Power> accessed 06 December 2022.
[219] Chukwuebuka C Okafor, Chinelo A Nzekwe, Charles C Ajaero, Juliet C Ibekwe and Festus A Otunomo, 'Biomass utilization for energy production in Nigeria: A review' (2022) 3 CES <https://doi.org/10.1016/j.cles.2022.100043> accessed 19 November 2024.
[220] ibid.

pest attacks. At the point of installation of the conversion technologies, it involves high investment costs.[221] The huge biomass resource potential in Nigeria makes it possible to successfully deploy its use in remote and rural areas.[222] The large magnitude of various biomass resources in Nigeria, the country could be one of the major players in the biofuel industry.[223] Also, bioenergy feedstock is greatly distributed in huge quantities in all parts of the country due to the favourable climatic conditions, which are well suited to growing biomass. Concerning capacity, in quantity, Nigeria can stand as one of the leading exporters of bioenergy products globally. Internally, biofuel production can ease, to a significant extent, the great burden placed on fossil fuels.[224]

Nigeria has about 11 million hectares in forest and woodland reserves, around 245 million in animal livestock and almost 28.2 million hectares in arable lands.[225] These figures represent about 30% of the total land mass of the entire nation and can lead to the production of over 1.2 million tonnes of biomass resources daily. About three decades ago, it was estimated that about 1.2 PJ of biomass resources, made up of wood residues and agricultural and animal wastes, was produced in Nigeria.[226] In addition, research revealed that the bioenergy potential of the country was about 83 million tonnes in crop residues, 13 million hectares in wood resources and 61 million tonnes in animal waste yearly, and Nigeria produces an estimated 227,500 tons of animal waste per day. In its conversion, it found that Nigeria can potentially produce about 6.8 million m3 of biogas from animal waste daily since 1 kg of animal waste

[221] Collins O Ugwu, Paul A Ozor, Chigbogu G Ozoegwu, Agwu Ndukwe, and Charles Mbohwa, 'Biomass Resources in Nigeria and the Conversion Pathways' (Proceedings of the International Conference on Industrial Engineering and Operations Management Nsukka, Nigeria, 5 - 7 April 2022) <https://ieomsociety.org/proceedings/2022nigeria/142.pdf> accessed 19 November 2024.
[222] ibid.
[223] Adekunle A Adeleke, Nzerem Petrus, Salihu Ayuba, Asmau M Yahya, Peter P Ikubanni, Ikechuckwu S Okafor, Stephen S Emmanuel, Adebayo I Olosho, and Ademidun A Adesibikan, 'Nigerian Biomass for Bioenergy Applications: A Review on the Potential and Challenges' (2023) 11 12 JRM 4123-4141 <https://doi.org/10.32604/jrm.2023.043915> accessed 19 November 2024.
[224] Collins O Ugwu, Paul A Ozor, Chigbogu G Ozoegwu, Agwu Ndukwe, and Charles Mbohwa, 'Biomass Resources in Nigeria and the Conversion Pathways' (Proceedings of the International Conference on Industrial Engineering and Operations Management Nsukka, Nigeria, 5 - 7 April 2022) <https://ieomsociety.org/proceedings/2022nigeria/142.pdf> accessed 19 November 2024.
[225] ibid 747.
[226] ibid.

produces about 0.03 m3 of biogas. Generally, Nigeria's annual capacity for biomass is about 144 million tonnes.[227]

In other words, in present-day Nigeria, it is mostly rural dwellers who utilise biomass to meet their energy needs.[228] Nigeria's distribution and type of bioenergy resources are dependent on the climatic conditions prevalent in that region, and fuel wood, animal wastes, energy crops and agricultural residues are the key forms of biomass resources available in Nigeria.[229] For instance, mostly woody biomass is found in the rainforest zone, while crop residues are more prevalent in savannah zones. Due to lesser rainfall in the north, mostly millet, wheat, sorghum and short-season cereals are found in the north as opposed to the south, with increased rainfall that produces yams, cassava and rice.[230] In northern Nigeria, crops such as groundnuts, cotton and tobacco are grown, while in rainy southern Nigeria, crops grown include coffee, oil palm, cocoa, ginger, sugar and rubber.[231]

3.4 Wave and Tidal Energy and Nigeria

Nigeria possesses a large expanse of ocean and coastline with significant potential for TWE.[232] The theoretical wave energy potential of approximately 58 terawatt-hours per year (TWh/y) is derived from the estimated average wave energy of 7.5 kW/m in Nigeria's coastal regions. Nevertheless, the potential that can be practically explored is estimated to be around 3 TWh/y, taking into account technological and environmental constraints.[233] With regards tidal energy, contextually, the annual tidal energy output within Nigerian waters would be 391 MW/h assuming the Atlantis AR1500 tidal turbine, which has a turbine rotor diameter of 18 m, a swept area of 254.47 m^2, and a modest/conservative velocity estimate of 2 m/s is installed.

[227] Obada and others (n 36).
[228] Ugwu and others, (n 216).
[229] ibid 748.
[230] ibid.
[231] Juliet Ben-Iwo, Vasilije Manovic, and Philip Longhurst, 'Biomass resources and biofuels potential for the production of transportation fuels in Nigeria' (2016) 63 RSER 172-192 <https://doi.org/10.1016/j.rser.2016.05.050 > accessed 19 November 2024.
[232] Ebuete Abinotami Williams*, et al,* 'Renewable Energy Sources for the Present and Future: A Alternative power supply for Nigeria' (2019) 2(2) EES 18-44 <https://www.academia.edu/40264697/Renewable_Energy_Sources_for_the_Present_and_Future_An_Alternative_Power_Supply_for_Nigeria?email_work_card=view-paper> accessed 20 February 2023.
[233] Olakunle Kayode and Olufemi A Koya, (n 86).

Additionally, the annual total tidal energy output by all turbines would be approximately 15.6 GW if 40 tidal turbines were deployed at any of the sites investigated including Bakana, New Calabar River, Apapa Lagos and Lagos Bar. These locations clearly have the capacity to generate substantial quantities of energy.[234]

Nonetheless, TWE development and promotion have been stagnant and, in fact, largely neglected.[235] As will be shown in Chapter 4, this researcher did not find any law, policy or project towards harnessing Nigeria's huge ocean energy resources. The literature review section of Chapter 2 demonstrated that most of the literature on RE focuses on other RE sources and merely mentions TWE in passing and without depth. Bassel Soudan, in his paper titled, 'Community-scale baseload generation from marine energy', asserted that marine energy still faces several impediments to wide-scale adoption, including the high initial capital cost required to implement such systems.[236] However, most marine energy systems have an expected life span exceeding twenty–five years and reaching up to almost 100 years for tidal barrages.[237] Once the initial capital cost is amortised over the extended lifespan of these systems, the overall levelized cost of energy ends up being comparable to other generation mediums.[238] For example, in-stream tides operate only when the tide is flowing in or out of a given passage and are thus intermittent sources of energy.[239] However, unlike other intermittent renewables such as wind and solar, tidal energy is highly temporally predictable due to the periodicity of the tide.

Therefore, if WTE are harnessed, they have the potential to surpass the global demand for sustainable energy in the future. Thus, it is essential that the Nigerian government, along with all industry stakeholders, including the relevant literature, initiate an investigation of potential sites, the amount of available power, the efficiency of emerging technologies, and the environmental impacts. IRENA report

[234] L M Amoo, (n 69).
[235] International Renewable Energy Agency (IRENA, 2023) (n 158).
[236] B Soudan, 'Community-scale baseload generation from marine energy' (2019) 189 Energy 116-134, <https://www.sciencedirect.com/science/article/pii/S0360544219318298>accessed 19 November 2024.
[237] ibid.
[238] ibid.
[239] A Roberts, B Thomas, P Sewell, Z Khan, S Balmain and J Gillman, 'Current tidal power technologies and their suitability for applications in coastal and marine areas' (2016) 2 JOEME, 227–245 <https://doi.org/10.1007/s40722-016-0044-8> accessed 19 August 2023.

emphasised the need for the development of Nigeria's wave and tidal energy resources. Positively, in 2024, following its establishment, the new Ministry of Blue Economy has recently expressed an interest in developing the country's ocean energy potential, which includes wave and tidal energy.[240]

3.5 Conclusion

In sum, Nigeria's huge renewable energy resources have the potential to generate enough electricity to solve the country's energy poverty. However, Nigeria's renewable energy sources, specifically non-wave and tidal energy, such as biomass, hydropower, solar, and wind, are currently falling short of meeting the country's set target for electricity needs. Additionally, this chapter, in looking at the problems and prospects of renewable energy resources in Nigeria's energy mix, demonstrates that wave and tidal renewable energy resources are yet to be exploited. This is evident from the non-wave and tidal energy discussion above and their little impact on Nigeria's current energy mix. Furthermore, this chapter reveals a lack of legal framework that supports the development of wave and tidal energy resources in Nigeria. As a result, the next chapter is a critical analysis of Nigeria's existing renewable energy enactments with a specific focus on how it deals with wave and tidal energy, as well as the search for any gaps or inconsistencies in the legal framework.

[240] Rafiq Anammah and Linda Ezenyimulu, 'The Regulatory Framework of The Nigerian Blue Economy, (*Mondaq*, 8 March 2024) <https://www.mondaq.com/nigeria/economic-analysis/1436256/the-regulatory-framework-of-the-nigerian-blue-economy> accessed 25 July 2024.

CHAPTER FOUR - A CRITICAL ASSESSMENT OF THE LEGAL CONTEXT OF RENEWABLE ENERGY IN NIGERIA

4.1 Introduction

In recent years, the Nigerian legal and regulatory framework for electricity has undergone several changes, including the enactment of the Electric Power Sector Reform (EPSRA) in 2005, which aimed to encourage private-sector investment in the electricity sector, promote competition and efficiency, and increase access to electricity.[241] However, despite these efforts, the development of renewable energy resources for electricity generation in Nigeria has been slow, and the country continues to rely heavily on fossil fuels such as oil and gas.[242] This is the result of several factors, including limited financing options, weak infrastructure, and limited public awareness of the advantages of renewable energy.[243] Although the cost of wind and solar technologies globally are cheaper when compared to fossil fuels, in Nigeria, renewable energy technologies have high costs.[244] By justification, in its report, IRENA 2023, "*Renewable energy Roadmap: Nigeria",* argues that the primary reasons for these are the financing costs, the fact that most renewable energy technologies are imported into the country, and the absence of an enabling environment for the local manufacturing of renewable energy technologies.[245] A critical suggestion is to establish an environment that facilitates the manufacturing of renewable energy technologies in the nation by increasing the local demand for these technologies.

As discussed in the previous chapter, renewable energy sources (RES) in Nigeria account for less than 10% of the country's energy consumption, proving that RES

[241] Kamoru Lawal, 'Law, Policy, and the Development of Renewable Energy for Electricity: A Case for a Renewable Energy Law in Nigeria' (2021) 49(1) IJLI <https://www-cambridge-org.ezproxy.rgu.ac.uk/core/journals/international-journal-of-legal-information/article/law-policy-and-the-development-of-renewable-energy-for-electricity-a-case-for-a-renewable-energy-law-in-nigeria/5EF19840DFC8FF395DE60F692D83FDCA> accessed 20 February 2023.
[242] Aniefiok Etuk Okposin, 'Renewable Energy Utilization and Energy Efficiency in Nigeria' in Lawrence and Sunday Dauda (eds), *Beyond Fossil Fuels: Renewable Energy* (Fifers Lane 2019) 138.
[243] Abubakar Sadiq Aliyu, Joseph O. Dada, Ibrahim Khalil Adam, 'Current status and future prospects of renewable energy in Nigeria' (2015) 48 336, 342 RSER <https://doi.org/10.1016/j.rser.2015.03.098.> accessed 11 March 2023.
[244] Malgorzata Wiatros-Motyka, 'Global Electricity Review 2023' (*EMBER,* 12 Apr 2023) <https://ember-climate.org/insights/research/global-electricity-review-2023/> accessed 4 August 2023.
[245] IRENA 2023 (n 158) 98.

has been underdeveloped and underutilised.[246] Unlike the United Kingdom, where energy is characterised by electricity, heating, and transportation, Nigeria's energy needs, including renewables, are primarily for electricity. However, a recent report by IRENA titled "Renewable Energy RoadMap Nigeria" (RE RoadMap)[247] shows a deliberate planning exercise to attempt to pull all of Nigeria's renewable energy resources together and to see how their use might be expanded in a deliberate and focused mapping. For example, as rightly noted by IRENA DG Francesco La Camera:

> *Nigeria has, therefore, reached a vital juncture at which it must decide whether to maintain its reliance on fossil fuels – accepting the inevitable environmental and economic risks that path entails – or capitalise on its ample indigenous renewable energy resources to drive economic development, decrease energy costs and significantly reduce its greenhouse gas emissions*.[248]

Nigeria's policy and legal framework concerning the renewable energy sector will now be scrutinised in line with the aim of this thesis in Chapter One, which is primarily to critically search and identify gaps concerning wave and tidal energy.

Commencing with the renewable energy laws, policies and plans, this researcher will review the following: the Constitution of the Federal Republic of Nigeria; the Electric Commission of Nigeria (ECN) Act 1965; and the EPSRA 2005. Thereafter, the relevant policies will be reviewed, including the Electric Power Implementation Policy 2001, Nigeria Energy Policy 2003,[249] Renewable Energy Master Plan 2005, Renewable Energy Policy Guidelines 2006;[250] National Renewable Energy Efficiency Policy 2013; National Energy Efficiency Action Plans 2015 – 2030; the Order On The Mandatory Dispatch of Hydropower Plants 2019; and Energy For All – Mass Rural Electrification Programme and the National Climate Change Policy 2021 – 2030. The chapter will also critically assess some enactments, including the Land Use Act 1978, Petroleum

[246] Akuru (n 149).
[247] IRENA 2023 (n 158).
[248] ibid.
[249] Nigeria Energy Policy, 'The Presidency Energy Commission of Nigeria' (*Nigeria Energy Policy* 2003) <https://rea.gov.ng/wp-content/uploads/2017/09/National_Energy_Policy_Nigeria.pdf> accessed 12 March 2023.
[250] Aarti Gungah and others, (n 82).

Act 2021, CCA 2021, Finance Act 2021, and Science, Technology and Innovation Act 2022. These pieces of legislation are closely related to RE, and so it would be remiss not to mention them. However, this researcher did not assess some ocean related legislations including the Exclusive Economic Zone Act 1978[251] and the Territorial Waters (Amendment) Act, 1998.[252] Access to deployed ocean energy technologies and transmission of the generated energy, for instance, requires contiguous land area to facilitate such developments. The licenses required to develop wave and tidal energy resources internationally include land permits.

4.2 Laws

4.2.1 The Constitution of the Federal Republic of Nigeria

The Constitution of the Federal Republic of Nigeria[253] is the foundation for electricity regulation, including renewable electricity. The Constitution is unambiguous, and it permits both the federal and state governments to regulate the electricity industry as stated in the Constitution of the Federal Republic of Nigeria, Second Schedule Legislative Power, Part II Concurrent legislative list.[254]

At the Federal level, under Part II – Concurrent Legislative List, Extent of Federal and State Legislative Powers, serial 13(a) – (f), the Constitution delegates law making authority to the National Assembly. It stipulates that the National Assembly may enact legislation for the entire federation or any of its constituent parts regarding electricity and the establishment of electric power stations, generating and transmitting electricity within or to any portion of the federation and between states. Further, the Constitution stipulates the regulation of the right of any person or authority to dam up or otherwise interfere with the flow of water from sources in any part of the Federation. Also the Constitution stipulates the participation of the Federation in any arrangement with another country for the generation, transmission, and distribution of electricity for any area partly within and partly outside the

[251] The Exclusive Economic Zone Act of 1978.
[252] The Territorial Waters (Amendment) Act 1998.
[253] LawNigeria, 'The Constitution of the Federal Republic of Nigeria 1999, (With Amendments)' (1999) <https://constitution.lawnigeria.com/2018/03/26/1999-constitution-with-amendments-nigerian-constitution-hub/> accessed 25 February 2023.
[254] Jurist.ng, 'Constitution of the Federal Republic of Nigeria. Part II. Concurrent Legislative List.' (2024) <https://jurist.ng/constitution/1023#google_vignette> accessed 20 November 2024.

Federation. In addition, the Constitution stipulates the regulation of the right of any person or authority to use, work or operate any plant, apparatus, equipment or work designed for the supply or use of electrical energy.

At the State level, under Part II – Concurrent Legislative List, Extent of Federal and State Legislative Powers, serial 14(a) – (c) of the Constitution, the State Houses of Assembly are charged with enacting legislation to regulate electricity. The States House of Assembly is empowered to pass laws for the state regarding electricity and the establishment of electric power stations in that state; generation, transmission, and distribution of electricity to areas of that state not served by a national grid system; and the establishment of any authority within that state for the promotion and management of state-established electric power station.[255] The Constitution of the Federal Republic of Nigeria reflects the spirit of Nigeria's democratic federalism, including respecting the rights and responsibilities of the federating entities to their citizens, as this also promotes development in the areas of comparative advantage.

The Federal government has continued to dominate entities that enacted electricity laws in line with the Second Schedule Legislative Power, Part II Concurrent legislative list of the Nigerian Constitution. The Nigerian Constitution supports decentralised electricity regulation as it gives federal and state governments the authority to make laws that would enhance supply.[256] However, some energy experts have argued that there is a need for clarity in the implementation and application of this aspect of the Constitution.[257] Also, the implementation of the Second Schedule, under Part II – Concurrent Legislative List, Extent of Federal and State Legislative Powers, serial 14(a) – (c) of the Constitution of Nigeria has been described as "unclear".[258] As discussed earlier in Chapter 4.0, Nigeria's legal and regulatory framework for electricity has not resulted in significant changes in developing renewable energy resources for electricity generation sources. Many duplicities and inconsistencies

[255] ibid.
[256] Jack Marley, 'Conflicting laws keep Nigeria's electricity supply unreliable', (*The Conversation,* 23 August 2017) <https://theconversation.com/conflicting-laws-keep-nigerias-electricity-supply-unreliable-81393> accessed 26 February 2023.
[257] ibid.
[258] ibid.

have remained a major challenge in Nigeria's energy/electricity development. For example, the Nigerian Constitution legislates a decentralisation of electricity and grants the federal and state governments the authority to enact supply-enhancing legislation. However, electricity regulation remains the exclusive responsibility of the federal government.

According to Onwubuariri, over time, the federal government, through enactments, programme implementation and regulatory mechanisms, continue to have overarching control, which has stunted the growth of the electricity sector, unhinged the systemic balance between the federal and the state government to the extent that the sector cannot support economic development.[259] During this research, a new development relating to the decentralisation of electricity generation, transmission, and distribution occurred, which can be considered a constitutional change. On 17 March 2023, the Nigerian president assented to the Fifth Alteration (No 17) Bill, which sought to alter the Constitution of the Federal Republic of Nigeria, 1999, to allow States to generate, transmit, and distribute electricity in areas covered by the national grid and for related matters.

Although this alteration clarifies the devolution of the powers to the States to engage directly in the development of the electricity sector, the Bill neither identifies renewable energy sources nor addresses wave and tidal energy. The researcher considers this as a gap in Nigeria's RE Legal framework. It was argued that the lack of constitutional clarity and flux in the erstwhile Constitution of the Federal Republic of Nigeria and the recent Fifth Alteration (No. 17) Bill remains an ongoing challenge to the development of wave and tidal energy, and the extant gap remains unfilled. Furthermore, as discussed in the earlier two paragraphs, recognising the inherent weakness in Nigeria's energy policy framework, in 2022, a constitutional amendment decentralised electricity regulation, including the sources of energy generation, transmission and distribution and the means of funding the electricity sector.[260]

[259] Jama Onwubuariri, 'Reviewing the Legal Framework for Renewable Energy Projects in Nigeria' (2015) <https://www.academia.edu/12116036/Reviewing_the_Legal_Framework_for_Renewable_Energy_Projects_in_Nigeria> accessed 26 February 2023.
[260] Jurist.ng (n 254).

The constitutional amendment acknowledged the need to allow the federating entities to have control over certain aspects of the development of the country. Invariably, it remains to be seen how the decentralisation will translate to the concrete development of RE in the States, especially as the States still must enact their legislation through their State Houses of Assemblies. As of 28 February 2024, while some states have committed to enacting their State Electricity legal framework, and most States have not addressed plans to domesticate the Electricity (Amendment) Act 2024, only Lagos State has commissioned its electricity policy.[261] As of October 2024, Lagos State has established a 50% renewable electricity target to be added to Nigeria's Mix.[262] Consequently, these new constitutional changes are one of the reasons that the new Electricity (Amendment) Act 2024 (discussed below) has been enacted. However, it is foreseeable that other related enactments, such as the Land Law 1978, are likely to be amended. Further, in a federal system of Government such as Nigeria, the decentralisation will attract corresponding amendments to related enactments and establishment of State laws. As a result, gaps concerning wave and tidal energy could be adapted.

Next, the federal legislation on the electricity sector will be critically reviewed, starting with the electricity sector primary legislation, the Electricity Commission of Nigeria Act (ECNA) 1989, and the "Electric Power Sector Reform Act 2005", which has now been replaced by Electricity (Amendment) Act 2024. A critical review of the Electricity Act (Amendment) 2024 will be carried out to examine if the gaps being discussed in this research subsist. Other laws to be discussed include the NERC Mini-Grid Regulation and NERC Renewable Energy Feed-in Tariff Regulations 2015.[263]

[261] Lagos State Ministry of Energy and Mineral Resources, Lagos State Electricity Policy (2021) <https://lagosstate.gov.ng/wp-content/uploads/2021/04/Lagos-Electricity-Policy-Consultation-Paper-Issued-19042021-1.pdf> accessed 28 February 2024.
[262] Petlong Dakhling, 'Nigeria Aims for 5,000MW Renewable Energy by 2030' (*African Energy Council,* 3 September 2024) <https://africanenergycouncil.org/nigeria-aims-for-5000mw-renewable-energy-by-2030/> accessed 23 October 2024.
[263] NERC Renewable Energy Feed-in Tariff Regulations 2015 <https://rise.esmap.org/data/files/library/nigeria/Renewable%20Energy/Nigeria_REGULATIONS%20ON%20FEED-IN%20TARIFF%20FOR%20RENEWABLE%20ENERGY%20SOURCED%20ELECTRICITY_REFIT_2015.pdf> accessed 18 December 2024.

4.2.2 Electricity Commission of Nigeria Act (ECNA) 1989

The Electricity Commission of Nigeria Act (ECNA) 1989 was initially established in 1979 and revised in 1988 and 1989, officially established the Energy Commission of Nigeria (ECN). The ECNA 1989 mandates the ECN to coordinate and generally supervise the systematic development of Nigeria's various energy resources, including making sure that all levels of national energy policy are strategically planned and coordinated.[264] The ECN performs many roles, including:

- Functioning as a clearinghouse for data collection and dissemination on energy development policy at the national level.

- Acting as a hub for the resolution of all technical issues that may arise during the execution of any energy policy.

The ECNA does not mention renewable energy sources. However, this is understandable given the date of the Act and the fact that renewable energy was not a priority when it was drafted. While the ECNA 1989 makes no direct mention of renewable energy, it does require the ECN to create plans for the future of Nigeria's energy sector, and these plans must include suggestions for the use of alternative energy sources.[265] The term "new sources of energy" could include renewable power. The ECN's Renewable Energy Master Plan, developed within the scope of this mandate, will be discussed in greater detail below.

4.2.3 Electric Power Sector Reform Act (EPSRA) 2005

As discussed earlier in Chapter 4.2, the Nigeria Electricity Supply Company (NESCO) began operations in 1929, and NESCO experienced multiple transformations and reforms. It had a mandate to connect all parts of the country to the national grid and ensure a secure electricity supply. In 1972, it was renamed the National Electric Power Authority (NEPA). NEPA was known for its subsidies burden, poor service

[264] Chitzi Ogbumgbada, 'Developing an effective legal framework for Renewable Energy Utilization in Nigeria' (2018) 8(3) ElgarOnline 45, 49 <http://doi.org/10.4337/relp.2018.03.05> accessed 28 March 2023.
[265] Electricity Commission of Nigeria Act 1989, s 5(d).

quality, and inept collection of bills. The EPSRA 2005 dismembered NEPA into 18 companies (under the banner of Power Holding Company of Nigeria): six generating companies, one transmission company, and eleven distribution companies.[266] The generating companies consist of three hydroelectric and nine thermal (gas-based) power plants.[267]

The EPSRA was adopted in response to the terminal inefficiency of NEPA[268]. NEPA was later rebranded Power Holding Company of Nigeria (PHCN), and the latter exists today[269] to generate and distribute power across Nigeria.[270] The EPSRA (2005) made provision for the repeal of the NEPA,[271] including unbundling of NEPA along functional and jurisdictional lines. In addition, the generation, distribution and transmission functions were decoupled and incorporated as independent entities; privatisation of the decoupled entities; establishment of the Electricity Regulatory Commission of Nigeria (ERCN) to regulate activities of generation, distribution and transmission companies; and granting of licenses by NERC for electricity generation, distribution, system operation, trading and transmission.[272] However, EPSRA (2005) is silent on the use and deployment of renewable energy resources.[273]

Under the EPSRA (2005), all regulations concerning electricity are made centrally for the 36 states and their 774 local government areas.[274] The Rural Electrification Agency was set up by Section 88 of the Electric Power Sector Reform Act of 2005, and the Board and Management of the Agency were inaugurated on March 16,

[266] Aliyu and others (n 243).
[267] ibid.
[268] Felix Orah Ndukwe, 'Nigeria's Economy will not Transform Without Adequate and Reliable Electricity' (2023) 14(3) ADBG <https://www.afdb.org/en/documents/nigerias-economy-will-not-transform-without-adequate-and-reliable-electricity-volume-14-issue-3> accessed 20 November 2024.
[269] Tobi Folasade Ejumudo and Kelly Bryan Ovie Ejumudo, 'The Operations of the Power Holding Company of Nigeria and Discriminatory Monopoly' (2014) 4(6) JETP <https://core.ac.uk/download/pdf/234667902.pdf> accessed 20 November 2024.
[270] Jama Onwubuariri, 'Reviewing the Legal Framework for Renewable Energy Projects in Nigeria' <https://www.academia.edu/12116036/Reviewing_the_Legal_Framework_for_Renewable_Energy_Projects_in_Nigeria> accessed 26 February 2023.
[271] Ndukwe (n 268).
[272] Electric Power Sector Reform Act 2005.
[273] Ivie Ehanmo, 'Policy Brief: Lagos State Electricity Policy' (*LindkedIn*, 31 May 2021) <https://www.linkedin.com/pulse/policy-brief-lagos-state-electricity-ivie-ehanmo/> accessed 26 February 2023.
[274] Electric Power Sector Reform Act 2005.

2006.[275] Essentially, the EPSRA (2005), which was signed into law in March 2005, provided legal support to Nigeria's Electric Power Sector Reforms.[276] This legislation established the Nigerian Electricity Regulatory Commission, which is responsible for regulating tariffs and monitoring the quality of the Power Holding Company of Nigeria's services (PHCN).[277] The EPSRA (2005) includes the following provisions:

According to Section 88(9), the Minister of Power and Steel is required to provide the President with information regarding, among other things, the expansion of the main grid, the development of isolated and mini-grid systems, and the generation of renewable energy power. Section 88(9) demonstrates the clutch of the Federal Government on the development of electricity generation, including from which sources the electricity derives. Further, it also shows that the authority to develop renewable technology resides in one person's whims and caprices, especially as he must be informed before any renewable energy support for mini-grid development is implemented. Section 88 also stipulates the establishment of a Rural Electrification Agency tasked with the electrification of rural areas in Nigeria. In addition, Section 76 establishes incentives for investors as well as tariffs for transmission, distribution, and power system operations.

Although Section 88 established the Rural Electrification Agency and Section 76 established incentives, there is no specific mention of renewable energy sources, thus leaving the choice of clean sources of electricity generation uncertain, a hallmark for investor unfriendliness to invest in the renewable energy sector in Nigeria. This uncertainty constitutes a structural gap in Nigeria's legal enactments in support of wave and tidal energy.

Following the EPSRA (2005), independent power producers (IPPs) acquired 20 licences between 2006 and 2007. However, the EPSRA (2005)'s targets for electricity generation and distribution were deemed insufficient for Nigeria's population of 140

[275] Rural Electrification Agency, 'History' (*Rural Electrification Agency*, 2024) <https://rea.gov.ng/> accessed 18 March 2023.
[276] Electric Power Sector Reform Act 2005.
[277] Aliyu and others (n 243) 336, 338.

million in 2007, then, and now, over 200 million in 2024. Unfortunately, as of 2007, Nigeria could only boast of generating 6227MW from the National Electricity grid. Sixteen years later (2023), as earlier mentioned in the Introduction section of Chapter 4, Nigeria generates 7420MW, representing an addition of just 1193MW in over two decades;[278] and as of September 2023, it generates 8,415GWh.[279] By other measurements in hours, Nigeria's electricity generation from fossil represents 24.33TWh and hydro (low carbon) represents 8.03TWh, totalling 32.38TWh.[280] Evidently, the EPSRA 2005 did not adequately and explicitly provide for renewable energy power generation. Further the EPSRA 2005 s 88 supports the diversification of energy production without mandating the production of other renewable energy sources, such as solar, wind, and biomass.[281]

Statutorily, the Rural Electrification Agency (REA) advocates for local producers of rural electrification equipment and materials to receive tax incentives, investment capital allowances, and low-interest loans. Hence, import duties on renewable electricity generation equipment and inexpensive supplies must be decreased. While the Nigerian industry prepares to compete in this area, rural electrification schemes must have access to imported materials, components, and equipment for rural electrification systems without having to pay excessive import taxes. Under the Rural Electrification Agency and through its fund, rural communities with limited or non-existent energy are to be provided electricity, including through off-grid and mini-grid electricity supplies from renewable energy sources.[282] Although this Rural Electrification Agency has committed to aggressive rural electrification, according to the World Bank Group, a report titled 'Nigeria: Energizing Economies Programme', the progress in harnessing Nigeria's huge renewable energy resources has been slow and insufficient.[283]

[278] CEIC, 'Nigeria Electricity Production 2005 – 2024' (*CEIC Data,* 2024), <https://www.ceicdata.com/en/indicator/nigeria/electricity-production> accessed 21 March 2023.
[279] ibid.
[280] LowCarbonPower, 'Electricity in Nigeria in 2023/2024' (*LowCarbonPower,* 21 January 2021) <https://lowcarbonpower.org/region/Nigeria> accessed 23 September 2024.
[281] Muhammed Tawfiq Ladan, 'Policy, legislative and regulatory challenges in promoting renewable energy in Nigeria' 4719 167 ISS 93, 95 <https://issafrica.s3.amazonaws.com/site/uploads/M167Chap5.pdf> accessed 21 March 2023.
[282] Rural Electrification Agency (n 275).
[283] World Bank Group, 'Nigeria: Energizing Economies Programme' (2020) Washington DC

Furthermore, in 2016, the Rural Electrification Agency developed the Rural Electrification Strategy and Implementation Plan approved the overarching objective of the Nigerian Rural Electrification Policy and, by extension, this Rural Electrification Strategy and Implementation Plan (RESIP)[284] is to expand access to electricity as quickly and affordably as possible. This necessitates using grid-based and off-grid methods, with subsidies primarily geared towards expanding access rather than consumption. The RESIP outlines the government's strategy for achieving the goals outlined in the EPSRA 2005 and the Rural Electrification Policy. It was developed with input from various rural electrification stakeholders in Nigeria. Together, the Rural Electrification Strategy and the Rural Electrification Policy constitute the framework for achieving the expansion of electricity services to rural areas.[285] The plan established a foundation for the use of renewable energy in rural communities by mandating that the federal government fund renewable energy projects such as mini-grids, grid extension, and stand-alone systems. According to the plan, "the goal of the Federal Government of Nigeria is to increase access to electricity to 75% and 90% by 2020 and 2030 respectively with renewable energy contributing at least 10% to the energy mix by 2025 as contained in the National Electric Power Policy (NEPP) of 2001 and the Rural Electrification Policy of 2005 respectively".[286], as of 2024, these goals have not been achieved, and it is yet to be seen if the 2025 and 2030 goals will be achieved.

Arguably, the 10% contribution to renewable energy does not demonstrate a concrete commitment to RE energy sources. On the contrary, it illustrates low expectations for renewable energy sources and a greater emphasis on fossil fuel energy sources. The low renewable energy allocation of 10% may also be indicative of the absence of legislation mandating institutions to develop renewable energy. In sum, even though EPSRA 2005 manifestly deregulated Nigeria's electricity sector, thereby allowing the private sector to participate in the power generation sector, no

[284] REA, 'Rural Electrification Strategy & Implementation Plan (RESIP)' <https://rea.gov.ng/download/rural-electrification-strategy-implementation-plan-resip/> accessed 22 March 2023.
[285] ibid.
[286] REA, 'Rural Electrification Strategy & Implementation Plan' (*RESIP, 25 August 2017)* <https://rea.gov.ng/download/rural-electrification-strategy-implementation-plan-resip/> accessed 22 March 2023.

significant success was achieved, not least in the generation, transmission and distribution of electricity. Further, wave and tidal energy did not attain any priority position nor any development, aside from a nominal academic mention that it represents a renewable energy resource. Consequently, this demonstrates a gap which can be related to the neglect of wave and tidal energy by Nigeria's renewable energy legal framework.

4.2.4 Electricity (Amendment) Act 2024

In June 2023, a new Electricity Act[287] was enacted and later amended on 9 February 2024 and designated as the Electricity (Amendment) Act 2024 (EAA 2024). The researcher critically assessed the EEA 2024 within the context of wave and tidal energy, and searched how the EAA 2024 addressed the development of wave and tidal energy. On the contrary, where the EAA 2024 is lacking, that would have created a gap in the legislation. According to the Explanatory Memorandum, the EAA 2024 repeals the Electric Power Sector Reform Act No 6, 2005.[288] Generally, EAA 2024 seeks to consolidate the laws relating to the Nigeria electricity supply industry, provide a comprehensive legal and institutional framework for the power sector in Nigeria. Furthermore, it provides for a holistic, integrated resource plan and policy that recognises all sources, including the integration of renewable energy into Nigeria's energy mix and attract investments. Additionally, the EAA 2024 was signed by President Bola Tinubu and seeks to deal with the development and environmental concerns of host communities, including setting aside five per cent of the actual annual operating expenditures of power-generating companies (GENCOs) from the preceding year for their host communities' development.[289]

Hitherto, the enactment of the EPSRA 2005 unbundled the monopoly in the electricity sector.[290] Specifically, the EAA 2024 acknowledges the necessity of conducting a

[287] Electricity (Amendment) Act 2024.
[288] ibid.
[289] Press release, 'Tinubu signs Electricity Act Amendment Bill into law' (*Premium Times,* 9 February 2024) <https://www.premiumtimesng.com/news/more-news/667028-tinubu-signs-electricity-act-amendment-bill-into-law.html> accessed 28 February 2024.
[290] Nicholas C. Okaafor, Adeola Sunmola, Godson Iwuozo, Omeiza Alao, Udo Udoma and Belo-Osagie, 'Nigeria: The Nigerian Electricity Act 2023: Illuminating The Path Towards Power Sector Transformation In Nigeria' (*Mondaq,* 5

review process every five years to refine and update the Plan. By recognising the right of federating states to enact legislation and establish markets for various components of the electricity value chain, the EAA 2024 effectively alters the dynamics of the nation's electric power sector in a significant way. However, s 63 (2)(b) of the Electricity Act prohibits interstate and transnational electricity distribution if the licensee does not have permission from the regulatory body. In essence, this provision is a restrictive and anti-large-scale development project. This provision is likely to create a barrier to the sale of excess electricity generated to contiguous States.

Further, s 80 (1) of the Act states that the NERC and the Independent Systems Operator (ISO) must continuously encourage the production of electricity from renewable energy sources. Additionally, the EAA 2024 specifies regulations for connecting renewable energy generators to transmission and distribution systems and highlights the significance of utilizing local resources in the renewable energy sector. The EAA 2024 also offers tax incentives to support and promote renewable energy projects, stimulating investment and expediting the progress and advancement of renewable energy projects in Nigeria.[291] Furthermore, the EAA 2024 includes feed-in tariff provisions and other mechanisms to promote investment and involvement in renewable energy projects, aiming to stimulate the growth and implementation of renewable energy generation capacity. The detailed regulations in the EAA 2024 regarding renewable energy generation demonstrate a positive addition with the potential to establish sustainability in the NESI, if executed effectively. The EAA 2024 is characterised as having robust provisions that give the impetus to developing and expanding Nigeria's electricity markets.[292] Okaafor and others and Ezekwesiri and others commended the enactment of the EAA 2024. In their article titled "A Review of the Electricity Act, 2023—Impact and Major Issues Arising" Ezekwesiri and others described the Act as a welcome development in the Nigerian

September 2023) <https://www.mondaq.com/nigeria/renewables/1362400/the-nigerian-electricity-act-2023-illuminating-the-path-towards-power-sector-transformation-in-nigeria> accessed 28 February 2024.

[291] Electricity (Amendment) Act 2024.

[292] Emeka Ezekwesiri, Favour Ogini, and Iyanuoluwa Adeyemo 'A Review of the Electricity Act, 2023 - Impact and Major Issues Arising' (2023) SSRN <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4560855> accessed 20 November 2024.

electric power sector, which provides the impetus to develop and expand Nigeria's electricity market."[293] The EAA 2024 recognizes the concurrent powers of the states in this regard. Nevertheless, there are still challenges that are yet to be resolved. In this respect, Ezekwesiri and others argued that the Act did not introduce substantial incentives to encourage investments in the electricity sector, especially as it did not also address the liquidity issues in the market.[294]

Although the EAA 2024 received accolades from many scholars for its strong construction and resolution of EPSRA 2005 shortcomings, like its precursor law, it continues to ignore wave and tidal energy. In other words, the EAA 2024 did not specifically recognize and adequately tackle the substantial ocean energy resources of Nigeria, particularly those associated with wave and tidal energy. It is evident that this represents a gap in the EAA 2024, as it concerns wave and tidal energy, and this affirms the primary aim of this thesis and buttresses the researcher's argument.

4.3 Policies

4.3.1 National Electric Power Policy (NEPP) 2001

The objective of the National Electric Power Policy 2001 was to establish an effective electricity market in Nigeria. Oyewumi highlights in her article, "Nigeria: Energy Policy", that the primary objective of the NEPP is the liberalization, competition, and private sector-led expansion of the Nigerian electricity sector.[295] Oyewumi further commented that the NEPP 2001 prioritized the development of well-structured market structures, a transparent regulatory framework, and competition in the generation and sale of electricity while promoting the sound growth of the transmission network. In essence, NEPP 2001 aimed to transfer the ownership and management of the electricity industry's infrastructure and assets to the private

[293] ibid.
[294] ibid.
[295] Tade Oyewumi, 'Nigeria: Energy Policy' in G Tiess, T Majumder and P Cameron (eds), *Encyclopedia of Mineral and Energy Policy*. (Springer 2017) <https://doi.org/10.1007/978-3-642-40871-7_158-1> accessed 20 November 2024.

sector, thereby facilitating the formation and maintenance of an electricity market in Nigeria.

NEPP 2001 did not specifically mention renewable energy sources, not least wave and tidal energy. Although at this time the NEPP 2001 was adopted, within the international energy sector, renewable energy had attained a stage where many countries had adopted policies and programmes to develop their RES potential. Following the NEPP 2001, the National Energy Policy that will be discussed in the next sub-section 4.3.2 established a more encompassing policy that addressed renewable energy specifically and still with some gaps hitherto identified especially wave and tidal energy.

4.3.2 National Energy Policy (NEP) 2003

Historically, Nigeria's National Energy Policy (NEP) 2003 aimed at integrating sub-sectoral policies within and outside the energy sector, for example, oil and gas, solid minerals, transportation, agriculture, science, and technology. From 1987 to 2003, the world witnessed significant changes in the energy sector, not least, the increased interest in and greater attention towards renewable energy, energy security, and energy efficiency for sustainable development. Since Nigeria adopted the NEP 2003, many researchers have argued that there are gaps and inadequacies in the NEP 2003 and other energy-related sub-policies. Going forward, this author deciphered Nigeria's energy policies by specifically identifying areas where the policy dealt with renewable energy as related to wave and tidal energy.

Nigeria's position on the development and exploitation of all of the country's energy resources was spelt out in 2003 with the launch of the National Energy Policy 2003 to address environmental concerns, energy utilization/efficiency, financing, and policy implementation.[296] The policy aimed to ensure energy security using the principle of "an energy economy in which renewable energy increases its share of energy consumed and provides affordable access to energy throughout Nigeria, and

[296] ibid.

contributing to sustainable development, and energy conservation" through diversifying the energy supply and energy carriers. Chapter 2 of the NEP 2003,[297] section 4.3.2 states:

- The recognition of biomass, wind, solar, hydro, and hydrogen as environmentally sustainable energy sources to be utilised by the nation.[298]

- Local research, development, and exploitation of the energy potentials shall be conducted commercially with public, private, and native participation.

- Non-renewable energy sources are to be used sparingly while Nigeria provides constant and reliable power to at least 75% of the population at affordable rates for social, industrial, and economic activities by 2020, and

- The development of an integrated energy planning system involving energy-related programmes and activities in other sectors.[299]

Ojo criticized the NEP 2003 for "lacking legal authority" and failing to impose any enforceable obligations on the government or investors.[300] However, Ojo's critique seems misplaced, as a policy would not contain enforceable obligations, only a law would be capable of this. Ojo's argument is likely referring to the absence of RE legislation in Nigeria. Further, this deficiency, which affirms this researcher position, has resulted in a situation in which defaulting investment parties or government institutions cannot be compelled by a court order to implement the policy's core or periphery objectives. However, in a recent development, it is noteworthy that under the EAA 2024, decisions by the regulatory body NERC can be challenged in the court. In this regard, the EPSRA 2005 did not make provisions for redress where any person

[297] The Federal Republic of Nigeria, 'National Energy Policy 2003' (2003) Chapter 2 23 -31, <https://rea.gov.ng/wp-content/uploads/2017/09/National_Energy_Policy_Nigeria.pdf> 10 June 2023.
[298] Oluwaseun Viyon Ojo, 'An Overview of the legal and Regulatory Framework for Renewable Energy Projects in Nigeria: Challenges and Prospects' (2017) 1(1) ULR 22, 29 <https://unilaglawreview.org/james/wp-content/uploads/2017/06/oluwaseun-viyon-ojo-an-overview-of-the-legal-and-regulatory-framework-for-renewable-energy-projects-in-nigeria.pdf> accessed 18 December 2024.
[299] ibid 30.
[300] ibid.

is dissatisfied with final decisions of the NERC.[301] However, by the provisions of the EAA 2024, any person dissatisfied with the decision of the NERC on the grant of a license, or any other matter may file an appeal to the Federal High Court (FHC) within 30 days, subject to the rules of the FHC.[302] The FHC may affirm, modify, or vary the decision of the NERC.[303] However, every aggrieved person must exhaust all internal dispute settlement mechanisms provided pursuant to the provisions of the Act, before initiating court action at the FHC.[304]

It is evident that the NEP 2003 did not mention wave and tidal energy list of renewable energy sources in Chapter 2. However, in page 34 of Chapter 2, of the NEP 2003, wave and tidal energy came under the heading of "Other Renewables". Unlike bio, hydropower, solar and wind energy, wave and tidal energy under "other renewables", the NEP 2003 'merely' aimed at maintaining an interest in emerging sources of RE. According to the NEP 2003 implementation approach:

> *Other renewable energy resources, which are not in common usage worldwide, include ocean waves, tidal energy, ocean thermal gradients, and geothermal energy. There is still much more work to be done on these energy resources in Nigeria. They may in future make contributions to the energy mix of the country.*
>
> *Policy: The nation shall maintain an interest in other emerging sources of renewable energy.*
>
> *Objectives:*
> *i. To develop a database on the potentials of these emerging energy resources.*
> *ii. To keep abreast of international trends in energy technology development.*
> *iii. To ensure incorporation of any new proven cost-effective energy resource into the energy mix.*

[301] EPSRA 2005, s 50(1)(2).
[302] Electricity (Amendment) Act 2024, s 51(3).
[303] Electricity (Amendment) Act 2024, s 51(4).
[304] Electricity (Amendment) Act 2024, s 51(5).

Strategies:

i. Gathering information on the development of these emerging technologies.

ii. Encouraging R & D in the technologies of the exploitation of these emerging energy resources.

iii. Prioritizing the level of need, level of technological development and viability of emerging renewable energy resources.

The objectives for promoting wave and tidal energy resources can be evaluated as a passive '*wait and see*' approach, lacking a concrete plan to ensure progress. Moreover, the strategies set forth to support wave and tidal energy resources have not been accomplished. For example, of the six research and development centres related to RE, no one of them has developed any projects in support of wave and tidal energy. Relatedly, Ojo's criticism supports the argument that a gap exists in Nigeria's RE policy and legal framework.

4.3.3 Renewable Energy Master Plan (REMP) 2012

In 2005, Nigeria's Renewable Energy Master Plan set short-, medium- and long-term targets to meet Nigeria's growing energy needs and to support economic development to contribute to Nigeria's energy mix.[305] The goal of Nigeria's Renewable Energy Master Plan (REMP) 2012 is to increase renewable electricity supply from 13% of total electricity generation in 2015 to 23% in 2025 and 36% in 2030.[306] (See Table 2). The REMP 2012 implemented a set of fiscal and market incentives to support the deployment of renewable energy across the nation. The plan includes an import duty moratorium for renewable energy technologies in the short term. In the long term, the plan recommends the development of additional tax credits, capital incentives, and favourable loan options for renewable energy projects.[307]

[305] IEA, 'Nigeria Renewable Energy Master Plan 2013' (*IEA*, 3 July 2013) <https://www.iea.org/policies/4974-nigeria-renewable-energy-master-plan> accessed 27 July 2024.
[306] ibid.
[307] Energy Commission of Nigeria (ECN), 'Renewable Energy Master Plan Final Draft Report 2005' (*Energy Commission of Nigeria*, November 2005) <https://www.iceednigeria.org/resources/nov.-2005.pdf> accessed 4 August 2023.

According to REMP 2012, by 2025, renewable energy will account for 10% of Nigeria's total energy consumption. The renewable energy plan includes declining installed capacity targets for a variety of suitable renewable energies:

a) *600 MW in 2015 and 2,000 MW by 2025 for small hydro; 500 MW for solar PV by 2025.*
b) *50 megawatts (MW) in 2015 and 400 megawatts (MW) by 2025.*
c) *40 megawatts of wind energy by 2025.*
d) *In tandem with this increase in electricity supply, the REMP aims to increase electrification rates from 42% in 2005 to 60% in 2015 and 75% by 2025.*

This researcher foresees that Nigeria is unlikely to achieve these set targets by 2025,[308] of which can be attributed to policy inconsistencies, with consequences on addressing energy poverty in the country. Concurrently, these RE targets have been adjusted and raised in Nigeria's Energy Transition Plan (ETP), even though no targets earlier set have been achieved to date.[309] Recently, the target to achieve carbon neutrality by 2060 was set with "ramping up of renewable energy-backed electrification."[310] As of 2025, the renewable energy market is projected to grow from 3.13GW in 2024 to 5.01GW in 2029, with a compound growth rate of 9.88%.[311] Hitherto, Nigeria established the ETP with a 2050 net-zero target.[312] However, given the significant financial, social and technological requirements, the nation concluded that a more realistic pathway to deep decarburisation would land in 2060.[313]

[308] Nigeria Energy Transition Plan, 'Nigeria's pathway to achieve carbon neutrality by 2060' <https://energytransition.gov.ng/> accessed 3 August 2023.
[309] ibid.
[310] Nigeria Energy Transition Plan (ETP), 'Nigeria's pathway to achieve carbon neutrality by 2060' <https://energytransition.gov.ng/> accessed 3 August 2023.
[311] Powerelec Nigeria, Market Info: Market Data, 3 – 5 February 2025, <https://powerelecnigeria.com/market-info/> 28 April 2025.
[312] Doris Dokua Sasu, Renewable energy in Nigeria - statistics & facts, Statista, 26 Sep 2024, <https://www.statista.com/topics/12629/renewable-energy-in-nigeria/#topicOverview> accessed 26 March 2025.
[313] ibid.

Table 2: Nigeria's Renewable Energy Targets from 2005 -2060

Policy	Year	Targets	Sources	Status
Renewable Energy Master Plan (REMP) 2012[314]	2015 – 2025 – 2030	To increase the supply of renewable electricity from 13% of total electricity generation in 2015 to 23% in 2025 and 36% by 2030. Renewable electricity would then account for 10% of Nigerian total energy consumption by 2025.	Solar PV Wind, Hydro	Target set not accomplished
Nigeria Energy Transition[315]	2030	30 GW of grid connected capacity; at least 30% of RE capacity by 2030	Solar PV Wind, Hydro	Working progress
Carbon Neutrality	2060	Nigeria's power system runs on 100% renewable energy and reaches net zero with a total installed capacity of 1,190 GW	Solar PV Wind, Hydro	Work in progress

Nigeria's newly established RE target stipulates achieving a generation capacity of 30,000 MW by 2030.[316] However, achieving this goal will necessitate significant public and private sector investment in power generation infrastructure, upgrades to transmission and distribution networks, and loss reduction.

4.3.4 National Renewable Energy and Energy Efficiency Policy 2015

In April 2015, the Federal Executive Council published the National Renewable Energy and Energy Efficiency Policy (NREEEP) for the electricity sector.[317] The NREEEP 2015 captures the two-pronged imperative of having a coordinated, coherent, and comprehensive renewable energy policy to drive hydropower, biomass, solar, wind,

[314] IEA 50, 'Nigeria Renewable Energy Master Plan 2013' (*IEA 50,* 3 July 2013) <https://www.iea.org/policies/4974-nigeria-renewable-energy-master-plan> accessed 22 September 2024.
[315] Wartsila, 'Nigeria Energy Transition,"30-30-30" and beyond' <https://www.wartsila.com/energy/towards-100-renewable-energy/pathways-for-africas-energy-future/nigeria-30-30-30-and-beyond> accessed 21 November 2024.
[316]Samuel Ajala, 'On Nigeria's Clean Energy Plans and Improved Energy Access by 2030' (*Dataphyte,* 26 January 2022) <https://www.dataphyte.com/latest-reports/climate/on-nigerias-clean-energy-plans-and-improved-energy-access-by-2030/> accessed 17 March 2023.
[317] The Federal Executive Council (FEC), 'Nigeria's National Renewable Energy and Energy Efficiency Policy 2015' (*Cleantechnology Hub,* 20 April 2015) <https://cleantechnologyhub.com/wp-content/uploads/2022/07/NATIONAL-RENEWABLE-ENERGY-AND-ENERGY-EFFICIENCY-POLICY-NREEEP.pdf> accessed 21 November 2024.

wave and tidal as energy sources and ensure energy efficiency in the country.[318] The NREEEP acknowledges the multifaceted nature of energy and therefore seeks to address complex problems such as renewable energy availability and usage; renewable energy pricing and financing; legislation, regulation, and standards; and technology development and deployment. The need for the exploitation and creation of other energy sources to complement and supplement the limited power generation and supply available in Nigeria encouraged the adoption of the Renewable Energy and Energy Efficiency Policy (NREEEP) 2015. Principally, as an alternative energy, renewable energy is a practical option to enhance Nigeria's electricity supply.

According to the NREEEP 2015, "Despite the abundance of natural resources in Nigeria, there were no nationally acceptable renewable energy or energy efficiency policies to drive Nigeria's renewable energy sector." However, this does not underestimate previous efforts by Nigeria's ministries, departments, and agencies (MDAs) to develop documents that "allowed them to pursue uncoordinated, isolated, and stand-alone ventures in the RE sector." In furtherance of the EPSRA 2005, to diversify Nigeria's energy mix and provide practical affordable and realistic access to electricity to all Nigerians, an inter-ministerial committee of stakeholders' MDAs, a standing committee that is co located in the Federal Ministry of Science Technology and Innovation, was constituted to attract investment into the electricity sector.[319]

The purpose of the NREEEP 2015 is to set out a framework to address Nigeria's challenge to inclusive access to modern and clean energy sources. Additionally, the policy sets national targets for achievements in electricity by 2030. Specifically, the NREEEP 2015 set Nigeria's Vision 20:2020 target of 40,000MW. Under Chapter 2 of the NREEEP 2015 – National Energy Policy 2013, policies guidelines, objectives, and strategies for implementing the plans to develop the RE sources – hydropower, biomass, solar, and wind energy were specifically spelt out in appreciable detail.

[318] ibid.
[319] Sustainable Energy For All Action Agenda (Se4all AA), Adopted By Interenergy And Energy Efficiency (ICREEE) Ministerial Committee On Renewable, (*Sustainable Energy For All Action Agenda (Se4all AA* July, 2016) <https://www.seforall.org/sites/default/files/NIGERIA_SE4ALL_ACTION_AGENDA_FINAL.pdf> accessed 22 September 2024.

However, Chapter 2.5 – Geothermal, Wave and Tidal Energy sources were all grouped together and dealt with by a one-paragraph statement as follows:

> *"Geothermal, wave and tidal energy sources are among the various energy sources that are available in Nigeria. Although these sources are not in use for energy supply at the moment;"* 'that is, as at 2015; and even at the time of writing this thesis in 2024, this policy encourages relevant agencies to ensure data and information relating to these resources are obtained through research and development programmes with a view to immediately commence using these resources to provide power supply where ever it is competitive'.[320]

Fundamentally, the NREEEP was determined to provide a "conducive political environment that will attract investments in the RE and energy efficiency sector".[321] According to NREEEP 2015, the renewable energy strategy entails the use of available renewable energy resources both on-grid and off-grid to drive "hydropower, biomass, solar and wind" as energy sources. The policy also acknowledges the gap in Nigeria's RE legal framework, especially the absence of RE policy framework.[322] According to the policy, "many of the tools necessary to drive RE development and improve energy efficiency require important rule changes and coordinated actions by MDAs, which are yet to be actualized".[323]

4.3.5 Nigeria's Feed-in-Tariffs

From 2008–2013, the NERC established the Multi-Year Tariff Order 1, (MYTO)1, which set prices for various energy sources, including solar, to be paid to licensed electricity generation companies for supplying electricity to distribution and retail companies.[324] With its statutory methodology,[325] MYTO1 supported cost recovery, financial

[320] ibid.
[321] National Renewable Energy and Energy Efficiency Policy (NREEEP), (*Ministry of Power, Federal Republic of Nigeria*, 20 April 2015) 8 <*https://admin.theiguides.org/Media/Documents/NREEE%20POLICY%202015-%20FEC%20APPROVED%20COPY.pdf*> accessed 22 September 2024.
[322] ibid 3.
[323] ibid.
[324]IEA 50, 'Multi-Year Tariff Order (MYTO)I (2008-2013)' (*IEA/IRENA Policy and Measures Database*, 18 March 2016) <https://www.iea.org/policies/5649-multi-year-tariff-order-myto-i-2008-2013> accessed 22 September 2024.
[325] Nnamdi B Anosike, Jude E Dara, Ugochukwu C Ngwaka, and Frances O Enemuoh, 'Analysis of Nigerian Electricity Generation Multi Year Tariff Order Pricing Model' (2017) 9(10) EPE, <https://www.scirp.org/journal/paperinformation?paperid=78990> accessed 21 November 2024.

sustainability, investment, and performance improvement for regulated entities. The 2015 feed-in tariff regulation replaced Multi-Year Tariff Order 2 (MYTO 2) (2012-2017) in Nigeria.

Subsequently, in November 2015, the Nigerian government approved the Feed-in Tariffs regulation with an effective date of February 2016.[326] The FiTs rates were determined using the Long Run Marginal Cost (LRMC) and Levelized Cost of Energy (LCOE) methodologies, as discussed in section 4.3.5.1. The FiTs were to be reviewed every three years from the date of publication. The PPA is valid for twenty years from the date of commercial operation. Prospective suppliers of electricity generated from renewable sources may submit applications to the NBET's Unsolicited Power Programme. Upon project approval, the producer receives the maximum feed-in tariffs established by MYTO II.[327] The worth of FiTs for renewable energy technologies in Naira, Nigeria's currency, are displayed in Table 3

Table 3: MYTO II FEED-TARIFFS – WHOLESALE CONTRACT PRICES (Naira/MWH)[328]

	2021	2013	2014	2015	2016
Hydropower plants, small up to 30MW	23, 561	25,433	27,456	29,643	32,006
Land-mounted wind power plants	24,543	26,512	28,641	30,943	33,433
Solar PV plants, ground mounted, fixed	67,917	73,300	79,116	85,401	92,192
Biomass power plants	27,426	29,623	32,000	34,572	37,357

Source: Nigerian Energy Support Programme (NESP) 2015.

According to the FiTs regulations, tariffs must be reviewed every three years. Consequently, the first revision was scheduled for 2019, but this did not take place, probably because of 'official inaction' as there has been no official statement or explanation gathered during the research. However, as of 28 December 2023, the issuance of MYTO by NERC established a new legal framework in the tariff system for the NESI. NERC has sanctioned an increase in end-use tariffs in Nigeria by the

[326] EMRC, 'Understanding Feed in Tariffs' (*EMRC*, 3 April 2024) <https://www.energymrc.ng/understanding-feed-in-tariffs/#:~:text=Feed%2DIn%20Tariffs%20in%20Nigeria,development%20objectives%20and%20promoting%20innovation.> accessed 21 November 2024.
[327] Nigerian Energy Support Programme (NESP), 'The Nigerian Energy Sector An Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification', 2015, Nigerian Energy Support Programme (NESP), 2nd ed, p 99 <https://www.giz.de/en/downloads/giz2015-en-nigerian-energy-sector.pdf> accessed 1 April 2025.
[328] ibid.

aforementioned Order. Nonetheless, Nigerians are spared from the consequences of the increase at this moment, as the Federal Government of Nigeria will compensate for the disparity between the actual tariffs paid by consumers and the cost-reflective tariffs sanctioned by the Nigerian Electricity Regulatory Commission through an electricity subsidy.[329] Moreover, the implementation of the FiTs encountered official disruption which has caused policy uncertainties.[330]

The Regulations recommended fixed-period FiTs for producing renewable energy, and incentives such as subsidies and tax reductions.[331] These FiTs were adopted as at section 4.3.5. For example, the Rural Electrification Strategy, and Implementation Plan (RESIP) 2016 stated that to reduce the economic barriers to entry, subsidies will be granted towards the initial capital costs associated with establishing rural electrification programmes.[332] These will be distributed by the Renewable Energy Fund (REF) as capital grants based on a transparent, competitive, and sustainable method of allocation. In this instance, subsidies for rural electrification served as social justice instruments. The Federal Government of Nigeria has identified the importance of addressing the needs of rural populations and alleviating poverty as a matter of equity. However, Nigeria's FiTs have not supported renewable energy technology towards the objectives of the support scheme because of policy uncertainties.[333]

4.3.6 Levelized Cost of Electricity (LCOE)

The LCOE is the discounted lifetime cost of building and operating a generation asset, expressed as a cost per unit of electricity generated (£/MWh).[334] It covers all relevant

[329] Olaniwun Ajayi, No Change to Electricity Tariffs in NERC's MYTO 2024, https://www.olaniwunajayi.net/blog/wp-content/uploads/2024/03/Power-Newsletter-18-March-2024.pdf> accessed 1 April 2025.
[330]Fadekunayo Adeniyi and Abdulrasheed Isah, 'Unlocking renewables amid rentierism: Market constraints to Nigeria's energy transition' (2023) 104 9 ERSS <https://doi.org/10.1016/j.erss.2023.103248.> accessed 20 September 2024.
[331] Nigeria Energy Support Programme, 'The Energy Sector: An Overview with a Focus on Renewable Energy, Energy Efficiency, and Rural Electrification' (2015) <https://www.giz.de/en/downloads/giz2015-en-nigerian-energy-sector.pdf> accessed 21 November 2024.
[332] Federal Ministry of Power, Works and Housing, 'Rural Electrification Strategy and Implementation Plan (RESIP)' (*REA*, July 2016.) <https://rea.gov.ng/wp-content/uploads/2017/09/RESIP.pdf> accessed 21 November 2024.
[333] Adeniyi and Isah, (n 330) p 9.
[334] Department for Energy Security & Net Zero, 'Review of Technical Assumptions and Generation Costs Levelized Cost of Electricity from Tidal Stream Energy' (2023) 1(1) Frazer-Nash Consultancy <https://assets.publishing.service.gov.uk/media/655372484ac0e1001277d819/tidal-lcoe-report.pdf> accessed 17 December 2024.

costs faced by the generator, including pre-development, capital, operating, fuel, and financing costs.[335] The levelized cost of a generation technology is the ratio of the total costs of a generic plant to the total amount of electricity expected to be generated over the plant's lifetime. Both are expressed in net present value terms. This means that future costs and outputs are discounted when compared to costs and outputs today. In 2023, the global weighted average levelized cost of electricity (LCOE) from newly commissioned utility-scale solar photovoltaic (PV), onshore wind, offshore wind and hydropower fell.[336] Renewable power generation has become the default source of least-cost new power generation. The progress made in 2023 is a significant step toward transitioning to a system based on energy efficiency and renewable technologies. According to analysis, it is forecast representative LCOEs in 2030 and 2035 to be £116±38/MWh and £78±25/MWh respectively for tidal stream energy.[337] This is assuming global deployment of 730MW by 2030 and 2.6GW by 2035.

Table 4: Total installed cost, capacity factor and LCOE trends by technology, 2010 and 2023[338]

	Total installed costs			Capacity factor			Levelized cost of electricity		
	(2023 USD/kW)			(%)			(2023 USD/kWh)		
	2010	2023	Percent change	2010	2023	Percent change	2010	2023	Percent change
Bioenergy	3010	2700	-9%	72	72	0%	0.084	0.072	-14%
Geothermal	3011	4589	52%	87	82	-6%	0.054	0.071	31%
Hydro energy	1459	2806	92%	44	53	20%	0.043	0.057	33%
Solar PV	5310	758	-86%	14	16	14%	0.460	0.044	-90%
CSP	10 453	6 589	-37%	30	55	83%	0.393	0.117	-70%
Onshore Wind	2 272	1 160	-49%	27	36	33%	0.111	0.033	-70%
Offshore Wind	5 409	2 800	48%	38	41	- 8%	0.203	0.075	-63%
Wave Energy	-	-	-	-	-	-	-	-	-
Tidal energy	-	-	-	-	-	-	-	-	-

[335] ibid.
[336] IRENA, 'Renewable Power Generation Costs in 2023' (*International Renewable Energy Agency, Abu Dhabi*, September 2024) <https://www.irena.org/Publications/2024/Sep/Renewable-Power-Generation-Costs-in-2023?trk=public_post_comment-text> accessed 29 September 2024.
[337] Catapult, 'Cost Reduction Pathway of Tidal Stream Energy in the UK and France' (*Catapult,* 17 October 2022) <https://ore.catapult.org.uk/resource-hub/analysis-reports/cost-reduction-pathway-of-tidal-stream-energy-in-the-uk-and-france> accessed 19 October 2024.
[338] IRENA, Renewable Power Generation Costs in 2023, (*International Renewable Energy Agency, Abu Dhabi*, September 2024) <https://www.irena.org/Publications/2024/Sep/Renewable-Power-Generation-Costs-in-2023?trk=public_post_comment-text> accessed 29 September 2024.

Notes: CSP = concentrated solar power; kW = kilowatt

4.3.7 Marine Spatial Planning

Nigeria has not carried out marine spatial planning.[339] Marine Spatial Planning (MSP) is a public process that involves the analysis and allocation of the spatial and temporal distribution of human activities in marine environments to fulfil ecological, economic, and social objectives established through a political process. MSP serves not as a final objective but as a pragmatic approach to optimize the use of marine space and its interrelated activities, aiming to reconcile developmental demands with environmental preservation while facilitating social and economic benefits transparently and systematically. One important aspect of developing wave and tidal energy is achieving key goals such as establishing and committing to a comprehensive legal framework, not least, institutional framework and application of critical sustainability enablers such as environmental management, marine spatial planning, and innovative financing mechanisms.

4.4 Assessment of the Renewable Energy Policies

The above review of the laws and policies on renewable energy in Nigeria has noted several problems. The need for specific renewable energy legislation is the first issue. The essence of law is to provide clearly defined objectives and direction in public affairs and to influence individual and official behaviour. The Nigerian government's reliance on policies to regulate and promote renewable energy is troublesome, as policies can be viewed as weak and unbinding, thus resulting in unfulfilled achievement of set targets. The failure of governments to implement these policies, for example, because of policy uncertainties, constitutes a hindrance to the policies' objectives being fully realised.[340]

Examining the plethora of policies on renewable energy in Nigeria, it is also evident that there is a proliferation of these policies, which can lead to confusion. Since

[339] Chidozie Ezeozue, 'Piratical Challenges in the Nigeria Ocean Space: Implication for National Security' (2019) Volume IV(X) IJRIAS) 57 – 65 <https://rsisinternational.org/journals/ijrias/DigitalLibrary/Vol.4&Issue10/57-65.pdf> accessed 20 December 2024.
[340] ibid.

investments require certainty in the form of clarity, having too many policies will serve as an impediment. Consequently, the view of the author of this dissertation is that if the current approach is continued, Nigeria's energy mix will not be expanded, and renewable energy will continue to, undeservedly, contribute a negligible portion to the energy mix, thus exacerbating its persistent energy poverty. In Nigeria, there are related enactments that support the development and growth of renewable energy thereby enabling energy security and access, reducing greenhouse gas emissions, and fostering economic growth.

4.5 A Review of Related Enactments

Now that we have looked at the laws and policies directly concerning RE in Nigeria, the researcher will discuss other enactments which have a bearing on RE. Some examples of such legislation include the Land Use Act 1978,[341] Science, Technology, and Innovation Act 2019 as revised, Finance Act 2021, CCA 2021,[342] and Petroleum Industry Act 2021. These legislations will be critically discussed in turn to determine whether there are gaps in the development of wave and tidal energy in Nigeria. The thesis will then investigate whether these bespoke enactments are skewed against wave and tidal energy or are fit for supporting the development of wave and tidal energy. In the next chapter, the legislation assessed here will be compared to legislation in other jurisdictions such as Scotland, Canada, and South Korea.

4.5.1 The Land Use Act 1978

In Nigeria, the Land Use Act 1978 is the principal law that guides the owner, and land use. Concomitantly, land ownership largely resides with the government at the Federal, State and Local Government levels. Ownership and rights over land play an important role in a successful wave and tidal energy technology project. This is because the land is an increasingly important area in constructing research and development centre infrastructure, the transmission of energy from subsea cables and other related activities including residential houses. Recent developments in the

[341] Land Use Act 1978.
[342] Climate Change Act 2021.

field of wave and tidal energy have demonstrated the need for a fit-for-purpose land law. This study sets out to investigate whether there is a gap in Nigeria's Land Use Act 1978 as related to wave and tidal energy to determine if the land legislation is fit for purpose.

The enactment of the 1978 Land Use Act (LUA) cured Nigeria's prevalent land crises.[343] Arguments for the LUA 1978 extol that it has helped national unity and control, facilitated land management, and reduced land disputes, especially as Land Use Act No. 6 of 1978 harmonised tenure systems across the country.[344] Constitutionally, land use in Nigeria is administered by the federal, state, and local government councils.[345] In this regard, Part I, Section 1 of the LUA 1978 vests all land in a state on the governor for the benefit of all Nigerians.[346] Non-Nigerians are not excluded from the governor's trusteeship, as Section 1 is subject to Section 43, which permits the granting of occupancy rights to Nigerians and non-Nigerians,[347] and both are subject to the same requirements and conditions to acquire and hold interest in land in Nigeria. An investor is statutorily permitted to acquire and develop land in Nigeria for 99 years, and this land can be used for any developmental project.

However, the LUA 1978 expressly provided for mining and oil pipeline projects but did not expressly provide for renewable energy sources, especially wave and tidal energy sources.[348] Meanwhile, under Section 5 of the LUA 1978, the Governor has the power to grant the rights of occupancy and any other interest in land to any person for any reason that is deemed to be in the public interest. Irrespective of Section 5 of the LUA, it remains that LUA 1978 did not make any direct provision for land to be utilized for RE development despite Nigeria's RE potential. For instance, Sections 6, 14, and 28 of the LUA cover issues of ownership of land as it concerns oil

[343] Otty Emmanuela Uzoamaka, Nwosu Chiemezie Chisom, and Udobi Alexander Nnamdi, 'Critique of the Nigerian Land Use Act of 1978' (2021) 11 06 IJESC 28115-28120 <https://www.researchgate.net/publication/352327637_Critique_of_Nigerian_Land_Use_Act_of_1978>accessed 21 September 2024
[344] Land Use Act 1978.
[345] ibid, pt1 s 1.
[346] EO Nwabuzor, 'Real property security interests in Nigeria: Constraints of the Land Use Act' (1994) 38(1) JAL 2–5 <https://doi.org/10.1017/S0021855300011426> accessed 17 December 2024.
[347] s 5(1)(a), and s 6(1)(a)(b) Land Use Act 1978; also, ss 34, 36 and 46.
[348] LUA 1978, Section 28 (3) (b), <https://faolex.fao.org/docs/pdf/nig67625.pdf> accessed 6 April 2025.

and gas discovery and development, but these did not have specific provisions for ocean energy resources that are contiguous to land.[349] These development projects include technology parks, research and development centres and innovation. Furthermore, Section 28 of the LUA 1978 makes provisions for the payment of compensation to persons, whose land is acquired by the government for public purposes, including the development of ocean-based renewable energy projects.

The LUA 1978 can be described as dated and not specifically fit for the development of renewable energy resources, including wave and tidal energy. An evident demonstration of the gap resonates from the enactment of the Lagos State Waterfront Infrastructure Development Law (2009) (WIDL 2009), enacted based on the power of compulsory acquisition under the LUA 1978.[350] As a way of explaining the need for the Lagos State WIDL 2009, statutorily, it legislates the efforts of the government to urbanise and develop the coastal estate areas,[351] particularly in a complex and rapidly expanding city such as Lagos. As with the case of Lagos State legislating the Lagos State waterfront, developing wave and tidal energy in Nigeria will require that the LUA 1978 should be adapted. In other words, the LUA 1978 requires more specificity regarding the distinct challenges presented by waterfront regions, which are essential for the advancement of wave and tidal energy, as it is in other jurisdictions such as Scotland, South Korea and Nova Scotia. Arguably, the Waterfront enactment underpins the weaknesses of the LUA 1978, especially in addressing specific issues such as coastal management and environmental sustainability. In the adaptation of the LUA 1978, specific provisions should uphold the rights and interests of the Coastal communities and promote their socio-economic interests. In sum, although the LUA 1978 establishes a comprehensive framework for land management in Nigeria, the WIDL 2009 presents more localised, specific, and pragmatic solutions to the intricate challenges encountered by Lagos as a swiftly urbanising coastal city.

[349] Land Use Act 1978 ss 6, 14, and 28.
[350] Omotayo Joseph Odukola, 'How a Misdirected Land Use Law Disregards Coastal Dwellers' Rights' (*Urbanet*, 25 March 2021) <https://www.urbanet.info/how-a-misdirected-land-use-law-disregards-coastal-dwellers-rights/> accessed 21 September 2024.
[351] ibid.

Meanwhile, in a positive development, the EAA 2024 has addressed some of the issues of the acquisition of land and access rights as it concerns renewable energy projects. For instance, Part XII, s 118 (1 to 3) of the EAA 2024 makes provisions for the acquisition of land and access rights in Nigeria. According to s.118 (1), '*acquisition of land and access rights for electricity projects in Nigeria including projects related to generation, transmission, distribution and supply of electricity shall be through voluntary, and compulsory land acquisition procedures in compliance with provisions of this Act, the Land Use Act '1978' and the Commission's Acquisition of Land and Access Rights for Electricity Projects Regulations, or any amendment to it or regulations replacing it*." Furthermore, s 118 (2) entitles a licensee to access rights over lands, buildings and streets as stipulated in the Commission's Acquisition of Land and Access Rights for Electricity Projects Regulations. As of November 2024, under the EAA 2024, a developer who has a license to develop an electricity project will be granted occupancy rights of land at sea or anywhere in Nigeria to develop a wave and tidal energy project. While this is a positive development that addresses a key area of this research concerning Nigeria's renewable energy legal framework, it is too early to determine its practical effect. In addition, the LUA 1978 would still need to be reformed.

In essence, this researcher argues that land issues can be complex, especially when a private sector project is planned for the land. Situating and securing permits for wave and tidal energy plants along the Nigerian coastline could encounter significant obstacles, with land legislation that lacks specificity regarding renewable energy technologies, even though it generally foresees such need in its provision in Part V Section 28 – 33 of the LUA 1978. Rural communities use most of their land for agriculture and fishing, which are the residents' primary source of income. Many communities are averse to yielding their land out of concern for their entire cultural and ancestry heritage. In a similar vein, environmental issues such as the oil spill in the Niger Delta, which destroyed aquatic life, have exacerbated land issues in the coastal areas, where wave and tidal energy resources projects will be carried out. Since large-scale wave and tidal energy projects will likely involve private/foreign developers, restricting foreigners from owning land can hinder project development,

thereby posing a significant barrier to wave and tidal development, especially large-scale wave, and tidal energy technology. Although it is possible to infer that the LUA 1978 included provisions for the "development of technological projects," there are no specific provisions regarding land acquisition for wave and tidal energy projects.

It is worth noting that Part V, sections 28-33 of the LUA 1978, which provides for revocation of rights of occupancy and compensation, permits compulsory acquisition for the public interest. In this respect, Part V of LUA 1978 sufficiently envisages situations where land may be acquired for public interest/purposes, including wave and tidal energy projects. Nonetheless, the inadequacy of the LUA 1978 might have made the Electricity Act Amendment Act 2024 specifically make provision for land use. For instance, the EAA 2024, specifically Part XII, s.118, has addressed the issue of land acquisition for developing electricity projects, including wave and tidal energy resources projects. However, it is still uncertain whether this legislation will be able to bridge the gap. Nigeria's land laws may need to be amended to be more compliant with modern technologies and specific about renewable energy technologies, especially ocean energy – wave and tidal energy.

4.5.2 Nigeria's National Science and Technology Laws and Policies

Law is a significant enabler of science, without which it cannot flourish, because it protects the freedom of thought, which is the foundation and linchpin of scientific and technological advancements.[352] This section comprises an assessment of the extent to which Nigeria's current laws and policies on science and technology support renewable energy development. The relevance of Law and policy in the support and development of renewable energy technologies is paramount, and as rightly argued by Abdullahi and others, law and policies play a very important role in the development of science and technology especially in any developing nation.[353] It is, therefore, necessary for states, especially the developing world through its laws and policies to enact legislation to promote RE technology development.

[352] M H Abdullahi, M D Popoola, S A Basiru, and M T Adekilekun, 'The Role of Law in the Development of Science, Technology and Innovation in Nigeria' (2021) 3(1) IRLJ 3 <Https://Www.Nigerianjournalsonline.Com/Index.Php/Irlj/Article/View/1504> Accessed 21 June 2023.
[353] ibid, 1.

4.5.3 National Science, Technology, and Innovation Policy 2022

A National Science, Technology, and Innovation Policy (NSTIP) was adopted in 2022.[354] It will now be critically examined in line with the aim and objectives of this research to see whether it supports the development of wave and tidal energy. The NSTIP 2022 s 3.7(i) calls for a review of the National Science and Technology Act, CAP 276 of 1977 and Federal Ministry of Science and Technology Act No 1, 1980 to incorporate the NSTIP 2022 and its succeeding policies. Accordingly, s 3.12 rationalizes that R&D and innovation form the core of activities of the FMSTI to the extent that there is need to prioritize strategies. For example, R&D sectoral issues, for multi-disciplinary, mission-oriented activities in science, technology and innovation that are propelled towards the generation, acquisition, storage, application and diffusion of science, technology and innovation for development.[355] In this respect, one of the specific strategies includes energy and power, where wave and tidal energy are not specifically mentioned and only broadly inferred under "other renewable energies". According to s 3.12.5 (i), "Energy and Power" of the NSTIP 2022 lists renewable energy resources without mentioning wave and tidal energy. It states, "Developing of R&D, demonstration and deployment capabilities in thermal, (Coal, Oil & Gas) methanol, nuclear, solar, wind, biomass (Biofuels) hydro and "other renewable energies".[356] It is inferred that wave and tidal might be covered by the generic phrase "other renewable energies".

There are a couple of other sections of NSTIP 2022, which are relevant. Essentially, the provision of the National Science, Technology, and Innovation Policy 2022 s 3.1.4 (iii) to Convention (v) stipulates:

> *Enhancing the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations*

[354] ibid.
[355] Federal Ministry of Science, Technology and Innovation Policy 2022, (*FMSTI,* 2022) p 40 accessed 27 November 2024.
[356] ibid, 44.

Convention on the Law of the Sea (UNCLOS)"; "intensifying investments and harnessing the full potential of the oceans, seas, lakes, and river to accelerate economic growth, create jobs and to fight poverty; and "Strengthening science and research to generate and disseminate evidence-based knowledge and information on advancing the sustainable blue economy.

Though the policy mentioned harnessing the ocean resources for the betterment of the citizens, it remains vague concerning harvesting renewable energy from the sea through wave and tidal energy or any other RE sources such as offshore wind energy.[357] In addition, Nigeria has not established a marine spatial plan to promote the development of ocean energy resources as discussed in section 4.3.7 above.

The NSTIP 2022 promotes government collaboration with other stakeholders to create policies and programs that support renewable energy development. While the NSTIP 2022 does not explicitly focus on wave and tidal energy, it does provide the policy framework that can support the growth and development of Nigeria's RE sector. Essentially, the NSTIP 2022 supports renewable energy, in part, by establishing a platform for research and development in this field.

4.5.4. Assessment of Nigeria's National Science, Technology, and Innovation Policy 2022

A critical assessment of Nigeria's research and development activities demonstrates that most of the RE technologies did not emanate from Nigeria's R&D centres, unlike other jurisdictions such as Canada and the UK where their research and development centres, for example, EMEC Limited, established in 2003 served as the hub of RE innovations and development. In May 2023, the Nigerian government and a UK firm, Across Atlantic Development (AAD), signed an MoU to develop and establish a science and technology Park as well as a Science Museum at Sheda Science and Technology Complex (SHESTCO), Abuja.[358] This is a private-public partnership (PPP) initiative,

[357] IRENA 2023 'Renewable energy roadmap: Nigeria' (n 158).
[358] Emmanuel Elebeke, 'FG signs agreement with UK firm on Tech Park' (*Vanguard Newspaper*, 3 May 2023) <https://www.vanguardngr.com/2023/05/fg-sign-agreement-with-uk-firm-on-tech-park/> accessed 17 July 2023.

with the AAD committing to provide the funding. Surprisingly, the Minister of Science, Technology, and Innovation said, that since 2006, the government wanted to establish this Technology Park in Nigeria.[359] In essence, it took 17 years to get an MOU for the Park, thus demonstrating a lack of creativity and a sense of urgency in promoting technological development. Given the potential for wave and tidal energy in Nigeria's coastal waters, SMEs' expertise, and other foreign partners' experience in developing and deploying marine energy technologies could assist Nigeria's ocean energy development.

Approximately 46% of Nigeria's primary energy supply is derived from renewable resources.[360] Biomass dominates Nigeria's energy mix with a 43% share due to its extensive use for heating and cooking, where substantial progress remains in access to clean cooking fuels, as shown in the following sections.[361] In other words, the remainder of Nigeria's RE sources have contributed only 3% to the renewable energy pool. These statistics demonstrate a less productive performance by science and technology towards the development and promotion of Nigeria's RE. Further, even though the NSTIP 2022 provisions in s 3.12.5 expressly averred that R&D should be developed alongside demonstration, and deployment capacities in solar, wind, biomass, hydro and "other renewable energies", disappointingly, over the years, Nigeria's technological development, including the R&D centres have not produced any significant results. Therefore, the researcher maintains that Nigeria's Science and Technology policy implementation has not impacted the development of renewable energy. The NSTIP 2022 can promote the adoption of wave and tidal energy in Nigeria and contribute to the country's sustainable development through the promotion of private sector-led research and development centres, partnerships, and collaborations.

[359] Aliyu and others (n 243).
[360] ibid.
[361] ibid.

4.5.5 Nigeria's Research and Development Centres

The NSTIP 2022 supports the establishment and operation of research and development centres in Nigeria. These research and development centres are to support research and development in a variety of fields, including science, technology and innovation. Under the NSTIP 2022, federal, state, and local governments including private individuals and organizations may establish research and development centres. Nigeria has established six research and development centres around the country including the National Centre for Energy Research and Development, University of Nigeria, Nsukka;[362] the National Centre for Energy and Environment, University of Benin,[363] Centre for Renewable Energy Research, Bayero University, Kano;[364] National Centre for Energy Efficiency and Conservation, University of Lagos,[365] National Centre for Hydropower Research and Development; University of Ilorin, Ilorin;[366] and the Sokoto Energy Research Centre, Usman Danfodiyo University, Sokoto.[367] These research centres focus on a variety of disciplines, including renewable energy, biotechnology, hydropower, solar and wind technology, and engineering. However, none of these research and development centres deals with wave and tidal energy technologies.

NSTIP also makes provisions for the funding of research and development centres in Nigeria. The Policy requires the Federal Government to fund science, technology and innovation research and development. Also, it permits partnerships between the government, the private sector, and international organizations to support the establishment of research and development centres. Additionally, the NSTIP 2022 promotes collaboration and networking between research and development centres in Nigeria. It enables networks and partnerships between research and development centres and other Nigerian and foreign institutions. With the enabling legal framework

[362] Energy Research Centre, 'Brief History' (*University of Nigeria Nsukka,* 1982), <https://energyresearch.unn.edu.ng/> accessed 8 April 2023.
[363] National Centre for Energy and Environment, 'Our History' (2019) <https://ncee.org.ng/> accessed 8 April 2023.
[364] Centre for Renewable Energy Research, 'Mandate' (*Bayero University Kano*, 2022) <https://buk.edu.ng/cre/> accessed 8 April 2023.
[365] H B Adedayo, S A Adio, B O Oboirien, 'Energy research in Nigeria: A bibliometric analysis' (2021) 34 ESR 1, 5 <https://doi.org/10.1016/j.esr.2021.100629.> accessed 9 April 2023.
[366] ibid 5.
[367] ibid.

in place, knowledge sharing, and collaboration can be fostered among researchers and experts from various fields, as well as innovation and the creation of new technologies. In sum, the NSTIP 2022 facilitates the establishment and operation of research and development centres in Nigeria by establishing a legal framework for their establishment, funding, and collaboration. These centres are vital to advancing science, technology and innovation in Nigeria and the country's sustainable development. However, wave and tidal energy-specific provisions or initiatives under NSTIP 2022 are conspicuously absent.

In Nigeria, the Ministry of Science Technology and Innovation coordinates R&D research activities.[368] Meanwhile, there are cross-references to national development priorities, the proliferation of competing sectoral policies and strategies combined with inadequate mechanisms to ensure their implementation harms the research system thereby creating overlapping policies, fragmented activities, and a failure to achieve benefits for national objectives.[369]

In sum, the researcher argues that the current National Science and Technology Innovation Policy is incapable of harmonizing research initiatives, including those funded by international donors. This is because even though Nigeria has a vast network of universities to meet the rising demand for higher education it has a relatively small number of researchers relative to its population.[370] Only about one-third of researchers hold a PhD or its equivalent, and while the country commissions a substantial amount of research, overall productivity per researcher is low.[371] As indicated by the low number of citations recorded by Nigerian research publications in comparison to other Sub-Saharan African nations, a significant proportion of Nigeria's research appears to be of low quality.[372] Further, an academic review

[368] Mattia Fosci, Lucia Loffreda, Andrew Chamberlain, and Nelisha Naidoo, 'Assessing the needs of the research system in Nigeria', (2019), <https://assets.publishing.service.gov.uk/media/5ef4ad5ee90e075c5cc9d7e6/NA_report_Nigeria__Dec_2019_Heart___1_.pdf> accessed 13 Jul 2023.
[369] ibid 5.
[370] ibid.
[371] UNESCO 'Welcome to UIS Stat, Science Technology and Innovation Technology' <http://data.uis.unesco.org/> accessed 17 July 2023.
[372] Fosci and others (n 368) ch 5.

deciphered that there are no mechanisms for evaluating the quality of research.[373] In addition, scarce public research funding and the exclusion of public and private research institutes and private universities from receiving public funding place significant constraints on research production; and international actors have a lesser impact on research production than in other African countries, (according to the most recent available UNESCO data, they accounted for approximately 1% of the total expenditure on R&D in 2007).[374] There is a need to strengthen the capacity for national research funding because there is no national organization in Nigeria that is dedicated to funding research. TETFund, a government-controlled foundation whose focus is education, manages the National Research Fund.[375] Evidently, this arrangement creates a research-funding drought, unclear research funding priority areas, the absence of research evaluation activities, and the ineligibility of private universities and public and private research institutes. Nigeria has a large overall research output despite its low productivity per researcher, and a smaller proportion of its research is conducted through international collaborations other than the 'Strengthening Research Institutions in Africa' (SRIA) countries.

Nigeria is one of the seven countries (Ethiopia, Ghana, Kenya, Nigeria, Rwanda, Tanzania and Uganda), that make up the 'Strengthening Research Institutions in Africa', where DfID conducted an assessment to ascertain the key challenges to research capacity strengthening and some priority areas for intervention to support decision-making.[376] Among the findings, the quality of research appears to be lower than in other Sub-Saharan nations, and research management support is virtually non-existent at most of universities.[377] There appears to be an opportunity for universities to invest in research support functions that can aid researchers in managing research projects from inception through publication. Given the magnitude of Nigeria's research output, such assistance could have a significant impact. This research deficiency is likely to affect the development of WTE if the situation

[373] ibid.
[374] UNESCO, A Global Perspective on Research and Development, <https://unesdoc.unesco.org/ark:/48223/pf0000217136> accessed 21 September 2024
[375] TETFund, 'Mandate & Objectives' <https://tetfund.gov.ng/index.php/mandate-objectives/> accessed 21 September 2024.
376 Fosci and others (n 368) 1.
[377] ibid.

continues. However, organisations such as the UK Department for International Development (DFID), and EMEC could collaborate with existing university networks like the Nigerian Research and Education Network (NgREN), to establish a programme for strengthening research management capacity that will promote WTE.

In conclusion, the research reviews Nigeria's national science technology and innovation policies to identify gaps and to determine their effectiveness thereby answering the research questions. However, these policies specifically address renewable energy resources such as solar, and wind, unlike wave and tidal energy. Consequently, these policies established the groundwork for implementing policies and programs that support the expansion of specific RE technologies such as solar, hydro and wind. Moreover, their impact on renewable energy technologies remains abysmal with no significant innovative impact. The NSTIP 2022 facilitates the establishment and operation of research and development centres in Nigeria by establishing a legal framework for their establishment, funding, and collaboration. The six government-operated research centres established are critical to the development of renewable energy in Nigeria. However, wave and tidal energy-specific provisions or initiatives under NSTIP 2022 are conspicuously absent and no research centre caters to wave and tidal energy resources. Critically, unlike bioenergy, solar and wind, the National Science and Technology policies did not specifically mention wave and tidal energy, but 'inferred and lumped' wave and tidal energy under the title "other renewable energy". Revealingly, these policies affirm the gap in Nigeria's policy framework in the development and growth of RE technologies.

4.5.6 Finance Act 2023

The Finance Act 2023 (FA 2023) represents a key related enactment in the development of renewable energy as it provides the appropriate financial mechanisms in support. In Nigeria, the Nigerian government enacted the FA 2023 to regulate the country's fiscal policies.[378] President Muhammadu Buhari signed the most recent FA into law in Nigeria on 31 December 2023.[379] Funding renewable

[378] The Nigeria Finance Act 2020.
[379] Andersen, 'President Buhari Signs Finance Bill, 2021 into Law' (2022) <https://ng.andersen.com/president-buhari-signs-finance-bill-2021-into-law/> accessed 7 April 2023.

energy projects can be capital intensive, therefore, there is a need to identify and utilize available options.[380] Intrinsically, Nigeria has huge challenges in funding the development of renewable energy technologies.[381] Generally, Nigeria's financing options for renewable energy development fall into two categories: public finance instruments and private finance instruments. While grants, subsidized loans, and subsidies are examples of public finance instruments; alternatively, private finance instruments consist of equity, debt, and mezzanine financing. Essentially, the Nigerian government primarily funds renewable energy projects by providing fiscal allocations to federal and state governments, utilizing instruments such as green bonds. Administratively, the REA has taken the lead in providing public financing for decentralized clean energy through the Fund. This Fund is usually funded through allocations in Nigeria's federal budget or through loans acquired from Multilateral Development Banks (MDBs).

Grants are funds provided by the government or international development organizations to finance renewable energy projects. For example, the African Development Bank (AfDB), via Sustainable Energy for All (SEFA), has developed several initiatives to support developers of RETs by offering grants and technical support. In the same vein, the United Nations Development Programme (UNDP) provides funding for renewable energy projects in Nigeria. A $750 million credit was approved by the World Bank in December 2023 for the Nigeria Distributed Access through Renewable Energy Scale-up (DARES) project.[382]

Concessional loans: The interest rate on a line of credit is lower than the market rate. The Nigerian Electrification Project (NEP) is one example of a loan programme with favourable terms. The objective of the project is to expand rural access to electricity.

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[380] AO2LAW, 'Financing Renewable Energy Projects In Nigeria' (*AO2LAW*, 23 May 2024, <https://ao2law.com/financing-renewable-energy-projects-in-nigeria/#:~:text=The%20Nigerian%20government%20finances%20Renewable,the%20REA%20through%20the%20Fund.> accessed 01 July 2024

[381] ibid.

[382] Tolu Ogunlesi, 'African Development Bank Group approves $500 million loan to boost electricity access in Nigeria' (*African Development Bank Group*, 31 July 2024) <https://www.afdb.org/en/news-and-events/press-releases/african-development-bank-group-approves-500-million-loan-boost-electricity-access-nigeria-73123#:~:text=African%20Development%20Bank%20Group%20approves,Nigeria%20%7C%20African%20Development%20Bank%20Group> accessed 21 September 2024

The purpose of the project is to subsidise the large-scale development of mini-grids by reducing initial costs and allowing for the scalability of operations and the recovery of developers' investments during the project's duration.

Subsidies: Subsidies are an additional source of financing for renewable energy development in Nigeria. To reduce the cost of renewable energy projects, the government provides subsidies for renewable energy equipment purchased by developers. For instance, the Nigerian government exempts renewable energy equipment from import duties, including solar panels, inverters, and batteries.

Private finance instrument: The private finance instruments consist of equity, debt, and mezzanine financing. In exchange for capital, investors acquire ownership of a project through equity financing. In Nigeria, many venture capital firms, such as All On,[383] Sahel Capital,[384] and Off-Grid Electric,[385] have invested in renewable energy projects, mainly solar energy.

Debt financing: Debt financing for the development of renewable energy entails borrowing funds from financial institutions, such as banks or pension funds, to finance projects. In Nigeria's renewable energy sector, debt financing is a common instrument. Access Bank, one of the leading banks in Nigeria, provides debt financing for renewable energy projects.

Mezzanine financing: Mezzanine financing is a combination of equity financing and debt financing. It entails providing capital to the project in exchange for a share of ownership and a substantial return on investment. Mezzanine financing is an attractive financing instrument for renewable energy projects because it enables project developers to gain access to capital without substantially diluting their

[383] Wisdom Chapp-Jumbo, 'GEAPP Commits $11 Million to Support 25 Mini-Grid Projects in Nigeria' (*All On*, 9 Jun 2023) <https://www.all-on.com/media/media-releases/all-on-geapp-commits-11-million-doller-to-support-25-mini-grid-projects-in-nigeria.html> accessed 22 July 2023.
[384] Sahal Capital, 'Investments' <https://sahelcapital.com/portfolio-companies/> accessed 22 July 2024.
[385] Off-Grid Nigeria, 'Renewable Energy Global' <https://www.offgridnigeria.com/category/re-global/> accessed 22 July 2023.

ownership stake. Mezzanine financing is not yet widespread in Nigeria, but its popularity is growing as more investors become aware of its advantages.

In addition to the above, there are several other financing options for the development of renewable energy sources in Nigeria. These consist of crowdfunding, green bonds, and carbon credits. Crowdfunding is the practice of raising small amounts of capital from many people, typically through online platforms. Green bonds are debt securities issued by businesses to fund environmentally sustainable projects. Carbon credits, on the other hand, represent a reduction in greenhouse gas emissions through a financial instrument. These credits can be purchased and sold, and the proceeds can be used to fund renewable energy projects. Following the nation's climate action objectives and the global commitment to transition to cleaner energy sources, the development of renewable energy is of the utmost importance. To enable this, however, more information, awareness, and support should be provided for financing options for renewable energy development in Nigeria. For example, in 2017 and 2019, the Federal Government of Nigeria (FGN) issued a debt security worth N150 billion for a Sovereign Green Bond programme. This initiative was carried out through the Debt Management Office to fulfil the country's NDC target.

In December 2023, the World Bank authorised the Nigeria Distributed Access through Renewable Energy Scale-up DARES project.[386] This project is funded by a $750 million credit from the International Development Association (IDA) and will attract more than $1 billion of private investment, as well as substantial additional funding from development partners. These partners include $100 million from the Global Energy Alliance for People and Planet and $200 million from the Japan International Cooperation Agency. The programme also involves collaboration with other development partners such as the United States Agency for International Development (USAID), the German Development Agency (GIZ), SE4ALL, and the African Development Bank (AfDB). The objective of the DARES project is to enhance

[386] Mansir Nasir and Maryam Laushi, 'Nigeria to Expand Access to Clean Energy for 17.5 Million People' (*World Bank Group, Abuja*, 14 December 2023) <https://www.worldbank.org/en/news/press-release/2023/12/15/nigeria-to-expand-access-to-clean-energy-for-17-5-million-people> accessed 01 July 2024.

electricity accessibility for more than 17.5 million Nigerians by implementing distributed renewable energy solutions. The DARES project aims to utilise pioneering financial methods to expand the provision of clean electricity in Nigeria, with a focus on the private sector.

Table 5: Key Funds and Financial Initiatives

FUND	Period	Project	RES	Agency	Amount ($)
Nigeria Sovereign Green Bond	2021	Climate friendly and RE	Solar	Federal Ministry of Environment	36 million
World Bank (Nigeria Electricity Project) RMI/DARES[387]	2021- 2023	Rural Electrification/ Off Grid RE Development	Solar mini grids and home system	Rural Electrification Agency (REA)	1,100 Billion
African Development Bank	2022	Small to medium scale RE projects	Solar PV Small Hydro Wind	AfDB and Sustainable Energy for Africa	50 million
Global Energy Alliance for People and Planet.(GEAPP)	2022	Off grid RE solutions/ Mini grids	Solar	GEAPP	50 million
Central Bank of Liberia/ Solar Power Naija[388]	2021 to 2023	Rollout of five million homes system	Solar Off grid	CBN/ESP/ Naija	341 million
US Trade and Development Agency Grant for RE	2022	Feasibility Study	Solar Storage System	US Trade and Development Agency	1 million
EU/ GTZ/Nigeria Energy Support Program III	2022 – 2026	Off Grid Energy Efficiency	Renewable Energy Sources	38 million	38 million
AfDB	2023	Desert-to-Power (10,000MW)	Solar AfDB		25 million
InfraCredit RE Guarantee Initiative	2021 -2023	Off Grid Local RE developer	Solar	InfraCredit	25 million
UNDP/Global Climate Fund (GCF)	2021 – 2023	Large-scale Energy Access for rural communities	Solar PV	UNDP	62 million
UK Government (FCDO) Clean Energy Innovation Facility	2023	R&D Technological Development and Innovation	RES	A portion is for Nigeria	65 million
TOTAL					$1,796 Billion

[387] Benson Kibiti, 'RMI's World Bank DARES Award Expands Program to Scale Renewable Energy Deployment in Sub-Saharan Africa' (*Rocky Mountain Institute*, 4 June 2024) <https://rmi.org/press-release/rmis-world-bank-dares-award-expands-program-to-scale-renewable-energy-deployment-in-sub-saharan-africa/> accessed 2 September 2024.

[388] Munir Husein, Magda Moner-Girona, Giacomo Falchetta, Nicolò Stevanato, Fernando Fahl, and Sandor Szabó, 'The impacts of incentive policies on improving private investment for rural electrification in Nigeria – A geospatial study' (2024) 10(5) Heliyon 2405-8440, <https://doi.org/10.1016/j.heliyon.2024.e27440> accessed 22 September 2024.

In conclusion, the Finance Act 2023 has provided a legal framework to support, among others, the development of renewable energy. The financial instruments provided by the FA 2023 include government budgetary allocations, grants, loans, private capital, subsidies, green bonds, and tax holidays. In addition, the Nigerian government established initiatives to promote renewable energy, including the 2012 formation of the Nigerian Renewable Energy Master Plan, which aimed to increase the proportion of renewable energy in the country's energy mix to 10% by 2025.[389] Moreover, the government has launched new initiatives and programmes to promote the development of renewable energy, such as the Solar Home System (SHS) programme[390] and the Renewable Energy Fund (REF).[391] While the government efforts to promote renewable energy have occurred in a piecemeal and largely uncoordinated manner, there is still much work to be done to develop a robust and effective legal and regulatory framework to encourage the growth of renewable energy resources for electricity generation.[392] Greater efforts are required to foster private sector investment in renewable energy, improve infrastructure and financing options, and increase public awareness of the advantages of renewable energy.

The development of renewable energy sources in Nigeria remains a formidable challenge. In an article titled "Barriers to National Renewable Energy Policy Adoption: Insights from a Case Study of Nigeria," Adelaja critically attributes the lack of progress in renewable energy generation and infrastructure development (electricity generation, transmission and distribution) in many developing countries to specific obstacles, many of which are policy-related.[393] In addressing these challenges, Ogbumgbada argued that Nigeria needs an overarching legal framework for

[389] Olufolahan Osunmuyiwa and Agni Kalfagianni, 'Transitions in unlikely places: Exploring the conditions for renewable energy adoption in Nigeria' (2017) 22 EIST 26, 34 <https://doi.org/10.1016/j.eist.2016.07.002.> accessed 11 March 2023.
[390] Solomon Ezeme, 'World Bank disburses $75million to fund off-grid solar home system projects' (*Energy Day Nigeria*, 3 August 2021) <https://energydayng.com/2021/08/03/world-bank-disburses-75million-to-fund-off-grid-solar-home-system-projects/> accessed 12 March 2023.
[391] Aisi Atiti, 'Exploring the Adoption of Solar Energy Projects in Nigeria', (*Nextier,* 16 August 2022) <https://thenextier.com/exploring-the-adoption-of-solar-energy-projects-in-nigeria/> accessed 12 March 2023.
[392] Ogbumgbada (n 264) 1, 48.
[393] Adesoji O. Adelaja, 'Barriers to national renewable energy policy adoption: Insights from a case study of Nigeria,' (2020) 30 ESR 1, 2 <https://doi.org/10.1016/j.esr.2020.100519.> accessed 12 March 2023.

renewable energy sources,[394] and that there are no laws in Nigeria that favour renewable energy electricity generation, transmission, and distribution.[395]

Certainly, there are some good developments in Nigeria on renewable energy sector including legislations, policies, and support schemes, which are compliant to global demands towards the promotion of renewables. However, some Nigeria's existing legislations need to be made more consistent to advance renewable energy resources development;[396] and concrete policies gaps filled to attract private sector investment in renewable energy, especially harnessing energy through the wave and tidal energy sources.[397] Additionally, there is a need for increased investment in research and development, as well as capacity building and training for professionals in the renewable energy sector.[398] Given Nigeria's abundance of viable renewable energy sources, as demonstrated in Chapter 4, the need to successively pursue a diversity of energy sources for electricity generation is not only urgent, but essential for increasing electricity penetration.[399] Socioeconomic development, particularly industrial growth, urban development, and improved living standards, remains dependent on energy. As such, with the right policy framework and financing in place, the future appears bright for the renewable energy sector in Nigeria.[400]

4.5.7 Climate Change Act 2021

Nigeria signed and ratified the Paris Agreement 2015, a landmark agreement to reduce global greenhouse gas emissions to limit global temperature increase to below 2°C and has made commitments to develop its energy system in line with these goals.[401] In its recent revision of its NDC submitted to the UNFCCC as part of the Paris Agreement, Nigeria has pledged an unconditional 20% reduction in emissions in a

[394] Ogbumgbada (n 264).
[395] ibid.
[396] ibid.
[397] ibid.
[398] Chanchangi and Other (n 169).
[399] Akuru and others (n 149) p 949.
[400] AO2LAW (n 380)
[401] Federal Government of Nigeria, *Second Biennial Update Report (BUR2) to the United Nations Framework Convention on Climate Change (*FGN Report, BUR2 to UNFCCC June 2021) <https://unfccc.int/sites/default/files/resource/NIGERIA%20BUR%202%20-%20Second%20Biennial%20Update%20Report%20%28BUR2%29.pdf> accessed 22 November 2024.

business-as-usual scenario by 2030 and an upward revision of its conditional reduction pledge from 45% to 47% dependent on sufficient financial assistance, technology transfer and capacity building.[402] In addition, at the 26th Conference of the Parties (COP26), Nigerian President Muhammadu Buhari pledged that Nigeria will cut emissions to net zero by 2060.[403]

Along the same line, the conditional target was increased from 45% to 47% for several reasons, key amongst them is Nigeria's consistent commitment to the international initiative, as earlier argued, particularly in the aftermath of COP26, to increase climate ambition to restrict global warming to 1.5°C.[404] An indication of Nigeria's objective to substantially enhance renewable energy capacity, decrease its dependence on diesel and gas-fired power, and enhance energy efficiency. Access to International Climate finance, thereby attracting international climate finance from sources such as the Green Climate Fund (GCF) and development institutions, which can be essential for the implementation of large-scale renewable energy projects, the enhancement of grid infrastructure, and the support of climate resilience initiatives. In addition, Nigeria's revised NDC includes specific adaptation measures, including reforestation programs, improved water resource management, and climate-smart agriculture, all of which have the potential to reduce emissions. The expanded scope of these combined mitigation and adaptation actions is reflected in the conditional 47% target.[405]

Nigeria's attempts to address the global concerns about the effect of GHG on the environment and humanity, as well as meeting international obligations, resulted in the promulgation of the CCA 2021.[406] The CCA 2021 provides for the mainstreaming of climate change actions, and it establishes the National Council on Climate. The CCA 2021 objectives include:

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[402] ibid.
[403] IRENA 2023 (n 158).
[404] Michael Simire, 'Nigeria submits final report of updated NDCs to UNFCCC' (*EnviroNews Nigeria*, 1 August 2021) <https://www.environewsnigeria.com/nigeria-submits-final-report-of-updated-ndcs-to-unfccc/> accessed 25 October 2024.
[405] Stefan Küper, 'Nigeria - Climate Performance Ranking 2024' (*Climate Change Performance Index*, 2024) <https://ccpi.org/country/nga/> accessed 23 October 2024.
[406] Climate Change Act 2021.

- Formulate and implement climate change mitigation and adaptation programs.
- Coordinate the national climate response.
- Mainstream climate change actions nationally and sub-nationally across all sectors.
- Facilitate the mobilisation of climate finance.
- Integrate climate change policies and actions with national priorities to promote sustainable development.
- Set targets for the achievement of a carbon net zero economy for the period 2050 - 2070.
- Build resilience and strengthen existing adaptive capacities.
- Ensure climate mitigation by promoting a low-carbon economy; and
- Coordinate the involvement of private and public entities in the climate response.

Nigeria's dependence on its oil and gas sector for economic growth has resulted in the country being one of the largest emitters in sub-Saharan Africa.[407] Contribution to the national total Green House Gas Emissions in Nigeria in 2018 is (347 MtCO2e).[408]

To support the reduction of GHG by 2030, Nigeria has adopted various policies, including Nigeria Climate Change Policy (2021 – 2030);[409] National Action Plan to Reduce Short-Lived Climate Pollutants (2019);[410] National Adaptation Plan (NAP) framework (2020);[411] National Green Bonds Programme;[412] National Action Plan on

[407] Fernando Barrio, Angela Mutsotso, Atâyi Babs, Sam Ogallah, and Stephen Abu, 'Nigeria's Climate Change Response, Analysis of the 2021 Nigeria Climate Change Act' (*Queen Mary Global Policy Institute*, 24 October 2022) <https://www.qmul.ac.uk/gpi/media/global-policy-institute/QMGPI-Nigeria's-Climate-Change-Response-FINAL.pdf> accessed 23 July 2023.
[408] ibid 4.
[409] Federal Ministry of Environment, 'Climate Change Policy 2021 – 2030' <https://faolex.fao.org/docs/pdf/NIG209876.pdf> accessed 22 November 2024.
[410] IEA 50, 'National Action Plan to Reduce Short-Lived Climate Pollutants' (*International Energy Agency*, 8 March 2024) <https://www.iea.org/policies/12508-nigerias-national-action-plan-to-reduce-short-lived-climate-pollutants> accessed 24 November 2024.
[411] Federal Ministry of Environment, 'Nigeria's National Adaptation Plan (NAP) framework (2020)' (*Clean Technology Hub*, 2024) <https://cleantechnologyhub.com/wp-content/uploads/2023/06/ECA-Policy-Guide-2.pdf> accessed 22 November 2024.
[412] Jubril Adeojo, 'Nigeria's Green Bond Programme: Aspirations, Realities and Solutions National Green Bonds Programme' (*Heinrich Böll Foundation Abuja,* February 2022) <https://ng.boell.org/sites/default/files/2022-02/Nigeria%E2%80%99s%20Green%20Bond%20Programme2022Report.pdf> accessed 22 November 2024.

Gender and Climate Change for Nigeria;[413] and the Flare Gas (Prevention of Waste and Pollution) Regulation 2018.[414] Among all these policies, it is only the National Greens Bond Programme that mentions renewable energy and funded renewable projects.[415]

Table 6: Nigeria's Main Climate Targets

NIGERIA - Main climate targets	
2030 unconditional NDC target	
Formulation of target in NDC	20% below BAU by 2030
Absolute emissions level in 2030 excl. LULUCF	304-331 $MtCO_2e$ [17-27% above 2010]
Status	Submitted on 30 July 2021
2030 conditional NDC target	
Formulation of target in NDC	47% below BAU by 2030
Absolute emissions level in 2030 excl. LULUCF	201-264 $MtCO_2e$ [1% above to 23% below 2010]
Status	Submitted on 30 July 2021
Net zero & other long-term targets	
Formulation of target	Nigeria has committed to set a net zero GHG target in the range of 2050 and 2070
Absolute emissions level in 2050 excl. LULUCF	N/A*
Status	Included in the Climate Change Act passed in November 2021

Source: Climate Action Tracker, Nigeria.[416]

*For details on what we do for our Optimistic Target global temperature estimate, see the Assumptions tab.

[413] Federal Ministry of Environment, 'National Action Plan on Gender and Climate Change for Nigeria 2020' (*Clean Technology Hub*, 2024) <https://cleantechnologyhub.com/wp-content/uploads/2023/06/ECA-Policy-Guide-6.pdf> accessed 22 November 2024.
[414] Federal Government of Nigeria, *Flare Gas (Prevention of Waste and Pollution) Regulation 2018* (Gazette No 88 Vol 105, 2018)
[415] Omono Okonkwo, 'How Green Bonds have impacted Nigeria's renewable energy sector' (*LinkedIn*, November 2023) <https://www.linkedin.com/posts/solar-financed-africa_how-green-bonds-have-impacted-nigerias-renewable-activity-7051154350731112448-bPma/ accessed 22 November 2024.
[416] Climate Action Tracker, 'Nigeria' (*Climate Tracker*, 13 July 2023) <https://climateactiontracker.org/countries/nigeria/targets/> 24 July 2024.

Specifically, it states that in 2017, the Nigerian Government issued a five-year Green Bond to finance projects in the 2017 Appropriation Act for Afforestation, Renewable Energy and Clean Energy to support education. The Green Bond funded renewable energy projects, education, and afforestation programs.[417] In conclusion, these Climate Change policies and CCA 2021 are set apart for their legally binding commitments, articulated timelines, a coordinated climate response, dedicated functions, and leveraging existing resources. However, it is only the Green Bond programme that specifically deals with generating funding for renewable energy programmes, without specific RES. Meanwhile, over 60% of GHG in Nigeria is known to be generated by fossil-fuel-related activities, and renewable energy remains the most viable replacement. Understandably, assessing the CCA 2021 and recent climate change policies with expectations of credible support for renewable energy might be too early. However, it is unlikely that the provisions will promote renewable energy resources unless there are specific and robust legislative and regulatory reforms, which this thesis proposes.

4.5.8 Petroleum Industry Act 2021

Nigeria's Petroleum Industry Act (PIA) 2021[418] according to the General Manager, Operations, Asiko Energy Holdings Limited, Busayo Fabunmi, is "one of the most audacious effort to reform the country's petroleum industry".[419] The Nigerian Petroleum Industry now has a legal, governance, regulatory, and fiscal framework because of the PIA 2021, which was enacted 21 years after its conception. The fact that it took 21 years to enact the PIA made investments in Nigeria's petroleum industry uncertain and less attractive, which is why Nigeria attracted only 3% of the USD70 billion in investments made in the African oil and gas industry from 2015 to 2019.

[417] Omono Okonkwo, (n 415)
[418] Petroleum Industry Act 2021.
[419] Dayo Ayeyemi, 'PIA, most audacious attempt to overhaul oil & gas industry' Nigerian Tribune 17 October 2023, <https://tribuneonlineng.com/pia-most-audacious-attempt-to-overhaul-oil-gas-industry-fabunmi/> accessed 18 December 2024.

The petroleum industry is Nigeria's economic backbone. It accounts for 80% of the FGN revenues and 90% of foreign exchange receipts but less than 10% of the country's gross domestic product. This is primarily because only a small portion of the oil and gas value chain is domesticated.[420] The implementation of the PIA has alleviated the uncertainty surrounding Nigeria's petroleum industry fiscal and regulatory environment. With the expectation that other industry-related issues, such as infrastructure deficits and security (including crude oil theft), will be addressed, a new wave of Foreign Direct Investment (FDI) is anticipated in the fossil fuel industry, barring any impact of the energy transition on new investments in fossil fuel.[421] As of January 2024, Nigeria has a combined reserves of Crude Oil and condensate of 37.50 billion barrels, while the reserves of Associated Gas and Non-Associated Gas stood at 209.26 trillion cubic feet (TCF) of proven gas reserves at an average daily production rate of 2 million barrels per day (mmb/d) of crude oil and 7.6 billion cubic feet per day (bcf/d) of gas respectively.[422]

Given concerns regarding the development of renewable energy in support of the energy transition, fossil fuels may no longer be the primary source of global energy by 2040 or 2050, which is only 20 to 30 years away. Nigeria aspires to double its oil and gas output. If this is accomplished, the production lifetime of Nigeria's petroleum reserves will be cut in half, allowing the nation to monetise its reserves before a significant loss in economic value. The implementation of the PIA brings Nigeria closer to achieving these audacious goals, but Nigeria should also address other industry concerns. Additionally, the Petroleum Industry Act of 2021 establishes new incentives for oil exploration in inland basins outside of the traditional oil and gas region of the Niger Delta. In conclusion, government policies persist in fostering rather than discouraging dependence on the oil and gas industry. Additionally, it is crucial to note that the PIA 2021 does not contain any inherent provisions that

[420] Deloitte Insight, 2024 Oil and Gas Industry Outlook, (*Delloite, 2024*) <https://www2.deloitte.com/us/en/insights/industry/oil-and-gas/oil-and-gas-industry-outlook.html> accessed 27 November 2024.
[421] ibid.
[422] Nigerian Upstream Petroleum Regulatory Commission, 'Nigeria's Oil and Gas Reserves Soar: NUPRC Unveils Impressive Figures' (2024) <https://www.nuprc.gov.ng/nigerias-oil-and-gas-reserves-soar-nuprc-unveils-impressive-figures/> accessed 1 July 2024.

endorse and support the development of renewable energy sources, even though it may be unrealistic to anticipate that the PIA would address wave and tidal energy.

4.6 Conclusion

Chapter 4 has described Nigeria's key renewable energy laws, policies, and key related enactments. In this respect, the constitution, which is the grundnorm, was critically assessed for gaps in wave and tidal energy. Other relevant laws assessed are the Electricity Commission of Nigeria Act 1989, the EPSRA 2005 and the Electricity Act 2023 as amended. Additionally, related enactments assessed include the Land Use Act 1978, the Science, Technology, and Innovation Act 2019 as revised, the Finance Act 2021, CCA 2021, and the Petroleum Industry Act 2021. Furthermore, relevant policies critically assessed include the National Electric Power Policy 2001, National Energy Policy 2003, Renewable Energy Master Plan 2012, National Renewable Energy and Energy Efficiency Policy 2015, Nigeria's FiTs Policy, Rural Electrification Strategy and Implementation Plan, Renewable Energy Fund, and National Science, Technology and Innovation Policy 2022.

It has been shown that there are inherent gaps in Nigeria's renewable energy laws concerning wave and tidal energy resources. For example, there are no specific provisions that mandatorily promote the development of wave and tidal energy. In addition, where wave and tidal energy have been mentioned, they were lumped and nominally addressed under the nomenclature "other renewable energy resources", a term generally used to describe renewable energy resources that have not been specifically catered to by the laws.

Further, the most recent legislation, EAA 2024, which mentioned wave and tidal energy rather, made provisions for the development of bio, hydropower, solar and onshore wind, leaving behind wave and tidal energy. It is noteworthy that the EAA 2024 was amended only about five months after it was signed into law, and wave and tidal energy did not get the appropriate attention it deserved. This yawning gap needs to be bridged. With regards to related enactments, aside from the LUA 1978, which is obsolete and makes no specific provisions for wave and tidal energy, other

enactments like the laws have also addressed wave and tidal energy either in a generic manner or with no specific attention to their development. For example, the CCA 2021 requires the development of wave and tidal energy to mitigate climate change effects and achieve the set targets that did not have specific considerations for wave and tidal energy. Meanwhile, enactments such as the PIA 2021 have promoted the continued use of fossil fuels rather than encouraging the development of renewable energy resources, not least wave and tidal energy resources.

Fundamentally, the Science and Technology and Innovation Act 2021, which should form the bedrock of the development of renewable energy technology, is not strong in Nigeria, especially with limited and weak renewable energy research and development centres that have not produced any significant outcomes in the areas of renewable energy. Generally, Nigeria's Science and Technology Policy has demonstrated limited productive performance towards the development and promotion of Nigeria's renewable energy. Further, even though the NSTIP 2022 provisions in s 3.12.5 expressly stated that R&D should be developed alongside demonstration and deployment capacities in solar, wind, biomass, hydro and "other renewable energies", deplorably, Nigeria's technological development, including the R&D centres have made any significant impact in renewable energy development. Therefore, the researcher maintains that Nigeria's Science and Technology policymaking and implementation can be inclusively more robust to impact the development of RE. Further, Nigeria's lack of MSP and archaic land law constitute challenges to the development of wave and tidal energy resources.

A critical assessment of Nigeria's key renewable policies as of the writing of the thesis has also not specifically made provision for the development of wave and tidal energy in a similar manner that solar, bio and wind energy resources have been addressed. Fundamentally, Nigeria's renewable energy policies continue to suffer from policy "somersault", resulting from inconsistent priorities, institutional inertia, and coordination failures that breed barriers within the renewable energy development efforts.

In sum, Nigeria has not enacted a renewable energy law. There is no Nigeria's law or policy that has specifically addressed wave and tidal energy. Moreover, the renewable energy policies, for instance, the REMP 2015 that set seemingly ambitious targets, have not, as of the date of writing, achieved the targets. According to IRENA's 2023 report, "Renewable energy roadmap: Nigeria", "Other renewable energy" where wave and tidal energy are grouped, it stated, "potentials yet to be quantified and no policy/target yet".[423] Consequently, these findings affirm this thesis' position that there has been a gap in Nigeria's legal framework concerning wave and tidal energy. The gaps identified and critically assessed include making specific legislation for renewable energy and specifically addressing wave and tidal energy, carrying out specific planning and budgeting for wave and tidal energy, creating research and development centres that focus on wave and tidal energy, carrying out the MSP and adapting Nigeria's related enactments to address wave and tidal energy resources as well as all Nigeria's renewable energy resources. Subsequently, these gaps would be addressed, and the author will make recommendations as to how Nigeria can provide a more integrated renewable energy law and policy framework in Chapter 7. The recommendations will draw lessons from a review of the global understanding of renewable energy and a comparative analytical study of other jurisdictions, including Scotland, Canada and South Korea going forward.

[423] IRENA, 'Renewable Energy Roadmap: Nigeria, 2023' (n 158) p 121.

CHAPTER 5 - A CRITICAL REVIEW OF RENEWABLE ENERGY ENACTMENTS OF SCOTLAND, NOVA SCOTIA, BRITISH COLUMBIA AND SOUTH KOREA – A CASE FOR WAVE AND TIDAL ENERGY

5.1 Introduction

The global quest for energy source diversification remains essential, especially when it will keep the environment safe for future generations. Countries, organisations, and individuals might have different views and opinions about the world's critical issues. Still, one issue that concerns everyone and most people seem to agree on is the need to protect the environment. Thus, governments and organisations are legislating laws and policies, collectively and individually, to curb carbon emissions while encouraging the development and robust use of renewable sources of energy, including wave and tidal energy sources. Wave and tidal energy resources undeniably have the potential to significantly contribute to renewable energy portfolios, although they are currently not major contributors in most countries. Currently, wave and tidal energy account for a relatively small proportion of global renewable energy generation. Harnessing the power of ocean movements to generate electricity is an exceptionally reliable and predictable source of renewable energy.

However, several factors have hindered their widespread production compared to other renewable sources like solar, wind, and hydropower. Wave and tidal energy face several challenges, including high costs, technical obstacles, infrastructure, grid integration difficulties, and environmental and regulatory concerns.[424] Nevertheless, wave and tidal energy and other forms of renewable energy possess significant potential for future development.[425] Ongoing research and technological advancements are expected to decrease the cost and enhance the efficiency of wave and tidal energy, thereby increasing their competitiveness.[426] Furthermore, wave and tidal energy provide a higher degree of reliability and uniformity in energy production.

[424] Danial Khojasteh and others, (n 45).
[425] ibid.
[426] Miguel Esteban, David Leary, Current developments and future prospects of offshore wind and ocean energy, Applied Energy, Volume 90, Issue 1, 2012, Pages 128-136, <https://doi.org/10.1016/j.apenergy.2011.06.011.> accessed 25 March 2025.

Consequently, this could render them highly valuable as a component of a well-rounded renewable energy collection, particularly in nations with extensive oceanic resources, such as the UK, Canada, France, South Korea, and Nigeria. Currently, the UK stands out as a prominent nation in the field of tidal energy advancement. Scotland is at the forefront of this development, with the EMEC in Orkney serving as the central location for testing and refining marine technologies. Nova Scotia in Canada has been actively investigating tidal energy through initiatives like the Fundy Ocean Research Centre for Energy (FORCE) located in the Bay of Fundy.

Going forward, an in-depth analysis will be conducted on the efforts made by these countries to develop wave and tidal energy technologies. There is a growing interest in the development of marine energy, with both government and private sector funding being allocated to innovative research and pilot projects. The goal is to encourage the widespread adoption of wave and tidal energy in the future. It is fitting that Nigeria should possess a suitable legal structure in preparation for the future. In sum, wave and tidal energy currently have a limited impact on the renewable energy portfolio of any country, but they possess substantial potential for future expansion. The UK, France, and Canada are at the forefront of researching and advancing these resources, although they are currently in the experimental or early deployment phases. For wave and tidal energy to have a significant impact, it is crucial to make further advancements in technology, reduce costs, and establish supportive policy frameworks. Wave and tidal energy have the potential to significantly contribute to achieving long-term renewable energy goals, especially in coastal nations, as they form part of a diverse energy portfolio. Therefore, the purpose of this chapter is to explore and evaluate the legal and policy framework of other jurisdictions in the world that have engaged in significant development of wave and tidal energy resources. The jurisdictions which will be considered are Scotland, Nova Scotia, British Colombia, and South Korea.

5.2 Wave and Tidal Energy in Scotland

Scotland's geographical location, with its 16,500km of coastline, makes it ideal for wave and tidal energy resources.[427] Scotland is home to the EMEC.[428] Estimates show that tidal power could generate about 20% of Britain's energy requirements.[429] Approximately 25% of Europe's tidal energy resources are believed to be located in the coastal areas of Scotland.[430] Furthermore, it is widely believed that tidal power has the potential to fulfil one-third of Scotland's energy requirements. Of twenty sites identified in the world as being ideal locations for large-scale tidal power arrays, the UK accounts for eight sites, including The Severn, Dee, Solway, and Humber estuaries are great potential.[431] Other sites hosting tidal turbines include Islay, and the Pentland Firth, with the narrow waterway located between the northeast tip of Scotland and the Orkney Islands are appropriate to generate electricity from the tidal movements.[432]

The UK Government set its renewable energy targets based on international, regional and national requirements, not least the need to meet emission reduction demands. For instance, the UK Government, through the UK Climate Change Act 2008 (2050 Target Amendment) Order 2019, set a Net Zero target to be achieved by 2050.[433] In Scotland, the Scottish Parliament, by the Climate Change (Emission Reduction Targets)(Scotland) Act 2019, set an earlier date for Net Zero 2045.[434] In Scotland, the law demonstrates an ambitious new target set, bringing forward the initial 2050 target set in Part 1(A1)(1) of the Climate Change (Scotland) Act 2009.[435] Commenting on the fact that the Net Zero targets are law at the House of Commons, Scottish Affairs Committee Oral Evidence on Renewable Energy in Scotland, Prof

[427] Scotland's Nature Agency, 'Wave and tidal energy' (*NatureScot,* 2020) <https://www.nature.scot/professional-advice/planning-and-development/planning-and-development-advice/renewable-energy/marine-renewables/wave-and-tidal-energy> accessed 3 March 2022.
[428] The European Marine Energy Centre, 'Our History' <https://www.emec.org.uk/about-us/emec-history/> accessed 24 April 2022.
[429] Scotland's Nature Agency, 'Wave and tidal energy' (n 427).
[430] Tidal Energy Scotland, <http://www.tidalenergy.eu/tidalenergyscotland.html> accessed 3 March 2023.
[431] Simon P Neill, Arne Vögler, Alice J Goward-Brown, Susana Baston, Matthew J Lewis, Philip A Gillibrand, Simon Waldman and David K Woolf, 'The wave and tidal resource of Scotland' (2017) 114 Pt A RE 3-17 <https://www.sciencedirect.com/science/article/pii/S0960148117302082> 3 March 2022.
[432] ibid.
[433] Climate Change Act 2008 (2050 Target Amendment) Order 2019, s 1(1).
[434] Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.
[435] Department for Business Energy Industrial Strategy, 'Net Zero Strategy: Build Back Greener' (*DBEIS Policy Paper*, 2021) <https://www.gov.uk/government/publications/net-zero-strategy> accessed 16 May 2022.

Keith Bell of UK Energy Research Centre co-director, University of Strathclyde said, "These targets now have to be backed up with concrete policies to deliver the outcomes."[436]

Indeed, on 18 April 2024, the Scottish Government declared plans to make ''minor'' changes to climate change legislation and a climate change policy package, covering 19 actions across policy areas, including transport and land use.[437] Evidently, the "minor" changes demonstrate how seriously the Scottish Government takes the issues of climate change and achieving the set ambitious net-zero targets by 2045. However, according to the government, set targets had been missed, except during the 2021 COVID period when travel restrictions impacted positively, causing reduced emissions.[438] Instructively, a clear delivery plan on how set targets will be achieved is still missing, and there is no quantification of how policies combine to give the emissions reduction required to meet Scotland's targets.[439] Invariably, the policy rejig accedes to how policies can affect achieving set targets especially when proactively carried out. In this respect, on 18 April 2024 the Scottish Government announced plans to make 'minor' changes to climate change legislation, and a climate change policy package, which includes 19 actions across policy areas including transport and land use.[440]

As of 8 February 2022, Crown Estate Scotland contracted to private firms two leases for wave energy and seven leases for tidal energy sites,[441] of which position Scotland to generate wave and tidal energy from natural marine resources.[442] Scotland's endowment with abundant RE resources, including wind, wave, solar, tidal, and

[436] Net Zero Target, HC Deb 27 May 2021, 51.
[437] SPICe Spotlight, 'A changing climate? The Scottish Government's newly announced policy package' (*SPICe Spotlight*, 19 April 2024) <https://spice-spotlight.scot/2024/04/19/a-changing-climate-the-scottish-governments-newly-announced-policy-package/> accessed 26 August 2024.
[438] ibid.
[439] ibid.
[440] ibid.
[441] marine.gov.scot, 'Crown Estate Scotland Marine Renewable Lease Sites' (*marine.gov.scot*, 7 September 2017) <https://marine.gov.scot/information/crown-estate-scotland-marine-renewable-lease-sites> accessed 16 May 2022.
[442] Simon P Neill, Arne Vögler, Alice J Goward-Brown, Susana Baston, Matthew J Lewis, Philip A Gillibrand, Simon Waldman and David K Woolf, 'The wave and tidal resource of Scotland' (2017) 114 Pt A RE 3-17 <https://www.sciencedirect.com/science/article/pii/S0960148117302082> accessed 3 March 2022.

hydro, makes the country a strategic RE generator.[443] According to Nick Sharpe, the Director of communications and strategy at Scottish Renewables, "Scotland has an enormous renewable energy resource: our winds, waves, tides, rainfall and even our longer daylight hours are tremendous assets to the country, and renewable energy technologies enable us to use them to produce direct economic and environmental benefits."[444] Relatedly, the Scottish government announced that RE generated electricity amounted to 18,084 GWh in the first half of 2024.[445] According to the Net Zero and Energy Secretary Michael Matheson, "the achievement would help deliver on Scotland's climate obligations." Progressively, Scotland generated more renewable energy electricity than it is consuming, as Renewable technologies generated the equivalent of 113% of Scotland's overall electricity consumption in 2022.[446]

In 2023, Scotland continued to generate more electricity than it needed, with net exports of electricity to other UK nations amounting to 15.9 TWh.[447] As asserted by the Scottish Energy Secretary Neil Gray, "This is a significant milestone in Scotland's journey to Net Zero."[448] For the first time, Scotland has produced more renewable electricity than it consumed, demonstrating the enormous potential of Scotland's green economy."[449] Ostensibly, the Scottish government's successes have been attributed to commitments such as providing up to 500 million pounds to leverage private investments to support RE infrastructure. Further, this landmark achievement came about because of skills, talent and natural resources, as well as an ambition to

[443] Scottish Renewable, 'Statistics' (*Scottish renewables*, 2024) <https://www.scottishrenewables.com/our-industry/statistics> accessed 27 November 2024.
[444] BBC, 'Scotland generates record amount of renewable electricity' (*BBC,* 13 October 2022) <https://www.bbc.com/news/uk-scotland-63229402> accessed 26 August 2024.
[445] Energy Voice, 'Scotland's renewable electricity generation reached record high in first half of 2024' <https://www.energyvoice.com/renewables-energy-transition/wind/uk-wind/560343/scotlands-renewable-electricity-generation-reached-record-high-in-first-half-of-2024/> accessed 18 December 2024.
[446] Scottish Government, 'Record renewable energy output' 26 January 2024, <https://www.gov.scot/news/record-renewable-energy-output/> accessed 18 December 2024.
[447] Scottish Government, 'Energy Statistics for Scotland - Q4 2023' (*Scottish Government*, 20 March 2024) <https://www.gov.scot/publications/energy-statistics-for-scotland-q4-2023/pages/progress-towards-energy-targets/> accessed 31 August 2024.
[448] Neil Gray, 'Record Renewable Energy Output' (*Scottish Government,* 26 January 2024 <https://www.gov.scot/news/record-renewable-energy-output/> accessed 22 November 2024.
[449] Scottish Government, 'Record renewable energy output' (*Scottish Government*, 26 January 2024) https://www.gov.scot/news/record-renewable-energy-output/#:~:text=Renewable%20technologies%20generated%20the%20equivalent,point%20increase%20compared%20to%202021.> accessed 29 August 2024.

export electricity to neighbours, supporting jobs and decarbonisation ambitions. Invariably, to sustain this achievement, the Scottish government promised to publish a "Green Industrial Strategy",[450] which sets out the steps to maximise the benefits that Scotland's abundant natural resources can deliver jobs and opportunities throughout Scotland. On the contrary, government policy directions could dampen these successes if the political dynamics continue. As a result, Green Energy analysts aver that "the political dynamics have cast a dim shadow on the progress and prospects of RE in Scotland".[451] For instance, First Minister Hamza Yousaf ended his Scottish National Party's power-sharing agreement with the Green, saying their climate targets were no longer achievable.[452] Arguably, this has left Scottish energy policy in a state of flux and uncertainty. Following eight out of 12 annual emission targets missed, wider plans were suggested by industry critics. On his part, on 18 April 2024, shortly before his departure, the First Minister, the government announced its plans to remove the 2030 climate change target to reduce emissions by 75% from the 1990 baseline.[453] This is the highest recorded to date and a 26-percentage point increase compared to 2021. In essence, a mix of the natural environment, local industries, and academic and governmental support underpin Scotland's wave and tidal energy.

Further, the creation of the EMEC in Orkney in 2003 opened an opportunity to develop, deploy and experiment on the various wave and tidal schemes.[454] EMEC test wave and tidal energy converters, and the Centre aims to make the marine energy sector globally successful in the quest for clean energy systems,[455] thereby reducing technology cost, development time, and risks in wave and tidal energy technologies

[450] Scottish Renewables, 'Scottish Government promises a Green Industrial Strategy' (*Scottish Renewables,* 5 September 2023) <https://www.scottishrenewables.com/news/1376-scottish-government-promises-a-green-industrial-strategy> accessed 3 August 2024.
[451] Kirsten Jenkins, 'How Scotland can get its energy for renewables back' (*Energy Transition* 18 June 2024) <https://energytransition.org/2024/06/how-scotland-can-get-its-energy-for-renewables-back/> accessed 30 August 2024.
[452] Charlie Cooper 'How a climate U-turn broke the Scottish government' (*Politico*, 25 April 2024) <https://www.politico.eu/article/climate-u-turn-broke-scottish-government-snp-humza-yousaf-bute-house-agreement-greens/> accessed 23 November 2024.
[453] Jenkins (n 449).
[454] European Marine Energy Centre, 'About Us-History' (*EMEC*, 2024) <https://www.emec.org.uk/about-us/emec-history/> accessed 24 November 2024.
[455] ibid.

development and deployment.[456] In 2021, EMEC won the "Champion of Renewables" award at the Scottish Energy Awards.[457] At inception, EMEC, a not-for-profit private company limited by guarantee, was sponsored by the Scottish Government, Highland and Islands Enterprises, the Carbon Trust, the UK Government, Scottish Enterprises, the European Union, and Orkney Islands Council.[458] However, in 2011, EMEC became self-sufficient.[459]

5.2.1 A Brief Overview of the UK Energy Laws and Policies

This section reviews the UK's renewable energy laws and policies, especially the links with Scotland's renewable energy legal framework, not least how wave and tidal energy have developed. The UK is a union of England, Northern Ireland, Scotland and Wales. Under its parliamentary system of government and unwritten constitution, most of the UK's energy laws and policies emanate from Westminster-the seat of government. Consequently, the UK Government guides, directs, influences, and affects renewable energy laws and policies for the members of the Union. However, under the UK's devolved Powers,[460] the UK Government has devolved powers to members of the Union to manage many matters excluding renewable energy resources reserved.[461] For instance, following a referendum by the Scottish in 1998, the UK Parliament passed the Scotland Act (1998), establishing the Scottish Parliament for the first time since 1707. Although energy is a reserved UK matter, nonetheless, planning is a devolved matter,[462] and as a result, the Scottish Government can decide on the direction of energy generation by approving or refusing to approve new projects.[463] Primarily, this paper focuses on Scotland's wave and tidal energy legal framework.[464] However, because of the 'Devolved matters', the

[456] ibid.
[457] ibid.
[458] ibid.
[459] European Marine Energy Centre, 'The European Marine Energy Centre LTD, Funders' (*EMEC,* 2024) <https://www.emec.org.uk/about-us/funders/> accessed 16 May 2022.
[460] UK Civil Service, 'Devolution: Factsheet' <https://assets.publishing.service.gov.uk/media/5c38cc6ce5274a70ca3c3cef/DevolutionFactsheet.pdf> 23 November 2024.
[461] ibid.
[462] Scottish Parliament, 'Devolved and Reserved Powers' (*Scottish Parliament,* 2024) <https://www.parliament.scot/about/how-parliament-works/devolved-and-reserved-powers> accessed 26 January 2024.
[463] ibid.
[464] ibid.

author will briefly review and gain insight into how the UK Government's renewable energy legal framework supports Scotland's development of wave and tidal energy resources.

Energy efficiency has propelled the history of the UK's energy. For example, during and after the Second World War, energy shortages compelled efficient energy use, and the 1973 oil crisis spurred government action, including establishing the first Department of Energy.[465] UK energy policies evolved from the 1940s domesticating energy industry, when the Government directly intervened to create efficiency for industry service, to energy private sector participation in the 1980s to 1990s.[466] According to the then Secretary of State, Nigel Lawson, the UK's energy was "to set a framework which will ensure that the market operates with a minimum of distortion and energy is produced and consumed efficiently."[467] As a result, the UK's energy became market-based, including generators, distribution companies, and electricity and gas transmission systems operators – National Grid, with Ofgem as the regulator.[468]

Since 1990, the UK Government has re-adjusted its renewable energy policies many times to improve delivery and outcomes.[469] The UK's renewable energy policy goals were stipulated in the 1988 Energy Paper.[470] The purpose of this policy includes stimulating the full economic exploitation of alternative energy resources in the UK, establishing and developing options figures, and encouraging UK industry to develop

[465] Department of Energy & Climate Change 'Contents 60th Anniversary: Digest of United Kingdom Energy Statistics, Annex A, Timeline of selected events' (*DECC*, 30 July 2009) <https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-60th-anniversary> accessed 23 November 2021.
[466] David Vincent, 'The historical foundation of UK energy policy since the 1940s' (*University of Sussex*, 11 January 2017) <https://blogs.sussex.ac.uk/sussexenergygroup/2017/01/11/historical-foundations-uk-energy-policy-since-1940s/> accessed 17 May 2022.
[467] DBEIS, 'Energy policy now and the direction it's headed' (*DBEIS*, 21 June 2018) <https://www.gov.uk/government/speeches/energy-policy-now-and-the-direction-its-headed#:~:text=Britain%20was%20at%20the%20forefront,is%20produced%20and%20consumed%20efficiently%E2%80%9D.> accessed 23 November 2024.
[468] David Vincent, 'The historical foundation of UK energy policy since the 1940s' (*University of Sussex*, 11 January 2017) <https://blogs.sussex.ac.uk/sussexenergygroup/2017/01/11/historical-foundations-uk-energy-policy-since-1940s/> accessed 17 May 2022.
[469] Catherine Mitchell and Peter Connor, 'Renewable energy policy in the UK 1990–2003' (2004) 32 17 EP 1935-1947 <https://doi.org/10.1016/j.enpol.2004.03.016.>accessed 25 May 2022.
[470] Department of Energy, *Renewable Energy in the UK: The Way Forward* (Energy Paper 55, 1988)

capabilities for the domestic and export markets.[471] Energy Paper 60 (July 1994) - *Empowering Change*[472] emphasised the aforementioned goals. The Energy Paper 62 (1994) – *New and Renewable Energy: Future Prospects for the UK* - also underscored the benefit of renewable energy to the environment and barriers to increased installation.[473] Evidently, these policies demonstrated the UK government's need to mitigate energy security and promote the use of renewable energy. Also, in the past two decades, the UK Energy policy plans have been characterised by five main policies, including the UK Renewables Obligation 2000, which ended on 31 March 2017;[474] Action Plan for Energy Efficiency 2004; the Renewable Energy Strategy Plan 2009; National Renewable Energy Action Plan 2010, and the British Energy Security Strategy 2022,[475] which provides the fulcrum of UK's energy policies, will now be summarily discussed.

5.2.2 UK Renewables Obligation (RO) 2000

The UK Renewables Obligation (RO) 2000 is a major UK Government policy tool to achieve its renewable supply targets. The RO plan was planned to last for 25 years. As a part of the Utilities Act 2000, it required licensed electricity suppliers to buy specified portions of their purchases from RES[476] The author will discuss the RO in section 5.2.5.3 of the Chapter.

5.2.3 The UK Energy Efficiency Plan 2004

The UK Energy Efficiency Plan was published on 26 April 2004 to map out how the Government would cut carbon emissions by an extra 12 million tonnes through

[471] Environmental Audit Committee, *Empowering Change?* (HC 2002 – 03- 1333).
[472] ibid.
[473] Peter M. Connor, "UK renewable energy policy: A review," (2003) 7(1) Renewable and Sustainable Energy Reviews, pp 65-82. <https://doi.org/10.1016/S1364-0321(02)00054-0.> accessed 17 December 2024.
[474] Ofgem, Renewable Obligations, <https://www.ofgem.gov.uk/environmental-and-social-schemes/renewables-obligation-ro/renewables-obligation-ro-ro-closure#:~:text=Closure%20dates%20and%20grace%20periods,Ireland%20Renewables%20Obligation%20(NIRO).> accessed 25 May 2022.
[475] Department for Energy Security and Net Zero, 'British energy security strategy' (*DESNZ* Policy Paper, 7 April 2022) <https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy> accessed 30 August 2024.
[476] International Energy Agency, 'Renewables Obligation Plan' <https://www.iea.org/policies/3485-renewables-obligation-plan?q=UK%20energy%20act%202010&s=1> accessed 25 May 2022.

energy efficiency by 2010. In this regard, some of the key measures in the plan include securing carbon savings from the household sector in the UK of 4.2 million tonnage and New energy pilots to support energy suppliers to offer innovative new energy efficiency packages to their customers.[477]

5.2.4 The Renewable Energy Strategy 2009

The Renewable Energy Strategy 2009 is a white paper that outlined the ways and means for the UK to achieve its legally binding target to ensure 15% of energy derived from RES by 2020. Under the UK Climate Change Act 2008, the UK must meet legally binding carbon "budgets", thereby committing the UK to cut its emissions by 34% by 2000 and by 2050. In other words, the strategy set carbon emissions to developing RE technologies (using part of GBP 405 million) of funding for key emerging technologies for RE technologies, including wind, wave, and tidal energy.[478]

5.2.5 The National Renewable Energy Action Plan (NREAP) 2010

The National Renewable Energy Action Plan (NREAP) 2010 set out plans to allow the UK to accomplish its 2020 renewable energy targets under the EU Directive 2009/28/EC. This EU Directive obliged member countries of the European Union to draft and submit their plan. Unequivocally, the NREAP that was prepared before BREXIT (British exit from the European Union in 2020) contained UK targets by 2020 and measures that will allow the UK to achieve its targets.[479]

5.2.6 British Energy Security Strategy 2022

Historically, from the days of coal to oil and gas and now renewable energy, energy independence remained the UK's key energy focus to ensure energy security. Energy

[477] IEA, 'Action Plan for Energy Efficiency' (*IEA*, 5 November 2017) <https://www.iea.org/policies/1707-action-plan-for-energy-efficiency?q=UK%20energy%20act%202010&s=1> accessed 25 May 2022.
[478] IEA, 'Renewable Energy Strategy 2009' (*IEA*, 24 August 2021) <https://www.iea.org/policies/4891-renewable-energy-strategy-2009?q=UK%20energy%20act%202010&s=1> accessed 25 May 2022.
[479] IEA, 'National Renewable Energy Action Plan (NREAP)' (*IEA*, 2 November 2017) <https://www.iea.org/policies/4838-national-renewable-energy-action-plan-nreap?q=UK%20energy%20act%202010&s=1> accessed 25 May 2022.

security has been exacerbated against a backdrop of geopolitical turmoil caused by a series of events of energy significance, including the recent Russian-Ukraine crisis.[480] Inevitably, these events led to the apprehension that global geopolitics remains a threat to energy security. In this vein, renewable energy is considered a potential game changer in energy security.[481] In 2022, the UK government designed the British Energy Security Strategy to accelerate homegrown power for greater energy independence.[482] This energy independence, which embeds providing clean, affordable and secure power, stems from rising global energy costs, soaring electricity demand, especially factories roaring back into life after COVID-19, and Russian President Putin's invasion of Ukraine, and accompanying consequences, not least, Western sanctions against Russian.[483] Consequently, President Putin imposed restrictions on the supply of Russian gas to the European market, which further pushed up prices.[484] According to Boris Johnson, the UK's dependence on foreign energy sources resulted from "policy fudges, decision-dodging and short-term thinking". For example, because of all these factors, "European gas prices soared by more than 200% in 2021, and coal prices increased by more than 100%. This record rise in global energy prices has led to an unavoidable increase in the cost of living in the UK for the majority of 28 million homes.[485]

Consequently, the immediate priority of the energy security strategy's "Ten Point Plan" assisted struggling families and businesses. Then, ensured energy efficiency measures, thereafter, the government invested over 6 billion in decarbonising of homes and buildings. However, the long-term measures addressed the vulnerability to international oil and gas, thereby reducing the UK's dependence on imported oil and gas through domestic sourcing through a second lease of life for the UK's North Sea.[486] Invariably, the government's Ten point plan for a green industrial

[480] John A. Paravantis and Nikoletta Kontoulis, 'Energy Security and Renewable, Energy: A Geopolitical Perspective' in Mansour Al Qubeissi, Ahmad El-kharouf and Hakan Serhad Soyhan, (eds), *Renewable Energy - Resources, Challenges and Applications* (IntechOpen 2020).
[481] Department for Energy Security and Net Zero, 'British energy security strategy' (DESNZ Policy Paper, 7 April 2022) https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy> accessed 24 November 2024.
[482] ibid.
[483] ibid.
[484] ibid.
[485] ibid.
[486] ibid.

revolution,[487] the Energy Strategy together with the Net zero strategy has been driving an unprecedented £100 billion - private sector investment by 2030 into new British industries, including offshore wind and supporting about 480,000 clean employment by the end of the decade.[488] By the summer of 2024, a new, independent, public National Energy System Operator (NESO) will be launched with responsibility for planning and operating electricity and gas networks and new provisions for emerging energy infrastructure such as carbon capture, usage and storage, and hydrogen production.[489]

In sum, the UK's Energy Security Strategy establishes an unambiguous trajectory for the country's energy future. However, the government is unable to accomplish this objective independently. A framework for businesses to adapt, innovate, and thrive in the new era of energy security and environmental stewardship is provided by the strategy's holistic approach, which balances short-term needs with long-term sustainability goals. By adopting energy efficiency, energy management, and decarbonisation systems, businesses can drive growth in an increasingly competitive global landscape and contribute to the UK's energy security.

5.2.7 UK Energy Electricity Distribution and Grid System

Originally, the UK's electricity grid infrastructure was constructed to distribute electricity from sources such as coal-fired power plants and, later, fossil fuels.[490] However, the ageing electricity grids throughout the UK have become a challenge. Additionally, the upsurge in the development of renewable energy sources has also buttressed the need to upgrade the UK's grid system. For example, 22% year-on-year represents how much fossil fuel-powered electricity declined in the UK in 2023.[491] Further, the International Energy Agency suggests that the need to upgrade

[487] Department for Energy Security and Net Zero, *The ten point plan for a green industrial revolution* (Policy paper, 2020) <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution> accessed 27 November 2024.
[488] ibid.
[489] ibid.
[490] GivEnergy, 'Great grid upgrade: what is it and why do we need it?' (*GivEnergy,* 23 July 2024) <https://givenergy.co.uk/great-grid-upgrade-what-is-it-and-why-do-we-need-it/> accessed 1 September 2024.
[491] ibid.

grid infrastructure is global. In Scotland, energy transmission from generation to consumer via the grid constitutes a challenge to its vast potential to generate renewable energy. Furthermore, from 2015 to 2023, the Government allocated 2.62 billion pounds to manage the ageing networks.[492] Among others, replacing 30 grid substations and making 25% of the High Voltage network and 32% of the Low Voltage network resilient to storms.[493]

In May 2024, the National Grid initiated the Great Grid Partnership, a collaboration of seven entities aimed at facilitating the implementation of nine Accelerated Strategic Transmission Investment projects.[494] The Great Grid Upgrade, which comprises 17 major infrastructure projects across England and Wales, is the largest overhaul of the electricity grid in generations. The collaboration intends to expedite the provision of national electricity infrastructure by synchronising the process of planning and implementation. As part of the £9bn supply chain framework, the collaboration will centralise network design and construction for nine significant infrastructure projects in England and Wales. Furthermore, in August 2024, Ofgem officially approved the final costs for delivering Eastern Green Link 2 (EGL2), allowing construction to commence on the 525kV, 2GW subsea conduit connecting Peterhead in northeast Scotland to Drax on the east coast of England. Additionally, Aberdeenshire Council has awarded final planning approval for the construction of a new HVDC converter station near Peterhead.[495] The construction is scheduled to commence at the site near Boddam, highlighting the ongoing progress on the project.[496]

[492] ibid.
[493] ibid.
[494] Nationalgrid, 'The Great Grid Upgrade' <https://www.nationalgrid.com/the-great-grid-upgrade> accessed 1 September 2024.
[495] Nationalgrid, 'Go-ahead for UK's biggest subsea connection project' (*Nationagrid,* 2024) <https://www.nationalgrid.com/media-centre/press-releases/go-ahead-uks-biggest-subsea-connection-project> accessed September 2024.
[496] ibid.

Figure 4: Map shows the UK Grid System[497]

EGL2, with an anticipated nominal investment of around £4.3bn,[498] is a collaborative effort between National Grid and SSEN Transmission, which will feature the longest HVDC subsea cable in the UK and is the largest electricity transmission project in the UK to date. It will generate sufficient electricity to power two million homes.

Concurrently, the volatility of transmission charges is also a challenge to developers who must pay to transmit the electricity they produce. The volatility of transmission charges is assessed by measuring the percentage change in the charge per MWh from one year to the next.[499] Following the analysis undertaken in the UK by the north of Scotland, generators raised valid concerns about Transmission Network Use of System (TNUoS) charges that are higher than the rest of GB because they are volatile and unpredictable.[500] The effect of these features of TNUoS includes contributing risk and uncertainty to the commercialisation to invest in generation in the north of Scotland. For an investor, there is limited opportunity to respond to year-on-year unexpected functions in TNUoS charge.[501] The Transmission Network Use of System charges are set by the Office of Gas and Electricity Markets (Ofgem). Developers pay these transmission fees to transmit electricity to customers, and consumers bear the cost as a "network" cost in their energy bill.[502] However, ongoing maintenance and expansion grids ensure that Scotland's generated energy can connect to the grid to

[497] ibid.
[498] ibid.
[499] Scottish & Sothern Electricity Networks, 'Transmission, Transmission Charges, An Overview of Charges for Use of the GB Transmission System' (*SSEN*, February 2021) 11 <https://www.ssen-transmission.co.uk/globalassets/documents/tnuos/tnuos-charging-paper---february-2021.pdf> accessed 16 May 2022.
[500] ibid 13.
[501] ibid.
[502] ibid.

benefit the rest of the UK.[503] In addition, the introduction of 'smart grids' allows for bulk storage, which provides solutions to the effects of intermittency on the grid.[504]

In summary, the UK's renewable energy policies from 1990 to 2003 have been characterised as lacking clear goals and failed to deliver deployments.[505] Catherine and others attributed this policy failure to discriminatory attention of the policies on benefits by mainly large companies and electricity-generating technologies. Catherine and others also argued that these policies neither created a diversity of technology, project size, generators, investors, or customers; they did not also promote new technologies and small-scale schemes. UK's renewable energy policies from 2003 to date have witnessed ambitious and visionary approaches which have largely rectified many of the challenges identified during the period 1990 to 2003.[506] Anandarajah and others argued that the UK government established ambitious policies to promote renewable energy and set targets to reduce carbon emissions and deployments.[507] According to Anandarajah and others, Scotland, a "constituent nation of the UK", set its targets for renewable energy.[508] The details of Scotland's renewable energy policies is discussed in section 5.3.4

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5.3 Scotland's Renewable Energy Laws

Scotland's renewable energy laws are robust, ambitious, and deliberately dynamic.[509] The primary legislation that forms the bedrock of the legal framework, includes the Electricity Act 1989, Utilities Act 2000, and the Energy Acts of 2004, 2010, 2011, and 2013. The Climate Change (Scotland) Act 2009, as amended by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, advance emissions reduction to

[503] Nationalgrid, 'Go-ahead for UK's biggest subsea connection project' (n 493).
[504] A. Shepherd, S. Roberts, G. Sünnenberg, A. Lovett, and A.F.S. Hastings, 'Scotland's onshore wind energy generation, impact on natural capital & satisfying no-nuclear energy policy' (2021) 7 ER 7107 <https://doi.org/10.1016/j.egyr.2021.10.063.> accessed 17 December 2024.
[505] Catherine Mitchell and Peter Connor (n 469).
[506] ibid.
[507] Gabrial Anandarajah and Will McDowall, 'What are the costs of Scotland's climate and renewable policies?' (2012) 50 EP 773-783 <https://doi.org/10.1016/j.enpol.2012.08.027.> accessed 25 May 2022.
[508] ibid
[509] Scottish Energy Strategy, 'The future of energy in Scotland' (*Scottish Energy Strategy,* December 2017) <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2017/12/scottish-energy-strategy-future-energy-scotland-9781788515276/documents/00529523-pdf/00529523-pdf/govscot%3Adocument/00529523.pdf> accessed 28 April 2022.

Net Zero by 2045 and a revision of the interim and annual emission reduction targets.[510] Notably, the application of law changes over a period, as law functions within the context set by politics.[511] For example, as earlier stated, the political devolution of power to Scotland has witnessed increasing intervention of the Government in the generation of electricity, however, Westminster handles issues of energy.

5.3.1 Electricity Act 1989

Electricity Act 1989 gave powers to the Scottish Ministers to determine applications for electricity infrastructure, not least the electricity grid, granting or refusing applications for consent and supporting the ambition of a public energy company offering retail energy supply.[512] According to section 36, the applications for the construction, expansion, and operation of onshore electricity generating stations with a capacity greater than 50 megawatts. Under sections 36, 36C, and 37 of the Electricity Act 1989, developers should take cognizance of some regulations that support their infrastructure applications.[513] Notably, the Electricity Act 1989 devolved power to Scotland for the inshore electricity infrastructure, which implied that offshore electricity infrastructure such as wave and tidal energy remained in the UK.

5.3.2 Utilities Act 2000

The Utilities Act 2000 provided for the establishment and functions of the Gas and Electricity Markets Authority and Gas and Electricity Consumer Council to amend the legislation regulating the gas and electricity industry and for related purposes.[514] According to the Utilities Act 2000, Regional Electricity Companies (RECs) became legal entities on which the NFFO was placed. In April 2001, New Electricity Trading Arrangements (NETA) commenced, and the Office of Gas and Electricity Markets

[510] Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.
[511] John Baylis, Steve Smith and Patricia Owens, *The Globalization of World Politics: An Introduction to International Relations,* (7th edn, OUP 2016).
[512] Electricity Act 1989.
[513] Electricity Act 1989 ss 36, 36C and 37.
[514] Utilities Act 2000.

(OFGEM) and Regulators protected more customers' interests, thus retaining competitiveness.

5.3.3 Energy Acts of 2004, 2010, 2011, 2013 and 2023

The author will now briefly discuss the UK Energy laws from 2004 to 2023 with a view to see how the laws evolved in support of RE development. The Energy Act 2004[515] legislated nuclear energy sustainability and renewable energy sources, specifically offshore energy, and renewable obligations relating to electricity and renewable transport fuel obligations. The Energy Act 2004 also created a Renewable Energy Zone (REZ), adjacent to the UK's territorial waters to install renewable energy infrastructure. Thus, the Act empowers the Crown Estate to award licenses for the development of wind farm sites in the REZ. Specifically, section 84 (2) (a) of the Energy Act 2004 provided for the development of marine renewable energy sources. The Energy Act 2008 orchestrated key developments such as feed-in-tariffs for low-carbon electricity generation on a small scale, smart meters, and the creation of a Renewable Heat Incentive.[516] Unlike the Electricity Act 1989, the Energy Act 2004 provided for the "exploitation of those areas for the production of energy from water or winds." In other words, marine renewable energy without being specific about wave and tidal energy.

5.3.3.1 Energy Act 2010

The Energy Act 2010[517] comes after the carbon transition plan was published in July 2009. The Act aimed to deliver emissions cuts of 34% from 1990 levels by 2020 and 80% by 2050, maintain the security of supply, maximize economic opportunities, and protect vulnerable consumers. In this regard, Ofgem and the Government have been empowered to set the period within which energy companies must inform consumers of changes to their tariffs.[518] Part 2 of the Energy Act 2010, empowered the Scottish Ministers to make support schemes. However, some limitations as specified in

[515] Energy Act 2004.
[516] Energy Action Scotland, 'UK Legislation' (*EAS,* 2022) <https://www.eas.org.uk/en/uk-legislation_50556/> accessed 25 May 2022.
[517] Energy Act 2010.
[518] ibid.

sections 4 and 5 of Part 2, Energy Act 2010, which states "The power of the Scottish Ministers under section 9 does not include the power to make provision in relation to the subject-matter of sections 88 to 90 of the Energy Act 2008 (Smart Meters). (5) The Scottish Ministers may not make regulations under section 9 unless—(a) they have consulted the Secretary of State about the proposed regulations, and (b) the Secretary of State has agreed to the regulations being made."[519]

5.3.3.2 Marine (Scotland) Act 2010

The Marine (Scotland) Act establishes a comprehensive framework aimed at effectively managing and reconciling the various and often conflicting demands placed upon Scotland's marine environment.[520] Further, this legislation incorporates an obligation to safeguard and improve the marine ecosystem, while also encompassing strategies to stimulate economic investment and foster growth in sectors such as marine renewables. Principally, the vital provisions in the Marine (Scotland) Act 2010 include Marine planning, which entails the legal marine planning system to handle the needs on the seas such as a simpler marine licencing system for development in the marine environment, which cuts down on red tape and encourage business investment. Additionally, provisions for enforcement to improve marine conservation – (marine nature and historic conservation with new powers to protect and manage areas important for marine wildlife, habitats, and historic monuments and Seal conservation) and licencing powers.

5.3.3.3 Energy Act 2011

The Energy Act 2011 legislated the key energy efficiency policy through the 'Green Deal' and the Energy Act 2011 sets out plans to support the UK's transition to a secure, safe, low-carbon, affordable energy system and to mobilize commitment to ambitious action on climate change internationally.[521] Specifically, the Energy Act 2011 provided for the extension of the extension of existing Ofgem powers in

[519] Energy Act 2008, ch 32.
[520] Marine (Scotland) Act 2010.
[521] Energy Act 2011.

Electricity Act 1989 to allow the implementation of an enduring offshore electricity transmission regime beyond 2010.[522]

5.3.3.4 Energy Act 2013

The Energy Act 2013 is a legislative framework to deliver secure, affordable and low carbon energy.[523] Essentially, the Energy Act 2013, which focussed on market transformation, attracting more investment, and decarbonisation targeted the generation of enough energy to meet needs even if demand increases. Among others, the Energy Act 2013 made provisions for the Electricity Market Reform in CfD and Renewables Transitional- transition arrangements for investments under the Renewables Obligation scheme. The CfD is a long-term contract to provide stable and predictable incentives for companies to invest in low-carbon generation. In effect, the CfD became the main support scheme in the Scotland in 2017. Explicitly, the Energy Act 2013 provides protection to consumers by setting limits on the number of energy tariffs offered to domestic consumers; requiring the automatic move of customers from poor value closed tariffs to cheaper deals; and requiring that suppliers provide information to consumers on the best alternative deals available. Further, Ofgem is empowered to require energy businesses that breach gas and electricity license conditions, or other relevant regulatory requirements to provide redress to consumers who suffer detriment resulting from the breach.

The provisions in Chapter 2 of the Energy Act 2013 avails regulations to encourage low carbon electricity generation, designation of a CfD counterparty – that is a person eligible, or a company formed and registered under the Companies Act 2006, or a public authority including any person any of whose functions are of a public nature.

[522] Department of Energy & Climate Change, 'Energy Act Aide Memoire' (*DECC,* 2011) <https://assets.publishing.service.gov.uk/media/5a79a975e5274a18ba50de36/3211-energy-act-2011-aide-memoire.pdf> accessed 22 May 2022.
[523] Energy Act 2013.

5.3.3.5 Energy Act 2023

On October 26, 2023, the Energy Act 2023, the most significant primary energy legislation in over a decade, was granted Royal Assent and became law.[524] Energy infrastructure, energy efficiency, regulation of nascent technologies such as CCUS and hydrogen production, and the strengthening of the regulatory landscape around more established sectors such as offshore wind and oil and gas are all covered by the Act, which is impressive in its breadth. Strategically, the Energy Act 2023 contributes to the maintenance of low energy costs by establishing a more efficient energy system. This is accomplished by implementing a new tender process to enhance competition in Great Britain's onshore electricity networks, thereby reducing the costs of network operation and development, as well anticipated savings of up to £1 billion on energy bills for consumers by 2050. Additionally, the Competition and Markets Authority will establish a merger regime tailored towards energy networks. The Act is the result of the UK government's Offshore Wind Environmental Improvement Package (OWEIP) initiative, which is designed to significantly reduce the offshore wind consenting process, which has been long regarded as a hindrance to the much-needed acceleration of new offshore wind development. The Act also ensures the critical protection of the marine ecosystems surrounding such developments. The Act establishes a solid foundation to facilitate the acceleration of offshore wind deployment while simultaneously safeguarding the marine environment, a critical concern for the industry in recent years. It supports the ambitious government objectives to deliver up to 50 GW of offshore wind by 2030, with up to 5 GW of this capacity derived from floating offshore wind.

5.3.4 Scotland's Renewable Energy Policy and Support Schemes

In this section, the author will provide an overview of the evolution and development of Scotland's RE support schemes from 1990 to 2024. The Devolution in 1999 injected the direct intervention of the Government in policies concerning electricity generation

[524] Department for Energy Security and Net Zero, 'New laws passed to bolster energy security and deliver net zero; (*DESNZ,* 23 October 2023) <https://www.gov.uk/government/news/new-laws-passed-to-bolster-energy-security-and-deliver-net-zero> accessed 1 September 2024.

in Scotland, notwithstanding that energy is reserved for Westminster.[525] Support scheme systems promote renewable energy as an alternative to fossil fuel and motivate political support for renewable technologies, bringing about policies and measures to advance market penetration of electricity generated from renewable energy sources. In addition, issues of energy security, job creation, and strengthening the competitiveness of technologies aggregate towards creating support schemes to help achieve policy objectives. Consequently, the author will now discuss the key scheme/instruments in place to support RE in Scotland.[526] Scotland's RE electricity programme has been pushed since 1990, first by the Non-Fossil Fuel Obligation (NFFO) and, since 2002, by the Renewable Obligation (RO).[527]

5.3.4.1 The Non-Fossil Fuel Obligation (NFFO)

As initially conceived, the NFFO aimed to support nuclear power generators that continued to be state-owned.[528] However, the NFFO was enlarged in scope before the obligation was brought into operation in 1990 to include the renewable energy sector. In essence, the NFFO was put in place under powers in the Electricity Act 1990, which allowed for the generation of funds from a fossil fuel levy to pay for the NFFO with specific RE technologies eligible to benefit under the suitable non-fossil fuel technologies.

In the first few years, 1990 to 1998, how RE fitted into the NFFO scheme was uncertain. There was no specific capacity target for Renewable Energy Sources (RES).[529] Little competition occurred during bids. However, the NFFO -2 contracts handled new capacity with limited competition. NFFO incentivised generators to maximise available resources and support wind energy.[530] This attracted a negative

[525] Janette Webb and Dan Van Der Horst, 'Understanding policy divergence after United Kingdom devolution: Strategic action fields in Scottish energy efficiency policy' (2021) 78 ERSS <https://www.sciencedirect.com/science/article/pii/S2214629621002140> accessed 28 April 2022.
[526] Fiona Robertson Munro, 'Renewable energy and transition-periphery dynamics in Scotland' (2019) 31 EIST 273-281 <https://www.sciencedirect.com/science/article/pii/S2210422418301102> accessed 8 April 2022.
[527] Ofgem, 'Non Fossil Fuel Obligation (NFFO) / Scottish Renewable Obligation (SRO)' (*Ofgem*, 2022) <https://www.ofgem.gov.uk/non-fossil-fuel-obligation-nffo-scottish-renewable-obligation-sro> accessed 7 April 2022
[528] UK Parliament, Parliamentary Office of Science and Technology, Postnote, 'Renewable Energy', October 2001, Number 164, <https://www.parliament.uk/globalassets/documents/post/pn164.pdf> accessed 7 November 2021.
[529] ibid, 2.
[530] ibid.

publicity campaign and was one of the reasons onshore wind development has slowed down.[531] There were challenges for other technologies; for example, the NFFO-2 waste–to–energy power plant contracts discovered that the length of time to obtain planning permission and forgone revenue from the processes showed that economic return on investment was impossible by 1998. The UK Government asked the European Commission to extend the NFFO contracts for RE, which resulted in the rules guiding NFFO-3 to NFFO-5 changing[532] With enthusiasm about the changes to the regulations of NFFO-3 to NFFO-5, optimism increased. However, the total cost cap was too low and insufficient penalties existed for companies who could not carry through their contracts, thus making the contract bids uneconomical.[533]

By 1997, the second round of opportunities arrived when the Labour Party came to power with a manifesto policy for RE to supply 10% electricity by 2010. Discussion about the future of RE policy within overall energy policy ensued.[534] The NFFO-4 provided for 1700MW DNV of new contracts to RE industries after a 3-year gap. At the end of 1998, the NFFO-5 order announced a total of 261 projects contracted and a total capacity of 1177 MW DNV.[535] Nevertheless, developers did not develop most of the NFFO-4 and NFFO-5 contracts because of low bids and difficulties with obtaining planning permission.[536] Between 1998-2000, optimism about RE dwindled as Government announced the Renewable Obligation. At this time, delivery was slow, and the development of RE was not evident as planned, coupled with red tape in securing permission and approvals.

5.3.4.2 The Renewable Obligation / Quota System

Renewable Obligation (RO) Scotland supports large-scale electricity generation in Scotland. The renewables obligation has closed to all new generating capacity in the UK, including Scotland.[537] However, the closure did not affect capacity accredited on

[531] Catherine Mitchell and Peter Connor (n 469) 1935 - 1936.
[532] ibid 1936.
[533] ibid 1937.
[534] ibid 1938.
[535] ibid 1937.
[536] ibid.
[537] Gov.Scot, 'Renewable and Low carbon energy, Renewables obligation' <https://www.gov.scot/policies/renewable-and-low-carbon-energy/renewables-obligation/.> accessed 28 May 2022.

or before the closure date. The RO scheme operated through renewables obligation certificates or Scotland renewables certificates to accredited renewables generators of renewable electricity. These operators trade ROCs with other parties and suppliers who can acquire the ROCs to demonstrate that they have accomplished their obligations. In line with the Renewables Obligation (Scotland) Order 2009 (as amended), Scottish Ministers announce the level of the Obligation, that is, the number of SROCs that suppliers serving customers in Scotland are obliged to present per megawatt-hour (MWh) of electricity supplied, every six months before the commencement of the obligation period.

In 2000, the UK government announced the adoption of renewable obligations (RO), *also called "grandfathering of support"*,[538], with some changes to the UK's hitherto RE policy goals, as earlier discussed in section 5.1. These renewable obligations policy goals included assisting the UK in meeting national and international objectives for the reduction of emissions, including greenhouse gases; to help provide secure, diverse, sustainable, and competitive energy supplies; to assist the UK renewables industry in becoming competitive in home and export markets and in doing so, provide employment; and to contribute to rural development.[539] The quota system entails two types of concepts – a quota obligation and a green certificate.[540] The quota system is a percentage of renewable energy sources electricity to be supplied obligatorily, and the green certificate is the physical certificate that guarantees the production of electricity from renewable energy sources.[541] In Scotland, the quota system, also known as Scotland Renewable Obligation (SRO), and the State-mandated programme established the percentage of the State's overall electricity that must come from renewable energy, also termed Renewable Portfolio Standard

[538] Ofgem, 'Renewables Obligations Guidance' (*Ofgem*, April 2019) <https://www.ofgem.gov.uk/sites/default/files/docs/2019/04/ro_generator_guidance_apr19.pdf> accessed 7 November 2021.
[539] Scottish & Sothern Electricity Networks (SSEN), 'An Overview of Charges for Use of the GB Transmission System' (n 499).
[540] Ofgem, 'Renewables Obligations, Guidance' (n 538).
[541] Ofgem, 'Renewable Energy Guarantees of Origin (REGO)' (*Ofgem,* 2022) <https://www.ofgem.gov.uk/environmental-and-social-schemes/renewable-energy-guarantees-origin-rego> accessed 7 April 2022.

(RPS).[542] Elsewhere, for example, in most EU countries, it was known as Quota Obligation and Green Certificates and Renewable Energy Credits (REC) in the US.[543] In practice, quota obligation systems are tradable green certificates that use decentralised market systems to satisfy set targets.[544]

For example, a former Secretary of State for Trade and Industry, Stephen Bryers, described the RO as "a policy of action, not of direct intervention".[545] By 2012, RO supported the development of onshore and offshore wind energy to the extent that the UK had emerged as the world's largest offshore wind energy developer.[546] At inception, the Renewable Obligation started with the expectation that it would perform better than the NFFO in deployment.[547] However, its performance did not meet the expectations. The RO is a high-risk mechanism, and unlike the NFFO, it is a market-based instrument, which leaves price and technology choice (no requirements on what type of RES-E to be purchased) to the market forces. Meanwhile, the Government sets a quantity to accomplish through an Obligation target. RO's lack of supporting different renewable energy technologies led to the creation of a single market for all RETs. The RO priced out technologies that are more expensive and made them uncompetitive, for example, wave and tidal energy, while cheaper and more mature technologies, such as onshore wind, benefited.[548] In the end, the RO underperformed, hence the need for policy change.[549] On 1 April 2010,

[542] Ofgem, Non Fossil Fuel Obligation (NFFO) / Scottish Renewable Obligation (SRO), (*Ofgem,* 2022) <https://www.ofgem.gov.uk/environmental-and-social-schemes/previous-environmental-and-social-schemes/non-fossil-fuel-obligation-nffo-scottish-renewable-obligation-sro> accessed 7 April 2022.
[543] US Environmental Protection Agency, 'Renewable Energy Certificates (RECs)' (*US Environmental Protection Agency*, 2022) <https://www.epa.gov/green-power-markets/renewable-energy-certificates-recs> accessed 7 April 2022.
[544] ibid.
[545] Vaulker Lauber, *Switching to Renewable Power, A Framework for the 21st Century* (2nd, Routledge 2016) 184.
[546] Derek Bunn and Tim Yusupov, 'The progressive inefficiency of replacing renewable certificates with contract for differences in the UK electricity market' (2019) 82 EP 298 <https://reader.elsevier.com/reader/sd/pii/S0301421515000038?token=D0F2B05FACC714FB0BF1B5F45781644BB5B13F4118832DBC571CCEB5FFEEB3CB3F13722926E3B71221C505117CFC3AB4&originRegion=eu-west-1&originCreation=20220430224658> accessed 22 April 2022.
[547] Catherine Mitchell and Peter Connor (n 469) 1940.
[548] Geoffrey Wood and Stephen Dow, 'What lessons have been learned in reforming the Renewables Obligation? An analysis of internal and external failures in UK renewable energy policy' (2011) 39(5) EP 2230 <https://www.sciencedirect.com/science/article/pii/S0301421510008360> accessed 17 May 2022.
[549] ibid, 2230.

the UK government replaced RO with the FiTs scheme under the powers derived from the Energy Act 2008.[550]

5.3.4.3 Feed-In Systems

According to the description of some renowned scholars, A feed-in tariff (FIT) is financial support involving paying set, guaranteed tariffs for renewable energy for a long-term period, for example, 15 years.[551] FITs are used successfully in continental Europe to promote renewable energy, for example, in Germany. The tariffs are funded out of electricity consumers' bills, an approach it shares with the Renewables Obligation Scotland (ROS). The feed-in systems, a price-based system that Germany first tested in the 1970s, comprises FiTs and feed-in premiums (FiPs).[552] Many countries across the world use or have used feed-in systems. It involves direct subsidies for electricity production from renewable energy.[553] FiTs entail payment of a fixed price to renewable energy sources and electricity producers per unit of electricity, and the RES technology determines the changes in the tariff amount. In the case of the feed-in premium (FiP) system, the payment or premium is on top of the market price of the electricity, and it is dependent on the technology.[554]

5.3.4.4 Contract for Difference (CfD)

As of December 2024, the mainstay of the UK's support scheme for renewable energy is the CfD auctions. The past decade saw the emergence and rapid development of the CfD from the 2013 UK Electricity Market Reform.[555] Ever since, the CfD system has significantly promoted the achievement of low prices for low-carbon technologies.[556] This can be seen in the case of offshore wind energy that has

[550] DECC, 'Performance and Impact of the Feeding Tariff Scheme: Review of Evidence' (*DECC,* 2015) <https://assets.publishing.service.gov.uk/media/5a819fd0ed915d74e623343b/FIT_Evidence_Review.pdf> accessed 27 November 2024.
[551] David Toke, Charles Warren, and Peter Strachan, 'A Scottish marine feed-in tariff? Submission to the Scottish Government's consultation on the Renewable Obligation (Scotland)' <https://wind-works.org/wp-content/uploads/2022/12/David_Toke_A_Scottish_marine_FITsubmission.pdf> accessed 22 May 2022.
[552] DECC (n 548) 1425.
[553] ibid.
[554] DECC (n 550).
[555] Marijke Welisch and Rahmatallah Poudineh, 'Auctions for allocation of Offshore wind contracts for difference in the UK' (2020) 147 RE 1266, https://doi.org/10.1016/j.renene.2019.09.085. accessed 15 December 2024.
[556] ibid, 1266.

witnessed three allocating rounds (AR) - AR1, AR2, and AR3 from October 2014,[557] with an outcome of cost reduction of offshore wind energy by more than two-thirds, from £119.9/MWh to £39.7 from 2017 to 2023.[558] The Department of Energy and Climate Change (DECC), which changed to Business, Energy and Industrial Strategy (BEIS)) was in charge of the first CfD allocation round that ran from October 2014 to March 2015.[559] The DECC was established under the leadership of Gordon Brown to ensure that the UK has secure, clean, and affordable energy supplies and promote international action to mitigate climate change.[560] To date, BEIS has changed to the Department of Energy Security and Net Zero (DESNZ), whose core responsibilities are delivering security of energy supply, ensuring properly functioning energy markets, encouraging greater energy efficiency and seizing the opportunities of net zero to lead the world in new green industries.[561]

The CfD is the government's primary support scheme for non-carbon power infrastructure. CfD functions by guaranteeing a set price for electricity, which is known as *"strike price; the strike price is the price that generators receive per unit of power output."*[562] The CfD, a long-term (15 years) contract between the CfD Counterparty, a state-owned limited liability company "Low Carbon Contract Company (LCCC),"[563] and a low carbon generator to eliminate long-term price risk incurred by generators of low carbon electricity at the sale of electricity, thereby having stable and predictable revenue and reduction in financing costs of the technological project.[564] Essentially, the counterparty and generators agree to pay the difference between the strike price that aptly replicates the investment cost in a low-carbon technology that is eligible for the CfD, indexed to the Consumer Price

[557] Department for Business Energy and Industrial Strategy, 'Contracts for Difference' (*DBEIS*, 9 November 2016) <https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference> accessed 8 April 2022.
[558] Charlton Bannister, 'CfDs and their future in the UK energy market' (*Offshore Renewable Energy, Catapult,* 6 July 2023) <https://ore.catapult.org.uk/blog/cfds-and-their-future-in-the-uk-energy-market/> accessed 24 February 2024.
[559] Department for Business Energy and Industrial Strategy, 'Contracts for Difference' (n 555).
[560] DECC, <http://www.decc.gov.uk> accessed 10 April 2022.
[561] Department of Energy Security and Net Zero, <https://www.gov.uk/government/organisations/department-for-energy-security-and-net-zero/about#our-responsibilities> accessed 24 February 2024.
[562] House of Commons Library, Contracts for Difference, September 2023, <https://researchbriefings.files.parliament.uk/documents/CBP-9871/CBP-9871.pdf> accessed 2 December 2023.
[563] Low Carbon Contracts Company, 'Powering Net Zero' (*Low Carbon Contracts Company,* 2024) <https://www.lowcarboncontracts.uk/> accessed 3 December 2022.
[564] ibid.

Index, and the market reference price that is the market price for electricity at a particular point in time on the UK grid.[565]

In this regard, the market reference price is calculated for both baseload generators and intermittent generators. The baseload generators are based on season-ahead prices, moving to yearly ahead prices when conditions allow. Concerning intermittent generators, it is based on an hourly day-ahead fee; when the market reference price is below the strike price, the generator receives a top-up payment from the CfD Counterparty; and when the market reference price is above the strike price, the generator must pay back the difference to the CfD Counterparty.[566]

The Levy Control Framework manages the total annual CfD expenditures and other support mechanisms for low-carbon technology funding raised through a levy on all licensed suppliers. The funds move from the CfD Counterparty to the generator through a settlement agent. The CfD is allocated through an auction process to ensure that the strike prices are lower than the published strike prices for every technology, reducing some funding pressures.[567] The revenue stabilisation provides risk profiles for CfD, making a more effective support mechanism for low-carbon generators relative to RO. As of September 2023, the UK government, through BEIS –LCCC, conducted five CfD rounds of allocation or auction, issuing the contracts, managing the construction and delivery phase, and making CfD payments.[568]

As of writing, the UK government has announced the publication of the documents relating to CfD allocation round 6 (AR6), and it will be opened in March 2024.[569] The documents provide a comprehensive source of current information on all aspects of AR6 and future rounds as well as information from DESNZ and CfD delivery partners,

[565] ibid.
[566] Natalie Kozlov, 'Contract for Difference: Risks faced by generator under the new renewables support scheme in the UK' (2014) 7(3) JWELB 282, <https://doi.org/10.1093/jwelb/jwu016> accessed 15 December 2024.
[567] ibid.
[568] Department for Business Energy and Industrial Strategy, 'Contracts for Difference' <https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference> accessed 10 April 2022.
[569] Department for Business Energy and Industrial Strategy, 'Contracts for Difference (CfD): Allocation Round 6' (*DBEIS 2023*) <https://www.gov.uk/government/collections/contracts-for-difference-cfd-allocation-round-6.> accessed 3 December 2023.

namely National Grid Electricity System Operator (Electricity Market Reform Delivery Body), LCCC and Ofgem.[570]

Five allocating rounds (AR), AR1, AR2, AR3, AR4 and AR5, AR6 (September 2024) have now taken place since the announcement in October 2014 of the first CfD allocation round that ran from October 2014 to March 2015. The second CfD allocation round spanned from March to September 2017. The AR2 detailed how bidders of projects greater than or equal to 300MW could apply for a supply chain plan statement and how to assess such requests. As stipulated in the statutory notices, the process for the auction includes the budget and accompanying note, the strike prices, delivery years, and details of the maxima for that allocation round. Notably, less established technologies also competed for an annual budget of 290 million pounds for 2021 to 2022 and 2022 to 2023.

Also, in April 2023, the Government announced that CfD, in combination with the RO and small-scale FiTs schemes, the CfD scheme made a significant impact on the UK, including Scotland's transition to a low carbon economy.[571] As of December 2024, CfD was supporting 43,126 projects, including a range of technologies, of which 122 are tidal stream projects.[572] Table 5 displays the capacity of projects awarded CfDs by technology (MW).[573]

[570] ibid.
[571] Department of Business, Energy and Industrial Strategy, 'Government explores major reform to flagship renewables scheme to improve energy security and drive investment' (*DBEIS* Press release, 17 April 2023) <https://www.gov.uk/government/news/government-explores-major-reform-to-flagship-renewables-scheme-to-improve-energy-security-and-drive-investment> accessed 6 December 2023.
[572] Nicole Watson and Paul Bolton, 'Contracts for Difference, Research Briefing' (*House of Commons Library*, 12 September 2023) 7 < https://researchbriefings.files.parliament.uk/documents/CBP-9871/CBP-9871.pdf> 18 December 2024.
[573] ibid, 8.

Table 6: Capacity of Projects awarded CfD by Technology (MW)

Capacity of projects awarded CfDs, by technology (MW)								
Auction round								
	Pre-AR1	AR1	AR2	AR3	AR4	AR5	AR6	Total (**MW**)
Offshore Wind	3,101	1,162	3,196	5,466	6,994	-	4,942	24,861
Solar PV	-	72	-	-	2,209	1,928	3,288	7,497
Nuclear	3,277	-	-	-	-	-	-	3,277
Onshore Wind	-	749	-	-	888	1481	990	4,108
Remote Island Wind	-	-	-	275	598	224	-	1,096
Biomass conversion	1,052	-	-	-	-	-	-	1,052
Dedicated Biomass with CHP	299	-	86	-	-	-	-	385
Advanced Conversion Technology	-	62	64	34	-	-	-	160
Energy from Waste with CHP	-	95	-	-	30	-	-	125
Tidal Stream	**-**	**-**	**-**	**-**	**41**	**53**	**28**	**122**
Floating Offshore Wind	-	-	-	-	32	-	400	432
Geothermal	-	-	-	-	-	12	-	12
Total	**7,729**	**2,139**	**3,346**	**5,775**	**10,792**	**3,697**	**9,648**	**43,126**

CHP = Combined heat and power *Source:* House of Commons Library [574]

The CfD AR3, which spanned from 21 January 2019 to 1 May 2019, aimed at rule 3 only,[575] in this case, the rules for the Allocation Round 3 and the eligibility requirements, which applicants must satisfy (as stipulated in the contracts for difference (Allocation) Regulations 2014 (as amended). Specifically, CfD AR3 dealt with Remote Island Winds: Schematic diagram including application for Remote Island Wind (RIW) CfD Unit connecting to the national transmission system or a distribution system in the local government areas of Comhairle nan tilean Siar, Orkney Islands Council and Shetland Islands Council. The two significant differences between CfD AR2 and CfD AR3 are the inclusion of a capacity cap in (Rules 6, 9, 10, 16, and 18)[576] and a new technology type for Remote Island Wind.

Applications for CfD AR4 opened on 13 December 2021 and closed on 14 January 2022. The budget notice has set out the parameters, which apply to eligible projects that will compete for an overall budget of 285 million in delivery years 2023 to 2024 and 2024 to 2025 for Pot 1, 2025 to 2026, and 2026 to 2027 for Pot 2, and Pot 3.

[574] Scottish Government, House of Commons Library, <https://researchbriefings.files.parliament.uk/documents/CBP-9871/CBP-9871.pdf> accessed 18 December 2024.
[575] Department of Business, Energy and Industrial Strategy, 'Contracts for Difference Scheme for Renewable Electricity Generation' (*DBEIS, 2019)* <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799074/Allocation_Round_3_Allocation_Framework__2019.pdf> accessed 28 May 2022.
[576] ibid, 7 – 21.

Pot 1 is capable of 5GW. This notice was published as a draft on 13 September 2021, except for an increase in the budget that shows an additional minimum for the tidal stream. The CfD AR4 applies to eligible generators of Hydro generating stations of sizes ranging from>5MW and <50MW (Pot1), and CfD AR4 is open to:

- Pot 1 (established technologies),
- Pot 2 (less established) technologies and
- Pot 3 (Offshore wind projects).

The CfD AR4 worked on to the basis of a pay-as-clear subject to no project receiving a higher strike price than its technology-specific Administrative strike price (ASP). Therefore, the ASPs act as a cap on the level of support available to such technology. The pay-as-clear is a pricing rule, and it is significant for renewable procurement, resulting in pricing and support costs, actors or participants' diversity, market competition, sector innovation, and efficient resource allocation.[577] In other words, the pay-as-clear incentivises bidders because it automatically awards bidders with a price offer of the most expensive offer accepted. On the other hand, the pay-as-bid bidders have the incentive to bid at the price of the costliest offer accepted.[578]

The fifth CfD allocation round (AR5) opened to applications from developers of renewable technologies in September 2023.[579] Hitherto, on 4 February 2022, closed consultations between LCCC and developers began. The CfD AR5 approved several solar, onshore wind, tidal, and geothermal projects.[580] However, even though offshore wind was the dominant technology in previous CfD auction rounds, no bids from offshore wind developers were received in the fifth auction round.[581] Offshore wind industry representatives expressed their displeasure with the outcome. In response to the criticisms, the government expressed its continued commitment to the ambition to decarbonise the UK's electricity supply and ambition to build 50GW

[577] House of Commons Library, Contract for Difference, September 2023, <https://researchbriefings.files.parliament.uk/documents/CBP-9871/CBP-9871.pdf> accessed 2 December 2023.
[578] ibid.
[579] ibid.
[580] ibid, 16.
[581] ibid.

of offshore wind capacity by 2030. However, tidal energy benefited from the AR5 with 53 approved projects, an increase of 12 projects from AR4, where 41 projects were approved.[582]

The success attained by CfD has been phenomenal. Generally, the Contracts for Difference scheme is considered a great UK energy policy success. The scheme has supported investment while, at the same time, driving down costs and passing the benefits of low-carbon energy back to the consumer.[583] In a debate about CfDs on 19 September 2023, Secretary of State for Energy Security and Net Zero, Claire Coutinho, stated the CfD programme had driven prices down over time to enormous effect, by 70% since they started, which is much more than people expected.[584]

In November 2023, the Government published the core parameters for Allocation Round 6 (AR6) of the Contracts for Difference scheme alongside several other documents relating to AR6.[585] On 27 March 2024, Allocation Round 6 commenced; and as it were, the core parameters are pot structure, delivery years and administrative strike prices for the sixth CfD. Meanwhile, in February 2024, the government started consultations on the CfD AR7 to seek views and supporting evidence on specific changes proposed for the seventh Allocation Round of the CfD Scheme scheduled to open to applications from generators of renewable technologies in March 2025.[586] Inherently, the success of previous CfD Allocation Rounds in securing substantial amounts of new, low-carbon electricity whilst minimising cost to consumers has been a major consideration in reviewing the CfD scheme ahead of the next round.

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[582] ibid, 8.
[583] Regen, 'Contract for difference – driving investment and lower costs' (*Regen, Insight Paper*, March 2023) <https://www.regen.co.uk/wp-content/uploads/Regen-Insight-Insight-Paper-March-2023-Contracts-for-Difference.pdf> accessed 3 December 2023.
[584] UK Parliament, Hansard, Contracts for Difference Scheme, Volume 737: <https://hansard.parliament.uk/Commons/2023-09-19/debates/F20C905E-A7E1-45BC-A453-86CB6DC7F74/ContractsForDifferenceScheme> accessed 3 December 2023
[585] Department of Business, Energy and Industrial Strategy (n 569).
[586] Department of Energy Security and Net Zero, 'Contracts for Difference for Low Carbon Electricity Generation Consultation on proposed amendments for Allocation Round 7 and future rounds' (*DESNZ*, 11 January 2024) <https://assets.publishing.service.gov.uk/media/65e9d1e962ff489bab87b2a5/proposed-amendments-for-ar7-and-future-rounds.pdf> accessed 3 September 2024.

In summary, it has been shown from the review that the CfD scheme has successfully driven down the cost of offshore wind and provides certainty to developers of renewable technology. However, more could be done to improve the CfD system. Inevitably, by focusing on net zero goals, the CfD scheme could readjust to prioritise "best value" and not just the lowest cost.[587] In this regard, the CfD scheme could prioritise renewable energy systems, for instance, wave and tidal, with a long-term focus on net zero targets and best value for money up to 2050. CfD is a significant contributory support scheme for the development of renewable energy sources in Scotland. As of 2024, CfD supported more than one-third of Scotland's RE projects.[588] Thus far, the CfD scheme has awarded contracts for a total of more than 30GW of new renewable capacity, and contracts were awarded to a substantial capacity of solar and onshore wind generation; and new tidal stream projects that are coming online now and the next few years, and for the first time, geothermal projects through the most recent Allocation Round 5.[589]

5.3.5 Other Related Renewable Energy Arrangements in Scotland

5.3.5.1 Licencing, Authorization and Approvals in Scotland

In June 2015, the Marine Scotland Guidance for Marine License Applicants was developed to guide developers on the process, roles, and responsibilities of the developer about marine license applications and their necessary consents.[590] The Marine (Scotland) Act 2010 makes provisions for the licensing process. In this respect, the Marine Scotland Licencing Operations Team (MS LOT) has the responsibility for the oversight of all marine renewable energy development in Scotland, including wave and tidal energy. MS LOT provides a "One-Stop-Shop" for all marine licence applications in Scottish waters. MS LOT is responsible for the assessment of applications, ensuring compliance with legislation and appropriate consultation and liaison. MS LOT works in close liaison with Statutory Nature

[587] UK Parliament, Renewable energy in Scotland Contents, <https://publications.parliament.uk/pa/cm5802/cmselect/cmscotaf/51/5105.htm> accessed 24 February 2024.
[588] ibid.
[589] DESNZ (n 586) 7.
[590] Marine (Scotland) Act 2010.

Conservation entities such as the Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee, Local Planning Authorities, the Maritime and Coastguard Agency, the Northern Lighthouse Board and the Scottish Environmental Protection Agency.

- Application for Marine Renewable Energy Projects in the Territorial Sea and UK Controlled Waters Adjacent to Scotland

The application for Marine Renewable Energy Projects in the Territorial Sea and UK Controlled Waters Adjacent to Scotland describes the requirements in line with the Marine (Scotland) Act 2010.[591] Sections 2 to 4 of the Explanatory Notes make provisions for the applicant, agent and duration of the project. Specifically, the proposed commencement and completion dates of projects are stipulated and not to be backdated except in "exceptional circumstances". In addition, a licence is normally valid for one calendar year or the duration of the project (whichever is larger).[592]

5.3.5.2 Renewable Energy Targets

Renewable energy targets form compelling enablers for the advancement of renewable energy penetration in the energy mix of countries.[593] Many countries have set ambitious targets to propel their renewable energy developments.[594] For example, Canada set ambitious goals, including achieving net-zero emissions by 2030–2050;[595] China has demonstrated a strong commitment to renewable energy development and sustainability and has implemented policies and set ambitious targets to support

[591] Scottish Government, 'Marine Renewable Energy Projects in the Territorial Sea and UK Controlled Waters Adjacent to Scotland' (2022) <https://marine.gov.scot/sites/default/files/2301272.pdf> accessed 17 December 2024.
[592] ibid.
[593] Qusay Hassan and others, (n 66).
[594] 'Scotland Sets Ambitious Target of 80% Renewables by 2020' (2010) 23(10 TEJ 3, <https://doi.org/10.1016/j.tej.2010.11.008.> accessed 21 February 2024.
[595] Panagiotis Fragkos *et al*, Energy system transitions and low-carbon pathways in Australia, Brazil, Canada, China, EU-28, India, Indonesia, Japan, Republic of Korea, Russia and the United States, Energy, Volume 216, 2021, 119385, <https://doi.org/10.1016/j.energy.2020.119385.> accessed 23 February 2024.

renewable energy growth;[596] Germany set a target of 80 per cent by 2050.[597] Similarly, Scotland has set ambitious renewable energy targets.[598]

The Net Zero Emission Year Targets and the 2050 and Interim Targets are provided for in the Climate Change (Emission Reduction Targets) (Scotland) 2019 with the objective of Scotland's contributions towards the global efforts to deliver on the Paris Agreement reached at the Conference of Parties (COP) 21 in Paris, France. Under Part 1 (A1) subsection 1 – 3, the Net Zero emission targets mandate the Scottish Ministers to ensure that the Scottish emissions account for the net zero emission target year is at least 100% lower than the baseline with the target year as 2045.[599] The 2050 and Interim targets comprise: (a) 2020 is at least 56% lower than the baseline; (b) 2030 is at least 75% lower than the baseline; and (c) 2040 is at least 90% lower than the baseline, which the Scottish Ministers must ensure that the net Scottish emissions account for the year assigned.[600] Additionally, this target can be modified to an earlier or later date after due consideration for the target-setting criteria and the most up-to-date advice received from the relevant body.

Inherently, Commin and others argued Scotland's renewable energy potential allowed the Scottish Government to set several ambitious renewable electricity targets of generating the equivalent to 100% of Scotland's electricity demand from renewable sources by 2020[601] As of 2022, the equivalent of 113% of Scotland's gross electricity consumption was generated from renewable sources.[602] According to Energy Secretary Neil Gray, "This is a significant milestone in Scotland's journey to Net Zero. For the first time, Scotland has produced more renewable electricity than

[596] Wang Lei, I Ozturk, H Muhammad, and S Ullah, 'On the asymmetric effects of financial deepening on renewable and non-renewable energy consumption: insights from China' (2022) 35(1) Economic Research-Ekonomska Istraživanja, 3961-3978 <https://doi.org/10.1080/1331677X.2021.2007413> accessed 23 February 2024.
[597] Scotland Sets Ambitious Target Of 80% Renewables by 2020, (n 594) 3.
[598] ibid 3.
[599] Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.
[600] ibid.
[601] Andrew N Commin, Andrew S French, Matteo Marasco, Jennifer Loxton, Stuart W Gibb, and John McClatchey, 'The influence of the North Atlantic Oscillation on diverse renewable generation in Scotland' (2017) 205 AE 855-867, <https://doi.org/10.1016/j.apenergy.2017.08.126.> accessed 15 December 2024.
[602] Scottish Government, 'Energy Statistics for Scotland - Q3 2023 Pt 2'
25 January 2024 <https://www.gov.scot/publications/energy-statistics-for-scotland-q3-2023-part-2/pages/renewable-electricity-target/> accessed 24 September 2024.

it consumed, demonstrating the enormous potential of Scotland's green economy."[603] The renewable electricity target is calculated as all electricity generated from renewable sources within Scotland divided by Scotland's gross electricity consumption (all electricity generated minus net electricity exports).[604] Inherently, while set targets on their own do not determine success, they must be accompanied by favourable, consistent, and impactful policies, regulatory framework, support schemes and financial incentives to deliver the set outcomes.[605] Increasingly, these renewable energy set targets changed several times based on many factors, including energy security.[606] However, by 2024, Scotland will have achieved its set renewable energy target.[607] The Scottish Government's approach to setting renewable energy targets has largely been underscored by a stable, UK-wide support regime for renewables policies, incentives and support schemes that the author will discuss in the following section.

5.3.6 Conclusion

This section discusses the overall conclusion of Scotland as a key comparator, thereby discussing its wave and tidal energy accomplishments, challenges and prospects. Historically, Scotland has been recognised for its abundant natural resources, capacity for self-sufficiency, and world-leading expertise in research, development, and production and a pioneer in renewables. For example, renewable technologies generated the equivalent of 113% of Scotland's overall electricity consumption in 2022, and Scotland has further ambitious targets, aiming for 50% of total energy demand across electricity, heat, and transport to be supplied by renewable sources by 2030. Scotland has made specific progress in mainstreaming wave and tidal

[603] Record renewable energy output, 26 January 2024, <https://www.gov.scot/news/record-renewable-energy-output/> accessed 23 February 2024.
[604] Scottish Government, Energy Statistics for Scotland - Q3 2023 Part 2, <https://www.gov.scot/publications/energy-statistics-for-scotland-q3-2023-part-2/pages/renewable-electricity-target/> accessed 23 February 2024.
[605] Royal Society of Edinburg, 'Renewable Energy in Scotland: A response to UK parliament's Scottish Affairs committee, Scotland's renewable energy targets' (2021) 21–06 AP I <https://rse.org.uk/wp-content/uploads/2022/04/RSE-AP-Renewable-energy-in-Scotland-2021.pdf> accessed 24 February 2024.
[606] Scottish Government, 'Written evidence submitted by the Scottish Government' <https://committees.parliament.uk/writtenevidence/64891/html/> accessed 23 February 2024.
[607] Scottish Government, Energy Statistics for Scotland - Q3 2023 Part 2, <https://www.gov.scot/publications/energy-statistics-for-scotland-q3-2023-part-2/pages/renewable-electricity-target/> accessed 23 February 2024.

energy development in its laws, policies, technological infrastructure and financial support, including ringfenced government budgets and support schemes (CfD).

Scotland has attained some key achievements, including the introduction of an ambitious net zero target by 2045 in the amendment of the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, representing a novel development in mainstreaming low carbon emissions into Scotland's laws and policies. Further, the EMEC, an internationally recognised research and development facility located in far Northern Scotland's Orkney Islands, provides purpose-built, open-sea testing facilities for prototype technologies, including wave and tidal energy. Scotland's policies accelerate home-grown power for greater energy independence, thus promoting renewable energy and increasing funding towards the development of wave and tidal energy. For example, following successive ring-fences in its renewable auctions, the UK is now on course to have over 100MW of tidal stream capacity deployed in its waters with 11 projects ((53 MW) at £198.00/MW/h) receiving funding in Allocation Round 5 (AR5) by 2028.[608] To address rate tape, Scotland adopted a policy guidance, which addressed this challenge by establishing a One-stop-shop to make the processes simpler and more streamlined, thereby reducing the burden on applicants, stakeholders, and regulators alike.

Policy shift triggered by the dire consequences of the Russian -Ukraine war thus exacerbated the energy security, government's support for fossil fuels that led to authorising more than 100 new North Sea licences in North-east Scotland, thus justifiably attracting protests by Climate campaigners and some Scottish supporters. Wave and tidal energy have not gained the expected priority, unlike wind and nuclear energy, as mentioned in the British Energy Strategy The Energy Strategy 2022 prioritised wind, hydrogen, and solar renewable energy and nuclear and hydrogen, explicitly leaving out wave and tide energy. This development seems to diminish the importance of promoting wave and tidal energy.

[608] EMEC, Record number of tidal energy projects awarded CfD revenue support, 8 September 2023, <https://www.emec.org.uk/record-number-of-tidal-energy-projects-awarded-cfd-revenue-support/> accessed 1 April 2025.

However, according to the UK Marine Energy Council, there is an exciting opportunity to "co-locate" wave energy converters with offshore wind in the future, thereby reducing overall costs by 12% for both technologies. Additionally, wave energy is one of the World's largest and most abundant renewable resources, and it has a complementary generation profile with technologies such as solar and wind, which will form the backbone of the UK's future energy system. In sum, this researcher believes that the future of wave and tidal energy seems brighter because of increasing technological advancement, research, and development, as well as the designs of tidal dams or barrages.

5.4 Wave and Tidal Energy in Canada

5.4.1 A Review of Canada's Parliamentary Structure and wave and Tidal energy Potential

Canada has a federal parliamentary democracy system of government with a constitutional monarchy.[609] The parliamentary structure comprises three components: the Monarch, who is symbolically represented by the Governor General, the Senate, and the House of Commons.[610] Throughout its history, Canada has been under the governance of two prominent political parties, namely the Liberal Party of Canada and the Conservative Party of Canada. Canada was among the original members of the United Nations in 1945,[611] the Organisation for Economic Co-operation and Development (OECD) in 1961,[612] and the International Energy Agency

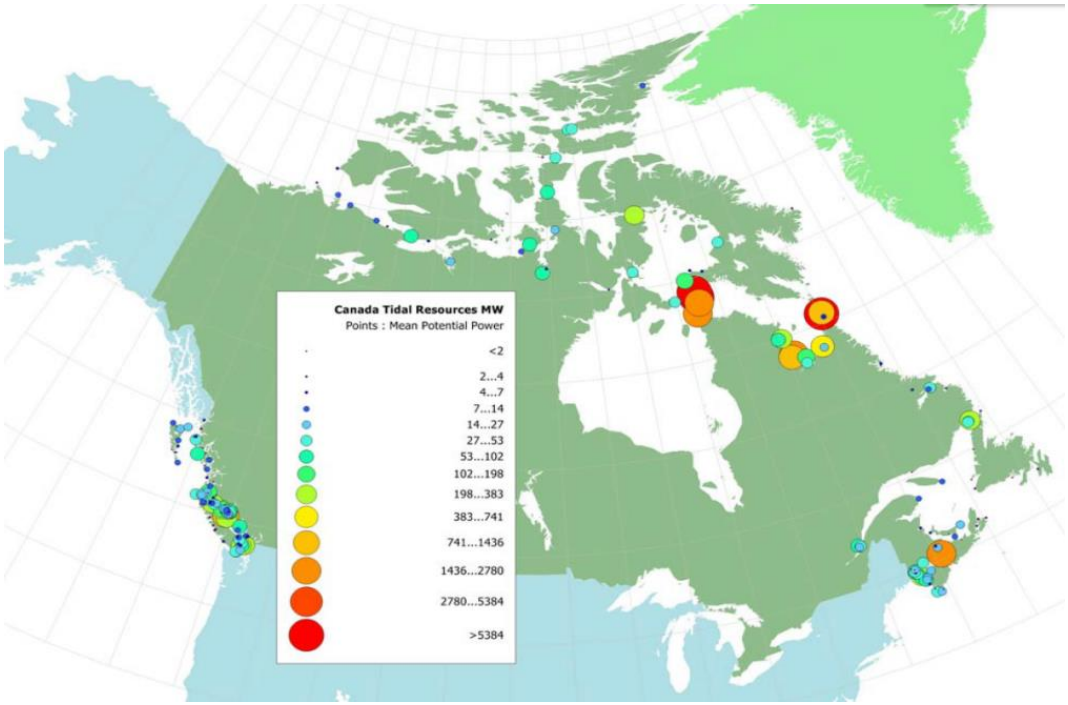
[609] IEA, 'Canada 2022' (2022) 21 EPR 1 <https://iea.blob.core.windows.net/assets/7ec2467c-78b4-4c0c-a966-a42b8861ec5a/Canada2022.pdf> accessed 21 August 2023.
[610] ibid.
[611] Dag Hammarskjold, Library, 'UN Membership,' <https://research.un.org/en/unmembers/founders> accessed 21 August 2023
[612] Organisation for Economic Co-operation and Development (OECD), 'List of OECD Member countries - Ratification of the Convention on the OECD'
<https://www.oecd.org/about/document/ratification-oecd-convention.htm> accessed 21 August 2023.

(IEA) in 1974. Canada is a participant in both the Group of Seven (G7);[613] and the Group of Twenty (G20).[614]

In 2005, at a Vancouver industry-government roundtable on ocean renewable energy, it was decided to commission a Technology and Innovation Research and Development-funded project for the creation of a Digital Atlas of Canadian Hydraulics Centres (CHC), Inventory of Canada's Marine Renewable Energy Resources.[615] The purpose of the Atlas project was to quantify and map Canada's renewable ocean energy resources because of tidal currents, waves and winds and avail the results to Canadians via an interactive digital atlas internet website. The results of the Atlas project have provided details of areas that have the greatest wave and tidal energy resources.[616] Canada's coastline is over twice as long as the coastlines of any other country in the world, at over 200,000 kilometres. The combination of abundant wave and tidal resources gives Canada a natural advantage in establishing itself as a world leader in marine renewable energy.[617]

[613] Government of Canada, 'Canada and the G7' <https://www.international.gc.ca/world-monde/international_relations-relations_internationales/g7/index.aspx?lang=eng> accessed 21 August 2023.
[614] Council on Foreign Relations, 'Who is in the G20?' <https://www.cfr.org/backgrounder/what-does-g20-do#:~:text=The%20countries%20are%20Argentina%2C%20Australia,)%2C%20and%20the%20United%20States.> accessed 21 August 2023.
[615] Canadian Hydraulics Centres (CHC), 'Inventory of Canada's Marine Renewable Energy Resources' (*Canadian Hydraulics Centres*, 2006) <https://tethys-engineering.pnnl.gov/sites/default/files/publications/Cornett2006.pdf> accessed 21 August 2023.
[616] ibid.
[617] Bryson Robertson, Helen Bailey and Bradley Buckham, 'Wave Energy, A Primer for British Columbia' (*Pacific Institute for Climate Solutions*, 31 March 2017) p 26 <https://pics.uvic.ca/sites/default/files/uploads/publications/Wave%20Energy%20Primer%20WEB%2003_31_2017a_0.pdf> accessed 15 February 2023.

Figure 5: Map Showing Potential Tidal Resources in Canada



Source: Energy BC, Tidal Energy Resources.[618]

The province of British Columbia was an early leader in tidal stream technology, boasting one of the world's first demonstration projects at Race Rocks just south of Victoria.[619]

Canada has a highly decentralised federal system of government, where the provinces and territories hold considerable jurisdiction over energy policy and regulation. Coordination across provinces and with the federal government remains an essential element to successful energy development outcomes.[620] Depending on the size and type of the RE project, new, changed, or expanded facilities need an environmental assessment and several permits, licenses, and authorisations that cover environmental, land use, safety, and other regulated parts of the project.[621]

[618] Marine Renewables, 'Tidal Energy Resources Inventory of Canada's Marine Renewable Energy Resources' (*Marine Renewables,* 2006) <https://marinerenewables.ca/facts/tidal-energy/#:~:text=Tidal%20Energy%20Resources%20%E2%80%93%20Inventory%20of%20Canada%E2%80%99s%20Marine%20Renewable%20Energy%20Resources%2C%202006.> accessed 20 November 2023.
[619] EnergyBC, 'Tidal Power in Canada' <http://www.energybc.ca/tidal.html> accessed 20 November 2023.
[620] IEA, Canada (2022) 12 EPR 1 <https://iea.blob.core.windows.net/assets/7ec2467c-78b4-4c0c-a966-a42b8861ec5a/Canada2022.pdf> accessed 29 January 2023.
[621] ibid.

Canada has some of the most significant wave and tidal potential in the world, with the Atlantic coast particularly rich in tidal resources and the Pacific coast particularly rich in wave resources. [622] The sections, which follow investigate whether Canada's energy legal framework contains express provisions for wave and tidal energy, as well as a critical assessment of these provisions with a view to learning lessons for Nigeria.

5.4.2 Canada's Renewable Energy Legal Framework

There is no explicit mention of renewable energy in the Canadian Constitution.[623] As per the Constitution Act of 1867, the provinces are owners of their ground resources except for those in Aboriginal and federal lands.[624] As well, the provinces and territories are responsible for electricity systems within their borders. In other words, while the Constitution establishes the framework for federal-provincial-local government relations,[625] and certain legal principles, specific policies and regulations regarding renewable energy are developed at the federal, provincial, and local government levels through legislation, regulations, and policy initiatives. Depending on their respective priorities, resources, and energy requirements, these policies can vary between provinces and territories. However, shared responsibility characterises the works of the federal government with the provincial and territorial levels on many energy issues, thereby ensuring coordinated action.[626] See Table 7.[627]

[622] Bryson Robertson, Helen Bailey and Bradley Buckham, 'Wave Energy, A Primer For British Columbia' (n 589).
[623] IEA, 'Canada 2022' (2022) 20 EPR 1 <https://iea.blob.core.windows.net/assets/7ec2467c-78b4-4c0c-a966-a42b8861ec5a/Canada2022.pdf> 15 February 2023.
[624] SenCanada, 'Federal, Provincial and Territorial Energy Jurisdiction' <https://sencanada.ca/Content/SEN/Committee/411/enev/DPK-Energy/appendices/Appendix05-EN.pdf> accessed 15 February 2023.
[625] Stephanie Hewson, Linda Nowlan, Georgia Lloyd-Smith, Deborah Carlson, and Michael Bissonnette, 'Protecting the Coast and Ocean, A Guide to Marine Conservation Law in British Columbia, <https://www.ubcpress.ca/media/9780774865517_OA.pdf> accessed 5 September 2023.
[626] IEA, 'Canada 2022', (n 621) 30.
[627] ibid.

Table 7: Canada's Provincial and Federal Resources Administration

Federal Responsibility	Shared Responsibility	Provincial Responsibility
International and interprovincial energy trade	Environmental regulation of energy projects	Jurisdiction and management of energy resources
International and interprovincial energy	Scientific research and development	Royalty design and Collection
Regulation of nuclear energy and uranium	Management of offshore under accords	Electricity production, distribution and regulation
Energy resources on federal Crown land, offshore and north of 60º latitude		Land-use planning and Allocation
Energy resources on federal Crown land, offshore and north of 60º latitude	Regulation of energy-using products (federal regulation of cross-border trade, provincial regulations cover products manufactured and sold in a province) Development of house and building energy codes	Laws and regulations on exploration, development, conservation, and energy use. Adoption and enforcement of house and building energy codes

Source: IEA, Canada, 2022, Energy Policy Review.[628]

Given that renewable energy law is enacted at the federal, provincial, and local government levels, there is no unified definition of "renewable energy" or "clean energy" throughout Canada.[629] However, renewable energy is commonly understood to include energy produced from sources such as hydro, wind, solar, geothermal, biomass, biogas, green hydrogen, wave and tidal.

5.4.2.1 The Constitution Act, 1867

The Constitution Act 1867 outlines the division of powers between the federal and provincial governments.[630] The Canadian Constitution grants provinces most of the

[628] ibid.
[629] International Comparative Legal Guides (ICLG) 'Renewable Energy Laws and Regulations Canada' (*ICLG*, 10 Aug 2023) <https://iclg.com/practice-areas/renewable-energy-laws-and-regulations/canada> accessed 12 August 2023.
[630] The Constitution Acts, 1867, s 91.

authority over natural resources, energy, and electricity policy.[631] The management and control of natural resources, including energy resources, primarily fall under provincial jurisdiction. This means that provinces are permitted to regulate the exploration, development, and conservation of renewable energy sources within their borders. Despite this, some implications for renewable energy policy and development do flow from the Canadian Constitution.

The federal government has certain powers that relate to energy issues, such as the regulation of commerce and trade, navigation, and the environment. For example, although not explicitly stated in the Constitution Act 1867, the federal government has the authority to legislate on environmental matters, which may include regulations and policies about renewable energy as part of environmental protection initiatives. In addition, Section 35 of the 1982 Constitution Act recognises and confirms the existing Aboriginal and treaty rights of Indigenous peoples in Canada. These rights can have implications for renewable energy projects that may have an impact on Indigenous lands and resources, necessitating meaningful consultation and, in some cases, consent. In respect of international agreements, the federal government has the authority to enter into international agreements, which may include renewable energy, climate change, and environmental sustainability agreements.

5.4.2.2 Canadian Energy Regulator Act 2019

The Canada Energy Regulation (CER) Act (S.C. 2019, c. 28, s. 10) represents the all-encompassing law through which all other related energy laws and regulations are implemented.[632] In essence, every certificate, license, or permit issued by the National Energy Board is issued under the Canada Energy Regulator Act 2019. The CER Act 2019 covers Pipelines and Processing Plants, Electricity Exports and Imports (Oil and Gas), Enforcement, Rules of Practice, Substituted Services and Pipeline Arbitration Committee, Tolls, Tariffs and Accounting (Gas and Oil), Pipeline Financial

[631] ibid.
[632] Canadian Energy Regulator Act (SC 2019, c. 28, s 10) – Regulations an Related Regulatory Documents, <https://www.cer-rec.gc.ca/en/about/acts-regulations/cer-act-regulations-guidance-notes-related-documents/index.html> accessed 14 August 2023.

Requirements, and cost recovery.[633] The objective of Canadian Energy Regulator Act 2019 is to govern specific energy-related issues falling under the jurisdiction of Parliament, with a particular focus on, among others, guaranteeing the safe, secure, and efficient construction, operation, and abandonment of pipelines, power lines, and offshore renewable energy project-related facilities, equipment, and systems. It is imperative to prioritise the protection of individuals, property, and the environment.

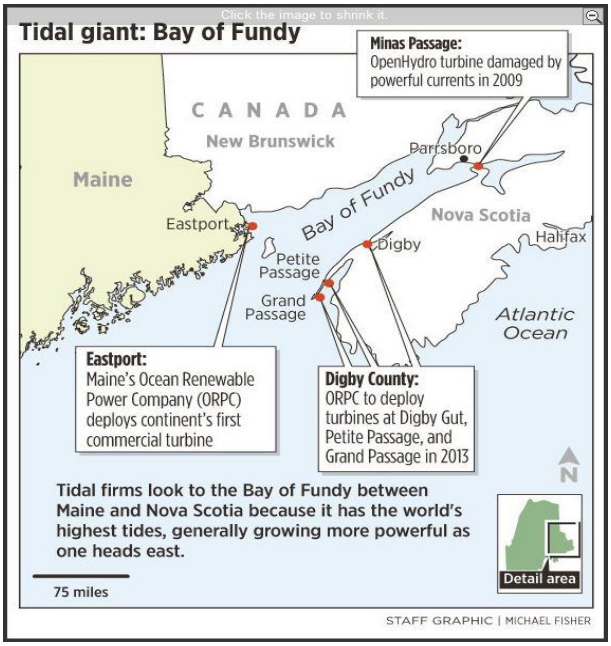
Given the history of Canada's Federation and its constitutional provisions, which delegate huge responsibilities of developing energy to the provincial authorities, this research will focus on the legal framework of two provinces, namely British Columbia and Nova Scotia. The critical examination of British Columbia and Nova Scotia Provinces provides a case study for Nigeria to learn lessons considering the new legislation that decentralised energy generation to the states. The States in Nigeria are politically like Canada's Provinces. In this regard, a justification for the choice of these two provinces will be discussed, and subsequently, their legal framework in support of wave and tidal energy will be critically examined.

5.4.3 Justification for the Selection of British Columbia and Nova Scotia Provinces

Several provincial and municipal authorities are involved in the regulation of tidal energy in Canada.[634] This researcher decided to study the regulation of WTE in Nova Scotia and British Columbia based on several reasons after a thorough review of Canada's renewable energy sources landscape. From the Atlantic coast, Nova Scotia has recently led the development of marine energy in Canada, with a focus on tidal energy rather than wave energy. The Bay of Fundy, which is located between New Brunswick, Nova Scotia, and Maine, has the world's highest vertical tidal range and may have the greatest potential for tidal energy. Nova Scotia hosts one of the world's largest estimated tidal energy resources in the Bay of Fundy, more than 2500 MW.[635]

[633] ibid.
[634] Elisa Obermann, 'The regulatory regime for tidal energy' (2023) 4 ATEI 1, 54 <https://tidalenergy.acadiau.ca/tl_files/sites/atei/Content/Reports/Module_4_The_Regulatory_Regime_for_Tidal_Energy.pdf> accessed 17 December 2024.
[635] Michael Tarbtton and Max Larson, 'Canada Ocean Energy Atlas (Phase 1) Potential Tidal Current Energy Resources Analysis Background' (*Ottawa, Ontario Canadian, Hydraulics Centre,* May 2006) <https://tethys-engineering.pnnl.gov/sites/default/files/publications/Tarbotton-Larson-2006.pdf> accessed 19 August 2023.

Figure 6: Map of the Bay of Fundy



Source: ResearchGate.[639]

In contrast, from the Pacific coast, British Colombia has good wave resources. [636] Global wave energy inventories revealed that the west coast of Canada – British Columbia province possesses one of the most energetic wave resources in the world.[637] In this respect, Ocean Energy Systems, an international energy body, estimated that the annual global wave resource could provide up to 29,500TW.[638] Further, the West Coast Wave Initiative engaged in a wave resource assessment to develop a method to quantify the temporal and spatial detail of the wave resource and wave energy converters (WECs) in Canada and study the costs and impacts of integration of wave energy into the grids.

The outcome of the assessment affirmed wave energy's comparative advantage and the need to "Develop the necessary infrastructure to allow BC and Canadian companies to test, operate and maintain WECs and ancillary technologies in BC; develop relevant legislation to support the nascent wave energy industry when it matures to deployment. This includes access to priority locations, streamlining of

[636] Robertson and others (n 622).
[637] ibid.
[638] Ocean Energy Systems (OES), Global wave and tidal stream energy production surges tenfold (*OES*, 13 March 2020) <https://www.ocean-energy-systems.org/news/global-wave-and-tidal-stream-energy-production-surges-tenfold/> 27 November 2024.
[639] ResearchGate, 'Bay of Fundy' <https://www.researchgate.net/figure/Map-of-Bay-of-Fundy-and-Gulf-of-Maine_fig1_49115803> accessed 27 November 2024.

permitting and co-operation of electrical utilities, and providing seed capital to assist the development and manufacture of WEC technologies designed for the Canadian wave climate."[640]

Another reason for selecting these two provinces is that they both have well-developed policies and laws in support of wave and tidal energy, respectively. Both provinces have implementation plans, research institutes and developed technologies that have attained commercial capacity. In 2008, Nova Scotia commenced its support for tidal energy development by commissioning a strategic environmental assessment of the Bay of Fundy, Cape Breton Island, and south and southwestern Nova Scotia. The assessment aimed at identifying the possible impact of developing tidal energy projects. Importantly, the development of Nova Scotia's wave and tidal energy started with the commissioning of a strategic environmental assessment to determine whether the tidal resources were viable, especially to identify the possible impact of developing tidal energy projects.

5.4.4 Nova Scotia: Regulatory and Policy Support for Wave and Tidal Energy

This section presents an overview of significant provincial policies, programmes, and legislation that have been implemented in recent years to address the development of tidal energy in Nova Scotia. Notably, Nova Scotia started to develop its renewable energy resources by preparing a Renewable Energy Plan,[641], which aimed to decarbonise and promote renewable energy sources, including tidal energy.[642] The Nova Scotia Renewable Energy Plan (NSREP) 2009 set "ambitious" and "futuristic" targets that were legislated by the parliament.[643] The NSREP 2009 identified areas for small and large tidal energy projects. Further, it is noteworthy that the NSREP 2009 specifically mentioned the development of tidal energy, stating as follows:

[640] Robertson and others (n 622) 45.
[641] Renewable Electricity Plan, (2009) <https://energy.novascotia.ca/sites/default/files/renewable-electricity-plan.pdf> accessed 14 August 2023.
[642] ibid 2.
[643] ibid.

"*The provincial government intends to sustain its investment in the research and development of tidal energy to harness our distinctive tidal resource potentially to address a substantial portion of our energy requirements. To promote the progress of this initiative, the proposed strategy introduces a community-oriented feed-in tariff (COMFIT) for tidal projects that are connected to the distribution system. Additionally, a distinct feed-in tariff (FiT) is implemented to cover the specific additional expenses associated with deploying tidal arrays for developmental purposes, which are connected to the grid at the transmission level*".[644]

5.4.4.1 Nova Scotia Renewable Energy Plan – "Our Electricity Future: 2015 – 2040"

In 2015, Nova Scotia implemented another revision to its renewable energy development through the release of an updated renewable energy plan titled "*Our Electricity Future: 2015–2040*."[645] The updated NSREP 2015 provided for the deployment of 18–22 MW of tidal energy devices at the Fundy Ocean Research Centre for Energy by the early-mid 2020s and targeted 300MW of tidal energy deployments by 2025. Further, it introduced two programs, including a net metering program for small and privately owned RE projects and the sale of power generated to the local distribution grid.[646] However, tidal energy-generated electricity could not benefit from these programs because of tits uncompetitive rates relative to other renewable energy sources.[647] By 2022, the net metering program was reformed and now legislated in section 3AB of the Electricity Act 2004 as amended and termed *"Advanced metering Infrastructure program".*[648]

5.4.5 Nova Scotia Enactments in Support of the Development of Tidal Energy

As the research seeks to justify the necessity for the development of wave and tidal energy in Nigeria and ultimately provide a framework to integrate it into Nigeria's RE

[644] ibid 3.
[645] Nova Scotia Canada, Our Electricity Future Nova Scotia's Electricity Plan 2015-2040' (*Nova Scotia Canada*, 2015) <https://energy.novascotia.ca/sites/default/files/Our-Electricity-Future.pdf> accessed 26 August 2023.
[646] Jordan Thomas Carlson and Michelle Adams, 'Assessing the consistency of in-stream tidal energy development policy in Nova Scotia' (2020) 113 CMP 3 <https://doi.org/10.1016/j.marpol.2019.103743.> accessed 31 March 2023.
[647] ibid 3.
[648] Electricity Act 2004.

enactments, an evaluation of Nova Scotia's key enactments is essential for lessons to be learned. This review covers relevant provisions of the Nova Scotia Marine Renewable Energy (MRE) Act, 2015 as amended;[649] Electricity Act 2004 as amended,[650] and Public Utilities Act 1989 as amended, including the establishment of the Nova Scotia Utility and Review Board that regulate public utilities; and the set targets, particularly how they have promoted the development of tidal energy in Nova Scotia.

5.4.5.1 Marine Renewable Energy Act Chapter 32 of 2015 as Amended

The Marine Renewable Energy (MRE) Act Chapter 32 of 2015, as amended by 2017, c 12; 2019, c 34; 2022, c 19 (except s 9(6)), established the regulatory framework encompassing all marine renewable activities within the offshore region of Nova Scotia. It outlines a comprehensive approach for ongoing research, development, and regulation of this valuable resource. The Marine Renewable Energy (MRE) Act of 2015, as amended, captured and legislated recommendations from Nova Scotia's renewable Energy plans (NSREPs 2009 and 2015). At its core, the MRE Act 2015, as amended, has provisions for areas of marine renewable energy priority and marine renewable electricity areas. Additionally, the MRE Act 2015 stipulated licensing, permits, set targets, support schemes, and incentives.

5.4.5.2 Amendments to the Nova Scotia Marine Renewable Energy Act 2015

In 2018, Nova Scotia's Marine Renewable-energy Act 2015 was enacted, establishing a licensing system for the MRE projects, the first come, first serve system to encourage private developers, and a permitting system to demonstrate tidal Stream Energy technology in additional areas of the Bay of Fundy.

In March 2022, the government of the Canadian province of Nova Scotia introduced amendments to the Marine Renewable-energy Act 2015 aimed at improving the regulatory framework for the tidal energy industry. In this regard, the amendments included the Demonstration Permit Program, which created a competitive evaluation

[649] ibid.
[650] Electricity Act 2004.

process. Consequently, stopping the process of providing permits on a first-come, first-served basis, a provision in the Marine Renewable Energy Act 2015 *as amended* by 2019.[651] The process ensured that the projects that offered the best value obtained approval. In this respect, a demonstration permit allows marine renewable-energy developers to test or demonstrate new ways of generating marine renewable energy. The amendments enable the sharing of subsea infrastructure, including anchors and moorings, among multiple projects to decrease project costs. Additionally, the changes enhanced the clarity of the geographic area and the rights that accompany a licence.[652]

Thus far, Nova Scotia province has issued permits to six companies, including 1) Big Moon Canada (now rebranded as *Occurrent Power*, formerly Big Moon Power.)[653] Big Moon Power announced that it had begun the assembly of its first device for deployment in the Bay of Fundy.[654] 2) DP Energy: DP Energy has been progressing with the planning of Phase 1 of the 9 MW Uisce Tapa project;[655] 3) Jupiter Hydro Inc; Jupiter Hydro has continued planning for the development of its project in the Bay of Fundy.[656] 4) Nova Innovation: Nova Innovation received authorisation for Phase 1 of their 1.5 MW tidal energy project in Petit Passage, Nova Scotia.[657] 5) Sustainable Marine Energy (Demo Permit): Sustainable Marine continues to work towards the development of its 9 MW Pempa'q project at FORCE.[658] Sustainable Marine is a global company with international partners in Scotland and Germany. The company had received more than $30 million in government funding to pilot its technology over two years in calmer waters off Digby. In May 2023, Sustainable Marine Energy

[651] Offshore Energy, 'Nova Scotia tweaks tidal energy regulations to meet industry needs' (*Offshore Energy,* 28 March 2022) <https://www.offshore-energy.biz/nova-scotia-tweaks-tidal-energy-regulations-to-meet-industry-needs/> accessed 13 February 2023.
[652] ibid.
[653] Paul Wihters, 'Nova Scotia tidal power developer rebrands, seeks more money; (*CBC News*, 17 May 2024) <https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-tidal-power-rebrand-1.7206795> accessed 3 September 2024.
[654] Ocean Energy Systems, 'OES Annual Report 2021' (*Ocean Energy Systems*, 4 March 2022) <https://www.ocean-energy-systems.org/publications/oes-annual-reports/document/oes-annual-report-2021/> accessed 5 March 2023.
[655] ibid.
[656] Global News, 'Nova Scotia issues permits for new tidal energy projects in the Bay of Fundy' (*Canadian Press*, 12 July 2019) <https://globalnews.ca/news/5487874/nova-scotia-tidal-fundy-power/#:~:text=Nova%20Scotia%20has%20issued%20two,borne%20little%20fruit%20so%20far.> accessed 04 March 2023.
[657] ibid.
[658] ibid.

departed Nova Scotia after the Department of Fisheries and Oceans refused to grant all the permits needed to test a tidal turbine in the Minas Basin.[659] This departure resulted from the denial of Sustainable Development by the government's approving agency- the Department of Fisheries (DFO). Consequently, the government set up a task force to manage the situation.[660]

5.4.5.3 Areas of Marine Renewable Energy Priority (AMREP)

Areas of Marine Renewable-Energy Priority (AMREP) are designated areas that have been legislated,[661] under the Marine Renewable Energy (MRE) Act, Chapter 32 of the Acts of 2015[662] The AMREP provide developers with the opportunity to seek licences for the installation and operation of tidal energy generators. In Nova Scotia, the use of generators serves as either demonstration projects or test deployments, aiming to provide valuable insights for design enhancements. Importantly, a licence is mandatory for any field deployment within this region. The MRE Act of 2015, as Amended, officially designated the Bras d'Or Lakes and the Bay of Fundy as the Areas of Marine Renewable Energy Priority (AMREP)[663] The Marine Renewable Energy (MRE) Act, Chapter 32 of the Acts of 2015[664] established "areas of marine renewable-energy priority" (AMREP),

5.4.5.4 The Marine Renewable Energy Area (MREA)

The Marine Renewable Electricity Areas (MREA) were also created by the MRE Act 2015. The MREA refers to licenced regions wherein licences for the development of Marine Renewable Energy projects have already been granted. MREA and AMREP exhibit a distinction in that MREA refers to demarcated regions where explicit

[659] Jennifer Henderson, 'Second chance for Bay of Fundy tidal power' (*Halifax Examiner,* 3 March 2024) <https://www.halifaxexaminer.ca/economy/energy/second-chance-for-bay-of-fundy-tidal-power/> accessed 3 September 2024.
[660] Government of Canada, Task Force on Sustainable Tidal Energy Development in the Bay of Fundy Final Report' <https://www.dfo-mpo.gc.ca/pnw-ppe/ffhpp-ppph/publications/fundy-tidal-final-report-baie-fundy-marees-rapport-final-eng.html> accessed 3 September 2024.
[661] Marine Renewable Energy Act 2015, s 10 – 12.
[662] Marine Renewable Energy (MRE) Act 2015, as amended, ch 32
[663] ibid s 10.
[664] ibid.

development licences have been authorised, and the procedure for designating a location as an MREA is explicitly outlined in the MRE Act 2015, sections 18-20.[665] The aforementioned procedure involves a compulsory public consultation process by the MRE Act, strategies to prevent any potential conflicts with current marine renewable energy (MRE) projects and aquaculture licences that utilise sea space.[666] Concerning the recent MREA designations, it is mandated by the MRE Act that a strategic environmental assessment must have been carried out or revised within the past ten years.[667] The strategic environmental assessments (SEAs) take into account the socio-economic and environmental ramifications associated with potential tidal extraction activities in a specific region. The sole Marine Renewable Energy Area (MREA) explicitly mentioned in the initial 2015 Act is the FORCE site, which possesses a licence solely for in-stream tidal development.[668]

5.4.5.5 Permits and Licenses within the AMREP and MREA

The MRE Act, 2015, as amended, explicitly prohibits the establishment of tidal or other marine renewable energy (MRE) projects in areas that are not designated as AMREP or MREA sites.[669] In the year 2019, the industry projects that were nearing completion were primarily limited to those being carried out at FORCE. According to the legislation, developers are restricted to seeking a licence for deploying devices exclusively through a government-issued call for applications, a procedure that can only be initiated by the Minister of Energy.[670] The determination of licence holders' eligibility for provincial feed-in tariff (FIT)[671] programmes is also subject to the discretionary authority of the minister.[672] The legislation permits the submission of "permit" applications. However, it explicitly stipulates that permits for tidal energy can only be utilised for generators that are non-grid-connected and non-commercial.

[665] ibid, ss 18 – 20.
[666] ibid, s 16.
[667] ibid.
[668] ibid, s 13.
[669] ibid s 12.
[670] Carlson and Adams (n 646)
[671] Michelle Adams, David Wheeler, Genna Woolston, 'A participatory approach to sustainable energy strategy development in a carbon-intensive jurisdiction: The case of Nova Scotia' (2011) 39(5) EP 2550, 2557 <https://doi.org/10.1016/j.enpol.2011.02.022.> accessed 22 August 2023.
[672] Carlson and Adams (n 646) 4.

On the other hand, it should be noted that in Nova Scotia, the in-stream tidal licences have been specifically formulated to cater to developers who intend to sell electricity either to the grid or directly to customers. Therefore, developers who aim to assess devices during the pre-commercialization phase are the ones who obtain permits. The issuance of permits by the Minister of Energy does not necessitate a call for proposals.

5.4.5.6 Electricity Act Chapter 25 of the Acts of 2004 as Amended

Nova Scotia's Electricity Act Chapter 25 of the Acts of 2004 (EA 2024) as amended is the regulation for all generators of renewable electricity, retail customers, retail suppliers, wholesale customers, and energy storage devices with the "Minister" empowered with "general supervision and management of the EA 2004, through established policies, programs, standards, guidelines, objectives, codes of practice, directives and approval processes stipulated under the EA 2004. [673] The EA 2004 specifically made provisions for tidal energy development. For example, under sub-section 7(c – d), the EA 2004 provided for tariffs set for renewable low-impact electricity generated by small-scale in-stream tidal and developmental tidal arrays, respectively. Additionally, sub-section 14 of the EA 2004 provides for the expiry of the Ministerial approval issued to a generator if the generator is not constructed and ready for electrification within five years from the date of the issuance of the community feed-in tariff approval for in-stream tidal generation facilities. The Minister has the power to terminate a project that is not ready for electrification at the end of an extension of time. Further, sub-section 16 legislated the cancellation of the COMFIT when it stipulated that "on and after December 1, 2015, the Minister may not extend the term of any COMFIT approval.

5.4.5.7 Energy Reform (2024) Act

Nova Scotia is restructuring its energy regulation and governance in preparation for the rise of renewable energy. The new Nova Scotia electricity system aims to reset

[673] Electricity Act 2004 (as amended), ch 25.

and strengthen public utility regulation in the energy sector through the Energy Reform (2024) Act. (ERA 2024).[674] In this regard, ERA 2024 establishes the Energy and Regulatory Boards Act and the More Access to Energy Act while repelling the Utility and Review Board Act. In particular, the ERA establishes two novel legislations: the More Access to Energy Act (MAEA) and the Energy and Regulatory Boards Act (ERBA). The Energy Regulation Act (ERA) removes the Utility and Review Board Act and modifies the Public Utilities Act, Electricity Act, and other relevant laws. In other words, the new Energy and Regulatory Boards Act divided the Nova Scotia Utility and Review Board into two separate boards and established the Nova Scotia Energy Board, which specialises in and regulates public utilities in the energy industry. A restructured and renamed Regulatory and Appeals Board will retain the remaining responsibilities of the Utility and Review Board, while the new Board will take into account the Environmental Goals and Climate Change Reduction Act in its decisions. To execute specific important recommendations of the Nova Scotia Clean Electricity Solutions Task Force, which published its report to the public on February 23, 2024, the ERA was established.[675]

5.4.6 Nova Scotia Renewable Energy Policy

Renewable energy policies represent statements of the government's direction in the energy sector and how effective and binding these policies are depending on extant enactments. Nova Scotia's renewable energy policies set out to make sure that the electricity supplies generated from renewable energy are clear and sustainable. Nova Scotia's renewable policies, backed by enactments, aim to reduce nearly 90% of electric supply from imported fossil fuels – coal, and promote a clear path to move from demonstration to larger projects. In this respect, the key renewable energy policies include set targets, support schemes, particularly FiTs, GHG Caps, and financial incentives.

[674] Energy Reform Act 2024
[675] Nancy Rubin and James Gamblin, 'Reset for renewables: Nova Scotia overhauls energy regulation and governance in advance of influx of renewable energy' (*Stewart & McKelvey*, 5 April 2024) <https://stewartmckelvey.com/thought-leadership/reset-for-renewables-nova-scotia-overhauls-energy-regulation-and-governance-in-advance-of-influx-of-renewable-energy/> accessed 3 September 2024.

5.4.6.1 Renewable Energy Regulations 2010

The Renewable Electricity Regulations[676] were enacted in October 2010 as part of Nova Scotia's Electricity Act 2004 as amended,[677] serving as a legal framework for implementing various initiatives outlined in the Renewable Electricity Plan.[678] In this regard, the regulations provide a comprehensive overview of the legal standards and prerequisites governing the Community Feed-In Tariff (COMFIT) initiative. The COMFIT program was established to provide 100KW of independently produced energy on the grid. Accordingly, COMFIT provided an incentive for independent community-focused renewable energy production and guaranteed a sustainable energy KW per hour rate that fed into the provincial grid from local renewable energy projects, including tidal energy projects,[679] such as the Fundy Tidal in Digby (0.5MW), Petit Passage (0.5MW) and Digby (1.95MW).[680]

However, because of the assessment of the Government and some industry stakeholders, it was revealed that the COMFIT program would hurt energy rates. Therefore, in 2015, Nova Scotia stopped accepting new applications for the COMFIT program.[681] According to The Narwhal, Nova Scotia's COMFIT, "the world's first feed-in tariff system for local energy producers to plug into the grid," had achieved its objectives.[682] The COMFIT program has a significant impact on and "exceeded expectations both in clean energy output and its contribution to the economic development of Nova Scotia communities as it facilitated the development of over 80 projects.[683] Currently, these projects collectively contribute 150 megawatts of

[676] Renewable Energy Regulations 2010.
[677] ibid.
[678] ibid.
[679] Carol Linnitt, 'Nova Scotia Pulls Plug on World's first Renewable Energy Feed-In Tariff' (*The Narwhal*, 10 August 2015) <https://thenarwhal.ca/nova-scotia-pulls-plug-world-s-first-renewable-energy-feed-tariff/> accessed 24 August 2023.
[680] Nova Scotia Canada, Natural Resources and Renewables, Copy of Draft COMFIT Status' (*Nova Scotia Canada*, May 2019) <https://energy.novascotia.ca/sites/default/files/files/Copy%20of%20DRAFT%20Comfit%20Status%20as%20of%20May%202019.pdf> accessed 24 August 2023.
[681] Carol Linnitt, (n 679).
[682] ibid.
[683] Paul Withers, 'Nova Scotia says ratepayers guaranteed cheaper renewable electricity in historic procurement' (*CBC News*, 11 March 2022) <https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-ratepayers-cheaper-electricity-1.6382088> accessed 1 November 2023.

electricity to the grid. As of 2024, COMFIT has been statutorily cancelled.[684] Meanwhile, Nigeria can learn lessons for its renewable energy programs from the COMFIT program. However, the government of Nova Scotia has continued to create new policy programs to reduce renewable energy-generated electricity rates.

5.4.6.2 Enhanced Net-Metering Program

As of September 2024, Nova Scotia still uses the net metering program. The Enhanced Net-metering program is facilitated by Nova Scotia Power to provide consumers with opportunities to fulfil their annual electricity requirements using a maximum capacity of 1 MW renewable electricity generation facility.[685] This programme minimised the environmental impact associated with electricity consumption. To establish a connection with the distribution grid, the facility must be equipped with a metre that is capable of accurately measuring electricity flows in both directions. Tidal energy is regarded as a renewable resource with minimal environmental impact, making it eligible for inclusion in this programme. In October 2022, Nova Scotia amended Renewable Electricity Regulations 2022 and introduced a new Commercial Net-metering Program (CNMP), thereby eliminating the 100KW policy for the initial net-metering program.[686] In other words, the elimination of the 100KW provision positioned Nova Scotia's businesses to develop 1MW on-site renewable electricity and enable new program participants to reduce electricity bills and protect against future price increases. According to a publication by McInnes Cooper's law firm, the amendment offered the potential to increase the de-carbonization of the NS electricity grid and support net zeroing by 2050 targets.[687]

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[684] Offshore ENERGY, 'Nova Scotia ends COMFIT program' 7 August 2015, <https://www.offshore-energy.biz/nova-scotia-ends-comfit-program/> accessed 15 December 2024.
[685] Nova Scotia Canada, 'Enhanced Net-Metering' (*Nova Scotia Canada*, 2022) <https://energy.novascotia.ca/renewables/programs-and-projects/enhanced-net-metering> accessed 24 August 2023.
[686] Peter L'Esperance, 'Melanie Gillis & Noah Entwisle, Nova Scotia's New Commercial Net-metering Regime' (*McInnes and Copper*, November 2022) <https://www.mcinnescooper.com/publications/nova-scotia-ushers-in-a-new-commercial-net-metering-regime/> accessed 31 October 2023.
[687] Melanie Gillis, Noah Entwisle, Peter L'Esperance, McInnes Cooper Alum, 'Nova Scotia's New Commercial Net-metering Regime' *MCINNES COOPER, 10 November 2022*, <https://www.mcinnescooper.com/publications/nova-scotia-ushers-in-a-new-commercial-net-metering-regime/> accessed 4 April 2025.

Consequently, according to Nova Scotia Power,

> *"If your renewable energy generator produces more energy than you use at any one time, the unused electricity will flow onto the local grid for others to use. And if you generate more electricity than you can use, these surplus kilowatt-hours (kW) will be "banked" and applied to your next bill to offset any electricity drawn from the grid."*[688]

Additionally, the CNMP allows NS Power to register and retire Renewable Energy Certificates (RECs) for renewable energy generation. Essentially, Renewable Energy Certificates (RECs) are intangible assets that serve as evidence of the holder's legitimate entitlement to the environmental advantages derived from the production of 1 MW/h) of renewable energy.

5.4.6.3 Financial incentives

Currently, Nova Scotia's financial incentives for tidal energy projects generating electricity at FORCE are listed as follows:

- More than 16,640MWh per year receive $0.42kwh
- Less than or equal to 16,640kwh receive $0.53kwh
- Large-scale tidal projects that are not part of the FORCE receive incentives that are negotiated with the provincial Department of Energy and the Minister of Energy. Big Moon Power is the only project that has benefitted from this provision at $0.35kwh

5.4.6.4 Canada's Smart Renewables and Electrification Pathways Programme (SREPPs)

In 2021, the Government of Canada introduced the Smart Renewables and Electrification Pathways Programme (SREPP) to cover four years from April 2021 to April 2025.[689] The SREPP offers financial support of up to $964 million for projects

[688] Nova Scotia Power, 'Commercial Net Metering Program' (*Nova Scotia Power 2022*) <https://www.nspower.ca/your-business/save-money-energy/make-own-energy/commercial-net-metering#:~:text=Commercial%20Net%20Metering%20Program&text=If%20you%20generate%20more%20electricity,electricity%20drawn%20from%20the%20grid.> accessed 1 November 2023.
[689] Ocean Energy Systems, 'Canada, Supporting Policies for Ocean Energy, Public Funding Programmes' (*OES, 2021*) <https://www.ocean-energy-systems.org/ocean-energy-in-the-world/canada/> accessed 1 November 2023.

involving the modernisation of electrical grids and smart renewable energy.[690] Renewable marine projects are currently being supported by SREPs through the *"Emerging Technologies"* programme stream. For the SREPP, projects are required to have a minimum capacity of 4 MW. In the case of indigenous ownership, the minimum size criterion is 500 kW. Subsidies of up to 30% of project costs, with a maximum cap of $50 million, may be provided by SREPPs.[691]

In November 2023, the Canada 2023 annual budget supported the growth and development of its marine renewable energy sector through refundable tax credits and about $ 23 billion for wind, wave and tidal energy, as well as other clean electricity technology.[692] According to Elisa Obermann, executive director of Marine Renewables Canada, the investment tax credits, in conjunction with new funding, will play a significant role in catalysing as well as spurring the development of marine renewable projects across the country.[693]

5.4.6.5 Nova Scotia Wave and Tidal Energy Programmes: Small-Scale and Large-Scale Projects

Both small-scale (0.5 MW and below) and large-scale tidal energy projects (greater than 0.5 MW) are typically subject to many of the same provincial and federal regulatory requirements, given that many aspects of the marine environment such as navigation, transportation, and habitat, are governed by the federal government. The smaller size of a project does not necessarily mean it will not require the same permits and oversight as a larger project. However, projects under 2MW will not trigger the provincial environmental assessment. All aspects of a project are considered in terms of technology, location, size, number of devices, etc., that may dictate the regulatory requirements and processes.

[690] ibid.
[691] ibid.
[692] Government of Canada, 'A Made-In-Canada Plan: Affordable Energy, Good Jobs, and a Growing Clean Economy' Ch 3.2, <https://www.budget.canada.ca/2023/report-rapport/chap3-en.html#m19> accessed 11 November 2023.
[693] Marine Renewables Canada, '2023 Budget supports growth for Canada's marine renewable sector' (*Marine Renewables Canada*, (2023) <https://marinerenewables.ca/news-and-blog/2023-budget-supports-growth-for-canadas-marine-renewable-sector/> accessed 11 November 2023.

Currently, small-scale tidal energy projects that are proposed to be 0.5 MW or below, connected to the distribution system, and owned by an eligible community-based group can apply to the provincial COMFIT program. The COMFIT application process is a separate activity from the permitting and licensing process established for tidal energy projects. However, many of the steps and activities included in the COMFIT application process overlap with other federal and provincial regulatory requirements. The government posited that the COMFIT programme has effectively fulfilled its intended objective by incentivising the development of renewable energy initiatives with a total electricity generation capacity of 150 megawatts,[694] and Nova Scotians' raised more than 45 million dollars to develop COMFIT projects, which led to a $135 million investment in Nova Scotian communities.[695] The government promptly ceased the acceptance of fresh applications, opting instead to evaluate unapproved extensions and expired permit renewals on an individual basis, with a commitment to completing the processing within 60 days.[696]

5.4.7 Conclusion: Nova Scotia's Wave and Tidal Energy- Accomplishments, Challenges and Prospect

In Canada, the Province of Nova Scotia is geographically endowed with one of the highest tidal resources in the world. The Minas Passage area of the Bay of Fundy is home to an estimated 7,000 megawatts of energy potential, roughly equal to the power needs of 2 million homes – or all of Atlantic Canada.[*697*] With the system of government that permits devolution of powers to the provinces to manage their energy sector, of course, working in close liaison with the Federal government, Nova Scotia established laws, policies and institutions to develop its rich natural renewable energy resources, not least the marine energy resources. The Canadian province of Nova Scotia has offered several incentives for the development of in-

[694] Nova Scotia Canada, 'COMFIT' (*Nova Scotia Canada*, 2020) <https://energy.novascotia.ca/renewables/programs-and-projects/comfit#:~:text=The%20COMFIT%20program%20is%20no,renewable%20energy%20sources%20by%202020.> accessed 24 August 2023.
[695] ibid.
[696] ibid.
[697] Marine Renewables Canada, 'Tidal Energy' (*Marine Renewables Canada*,) <https://marinerenewables.ca/facts/tidal-energy/#:~:text=The%20Minas%20Passage%20area%20of,the%20rotation%20of%20the%20earth.> accessed 3 September 2024.

stream tidal energy projects. A summary highlight of achievements and challenges with prospects of development of tidal energy resources in Nova Scotia province will now be discussed.

5.4.7.1 Accomplishments

Nova Scotia possesses the four key elements to succeed in tidal energy development, namely, strong resource areas close to existing grid infrastructure,

International demonstration centres, marine renewable energy legislation and market incentives, including a feed-in tariff (FIT).[698] Since 2009, laws, policies, and incentives such as feed-in tariffs have been established to provide direct financial incentives for tidal power produced and sold to the grid. Additionally, collaborative funding of the Fundy Ocean Research Centre for Energy's development with the Canadian federal government and industry partners and substantial funding of research have been injected into environmental impact monitoring for tidal energy projects. Nova Scotia established the Fundy Ocean Research Centre for Energy (FORCE) at the Bay of Fundy, Minas Passage, which is characterised as Canada's leading test centre for tidal stream energy technology; FORCE has worked to advance marine research in the Bay of Fundy and beyond since 2009 with the first deployment of an OpenHydro turbine.

In 2014, FORCE installed four subsea power cables, which will enable berth holders to connect to the Nova Scotia electrical grid. FORCE also delivers common infrastructure and permits, including subsea power cabling: four 34.5kV cables have been installed, totalling 11km and 64MW capacity; a substation with 30MW transformer and turbine control bays; a 10km 69kV transmission line that connects the FORCE substation to the provincial power grid via the existing Parrsboro substation; and provincial and federal approvals, including Environmental Assessment and Generator Interconnection Agreements. FORCE also has several key programs, including the Fundy Advanced Sensor Technology (FAST) Program, which uses onshore and offshore assets to support research and development and advance efforts to monitor and characterise the FORCE site, and the Environmental Effects

[698] ibid.

Monitoring Program (EEMP), which has been in place since 2009 to better understand the Minas Passage's natural environment and turbines' potential effects on fish, sea life Risk Assessment Program for Tidal Stream Energy (RAP) uses biological and physical oceanographic data to create a detailed, credible assessment tool to determine the likelihood that fish will encounter a tidal device.

In April 2024, the Energy Reform (2024) Act was passed to restructure Nova Scotia's energy regulation and governance system.[699] For example, there is currently no marine spatial planning policy for ocean energy at the federal level.[700] Nova Scotia is the only province that has spatial planning for ocean energy.[701] In the Bay of Fundy in Nova Scotia, areas have already been chosen ahead of time for tidal current energy development. A Strategic Environmental Assessment (SEA) on tidal energy development in the Bay of Fundy (FORCE) helped choose the site. Assessments of resources were also considered when choosing the site. Cape Breton Island, which includes the Bras d'Or Lakes, is another area in Nova Scotia that just had a SEA.

5.4.7.2 Challenges

To utilise this in-stream tidal resource, Nova Scotia has implemented several policies, incentives, and programs since 2008 to attempt to encourage development. In the ten intervening years, only a handful of in-stream tidal devices have been installed in the province.[702] These in-stream tidal devices are: Cape Sharp Tidal Venture (2MW) deployed in 2016, Sustainable Marine Energy's PLAT-I Platform (420kW) deployed in 2019, Big Moon Power Project (500kW) deployed in 2019. Others that are proposed include Sustainable Marine Energy's FORCE Project (9 MW) and Halagonia Tidal Energy Ltd (21 MW). In 2008, at the outset of the development of tidal energy projects, the cost of the technology and the difficult ocean environment constituted the key challenges. Another critical challenge faced by tidal energy-

[699] Lucia Westin-Eastaugh, David MacDougall, and Alexandra Gosse, 'NS Energy Reform (2024) Act: 5 Key Electricity Sector Changes' (*McInnes and Copper,* 22 August 2024) <https://www.mcinnescooper.com/publications/n-s-energy-reform-2024-act-5-key-electricity-sector-changes/> accessed 4 September 2024.
[700] Ocean Energy Systems, 'Canada, Supporting Policies for Ocean Energy, Consenting processes' (*OES*, 2023) <https://www.ocean-energy-systems.org/ocean-energy-in-the-world/canada/> accessed 1 November 2023.
[701] ibid.
[702] Carlson and others (n 646)

generated electricity stemmed from the relatively high rate when the technology was expensive. In the early stages, support schemes and financial incentives mitigated the challenge of rates. In this regard, government with the inclusive participation of all stakeholders, including the communities and industry experts, new policies have been adopted to address challenges and promote the development of tidal energy.

In 2023, Sustainable Marine Energy, a Scotland-based company at the FORCE, departed the Minas Passage because of years of delays by the government and refusal to approve its application for new sites after three attempts.[703] In May 2023, reportedly, the Government red tape hindered tidal energy development at the FORCE.[704] According to the Washington Post, Tidal power turbines operating on the Bay of Fundy in Nova Scotia were suspended after the company running them was unable to get a permit to continue testing.[705] Invariably, the termination of the project resulted in the unemployment of approximately 20 individuals in Canada, coinciding with the company's pre-existing plans for expansion in this region.[706] The premier of Nova Scotia, Tim Houston, expressed his dissatisfaction as well. In an email, he expressed that this development represents a significant setback for the tidal industry in the region. Meanwhile, in June 2023, the Honourable Joyce Murray, former Minister of Fisheries, Oceans and the Canadian Coast Guard, and the Honourable Jonathan Wilkinson, Canada's Minister of Natural Resources, established a Task Force on sustainable tidal energy, especially to explore issues and opportunities associated with the deployment of tidal energy projects in the Bay of Fundy.[707] Based on some recommendations of the report of the Task Force, the Energy Reform (2024) Act was established.[708]

[703] Rubin and Gamblin (n 675)
[704] Canada New Observer, 'Chloe Logan, Tidal power company tanks Bay of Fundy project over federal red tape' (*Canada New Observer*, 25 May 2023) <https://www.nationalobserver.com/2023/05/05/news/tidal-power-company-tanks-bay-fundy-project-over-federal-red-tape> accessed 11 November, 2023.
[705] Ian Austen, 'A Once-Promising Green Energy Technology Hits a Roadblock, The New York Times 29 April 2023, <https://www.nytimes.com/2023/04/29/world/canada/sustainable-marine-tidal-energy-suspended.html> accessed 11 November 2023.
[706] ibid.
[707] THETHYS, Task Force on Sustainable Tidal Energy Development in the Bay of Fundy Interim Report, June 2023, <https://tethys.pnnl.gov/publications/task-force-sustainable-tidal-energy-development-bay-fundy-interim-report> accessed 11 November 2023.
[708] Rubin and Gamblin (n 675)

5.4.7.3 Prospects

The government recognised that tidal energy could have an important role to play in the clean energy future, especially as the Task Force's recommendation provided a strong path forward to support sustainable tidal energy in Canada.[709] The report addressed four key issues, including the administration of the Fisheries Act authorisation process, environmental risk assessment and monitoring standards, international data and research on environmental impacts and climate change, and economic benefits in decision-making.[710]

The actions of the government have been proactive, not least after the release of the report of the Task Force. Additionally, the promulgation of the ERA 2024 has demonstrated the government's interest in promoting the development of tidal energy resources. Inherently, the ERA 2024 provides a robust legislation and regulatory framework to drive the future development of tidal energy resources in Nova Scotia. According to Marine Renewable Executive Director Elisa Obermann, "Progress has been made towards establishing a viable and predictable regulatory path for projects"[711] however, she calls for effective and efficient implementation in collaboration with industry stakeholders. While it is evident that the legislation attempts to cure the previous red tape that led to the departure of Sustainable Marine Energy, it remains to be seen how the law will promote the development of tidal energy in Nova Scotia.

5.5 British Columbia Regulatory and Policy Support for Wave and Tidal Energy

At the time of writing, on 3 September 2024, British Columbia had 6,000 MW of wave energy and 2,000 MW of tidal energy development opportunities.[712] The Province of British Columbia allocates Crown land resources for ocean energy projects. The Province collaborates with industry and other agencies to develop ocean energy

[709] Nadja Skopljak, 'Canadian Govt charts path for sustainable tidal energy development' (*Offshore Energy,* 29 February 2024) <https://www.offshore-energy.biz/canadian-govt-charts-path-for-sustainable-tidal-energy-development/> 17 November 2024.
[710] ibid.
[711] ibid.
[712] British Columbia, 'Land Use – Ocean Energy' <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/crown-land/crown-land-uses/clean-energy/ocean-energy> accessed 4 September 2024.

planning projects. In every successful endeavour, planning is important. Therefore, it is key to briefly review the planning efforts in support of wave and tidal energy in British Columbia.

5.5.1 British Columbia's Clean Energy Planning Processes Which Support the Development of Wave and Tidal Energy

The province of British Columbia established based its clean energy legislation on two energy plans, namely, BC Energy Plan 2002 and BC Energy Plan 2007.[713] The Government engaged key stakeholders, including environmental non-governmental organisations, First Nations, industry representations, and communities, after about 100 meetings to attract ideas and feedback on new policy actions and plans contained in the BC Energy Plan 2007", which also improved the first BC Energy Plan 2002. The BC Energy Plans made provisions for wave and tidal energy. For example, the BC Energy Plan described wave and tidal energy as "other emerging technologies" and classified them as "future electricity supply option, which has great potential for British Columbia."[714] In 2005, the Race Rocks Tidal Energy Project announced a demonstration project between the provincial and federal governments, industry, and Pearson College to produce a zero-emission tidal power at the Race Rocks Marine Reserve on southern Vancouver Island.[715] The project produced about 77,000 KW/h of electricity per year, enough to meet the needs of approximately eight households. The knowledge gained about tidal energy has helped the province of BC to promote clean energy generation technology.

[713] The BC Energy Plan, 'A Vision for Clean Energy Leadership' <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/bc_energy_plan_2007.pdf> accessed 20 November 2023.
[714] ibid 25.
[715] TETHYS, Summary Report on Environmental Monitoring Related to the Pearson College - ENCANA - Clean Current Tidal Power Demonstration Project at Race Rocks Ecological Reserve, 1 December 2006, <https://tethys.pnnl.gov/publications/summary-report-environmental-monitoring-related-pearson-college-encana-clean-current> accessed 21 November 2023.

5.5.2 A Review of British Columbia's Key Enactments in Support of Wave and Tidal Energy

This research shows that there are no laws or policies in the province of British Columbia solely devoted to supporting wave and tidal energy. However, the province has many broad-based laws and policies aimed at promoting the development of renewable energy and clean technology that indirectly support wave and tidal energy. Generally, the following provincial enactments are applicable for the development of renewable energy projects:[716] Clean Energy Act 2010,[717] Land Act 1996 [RSBC] current to 15 November 2023;[718] Agricultural Land Commission Act 2002;[719] Water Act 1985;[720] Environmental Management Act 2003;[721] Forest Act 1985;[722] Heritage Conservation Act 1996;[723] Pipeline Act 2015;[724] Wildlife Act 1996;[725] Park Act 1996;[726] and, Geothermal Resources Act 1996.[727] In the same vein, the following federal statutes are also likely to apply: Federal Real Property and Federal Immovables Act 1991;[728] Navigable Waters Protection Act 1985;[729] Canadian Environmental Protection Act 1999;[730] Fisheries Act 1985;[731] Species at Risk Act 2002;[732] Migratory Birds Convention Act 1994;[733] and, Canadian Environmental Assessment Act 1994.[734] Impact Assessment. Lastly, for local governments, the relevant legislations are the

[716] British Columbia, Strategic Analysis of Renewable Energy Options for the Central Coast, North Coast And Haida Gwaii, OnPoint Consultant Inc,<https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/westcoast-region/great-bear-rainforest/hw03c_renewable_energy_final_report.pdf> accessed 3 September 2023.
[717] Clean Energy Act 2010.
[718] Land Act 1996.
[719] Agricultural Land Commission Act 2002, ch 36.
[720] Canada Water Act 1985.
[721] Environmental Management Act 2003, ch 53.
[722] Forestry Act 1985, c. F-30.
[723] Heritage Conservation Act 1996.
[724] Pipeline Safety Act 2015.
[725] Wildlife Act 1996.
[726] Park Act 1996.
[727] Geothermal Resources Act 1996.
[728] Federal Real Property and Federal Immovable Act 1991.
[729] Navigable Waters Protection Act 1985.
[730] Canadian Environmental Protection Act 1999.
[731] Fisheries Act 1985.
[732] Species at Risk Act 2002.
[733] Migratory Birds Convention Act 1994.
[734] Canadian Environmental Assessment Act 1994.

Local Government Act 2015,[735] and Community Charter 2003.[736] These enactments can be categorised into federal laws, province of British Columbia laws and regional or sub-national laws. This research will now evaluate some of the enactments that have promoted the development of wave and tidal energy. In this evaluation, the researcher will assess the nature, quality, extent and significance of these enactments, thereby ascertaining how effective they have promoted the development of wave and tidal energy.

5.5.2.1 Clean Energy Act 2010

The Clean Energy Act 2010 is the "dedicated" renewable energy enactment in the province of British Columbia (BC).[737] On 3 June 2010, following a Royal assent from the province of British Columbia legislature, the Clean Energy Act (CEA) 2010 was adopted. BC's energy plans in 2002 and 2007 and its 2008 Climate Action Plan formed the basis of the CEA 2010.[738] The CEA 2010 describes renewable electricity as "Clean Energy". Although the province of BC does not have dedicated legislation for wave and tidal energy, the Clean Energy Act 2010 mentions "ocean" energy in its definitive section when identifying "clean or renewable energy resources" as biomass, biogas, geothermal heat, hydro, solar, *ocean*, wind or any other prescribed resource.[739] CEA 2010 consolidated BC Hydro and BC Transmission Corporation to provide a single entity that plans and delivers clean energy required to meet BC's growing demands for electricity while fostering job creation throughout the province of BC.

In general, some of CEA 2010 key energy objectives include the attainment of electricity self-sufficiency, setting a conservative target of 66 per cent for BC Hydro by 2020 (an increase from 50 per cent), guaranteeing that a minimum of 93% of electricity generated by BC Hydro originates from clean or renewable sources.

[735] Local Government Act 2015.
[736] Community Charter Act 2003.
[737] Clean Energy Production in B.C. 'An Inter-Agency Guidebook for Project Development', (*Clean Energy Production in B.C*, 2016) <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/natural-resource-major-projects/major-projects-office/guidebooks/clean-energy-projects/clean_energy_guidebook.pdf> accessed 26 November 2024.
[738] Clean Energy Act 2010, *c*h 22.
[739] ibid.

Furthermore, CEA 2010 provides for consistently reducing GHG in alignment with established targets and promoting economic development and job creation. According to the Clean Energy Act 2010, BC Hydro is obligated to periodically present an Integrated Resource Plan (IRP) to the government of British Columbia for assessment and endorsement, with a frequency of once every five years. The Integrated Resource Plan (IRP) outlines the proposed initiatives that BC Hydro intends to implement in the next ten years to ensure the sustained provision of affordable and dependable electricity to the residents of British Columbia. As of the writing of this research, BC Hydro is in the process of developing an Integrated Resource Plan for the provision of dependable, cost-effective, and environmentally sustainable electricity to meet the present and future demands of its customers.[740] The plan considers BC Hydro's 20-year projections of electricity demand in the province of British Columbia.

The CEA 2010 recognises electricity generators, suppliers, and producers as proponents of clean energy projects. The proponents are grouped into two, namely, power producers that generate electricity to sell to a load-serving utility or a power marketer. These power producers need transmission lines and connections for transmission or distribution. The other group include self-generators who produce electricity primarily for their industrial use.[741]

5.5.2.2 Land Act 1996

Primarily, the Land Act 1996 is the legislation that is used by the government to convey land to the public for community, industrial and business use.[742] The Act allows the granting of land and the issuance of Crown land tenure in the form of leases, licenses, permits and rights-of-way. The Province of British Columbia operates within a framework of policies that govern the disposition, administration, and management of Crown land. These policies are developed in consultation with other

[740] Canadian Business Magazine, 'Our nature, Our power, Our future, Road Map 2030' (*Canadian Business Magazine*, 26 October 2021) <https://www.canadianbiomassmagazine.ca/british-columbia-launches-its-cleanbc-roadmap-for-2030-climate-plan/> accessed 26 November 2024.
[741] Clean Energy Act 2010 (n 736).
[742] Land Act 1996.

provincial agencies and stakeholder groups. The Crown Land Policies[743] cover strategic policy, general land policies and land use policies.

The Crown Land Allocation Principles[744] guide public officials who are involved in making decisions related to the allocation of Crown land. These principles include:

- *Crown land values are managed for the benefit of the public.*
- *Economic, environmental, and social needs and opportunities are identified and supported.*
- *The interests of First Nations communities are recognised.*
- *Decisions are timely, well-considered, and transparent.*
- *Public accountability is maintained during the allocation of Crown land.*

5.5.2.3 Land Authorizations and Permits (Crown Land Tenure)

The Province is responsible for issuing authorisations to use and occupy Crown land. Under the Land Act, the Province can issue approvals allowing proponents to investigate potential development sites, construct roads and infrastructure such as building transmission lines, and conduct commercial/industrial activities on Crown land. The eight regional offices are located throughout B.C. Land Act issue tenures. Proponents require these authorisations before they may construct project works. Thereafter, staff may inspect proponents work sites and operations to ensure proponents comply with stipulated terms and conditions. Proponents are responsible for understanding and meeting standards of practice expectations.

5.5.2.4 Canada's Impact Assessment Act 2019

The Canada Environmental Assessment Act 2012, as replaced by the Impact Assessment Act 2019, is an Act regarding a federal procedure for impact assessments

[743] British Columbia, 'Crown land policies' (*British Columbia*, 25 July 2024) <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/crown-land/land-policies#Strategic%20land%20policies> accessed 26 November 2024.
[744] ibid.

and to prevent significant adverse environmental effects[745] Under this Act, the Province is responsible for assessing the impact of clean energy projects on Crown lands.[746] Proponents may work with staff to identify impacts and develop mitigation techniques or alternatives to limit or eliminate concerns, including environmental and social impacts on the land, fish, wildlife and other stakeholders. Early discussion with staff is recommended to ensure concerns are identified, impacts are adequately assessed, and mitigation measures are developed during the early stages of the project development and approval process. Proponents may engage registered professional foresters, biologists, engineers, and other specialists to assist with the evaluation of impacts and the development of mitigation measures. Most, if not all, issues can and should be resolved before the Development Plan is submitted.

5.5.2.5 Environment Assessment Act [SBC 2018] Chapter 51

The Environment Assessment Act 2018 is the BC legislation for the assessment of renewable energy projects.[747] Under section 1 of the EAA 2018, the term "assessment," except in section 35 or 73, refers to an evaluation conducted by this legislation to determine the potential effects of a reviewable project.[748] This assessment is carried out about an application for either (a) an environmental assessment certificate or (b) an amendment of an environmental assessment certificate.

5.5.2.6 Utilities Commission Act, RSBC 1996, c 473

The British Columbia Utilities Commission Act promotes the adoption of inventive energy technologies by public utilities.[749] These technologies aim to enable self-sufficiency in electricity generation and promote energy conservation and efficiency, as well as the use of clean and renewable energy sources. Under section 125.1 (4)(g)(iii) of the Utilities Commission Act, the Minister responsible for the administration of the Hydro and Power Authority Act is empowered to make regulations to encourage the development and use of energy from clean or Often,

[745] Impact Assessment Act 2019, c 28, s 1.
[746] Canadian Environmental Assessment Act 1994, c 22.
[747] Environment Assessment Act 2018.
[748] ibid.
[749] Utilities Commission Act 1996, c 473.

the Crown jurisdiction overlaps between the provincial and federal governments. For instance, the Province of British Columbia holds Crown Jurisdiction title to large areas of the ocean between the mainland and Vancouver Island. , through its title to the submerged lands and the water column in these areas, but the federal government retains its legislative authority over many activities that take place within the water column, such as navigation, shipping, and fisheries.[750]

5.5.3 British Columbia Policies for Wave and Tidal Energy Resources

5.5.3.1 Ocean Energy Policy 2011

The Land Use Ocean Energy Projects (OEP) policy 2011 governs the disposition of Crown land for maintenance buildings, submerged marine cables, other plant facilities, road(s), transmission line(s), and surrounding Crown land for a single ocean energy power project application.[751] By definition, "Crown title" refers to provincial and federal Crown jurisdiction over lands and resources within its boundaries. These are typically any hydrocarbons, minerals, or aggregates on or beneath the land.[752] As the Crown, federal and provincial governments also have executive power over Crown lands, which refers to the rights that any property owner would have over land, including the right to sell, lease, or mortgage the land. According to this policy, the Ministry of Forests, Lands and Natural Resource Operations and Rural Development regulates the Crown Land ocean energy power project proposals. In essence, the OEP policy[753] applies to all ocean energy on upland, foreshore, and Aquatic Crown land.

On 1 December 2011, this policy was established, and since then, it was amended on 10 December 2019 with a summary of changes to continue the reduction of due

[750] Ocean energy, 'Land use – Ocean energy' (*Ocean energy,* 14 March 2024) <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/crown-land/crown-land-uses/clean-energy/ocean-energy#who-can-apply> accessed 4 September 2024.
[751] Ocean Energy, 'Land Use Operational Policy- Ocean Energy Projects' (*Ocean Energy*, 2023) <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/ocean_energy.pdf> accessed 14 February 2023.
[752] Stephanie Hewson, Linda Nowlan, Georgia Lloyd-Smith, Deborah Carlson, and Michael Bissonnette, 'Protecting the Coast an Ocean, Marine Conservation Law in British Columbia' (*UBC Press,* 2023) <https://www.ubcpress.ca/media/9780774865517_OA.pdf> accessed 14 February 2023.
[753] Ocean Energy, 'Land Use Operational Policy- Ocean Energy Projects' (n 749).

diligence requirements beyond 2020.[754] The most recent amendment carried out on 17 June 2022 reflects the general information regarding insurance and financial securities to the Insurance and Financial Securities Procedure.[755] Marketing activities under the Ministry of Lands, Parks, and Housing Act allow all citizens and corporations to buy crown land, and sales made through land use programmes under the Land Act, either through individual applications or planned disposition processes, are subject to the Land Act and the relevant land use program's eligibility requirements. The Land Act restricts Crown grants to Canadian citizens and permanent residents over 19. Corporations and associations can apply for Crown Grants.

5.5.3.2 The Permitting and Licensing Processes

The British Columbia province reserves the right to allocate land for ocean energy, including current, wave, and tidal energy power projects via a variety of procedures, such as:

- First Come, First Served: The Authorizing Agency accepts and processes applications according to the principle of First in Time, First in Right.[756] While an application is being processed, the Authorizing Agency will not accept competing Ocean Energy Project proposals. During the first phases of the Ocean Energy Project's development, this plan will be implemented.

- Planned disposition: As knowledge of ocean energy resources grows, the province may identify regions where ocean energy will be marketed using a planned disposition plan. Typically, this involves a competitive process for allocating the opportunity.

- Bonus Bid: The Authorizing Agency may allocate known sites (e.g., investigative tenures that default to the province due to non-diligent use) and

[754] ibid.
[755] ibid.
[756] ibid.

sites with known demand (e.g., adjacent to two existing ocean energy sites) through a bonus bid process.

The Land, Water and Resource Stewardship Ministry is the lead agency for the regulatory review of Crown land ocean energy project proposals below 50 megawatts (MW). The Environmental Assessment Office (EAO) will lead the review for projects that exceed 50MW.[757]

5.5.3.3 Utilities

An applicant for utilities is required to review the BC Utility policy and sample site map before submitting application documents.[758] Further, the documents that must be completed before the submission of the applications are the Crown Land Application Form and the Utilities Requirements List/Management plan. On the types of tenure, there are two types of tenure that utilities on Crown Land are usually authorised, namely by statutory rights-of-way or easement, which can be issued for as long as the land is requested. Meanwhile, the applicant must arrange for a land survey to be completed. In addition, an applicant needs an interim license of occupation for access, construction, and survey.[759] On ownership, only Canadian citizens or permanent residents, at least aged 19 years, or a partnership or corporation registered in the province of BC must apply for utility tenure. The term for other options of license of occupation for utilities ranges from 2 – 30 years.

On fees and costs, an applicant is required to make payment at the submission of an application as stipulated in the Crown Land Fees Schedule. At the same time, rents are determined subject to the type of tenure issued and zone land values. Zone land values are generally lower in remote areas and higher in areas including Vancouver Island and Lower Mainland. The policy has stipulated what an applicant shall pay for a tenure of choice from available options. For example, a right of way is a one-time

[757] ibid.
[758] Utilities, 'Land Use Operational Policy – Utilities' (*Utilities*, January 2019) <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/utilities.pdf> accessed 20 November 2023.
[759] ibid.

payment for the full term required on 100% of the zone land value and a minimum payment of $500. On the other hand, the tenure holder can request an annual payment option. Rent for a license is calculated at 7% of zone land value. A discount is available for applicants who choose to repay the rent instead of annual payment. A temporary license attracts $250 yearly or $500 prepaid biennially.

5.5.3.4 *British Columbia's "One Process Initiative"*

The One Process Initiative is the province initiative established to coordinate authorisation and consultation processes for project reviews and permitting. One Process Initiative aligns authorisation and processes across the natural resource sector into a single process for major land arrangement decisions. In this respect, consistent and complete information requirements are provided to proponents at the front end of the processes.[760] The One Process Initiative provides a major bridge between the plenty of laws and regulations available and the proponents, especially as there is no single enactment for the development of wave energy.

The Single Window of Service for Authorization and Permits for Clean Energy Projects initiative is termed *FrontCounterBC*. The concept of "*FrontCounterBC is the B.C. government's "single window service" for citizens and businesses seeking natural resource authorisations and permits for Crown resources."*[761] *FrontCounterBC* offers services on behalf of provincial ministries and agencies responsible for natural resources. It collaborates closely with the Major Projects Office to facilitate project management of clean energy initiatives.

[760] ibid, 11.
[761] Clean Energy Production 'An Inter-Agency Guidebook for Project Development, (*Clean Energy Production in BC,* 2016) <https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/natural-resource-major-projects/major-projects-office/guidebooks/clean-energy-projects/clean_energy_guidebook.pdf> accessed 20 November 2023.

FrontCounterBC staff can provide the following services for proponents of clean energy projects:

- *Explain what is involved in getting the Provincial environmental, land, and resource use approvals required to construct waterpower, wind, or other electricity generation projects in B.C.*
- *Help guide proponents through the application process by completing the required application forms, taking payments for each application package, and then ensuring applications get to the right agencies for approval.*
- *Identify First Nations and other stakeholders with which proponents should consult.*
- *Monitor and track applications.*

a. *Assist in the early identification of potential conflicts with overlapping tenures and other land use designations.*
b. *Because clean energy legislation, regulations, policies, and requirements are evolving, proponents are urged to contact FrontCounter BC to obtain up-to-date information about project requirements.*

5.5.3.5 Marine Spatial Planning Policy of the Province of British Columbia

In Canada, zoning in the Pacific occurred for provincial and federally regulated activities.[762] As a result, mariners and marine users are familiar with areas for specific uses, for example, zones for ballast water exchange for ships at sea, marine traffic separation schemes, conservation zones, fisheries management zones, military exclusion zones and ocean dumping zones. Marine Spatial planning is a specific case of integrated ocean management to assist with marine decision-making.

[762] Charlie Short, Joanna L. Smith, John Bones, Steve Diggon, Aaron Heidt, Chris Mcdougall, and Kylee A. Pawluk 'Marine zoning for the Marine Plan Partnership (MaPP) in British Columbia, Canada' (2023) 152 MP <https://doi.org/10.1016/j.marpol.2023.105524.> accessed 12 November 2023.

In 2011, the Marine Plan Partnership for the North Pacific Coast (MaPP)[763] MSP initiative was established by 18 Coastal First Nations and the province of British Columbia to contribute to integrated ocean management in the North Pacific and Northern Shelf Bioregion with the policy directive aimed at uses and activities within the stakeholder supported MaPP Framework. The MaPP practically helps to guide provincial decision-takers and First Nations' assessment of the suitability of a specific use or activity that takes place in a particular spatial location. Currently, a final version of the MaPP framework is being implemented as a policy by the province of BC, and this has also supported the siting of the wave energy projects. According to Karani, an African Union Technical Expert on the Environment, some AU Member States have initiated the MSP process as part of their national development agenda.

However, the implementation remains a significant challenge for most of the AU Member States.[764] The MSP initiative represents a best practice relative to Nigeria's ocean management, which has not developed its own MSP, as demonstrated from the MSP Roadmap webpage.[765] Nigeria has benefitted from a workshop on MSP in the Gulf of Guinea organised by the Swedish Government.[766] For example, Yourbrook Energy Systems (YES), a British Columbia-based developer of tidal energy technology, maintains its 500 kW Kamdis Tidal Power Demonstration Project in Masset Inlet, Haida Gwaii.[767] Yourbrook collected data on-site for four months and worked to refine technical aspects of the project, including the modelling of dynamic blades and platform design for testing and third-party validation.[768]

[763] Coastal & Marine Plans, 'Marine Plan Partnership for the North Pacific Coast (MaPP)' (*Coastal & Marine Plans*, 2023) <https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/coastal-marine-plans> accessed 12 November 2023.
[764] Patrick Karani, 'Africa Blue Economy Strategy Integrating Marine Spatial Planning into the Blue Economy' (*AU-IBAR*, 30 June 2024) <https://www.comhafat.org/fr/files/actualites/doc_actualite_12526157.pdf> accessed 30 June 2024.
[765] MSP Roadmap, 'Nigeria' (*MSP Roadmap,* 2023) <https://www.mspglobal2030.org/msp-roadmap/msp-around-the-world/africa/nigeria/> accessed 30 June 2024.
[766] MSP roadmap, 'Regional Workshop on Marine Spatial Planning (MSP) and Sustainable Blue Economy in the Gulf of Guinea' (*MSP roadmap,* 17 November 2020) <https://www.mspglobal2030.org/wp content/uploads/2020/11/MSProadmap_Presentation_GulfofGuinea_20201117.pdf> accessed 30 June 2024.
[767] Ocean Energy Systems, 'OES Annual Report 2021' (n 652) 180.
[768] ibid.

5.5.4 Conclusion: British Columbia – Wave and Tidal Energy – Accomplishment, Challenges and Prospects

In conclusion, the extensive and rugged coastline of British Columbia (BC) along the Pacific Ocean presents a substantial opportunity for the development of wave and tidal energy. In this respect, wave and tidal energy laws and policies in the province capitalise on this potential as part of its overarching renewable energy strategy. Consequently, BC has made commendable strides and accomplishments. Despite this, the sector is confronted with many obstacles, and its prospects are contingent upon their resolution.

5.5.4.1 Accomplishments

Law and Policy Support and Research and Development Initiatives: British Columbia promulgated and implemented the Marine Renewable Energy Act to regulate and facilitate the development of marine energy projects. This Act established a legal framework for the allocation of Crown land for wave and tidal energy projects. Additionally, environmental assessments and community consultations are essential components of project development. The marine energy sector has received funding from both the provincial and federal governments for research and development. In addition, this encompasses the provision of assistance for pilot projects and investigations into the environmental consequences of marine energy. For example, the Annapolis Royal tidal power plant in Nova Scotia is the sole operation in North America and the third largest tidal barrage plant in the world.[769] Constructed in 1984 as a pilot project to evaluate the impact of tidal barrages, it has a peak generating capacity of 20 MW and an annual yield of 30 GWh. Race Rocks, a tidal power pilot project that was initiated in 2006 off the southern coast of Vancouver Island, was one of the world's first tidal stream technology projects.[770] The sector has made strides resulting from the federal Ocean Energy Research Program and provincial initiatives such as the Innovate BC Fund. Fundy Ocean Research Centre for Energy (FORCE): Despite its location in Nova Scotia, BC can leverage the data and insights

[769] Andrew Farris, 'Comparing Tidal Power in B.C. and Nova Scotia', *Energy BC, February 2017,* <https://www.energybc.ca/bcns.html#:~:text=The%20third%20largest%20tidal%20barrage,annual%20yield%20of%2030%20GWh.> accessed 2 April 2025.
[770] ibid.

produced by FORCE to inform local projects that are vital to the research and development of tidal energy in Canada. BC has witnessed multiple pilot projects strategically designed to showcase the feasibility of wave and tidal energy. These initiatives have evaluated a range of technologies, such as floating wave energy converters and subaquatic tidal turbines. The West Coast Wave Initiative (WCWI) at the University of Victoria has played a crucial role in the modelling and scientific testing of wave energy potential along the coast of British Columbia.

5.5.4.2 Challenges

Technological Challenges: Wave and tidal energy technologies are currently in their nascent phases of advancement, and a significant number of the technologies under testing lack commercial economic feasibility. Substantial challenges arise from issues such as the challenging marine environment, exorbitant deployment and maintenance costs, and the requirement for robust and efficient energy conversion devices.

Environmental Impact Concerns: In BC, the possible effects on marine ecosystems, encompassing fish and marine mammals, are a matter of great concern. The environmental assessment procedures are demanding, and acquiring the required authorisations can be both time-consuming and expensive. Furthermore, the enduring impacts of marine energy installations on coastal ecosystems are still unclear.

Regulatory and financial obstacles: Marine energy in BC operates within a complex regulatory environment, which encompasses several levels of government and diverse stakeholders. Developers, especially small firms or those new to the industry, may find it difficult to navigate this terrain. The exorbitant expenses linked to the development of wave and tidal energy projects, coupled with the technical uncertainties, serve as formidable barriers to attracting investment. Although government funding and incentives exist, they frequently prove inadequate in meeting the substantial capital and operational expenses linked to these projects.

5.5.4.3 Prospects

- Technological Development and Innovation: British Columbia’s ongoing investment in research and development is expected to result in technological breakthroughs that could reduce costs and enhance the dependability of wave and tidal energy systems. Through initiatives such as the WCWI and partnerships with private companies and government agencies, BC's academic institutions, including the University of Victoria, are instrumental in the advancement of these technologies.

- Opportunity for Commercial Implementation:

  Commercial-scale deployments of BC's wave and tidal energy sector may occur within the next decade if technological and financial obstacles can be surmounted. The province's extensive coastline and robust tidal currents constitute a substantial resource base that, if utilised effectively, could make a substantial contribution to BC's renewable energy portfolio and its objectives under the Clean British Columbia Plan.

- Integrating the Comprehensive Renewable Energy Strategy:

  British Columbia's dedication to the reduction of greenhouse gas emissions and the transition to a low-carbon economy establishes a robust policy foundation for the advancement of marine energy. Incorporating wave and tidal energy into the province's comprehensive renewable energy strategy could help diversify the energy mix and reduce dependence on fossil fuels, particularly in coastal and remote communities.

In summary, the wave and tidal energy sector in British Columbia has achieved significant milestones, particularly in the areas of policy development and pilot projects. Nevertheless, the sector is confronted with substantial obstacles, such as intricate regulatory and financial barriers, as well as technological and environmental obstacles. The future of wave and tidal energy in British Columbia will be contingent

upon the ability to attract investment, effective policy support, and the continuation of innovation to transition from pilot projects to commercial-scale deployments. Wave and tidal energy have the potential to become a significant element of British Columbia's renewable energy landscape if these obstacles can be overcome.

5.6 A Critical Review of Wave and Tidal Energy Legal Framework and Development in South Korea

South Korea operates a constitutional democracy.[771] Historically, the rewriting of the Constitution in 1997-1998 and the democratic transfer of power to an opposition candidate signified the end of authoritarianism in 1987 and the successful transition to a well-functioning democracy.[772] Under the Constitution of the Sixth Republic, the president not only possesses the authority to introduce legislation but also possesses extensive emergency powers. The unicameral Korean National Assembly (NKA) represents the legislative branch of government,[773], while the Supreme Court and the Constitutional Court hold the judicial power.[774] South Korea imports fossil fuels from other countries to meet its huge energy requirements.[775] The significant reliance on imported energy sources exacerbated energy consumption challenges faced by South Korea.[776] For instance, in 2016, South Korea was the eighth largest consumer of energy in the world, consuming 282 million tonnes of oil equivalent,[777] and ranked seventh for petroleum consumption and seventh for electricity consumption.[778] Consequently, the primary objective of South Korea's energy policies has been national energy security and a stable energy security chain.[779]

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[771] European Parliamentary Research Service, 'The political system of the Republic of South Korea, Briefing Continental democracies' (*European Parliamentary Research Service*, July 2022) <https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733582/EPRS_BRI(2022)733582_EN.pdf> accessed 11 September 2023.
[772] ibid.
[773] Korea.Net, 'Constitution and Government, Executive, Legislature and the Judiciary' (*Korea. Net*, 2023) <https://www.korea.net/Government/Constitution-and-Government/Executive-Legislature-Judiciary> accessed 11 September 2023.
[774] ibid.
[775] Gunwoo Kim, Myung Eun Lee, Kwang Soo Lee, Jin-Soon Park, Weon Mu Jeong, Sok Kuh Kang, Jae-Gwi Soh, Hanna Kim, 'An overview of ocean renewable energy resources in Korea' (2012) 16(4) RSER 2278, 2279 <https://doi.org/10.1016/j.rser.2012.01.040.> accessed 11 September 2023.
[776] ibid.
[777] Dong-Hui Ko, Jaekwan Chung, Kwang-Soo Lee, Jin-Soon Park, and Jin-Hak Yi, 'Current Policy and Technology for Tidal Current Energy in Korea' (2019) 12(9) Energies 1807 <https://doi.org/10.3390/en12091807> accessed 8 September 2023.
[778] ibid.
[779] Chul Kim, 'A review of the deployment programs, impact, and barriers of renewable energy policies in Korea' (2021) 144 RSER <https://doi.org/10.1016/j.rser.2021.110870.> accessed 8 September 2023.

Moreover, global interest in developing marine energy to enhance national energy security and promote environmentally sustainable energy generation continued to increase.[780] According to the International Energy Agency World Outlook 2022, South Korea increased the share of renewables in its energy mix;[781] thereby, South Korea prioritised the development of its marine energy resources. Because of its geographical location, South Korea possesses a significant array of marine energy resources, encompassing tidal power, tidal current energy, and wave energy from inherent proximity to water bodies in three areas of the ocean.[782]

5.6.1 Korea's Tidal and Wave Energy Potentials

The geographical map representing South Korea can be seen in Figure 7. South Korea is in the southern portion of the South Korean Peninsula and experiences four distinct seasons, namely spring, summer, autumn, and winter, which are influenced by the East Asian monsoon. High temperatures and humidity, primarily influenced by the presence of the North Pacific air mass, characterise the summer season. Conversely, during winter, extremely low temperatures prevail because of the Siberian air mass and the northwest monsoon. South Korea is engulfed by three seas, namely the Yellow Sea, East China Sea, and East Sea. The Yellow Sea is located between Mainland China and the South Korean Peninsula. According to surveys, recorded tidal ranges are typically between 8m to 10m high along the Korean peninsula coast, [783,] thus making it feasible to develop tidal energy.[784]In addition, the Ria coast has formed

[780] Chul-Yong Lee, and Sung-Yoon Huh, 'Forecasting the diffusion of renewable electricity considering the impact of policy and oil prices: The case of South Korea' (2017) 197 AE 29-39 <https://doi.org/10.1016/j.apenergy.2017.03.124.> accessed 9 September 2023.
[781] International Energy Agency, 'World Energy Outlook 2022 Executive Summary' (*IEA,* 2022) <https://iea.blob.core.windows.net/assets/fe7c251b-8651-4d3a-8362-0ffe3e50d37b/Executivesummary_WorldEnergyOutlook2022.pdf> accessed 27 September 2023
[782] Danial Khojasteh, Abbas Shamsipour, Luofeng Huang, Sasan Tavakoli, Milad Haghani, Francois Flocard, Maryam Farzadkhoo, Gregorio Iglesias, Mark Hemer, Matthew Lewis, Simon Neill, Michael M. Bernitsas, William Glamore,. 'A large-scale review of wave and tidal energy research over the last 20 years' (2023) 282 OE <https://doi.org/10.1016/j.oceaneng.2023.114995.> accessed 27 September 2023.
[783] Edgar Mendoza, Debora Lithgow, Pamela Flores, Angélica Felix, Teresa Simas, and Rodolfo Silva, 'A framework to evaluate the environmental impact of OCEAN energy devices; (2019) 112 RSER 440 <https://doi.org/10.1016/j.rser.2019.05.060.> accessed 9 September 2023.
[784] Dong-Hui Ko, Yunzheng Ge, Jin-Soon Park, Lei Liu, Changlei Ma, Fengyun Chen, Jingping Peng, Seung-Koo Kang, Jin-Hak Yi, Weimin Liu, 'A comparative study of laws and policies on supporting marine energy development in China and Korea' (2022) 141 MP, 3 <https://doi.org/10.1016/j.marpol.2022.105057.> accessed 8 September 2023.

because of the partial submergence of the river valley at the southwestern coast.[785] Therefore, the high tidal range in the Yellow Sea combined with the Ria coastlines have resulted in rapid tidal currents at many locations, which made the development of tidal current energy feasible in the areas.[786] Further, South Korea's location in a temperate zone and prevalent westerlies in these zones during the winter make wave energy prevalent.

Figure 7: A Map of South Korea.

Source: The author took this map from the National Geographic Information Platform of South Korea.[787]

Historically, investigating and identifying the rich potential of wave and tidal energy in Korea commenced in 1930 when a Japanese team surveyed the Korean waters.[788] Since then, many institutions have engaged in surveys, field observations and research projects with all the information gathered not fully integrated.[789] However, the government now catalogues information on Korea's ocean energy initiative in a more integrated approach. For example, the Ministry of Knowledge Economy initiated a research and development project to conduct the "*study of the distribution of ocean*

[785] Kim and others (n 775).
[786] Ko and others (n 784)
[787] Map of South Korea, <https://www.mdpi.com/2071-1050/9/7/1260> accessed 7 December 2023
[788] Kim and others (n 775) 2278 – 2279.
[789] ibid.

energy resources in the South Sea of Korea" with KORDI.[790] Another government effort catalogues all recent advances in the field of renewable energy and sustainable energy development in South Korea through its "New and Renewable Energy White Book", published biennially by the Ministry of Knowledge Economy.[791] To this end, South Korea is progressively developing its wave and tidal energy resources armed with the required data and infrastructure towards commercialisation.

5.6.2 Tidal Energy

The north-western sea of South Korea has relatively large tidal ranges and decreasing patterns from north to south in the Yellow Sea latitude.[792] Moreover, the southwestern sea of Korea has strong tidal currents flowing between many of the islands, and there are advantages to developing tidal current energy. The southwestern coast of South Korea is considered a highly favourable location for the advancement of tidal current energy because of its substantial availability of tidal current energy resources. For instance, Uldolmok, Jang-Juk Strait and Maenggol Straits, located in the south-western Sea of Korea, are assessed as the best option sites for the development of tidal current energy.[793] The technical assessment was evaluated as 4841 MW and 3497 MW in the Jang-Juk Strait and the Maenggol-Geocha Strait, respectively.[794] The Uldolmok Tidal Power Station in South Korea was funded by a partnership between Korea East West Power Co. and South Jeolla Province. An investment agreement was signed by these entities in 2006 to develop the tidal plant in Jindo County. On 14 May 2009, in the initial phase of the project, a 1 MW pilot plant was constructed and commissioned. An estimated US$10 million investment was required for this phase.[795] According to official sources, the plant's capacity was

[790] KOISRA, South Korea Ministry of Knowledge Economy, (2019) <https://www.koisra.co.kr/news/korea-ministry-of-knowledge-economy/#pll_switcher> accessed 17 December 2024.
[791] ibid.
[792] Sok Kuh Kang, Michael G. G. Foreman, Heung-Jae Lie, Jae-Hak Lee, Josef Cherniawsky and Ki-Dai Yum, 'Two-layer tidal modelling of the Yellow and East China Seas with application to seasonal variability of the M2 tide.' (2002) 107(C3) JGRO 6-1. <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2001jc000838> accessed 13 September 2023.
[793] Dong-Hui Ko, Jaekwan Chung, Kwang-Soo Lee, Jin-Soon Park, and Jin-Hak Yi, 'Current Policy and Technology for Tidal Current Energy in Korea' (2019) 12(9) Energies 1807 <https://doi.org/10.3390/en12091807> accessed 13 September 2023.
[794] ibid.
[795] Kwang-Soo LEE, Tidal and Tidal Power Study in Korea, Coastal Engineering Research Department, May 2006, <https://energybc.ca/cache/tidal/KOREA.pdf> accessed 4 April 2025.

to be increased to 90 MW by 2013.[796] However, as of 2025, the plant continues to operate with an installed capacity of 1.5 MW, as the expansion has not gone through. One major tidal energy project commissioned in the southwestern area is the Sihwa Lake tidal project.

Figure 8: Sihwa Tidal Power Plant

Source: https://tethys.pnnl.gov/project-sites/sihwa-tidal-power-plant [797]

Built from 2011 to 2014, the Sihwa Lake Power Plant is a man-made lake turned into a commercially viable tidal power plant.[798] The Sihwa Tidal Power Plant is a flood-generating system that operates based on the difference between the sea and the artificial lake's tidal levels.[799]

As a result, the flood-generating systems produce electricity from the incoming tide or the water flowing from the ocean into a basin. At high tide, water flows through

[796]Hydro Review Content Directors, 'South Korea starts up, to expand 1-MW Jindo Uldolmok tidal project' 29 May 2009, https://www.renewableenergyworld.com/energy-business/energy-finance/south-korea-starts/

[797] Sihwa Tidal Power Plant <*https://tethys.pnnl.gov/project-sites/sihwa-tidal-power-plant*> accessed 14 September 2023.
[798] Y H Bae, K.O. Kim and B.H. Choi, 'Lake Sihwa Tidal Power Plant Project' (2010) 37 OE 454-463 <https://www.sciencedirect.com/science/article/pii/S0029801810000235> accessed 14 September 2023.
[799] ibid 454-460.

the turbines to produce electricity. Technically, separate gates are designed to open alongside the turbines during the ebb phase. When low tide arrives, the gates are raised, and water is allowed to egress. During the ebb phase, the turbines operate in a sluicing mode, and no energy is produced.[800] At the time of the research, the Sihwa Tidal Power Plant is one of the biggest tidal power plants in the world.[801] The implementation of the Sihwa project demonstrates a strong national commitment to supplying ocean energy through government-strengthened investment in technology and policy. For instance, recently, South Korea announced a new energy policy that will reduce the role of nuclear power[802] and thermal power plants while expanding the role of renewable energy technologies.[803] South Korea participates actively in global efforts to mitigate the adverse effects of global warming primarily caused by fossil fuels.[804] In pursuit of this objective, the implementation of environmentally friendly policies has emerged as a legally mandated approach to address this issue.[805]

5.6.3 Wave Energy

In South Korea, wave energy is an alternative source of energy.[806] As discussed earlier in section 5.6, characteristically, South Korea investigated its ocean resources to understand the capacity of available energy before the construction of infrastructures.[807] In essence, Korea's wave energy capabilities were determined through a "precise comprehension of the distributions and variation patterns of wave power and other wave characteristic in a region", where observational data was gathered at different points in the environment for about ten years.[808] Hindcasting is a technique that uses wave models by which previous wave conditions have been

[800] Bae and others (n 798) 454-460.
[801] TETHYs, 'Sihwa Tidal Power Plant' (*TETHYs,* 2023) <https://tethys.pnnl.gov/project-sites/sihwa-tidal-power-plant> accessed 28 November 2023.
[802] Juhern Kim, 'Assessing South Korea's Transition to Net Zero', in Chung Min Lee, *How South Korea is Honing a Competitive Edge*, Carnegie Endowment for International Peace, 22 November 2022, <https://carnegieendowment.org/2022/11/22/assessing-south-korea-s-transition-to-net-zero-pub-88426> accessed 28 November 2023.
[803] Ko and others (n 793) 4.
[804] ibid.
[805] Edgar Mendoza, Debora Lithgow, Pamela Flores, Angélica Felix, Teresa Simas, and Rodolfo Silva, 'A framework to evaluate the environmental impact of OCEAN energy devices; (2019) 112 RSER 440 <https://doi.org/10.1016/j.rser.2019.05.060.> accessed 9 September 2023.
[806] Ko and others (n 793) 4.
[807] H S Eum, W M Jeong, Y S Chang, S H Oh, and J J Park, 'Wave Energy in Korean Seas from 12-Year Wave Hindcasting' (2020), 8 JMSE ch.4.2 <https://www.mdpi.com/2077-1312/8/3/161> accessed 14 September 2023.
[808] ibid, ch 4.2.

represented and improved through comparison with observational data.[809] Based on the investigation, the region surrounding Jeju Island in Korea has been assessed as a potential location for the development of wave power.[810] Based on a 12-year wave hindcasting data,[811] the results indicated that the wave energy along the coasts of Jeju Island, the South Sea, the East Sea, and the Yellow Sea should be between 7 and 12 kW/m, 3 to 9 kW/m, 3 to 8 kW/m, and 0.6 to 13.3 kW/m, respectively.[812] The Ministry of Trade, Industry, and Energy (MOTIE) and the Ministry of Oceans and Fisheries (MOF) of the Republic of Korea supported the wave power development projects.

In 2016, the Korea Research Institute of Ships and Ocean Engineering (KRISO) built the 500 Kw, oscillating water column (OWC) Yongsoo Wave Power Pilot Plant on the west coast of Jeju Island.[813] However, a support system for renewable energy certificates (RECs) and the market have not yet been established for wave energy because of the lack of actual commercial power generation records.[814] Korea's wave and tidal energy resources are currently being harnessed to generate electricity. With abundant wave and tidal energy resources, South Korea has put in place concrete infrastructures to harness the energy resources through research and development to commercialisation for about two decades. Consequently, South Korea has built the largest tidal energy power plant – a 275MW Sihwa Tidal Power Plant and the 500 kW Yongsoo Wave Power Pilot Plant on the west coast of Jeju Island. Achieving this feat involved virile national policy support, investment, and development strategies. These concrete strategies supported Korea's wave and tidal energy through robust laws, policies, and subsidy systems, which motivated private enterprise participation. The research will now examine Korea's legal and policies, including incentive measures established to promote wave and tidal energy.

[809] ibid.
[810] ibid.
[811] ibid.
[812] ibid.
[813] Seongho Ahn and Taemin Ha, 'Characterization of wave energy resource hotspots and dominant wave energy systems in South Korean coastal waters', (2021) 309 JCP <https://doi.org/10.1016/j.jclepro.2021.127202.> accessed 14 September 2023.
[814] Kim (n 800).

5.6.4 Legislative and Policy Support for Wave and Tidal Energy

The year 1974 marked the beginning of energy policies in Korea.[815] The Heat Control Act 1974 was the first energy law enacted to enhance heat source management and eliminate energy waste.[816] Following this, the oil crisis of 1978 prompted social concerns that led to a revision of the Heat Control Act of 1974 in favour of the Energy Use Rationalization Act of 1979[817], and this Act has been credited with the birth of a new and renewable energy policy known as the Alternative Energy Development Promotion Act in 1988.[818] Specifically, the Framework Act on Low Carbon, Green Growth, also known as the Green Growth Act, 2010,[819] and the Energy Act No. 16859[820] serve today as the principal legal basis for national energy plans in Korea. Invariably, Korea's energy laws and policies evolved based on global trends and occurrences that motivated energy independence and national energy security. Indeed, other occurrences such as Japan's Fukushima nuclear accident, the Gyeonghu earthquake in September 2016 and the Pohang earthquake in November 2017 raised concerns and led to Korea's decision to generate power from clean and diverse energy resources with due consideration for safety.[821] In the 1980s, South Korea initiated renewable energy policy, without making it a priority in national energy policies.[822]

However, in 2017, the government committed to phasing out nuclear power plants and proposed renewable energy as a future national energy source. South Korean energy policy went through a period of significant change to deal with challenges, including over-reliance on fossil fuels and mitigating GHG. The Republic of Korea has initiated the process of gradually reducing its reliance on nuclear power and directed

[815] ibid.
[816] ibid, ch 2.2.
[817] KEA, '2018 Korea energy agency handbook' (*Korea Energy Agency, Ulsan, Korea*, 2018) <http://www.kemco.or.kr/web/kem_home_new/_common/ac_downFile.asp?f_name=2018%25uB144%25uB3C4%2520KEA%2520%25uC5D0%25uB108%25uC9C0%2520%25uD3B8%25uB78C.pdf&cc=306> accessed 15 September 2023.
[818] Ko and others (n 793*)*
[819] ibid.
[820] ibid.
[821] Dong-Hui Ko, Jaekwan Chung, Kwang-Soo Lee, Jin-Soon Park, and Jin-Hak Yi, 'Current Policy and Technology for Tidal Current Energy in Korea' (*MDPI,* 1996) <https://www.mdpi.com/1996-1073/12/9/1807> accessed 03 October 2023.
[822] Chul Kim (n 779)

its efforts towards the promotion of alternative and sustainable energy sources.[823] In this regard, there has been a significant level of interest surrounding the advancement of ocean energy. For instance, South Korea initiated research on the development of tidal energy in the 1930s.[824] Later on, in 1974, the Korea Ocean Research and Development Institute (KORDI) and Korea Electric Power Corporation (KEPCO) conducted a feasibility study on the development of tidal energy.

In 1978, the Korea Tidal Power Study conducted Phase 1 of a research and development project, demonstrating the potential for 6,500 MW of tidal energy at ten potential sites near the middle of the western coast of the Korean peninsula.[825] Among the various technologies harnessing energy from the ocean, tidal current energy stands out as the most advanced in terms of its progress towards commercial viability.[826] In essence, the national policy, strategy and market incentive affect the development of ocean energy. With Korea's estimated and steady yearly increases in power consumption and set a goal of reducing national emissions by 30% of the current 2020 estimate, biennially, the MOTIE has a plan to forecast the long-term energy demand management objective and review existing electricity facilities.[827] Characteristically, the formulation of ocean energy policy plays a crucial role in shaping the progress of Korea's ocean energy deployment.

5.6.5 South Korea Renewable Energy Targets

In 2018, the share of renewable energy generated was 4%, a very low level relative to targets set for 2030 and 2040 (shares of 20% and 30% to 35%, respectively. In November 2021, the South Korean government declared its intention to eliminate all coal power generation by 2050 at the 26th Conference of Parties (COP26).[828] In October 2021, South Korea also committed to the Global Methane Pledge, an international voluntary initiative that aims to reduce methane emissions by a

[823] Dong-Hui Ko and others (n 784) 3.
[824] ibid.
[825] K S Lee and J S Park, 'Natural Energy Produced by the Sea' (*KIOST Busan, Korea,* 2013) 94 -125.
[826] ibid.
[827] Ko and others (n 784) 12.
[828] InfluenceMap, 'Energy Transition, Policy Overview' (*InfluenveMap*, 2024) <https://korea.influencemap.org/policy/Energy-Transition-428> accessed 21 October 2024.

minimum of 30% by 2030 in comparison to 2020 levels. However, as of 2023, South Korea's renewable energy constituted only 9.64% of its power generation mix, significantly trailing global averages, despite a commitment to attain net-zero emissions by 2050.[829]

5.6.6 Enactments

South Korea adopted many enactments in support of new and alternative energy; and these enactments and regulations supporting consenting processes for wave and tidal energy will be categorised into three levels, namely ocean usage, energy development, and marine ecosystem protection. Under these three categories, the enactments are discussed as follows:

5.6.6.1 Ocean Enactments

Under ocean usage, all activities and energy developments that take place within Korea's Ocean ecosystems are governed by the Public Waters Management and Reclamation Act 2017 (Act No. 15009, Oct. 31, 2017). Article 1 of the Public Waters Management and Reclamation Act 2017 aims to enhance public welfare and enhance the overall quality of life for individuals by preserving and effectively managing public bodies of water for sustained utilisation.[830] Additionally, it aims to facilitate the environmentally friendly reclamation of public waters, thereby enabling efficient use of reclaimed land. According to Article 4, "the State or a local government that manages public waters shall manage them in an environmentally friendly manner so that waters may be preserved and continuously". Also, an occupancy or use permit is required to be obtained for "new energy and renewable energy" in line with Article 8. Further, under Article 11.3, an electric utility operator can install or operate electric resources for 30 years as stipulated under the Electric Utility Act 2017. Article 13 stipulates occupancy or use fees of public waters; the management agency is authorised to collect occupancy or use fees of public waters each year from a person

[829] Michelle (Chaewon) Kim, 'Report Renewables Energy Policy South Korea Asia
South Korea's economy risks missing out on global transition to renewables' (*IEEFA,* 14 August 2024)
<https://ieefa.org/resources/south-koreas-economy-risks-missing-out-global-transition-renewables> accessed 21 October 2024.
[830] Public Waters Management Act 2020.

who has obtained an Occupancy or Use permit or the consultancy or use of public waters. Additionally, Article 17 stipulates the authorisation of the implementation plan for Occupation and Use, and Article 18 stipulates the application for inspection on completion with the management agency promptly.

5.6.6.2 Energy Development

The energy development level comprises the Framework Act on Low Carbon, Green Growth, 2010; Integrated Energy Supply Act,[831] the Energy Act No. 16859; the Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy 2017 Act No.17169; Electric Source Development Promotion Act 2016;[832] Electric Utility Act 2017;[833] and, Submarine Mineral Resources Development Act 1999.[834] Article 2.2 of the Promotion of the Development, Use, and Diffusion of New and Renewable Energy Act No. 17169) defines renewable energy and specifically mentions 'marine energy', which covers wave and tidal energy and specifies the obligation to supply new and renewable energy in proportion.[835] This act aims to promote the development of new and renewable energy industries and diverse energy sources. Additionally, it promotes a stable energy supply and environmental preservation by lowering greenhouse gas emissions.

5.6.6.3 Marine Ecosystem Protection

The main legislation under marine ecosystem protection includes the Fishery Resources Management Act 2017 (Act No. 13385, Jun 22, 2015);[836] the Environmental Impact Assessment Act 2017 (Act No. 14532, Jan 17, 2017);[837] the Conservation and Management of Marine Ecosystems Act,[838] Marine Environment Management Act. These enactments provide the required legal protection for the marine activities. For example, all projects must conduct environmental assessment based on the provisions of Chapter 1, Article 4(1) to (6) of the EIA Act 2017.

[831] Framework Act on Low Carbon, Green Growth; Integrated Energy Supply Act 2018.
[832] Electric Source Development Promotion Act 2016.
[833] Electric Utility Act 2017.
[834] Submarine Mineral Resources Development Act 1999.
[835] Act on Promotion of New and Renewable Energy Development, Utilization, and Distribution, 2017.
[836] Korea Legislation Research Institute, Fishery Resources Management Act 2017.
[837] Korea Legislation Research Institute, Environmental Impact Assessment Act 2017.
[838] Conservation and Management of Marine Ecosystems Act 2017.

5.6.7 Policies

South Korea has enacted many policies to promote new and renewable energy development, including simplified administrative procedures. Three major policies have emerged to promote the development of new and renewable energy, including marine energy resources. First, in 2017, the Korean government, through the MOTIE, promulgated a national energy policy change roadmap that introduced phased reductions of nuclear power plants, expansion of renewable energy and promotion of regional industry.[839] The plan is known as the "RE3020" plan for the development of Renewable energy". The "3020 Plan" aimed to enhance the standard of life of its participants through the expansion of public participation, community-led site selection, large-scale project promotion and establishment of a new energy industry to upscale competitiveness among the existing energy industry.[840] In other words, the plan aimed to achieve a target of 20% of the national energy portfolio from new and renewable energy sources by 2030 (a target subsequently increased and extended to 30-35% by 2040).[841] In furtherance of the 3020 policy, the MOTIE designed and promulgated an ocean energy development plan that identified key benchmarks by establishing a strong and implementable strategic plan, including:

- Strategy I – Expansion of the research and development in ocean energy and establishment of a real sea test bed'.

- Strategy II- Construction of large-scale ocean energy farm.

- Strategy III – Enter the global market and expansion of domestic supply.

- Strategy IV – the establishment of a certification system and strengthening policy support.

[839] Chang Sup KWON, 'MOTIE Rings in New Year with Long-Awaited Long-Term Energy Plans' (*MOTIE,* March 2021) <https://www.kimchang.com/en/insights/detail.kc?sch_section=4&idx=22940#:~:text=December%202017%20was%20a%20momentous,to%2030%2D35%25%20by%202040> accessed 17 December 2024.
[840] ibid.
[841] ibid.

Korea's policies, such as the "3020 policy", have led to the implementation of a total of 1.5GW of ocean energy infrastructure, including tidal energy – 254MW, wave energy - 220MW, tidal current energy -700MW, and hybrid ocean energy - 300MW. In this respect, the Sihwa tidal plant project is maintained as 254MW without expansion.[842]

Secondly, in 2017, the Ministry of Fisheries (MOF) strategic plan included support for marine energy. This plan aims to provide about 750,000 households with clean energy and promote new energy enterprises. Further, in 2018, the MOF announced a Basic Plan for Marine Fisheries, Science and Technology Promotion in sync with the Marine Science and Technology Promotion Act. The Basic Plan's objective is to advance marine science and technology. To achieve its objective, strategies have been set out, including[843]

- To provide marine fisheries, science and technology for new industries and the creation of jobs.
- To develop marine science and technology and address the social challenges.
- To improve the support system for research and development.
- To create a network for the sustainable development of marine science and technology

Finally, in 2020, South Korea established a comprehensive plan for the Green New Deal project, which highlights the importance of action against climate change and transition to a low-carbon ecosystem.[844]

To attract industry stakeholder participation, the government had to establish a national support strategy such as the REC incentive. Further, by 2022, the government established an open sea test bed for tidal current energy performance

[842] Ko and others (n 748).
[843] ibid, 7.
[844] Jae-Hyup Lee and Jisuk Woo, 'Green New Deal Policy of South Korea: Policy Innovation for a Sustainability Transition' (*MDPI*, 2023) <https://www.mdpi.com/2071-1050/12/23/10191> accessed 17 December 2024.

test and evaluation of TEC. Then, the development of the commercialisation stage system for TEC will be conducted. South Korea planned to construct a 10MW Pilot array in the southwestern sea through the MW class TEC. Finally, South Korea projects that between 2026 and 2030, a 700MW tidal current energy farm will be constructed around the southwestern Sea of Korea.

5.6.7.1 Renewable Energy Support Systems

The FiT policy is an established and viable measure of renewable energy policy because it addresses the financial challenges associated with investing in renewable energy sources.[845] In 2001, South Korea adopted the FiT to promote the development of renewable energy sources. In 2011, the government decided to discontinue the FiT programme. South Korea's FiTs offered varying subsidy rates based on the capacity of renewable systems. This structure proved advantageous for smaller-scale renewable facilities, such as community participation projects and dispersed generations, as they were eligible for higher FiT rates. However, the implementation of South Korea's FiT system imposed a significant financial burden due to the government's decision to fund FiT projects using funds allocated for power industries rather than utility fees. This approach resulted in a lack of sustainable long-term financing to support the FiTs. However, to reduce the financial challenge of subsidies and promote the use of market mechanisms, the government discontinued FiTs in 2011.

Afterwards, in 2012, they implemented the Renewable Portfolio Standard (RPS) as a regulatory measure mandating a minimum level of energy generation from eligible renewable sources within utility companies. In sum, FiT played a significant role between 2001 and 2011 as a pioneering force in the market, facilitating the establishment of early renewable energy markets through the provision of compensation for initial construction expenses.[846] Feed-in tariffs have proven to be particularly advantageous for solar and wind power installations, with a particular emphasis on small-scale renewable energy facilities, such as community participation

[845] Ko and others (n 793).
[846] Kim (n 779).

projects. However, despite its advantageous features, Korea's FiT programme faced a significant financial burden resulting from government funding, leading to its termination in late 2011.[847] Consequently, South Korea adopted the Renewable Portfolio Standard (RPS) in 2012.[848] In 2018, the South Korean government retraced its FiTs policy. This was to respond to augmenting the prevailing Renewable Portfolio Standards policy and achieving the Renewable Energy 3020 (RE3020) objective. Invariably, the government reintroduced the Feed-in Tariff temporarily, specifically targeting small-scale solar photovoltaic (PV) projects.

5.6.7.2 Renewable Energy Portfolio Standard System

In 2012, South Korea established the Renewable Energy Portfolio Standard (RPS) system. The RPS requires power companies to allocate a designated percentage of their electricity generation derived from new and renewable energy sources. Intending to facilitate the expansion and advancement of new and renewable energy, the RPS system produces a Renewable Energy Certificate (REC), which is calculated by multiplying the amount of newly generated renewable energy supplied by the power plant (per megawatt-hour) by its corresponding weight.[849]

5.6.8 Assessment of Korea's Renewable Energy Policies and Laws

An assessment of South Korea's renewable energy policies and enactment helps to determine the effectiveness and efficiency of the legal instruments and identifies lessons learned. South Korea's renewable energy assessment is being reviewed against the key policies, including renewable energy targets, net metering, feed-in tariff, import tax incentives and prices and costs. South Korea has set ambitious goals to increase its share of renewable energy sources in the electricity supply chain. Consequently, measures have been put in place to gradually phase out coal and nuclear power. Further, South Korea aimed significantly to improve energy efficiency and energy security and highly prioritised domestic energy production. There are regulatory and institutional barriers and some rigid energy markets.

[847] ibid.
[848] ibid 5.
[849] Ko and others (n 793).

In its critical assessment, the IEA argued that for South Korea to facilitate greater deployment of renewable electricity, a closer engagement with local communities through the creation of frameworks for more active consumer engagement is required. In addition, Ko and others argued that awareness-raising efforts among industry players are very important.[850] The South Korean renewable energy sector, not least the ocean energy resources, has experienced challenges including *policy uncertainties, non-economic barriers, grid integration,*[851] and "*backsliding policies*."[852] South Korea does not have a one-stop-shop approval procedure to cure the consequences of many approving agencies. For instance, multiple agencies and applications participate in the procedure approval process[853] In the case of Ulsan City, over seven distinct ministries are involved, including the Ministry of Defence, the Ministry of Cultural Heritage, and the Ministry of Oceans and Fisheries.

In 2018, the share of renewable energy generated was 4%, a very low level relative to targets set for 2030 and 2040 (shares of 20% and 30% to 35%, respectively). As of the time of writing this research, the share has not changed. Invariably, achieving the established targets for 2030 and 2040 will require a "resilient and much more flexible electricity system" capable of bringing on board the growing share of valuable and decentralised renewables[854].

> According to BloombergNEF, "*South Korea has a power score of 1.91, which puts it at rank 65 in the global power ranking, and rank 26 in the developed markets power ranking. In comparison to 2021, South Korea has deteriorated in the power rankings by 37 places, from rank 28 to rank 65.*[855]

[850] International Energy Agency, 'Korea's energy transition and the Green New Deal' (*IEA*, 2020) <https://www.iea.org/reports/korea-2020> 3 December 2023.
[851] Ko and others (n 793).
[852] Kim (n 771).
[853] Alun Williams, 'A 'One Stop Shop' for South Korean offshore wind permitting?' (*RPS Group 23*, August 2021) <https://www.rpsgroup.com/insights/energy/a-one-stop-shop-for-south-korean-offshore-wind-permitting/> 3 December 2023.
[854] International Energy Agency, 'World Energy Outlook 2022 (n 752)
[855] Bloomberg NEF, 'Climatescope' (*Bloomberg NEF*, 2023) <https://www.global-climatescope.org/markets/kr/> accessed 29 November 2023.

As of 19 November 2023, BloombergNEF asserted that South Korea is still highly reliant on fossil fuels for electricity generation and has a long way to accomplish its 2050 net-zero target.[856] The price of electricity in South Korea is on a downward trend. For example, the average electricity price in South Korea dropped from 99.92 USD/MWh in 2021 to 97.8 USD/MWh in 2022. Since 2017, the average electricity price in South Korea has fluctuated between 97.71 USD/MWh (2019) and 103.98 USD/MWh (2018).[857] South Korea's electricity market is not competitive. The electricity market sector is operated as a mandatory pool with a single buyer – the government; and the wholesale and retail prices are not set by the market but by the government. The South Korea Electricity Regulatory Commission plays an advisory role. The failure to open the electricity sector and introduce true competition and independent regulation along the electricity value chain is an impediment.

The South Korean government has committed to advance the country's share of renewable energy electricity to 20% by 2030 and to 30% to 35% by 2040 to gradually phase out coal and nuclear power from its energy mix. Under the Paris Agreement, South Korea is committed to reducing its emissions to 536 metric tonnes of carbon dioxide equivalent in 2030. According to the IEA, by 2018, emissions were 709 metric tonnes of carbon dioxide equivalent, and as of the time of writing, it peaked at 727.6 metric tonnes of carbon dioxide equivalent.[858] This figure does not demonstrate that renewable energy policies, not least wave and tidal energy, have affected Korea's efforts to meet set targets. Aside from solar and wind energy resources, wave and tidal energy, which is reported as marine resources, did not demonstrate any significant contribution. Although South Korea has embraced the concept of renewable energy, including investments in wave and tidal energy resources, its ambitious targets are not likely to be achieved for several reasons, including policy failures. According to the International Energy Agency (IEA),

[856] Maria Eugênia Mitri, Sofia Maia, Ana Paula, Fonseca Teixeira, and Laura Foron 'Climatescope 2023, Power Transition Factbook' (*Bloomberg NEF*, November 2023) 34 <https://assets.bbhub.io/professional/sites/24/BNEF_Climatescope_Report.pdf> accessed 29 November 2023.
[857] BloombergNEF, 'Climatescope, Korea' (*Bloomberg NEF*, November 2023) <https://www.global-climatescope.org/markets/kr/> accessed 29 November 2023.
[858] Juhern Kim, (n 802)

accomplishing these targets will require, among others, measures addressing regulatory and institutional barriers, the introduction of flexible market designs and the utilisation of Korea's advanced technology.[859] It is noteworthy that the November 2023 IEA report, with the theme "*Energy Efficiency 2023*", released one day before the commencement of the COP 28 in Dubai, emphasised the growing imperative for more robust measures to ensure the 1.5 °C target remains attainable.[860] The report acclaims that to reach net-zero energy consumption by 2050, worldwide energy efficiency progress must be double within the next decade.[861]

5.6.9 Conclusion: South Korea's Wave and Tidal Energy- Accomplishment, Challenges and Prospects

South Korea has a significant potential to develop wave and tidal energy because of its extensive coastline and substantial tidal ranges. As part of its overarching renewable energy strategy, the nation has made substantial progress in the development of this sector. On the other hand, the prospects of wave and tidal energy in the region are significantly influenced by the challenges associated with technology, environmental concerns, and policy implementation.

5.6.9.1 Accomplishments

- Technological Development and Innovations:

In 2011, South Korea inaugurated the Sihwa Lake Tidal Power Station, the largest tidal power plant in the world, marking a significant milestone in pioneering projects and technological development. Situated on the western coast, this facility has a commissioned capacity of 254 MW, making a substantial addition to the renewable energy portfolio of the nation. Through the success of this project, South Korea has established itself as a prominent worldwide frontrunner in tidal energy. Another noteworthy accomplishment is the Uldolmok Tidal Power Plant, which, albeit of a smaller magnitude, has played a vital role in the testing and

[859] IEA 50, 'Korea 2020' (*IEA*, November 2020) <https://www.iea.org/reports/korea-2020> accessed 8 September 2024.
[860] IEA, 'Energy Efficiency' (*IEA*, 2023) <https://www.iea.org/events/energy-efficiency-2023> accessed 29 November 2023.
[861] ibid.

enhancement of tidal technology. Additionally, the facility functions as a research and demonstration site to promote the development of more efficient tidal energy technologies.

- Government Assistance and Strategic Initiatives:

As a part of its commitment to reducing greenhouse gas emissions, the South Korean government has acknowledged the potential of marine energy. The Renewable Energy 3020 Implementation Plan, which was first introduced in 2017, incorporates marine energy as a crucial element to augment the proportion of renewable sources in the energy composition.

- Incentives and R&D Funding:

The government has announced incentives for marine energy projects, which include financial support for research and development (R&D) activities. The emphasis placed by South Korea on innovation in renewable energy technology has resulted in the advancement of wave and tidal energy conversion systems with enhanced efficiency.

- International cooperation:

South Korea has established international partnerships to promote the development of its marine energy industry. The establishment of partnerships with countries such as the United Kingdom and Canada, which possess robust marine energy industries, has effectively enabled the transfer of knowledge, exchange of technology, and collaboration in research areas.

5.6.9.2 Challenges

Policy somersaults and inconsistencies remain a challenge to the development of wave and tidal energy resources, and this has become detrimental to the attainment of set targets. Contrary to government control and monopoly, and unlike the South Korean system, a free-market environment attracts investment in clean energy with new business opportunities to promote competition and efficiency, which eventually propel the growth of the electricity market and reduce electricity prices and costs. An

inherent obstacle in the advancement of wave and tidal energy in South Korea is the exorbitant expenses associated with their development and upkeep, particularly considering the technology's nascent stage. Costs associated with building and maintaining wave and tidal infrastructure in challenging marine conditions are substantial.

Further, the development of wave and tidal energy technologies is still hindered by technological barriers despite the progress made in these fields. Constraints such as energy efficiency, material durability, and resilience to severe weather conditions continue to be major obstacles to broader acceptance. Inherently, environmental concerns have arisen from the negative effects of wave and tidal energy on marine organisms despite their classification as green technologies. Tidal power projects, upon their construction and operation, have disturbed marine ecosystems, influenced fish migration patterns, and modified sediment transport. The challenge of achieving a balanced energy development concerning environmental preservation persists. Additionally, South Korea's geographical position presents considerable opportunities for harnessing tidal energy, but it is less advantageous for harnessing wave energy compared to other regions with more regular and dynamic wave activity. This geographical constraint impedes the growth of wave energy initiatives.

5.6.9.3. Prospects

In South Korea's pursuit of reducing its reliance on fossil fuels and nuclear energy, the diversification of the energy mix presents a promising opportunity through the utilisation of wave and tidal power. Such measures have the potential to bolster energy security and mitigate greenhouse gas emissions. The experience and current infrastructure of South Korea make it highly positioned to become a global leader in tidal energy. Sustained investment and innovation have the potential to enable the country to engage in knowledge and technology exports to other countries. Prospectively, ongoing research and development in the field of technology may result in significant advancements that reduce expenses and enhance the effectiveness and dependability of wave and tidal energy harvesting. Indeed, this would enhance the competitiveness of these energy sources in comparison to other

types of renewable energy. Significantly, there is untapped potential for both wave and tidal energy in South Korea, notwithstanding the existing challenges. Given appropriate policies, investment, and technological progress, these energy sources have the potential to significantly contribute to the country's energy industry in the future. South Korea has made significant progress in wave and tidal energy, particularly through tidal energy projects. However, obstacles such as high costs, environmental concerns, and technological barriers must be overcome to fully realise the potential of these renewable energy sources. The prospects for wave and tidal energy in South Korea are promising, especially with continued innovation and government support, which could propel the country to the forefront of the industry. However, the future success of these technologies will be dependent on overcoming current challenges and sustainably upscaling these projects.

CHAPTER SIX - COMPARATIVE LAW ANALYSIS OF SCOTLAND, BRITISH COLUMBIA, NOVA SCOTIA, AND SOUTH KOREA

6.1 Introduction

Comparative Law scholars, including Alan Watson and Erin Örücü, reasoned that lessons can be learned from other jurisdictions to promote and develop another jurisdiction's legal system.[862] This informed the previous Chapter's critical evaluation of four comparator-jurisdictions to illuminate four legal data points including technological development, legal framework, incentives and support systems and budgets in the promotion of wave and tidal energy. Essentially, the author investigates the legal data points of the four jurisdictions to identify and elicit the key similarities, differences and challenges concerning wave and tidal energy resource development. These similarities, differences, and challenges will form the basis for the framework to be proposed for Nigeria and lessons learned, and the above jurisdictions were chosen based on the criteria set in Chapter 2.3.4.

This Chapter presents the key similarities, differences and challenges resulting from the comparative law analysis of Scotland, British Columbia, Nova Scotia, and South Korea, specifically focusing on technology, legal framework, incentives and support systems, and budgets. Subsequently, under technology, section 6.2 presents brief details about infrastructure, research and development (R&D), innovations and deployments. Section 6.3 presents the most recent relevant laws and policies under the legal framework. Under incentives and support systems, section 6.4 elicits relevant data, including taxes, grants subsidies, feed-in tariffs, Contracts for Difference and Renewable Portfolio Standards. Penultimate, section 6.5 presents the similarities, differences and challenges derived from budgets and financial support to wave and tidal energy. Section 6.6 synthesises the findings, and finally, section 6.7 concludes the Chapter. The wave and tidal energy technologies, legal framework, incentives and support systems, and budgets of Scotland, British Columbia, Nova Scotia, and South Korea are summarised by the researcher in Table 8.

[862] Watson (n 113).

Table 8: Comparison of Scotland, British Columbia, Nova Scotia, and South Korea

	Scotland	British Columbia	Nova Scotia	South Korea
Technology and Infrastructure	**Tide:** Tidal streams - MeyGen, @ Pentland Firth, Shetland Tidal Array, Orbital Marine Power, SAE and MeyGen (100MW of by 2028) Commercial deployment innovative floating tidal turbine technology Orkney **Wave**- Blue X – Orkney Oscillating Water Column (OWC); European Marine Energy Centre's test sites EMEC x 30 tests Mooring, Electric connections.	**Wave** energy technology project at Yuquot, BC, Mowachaht/Muchalaht First Nation (MMFN).	**Tide** FORCE: 5 sites Nova Innovation- permit to develop a 1.5MW tidal array, its largest project to date, in Canada.	**Tide** 254 MW Sihwa Lake Tidal Power Plant Uldolmok Tidal Power Station Korea Tidal Current Energy Center (K-TEC)
Legal Framework (MSP, Route Map, Environmental Assessment, Targets, Legislation and Policies)	UK Energy Act 2023- Multi-purpose Interconnectors (MPIs). Planning (Scotland) Act 2019 Community Energy Policy. Draft Energy Strategy and Just Transition Plan. RO (Scotland) Order 2023.	Constitution Act 1982. Clean Energy Act [SBC 2010] Chapter 22 Wave and tidal energy as "Ocean" energy. Canadian Net-Zero Emissions Accountability Act 2023 Net-zero (GHG) emissions by 2050.	Marine Renewable Energy Strategy (May 2012). Marine Renewable-energy Act (2015) 2015 Electricity Plan	12 Ocean energy laws including New and Renewable Energy Development, Use and Spread Promotion Law (Act No. 14670); 2018 **Policies** RE Roadmap 2017, (MOF); "3020 RE plan" (MOTIE) 2017
Incentives	Government; Banks; Private Investment, Loans; Grants Trust; Price supports; EU	Federal, Provincial, and Private Sector. Private investment, financing, debt, Grants, tax	Government funding Private investment	Renewable Energy Certificate (REC) Tradeable Certificates.

Support Systems	Fast Track innovation; Credits; CfD organized by Westminster Renewable Obligations Certificates; Feed in Tariffs;	exemptions Tax credits- Feed in Tariffs	A package of capital grants and price Feed-in tariffs for large and small-scale projects The Community Feed-in Tariff (COMFIT)	Quota system Portfolio Standard (RPS) to provide Renewable Energy Certificate (REC).
Budgets	Government "ring-fenced" £10m for tidal stream under the CfD AR6 Pot 2 Wave -£18.25m (2023)[863] Wave Energy Scotland has funded 132 contracts, committed £50m involved 300 orgs and 18 countries.	2023 - Canada – USD $2.25Bn for wave and tidal energy PRIMED projects – USD$1.5m	2023 - Canada – USD $2.25n for wave and tidal energy resources. 2023, global value WTE USD$6.8Bn. 2030 - $13.7Bn	In 2024, USD$20.6M was budgeted for energy including wave and tidal energy

6.2 SIMILARITIES

As previously described in Chapter 5, technology represents the major means of harvesting wave and tidal electricity from the ocean. Consecutively, planning, designing, and developing suitable technological devices occurred in regions identified with potential for wave and tidal energy. This put in place appropriate measures for the strategic growth of the marine energy industry. For example, Scotland, British Columbia, Nova Scotia, and South Korea have abundant ocean resources, which share a significant portion of the over 30,000TWh/year estimated global theoretical wave energy resources,[864] and 800 – 1200 TWh/year of tidal energy

[863] The University of Edinburgh School of Engineering, 'Policy and Innovation Group UK Ocean', (2023) Energy Review <https://www.waveenergyscotland.co.uk/media/1505/policy_and_innovation_group_uk_ocean_energy_review_2023.pdf> accessed 26 April 2024.

[864] European Commission, 'Ocean and Fisheries, WaveFarm unleashes a wave of energy for a sustainable future' (Directorate-General for Maritime Affairs and Fisheries, 31 January 2024) <https://oceans-and-fisheries.ec.europa.eu/news/wavefarm-unleashes-wave-energy-sustainable-future-2024-01-31_en> accessed 8 September 2024.

resources.[865] Scotland, British Columbia, Nova Scotia, and South Korea have developed wave and tidal energy technology from the designs, prototypes, and demonstration stages to the pre-commercialization but are yet to achieve full commercialisation stages. Underpinned by comprehensive study, there is "evidence-based ambition to accomplish cost reductions and commercial deployments by 2050 in the UK.[866]

In the same vein, all the comparator-jurisdictions have developed similar wave and tidal energy technologies, including six major wave technologies - Archimedes Wave Swing (AWS), Wave Dragon (WD), Pelamis Wave Power (PWP), Aquabuoy (AB), Oyster, and Oscillating Water Column (OWC); and three tidal energy technologies including tidal power, tidal lagoon and tidal streams. See Table 8 above for the different wave and tidal energy technologies in the jurisdictions. Further, the technologies are either small-scale deployment (<100KW) or large-scale deployment (>500KW and above). The Sihwa Tidal Power Plant, which generates 254MW, is currently the largest in the world, followed by France's La Rance, built in 1966 and situated on the Rance River, which generates 250MW.

In assessing the similarities, all the comparators have infrastructure such as port facilities and services (engineering and fabrications) to support the wave and tidal energy projects. Similarly, the governments have established research and development centres engaged in the development of wave and tidal energy resources. In the same vein, there have been extensive technological innovations that have promoted the rapid development of wave and tidal energy, with Scotland demonstrating a global lead based on the number of patents recorded.[867] The legal framework of the countries studied supports the development of wave and tidal energy, as discussed in Chapter 5.

[865] Ocean Energy Europe, 'Tidal energy, A 100% predictable clean energy source' <https://www.oceanenergy-europe.eu/ocean-energy/tidal-energy/> accessed 8 September 2024.
[866] Wave Energy Scotland, 'News, Policy & Innovation Group report reveals latest wave & tidal stream forecasts' <https://www.waveenergyscotland.co.uk/news-events/policy-innovation-group-report-reveals-latest-wave-tidal-stream-forecasts/> accessed 28 April 2024.
[867] Scottish Government, National innovation strategy: scorecard - 2024 update, <https://www.gov.scot/publications/national-innovation-strategy-scorecard-2024-update/pages/3/> accessed 28 April 2025.

Again, from the three comparator-jurisdictions, the findings have revealed that legislation and policies formed the bedrock of their achievements. At the same time, some jurisdictions, such as Scotland and Canada, have robust and dynamic legislation and policies. As discussed in Chapter 5, all comparator-jurisdictions established legislation and policies which specifically address wave and tidal energy resources. These legislation and policies are characterised by a well-coordinated and integrated framework, especially with their strategic framework and planning. These policies establish clear targets for reducing emissions and increasing the capacity of renewable energy to decarbonise. For example, recently, in 2023, the Scottish Government published an Energy Strategy and Just Transition Plan and Scotland's Routemap specifically addressed wave and tidal energy.[868] Whereas, in 2023, Nova Scotia committed to targets established by the federal and provincial governments by introducing its Clean Power Plan, a strategic framework aimed at achieving climate objectives, 80% renewable energy by 2030 and attaining net-zero emissions by 2035. Also, in 2024, the launching of the CleanBC plan, or Roadmap to 2030, outlines British Columbia's strategy for reducing greenhouse gas emissions by 80% and enhancing the utilisation of clean and renewable energy by 2050.[869] A study of the comparator jurisdictions shows that they developed roadmaps on renewable energy sources, thereby making it a critical element of the development of renewable energy resources, including wave and tidal energy resources.

Essentially, planning to harvest wave and tidal energy resources commences from the assessment of the potential, which all the comparator-jurisdictions carried out. Also, Marine Spatial Planning (MSP) is a key component of developing wave and tidal energy. As described in Chapter 5, Scotland developed marine spatial planning methodologies that facilitated the identification and location of wave and tidal energy projects within the maritime environment of Scotland. Nova Scotia[870] has also carried

[868] Scottish Government, '2020 Routemap for Renewable Energy in Scotland' <https://www.connaissancedesenergies.org/sites/connaissancedesenergies.org/files/pdf-actualites/2020_feuille_de_route_ecosse.pdf> accessed 24 April 2024.
[869] British Columbia, 'CleanBC, Roadmap to 2030' <https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf> accessed 21 October 2024.
[870] Government of Canada, 'Scotian Shelf and Bay of Fundy' <https://www.dfo-mpo.gc.ca/oceans/planning-planification/areas-aires/scotian-shelf-bay-fundy-plate-forme-neo-ecossaise-baie-fundy-eng.html> accessed 9 September 2024.

out its marine spatial planning[871] within the broader context of the Canada Marine Protected Area as provided by the Oceans Act 1996. The Oceans Act made Canada the world's first country to have comprehensive national ocean legislation. Since then, various area-based measures have been implemented in Canada to improve the governance of marine and coastal spaces. Canada is now implementing MSP as a forward-looking approach to ocean governance. Also, British Columbia has established its own MSP regime.[872] Additionally, South Korea established an MSP system in April 2018 with the passing of the Marine Spatial Planning and Management Act. The MSP system aims to manage South Korea's jurisdictional seas in a way that prevents reckless use of marine space.[873]

Other important activities covered by the legislation and policies in the comparator-jurisdictions include:

- Environmental Assessment of Marine Renewable projects,
- Ambitious target setting,
- Incentives were provided for developing wave and tidal energy projects, including direct financial incentives; Support schemes such as FiTs ROs, CfDs,
- Community-oriented wave and tidal projects and innovative net-metering.

Governments are the mainstay of the financial support of wave and tidal energy. UK Government allocated 10 million pounds ring-fenced during the Allocation Round 6 for tidal energy. Private sector participation has provided financial support to developing wave and tidal energy projects. UK has many public funding schemes for

[871] Tim Hall, Melanie Hurlburt and Glen Herbert, 'Marine spatial planning on the Scotian Shelf' (2018) Nova Scotia, Canada ICES CM 2008/E:31 <https://www.ices.dk/sites/pub/CM%20Doccuments/CM-2008/E/E3108.pdf> accessed 9 September 2024.
[872] Government of Canada, 'Marine Spatial Planning' <https://www.dfo-mpo.gc.ca/oceans/publications/backgrounder-fiche/marinespatialplanning-planificationespacemarin/index-eng.html> accessed 9 September 2024.
[873] Ministry of Ocean and Fisheries, 'Marine Spatial Planning' <https://www.mof.go.kr/page/en/selectPage.do?menuSeq=1576&pageSeq=1007&listUpdtDt=2024-09-06++10%3A00#:~:text=ROK%20legislated%20the%20%22Marine%20Spatial,for%20managing%20its%20jurisdictional%20seas > accessed 9 September 2024.

ocean energy, including the EPSRC SuperGen Consortium,[874] Carbon Trust Technology Accelerators, and Marine Renewables Proving Fund (MRPF).[875]

6.3 DIFFERENCES

A principal difference among the four corporate jurisdictions is the location of the research and development and testing centres. Unlike in Scotland, where the testing centres are concentrated at the Orkney Islands and contiguous areas, in British Columbia, Nova Scotia, and South Korea, they are scattered over several areas with strong potential for either wave or tidal energy resources. While on dynamic policy formulation, South Korea's legislation and policies on renewable energy are formulated at the central government level, whereas, in Canada - British Columbia, Nova Scotia, and UK – Scotland, legislation and policies are devolved. For example, both the UK and Canada devolved wave and tidal energy powers to Scotland, British Columbia and Nova Scotia provinces, respectively.

British Columbia and Nova Scotia are different provincial jurisdictions, each with its own renewable energy policies and support mechanisms. In contrast, South Korea is a smaller country with a more centralised government, allowing for more uniform renewable energy policies across the nation. While overarching national strategy policies exist in Scotland, British Columbia and Nova Scotia, the specific design and implementation of wave and tidal energy incentives and support schemes vary because of differences in governance structures, political priorities, and stakeholder dynamics. For example, regional funding has provided support in the case of Scotland. European Innovation Accelerator Fund of about 2.8 million pounds loan was given to Nova Innovation to upscale tidal energy manufacturing and production output project for the construction of 200KWh. Similarly, there is Community-oriented funding of wave and tidal energy funding, for instance, in British Columbia

[874] D Greaves, 'Details of Grant' (2023) Engineering and Physical Sciences Research Council <https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/Y016297/1> accessed 28 April 2024.
[875] Valentin Heller, 'Technology Readiness Level approach for the development of WECs' (2012) Imperial College London, p 7 <https://www.drvalentinheller.com/Dr%20Valentin%20Heller_files/Heller_Technology%20Readiness%20Level%20approach%20for%20the%20development%20of%20WECs.pdf> accessed 28 April 2024.

and Nova Scotia. In addition, CfD support for projects that are nearing maturity represents and an effective means of support for projects, unlike other jurisdictions that utilize FiTs and Renewable Obligations.

6.4 CHALLENGES

There are several challenges facing wave and tidal energy technology development. However, the key challenge obstructing its development is the high cost of acquisition and deployment of wave and tidal energy technology. Additionally, the grid system to transmit the electricity generated remains a major challenge. Another key challenge is the community's opposition to wave and tidal energy resources, especially complaints of unsightly structures and environmental issues. Further, tidal power on the Annapolis River has demonstrated that the tidal generating station is not friendly to the environment as it traps fish and cetaceans.[876] In 2023, the government denied renewing permits in Nova Scotia for Sustainable Marine's PLAT-16.40 generating platform that was undergoing early trials at the Bay of Fundy's Grand Passage. Consequently, the nearly 60 million Canadian dollar project remains suspended. Government officials have argued that the suspension is due to the project's harmful effect on the environment.[877]

Another challenge has been the adoption of inconsistent laws on renewables. On incoherence and inconsistencies, for instance, Nova Scotia's repeated changes of rules and regulations created uncertainty until the enactment of the Marine Renewable Energy Act 2018. The political will to support wave and tidal energy, as well as the red tape and unclear processes of consenting and licensing, is also important. Institutional reforms in line with trends and global developments to meet national, regional, and international realities. For instance, in the UK/Scotland, DECC changed to BEIS and is now known as the Department of Net Zero. The development

[876] Malcolm J Bowman and A M Gorlov, 'Tidal Energy' (2019) Volume 5 Encyclopaedia of Ocean Sciences pp 663-673 <https://doi.org/10.1016/B978-0-12-409548-9.11632-X > assessed 24 April 2024.
[877] Paul Palmeter, 'Tidal power developer slams DFO for years of delays, stops application for N S project' *CBC News*, (Canada, 21 March 2023) <https://www.cbc.ca/news/canada/nova-scotia/tidal-energy-snag-nova-scotia-sustainable-marine-energy-1.6785015> accessed 27 April 2024.

of renewable energy resources results in different types of support schemes and incentives and low government budgetary support.

6.5 A Brief Comparison of the Comparator-Jurisdictions and Nigeria's Wave and Tidal Energy Resources

Earlier, in Chapter 4, a critical review of Nigeria's renewable legal framework established a gap concerning wave and tidal energy. Then Chapter 5 critically assessed the wave and tidal energy legal framework of Scotland, British Columbia, Nova Scotia and South Korea and demonstrably provided an understanding of the legal framework in support of wave and tidal energy. Table 8 presented a brief comparison of all the comparator-jurisdictions combined and Nigeria's wave and tidal energy.

From Table 8, it is evident that Nigeria has wave and tidal energy resources. However, there has been no specific mention in Nigeria's legal framework or development of wave and tidal resources. As discussed in Chapter 2, although the Nigerian Institute for Oceanography and Marine Research (NIOMR)[878] is best suited for research and development of Nigeria's wave and tidal energy, a critical review of its mandate dwelt more on fishery development and surveys to establish species at sea. For example, NIOMR is charged with the responsibility to conduct research into the resources and physical characteristics of the Nigerian territorial waters and the high seas beyond.

[878] AquaDocs, Highlights of 1960-1990 : Achievements in the last 30 years by the Nigerian institute for oceanography and marine research and its parent research division of the federal department of fisheries, Lagos, T.O Ajayi, 'Nigerian Institute for Oceanography and Marine Research', Victoria Island, Lagos<https://aquadocs.org/bitstream/handle/1834/1185/niomr.pdf;jsessionid=E2C28489B3027C0B5C221B80D2FD867A?sequence=1> accessed 27 April 2024.

Table 9: A Comparison of the Wave and Tidal Energy Comparator-Jurisdiction and Nigeria

	Comparator-Jurisdiction	Nigeria
Ocean resources	Huge marine resources with assessed enormous wave and tidal energy potentials	Huge marine resources with unassessed potentials for wave and tidal energy
Technology	Maturing and tested wave and tidal energy technology with standardized R&D centres	Technological base including R&D centres specifically established for wave and tidal energy unavailable
Legal Framework	Legislation and policies established to promote wave and tidal energy.	Wave and tidal energy not specifically mentioned in RE legislation and policies.
Incentives and Support Systems	Well established including grants/taxes holidays and CfD/FiTs/RPS respectively	Found in the Electricity (Amendment) Act 2023 for solar, wind, biomass, and hydro, but did not mention wave and tidal energy.
Budgets	Large scale European funding[879] in Scotland; Government allocation and private sector driven	Mainly private sector driven with support from grants and INGOs
Key projects	Wave – Scotland's AWS Waveswing Device and Blue-X Device; British Columbia's MMFN Wave energy proect Tidal- South Korea's Sihwa Tidal Power Plant; Nova Scotia's Annapolis Tidal Generating Plant;	There are no wave and tidal energy projects.

Nigeria can learn from the comparator-jurisdictions based on similarities and differences identified. Additionally, the challenges encountered can provide lessons. Eventually, proffering a framework for Nigeria's wave and tidal energy resources will draw best practices from the comparator jurisdiction.

6.6 CONCLUSION

The legal framework of a country plays an important role in promoting the development of wave and tidal energy resources. In this research, the author carried out a comparative study of comparator-jurisdiction, including Scotland, British Columbia, Nova Scotia and South Korea, thereby identifying key similarities, differences and challenges in their legal framework. Generally, in jurisdictions with significant focus on WTE, geographical advantages have been pivotal. Meanwhile, all

[879]Wave Energy Scotland, '2023 UK Ocean Energy Review report published: A Year of Progress for the UK Ocean Energy Sector' (2024) <https://www.waveenergyscotland.co.uk/news-events/2023-uk-ocean-energy-review-report-published/> accessed 26 April 2024.

the Comparators that have evolved over a period, depend on a diverse array of legislations and policies that influence their renewable energy initiatives, and in certain cases, specifically, wave and tidal energy. Notably, WTE is an evolving renewable energy source characterised by nascent technology; and many comparators are still in the experimental phase, with only one or two having reached the commercial development stage.

Further, some Comparators have encountered, and in some cases continue to encounter policy challenges. Scotland may be an outlier, having profited from a generally favourable UK-wide status regarding renewable energy generation. Certain comparators have also encountered bureaucratic obstacles, amidst other issues. Comparator jurisdictions still struggle to meet renewable energy generation targets, with the exception of Scotland. Additionally, comparators' jurisdictions have huge potentials of wave and tidal energy, yet, as at 2025, contribute small components of the overall renewable energy generation, except for Scotland.

The following conclusions have been reached:

- The comparator-jurisdictions have abundant wave and tidal energy resources, which are developed with all accoutrements, including R&D and testing sites in place, and varyingly, at different stages of technological development, with the commercialisation yet to be attained. On the contrary, Nigeria, a similarly endowed jurisdiction in tidal and wave resources, is yet to explore its potential.
- The comparator-jurisdictions established legislation and policies that specifically addressed wave and tidal energy resources. On the contrary, at the time of this research, Nigeria has not specifically mentioned wave and tidal energy in its legislation and policies to promote the development of these marine energy resources. For instance, as earlier discussed in section 4.2.4, under part XVII of Nigeria’s Electricity (Amendment) Act 2024, which legislated renewable energy, mentioned solar, wind, hydropower and biomass without specifically addressing wave and tidal energy.
- Together, the comparator-jurisdictions have developed their technologies with different incentives and support systems. The key support systems include

FiTs, CfD, and RPS and renewable energy certificates. Although many policies have been established to provide wave and tidal energy resources, Dong Hui Ko and others argued that these policies have been insufficient. Additionally, more proactive policy support is required to attract private entrepreneurs. In this respect, it is appropriate to comparatively understudy and adapt policy trends that have functionally succeeded, as in the case of Scotland's contract for Difference.

- In general, the comparator jurisdictions wave and tidal technologies are at different stages, including design, prototypes, demonstration, and pre-commercialization. Largely, at the time of this study, wave and tidal energy is yet to achieve the commercialisation stage, and the levelized cost of energy (LCOE) is high relative to solar and wind. (See Table 3 for the global LCOE for sources of energy). Unlike the comparator jurisdictions, Nigeria has not developed any wave and tidal technologies.
- WTE is a developing RE source with emerging technology and many of the comparators continue to experiment with wave and tidal energy technology, however, only one or two jurisdictions have attained the commercial stage of development.
- In all four comparator jurisdictions where there has been significant emphasis on WTE, geographical advantage has been a crucial factor.
- Most comparators have encountered, and in some instances, still encountering policy challenges. Scotland may be an outlier, having benefitted from an overall very good UK wide position on RE generation.
- Comparator jurisdictions often missed RE generation targets, except Scotland; and some comparators including South Korea have experienced red tape.

In sum, Nigeria's legal framework has an evident gap concerning wave and tidal energy. Invariably, for Nigeria's wave and tidal energy resources to be developed, lessons can be learned from best practices and challenges in the comparator-jurisdictions. Consequently, some key lessons that Nigeria can learn include marine environmental impact assessment, identifying potential areas for wave and tidal energy, adapting fit and proper and customised legal framework including reform and amendment of legislations to specifically address wave and tidal energy, creating

appropriate incentives, support systems, including government budgetary support. Additionally, licensing processes and the process of establishing technical standards need to be established. Going forward, the next Chapter will present a framework to address the established and extant gap in Nigeria's legal framework in support of wave and tidal energy.

CHAPTER SEVEN - PROPOSED RENEWABLE ENERGY LEGAL FRAMEWORK FOR NIGERIA'S WAVE AND TIDAL ENERGY RESOURCES

7.1 Introduction

Chapter Seven proposes a route map to promote wave and tidal energy resources in Nigeria. An effective legal framework for wave and tidal energy will enable the responsible and efficient exploitation of these resources, thereby supporting renewable energy generation. In other words, the model framework should achieve equilibrium between energy production, environmental preservation, involvement of stakeholders, and economic motivations to promote a sustainable and robust energy mix for the present and future. The wave and tidal energy proposal could fulfil Nigeria's energy requirements, stimulate economic growth and job creation, improve electricity access in remote coastal communities, and facilitate energy transition. Nonetheless, challenges exist concerning infrastructure, legal matters, political conditions, security issues, investment opportunities, and regulatory frameworks. Nigeria's existing infrastructure deficiencies, such as an inadequate electricity grid and a shortage of skilled labour, may impede the advancement of these technologies.

Thus, the framework proposes specific systematic approaches for the key stakeholders within Nigeria's renewable energy ecosystem. It proposes an effective and strategic planning consent system, a comprehensive legal framework, a well-structured institutional framework and a dynamic multi-stakeholder partnership and engagement network.

As a result, the principal question this research seeks to answer is how can we justify the necessity for the development of wave and tidal energy resources in Nigeria and ultimately provide a framework to integrate wave and tidal energy into Nigeria's Renewable Energy enactments? To answer this question, the researcher has set out below some measures that might be adopted to integrate wave and tidal energy resources into Nigeria's renewable energy legal framework, as well as the justification for the development of wave and tidal energy in Nigeria.

7.2 Wave and Tidal Energy Strategic Planning Process

The strategic planning process is the fulcrum of any successful renewable energy development project. The strategic planning process fundamentally entails consultations, an environmental impact assessment (EIA) project development plan, information management, design statements, as well as legislation and regulations. For example, Scotland's Marine Policy Statement 2011[880] robustly sets the framework for conducting marine planning. In other words, it covers planning consent and provides guidance and information relating to permissions and associated consents. Having critically reviewed the wave and tidal energy legal framework of four jurisdictions – Scotland, Nova Scotia, British Columbia and South Korea in Chapter 5, this researcher argues that a standard and comprehensive strategic planning process for wave and tidal energy resources. A critical component of strategic planning is expected to address the following aspects:

- Efficient permitting implies the implementation of a transparent and accelerated permitting procedure for wave and tidal energy infrastructure. The involvement of several government agencies, such as environmental, maritime, and energy departments, necessitates the adoption of a unified "one-stop-shop" approach to alleviate administrative burdens.

- Environmental Impact Assessment for Wave and tidal energy projects must be subjected to rigorous EIA to assess their effects on marine ecosystems, habitats, and biodiversity. This should encompass both preliminary evaluations and ongoing monitoring responsibilities.

- Marine Spatial Planning: Zoning and Site Allocation in marine environments determine the specific areas where wave and tidal energy projects should be permitted while considering the simultaneous objectives of environmental preservation and energy development. Together, this should be derived from

[880] HM Government, UK Marine Policy Statement, (2011) <https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2020/10/uk-marine-policy-statement-march-2011/documents/uk-marine-policy-statement-march-2011/uk-marine-policy-statement-march-2011/govscot%3Adocument/marine%2Bpolicy%2Bstatement.pdf> accessed 14 September 2024.

marine spatial planning that considers ecological sensitivity and navigational restrictions.

In summary, there is a need to establish a strategic planning process and Marine Spatial Planning management in Nigeria for the development of planning advice and guidance tools. Nigeria's Marine Spatial Plan Framework will ensure the promotion and development of MSP in a sustainable manner that seeks to accommodate and consider sectoral, community and public views.

7.3 An Inclusive and Effective Renewable Energy Law and Policy

7.3.1 Law

The researcher proposes the adaptation of Nigeria's renewable energy laws and policies in line with international best practices, not least from the comparative jurisdictions studied in this thesis and other jurisdictions. It is imperative to guarantee that every wave and tidal energy development in Nigeria adheres to the provisions of the United Nations Convention on the Law of the Sea (UNCLOS), especially for projects located in exclusive economic zones (EEZ) or international waters. Further, renewable energy legislation should be adapted and reformed to become robust and up to date with recent global efforts to accelerate the development of clean energy as underpinned in COP 28. For instance, as a matter of priority, the FGN should reform Nigeria's Electricity (Amendment) Act 2024, the Land Act 1978, and the NSTIP 2022 to specifically include wave and tidal energy infrastructure and clearly define land acquisition for wave and tidal energy developers.

7.3.2 Policy

The FGN should establish long-term policy objectives and targets to include wave and tidal energy targets at the national level, as well as the sub-national level. This should encourage Nigeria's littoral states, including Akwa Ibom, Bayelsa, Cross River, Lagos, Ondo, and Rivers, to develop policies to specifically address wave and tidal energy resources in line with the decentralisation of electricity policy in Nigeria. Further, the FGN should establish ambitious objectives for renewable energy, including specific targets for wave and tidal energy to the overall energy mix. In this respect,

consideration should be given to the fact that wave and tidal energy is still a relatively developing renewable energy resource, unlike solar, hydro and wind energy resources. For instance, as illustrated in Table 2 – Chapter Four in 2005, Nigeria set a target of 10% RE share in its energy mix to be accomplished by 2025. However, as of 2024, Nigeria has only attained about 6%, thereby unlikely to achieve its set RE target. Among others, this is why this research argues that Nigeria needs a robust policy to meet its RE target, especially when Nigeria's target is not as ambitious.

Nonetheless, as illustrated in Table 2 - Chapter Four, Nigeria announced a commitment to reach net-zero carbon emissions by 2060 at COP26 in Glasgow. Thus, what Nigeria needs is the appropriate policy and commitment to meet its RE target in future. In this regard, this set of objectives would provide direction to policymakers and industry stakeholders regarding the intended path of growth. Also, to ensure that the policies are flexible enough to accommodate technological progress and new demands in the wave and tidal energy industry. And establish periodic review periods to evaluate the efficacy of laws and regulations and implement any required modifications. Furthermore, to develop a marine spatial plan process underpinning the consenting process.

The researcher also proposes policies for financial incentives and support mechanisms, subsidies and tax incentives to address Nigeria's support system, including the FiTs, which this researcher found has not positively affected the RE development as discussed in Chapter 4. This thesis also proposes that the policies should ensure the proper implementation of support mechanisms to promote wave and tidal energy resources. Nigeria's green bond and utilisation of public-private partnerships can finance extensive wave and tidal energy infrastructure.

7.4 An Integrated Institutional and Infrastructural Development

This thesis proposes a well-integrated and structured renewable energy institutional and infrastructural framework to cater to wave and tidal energy. Consequently, the FGN should incorporate a National Renewables Institutional and Infrastructure Strategic Plan (NIISP), as this would facilitate a strategic approach to developing

Nigeria's renewable energy institutions and infrastructures. In addition, the thesis proposes that the NIISP should establish a centralised research and development hub structure to comprise major Hubs. One of these hubs should be established in one of the littoral States (Lagos, Ondo or Rivers States) to specifically cater to ocean renewable energy resources, including wave and tidal energy. Further, the thesis proposes that Nigeria's universities and research institutions should support the advancement of wave and tidal energy technologies. This research also proposes an urgent and radical refurbishment of Nigeria's Grid system, which should integrate wave and tidal energy resources. This will mitigate Nigeria's grid system, which continues to record serious disruptions, as discussed in Chapter Three. In all, with these proposals implemented, Nigeria can overcome institutional and infrastructural issues, including through effective partnerships with the private sector, with a more innovative approach to grid investment. For instance, NERC can engage the private sector for investment and government security agencies for infrastructure security.

7.5 Multi-Stakeholder/Community Integration and Partnership

This thesis proposes an inclusive and sustainable framework for the Multi-Stakeholder/Community Integration and Partnership Program for the development of wave and tidal energy resources within Nigeria's littoral States. The FGN should adopt this proposal to address the needs of local communities, thereby fostering flexibility, economic growth, and quality of life through collaboration and shared commitment. As discussed in Chapter 5, Nigeria can learn from Nova Scotia and Scotland concerning community participation in the development of wave and tidal energy resources. First, the FGN should establish a systematic approach to identifying key stakeholders, including government entities, regulatory agencies, private sector representatives, industry stakeholders, technology providers, local communities, traditional authorities, international development organisations, donors, and academic and research institutions.

Second, stakeholder engagement and consensus building encompass stakeholder mapping and analysis, the formation of a wave and tidal energy partnership forum, and the establishment of a multi-stakeholder forum, fostering trust with local

communities and ensuring their inclusion in decision-making processes. Third, establishing public-private partnerships that incentivise private sector involvement, facilitate technology transfer, enhance capacity building, and engage financial institutions. Fourth, establishing the development of a policy and regulatory framework, including explicit regulatory guidelines that align with national renewable energy objectives, while also creating the currently non-existent Master Service Plan (MSP) in Nigeria. Fifth, support advocacy and awareness while utilising media and civil society to disseminate information regarding the advancements and benefits of wave and tidal energy. The entire process will necessitate a well-organized monitoring and evaluation framework to assess the progress of wave and tidal energy projects and partnerships through regular reviews.

7.6 Conclusion

The framework proposed in this Chapter provides a pathway towards ensuring that wave and tidal energy resources are adapted within Nigeria's legal framework, thereby filling an extant gap. Additionally, Nigeria's renewable energy sector can benefit from this proposal to meet RE-set targets, reduce emissions, alleviate energy poverty and promote environmental sustainability. Further, more jobs will be created, and community participation in the generation of electricity will be enhanced. The proposal entails establishing an effective and efficient planning process with the participation of all industry stakeholders, adapting Nigeria's RE laws and policies to be more robust and inclusive of wave and tidal energy resources, and reforming archaic legislations such as the Land Act 1978 to support renewable energy.

In addition, the thesis proposed the establishment of robust policies for support systems and incentives and an integrated institutional and infrastructural development plan to provide for required facilities for wave and tidal energy resources. For example, research centre hubs should be established to cater for Ocean Renewable Energy and another research and development centre to cater to offshore renewable energy. A concentrated and more focused research centre would serve better than Nigeria's six existing research centres that have not made any remarkable impact on the renewable energy sector. A well-managed and modern

national grid system should be installed. Finally, the establishment of multi-stakeholder and community partnership structures to support the successful development of the wave and tidal energy sector. This multi-stakeholder and community partnership structure will bring together wave and tidal energy industry and utility investors with technology developers. In summary, the FGN should implement the proposed framework to resolve the existing gaps in Nigeria's renewable energy legal framework, as they were identified in this research.

CHAPTER EIGHT - CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This chapter concludes the thesis and proffers recommendations to the problems identified. Therefore, the chapter is divided into four sections. Section 8.2 summarises chapters 1 to 6 and sets out the conclusions and findings based on doctrinal and comparative law research. Section 8.3 presents the recommendations of the researcher. Further, this section categorises and discusses the findings of the research based on the research aims and objectives. The study's limitations are introduced in section 8.4, while section 8.5 offers recommendations for future research. The researcher's final brief thoughts on the study are presented in section 8.6, which also discusses the study's contribution to the body of knowledge.

8.2 Findings

The findings of the research will be presented in a structured manner by categorising the research objectives and discussing the themes, patterns and insight derived from the qualitative data to answer the research questions. This research thesis aims to search for any gaps or inconsistencies in Nigeria's renewable energy enactments and its governance strategy concerning wave and tidal energy, thereby justifying the necessity for wave and tidal energy resources in Nigeria and ultimately providing a framework to integrate wave and tidal energy into Nigeria's renewable energy enactments. To achieve these aims, the objectives as set out in Chapter One of this research are as follows:

- To identify and critically analyse Nigeria's renewable energy enactments with a specific focus on how it deals with wave and tidal energy.

- To identify and critically examine how related enactments, such as financial and technological Acts, can promote the development of wave and tidal energy in Nigeria.

- To critically evaluate what effects, if any, Nigeria's existing RE enactments have had on set targets, policies and programmes which support the energy mix.

- To evaluate RE enactments and policies from other jurisdictions with a focus on wave and tidal energy sources, including Scotland, Canada, South Korea and other countries.

This will guide the most appropriate laws and policies to allow harvesting energy from marine resources through a comparative study of other jurisdictions, proposing a framework that will incorporate best practices and lessons from other jurisdictions into the governance of Nigeria's RE legislation, specifically in wave and tidal energy.

8.3 Presentation of Findings

The overall study aimed to search for any gaps or inconsistencies in Nigeria's renewable energy legal framework as it concerns wave and tidal energy resources while recommending a roadmap to address the challenges. In this research, the aim was accomplished by proffering answers to the main research question of how to justify the necessity for wave and tidal energy resources in Nigeria and ultimately provide a framework to integrate wave and tidal energy into Nigeria's RE legal framework. The purpose of asking this question is to establish whether there are gaps in Nigeria's energy legal framework and to design a framework to exploit the country's renewable energy potential. The review of key laws and policies in Nigeria established extant gaps concerning wave and tidal energy resources from Nigeria's rich ocean resources.

Going forward, as discussed in Chapter 2, the research methodology through doctrinal and comparative legal methodology approaches critically reviewed laws, policies, rules, principles, interpretive guidelines and values to achieve the aim of the study. In essence, the relevant qualitative documentary data were located, identified, compiled and synthesised using primary sources, including books, journals, peer-reviewed articles, online sources, the RGU library, and relevant

organisation websites. These data-gathering methodologies provided the requisite answers to the research question. Consequently, the study identified five specific research objectives to establish its findings, which are discussed below.

8.3.1 Objective One

This is to identify, review, and critically analyse wave and tidal energy resources, focusing on their development, thereby determining how it is embraced in Nigeria's renewable energy legal framework.

Globally, wave and tidal energy development is still maturing compared to wind and solar. Nevertheless, this should not hinder Nigeria, which has a huge wave and tidal energy potential, from putting in place a robust and futuristic legal framework. It could be argued that Nigeria's policy and legal "shortcomings" are due to the fact that wave and tidal energy are still in the early stages of development. Consequently, there is a lack of pertinent information to inform the formulation and implementation of policy. However, in recent times, demand for wave and tidal energy development has increased as countries realise its potential and benefits. Similarly, wave and tidal energy technologies and their international legal framework are evolving. The massive ocean energy potential in Nigeria could power rural and urban areas. Chapter 1 cited primary sources attested to Nigeria's wave and tidal energy potential. However, they did not discuss how Nigeria's legal framework addressed wave and tidal energy. On the other hand, non-wave and tidal energy resources in Nigeria are not meeting the targeted electricity supply quota of 30%. For instance, according to EnerData, Nigeria is targeting universal power access by 2030 and 30% of renewables in its power mix [881]. Unlike biomass, hydropower, solar, and wind, Nigeria has not yet developed wave and tidal energy.

Accordingly, Chapter 3 followed a critical evaluation of Nigeria's renewable energy legal framework to identify any gaps or inconsistencies. The findings revealed that wave and tidal energy are not specifically included in the extant RE legal framework.

[881] EnerData, 'Nigeria energy report' (2024) <https://www.enerdata.net/estore/country-profiles/nigeria.html > accessed 21 October 2024.

For example, in the Electricity (Amendment) Act 2024, under Part XVII, Sections 168 -171, the Act made specific provisions for the development and promotion of biomass, hydropower, solar and wind, but not for wave and tidal energy. Additionally, most of Nigeria's legislation and policies subsumed wave and tidal energy under "other renewable energy resources". Nevertheless, attempts to address wave and tidal energy resources presented a passive '*wait and see'* approach in addition to the official inference of the immature nature of wave and tidal energy resources. Thereby providing an alibi not to engage in any concrete development projects. For instance, in Section 4.3.2, according to the NEP 2003 implementation approach: "Other renewable energy resources, which are not in common usage worldwide, include ocean waves, tidal energy, ocean thermal gradients, and geothermal energy.[882] The NEP further notes that there is still much more work to be done on these energy resources in Nigeria, which may in future contribute to the energy mix of the country.[883]

Essentially, the implementation approach aimed for the nation to maintain an interest in other emerging sources of renewable energy, including wave and tidal energy. However, the strategies and objectives itemised under this policy have been largely unaccomplished. But a decade later, NEP 2013 did not still address wave and tidal energy comprehensively. For instance, in Chapter 2.5 of the NEP 2013, geothermal, wave and tidal energy sources were all grouped and dealt with by a one-paragraph statement. Asserting that Geothermal, wave, and tidal energy sources are among the various energy sources that are available in Nigeria. Although these sources are not in use for energy supply now, in 2015, and even until the time of writing this thesis, the NEP policy encourages relevant agencies to ensure data and information relating to these resources are obtained through research and development programmes to immediately commence using these resources to provide power supply wherever it is competitive. Therefore, there is a gap in Nigeria's renewable energy legal framework.

[882] Energy Commission of Nigeria, 'National Energy Policy 2003' <https://rea.gov.ng/wp-content/uploads/2017/09/National_Energy_Policy_Nigeria.pdf> accessed 21 November 2024
[883] ibid.

8.3.2 Objective Two

This implies identifying and critically examining how related enactments can promote the development of wave and tidal energy in Nigeria.

This research critically examined three key related enactments, including the Land Use Act (LUA) of 1978, the National Science, Technology and Innovation Act 2022, and the Finance Act 2023. These laws did not specifically address the development of wave and tidal energy.

- *Land Use Act 1978*

As argued in Section, although Nigeria's LUA 1978 included provisions for the "development of technological projects," it did not specifically address land acquisition for renewable energy projects, not least wave and tidal energy projects. Nigeria's land laws are outdated. Consequently, Part XII, Section 118 of the Electricity (Amendment) Act 2024 addresses land acquisition for electricity projects, including wave and tidal energy resources. Also, as of July 2024, less than six months after promulgating the Electricity (Amendment) Act 2024, the effect of the Act cannot be determined. So, it is not clear yet if this legislation will close the gap created by the LUA 1978. The researcher submits that the Land Use Act 1978 should be revised.

- *National Science, Technology and Innovation Policy 2022*

The NSTIP aimed to prepare the environment for the development of renewable energy in Nigeria. However, policy implementation and uncoordinated policy implementation structure have led to difficulties. For example, in 2020, at the Nigeria RE Roadmap conference, Adeleke Olorunimbe Mamora, Nigeria'sMinister of Science, Technology and Innovation said 'nicely': "*The highly distributed institutional structure of the energy sector in Nigeria means that coordination of policies will be essential to unlocking integrated energy transition planning and ensuring its success.*[884] In other

[884] Energy Commission of Nigeria, <https://energy.gov.ng/REmap.php#:~:text=Dr.,planning%20and%20ensuring%20its%20success.> accessed 12 July 2024.

words, the challenge of uncoordinated policy implementation by multiple agencies was duly acknowledged. Although the NSTIP 2022 endorses the establishment of six research and development centres, none of these centres have participated in the development of wave and tidal energy resources.

Furthermore, these R&D Centres have not demonstrated any noteworthy scientific excellence in the field of renewable energy, and this could be attributable to underfunding and a lack of capacity to facilitate the development of RE. Promulgating legislation and policies to create adequate funding for technological innovations, establishment of more R&D centres, and collaboration and partnership could promote the development of wave and tidal energy resources in Nigeria. Finally, unlike bioenergy, solar, and wind, the National Science and Technology Policies 'inferred and lumped' wave tidal energy under "other renewable energy". This leads to the conclusion that Nigeria's renewable energy technology policy framework is lacking.

- *Finance Act 2023*

Despite Nigeria's extensive coastline, which has the potential to generate wave and tidal energy, there is a lack of concrete funding for the development of these RE sources. Additionally, the researcher discovered that the government has not exclusively allocated funding or ring-fenced for wave and tidal projects, and the primary emphasis is still on solar and small-scale hydroelectric power. The reason for this neglect may be caused by the relatively expensive and less mature wave and tidal energy. Furthermore, Nigeria lacks domestic expertise in ocean-based renewable energy technologies. Financial institutions in Nigeria may have regarded wave and tidal energy as a high-risk investment, particularly given the nascent technology.

- *The Nigeria Climate Change Act 2021*

The CCA 2021 and its policies downplayed commitments and programmes to develop renewable energy. Inherently, these Climate Change Policies and CCA 2021 are distinguished by their legally binding commitments, articulated timelines, a coordinated climate response, dedicated functions, and the utilisation of existing

resources. Nevertheless, the Green Bond Programme is the sole initiative that is responsible for the generation of funding for a renewable energy programme without any specific renewable energy sources (RES). Meanwhile, it is acknowledged that fossil-fuel-related activities are responsible for the generation of over 60% of GHG in Nigeria, and renewable energy continues to be the most viable alternative.

- *Petroleum Industry Act 2021*

The researcher deciphered that the Petroleum Industry Act 2021 and other government policies are still encouraging dependence on oil and gas, which provides a huge obstacle to the growth of renewable energy. In all, these related legislations and policies are not fit for purpose in promoting wave and tidal energy and, indeed, renewable energy, thereby achieving set national renewable energy targets of 30%. Accordingly, the strategy for promoting wave and tidal energy resources can be evaluated as a "wait and see" approach, as there is no concrete plan in place to guarantee any progress. Also, an MSP-based initiative would synchronise with the United Nations Sustainable Development Goals (UNSDG) 14 and 17 on Life below Water and partnership as it aims at ensuring conservation of the oceans and its resources through partnership and cooperation among member states.

In addition, this research has substantiated the argument that investors in Nigeria's renewable energy sector have been discouraged by regulatory and policy shortcomings, uncertainty, and delays in policy implementation. Unlike the comparative jurisdictions that the researcher has understudied, Nigeria's financial institutions, particularly local banks, are not as involved in RE projects. This is due to the politically risky environment and unstable foreign exchange rates. Nigeria receives a substantial portion of its funding for renewable energy projects from international donors and agencies, such as the United States, the United Kingdom, Germany, the United Nations Development Programme (UNDP), the World Bank, USAID, and the African Development Bank (AfDB), as illustrated in Table 4, Chapter Four.

In sum, Nigeria's renewable energy budgets have been supported principally by government financing – public funds or subsidies, corporate financing, public-private partnerships, and project financing and these financing come from government institutions, international development finance – World Bank, Africa Development Bank, International Finance Corporation, European Investment Bank and UNDP. Further, commercial banks and private investors also fund renewable energy projects. However, uncertain regulations and policies, policy shifts, delays in decision-making and unclear rules regarding acquisition of land, permits and approvals constitute challenges in the renewable energy sector. Thus, it is argued that Nigeria's renewable energy legal framework has many challenges militating against the development and progress of renewable energy resources. These challenges include legislation and policies, which have diminished the contribution of the renewable energy sector to Nigeria's energy mix.

8.3.3 Objective Three

To critically evaluate what effects, if any, Nigeria's existing Renewable Energy enactments have had on set targets and programmes which support the energy mix.

Although Nigeria has taken steps to formalise renewable energy through legislation, as earlier mentioned in Chapter 4. However, the real impact of reaching established targets and programmes that support the energy mix has been inconsistent. As shown in Chapter 4, Nigeria has established many renewable energy policies, laws, and regulatory frameworks since 2003 to diversify its energy mix, improve energy access, and meet international climate commitments. A brief overview of the policies, legislation, and programmes shows this insignificant impact. As illustrated in Table 2 - Chapter 4, the REMP set ambitious targets for renewable energy penetration, aiming for 20% of Nigeria's electricity supply to come from renewables by 2030. Also, the NREEEP 2015 set a goal for solar energy to contribute 30% of the country's energy mix by 2030, while wind, small hydro, and biomass were also identified as important contributors, exempting wave and tidal energy. Nevertheless, this research revealed that the overall impact of these initiatives on Nigeria's renewable energy targets and

programmes has been limited, resulting from subsisting challenges. For instance, according to Jonathan Okoronkwo, the NERC's Head of Renewable Energy/Corporate Planning and Strategy, at a webinar organised by the Major Energies Marketers Association of Nigeria (MEMAN) under the topic "Energy Transition through Solar Energy, the entry barrier remained a major setback for would-be solar energy users due to the initial cost.[885] However, to reverse this constraint, he said, the government should offer tax breaks, low-interest loans, and grants to reduce the initial capital costs associated with solar energy projects. The inherent entry barrier is caused by bureaucratic bottlenecks and policy inconsistencies, as argued in Chapter 4.

As of October 2024, Nigeria's RE contribution to Nigeria's energy mix stands at about 21%, compared to the missed target of 30%.[886] Several challenges have affected the success of Nigeria's renewable energy enactments, including policy inconsistency and regulatory challenges, weak and inadequate grid infrastructure, and limited mini-grid projects to have a wider national impact. In addition, financing obstacles, such as actual investment in renewable energy, remain low due to access to finance challenges, currency volatility, and a lack of confidence in Nigeria's electricity market. Also, political and economic uncertainty, especially numerous changes in government priorities, fluctuating exchange rates and inflation, have created uncertainty in the investment climate for renewable energy. With Nigeria's continued dependence on international funding rather than rallying domestic investment.

However, there has been some positive development that can be attributed to the new Electricity (Amendment) Act 2024 that decentralised electricity management, as discussed in Chapter 4 – section 4.2.4. In this regard, Lagos State has set an ambitious goal to generate 50% of its electricity from renewable sources by 2030, with programs like "Solar for All" being key to achieving this objective.[887] Nigeria also has a net-zero target or carbon neutrality of 2060.[888] Meanwhile, renewable energy

[885] AEC, 'Nigeria Aims for 5,000MW Renewable Energy by 2030' <https://africanenergycouncil.org/nigeria-aims-for-5000mw-renewable-energy-by-2030/> accessed 23 October 2024.
[886] ibid.
[887] ibid.
[888] Nigeria Energy Transition Plan, 'Nigeria's pathway to achieve carbon neutrality by 2060' <https://www.energytransition.gov.ng/> accessed 23 October 2024.

plays a central role in achieving these emission reduction targets. This researcher argues that it is essential to have a coherent approach to implementing climate policy to develop a national strategy for technology transfer, increase investments in climate-resilient infrastructure, and expedite the transition from fossil fuels to renewable energy sources such as wave and tidal energy resources.

In summary, Nigeria's renewable energy enactments have laid the groundwork for progress, but have not yet resulted in the transformational changes needed to meet the country's renewable energy targets. The contribution of renewable energy to Nigeria's energy mix remains limited, not least without large-scale utility projects and the absence of wave and tidal energy resources in Nigeria's energy mix. Thus, to meet its renewable energy targets and effectively diversify its energy mix, Nigeria needs to improve the extant gaps identified in this research, including specifically dealing with wave and tidal energy, implementing the policies, providing more regulatory clarity, mobilising local financing, and investing in grid infrastructure. It is therefore argued that mitigating these challenges can significantly enable Nigeria to achieve its ambitious targets towards the role of renewable energy in the energy mix and meet its international obligation of carbon neutrality in 2060.

8.3.4 Objective Four

To evaluate RE enactments and policies from other jurisdictions with a focus on wave and tidal energy sources to guide the most appropriate laws and policies to promote harvesting energy from ocean resources through a comparative study of other jurisdictions.

To achieve Objective Four, in Chapter 5, the research adopted the comparative method research, as discussed in Section 2.5. British Columbia, Nova Scotia (Canada), Scotland (UK) and South Korea were selected based on established criteria found in Section 2.6. Fundamentally, these criteria provided the foundation of the legal framework that advanced the laudable development of wave and tidal energy from which Nigeria can learn lessons. In this regard, key criteria include proximity to ocean resources, legal system, system of government, level of technological

development, et cetera. Additionally, the comparative evaluation specifically examined technology, legal framework, incentives, and support systems and budgets. As a result, the research identified similarities, differences and challenges from which Nigeria can draw lessons to develop its have and tidal energy resources.

Essentially, the key findings of Chapter 5 after critical evaluation show that the four comparator-jurisdictions have robust legal frameworks that adequately address wave and tidal energy resources. For instance, the investigation finds that Scotland's legal framework adequately addressed the licensing and acquisition of land in support of wave and tidal energy resources with clearly spelt-out procedures. In addition, the policies in Scotland are dynamic and representative, with mechanisms to allow the participation of stakeholders in its adaptation, not least providing for community participation. In a similar vein, all the comparator-jurisdictions have established robust technological infrastructures, including innovative initiatives centred around private investors, with the government providing appropriate regulatory support.

Thus, upon the critical review of the legal framework of the comparator-jurisdictions, Chapter 6 entailed comparative law analyses to identify the similarities, differences and challenges in the areas of wave and tidal energy technology, legislation and policies, incentives and support systems and budget and financing. The central finding of Chapter 6 is that the legal framework of all the comparator-jurisdictions reasonably supported wave and tidal energy. They have also developed other renewable energy resources, including solar and wind energy resources. Moreover, the development and innovation in wave and tidal energy resources remain an evolving technology that is still expensive but, with innovations, is likely to reduce the cost of generated electricity.

8.3.5 Objective Five

> *This is proposing a framework that will incorporate best practices and lessons from other jurisdictions into the governance of Nigeria's RE legislation, specifically concerning wave and tidal energy resources.*

Chapter 7 addressed Objective Five by recommending a proposed framework covering best practices and lessons based on critical comparative law method research in Chapter 6. Therefore, following the critical and expansive literature review and examination, and by utilising doctrinal law research methodology, this thesis finds that there is an existing gap in Nigeria's renewable energy legal framework as it specifically concerns the development of wave and tidal energy resources. Inherently, as discovered in this thesis, there is a pattern of designing renewable energy enactments and policies without specifically addressing concrete means to develop wave and tidal energy resources. Additionally, the thesis finds that wave and tidal energy are generally grouped under "other renewable energy resources", unlike biomass, hydropower, solar and wind energy, which have been specifically mentioned in every legislation and policy, proactively supported and developed. Nevertheless, Nigeria's wave and tidal resources have been widely acknowledged by most authors as 'potential' sources of renewable energy.

In all, the lack of substantial and concrete policy support for Nigeria's huge wave and tidal energy resources amounts to abandonment and an obvious gap in its renewable energy legal framework. Additionally, the study also finds that Nigeria's renewable energy resources have not made significant contributions and impact on its energy mix. Consequently, the extant gaps in the renewable energy legal framework show a lack of technological infrastructure, archaic legislation, uncertain and uncoordinated laws and policies, and lack of prioritisation of renewable energy, exacerbated by weak financial and budgetary support, all put together, work against the development of all renewable sources of energy in Nigeria. Therefore, this thesis concludes that while Nigeria has huge wave and tidal energy resources, inherent gaps in Nigeria's renewable legal framework have hindered its development. For example, even the

most recent Electricity Act of 2024 did not specifically address wave and tidal energy resources. As argued, the Electricity Act (Amendment) 2024 was amended only after about seven months following signing it into law in July 2023 by Nigeria's President Bola Ahmed Tinubu buttresses. This thesis' conclusion is about inherent gaps and inconsistency in legislation. Consequently, this thesis proposes a robust, inclusive and practical legal framework for Nigeria's renewable energy sector that learns lessons from other jurisdictions, including Canada's British Columbia, Nova Scotia, the UK's Scotland and South Korea.

8.4 Recommendations

In the discussion above, the study aimed at critically assessing Nigeria's renewable energy legal framework, thereby identifying gaps concerning wave and tidal energy and recommending measures to emend it by proposing a robust, inclusive and practicable alternative. Upon investigation, the research findings show that wave and tidal energy resources are not specifically addressed in Nigeria's renewable energy legal framework, not least in legislation and policies. Proactively, the FGN must prioritise design and operationalise an inclusive and robust renewable energy legal framework to achieve Nigeria's renewable energy potential.

In addition, the FGN must engage in a holistic approach in the redesign of Nigeria's renewable energy legal framework to ensure that wave and tidal energy sources benefit from the legal reform. Further, the FGN must legislate and create an enabling environment for all stakeholders to enter and participate in the development and growth of Nigeria's renewable energy sector. Accordingly, the immediate step for the FGN is to reset, recommit and re-strategize its priorities and efforts toward wave and tidal energy resources. Subsequently, this thesis proposes a renewable energy legal framework that is fit for bridging the evident gaps in Nigeria's RE legal system, specifically concerning wave and tidal energy resources. Correspondingly, the proposed RE legal framework seeks to improve the existing one to ensure that Nigeria's renewable energy sector accomplishes set targets, thereby becoming a viable and impactful source of energy in the country's energy mix.

Having critically investigated and comparatively evaluated the wave and tidal energy legal framework of comparator-jurisdictions including British Columbia, Nova Scotia, Scotland and South Korea, the key areas of similarities, differences, and challenges are technology, laws and policies, incentives and support systems and finance and budgets. Other areas critically assessed are stakeholders, community participation and environmental sustainability. Proposing a comprehensive framework for Nigeria's wave and tidal energy legislation and policy can benefit from studying the most effective approaches utilised in other jurisdictions. The suggested framework is categorised into various essential elements: regulatory framework, financial mechanisms, technological advancement, assessments of environmental and social impacts, involvement of stakeholders, and enhancement of capabilities. Presented below is the proposal:

8.4.1 Technological Development

Research and Development (R&D) is the fulcrum of all renewable energy technology growth, not least helping to create technologies that consequently reduce the cost of electricity. For instance, as discussed in Ch. 5, EMEC, Orkney Islands houses Scotland's R&D activities and wave and tidal energy resources are most prevalent in that part of Scotland. As discussed in section 2.2, the South-South region of Nigeria, specifically Akwa Ibom and Rivers States, has been identified as possessing the potential for wave and tidal energy. Therefore, FGN must, as a matter of priority, establish innovation hubs to promote collaboration between key stakeholders, including universities, research institutions, and industry.

- Funding for R&D: The FGN must allocate government funding for R&D in wave and tidal energy technologies.

- International Collaboration: The FGN must identify international partners such as Scotland, British Columbia, Nova Scotia and South Korea with international research organisations to stay abreast of technological advancements and best practices.

- Standards and Certification, which entails technical Standards. The government must develop and enforce technical standards for the design, installation, and operation of wave and tidal energy devices.

- Certification Programs: R&D must implement certification programs for technologies and professionals to ensure high-quality and safe project execution.

8.4.2 Legal and Policy System

Implementation of well-defined legal and institutional frameworks

- Policy Integration: Incorporate wave and tidal energy into the existing national energy policy. Ensure consistency with other pertinent policies, such as environmental, maritime, and industrial policies.
- Legislation: Implement precise legislation for wave and tidal energy, establishing clear ownership of resources, streamlining permitting procedures, and setting rigorous operational benchmarks.
- Regulatory Authority: Establish or assign a regulatory entity specifically focused on marine renewable energy to ensure adherence to regulations, track progress, and promote investments.

Efficient Permitting and Licensing Process

- Establish a one-stop-shop central system for expediting the approval process by implementing a single-window clearance system.
- Explicit Instructions: Formulate thorough instructions for project developers, encompassing procedures for assessing environmental impact (EIA), standards for construction, and requirements for decommissioning.

8.4.3 Incentives and Support Systems

- Incentives and Support Systems.
  Implement Feed-in Tariffs for wave and tidal energy, ensuring a predetermined price for producers of such energy.

8.4.4 Financial Mechanisms and Budgets

- Fiscal incentives: Implement tax holidays, lower corporate taxes, and waive import duties for wave and tidal energy projects.
- Financial support and capital investment. Utilise green bonds to generate funds for marine energy initiatives.
- Public-Private Partnerships (PPPs): promote the utilisation of PPPs to harness private sector investment and expertise in wave and tidal energy projects.
- Provide grants and low-interest loans specifically for research and development activities and the implementation of projects.

8.4.5 Environmental and Social Impact Assessments

- Stringent EIA Procedures Baseline Studies: Carry out thorough baseline environmental and social studies before project authorisation. Cumulative Impact Assessments involve the evaluation of the combined effects of multiple projects that occur in the same geographic area.
- Reduction and Surveillance. Mitigation Plans: Create and execute comprehensive mitigation plans to reduce negative effects on marine ecosystems and local communities.
- Ongoing Surveillance: Implement initiatives to evaluate and mitigate persistent environmental and social effects.

8.4.6 Stakeholder Engagement

- Ensuring the involvement of all relevant parties in decision-making processes.
- Public Consultation: Involve local communities, non-governmental organisations (NGOs), and other stakeholders by conducting public consultations and engaging in participatory planning processes.
- Transparency of information: Facilitate clear and open communication regarding project plans, effects, and advantages.
- Community Benefits To ensure that local communities directly benefit from wave and tidal energy projects, it is important to implement benefit-sharing mechanisms such as community funds or local job creation.

8.4.7 Capacity Building

- Training

  Professional Training: Offer comprehensive training programmes for professionals in the fields of marine renewable energy technologies, policy, and management.

  Academic Initiatives: Establish educational programmes with a specific emphasis on ocean renewable energy within universities and technical institutions.

- Enhancing Institutional Capacity

  Enhancing the capabilities of regulatory bodies, research institutions, and other pertinent organisations through training and allocation of resources. Global standards and exemplary methods: Ensure consistent and ongoing training of institutional staff on the latest international standards and emerging developments in marine renewable energy.

8.5 Conclusion

This framework provides a comprehensive and adaptable approach to integrating best practices into Nigeria's governance of wave and tidal energy resources. Instructively, the current advancements in the energy sector, such as the transition from fossil fuel to renewable sources, necessitate that Nigeria prepare for a future in which WTE may make a substantial contribution to the energy mix. This will be the case as technology becomes more cost-effective, reliable, and tested, and as generation from WTE becomes more dependable. Therefore, to develop its wave and tidal energy resources effectively, Nigeria must establish clear regulatory and institutional frameworks, provide financial incentives, foster technological innovation, ensure rigorous environmental and social impact assessments, engage stakeholders, and build capacity while learning from global experiences.

8.6 Future Research

The areas of future research suggested are:

- Research on the possible impacts of wave and tidal energy development on the marine environment in Nigerian waters. This is essential to ensure the expansion of wave and tidal energy with the preservation of marine ecosystems.

- A further study on the effect of legislation dealing with habitat alteration, especially how these devices affect local species that rely on these habitats for shelter, food, or breeding.

- Study on a possible policy and regulatory framework for environmental protection for establishing a strong regulatory framework to guide the sustainable development of wave and tidal energy projects, including environmental impact assessments (EIAs) and marine spatial planning (MSP). This might allow Nigeria to allocate specific areas for energy development, balancing environmental conservation, fishing, shipping, and other marine uses.

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