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Justice in Solar Energy Development

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Abstract:

To achieve national energy and climate targets across the world, there needs to be a key focus on solar energy development. It is clear from the literature that many countries have enormous, under-utilised potential for solar energy, which can significantly change their energy mix and contribute to the low-carbon ambitions they signed up to under the 2015 Paris Agreement. Our research highlights that there are benefits to solar energy development from a law and economic perspective that are still underexplored. These benefits centre on justice and on how solar energy increases justice within the energy system. From a legal perspective, we review 72 countries and their introduction of energy law and their resulting solar energy development. Our analysis illustrates that it is mainly the developing countries where legislation has not yet led to an increase in the share of solar energy in the energy mix. We then highlight how to achieve solar energy development through law that can provide certainty for investment and stressing the importance of flexibility that allows the full potential of solar energy to be realised within the energy system. The corresponding form of flexibility justice, combining law and economics, can contribute to increased economic welfare based on market reforms that centre on new market structure, market design, and market access while ensuring that it keeps pace with ongoing developments in technology, cost and ownership.

Keywords: solar energy justice; energy justice; flexibility justice; just transition; electricity markets

1. Introduction

The energy transition is happening worldwide. There are many reasons for this in both the practitioner and research literature—ranging from technological development, public health issues, the influence of international actors, etc. However, a significant factor has to be the success of the Paris COP21 climate change negotiations (through the 2015 Paris COP21 Agreement), which have really provided an impetus to the energy transition. The Paris COP21 Agreement is a legal document that calls for change, including more justice in the energy sector. International commitment has been profound, with 195 countries signing and ratifying this agreement. Indeed, the Irish poet Seamus Heaney stated ‘*History says Don’t hope on this side of the grave. But then, once in a lifetime the longed-for tidal wave of justice can rise up, and hope and history rhyme*’ (Heaney, 2018). One of the key energy sources to benefit from the new wave of developments has to be solar energy.

In focusing on solar energy, there is significant research on the development from a technical perspective and its value for reducing carbon dioxide emissions. However, one area that has only received limited attention to-date refers to the justice implications resulting from solar energy development. This paper addresses this literature gap on justice and solar energy from a project-development perspective, which is its first contribution. From a justice point of view, if solar energy is economic and affordable, it will be capable of supplying people with sustainable energy in a just way. A second contribution involves a first exploration of identifying the introduction of energy law and incentives with solar energy development using real-world data. Our analysis shows evidence that it is mainly the developing countries where legislation has not yet led to an increase in the share of solar energy in the energy mix.

A third important contribution of this article is to leverage the development of solar energy and challenge the perception in the Global South that coal continues to be viewed as a cost-effective option. Indeed, a recent statement by the EU Energy Commissioner Kadri Simson (Simson, 2020) highlights how the current (market) system still favours fossil fuels over renewables. Forth, we stress the role of flexibility to harvest the full benefits of solar energy. The term flexibility refers to the ability to balance fluctuating electricity production of solar energy and demand, which is highly important as the sun does not always shine when electricity is to be consumed. As a result, the paper contributes to the growing literature on flexibility and flexibility justice in interdisciplinary energy research scholarship.

Fifth and finally, there is a significant contribution to the role law and economics can play together in terms of planning the future energy sector, with a particular focus on the market design and the timelines that countries worldwide are setting for their climate and energy goals. This is critical because for a country to meet its 2030 energy and climate goals, the law must be formulated, passed, and implemented as soon as possible. This is because energy infrastructure takes not only time to plan, raise finance for, and to build, but there are also significant economic, planning, and environmental hurdles to overcome. In fact, the role of law in solar energy development was recognized (Robbins, 1976) in this journal itself, as early as 1976 in a seminal article. In this latter article, the importance of legal impediments and inducements were highlighted and analysed, but there has been limited work on this since then. It is this gap, which our article aims to contribute to filling.

The structure of this paper in Section 2 examines previous literature of relevance. Section 3 introduces the main concepts of energy law for future solar energy development. The main part of our paper provides a legal analysis of solar energy development in Section 4. Our legal analysis covers 72 countries that have introduced energy law (with an explicit link to solar energy) in the past years. Results from the legal analysis confirm the importance of law and economics for the future development of solar energy, where flexibility plays a crucial role. Flexibility and its future role are therefore elaborated on in Section 5. Finally, the paper concludes in Section 6 with implications drawn from our study.

2. Justice in Solar Energy Literature

2.1 Introduction

Justice has been a mainly overlooked theme in solar energy literature. It is this area where our article aims to make its original research contribution to. In fact, an analysis of previous work shows an apparent lack of literature in this area, as will be explained later. Ensuring that justice is a part of solar energy literature is vital as it presents a further argument of why solar energy development should happen and receive fair treatment in terms of its entry to the electricity market. In addition, this article also contributes to the literature on the role of law in solar energy development.

2.2 General Energy Justice Literature

With respect to general energy justice literature, this paper does not aim to delve into depth and to discuss each form of justice in detail, as this has already been achieved by previous literature (see, for example, Heffron and McCauley (2017) and recent journal special issues on energy justice in *Nature Energy* (2016) and more specifically in *Energy Policy* (2017) or *Applied Energy* (2019)). Briefly, the core forms of justice at the heart of energy justice are given below in line with Heffron and McCauley (2017):

- *Distributive justice*: this concerns the distribution of benefits from the energy sector together with the negatives (in particular, for a polluting energy source).
- *Procedural justice*: the focus here is on the legal process and the necessary full legal steps (that is, are all the steps for an environmental impact statement observed?).
- *Recognition justice*: this concerns the consideration of rights recognized for different groups in society (that is, are we recognizing the rights of indigenous communities?).
- *Cosmopolitanism justice*: this stems from the belief that we are all citizens of the world (that is, have we considered the effects beyond our borders and from a global context?).
- *Restorative justice*: any injustice caused by the energy sector should be rectified; it focuses on the need for enforcement of particular laws (that is, energy sites should be returned to former use, hence waste management policy and decommissioning should be planned and paid for).

What is clear from the academic literature in these journals on energy justice is that solar energy represents a type of energy source that can deliver energy justice

(involving these five forms of justice) more than conventional energy sources, which currently still dominate the market. Utilizing this energy justice framework and ensuring more convergence on research from different disciplines, society can meet its energy and climate goals and have a just transition to a low-carbon economy through solar energy development (Heffron and McCauley, 2018; Heffron, 2018).

2.3 Literature on Solar Energy Development and Justice

The second part of the relevant literature focuses more directly on solar energy development and justice. There is specific literature to this journal that highlights the need for more fairness (procedural and distributive justice) in the market for solar energy to compete (Robbins, 1976; Swain et al., 1979). The literature also focuses on solar justice (Clean Energy States Alliance, 2019) and renewable energy justice more broadly in connection with the energy transition (Howat et al., 2019). This is further elaborated in this paper. Other literature on solar energy and justice now is on different topics which can be identified as looking at¹:

- *Locations of solar energy infrastructure*: this work has more a focus on procedural and recognition justice (Yenneti and Day, 2016; Poruschi and Ambrey, 2019; Saxe et al., 2019; Yenneti et al., 2016; Roddis et al., 2018).
- *Access and benefits from the utilization of solar technology*: this involves more distributive and procedural justice (Lukanov and Krieger, 2019; Kubli, 2018; Simpson and Clifton, 2016; Yadav et al. 2019; Simpson and Clifton, 2016).
- *Increased role of justice, equity, and inclusion*: (Cook et al., 2019; Clean Energy Group, 2018; Vote Solar, 2018).
- *General justice issues*: these generally cover issues from all five justice issues, but in particular cross-border issues of energy justice. Hence, they focus more on cosmopolitan justice (Dolter and Boucher, 2018; McLaren, 2018; Allen et al., 2019; Goedkoop and Devine-Wright, 2016; Broto et al., 2018; Kumar et al., 2019; Banerjee et al., 2017).
- *Policy development*: (Shelly et al., 2020; Shanughnessy et al., 2020; Terashima et al., 2020; Roddis et al., 2020; and Jadidi et al., 2020).
- *Developing countries*: (Yadav et al., 2021; Jurasz et al., 2020; Zell et al., 2015; and Fadlallah and Serradj, 2020).

The research in this article aims to explore justice and solar energy from a project development perspective and in many ways echoes that early article in 1976 from this journal (Robbins, 1976). While justice literature can be general, there needs to be more literature concerning its project development and the conditions, where it gains from and impacts upon the market. There is already first literature on these issues, but this literature is rather economics driven and generally emanates from the practitioner side, including key international institutions such as the World Bank (World Bank, 2020), the International Energy Agency (IEA, 2019), the European Union (European Union, 2020), and the International Renewable Energy Agency (IRENA) (IRENA, 2019; IRENA, 2020a; IRENA, 2020b; IRENA, 2020c).

¹ It should be noted that restorative justice issues receive little attention in the literature on solar energy—a fact, which, however, can generally be expected due to the rather lacking restorative justice perspective in the energy sector.

There are other quasi research and practitioner guides on solar energy development and its prospects, with a key one from the Massachusetts Institute of Technology (MIT) (MIT, 2015). However, all of these reports pay little attention to the justice impacts that solar energy development can bring. It is this literature gap around solar energy justice and project development that this paper makes its major contribution to.

It should finally be noted that much of the existing literature is rather US-focused and/or analyses solar energy development from a more local project (and participation) perspective (Cook et al., 2019; Clean Energy Group, 2018; Vote Solar, 2018). Our research also builds on that literature but by also having a focus on developing countries and exploring the issue of solar energy development from a larger scale project perspective as described above.

3. The Role of Law and the Practice of Justice in Solar Energy Development

3.1 Introduction

Law can play a vital role in enabling new solar energy development, which can, in turn, drive at a national level the energy transition (Zillman et al., 2008). However, to-date there has been slow progress in introducing and/or refining energy law to deliver solar energy development. This section examines in a normative way what generally needs to happen via the reformulation (or the introduction) of energy law through a principle-based approach. A special focus lies on ensuring legal certainty. What then follows in Section 4 is an analysis of 72 countries and their introduction of energy law, including that of developing solar energy.

It should be noted that the aim of this article is to highlight how to improve justice in terms of the development of solar energy. Developed countries have a commitment to support low-carbon energy development (contained within the 2015 Paris Agreement) and indeed a responsibility given they account for a large amount of the world's carbon dioxide emissions. This research does not discuss the debates around these commitments, but rather views solar energy development as a means of achieving increased justice within the energy sector, availing the benefits of this increasingly lower cost energy source.

3.2 General Re-Formulation of Energy Law for Solar Energy Development

If a country is thinking about how to meet its 2030 climate and energy targets, it needs to enact new laws on how to successfully implement its energy transition. There is no common solution to this challenging task, as countries have control over their own energy resources. Typically, countries have different geographies, cultures, and socio-economic characteristics. The three layers of law—international, national, and local law—have roles to play in this development (Heffron & Talus, 2016), and this research here focuses on the national level. It should be acknowledged, however, that local law, as identified in the literature review, can also play a vital role and, therefore, has to be developed accordingly.

In particular, there needs to be a guiding set of principles to follow for the development and application of new energy law to ensure justice within the energy sector. Such

guiding principles can be a driver for transformation. For instance, one may consider one of the most established environmental principles, i.e., the polluter pays principle. In this context, principles of energy law can “*act as a guide to policymakers, academics, lawyers, judges, and arbitrators when adjudicating, enforcing, making or formulating documentation, laws, regulations, judgments, etc on energy law*” (Heffron et al., 2018: 48). There are seven guiding principles of energy law that are summarized below in Figure 1. Clearly, solar energy development aligns with these principles.

Figure 1: Principles of Energy Law.

Principles of Energy Law	
1. The Principle of Natural Resource Sovereignty	<i>The right of a state to use their natural resources in their own national interest</i>
2. The Principle of Access to Modern Energy Services	<i>Access to energy should be available to all citizens of a nation</i>
3. The Principle of Energy Justice	<i>The application of human rights across the energy system</i>
4. The Principle of Prudent, Rational and Sustainable Use of Natural Resources	<i>Natural resources should achieve a balance between economic development and environmental concerns</i>
5. The Principle of the Protection of the Environment, Human Health & Combatting Climate Change	<i>The use of energy and natural resources should comply with the triple objective of protecting the environment, public health, and climate change mitigation</i>
6. Energy Security and Reliability Principle	<i>There should be a secure supply of energy that should also be reliable</i>
7. Principle of Resilience	<i>The different energy activities in the energy system should be resilient so they can plan, recover, and adapt to adverse events</i>

Source: Based on (Heffron et al., 2018) and adapted by authors.

In thinking of the energy transition in developing countries, these principles of energy law should act as a guide. They underline that decisions need to have a *long-term perspective* and should be *integrated*. The continued use of coal—while it may promise advantages in the short-term (i.e., such as reduced cost, better energy access, and increased energy security)—meets few of the other energy law principles.

Indeed, a more thorough analysis of the cost of coal needs to be completed. Cost calculations typically underestimate and/or do not factor in corresponding costs of the public health system, full decommissioning, and pollution costs (including effects on water supply). There are valid reasons why in both the US and UK energy sectors there has been a retraction and banning on coal—in the US, coal is now nearly an all but abandoned industry with the latest indication that gas is more affordable (Victor et al., 2017), while in the UK the plan is to phase out coal by 2025 (UK Government, 2016).

The problems with coal and its cost calculations are even more widespread, as two recent coal projects have illustrated. For example, in a decision in Australia in February 2019 (*Gloucester Resources Limited v Minister for Planning, [2019] NSWLEC 7*), the

judge in rejecting the coal project noted the weak economic benefits of the project—a fact that was also noted in the journal *Nature* (*Nature*, 2019). In Kenya, the costs (and benefits) of a coal project were challenged and seen to be hardly credible in June 2019 (Bloomberg, 2019). Today, coal projects are frequently questioned in terms of the economic and environmental viability, irrespective of whether they are built in the developed or developing world.

Renewable energy, such as solar energy, offers a more feasible option (even in the short-term) that can supply both urban and rural areas in many developing countries. In the long-term, it is more sustainable, protects the environment, benefits human health, and can also increase energy security and access (see Principles 5, 7, and 7 above). Even though they may appear more costly from a short-run perspective, renewable energy projects should be able to raise finance and also go through environmental impact assessment (EIA) processes fast (in this way, reducing overall construction and project finance costs).

3.3 Legal Certainty Reduces the Risk-Profile of Solar Energy Developments

The importance of the long-term focus of the energy law principles highlighted above cannot be understated. These principles, combined with long-term ambitions for the energy sector, can provide legal certainty. Such ‘certainty’ in the energy sector, in turn, leads to a reduction in the risk profile of an infrastructural project and also to a reduction in borrowing costs.

When the renewable energy sector in developing countries is provided with legal certainty, it will be able to develop, grow, and mature. Consequently, investments may flow, and the general cost of financing will tend to further reduce over time. In this way, an affordable and effective energy transition becomes feasible. An example is the transformation of Denmark from its almost 100 % reliance on fossil fuel to renewable energy sources (in particular, wind energy) in the past (Heffron and McCauley, 2014).

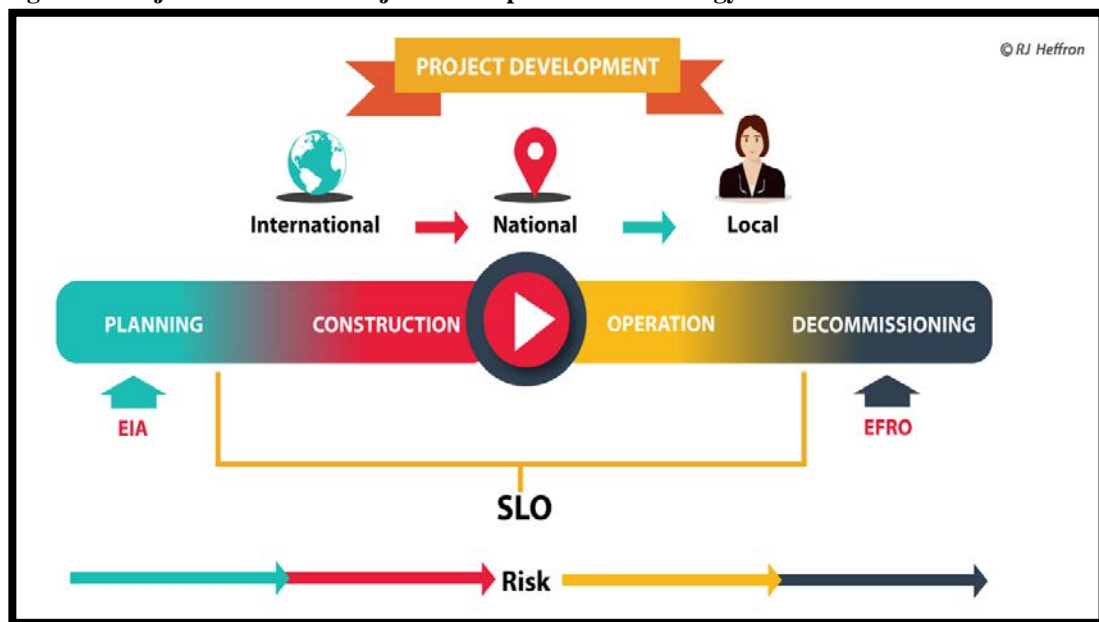
Overall, policymakers need to ensure that investors see a long-term vision in their country, enabled by supporting legislation that provides legal certainty regarding the government’s objectives. While this may generally be difficult to achieve, it has the advantage of providing a platform for securing investor confidence, as investors can then invest in new energy infrastructure projects due to risk reductions. Indeed, new energy law based on the above guiding principles can provide the necessary clarity and certainty for investors and for the public, which are two of the important stakeholders in a country’s energy sector.

The aim of nations is to ensure that the energy transition (including the subsequent development of a just low-carbon economy according to Heffron and McCauley, 2018) results in a positive societal experience with far more benefits and fairness than a retention of the current *status quo*. A recent international report targeting investors emphasizes, how to ensure a just transition to a low-carbon economy and the need to incentivize the private sector with reduced barriers to investment in renewable energy sources (HSBC, 2018).

Generally, legal certainty needs to be provided across the whole lifecycle of an energy project. In this way, it can ensure that all stakeholders of the energy sector can benefit,

including marginalized communities or indigenous communities – however, there is research on the power dynamics of resource extraction which states gradually one stakeholder may begin to benefit more (Zeuner, 2018). The project lifecycle typically comprises the key parts of Environmental Impact Assessments (EIA), the Social Licence to Operate (SLO), and the Energy Finance Research Obligation (EFRO). All these parts, and especially the SLO phase, require the active involvement of the local community. Here, the existence of negotiated agreements helps to further reduce the project risk for the investor—with corresponding benefits for the various stakeholders and not only the investor. In this way, project risk and the creation of legal certainty goes far beyond investors and has many other benefits, especially for local communities where the projects are built, as shown in Figure 2 below.

Figure 2: Project Risk across Project Development in the Energy Sector.



Source: Authors' creation.

4. Legal Analysis: New Energy Law and Solar Energy Development

4.1 Method

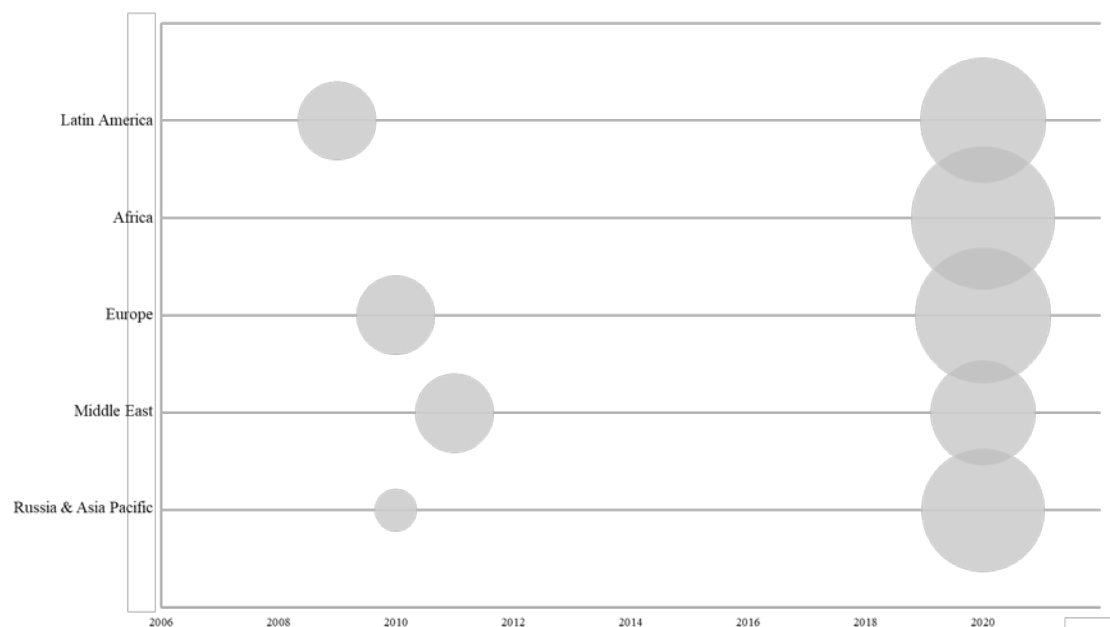
The analysis here involves assessing 72 countries across different regions—Latin America, Africa, the Middle East, and the European Union. Solar energy has clearly existed in different forms for centuries, but it really gained significance with even Albert Einstein publishing a paper on the photoelectric effect (along with a paper on his theory of relativity in 1905). In the following, 1998 is taken as a base year for our analysis, since this is when solar energy technology really began to emerge with rooftop solar technology expansion (US Department of Energy, 2003). Using 1998 as a base year, we determine the year of the introduction of (new) energy legislation that was aimed to incentivize renewable energy, including solar energy. Then, we use data on the solar energy market share of the base year and the year 2020 to derive first evidence on how the introduction of energy law correlated with new solar energy development.

In searching for the legislation and market shares of solar energy, we used data from the International Renewable Energy Agency. The identified legislation was then verified with national ministries whenever language permitted it.

4.2 General Results: Solar Energy Development Legal Analysis

Figure 3 below illustrates global regional pathways for solar energy. Here, we use both the market share of solar energy for the year when energy law was introduced and for the year 2020. We note that data was aggregated for each region.

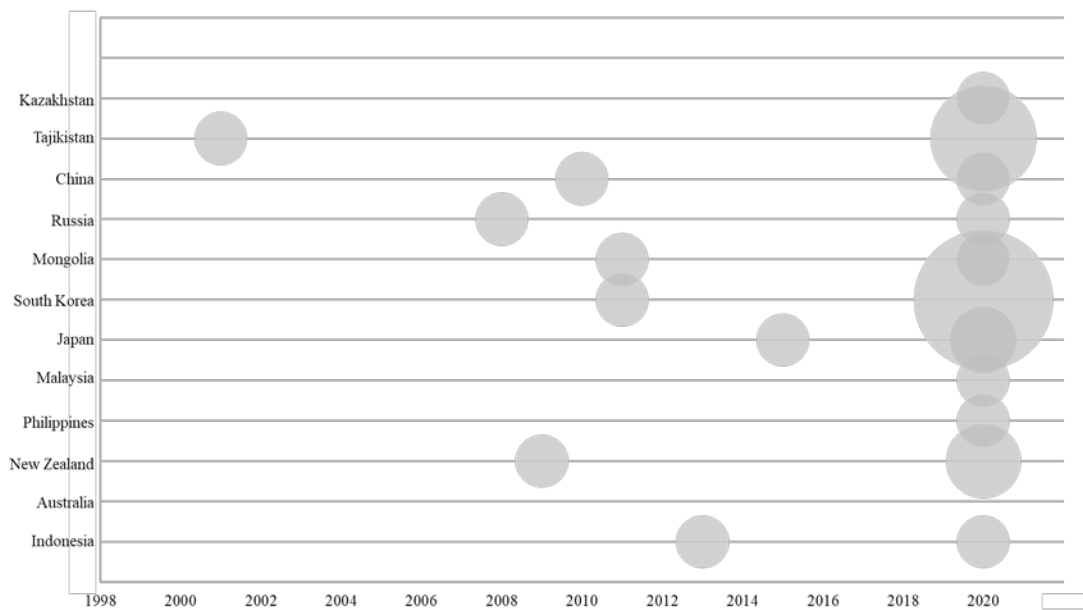
Figure 3: Solar Energy Pathways by Global Region.



Source: Authors' construction.

Figure 3 generally indicates that worldwide solar energy has increased as legislation developed. In order to dive deeper and explore developing countries in some more detail, in Figure 4 we show corresponding pathways for the Asia-Pacific Region and for Russia. In fact, this figure illustrates that there are some countries with notable success in terms of solar energy development, but those are rather developed countries, e.g., Japan. We also see that despite having a law for solar energy, other countries have achieved only limited success like Indonesia.

Figure 4: Solar Energy Pathways in Russia and the Asia-Pacific Region



Source: Authors' construction.

4.3 The case of Indonesia

A country of focus here is Indonesia, as it represents one of the largest developing nations in terms of population size and has an expected population of 295 million by 2030 (Jones, 2014). Indonesia has had renewable energy legislation, but yet this has not opened a real opportunity for solar energy, remaining under just 1% in terms of market share. With respect to legislative development in Indonesia, a key inhibitor in the development of solar energy is the lack of economic incentives for private investors to enter the market. Legal certainty helps to attract private investment into the renewable energy sector via effective regulations and policies (IRENA, 2020; Frankfurt School-UNEP Centre/BNEF, 2019). For investors, legitimate expectation and legal certainty go in tandem, and this (theoretically) means that investors can trust national governments to hold their end of the bargain, as highlighted before. This, in essence, would imply confidence and a subsequent favourable decision when investors make investment choices on solar energy projects in Indonesia.

Indeed, Indonesia mirrors problems in other developing nations, such as in Africa (see Figure 3). The impact of the lack of legal certainty can be seen in the flow of investment into solar energy projects in most developing countries in Africa. Although global investment in renewable energy projects is on the rise (IEA, 2019), the rise is only marginal in Africa (IEA, 2019a). This is despite the view that combined solar energy projects in the region could potentially provide the continent with more than 660 000 Terawatt hours of electricity annually, which is far above its estimated needs (IEA, 2019). Reports and studies on low investments in renewable energy in general and more specifically on solar projects in Africa reveal that investors are apprehensive when it comes to investing their money in developing countries due to the general environment of legal uncertainty and weak regulatory regimes in the energy sectors (Bloomberg, 2019).

5. Into the Future: Targeting ‘Flexibility Justice’ to improve Solar Energy Development

Variable solar energy generation mainly adds value when applied at times of high demand. In addition, we note that the costs for grid integration and management will generally tend to increase with increasing shares of solar energy, as a decentralized solar system requires additional transmission services (Baker et al., 2013). One option to increase the short-run value of solar energy is energy flexibility; that is, the ability of an energy system to better balance fluctuating electricity generation and consumption patterns (Gellings, 1985; Palensky and Dietrich, 2011). In thinking of the practical outcome of flexibility, one could ascribe the need for the notion of flexibility justice—as was stated recently in *Nature Energy* (Fell, 2019).

Flexibility justice is concerned with the operation of the energy sector and aims to ensure the marketplace is open to existing and new stakeholders that (can) supply flexibility, for example, the industry, households, storage facility operators, etc. Flexibility justice is an applied form of justice that aims to deliver energy justice (Powell and Fell, 2019). It fosters new entrants in the energy market (that is, stakeholders). This meaning of “stakeholders” is broadly defined and includes new entrants in terms of technology, ownership, market access, finance, and protection. In terms of the development within societies of a transition to a low carbon economy or a zero-carbon society, markets, therefore, need to change and ensure that they keep pace with developments in technology. Flexibility justice aims at a flexible and dynamic energy system in which the market is open to all players and in which the energy system can, as a result, use the advantages of available technologies accordingly (Heffron et al., 2020). Solar development may contribute to flexibility (justice) if market structures allow stakeholders to participate and benefit from corresponding (welfare) gains.

Against the background of an expected increase in electricity demand, developing countries initially targeted providing their population with a secure electricity supply, i.e. coal in many cases. However, to avoid a lock-in into a fossil fuel future, short- and long-run goals should be addressed and alternate strategies employed. A possibility to approach short- and long-run objectives represents a fundamental adjustment of current structures and a restructuring of existing electricity systems, for example, by liberalizing electricity sectors and introducing new pricing regimes on corresponding wholesale markets that foster flexibility in addition to solar energy itself and in the future developing associated battery technology. Prominent examples are nodal (or zonal) pricing regimes that are successfully used in the US and in many other liberalized countries all around the world (Weibelzahl, 2017).

6. Conclusions

In the research and practitioner literature, there is a gap with respect to work on solar energy development and justice (see Section 2). Increased justice that solar energy development can bring may be associated with economic benefits for the various stakeholders, including consumers. The combination of law and economics can deliver additional impacts to society from solar energy that are overlooked in current literature.

Our legal analysis examines the introduction of renewable energy law in 72 countries internationally. We present first evidence on how the share of solar energy increased in the energy mix over the last decades. In particular, some legislation has struggled to have an impact, especially in developing countries. We highlight how a principle-based approach, where energy justice is at the core, can aid in re-formulating renewable energy law so it can increase its impact. The goal of such reform is to create legal certainty, which investors need in order to make their investments. In addition, also more flexibility within the existing electricity system (and the wider energy system) will be necessary to allow for new solar energy development and its use to be maximized.

Ultimately, our research aims at showing that public decision-making that is guided by different forms of energy justice—such as distributive, procedural, recognition, restorative, and cosmopolitanism—can increase certainty in the market and give investors confidence. Further, our research underlines the benefit of increased flexibility in energy and electricity planning. Here, flexibility justice would ensure that a country is able to benefit quickly, efficiently, and cost-effectively from the broader use of new technological applications such as solar energy.

Finally, this research advances that through have more justice in solar energy development there will be benefits from meeting a country's energy and climate goals. There is a need to diversify energy development and also meet new energy demand (for example, in Indonesia as we highlight), and developing solar energy can meet this twin goal and ensure a just energy transition.

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