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Feed-in Tariff for Solar Photovoltaic: The Rise of Japan

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Abstract: Japan started implementing a national Feed-In Tariff (FiT) mechanism on the 1st July 2012, which included specific payment tariffs for solar photovoltaic (PV) installations. This marks a new era in the renewable energy landscape in Japan. This paper aims at analysing the solar PV prospect in Japan, particularly in both residential and non-residential sectors. The paper presents, first, an overview of energy trends in Japan prior to the Fukushima event. This is followed by a short review of solar PV progress in the country, highlighting the major policies and programmes that have been implemented as well as the installations that have been carried out over the past two decades. Next, the financial impact of the new FiT scheme on consumers is evaluated. The financial analysis investigates the total profit, the average rate of return and the payback period. For a comparison purposes, a similar financial analysis is also conducted with selected countries around the world – namely Germany, Italy and the United Kingdom. The results from this analysis indicate that the new Japanese FiT rate generates a good profit, a moderate rate of return and an acceptable payback period, suggesting an increasing trend of solar PV uptake over the next years.

Keywords: solar energy; photovoltaic; feed-in tariff; financial analysis.

1. Introduction

In March 2011, the coastal region of Tohoku in Japan experienced a massive earth quake with a magnitude of 9.0 on the Richter scale. This was followed by a tsunami that caused widespread damage to the region and crippled the 4.7 GW Fukushima-Daichi nuclear power plant. The severity of the radioactive leakage is considered as the second worst nuclear disaster after the one in Chernobyl [1] and has placed the country into a significant power crisis. The aftermath of this event has seen a turning point in energy production, by shifting Japan's energy policy away from nuclear provision [2].

This paper aims to evaluate the potential of solar photovoltaic (PV) in Japan specifically in the residential and non-residential sectors. The recent introduction of feed-in tariff (FiT) scheme in July 2012 is expected to accelerate the penetration of PV in Japan - mainly due to the lucrative incentive given by the Japanese government. To evaluate the FiT scheme, a financial analysis is carried out to calculate the potential total profit, the payback period as well as the annual return on investment that will be obtained by installing a PV system in Japan. Note that, since it is not practical to cover the financial analysis of various installation sizes, this paper only demonstrates two cases of installations: (i) a 4 kW installation for residential sector, and (ii) a 100 kW installation for a non-residential sector.

Section 2 discusses the energy trend in Japan prior to the Fukushima event. In Section 3, the progress of solar PV installation in Japan is reviewed from 1990s until present time – focusing on the major policies, the incentives as well as on the major programmes implemented by the government. Afterwards, the new FiT scheme is explained in detail in Section 4, while in Section 5, a financial analysis is carried out to evaluate the impact of the FiT scheme on consumers. Finally, the conclusions are presented at the end of the paper.

2. Energy trend prior to Fukushima event

Since the 1950s, the energy consumption in Japan has shown a steady increase [3]. Japan has been relying heavily on fossil fuels to satisfy its energy needs – mainly petroleum, coal and natural gas. When the oil crisis occurred in 1973, Japan introduced a number of measures to reduce its dependency on petroleum [3]. As a result, the energy supplied from petroleum was greatly reduced from 77.4% in the fiscal year[1] of 1973 (FY1973) to 43.7% in FY2010 [3]. The remaining balance of the energy in 2010 was supplied by coal (21.6%), natural gas (17.3%), nuclear power (10.8%), hydro (3.1%) and other renewables (3.5%). The energy is consumed mainly by three sectors: (i) industrial; (ii) transport,

[1] Fiscal year for Japan is from 1 April of the current year until 31 March the following year.

and (iii) commercial and residential.

The rising energy consumption trend is also reflected in a rising in the electricity consumption in Japan. It is reported that around 50% of the primary energy supply is converted into electric power [3]. Based on a recent statistic from Japan's Federation of Electric Power Companies, the electricity consumption in Japan has varied between 945 TWh and 1,030 TWh for the past 10 years [4]. The percentage breakdown of the data is illustrated in Figure 1. Nuclear power has been contributing around a third of the electricity until FY2010, while renewables contributed only about 1% to the share [4]. However, the Fukushima incident pushed for a new reform regarding the nuclear energy future in the country.

In September 2011, the government introduced the "Innovative Energy Environment Strategy" [4] which has three main pillars: (i) to have a society independent of nuclear power; (ii) the creation of a Green Energy Revolution, and (iii) to have a secure and stable supply of energy. The strategy aims at phasing out nuclear power by 2030 through the contribution of renewable energy sources.

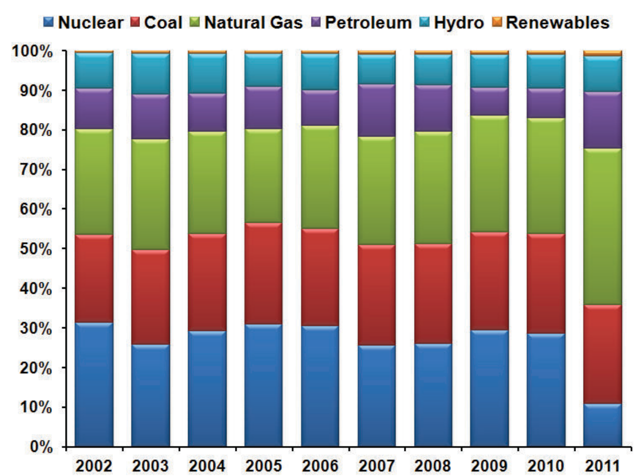

Figure 1: Breakdown of the total electricity supply by energy source for FY2002 – 2011. Adapted from [4].

3. Solar photovoltaic in Japan: Main policies, programme and installations (1974-2011)

Solar PV is one of the renewable energy technologies that has significant potential in supplying the world's energy needs. According to a statistic from BP Global [5], the total installed capacity of solar PV around the globe in 2012 reached 100 GW. Around 71% of the installations were carried out in Europe and Eurasia, 15.8% in Asia Pasific with the remaining balance in other parts of the world [5]. The rising trend of solar PV installation in many countries has been catalysed mainly by the implementation of a financial incentive known as the feed-in tariff (FiT) scheme, which is currently enacted in more than 80 countries [6].

Solar PV is not new in Japan; however, prior to the Fukushima incident, it only played a minor role in supplying the energy demand [2]. The main reason was the lack of a regulatory structure that emphasised on renewable energy [2]. The energy sector is under the responsibility of the Ministry of Economy, Trade and Industry (METI) which has been traditionally, ‘in league’ with organisations that monopolise the utilities and industry, and are also pro-nuclear [2],[7]. This close relationship diminished all attempts towards stringent renewable energy policies [8].

In spite of that, the country did carry out some programmes which helped to increase the uptake of solar PV. In terms of research and development (R&D) activities, in 1974, the Ministry of International Trade and Industry (MITI) funded the Sunshine Project, with a goal of providing a substantial amount of energy from non-fossil sources by 2000 [8]. With the oil crisis in 1979 and the failure of the solar thermal project in 1981, the Sunshine Project enjoyed a generous budget from the government, with an increase of more than 200% when compared with the initial funding [8]. This programme also catalysed the solar PV manufacturing industry to prosper. Some of the companies that benefited from this include SHARP, SANYO and KYOCERA [8].

As for the utility companies and the consumers, the first programme related to solar PV was the net billing programme, which started in 1992 [9]. This voluntary programme was carried out by 10 utility companies whereby each company purchased surplus electricity generated from PV installations with the purchase rate equalled to the retail electricity price (approximately ¥23 per kWh) [9]. In the following year, a specific guideline related to grid connection for solar PV was implemented by the government.

Subsequently, the government introduced a national subsidy programme for residential installation of solar PV in 1994 [9],[10]. The subsidy covered 50% of the installation cost with a maximum ceiling price of ¥900,000 per kW [10]. The installed capacity per household varied from less than 1 kW to 5 kW [11]. The subsidy was reviewed regularly and ceased in 2005. At the end of the programme, the subsidy value had been reduced to ¥20,000 per kW [10]. The programme was a significant success, and it funded over 250,000 installations with a capacity of over 930 MW [10]. It also managed to bring down the average installation cost of the system from ¥1,920,000 per kW in 1994 to ¥661,000 per kW by 2005 [12].

Parallel to the subsidy programme, the government also introduced another renewable energy policy known as the Renewable Portfolio Standard (RPS) in 2003 [2],[13]. This policy obliged the utility companies to generate a specific percentage of the electricity from renewable sources (1.35% by 2010) – including solar PV. However, due to little incentive from the government as well as the termination of the national subsidy for solar PV installations, the utility companies were less interested in expanding into renewables [13]. Unlike Europe, where FiT is the main driver for renewable energy, Japan opted for RPS instead of FiT mainly due to the influence of utility companies [8]. This caused Japan to lose its place as the world leader in terms of solar PV installations [13]. Consequently, the annual installation rate experienced a decline from 2005 to 2008 [9].

When it became clear that the target of achieving 1.35% of the national electricity from renewables by 2010 could not be met, the government restarted the subsidy scheme in January 2009, amounting to ¥70,000 per kW. In addition to that, an FiT scheme was adopted in November 2009 [2]. The scheme was only eligible for solar PV and for an installation of up to 500 kW. For domestic installations, the FiT rate was ¥48 per kWh up to 10 kW and paid for a duration of 10 years [9]. Both the subsidy and the FiT rate were revised on an annual basis. However, unlike the FiT scheme in other countries, Japan's FiT scheme obliged the utility companies to purchase only surplus electricity generated from the solar PV panels. Despite the restriction, the installed capacity grew by more than twice the figure in 2008, reaching a cumulative value of 4.9 GW in 2011 [16]. It is estimated that more than 90% of the PV installations were carried out in residential buildings [15]. This FiT scheme ended on the 30th of June 2012 [9]. Figure 2 summarises the progress of solar PV installations in Japan from 1992 to 2011.

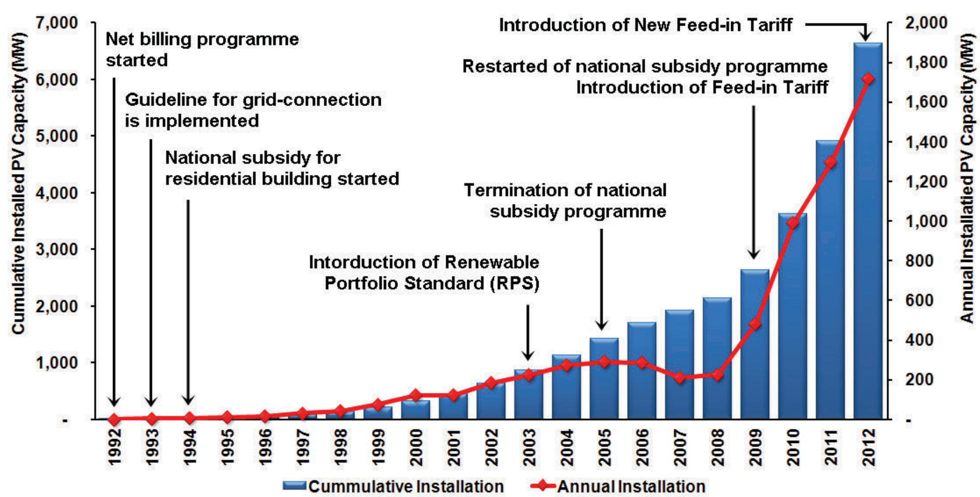

Figure 2: The progress of solar PV installations in Japan (1992 – 2011). Adapted from [9],[16].

4. New Feed-in Tariff Scheme

The Fukushima event has pushed for an aggressive reform in the country's energy policy. The Act on Purchase of Renewable Energy Sourced Electricity by Electric Utilities (Law No. 108) was passed in August 2011 in which a more comprehensive FiT was introduced [17]. The new FiT started on the 1st of July 2012 and incorporated other renewable energy sources besides solar PV, namely wind, geothermal, hydro and biomass [4].

The scheme is aimed at achieving between 20% and 35% of the energy from the renewables by 2030 [18]. Specifically for solar PV, it is expected that the installed capacity to grow up to 28 GW by 2020 and to 50 GW by the end of 2030 [18]. The FiT scheme is financed by the consumers themselves, with an average increase in the electricity bills of ¥100 per month [19].

The new FiT scheme is targeted at non-residential segments, such as large-scale PV projects, in the commercial and industrial sectors [15],[20]. According to the New York Times, Japan could surpass Italy to become the world's second-biggest market for solar power and possibly capture the top spot from Germany in terms of installed solar PV capacity [19]. This is mainly because of the lucrative FiT tariff, which is currently more than double the tariff offered in Germany and over three times the amount paid in China [21]. The scheme could increase revenue from renewable generation and related equipment to more than $30 billion by 2016 [21], with around $9.6 billion is projected from solar PV [19].

The rush to exploit this lucrative FiT from solar PV has caused the domestic shipment of solar related products into Japan to increase by 80% (627 MW) within 3 months of the launch date [22]. Besides established local solar PV companies, international solar PV companies (for example from China) have also started entering the Japanese market to take advantage of the scheme [19]. At the end of 2012, it was recorded that 1.7 GW of solar PV has been installed in Japan – an increment of 33% when compared with the previous year (see Figure 2) [16]. This pushed the total cumulative installation of solar PV to 6.6 GW [16]. The growth from non-domestic sector increased from 15% in 2011 to 30% in 2012 [16].

Several mega solar projects have started their operations by December 2012 [23]. Amongst the companies involves in these projects include ORIX Corporation and KYOCERA Corporation. In June 2013, ORIX announced that it is developing a total of 28 plants around Japan with a total installation of 143.2 MW (see Table 1) [24]. These projects are expected to start operations between July 2013 and June 2015 [24]. KYOCERA on the other hand had launched a 70 MW solar plant in Kagoshima prefecture which covers an area of 1,270,000 m^2 [25]. With a total cost of ¥27 billion, it is expected that this plant will produce 78.8 GWh of electricity annually – enough to cover the electricity requirement of 22, 000 households [25]. Figure 3 shows the aerial view of the plant.

Table 1: Solar projects proposed by ORIX Corporation. Adapted from [24].

No.	Location	Scale (MW)	Expected Annual Output -	Start of Operation

			Based on 1st year sales (GWh)	(Expected)
1	Hokkaido	18.2	19.06	12/2014
2	Hokkaido [a]	10.2	11.88	05/2014
3	Hokkaido	21.0	23.89	12/2014
4	Fukushima	2.1	2.37	10/2013
5	Ibaraki	5.6	6.07	10/2013
6	Tochigi [b]	2.5	2.40	01/2014
7	Gunma	2.6	3.00	03/2014
8	Toyama	2.5	2.63	01/2014
9	Yamanashi	2.7	3.37	11/2013
10	Nagano [a]	8.0	9.50	03/2014
11	Aichi	2.8	3.25	12/2013
12	Mie	1.7	1.77	12/2013
13	Mie	8.5	9.06	04/2014
14	Hyogo	2.5	2.79	03/2014
15	Hyogo	4.7	5.24	06/2014
16	Okayama	2.5	3.05	02/2014
17	Yamaguchi	2.9	3.06	03/2014
18	Kagawa	2.3	2.49	09/2013
19	Fukuoka [c]	11.7	12.78	06/2015
20	Fukuoka [d]	1.2	1.40	07/2013
21	Fukuoka [d]	1.3	1.46	03/2014
22	Nagasaki [d]	1.5	1.71	02/2014
23	Nagasaki [d]	1.3	1.45	11/2013
24	Oita [c]	2.2	2.33	02/2014
25	Kagoshima [c]	2.3	2.79	12/2013
26	Kagoshima [c]	8.7	8.74	09/2014
27	Kagoshima [c]	7.8	8.30	12/2014
28	Kumamoto [e]	1.7	1.82	09/2013
	Total	143.2	157.66	

[a] Joint development with Sharp Corporation
[b] Development by ORIX Golf Management
[c] Joint development with Kyudenko Corporation
[d] Joint development by Kyuko Lease Inc. and Kyudenko Corporation
[e] Joint development by Kyuko Lease Inc, Kyudenko Corporation and JFE Engineering Corporation

Figure 3: The 70MW Kagoshima Nanatsujima Mega Solar Power Plant [25].

For domestic PV installations, the terms are similar to the previous FiT scheme with a rate of ¥42/kWh paid for 10 years. The non-residential sector on the other hand, has a rate of ¥40/kWh paid for 20 years [9]. Because of the lucrative FiT incentive for the non-residential installation, it is projected that the non-residential sector will start to dominate the installation market in Japan. At the end of 2012, it was reported that the annual installation of residential sector share reduced to 70% from 85.4% in 2011. The Solar Electric Power Association (SEPA) has projected that the residential market share from the total installed PV capacity will reduce from 90% to 70% by 2020 [15]. GTM Research claimed that the residential sector will suffer a sharp decline in terms of installation from 2013 onwards [20]. Table 2 shows the summary of the solar PV programme in Japan for the residential sector from 1992 until the present time.

Table 2: Summary of residential solar PV programme in Japan. Adapted from [9].

Item	Net Billing Programme	FiT for Surplus PV Power	New FiT
Enforcement	1992 – 31/10/2009	01/11/2009 – 30/06/2012	01/07/2012 onwards
Legislation	None. Voluntary scheme by utilities.	Yes. Obligation to utilities.	Yes. Obligation to utilities.
Capacity	Not mentioned. Maximum capacity recorded was 5 kW.	10 KW	10 kW
Purchase rate	Averaging at ¥24/kWh	2009: ¥48/kWh 2010: ¥48/kWh 2011: ¥42/kWh	2012: ¥42/kWh
Purchase term	Not defined	10 years	10 years
Subsidy	Available between 1994 and 2005. 1994: ¥900,000/kW 2005: ¥20,000/ kW	2009 : ¥70,000/kW FY2011: ¥48,000/kW* FY 2012: ¥30,0000** or ¥35,000/kW***	FY 2012: ¥30,0000** or ¥35,000/kW***

* System cost: < ¥600,000/kW
** System cost: > ¥475,000/kW up to ¥550,000/kW
*** System cost: up to ¥475,000/kW

5. Financial analysis

This section presents a financial analysis[2] investigation of the impact of the new FiT scheme on the participants. Similar analyses on other countries have been carried out by the authors and are presented in [26]-[28]. This section analyses three parameters; the total profit, the average return on investment (ROI) and the payback period. Based on the nomenclature provided in Table 3, the relationships between each financial parameter are given in Equations (1) to (5).

First, the installation cost is calculated, which largely depends on the PV output rating. Next, based on the output rating and the value of annual solar insolation, the yearly electricity output in kWh is estimated and is later multiplied by the FiT rate to obtain the annual FiT income. The annual revenue is

[2] The analysis was conducted on the 10th December 2013. The FiT rate, the total cost of implementation and the exchange rate may vary once this paper is published, which consequently will vary the total profit, the average return on investment as well as the payback period.

obtained by subtracting the yearly maintenance cost from the annual FiT income (Eq. (1)). The total revenue for the whole contract period is calculated by multiplying the annual revenue by the duration of contract (Eq. (2)). The total profit generated is equal to the difference between the total revenue and the subsidised installation cost (Eq. (3)). To get the payback period, this figure is generated by dividing the subsidised installation cost with the annual revenue (Eq. (4)) while the average annual return on investment is calculated by dividing the total profit with the subsidised installation cost over the contract period (Eq. (5)).

Table 3: Nomenclatures for the financial analysis.

Abbreviation	Description
C	Installation Cost
E	Annual Electricity Savings
F	Annual FiT Income
M	Maintenance Cost
PP	Payback Period
R	Annual Revenue
ROI	Average Annual Return on Investment
S	Subsidy
T	Contract Duration
TP	Total Profit
TR	Total Revenue

$$R = F + E - M \qquad (1)$$

$$TR = R * T \qquad (2)$$

$$TP = TR - [C - S] \qquad (3)$$

$$PP = (C - S) / R \qquad (4)$$

$$ROI = (TP / [C - S]) / T \qquad (5)$$

To ease the calculation, a number of assumptions are made: (i) each site is retrofitted with solar panels with a capacity of 4 kW for residential installation and 100 kW for non-residential installation; (ii) the installation cost is paid in full at the beginning of the project – no loan is taken to fund it; (iii) the solar panel maintains 100% performance during the contract period; (iv) 100% of the electricity is exported back to the grid; (v) the maintenance cost is 1% of the capital cost [29], and (vi) the calculation is performed for the duration of the contract period, e.g. 10 or 20 years for any installation (depending on the size) implemented in Japan. Furthermore, the results are compared to the ones obtained for selected countries in Europe that have enacted the FiT scheme. These are Germany, Italy and the United Kingdom – owing to the fact that the FiT implementation has been a success in each of the country. The Japanese currency has been converted into Euros (€) based on the exchange rates on the 10th of December 2013 where ¥100 was equivalent to €0.708 [30]. As for the United Kingdom, £1 was equivalent to €1.196 [30].

5.1 Residential sector

It has been indicated in Section 3 that the Japanese government has been promoting solar PV installations in residential sector since 1992. To evaluate the effectiveness of the new FiT policy, it is good to compare the financial return of this scheme with the previous incentives offered by the government. In this section, three cases are evaluated: (i) the net billing programme (together with the national subsidy) in 1994; (ii) the FiT for surplus PV power in 2009, and (iii) the new FiT scheme. The calculations take into account the installation cost of solar PV at the start of each incentive as well as the subsidy provided by the government.

Figure 4(a) shows the installation cost of solar PV and the total profit gained from the installation of a 4kW solar PV under each scheme. The average ROI and the payback period are illustrated in Figure 4(b). The detail calculation for the residential installation is presented in Table 4. From the analysis, it is found that the new FiT provides a superior financial return when compared with the previous two incentives. The new FiT scheme in Japan generates a total profit of about €3,773, with an average ROI of 3.04%. The ROI is close to the value anticipated by the government, which is 3% [18]. In terms of payback period, it is calculated that the investment could be recovered in 7.7 years.

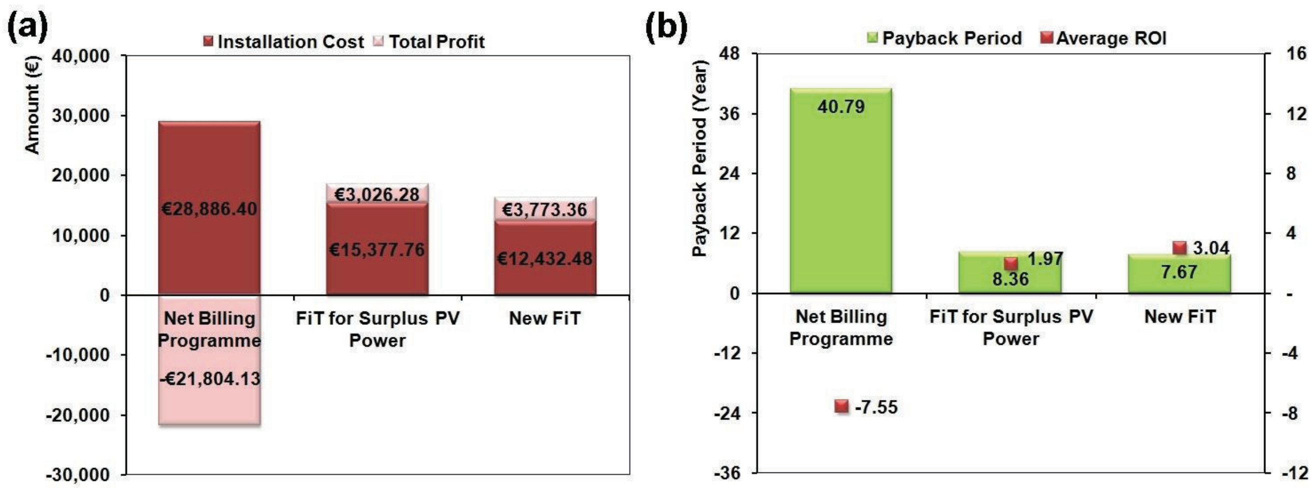

Figure 4: Financial analysis of a 4 kW installation of solar PV on residential building in Japan under different incentives where: (a) the installation cost of solar PV and the total profit, and (b) the payback period and the average ROI gained from each scheme.

Table 4: Financial analysis of a 4 kW solar PV installation on residential building in Japan under different incentives.

Item	Unit	Net Billing Programme	FiT for Surplus PV Power	New FiT
Average Yearly Solar Insolation [31]	kWh/m^2	1,467.00	1,467.00	1,467.00
Installation cost (with subsidy) [9],[16]	€	28,886.40	15,377.76	12,432.48
Electricity generated from the 4 kW PV panel	kWh	5,868.00	5,868.00	5,868.00
Contract Period	Year	10.00	10.00	10.00
FiT rate [9]	€/kWh	0.17	0.34	0.30
Income from FiT Scheme				
Generation of Electricity	€	997.09	1,994.18	1,744.91
Maintenance per year [29]	€	288.86	153.78	124.32
Annual Revenue	€	708.23	1,840.40	1,620.58
Total Revenue at the end of contract year	€	7,082.27	18,404.04	16,205.84
Investment Analysis				
Total profit	€	- 21,804.13	3,026.28	3,773.36
Payback Period	Year	40.79	8.36	7.67
Average Annual Return on Investment	%	-7.55	1.97	3.04

The comparative financial analysis between Japan's new FiT scheme and with the FiT scheme available in selected European countries is also evaluated. Figure 5(a) shows the installation cost of solar PV and the total profit gained from the installation of solar PV in each country. The average ROI and the payback period are illustrated in Figure 5(b). The detail calculation for the residential installation is presented in Table 5. Although the total profit is the lowest when compared to other countries, Japan is placed third behind the United Kingdom and Germany in terms of ROI, which is good considering that its FiT duration is only half the duration of the others. In terms of the payback period, Japan requires the least time to recover the investment, with a payback period of only 7.7 years. The European countries require between 7.8 and 13.9 years to regain the cost of installation. Based on this analysis, it could be argued that the moderate ROI could still encourage participants from the residential sector to install solar PV in their households.

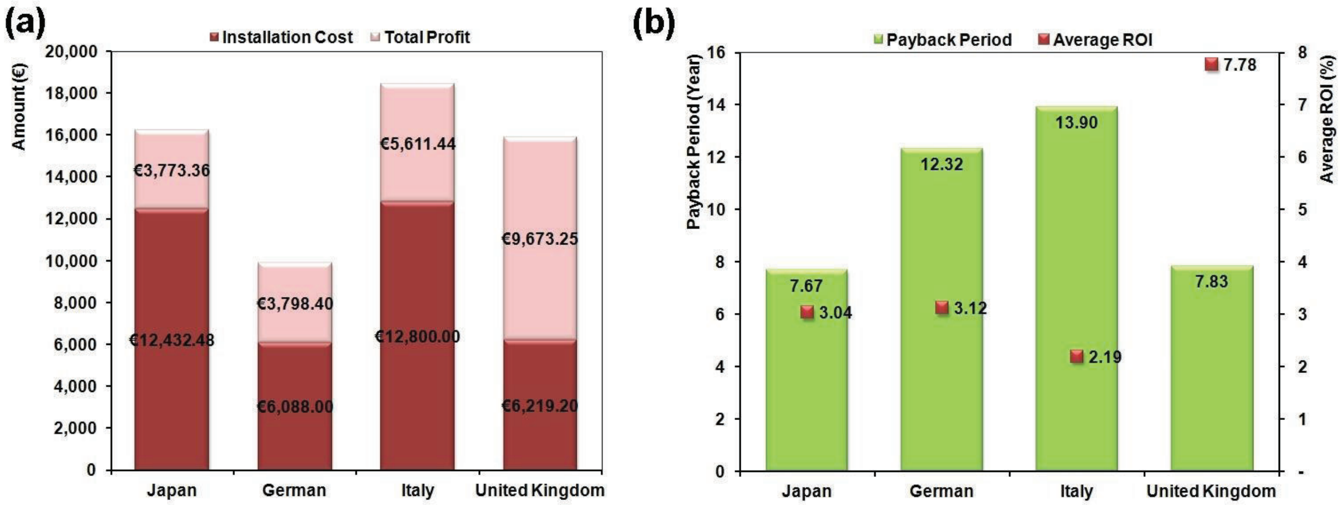

Figure 5: Financial analysis of a 4 kW solar PV installation on a residential building in each country where: (a) the installation cost of solar PV and the total profit, and (b) the payback period and the average ROI gained from the scheme.

Table 5: Comparative financial analysis of a 4 kW solar PV installation on a residential building in Japan and selected countries in Europe.

Item	Unit	Japan	Germany	Italy	United Kingdom
Average Yearly Solar Insolation [31]-[34]	kWh/m^2	1,467.00	1,000.00	1,533.00	1,000.00
Installation cost (with subsidy) [9],[16],[35]-[37]	€	12,432.48	€6,088.00	€12,800.00	€6,219.20
Electricity generated from the 4 kW PV panel	kWh	5,868.00	4,000.00	6,132.00	4,000.00
Contract Period	Year	10.00	20.00	20.00	20.00
FiT rate [16], [38]-[40]	€/kWh	0.30	0.14	0.17	0.21
Income from FiT Scheme					
Generation of Electricity	€	1,744.91	555.20	1,048.57	856.81
Maintenance per year [29]	€	124.32	60.88	128.00	62.19
Annual Revenue	€	1,620.58	494.32	920.57	794.62
Total Revenue at the end of contract year	€	16,205.84	9,886.40	18,411.44	15,892.45
Investment Analysis					
Total profit	€	3,773.36	3,798.40	5,611.44	9,673.25
Payback Period	Year	7.67	12.32	13.90	7.83
Average Annual Return on Investment	%	3.04	3.12	2.19	7.78

5.2 Non-residential sector

Figure 6(a) shows the installation cost of solar PV and the total profit gained from the installation for each country, while the average ROI and the payback period are illustrated in Figure 6(b). The detail calculation for the residential installation is presented in Table 6. The new FiT scheme in Japan generates a total profit of close to €459,634 - the highest when compared to other countries. The profit is more than eight times the amount receives by Germany (€54,800). Japan is placed first in terms of ROI, with an average value of 7.43%. The ROI is higher than the value anticipated by the government, which is 6% [18]. In terms of payback period, Japan requires the least time to recover the investment, with a payback period of only 8 years. The European countries require between 9 and 15 years to regain the cost of installation. Based on this analysis, it could be speculated that the lucrative ROI would encourage the participants from the non-residential sector to invest heavily in installing solar PV.

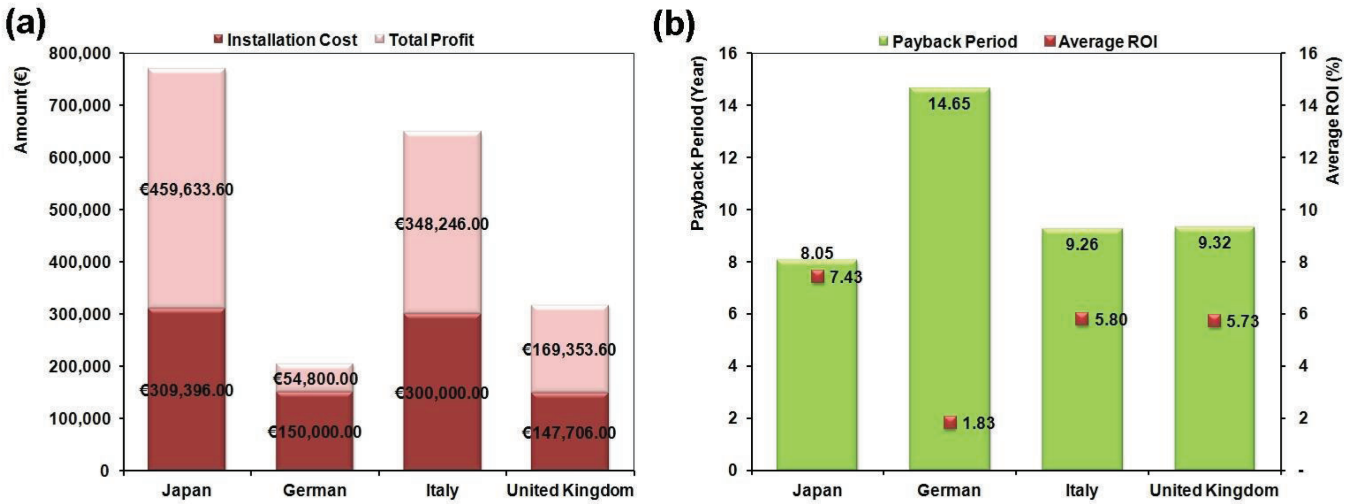

Figure 6: Financial analysis of non-residential installation of a 100 kW solar PV plant in each country where: (a) the installation cost of solar PV and the total profit, and (b) the payback period and the average ROI gained from the scheme.

Table 6: Comparative financial analysis of a non-residential installation of a 100 kW solar PV plant in Japan and selected countries in Europe.

Item	Unit	Japan	Germany	Italy	United Kingdom
Yearly Solar Insolation [31]-[34]	kWh/m^2	1,467.00	1,000.00	1,533.00	1,000.00
Installation cost [16], [37],[41],[42]	€	309,396.00	150,000.00	300,000.00	147,706.00
Electricity generated from the 100 kW PV panel	kWh	146,700.00	100,000.00	153,300.00	100,000.00
Contract Period	Year	20.00	20.00	20.00	20.00
FiT rate [16],[38]-[40]	€/kWh	0.28	0.12	0.23	0.17
Income from FiT Scheme					
Generation of Electricity	€	41,545.44	11,740.00	35,412.30	17,330.04
Maintenance per year [29]	€	3,093.96	1,500.00	3,000.00	1,477.06
Annual Revenue	€	38,451.48	10,240.00	32,412.30	15,852.98
Total Revenue at the end of contract year	€	769,029.60	204,800.00	648,246.00	317,059.60
Investment Analysis					
Total profit	€	459,633.60	54,800.00	348,246.00	169,353.60
Payback Period	Year	8.05	14.65	9.26	9.32
Average Annual Return on Investment	%	7.43	1.83	5.80	5.73

6. Conclusions

Solar PV shows potential as an option of electricity generation in Japan. The government has introduced a number of programmes and fiscal incentives to increase the penetration of solar PV in the country since the 1990s, with a total cumulative value of 6.6 GW. Around 90% of the installations have been carried out in residential buildings. Although there has been significant growth in terms of installation, solar only contributed to less than 1% to the electricity generation in Japan prior to the Fukushima incident.

Subsequently, the government has revamped their long term view on the country's energy policy - by reducing the dependency on nuclear energy and focusing more on renewables. With the recent introduction of the FiT in the second half of 2012, it is expected that there will be a significant growth in terms of numbers of solar PV installations – particularly in non-residential sector. This is proven by the financial analysis conducted in this paper that shows any non-residential installation (with an installation size of 100 kW) in Japan could gain as much as €459,634 with an ROI of 7.43% annually. The return is the highest when compared with installations conducted in European countries.

However, some analysts argued that the latest FiT could diminish the installations of solar PV in the residential sector. Based on the financial analysis conducted in this paper, it has been calculated that any 4 kW installation combines with the new FiT scheme could generate a reasonable profit (around €3,773), moderate ROI (approximately 3.04%) and an acceptable payback period (about 7.7 years). The financial analysis also suggests that the return is acceptable when compared to those available in European countries.

It can be concluded that this could and would potentially attract more interest in installing solar PV in both domestic and non-domestic sectors, giving a much better outlook in relation to solar PV installations in Japan.

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