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A study on global solar PV energy developments and policies with special focus on the top ten solar PV power producing countries

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ABSTRACT

The mitigations of global energy demands, climate change and energy related greenhouse gas effects are the most important factors in the modern days. However, renewable energy is one of the alternative sources which has the capacity to mitigate all the above. Among all the renewable energy sources, solar energy is one of the most abundant and the cleanest energy source. Different laboratories of the world have achieved different solar cell efficiencies, which are also discussed in the present paper. This paper presents the global solar PV developments, per capita values, government supportive invectives and policies of the top ten solar power producing countries. This paper also presents the investments of the global solar energy among the countries. Finally, through the study, it is found that these top ten leading countries are following fulfilment of their projections, supportive tariff rates, net metering, green certificates and government incentive policies as their instruments.

Contents

1. Introduction

Energy is a vital factor for the socioeconomic development of any country. About 80% of the world's energy demand comes from fossil fuel [1,2]. However, till date coal is the major source of electricity with sharing of electricity by 42% and continues to be the prime source of electricity in many countries in the coming few decades. The highest levels of electricity will be generated in the non-OECD countries. The generation will be increased by an average of 3.3% per year than the demand of these countries [3]. But, after a few years, it will be impossible to generate electricity from fossil fuels like coal

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and the others. It is projected that 40% of electricity generation from coal in 2008 will decline to 37% of electricity generation by 2035. This decreasing trend is pressurized for meeting the energy demands specially for our futures. It is predicted that, if the current global energy consumption pattern continues, the world energy consumption will be 50% more by 2030. Again, it is estimated that the large scale industries use nearly about 45–50% of the total energy consumption in the developing countries. The different organizations such as the US Energy Information Administration (EIA), the International Atomic Energy Agency (IAEA), the International Energy Agency (IEA), the World Energy Council (WEC) have given their future energy demands by different projections like for 2020, 2030 and 2050 [4]. The use of fossil fuel could have the capacity in regional, local and environmental challenges. So, a clean energy system has the capacity to neutralize the environmental impacts [5]. That clean energy is renewable energy which could have the capability of meeting the energy demands as well as mitigating the global warming. In the past few years, it has been observed that renewable energy technology is steadily maturing and its share of energy has been going up [6]. By the end of 2012, the renewable energy sources supply is nearly 16.7% of the total energy consumption. It is estmated that by the end of 2012, the total energy shared from renewable energy was about 1470 GW (including hydro) which was up by about 8.5% capacity of the year 2011, whereas hydro power alone shared 990 GW and other renewable energy sources shared 480 GW. Globally, it is estimated that wind energy added more than 39% of the total renewable energy capacity followed by hydro and solar PV each 26% in 2012. By the end of the year 2012, solar PV crossed a big milestone with the total capacity of 100 GW and took its position as the third largest capacity after hydro and wind energy. Renewable energy has produced more than 26% of the total global power generating capacity and it has supplied 21.7% of global electricity, whereas hydro has shared 16.5% of the global electricity. By the end of 2012, the EU-27 countries and BRICS shared the total renewable energy capacities by 210 GW and 128 GW, respectively. The countries like China, USA, Germany, Spain, Italy and India played crucial roles in the global energy markets and they shared the total capacity of renewable energy (not including hydro) by 90 GW, 86 GW, 71 GW, 31 GW, 29 GW and 24 GW, respectively. In the USA, the net electricity generation from renewable energy was 12.5%. At the end of 2012, Germany had consumed electricity up to 22.9% (up from 20.5% in 2011) from renewable energy and it met 12.6% of the energy demand. In Germany, the total power generation of renewable energy was 136 TWh (which was more than 10% of 2011), with the share of 33.8% of wind energy, 30% of biomass, 20.65% of solar PV and 15.6% of hydro energy.

Due to the economic crisis and policy changes, Spain's renewable energy addition was slowed down. Spain fulfilled only 32% of the energy demand from renewables, i.e., it decreased from 33% of energy in the year 2011. Similarly, Italy shared 27% of energy demands from renewables. During the period of 2012, India added more than 4.2 GW capacity of renewable energy including 0.7 GW from hydro and the remaining from renewables (mostly from wind), exceeding the total renewable energy capacities by 66 GW. It is estimated that by the end of 2012, India installed 31% of renewable energy (including hydro), and 11% of renewables (non-hydro), respectively. It is expected that India's annual clean energy investment will go up by 763% between 2010 and 2020. The BRICS shared 36% of renewable energy (including hydro) and 27% of renewable energy (not including hydro) by the end of 2012. Among these nations, Russia has shared the highest hydro energy, whereas countries like Brazil, India, and particularly China have shared the highest non renewable energy [7].

However, among all renewable energy sources, solar energy is one of the most abundant and the largest potential energy source in the world. The solar radiations reaching the earth's surface vary from 0.06 kW/m^2 at high latitudes to 0.25 kW/m^2 at low latitudes. It is given that the total global ice-free land is around 13,000 MHa, from this theoretically power collected from the solar source is about 21,840 TW. In particular, solar PV possesses a huge potential both in technical and sustainable solutions to the energy demands [8]. Different authors have estimated the technical average power potential of solar PV and some authors have also estimated both present and future solar densities in the global market, which is presented in Table 1 [9].

The rapid falling of the solar cell costs in the past few years has been making energy generation at a widespread rate in the global scenerio. However, the efficiency of solar cell is one of the important factors for stabilizing of the technology. Different laboratories of the world have achieved different efficiencies by using different materials in the period 1975–2010, which is shown in Fig. 1. The figure shows that by using the material GaAs, solar cell efficiency had achieved the highest by about 40% at the end of 2010. The new materials for solar cells, i.e., dye-sensitized and organic base cells were still rated at low efficiency with only 5.4% until 2010. The monocrystalline solar cell had 24.7% efficiency, polycrystalline cells had 20.3% and thin film technology had 19.9% in 2010 [10].

It is projected that the electricity generated from solar energy will be increased to 402 TWh by 2030, while electricity generation from PV will be 280 TWh. It is estimated that during the past five years, the total capacity of solar PV grew with average rates of 60% annually followed by CSP 43% and wind 25% [7].

Table 1
Estimations of global solar PV technical potentials by different authors.
Source: Ref. [9].

Authors	Power potential (TWe)	Present power density (We/m^2)	Future power density (We/m^2)
DeVries	170–490	20	25–50
WWF	57		
IPCC, 2012	53.5, 50–1580 (PV+CSP reviewed range)	21.6	
Grassl et al.	33 (sustainable)	23.5	42
Jacobson	170–340	12.6–16	
Jacobson–Delucchi	340		
Nakicenovic	>213		
Hoogwijk et al.	53.6	14.4	24.4
Hoogwijk	42.2	18.6	
Hofman	42		
Sorensen	52		
Zerta et al	23–46 (sustainable)		
De Castro et al.	2–4 TWe (techno-sustainable)	3.3	3.3 (2.5–5)

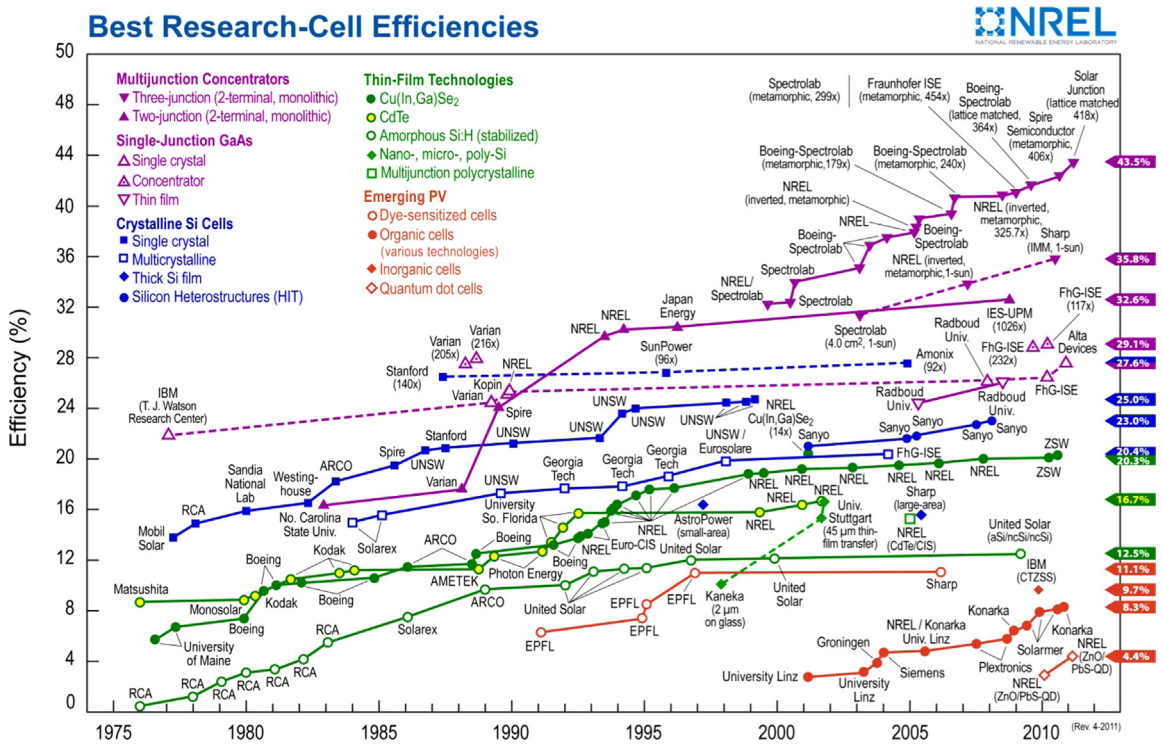

Fig. 1. Solar cells efficiencies found by different laboratories in the Global market by the end of 2010.
Source: NREL.

2. Global solar energy scenario

2.1. Global overviews

At the end of 2012, the new added installed global solar PV capacity was nearly about 29 GW, which was one-third of the total global capacity. During the year 2012, the market was fairly stable as compared to 2011. At the end of 2012, global energy invested $244 billion, which was 12% less than investment of 2011 and 8% above the investment of 2010. This decline of investments is due to not supportive policies in Europe and USA. China again dominated for the investments of USD 64.7 billion, followed by the United States (USD 34.2 billion), Germany (USD 19.8 billion), Japan (USD 16.0 billion), and Italy (USD 14.1 billion) in the global renewable energy sectors. The developing countries invested more than 16.6% and developed countries fell by 29% in 2012 as compared to 2011. In 2012, solar energy investment was more money by USD 140.4 billion (solar PV, USD 135.1 billion and CSP, USD 5.3 billion) as compared to other sources in the renewable energy. Germany, Italy, USA, China and Japan the five investor countries played an important role in the solar power by 2012. European Photovoltaic Industry Association (EPIA) has projected two scenarios on global solar energy developments, *i.e.*, the policy driven scenario and moderate scenario are shown in Fig. 2. In moderate scenario, the grid connected PV system would be 100 GW by 2012–13 while in the case of the policy driven scenario, more than 350 GW PV systems would be connected with the PV systems [6]. Europe's share dropped by 14%. Many solar manufacturers were from China, nearly about 650.

2.2. Regional overview

During the period 2000–2012, the EU countries led in the addition of renewable energy; nearly 70% of the global renewable energy capacity was added by these countries. Again European countries dominated the solar PV capacities in the global markets.

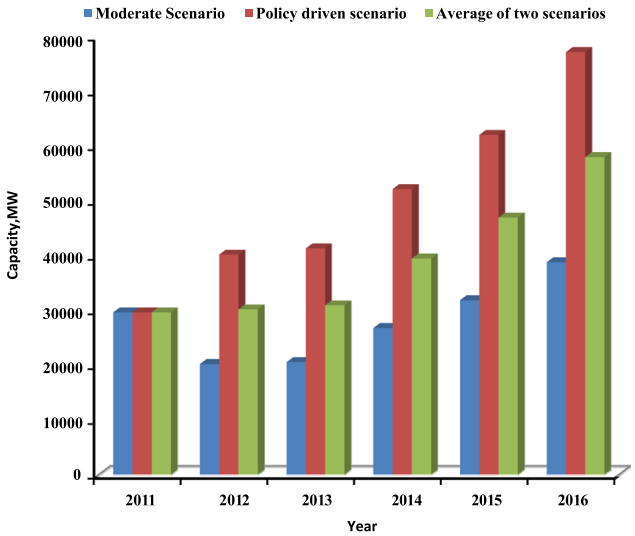

Fig. 2. Global annual market scenarios until 2016- moderate and policy driven.
Source: EPIA's 2016 predictions for solar PV market.

It is accounted that more than 16.9 GW was coming from Europe, which was 57% of the new installed capacities in 2012. But the additions had fallen down from 22 GW as compared to the new additions in 2011. This is due to large additions falling down in Italy, because of the country's FIT policy. However, both Italy and Germany added more new installed capacities of solar PV as compared to the wind energy. After EU, Asia added solar PV by the countries Japan and China including Korea, India, Taiwan and Thailand during the period of 2012 and was placed in the second position with a total new installed capacity of 7 GW. The third leading was North America by adding of the new installed capacity of 3.6 GW by the countries like USA and Canada. In Saudi Arabia and the Middle East–North Africa regions also interest in solar

power is being driven by rapid increases in energy demand, a desire to free up more crude oil for export, and high insulation rates. The market for building-integrated PV (BIPV) solar panels that double as singles, walls, or other building materials represents less than 1% of solar PV capacity being installed world-wide, amounting to an estimated 100 MW added in 2012. The economic downturn has slowed construction, dampening BIPV growth. Europe is the largest market with more than 50 companies active in the sector. By the end of 2012, eight countries in Europe, three in Asia, the United States, and Australia had at least 1 GW of the total capacity. South-East Asia had dominated by Thailand due to favorable policies.

2.3. National overviews

The top-most solar PV capacity countries such as Germany, Italy, USA, China, Japan, Spain, France, Belgium, Australia and Czech Republic had added new installed PV capacities by 7.6 GW, 3.6 GW, 3.3 GW, 3.5 GW, 1.7 GW, 0.2 GW, 1.1 GW, 0.6 GW, 1 GW and 0.1 GW, respectively (shown in Fig. 3, the last six years installed capacities). By the end of 2012, Germany shared the highest capacity of solar PV with generated 28 TWh of electricity during the period of 2012, up 45% over 2011. Italy reached a total capacity of 16.4 GW; however, the 3.6 GW brought on line was far lower than additions in 2011. The leaders for solar PV per inhabitant were Germany, Italy, Belgium, the Czech Republic, Greece, and Australia.

Considering the per capita values of the top ten countries of PV capacity in the global markets, Germany gives the highest values of 0.39 kW/capita followed by Italy 0.27 and Belgium 0.24 kW/capita whereas China and USA give poor values such as

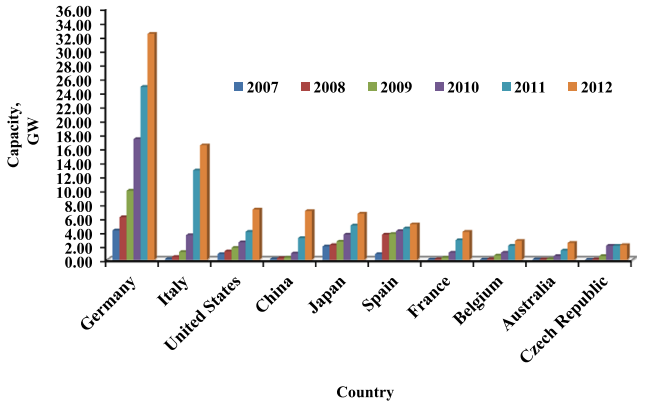

Fig. 3. Solar PV cumulative installed capacity of the top ten countries in the past six years.
Source: EPIA, REN21, 2012.

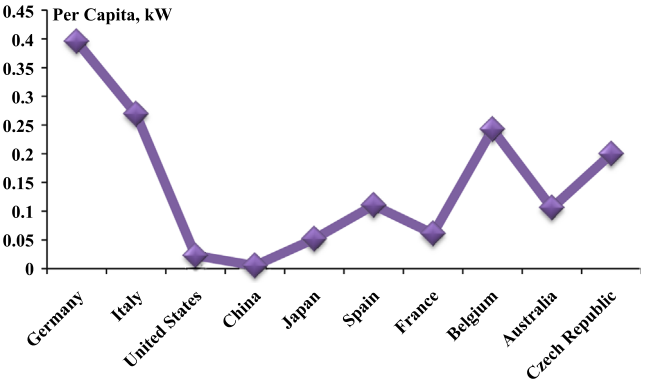

Fig. 4. Top ten countries of PV capacity in kW per capita.

Table 2
Top ten solar manufacturer suppliers in the world by the end of 2012.

Sl. no.	Top ten solar module manufacturer's Name	Country	Installed in 2012 (MW)
1	Yingli	China	2300
2	First Solar	US	1800
3	Trina Solar	China	1600
4	Canadian Solar	China	1550
5	Suntech	China	1500
6	Sharp Solar	Japan	1050
7	Jhinko Solar	China	900
8	Sunpower	US	850
9	REC Group	Norway	750
10	Hanwha SolarOne	China	750

0.005 and 0.022 kW/capita, respectively, which are shown in Fig. 4.

World's top 50 companies shared more than 4 GW PV capacities by the end of the year 2012 and 12 countries across Europe, North America, and Asia had solar PV plants of over 30 MW. A number of large-scale projects are going with the capacities range of 50–1000 MW worldwide. The year 2012 was good for PV distributors, consumers and installers. However, it was bad for cell/module manufacturers due to lower profits. The average price of silicon crystalline solar module has fallen by 30% or more whereas thin film price has fallen down by 20% [7]. During 2012, nearly about 31.9 GW of crystalline solar cells and 35.5 GW of solar modules were produced. Among the top 15 solar PV manufacturing companies, 11 companies were from Asia (9 companies from China and 2 companies from Japan). Yingli took the first position followed by First Solar (USA) and Trina Solar (China). The top ten solar PV manufacturing companies' ranking is shown in Table 2.

Energy policy is an important term for energy growth rates and it directly addresses the energy security for supply, environmental impacts and costs. And it is importantly supported by the research and technology development, industrial innovations and market creations; governments may improve the positioning and competitiveness of their domestic industries in world markets and simultaneously solve domestic energy needs [11]. More than 70 countries in the world have driven their energy policies for the development of renewable energy in the country by 2017. Thousands of cities in the world have adopted the renewable energy policies or laws for targeting the renewable energy and mitigations to the climate changes.

3. Solar PV policies of the top ten countries globally

3.1. Germany

Germany is one of the leading countries for the development of renewable energy sectors. Since 1974, after the oil crisis, Germany started its renewable energy policy. The important policy RES-E has been introduced in the renewable energy sectors since 1979. This policy has two important features, i.e., regulating of prices or quantity produced and support of the investments in RSE-E capacity. The first climate Enquete Commission recommended a goal to reduce the carbon dioxide and methane gas by 80% by 2050 [12]. The goals of the German Government are to extend the renewable energy and make the climate friendly with secure energy supply [13]. For promoting renewable energy sectors, the German government has adopted different laws such as Electricity Feed Law in the year 1990 and Renewable Energy Law in the year 2000, which play an important role. These laws mandated the purchase of renewable generated electricity by electric utilities and also offered large subsidies and government loans to renewable power producers.

Some of Germany's biggest companies are entering the renewable business and backing the innovations needed to expand the scale of the industry. In 2010, the National Renewable Energy Action Plan (NREAP) has projected that to share the renewable energy in Germany 38% by 2020, 50% by 2030, 65% by 2040 and 80% by 2050 and also, the total cumulative capacity of solar PV would be 51.75 GW by additions of 3.5 GW per year. Germany's National Sustainable Strategy was adopted in 2002 for achieving the different types of energy sources with their targets, like the climate gas emissions will be cut 40% by 2020 and 80–95% by 2050 (both compared to 1990 levels), to raise the share of renewable energies in final energy consumption to 18% by 2020 and to 60% by 2050 and to increase the share of electricity from renewable sources in total electricity consumption to at least 35% by 2020 and at least 80% by 2050. It has been seen that Germany shared the biggest capacities of solar PV capacities during the past decade [14]. According to Reuters, Germany aims to reduce the greenhouse gas emissions by 40% from the levels of the year 1990–2020 from the solar power [15].

The country has a national target to reach solar PV capacity with 51 GW by 2020. In 2000, power generation from solar power was 64 kWh but at the end of 2012, the power generation was 28,060 GWh, which shows a huge increase in demand for the generation of solar power. However, the rapid rise in PV capacity is a big question for German government policy in grid connected systems. The total number of PVs installed by the end of 2012 was 1,280,000. In the year 2011, Germany added its solar PV capacity very rapidly, about 40% of the new PV capacity came from the month of December. This is due to the fact that during the initial part of the year, there were problems with the weather conditions and slow FITs. The German Solar Industry Association (BSW-Solar) estimates that the solar power shares will be increased to 70% in the next fours in German electric mixer. According to the Prognos AG, the generations of shares of electricity from solar energy will be doubled by 2016 and consumer electricity price would be increased by 2.5 times. Robert Bosch GmbH (RBOS), the world's biggest car parts supplier based in Stuttgart, has invested about 1.5 billion Euros into its solar energy business by purchasing companies and building new plants in 2011. The country has forecast to take the benefits from photovoltaics about 56–75 billion € by 2030. The German solar industry sets targets increasing the share of electricity demands by solar PV by 10% in 2020 and by 20% in 2030 [16]. In addition to promotions of solar energy in research and development through the EEG plays an important role in global. More than fifty institutes have done research works on solar PVs. According to EuPD research, more than EUR 300 million was invested in PV R&D by the industry in 2010 and the German Patent and Trademark Office registered 290 German patents in solar technologies in 2010 alone [17].

Again, the German Government introduced a new policy "Renewable Energy Sources Act (EEG) 2012," the purpose of this policy is to facilitate the developments of sustainable energy for protecting the environmental effects, to reducing the cost of energy supply of the national economic and to promote the further developments of technologies for power generations of electricity from renewable energy sources. The share of electricity from renewable energy will be at least 35% by no later than 2020, 50% by no later than 2030, 65% by no later than 2040, and 80% by no later than 2050. On 30 June 2011, the German Bundestag adopted the "Act on the amendment of the legal framework for the promotion of electricity generation from renewable energies" (Gesetz zur Neuregelung des Rechtsrahmens für die Förderung der Stromerzeugung aus erneuerbaren Energien), which completely revised the EEG. The revised version was promulgated in the Federal Law Gazette on 4 August 2011 (BGBl. I p. 1634), and entered into force on 1 January 2012. The minimum tariffs were paid from the time of commissioning for a period of 20 years plus the year in which the installation was commissioned. The tariffs described below refer to the installations commissioned on or after 1 January 2012. As a rule, for all newly commissioned installations from this date tariffs are lowered on 1 January of each following year by a fixed percentage (degression rate). Tariffs for electricity from solar radiation are an exception: this tariff can fall on 1 January, and, where there is a high level of new build, also on 1 July of each year, depending on the new build of the previous year (flexible cap). If the installed capacity of installations registered within the twelve months before 30 September of the previous year is between 2500 and 3500 MW, the degression rate of 9% does not change at the end of the year. If within that period the registered installed capacity exceeded 3500 MW, 4500 MW, 5500 MW, 6500 MW or 7500 MW, with the increase in degression rate by 3, 6, 9, 12 or 15% points, respectively. By the end of each month of October, the Federal Network Agency (BNetzA) has announced Federal Gazette for the registered installed capacity, the resulting degression percentage rate for the following year and the tariffs. The BNetzA announced that the installed capacity of installations registered within 1 October 2010 and 30 September 2011 was about 5200 MW. Therefore the degression rate will be 15% as per the date 1st January 2012 [18,19].

Under Section 33(2), there is still entitlement to a (lower) tariff if electricity from solar radiation is not fed into the grid but is used by the installation operator or a third party (tariffs for own consumption). The government established feed-in-tariffs (FITs) that gradually decreased over a 20-year period to reward rapid adoption of renewables, while also ensuring that green-power generation would eventually become competitive. According to the German Solar Industry Association (BSW-Solar), the expansion of renewable energy sources now only makes up 0.15 cents or around 15% of the increase in the EEG surcharge, only 0.08 cents of which are attributable to photovoltaics. According to the Federal Ministry for the Environment, the costs incurred by new solar power systems have fallen by around 85% since 2010. According to current calculations by the German Solar Industry Association, about 70% in (ErneuerbareEnergien-Gesetz) EEG surcharge and thus the lion's share of this increase is attributable to causes not associated with the construction of new wind or solar power systems, namely, falling prices at the electricity exchange (36%) that are not passed on to electricity consumers and the expansion of industrial privileges in the apportionment of Energiewende costs (33%) [19]. German households paying among the highest electricity rates in the EU (and rates are set to rise again in 2014), industry is also feeling the bite despite EEG surcharge exemptions, worth about €4 billion, for energy-intensive sectors [20]. Germany's long term policies have a significant impact on reducing of soft cost, which associated with solar installation, such as permitting, inspection, interconnection, financing, customer acquisition. The EEG law Amendment in June 2012, major policy change under the PV Amendment is that the amount of electricity compensated under the FIT is limited to 90% of the system output for systems 10 kW–1 MW in size. The remaining 10% can be consumed on site, sold in wholesale markets or compensated at the average daytime spot

Table 3
Germany's solar PV tariffs for electricity fed into the public grid plan.
Source: German, EEG.

Sl. no.	Types	€cent/kWh
Free standing installations		
1	Not buildings	17.94
2	Sealed or converted land	18.76
Installations in, attached to, or on top of buildings		
3	Up to 30 kW	24.43
4	30–100 kW	23.23
5	100 kW to 1 MW	21.98
6	Over 1 MW	18.33

price markets (approximately 3–5€ cents/kWh). Table 3 shows the FIT levels as of January 2012, for electricity generated from solar PV.

But, the EEG did not set any limits or quotas on the amount of wind or solar capacity that could be installed, either in a given year or on a cumulative basis. The EEG modified a cumulative solar PV capacity limit of 52,000 MW, at which time FIT incentives will no longer be available for new projects. Germany preferred to use FIT reductions as policy adjustments, and a federal project registry to monitor and manage renewable electricity capacity additions. Generally, the purpose of the federal project registry is to provide the government with solar PV market transparency in order to quickly assess capacity installation levels over a certain period of time. The EEG introduced the solar PV grid connected policy in January 2012, the key of this policy changes includes 20–29% tariff cuts in April 2012 and monthly FIT reductions that use a degression approach based on capacity installations referred to as "corridor" degression. This change in policy encourages self-consumption of solar electricity and selling electricity in the wholesale power market [21]. In Germany, the banks also support the developments of solar PV either for the small industries or large industries, even in current economic crisis days [22].

The German FIT maximizes the investors' transparency, longevity and certainty (TLC) within the costs of overall costs or benefits. The main component of TLC is how feeds in tariffs link to and integrate the border climate change and renewable energy goals. Since 2007, the country has targeted to share the solar PV capacity by 30–50% on annual basis and projected to share 66 GW by 2030 [23]. The country newly proposed to cut out the subsidies on FITs up to 30%, limited the payback of electricity produced, and eliminated the self-consumption bonus. The effect will be taken from January 2013 but apply to everything installed by March 9, not April 1 as many had thought. (The previous FIT structure would have cut the levels by another 15% in July) [24]. That meant that customers were in effect simply plowing money into massive profits for the booming solar industry. Politicians in Berlin have become alarmed that the policy is becoming harmful for Germany. The rapid rate of panel installation has translated into high costs for utility companies and customers. Moreover, overcapacity and competition from cheaper solar modules, produced in Asia, mean that many domestic companies can not compete. Fig. 5 shows the solar PV prices have steadily decreased by 65% since Q2, 2006–Q2, June 2012 in Germany industry markets.

Starting from May, the FITs will be reduced monthly by 0.15 € cents/kWh for all new systems. All new small systems will be remunerated for 85% of the electricity produced; medium-sized and large-sized systems will get back 90%. However, German FIT will require for utilities to buy electricity from solar projects of 10 kW or smaller for 19.5 Euro cents per kilowatt hour (kWh) on a 20-year contract. Larger projects (over 1MW) will get just 13.5 Euro cents per kWh.

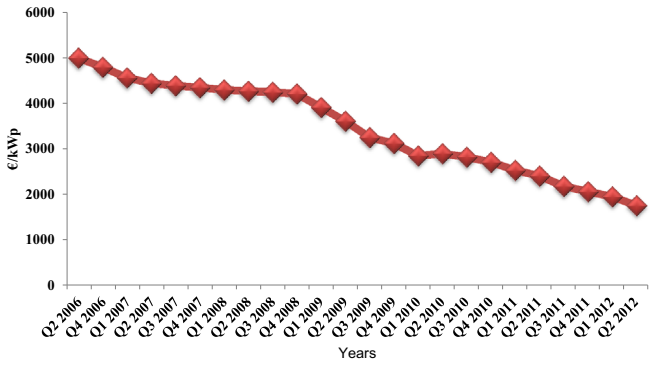

Fig. 5. PV price index – system prices decreasing steadily.
Source: German Solar Industry Association (BSW-Solar), June 2012.

3.2. Italy

Climate change is one of the important issues facing Italian energy policy makers. Under the EU burden sharing agreements, Italy is obliged to reduce the greenhouse gas effects by 6.5% as compared to the year 1990 in the period of 2008–2012 [25]. The European Commission estimates that 20% target will make it possible for renewable energy to cut CO_2 emissions by 600–900 million tonnes per year, generating savings of between 150 billion and 200 billion, if the price of CO_2 rises to 25 billion per tonne [26].

However, Policy is an important instrument in the European countries under a variety of schemes. In order to comply with the EU renewable energy directive, Italy has targeted to share 17% of renewable energy by 2020. To meet this target, Italy has implemented various policies such as green certificates, feed-in tariffs, market premiums, and reverse auctions for promoting renewable electricity generation, renewable heating/cooling, and transportation.. According to Italy's National Renewable Energy Action Plan (NREAP), the country has a target of sharing 26.4% of electricity from renewable energy. Italian energy policy can support the renewable energy sectors, but it is unclear and has faced several routes as per change in government directories. According to the Italian government, Italy had nearly met its renewable electricity production goal at the end of 2011, nearly eight years ahead of schedule [27]. Multiple government organizations such as Gestore dei Servizi Energetici(GSE), Gestore dei Mercati Energetici (GME) and Autorita per l'Energia Electrica e il Gas(AEEG) are involved in promoting the renewable energy policies in the country. The country has projected that renewable energy will be shared by 35% in 2020 [28]. Solar PV dominates in Italy's renewable sectors, due to good incentives and high solar radiation attracting developers from across the globe, especially in southern Italy [29]. The cumulative moderate projection by EPIA is to install 23 GW of solar PV by the end of 2016. It is estimated that 5.6% of national energy demands were fulfilled through solar PV in Italian energy markets [7]. The Government of Italy has introduced the renewable energy quotas and green certificates for the development of renewable energy since 1990. However, only the FIT (known as Conto Energia) is supported for the solar power generations and it was introduced in the year 2005 and later modified in 2007 (D.M. 28/07/2005, 06/02/2006, 19/02/2007, AEEG deliberation 188/05 and its updates), in 2010 (DM 6/08/2010) and in 2011 by Legislative Decree 28/2011 and DM 05/05/2011. The Italian Energy Service Provider (Gestore dei Servizi Energetici, GSE) issued the tradable green certificates (TGCs), the body in charge of collecting resources from electricity suppliers and giving them to the producers. The 4th Conto Energia, which operates from 2011 to 2016, Conto reduced the FIT (20–30%) and it allowed the new additions of 4 GW PVs in 2011 [30]. The 4th Conto still foresees at the time of publication that FITs should not cost more than "€ 6–€ 7 billion a year" [31]. However, for solar energy the Conto Energia V Policy has been introduced forcefully from August 2012 with a validation period of 20 years. The Conto Energia V, introduced the average incentive cuts of 43% for ground-mounted installations and 39% for rooftop systems when compared to incentive levels that were available prior to August 2012. The FITs' range from €0.106/kWh to €0.182/kWh is dependent on the size and location of the project. Additionally, the policy encourages self-consumption (on-site use) of solar PV electricity by providing premiums (€0.024–€0.100/kWh) for electricity and, not feeding into the power grid. The Conto Energia V policy includes an expenditure cap of €6.7 billion annually for solar PV. Since non solar renewable electricity projects are eligible for receiving the feed in premiums from

January 2013, solar PV installations came down by more than 50% in 2012 as compared to the installed capacity of 2011 [32]. The Government of Italy also introduced a net metering policy that will allow the solar PV projects with capacities less than 200 kW to receive compensations for electricity generation. The Government of Italy also introduced a tax-based policy which allows the owners of solar roof top PV installation capacity less than 20 kW to deduct 30–50% of system capital expenditure over a period of 10 years. The new target is to install 23 GW of solar PV by 2016, while the National Renewable Energy Action Plan (NREAP) targets to install 8 GW by 2020.

3.3. Japan

The Fukushima Daiichi nuclear disaster, Tōhoku earthquake and tsunami had impacts on all aspects of human life in Japan, particularly Japanese energy policies and politics. For facing the energy demands, the government has taken the projection for renewable energy between 25% and 35% of the total power generation by 2030, by which time some $700 billion will be invested in new, renewable energy. The Agency for Natural Resources and Energy (ANRE) has announced the present installations between April 1, 2012, and February 28, 2013, renewable energy has reached 1,662,000 kW, among which photovoltaic power facilities accounted for 1,559,000 kW [33]. The "Energy Policy Paper after 3.11" released by the Institute for Sustainable Energy Policies (ISEP) proposed a medium- and long-term strategy for installations of renewable energy by 100% of total power consumptions by 2050. The Central Environmental Council, the Global Environmental Committee of Ministry of the Environment, and the Energy Supply Working Group have announced a target for the share of renewable energy by 30% in 2030 in the long term projection. The Kiko Network gives its projection that achieves "three 25s " by 2020: reducing electricity consumption by 25%, reducing greenhouse gas emission by 25%, and supplying 25% of electricity from renewables [27].

Japan generates solar PV of about 4–5 TWh per year, which is less than 1% consumption of the nation [34]. The Japanese Government has taken the projections to reach the capacity of 28 GW and 53 GW for solar PV by the end of 2020 and 2030, respectively. The New Energy and Industrial Technology Development Organization (NEDO) has also reviewed its road maps of 2004 PV technology. Japan proposed the FIT in the solar PV at the rate of 0.534 USD per kWh for 20 years. However, considering the subsidy of 35,000 Yen per kW (FY2012) granted for power generation using systems for residences, the price will be 48 Yen in effect [35].

In March 2012, the Procurement Price Calculation Committee introduced the policy for purchase periods and prices in renewable energy sources like solar, wind, geothermal, small hydro, and biomass. However, taking account of the committee's report, The Ministry of Economy, Trade and Industry officially announced the details of the FITs system, such as the purchase period and the purchase price in the form of ministerial ordinance in mid-June and it started the work for promoting of solar photovoltaic installation capacities [35]. The FIT is one of the most attractive, with PV systems below 10 kW receiving ¥42/kWh (~$0.53) and systems above 10 kW receiving ¥40 (~$0.51). The solar PV could have a capacity supply of 6–8% of the total energy supply.

In 2009, Japan restarted a new policy for giving the subsidy for the residential PV systems and also introduced a new program for the purchase of surplus PV power. Through this policy, more than 99% of PV systems were installed into grid connected systems, distributed applications and residential PV systems. The Ministry of Economy, Trade and Industry allocated budgets for market revitalization, subsidy for installations of residential PV systems, technological developments for PV power generation, field testing of new technology, grid testing of large scale PV power generations and developments of an electric PV power energy system. Japan's FIT attracted lies to the investors to pay with subsidies of 42 Yen per kWh, which is very high for a period of 20 years. According to Reuter (the news agency), Germany offered incentives on solar energy by the double. Many European countries are providing subsidies on technology, which causes fall of the solar module and cell prices, and certain companies will be most benefitted by it, e.g., Panasonic and Sharp solar. In July 2012, financial services company Orix started construction of a 21 MW solar power plant on idle land inside the Tokachi Speedway circuit in Sarabetsu, Hokkaido, in a spot that boasts of one of the highest levels of sunlight in Japan. Another banking firm, Japan Regenesis Trust, meanwhile, announced it has started operations of its one-megawatt "Smart Farm" in Urakawa Town, Hokkaido, on 5 acres (2.15 ha) of land once used to raise horses.

3.4. France

In 2008, the European Union adopted for meeting the renewable energy of 20% by 2020. In 2012, ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie) has given its road maps for climate change and energy by 2030 and 2050. By 2030, to reduce the energy consumptions by 18%, to increase the renewable energy shares by 35%, to reduce the carbon dioxide by 40% as compared to 2010. Similarly, by 2050, to reduce the final energy consumptions by more than 45% and share the energy by more than 55% as compared to the 2010 scenario [36]. France developed a growth rate of 41% in the renewable energy sector from 2006 to 2011 scenarios. In order to do this, France has also given its targets of reaching the share of renewable energy by 23% generating nearly 225,000 jobs in renewable sectors by 2020. France added new $5 billion investments in the clean energy sectors with the fifth highest growth rates in G-20 out of more than $4.4 billion investments in the solar sector. From the past five years' scenario, it is observed that nearly 33% investments are in the solar energy sector after investments in wind energy. France experienced a 35% decrease in clean energy investments in 2012, falling to $4.3 billion, and placed in the 13th rank in G-20. The solar sector continued to garner the bulk of clean energy investment, $3.9 billion, more than 90% of the overall total. France received sufficient solar energy radiations with 1200 kWh/m²/yr (optimally inclined plane facing south) in the North to more than 1700 kWh/m²/yr in the South [29]. France has set out to install 5400 MWp capacity of solar PV by 2020.

Law no. 2000-108, dated 10 February 2000 and its implementing decrees (the Electricity Law), introduced an incentive regime that is one of France's main drivers for the development of renewable energy. The Electricity Law sets out the regulatory framework that opened up the electricity market to competition and privatized part of the activities of the utility company, Electricité de France (EDF). By an environmental forum called the "Grenelle de l'Environnement," which was officially launched on 6 July 2007, the French government brought together state players and stakeholders from interested sectors in order to define a comprehensive plan for sustainable development in France. Following a consultation phase, it is divided into two frameworks such as Grenelle 1 and Grenelle 2. After the strong growth due to large investments in solar PV, the French government recently decided for lower FIT in case of solar PV. In France, solar energy grows up through the support of attractive policies in FITs. But this policy was introduced in the month of March 2011, which was too late. On 5th March 2011, two decrees were published in the French official journals, the first one was for current repealing of frameworks and the second one was for the purchase of electricity from

PV systems [37]. The key factors for FITs are (i) the PV installed in a building whose capacity is less than 100 kW, when annual installation capacity target is 200 MW, (ii) when capacity will be greater than 100 kW, two types of tender processes will be applied as per the capacity and the types of plants. In order to benefit from the more favorable FIT, investments in solar power plants require a prior audit to check among others the date of acceptance of the technical and financial proposal for grid connections. The FIT varies from 12 c€/kWh (from 10th March 2011 to 30th June 2011) to 10.24 c€/kWh (from 1st October 2012 to 31st December 2012) [38]. From this policy, small solar plants ($<$ 100 kW) were benefitted but larger power plants proceeded through their tenders and complex processes at the lower rates. The targets for PV installations are also very low for France, *i.e.*, only 5.4 GW, which is ten times lower than in Germany. In France, the building integrated photovoltaic (BIPV) systems are most popularized. The FIT, which was introduced by the Grenelle de l'Environment, has encouraged the installations of solar BIPV in the French markets since 2006. The grid parity of PV in France will be achieved between 2014 and 2019 depending on the type of consumer and the development of high power photovoltaic stations. Therefore, PV provides a means of satisfying technical and strategic requirements to meet low consumption, building standards Bâtiment Basse Consommation (BBC) with a consumption of less than 50 kWh/m²/yr by 2012 and energy producing buildings Bâtiment à Energie Positive (BEPOS) by 2020 [32]. However, in France, solar FITs are based on both solar non-integrated PV systems and building integrated PV systems [39]. The current incentives range from 28.85 Euro cents ($38.69) for simplified BIPV systems from 36 to 100 kW for residence buildings for educational and health purposes, as well as other buildings such as farm structures, to 46 Euro cents ($61.69) for residential BIPV systems up to and including 9 kW. But the biggest drop is for non-BIPV systems covering simple rooftop add-on systems and non-tendered grounds-mounted installations. While the rates had been reduced in September based on increasing solar insolation in several horizontal corridors from between 27.6 euro cents (30 cents) in the south to 33.12 euro cents (45.7 cents) in the north with no upper limit in size, the amount has now been slashed to a straight 12 euro cents (1654), a reduction of between 57% and 64%. The size limit for those installations is now 12 MW. The Power Purchase Agreement (PPA) inspired third parties for the development of PVs under the falls of FiT schemes [40].

3.5. Spain

From the past decade, it is being observed that the renewable energy sector has been raised significantly in wind energy as well as solar photovoltaics in Spain. Out of this amount of generations of wind, nuclear, hydro and solar photovoltaics, the contributions are 16%, 21%, 11% and 3%, respectively. Spain has projected the share of electricity from renewables to be 38.1% by 2020. Spain has also given its forecasts for 2013 that the share of wind energy and solar photovoltaics will be 65% and 11%, respectively. Spain has published a National Renewable Energy Action Plan, which includes sharing the supply of renewable energy by 40% of electric generation by 2020. Spain's Ministry of Industry, Tourism, and Trade is the leading government organization for implementing and monitoring renewable electricity policies. Like many European countries, the Spanish government also provides priority for the access of the grid connections from renewable energy.

The FIT support is causing a boom in the renewable energy sector, especially in wind and solar energy in Spain. Since 1998, under Royal Decree (RD) 2818/1998, solar PV has been promoted in Spain, mainly with a FIT adjusted in 2004 (under RD436/2004) and 2007 (RD661/2007). Deployment of solar PV only started to rise significantly since 2006 under RD436/2004. The previous FIT of 1998 did not have a significant effect on RES-E deployment, mostly due to the relatively low support levels [34]. Since solar deployment was relatively behind the Renewable Energy Plan (2005–2010) targets (400 MW for 2010), the aim of the new Royal Decree was to accelerate solar deployment in order to comply with those targets. On September 28th, 2008, a new regulation entered into force (RD1578/2008) and solar PV capacity had reached 3116 MW. Due to the supportive FIT law for the solar PV, Spain became the world's leader in solar power installed capacity in 2008. The world leader's completely unsuitable policies are damaging the growth rates. From 2009 onwards, the Spanish government has declared its target to install 500 MW of solar photovoltaic each year. Due to the introduction of several barriers such as political issues and its administrations, the market has found it difficult to reach even 100 MW since 2009 and many installations were also canceled and delayed due to uncertainty. The announcements of incentives are sadly for the growth rate of solar and wind energy because the purchase of electricity from renewable energy is very costly, even being same as the cost of energy from fossil fuels. The Spanish government has to minimize the costs as its backed debt [41]. However, Spain halted subsidies for renewable energy projects to help curb its budget deficit and rein in power-system borrowings backed by the state, which reached 24 billion Euros ($31 billion) [42]. Spain's incentives mean it only provides the developers and suppliers, but not extents. Instead of passing on the tariff deficit to consumers, Spain has obliged utilities to hold it on their balance sheets as state-backed debt. The consumer will in principle repay the debt through gradual hikes in electricity bills, but successive governments have baulked at burdening people and businesses during the worst economic crisis in decades [43]. Diane Moss and Angelina Galiteva, both have written that the Spanish FIT has several weaknesses such as the Spanish government has made error FIT payments to the government budget and tax system, which had neither the flexibility to make quick pricing adjustments nor the cash flow to cover the costs of success – especially when Spain was hit hard by the global recession that began in 2008. Spain had no digression or rate adjustment mechanism built into the renewable energy law which caused the loss of 20,000 domestic jobs. Spain's feed-in tariff contained a loophole wherein higher rates were offered for systems of less than 100 kW, but there were no controls in place to prevent gaming of this offer by large project developers who would daisy-chain small projects together to take advantage of the higher rates [44]. The schedule arrangements for adjustments of supports could not raise the new solar PV installations' capacities. According to RD 1565/2010, the duration support is extended up to 28 years in RDL 14/2010 which was under RD661/2007 at 25 years. However, this putting of a cap also discourages the existing plants [45].

3.6. USA

In 2009–2010, USA shared nearly 11% of total electricity from renewable energy systems and it was found that solar energy grew up by 77% annually. In 2011, USA was the leading country among the G-20 countries for the investments of money in clean energy sector. The United States fell hard in 2012 from its G-20 clean energy leadership each year previously, with investment falling by 37% in 2012, to $35.6 billion [46]. At the end of 2012, it is estimated that USA reached the cumulative capacity of solar PV by 7.2 GW. In 2012, the country alone has added a new capacity of more than 84% of the cumulative capacity of 2011 with estimated 11 billion USD. In the year 2012, at the state levels, it was breaking the records from California, that installed more than 1033 MW followed by Arizona 710 MW, New Jersey 415 MW, Nevada 198 MW,

North Carolina 132 MW, Massachusetts 129 MW, Hawaii 109 MW and Maryland 74 MW. The eleven states installed over 50 MW capacity of solar PV alone in 2012. The fourth quarter (Q4) of 2012 shattered the all-time quarterly records as well, with 1300 MW of installed PV, improving the previous high by 64%. The residential and utility segments both had their best quarters ever, installing 144 MW and 874 MW, respectively. The residential market saw meaningful growth in California, Arizona, Hawaii, Massachusetts, and New York, as average residential system prices dropped by nearly 20% in one year from $6.16 per watt in Q4 2011 to $5.04 per watt in Q4 2012. The non-residential segment, which includes commercial, governmental, and nonprofit systems, installed more than 1000 MW in 2012. Leading non-residential markets included California, New Jersey, Arizona, Massachusetts, and Hawaii [47]. Four important terms have been seen which helped the growth in the year 2012, like (i) *Trade dispute resolution*: imports of Chinese solar cells allowed by government of US to decrease the costs of solar cells (ii) *The Third-Party-Owned (TPO) residential solar revolution*: the (power purchase agreements) PPA and residential solar leases have helped third parties and new venders in installing the new capacity. GTM Research forecasts that the third-party-owned residential solar market will maintain its momentum and become a $5. 7 billion market by 2016. (iii) *Mega-scale solar coming to fruition:* eight of the ten largest PV projects were completed in 2012, some of which were recipients of the DOE Loan Guarantee program. This trend should continue in 2013, with more than 4000 MW of utility solar projects currently under construction and more than 8000 MW of projects with PPAs in place and yet to begin construction and (iv) *ongoing manufacturing consolidation:* PV manufacturers saw little relief from global oversupply in 2012 as manufacturer margins remained depressed and less-competitive facilities were shuttered around the world [48,49].

The Modified Accelerated Cost Recovery System (MACRS) also continues to drive growth by providing more market certainty for investors. Under existing Federal law, solar energy policy is also eligible for public welfare investments. SEIA filed a petition with FERC to allow solar projects to qualify for a “fast track” interconnection process, eliminating the need for costly and time-consuming studies, and doubling the amount of solar applications. Third-party financing is also helping the solar industries in US solar markets for consumers, in getting the benefits. In Colorado, 80% of residential solar energy was installed in the first months of 2012 by a third-party model [50]. Many states of US are also allowing net metering, for residential and commercial customers that generate their own electricity from solar power, to feed electricity they do not use back into the grid. Through this policy many of the customers are benefited by bills, creation of jobs, inspiration for investment and income in the country [51]. Local Solar Permitting is one of the policies that helps solar energy developers, it depends on the state, local government, type and size of the system. The permitting process requires significant time and cost, both on the residential and commercial scales.

The Investment Tax Credit (ITC) is one of the important policies in US solar energy market. It was interred in 2005 and validity was up to the 3rd quarter of 2012. The ITC (Investment Tax Credit) reduces tax liability for individuals or businesses that purchase qualifying solar energy technologies, encouraging investment and spurring growth in solar energy. The 1603 Treasury Program allows developers to take a federal grant in lieu of the ITC, allowing taxpayers to maximize the return and value of existing energy tax incentives [52]. In order to build a significant market, states with very low energy rates or little sunshine must sometimes offer larger incentives than states with high electricity costs and/or plentiful sunshine [53]. The solar investment tax credit (ITC) reduces the tax liability for individuals or businesses that purchase qualifying solar energy technologies. As a stable, multi-year incentive, the ITC encourages private sector investment in solar manufacturing and solar project construction. In the U.S. tax code, the ITC is a 30% tax credit for solar systems on residential (under Section 25D) and commercial (under Section 48) properties. Under the current law, the ITC will remain in effect through December 31, 2016. It is incumbent on every member of the U.S. solar industry to be mindful of applicable laws and remain fully compliant with all statutory and regulatory requirements of the ITC and related programs. The Energy Policy Act of 2005 (P.L. 109-58) created a 30% of ITC for commercial and residential solar energy systems, that was applicable from January 1, 2006 through December 31, 2007. The sharp growth in project installations after the passage of the ITC occurred in tandem with growing domestic U.S. solar manufacturing. Today, over 600 manufacturing facilities are producing solar components across 46 states [54]. Before a solar system can be installed on a property, the system owner must complete all the necessary permission requirements. Depending on the state, local government, type and size of the system, the permitting process requires significant time and cost, both on the residential and commercial scales.

As of October 2012, 29 states, the District of Columbia, and Puerto Rico have instituted renewable portfolio standards (RPSs). The solar PV market demands by utilities in the states where RPSs are in place increased from 17% of on-grid demands in 2009 to 31% in 2010. Looking out for five more years, state RPSs will be the main factor for driving utility solar PV demand to account for nearly 60% of the US on-grid PV market in 2015 [55]. In 2012, the installed capacity was reduced from the national average price by 26.6%, from $4.10/W to $3.01/W. Quarter-over-quarter, the national weighted-average system price fell by 15.9%, from $3.58/W to $3.01/W. This capacity weighted number is heavily impacted by the volume of utility-scale solar installed in a given quarter, and there was substantially more in Q4 2012 compared to Q3 2012. Individually, average residential and utility prices decreased, while non-residential prices were up slightly quarter-over-quarter. From Q4 2011 to Q4 2012, residential system prices fell by 18.1%, from $6.16/W to $5.04/W. Quarter-over-quarter, installed costs decreased by 3.5% in majority of the states like California, Arizona, New Jersey, and Massachusetts, and in a number of states fell below $4.00/W, whereas non-residential system prices fell by 13.3% year-over-year, from $4.65/W to $4.27/W. Quarter-over quarter, installed costs actually increased by 1.4%, primarily due to a large quantity of higher-cost, government projects connected in California. In 2011, California Solar Initiative (CSI) demonstrated 311 MW of solar energy which was installed in the investor-owned utility territories and it has received a budget of US$ 2.4 billion, aiming to reach 1.94 GW solar capacity by 2016. The CSI estimated that in middle income markets (areas with median incomes between US$50,000 and US$100,000) have increased by 445% since 2007 and comprise the majority of applications received in 2011 [56]. The third-party PV Power Purchase Agreements (PPAs) were driving the solar markets in the western part of the country but it did not affect five states including Florida and Virginia. Fortunately, third-party ownership was less of an issue in the past year, as it has now been approved in most states with active solar energy incentive programs. Even in 2010, USA installed 54% more PV cumulative installation capacity, but its place went down from 4th to 5th position in the world. Due to the falling of costs in US markets with the help of the state incentives, the extension of federal incentives and the imminent expiration brings its doubling markets and it reaches 4 GW. In 2011, as per the report prepared by the California Public Utilities Commission, California is the first state in USA to install more than 1 GW for generating electricity for the customers.The US Department of Energy (DOE) has targeted to reduce the cost of the systems by 75% by 2020 in three sectors such as residential roof top, commercial rooftop and

utility scale ground mount [57]. According to a 2008 study by the National Renewable Energy Laboratory, only 22–27% of residential buildings are suitable for hosting an on-site solar PV system. The community renewable programmes also support the growth rates of solar energy. Solar buzz forecasts that the US will account for 12% of the global solar PV market by 2015, up from 5%. This would make the US the third-largest solar PV market worldwide, ranking behind Germany and Italy [55].

The TAX policy plays a vital role for creating of solar jobs, spurring economic growth, ensuring U.S. global competitiveness, lowering energy bills for consumers and businesses, and reducing pollution in American markets. A report released by SunRun shows that a standardized permitting process for residential systems could reduce costs by $1 billion over 5 years [58].The legislation prepared by Senator Sanders (I-VT) and Senator Boozman (R-AR) would provide an opportunity to the local communities to make the solar permits highly efficient [59]. This act may be known as "10 million Solar Roofs Act 2011". In this act, the best practices for solar permitting are discussed, such as (i) promoting standardization and uniformity for local permitting requirements in solar energy across jurisdictions (ii) lowering the solar energy system installation costs associated with local permitting or expediting the local permitting (iii) the local governments participating with roof top or any solar energy program through the department of energy. The goal of this act is to install solar energy systems on not less than 10,000,000 properties located in the USA by the end of 2020 with the cost of reductions in solar energy systems. The renewable energy was first adopted through the Public Utilities Regulatory Policy Act of 1978 (PURPA) which promoted the renewable energy developments. The PURPA can avoid the costs of purchasing of power from third parties to utilities. This avoided cost varies from state to state with the implementation. Due to avoiding of costs, renewable energy is competing with the conventional energy sources. However, everything is not included in this policy such as air pollution, so it is as much popularized. Moreover, as the guaranteed prices of PURPA contracts signed in the 1980s expire, many renewable power generators are going out of business [60].

3.7. Belgium

The European Renewable Energy Council (EREC) has projected that it intends to achieve 100% renewable energy from the European countries by the vision "Future Energy Policy –2050" which minimizes green house gas effects [62]. Belgium has taken projection for reducing the carbon content by 7.5% in 2008–2012 [61]. The green certificate system with a quota obligation is the main instrument for increasing the share of renewable electricity generation in Belgium. Apart from the green certificate system, implemented at a regional level, there are several small incentives in the form of tax deductions, subsidies or tenders; however, the impact of these schemes is probably small compared to the green certificate system [63]. The Bulgarian NREAP splits the overall 13% renewable energy target into 20.9% RES-E, 11.9% RES-H&C and 10.14% RES-T [64]. Using the NREAP energy demand scenario, EDORA plans a RES consumption target of 14.5% by 2020. In the Brussels-Capital Region and Wallonia, the production of electricity from renewable energy sources is promoted through the federal system of green certificates as well as through regional support schemes such as energy subsidies, investment assistance for companies and net-metering. However, Flanders supports renewable energy by means of a quota system, an ecological premium and a net-metering scheme [65].

By the end of 2012, Belgium reached with cumulative capacity of solar PV by 2.7 GW with the new installation capacity of 600 MW with global shared by 2.7%. The solar PV shared 2.8% of total electricity consumptions in the country [66]. In Belgium, there are three regions such as Flander, Wallonia and Brussels having huge solar energy potentials [67]. Flanders, the Flemish region, boosted a total installed photovoltaic capacity of 2.061 GW at the end of 2012, and Wallonia, the French speaking region, recorded 491 MW. While Brussels had installed just 15 MW by the end of 2012, it showed an 83% increase in capacity compared to 2011. Belgium allowed the net meter reading incentives which help to raise solar PV with widespread capacity in the European markets. The net metering benefit can be viewed as avoiding the purchase of electricity, which does not generate revenue for the operator, but does enable them to spend less on annual electricity bills. The benefit does not come from public funds or ratepayers, in contrast to FIT or grant type funding [68]. The Belgium government has adopted a scheme "*Ecologiepremie*" which helps to reduce the price cost of solar PV from 350 €/MWh in 2010 to 90 €/MWh in 2018. Through this scheme the solar PV costs reduced by quaternary [69]. The National RES Industry Roadmap projected that solar PV will generate 2913.4 GWh of electricity generation and 2.6% of electricity consumptions by 2020.

3.8. Czech Republic

According to the Kyoto Protocol, the Czech Republic is committed to reduce its Greenhouse gas (GHG) emissions by 8% by 2008–2012 compared to 1990 levels [70]. The Czech Republic, an EU country has taken the nation's targets to meet 13% of energy from the renewable sources. However, it has been seen that the country would not like to meet the energy within the given time frame. The country targets to increase the energy saving by about 11 PJ annually. The fulfilment could be done by renewable energy shares. As per the National Program to Abate Climate Change Impacts (Resolution no. 187 of 3 March 2004), the plan is the increase of primary energy consumption by 20% by 2030 in renewable energy. The rapid investment can almost be attributed to Directive 2001/77 EC through the Czech Act on the promotion of the use of Renewable Energy sources [No. 180/2005 col.]. The "mandatory purchasers" selected by the Ministry of Industry and Trade are responsible for the payment of the feed-in tariffs. At least for the years 2013 and 2014, these mandatory purchasers will be for the distribution grid operators [71]. The Czech Republic uses the personal income taxes for development of renewable energy at the rate of 15%. To avoid problems due to a different system for personal and corporate taxpayers, a similar exemption is implemented in corporate tax law. The feed-in tariff came into force in the year 2002 in the solar industry, but it was unsuccessful due to lack of RES schemes Act 2005. The Energy Regulatory Office can determine the feed-in tariff and green bonus each year in advance. The price may not be lower than 95% of the previous year. The price rate will set by the return investments for 15 years, price set will differentiate according to the renewable energy sources, and it will be commissioned by the year wisely. The 2001/77/EC directive act has also some weak points. The success of partly depending upon what practice the Energy Regulatory Office (ERO) will use for setting prices which are not stated directly in the text of the law. The ruling states that it should be in such a way that the payback time period of installations is less than 15 years. There is also a rule that for new installations the price cannot drop less than 95% against the level of those installations which started in the previous year. The country has also main long term objectives that increase the primary energy sources and energy efficiency. By the long term objectives, the primary energy sources will consume by the renewable energy 15–16% of the total energy by 2030 [72]. As of the Energy Regulatory Office's Price Decision No. 7/2011 of 23 November 2011, the purchase price and green premium for

Table 4
The purchase and green premium for electricity generation.
Source: The Energy Regulatory Office's Price Decision No. 2/2010 of 8th November 2010.

Sl. no.	Date of commissioning	Purchase prices of electricity supplied to the network (CZK/MWh)	Purchase prices of electricity supplied to the network (CZK/MWh)
1	Electricity generation using solar radiation for plants with an installed capacity of up to 30 kW, inclusive, and commissioned between 1 January 2012 and 31 December 2012	6160	5080
2	Electricity generation using solar radiation for plants with an installed capacity of up to 30 kW, inclusive, and commissioned between 1 January 2011 and 31 December 2011	7650	6570
3	Electricity generation using solar radiation for plants with an installed capacity of over 30 kW up to 100 kW, inclusive, and commissioned between 1 January 2011 and 31 December 2011	6020	4940
4	Electricity generation using solar radiation for plants with an installed capacity of over 100 kW and commissioned between 1 January 2011 and 31 December 2011	5610	4530
5	Electricity generation using solar radiation for plants with an installed capacity of up to 30 kW, inclusive, and commissioned between 1 January 2010 and 31 December 2010	12,750	11,670
6	Electricity generation using solar radiation for plants with an installed capacity of up to 30 kW, inclusive, and commissioned between 1 January 2010 and 31 December 2010	12,650	11,570
7	Electricity generation using solar radiation for plants with an installed capacity of up to 30 kW, inclusive, and commissioned between 1 January 2009 and 31 December 2009	13,690	12,610
8	Electricity generation using solar radiation for plants with an installed capacity of over 30 kW and commissioned between 1 January 2009 and 31 December 2009	13,590	12,510
9	Electricity generation using solar radiation for plants commissioned between 1 January 2008 and 31 December 2008	14,590	13,510
10	Electricity generation using solar radiation for plants commissioned between 1 January 2006 and 31 December 2007	14,960	14,960
11	Electricity generation using solar radiation for plants commissioned before 1 January 2006	7130	6050

electricity generations under (Section 1.9) by using solar radiation are shown in Table 4.

Again the rapid investment in solar energy promoted the share of energy from 3.8% in 2004 to 11% in 2012 in the country. However, a poor capacity of additions in 2012 brought its position down and placed it in the 9th position in 2011 to 10th position by 2012 in the world. By the end of 2012, the country Czech Republic added cumulative capacity of solar PV by 2.1 GW with shares of 2.1% in the world market. However, this country had added huge energy of solar PV capacity by 1.49 GW alone in 2010 which exceeds the target of National Renewable Action Plan cumulative capacity by 1.95 GW for 2020. The law promoting electricity from renewable and feed-in tariffs is valid up to 20 years.

For the promotion of solar energy, the PV capacity less than 30 kW that is located on the roof or perimeter wall of one building attached to the ground via firm foundations registered in the real estate registry. However, the solar production tax on revenue will not be applicable on top of buildings with a capacity lower than 30 kW (all ground-mounted PVs built in 2009–2010). So, the decrease of the purchase prices of solar energy under the FIT is supported to investors for 20 years by the government. The proceeds from the taxes will be used to reduce the increase in household and industrial electricity prices next year [73]. An electricity producer can choose two schemes, either fixed feed in tariff or market price + bonus. In 2010, the feed tariff was CZK 12.5 per kWh (0.48€/kWh) [74]. However, in February 2010, the CEPS (Czech Transmission Grid Operators) banned the interconnection of all new PV plants to the grid in the Czech Republic through all distribution operators (EZ, E-ON, PRE). Since then, it has not been possible to interconnect even a 1-kilowatt PV installation, which is indeed ridiculous, which also causes loss of 4000 jobs [75,76]. From January 2009 to 31st December 2010, the feed-in tariff is subjected to 26% and green bonus to 28% of the taxes. After 1st January 2011, the fixed feed-in tariff is commissioned as when $\leq$ 30 kW: 7.5 CZK/kWh (0.311 €/ kWh), $>$ 30 kW and $\leq$ 100 kW: 5.9 CZK/kWh (0.245 €/ kWh) and for greater than 100 kW: 5.5 CZK/kWh (0.288 €/kWh) [76].

3.9. China

In 2007, the Chinese government established a “Medium and Long-Term Development Plan for Renewable Energy in China” which projected that consumption of energy from renewable sources would go up by 15% by 2020. This target helps the country in developing of renewables and resolves the combining of national and provincial's energy planning methods. The model's main contributions are (i) implementing the national energy target, it provides more effective guidance for provincial renewable energy planning (ii) designing the more effective incentive mechanisms and (iii) increasing the reliability of renewable energy schemes [77]. Mainly, China's renewable energy policy can be categorised into three different types such as the first, second and third level policies. In the first level policy, it gives the direction and guidance for the renewable energy developments for the benefit of environment. Similarly, in the second level policy, it gives the objectives and developments in rural areas and also for promoting renewable energy technologies. Then again, for the third level policy, it gives the specific incentives and managerial guidelines [78]. China's “Renewable Energy Law,” which came into effect from 2006, was again updated in 2009 and is supported by two funds. The first fund is the RE Surcharge collected from all end users of electricity at the rate of 0.8 cents/kWh, and about RMB 20–25 billion Yuan will be collected each year; the other is Special

RE Fund, which is directly controlled by the Ministry of Finance, about RMB 10–20 billion Yuan will be available each year.

China lies in the eastern part of East Asia between 4° and 53° North latitudes and 73° to 135° East longitudes with an area of 9.6 million km square. The country's annual solar energy flux ranges from 3360 to 8400 MJ/m^2 and two-third of this country receives the solar radiations of about 5020 MJ/m^2 with annual sunshine hour 2000 h. The annual solar radiation energy on land is about 1700 billion *tce* [79]. China has entirely given focus on provinces like Quinghai, Gansu, Ningxia, Xinjiang and Inner Mongolia located in the western region parts receiving the highest solar radiations in the country. However, the western parts of the country struggle from issues like grid connections, transmissions and distribution systems. So, the Chinese government introduced "New FIT Regulation" schemes for development of large scale ground mounted systems across the country in the total of four different regions. The proposed new level of FIT is calling for reduction of the present FIT of 1 RMB/kWh (approx. € 12 cents/US $ 16 Cents) of up to 25% of different regions. This scheme also determined the level of solar radiations and that shall insure an IRR of 8% will be achieved in these four regions [80]. In 2012, 83.3% and 43% system prices had fallen for PV installations as compared to the year 2007 and 2011, respectively. In 2012, the average price for a typical grid connected system was about RNB 10 Yuan/Wp. Again the module price has also fallen down from RMB 36 Yuan/Wp in 2007 to RMB 4.5 Yuan/Wp in 2012. The total production capacities of the top 10 module manufacturers in China were 16.9 GW, and the annual yield was 12.18 GW in 2012. The total delivered PV modules made in China was 23 GW in 2012, 9.5% increase compared with the year 2011, contributing 61.8% of global outputs. The gross output value of the PV industry was more than RMB 300 billion Yuan (~37.5 billion BEUR). The global solar yield from the year 2005 to 2012 is shown in Fig. 6.

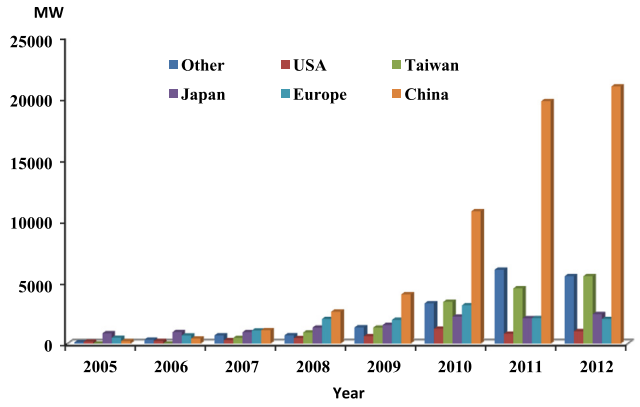

Fig. 6. Global solar cell yield (2005–2012).
Source: CPIA, 2013.

Table 5
PV power installed during calendar year 2012 in five market sectors.
Source: Ref [81].

Sl. no.	Market share	Annual installations in 2012 (MWp)	Share (%)
1	Rural electrification	20	0.57
2	Communication and industry	10	0.29
3	PV products	10	0.29
4	BIPV & BAPV	1460	41.27
5	LS-PV	2000	57.14

China was the leading country in the world for solar cell yield by the top ten solar manufacturing companies with a share of 12 GW in 2012 [81]. The PV power installed during the period of 2012 in five markets in China is shown in Table 5.

During the period of 2012, China shared 50% of the total installed capacity of solar PV. The Chinese solar PV made a history due to huge installed capacity alone in 2012 with the help of the Chinese solar PV manufacturing company. Despite that there have been some obstacles for smaller manufacturing companies due to the country's economic crisis [82]. The Chinese government also announced a policy for attracting the domestic solar PV producers for national grid connections of solar powers. The State Grid Corporation is expected to allow domestic companies at the city level to install solar power not less than 10,000 kW, which encourages the companies. The State Grid also plans that there will be no charges for the developers for grid connection systems as millions of Yuan [63]. The National Energy Board issued a period of "Interim Measures for photovoltaic power generation operations supervision" for three years. According to the National Energy Administration, the installation capacity of PV will reach 10 GW by 2015 and 50 GW by 2020. According to its 12th (2011–2015) planning, the Chinese government expects to cut the carbon dioxide emission by less than 17% and energy consumption by less than 16% of units GDP. In this plan, it is expected that the total investment to reach the power sector by $ 803 billion (€ 618 billion) is divided into $416 billion (€ 320 billion) in power generation sectors and $ 386 billion (€ 286 billion) in connection of transmission lines and other developments constructions of grid. The BRIC country has specified a 0.42 Yuan subsidy for every kilowatt-hour of electricity produced by distributed PV power units [82]. The Ministry of Housing and Urban Rural Development (MHURD), the Ministry of Finance (MOF) and the National Energy Academy (NEA) jointly initiated the Golden Sun Program in June 2009. The proposal of this program is to implement the solar PV projects, applications both on and off grid. The government has also supported a subsidy of 50–60% of the investment costs. However, it was not supported for high quality power generation because during operation and maintenance a problem on financial challenge was created. On 1st January 2013, the National Energy Administration (NEA) announced the country's 12th plan during 2011–2015 projections. The target is by the end of 2015, the total generation of power would be 1470 GW (including renewable, coal and natural gas), however, for solar power generations, the country expects to add an annual increase of 89%. Since March 2011, the country's projection is steadily increasing to add 5 GW, 10 GW, 21 GW and now 35 GW. The target of 35 GW was published after the plan's publication.

3.10. Australia

The development of renewable energy in Australia is important to address the concerns about climate change and security. The State of Climate 2012 reported that rising of CO_2 emission affected the temperatures in the country [83]. The Government of Australia has made some provisions for the development of renewable energy. Among all forms of renewable energy, Australia receives an average of 58 million PJ of solar radiation in the country. Usage of 0.1% incoming solar radiations could have the potential to fulfil 10% of the energy needs in Australia [84]. South Australia has huge potentials of solar energy. In Australia, the renewable energy policy focuses mainly on electricity and heat [85]. The Australian Government commissioned Australian Energy Market Operator (AEMO) has taken one projection for the year 2050, for achieving 100% of renewable energy in its future plans. However, for it high technologies and locations and very high levels of capacity reserves would be required to meet this reliability. Under the Renewable Energy Target (RET) it is ensured to contribute 20% of

the renewable energy by 2020. Since January 2011, the RET scheme operates in two parts, i.e., (i) the Small scale Renewable Energy Scheme (SRES) and (ii) the Large scale Renewable Energy Target (LRET) [86]. Under the Large-scale Renewable Energy Target (LRET, not less than 100 kW) to expose the additional renewable energy with a target of 41,000 GWh of electricity generation by 2020. The legislation allowed an upward revision of the LRET target in 2012 and 2013 if this trigger was activated, and this is offset by a downward revision of the target between 2016 and 2019. Generation of small-scale plants such as solar water heaters or rooftop PV systems contributes to the Small-scale Renewable Energy Scheme (SRES, less than 100 kW), and the combined renewable generation from the large-scale and small-scale schemes is expected to exceed the 45,000 GWh target of their predecessor, the expanded MRET (Mandatory Renewable Energy Target) scheme. The LRET scheme is otherwise similar to the MRET scheme in terms of issues such as banking of certificates and project eligibility periods. The Australian Renewable Energy Agency (ARENA) would like to invest AUD3.2 in the renewable energy sector in promoting the research and development (R&D) sector, demonstration, and commercialization, decrease the costs and improve the sectors in competitiveness. However, it includes $1.7 billion in uncommitted funds. The PV policies are strongly dependent on state-level incentives. The feed-in tariff is also implemented in every state in Australia except Tasmania.

A sharp increase in electricity prices, with decrease in the cost of solar PV plays an important role in Australian energy markets. The FiT scheme resulted in more installations of solar PV systems across the country but most notably in NSW driven by the 60 cent/kWh feed in tariff. By the end of 2012, FiTs were reduced to an average of 8 Cents/kWh. The Solar Flagships program also supports the large scale of PV system with grid connected power systems. With the help of RET scheme, it is estimated that small scale PV generation would rise from around 1300 GWh in 2011 to around 8200 GWh in 2020. However, Australian Renewable energy developments have some barriers like (a) administrative hurdles such as lengthy, regulatory approval and permit procedures, (b) non-transparency and costly procedures for grid connection, (c) support policy instability with sudden policy changes and stop-and-go situations, (d) lack of social acceptance, (e) cost competitiveness, (f) institutional familiarity and acceptance and (g) government support for existing electricity sources. Again FIT is not the same for small scale energy across all the states and territories in Australia. These FITs focus the renewable industry on small-scale technologies at the expense of medium to large scale generation. This focus creates issues regarding equity, network stability, and efficiency. Grid connection costs are a significant barrier to the development of the renewable energy industry and can substantially increase the capital expenditure required for a project [83].

4. Conclusion

In the present paper, the global renewable status, regional renewable energy status as well as country-wise renewable energy status have been analyzed. Among all renewable energy sources , solar energy has a tremendous potential across all the countries and it is the most prominent energy source. Similarly, the solar PV developments at global levels, regional levels and national levels are also discussed. This paper has given the main focus on recent developments of solar energy and the effective policies in the top ten countries. In the present scenario, the countries such as Germany, Italy, Japan, Spain, USA, China, France, Belgium, Czech Republic and Australia are the top ten global solar power producers. The per capita values of these leading countries are also taken for consideration. It is found that these countries are mainly depending upon their policies as instruments like FIT, net metering, quotas with green certificates, low interest bank loans, renewable portfolio standards (RPSs), country's national renewable energy targets, Investment Tax Credit (ITC), market premiums, and reverse auctions for the development of solar energy. The solar PV manufacturing companies are also playing in the global markets. A country like China has taken more benefits from them due to most of the leading manufacturing companies being from China. Again, due to rapid fall of the costs of solar PVs in the global markets, different countries have started their projections. Most of the leading countries are from Europe. The comparison studies have been taken for consideration.

References

[1] Luna-Rubio R, Trejo-Peria M, Vargas-Vázquez D, Ríos-Moreno GJ. Optimal sizing of renewable hybrids energy systems: a review of methodologies. Solar Energy 2012;86:1077–88.
[2] Muller-Furstenberger G, Wagner M. Exploring the environmental Kuznets hypothesis: theoretical and environmental problem. Ecol Econ. 2007;62:648–60.
[3] International Outlook. Independent Statistics and Analysis. U.S. Energy Information Administration; 2011.
[4] Suganthi L, Samuel Anand A. Energy models for demand forecasting – a review. Renew Sustain Energy Rev 2012;16:1223–40.
[5] Carbon capture and storage: a WEC “Interim Balance”. World energy council.
[6] Rahlwes H. Rainer. Renewable energy: paving the way towards sustainable energy security. Renew Energy 2013;49:10–4.
[7] Renewables. Global status report. REN21; 2013.
[8] Hermann WA. Quantifying global exergy resources. Energy 2006;31 (12):1349–66.
[9] Castro C de, Mediavill M, Miguel LJ, Frechoso F. Global solar electric potential: a review of their technical and sustainable limits. Renew Sustain Energy Rev 2013;28:824–35.
[10] Tyagi VV, Rahim NAA, Rahim NA, Selvaraj JA/L. Progress in solar PV technology: research and achievement. Renew Sustain Energy Rev 2013;20:443–61.
[11] Lund PD. Effects of energy policies on industry expansion in renewable energy. Renew Energy 2009;34:53–64.
[12] Lauber V, Mez L. Three decades of renewable electricity policies in Germany. Energy Env 2004;15:599–623.
[13] ⟨http://www.bmu.de/en/topics/climate-energy/renewable-energy/general-information/⟩ [accessed 26.04.13].
[14] Sarasa-Maestro CJ, Dufo-López R, Bernal-Agustín JL. Photovoltaic remuneration policies in European Union. Energy Policy 2013;55:317–28.
[15] Statistic data on the German Solar power (photovoltaic) industry [accessed 08.08.13].
[16] ⟨http://www.solarwirtschaft.de/en/media/single-view/news/one-out-of-ten-in-germany-is-already-producing-solar-power.html⟩ [accessed 17.09.13].
[17] Grigoleit T., Lenkeit D. The renewable energy industry in Germany. A glance at industry promotion policies in selected energy sectors.
[18] Tariffs, degression and sample calculations pursuant to the new Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz – EEG) of 4 August 2011 ('EEG 2012').
[19] ⟨http://www.solarwirtschaft.de/en/media/single-view/news/renewable -energy-sources-no-longer-a-price-driver.html⟩.
[20] ⟨http://www.renewableenergyworld.com/rea/news/article/2013/09/german-industry-calls-for-renewables-reform⟩ [accessed 22.09.13].
[21] Bloomberg new energy finance. Country profiles on-line database [proprietary database] [accessed 24.05.13].
[22] Hernández JM, Alonso BC, Álvarez JH, Celis-Carrillo B. An overview of solar photovoltaic energy in Mexico and Germany. Renew Sustain Energy Rev 2014;31:639–49.
[23] ⟨http://www.pvtech.org/news/germany_breaks_world_record_for_solar_power_generation _with_22gw⟩ [accessed 26.11.12].
[24] ⟨http://www.renewableenergyworld.com/rea/news/article/2012/02/germanys-new-solar-containment-policy?page=2⟩.
[25] ⟨http://www.iea.org/publications/freepublications/publication/italy2009.pdf⟩ [accessed 25.11.12].
[26] ⟨http://europa.eu/legislation_summaries/energy/renewable_energy/l27065_en.htm⟩.
[27] Renewables. Japan status report executive summary; 2013.
[28] Government of Italy, Ministry of Economic Development, Department of Energy. Italy's National Energy Strategy.
[29] Energetica India summaries European Photovoltaic Industry Association's predictions for Solar PV market's 2016. [accessed 08.12.12].
[30] ⟨http://cleantechnica.com/2012/04/18/italy-to-levy-carbon-tax-cut-solar-fit-in-wake-of-record-setting-growth/⟩.[accessed 09.12.12].
[31] Energetica India summaries European Photovoltaic Industry Association's predictions for Solar PV market's 2016 [accessed 08.12.12].
[32] European union wind and solar electricity policies: overview and considerations.

[33] ⟨http://www.meti.go.jp/english/press/2013/0517_02.html⟩.
[34] del Rı´o P, Mir-Artigues P. Support for solar PV deployment in Spain: some policy lessons. Renew Sustain Energy Rev 2012;16:5557–66.
[35] ⟨http://www.meti.go.jp/english/policy/energy_environment/renewable/pdf/summary201207.pdf⟩.
[36] Key facts; 2012.
[37] Global market outlook for photovoltaics until 2015. European Photovoltaic Industry Association (EPIA).
[38] ⟨http://www.Nortonrosefulbright.com/knowledge/publications/66831/European-renewable-energy-incentive-guide-france⟩.
[39] Solangi KH. A review on global solar energy policy. Renew Sustain Energy Rev 2011;15:2149–63 (accessed 28.11.12).
[40] EPIA Outlook; 2016. [accessed 11.12.12].
[41] ⟨http://gigaom.com/cleantech/spain-suspends-clean-power-incentive-program-to-reign-in-costs/⟩ [accessed 06.12.12].
[42] ⟨http://www.businessweek.com/news/2012-01-30/spain-halts-renewable-subsidies-to-curb-31-billion-of-debts.html⟩ [accessed 06.12.12].
[43] ⟨http://www.reuters.com/article/2012/01/27/spain-renewables-idUSL5E8CR2B620120127⟩.
[44] ⟨http://www.renewableenergyworld.com/rea/blog/post/2012/02/comments-on-spains-recent-renewable-energy-policy-decisions⟩ [accessed 04.12.12].
[45] Rı´o P, Mir-Artigues P. Support for solar PV deployment in Spain: some policy lessons. Renew Sustain Energy Rev 2012;16:5557–66.
[46] ⟨www.pewtrusts.org/cleanenergy⟩.
[47] ⟨http://www.greentechmedia.com/articles /read/u.s.-solar-market-grows-76-in-2012⟩.
[48] ⟨http://www.seia.org/research-resources/us-solar-market-insight-2012-year-review⟩.
[49] U.S. solar market insight report|2012 year in review|executive summary, GTM & SEIA reports.
[50] ⟨http://www.seia.org/ policy/finance-tax/third-party-financing⟩.
[51] ⟨http://www.seia.org/policy/distributed-solar/net-metering⟩.
[52] ⟨http://www.seia.org/ policy/finance-tax⟩.
[53] ⟨http://www.seia.org/ policy/distributed-solar/rebates-incentives⟩.
[54] ⟨http://www.seia.org/policy/finance-tax/solar-investment-tax-credit-itc⟩ [accessed 04.12.12].
[55] ⟨http://cleantechnica.com/2011/08/08/us-solar-pv-to-double-in-2011-grow-47-a-year-to-2015/⟩.[accessed 02.12.12].
[56] Annual Meeting Interstate Renewable Energy Council, Texas.
[57] Goodrich A, James T, Woodhous M. Residential, Commercial, and utility-scale photovoltaic (PV) system prices in the United States: current drivers and cost-reduction opportunities.
[58] ⟨http://www.seia.org/policy/distributed-solar/local-solar-permitting⟩.
[59] ⟨http://www.seia.org/policy/distributed-solar/local-solar-permitting⟩ [accessed 06.12.12].
[60] ⟨http://www.ucsusa.org/clean_energy/smart-energy-solutions/strengthen-policy/public-utility-regulatory.html⟩ [accessed 09.12.12].
[61] ⟨http://www.erec.org/ policy/eu-policies/future-energy-policy-2050.html⟩. [accessed 12.12.12].
[62] ⟨http://ec.europa.eu/environment/pdf/policy/belgium.pdf⟩ [accessed 11.11.12].
[63] Renewable energy policy country profiles, 2011 version based on policy information available in November 2011.
[64] National renewable energy action plan pursuant to Directive 2009/28/EC.
[65] ⟨http://www.res-legal.eu/search-by-country/belgium/⟩.
[66] ⟨http://www.pv-magazine.com/news/details/beitrag/belgium-reaches-26-gw-of-installed-pv-power-_100010139/#axzz2nQ91XWoi⟩.
[67] ⟨http://www.solarplaza.com/article/belgiums-2011-pv-market-beats-previous-recordyear⟩ [accessed 29.11.12].
[68] ⟨http://www.solarbuzz.com/ resources/analyst-insights/changing-pv-demand-netherlands-and-belgium-suggests-post-incentive-eu-demand-profile⟩ [accessed 24.11.12].
[69] ⟨http://www.climatepolicytracker.eu/sites/all/files/Belgium2011_0.pdf⟩ [accessed 05.12.12].
[70] IEA; 2010.
[71] ⟨http://www.res-legal.eu/search-by-country/czech-republic/single/s/res-e/t/promotion/aid/ feed-in-tariff-act-on-the-promotion-of-the-use-of-res/lastp/119/⟩.
[72] Sustainable Energy Policy of the Czech Republic.
[73] ⟨http://www.pv-tech.org/tariff_watch/czech_republic⟩ [accessed 20.11.12].
[74] ⟨http://www.thinfilmpv.eu/wp-content/uploads/2012/03/PV-Status-Report-2011.pdf⟩ [accessed 20.11.12].
[75] ⟨http://www.solarplaza.com/article/czech-republic-facing-new-rooftop-pv-boom⟩ [accessed 25.11.12].
[76] PV status report; 2011.
[77] Liu Z, Shi Y, Yan J, Ou X, Lieu J. Research on the decomposition model for China's National Renewable Energy total target. Energy Policy 2012;51:110–20.
[78] ⟨http://www.nrel.gov/docs/fy04osti/35786.pdf⟩ [accessed 09.12.12].
[79] Liu L, Wang Z. The development and application practice of wind–solar energy hybrid generation systems in China. Renew Sustain Energy Rev 2009;13:1504–12.
[80] ⟨http://www.aecea.com.de/mediapool/134/1345433/data/2013_03_28_China_Briefing_Paper_Solar_Market_Development_Frank_Haugwitz_AECEA.pdf⟩.
[81] Fang L, Honghua X, Sicheng W. International energy agency co-operative program on photovoltaic power systems. National Survey Report of PV Power Applications in China; 2012.
[82] ⟨http://www.renewable-energy-technology.net/solar-energy-news/china-introduces-20-year-pv-subsidy-policy-boost-solar-power⟩.
[83] Australian renewable energy policy: barriers and challenges.
[84] ⟨http://www.ga.gov.au/ image_cache/GA17057.pdf⟩.
[85] WEO; 2012.
[86] ⟨http://www.environment.gov.au/topics/cleaner-environment/clean-air/renewable-energy-target-scheme⟩.