Solar Energy Policies

Solar energy policy in USA

In 2008 solar energy deployment increased at a record pace in the United States and throughout the world, according to industry reports. The Solar Energy Industries Association's, "2008 U.S solar Industry Year in Review", found that U.S. solar energy capacity increased by 17% in 2007, reaching the total equivalent of 8775 megawatts (MW). The Solar Energy Industry Association (SEIA) report tallies all types of solar energy, and in 2007 the United States installed 342 MW of solar photovoltaic (PV) electric power, 139 Thermal megawatts (MWTh) of solar water heating, 762 MWTh of pool heating, and 21 MWTh of solar space heating and cooling. All renewable resources (solar, wind, geothermal, hydroelectric, biomass, and waste) provide 12% of the nation's electricity supply as of 2010. The DoE (Department of Energy) has established the goal of generating 10–15% of the nation's energy from solar sources by 2030. Solar power's contribution could grow upto 10% of the nation's power needs by 2025. The report, prepared by research and publishing firm Clean Edge and the nonprofit Co-op America, projects nearly 2% of the nation's electricity coming from concentrating solar power systems, while solar photovoltaic systems will provide more than 8% of the nation's electricity. Those figures correlate to nearly 50,000 MW of solar photovoltaic systems and more than 6600 MW of concentrating solar power

Renewable portfolio standard.

United States of America has adopted RPS mechanism in its 28 states; the maximum production energy is required by RPS from renewable energy such as solar, wind, geothermal and biomass. Most policy objectives aim to facilitate the diversification of electricity generation mixes, reduce state reliance on fossil fuels, increase renewable energy deployment, reduce carbon emissions, or various combinations thereof. Most states with RPS policies allow utilities to exchange renewable energy certificates or renewable energy credits (RECs), to help utilities comply with their RE obligations.

Three assumptions were made about RPS policy program implementation.

First, an RPS policy is only considered operational according to the effective date of policy implementation, not the adoption date.

Second, any RPS policy that became effective in either November or December is not coded as effective until the following fiscal year. For instance, if a state effectively begins an RPS program in November 2003, the value of their RPS variable equals zero from 1998 to 2003, and one thereafter.

Third, they do not code any voluntary or "goal" based RPS policies as a mandated standard. They have to carefully assess the solar resource under worst conditions for renewable energy to totally meet its full potential in the US.

Since, having added storage capacity in the form of CAES and thermal storage ensures that solar electricity production on the lowest radiation day, combined with the electricity production from the other renewable energy power plants, is sufficient to meet winter peak day load in 2100. To meet this hypothetical peak load, the solar power plant capacity is increased to the following: 4.72 TW of CAES–PV plants connected to 10.16 TW of supporting PV plants, 4.11 TW of CSP, and1.26 TW of distributed PV

The formation incentives.

It was first adopted as the Public Utility Regulatory Policies Act or PURPA in 1978. Like Denmark and many other developed nations, the U.S. crafted national policies to support energy alternatives and conservation in response to the rising cost of fossil energies throughout the 1970s. PURPA required utilities to purchase renewable electricity from qualified independent generators over long-term contracts. Unlike today's feed-in tariffs, which guarantee a premium for the renewable electricity delivered to the grid, PURPA payments were based upon the avoided cost of generating electricity from conventional sources. Approximately 12,000 MW was installed around the U.S. under PURPA from its implementation in 1981 until 1990. But the substantial drop in the price of oil and natural gas in the 1990s made these payments based on avoided cost too low for renewable energy projects to compete. Therefore, PURPA has resulted in only marginal amounts of renewable energy development since the early 1990s. It was also in 1978 that the first investment tax credits (ITC) was established for renewable energy technologies. The Energy Tax Act of 1978 created residential tax credits for 30% of the first $2000 invested in a solar or wind system and 20% of the next $8000 invested; business tax credits for 15% of investment in a solar, wind and geothermal system; and an excise tax exemption for gasohol, which was later turned into a tax credit for ethanol. Tax credits had been available for the oil and natural gas industries but not

for renewable energy, before this piece of legislation. Over the last three decades, the renewable energy tax credits have undergone many changes, largely because of the shifting political climate in Washington, DC. In 1985, Congress was encouraged by the Reagan Administration to allow the residential solar and wind investment tax credits to expire for the first time.

Production tax credit.

In 1992, a production tax credit (PTC) of 1.5 cent/kilowatt-hour (kWh) of electricity was created for largescale wind projects. This tax credit was created partly in response to fraudulent developers who were installing turbines that did not function and taking advantage of the energy and investment tax credits, which were based on up-front capital costs. The business ITC for solar was reduced to 10% from 1986 to 1988.The residential and business ITCs were raised to 30% and extended for 3 years in 2005, resulting in a doubling of installed PV capacity in the U.S. The 2007–2008 political seasons capped off the tumultuous 30-year ride for these tax credits. Congress finally passed a tax extenders bill in October as part of a financial bail-out package for struggling Wall Street banks after a 2-year political stand-off over extending the credits before their expiration at the end of 2008. Today, the solar industry has an 8-year extension of the ITC. When looking at the brief history of renewable energy incentives in the U.S., it seems the only thing consistent about the tax credits has been in consistency. This all-too-familiar issue has fueled the debate over the effectiveness of relying on unstable short-term tax credits that are easily impacted by politics to incentivize renewable energy. Part of that debate revolves around the inequitable nature of the tax credits Target. Millions of Americans are enjoying the benefits of owning a solar hot water system or solar–electric. There were 83,000 solar–thermal and solar–electric systems installed around the U.S in 2007. Although state solar programs have played a key role in driving this growth, the 30% federal ITC has been the most important component. In recent report on the economic impact of the ITC, 8-year extension of the residential and business credits could result in over 6000 MW of annual solar PV and solar thermal installations by 2016. If Congress had failed to extend the ITC in 2008, Navigant projected that annual installations would have fallen to about 1500 MW by 2016.

Solar energy policies in Germany

Germany is the world market leader for solar PV systems installation with an estimated cumulative installed capacity of 3.8 GW at the end of 2007. BMU states about 14% of German electricity was generated from renewable sources at the end of 2007. However, solar PV has still a very small share of about 4% of total electricity generated from renewable sources. Other technologies have taken place on top of it with their share from wind around 45%, bio-energy around 27%, and hydropower around 24%. Out of all solar PV systems installed in Germany so far, about 99% are connected to the grids and only 1% is off grid type. The economic analysis showed that grid connected PV systems is still not economically feasible in Germany under the boundary conditions used in this study. But they would make profit if systems with longer life time of up to 40 years are available. Even the calculations carried out considering FIT schemes show that PV systems with shorter system life time (e.g. 25 years) are not economically feasible. The breakeven analysis show that the systems would have been at breakeven as of today if the module price was as low as 0.72 D /Wp or the base year electricity price was as high as 0.29 D /kWh. In this year the module price will be around 1.52 D /Wp and the base year wholesale electricity price is projected to be around 0.13 D /kWh. It has been calculated that the learning investment for PV systems between year 2009 and breakeven year 2021 will be around 29.4 billion Euros. This loss will be covered by the installations after this year and a win point is expected to occur in 2032–2033. Feed-in tariffs. The document establishes the FITs' mechanism in the country with a contract duration time of 20 years and a constant remuneration for the produced energy. Different values of FITs are established for the different types and the different rated powers of the generation system. In order to stimulate a stronger price reduction, an amendment of the Erneuerbare–Energien–Gesetz (EEG) was decided in late 2008. A digression rate of FITs' values for new PV systems was decided. Furthermore, the digression rate was adapted to the market growth. If the growth of the PV market (new installations) in a year is higher or lower than the defined growth corridor, the digression rate will be increased or decreased by 1% for the next year. The rates were guaranteed for an operating period of 20 years. For small systems (<30 kW) installed in 2009 the producers have the possibility to auto-consume the electricity they produce. In this case, they receive a premium FIT of 0.2501 D /kWh for 2009 (instead of 0.4301) for the self-consumed PV electricity. If one includes the savings on electricity delivery costs (approximately 0.22 D /kWh [54], this way of operating the PV system may become attractive as every kW PV power is worth 0.47 D /kWh.

Incentives. Additional supports are beneficial in credit terms and tax incentives. They depend on whether the PV installations are done privately or by a commercial investor. Commercial systems are VAT (value-added taxes) exempt (VAT is 19% in Germany). Furthermore, investment grants exist in different German regions

Solar Energy policies in India

To promote R&D in the photovoltaics sector, the Government of India had set up the Commission for Additional Sources of Energy in the Department of Science and Technology. It was later merged with the department of Non-Conventional Energy Sources in 1992. Despite the establishment of these organizations, the renewable energy installed capacity was limited to only 29% of total installed capacity in 2002. Lack of exploitation of the available non-conventional resources led to the formation of many policies that later shaped the development of the solar PV industry. These policies were introduced as part of 5-year plans (10th and 11th) from 2002 to 2012. These plans targeted an addition in the installed capacity of 25 GW by 2012.

These policies have helped increase the installed capacity of renewable energy with solar accounting for 19% of total installed renewables. A positive trend in the installation and development of solar energy has induced lucrative investments from the Government with INR 3000 crores (equivalent to 30 billion) being solely set aside for the development of solar energy in the fiscal year 2016–17 as well as increased the solar photovoltaic targets to 100 GW by the year 2022. Private investments have also played a major part in the development of solar energy.

Electricity Act 2003

The Electricity Act of 2003 was enacted to transform the power sector in the country and to consolidate laws relating to generation, transmission, and distribution of energy throughout the country. It was introduced with the aim to promote the development of the electric industry, supply of electricity to all areas especially rural as well as to rationalize the tariff. This act authorized the Central Government to introduce polices regarding electricity generation in consultation with the State Governments. The Tariff Policy came into existence because of the implementation of the Electricity Act. It suggested a policy that permitted the development of stand-alone systems. The Electricity Act also aimed to privatize the generation, distribution, and transmission sectors. In

accordance with the act, Feed in Tariff (FIT) and Renewable Purchase Obligation (RPO) were introduced.

Tariff policy (2006)

The Tariff Policy of 2006 was brought into effect in continuation with the National Energy Policy of 2005. This policy was to include provisions regarding renewable energy and cogeneration. The Tariff Policy was developed keeping in mind the framework established by the Electricity Act of 2003. The tariff policy has evolved over the years in consultation with the state governments and the Central Electricity Authority. The aim of this policy was to give special tariff to renewable energy generation. The Central Government notification suggests that guidelines have been issued for tariff-based bidding process to procure electricity generation and distribution licenses. Through this, the Central Government aims to introduce competitiveness in the process of price determination. The Central Government believes that this competition will lead to significant benefits to consumers by bringing about reduction in capital costs and a significant increase in efficiency. The tariff policy was further amended on 31st March 2008, 20th January 2011, 8th July 2011 and the last amendment being notified on 28th January 2016. This amendment added certain objectives to the original Tariff Policy as more focus was given to renewables and Hydro power to facilitate adequate and uninterrupted supply of electricity to consumers .

Integrated energy policy 2006

The Integrated Energy Policy was developed by an expert committee of the Planning Commission under the directive of the Deputy Chair of the Planning Commission and the then Prime Minister of India Manmohan Singh. This policy was brought into effect in August of 2006 addressing all aspects of energy in the country including energy security, access and availability, affordability and effects on the environment. Recognizing the adverse effects and the inadequacy of supply coupled with projected increase in demand for conventional sources of energy, the policy proposed the following in relation to solar energy.

National Action Plan on climate change

Recognizing that climate change is challenge that needed immediate attention, India, in collaboration with the United Nations Framework Convention on Climate Change, introduced the National Action Plan for Climate Change (NAPCC) in 2008. The aims of the NAPCC was

primarily to address the urgent and critical concerns of the country as well as to promote the development objectives without compromising the environment. One of the most successful plans of NAPCC was the National Solar Mission which aimed to increase the share of solar energy in the total energy mix of the country. The National Solar Mission also aimed to launch major R&D programmes in order to create more affordable and convenient solar systems with provisions for long term storage options. Many research works have recognized the numerous schemes that have been introduced under the National Solar Mission that have assisted in electrifying remote areas which earlier had next to zero access to electricity. Under these schemes Dharnai has become the first village to achieve 100% installed solar capacity with 100 kW lighting around 450 homes. Along with that, aggressive R&D has also been initiated empowering the domestic manufacturing sector and creation of intra-state transmission lines in states like Gujrat, Himachal Pradesh, Karnataka, Madhya Pradesh, Rajasthan and Maharashtra. Generation based incentives for solar (2009) The generation based incentives scheme for generation of energy using solar energy was introduced in 2009 to boost electricity generation using solar photovoltaics. This scheme targeted mainly the small grid solar projects below 33 kV and aimed to lower the gap between base tariff of INR 5.5 and the tariff demanded by the Central Electricity Regulatory Commission. This was presented as an incentive to attract private investments in the field of electricity generation using solar photovoltaics.

Jawaharlal Nehru National Solar Mission (2010) The Jawaharlal Nehru National Solar Mission is a major initiative by the Central Government with active participation of the states to promote ecologically sustained growth while addressing the challenges of energy security and energy poverty. Before JNNSM, the solar capacity of the country was a mere 17.8 MW. The mission was announced in 2010 with it being implemented in January 2011. The mission outlined specific targets of 20000 MW grid connected and 2000 MW of off grid solar power capacity, including both solar photovoltaics and solar thermal energy [20,34]. The main objective of JNNSM is to establish India as a global leader in solar energy. The mission adopted a three-phase approach spanning a period of 10 years with targets set for each phase based on the success of the previous phase and any improvement in technology for use of solar energy. Different schemes and policies have been introduced under the JNNSM to accomplish the targets set for solar power addition. The MNRE, under the tutelage of the Government of India, has initiated the concept of solar cities. These solar cities aim at about 10% deduction in the projected demand for the presently used

conventional sources of energy. Over 50 cities have been identified for conversion into solar cities with a funding of INR 5 million per city varying based on population and initiatives. In addition to solar cities, development of solar parks has also been initiated wherein solar parks will be developed in regions with a solar capacity of over 500 MW supported by appropriate funding by the Government to develop the necessary infrastructure. As per the latest data published by the MNRE, solar parks with a capacity of 26.5 GW have been approved all over India in 22 states. The government has also implemented the scheme of awarding concessional customs duty certificates as a financial incentive to developers for developing grid connected solar power plants. This scheme offers developers concessions on duty that is levied on imports and exports. There have also been increased efforts to develop grid connected solar PV plants on canal banks and tops. With this scheme, the MNRE intends to set up PV plants of capacity 1–10 MW to an aggregate capacity addition of 100 MW to help achieve the targets under phase II of JNNSM. Under this scheme, eight canal top and canal bank projects have been approved in eight states. A funding of INR 30 million/MW for canal top SPV projects and 15 million/MW for canal bank SPV projects have been approved for each project.

China

China has had double-digit rates of economic growth for much of the past two decades. This growth has had huge implications for energy consumption and environmental impact. One of the environmental problems associated with energy consumption is carbon emissions. Though, China's carbon emissions are low on a per capita basis, China is already ranked the world's second largest producer of carbon emission, behind only America. It is reported that 75 percent of China's pollution is due to the burning of Coal as a source of primary energy and this accounts for the dominant share of China's total consumption. Though this share has declined recently, it is still too high relative to other countries. With the rapid rise of the energy price, the application of solar energy is accelerating, and the great environmental and economic benefits have been brought by using the PV. Some policies were formulated in China by the central government and operated in the whole nation. Hundreds of manufactories have produced millions of PV equipments in the last 5 years.

The potential of solar energy in china is very high. Recently, it has been found that the special considerations on solar power have effectively decreased the cost of PV power generation. For

instance, in 2007, electricity tariff from PV generation was 4 Yuan (US Cent 58.9)/kWh. In 2008, Sun tech Power Co., Ltd, the biggest Chinese solar cell producers, declared that it can reduce the PV power price to 1 Yuan (US$ 0.15)/kWh by 2012. Moreover, in 2009 the PV concession demonstration project has propelled the PV generation to reduce to 0.69 Yuan (US$ Cent 0.1)/kWh. The continuous pressure for carbon reduction has tempted China to determine its future energy policies. It is optimism that PV installed capacity will be rapid growth with the solar energy supportive policies.

Renewable energy law.

In 2005, the National People's Congress has passed The Renewable Energy Law [55]. This law has marked a new stage of renewable energy development program in China. Since the introduction of REL, several supporting regulations and guide-lines have been put into place to implement it. The NDRC (National Development and Reform Committee) published "Guidelines for Using the Public Fund for Renewable Energy Development in 2006." These guidelines list three priorities. One is support for renewable electricity generation (including wind, solar, and ocean). The other two priorities are research on energy sources able to replace oil, and support for the use of renewable energy by the heating- and-cooling systems of buildings. They decided that the public fund can be used in two forms. First, it can be issued as a grant. Recipients of such grants use the funds for renewable energy research and development. Second, it can be used to subsidize loan interest. Eligible renewable projects may obtain public funds to pay part of its loan interest.

Chinese government formulates a series of policies and regulations to encourage renewable energy utilization. These policies include:

(I) all PV electric power should be purchased by Power Company, and which should provide enough grid-connect service.

(II) The electrovalence is established more than conventional price in order to encourage the development of solar energy, the benefits of investor should be ensured.

(III) The central government gives some allowances to the renewable resources industry.

(IV) The central government encourages the renewable resources DG (distributed generation) in order to improve the electric power serves of no electric power supply

region, and the early investment and medium-term maintenance are afforded by central government.

(V) Although the end user uses the electric power from PV generation, but the electrovalence of end user is same compared with the end user who uses the conventional electric power? As mentioned above, the central government of China regards the development of PV in order to improve the unreasonable energy structure.

In order to improve the inopportune energy structure and sustainable development the Chinese central government has established some policies and laws, in this regard the following measures were especially recommended:

(i)The applications of solar energy are promoted by the e policy of central government and local governments, the allowance of government is important to increase the competitive power of PV production. And the Chinese central and local government should increase the research fund of PV to grasp the pivotal technology, such as circuit topology and MPPT (maximum power point tracking) control method and grid-connect. Moreover, the tax should be reduction or exemption by government, which will motivate the enthusiasm of entrepreneurs, and which will increase the PV market through government policy initiatives. The advantage of investors should be ensured by government policies. Certainly, the government fund should be launched in the vast power supply project in order to improve the energy structure in the foreseeable future. For example the large desert grid-connect power plant must be established. The ordinary investor and corporation cannot supply the vast fund in the desert grid-connect power plant domain. The devotion of government is obligatory.

(ii) Abundant fund and personnel should be launched into the interrelated research of PV, and the universities and graduate schools should be encouraged to research in solar energy. The cooperation between corporation and university should be enhanced in order to improve the research level. The student is trained by universities in order to supply enough persons with ability to cooperation. Certainly, international cooperation should be encouraged to improve the domestic technology by central government and local governments. (iii) The PV industry chain should be established in order to enhance the economy benefit of Chinese PV industry. Especially, the lack of silicon material and pivotal technology should be settled in future. The PV market should be enlarged in order to digest large numbers of PV product. The attestation

and detect organization lack the contact with the international organization, and the criterion of whole industry should be established. In the future, central government of china should recognize the pertinence of solar energy utilization, prioritize it accordingly and increase investment. Meanwhile, the local government should develop a medium and long-term plan of solar energy utilization, especially focused on systems operation and maintenance. The high cost of PV power generation is the biggest barrier. Energy policy supports are necessary to reduce the cost of PV power generation in order to enable the solar power generation to advance on a large scale. As the good energy policies can effectively decrease the cost of power generation. China needs the substantial program as well as the policy to build environments that encourage the solar energy, so as to advance its rich solar energy resource and to use it's the great production capacity