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Article

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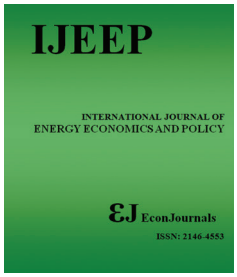

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Government Policy and Financing Options for Solar Energy: World Prospects

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ABSTRACT

The project financing of solar projects has been proven challenging given the relatively high costs (both for utility solar and rooftop solar) of solar projects, the uncertain life cycle for solar panels, and the lack of business models for financing in the private sector. Several governments have loan-financing programs available for solar-energy projects. The article describes the peculiarities of government policy in the solar energy field of countries that have already implemented large-scale projects for the construction of Solar powered satellite (SPS) (USA, China, India, EU) and countries that have just started to implement this option as an alternative energy into the country's overall energy system (Eastern Europe: Russia, Kazakhstan). This article is universal in nature. The data obtained and developments can be applied both in the local and international practice of managing an energy business operating in the field of alternative energy - the "solar" industry.

Keywords: Solar Energy, Government Policy in the Solar Energy Field, Alternative Energy Business
JEL Classifications: Q13, Q4, Q42

1. INTRODUCTION

The solar photovoltaics (PV) market grew very rapidly in recent years, mostly driven by technological improvements that reduced costs and government policies supportive of renewable energy. However, solar energy still is more expensive than conventional energy-resources despite rapidly declining costs, and thus, sustained policy support is needed, so that its growth will continue. The right mix of policy towards solar-energy development should arise from the hidden benefits of solar energy, and indeed go beyond the achievement of parity in grid costs. Policy makers' agenda should include an expansion in the generation of renewable energy and so maintain the reliability of the power grid to address climate change, boost energy-security, develop a domestic industry for green jobs, secure access to electricity in remote areas, and address the external costs of fossil-fired power generation. The need to achieve multiple objectives and gain political- and socialsupport for the solar industry requires a coordinated effort to come up with the optimal policy mix.

The issue related to the exhaustion of natural resources in the world stimulates the intensification of studies and projects on the development of alternative sources of electricity and fuel. Energy consumption and production makes up for about two thirds of global greenhouse gas emissions, and 81% of global energy consumption is still based on natural fuel — the same value

as 30 years ago. The issue related to the exhaustion of natural resources in the world stimulates the intensification of studies and projects on the development of alternative sources of electricity and fuel. Energy consumption and production makes up for about two thirds of global greenhouse gas emissions, and 81% of global energy consumption is still based on natural fuel — the same value as 30 years ago thirds of global greenhouse gas emissions, and 81% of global energy consumption is still based on natural fuel — the same value as 30 years ago.

Throughout the modern era, the humankind has used a natural fuel to meet its energy needs. For centuries, coal, oil and natural gas have illuminated houses and set vehicles in motion, contributing to the development of civilization. But, as the human development has sped up, the instability of such energy has become apparent. Global fuel supplies have gone down, and the atmosphere has become more polluted. In order to ensure the steadiness, the search for renewable energy sources (RES) have been launched. Today our civilization is at a critical stage. We are on the verge of adopting alternative ("clean") energy in such a scale that we have never seen before. However, with the purpose for RES to continue their rapid development, it is necessary to make the right decisions (World Economic Forum, 2019; 2019b; 2019c).

When the alternative energy first has achieved a progress globally, this has caused questions in reference to its stability and scalability. At the macro level, unstable policy of ensuring future development has been stipulated by technological non-readiness and lack of funding. Nevertheless, clean power plants have been developed, albeit slowly, and this has been continued until a crucial change few years ago (Bloomberg New Energy Finance, 2014; Bio-prom.net, 2019).

In overall, the necessity to start using alternative (ecologically clean) electric power and heat sources is as a result of impact of the following factors:

- Global warming is becoming increasingly systematic. Within the Paris climate agreement specific measures are identified to reduce greenhouse gas emissions;
- Development of electricity generation based on RES has a targeted support from the states, tariff and tax incentives allow competing with generation based on traditional energy sources;
- The cost of PV (the main technology of power generation using solar panels) is reduced - the cost of solar panels in the world is reduced by 10% annually (Ac.gov.ru, 2017).

Currently the scientific and business communities have a challenge of transforming to a more sustainable, available, safe and inclusive energy system. Most understands that it is necessary to transfer to alternative energy sources.

The majority of leading analysts, leaders of policy and business highlight the need to transfer to a more inclusive, sustainable, available and safe global energy system, aiming at solving global energy issues by creating benefits for business and society, and without jeopardizing the correlation between energy triangle components (safety and availability/ecological sustainability/ economic development) (Feldman et al., 2015; Kearns et al., 2018; Stacey, 2018).

Thus, a general initiative on reshaping the current energy situation should tend to accelerate the development of effective policy, private sector activity as well as cooperation between public and private sectors necessary to ensure the transition to energy consumption (World Economic Forum, 2019b).

Last time a special attention has been paid to the development of solar power generation. As it is known, the sun energy is used as a source of both electric and thermal energy. It is environmentally-clean, and in the process of the conversion there are no generated hazardous emissions. This relatively new way of electricity production had got a fast development in the mid-2000, when the EU countries started to reduce dependence on hydrocarbons in the field of electricity generation. Another goal was to diminish greenhouse gas emissions. Particularly for these years the cost of manufacturing solar panels began to lower down, and their efficiency was increased.

Focusing on research data from government and research organizations that have conducted study in energy field, within few upcoming years the alternative sources of energy, including the wind, sun, water, biomass and others will be able to almost completely replace the traditional energy sources, which will also have a positive effect on ecology due to reduced air and water pollution (Ac.gov.ru, 2017; Energytrend.com, 2019; Expert portal on Russian Federation energy saving issues, 2019; Habr.com, 2019; Idsa.in, 2019; Minenergo.gov.ru, 2019).

So, recently, the use of PV panels that convert the sunlight into useful electric energy by using a concentration of solar power (CSP) has become quite widespread. For instance, in the USA roofs of PV panels make the solar energy useful practically in every state. In sunny locations such as Los Angeles or Phoenix, a 5 kilowatt system produces an average of 7,000-8,000 kilowatt-hours per year, which is roughly equivalent to using electricity in a typical US household. Large-scale PV projects use PV panels to convert the sunlight into electricity. These projects often have outputs in the range of hundreds of megawatts; that is, these are millions of solar panels mounted on a large area of land (Habr.com, 2019).

The project financing of solar projects has been proven challenging given the relatively high costs (both for utility solar and rooftop solar) of solar projects, the uncertain life cycle for solar panels, and the lack of business models for financing in the private sector. Several governments have loan-financing programs available for solar-energy projects. In India, Shell Foundation worked with two investment banks to develop renewable-energy financing portfolios. This project helped the banks put in place an interest rate subsidy, marketing support, and a vendor qualification process. Within two and a half years, these programs had financed nearly 16,000 solar home systems (Timilsina et al., 2012). In the United States, the Energy Policy Act of 2005 authorized the Department of Energy (DOE) to issue loan guarantees for projects that "…avoid, reduce or sequester air pollutants or anthropogenic emissions of greenhouse gases;

and employ new or significantly improved technologies as compared to commercial technologies in service in the United States at the time the guarantee is issued." The current loans for energy efficiency, renewable energy, and advanced transmission and distribution projects under the Loan Programs Office adds up to to $35 billion as of May 2013 (LGP, 2013).

One of the main drivers of solar energy development in developing countries is public investment. Many developing countries (e.g., China, India) host several government- and donor-funded projects to support solar energy under their rural electrification programs.

The solar power generation is a solution for issues in the world regions related to access to traditional sources of heat and electricity, such as Africa, for example. Only 30% of Sub-Saharan Africa has an access to energy sources. Autonomous solar plants and micro-networks are being developed there. Africa, as a region with a powerful mining industry, strives to get an alternative to diesel power plants, as well as a reliable backup source for insecure power grids (Gratanet.com, 2019).

The relevance and importance of solar power generation is also stipulated by the increasing involvement of international corporations in the business. For example, in 2000 Apple corporation has established a new subsidiary of Apple Energy LLC with the purpose not to produce the latest computer and mobile devices, but to sell the energy surpluses generated on their solar plants.

In Russia now the solar power generation is being developed. The first PV station with a capacity of 100 kW, located in the territory of the Belogorodskoy region, was launched in 2010. The solar polycrystalline panels for it were purchased at the Ryazan plant of metal-ceramic devices. Starting from 2014 the construction of a 5 MW solar power plant began in the Altai Republic. Other related projects are being considered, including ones for Primorsky and Stavropol regions, as well as in the Chelyabinsk region (RBK, 2017; Minenergo.gov.ru, 2019).

At the same time, the extension of projects as regards the construction and installation of facilities generating solar energy have caused a number of legislative issues. It is also necessary to elaborate an effective, but quite flexible state policy in terms of accounting of energy resources, their distribution and use by the population. At the moment these issues are highly relevant in the United States, Europe, China and India, as leading countries that are actively introducing solar power generation into the country's energy system.

However, there are still not fully covered issues with reference to possible harm that solar plants can cause and a general impact on the environment and human health.

So, the issues, addressed in the study, are:

- Consideration of the main issues related to the world community as regards the state policy as for solar power generation;
- Analysis of the dynamics of upgrade of alternative power generation facilities in all regions of the world, identify leading countries. As a result, consider the man issues and solutions for accounting of solar energy usage as a source of heat and electricity for the population of the country, as well as a policy on specified energy resources distribution;
- Evaluation of the demand and efficiency of the projects related to the construction of facilities generated a solar energy;
- Consideration of the prospects for Russia and Kazakhstan in terms of implementation of a solar power generation in the framework of their general energy system, and assess the possible effect from it.

2. METHODS

2.1. Research Design

The study is proposed to be carried out on the basis of an integrated approach. Firstly, it is necessary to analyze the worldwide market of alternative solar power generation. During the analysis the solar power generation share in the industry framework should be identified as well as to study forecasts regarding its development. Then, it is necessary to explore the main trends and features of the policy development within solar power generation by countries, which have already launched the projects for the construction of power plants of this type, and are actively using them as one of the main sources of electricity and heat (for example, the USA, some countries in Europe, China, India). Thirdly, we consider it relevant to regard the situation in the developing countries of Eastern Europe (using the example of Russia and Kazakhstan), to identify general trends and development prospects, and offer our own forecasts and a common vision of the situation. As a result, this will allow us to build a common basic model for the solar energy system functioning, taking into account the best practices within the framework of state policy of the countries that have achieved some success in this area. Moreover, in order to solve all the tasks assigned during working process, in the course of the research it was necessary to evaluate the effectiveness (profitability) of the projects for the construction of power plants (PV panels) using solar energy. The results of the assessment will allow making a detailed view on trends of the state policy in the field of development of alternative power generation, which can be useful primarily to developing countries of the world and which are at the initial stage of its introduction into the country's overall energy system.

2.2. Data Analysis

2.2.1. Overview of the global market for alternative and solar energy

The solar power generation is considered the most promising area of the energy industry, as for the last years the market prices for solar modules have significantly decreased, and their efficiency has increased. The solar power generation has shown fast development with an expected output of 6.2% of world electricity production by 2040. According to the statistical report of British Petroleum, at the end of 2017, the total amount of installed capacity of solar power plants built and brought into production throughout the world amounted to 303 GW. This power is generated by 301.5 thousand solar power plants (SES). It is noteworthy that 48% of

them are located in Asia. The cumulative installed production capacity demonstrates a steady positive dynamics over an already long period. According to the Energytrend report, by the end of 2019 the specified value will increase by 150-200 GW.

Today, one fifth of all electricity in the world is generated from RES. In 2017 in the world there were 160 GW of plants for the pollution-free energy production. This is by 10% more than in 2016, but upon the cost these plants are almost a quarter lower. Due to dynamics analysis of the total alternative energy industry in the world, we have commented that in 2017 the solar energy industry has given the greatest increase (Figure 1), ensuring the generation of almost half of the total net power, followed by wind energy, which has been increased by one third compared to last year's result, and hydropower, which has increased by 15%. Many experts consider 2015-2016 in history as those that gave the most powerful impetus to the development of solar energy, when the power of the sun exceeded any other technology of electricity generation, followed by wind energy, which has been increased by one third compared to last year's result, and hydropower, which has increased by 15% (Energytrend.com, 2019; Kreston, 2019).

We should pay attention to the fact that rates of the solar power generation increase in 2010-2016 have exceeded almost in 3.5 times the rates of power generation increase based on the traditional type of fuel - coal and natural gas (Figure 1).

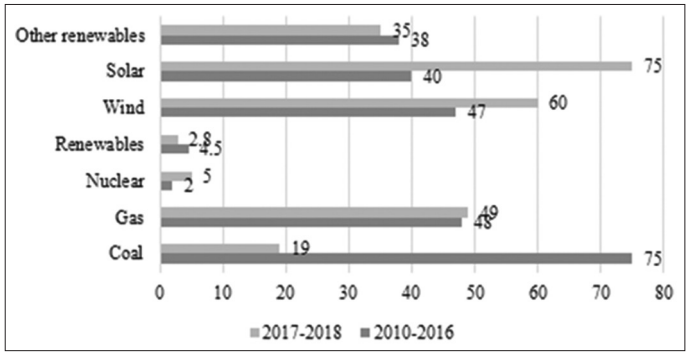
As we see in Figure 2, in 2017 the structure of alternative power generation in the world consisted for the most part of wind energy (54.14%), solar (31.25%), further - energy generated from biomass (8.28%) and the Earth depths (geothermal energy, 6.37%). In the regional context - the countries of Europe and the BRICS Union (the Russian Federation, India, China and South Africa) are already facing some changes in the structure. Thus, the solar power generation share in the EU countries amounts to 38.04%, while in the BRICS countries it is only 18%. However, in general, the structure is of a similar nature.

On the Figure 3 you can see the solar power generation system capacity within leading countries in the process of implementation of such fuel and electricity at the end of 2017. These data were presented at the World Economic Forum in Davos in 2018. This demonstrates that the most efficient solar power generation is in China, then - Germany, the USA, Japan.

Paying your attention that China has the most of solar energy high-capacity than any other country in the world, with giant 130 gigawatts. If all of them are producing electricity at the same time, this could have launched the electricity in the entire UK by several times. China is a place for headquarters of many large solar plants, including a 850 megawatt huge facility of Lianyans on the Tibetan plateau with four million panels. Moreover, the largest solar power plant in the world is currently located in the Chinese Tenger desert - its capacity exceeds 1.500 megawatts (Baraniuk, 2019).

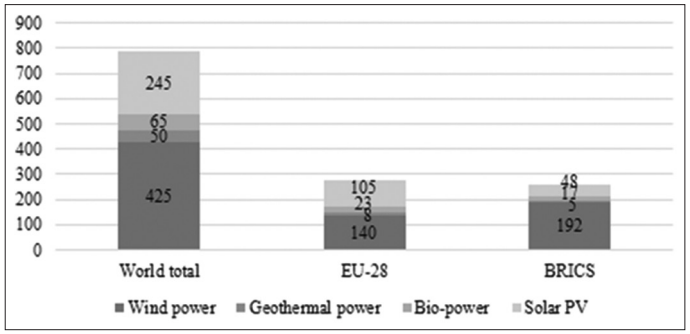
India takes the last place in Top7. However, due to rather lower and non-uniform level of economic development in this developing country, for a significant population rank, which is below the poverty line, the development of solar power generation is a considerable achievement.

Figure 1: Global average annual net capacity additions by type, GW



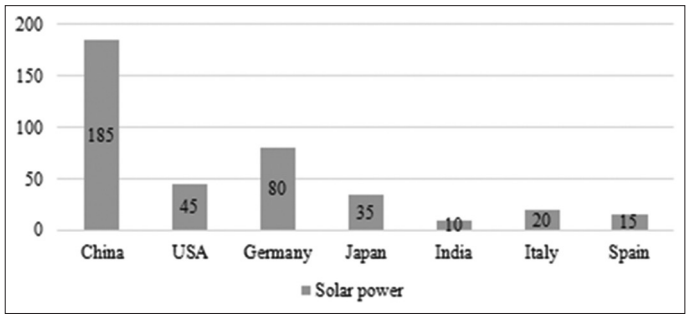
Source: World Energy Outlook 2017, IEA

Figure 2: Renewable power capacities in the world, EU-28 and BRICS (Russian Federation, India, China and South Africa), gigawatts, 2017



Source: (Energytrend.com, 2019; Ren21.net, 2019; US EPA, 2019)

Figure 3: Renewable power capacities in the world, EU-28 and BRICS (Russian Federation, India, China and South Africa), gigawatts, the end of 2017



Source: WEF (World Economic Forum, 2019c)

The results above also have confirmed the data of the international analytical agency Energytrend. Based on the latter, a geographical structure of electricity generation was elaborated taking into account information about solar power plants (hereinafter referred to as SES). Thus, pursuant to the report of the International Energy Agency (IEA) as of 2016, energy from the usage of solar PV systems accounts for about 1.8% of global electricity consumption and 4% of European countries. Under the forecast of Energytrend, in 2017 the countries such as China, the United States, Japan and India will have 75% of the new global solar power generation capacity.

The situation in other countries of the world that have not been included into the main geographical structure of the leading countries on solar power generation (Figures 3 and 4) is slightly different.

So, for example, in Russia the volume of solar energy used has not been large so far, although within small volumes the development of this industry segment is continuing. Considering the overcapacity in the "big" power generation industry, solar power generation plants are reasonable to build in remote and isolated areas, where the delivery of traditional fuel is expensive. In Russia projects on the construction of solar power generation plants operating on RES, including SPP only in 2014-2016 (Table 1). However, the potential for the development of solar power generation in the countries of Eastern Europe, including, for example, Russia and Kazakhstan, is also estimated to be quite high.

Thus, according to the Institute of Energy Strategy, the theoretical potential of solar power generation in Russia makes up more than 2.300 billion tons of reference fuel, the economic potential makes up 12.5 million tons of equivalent fuel. The volume of the solar energy entering the territory of Russia for 3 days exceeds the energy volume of the entire annual electricity production in the country.

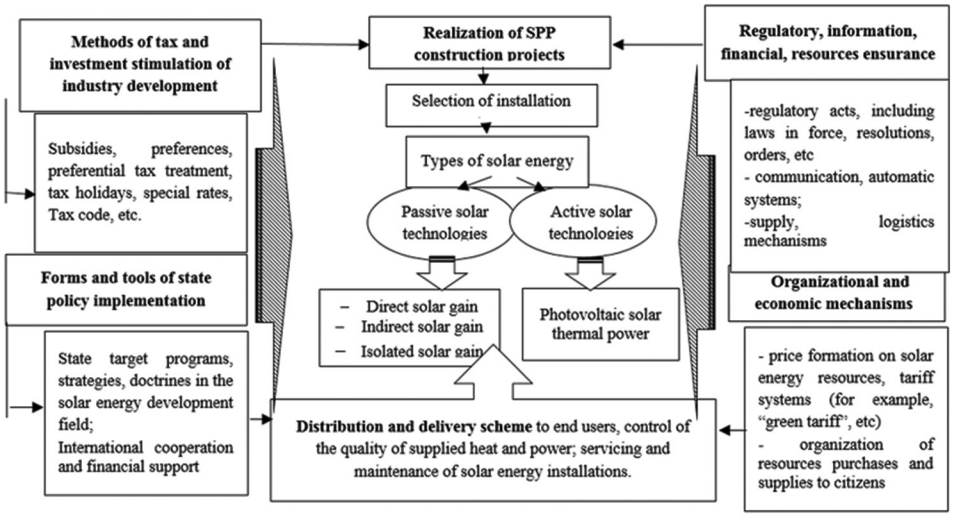
Due to the location of Russia (between 41 and 82 degrees of north latitude), the level of solar radiation varies considerably: from 810 kW per hour/m² per year in remote northern areas to 1400 kW per hour/m² per in southern areas. The level of solar radiation is also influenced by large seasonal fluctuations: at a width of 55 degrees, the solar radiation in January amounts to 1.69 per hour/m² per, and in July - 11.41 per hour/m² per.

The potential of solar energy is greatest in the south-west (the North Caucasus, the region of the Black and Caspian Seas) in Southern Siberia and the Far East (Ac.gov.ru, 2017; RBK, 2017).

The most promising regions in terms of using solar energy are Kalmykia, Stavropol Territory, Rostov Region, Krasnodar Territory, Volgograd Region, Astrakhan Region and other regions in the south-west, Altai, Primorye, Chita region, Buryatia and other regions in the south-east. Moreover, in some areas of Western and Eastern Siberia and the Far East the solar radiation is exceeded the same one in the southern regions. So, for example, in Irkutsk (52 degrees of north latitude) the solar radiation reaches 1340 kW per hour/m², whereas in the Republic of Yakutia-Sakha (62 degrees of north latitude), it makes up 1290 kW per hour/m² (RBK, 2017).

The management of the Republic of Kazakhstan, following the world trend, has started to pay more attention to the development of RES in the region. An ambitious goal is declared that is to achieve a 3% content of RES in the overall energy balance of the state by 2020, although this is a rather modest value (in Spain, by 2020 it is planned to reach 40% upon today value 25%) (Ac.gov.ru, 2017).

Figure 4: Basis model of solar energy development in modern business conditions



Source: Developed by the authors

Table 1: Solar power generation plants, constructed in Russia ные в России according to DPM RES in 2014-2016

No.	SES	Company	Capacity	Implementation year
11.	Kosh-Agachskaya	Avelar Solar Technology LLC (ООО "Авелар Солар Технолоджи")	10 MW	I (2014), II (2015)
22.	Perevolotskaya	Avelar Solar Technology LLC (ООО "Авелар Солар Технолоджи")	5 MW	2015
33.	Buribayevskaya	Avelar Solar Technology LLC (ООО "Авелар Солар Технолоджи")	20 MW	I (2015), II (2016)
44.	Orskaya (Sakmarskaya)	"T Plus" PJS ("ПАО Т Плюс")	25 MW	2015
55.	Abakanskaya	"EuroSibEnergo" PJS (ПАО "ЕвроСибЭнерго")	5 MW	2015
66.	Bugulchanskaya	Avelar Solar Technology LLC (ООО "Авелар Солар Технолоджи")	15 MW	I (2015), II и III (2016)

Source: Ministry of energy of the Russian Federation (Minenergo.gov.ru, 2019)

In line with the Ministry of Energy of Kazakhstan, the RES market is increasing from year to year. For example, in 2017, 1.1 billion kW was generated, which is 22% more than the one in 2016. In 2018 it has amounted to 1.7 billion kW. At the same time, in 2017, five RES facilities were brought into operation in the region: three hydroelectric power plants, one wind power plant, one solar power plant (SPP).

The government of the Republic of Kazakhstan intends to reach 50% of RES in the total energy balance by 2050, with an intermediate objective of 3% by 2020 and 10% by 2030. Mr. Kanat Bozumbayev, Minister of the Ministry of Energy commented that the RE Auctions procedure, which will be launched in May 2018, should become one of the key tools for attracting necessary investments (Gratanet.com, 2019; Kazakhstan develops renewable energy sources | International Centre for Trade and Sustainable Development, 2019).

Now we regard the forecasts as for the development of the solar power generation industry for next several years.

Thus, due to the assessment of Frost and Sullivan company in 2017 the investments into RES will amount to 243 billions US dollars, out of which 142 billions US dollars refers to the solar power generation. Further development will be stipulated by the following tendencies:

Pursuant to IEA forecasts:

- By 2022 the overall capacity of RES will increase more than 920 GW that is by 3 times exceeding the same value in 2016;
- The wind and the sun will cover 80% of the global development of RES market during next 5 years.
- China: Cumulative established capacity of RES by the end 2022 will increase by 63.6% compared to 2017.
- In May 2019 there will be construction of the largest floating SPP in the world with a capacity 150 MW;
- The USA: stating in advance and referring to the issues related to the state policy in the solar power generation in the country, we should comment that in the country the situation as for uncertainty with implementation of federal tax reforms in the context of RES execution is still non determined;
- EU: Transfer from state support (rejection of financial support in terms of RES implementation) to a more competitive market;
- Developing countries of Asia and Sub Saharan Africa: development of off-grid solar PV applications - according to the IEA forecasts, by 2022 an off-line flow capacity will go up to 3 000 MW, which is in 3 times more than in 2017.
- Transition from "green" tariffs to competitive auctions and long-term contracts on purchasing the energy for utilities (Gratanet.com, 2019; Kazakhstan develops renewable energy sources | International Centre for Trade and Sustainable Development, 2019).

2.2.2. Government policy of leading countries in the implementation of solar power generation projects

The state policy should contribute the increase of SPP quantity and their energy generated share within the overall balance. Usually the power generation cost based on RES exceeds the energy cost from traditional sources as well as to bring new players to the market only under systematic support of states. Over the past 10 years leaders in power generation based on SPP have been Germany and Italy. However, as a result of the implementation of large-scale solar power generation incentive programs, such countries as China, the USA and Japan have joined the leading countries. RES policy exists in 85 countries. Moreover, programs in this area are being developed both at the national level and at the level of individual regions.

Globally, we can talk about several approaches to stimulating the development of solar power generation industry. Usually within advanced economies where solar power generation has mainly reached its target performance, the development of PV is gradually less undergone direct incentive measure for the following reasons:

- The cost of PV-based generation has significantly decreased in recent years. According to Lazard's levelized cost of electricity estimates, the value for the wind and the sun have lowered down for the period 2010-2017 by 66% and 85% respectively that is equal to similar gas and coal values. As a result, the generation cost makes such projects competitive with traditional fuels and without government support.
- Tariff-regulated selling price of energy from renewable sources is higher compared to the cost of energy from traditional sources.

Usually the current policy binds distribution network operators in European countries to enter into contracts for the supply of such energy for a long period (from 10 years) with price fixing. For example, in Germany, under contracts, concluded 10 years ago, it is redeemed at 45-50 cents per kilowatt, whereas the current market price of a kilowatt for solar energy in Germany amounts to about 12 cents. Mainly this factor has caused a slight decrease of development rates of PV in the EU and the USA. In view of it the solar generation in China, fully supported by the state, has shown the highest rates of development. However, manufacturing of SPP components, including PV elements, is actively developing in China. The state support allows Chinese suppliers, by minimizing the cost of products, to maintain price leadership in the global market. International authorities have a relatively non-significant impact on enabling the development of solar power generation globally. The most powerful organization in the industry is the IEA and the International Renewable Energy Agency (IRENA), whose activities include analytical work, information sharing and the development of international cooperation (Ac.gov.ru, 2017).

The value of the estimated rated value of electricity from RES are essentially influenced by actual climatic conditions, accounting for indirect subsidies, macroeconomic parameters, etc. Nevertheless, the emergence of more and more countries (preferably, among energy-importing countries) testifies a complete competitiveness of solar power generation in the power industry every year. This fact is stipulated in reports presented during the recent World Economic Forum. The further extension of the solar power generation has positive tendencies due to the goals of most countries to strengthen energy security, reduce pollution and greenhouse gas emissions. Rated power cost of large photoelectric power plants has almost reached the value of fossil fuels, even without subsidies.

Considering the specifics of the state policy formation in the solar power generation industry in the United States it is necessary to highlight as follows. Federal policy measures aimed at integrating RES into the US electric network have contributed the development of renewable energy technologies, in particular solar and wind energy technologies. Currently, California is a leader in installed solar capacity (solar photoelectric – photoelectric panels and solar thermal technologies), while Texas leads in generated wind energy.

Federal initiatives aimed at developing and implementing renewable technologies are included in the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009. A recent amendment to the Clean Air Act, better known as the Clean Energy Plan, ensures the political basis for expanding the production of electricity from renewable sources.

The federal policy enables the states to select how the initiatives can be applied. These policies include:

- Standards of RES package (RPS) that preview a minimum quantity of RES, which can be used by power generation manufacturers for power production.
- A system of loans' issuance on REC, which would ensures manufacturers who have produced it more than needed, to sell or exchange the latter on credits to other suppliers,
- Fitting tariff (FiT), which compensates financial expenses of clients who possess RES (such as solar photoelectric panel on the roof).
- Clean tariffs that enable clients owning RES (such as solar panels on the roof) to make use of electricity manufactured under their technologies instead of electricity received from the central electric network.
- Federal tax privileges on production (PTC),
- Tax discounts for manufacturers of solar and wind energy are continuously upgraded until the expiry of their validity. In December 2015 the Congress approved the extension of these federal tax privileges upon solar and wind technology (Sustainable Energy Coalition, 2019).

China's state policy in the field of solar energy is based on two components - the construction of large-scale solar parks and subsidies. Thus, the large-scale production of solar panels have facilitated China to establish huge solar farms both inside the country and abroad. China has the world's largest solar farm - the solar energy park at the Lunyansya Dam in Tibet with four million solar panels covering an area of 10 square miles. Companies such as Panda Green Energy, which built the Panda massifs in Datun, plan to install similar farms in other parts of the country and abroad. The company's Panda 100 program aims to create similar solar farms in countries that are part of the Belt and Road initiative (BRI). A 100 MW Panda power plant can provide 3.2 billion kWh of clean electricity for 25 years, equivalent to saving 1.056 million tons of coal or reducing 2.74 million tons of carbon dioxide emissions. China also has the world's largest floating solar farm in Anhui province, which is built by Sungrow Power Supply.

Despite the fact that there is a boom in large-scale solar farms in different parts of China, the Ministry of Energy reports that the distributed solar PV system in the country is developing much faster than that of large solar power plants, and it accounts for 27.1% of all its solar PV installations. It is caused by the objective of the government to reform public energy company State Grid. Besides, in order to tackle with excess production capacity and get rid of excessive dependence on foreign trade markets, the government insisted on installing solar panels in the country by expanding incentives. The Solar Roofs program and the Golden Sun Demonstration Project are results of efforts subject to creation of a prosperous solar industry in household sector that is crucial to its economy (Idsa.in, 2019).

Currently among the key issues that can prevent the extension of China's solar industry is the cancellation by the Chinese government of important subsidies for large-scale solar projects, which means that now their construction is much more expensive. State funding reduction was caused by the indebtedness at the amount of over $15 billion of state renewable energy fund. Due to this fact, the impact on the industry will be tremendous. So, in 2018 in China there has been 53 GW of the solar energy, but to the end 2019 the total number of installations will amount to no more than 35GW (Baraniuk, 2016; Bloomberg, 2018).

2.2.3. Russian and Kazakhstan state policies in the framework of solar power generation industry

The solar power generation industry in Russia was formed some years ago. It is still at the initial development stage. Its development was caused by creation of state support system of power generation development based on RES. It was based on the Decree of the Government of the Russian Federation No. 449, adopted in May 2013. This determines RES maintenance mechanism at the wholesale electricity and capacity market (PDM RES - special contracts for the construction of generating facilities of RES), selected on a competitive ground. The mechanism will guarantee the investor a stable revenue for 15 years, if the facility is put into operation on time and the necessary level of localization is provided. In 2015 the mechanism for supporting RES in the retail electricity market (Decree of the Government of the Russian Federation dated January 23, 2015 No. 47) was approved, as well as a number of regulatory acts aimed at stimulating the RES development in the country as a whole. On conducting the first competitive selection of projects on PDM RES in 2013 allowed to outline the initial structure of the industry, which after 4 years have undergone no critical changes at stimulating the RES development in the country as a whole.

Russia has in its possession all necessary modern solar energy technologies, silicon and multi-junction photoelectric converters that concentrate systems are being developed and improved. In 2016 three companies showed themselves to be active participants in the industry. A joint venture between state companies - Renova Group and Rosnano produced modernized solar batteries in Chuvashia. The state company Hevel announced at the beginning of the year about the launch of the Pleshanovskaya and Grachevskaya SPP in the Orenburg region, the capacity of each of them makes up 10 MW. The Russian Space Systems holding,

which is part of the Roscosmos state corporation, completed by the beginning of 2017 the creation of an improved application of electrical protection for domestic solar batteries. The most significant facility of Russian industry is a 100 kW power station, operating at the expense of solar energy and located in the Belgorod Region. The Pleshanovskaya and Grachevskaya SPP in the Orenburg region, the capacity of each of them is 10 MW. The Russian Space Systems holding, which is part of the Roscosmos state corporation, completed by the beginning of 2017 the creation of an improved application of electrical protection for domestic solar batteries. Based on state support 12 MW solar parks are being built in the Stavropol region and 10 MW ones are in Dagestan. > The Pleshanovskaya and Grachevskaya SPP in the Orenburg region, the capacity of each of them is 10 MW. The Russian Space Systems holding, which is part of the Roscosmos state corporation, completed by the beginning of 2017 the creation of an improved application of electrical protection for domestic solar batteries. The support of enterprises working with solar energy implies the use of a "green tariff" that guarantees the investor's income at the level of 14%, achieved due to the higher cost of services for the consumer. Participation in the program requires a competitive selection, held annually. Projects are prepared upon the request of the regions. A law draft is being developed to enable the microgeneration of environmentally friendly electricity by consumers. In the courtyards or on the roofs of private houses it is planned to allow the installation of stations up to 15 kW, equipped with a system for disposing surpluses to the network. Payment of such stations upon a wholesale price is charged to energy sales companies. Individuals' revenues from this source will not be taxable (Expert portal on Russian Federation energy saving issues, 2019; Sun collectors "Solar Fox", 2019).

The expansion of existing and construction of new production facilities for SPP should give an additional impetus to the development of solar power generation in Russia, ensuring to reduce capital costs and improve the competitiveness of the projects for the SPP construction due to the scale factor. Moreover, the manufactured products will be of great need for consumers not only within Russia, but also in neighboring countries, mainly in the EAEU partners. Thus, within the period up to 2020-2025 in Armenia, Kazakhstan and Kyrgyzstan there are about 400 MW of SPP scheduled for construction, while for the CIS market SPP launch is planned until 2020 and is estimated by 5 GW of SPP. The expansion of existing and construction of new production facilities for SPP should give an additional impetus to the development of solar energy in Russia estimated by 5 GW of SPP (Sun collectors "Solar Fox", 2019).

The direct influence of the Russian state policy on solar power generation industry development is displayed in the following way:

- Public support: the existence of legislatively established economic incentives for solar power generation is of crucial importance for its development. Among the types of state support that are successfully used in a number of countries in Europe and the USA, there are: A privileged tariff for solar power plants, subsidies for the construction of solar power plants, various types of tax breaks, compensation for part of the cost related to servicing loans for purchasing solar installations;
- Environmental standards: very tough environmental standards (restrictions and fines) as of revision of the Kyoto Protocol can positively affect the solar energy market. Improvement of the mechanisms for selling emissions quotas may provide a new economic incentive for the SPEU market;
- Initiatives of domestic authorities: initiatives of local authorities: regional and municipal management authorities can implement their own programs for the development of solar energy or, more generally, renewable/non-traditional energy sources. Today, such programs are already being implemented in the Krasnoyarsk and Krasnodar territories, the Republic of Buryatia, etc. wable/non-traditional energy sources;
- Inducement of development of own production: the Russian production of SFEU may have a positive impact on the development of Russian consumption of solar energy. Firstly, due to our own production, general public awareness of the availability of solar technologies and their popularity are increasing. Secondly, the cost of SFEU for end users is reduced due to a decrease in the intermediate links of the distribution chain and due to a decrease in the transport component.

Currently in Kazakhstan there is a state support system within the Law "On support of using RES". Starting from 2017, the Ministry of Energy of Kazakhstan gives the right to support renewable energy on the basis of competitive selection, while until 2017 the country had fixed tariffs that the investor received for 15 years. The mechanism of fixed tariffs at the initial stage of the development of RES allowed launching quickly the RIS market in the country. At the moment in Kazakhstan there are 58 RES working facilities with the cumulative capacity 343 MW. In overall, extension of employees' quantity due to RES share increase in the country as well as transfer to "green" technologies is one of the priorities defined by the leader of the country in the Letter "New development opportunities in the fourth industrial revolution." The Ministry of Energy of Kazakhstan states that the issue as of development of employees' potential in the country is consistent: in the Development Strategy of Kazakhstan until 2050, one of the challenges of the modern world is the exhaustion of natural resources (Kazakhstan develops renewable energy sources | International Centre for Trade and Sustainable Development, 2019).

The European Bank for Reconstruction and Development (EBRD) has been implementing 121 projects at the amount of $3 billion in the country. So, there are about 80% of the projects related to infrastructure and transport industries, as well as energy and mining, about 40% of the projects related to the energy industry, including RES. So, last year the EBRD invested $50 million into the "Stormy Solar-2" project (solar power generation). At the beginning of 2018 $8.8 million were invested into another solar power generation project (Kazakhstan develops renewable energy sources | International Centre for Trade and Sustainable Development, 2019).

On March 19, 2010 the President of the Republic of Kazakhstan approved the State Program of Forced Industrial-Innovative Development in the Republic of Kazakhstan for 2010-2014.

Then, in August 2014 the the State Program of Forced Industrial-Innovative Development in the Republic of Kazakhstan for 2015-2019 was adopted. Both programs focus the attention on the significant potential of RES such as the water, wind and solar energy in Kazakhstan in the short and long-term perspective. Following these programs by the end of 2019, RES share in total energy production should exceed 1%. The concept of transition of the Republic of Kazakhstan to a "green economy," identifying objectives, duties, basic principles and general approaches on the transition to the "green economy," stipulates that the engineering development for an alternative energy in Kazakhstan should be performed via the construction of wind and solar power plants, so that the share of such power plants in total electricity production reaches 3% in 2020 and 10% in 2030.

In particular, according to experts' calculations and, notwithstanding the geographical location of Kazakhstan, the solar energy resources in the country are stable and usable due to favourable climatic conditions. Studies show that the capacities of solar energy industry in the southern regions of the country amounts to 2500-3000 of solar hours per year.

We have to comment that today there are relatively few projects on the alternative energy, and they are mainly implemented in the field of wind and water energy. However, by the end of 2019 there are 4 solar power plants with a total capacity of 76 MW subject for construction. The projected capacities will be an unprecedented result for the Republic, but they are not high compared to other countries where absolutely different projects are in process of implementation for a long time.

So, in order to carry out RES construction projects[1] including solar energy facilities, the state has previewed the following incentives and preferences:

- Customs duties exemption (under the import of equipment within RES construction projects);
- State natural grants (not exceeding 30% of the investments into Kazakhstan fixed assets of a Kazakhstan legal entity).
- Tax preferences (reduction of calculated corporate income tax by 100%, application of 0% coefficient to the tax base). The investment contract defines the validity duration of each type of tax preferences, but not exceeding the limited duration for their usage stipulated in the Tax Code);
- Investment subsidy (provided as a compensation up to 30% of actual costs for construction and installation works as well as the purchase of equipment without VAT and excise taxes, but not exceeding the expenditure stipulated in the pre-project documentation having a state expertise opinion).

However, in general the Tax Code of Kazakhstan does not provide for any special tax regime or additional benefits for activity related to the use of RES. But, starting from January 1, 2014 studies and development within RES are included into the list of activities corresponding to the objectives of creating a special economic zone "Park of Innovative Technologies". Therefore, organizations functioning in such specific economic zones can obtain certain tax privileges under adhering to definite conditions.

As a result, the outcomes of the analysis of the development capacity of solar energy in Kazakhstan deserve attention. Thus, the RES capacity, power supply market and legislation can finally enable to structure investment and attractive projects (bankable projects) on the use of RES in Kazakhstan (Ac.gov.ru, 2017; Kazakhstan develops renewable energy sources | International Centre for Trade and Sustainable Development, 2019).

3. RESULTS

According to analysis results key features of state policy in the solar energy field both the countries that are actively implementing relevant projects and countries that are only at the initial stage of integrating alternative sources of electricity and heat into the general energy system of states, are systematized and specified in a Table 2.

The choice of parameters that evaluate the effectiveness and intensity of the implementation of projects for the construction of SPP (Table 2) reflects as follows. By introducing alternative energy (RES) into the national energy system, the state ultimately seeks to gradually increase the share of RES in the overall energy balance and consumption. Summarizing the state programs and projects in the field of alternative energy already analyzed in this article. 6 reflects examples of target shares of renewable energy sources within final consumption by 2020.

Thus, the EU countries, namely France, Great Britain and Italy plan to reach the highest target values for themselves (23%, 18% and 17%, respectively), followed by the United Kingdom, China and India.

Paying your attention that quite powerful extension of solar energy for the past few years, including cost reduction (cheapening) of projects for the solar power plants' construction (including the installations of PV solar PV panels, see the Figure 4). Thus, based on the estimates of the international organization Energytrend, for example, in 2018 the cost of an average project for the solar power plant construction in the specific measurement of US dollars million per 1 MW makes up 2.89 times less than it could have been in 2010. In general, a gradual decrease in specific capital costs contributes to the profitability in the solar energy field. This reduction in the project cost is partly due to both the cost decrease of the equipment itself for the solar power plants' construction, and the investment increase due to rather high estimates of projects' profitability, development and further solar energy implementation in energy systems of the countries.

In the Table 3 there are results of the average quantitative estimate by the research unit of the Ministry of New and Renewable Energy (USA) of the electricity volume that can be generated by power plants operating in a number of American and European countries.

Therefore, the solar energy is highly estimated (50,000 MW), followed by wind and biomass energies (45,000 MW each,

1 In line with the Investment Law, investment preferences are rendered upon an investment contract concluded with the Ministry for Investment and Development ("MID").

Table 2: Results of comparative analysis of state policy features in the solar power generation field in countries conducted RES construction projects

Value - country	EU	The USA	China	Russia	Kazakhstan
RES share in total energy balance and solar energy share in RES structure	At the final stage of consumption - 16.7% as of 2015	The aggregate share of all RES has reached 19.4% as of 2016	"Green energy" share is exceeding 35% out of determined capacity within the country as of 2016	Until 2015 - up to 1%, as of 2018-2-3%	Up to 1%
Specifics of development inducement of solar power generation by country's state policy (union of states)	Determination of privileged power purchase cost generated by RES: feed-in-tariff or feed-in-premium; Trading in green certificates based on power consumption quotas generated by RES	Federal measures of solar power generation support are in the form of 30% of investment tax discounts	Purchase of clean power upon privileged and full tariffs; Creation of funds for financing developments in the solar energy field; Adoption of the programs of prioritized RES development, in particular, the document 625 issued by the National Commission on development and reforms, based on which the minimum volume of mandatory consumption of power by the largest network companies from renewable energy sources is defined	In 2015, the mechanism for supporting RES in the retail electricity market was approved (Decree of the Government of the Russian Federation dated January 23, 2015 No. 47) Decree of the Government of the Russian Federation No. 426 "On the Qualification of a Generating Facility Functioning on the basis of Using Renewable Energy Sources", issued on July 3,2008; Order of the Government of the Russian Federation No. 1-p "On the Main Directions of the State Policy in the Field of Increasing the Energy Efficiency of the Electric Power Industry through the Use of Renewable Energy Sources for the Period until 2020" dated January 8, 2009; "green tariffs" usage	Government programs on accelerated industrial-innovative development; Exemption from customs duties on state natural grants; tax preferences, investment subsidies, etc.
Forecast of achieving RES share in total energy balance and solar energy share in RES structure	Up to 2020 renewable energy sources used will cover 20% out of the entire power supply. So far there are only 6 EU countries that have performed their obligations	In 2015 a Statistical Office of the Ministry of Energy of the USA has forecasted the increase of renewable energy sources from 13% in 2013 to 18% in 2040. In fact, currently the development has been anticipated the forecasts for decades	It was forecasted that by 2020 RES will cover 15% of power supply, but now the objective on solar energy is achieved, and by 2019 it is planned to fulfill the forecast values upon wind power	By 2020 it is planned to achieve forecasts within 4-5%	3% in 2020 and 10% in 2030

RES: Renewable energy sources

respectively). In addition, there is a high result from the power plants' construction in Switzerland, which convert small hydro power energy, and bioenergy generating plants (Brazil, USA).

Moreover, specific projects and examples of the realization of government activities and programs for the solar energy industry development in several leading countries, which were discussed above, have been considered. To be more consistent, let us let us go deeply into details as regards the above-mentioned issue, for example, focusing on the United States.

Governance of price determination for the solar energy resources by the help of "green" tariff systems. Thus, the purchase of renewable energy resources in the United States is performed by the help of renewable energy certificates (REC), as well as green labels, green energy certificates or traded renewable certificates that represent the technological and environmental attributes of electricity generated from renewable resources. The renewable energy is purchased from a grid company through a "green" transformation or "green" marketing program, where buyers pay a small premium in exchange for electricity produced locally from RES.

Table 3: The results of energy alternative types' potential evaluation that can be generated by EU and USA

No.	Renewable resource	Estimated	Remarks
1.	Solar power	50,000 MW	Assuming solar energy: 4-6 kWhr/m^2/day and depending upon future developments making solar technology cost-competitive for grid power applications (China, USA)
2.	Wind power	45,000 MW	Sites with wind densities of 300 W/m^2 or higher with 9% of assessed area available for wind farms requiring 12 ha/MW (USA)
3.	Biomass power	45,000 MW	20 mha of wastelands yielding 10 MT/ha/annum of woody biomass giving 4000 kcal/kg with system efficiency of 30% and operating at 75% PLF. (USA, Canada)
4.	Small hydro power	15,000 MW	For example, in Switherland the new small hydropower projects generate 498 gigawatt hours (GWh) per year, <1% of the country's annual generation. In comparison, a project to rebuild an existing large hydropower dam on the Rhine with a new design added more than 400 GWh, nearly equivalent to the generation produced by the 116 new dams (Opperman, 2019)
5.	Bio-energy	24,000 MW	During 2017, the capacity of bioenergy reached over 14 gigawatts in Brazil. Bioenergy is energy derived from biological materials which are characterized as organic materials with stored chemical energy like wood and manure. In 2017, the United States generated approximately 43.28 billion kilowatt hours of electricity from wood (Statista, 2019)

Source: Systemized by the authors

Adoption of standards of renewable energy sources portfolio (RPS), which need from power companies and other retail power electricity providers to ensure a certain percentage or amount of power electricity to a consumer with acceptable renewable resources.

Creation of the Public Benefit Fund for Renewable Energy Sources, which implies a set of resources used for investing into clean energy projects. Funds are usually established by charging a small fee to electricity tariffs for consumers (that is, for the account of comprehensive privileges).

Policy on compliance with environmental standards, based on outcomes, identifying limits on emissions per unit of productive energy, namely electricity, thermal energy or shaft power with the purpose to ensure the efficient conversion of fuels and RES as measures to mitigate air pollution.

System "Net Metering," which allows private and commercial customers who generate their own renewable electricity (for example, solar PV panels), to receive compensation for the electricity they produce.

Rules of "clean accounting" of the solar energy, which require electric utilities to be able to ensure that consumers' electricity meters accurately track how much electricity is used on site or is transferred to the electrical grid.

The system of "input" tariffs that stimulate the development of RES, obliging electric power companies to pay for renewable energy supplied to the network under tariffs, which have been determined earlier and higher than market ones.

The clean energy with property assessment (PACE) is a favorable financing option that implies a commitment to reimburse costs on installing RES or upgrading the energy efficiency of residential real estate, investing into clean energy improvement, even if the payback period exceeds the period that the owner intends to save.

A flexible system of financial incentives for the solar energy development, such as grants, loans, discounts and tax breaks, which are provided in some states to encourage the development of RES.

Database of government incentives for RES and EXIT efficiency allows to track the existence of incentives offered by the state.

Electronic Database of Governmental Incentives for Renewable Energy Sources (DSIRE EXIT) is a comprehensive source of information on the status of state programs and incentives that promote RES, including information about financial incentives and net-measurement policy, as well as about relevant information and investment programs.

It is worth to highlight EPA (Environmental Protection Agency) programs, supporting renewable energy:

- Green power partnership (GPP) is a voluntary program that supports the purchases on the level of organization of clean energy, offering expert advice, technical maintenance, tools and resources.
- The methane landfill awareness program (LMOP) is a voluntary assistance and partnership program that ensures the use of landfill gas as a renewable source of green energy.
- AgSTAR is a voluntary program that promotes the use of biogas recovery systems to reduce methane emissions from livestock waste.
- RE-Powering America's Lands – EPA program that stimulates the development of RES at the existing and earlier polluted pieces of land as well as at mining sites (US EPA, 2019).

India has a National Center for Testing, Research and Modeling Solar Thermal Energy. For last years, some of the most serious projects are:

- The project on connection of various solar concentrators to the solar thermal power plant, coatings and materials, components and systems, which is implemented by IIT Mumbai and partners in the consortium consisting of Tata Power, Tata Consulting Engineers, Larsen & Toubro, Clique, KIE Solatherm. The facility has a 1 MW solar power plant connected to the power grid. This will also contain a test installation allowing companies and research institutions to test performance.
- Concentrated solar thermal technology is based on parabolic plates. This project is a result of collaboration of Megawatt Solutions Pvt. Ltd. and the SEC in the framework of the MNRE initiative to promote research, development and demonstration

of renewable energy systems and technologies developed locally, based on cost-sharing. It includes the demonstration and evaluation of 4 connected dish concentrators, each of which has an aperture area of 90 m^2 and provides heating of thermal fluids up to 4000°C.

- Stirling solar heat engine. The project was reviewed in collaboration with the ONGC Energy Center (OEC). Three engine blocks with a capacity of 3 kW each were installed and put into operation in campus. The goal of the project is to conduct a long-term performance evaluation in Indian conditions. The motors are connected to the local network, and electricity produced during the sundial is used in the technical unit. The rated power of the plant is 9 kW (peak power) under a solar insulation of 850 W/m^2 and an ambient temperature of 200°C.
- Development of a modular central solar power plant with a central receiver for decentralized power generation from SunBorne Energy under MNRE support in collaboration with the SEC. The main goal is to develop optimized designs of the heliostat field, a volumetric air receiver and heat accumulator, the three main components of the central receiving plant of CSP, as well as the development of local sources for all key components with a focus on cost reduction.
- Highly efficient solar thermal air conditioning systems are a joint project of Thermax Limited and the Solar Energy Center (Mnre.gov.in, 2019).

Therefore, summarizing all the study outcomes as regards the state policy in the solar energy field of a number of countries analyzed during the work, assessments of the potential development of this industry both in the world as a whole and in the country context, as well as on the grounds of specific examples and practices of government programs and projects discussed above, we propose a basic model for the solar energy development.

In contrast to those already proposed, this model is more comprehensive, takes into account different types of solar energy generation and reflects the relationship between the forms of state policy implementation in the solar energy field, its tools, in particular tax benefits and preferences and, as a result, construction of SPP and features of the organization of distribution and delivery of energy to end users. In turn, the latter also determines the tariffs established in the framework of state policy (including legislative and regulatory acts, laws in force, the Tax Code) tariffs, rules and procedures for organizing procurement processes.

4. DISCUSSION

4.1. Policies in Selected Countries

By 2012, at least 109 countries had some type of renewable energy policy (Renewable Energy Policy Network for the 21st Century, 2012). More than half of them are developing countries or emerging economies. Of all the policy instruments that were detailed in the earlier section, feed-in-tariffs and renewable portfolio standards are the commonest. We make recommendations towards developing solar policies, based on our review of those in different countries and later, in Section 6, offer an assessment of future trends in solar energy.

4.2. United States

United States has a combination of "pull" and "push" policies towards developing solar energy, some of which were discussed previously. Among various state- and federal-level incentives, perhaps the most effective one is the Federal ITC for solar PV projects that is equal to 30% of expenditures on any equipment that employs solar energy to generate electricity. In addition to ITCs, the US Federal Government also assures an additional cost recovery through accelerated depreciation schedules. Solar energy projects qualify for a 5-year depreciation. The projects that were completed by 2011 used to get a 50% bonus depreciation in the 1st year because of the Economic Stimulus Act of 2008. However, the new solar projects will not get this bonus depreciation unless another Act is passed. The DOE's Loan Guarantee program is a good example of push policy incentives, which supports the manufacturing side of the industry. Increased R&D support also is designed to sustain a technological advantage that is a prerequisite for the continuation of PV evolution.

4.3. Germany

In 2000, the German government introduced a large-scale feed-in-tariff system under the "German RES Act". It resulted in explosive growth of solar PV deployment. By 2011, Germany was producing 14% of its energy from renewable sources that has been attributed to the success of its comprehensive FIT system (Reddy, 2012). German FIT payments are technology- specific, such that each renewable-energy technology type receives a payment based on its generation cost, plus a reasonable profit. Each tariff is eligible for a 20-year fixed price payment for every kWh of electricity produced. Germany's FIT assessment technique is based on a so-called corridor mechanism. This mechanism sets a corridor for the growth of PV capacity installation that is dependent on the PV capacity installed the year before; this results in a decrease or an increase of the FIT rates according, respectively, to the percentage that the corridor path is exceeded or unmet. As PV capacity installations were above those planned by government in 2010, the FIT rates were decreased by 13% on January 1st, 2011. Germany's generous FIT system has been criticized for not producing the desired results in accord with its total costs of nearly $30 billion euros between 2000 and 2010 (Frondel et al., 2008). In its report on German energy policy, the IEA suggests that 'policies funding R&D activities can be more effective in promoting PV than the very high feed-in tariffs, on the ground that "the government should always keep cost-effectiveness as a critical component when deciding between policies and measures."

4.4. China

The rapid development of the PV industry and market in China primarily reflects governmental support. Programs for rural electrification were the driving force for expansion of the solar PV market in China in the last two decades. Most PV projects were government sponsored with international aid, or within the framework of government programs at the national or local levels. China's energy policy is developed through a two-step approach. The central government first sets up broad policy goals in its 5 year plans. Ministries, agencies, and the National People's Congress then use those plans to design specific- and targeted- programs and policies (National Research Council, Chinese Academy of

Sciences, 2010). The major supporting programs are the Brightness Program Pilot Project, the Township Electrification Programs, and the China Renewable Energy Development Project (Timilsina et al., 2012). The plans in the Brightness Program Pilot Project, launched in 2000, will provide electricity to 23 million people in remote areas by 2010, using 2300 MW of energy from wind-, solar PV-, wind/PV hybrid- and wind/PV/diesel hybrid- systems. The Township Electrification Programs, launched in 2002, installed 268 small hydro stations and 721 PV-, PV/wind hybrid-systems by 2005. The China Renewable Energy Development Project (REDP), also established in 2002 and supported by a World Bank's Global Environmental Facility grant, afforded a direct subsidy of $1.5 per W to PV companies to help them market, sell, and maintain 10 MW of PV systems in Qinghai, Gansu, Inner Mongolia, Xinjiang, Tibet, and Sichuan (Timilsina et al., 2012).

4.5. Japan

Japan was the worldwide market leader in installed solar generation capacity until the end of 2004 (Dincer, 2010) despite its scarcity of wide open fields suitable for installing large-scale PV systems and relatively low solar irradiance throughout the year. That success was driven by long-term Japanese PV research and development programs, as well as market implementation that started in 1994.

In 2008, the Japanese Government announced an 'Action Plan for Achieving a Lowcarbon Society' that targets increasing by tenfold the installations of solar power generation systems by 2020, and fortyfold by 2030 (Reddy, 2012). That same year, "Action Plan for Promoting the Introduction of Solar Power Generation" announced measures to support the development of solar technology and promote installation of solar in selected sectors (Deshmukh et al., 2011). As directed by these action plans, the Ministry of Economy Trade and Industry (METI) announced its FITs policy in July 2010, which took effect in 2012. Under this FITs scheme, if a renewable energy producer requests an electric utility to sign a contract to purchase electricity at a fixed price and for a long-term period guaranteed by the government, the electric utility is obligated to accept this request. In the 2012 FITs scheme, solar PV generation was given a 42 yen/kWh fixed price (≈50 cents/kWh) of 20 years for projects >0 kW, and of 10 years for projects smaller than 10 kW (METI, 2012). The high tariff rates of solar energy mostly are necessitated by the low solar irradiance and are justified by the high costs of imported natural gas and oil in Japan. Since the surplus electricity purchase system that allows customers to sell their excess solar electricity back to the power grid was established in 2009, the introduction of residential PV power generation largely increased in Japan.

4.6. India

In India, the primary policy driver is all-in FITs of around 15 cents/kWh for solar PV and thermal projects commissioned after March 2011 for up to 25 years. Solar PV projects in remote locations even receive higher subsidies. One such program that aims to establish a-single light solar PV systems in all non-electrified villages covers 90% of costs of projects. For below-poverty-level families, state governments underwrite 100% of the system costs (Timilsina et al., 2012).

Currently, experts and leaders of the energy business point out that solar panels have continued to become cheaper and cheaper. This is also confirmed by our research results. Thus, it may take only a few years before the subsidy policy becomes irrelevant. So, regarding China as an example, reduced subsidies will stop working - solar energy will be too expensive for investors to ignore. It makes to think about new methods of encouraging investment into the SPP construction in the nearest future (Baraniuk, 2016; Yuan et al., 2017; Stacey, 2018; Cox et al., 2019).

However, at the same time, a number of other analysts highlight that even if the giant solar parks will be built, then in the next decades it will be necessary to take into account one of the often ignored complications: the waste of solar cells. The panels have worked for only 30 years or so, after which they must be disposed of. However, this is difficult to do because they contain harmful chemicals such as sulfuric acid. It is expected that in China there will be a sudden boom of solar panel waste around about 2040, and there is currently no clear plan for what to do with all this material (Zhang and He, 2013; Bloomberg, 2018; Renewable Energy: China Has Set the Benchmark High, 2018; Baraniuk, 2019).

Analyzing the advantages and disadvantages of the "clean metering" system of solar energy used in the United States, on the one hand, the creation of new jobs and the attraction of private investment are encouraged. So, experts point out that the "clean metering" system provides significant economic benefits across the state in terms of jobs, incomes and investments, and also increases the demand for solar energy systems, which in turn creates jobs for installers, electricians and producers who work in the solar energy supply chain. Today, more than 250,000 American workers are employed in the solar industry, mainly due to a tough government net accounting policy that enabled a significant development of the solar industry (Parnell, 2014; DSIRE, 2019; Statista, 2019).

However, unfortunately, there are opponents of this system. They state that some utilities perceive the policy of net accounting as a lost opportunity to generate income. In fact, the policy of net metering creates a smoother electricity demand curve and allows utilities to better manage their peak electricity loads. By stimulating production near the point of consumption, net measurement also reduces the load on distribution systems and prevents losses during transmission and distribution of electricity over long distances (Statista, 2019).

There is a separate topic of scientific discussion in the solar energy field, which is related to the fact that most renewable resources are located in remote areas where there is no ready or cost-effective access to transmission. States that have not established strict rules in the field of public services, which makes it possible to recover investments in transmission (ie, reimbursement of costs), and also did not coordinate the processes of planning and issuing permits, slow down the development of renewable energy projects on their territory. To overcome this situation, it is necessary to develop international uniform standardized rules for the installation of SPP, at the same time, taking into account the need to take into account local peculiarities (Bird et al., 2012; Abadzi, 2015; Feldman et al., 2015; Baraniuk, 2016; Baraniuk, 2019; Cox et al., 2019).

Looking ahead, most scientists have commented that large-scale technologies for using RES are regulated by all the necessary environmental permits of large industrial facilities. Generating renewable energy by using new technologies may face permissive obstacles until officials will be aware of the environmental impact of solar electricity and heat generation processes (Philibert, 2011; Mirmira et al., 2013; Yuan et al., 2017; Opperman, 2019).

To sum up the said above, it is worth to state that they can create a new but not less necessary and sophisticated trend for further studies in this field.

5. CONCLUSION

Based on the research results, we can affirm that the solar energy, as in principle, and renewable energy in general, is electricity generated by fuel sources that are regenerated in a short period of time and do not decrease. Although some renewable energy technologies have an impact on the environment, RES are considered environmentally preferable compared to traditional sources and, when replacing fossil fuels, have significant potential for reducing greenhouse gas emissions.

Considered political, tax and investment incentives detected in the course of the study, used by most countries of the world with the purpose to strengthen and develop the solar energy, which currently operate at the regional and state levels, are aimed at improving the long-term competitiveness of RES technologies. Although in the short-term energy perspective, an increase in electric power production from renewable sources (including solar energy) is forecasted. There is still uncertainty about the impact of clean energy policies on carbon emissions in the coming years. We hope that the expansion of tax breaks will enable new technologies to successfully enter the energy market in the course of time. Moreover, the situation in China, and the continuous cheapening of solar equipment indicate that it is already necessary to think about developing new methods and tools to stimulate the development of this industry, especially small farms. However, for states that are just starting to implement projects for the construction of RES (for example, Russia and Kazakhstan), including SPP, tax incentives, tax breaks, subsidies, investment programs have been still relevant and effective.

In addition, revising and analyzing research outcomes, we see that, regardless of technology or size, every aspect of solar energy depends on local, regional and state policies. So, it is necessary to establish a system of interaction with political authorities at the level of governance and legislation both in head offices of energy companies and throughout the country in regional offices in order to create supportive policy frameworks that will allow solar energy to compete in the market and offer consumers the energy supply under competitive prices.

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