



## **Impedimental Policies Impacting Shrinking World Solar Industry Eco-economic Development**

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### **ABSTRACT**

This paper is devoted to one of the most current issues in eco-economic development disclosing constraining factors, particularly, the policies impacting shrinking world solar industry. In the research it is underlined the significance of solar industry development as a highly potential green renewable energy resource branch. It is considered the most contemporary sources concerning this issue including European, the US and Asia experts to form the worldwide picture attitude to solar industry and green energy potential. It has been characterized the solar capacity over last 10 years from 2006 to 2016. It has been defined key countries those contributed mostly of total world's solar installed capacity addition for 2016 and have ambitious green energy targets for future. It has been conducted the gap analysis between planned capacities and achievements which is in line with the country's commitment to the international energy agency in contrast to their achievement in 2017. Moreover, it has been found out policies that are impacting the exponential growth of this industry and what kind of impact these impedimental policies have in context of economic sectoral growth, ecological climate change and other industrial sectors.

**Keywords:** Development, Solar Industry, Green Energy, Green Economy, Impedimental Policies

**JEL Classifications:** Q01, Q4, Q5, O1

### **1. INTRODUCTION**

Nowadays, one of the most current issues in eco-economic development is solar energy as a highly potential green renewable energy resource. Many contemporary scientists underline the relevance in research of the alternative energy potential. Alternative energy is a set of promising methods to generate energy from renewable sources, which are not as widespread as traditional, but are of interest because of the advantage of using them at low risk of harming the environment (Gingerich, 2018; Onyusheva et al., 2018; Samarina et al., 2018).

In this regard, the vast majority of the earth's energy is derived directly from the sun's power. The use of the term "solar energy" today typically refers to directly harnessing the energy of the sun's radiation to produce electricity (Smith, 1995). While there is such limitless potential in solar energy, the great challenge is to harness this potential into an economically viable resource that is competitive in the energy marketplace.

Currently, in the United States 0.1% of the yearly electricity is supplied by solar energy approximately. While there has been significant discussion about the potential and importance of solar resources, entrenched fossil fuels and the comparatively high prices of solar energy have restricted any significant progress. By the way, the United States has been slow to capitalize on its solar potential (Amadeo, 2017).

However, internationally, many nations have achieved much greater success with solar energy. In particular, the European Union has achieved tremendous success in increasing solar capacity. In Germany, solar power meets approximately 1% of total electricity demand and this number is rapidly rising. In Spain, this number is 2.8%. In fact, for several days last year, over 50% of Spain's electricity demand was powered by solar energy (Crisp, 2016).

Moreover, China has also developed a significant solar presence, in both consumption and production of solar panels (Clark, 2016; Fialka, 2016). As these countries invest greater resources

and technology into the rapidly developing solar market, prices will decrease and, ultimately, allow for non-subsidized solar technologies to achieve success.

However, according to the recent news, the solar industry development covers more political aspects now. The President of the United States of America, Donald Trump, has been taking the decision on the recommendations made by the US International Trade Commission (ITC) concerning the policies regulating the solar industry. The issue has been announced in January, 2018 by world mass media (Hopkins, 2018).

Two bankrupt solar panel manufacturer's—Solar World Americas and Suniva—demand to raise in tariffs increasing the import price to US\$ 0.74 per KW lead to ITC into investigating into cheap solar modules import. According to Silverstein of Forbes, POTUS's decision will impact international relationship and trade with specific implications on solar industry (Silverstein, 2017).

All these facts are real proof that the solar industry development as an alternative energy source is the issue of a great significance that needs detailed consideration and exploring.

Solar energy has experienced phenomenal growth in recent years. Theoretically, solar energy has resource potential that far exceeds the entire global energy demand (Bradford, 2006). Despite this technical potential and the recent growth of the market, the contribution of solar energy to the global energy supply mix is still negligible (Renewables, Global Status Report, 2016). This study attempts to address why the role of solar energy in meeting the global energy supply mix continues to be so small. What are the key barriers that prevented large-scale deployment of solar energy in the national energy systems? What types of policy instruments have been introduced to boost the solar energy markets? Have these policies produced desired results? If not, what type of new policy instruments would be needed? This research analyzes the technical, economic and policy aspects of solar energy development.

## 2. LITERATURE REVIEW

The solar energy and as an alternative energy source is a very urgent research area in eco-economic science. It refers to sources of energy that can be directly attributed to the light of the sun or the heat that sunlight generates (Bradford, 2006). Its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air (Timilsina et al., 2011).

Solar energy technologies have a long history. Between 1860 and the First World War, a range of technologies were developed to generate steam, by capturing the sun's heat, to run engines and irrigation pumps (Smith, 1995). Solar PV cells were invented at bell labs in the United States in 1954, and they have been used in space

satellites for electricity generation since the late 1950s (Kazmerski and Broussard, 2004). The years immediately following the oil-shock in the seventies saw much interest in the development and commercialization of solar energy technologies. However, this incipient solar energy industry of the 1970s and early 80s collapsed due to the sharp decline in oil prices and a lack of sustained policy support (Bradford, 2006). Solar energy markets have regained momentum since early 2000, exhibiting phenomenal growth recently. The total installed capacity of solar based electricity generation capacity has increased to more than 40 GW by the end of 2010 from almost negligible capacity in the early nineties (Energy Sector Management Assistance Program, 2011).

A number of studies (Arvizu et al., 2011) have addressed various issues related to solar energy. This study presents a synthesis review of existing literature as well as presents economic analysis to examine competitiveness solar energy with fossil energy counterparts. Our study shows that despite a large drop in capital costs and an increase in fossil fuel prices, solar energy technologies are not yet competitive with conventional technologies for electricity production. The economic competitiveness of these technologies does not improve much even when the environmental externalities of fossil fuels are taken into consideration. Besides the economic disadvantage, solar energy technologies face a number of technological, financial and institutional barriers that further constrain their large-scale deployment.

Policy instruments introduced to address these barriers include feed in tariffs (FIT), tax credits, capital subsidies and grants, renewable energy portfolio standards (RPS) with specified standards for solar energy, public investments and other financial incentives. Among positive sides, while FIT played an instrumental role in 3 Germany and Spain, a mix of policy portfolios that includes federal tax credits, subsidies and rebates, RPS, net metering and renewable energy certificates (REC) facilitated solar energy market growth in the United States. Although the clean development mechanism (CDM) of the Kyoto Protocol has helped the implementation of some solar energy projects, its role in promoting solar energy is very small as compared to that for other renewable energy technologies because of cost competitiveness. Existing studies we reviewed indicate that the share of solar energy in global energy supply mix could exceed 10% by 2050. This would still be a small share of total energy supply and a small share of renewable supply if the carbon intensity of the global energy system were reduced by something on the order of 75%, as many have argued is necessary to stem the threat of global warming (Renewables, Global Status Report, 2016).

Nowadays, solar energy represents our largest source of renewable energy supply. According to the International Energy Agency (IEA), "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered

learning investments; they must be wisely spent and need to be widely shared” (Emerging Energy Research, Global Concentrated Solar Power Markets and Strategies, 2009-2020).

Moreover, the development of the global eco-economy and studying the possibility of using solar energy as a highly potential alternative energy sources has been considered in detail in 2017 during the international exhibition “EXPO-2017” hosted in Kazakhstan, Astana capital city during June till September 2017 (Onyusheva et al., 2017).

However, analyzing contemporary sources, how other economic analysts and industry pundits see the contemporary development of solar industry it needs to mention about the following.

Solar industry poised an exponential growth in US market creating jobs by surging the solar installations in US as a result of availability of cheaper Chinese solar panels (Silverstein, 2017).

Topping among Donald Trump’s other campaign manifestos was a policy to protect the US coal and nuclear power industry. ITC just gave him an opportunity to become the Godfather for “his pals in fossil fuel industry.” So, will Trump exercise his executive powers to impose additional import tariffs on solar modules and crush the declining solar industry in US is a question looming over the industry experts (Hanley, 2017).

McCown of Forbes lambasts the bankrupt solar companies for executing their business plans poorly over the years leading to their failure. Moreover, he adds that imposing tariffs thereby increasing the cost of solar installation is not the right remedy to bail out failed companies (McCown, 2017).

Many provincial governments such as Indiana had already rolled back on the “incentive for solar rooftops” considering the plummeting prices of solar modules imported from China. However, if Trump decides to increase the tariffs then it would, as Hopkins predicts, further destabilize the solar industry (Hopkins, 2018).

Brussels committee of EU had agreed to impose minimum import duties on Chinese solar modules thereby increasing their cost by 30% in European markets. This is again in line with US planning to increase the import duty by end of January 2018 (Nelsen, 2017).

Export of Chinese solar equipment plummeted by 10% between 2015 and 2016. Zhang Sen, secretary general of Solar Division of China Chamber of Commerce for Imports and Exports of Machinery and Electronic Products, attributed this decline largely to anti-dumping and anti-subsidy policies by countries including but not limited to the US, the EU, Australia, Canada, India, and Turkey (Geuss, 2017).

In India, solar feed-in tariffs reached an all-time low in September 2017 which was based on the industry’s expectation that “prices of solar modules will further drop by 10–15%”. Though some industry experts believe that increased prices due to anti-dumping duty is short-lived trend, some industry players fear high risk

in recently bid projects for the price sensitive Indian market (Kondratieva, 2017; Singh and Dhillon, 2018).

### 3. THE RESEARCH OBJECTIVE

The research objective is the study of factors constraining eco-economic development, particularly the policies impacting shrinking world solar industry. The research is aimed to consider the most contemporary resources concerning this issue including European, the US and Asia experts to form the worldwide picture attitude to solar industry and green energy potential, to analyze the solar capacity over last 10 years from 2006 to 2016, to define key countries those contributed mostly of total world’s solar installed capacity, to conduct the gap analysis between planned capacities and achievements, and to find out policies that are impacting the exponential growth of this industry and what kind of impact these impedimental policies have in context of economic sectoral growth, ecological climate change and other industrial sectors.

### 4. METHODS OF RESEARCH

Methods of research are comparative and systematic analyses, causes and consequences analysis, methods of statistic grouping and expert assessment.

### 5. KEY RESEARCH RESULTS

Renewable energy production comes from fuel sources that are naturally replenished with or without impact on environment. This way, some experts argue, at least major environmental impact of depleting fossil fuel resources is reduced. Renewable energy sector had seen an immense growth over the last couple of decades recognizing the need for alternative source for power generation due to depleting fuel sources for conventional energy production.

While fuel sources are replenished, the environmental impact factor differentiates the energy production methods in which green energy production is most beneficial considering the huge land space required for other renewable energy production techniques. Thus, green energy is the subset of renewable energy methods.

Energy production from sunlight is carried out by two different processes. Photovoltaic Solar Technology uses direct sunlight to generate electricity. By using inverters direct current is converted to alternating current and is distributed further through the network.

Concentrated Solar Thermal Power uses sun’s radiation to heat liquid substance, which is further used for driving a heat engine for electric generation. It is indirect method of generating AC for distribution on power network.

Moreover, solar energy production has numerable advantages as compared to other green energy resources. Lower Cost of Energy Production – simple system in terms of Installation, operation and management. Energy dispatch ability – energy produced at module levels can be transmitted to national sub-station grid with very low energy transmission losses. Source of energy production

– sunlight – is highly reliable in the sense of its availability every day (excluded rainy and cloudy periods) in a 12-h rotation. No single country or individual can monopolize the use of sunlight and hence is considered as highly secured fuel source for energy generation. Since sunlight is available for all the countries. This fuel source does not hold any country dependent on any other for energy production. It is widely acknowledged fact that energy production using solar installations produces nearly zero CO<sub>2</sub> emission thus reducing global warming.

During 2006 and 2016, installed solar capacity around the world grew at a CAGR of 49% with a steady YoY growth rate of 33%. In Figure 1 below it is represented the information concerning solar capacity growth over the decade 2006–2016.

Compiled on the base of renewable energy policy network for 21<sup>st</sup> Century, 2017 China, United States, Japan, India, UK, Germany, Republic of Korea, Philippines, and Chile are the top - 10 countries which contributed 92% of total world’s solar installed capacity addition for 2016 and have ambitious green energy targets for future (Renewable Energy Policy Network for 21<sup>st</sup> Century, 2017).

In the United States of America, the solar industry grew by an average of 68% over the last decade. Solar energy’s share of total electricity generated in the US jumped from just 0.1% in 2010 to 1.4% in 2016 with annual capacity additions rising from 4% (2010) to 39% (2016).

China, the world’s largest contributor to green energy, had an installed capacity of 18,100 MW with 11.3 GW added to the national grid as of 2013 which attributes to 166% annual growth for that year.

Though not comparable, Thailand had an incredible growth in installed solar capacities from 49MW to 2753MW in 6 years between 2010 and 2016 with an annual growth rates of 36%.

India has been a frontrunner among developing countries with rapid installed solar capacity additions between 2013 and 2016 with YoY growth of 100% adding 3.9GW – from 1.9 GW to 5.8 GW – in these 3 years. So, we can see that world over countries have shown increased commitments to switchover from conventional energy sources to green energy.

Further, to analyze the growth rates better we collected data for solar irradiance levels, individual government policies, government commitments to the IEA, planned solar capacities, installed solar capacities, grid feed-in tariff rates, and consumption tariffs of 30 countries spanning the Americas, Europe, Africa, Asia (covering SAARC and ASEAN regions) and Australasia. And what we found was startling gaps between planned capacities (which is in line with the country’s commitment to IEA) visa-e-vis their achievement as of 2017.

As of 2017, China is the only country in the world to have surpassed their committed 105 GW capacity for 2022 by 7GW. China’s expeditious growth in the sector is attributed to the agility of its solar industry towards technological advancements in developing high quality solar cells (thereby solar modules) whilst plummeting the costs.

World’s dominant superpower, the United States of America, planned to have 150GW of green energy by 2020. However, as of 2017 its installed capacity has only reached 49.3GW lagging by 67% to be fulfilled in 5 years.

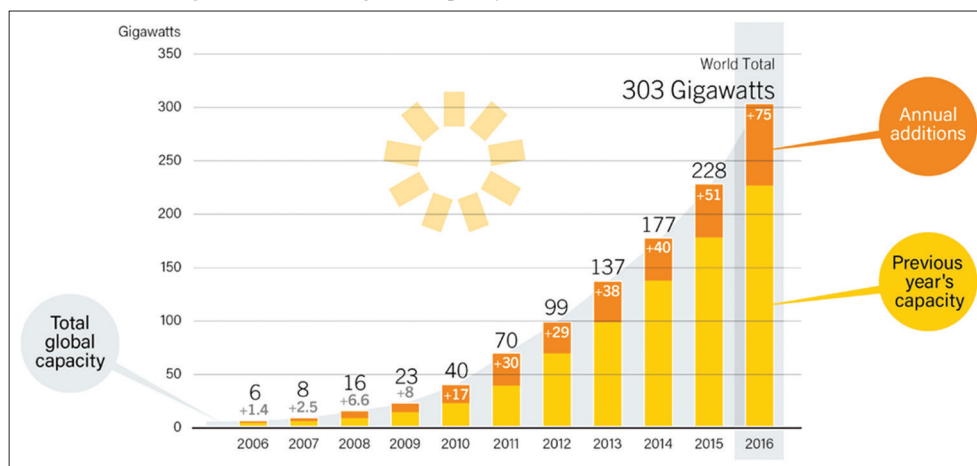
In 2015, during the inauguration of India’s pavilion at Climate Change Conference in Paris, Honourable Prime Minister of India, Shri. Narendra Damodar Modi, announced the revised target installed solar capacity of 100GW by 2022 (Dave, 2015). However, as of September 2017 its tally has reached only 19GW which means India has to fill the gap of 81% in the next 5 years.

Though Thailand had made expeditious growth in the last 6 years, it is interesting to note that in order to achieve it planned capacity the balance 54% of 5GW it had extended the time frame to 2030 (Singh and Dhillon, 2018).

Likewise, many countries excluding China either have declining YoY growth rates in capacity additions or have extended the time period to achieve its planned targets. At this pace and with raising energy demands, the demand-supply gap will increase many folds.

Between 2008 and 2013 China slashed the price of solar panels by 80% which motivated countries worldwide to initiate anti-dumping proceeding against China while few others plainly increased the

**Figure 1:** Solar PV global capacity and annual additions, 2006–2016





import duty tariffs on imports of Chinese solar modules. In this case it should to be defined the following.

**Anti-Dumping policies.** It is basically charging extra import duty on the product from exporting country to bring its price closer to the normal value to save the domestic market (GATT, Article VI). If anti-dumping duties were imposed, it would increase the market price of Chinese PV module, thereby increasing the costs of installations. Thus, negatively impacting the solar markets in different countries, which rely on Chinese markets for Solar panels. China commands over 60% of the total solar market around the globe. Around 80% of Countries which heavily rely on Chinese markets are ASEAN, US and India will affect the countries and its consumption will be minimized.

**Import Tariffs.** Custom taxes, also called import tariffs, are levied by the government on any imported goods. When China cut off 80% of the prices of the solar modules exported to the world between 2008 and 2013, which increased the consumption around the globe thus lending them the title of being “global leader of the solar modules” other countries responded by plainly increasing the import tariffs to protect this industry within their countries (Fialka, 2016). Imposing import tariff will, however, act on the positive side of the importing country as it will allow local companies to compete against the foreign companies entering local markets. But as on the other side of the coin, it will raise the prices of the solar modules thereby straining the developing solar industry finally leading to shutdown of the companies leading loss of jobs and in the long run would cause serious damage to the solar industry as whole.

The Impact of these impedimental polices on project viability is reflected in increase in the market price of Chinese PV modules; increase in cost of solar installations; decrease in PV modules demand; probability of Solar Tariffs skyrocketing by 35% (Crisp, 2016).

Speaking about the types of impact, firstly, it is impact on sectoral growth. The renewable energy ministry has cautioned anti-dumping authorities against imposing high duties on imported solar equipment on the grounds that this can raise tariffs, make many projects unviable and seriously impede the growth of the sector. It should be moderate so that there is not too much impact on solar power tariffs, otherwise the growth of the solar sector may be negatively affected. Solar will become more expensive (by at least 70 paisa per kWh) and up to 1 GW of existing projects could be scrapped. This will set the solar market back by 2 years (Engelmeier, 2014) The anti-dumping measures were conceived as a way of guaranteeing fair competition with European manufacturers. It remains the largest trade dispute between the EU and China.

Secondly, it is impact on climate change. The total warming effect from greenhouse gases added by humans to the Earth’s atmosphere increased by 35% (United States Environmental Protection Agency, NA; Clark, 2016). The sea level is increasing due to smelting of ice of the poles. The reason behind this is increase in earth’s temperature. And Earth’s temperature is increasing due

to increase in greenhouse gases in the atmosphere. The changing climate would affect the length and growing season and farmer will experience the increasing damage to their crops, caused by draught, flood or fire.

Thirdly, it is impact on other industrial sectors. Every sector of the economy needs the energy to work. Increment on the tariff on solar will affects all the sector of the economy (Pettinger, 2015). The companies have to install the solar to get the energy for the production, when they have to pay more for the installation of the solar system then it will affect the cost of production. And if the cost of production of the goods will be high then the price of the products will also be high. Due to increase in the price of the solar system there will be much of people who will not be able to afford the solar system. Basically, the PV system. Due to recession, there will be a possibility of job losses in solar energy sector. Because much of the project are going to be affected by this policy and may tends to closure. It is possible that cost push inflation can cause a recession, especially if inflation is above nominal wage growth. In this case, prices go up by more than wages (a fall in real wages) and therefore there will be lower consumer spending, and this could cause a recession.

## 6. DISCUSSION AND CONCLUSION

NASA on its website recently updated the information showing the world electricity power access. It is hard to miss that most part of the world has least access to electricity, taking particular cognisance to Africa considering we are currently living in 21<sup>st</sup> century and that Thomas Alva Edison invented the first electric bulb in 1879 and Benjamin Franklin invented electricity in 1759.

Analysing the situation, the following questions are arisen. Is electricity not the basic requirement of mankind? If so, should mankind still be devoid of accessing electricity? Should the common suffer for the protectionist capitalism?

In this sense, maybe it is reasonable to think for a new type of enterprise - “Commercialized Social Enterprise” which can be defined as an enterprise that shreds protectionist policies and whose value proposition should be in alignment with a vision for betterment of mankind.

To conclude, one of the most current issues in eco-economic development is solar energy as a highly potential green renewable energy resource. In the research we have disclosed main factors constraining eco-economic development, particularly the polices impacting shrinking world solar industry. It has been underlined significance of solar industry development as a highly potential branch for worldwide eco-economic development. It has been considered the most contemporary resources concerning this issue including European, the US and Asia experts to form the worldwide picture attitude to solar industry and green energy potential. It has been characterized the solar capacity over last 10 years from 2006 to 2016. It has been defined key countries those

contributed mostly of total world's solar installed capacity addition for 2016 and have ambitious green energy targets for future. It has been conducted the gap analysis between planned capacities and achievements which is in line with the country's commitment to the IEA in contrast to their achievement in 2017. Moreover, it has been found out policies that are impacting the exponential growth of this industry and what kind of impact these impedimental policies have in context of economic sectoral growth, ecological climate change and other industrial sectors. And the presented results can serve as a background for further research concerning eco-economic development particularly, solar industry and green energy resource development.

## REFERENCES

- Amadeo, K. (2017), Tariffs: Pros, Cons, and Examples. The Balance. Available from: <https://www.thebalance.com/tariff-pros-cons-and-examples-3305967>. [Last retrieved on 2018 Jan 05].
- Arvizu, D., Balaya, P., Cabeza L., Hollands, T., Jäger-Waldau, A., Kondo, M., Konseibo, C., Meleshko, V., Stein, W., Tamaura, Y., Xu, H., Zilles, R. (2011), Direct solar energy. In: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Cambridge, United Kingdom, New York, NY, USA: Cambridge University Press.
- Bradford, T. (2006), Solar revolution. The Economic Transformation of the Global Energy Industry. Cambridge, MA: The MIT Press.
- Clark, D. (2016), How Will Climate Change Affect Food Production? (The Guardian). Available from: <http://www.theguardian.com>; <https://www.theguardian.com/environment/2016/sep/19/climate-change-affect-food-production>. [Last retrieved on 2017 Dec 25].
- Crisp, J. (2016), Europe's Climate Policy Goals Hinge on Renewables, Solar Power. (Euractiv). Available from: <http://www.Euractiv.com>; <https://www.euractiv.com/section/energy/news/europe-will-miss-climate-and-policy-goals-without-more-solar-power>. [Last retrieved on 2017 Dec 26].
- Dave, A. (2015), India's 2022 Renewable Energy Goal Will Require Investment Four Times the Defence Budget. Available from: <http://www.Scroll.in>; <https://www.scroll.in/article/774844/indias-2022-renewable-energy-goal-will-require-investment-four-times-the-defence-budget>. [Last retrieved on 2017 Dec 25].
- Emerging Energy Research. (2009), Global Concentrated Solar Power Markets and Strategies, 2009-2020. Cambridge, MA: Emerging Energy Research. Available from: [http://www.emerging-energy.com/user/GlobalConcentratedSolarPowerMarketsandStrategies200920201561467216\\_pub/SolarCSPTableofContents.pdf](http://www.emerging-energy.com/user/GlobalConcentratedSolarPowerMarketsandStrategies200920201561467216_pub/SolarCSPTableofContents.pdf). [Last retrieved on 2018 Apr 20].
- Energy Sector Management Assistance Program (ESMAP). (2011), Unleashing the Potential of Renewable Energy in India. Washington DC: World Bank.
- Engelmeier, T. (2014), Anti-Dumping Duties on Solar PV Cells and Modules Will Bring the Indian Solar Market to a Halt. (Bridge To India). Available from: <http://www.BridgetoIndia.com>; <http://www.bridgetoindia.com/anti-dumping-duties-on-solar-pv-cells-and-modules-will-bring-the-indian-solar-market-to-a-halt>. [Last retrieved on 2017 Dec 25].
- Fialka, J. (2016), Scientific American. Why China Is Dominating the Solar Industry?. Available from: <https://www.scientificamerican.com/article/why-china-is-dominating-the-solar-industry>. [Last retrieved on 2018 Jan 05].
- Fialka, J. (2016), Why China Is Dominating the Solar Industry?. Available from: <http://www.Scientific American>; <https://www.scientificamerican.com/article/why-china-is-dominating-the-solar-industry>. [Last retrieved on 2018 Jan 05].
- Geuss, M. (2017), Chinese Solar Exports Fall in 2016 with Global Anti-Dumping Measures. (ARS Technica). Available from: <http://www.arstechnica.com>; <https://www.arstechnica.com/information-technology/2017/02/chinese-solar-exports-fall-in-2016-with-global-anti-dumping-measures>. [Last retrieved on 2017 Dec 25].
- Gingerich, E. (2018), Generation and storage of renewable energy: Rising parity of emerging economies. International Journal of Energy Economics and Policy, 8(1), 17-26.
- Hanley, S. (2017), Will Trump Crush US Solar Power With New Tariffs? Industry Already Shaking. (Clean Technica). Available from: <http://www.CleanTechnica.com>; <https://www.cleantechnica.com/2017/10/05/will-trump-crush-us-solar-power-new-tariffs-industry-already-shaking>. [Last retrieved on 2017 Dec 25].
- Hopkins, E. (2018), Trump Tariff Decision Could Further Destabilize Indiana Solar Industry. (Indy Star). Available from: <http://www.IndyStar.com>; <https://www.indystar.com/story/news/2018/01/01/trump-tariff-decision-could-further-destabilize-indiana-solar-industry/965035001>. [Last retrieved on 2018 Jan 04].
- Kazmerski, L., Broussard, K. (2004), Solar Photovoltaic Hydrogen: The Technologies and Their Place in Our Roadmaps and Energy Economics, Proceedings of the 19<sup>th</sup> European Photovoltaic Solar Energy Conference. Golden CO: National Renewable Energy Laboratory, NREL/CP-520-36401.
- Kondratieva, K. (2017), Industry Divided Over Anti-Dumping Duty on Solar Inputs. Business Line. Available from: <http://www.thehindubusinessline.com/economy/industry-divided-over-anti-dumping-duty-on-solar-inputs/article9821706.ece>. [Last retrieved on 2017 Jan 05].
- McCown, B.A. (2017), Why Messing With The U.S. Solar Industry Is Bad For The Economy. (Forbes). Available from: <http://www.Forbes.com>; <https://www.forbes.com/sites/brighammccown/2017/11/06/why-messing-with-the-u-s-solar-industry-is-bad-for-the-economy/#4bbbf00b6b39>. [Last retrieved on 2017 Dec 25].
- Nelsen, A. (2017), Solar Industry Says EU Tariffs on Chinese Imports will Raise Panel Prices. (The Guardian). Available from: <http://www.theguardian.com>; <https://www.theguardian.com/environment/2017/sep/08/solar-industry-says-eu-tariffs-chinese-imports-will-raise-panel-prices>. [Last retrieved on 2017 Dec 25].
- Onyusheva, I., Trubnikova, N., Ridho, T.K. (2017), Eco-economy and future energy development: The case of Kazakhstan EXPO-2017. International Journal of Ecological Economics and Statistics, 38(4), 141-151.
- Onyusheva, I., Ushakov, D., Tran Van, H. (2018), The eco-problems and green economy development in Kazakhstan: The analytical survey. International Journal of Energy Economics and Policy, 8(2), 148-153.
- Pettinger, T. (2015), Can Inflation Cause a Recession? (Economics Help). Available from: <http://www.EconomicsHelp.com>; <https://www.economicshelp.org/blog/1128/economics/is-inflation-causing-recession>. [Last retrieved on 2017 Dec 25].
- Renewables, Global Status Report. (2016), REN21. France: Renewables, Global Status Report.
- Samarina, V., Skufina, T., Samarin, A., Ushakov, D. (2018), Alternative energy sources: Opportunities, experience and prospects of the Russian regions in the context of global trends. International Journal of Energy Economics and Policy, 8(2), 140-147.
- Silverstein, K. (2017), Will The U.S. Solar Industry Survive Import Tariffs? Trump Holds The Cards. (Forbes). Available from: <http://www.Forbes.com>; <https://www.forbes.com/sites/kensilverstein/2017/10/03/will-the-u-s-solar-industry-survive-import-tariffs-trump-holds-the-cards/#1d86e7524a15>. [Last retrieved on 2017 Dec 25].
- Singh, K., Dhillon, S.S. (2018), Economic development and environment:

- The Indian experience. *International Journal of Ecology and Development*. 33, 67-93.
- Smith, C. (1995), *History of Solar Energy: Revisiting Solar Power's Past*. Available from: <http://www.solarenergy.com/info.history.html>. [Last retrieved on 2018 Apr 20].
- Timilsina, G., Lado, K., Patrick, A.N. (2011). A review of solar energy. *Markets, Economics and Policies*, The World Bank, 1, 4-12.
- United States Environmental Protection Agency. (NA). *Climate Change Indicators: Greenhouse Gases*. (United States Environmental Protection Agency). *Climate Change Indicators*. Available from: <https://www.epa.gov/climate-indicators/greenhouse-gases>. [Last retrieved on 2017 Dec 25].