

Leading Approaches to Energy Solutions in the 21st Century

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Abstract. Our paper tackles the issue of the novel energy solutions in the 21st century and the leading approaches how to face them. Specifically, we are researching the leading approaches to saving, generating and storing energy, as well as their impacts on the world's economic growth. Moreover, we look into the investments into energy technologies that encompass renewable energy sources (RES) and energy efficiency solutions.

Renewable energy sources are expected to become the main source of electricity by 2030. In order to achieve that, governments need to take serious steps in funding and supporting renewable energy initiatives (e.g. in a form of feed-in-tariffs, incentives for installing solar panels or wind turbines, or payments for house insulation). In addition, a general understanding of the importance of the shift to the renewable energy for the sake of mitigating the results of global warming and climate change should be established. Consumers should be informed of the approaches to energy saving and energy efficiency and a nation-wide support for them should be gained. The leading approaches to energy solutions should also be popular and sustainable among the masses.

In general, one can see that renewable energy is protected from these risks by state subsidy programs and continually falling costs. In the long term, this will reduce the supply of traditional energy resources such as oil and gas and, as a result, increase their prices. An impetus in the energy transition process should in turn lead to cheaper renewable energies.

1 Introduction

Recent climate changes have started to take frightening dimensions and the world's community is calling for profound changes. One of these changes would be the changes in the approaches to the leading energy solutions represented by the shift from the fossil fuels to the renewable energy sources (Paska and Surma 2014).

In recent years, much commitment has been made by consumers to utilities. Part of the pressure comes from regulators mandating utilities to educate customers about smart grid investments. Other utilities are looking to build new relationships to attract private customers to demand response or energy efficiency programs (Vlasov et al. 2017). But energy efficiency programs that are growing nationwide are a completely different issue. Discounts offer the double advantage of promoting the introduction of energy efficiency measures and proving proof of implementation (Kuzmin et al. 2019). The discount as the only currency of the energy efficiency transaction made sense in the 20th century but has led to an unfortunate data and experience silo that makes no sense in the digital age of the smart grid (Vlasov et al. 2019). First, all of this energy efficiency data is often included in an opaque silo: project data, cost data, assumed or modeled savings, customer information, and installation data (Avdonin et al. 2016). Imagine that drivers are responsible for the disposal of kilograms of carbon waste after each journey. Since 1980, the humanity's progress on energy efficiency has probably saved the economy somewhat, similar to the cost of the global economic crisis. Inefficiency unnecessarily contributes

to increasing greenhouse gas emissions, contributes to the growing burden of air pollution costs, reduces industrial productivity and complicates our energy security and economic resilience.

Despite the major shortcomings of the Paris Climate Agreement, a major reason why the globe could come together to sign the Paris Climate Agreement was that large industrial nations such as the United States finally realized that they played an excessive role in creating the climate, an oversimplified obligation for less industrialized nations countries to help them reduce CO₂ emissions in the same way while improving the quality of life in those countries (Strielkowski et al. 2016; Upton 2016).

One would probably agree with the fact that the main drivers of energy and power sector in the 21st century are climate change mitigation, population change, and radical technological change (Coates 2016; Abrahamse and Shwom 2018). Climate change also affects the energy needs and performance of the energy infrastructure. For countries like Australia, tackling the decline of the politically powerful fossil fuel industry is a key challenge. Several pilot projects have recently been launched to test new technologies and demonstrate innovative approaches to energy efficiency. As energy value appreciation and procurement change, new opportunities open up for customers to be directly involved in the way they consume energy, enabling them to design more effective programs and even open up new markets. While several pilot projects are underway across the country, new models for delivering energy efficiency are still in their infancy. Members of the Leadership Forum also support the implementation of programmatic activities identified in the Energy Partnership work plan by providing resources for joint efforts. Membership in the Leadership Forum is open to all companies active in the energy sector. Power Partnership welcomes the industry's diverse representation in terms of technologies, all aspects of power supply and related energy systems, and legal, financial and regulatory aspects.

The Panel on Climate Change, the United Nations scientific advisory body for the analysis of the science of global climate change, reports that unless the world takes drastic and immediate steps to reduce emissions of gases that create an increased greenhouse effect Global temperatures could rise another 1.6 to 6.3 degrees Fahrenheit by 2100.

However, it is quite possible to identify measures to reduce the causes of climate change, thereby reducing the intense risks associated with such a hot planet. Because power plants and related power plants account for 36 percent of total U.S. greenhouse gas emissions, reductions in this sector can play an important role in slowing global climate change. Party conference in Paris in 2015, the parties of the UNFCCC have reached a groundbreaking agreement to combat climate change and to accelerate and intensify the measures and investment necessary for a sustainable low-carbon future. The Paris Agreement builds on the convention and, for the first time ever, brings all nations together to make ambitious efforts to tackle climate change and adapt to its impact, strengthening support for developing countries. As such, it points to a new path in global climate protection.

2 Sustainability and energy security

Energy security is also a problem of power outage, that is, the power supply need not be interrupted, while the key lies in the diversification of energy resources and the optimal use of local resources. It really is a challenge for developing countries to be in the early stages of industrialization and to ensure energy security, mainly because of limited financial resources and the spread of appropriate policies. Reliability, affordability and accessibility, as well as sustainability, are four main components of energy security for each country.

Some countries may have greater potential for generating solar energy, while others are more likely to rely on wind, hydropower, tidal or local biomass. Combining multiple sources is one of the keys to ensuring a steady supply of energy until clean renewable energy can be stored and transported in sufficient quantities to be used at a later date and in any location. Energy security concerns can even encourage countries that export energy to invest in local renewable energy sources.

Figure 1 shows the comparison of total investments into traditional and renewable energy sources over the past eight years (measured in billions of U.S. dollars).

Easy access to some of the cheapest energy sources in the world thanks to generous subsidies can keep domestic energy prices low. Low energy consumption does not promote efficiency, and the inefficient burning of fossil fuels makes the Gulf States one of the worst performing countries in terms of sustainability. In some countries, safety has also deteriorated as fossil fuel dependency has increased.

The future trilemma development of the Gulf States will therefore depend heavily on concurrent efforts to reduce energy subsidies and promote renewable energies. The security of supply of seven primary energy sources (oil, natural gas, coal, bioenergy and waste, hydropower, geothermal and nuclear) and two groups of secondary fuels (petroleum products and biofuels) can be analysed. Four dimensions of energy security are considered, including external factors related to imported energy and domestic factors related to the use, conversion and distribution of energy within national borders.

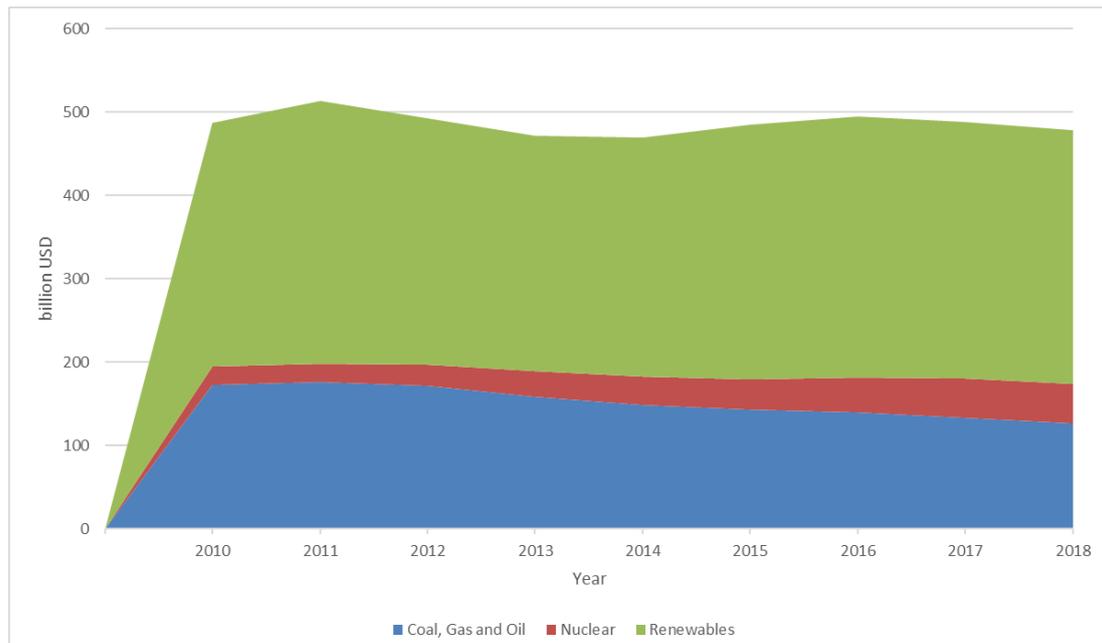


Fig. 1. Total investments into renewable energy sources and traditional energy sources (2010-2018)
Source: IEA (2019)

External and domestic factors analyzed in the MOSES reference framework reflect both the risk and resilience, which is defined here as the ability of energy systems to withstand disruption. 6MOSES analyzes the four dimensions of energy security through 35 indicators that identify the risk or adequacy of resilience to different energy sources and fuels in national energy systems.

3 Investment into the new energy technologies

One area in which the gradual and fast scenarios differ is the adoption of renewable energy. For the markets, the key moment will be when renewables make up the entire growth of energy supply and all the growth in electricity supply. As renewable energy becomes one of the leading growth sectors in the energy sector, financial markets will increasingly shift capital accordingly.

For developing countries, the new sources of energy promise to reduce dependency on oil imports and free up capital for investment in domestic energy sources. Although only a few countries have their own oil fields, all have wind and solar energy. In terms of economic expansion and job creation, these new energy technologies are a godsend. More than half of all countries have demonstrated their willingness to support renewable portfolio standards and renewable energy credit programs. And within the meaning of the Highway Act, several states are now preparing to support unprofitable nuclear power plants with Zero Emission Credits (ZECs). The spirit of the Highway Act has been on the national stage lately, especially in the Green New Deal, which calls for direct government spending on a range of clean energy technologies. The size of onshore wind projects has halved over the same period. Europe has not followed this trend with such intensity, but the final cost of electricity has fallen. The privatization of the energy sector has opened the door to alternative mechanisms for renewable energy projects. Advanced markets such as Europe allow for direct interaction between power generators and large consumers, including utilities, businesses and even spot markets.

Table 1 that follows shows the investment into the renewable energy by region in 2018 expressed in billions of U.S. dollars. The picture becomes somewhat clear, especially when it is split by regions and types as shown here.

Investors worldwide have paid more attention to this emerging industry in recent years. In many cases, this has led to rapid commercialization of renewable energy and significant expansion of the industry. Examples include the wind and solar photovoltaic (PV) industries.

PPP or EPC, which use cost savings from lower energy consumption to reimburse the cost of implementing energy-saving measures, are often cited as a critical issue. Several Member States use EU Structural and Cohesion Funds to finance energy-efficient renovation of residential and public buildings. The ERDF, for example, finances the improvement of the energy efficiency of residential and social housing in Latvia. Energy efficiency investments in buildings can be financed from contractual valuations of existing real estate (ie property taxes).

Table 1. Investment in renewable energy in the world by type in 2018

Region	Renewables transport and heat	Electricity networks and battery storage	Energy efficiency
North America	2	75	47
United States	2	68	42
Central and South America	2	10	7
Brazil	2	6	2
Europe	5	44	76
European Union	3	34	70
Africa	1	13	5
South Africa	0	1	1
Middle East	0	7	2
Eurasia	0	11	5
Russia	0	8	4
Asia Pacific	15	138	98
China	13	83	61
India	1	21	10
Japan	0	8	9
Southeast Asia	0	11	4
World	25	297	240

Source: IEA (2019)

Loans under PACE programs are secured by the placement of an additional lien on a property that precedes the existing mortgage debt. PACE funding programs are particularly well suited to energy efficiency projects in residential areas.

4 Changes on the energy market

The use of renewable energy, especially solar and wind, that provide electricity without causing carbon dioxide emissions is widespread. Making them usable for electricity depends on the cost and the efficiency of the technology, which is constantly improving, reducing the costs per peak kilowatt and per kWh at the source. Policies promoting renewable energy are generally needed to prioritize and subsidize network systems. These provisions apply in around 50 countries all around the world.

The directive also requires normalization of hydropower and wind power generation. For the calculation of the share of renewables in heating and cooling, the final consumption of energy from renewable sources is defined as the final consumption of renewable energy in industry, households, services, agriculture and forestry, and in heating for heating and cooling. Renewable heat from renewable sources. With their hydroelectric power plants, they use the energy that is generated by the flow of water into electrical energy. Finally, their geothermal power plants generate electricity from the naturally occurring steam. Investing in sustainable energy sources to protect the interests of future generations. The company uses wind energy, solar energy, energy, hydropower and geothermal energy. Investors can take many different paths to find potential shares in the renewable energy sector. One focus is on companies that build or install renewable energy components or produce renewable fuels. For this reason, most of these renewable energy companies usually pay a large portion of that money as a dividend.

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The technology with which the forces of nature can be used to satisfy the needs of man is as old as the first sailing ship. However, attention was no longer turning to renewable sources as the industrial revolution progressed on the basis of concentrated energy trapped in fossil fuels. As demand for electricity escalated and supply depended mainly on fossil fuels and some hydropower and then on nuclear, there were concerns about carbon dioxide emissions that could contribute to potential global warming.

5 Increasing deployment of renewable energy

In the past, different countries around the world faced particular challenges in integrating renewable energy into their electricity grids, while the manufacturing sector, notably wind and solar, went through a complex period of restructuring and consolidation (Chaudhary et al. 2015; Lin and Purra 2019).

In addition, renewable energy sources are being introduced in an unequal environment where their energy prices do not fully reflect the externalities. The global subsidies for traditional fuels and nuclear energy remain high despite the benefits of renewable energy and concerns about environmental quality. Much of the expansion of renewable capacity occurs in countries with large subsidy systems that can compensate investors for the relatively high cost of renewable energy technologies (Riesz and Elliston 2016). Due to the high modularity of many of these technologies, especially solar photovoltaic (PV) and onshore wind power, for the first time in the history of the electricity sector, individuals and communities play an active role in their own power supply.

Renewable energy technologies are at the forefront of a more democratic, distributed energy system. The benefits of renewable energy are obvious, but they have also been obstacles to their introduction. Market structures, lack of understanding of emerging renewable technologies, difficulties in accessing finance, high financing costs, inadequate regulatory frameworks, lack of compensation for the external effects of fossil fuels (e.g. emissions of carbon and local air pollutants), small markets and political insecuritya role in obstructing the use of renewable energy. For many developing countries, there are opportunities to use renewable energy sources, especially in cases where resource conditions are good and the need for energy access is high (Kumar et al. 2017). The majority of developing countries are blessed with significant renewable energy sources such as the sun and wind that cover large geographical areas and do not require a centralized approach to distribution (Yoldas et al. 2017). The use of renewable energy can effectively harness the available human capital in underemployment countries without compromising the desirable characteristics of the energy supply. Renewable energy sources are increasingly seen as investments that can bring economic benefits by reducing dependence on foreign fossil fuels, improving air quality and health security, improving access and safety to energy, creating opportunities for economic development and reducing unemployment. Global (public and private) R&D investment in renewable energy technologies has almost doubled in the past decade (Gielen et al. 2016). However, the profile of renewable energy development is becoming ever more diverse and in some regions of the world more and more challenges will have to be overcome. While global new investments in renewable energies are still relatively high, there has been a decline in recent years. Supporting renewable energy demonstration projects to disseminate information in remote areas, training microfinance leaders, and decentralizing the implementation of renewable energy projects can promote the dissemination of renewable energy projects. Most of the support for renewable energy strategies and technologies in developing countries comes from local governments or from international donors, undermining their sustainability as funds vary with changing priorities and crises. Finally, the introduction of innovative strategies and the sustainability of renewable energy markets and technologies can benefit from the adoption of a comprehensive energy governance framework.

Renewable electricity is, in most cases, more expensive than electricity from fossil fuels. In the short term, political incentives such as the Renewable Energy Tax Credit (RETC) would encourage the use of electricity from renewable sources.

Overall, technological developments and a coherent policy must be coordinated with production capacity and access to capital to accelerate the use of renewable electricity. However, from a power generation point of view, renewable energy has not always increased. In addition to meeting the new electricity needs, in 2015 renewable energy began to replace the thermal energy storage system for the first time. Given the current slowdown in growth and surplus power, these fluctuations reflect the voltage and polarity between the thermal power industry and the renewable energy industry. Renewable energies will shift from meeting the new electricity needs to replace existing electricity needs, traditionally covered by thermal power plants.

In recent years, the annual share of renewables in the newly installed capacities has gradually increased. To achieve this, a more comprehensive electrification program, coupled with accelerated expansion of renewable energy capacity, is needed to drive this growth, without the unsustainable restriction of ever-increasing fossil fuel imports. Network stability and connectivity needs to be further improved, hampered by the different nature of renewable energy. Acceleration of Existing Transmission and Distribution Investment Plans by Power Grid Corporation, India, Adani Transmission et al. is also required, but good in the hand. The demand of energy

consumers has essentially focused on three goals with which the first three trends could best meet renewable energies.

With a different focus on each goal, consumers are looking for the most reliable, affordable and green energy sources. Key consumers include cities that integrate renewable energy into their smart city plans, municipal energy projects that democratize access to the benefits of renewable energy in and out of the grid, emerging markets that use renewable energy on their path to development and companies expanding their scope of application. Solar and wind procurement

6 Conclusions

Thus, leading approaches to the energy solutions in the 21st century include those that would enable to soothe the drastic climate changes and halt global warming. The world is standing on the brink of the energy and climate collapse and some fast and effective measures are desperately needed. A global action taken both by national governments and on the international level is required.

The shift to the renewable energy seems to be a good solution that would help to change the patterns of energy consumption that have been imposed by the decades of using coal and oil for industrial production, transportation, and consumers' use. This "green revolution" as many people call it is envisaged to bring some results quite soon. The question is, however, whether energy consumers all around the world would embrace this rhetoric and change their behavioural and consumption patterns when it comes to using electricity or heating houses.

In addition, novel technological solutions might be helpful for supporting this "green revolution". The Internet of Energy (IoE) that is composed of smart grids and smart meters might help in collecting, processing and analysing the data needed for ensuring that the energy is produced, transferred, and used in the most efficient way. Thus, the leading solutions for the 21st century are two-fold: focused both on changing the energy mix and using more technological innovation in order to use the existing mix more efficiently.

Acknowledgements

This paper was funded by RFBR, project number No 19-07-00463.

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