# GSCESD-2019

## GRADUATE STUDENT CONFERENCE ON ENERGY AND SUSTAINABLE DEVELOPMENT

***3 May 2019***

***Kadir Has University***
***Cibali Campus, Galata Hall, Istanbul***

# PROGRAM & ABSTRACTS

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# PROGRAM

| | |
|---|---|
| 09:00-09:30 | **Registration*** |
| 09:30-09:50 | **Opening Session**<br>Gözde Nur Karagöz, Conference Chairwoman<br>Prof. Dr. Volkan Ş. Ediger, Director, CESD, Kadir Has University |
| **Session I** | **Sustainable Energy Development**<br>Moderators and Discussants<br>Prof. Dr. Meltem Ucal<br>Assoc. Prof. Gökhan Kirkil |
| 09:50-10:10 | The Impact of Energy Independence and Security Act of 2007 on Renewable Energy Consumption in The United States<br>Mirali Seyedrezaei and Abdul Nabiyev, Istanbul Technical University |
| 10:10-10:30 | The Geopolitics of Oil and Natural Gas in the Middle East<br>Şebnem Sezgin, Grenoble Institute of Political Studies |
| 10:30-10:50 | Development of Using Energy Resources in the United Arab Emirates<br>Eman Abusaada, Kadir Has University |
| 10:50-11:10 | International Contributions to Global Renewable Energy Governance<br>Hazal Mengi Dinçer, Kadir Has University |
| 11:10-11:20 | Discussions |
| 11:20-11:35 | Coffee Break & Networking |
| 11:35-12:30 | **Invited Speaker**<br>Uygar Özesmi<br>What is Sustainable Energy? |
| 12:30-13:30 | Lunch** |
| **Session II** | **Policies, International Relations, and Energy Geopolitics**<br>Moderators and Discussants<br>Assoc. Prof. Dr. Akın Ünver, Kadir Has University<br>Asst. Prof. Dr. Emrah Karaoğuz, Kadir Has University |
| 13:30-13:50 | The Relationship Between Circular Economy and Energy: Exploring A New Pattern<br>Begüm Ünlü, Kadir Has University |
| 13:50-14:10 | Circular Economy as a Transition Model for Sustainable Development<br>Vildan Demirkıran, Kadir Has University |
| 14:10-14:30 | Resilience in Energy Infrastructures; Climate Change Effects, Turkey Case<br>Fatih Avcı, Kadir Has University |

* Coffee, tea, and light breakfast will be served during registration.
**Lunch will be served

| | |
|---|---|
| 14:30-14:50 | Renewable Energy Finance in Turkey: Opportunities, Needs and Threats<br>Başar Yılmaz, Kadir Has University |
| 14:50-15:10 | Unboxing the Turkish Energy Security: A Foreign Policy Analysis<br>Samed Şahin, Boğaziçi University |
| 15:10-15:20 | Discussions |
| 15:20-15:40 | Coffee Break & Networking |
| **Session III** | **New Technologies in Energy Transition**<br>Moderators and Discussants<br>Assoc. Prof. Dr. Ahmet Yücekaya, Kadir Has University<br>Asst. Prof. Dr. Emre Çelebi, Kadir Has University |
| 15:40-16:00 | European Countries Electricity Consumption Modelling and Demand Pattern Analysis<br>Ergün Yükseltan, Kadir Has University, Istanbul, Turkey |
| 16:00-16:20 | Nuclear Safety, Security and Safeguards<br>M. Cüneyt Kahraman, Istanbul Technical University |
| 16:20-16:40 | Decentralized Energy in Turkey: Opportunities and Barriers<br>Burak Şuşoğlu, Kadir Has University |
| 16:40-17:00 | The Future of Electric Cars in Turkey<br>Mesut Can Yılmaz, Kadir Has University |
| 17:00-17.10 | Discussions |
| **17:10-17:30** | **Closing Remarks**<br>Prof. Dr. Meltem Ucal, CESD, Kadir Has University |

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# ABSTRACTS

C.E.S.D.
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# The Impact of Energy Independence and Security Act of 2007 On Renewable Energy Consumption in The United States

Mirali Seyedrezaei [a], Abdul Nabiyev [b]

[a] *Mining Engineering, Istanbul Technical University, Istanbul, Turkey*
[b] *Economics, Istanbul Technical University, Istanbul, Turkey*

A B S T R A C T

In recent years, global warming, climate change, increase in CO2 levels in the atmosphere, fluctuations in oil prices and countries' reliance on imported energy resources have increased the number of studies in the renewable energy field. Recognition of renewable energy sources as the main energy source coincided with the 1970s, and the number of studies carried out in this area is steadily increasing.

In the literature, there are several studies in relation to the association between renewable energy consumption and economic growth. Differently, from other studies, the contribution of existing empirical study to the economic literature addresses the effectiveness of implemented sustainable energy policies. This study examines the impact of the Energy Independence and Security Act of 2007 (EISA 2007) on renewable energy consumption in the US. The results obtained from this study are important for the countries that support renewable energy investments such as Turkey, India, China and aims to provide guidance for future studies. In this study, independent variables GDP, oil price and CO2 emissions which affect renewable energy consumption were introduced. Then our control variable which is EISA (2007) was explained. A set of time series consisting of total renewable energy consumption and CO2 emissions were chosen from the Energy Information Agency (EIA), and real GDP and oil prices were obtained from the Federal Reserve Economy Database (FRED). This dataset covers the first quarter of 1990 and the last quarter of

2017. First, to test the stability of these time series, ADF, PP, DF-GLS stationarity tests were employed and according to the obtained results it was understood that the series were stationary at their first differences. After performing the Johansen Cointegration test, the model was estimated with Dynamic OLS estimator. According to the results obtained from the estimator, EISA (2007) positively and statistically significantly affects renewable energy consumption from 2008 to 2017 in the USA.

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# The Geopolitics of Oil and Natural Gas in the Middle East

Şebnem Sezgin[a]

[a]*Middle East and Mediterranean Studies, Grenoble Institute of Political Studies, Grenoble, France*

A B S T R A C T

Geopolitics is the study of the influence of geography, economics and demography on politics and especially on the foreign policy of a state. There are military, economic and political geopolitics. There is also energy geopolitics that describes the effect of energy resources in political and economic systems, as well as their impact on international relations. Oil, gas, coal as main natural resources are often used by States as strategic tool in domestic and foreign policy. For example, Turkey -transit country- enjoys its geographic location close to Mediterranean, Caspian and Middle Eastern energy sources. Another example, a major energy supplier Russia uses widely "pipeline diplomacy" against important European energy consumer countries. Therefore, the energy importer countries, on the one hand, try to access cheap and continuous energy inflow and secure the energy supply on their energy policies. On the other hand, the energy exporters focus on more efficient utilization of the reserves, investing on energy infrastructures and continuous revenues from the energy exports. In short, the geographic location broadly provides the explanation of States' foreign and energy policies.

From this perspective, this study will discuss the geopolitics of oil and natural gas in Middle East. Since the region has almost three-quarters of the worlds proved oil and natural gas reserves, these resources are the most important geopolitical drivers of foreign interests in the region. Russia, Iran and Qatar account for about 54% of the world proved natural gas reserves as of January 1, 2016 (EIA,2016). According to BP's 2019 outlook, the oil and gas will continue to play a significant role in the global energy system in 2040. That means that Middle East will maintain its role as a key source of energy, supported by the growth of OPEC oil production, together with an expansion in gas production in Qatar and Iran. While Western countries will continue to consume Middle Eastern oil and gas, Asian countries notably China and India will become more dominant in the Middle Eastern energy sector.

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# Development of Using Energy Resources in the United Arab Emirates

Eman Abusaada[a]

[a] *Energy and Sustainable Development, Kadir Has University, Istanbul, Turkey*

A B S T R A C T

The human hunger for energy has cost the world a hefty price; the increasing levels of CO2 and greenhouse gases have contributed to global warming, leading to a significant increase in global temperatures along with making the globe prone to harsh weather shocks and natural disasters. As a result, the world is racing towards the adoption of sustainable, safe and clean sources of energy. Nonetheless, the dependence on fossil fuels is yet to end and this situation is not anticipated to end soon. Therefore, some countries refused to transition from fossil fuels to renewable energies. Natural gas is considered as a transitional source of energy since it is a cleaner form of fossil fuel as it contains the highest content of hydrogen compared to coal and oil.
This paper investigates to understand the development of using energy recourses in the United Arab Emirates (UAE). Oil in UAE was discovered in 1958 and a field in Sharjah predominantly yielding natural gas, was discovered a few years later. While a mainstay to the economy is fossil fuels production, the but production dwindled as the Emirates diversified its economy. Nowadays, oil exports account for about one-third of the economic activity as a result of aggressive government policies designed to diversify the UAE exports. Because of the rapid growth in energy demand, the UAE has one of the world's highest per capita rates of energy consumption which has raised a global concern over CO2 emissions and climate change. To limit the consequences of climate change, the UAE started searching for alternative energies using nuclear power. Unfortunately, using nuclear energy involves many risks that effects health, safety and the environment. Hence, UAE began to invest in renewable energies. In a nutshell, the transitioning to the renewables do not have only the side of fossil fuel scarcity, but there are also economic and environmental reasons for this transition. United Arab Emirates (UAE) together with Saudi Arabia is the most successful country for energy transition among GCC.

This study was investigated to understand the development trends of scientific studies of renewable energies in the UAE. Based on the Scopus database using several keywords including the words ''renewable energy'' and "United Arab Emirates", the total number of scientific publications between the years 1988 and 2018 is 898 (56%) while in the entire Middle East is 1618. The number of publications in solar energy (59%) and wind energy (46%) was dominating. The number of publications increased dramatically after 2008 and approximately half of the total contributions were published last four years.

UAE has already shown a significant effort regarding the development of Renewables while other GCC countries have shown some progress regarding the promotion of Renewables but still, significant efforts need to be made.

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# International Contributions to Global Renewable Energy Governance

Hazal Mengi Dinçer[a]

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A B S T R A C T

Energy transition is generally moving towards more affordable, environmentally friendly, efficient, and quality energy resources. For example, coal was preferred to biomass because of deforestation and coal is more efficient than biomass, oil and natural gas were chosen because they have higher calorific values, clean features than coal. Hence, in this century, a transition from fossil fuels to renewable energy sources is expected because they are cleaner energy sources. However, new policies, strong and reliable markets, consumer behaviors and technologies need to be developed. For this reason, changes in local, domestic and global policies should be ensured in all political levels. Governments are the main actors in determining renewable energy policies; they set objectives, promote fiscal incentives, put various quotas, feed-in tariffs, provide legal infrastructure and improve rural development and electrification. But, international organizations as well as governments are important in renewable energy policies. Therefore, in the study, the contributions to global governance as well as the institutions for renewable energy are discussed.

Even it is thought that the relevance between international society and renewable energy governance is a youth notion, the relationship dates back to 70 years ago. In 1949, the UN Conference on the Conservation and Utilization of Resources that was held. In the conference, the limits of the fossil fuels were set and the potential to harness wind and solar power to produce electricity was expressed. Since then, various international meetings were organized for providing global renewable energy governance, specifically within the UN. However, the issue was not aroused interest to create an international renewable energy organization because the attention of states differed from each other in national security and economic issues.

Some countries called for establishment of an international organization for renewable energy at the end of the 20th century. The UN also expressed a need for a global renewable energy institution for renewable energy, however, the voice of the renewable energy supporter countries was inadequate. It is understood that a bottom-up initiative for a renewable energy institution was not possible, thus, a group of countries specifically in Europe and Small Island States created a top-down movement. Then, a new renewable energy coalition, independent from the UN, was started at the beginning of 21st century. The structure of this new coalition was driven by the eagerness of individual states instead of the UN-wide consensus system and was designed in order to reduce the proportion of hydrocarbons and nuclear in the global energy mix. Then, the first global renewable energy organization, International Renewable Energy Agency (IRENA), was created in 2009. The establishment of the Agency is seen as an institutional innovation because before IRENA, there was no renewable energy organization globally.

It should be taken into account that, before IRENA, there have been various international treaties and organizations as International Energy Agency (IEA), UN Framework Convention on Climate Change (UNFCCC), World Bank which are interested renewable energy issues for a long time. But, their main different aims are not different as energy security, climate change or economy, thus IRENA could be seen as an effective solution for global renewable energy governance so far.

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# The Relationship Between Circular Economy and Energy: Exploring A New Pattern

Begüm Ünlü[a]

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A B S T R A C T

Materials in the world do not disappear, their shape change. Human transform the energy of all materials between potential and kinetic in line with the requirements. Conventional consumption figures ignore that wastes are deformed energy by making this cycle into linear process. Due to this fact, there is a shift from linear economy to circular economy in terms of decreasing greenhouse gas emissions in industrial production systems that regenerate this cycle by referring to the generic terms for the reducing, reusing and recycling activities in such process as production, circulation and consumption. However, in the circular economy literature review it is seen that there are few studies focused on the relationship between energy and each stage in the manufacturing of a product from raw material extraction to the final distribution and eventual disposal. In this sense this research aims to explore the relationship between energy and circular economy.

Firstly, the research will begin with determination of countries and companies which execute circular economy model, then all the stages of this model will be specified. In the light of this structure, it will be explored how the stages are conducted in the context of energy. To describe the pattern between energy and circular economy, content analysis method will be used. As an outcome of this research, this pattern acts as a guideline for companies or countries which in energy transition and have a circular economy model by determination of important points in terms of transformation. Also it could contribute to improvement of Turkey's circular economy model and to accelerate energy transition of industrial production systems.

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# Circular Economy as a Transition Model for Sustainable Development

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A B S T R A C T

Meeting the need for energy in a sustainable way is one of the major challenges facing the world today. The purpose of the cyclical economy is to use less resources through more efficient processes, prevention of waste, reuse, repair, reproduction and recycling to overcome those challenges. Circular economy can be defined as an industrial economy in which the resources are managed in a cyclical manner, which are curative for their nature and purpose. This economy primarily focuses on raw material cycles and energy from renewable sources. The basic idea is to develop innovative business models and to save growth from dependence on resources consumption. The concept of cyclical economics enables society to maximize its resources and adapt resource consumption to real and future needs. Waste prevention, reuse, recycling and recovery (material and energy) enable society to maximize its resources and adapt consumption to real needs. In this way, the demand for primary resources is optimized and related to this, the

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# Resilience in Energy Infrastructures; Climate Change Effects, Turkey Case

Fatih Avcı[a]

[a] *Industrial Engineering, Kadir Has University, Istanbul, Turkey*

A B S T R A C T

The climate is changing faster than any time since the beginning of the modern civilizations. Human impact has been the principal reason for global warming since the mid-twentieth century. Global climate change has brought about a broad scope of impacts over many regions, countries and developing industries like power, manufacturing, and others. The atmosphere and oceans have warmed, the amount of the ice caps have decreased or (Arctic sea ice has declined), sea levels have risen, and GHG concentrations in the atmosphere have increased.

Climate change will have substantial impacts on power generation, transmission, distribution as well as upstream and downstream points in the sector value chain. Also, investors and stakeholders need to change their perspective to design and operate power infrastructures for these possible upcoming risks like extreme events, changing climate patterns and changing resources. 1°C rise of the global temperatures will reduce available electricity both in generating capacity because of cooling or pressure constraints and transmission because of ambient temperature.

These consequences will either require additional capacity or a greater demand-side response during peak times. Since electricity cannot be stored on a large scale economically, so supply and demand should be balanced permanently. Both will be affected by climate change, presumably in an opposing way. Enhanced and accurate projections will benefit power utilities to adjust choice, dimension, design, and location of new power infrastructures

to meet the expected changes in the short, medium or long period. As the earth faces these climate uncertainties, power sector and decision makers must decide the potential effects, assess the available investment options and choose the alternatives, cost-efficient systems that will make the power system more resilient.

In this study, for power plants case in Turkey, the outage & maintenance platform is examined to detect any possible climate-related effects that are seen in power plants in EPIAS system. There are more than 500 messages that related directly or indirectly related to climate-related issues between the inspected period of 2016 and 2018. Some power plants are selected from annual temperature data that is provided by the Meteorological Institute. Both EPIAS data and temperatures are reviewed and showed the faults and climate change effects on the same points. Especially thermal power plants and hydropower plants are the most affected plants from the extreme weather events in Turkey.

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# Renewable Energy Finance in Turkey: Opportunities, Needs and Threats

Başar Yılmaz[a]

[a] *Energy and Sustainable Development, Kadir Has University, Istanbul, Turkey*

A B S T R A C T

Energy policies need efficient and functional financial models. Nowadays, with the new developments in energy resources and their usage, financial models have been started to be transformed with various mechanisms.
Actually developed and developing countries' problems are quite different when developing a financial model. Basically developed countries try to use their own low-cost capital, minimalize operational cost, improve their technologic machinery and equipment export opportunities and trying to find the fastest way to transform the energy usage. On the other hand, the developing countries trying to find a fund to finance their energy transition under the minimum capital conditions and in the getting worse world economic situation. Under the cost of capital or interest rating decrease condition like these days, developing countries have to use new financial models to apply in their energy policies.

Today, countries all over the world are switching to renewable energies. Therefore, financing models which focuses on financing renewable energy based energy projects increased in the recent years. Turkey, imports 75% of its total energy although there is a huge potential for renewable energies. In order to increase self-sufficiency and reduce import dependency, Turkey is aiming at increasing the share of renewable energies in the energy mix. Hence, Turkey is a good case to analyze the renewable energy finance issue in the developing countries. In a broad sense energy finance has caused similar problems in the developing countries. This work focused on the renewable energy based electricity generation in and the financing of renewable energies in Turkey. While explaining Turkey's situation, this study also examined other country cases and compared them to Turkey

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# Unboxing the Turkish Energy Security: A Foreign Policy Analysis

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A B S T R A C T

In recent times, Turkey pursues a "compartmentalization strategy" in foreign policy to secure its interests in energy politics since the bilateral relations have been challenged severely by diplomatic crises. Putting the energy security concerns at the center of the discussion, how does Turkey compartmentalize its bilateral relations in the global arena? Here, the term compartmentalization refers to the phenomenon that Turkey is following a foreign policy agenda where energy security has been considered as an independent policy area in a continuum. Although there are critical rifts in bilateral relations with the actors who consists the important parts of supply and demand chain in the energy trade, the continuity in energy security has been maintained to some extent. As a versatile concept, energy security requires a contextual definition and interpretation according to the dynamics of each country, hence, the compartmentalization in the Turkish case provides its own particularities and complexities as a strategically located country in the sense of geopolitics. Bridging the resource-abundant Caucasia, Middle East and Eastern Mediterranean regions with the import-dependent but economically rich European countries, Turkey pursues its foreign policy goals through politics of transit. Even though Turkey is dependent upon the producing countries for energy import, the compartmentalized politics of transit implemented by Turkey deserves attention as it has a say on the energy security of both supplying and demanding countries through a wide geopolitical setting. Therefore, the Turkish foreign policy has been shaped by the energy security concerns regarding its bilateral and multilateral relations with both the West and the East.

Compartmentalization allowed Turkey to secure its energy-related rational interests even though the diplomatically and ideationally driven political conflicts resulted in deterioration of the bilateral relations. In other words, Turkish foreign policy has prioritized the energy security as a rational interest that serves to the long-run economic goals, hence, the possible detrimental effects of the conflictual foreign relations have been tried to be controlled by compartmentalizing the bilateral relations. Nevertheless, the Turkish economy has suffered from the international sanctions made against the other business sectors in Turkey such as trade, agriculture and tourism. Moreover, this strategy works two-sided as it is applicable to both Turkey and its counterparts since the era of interdependence requires continuity in economic relations. Either on the supply or demand side, interdependency forces the countries to think about their global affairs in a continuum, especially on the economic issues. As a result, interdependency in the global economic affairs motivates the officials to settle the international disputes quickly before the domestic economies get worsen due to the conflicts although they compartmentalize their energy trade.

In the light of the information mentioned above, this work will elaborate the 17-years-long Justice and Development Party (AKP) rule which witnessed significant developments in foreign policy characterized by ups and downs. In the era of interdependence, Turkey has managed a multifaceted foreign policy towards each actor, namely the European Union (EU) in the West as the main demander, and Russia in the East as the main supplier considering the natural gas that consists an important part of its energy outlook. The theoretical background of the work will be based on the complex interdependency theory, brought forward by Robert Keohane and Joseph Nye in their Power and Interdependence: World Politics in Transition, which suggests that the global affairs are defined by interdependence associated with a reciprocal cost for each actor whether or not symmetrically. One of the basic premises proposed by the complex

interdependency theory highlights the decrescent importance of military based practices in order to solve international disputes. On the contrary, the focus on welfare has been rapidly increasing as a crucial dynamic that regulates the international conflict which prioritizes the interconnectivity between foreign and domestic affairs. Thus, the tumultuous outlook of the Turkish foreign policy will be interpreted under the light of these premises of complex interdependency theory in this work.

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# European Countries Electricity Consumption Modelling and Demand Pattern Analysis

Ergün Yükseltan[a]

[a] *Industrial Engineering, Kadir Has University, İstanbul, Turkey*

A B S T R A C T

In the recent years, with increasing concern of using fossil fuels and changing primary energy resources to renewable energies, electricity demand prediction becomes more important to use resources efficiently. There are many modelling and prediction techniques for these purposes to give an idea about future electricity consumption. These models are mainly separated as long term and short term. Long term models are important to determine enough capacity for the maximum demand that can be occurred. Energy investments strategies and plans are based on according to these models' assumptions. On the contrary, short-term demand forecasting focuses on near future like daily or hourly. It is important because all operations that are based on short term forecast results in de-regulated markets. Companies bid or decide and create a production plan according to the short term forecast. Both types of the models consider different input for accuracy. Long term forecasting models considers economic growths, production rate etc. While short-term forecasts are affected by daily events like temperatures and holidays.

In this study, we used Fourier Expansion short-term and long-term modelling and forecasting without using any other information except calendar information. Fourier expansion method are very powerful for periodic series. We have 38 countries consumption data between the years 2006-2015 and after first data analysis, we eliminated five countries that have missing years. Remaining data controlled and missing values and outliers are replaced with polynomial function. Then, we applied the model and make one-year forecast based on previous two years.

Electricity is mainly used for heating, cooling, industrial and residential necessities. Usage purposes for the industrial and residential are mostly stable and periodic during the years and consumption increase for these purposes can be explained with external factors like illumination, seasonal or economic growth rate. However, cooling and heating directly depend on temperature and countries consumption characteristic. Some countries use different resources for heating like natural gas and some countries has no cooling necessities due to average temperature. This directly affects modelling errors. Our model mean absolutes percentages errors (MAPE) are distributed between 7% and 1.1% with around 4%. Forecast errors are quite higher than modelling and MAPEs are distributed between 19% and 1.3% with around 7.2%. With this model, we can make different forecast for different periods without using any other information for both long-term and short-term.

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# Nuclear Safety, Security and Safeguards

Mahmut Cüneyt Kahraman[a]

[a] *Energy Science and Technologies, Istanbul Technical University, Istanbul, Turkey*

A B S T R A C T

One of the most important challenges today is to meet energy demand without causing environmental problems specifically without contributing to global warming. Nuclear energy is one of the energy sources that almost has no effect on global warming. In 2018, 449 nuclear power plants around the world were in operation and the share of nuclear power in worldwide electricity generation was 11%. For the future, 200 new power plants are planned or pre-planned to be commissioned by 2030 and 57 plants are under construction. It shows that nuclear energy usage is spreading around the world in spite of Fukushima accident in Japan in 2011. The figure given below indicates this statement. However, after Fukushima accident and terrorist actions around the world, the importance of safety, security and safeguard in nuclear energy reached the highest level. Turkey decided investing Nuclear energy and the first project is Akkuyu Nuclear Power Plant in Mersin. The first unit is planned to generate electricity in 2023. Two other projects are planned in Sinop and İğneada. The awareness of nuclear safety, security and safeguard issues in Turkey should increase in public, in government, and among engineers/technicians.

Even though the number of nuclear accidents are few compared to other energy generation systems, the impact of the accidents is very high. Previous accidents in Chernobyl and Fukushima had a huge impact directly or indirectly on people and the environment. It means nuclear power plants have risks and they can operate only with security systems to decrease the risks. Therefore, we have to have a high level of nuclear safety, security and safeguards in the nuclear power plants and in the nuclear industry.

Safety is based on openness, transparency, information sharing and integration with good management. The fundamental safety objective in nuclear industry is to protect people an d the environment from harmful effects of ionizing radiation. In order to meet the objective, three main issues must be ensured while operating the reactor; control the reactivity, cool the fuel, contain the radioactive material. New safety systems which are active and passive should be installed to nuclear power plants. In case of an accident, emergency preparedness plans shall be implemented.

Nuclear security includes of the prevention - detection- response to any criminal or intentional unauthorized acts against nuclear facilities or materials. Nuclear security must implement parallel to an effective national nuclear security regime. The objective of the nuclear security regime is to protect people, property, society and the environment from the consequences of a nuclear security event, which occurs from the harmful attempts of person or terrorist groups. Nuclear security focuses on blocking these attempts and has nothing to do with the organizational safety aspects of reactors.

Safeguards are an essential component of the international security system. Safeguard objective is to ensure that nuclear facilities are properly used and nuclear material is not diverted from peaceful uses. International nuclear safeguards are focused on the control of fissile materials only. They have nothing to do with engineering or organizational safety aspects of reactors. The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) efforts to prevent the further spread of nuclear weapons. NPT safeguards require states to; declare to the International Atomic Energy Agency (IAEA) their nuclear facilities, report to the IAEA what nuclear materials they hold and their location, accept visits by IAEA auditors and inspectors to verify independently their material reports and physically inspect the nuclear materials concerned, to confirm physical inventories of them.

IAEA has the responsibility of knowledge management of nuclear energy and makes inspections and safeguards of nuclear plants, research reactors, and nuclear materials. Therefore, IAEA publishes and spreads of safety and security fundamentals, requirements, standards and guides. Turkey shall follow these requirements while operating nuclear plants and raise the awareness of workers, technicians and the public.

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# Decentralized Energy in Turkey: Opportunities and Barriers

Mehmet Burak Şuşoğlu[a]

[a] *Energy and Sustainable Development, Kadir Has University, Istanbul, Turkey*

A B S T R A C T

Turkey is one of the major developing countries with a constantly rising primary energy demand of which the long-term average annual rate of increase is around 5%. In order to secure the supply to meet its demand, the country is persistently looking for new ways to produce domestic energy. This is specifically true for electricity generation which mostly runs on fossil fuels. The electricity generated in 2017 is from natural gas (37.2%), coal (32.8%), hydro (19.6%), renewables (10.1%), and oil (0.4%).

The total contribution of fossil fuels in electricity generation is roughly 70%, but only 38.1% of coal, 5.9% of oil, and 0.7% of natural gas are produced domestically and the rest is imported. This is a major issue for the Turkish economy since energy imports have the biggest share in total imports with 16%. In addition to the economic side, these resources emit carbon dioxide and other greenhouse gases, which cause global climate change and other environmental problems. The electricity from fossil fuels is mostly generated in centralized power plants, which are not very efficient in electricity transmission and distribution. In 2017, 1,9% in transmission and 10,2% in distribution were lost.

Decentralized systems could be an alternative to centralized power plants since it promotes local and clean renewable resources with a more efficient supply. According to the report of the European Parliament of 2010, decentralized generation (DG) described as microgeneration with capacities lower than certain MW of electricity for different types of renewables; solar PV less than 3 MW, small hydro less than 1 MW, wind less than 6 MW, geothermal less than 3 MW and biogas plants less than 10 MW. For decentralized systems, an amount as little as these limits to be beneficial for the country and reduce dependency, it requires extensive engagement of prosumers; people who produce and consume their own energy.

In Turkey, the percentages of power plants within these limits are 86% for solar, 7% for hydro, 15% for wind, 4% for geothermal, 87% for biomass. Solar is one of the most important resources that people could engage in. Even though the solar PV within limits are at 86%, total solar installments are quite low. The installed capacity of unlicensed PV is 5% of total installed capacity, the actual generation is lower than 1%. There are over 9 million rooftops on which solar PV panels could be installed.

In order for Turkey to overcome the issue of import dependency and climate change mitigation, renewable-based decentralized energy generation (RDES) is an important option. Although Turkey is aiming at increasing renewables, decentralization is not a part of the related policies and strategies and its deployment often faces different barriers. There have been regulations and incentives to ease the application of renewables, but their applicability is still challenging. Another issue for Turkey is the lack of technical capabilities like the interconnection problem of a DG, lack of technical human resources in the renewable sector etc. Social acceptability is also an issue since people still prefer natural gas over renewable resources, mostly because of the high costs of renewables.

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# The Future of Electric Cars in Turkey

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A B S T R A C T

Transportation is one of the basic needs of society, and its technologies have come a long way over the years. It has started with animals then continued with motor vehicles. Today, almost all transport vehicles use fossil fuels that produce toxic emissions which are very harmful to the environment. Electric cars offer new solutions for environmental problems. Since the world is in a transition period from fossil fuels to renewable energies, the transition from conventional fossil-based vehicles to electric ones is crucial. It is expected that electric cars will dominate the traffic in the near future. Governments have already started to invest in electric cars as an alternative to conventional ones. Policies are made in most of the developed countries that ban conventional cars and promotes switching to electric vehicles. Within this regard, Turkey has a high potential for utilizing electric vehicles. However, even though there are nearly 12 million registered cars in Turkey, the share of electric vehicles in total is quite low (TÜİK, 2018). This study provides accurate information about researches that characterize the situation of electric cars in Turkey and compares the case with other countries. Also, it gives brief details on technological developments including range, efficiency, and capacity of electric vehicles. Additionally, it investigates the affordability, availability, potential, and barriers and compares them to the conventional ones. The final part of the presentation covers the problems that are related to electric cars and gives some suggestions to Turkey's roadmap of electric vehicles. To be able to compare Turkish electric car market to the international market, the data is gathered from the International Energy Agency, Turkish Statistical Institute, Turkish Electric and Hybrid Vehicles Association, Automotive Distributer's Association and related organizations.

The study collects and interprets the current situation in the electric car market and making a comparison between countries. Also, statistical forecasting methods such as moving average and exponential smoothing were used to estimate the future status of Turkey.