GSCESD-2020

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17 December 2020

Kadir Has University
Center for Energy and Sustainable Development
Online Event

PROGRAM & ABSTRACTS

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PROGRAM

09:00-09:30	**Opening Session** Vildan Demirkıran, Conference Organizing Committee Chairperson Assoc. Prof. Dr. Gökhan Kirkil, Conference Scientific Committee Chairperson Prof. Dr. Volkan Ş. Ediger, Conference Honorary Chairperson
Session I	**Green and Sustainable Energy** **Moderators and Discussants:** Assoc. Prof. Dr. Gökhan Kirkil, Kadir Has University Dr. Değer Saygın, SHURA Energy Transition Center, Director
09:30-09:45	The Effect of Climate Change on Power Generation Resilience: Two Case Studies from Turkey Fatih Avcı & Volkan Ş. Ediger, Kadir Has University
09:45-10:00	Technical Potential of Public Rooftop Solar Photovoltaic for Ankara: A Preliminary Study Ceren Kutlu, Beyza Durusoy, Bülent G. Akınoğlu, Middle East Technical University
10:00-10:15	Turkey Takes Notable Steps in Renewable Energy Development Mohsina Majeed, Kadir Has University
10:15-10:30	The Use of Decision Support Systems to Manage Behavior Change in Energy Consumption Through Climate Adaptation and Mitigation Elif Çora & Şevval Çavuşoğlu, Middle East Technical University
10:30-10:45	Towards SDGs: How to Evaluate Turkey's Metropolitan Municipalities Elif Güney Menderes & Hazal Mengi-Dinçer, Kadir Has University
10:45-11:15	Discussions
11:15-11:30	Break
Session II	**Energy Policy, Markets, and Regulations** **Moderators and Discussants:** Dr. Okan Yardımcı, Oxford University, Academic Visitor Adv. Değer Boden, Boden Law, Founding Partner
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11:45-12:00	Optimal Diversification Among Energy Sources Conditional on Capacity Factor: Evidence from Electricity Generation in Turkey Mehmet Bodur, Kadir Has University
12:00-12.15	From Blockchain to Smart Contracts Merve Ergun, University of Bradford
12:15-12:30	A Preliminary Analysis of the Turkish Hydrogen Legal Landscape Ayşe Şehnaz Kart & İskender Gökalp, Middle East Technical University
12:30-12:45	On the Problematique of Renewable Energies: Two Paths Ahead Atamer Aykaç, Hacettepe University
12:45-13:15	Discussions
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Session III	**Innovative Energy Technologies** **Moderators and Discussants:** Prof. Dr. İskender Gökalp, Middle East Technical University Assoc. Prof. Ahmet Yücekaya, Kadir Has University
14:15-14:30	Energy Systems of the Future: Bidirectional Energy Systems Muiz Adekunle Agbaje, Yıldız Technical University
14:30-14:45	Hydrogen as a Potential Fuel for Clean Burners in Turkey Tahsin Berk Kıymaz & İskender Gökalp, Middle East Technical University
14:45-15:00	Green Hydrogen for Turkish Glass Industry Dilay Güleryüz & İskender Gökalp, Middle East Technical University
15:00-15:15-	A Sustainable Approach: Use of Municipal Solid Waste Incineration Ashes in Production of Concrete in Perspective of Zero-Waste Concept Simge Sertgümeç, Burak Koçoğulları & İbrahim Demir, İstanbul Technical University
15:15 15:30	The Potential for Lignite Gasification and Syngas Electricity Production in Turkey Emre Böncü & İskender Gökalp, Middle East Technical University
15:30-16:00	Discussions
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Session IV	**Energy Security and Geopolitics** **Moderators and Discussants:** Prof. Dr. Volkan Ş. Ediger, Kadir Has University Dr. John V. Bowlus, Kadir Has University, Visiting Scientist
16:15-16:30	Cancelled
16:30-16:45	In Pursuit of the "New Great Game": An Overview of Caspian Energy Disputes after the Soviet Breakup Leonardo Zanatta, Bologna University
16:45-17:00	Challenges and Solutions of EU Energy Security Yasin Tüzün, Kadir Has University
17:00-17:15	Turkey's Natural Gas Security Berk Dede, Kadir Has University
17:15-17:30	Cancelled
17:30-18:00	Discussions
18:00-18:15	**Closing Remarks** Prof. Dr. Volkan Ş. Ediger, Director, CESD, Kadir Has University Prof. Dr. Meltem Ucal, Board Member, CESD, Kadir Has University

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The Effect of Climate Change on Power Generation Resilience: Two Case Studies from Turkey

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A B S T R A C T

There is a growing interest in improving resilience in power systems to extreme climate events because of societies' high dependence on electrical energy and its vital role in economies. Resilience is especially important in the power system planning and implementation, that can accelerate the country's energy transition. In this study, we examined the lignite-fired Çan in Çanakkale and hydroelectric Eğlence in Adana, these two power plants in Turkey that can reveal the effects of extreme weather/climate events on electricity generation. This study used hourly air temperature data for the Çan thermal power plant and daily precipitation data for the Eğlence hydropower plant. The results of the investigation confirm the findings of previous studies: extreme weather/climatic conditions that occur mainly from global climate change cause considerable losses in electricity generation. Efficiency losses in power generation severely undermine Turkey's energy supply security and economy, especially when the country's high level of energy-import dependency is considered. It is clear that it is impossible to design every power plant in resistance with all possible threats at the same time, but the effect of extreme climatic events can be reduced. We strongly recommend that the concept of resilience must be immediately taken into consideration in designing new power plants and in adapting already existing ones to make them more flexible to any rapid changes in climate. Resilience should be seen as the top priority in the energy agenda in order to enhance supply security as well as decrease energy import dependence.

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Technical Potential of Public Rooftop Solar Photovoltaic for Ankara: A Preliminary Study

Ceren Kutlu[a] , Beyza Durusoy[b,c], Bülent G. Akınoğlu[c,d]

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A B S T R A C T

Energy consumption and energy demand are critical increasing problems in today's World. Total final energy consumption has risen 17% in the last decade, and cities are responsible for over two-thirds of total energy consumption due to the population's externalities. The buildings in the urban areas cause half of this energy consumption. Two hundred fifty cities have a 100% renewable energy target worldwide, including nineteen metropolitans such as London, Los Angeles, Tokyo, and Paris aim at zero emissions in new buildings by 2030 and the existing ones by 2050. As policymakers emphasize, more decentralized solutions as city-wide and municipality-based policies would provide faster and more effective results to reach renewable energy targets.

There are three stages in the conceptual frame of energy consumption in buildings: Reducing the demand, efficient usage of energy, and adding renewable energy sources. As stated in Energy Efficiency Regulation in Public Buildings, Turkey set a target to reach 15% energy efficiency by 2023. This regulation includes constituent 1.c, which encourages nZEB (nearly zero-energy buildings) in high-energy consumed public buildings. It is in parallel with the increase in energy efficiency in public buildings; the nextstep should be increasing the share of renewable energy consumption in buildings. Public buildings are responsible for 4.6% of total electricity consumption, and as stated in the Zero Building Platform, applications in public buildings should lead to the energy sector. Owing to the capital, Ankara includes many public buildings, and with 1650 kWh/m2 solar irradiation, Ankara has high rooftop solar PV potential.

This study focuses on building types and roof types by obtaining constants from samples to generalize for public buildings in a city. We develop an accurate methodology to determine the public rooftop technical PV potential, reliable, and applicable to every type of roof. We categorized public buildings in Ankara as a pitched roof and flat roof. After the manual selection, the presented methodology is into the well-known Helioscope software program. Suitable area constants (access factors) are determined for the three categories due to three sub-types of modules: Mono-Si, Poly-Si, and Bifacial modules. We applied the constant value method to create a generic constant for all public buildings. The results indicate that the Mono-Si module application is the optimum for pitched-roof public buildings, whereas bifacial modules have better results for flat roof public.

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Turkey Takes Notable Steps in Renewable Energy Development

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A B S T R A C T

It is mainly accepted, both in academia and applied fields that in order to overcome the climate crisis, a shift of sort has to be actualized from fossil fuels to renewable energies. However, the form of the usage of renewable energies after such a shift is a field that is not researched enough. By taking this field that is not researched enough as its point of reference, this paper aims to draw a conceptual cartography that aims to shed light upon the subject of the climate crisis and solutions towards it. In order to achieve such a goal, it will focus on two different paths that are contradictory with one another.

The first approach will be conceptualized as 'sustainable capitalist development' and the latter approach will be conceptualized as 'post-capitalist degrowth'. Article will claim that in order to explain above mentioned two different possible appropriations of renewable energies, a particular focus on the concept of 'natural capital' has to be maintained. First approach, which is the main approach of both neoclassical economics and ecological economics, sustainable capitalist development, has two different perspectives towards the concept of natural capital; weak sustainability and strong sustainability. After elaborating on this theoretical economic background, this article will present why this first approach will not be able to solve the climate crisis issue fundamentally and at best can merely postpone its catastrophic consequences. In doing so, the article will be giving examples from the usage of renewable energies of our contemporary global energy production. In the second approach, which is fundamentally a critique of the capitalist mode of production, post-capitalist degrowth, the article will be focusing on Marxian economics with special emphasis on nature and its critique towards appropriation of natural resources as capital.

To achieve that end, the article will articulate Marxian economics on nature with the literature on degrowth. The article will end with claiming that a mere defence of the transition from fossil fuels to renewable energies is not powerful enough to find possible solutions for the climate crisis. In order to find such possibilities; the social, economic and political aspects of the usage of renewable energies have to be researched as well, which forms the fundamental goal of this article.

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The Use of Decision Support Systems to Manage Behavior Change in Energy Consumption Through Climate Adaptation and Mitigation

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A B S T R A C T

Climate change is a long-term shift in local, regional or global climate patterns and changes in the composition of the global atmosphere. It is observed over comparable periods because of the direct or indirect human activity in addition to natural climate variability. Furthermore, energy consumption is one of the prominent human activities that cause climate change. Climate change adversely affects the ecological balance of the planet and thus social and economic activities of the society, so tackling climate change is becoming more of a topical issue between countries, academics, and international organizations in the last several decades. Furthermore, adaptation and mitigation to climate change are among the essential concepts for political, social, and economic arguments, which are developed to tackle climate change and its effects on human life and ecology. Adaptation to climate change is defined as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007). On the other hand, IPCC defines mitigation to climate change as anthropogenic interventions to reduce greenhouse gas sources or increase carbon sinks.

Adaptation and mitigation are two different but related methods and energy consumption is one of the most focused subjects within these methods and is directly related to individual and collective behavior change. Although it is advocated that mitigation should be highlighted, it has become important to use both concepts in an integrated way in combating climate change today. Also, it is not wrong to say that successful climate change modeling should reflect people and organizations and that there should be plans that can bring them to real life and create behavior change to provide climate change adaptation and mitigation, based on the researches conducted and the outputs of

previously implemented projects. As another essential point, different sectors such as agriculture, transportation, industry, building, waste are positioned as effectors and affected by the climate change process. These sectors have been adversely affected by the problems caused by climate change, and therefore, plans and projects within the scope of climate change should be examined in terms of different sectors. The transport sector consumes a third of all final energy within the EU and can also contribute to consequences such as air pollution and noise, covering large strips of land, and unplanned urbanization (EEA, 2020). Therefore, innovations should be made within the scope of adaptation and mitigation, especially for the transportation sector.

It can be inferred that the participation of citizens and multidisciplinary and interdisciplinary decision-making processes are important, and, nowadays, thanks to the level of development of technology and innovation, it has become very easy to integrate concepts like participation and interdisciplinary decision-making into adaptation and mitigation methods in combating climate change. Therefore, decision support systems' importance stands out to manage behavioral change through climate change adaptation and mitigation in contemporary society. Collecting real-time data to produce energy efficiency and consumption reduction strategies, quickly showing the impact on climate change with measurable parameters, and ensuring monitoring-evaluation of implementation processes are the main support items that decision support systems can provide in this context.

From this perspective, firstly, the research will begin with the literature reviews based on climate change, behavioral change, adaptation and mitigation methods to climate change and decision support systems, then the decision support system samples with adaptation and mitigation concept in different sectors to change human behavior will be examined according to the outputs of the literature review. In the light of this structure, advantages and missing points in terms of behavior change, and convenience and disposability of these DSS samples for the country will become prominent and the answer to the question of *How to use decision support systems to manage behavioral change through climate adaptation and mitigation especially in the transportation sector?* will be sought.

Towards SDGs: How to Evaluate Turkey's Metropolitan Municipalities

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A B S T R A C T

The Sustainable Development Goals (SDGs) aims to protect the planet and ensure all people live in peace and prosperity by 2030. According to the SDGs and Indicators Index report, Turkey ranks 79 among 156 countries in achieving these goals. Since the local governments play an essential role to achieve 17 SDGs, we examine sustainable development objectives in specific metropolitan municipalities in Turkey between 2014-2018 to evaluate the situation of Turkey's metropolitan municipalities. In the study, the public strategies, sub-targets, websites, actions reports, and projects of 30 metropolitan municipalities in Turkey are examined to understand their sustainability situations.

Herein, it should be taken into account that Turkey has already basic level infrastructure in many areas. Especially fighting against poverty, urbanization, industry, health, and education are the areas where municipalities work most. Social assistance and the number of health centers have been increased, vocational training courses have been opened, and various infrastructure works have been carried out for the development of the industry. However, efforts to combat climate change, use clean energy, protect land and sea life, ensure social peace-justice and gender equality are inadequate in general. Some of the results in the research are discussed below:

When we had examined the goal of "Affordable and Clean Energy", it is obvious that around one-third of the municipalities have renewable and clean energy targets. In the actions of municipalities, the development of different renewable energy sources for different regions was emphasized. For example; obvious objectives have been set such as biomass in Erzurum, geothermal in Aydın and Balıkesir, and solar energy in Diyarbakır. Besides, various initiatives were planned, such as ecological building in Konya, clean energy in transportation in Maraş, a solid waste facility producing energy in Trabzon, and self-consumption energy in Manisa.

Regarding the "Sustainable Cities and Communities" goal, only 18 of the strategic plans of metropolitan municipalities included the definition of "sustainability". In line with this goal, the sustainable city plan of Balıkesir Metropolitan Municipality can be shown as an excellent example by handling the issues of "history, culture, education, health, sociology, agriculture, energy resources, and resource reserves" together. Municipalities such as Erzurum, Maraş, and Konya set fundamental goals in creating a green city, even if they do not directly address the issue of sustainability.

The efforts for the "Climate Action" goal are the most challenging situation since the urgency of the goal is frequently voiced by the public. However, only 17 of the metropolitan municipalities have a climate action plan. The most commonly mentioned concept is "drought": The primary approach of metropolitan municipalities for climate action is defined by the impact of drought on agriculture and water resources.

Municipalities are the closest institution to citizens, and the institutions have essential responsibilities for the achievement of the SGDs. However, it should not be forgotten that the governments, private sectors, civil societies, and citizens have separate duties and responsibilities to realize these goals and leave a better planet for future generations.

Optimal Diversification Among Energy Sources Conditional on Capacity Factor: Evidence from Electricity Generation in Turkey

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A B S T R A C T

Securing a nation's energy demand has several pillars and the level of operational efficiency is one of them, besides the ability to provide various energy sources from counterparty nations. Electricity generation operations are a highly crucial and vital responsibility to cover a nation's seasonally varying demand, thus many kinds of research have covered the topic of demand forecasting (Ediger and Tatlıdil, 2002; Yumurtacı and Asmaz, 2004; Ediger and Akar, 2007). However, both predicting and managing electricity generation are significantly challenging tasks since it does consist of different energy sources mainly divided into primary and renewable. Each energy source has its own installed capacity level in a country for a given period. The precise electricity generation is very much linked to respective installed capacities for individual energy sources. Additionally, how (efficiently) to manage those installed capacities is also another direct determinant on final electricity generation level for a country.

In order to eliminate unexpected exogenous risks related to an individual energy source, diversification implementation is a must for any country, especially under the recent circumstances due to the Covid-19 epidemic related ambiguity, all over the world. According to the latest monthly report by the EPDK, Turkey generates c.3/4 of its electricity through 3 different energy sources out of 12. This level of concentration brings additional risks for a sustainable long-term electricity supply policy, especially considering individual energy sources' capacity factor and emission level. Lower capacity factor energy sources concentrated activities will eventually lead to inefficient electricity generation and consequently, additional energy source importation cost. On the other hand, related to emission levels, undiversified (not diversified enough) electricity generation policies disable carbon emissions through lower gas holding energy sources. Thus, in a holistic perspective, diversification would lead to an enhanced balance on the Energy Trilemma through reduced energy security shocks, improved environmental and sustainable operations, and accessible energy via lowered cost of electricity generation. Most importantly, a portfolio approach of diversification is expected to increase independence and flexibility on political relations (Stringer, 2008) with other countries due to reduced concentration on a single energy source.

Implementing an optimally diversified portfolio of energy sources during the electricity generation process would yield positive outcomes. First, concentrating on higher capacity factor energy sources will positively affect the aggregated capacity factor of Turkish electricity generation. Accordingly, unnecessary importation needs will be revoked. Second, with building a lower emission concentrated portfolio of sources, Turkey would i) benefit with better-qualified environment, ii) positively contribute to the Kyoto Protocol, and iii) benefit via emission trading activities with counterparty sovereigns. When considering all the above components, with a simple diversification, both endogenous and exogenous risks will be efficiently reduced. Last but not least, EPDK's action in May 2020 related to using multiple energy sources in electricity generation makes this study befitted at the moment, especially considering the recent shift towards renewable energy sources, globally. Therefore, during an energy substitution period, Turkey needs to allocate its dependency on energy import through less concentration on specific sources and diversify away.

This study aims to implement an empirical work on Turkey's electricity generation decomposition by testing multiple portfolios of energy sources

via different weights. The main objective function is to maximize the aggregate capacity factor. The second objective function is to minimize the aggregate emission level. All two objective functions are constructed with respect to the national electricity supply-demand relationships. Thus, proposed optimal portfolios will be meeting with public demand in any scenario. Based on seasonality, dynamic portfolio construction and energy source allocation will be implemented. To run an optimization, machine learning optimization algorithms will be built in R, feeding on historical capacity factor, emission level, and electricity demand data provided by the EPDK and EPİAŞ. In the end, the study is willing to propose a dynamically diversified electricity generation model on behalf of Turkey's recent actions on sustainable energy policies.

From Blockchain to Smart Contracts

Merve Ergun[a]

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A B S T R A C T

Blockchain, as a form of fintech, is centered around the artificial intelligence(AI)-driven algorithms which provide their users with objectivity and certainty.[1]While objectivity refers to the non-appearance of any subjective situation that may affect the instruction given, certainty is associated with the result-oriented perspective. These result-oriented perspectives or AI-driven logics can cause problems due to their strict liability to the codes and classifications made. To be more precise, as codes have no other option than the fulfillment of the command given to them; they can fail due to this strict application.

Terminologically, it is seen that people have the presumption that blockchain and distributed ledger technologies are the same. The truth is that a distributed ledger is a database that performs multi-places or between several users; and, blockchain is just one form of it. Even though distributed ledgers are more secure than centralized ledgers, the number of hacking examples show that this area still includes many risks. Even worse, stolen funds or similar illegal activities cannot be traced easily due to the anonymity nature of the blockchain technology.

Blockchain has been promoted along with Bitcoin, another form of Fintech, that is produced via blockchain. Although blockchain is engaged with bitcoin, it has many other usages including but not limited to smart contracts, money transfer systems, Automated Teller Machines (ATMs), so on. Through blockchain, the financial industry has achieved cost-efficient results through searchable and easily-stored electronic documents. As a result, blockchain has not only lowered transaction costs but also enabled individuals to access and control their money transfers via ATMs or online banking tools easily and effectively. For instance, like many fintech models, ATMs' logic is based on smart contracts in which the owner of the fund is expected to prove his ownership by using his password, which is an equal with the signature he created. Smart contracts can be defined as contracts made by using blockchain technology to facilitate, verify, execute, and enforce the agreed terms of an agreement.Since the self-executing nature of Smart Contracts eliminates unnecessary third-party involvements, they are seen as a great tool to minimize counterparty risk and settlement times. Similar to the cryptocurrencies, blockchain can be internationally regulated by the European Union, the World Trade Organization, and the International Monetary Fund. However as of today, there is no international regulation that directly regulates blockchain. Thereby, the applicable law as to blockchain and smart contracts is subject to change from country to country and legal system to the legal system. For instance: Because the UK has a technology-neutral approach originated from the ICT regulation, the use of blockchain technology in the finance industry is not regulated separately. Even though applicable law is not that precise, smart contracts have started to be a part of the commercial and financial sectors. Financial contracts, by their very nature, are in accordance with mathematical definitions, because they are based on an agreement to exchange cash flows.

One of the problems as to smart contracts is that some contract law terms requires interpretation or human judgment, i.e. default, non-payment, or delayed payment responsibilities which are not suitable for this math logic. This if-then logic that the smart contracts are based on may not cover all aspects of the commercial relations and thereby, small changes as to amount, delay or transfer method may not be accepted by the system. Thereby, it can be said that one of the major concerns as to smart contracts, especially for the contracts that are written for the long term, is the ambiguity as to what could happen in the future. In addition to the aforementioned problems, smart contracts may not be amended once they are created by combining the blockchain and cryptographic systems.

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A Preliminary Analysis of the Turkish Hydrogen Legal Landscape

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ABSTRACT

For a few years, there is a global momentum driven by the potential of a hydrogen economy: 20 countries representing 44% of the global GDP have already adopted a national hydrogen strategy and other 30+ countries are supporting national projects and discussing policy actions. Despite this increasing awareness, the legal and administrative processes necessary for the deployment of hydrogen technologies are immature, complex, and differ from one country to another. An integrated vision of the hydrogen infrastructure at the EU level is in its infancy. In this presentation, first, a general outlook of the EU hydrogen legal landscape, specifically around gas grid issues, will be discussed. Next, the existing regulatory landscape in Turkey for hydrogen will be assessed. Drawing insights from the current legal infrastructure and most recent developments in the EU, preliminary legal priority areas for Turkey will be suggested, specifically regarding the injection of hydrogen into the existing natural gas grid.

After its predecessors of 1998 and 2003, the third EU Energy Package adopted in 2009 introduced the current Gas Directive (2009/73/EC) in force. It was the "golden age of natural gas", and the focus was on the liberalization of the markets via unbundling, the creation of the Agency for the Cooperation of Energy Regulators, etc. Hydrogen was not on the table at all; topics of consideration such as power-to-gas or hydrogen storage were completely absent during this legislative process. Directive 2009/73/EC establishes common rules for the transmission, distribution, supply, and storage of natural gas. During the negotiations leading to the 2003 Gas Directive (2003/55/EC), the European Parliament pushed for the inclusion of biogas and other gas from biomass to increase the share of renewable energy in energy consumption. The European Commission expressed its willingness to accept this proposal on the condition that a clause is added to emphasize that the Directive would only apply to such gases "if they can be technically and safely injected into the natural gas system". Finally, the Council instigated that the scope of Directive 2003/55/EC also applies to "other types of gases" than natural gas and biomass-based gases. The specific "other types of gases" the Council had in mind when it introduced this addition cannot be inferred from the legislative history. A few years later, during the negotiations of 2009/73/EC, the element of non-discrimination was added to Article 1(2) on the initiative of the European Parliament. This reference to the non-discrimination principle was justified by the statement that "assuming the technical and chemical safety threshold for the different gases are met, the need for non-discrimination for access between the gases from different sources must be emphasized".

Taking into account these two normative elements of Article 1(2), it can be concluded that the Directive covers hydrogen as long as it can technically and safely be injected into, and transported through, the natural gas system. Today, Directive 2009/73/EC is the most important regulatory framework in the EU about hydrogen.

Ten years later, the Commission came up with the famous Clean Energy Package which is more than 8000 pages of regulation including the recast of the Electricity Directive 2019/944. Most legal interpretations suggest that hydrogen reconverted into electrical energy by a fuel cell or gas turbine is covered by this legislation but there is no specific mention of that. Neither hydrogen nor power-to-gas is explicitly mentioned in 2019/944. On the gas front, there is no legislation mirroring this new electricity package, leaving many open questions to the old linkage between the natural gas system and the penetration of any kind of hydrogen.

In the Clean Energy Package, the modifications are done in the Renewable Energy Directive (RED II, revised version) offer only indirect legal classification/categorization of hydrogen. Article 7(1) indirectly partly covers hydrogen and Recital 59 states indirectly that the term renewable gas implies hydrogen from renewable energy sources. However, these interpretations are far from being solid and they are not clear enough to build up support schemes for hydrogen as provided by the RED II. Therefore, in terms of the regulatory framework, the scenery is patchy and blurry. Recognizing this, the Commission came up with a strategy, namely the 2020 EU Hydrogen Strategy which is not a turning point but an important starting point to start assessing what is missing. Nevertheless, it does not introduce any regulatory changes. It is highly anticipated that the necessary regulations that will clarify the blurriness and reorganize the patchiness will come up with the new Gas Decarbonization Package, expected to be published in 2021.

In the absence of a standard for hydrogen blending percentage in natural gas at the EU level, Member States have discretion to set the hydrogen limit at the national level, including for gas interconnection points. As no limit values for blending are provided, the authorized concentrations largely differ among member states. Some examples of the maximum hydrogen concentration allowed in the gas grid, according to the countries are (in terms of volume %): UK 0.1, Netherlands 0.02%, Spain 5%, France 6%, Japan 0%, Germany <10% (<2% for CNG tanks), Italy <2-3% (0.5% for bio-methane). The new Gas Decarbonization Package is expected to deal with this issue for both, the benefit of the trade of hydrogen-enriched gas-streams and, ultimately, the creation of the long-promised internal gas market in the EU.

The Turkish regulatory landscape regarding hydrogen is largely immature and necessitates the coordinated assessment of the issue by the relevant actors such as the Ministry of Energy and Natural Resources, The Parliament, and the Presidency. The main legal instrument which is most relevant to approach the "hydrogen problem" in Turkish law in accordance with the hierarchy of norms is the Natural Gas Market Law numbered 4646. Article 2 about the scope of 4646 reads as follows: "The Law covers the import, transmission, distribution, storage, marketing, trade and export of *natural gas* and the rights and obligations of all real and legal persons relating to these activities" (emphasis added). Unlike the above-mentioned related European Directive 2009/73/EC, current Turkish legislation on natural gas does not include "biogas and gas from biomass or other types of gas" in its scope. This seems to be the major legal barrier regarding the injection of hydrogen into the existing natural gas system.

The deployment of hydrogen technologies in Turkey could be facilitated by an amendment to Article 2 that will broaden the scope of 4646. This could be done by the General Assembly of the Turkish Parliament or by a statutory decree introduced by the President. EMRA (EPDK) as an independent autonomous authority has a regulation function defined in 2002/12 numbered Report of the State Supervisory Council (Devlet Denetleme Kurulu); yet until authorized specifically by law by the legislator, EMRA cannot introduce any direct regulations regarding hydrogen, as its mandate is strictly limited by the powers invested in it by the Electricity Market Law, Natural Gas Market Law, Petroleum Market Law, and LPG Market Law. EMRA's power to regulate is derivative which can only be performed in accordance with the "administrative legality" principle.

Other existing dispersed hydrogen regulations here and there can be categorized under three titles. The first category is the Energy Efficiency Law numbered 5627 and its by-law. There are also two by-laws (AB/2019/2144 and AB/134/2014) regarding vehicles running on hydrogen, flexibility of mixed fuels. The third is an EMRA decision dated 18/06/2020 numbered 9394, regarding pre-license and construction periods for renewable energy power plants. The wording of this decision is unclear, treating "solar/hydrogen energy" in the same category.

Similarly, to the challenges that Europe is facing, Turkey needs to avoid regulatory patchwork and multiple standards which would create distortions in the natural gas market, put at risk its integrity, undermine potential strategies of repurposing, and indirectly delay the development of legal stability needed for large-scale investments. Instruments such as regulatory sandboxing for piloting strategic hydrogen initiatives could be considered and safety in line with the precautionary principle should be an issue of primary concern.

This presentation provides a short snapshot to the on-going task of investigating the Turkish legal landscape for hydrogen system deployment. Further research is needed to develop the current analysis to cover several substantial topics regarding the regulatory gaps and needs of the Turkish legal landscape for an efficient and safe deployment of hydrogen technologies.

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On the Problematique of Renewable Energies: Two Paths Ahead

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A B S T R A C T

It is mainly accepted, both in academia and applied fields that in order to overcome the climate crisis, a shift of sort has to be actualized from fossil fuels to renewable energies. However, the form of the usage of renewable energies after such a shift is a field that is not researched enough. By taking this field that is not researched enough as its point of reference, this paper aims to draw a conceptual cartography that aims to shed light upon the subject of the climate crisis and solutions towards it.

In order to achieve such a goal, it will focus on two different paths that are contradictory with one another. The first approach will be conceptualized as 'sustainable capitalist development' and the latter approach will be conceptualized as 'post-capitalist degrowth'. Article will claim that in order to explain above mentioned two different possible appropriations of renewable energies, a particular focus on the concept of 'natural capital' has to be maintained. First approach, which is the main approach of both neoclassical economics and ecological economics, sustainable capitalist development, has two different perspectives towards the concept of natural capital; weak sustainability and strong sustainability. After elaborating on this theoretical economic background, this article will present why this first approach will not be able to solve the climate crisis issue fundamentally and at best can merely postpone its catastrophic consequences.

In doing so, the article will be giving examples from the usage of renewable energies of our contemporary global energy production. In the second approach, which is fundamentally a critique of the capitalist mode of production, post-capitalist degrowth, the article will be focusing on Marxian economics with special emphasis on nature and its critique towards appropriation of natural resources as capital. To achieve that end, the article will articulate Marxian economics on nature with the literature on degrowth. The article will end with claiming that a mere defence of the transition from fossil fuels to renewable energies is not powerful enough to find possible solutions for the climate crisis. In order to find such possibilities; the social, economic and political aspects of the usage of renewable energies have to be researched as well, which forms the fundamental goal of this article.

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Energy Systems of the Future: Bidirectional Energy Systems

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A B S T R A C T

The problem of climate change has caused so many shifts in the use, application, and research of energy systems. Renewable and green energy systems have been tagged energy of the future due to their effectiveness in mitigating CO2 emissions and their sustainability. The penetration of renewable energy systems for large-scale electrical energy supply has been seen to increase over the years with countries setting renewable energy generation goals as a percentage of national total energy generation. However, the major challenge of renewable energy systems is its intermittent and unpredictable nature. The unpredictability of both the supply of renewable energy and consumer demand for energy further increases the imbalance so much that renewable energy systems cannot thrive without energy storage systems at every scale of application.

Bidirectional energy systems are systems that serve both energy generation and storage. These systems double as energy storage systems when there are excess energy supply and energy generation systems when energy sources are off or inadequate.

This study focuses on Reversible Solid Oxide Cell (Re-SOC) Systems and investigates its roles as a bidirectional energy system in the future of energy. This system works as a fuel cell for generating electricity and as an electrolyzer for energy storage. The study is carried out to give a holistic view to the concept of an energy grid built around a Re-SOC system and to predict the feasibility and implication of having such a system after the maturity of this technology. Previous research done has aimed at introducing the technology and exploring various options of system configurations. However, a bird's eye prediction of this system and its role in the future of energy systems have been given less attention. In this paper, a review of existing literature was carried out on different system configurations of Re-SOC systems and integration with renewable energy systems and the consumer side of the energy grid.

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Green Hydrogen for Turkish Glass Industry

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A B S T R A C T

Hydrogen has a wide range of uses in various industrial sectors. It is used as a protective gas in electronics, float glass production, and in cleaning power-plant pipelines. It is also used in ammonia production in the fertilizer industry. Hydrogen provides also substantial opportunities to decarbonize various carbon-intensive industrial sectors, such as iron & steel or cement. Since hydrogen can be produced using several technologies and renewable or non-renewable sources, it also increases the flexibility of energy systems.

Hydrogen generation technologies are classified based on their CO2 emission propensities and a color code is used to name the produced hydrogen. Grey hydrogen is generated from fossil fuels such as natural gas by steam reforming which generates 285 gCO2/kWh (or 9.5 kgCO2/kgH2) and from coal gasification where the emission factors are on average 675 gCO2/kWh. Blue hydrogen uses the same technologies as Grey hydrogen but adds carbon capture and storage technologies. Blue hydrogen is an interesting concept, especially when considering the pending stringent taxes and regulations for CO2 emissions. However, the additional costs are high. Green hydrogen is generated from water electrolysis using decarbonized electricity, from renewable sources or nuclear energy. When the high cost of blue hydrogen is considered, it makes sense to directly put the effort into using green hydrogen. As the cost of electricity using renewable sources decreases every day, water electrolyzers (both PEM and Alkalin) are today getting much attention.

To develop a rapid market introduction of green hydrogen, one option could be to substitute green hydrogen to grey hydrogen generated by natural gas steam reforming (which is the dominant technology today), in already hydrogen using industrial sectors. One such sector is the glass industry which is an important sector in Turkey. The float glass process, used for flat glass production, needs an inert environment; this is achieved by using nitrogen (90%) and hydrogen (10 %). The role of the hydrogen is to react with any oxygen that may leak into the process and to prevent its oxidative power. Today, float glass producers use up to 86 Nm3 Hydrogen and 765 Nm3 Nitrogen per hour. The hydrogen and glass industry connection is therefore important for Turkey as the Turkish glass industry production capacity is about

3.8 million tons per year, half of it being float glass. The company Şişecam is the most significant contributor to the float glass production in Turkey. The company has facilities in 4 different locations in Turkey and manufactures 90% of the float glass produced in the country. Considering the size of the industry and the quantity of hydrogen used, it seems meaningful for the glass industry to produce its hydrogen using renewable sources.

This work is a preliminary study to assess the feasibility of using green hydrogen in the Turkish glass industry. The technology chain considered is water electrolysis using wind and solar energies. Reference solar photovoltaic panels, wind turbines, and electrolyzers are considered to construct the feasibility study. Solar and wind energy potentials in regions close to Şisecam float glass facilities in Turkey are considered. Several scenarios are compared to assess and discuss possible development pathways for the substitution of green hydrogen to grey hydrogen in the glass industry.

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Hydrogen as a Potential Fuel for Clean Burners in Turkey

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A B S T R A C T

Natural gas is the most widely used domestic and industrial fuel around the globe, including Turkey. However, due to its high carbon content, its applications generate high amounts of carbon emissions which lead to global warming. Hydrogen is an alternative to fossil fuels with no carbon content. The interest in welcoming hydrogen as an energy carrier is increasing worldwide both for combustion and fuel cell applications. Turkey needs to take a step forward for implementing hydrogen energy for everyday usage in our homes and commercial applications for a cleaner future.

Hydrogen can not be replaced immediately and fully with natural gas due to the different properties of the two gases, without significantly changing the transmission infrastructure and usage equipment. Thus, on the way to 100% hydrogen, hydrogen enriched natural gas (HENG) for combustion applications receives today significant attention. Figure 1 presents the reduction of CO2 emissions for various hydrogen enrichment rates for either a fixed amount of produced energy or a fixed duration of the same energy yield. It is observed that significant CO2 reduction only occurs at high H2 enrichment rates. Therefore it is important to determine the safe hydrogen injection limits into the existing natural gas transmission and distribution pipes and also the safe combustion limits in the existing household applications.

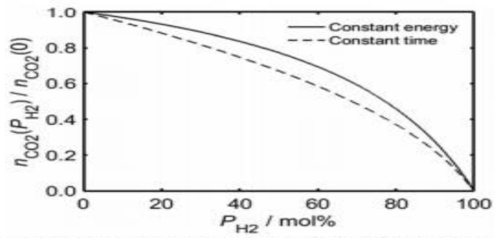

Figure 1: relationship between the volume of carbon dioxide generation per unit volume of fuel, nCO2 , and the molar hydrogen percentage in HENG

Preliminary studies have shown that transport of HENG is possible in the current infrastructures up to some hydrogen enrichment rate, however detailed experimentation is required for the actual implementation. It is also important to investigate the change of performances of current combustion devices such as gasfired ovens, water heaters (boilers), and cooktop burners when fueled with HENG. Presently, the level of R&D efforts is not sufficient in Turkey to address the question of safe fuel interchangeability for household combustion applications of HENG and to determine the safe limits of hydrogen concentration in HENG. There are however significant efforts in several countries. For example, a current project in the United Kingdom (HyDeploy) aims to demonstrate that hydrogen can safely be injected into the UK gas grid at 20 mol% without prejudicing the safety of end-users or modifying the appliances. For household applications, an important issue is the flame flashback limit. The flame propagation speed of hydrogen is greater than that of the natural gas, therefore flame flashback, which happens when the flame speed is larger than the flow speed, is an important risk for the safe use of HENG in household appliances. Figure 2 shows this phenomenon at the ignition of a cooktop burner.

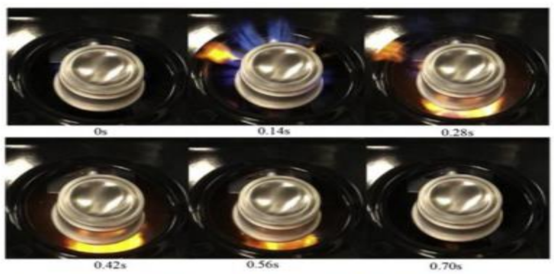

Figure 2:Flashback at the ignition of cooktop burner

In this work, we discuss the necessary R&D steps that should be taken in Turkey to assess the potential and the feasibility of the development of hydrogen-enriched natural gas use in household appliances.

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A Sustainable Approach: Use of Municipal Solid Waste Incineration Ashes in Production of Concrete in Perspective of Zero-Waste Concept

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ABSTRACT

The population around the world is increasing very rapidly. Likewise, it has also increased in Turkey. According to the latest data supplied from Turkey Statistical Institute (TURKSTAT), while the population of Turkey in 2018 was 82 million 3 thousand 882 people, this number increased by 1 million 151 thousand 115 people in just one year, and Turkey's population in 2019 was recorded as 83 million 154 thousand 997 people. Along with the population growth, effects such as economic conditions also cause changes in living standards. Accordingly, there is an increase in the amount of solid waste generated and changes in characterization. All of these necessitates good waste management. Today, integrated solid waste management practices have been adopted by choosing suitable methods and technologies.

In Turkey, there are generally sanitary landfills, compost, and recovery facilities for solid waste management. Especially in places with very crowded populations such as Istanbul, the amount of domestic waste going to landfill is quite high. In Komurcuoda and Seymen sanitary landfills, which are being actively used in Istanbul, a total of approximately 19000 tons of domestic waste per day is disposed of. By the way, the Odayeri sanitary landfill was closed in 2018.

On a global scale, the concept of waste to energy (WtE) is taking an important role. There are examples of the common use of this concept in most European countries and countries such as Japan. In Turkey, Izaydaş can be given as an example of facilities producing energy from waste. However, Izaydaş generally incinerates hazardous waste. In Turkey, no facility has been put into operation yet to actively generate energy by incinerate municipal solid waste (MSW). However, in Eyüpsultan Kısıkmandıra Mevkii Kemerburgaz in Istanbul, the construction of the first waste incineration and power generation facility of Turkey continues since 2017. It is stated that the facility will also be Europe's largest domestic waste incineration facility as of its commissioning. The facility has a capacity of incinerate 3000 tons MSW per day, approximately 1 million tons MSW per year. In addition, the facility, which is planned to produce an average of 78 MWh of electricity per hour, is expected to meet the domestic electricity needs of 1 million 500 thousand people. However, there is ash formation as a natural step in the incineration process in domestic waste incineration plants. These ashes are divided into bottom ash and fly ash. It is known that about 15-20% of the amount of waste entering the facility on a daily basis consists of bottom ash, and again, about 5% of the amount entering is formed as fly ash. These values show that a considerable amount of ash is produced on a daily basis. There is no storage area for ash inside the facility under construction. It is planned to send the generated ashes to the landfill sites for final disposal.

Divided into two groups as natural and artificial, although they are not hydraulically binding, substances that form compounds with a binding structure by combining with calcium hydroxide in normal temperature environments with sufficient moisture are called pozzolan. Fly ashes are materials that can be considered as pozzolan due to their structure and they are in the artificial pozzolan group. It is known that bottom ashes can also be used as a pozzolan in various studies. It is known that such ashes are used as a pozzolan in various fields in the construction sector. Examples of these are concrete production, cement, aggregate, insulation material production, etc. can be given. Sand is used in

concrete production and especially fly ash can be used instead of sand, or it can be added to the concrete structure by mixing with cement. The fly ash and bottom ashes mentioned here generally occur as a result of the incineration process in thermal power plants. However, it is known that fly ash and bottom ash from MSW incineration plants are also used in concrete and cement production. The use of concrete in the construction sector in Turkey is quite common. Concrete is used in a wide variety of areas in our country; there is a rapid increase especially in ready-mixed concrete production until 2017. Ready-mixed concrete production, which has reached a value of 115,000,000 m3 in 2017, decreased in the last 2 years due to the low activity in the construction sector, and the production value for 2019 reached 67,000,000 m3. During the production of cement and concrete, energy consumption is high and there is generally CO2 emission. In this area, by using the ashes originating from the MSW incineration plant, environmental problems such as emissions that causes global warming can be prevented and the circular economy is contributed by adopting a zero-waste approach. As a result, if the fly ash and bottom ash from the waste incineration and energy production facility that is the first one for Turkey are stabilized and meet the necessary conditions, it is recommended to use them in the concrete production to reduce the load to the landfills and to adopt the zero-waste approach.

The Potential for Lingnite Gasification and Syngas Electricity Production in Turkey

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A B S T R A C T

Due to its relatively low cost, lignite (also known as low-rank coal or brown coal) has a vital position in the energy mixes of numerous countries worldwide. In Turkey, the use of lignite in the energy mix is 10.5% of the total energy generation in 2020. However, power plants using lignite as fuel have some unfavorable characteristics and limitations on performances, mainly due to the very high water concentration in this type of coal, which varies from 50 wt. % to as high as 70 wt. %. In addition, lignites also have high ash content. The use of lignite is not limited to only power plants; lignite can also be gasified efficiently to generate a synthetic gas for various uses, such as substituting natural gas for combined heat and power (CHP) generation in gas turbines or as raw material for the chemical industry, for example for methanol production. A significant advantage of syngas electricity generation is that this process is much more environmentally friendly than burning coal directly in conventional power plants, mainly because the temperatures attained in gasification reactors are lower. Also, gas turbines have higher energy conversion efficiencies than steam turbines.

This work will report on the initial phases of a project aiming to assess the feasibility of using synthetic gas (syngas) generated by lignite gasification in gas turbines for CHP in Turkey. The objectives of this project are several. The first aim is to start to acquire gas turbine technology in Turkey. This will be done by converting existing gas turbine combustion chambers optimized for natural gas to burn syngas and its blends with natural gas. There are indeed several gas turbines inactive today in Turkey. Arrangements with partners are made to use a typical gas turbine combustion chamber in this fuel conversion study. This part of the study will be conducted both by numerical simulation of syngas combustion under gas turbine conditions and by testing the syngas combustion performances in the modified combustion chamber. Syngas is mainly composed of carbon monoxide (CO) and hydrogen (H2), and natural gas is mainly composed of methane (CH4). This study allows defining the ideal syngas composition (in terms of the H2/CO ratio) for gas turbine burning (both as pure syngas and blended with natural gas at different proportions). This information is used to optimize the design of the lignite gasification reactors to approach this ideal syngas composition. This second part of the project is using the knowledge and data generated in a previous project on the optimization of high ash content lignites in Turkey and India (the EU FP7 OPTIMASH project. With this data in hand, the potential of the largest lignite reserves in Turkey (the Afsin-Elbistan reserves) is assessed in terms of its natural gas import substitution capacity. The present state of progress of the project will be summarized in this presentation.

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In Pursuit of the "New Great Game": An Overview of Caspian Energy Disputes After the Soviet Breakup

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A B S T R A C T

With a massive 48 billion barrels of oil and 9 trillion cubic meters of natural gas in proven offshore reserves, the Caspian Sea represents a real Eldorado for powerful states and energy companies. After the collapse of the Soviet Union in 1991 and the emergence of new sovereign states (Azerbaijan, Kazakhstan, and Turkmenistan), the legal status of the Caspian reservoir and the partition of its underground resources have triggered strategic competition among regional and extraterritorial actors. After more than two decades of the discussions, a breakthrough in the resolution of this long-standing maritime border dispute took place on August 12, 2018, when the leaders of the littoral countries (Azerbaijan, Iran, Kazakhstan, Russia and, Turkmenistan) signed the *Convention on the Legal Status of the Caspian Sea* in the port city of Aktau, Kazakhstan. Giving a new special jurisdiction to the Caspian, the riparian states hoped to overcome their divisions and pave the way for new possibilities of cooperation and economic development. Against this background, the paper aims to provide a historical framework of the energy disputes within the Caspian Sea Region and assess the short-term impact that the above-mentioned convention. The method adopted is discourse analysis: statements of major energy companies involved in the region, as well as reports of experts and relevant academic sources will be examined to highlight the investments and geopolitical forces characterizing the complex environment of the Caspian Sea. The finding shows that, although the treaty represents a symbolic landmark in the region and, whenever implemented in good faith, it could facilitate the implementation of new energy projects, what prevails more, at least in the short term, are Russia's geopolitical ambitions and Iran's geo-economic anxieties.

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Challenges and Solutions of EU Energy Security

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A B S T R A C T

The European Union (EU) mostly depends on imported energy resources, energy supply security is considered as one vital problem which needs to be solved in the region This paper analyzes EU energy security in terms of both challenges and solutions. While most studies have focused on this issue by defining one dimension, this paper examines various issues related to the Union's energy security. The paper firstly describes the dimension of energy security and analyzes the EU energy market. Then, the study explains the reasons behind EU energy import dependency. and explain the and challenges of the current system. and then the suggested solutions will be given. Finally, the paper tries to find solutions while considering clean energy opportunities for the future energy structure in the EU. The findings indicate that Russia will maintain their role as a primary energy importer of the EU but the efforts of the EU show that they want to decrease their dependence on Russia.

Turkey's Natural Gas Security

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A B S T R A C T

The use of fossil fuels has increased to meet increasing energy needs since the industrial revolution. The boost of fossil fuel-dependent technologies has led to the emergence of import dependent countries for energy resources. For a stable economy, it is necessary to reach sufficient, uninterrupted, and affordable energy sources. It is vitally important for developing countries to sustain their economic growth. Many countries obtain fossil fuels except coal from external sources. Turkey, as a developing country, experiences a variety of energy security problems which occur from dependence on external sources, especially import dependence on natural gas. 99 percent of Turkey's natural gas is imported and these imports are largely supplied through pipelines from Russia and various countries. The dependence on largely single source pipelines has caused problems in recent history. Therefore, the uninterrupted, affordable, and sufficient delivery of natural gas is vital for Turkey's energy security. Increasing energy supply diversity, accelerating trend in renewable energy, and increasing energy efficiency are the possible solutions for the country's energy future.