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Research Article

ENERGY IMPORT DEPENDENCY AND SEEKING FOR NEW ENERGY TECHNOLOGIES EUROPEAN UNION CASE

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Abstract

In this paper, energy poverty and as a result of this energy import dependency and its possible negative results have been examined by taking European Union (EU) into consideration. This analysis has two aims: the first one is questioning the European Unions' energy security from supply perspective and the second one is investigating the solutions produced by European Union to get away or at least to reduce its energy import dependency. To guarantee its energy supply security at affordable price and to attain its targets about energy security, some action plans has been being put into practice at energy technologies by the Union, especially about renewable energy technologies and energy efficiency. By analyzing them this study aims to give a perspective for other energy dependent countries such as Turkey. Because, as an imported energy depended country, Turkey has same supply security risks with European Union. Modeling the strategies developed and experienced by the EU at renewable energy and energy efficiency, to cope with energy import dependency, might give Turkey an opportunity to minimize drawbacks of its own import dependency problem.

Keywords- *Energy Security, European Union, Strategic Energy Technology Plan, Renewable Energy, Energy Efficiency.*

1. Introduction

Today, for all countries in the world, to sustain their development, one of the most important instrument is energy security. It is because of, without maintained energy supply, there are no electricity, heating, transportation and industrial production, which means no life for modern society. According to International Energy Agency (IEA), which established after a very serious energy supply security crises in 1974, after Yom-Kippur War, energy security is the uninterrupted availability of energy sources at an affordable price. For the Agency, long-term energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance [1]. At this point defining energy sources which are subject of energy security is crucial since lack of energy security is defined by giving priority to oil and natural gas. Oil and natural gas are principal conventional energy sources with coal. Their physical availability and pricing mechanism makes them subject of energy security in general for energy poor regions and countries such as the European Union [2].

During last fifty years some energy crisis were seen in the world mostly because of regional wars at the Middle East. As outcomes of the oil crises of the 1970s and 1980s, oil price increased as a result of petroleum embargo of oil rich and exporter Arab governments [3]. Today, scarcity of fossil fuels is not just because of any political or military crises. Its because reserves of oil, natural gas and coal are running out while demand is globally increasing. Only coal reserves still appears to be sufficient longer than oil and gas as seen a Table 1 [4]. However, turning back to coal includes some other security questions about climate change, which could play an important role at rising global CO_2 emission.

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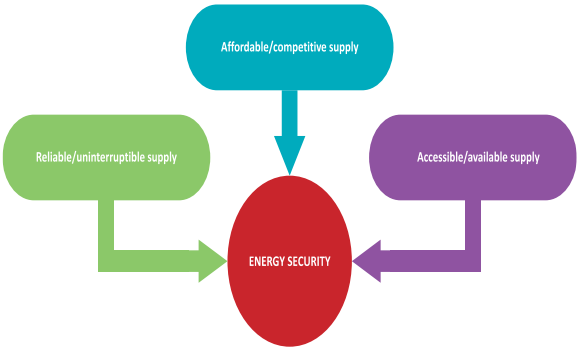


Fig. 1. International Energy Agency Energy Security Scheme.

Table 1. Remaining Coal, Natural Gas and Oil Reserves in the World (2015).

YEARS	1995	2005	2014	2015	REMAINING
COAL (Million Ton)	.....	.....	.....	89115.31	114 YEARS
NATURAL GAS (Trillion Cubic Meters)	119.9	157.3	187.0	186.9	52.8 YEARS
OIL (Thousand Million Barrels)	1126.2	1374.4	1700.0	1697.6	50.7 YEARS

The extent of the problem is not restrictable just with upcoming source shortage and climate issues. The remaining oil and gas reserves are concentrated in politically unstable countries and regions. If big consumer countries and regions cannot be successful at energy saving, efficiency and renewable energy policies, etc. it could be a real threat for their energy supply security and everything about maintain existence of their well-fare and economic development, which are related to it.

As one of the most developed region in the world, EU has been having problems at providing its energy security because of the big gap between the Unions energy consumption and energy production from fossil fuels. That makes the EU fragile to energy supply interruptions because of any reason and price volatility at energy market where producer countries have advantage against supplier countries. To cope with this problems and get its own energy security the Union has been investing and supporting renewable energy projects as indigenously produced clean energy and additionally putting into practice energy efficiency policy. Especially for last ten years the Union has gave momentum to his achievents to be successful at its energy security strategy. To understand this process, in this study first we are going to examine the energy outlook of the Union and then, as an example to energy technology action plans to the EU, Strategic Energy Technology Plan, in short SET-Plan, is going to be explained.

2. European Union Energy Outlook

Throughout the introduction, some aspects about energy security has been mentioned like, energy scarcity or poverty, unfair distribution of energy sources throughout the world, energy supply security and getting energy at affordable price, etc. To understand all those facts properly, first, we are going to set light to world energy outlook by some figures from IEA, European Commission and BP. After that, under light of all those information we are going to take a picture of, energy outlook of the EU to understand main problems about its energy security.

According to, International Energy Agency "*World Energy Outlook 2014*" by 2040, the world's energy supply mix divides into four almost-equal parts: oil, gas, coal and low-carbon sources as seen at Fig. 2 [5].

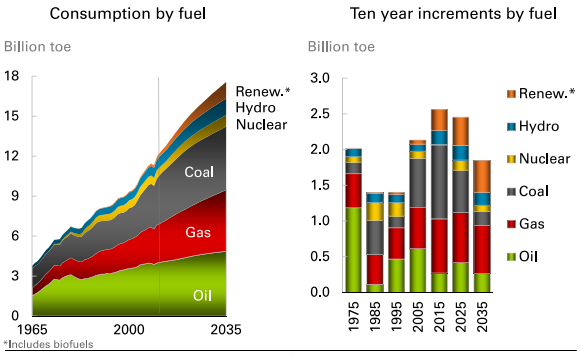


Fig. 2. Energy consumption by fuel between 1965-2035 and ten year increments by fuel between 1975-2035.

The world's energy resources are plentiful and capable of meeting energy demand far beyond 2040; but many are also dispersed unevenly and they are not all inexhaustible as seen at Table 1. While the assessed abundance of energy resources seldom changes dramatically from one year to the next, the circumstances surrounding their successful exploitation never stand still [6].

According to BP, primary energy consumption is getting slower when we focus on per annum (p.a.) on the other hand cumulative demand growth says something else, at which %41 increment is expected between 2012 and 2035 [7]. To cope the demand growth, 900 billion dollars is needed per year in upstream oil and gas development by the 2030s.

Investment of some $900 billion per year in upstream oil and gas development is needed by the 2030s although there are many uncertainties over whether this investment will be forthcoming in time. Here many obscurities could count. For example, the production of tight oil level starts to fall back in United States. Tight oil output levels off in the early 2020s and its total production eventually starts to fall back. The situation of Brazilian deep-water fields and Canadian oil sands output are still a conundrum. The sanctions that restrict Russian access to technologies and capital markets and – above all – the political and security challenges in Iraq could all contribute to a shortfall in investment below the levels required. The situation in the Middle East is a major concern given steadily increasing reliance on this region for oil production growth, especially for Asian countries that are set to import two out of every three barrels of crude traded internationally by 2040 [8].

As seen at Fig.3 [9] at the end of 2014, 13805 Mto energy was produced in the world. The share of petroleum and products is %31.2, solid fuels %28.8, natural gas %21.2, renewables %13.7, nuclear %4.8 and other fuels %0.3 at this production. Almost %33 of the production was made by United States and China, which are also biggest consumers in the world at the end of 2014. The current balance between energy production and consumption for the United States and China, turns to imbalance at energy outlook of the EU.

	1995	2000	2005	2010	2014	2014 (%)
EU-28	966	950	909	840	775	5.6%
China	1064	1129	1707	2316	2593	18.8%
United States	1659	1667	1631	1723	2012	14.6%
Middle East	1137	1324	1516	1619	1807	13.1%
Asia*	815	922	1105	1343	1496	10.8%
Russia	968	978	1203	1279	1306	9.5%
Africa	774	885	1087	1173	1129	8.2%
Rest of the World	1880	2176	2430	2575	2687	19.5%
World	9263	10032	11588	12869	13805	100.0%

Fig. 3. World Energy Production by Region (Mtoe).

	1995	2000	2005	2010	2014	2014 (%)
EU-28	1648	1695	1793	1725	1565	11.4%
China	1055	1149	1830	2629	3066	22.4%
United States	2067	2273	2319	2215	2216	16.2%
Asia*	867	1038	1237	1526	1741	12.7%
Russia	637	619	652	688	711	5.2%
Africa	444	496	600	694	772	5.6%
Middle East	307	353	468	623	721	5.3%
Rest of the World	2202	2414	2635	2852	2907	21.2%
World	9227	10037	11533	12952	13699	100.0%

Fig. 4. World Gross Inland Consumption by Region (Mtoe).

When we look at Fig. 4 [10], the EU is seen as the forth-biggest energy consumer region in the world by %11.4 but according to Figure 3, it produced only %5.6 of the world energy. The gap between production and consumption means the Union is supplying more than half of its energy by import.

The dependency of the EU on energy imports, particularly of oil and more recently of gas, forms the backdrop for policy concerns relating to the security of energy supplies. Indeed, more than half (53.5 %) of the EU-28's gross inland energy consumption in 2014 came from imported sources.

Production of primary energy in the EU-28 totaled 775 million tonnes of oil equivalent (Mtoe) in 2014. This continued the generally downward development observed in recent years, with 2010 the main exception as production rebounded following a relatively strong fall in energy production in 2009 that coincided with the financial and economic crisis. When viewed over a longer period, the production of primary energy in the EU-28 was 17.3 % lower in 2014 than it had been a decade earlier. The general downward development of EU-28 primary energy production may, at least in part, be attributed to supplies of raw materials becoming exhausted and/or producers considering the exploitation of limited resources uneconomical [11].

In 2014, close to one quarter (25.5 %) of the EU-28's total production of primary energy was accounted for by renewable energy sources, while the share for solid fuels (19.4 %, largely coal) was just below one fifth and the share for natural gas was somewhat lower (15.2 %). Crude oil (9.1 %) was the only other major source of primary energy production.

The growth of primary production from renewable energy sources exceeded that of all the other energy types; this growth was relatively uniform during the period covering 2004–14, with a small dip in production in 2011 as seen at Fig. 5 [12]. Over this 10 year period the production of renewables increased by 73.1 %. By contrast, the production levels for the other primary sources of energy generally fell over this period, the largest reductions being recorded for crude oil (-52.0 %), natural gas (-42.9 %) and solid fuels (-25.5 %), with a more modest fall of 13.1 % for nuclear energy [13].

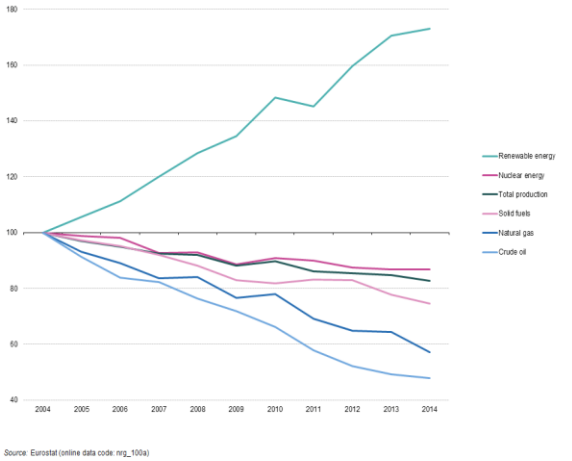


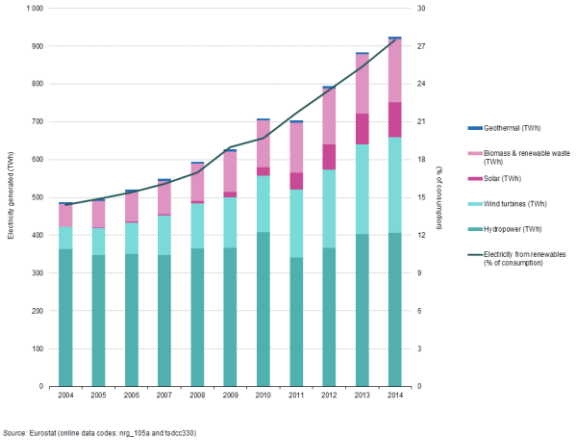
Fig. 5. Development of the production of primary energy (by fuel type), EU 28, 2004-2014 (2004=100, based on tonnes of oil equivalent).

The use of renewable energy has many potential benefits, including a reduction in greenhouse gas emissions, the diversification of energy supplies and a reduced dependency on fossil fuel markets (in particular, oil and gas). The growth of renewable energy sources may also have the potential to stimulate employment in the EU, through the creation of jobs in new 'green' technologies [14].

In the EU, renewable energy sources include wind power, solar power (thermal, photovoltaic and concentrated), hydroelectric power, tidal power, geothermal energy, biofuels and the renewable part of waste. Among renewable energies, the most important source in the EU-28 was solid biofuels and renewable waste, accounting for just under two thirds (63.1 %) of primary renewables production in 2014. Hydropower was the second most important contributor to the renewable energy mix (16.5 % of the total), followed by wind energy (11.1 %). Although their levels of production remained relatively low, there was a particularly rapid expansion in the output of wind and solar energy, the latter accounting for a 6.1 % share of the EU-28's renewable energy produced in 2014, while geothermal energy accounted for 3.2 % of the total. There are

currently very low levels of tide, wave and ocean energy production, with these technologies principally found in France and the United Kingdom [15].

The latest information available for 2014 (see Fig.6) shows that electricity generated from renewable energy sources contributed more than one quarter (27.5 %) of the EU-28's gross electricity consumption [16]. In Austria (70.0 %) and Sweden (63.3 %) at least three fifths of all the electricity consumed was generated from renewable energy sources, largely as a result of hydropower and solid biofuels.



Source: Eurostat (online data codes: nrg_105a and tsdcc330)

Fig. 6. Electricity generated from renewable energy sources, EU-28, 2004-2014.

The growth in electricity generated from renewable energy sources during the period 2004 to 2014 (see Fig. 5) largely reflects an expansion in three renewable energy sources, namely, wind turbines, solar power and solid biofuels. Although hydropower remained the single largest source for renewable electricity generation in the EU-28 in 2014 (43.9 % of the total), the amount of electricity generated in this way in 2014 was relatively similar to that recorded a decade earlier, rising by just 12.1 % overall. By contrast, the quantity of electricity generated from solid biofuels (including renewable waste) and from wind turbines in 2014 was 1.8 times and 3.3 times as high as in 2004. The relative shares of wind turbines and solid biofuels in the total quantity of electricity generated from renewable energy sources rose to 27.4 % and 18.0 % respectively in 2014. The growth in electricity from solar power was even more dramatic, rising from just 0.7 TWh in 2004 to overtake geothermal energy in 2008, reaching a level of 92.3 TWh in 2014. Over this 10 year period, the contribution of solar power to all electricity generated from renewable energy sources rose from 0.1 % to 10.0 %. Tide, wave and ocean power contributed just 0.05 % of the total electricity generated from renewable energy sources in the EU-28 in 2014 [17].

At the end of 2008, the EU agreed to set a target for each Member State, such that renewable energy sources (including liquid biofuels, hydrogen or 'green' electricity) should account for at least 10 % of all fuel used within the transport sector by 2020. The average share of renewable energy sources in transport fuel consumption across the EU-28 was 5.9 % in 2014, ranging from highs of 21.6 % in Finland and 19.2 % in Sweden (the only Member States with double-digit shares) to less than 1.0 % in Spain and Estonia [18].

The share of renewable energy in gross final energy consumption is identified as a key indicator for measuring progress under the Europe 2020 strategy for smart, sustainable and inclusive growth. This indicator may be considered as an estimate for the purpose of monitoring Directive 2009/28/EC on the promotion of the use of energy from renewable sources-however, the statistical system in some countries for specific renewable energy technologies is not yet fully developed to meet the requirements of this Directive; for example, ambient heat energy for heat pumps is not reported by many countries. Furthermore, for the calculation of the share the Directive requires hydropower and wind energy to be normalized to smooth the effects of variations due to weather; given the 15-year normalization requirement for hydropower production and the availability of energy statistics (for the EU-28, starting from 1990), long time series for this indicator are not available [19].

On 6 June 2012, the European Commission presented a Communication titled, 'Renewable energy: a major player in the European energy market' (COM(2012) 271 final), outlining options for a renewable energy policy for the period beyond 2020. The Communication also called for a more coordinated European approach in the establishment and reform of support schemes and an increased use of renewable energy trading among EU Member States. In January 2014, the European Commission put forward a set of energy and climate goals for 2030 with the aim of encouraging private investment in infrastructure and low-carbon technologies. One of the key targets proposed is for the share of renewable energy to reach at least 27 % by 2030. These objectives are seen as a step towards meeting the greenhouse gas emissions targets for 2050 put forward in the Roadmap for moving to a competitive low-carbon economy in 2050 (COM (2011) 112 final).

One of the 10 priorities of the European Commission put forward in 2014 is an energy union. It is intended that a European energy union will ensure secure, sustainable, competitive and affordable energy. In February 2015, the European Commission set out its plans for a framework strategy for a resilient energy union with a forward-looking climate change policy in a Communication (COM(2015) 80 final). The Communication proposes five dimensions for the strategy, one of which is decarbonizing the economy [20].

3. European Union Strategic Energy Technology Plan

The European Strategic Energy Technology Plan (SET-Plan) aims to accelerate the development and deployment of low-carbon technologies. It seeks to improve new technologies and bring down costs by

coordinating research and helping to finance projects. The SET-Plan promotes research and innovation efforts across Europe by supporting technologies with the greatest impact on the EU's transformation to a low-carbon energy system. It promotes cooperation amongst EU countries, companies, research institutions, and the EU itself. The SET-Plan includes the SET-Plan Steering Group, European Industrial Initiatives, the European Energy Research Alliance, and the SET-Plan Information System [21].

The Integrated SET-Plan identifies 10 actions for research and innovation, based on an assessment of the energy system needs and on their importance for the energy system transformation and the potential to create growth and jobs in the EU;

- Addresses for these actions the whole innovation chain, from basic research to market uptake, both in terms of financing as well as in terms of regulatory framework;
- Adapts the structures set up under the SET-Plan to ensure a more effective interaction with Member States and stakeholders;
- Proposes to measure progress as part of the annual reporting of the State of the Energy Union via overall Key Performance Indicators (KPI's), such as the level of investment in R&I, as well as specific KPI's to measure progress on the performance and cost-reduction for the priorities.

Low-carbon technologies such as photovoltaics, wind power, nuclear fusion or carbon capture and storage are essential to reduce greenhouse gas emissions and improve the sustainability of the energy system. The uptake of new energy technologies can also decrease the Unions reliance on external suppliers of fossil fuels, as well as spur job creation and economic growth [22].

At the same time, technological investment is often expensive and commercially risky. Energy companies on their own may not deliver technological breakthroughs quickly enough. Public policy and investment, in partnership with the private sector, is therefore necessary to boost the development and deployment of low-carbon technologies for the future. To reach its low carbon energy targets the EU has a foundation programme, Horizon 2020, which is in accordance with SET- Plan targets [23]. According to SET-Plan Progress Report 2016, the funding from the European Union for Horizon 2020 reached EUR 1.1 bilion in 2014. In the same year, public investment from national research and development (R&D) programmes accounted for nearly EUR 4.2 bilion. In 2014, total EU-28 Investments in Energy Union's R&D priorities reached EUR 27 bilion, Private sector investment represented almost 85% of the total investment this year [24].

Under circumstances of SET-Plan, 446 projecst are being waged. For example, Biowalk4Biofules, HESCAP, BIOCORE, ORECCA, VALORGAS, INTEGRIS, SUPRA-BIO, SUNSTORE, WAVESTAR, CACHET, etc. [25]. They are all in accord with SET-Plan 10 prominent action area, like renewable energy, planning smart cities, energy efficiency, sustainable transport, carbon capture, storage and use and increasing safety in use of nuclear energy.

4. Conclusions

As has been told through the study, conventional fossil fuels are running out year by year. If we take coal to the center, they will not be in the world almost after a century. This time is almost fifty fifty for oil and natural gas. That means as an energy import dependent region, not only the members of the European Union, but also all countries in the world need to be ready for a time without coal, oil and natural gas especially which are already having energy poverty.

The only problem, the world will possibly face, is not energy poverty, related to high carbon technology, the world is also in danger to face with climate change that would be reason of a real catastrophe in the world. As it turns out, the EU has a real awareness about these two upcoming dangers and planning its energy security action according to that future. By its energy supply security policy, especially to reach 2020 and 2030 renewable targets, the Union is taking measures for both, sustainable and affordable energy supply and reducing carbon emission. To reach its clean and domestic energy targets it has lots of programmes in practice, which are supporting financial and political collaboration with other countries. With all that pre-emptive measures the Unions energy strategy is a good model for other countries in the world. Especially which are highly dependent to import energy, fragile to external energy shocks and using fossil energy sources which contain high carbon.

The applications of the EU about renewable energy, smart cities, energy storage etc. need to be followed closely by Turkey. As the Union, Turkey is also highly dependent to the import fossil fuels. As understood from SET-Plan 2016 Progress Report, to get rid away fossil fuel dependency, first ingenious, clean and renewable sources need to get more investment and second new technologies which are valuable for energy saving and energy efficiency have to be supported by country. To sum up, like the EU, Turkey needs to be ready for the near future by effective energy policies to sustain its development and prosperity.

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