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Local and Regional Economy in Theory and Practice ISSN 1899-3192

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INFRASTRUCTURE OF ENERGETICS AND ITS DIVERSIFICATION

Summary: The sun is an inexhaustible source of energy for millions of years. The amount of solar radiation emitted to Earth every year hugely exceeds the needs of the countries on the planet. In general, the European Union as a whole is dependent in more than 50% on imports of energy sources, often from politically or economically unstable regions. Therefore, the inevitable effort of every EU country should be developed to use to the maximum renewable energy sources. The Slovak Republic lags behind in this area, in spite of the fact that the government takes measures to support the exploitation of renewables.

Keywords: renewable energy sources, solar radiation, KWh, solar panel, state subsidy.

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1. Introduction

Renewable energy sources have come more and more to the forefront in the context of saving the environment and reducing the cost of energy. The directive of the European Parliament and Council 2009/28/EC dated 23rd April, 2009 about the support of utilization of Renewable Energy Sources (RES) as a strategic document, aims at the period until the year 2020. It creates the basis for the ongoing sustainable development of the utilization of RES even further on. The EU member states have been obliged to develop their own legal acts complying with the above mentioned regulation and its consequent directives. The purpose of this article is to analyse and comment on the production and exploitation RES, both worldwide and regionally, in order to follow the directives. The findings also relate to fossil fuels. The article is part of research within the Research project VEGA No. 1/0787/11 "Prospects of SMEs participation in the diversification of the energy infrastructure". The project is supported by the Slovak Ministry of Education.

Renewable energy sources (RES), based on solar radiation (biomass, hydro, wind and solar power) are able to satisfy completely all forms of energy consumption virtually in every country of the world. The Sun is the only source of energy on which human beings can rely. Solar energy can give us everything we expect from

energy consumption. Moreover, it is often very simple, clean and safe. It is not just electricity, heat and light for our homes, but also bio fuel for running our cars . The amount of solar radiation hiting the Earth during one year is 20 000 times higher than the global energy consumption. Even the energy hiting the roof of a house in areas with low amounts of sunshine (such as Northern Europe) is 10 times higher than its consumption needed for heating and operating electrical appliances. Using clean fuels for transport actually means generating such electricity which can be used to recharge electric batteries, as well as to produce hydrogen for fuel cells or biofuels on a large scale. Electricity is not difficult to produce. The current methods of generating it from coal, oil, natural gas or uranium are neither clean nor sustainable as they only use fossil fuels. Ensuring the sustainable and reliable development of a fuel supply for transport requires using renewable (alternative) energy sources. It is clear today that such generated electricity would be able gradually to replace oil as a feedstock for producing gasoline and diesel oil. What is the current situation in the exploitation of crude oil, the most important representation of fossil fuels?

2. Oil as a world basic energy feedstock

We consume more and more oil, faster and faster, and it seems we cannot overtake exploitation of it. What will happen when the oil wells run out? It will begin a huge global crisis resulting in conflicts and fighting for the remaining oil. Soon after , the conflicting parties will unleash the final war of this civilization. Experts predict this scenario. Our world is one big machine with millions of parts, which is driven by oil. Just in the U.S., 300 million cars run on gasoline and diesel oil. Almost 100% of agricultural technology burns this fuel, 69% are diesel locomotives and also all aircraft burn kerosene.

“The oil is supplied in large tankers and is processed in large refineries. The gas is distributed through a limited number of pipeline networks. It is obvious that such an infrastructure is appropriate only during periods of peace. In contrast, it is very risky in wartime (http://www.inforse.dk/europe/fae/publik/oez.pdf, 9th September, 2013).

If the oil is flowing everything is fine, but it is not forever. And the experts know that this is the reality. The question is when? They already know that oil sooner or later will „dry up”.

It is the beginning of the 21st century, global oil production is starting to decline slowly, and we do not have a backup plan. In February 2007, an analysis of specialists published by the Congressional Audit Office said that over the next 30 years global oil production would begin to decline. “World oil reserves are depleted and we can expect to live to see rationing, riots and perhaps even wars.” (http://www.eia.doe.gov/, 9th September, 2013).

The demand for oil is going up steadily. And, when the demand increases and supply decreases this leads to economic crisis. The worst case scenario assumes

a worldwide global recession that will not end. People will demand that the governments do something about it and will probably go to wars. We are heading for ruin and to avoid it we must be prepared. The common citizen is unaware of this serious situation. New technologies have always found a solution, the politicians came up with something so the common people believe that these living conditions will continue forever. But now there is the danger that it may finish differently.
Oil fuels the vast majority of vehicles but also produces electricity. Moreover, it is an essential ingredient of most products of everyday use: plastic, bitumen coated gravel, tires, as well as cosmetics and pharmaceuticals.

Most European, American and Asian countries are dependent on imports of oil, which will be increasingly inaccessible and increasingly expensive. "By some predictions the world deposits of oil will be exploited in 30 to 50 years" [Majtán, 2012, p. 75]. It was also estimated that global oil exploitation would reach a peak at the beginning of the 21st century and then would start to fall. Nevertheless, we should still realize our culture of dependence on it. The infrastructure in which we live presents a massive outflow of people to suburbs, where we cannot live without cars. You have to go to work, shopping, school. Cars are part of the lifestyle and people like to drive especially in off-road cars, which are fast, comfortable and safe.

India, China and other developing countries are being rapidly industrialized and today there is a strong growing demand for cars. Taking into account this fact we should search for new deposits of oil, despite the exploitation being more and more expensive, which means the price of fuel will be growing, too. But during the coming decades there is the inevitable task in front of us to intensify the use of renewable sources of energy.

3. The plan of progress in the energy sector up to 2050

The plan of progress in the energy sector up to 2050 examines these challenges with a focus on the decarboniization, whilst concurrently ensuring supplies of energy and competitiveness.

In the projects of this plan there have been examined all the scenarios to reach 80% reduction of CO_2 emissions. This means an approximately 85% reduction of CO_2 related to energy, including transport. Great changes will come from all these scenarios, e.g. in the price of carbon, technologies and networks. The plan of progress also suggests the elaboration of a long-term technology neutral European framework, in which the regional policies and endeavours within countries, focused on modernization of energy supplies, will be more effective.

The EU is committed to reducing greenhouse gas emissions to 80-95% below the 1990 levels by 2050 in the context of necessary reductions by developed countries as a group.[1] The Commission analysed the implications of this in its „Roadmap

[1] European Council, October 2009.

for moving to a competitive low-carbon economy in 2050.[2] The „Roadmap to a Single European Transport Area"[3] focussed on solutions for the transport sector and on creating a Single European Transport Area. In this Energy Roadmap 2050, the Commission explores the challenges posed by delivering the EU's decarbonisation objective, while at the same time ensuring the security of energy supply and competitiveness. It is a responce to a request from the European Council.[4]

Forecasting the long-term future is not possible. The scenarios in the Energy Roadmap 2050 explore the routes towards the decarbonisation of the energy system. All these imply major changes in, for example, carbon prices, technology and networks. A number of scenarios to achieve 80% reduction in greenhouse gas emissions implying some 85% decline of energy-related CO2 emissions including from transport, have been examined.[5]

The scenario analysis undertaken is of an illustrative nature, examining the impacts, challenges and opportunities of the possible ways of modernizing the energy system. They are not „either-or" options but focus on the common elements which are emerging and support longer-term approaches to investment.

Uncertainty is a major barrier to investment. The analysis of the projections conducted by the Commission, Member States and stakeholders show a number of clear trends, challenges, opportunities and structural changes to design the policy measures needed to provide the appropriate framework for investors. Based on this analysis, this Energy Roadmap identifies key conclusions on the „no regrets" options in the European energy system. This makes it also important to achieve a European approach, where all Member States share a common understanding of the key features for a transition to a low-carbon energy system, and which provides the certainty and stability which are needed.

For example the decarbonisation scenarios include:

– High Energy Efficiency. Political commitment to very high energy savings; it includes e.g. more stringent minimum requirements for appliances and new buildings; high renovation rates of existing buildings; establishment of energy savings obligations on energy utilities. This should lead to a decrease in energy demand of 41% by 2050 as compared to the peaks in 2005-2006.
– Diversified supply technologies. No technology is preferred; all energy sources can compete on a market basis with no specific support measures. Decarbonisation is driven by carbon pricing assuming public acceptance of both nuclear and Carbon Capture & Storage (CCS).
– High Renewable energy sources (RES). Strong support measures for RES leading to a very high share of RES in gross final energy consumption (75% in 2050) and a share of RES in electricity consumption reaching 97%.

[2] COM (2011) 112, 8 March.
[3] COM (2011) 144, 28 March.
[4] Extraordinary European Council, 4 February 2011.
[5] The model used for this purpose is the PRIMES energy system models.

– Delayed CCS (Carbon Capture Storage). Similar to Diversified Supply Technologies (DST) scenario but assuming that CCS is delayed, leading to higher shares for nuclear energy with decarbonisation driven by carbon prices rather than a technology push.
– Low nuclear. Similar to Diversified Supply Technologies scenario but assuming that no new nuclear installations (besides the reactors currently under construction) are being built resulting in a higher penetration of CCS (around 32% in power generation).

Taken together, all the scenarios make it possible to extract some conclusions which can help shape decarbonisation strategies today which will deliver their full effects by 2020, 2030 and beyond.

4. Electricity plays an increasing role

All the scenarios show that electricity will have to play a much greater role than now (almost doubling its share in the final energy demand to 36-39% in 2050) and will have to contribute to the decarbonisation of transport and heating/cooling. Electricity could provide around 65% of the energy demand by passenger cars and light duty vehicles, as shown in all the decarbonisation scenarios. The final electricity demand increases even in the high energy efficiency scenario. To achieve this, the power generation system would have to undergo structural change and achieve a significant level of decarbonisation already in 2030 (57-65% in 2030 and 96-99% in 2050). This highlights the importance of starting the transition now and providing the signals necessary to minimise investment in carbon intensive assets in the next two decades.

5. Electricity prices rise until 2030 and then decline

Most scenarios suggest that electricity prices will rise up to 2030, but fall thereafter. The largest share of these increases is already happening in the reference scenario, and is linked to the replacement in the next 20 years of old, already fully written-off generation capacity. In the High Renewables scenario, which implies a 97% share for renewable sources in electricity consumption, the modelled electricity prices continue to rise but at a decelerated rate – due to high capital costs and assumptions about the strong need for balancing capacity, storage and grid investment in this „near 100% RES power" scenario. For example, RES power generation capacity in 2050 would be more than twice as high as today's total power generation capacity from all sources. However, substantial RES penetration does not necessarily mean high electricity prices. The High Energy Efficiency scenario and also the Diversified Supply Technology scenario have the lowest electricity prices and provide 60-65% of electricity consumption from RES, up from only 20% at present. In this context, it has to be noted that prices in some Member States are currently artificially low due to price regulations and subsidies.

6. Renewables rise substantially

The share of renewable energy (RES) rises substantially in all scenarios, reaching at least 55% in gross final energy consumption in 2050, up 45 percentage points from today's level at around 10%. The share of RES in electricity consumption reaches 64% in a High Energy Efficiency scenario and 97% in a High Renewables Scenario that includes significant electricity storage to accommodate varying RES supply even at times of low demand.

7. Carbon capture and storage has to play a pivotal role in system transformation

Carbon Capture and Storage (CCS), if commercialised, will have to contribute significantly in most scenarios with a particularly strong role of up to 32% in power generation in the case of constrained nuclear production and a share of between 19 to 24% in other scenarios with the exception of the High RES scenario.

8. Nuclear energy provides an important contribution

Nuclear energy will be needed to provide a significant contribution in the energy transformation process in those Member States where it is pursued. It remains a key source of low carbon electricity generation. The highest penetration of nuclear comes in Delayed CCS and Diversified Supply Technologies scenarios (18% and 15% in primary energy respectively) which show the lowest total energy costs.

9. Switching to renewable energy sources

Analysis of all the scenarios shows that the biggest share of energy supply technologies in 2050 comes from renewables. Thus, the second major pre-requisite for a more sustainable and secure energy system is a higher share of renewable energy beyond 2020. In 2030, all the decarbonisation scenarios suggest the growing share of renewables at around 30% in gross final energy consumption. The challenge for Europe is to enable market actors to drive down the costs of renewable energy through improved research, industrialisation of the supply chain and more efficient policies and support schemes. This could require greater convergence in support schemes and greater responsibilities for system costs among producers, in addition to Transmission System Operators (TSO).

Renewables will move to the centre of the energy mix in Europe, from technology development to mass production and deployment, from small-scale to larger-scale, integrating local and more remote sources, from subsidised to competitive. This

changing nature of renewables requires changes in policy, parallel to their further development.

Incentives in the future, with increasing shares of renewables, have to become more efficient, create economies of scale, lead to more market integration and as a consequence to a more European approach.

Renewable heating and cooling are vital to decarbonisation. A shift in energy consumption is needed towards low carbon and locally produced energy sources (including heat pumps and storage heaters) and renewable energy (e.g. solar heating, geothermal, biogas, biomass), including through district heating systems.

As technologies mature, costs will decrease and financial support can be reduced. Trade among Member States and imports from outside the EU could reduce costs in the medium to long-term. The existing targets for renewable energy appear to be useful for giving predictability to investors while encouraging a European approach and the market integration of renewables.

10. Gas plays a key role in the transition

Gas will be critical for the transformation of the energy system. The substitution of coal (and oil) with gas in the short to medium term could help to reduce emissions with existing technologies until at least 2030 or 2035. Although gas demand in the residential sector, for example, might drop by a quarter until 2030 due to several energy efficiency measures in the housing sector[6], it will stay high in other sectors such as the power sector over a longer period. In the Diversified Supply Technologies scenario for example, gas-fired power generation accounts for roughly 800 TWh in 2050, slightly higher than current levels. With evolving technologies, gas might play an increasing role in the future.

11. Transforming other fossil fuels

Coal in the EU adds to a diversified energy portfolio and contributes to the security of supply. With the development of CCS and other emerging clean technologies, coal could continue to play an important role in a sustainable and secure supply in the future.

Oil is likely to remain in the energy mix even in 2050and will mainly fuel parts of long distance passenger and freight transport. The challenge for the oil sector is to adapt to changes in oil demand resulting from the switch to renewable and alternative fuels and the uncertainties surrounding future supplies and prices. Maintaining a foothold in the global oil market and keeping a European presence in domestic

[6] On the other hand, gas heating may be more energy efficient than electric heating or other forms of fossil fuel heating, implying that gas may have growth potential in the heating sector in some Member States.

refining – though one that is able to adapt capacity levels to the economic realities of a mature market – is important to the EU‘s economy, to sectors that depend on refined products as feedstocks such as the petrochemical industry, and for security of supply.

12. Nuclear energy as an important contributor

Nuclear energy is a decarbonisation option providing today most of the low-carbon electricity consumed in the EU. Some Member States consider the risks related to nuclear energy as unacceptable. Since the accident in Fukushima, public policy on nuclear energy has changed in some Member States while others continue to see nuclear energy as a secure, reliable and affordable source of low-carbon electricity generation. It is necessary to say that the islands of Japan are situated in a high volcanic area, therefore the construction of nuclear power stations is very risky there.

The scenario analysis shows that nuclear energy contributes to lower system costs and electricity prices. As a large scale low-carbon option, nuclear energy will remain in the EU power generation mix. The Commission will continue to further the nuclear safety and security framework, helping to set a level playing field for investment in Member States willing to keep the nuclear option in their energy mix. The highest safety and security standards need to be further ensured in the EU and globally, which can only happen if competence and technology leadership is maintained within the EU. Furthermore, on a 2050 perspective, it will become clearer what role fusion power will be able to play.

13. Mobilising investors – a unified and effective approach to energy sector incentives

Between now and 2050, there must be a wide-scale replacement of infrastructure and capital goods throughout the economy including consumer goods in people’s homes. These are very substantial upfront investments, often with returns over a long period. Early Research and Innovation efforts are necessary. A unified policy framework that would synchronise all instruments, from research and innovation policies to deployment policies, would support such efforts.

Massive investment is needed in infrastructure. The increased costs of delay, particularly in the later years, need to be highlighted, recognising that final investment decisions will be influenced by the overall economic and financial climate[7]. The public sector might have a role as a facilitator for investment in the energy revolution.

[7] Scenarios for the Low Carbon Economy Roadmap of March 2011 show the additional costs of delayed action. Also, the IEA (2011) World Energy Outlook 2011 argues that on a global level, for every $of investment avoided in the power sector before 2020 an additional $ 4,3 would need to be spent after 2020 tocompensate for the increased emission.

The current uncertainty in the market increases the cost of capital for low-carbon investment. The EU needs to move today and start improving the conditions for financing in the energy sector.

Investment risks need to be borne by private investors, unless there are clear reasons for not doing so. Some investments in the energy system have a public good character. Thus, some support for early movers may be warranted (e.g. electric cars, clean technologies). A move towards greater and more tailored financing via public financial institutions, such as the European Investment Bank (EIB) or the European Bank for Reconstruction and Development (EBRD) and the mobilisation of the commercial banking sector in the Member States could also help to make the transition work.

Private investors will remain most important in a market-based approach to energy policy. The role of utilities could change substantially in the future, notably as regards investments. While in the past many generation investments could be done by utilities alone, some argue that this is less likely in the future, given the scale of investment and innovation needs. New long term investors need to be brought in. Institutional investors could become greater players in the financing of energy investments. Consumers will also play a more important role, which requires access to capital at reasonable cost.

14. Conclusion

The Energy Roadmap 2050 shows the way forward. It shows that decarbonisation is feasible. Whatever scenario is chosen, a number of „no regret" options emerge which can bring down emissions effectively and in an economically viable way.

Transforming the European energy system is imperative for reasons of climate, security and the economy. The decisions being taken today are already shaping the energy system of 2050. To make the necessary transformation of the energy system in time, the EU needs much greater political ambition and a greater sense of urgency. The Commission will discuss this with other EU institutions, the Member States and stakeholders on the basis of this Roadmap. The Commission will update it regularly, reassessing what is necessary in the light of progress and changes and envisages an iterative process between the Member States, through their national policies, and the EU, resulting in timely action to achieve an energy system transformation which delivers decarbonisation, greater security of supply and increased competitiveness for the benefit of all.

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INFRASTRUKTURA ENERGII ELEKTRYCZNEJ I JEJ DYWERSYFIKACJA

Streszczenie: Słońce stanowi niewyczerpane i nieustające źródło energii w perspektywie milionów lat. Ilość promieniowania słonecznego corocznie emitowanego na naszą planetę znacznie przewyższa potrzeby zamieszkującej ją ludności. Generalnie rzecz ujmując, Unia Europejska jest w całości zależna od ponad 50% importu energii, często z obszarów niestabilnych zarówno politycznie, jak i gospodarczo. Dlatego też każde z państw członkowskich Unii powinno podjąć niezbędne wysiłki w celu zmaksymalizowania wykorzystania odnawialnych źródeł energii. Słowacja ma w tym względzie zaległości, pomimo faktu, iż rząd podejmuje działania wspierające eksploatację źródeł odnawialnych.

Słowa kluczowe: odnawialne źródła energii, promieniowanie słoneczne, KWh, panele słoneczne, dotacje państwowe.