OVERCOMING ENERGY CHALLENGES IN THE FUTURE: DIVERSIFICATION OF ENERGY SOURCES AND TECHNOLOGIES

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ABSTRACT

The European Union is facing major challenges in the energy field that are taking its toll on sustainable development as well - growing import dependency, the need for substantial investment and lack of competitive energy market. It has adopted binding legislation and non-binding recommendations, but they do not suffice. The latest Green paper identifies the goal of balancing sustainable development, competitiveness and security of supply and stresses the diversification of energy mix as one of the key areas, where further action is needed, if Europe is to achieve this goal. The key role in this process will be played by legislative initiatives and energy efficiency programmes with encouragement to competitive and effective renewable energy. Action on renewable energy sources and energy efficiency, besides tackling climate change, will contribute to security of energy supply and help limit our growing import dependence.

Diversification in the field of supply and of demand, namely the use of all available options and technologies, is also a key recommendation, delivered by a recent Eurelectric project Role of electricity, where four different scenarios of future development in the energy field and their consequences were investigated. The scenario that proves to be the most sustainable is the one that envisages the use of all options – energy efficiency, renewables, nuclear energy and Carbon Capture and Storage technologies and stresses the development of all energy sources with appropriate and advanced technologies. This will enable sustainable results in the field of security of supply and competitiveness as well as in the field of climate change. As the case of Germany, one of the countries that has a major impact on global energy policy, clearly shows – the consequences of its consideration to possibly abandon one of the available options and carry out a progressive nuclear phase-out could significantly interfere with the fragile balance of energy security, economic efficiency and environmental sustainability. For such reasons, HSE, one of the leading Slovenian companies in the power sector, is strongly aware of the importance of maintaining this balance and developing an optimal diversification of energy sources. Through the supply of electricity stemming from the mix of different sources, HSE's strategy, which will be examined as an example of application of this balanced approach, is to play a key part in ensuring secure, reliable, competitive and environmentally friendly supply to domestic and foreign customers.

Key words: diversification, sustainable development, CO_2 emissions, renewable energy sources, balanced scenario.

INTRODUCTION

The European Union (EU) is facing major challenges in the energy field that are taking its toll on sustainable development as well - growing import dependency, the need for substantial investment and lack of competitive energy market. It has adopted binding legislation and non-binding recommendations, but they do not suffice. The latest Green paper identifies the goal of balancing sustainable development, competitiveness and security of supply and stresses the diversification of energy mix as one of the key areas, where further action is needed, if Europe is to achieve this goal.

This paper is thus based on the supposition that diversification of energy sources and technologies is an essential element in ensuring sustainable, competitive and secure energy over a longer term. The balanced diversification of sources and measures on the side of supply and of demand should play a major part in determining the energy strategy of an individual state. Such diversification will contribute most to tackling climate change, since it is based on a mix of sustainable technologies and sources, stemming from activities in the field of energy efficiency, renewable energy sources, Carbon Capture and Storage (CCS) technologies, and other appropriate measures.

The paper gives a brief overview of strategic documents and legislative proposals of the EU in the areas of sustainable development, especially the latest strategy, Green paper, relevant documents of the new energy package and decisions of the EU and European Councils. Further, it explains the results of the Eurelectric Role of Electricity project, identifying the most sustainable scenario for the future energy development. It examines briefly the case of Germany and the possible consequences of its deliberation to gradually phase-out nuclear energy. In the end, the paper concludes by examining HSE's strategy in the light of all the findings from the previous chapters.

KEY AREA OF ACTION: CONTRIBUTION OF ENERGY SECTOR TO SUSTAINABLE DEVELOPMENT

The latest Green paper A European Strategy for Sustainable, Competitive and Secure Energy, adopted in March 2006, speaks of a new energy area, characterised also by greenhouse gas emissions, already making the world 0,6 degrees warmer. It further identifies the goal of balancing sustainable development, competitiveness and security of supply and stresses the diversification of energy mix as one of the key areas, where further action is needed, if Europe is to achieve this goal. The key role in this process will be played by an integrated approach to tackling climate change, including legislative initiatives and energy efficiency programmes with encouragement to competitive and effective renewable energy. Action on renewable energy sources and energy efficiency, besides tackling climate change, will contribute to security of energy supply and help limit our growing import dependence.[1]

[1] Green Paper "A European Strategy for Sustainable, Competitive and Secure Energy" COM(2006)105 final, p. 3-5, 10.

In June 2006 the Renewed EU Sustainable Development Strategy was adopted. In the field of climate change and clean energy it calls for limiting climate change and its costs and negative effects to society and the environment by aiming for a global surface average temperature not to rise by more than 2ºC compared to the pre-industrial level. At the same time the energy policy should be consistent with the objectives of security of supply, competitiveness and environmental sustainability. Since this policy is crucial when tackling the challenge of climate change, adaptation to, and mitigation of, climate change should be integrated in all relevant European policies. Furthermore, the strategy stresses that by 2010 12 % of energy consumption, on average, and 21 % of electricity consumption, as a common but differentiated target, should be met by renewable sources, considering raising their share to 15 % by 2015, while at the same time by 2010 5,75 % of transport fuel should consist of biofuels, as an indicative target, considering raising their proportion to 8 % by 2015. These measures should be accompanied also by reaching an overall saving of 9 % of final energy consumption over 9 years until 2017.[2]

The key actions in the field of energy efficiency, renewable energy sources and CCS were further developed in the so called new energy package of the European Commission (EC), adopted in January 2007.[3] First of the nine documents for an ambitious energy policy for Europe, the Action Plan for Energy Efficiency, outlines a framework of policies and measures for a six-year period with a view to intensify the process of realising the over 20 % estimated savings potential in EU annual primary energy consumption by 2020. Realising the 20 % potential 2020, equivalent to some 390 Mtoe, will result in large energy and environmental benefits. The EC thus proposes actions, stemming from appliance and equipment labelling, building performance requirements, more efficient power generation and distribution, to achieving fuel efficiency of cars, facilitating appropriate financing of energy efficiency investments, coherent use of taxation, raising awareness, and finally fostering energy efficiency worldwide.[4]

A Renewable Energy Roadmap includes a proposal for an overall binding 20 % renewable energy target and a binding minimum target of 10 % for transport biofuels for the EU by 2020.[5] This proposal for binding targets was adopted by the heads of states and governments at the European Council in March 2007. The Council stressed that from the overall renewables target, differentiated national overall targets should be derived with due regard to a fair and adequate allocation taking account of different national starting points and potentials, including the existing level of renewable energies and energy mix, and, subject to meeting the minimum biofuels target in each Member State, leaving it to Member States to decide on national targets for each specific sector of renewable energies (electricity, heating and cooling, biofuels). The European Council also endorsed the 20 % energy efficiency target and a 30 % reduction in greenhouse gas emissions by 2020 compared to 1990, provided that other developed countries commit themselves to

[2] Council of the European Union Conclusions, 9 June 2006, Annex: Renewed EU Sustainable Development Strategy, p. 7-8.
[3] Except the Action Plan for Energy Efficiency that was adopted in October 2006.
[4] Action Plan for Energy Efficiency: Realising the Potential, COM(2006)545 final, p. 3,5, 10-19.
[5] Renewable Energy Roadmap - Renewable energies in the 21st century: building a more sustainable future, COM(2006)848 final.

comparable reductions, while the EU makes a firm independent commitment to achieve at least a 20 % reduction of greenhouse gas emissions by 2020.[6]

The last relevant document of the new energy policy in the field of climate change, Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020, is an EC Communication on how to generate power from fossil fuels in a sustainable manner with a focus on sustainable coal technologies, enabling coal to maintain its important contribution to secure and competitive energy supplies for Europe. It stresses that if the EU is to achieve its long term climate change objectives, much cleaner coal technologies and a significant reduction of CO2 emissions will be necessary. Thus, in 2007 the Commission will begin to develop a mechanism to stimulate the construction and operation by 2015 of up to 12 large-scale demonstrations of sustainable fossil fuel technologies in commercial power generation in the EU and try to provide a clear perspective when coal- and gas-fired power plants will need to install CO_2 capture and storage. Today, the Commission believes that by 2020 all new coal-fired plants should include CO_2 capture and storage technologies and existing plants should then progressively follow the same approach.[7] A European strategic energy technology plan, defining these mechanisms, should be prepared by the end of this year and is due to be adopted at the spring 2008 European Council.

From the above we can conclude that the contribution of the energy sector to tackling climate change and ensuring sustainable development in the future, has to based on diversity of energy sources, making use of the most sustainable and advanced technologies, the EU becoming a leading region in these efforts.

ROLE OF ELECTRICITY – A BALANCED SCENARIO FOR THE FUTURE

The triple challenge of making substantial reductions in emissions of greenhouse gases while ensuring a secure supply of energy, all at reasonable cost to economy, is the key starting point of the Eurelectric project entitled The Role of Electricity, launched towards the end of 2005, with a purpose to draw up an authoritative view on what role electricity will play in helping to meet these challenges.

The project investigated the impact of different demand-side and supply-side policies and technologies through quantitative modelling and scenario building up to the year 2050. Working against a baseline scenario, several alternative scenarios were set up to explore the impact of a theoretical mandatory reduction in greenhouse gas within the EU25 of 30 % by 2030 and 50 % by 2050, versus the 1990 level.

Four scenarios were investigated:

- The Baseline scenario, which includes ongoing current policies on energy efficiency and support for renewable energy sources, but does not expand them, nor does it

[6] European Council Conclusions, 9 March 2007, p. 12, 20-21.
[7] Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020, COM(2006)843 final.

foresee any change in the current constraints on the development of nuclear energy or envisage the emergence of CCS technology

- An Efficiency & RES scenario, which centres on energy efficiency and renewables, with the same constraints for nuclear energy as under Baseline, and without the emergence of CCS
- A Supply scenario based on a nuclear renaissance and CCS technology
- A **Role of Electricity scenario**, which envisages **the use of all options** towards a low-carbon energy system - energy efficiency, renewables, nuclear energy and CCS. The scenario exploits the synergy between a low-carbon electricity supply system and efficient electro-technologies, including in areas traditionally largely limited to direct combustion of oil and gas – namely road transport (through the introduction of plug-in hybrid cars) and heating & cooling (through heat pumps).

Table 1.: Summary of scenarios' policies.

Scenarios / *Policies*	**Efficiency & RES**	**Supply Scenario**	**Role of Electricity**
Energy Efficiency - policy package for all sectors	**YES**	**NO**	**YES**
Electro-technologies - lighting, appliances, motor drives, heat pumps, plug-in hybrid cars	**NO**	**NO**	**YES**
Renewables - supportive policies, no further subsidies	**YES**	**NO**	**YES** (*)
Nuclear Policy - no phase out, extension of lifetime, but no new nuclear country except the new MS	**NO**	**YES**	**YES**
Carbon Capture and Storage for Coal and Gas Plants and development of transport and storage	**NO**	**YES**	**YES**

(*): Lower support for Biomass than "Efficiency & RES"

Table 2.: Scenarios' results.

Scenario results for 2030 (2005=100)	Baseline	Supply Scenario	Efficiency & RES	**Role of Electricity**
CO_2 Emissions	110	70	70	**70**
Total Cost of Energy	146	161	156	**147**
Maximum Carbon Value	5	116	125	**56**
Oil & Gas Import Dependency	126	115	128	**105**

The results of the project confirmed that the Baseline scenario is unsustainable, both in terms of greenhouse gas emissions and gas and oil import dependency. On the other side, the Role of Electricity scenario proves to be the most sustainable due **to its more balanced and synergy seeking approach**.

At the same level of CO_2 emissions reduction as the two other alternative scenarios it convincingly performs best in terms of controlling both total energy costs and oil and gas import dependency. The objective of carbon reduction is reached without additional total energy costs compared to Baseline. Oil and gas import dependency in 2030 and 2050 remains almost stable compared to 2005 whereas all other scenarios see significant rise in oil and gas dependency. It is the only scenario leading to a reasonable and stable level of carbon value - some €40-50/tCO_2 – whereas the other scenarios peak at €120/tCO_2. This has great significance not only in economic terms but also in terms of worldwide relevance and of **acceptance of EU climate change policies**.

The Role of Electricity scenario thus proves to be the most sustainable in answering the triple challenge mentioned above: regarding security of supply it delivers lower gas and oil dependency and high energy efficiency; regarding competitiveness it delivers low additional costs, high investment in generation, growth through new electro-technologies; and moreover, regarding climate change it lowers emissions for the same amount as two other alternative scenarios that give up the use electro-technologies, nuclear energy and CCS or energy efficiency and renewables, respectively.[8]

Consequently, we can conclude that **substantial reduction of green-house gas emissions without unreasonable costs together with reduced oil-gas dependency is possible**, if we focus, among other, on developing a low-carbon electricity system by using all available options. The recommendation of the Role of Electricity project is therefore to accelerate "progress towards low-CO_2 electricity generation mix through **proactive use and development of all available options**. Any policy that tends to exclude specific elements of this balanced portfolio will fail to build a robust and economically sound low-carbon electricity system."[9] We will examine in the following chapter the possible consequences of excluding one important available element from the country's energy portfolio.

THE CASE OF GERMANY

In its latest report on Germany, the International Energy Agency (IEA) finds, that the country has maintained its commitment to energy security, economic efficiency and environmental sustainability. Moreover, in the environment field, few countries can boast Germany's record in bringing environmental issues to the forefront of policy making. However, its agreement, negotiated between the government and the utilities in 2000, to progressively shut down nuclear power plants as they age with complete shut-down of all

[8] The chapter is based on: The Role of Electricity – a new path to secure, competitive energy in a carbon-constrained world, Eurelectric, March 2007.

[9] The Role of Electricity – a new path to secure, competitive energy in a carbon-constrained world, Eurelectric, March 2007, p. 11.

plants estimated for 2022, raises some concerns. The nuclear energy represents 12 % of primary supply and over a quarter of electricity generation. Thus, the IEA stresses that, despite the research models showing that the nuclear shut-down can be completed without increased emissions due to greater role of renewables and energy efficiency, the reality suggests that the phase-out will result in increased fossil fuel fired power plants, leading to higher overall CO_2 emissions.

If we set aside the reduced supply diversity and energy security, as the shut-down eliminates one potential generation option from a portfolio available to German companies, growing import dependency (nuclear power is a largely domestic source and reduces the need to rely on imports of other fuels), which would likely raise Germany's reliance on Russia, and additional cost for the economy having to provide additional near-term investments in new capacity, all of which are likely consequences of the shut-down, the IEA emphasizes that the shut-down of nuclear power plants might have the biggest effect on Germany's environmental goals. The IEA concludes by stressing that while the nuclear phase-out threatens to result in higher overall CO_2 emissions than today, it will certainly prevent Germany from reaching its full potential over the longer term. With nuclear energy in the mix, the opinion of the IEA suggests that Germany's CO_2 emissions could be cut even further. [10]

Taking into account the above findings, in the following chapter we will explore briefly HSE's strategy in the light of its contribution to diversification and sustainable development.

HSE'S STRATEGY

HSE, one of the leading Slovenian companies in the power sector, is aware of the importance of maintaining the balance of energy security, economic efficiency and environmental sustainability and developing an optimal diversification of energy sources and measures. Through the supply of electricity stemming from the mix of different sources, HSE's strategy is based on a balanced approach, including measures of energy efficiency and development of renewables, the company thus seeking to play a key part in ensuring secure, reliable, competitive and environmentally friendly supply to domestic and foreign customers.

Maintaining and further developing the optimal portfolio of production sources, reducing the effects of power generation and use on the environment, implementation of common ecology policy, efficient energy use and energy saving, and generation of cleaner energy are parts of the balanced strategy regarding sources and measures, the HSE is trying to pursue. HSE's strategies and development outlook are thus based on the balanced use of natural sources taking into account their natural restoration ability, as well as on developing all available technologies and processes that reduce the harmful effects of energy production on our natural and residential environment. By incorporating the principles of

[10] The chapter is based on: Energy Policies of IEA Countries – Germany – 2007 Review, Executive Summary, IEA, 2007, p. 7-13.

sustainable development into the management system, strategic and business plans, HSE is demonstrating its commitment to cohabitation with the nature and environment on a local, national and global level.

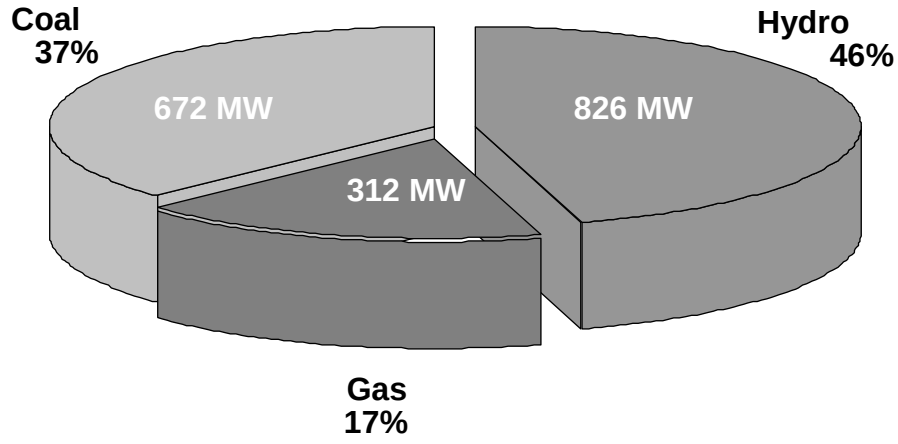

Diagram 1.: Optimal HSE electricity sources structure.

New investments of the company are thus focused on modernizing existent thermal and hydro facilities and constructing new power generation facilities with a view of optimizing our energy structure. These new investments on the supply side are taking into account the provisions of the National Energy Programme, adopted in 2004, among other the balanced diversification of primary energy sources, secure and reliable electricity generation, the economically feasible exploitation of renewable energy sources and inclusion of advanced and environmentally friendly technologies. In addition to these measures, HSE is trying to influence the demand side as well, namely the consumers, focusing on promoting renewable energy and energy efficiency. Through the Azure Energy project we encourage responsible energy behaviour, so that great many individuals and companies become aware of the importance of environment protection and decide to purchase renewable electricity. Furthermore, in the efficient energy use field, we launched a national information and education campaign in September 2006 regarding the rational and efficient energy use, aimed at introducing to electricity consumers the advantages of thoughtful use of appliances that we use daily and that contribute to the continuously growing electricity demand in Slovenia.[11]

CONCLUSION

The strategic European documents, research and modelling done by Eurelectric, and suggestions of the IEA lead us to conclude that diversification of energy sources and

[11] The chapter is based on HSE strategic documents.

technologies is an essential element in ensuring competitive, secure, and above all sustainable energy over a longer term. The balanced diversification of measures and activities on the side of supply through exploitation of all available sources and technologies, and on the side of demand through developing electricity saving and energy efficiency, should play a major part in determining the energy strategy of EU as a whole and of its individual member states. Excluding an important technology, available source or measure from our portfolio could jeopardize our common goals regarding climate change. Thus, the most sustainable scenario is the most balanced scenario.

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PRESEGANJE IZZIVOV ENERGETIKE V PRIHODNOSTI: DIVERZIFIKACIJA ENERGETSKIH VIROV IN TEHNOLOGIJ

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POVZETEK

Evropska unija se sooča s številnimi izzivi na energetskem področju, ki posegajo tudi v trajnostni razvoj – naraščajoča uvozna odvisnost, nujnost precejšnjih naložb in neobstoj resnično konkurenčnega energetskega trga. Sprejela je tako zakonodajne akte kot neobvezujoča priporočila, a ne zadoščajo. Nedavna Zelena knjiga kot cilj izpostavlja uravnoteženje trajnostnega razvoja, konkurenčnosti in varnosti oskrbe, pri tem pa poudarja diverzifikacijo energetske mešanice kot eno ključnih področij, kjer so potrebni dodatni ukrepi, da bi Evropa lahko dosegla ta cilj. Pri tem bodo ključno vlogo igrali zakonodajni ukrepi in programi za energetsko učinkovitost ter spodbude za konkurenčne in učinkovite obnovljive vire energije. Ukrepi glede obnovljivih virov energije in energetske učinkovitosti bodo poleg boja proti podnebnim spremembam prispevali k varnosti oskrbe z energijo in pomagali omejiti našo naraščajočo uvozno odvisnost.

Diverzifikacija na ravni dobave in povpraševanja oz. uporaba vseh primernih obstoječih tehnologij pa je tudi ključno priporočilo, ki izhaja iz nedavnega projekta organizacije Eurelectric z naslovom Vloga električne energije, kjer so izdelali štiri različne scenarije prihodnjega razvoja energetike in njihovih posledic. Kot najbolj vzdržen scenarij se je izkazal prav tisti, ki je vključeval ukrepe na področju energetske učinkovitosti, obnovljivih virov energije, jedrske energije, ter tehnologij CCS in poudarja razvoj vseh obstoječih virov energije s primernimi in naprednimi tehnologijami. S tem dosežemo najbolj vzdržne rezultate tako na področju varnosti dobave in konkurenčnosti, kot tudi na področju klimatskih sprememb. Kot kaže primer Nemčije, ki je eden glavnih akterjev pri oblikovanju globalne energetske politike, bi posledice njenega razmišljanja, da se morda odpove eni od obstoječih tehnologij in postopoma ukine jedrsko energijo, lahko pomembno posegle v krhko ravnovesje med varnostjo dobave, ekonomsko učinkovitostjo in trajnostnim razvojem. HSE, ena od vodilnih slovenskih družb na področju energetike, se zato močno zaveda pomena ohranjanja tega ravnotežja in skuša vzpostaviti optimalno diverzifikacijo energetskih virov. Z dobavo električne energije, ki vključuje kombinacijo različnih virov, je strategija HSE, ki bo predstavljena kot primer uporabe tega uravnoteženega pristopa, igrati ključno vlogo pri zagotavljanju varne, zanesljive, konkurenčne in okolju prijazne oskrbe domačih in tujih odjemalcev.

Ključne besede: diverzifikacija, trajnostni razvoj, CO_2 emisije, obnovljivi energetski viri, vzdržen scenarij.