Executive summary | Wuppertal, July 2016

Alternative and Sustainable Energy Scenarios for Hungary

for Greens / EFA Group –

European Parliament

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1 Executive Summary

Background

On December 12th 2015 at the United Nations climate conference (COP21), 195 nations reached the Paris Agreement aiming to combat climate change. A key element of the agreement is the long-term goal of limiting global warming to "well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels". According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), in order to have good prospects of meeting the 2 °C limit, global greenhouse gas (GHG) emissions would have to be reduced to about 50% of their 2010 levels and would need to reduce to around zero by the end of the century. There is widespread agreement that industrialised countries, with their relatively high GHG emission per capita, will need to reduce their emissions faster than the global average.

The EU has set itself ambitious targets with regards to a significant reduction of its greenhouse gas emissions by 40% by 2030 and by 80% to 95% by 2050 relative to 1990 emissions levels. It has presented roadmaps depicting an overall decarbonisation of its economy by the middle of the century.

Climate change is, however, not the only factor that will drive change of European energy systems. Other major factors include (a) threats to energy security; (b) increasing integration of European markets; (c) efforts to increase energy efficiency of the European economies.

Motivation

Given this background member states of Europe need to gain a better understanding of precisely how the energy system is expected to change in their country in order to be better prepared and to identify options to be pursued in their national energy policy priorities contributing to achieve the Union overall targets. However, contrary to the situation in some other EU member states, for Hungary there are only a small number of energy scenarios describing the potential drivers of change and their possible consequences and policy options. Also the framework conditions have changed substantially compared to 2011 when the existing Hungarian Energy Strategy with strong fossil fuel and nuclear focus was approved. Amongst others the South Stream project has been suspended, risks associated to Russian energy dependency have grown, the EU has been raising concerns around the planned extension of Paks nuclear plant, renewable energy costs continued to drop and the Paris Agreement was reached, making a fresh look at the situation necessary.

Therefore, The Greens / European Free Alliance Group of the European Parliament contracted Wuppertal Institute for Climate Environment and Energy together with Energiaklub to develop scientifically sound, comprehensive, alternative and sustainable long term energy scenarios for Hungary with a time horizon of 2030 and 2050. The scenarios developed for this report shall deliver information about the costs and long-term effects of different energy choices for Hungary. The potential benefits of greening the energy mix are also detailed in the research. The study aims to provide policy makers with better evidence for making informed, prudent and forward-looking energy policy related decisions.

The authors hope that the project and its results will be instrumental to initiate a public debate in Hungary building a sense of ownership among different stakeholders and citizens in Hungary and at the same time enable national decision-makers to reflect the changing geopolitical and policy context in view of reshaping the national energy policy with a long-term, sustainable, strategic mind-set.

Furthermore, in the context of the Energy Union package, the project aims to be a very first step to explore the long term possibilities of a mutually beneficial regional cooperation for a sustainable energy system between Hungary and its neighbours.

Four Scenarios

In order to explore possible future developments of the Hungarian energy system in a European context four scenarios were developed, of which the first scenario basically follows current policy while the other three describe alternatives assuming energy efficiency improvements and the spread of renewable energy at different levels of ambition. All scenarios share the same basic data as well as the assumptions on population and GDP development.

The "NUCLEAR" scenario aims to describe a development of the energy system as if "business as usual" that is a continuity of the current energy policy mainly focusing on the expansion of nuclear operations at the Paks power plant as a solution to energy policy needs. Technically the scenario is based on the most recent EU energy reference scenario for Hungary (EC 2013), however, we assumed less nuclear activity in the long-term.

The "GREEN" scenario on the contrary envisages a strong energy policy focus on energy efficiency and the expansion of renewable energy generation in Hungary. It is based on a deep sector by sector analysis of the existing potentials for improving energy efficiency and the potentials to sustainably expanding the production of renewable energy generation. This includes an analysis of the future integration of the regional and European electricity systems in order to balance variations in production and demand.

To explore further alternative options of the future development of the Hungarian energy system two "INTER" scenarios were developed which both assume that neither Paks2 nor any other new nuclear reactors will be built in Hungary. Besides this the scenario INTER-A follows the lines of the current trends and current policy for the energy demand side. Instead of new nuclear power plants renewable electricity generation is expanded to supply the electricity demand in the scenario. Scenario INTER-B adds to this also an active policy for energy efficiency and energy savings – which is, however, less ambitious than in the respective policy in the GREEN scenario.

All four scenarios score differently with regards to the core sustainability criteria for the Hungarian energy system namely (a) the amount of GHG emissions from the energy system, (b) the amount of nuclear energy used and of nuclear waste produced, (c) the import and use of fossil energy carriers, and (d) the costs of the energy system which have to be carried by Hungarian businesses and households.

The scenarios have been modelled using a combination of two models. The WISEE-Model was developed by Wuppertal Institute and has been used to simulate energy demand and the potentials for increasing energy efficiency. The EnergyPlan model has been developed by the University of Aalborg and was used here to simulate electricity and heat supply as well as demand on an hourly basis to analyse the functioning of future high RES electricity systems. The models have been calibrated to be comparable and compatible with the most recent European Reference Scenarios published by the European Commission (2013).

Scenario Results

The sector by sector technology oriented analysis of the future final energy demand in the residential, tertiary and industry as well as transport sectors demonstrates significant potentials to increase energy efficiency and thus reduce overall demand for final energy in Hungary. In the GREEN scenario a significant share of the existing potentials would be exploited, which could lead to final energy savings of more than 40% by 2050 (vs. 2010) whereas final energy demand is expected to slightly increase under a business as usual policy (which is assumed for the NUCLEAR scenario).

Sectors with the highest rates of savings in the GREEN scenario are residential and commercial as well as public buildings. Here large energy saving potentials exist. Also a significant share of them can be realized by targeted policy for insulating and modernising existing buildings and by introducing low energy and passive house concepts in new developments. In transport and energy intensive industries on the contrary energy efficiency potentials are more difficult to realise. Savings vs. 2010 amount to 30% in transport an 13% in industry albeit in the business as usual, these sector also show the highest increases in final energy demand. Increasing energy efficiency leads to a reduction of coal use in final energy by almost 98% and of oil by more than 50% vs. 2010. Due to the high savings, as well as the expansion of renewable heating systems and electrical heat pumps in buildings, natural gas demand for final energy purposes decreases by over 70% by 2050. Due to an expansion of electric appliances e.g. in the heating segment as well as in transport electricity demand remains more or less stable in the GREEN scenario, which means that the share of electricity will increase from 18 to 34% from 2010 to 2050. However, compared to the expected 45 % increase of electricity demand in the business as usual case the GREEN scenario will need 12 TWh or 25% less electricity in 2050.

Next to energy efficiency renewable energy generation (RES) has the second largest potential to increase the sustainability of the Hungarian energy system. For RES generation to be sustainable it needs to respect the multiple demand for limited free space and agricultural land in Hungary. In recent years technological development of solar photovoltaics (PV) as well as wind energy (particularly for slow wind sites) has been impressive and significantly reduced costs as well as increased efficiency of the technology. Thus, in this study a review of existing studies on renewable energy potentials for Hungary was carried out. This review took into account Hungarian studies, European studies with a country wise resolution and German studies which were extrapolated. All in all, this comparison showed that there is a significant potential for solar, wind and bioenergy as well as geothermal– even if the use of agricultural lands is strictly limited. In total wind and PV each would technically be sufficient to supply the complete Hungarian electricity demand of the year 2050 even in the NUCLEAR scenario. The sustainable potential of biomass would be sufficient to supply twice the non-electric final energy demand in the GREEN scenario in 2050 and almost 80% of the respective demand in the NUCLEAR scenario.

In the GREEN as well as INTER scenarios between 10 and 20% of the identified RES electricity generation potentials will be implemented until 2050 – to generate between 62 % (INTER) and 83 % (GREEN) of Hungarian electricity and to supply between 26 and 51% of total primary energy. In the NUCLEAR scenario renewable electricity will only account for 24% of electricity generation and some 15% of primary energy supply by 2050, which means only marginal improvements between 2020 to 2050 over the national target of 14,65% of gross final energy demand which is set in the RES-directive for 2020.

Instead of a steady expansion of RES electricity, the NUCLEAR scenario assumes two new nuclear power plant blocks to be completed before 2030 at Paks. They will mainly replace old fossil coal and natural gas fired power plants. By 2035, however, the currently existing nuclear power plants will have to be phased out. In order to replace them, in the 2030's new gas fired power plants would be built in this scenario.

The analyses on energy efficiency and renewable energy potentials and the alternative and sustainable energy scenarios based on the potentials clearly show in two different future energy policy paths for Hungary. This is particularly pertinant for the electricity system. Hungary basically has to decide between

- A) heavy investment into a strong expansion of renewable energy generation and substantial improvements of energy efficiency together with a decentralization of electricity generation as depicted in the GREEN scenario or to
- B) concentrate future investment in new nuclear and fossil infrastructure. This strategy would mean to concentrate future investment on a very small number of

big power plants which would lead to an increasingly centralized electricity production.

As the study shows, both solutions will need significant investments in the next decades as the current power plant stock in Hungary is relatively old and needs substantial reinvestment over coming years. The two main scenarios, however, differ with regards to the timing of the investment needs: in the case of the NUCLEAR scenario high investment is needed soon as by 2030 new nuclear power plant capacities at Paks will have to be completed. In the case of the GREEN scenario the necessary investment is more evenly spread out in time. The bulk of all investments will occur in the period 2030 – 2050 due to the fact that investment will be in incremental steps and also gradually increase over time as exploitation rates of the potentials will increase together with lower costs of the technology.

The results on the electricity production costs of the scenarios show that the pathway described by the GREEN scenario leads to annual average cost levels, which are roughly similar to those of the conventional pathway, when conservative assumptions are taken into consideration. However, once plausible higher levels of natural gas prices and CO2 costs are considered, the economic advantage of the GREEN scenario becomes more significant. This indicates that the GREEN scenario provides the most robust alternative, when the aim is to ensure the less costly pathway for the future development of the Hungarian energy system (in terms of electricity production costs).

What is more, the GREEN development path offers further co-benefits: as the investment into decentralised renewable power generation is much more widespread over the whole country it supports local development everywhere in the country instead of few spots with big power plants and therefore supports also regional and particularly rural development. Regarding job creation particularly the increased energy efficiency in the GREEN scenario has strong positive effects. The RES expansion, however, also has moderate positive job effects over the time period until 2050 as compared to the investment into a conventional power sector. Further these effects are better distributed around the whole country.

Regarding non-economic benefits it can also be concluded that the GREEN option is more in line with the international as well as European climate policy goals as it achieves significant reductions energy related CO_2 emissions of almost 80% vs. the climate political base year of 1990. The NUCLEAR scenario in contrary only leads to small additional emission reductions vs. 2010 and thus remains more or less stable at a level about one third below 1990.

The GREEN scenario, however, implies significant challenges with regards to the expansion of the distribution as well as transmission grids as they will have to accommodate high amounts of fluctuating renewable electricity. However, the bulk of the costs are independent of the chosen development path, be it green or conventional/nuclear, as a significant expansion of the grids has already been planned in the context of the integration of European electricity markets and further expansions of European grids are foreseen anyhow.

Policy Requirements for a GREEN Scenario

To go for a GREEN and sustainable energy scenario for Hungary, however, it is not enough not to opt for nuclear expansion. In order to harvest the advantages of such an energy scenario a comprehensive energy policy had to be developed, which covers all sectors of the energy system and all consumer groups as well as the energy supply side. Some core requirements and policy actions to achieve the energy transition include:

- Clear political commitment to a comprehensive, sustainable energy transition, political endorsement of milestones as well as highly ambitious, and optimally legally binding, national energy efficiency and renewable energy goals and targets in order to create clear signals and long term reliable conditions for investors.
- Enable investment into decentralised renewable electricity generation, particularly wind and PV. The investments needed can be financed by domestic but also international funds. To achieve such a broad portfolio as needed for a widespread RES development, broad groups of investors should receive incentives. This should particularly include citizens and cooperatives as they guarantee high local involvement and a flow back of revenue into the regions where the RES generation takes place. Feed-in-tariffs and other schemes are already well developed and explored. Together with the already significantly reduced costs of wind and PV such instruments could enable a steadily increasing investment into renewable electricity generation, with due regard to long-term sustainability requirements.
- Such a development, however, also needs appropriate planning regulatory environment especially to expand and increase flexibility of the electricity grid. Supporting schemes and provisions for these should be provided to subnational entities especially municipalities, enabling them to participate in and foster local developments.
- Efforts should be made to increase the capacity for heat and electricity production also in the area of geothermal energy, implying further research and development to overcome technical problems and minimise environmental impacts, with special attention to the issue of reinjection.
- In terms of energy efficiency, like in many other EU member states, policies could and should be improved. They range from regulation regarding minimum efficiency standards for buildings, cars, machines and appliances to clear economic incentives for energy efficiency, particularly in the building sector. These measures have to be tailored for every demand sector and application of energy as each of them has strong individual characteristics. Specific measures should be provided to deprived, energy-poor households. Cross-cutting policies such as energy or CO_2 taxes or an energy efficiency fund that runs awareness campaigns and funds respective measures can significantly improve the effectiveness of such policy mixes.
- Particularly important is also the transport sector. Based on the currently rather low energy use in Hungary taxation of cars with rebates for environmentally friendly low consuming cars together with fuel taxes and other instruments could be used to maintain low levels of transport energy consumption. This should be complemented by a strong support for public transports as well as a future introduction of alternative fuels and particularly electric vehicles.