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An Independent Review

Barbara Kudrycka: Poland's Foresight

As Poland's profile in the European Union continues to rise, its government is focusing on new ventures in scientific research and development, with a long-term aim of creating a secure and sustainable future for the country, and helping it to thrive within Europe. Polish Minister of Science and Higher Education Barbara Kudrycka and her ministry have created a scientific policy with a strong European focus – in line with the aims of the EU's recent Europe 2020 policy – taking into account 'participation in the creation and implementation of scientific activity on a pan-European level'[1].

For four years, between 2004 and 2008, 3,000 Polish science and research experts have contributed to the National Foresight Programme Poland 2020. Foresight combines statistical calculations with creative imagination in order to propose hypothetical outcomes for the future of the country. Then, using these possible futures, policy recommendations are selected in order to ensure that the optimal outcome for the country is attained.

The report specifies three different areas of research and development of particular importance for Poland's future. Firstly, the sustainable development of Poland itself, with emphasis on the integration of new materials and technologies and utilisation of natural resources; secondly, improvement of ICT facilities, making the transfer of digital information for all easier; and thirdly, Poland's economic, intellectual, social and technological security. Writing in *Public Service Review:* European Union 18, Kudrycka praised the programme: 'It is my conviction that this food for thought will influence public policy favourably for years to come'.[2]

It is not only internal changes within the Polish scientific policy that are being targeted. The ministry is looking outwardly at other branches of society – such as the business and innovation sector – in order to build a symbiotic, mutually beneficial relationship and spread the positive effects of scientific development across the nation.

For instance, a sizeable portion of EU funding – €9.7bn of the total €67bn designated for Polish investment – is to be dedicated to the Innovative Economy Programme, which looks to strengthen the relationship between scientific research and the business sector, with an overall aim of increasing the international competitiveness of Polish science.

In addition, Minister Kudrycka highlights the idea of using the potential of academia 'for the sake of boosting innovation and thus contributing to sustained economic growth and social development', and as such wishes to encourage 'meaningful cooperation with the private sector' throughout Polish academic institutes.

[1] http://www.euraxess.pl/index.php/research-landscape

[2] *Public Service Review*: European Union 18, page 60

e-government and promote innovation in the economy. This can be done through support for newly created micro, small and medium-sized enterprises providing e-services, access to broadband or developing public information systems. In response to the lack of IT infrastructure, we have also carried out one of the most complex ICT projects in Europe – Broadband Internet Network for Eastern Poland, covering five voivodeships.

European funds are playing an integral role in helping to usher the Polish economy into a modern and innovative era.

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The new power generation

Günther H Oettinger, European Commissioner for Energy, details the EC's long-term ambitions to radically improve the continent's energy-efficiency...

Energy is at the heart of our economy and our society, and the EU has come a long way in creating a consensus on the direction we must move in. In recent years, it has developed a comprehensive European energy policy that sets clear requirements and targets for sustainable, competitive and secure energy. Our main aims are to achieve a 20% reduction in greenhouse gases, to provide EU consumers with a supply that includes a 20% share sourced from renewable energies and a 20% improvement in energy-efficiency by 2020.

Since 2000, the EU has also made significant moves towards a more efficient energy system. New legislation to oblige the use of renewable energy sources, together with greater transparency and unbundling in energy markets, updated emergency provisions and coordinated network planning at the European level prepare the ground for high levels of energy investments in alternative sources, new technologies and additional infrastructure and integration.

Making the next move

It is time now to update the energy policy for the next 10 years. The 20-20-20 objectives will remain the foundation of EU energy policy and measures. Ensuring the prompt and correct implementation of existing legislation will be one of my top priorities. In this respect, the internal market is crucial. A properly functioning, well-regulated, transparent and interconnected market, with market price signals and investment incentives, is the most effective instrument to assure security of supply.

Implementing the third internal market package for energy will involve considerable changes in terms of network planning, including requirements on unbundling, coordinating the regulations through the European Agency for the Cooperation of the Energy Regulators and reorganising how the European networks of transmission system operators (ENTSO-E and ENTSO-G) work together. Another key issue is the development of the community-wide 10 year network development plans and increased transparency to promote an efficient and secure network.

The need to invest in new energy infrastructure, technologies and sources is enormous. It is estimated that by 2030 up to €1trillion will have to be invested in the European electricity grids and electricity generation and €150bn in the gas network, excluding import pipelines from third countries. We must not forget that investments in the energy industry work on a long-term basis. Investments made today date back to decisions made years ago and determine the structures of our energy supplies for the period up to 2030 and 2050.

Infrastructure – a prerequisite for the internal market

Infrastructure is the circulatory system of the internal market in energy. It is also vital for a successful 'decarbonisation' policy, which requires adjusting the network to more renewable and local production.

The gas crisis of January 2009 and June 2010, as well as the power cuts in Italy in 2003 and Germany in 2006, show that Europe's network is too weak to deal with such interruptions. In 2009, many of the new member states had no alternatives to compensate for being cut off from the Russian gas supply. The EU is committed, through the Lisbon Treaty, to solidarity in energy supply, but our networks currently make this very difficult to achieve.

Our domestic resources are also in continual decline. At the moment, around 61% of the EU's domestic consumption of natural gas comes from imports. 42% of these imports come from Russia, 24% from Norway, 18% from Algeria and around 16% from other countries. At national level, some member states get their natural gas from a sole supplier for historical reasons. We therefore need to increase import capacities and diversify sources. New gas pipelines are needed, particularly in the new member states, and the import sources and channels must be diversified.

As far as the electricity industry is concerned, the lack of suitable grid connections is an obstacle to investments in renewable energies and local production. The current network is not geared towards local electricity production, and the increased use of renewable energy sources requires cross-border solutions, since wind, water, solar and geothermal energy are dependent on local conditions. There is an neccessity, therefore, to develop the modern, sustainable and flexible smart grids needed to achieve climate objectives.

It is important to exploit the potential of the smart grid in combination with smart electricity meters. By better managing demand, network operators could better manage peaks and troughs in production and reduce the need for considerable surplus capacities (often from coal,

The EU is investing almost €4bn in major energy projects including offshore wind and carbon capture and storage

gas or oil) by up to 50%. More adept control of electricity use could allow consumers to reduce their energy consumption by 20% and thus contribute to reducing the total demand, energy costs and CO_2 emissions.

The convergence between information and communication technology and energy production that forms a central element of a smart grid will be important to this transformation.

Technology and sustainable energy supply

The development of a new generation of technologies is imperative if we are to achieve our energy and climate targets. As it often takes decades before new technologies become established and achieve a significant market presence, it is very important to launch them as soon as possible.

It is estimated that the global market for renewable energies will generate over €400bn in the next four years, which explains the keen interest of investors. Energy technologies and services that are low in CO_2 will undoubtedly be the biggest growth sectors in the coming decades, and the best way to nurture this market is through European cooperation. The European Strategic Energy Technology Plan (SET Plan) has paved the way for this.

At present, research and development are chronically underfunded in the EU. The Commission estimates that another €50bn must be invested in energy research over the next 10 years, almost tripling the annual volume of investment in the EU from €3bn to €8bn.

Energy-efficiency

Although some may consider energy-efficiency the least glamorous of our objectives, it is surely the most important. Energy-efficiency is arguably the cheapest way to fight climate change and secure energy supply. It will reduce energy imports, boost household incomes, increase the competitiveness of EU businesses and industry, and, at the same time, make a huge contribution to reducing our greenhouse gas emissions.

The EU has therefore adopted a whole series of rules and standards applicable to a wide range of energy consuming sectors such as buildings, cars, and brown and white appliances. I would like to highlight the importance of extending the scope of two directives that go hand-in-hand in enhancing energy-efficiency – the Ecodesign Directive, which sets the mandatory requirements for the products available at the market, and the Energy Labelling Directive, which encourages consumers and businesses to use the most energy-efficient product.

> *'The need to invest in new energy infrastructure, technologies and sources is enormous. It is estimated that by 2030 up to €1trillion will have to be invested in the European electricity grids and electricity generation and €150bn in the gas network, excluding import pipelines from third countries.'*

Given the potential in energy saving, I believe that we should do much more. I will be presenting an Energy-Efficiency Action Plan early next year. It is an area where technology and regulation should work hand-in-hand to accelerate the use of new solutions such as smart metering and new building standards and material.

Investment – the key to supply security

Strategic goals and political commitment alone will not build any infrastructures or place any new technologies on the market, but money remains a significant obstacle. The International Atomic Energy Agency has established that following the financial and economic crisis, investments in the oil and gas infrastructure in 2009 decreased by around 21% worldwide in comparison to the previous year. This means that the amount globally invested fell by around €80bn.

Almost €4bn of EU funds are being allocated in the framework of the European Economic Recovery Plan for Energy for major projects in the areas of electricity and gas interconnections, offshore wind and carbon capture and storage by the end of this year. Not only does this represent an unprecedented amount of funding from the EU budget for energy infrastructure, it is also a political statement on the benefits of such a programme of investments for the wider community. It demonstrates a consensus among member states on the need for an EU role in stimulating the investments that our energy system needs.

Securing the energy supply has a price and the earlier we invest in it, the lower this price will be. It is, therefore, particularly important not to allow the recession to restrict our efforts to invest. The European measures will not just stimulate the economy. They will also decrease our dependency on fluctuating oil prices in the future.

By the end of the year, the Commission will present a package showing the challenges and specific requirements for developing new electricity networks to facilitate the integration and extension of renewable energy sources.

The public sector will not be able to pay for everything but it will be able to offer an incentive. Through investment in our energy economy, we are also investing in people. Low carbon energy networks, 'green' manufacturing and renewable technology and maintenance create the need for new skills and expertise. More efficient businesses will grow alongside more efficient homes and transport. New technologies, such as second generation biofuels, offshore wind 'intelligent' grids or fourth generation nuclear power, will create new markets for Europe's businesses. These developments will not only benefit Europe's security of supply, but also society and the economy.

Ambitious but realistic

The European Commission's vision of achieving a carbon-free energy and transport system by 2050 is indeed ambitious but entirely feasible. Besides a considerable increase in energy-efficiency, we want to produce electricity exclusively from sources with the lowest possible CO_2 emissions. We are talking about a future energy mix produced predominantly from renewable and nuclear sources, but also fossil fuels with carbon capture and storage.

For these reasons, the EU must above all create the necessary energy policy stimuli and incentives to boost investments in infrastructure, technology and energy-efficiency. Ultimately, it comes down to the energy mix and market players' behaviour.

The main issues for Europe's energy policy are the internal market in energy, energy supply security, energy-efficiency, renewable energies, infrastructure and low emission energy networks for tomorrow. Together with the development of an external European policy for energy, they are also my priorities as Energy Commissioner for the coming years.

Günther H Oettinger
European Commissioner for Energy
European Commission
http://ec.europa.eu/commission_2010-2014/oettinger/index_en.htm

Poland's work on nuclear energy

2011 – the year of Maria Skłodowska-Curie and the year of chemistry…

Poland decided to start a national nuclear energy programme 55 years ago and the Institute of Nuclear Research (IBJ) was established. Research in nuclear and analytical chemistry, nuclear chemical engineering and technology (including fuel cycle), radiochemistry and radiation chemistry, and radiobiology were carried out mainly in the Chemistry Division, located in Warsaw Żerań, which became the interdisciplinary Institute of Nuclear Chemistry and Technology (ICHTJ) in 1983.

ICHTJ is Poland's most advanced institution in the fields of radiochemistry, radiation chemistry, nuclear chemical engineering and technology, application of nuclear methods in material engineering and process engineering, radioanalytical techniques, design and production of instruments based on nuclear techniques, environmental research, cellular radiobiology, etc. The results of work at ICHTJ have been implemented in various branches of the national economy, particularly in industry, medicine, environmental protection and agriculture. Basic research is focused on: radiochemistry, chemistry of isotopes, physical chemistry of separation processes, cellular radiobiology, and radiation chemistry, particularly that based on pulse radiolysis method. With its nine electron accelerators in operation and with staff experienced in the field of electron beam application, the institute is one of the most advanced centres of science and technology in this domain. The institute has four pilot plants equipped in six electron accelerators: for radiation sterilisation of medical devices and transplantation grafts; for radiation modification of polymers; for removal of SO_2 and NO_x from flue gases; for food hygiene. The electron beam flue gas treatment in EPS Pomorzany with the accelerators power over 1MW is a biggest radiation processing facility ever built.

The institute trains many of IAEA's Fellows and plays a leading role in agency regional projects. Because of its achievements, ICHTJ has been nominated the IAEA's Collaborating Centre in Radiation Technology and Industrial Dosimetry (www-naweb.iaea.org/na/collaborating-centres.html). It also is editor of the scientific journal Nukleonika (www.nukleonika.pl).

ICHTJ conducts PhD studies in nuclear chemistry, the country's only programme in this field. The institute represents the country in the GNEP Fuel Supply Working Group, Euratom Fuel Supply Agency and radioactive waste working group NEA – OECD.

ICHTJ has begun the implementation of several projects in the programme 'Innovative Economy' POIG, granted on the basis of high evaluation of the institute's achievements:

- Centre for Radiochemistry and Nuclear Chemistry – meeting the needs of nuclear power and nuclear medicine;
- Analysis of thorium usage effects in a power nuclear reactor (Coordinated by the Institute of Atomic Energy);
- Analysis of the possibilities of uranium extraction from indigenous resources (in cooperation with the Polish Geological Institute – NRI);
- New generation of intelligent radiometric tools with wireless data transmission;
- Development of a multi-parametric triage approach for an assessment of radiation exposure in a large-scale radiological emergency.

ICHTJ is a leading institute in Poland regarding the implementation of nuclear energy related EU projects. Its expertise and infrastructure was the basis for participation in Euratom and FP7 grants:

- ACSEPT: Actinide reCycling by SEParation and Transmutation;
- ADVANCE: Ageing Diagnostics and Prognostics of Low-voltage I&C Cables;
- IPPA: Implementing Public Participation Approaches in Radioactive Wastes Disposal;
- MULTIBIODOSE: Multidisciplinary Biodosimetric Tools to Manage High Scale Radiological Casualties.

The mission of ICHTJ is the implementation of nuclear energy for social development, health and environmental protection.

INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

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Nuclear energy renaissance in Italy

The Italian commitment to nuclear energy…

Italy was amongst the first countries to study and develop nuclear power technology. Only a few years after the famous Chicago experiment carried out by the Italian Enrico Fermi, who realised the first controlled fission chain in 1942, Italy started to study nuclear technology for civil use. Officially the research and development of nuclear power started in Italy in 1946, with the establishment of a scientific body to pursue this technology.

The first agency to develop and promote nuclear power, the National Committee for Nuclear Research, was created in 1952. In line with the US programme Atoms for Peace, this agency was reorganised in 1960 to become the National Committee for Nuclear Energy (CNEN, now called ENEA – Italian National Agency for New Technologies, Energy and Sustainable Economic Development). In the 1960s, the Italian nuclear sector was amongst the most advanced in the world: Italy was the fourth country to install plants and ranked third in 1966 in terms of electricity production from a nuclear source.

But after the Chernobyl accident in 1986, under the pressure of a large emotional wave and on the basis of the result of a national referendum, nuclear power was phased out. Works related to a new boiling water reactor (BWR), though almost completed, as well as to six planned, locally designed pressurised water reactors (PWRs) were stopped. ENEA also closed various fuel-cycle facilities and halted the construction of two large prototype reactors (namely CIRENE and PEC).

Starting from 2008, a new policy began on nuclear electricity production. The new programme foresees the quick start-up realisation of four new nuclear power stations, jointly designed and constructed with France, with the target of 6,400MWe in the next decade. The new ambitious energy plan proposed by the Ministry of Economic Development foresees 25% of electricity demand supplied by nuclear power by 2030, which requires eight to 10 large new reactors.

Nuclear industry development

In 1959, at Ispra (close to Milan) the first experimental reactor was started, and the construction of the first civil reactor – a British Magnox unit – began in 1958 just south of Rome. Construction of the first GE BWR began the following year, and in 1961, the erection of the first Westinghouse PWR started.

The ambitious national plan of the 1960s and 1970s, even if not fulfilled, allowed the Italian industry, and mainly the ANSALDO Group, to develop the components and systems for nuclear power plants, gaining, in some cases, a leading position worldwide with significant export capability.

In parallel, as far as fast-breeder reactors, in the 1970s and in the 1980s Italy (Ansaldo, ENEL and ENEA) was mainly involved in two large endeavours:

- From 1973, the design and realisation in France of the Superphenix fast-breeder reactor, which operated between 1986 and 1998;
- The development, design and realisation in Italy of a 120MWth fast-spectrum Material Test Reactor called PEC (Prova Elementi Combustibile); this project was terminated as a consequence of the above mentioned referendum.

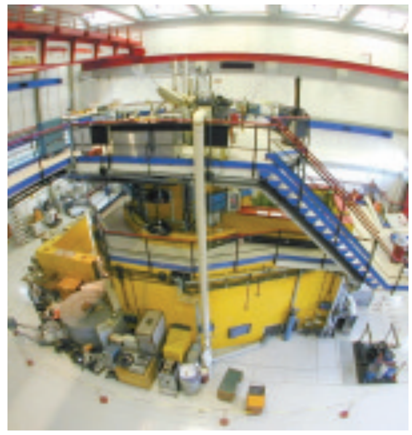

Fig. 1: TRIGA Mark II at ENEA Casaccia Centre (Rome)

Nowadays, ANSALDO Nucleare is building Cernavoda 2 in Romania and participating in the first AP1000 realisation in China. The company is also involved in international R&D on new generation reactor systems and, in particular, is developing – together with other 20 European organisations (among which is ENEA) and with financial support from Euratom – the conceptual design of a very innovative Generation IV Lead-cooled Fast Reactor, named ELSY (European Lead-cooled System).

In 2005, ENEL, Italy's largest electric power company and Europe's second listed utility by installed capacity, signed a cooperation agreement with Electricité de France (EdF), allowing ENEL to manage 200MWe from the Flamanville-3 EPR reactor and an additional 1,000MWe from other French reactors. In the same year, ENEL bought 66% of the Slovakian electric utility, Slovenské elektrárne, operating four nuclear reactors and planned new investments for the completion of two further nuclear power units (942MW to go online in 2011-12). In 2009, ENEL established an agreement with Spain's Endesa to acquire 25% of the

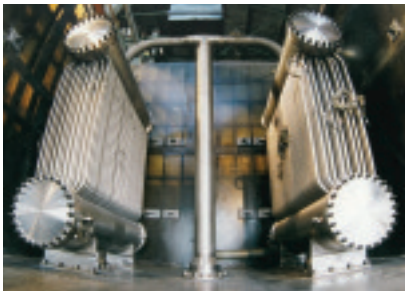

Fig. 2: Large test facility for advanced LWR at SIET (Piacenza)

company (and take its ownership to 92% in 2007), managing three PWRs (Asco 1, Asco 2 and Vandellos 2).

Links with France were reinforced in August 2009: an EdF-ENEL joint venture, Sviluppo Nucleare Italia, was set up with 50-50 ownership. Initially, it will conduct feasibility studies on building at least four 1,650MW Areva EPR units at three different Italian sites. ENEL expects the first site to be licensed in 2011, and operation of the first unit to start in 2020.

Radioactive waste management and decommissioning have been carrying out in the frame of bilateral cooperation agreements with France and the United Kingdom. Italian SOGIN company is responsible for these activities and has the task of siting, realising and managing the national radioactive waste repository in the so-called Nuclear Technology Park.

Nuclear R&D activities

Despite the political decision to halt nuclear activities in 1988, Italy has remained active in nuclear R&D over the last two decades and a large number of activities have been carried out in the field of applying ionising radiation, material science, nuclear safety and security, and simulation and modelling, etc., also taking advantage of the two still running ENEA research reactors (TRIGA-RC-1, see Fig. 1, and TAPIRO), of the TRIGA-II Reactor at University of Pavia and of several experimental facilities at ENEA and SIET (Fig. 2).

The leading agency for applied nuclear research continues to be ENEA. R&D is set in the frame of European and international projects, as well as a multi-year R&D national programme lead by ENEA with the joint involvement of CIRTEN (Italian Universities Consortium for Research in Nuclear Technologies) and SIET (an ENEA subsidiary). The programme is funded yearly at the level of about €6m and involves about 200 researchers and nuclear engineers. R&D activities are focused on the development, at European and international level, of small modular reactors and generation IV nuclear systems. Other important topics concern the scientific and technical support of the Nuclear Safety Authority, some scientific key issues related to waste management, advanced nuclear fuel-cycles, scenario studies and, last but not least, education and training, and communication in the nuclear field. The competences and capabilities being developed through this programme also represent the essential scientific and technical background to support the new nuclear energy policy of the government, in view of the planned nuclear power plants realisation in Italy.

As far as generation IV systems, the main ENEA effort concerns participation in the already mentioned ELSY project aimed at investigating the technical and economical feasibility of a 600MWe power reactor cooled by molten lead and demonstrating that it is possible to design a competitive and safe, fast critical reactor, capable of recycling its own nuclear wastes by adopting simple engineered technical features. The Lead Fast Reactor (LFR) is one of the six innovative systems being considered by the Generation IV International Forum (GIF), as it may represent a significant step forward for sustainable, safe, non-proliferation, economic nuclear energy.

The Italian commitment at international level

In October 2007, Italy became the 17th member of the Global Nuclear Energy Partnership (GNEP, now IFNEC) set up to develop new nuclear fuel-cycle technologies to improve proliferation resistance, while increasing recycling and reducing wastes. In 2009, Italy also became a full partner of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) promoted by the IAEA in 2001. Italy is also contributing to GIF through Euratom and a number of Italian organisations are members of the European Sustainable Nuclear Energy Technology Platform (SNETP) and of the European Sustainable Nuclear Industrial Initiative (ESNII). In September 2009, a nuclear cooperation agreement with the USA cleared the way for the use of US nuclear technology alongside the planned French EPRs.

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