Energy Knowledge and Innovation Agenda

Challenges and aspirations

Our energy system is in transition: driven by climate change, scarcity and the need for affordable, reliable and sustainable energy supplies, fossil fuels are making way for sustainable, renewable sources. This has consequences for the ways in which energy is generated, transported, stored, consumed and saved. Sustainable generation methods, the integration of energy carriers, the opportunities afforded by ICT and energy users' behaviour are changing. As a result, energy innovations are not solely technological in nature, they also have important economic and social aspects.

The Energy top sector is the driving force behind the innovations needed in order to transition to an affordable, reliable and sustainable energy system. It is doing this by encouraging the development of innovations that speed up the transition to a completely sustainable energy supply. At the same time we are creating new economic activity and enhancing our international competitiveness, in collaboration with industry, knowledge institutions, organised interests and authorities.

Given the dual aims – energy transition and growth –, the sector's aspirations are in line with the Energy Agreement and the European energy targets. The Energy Report that is to be published at the end of 2015, setting out the Government's views on meeting the European target for 2050, could affect the Knowledge and Innovation Agenda for the Energy top sector. The transition to a clean, reliable and affordable energy supply will benefit not only from new technologies but also from making existing technologies more efficient and cheaper. To meet the 2050 target we shall have to work for innovation at all TRLs.[1]

Energy Agreement targets for 2020/2023
- 16% sustainable energy by 2023
- 100 PJ of energy savings in final consumption by 2020 compared with the 2013 level
- 15,000 net additional jobs in the energy sector
- The Netherlands to be among the top ten in the international Clean Tech ranking by 2030
- An energy technology chain with four times more economic value by 2020 compared with 2010

European targets for 2030
- 40% reduction in greenhouse gas emissions compared with 1990
- 27% renewable energy
- 30% energy savings

European targets for 2050
- A completely sustainable energy supply
- An 80-95% reduction in CO_2 emissions compared with the 1990 level

Knowledge and Innovation Agenda 2016-2019

Energy saving (in industry and the built environment), offshore wind power, solar power, use of biomass, system changes (integration, smart grids, social innovation) and using gas as a transitional fuel are the priorities for the Energy top sector. Five of the themes are being managed by a programming TKI (Top Consortium for Knowledge and Innovation); the System integration theme, which overlaps with all the other themes, has a single integrated programme 'at the front', fuelled and supported 'at the back' by the TKIs working together in the Energy top sector to produce tailor-made solutions.

Offshore Wind

The Offshore Wind TKI aims to ensure that offshore wind power makes a substantial, affordable, reliable and socially responsible contribution to the energy supply. The focus is on five programme lines and two themes. The programme lines are (1) Support Structures, (2) Wind Turbines and Wind Power Plant, (3) Internal Power Grid and Connection to the High-Voltage Grid, (4) Transport, Installation and Logistics, and (5) Management and Maintenance. The two themes are Demonstration Facilities and Strategic Workflows (non-technical activities).

Gas

The Netherlands is a gas country, with a very important trade in gas. The programme lines on the agenda, based on optimum utilisation and sustainability, are as follows:
- Green Gas Fermentation and Green Gasification, with a production target of 750 million Nm^3 of green gas by 2020 and at least 3 billion Nm^3 by 2030
- Upstream Gas, with the aspiration of making Dutch gas available with minimum social impact
- Small Scale LNG, focusing on the use of liquefied natural gas for heavy goods transport (by road and waterway), with a target of 1 billion m^3 of gas as LNG by 2020 and 3-4 billion m^3 by 2030
- CCUS, focusing on innovation issues with the implementation of CCUS and exploring the re-use of CO_2: dam projects should help to explore these issues and address them internationally.
- Hydrogen: with the aim of making the gas system climate-neutral
- System integration: a top sector-wide programme, the main topic being the role of gas in the system

Urban Energy

The innovation themes have been selected on the basis of their impact on the aspirations, and because they are interconnected: generation, integration and smart management of the energy system, including the infrastructure, are the keys to achieving the desired innovations. The priority is on the topics that have the

1 TRL = Technology Readiness Level (of basic research, via R&D and demonstrations to market launch)

maximum impact on energy transformation in the built environment and also have a good base in the Dutch industry – from machine tools manufacturers and the supply industry to user organisations and the knowledge institutions. The five programme lines are Solar Power Technology (PV), Thermal Energy Installations, Multipurpose Building Components, Flexible Energy Infrastructure, and Energy Control Systems and Services.

ISPT
Energy saving in industry is concerned with more efficient processes and the re-use of heat. The ISPT is working together with a large number of large companies and SMEs to make processes in industry smarter and more efficient. The programme lines focus on Energy Saving in Industry (new-generation heat systems, separation technology, drying processes and so on), The Transition to Sustainable Energy (power to heat, power to products), and Industrial Symbiosis.

BBE
The biobased economy (BBE) applies the cascade principle, with food and animal feed at the top of the list and higher added value anticipated from pharmaceuticals and chemicals than from using biomass for power generation. The biobased economy is thus a cross-over between Agri & Food, the Chemical industry and Energy. The programme lines are Refinery and Thermal Conversion of Biomass, Refinery and Chemical Catalytical Conversion Technology, Refinery and Biotechnological Conversion Technology, and Solar Capture & Biomass Production.

System integration
System integration is based on the expectation that the separations between different energy systems will become increasingly blurred: you can produce gas (hydrogen) from electricity, also ammonia, heat and cold. Conversion between energy carriers will make for more flexible systems, which we need to offset the price peaks and troughs that can be expected as the share of sustainable energy increases. In this way electricity can also help to make the heat demand, transport and mobility more sustainable.

Cross-sector collaboration
The Energy top sector is working together with other top sectors in many areas. Sustainable mobility, for example, requires collaboration with the HTSM and Logistics top sectors (electric transport and smart grids: cars as batteries on wheels; LNG, hydrogen and biodiesel/kerosene). Energy is also working together closely with the HTSM top sector on materials studies (biosolar cells; composites; perovskite for solar cells), nanotechnology and solar power. And it is collaborating with the Chemicals top sector, focusing on materials, biobased processes and energy saving. Energy and Chemicals have jointly set up InnovationLink, a support desk for SMEs. Advances in big data, smart grids and SCADA systems for offshore wind farms and in industry, for example, require collaboration with ICT. Ideas from the Creative Industries are also contributing to design (attractiveness to consumers) and market launch strategies. Work is in progress in collaboration with the Water top sector on obtaining energy from water (tidal current power, salinity gradient power, offshore wind, for example).

In the city of the future there will be a place for cross-overs between energy, drinking water, waste processing, logistics, ICT and green spaces and food supply. The Energy top sector is working together with other top sectors on integrated solutions to the vision of the Netherlands as a Sustainable Urban Delta.

Societal challenges
The Energy top sector's agenda touches upon virtually all the societal challenges, but the most important ones are secure, clean and efficient energy, climate, resource efficiency and raw materials, and smart, green and integrated transport.

Strategic PPPs
The top sector's various programme lines are reflected in public-private partnership programmes. A few outstanding examples are the large-scale joint venture in the area of CO2 Storage and Valorisation; the System Integration Consortium (power2heat, power2products) under the ISPT, in which some twenty companies are participating; BioSolar Cells (nine knowledge institutions and 35 companies); the CATO Platform (carbon capture & storage); the National LNG Platform; Solliance (with some 30 private and eight public participants); Green IT Amsterdam Region; Dutch Power; the Upstream Gas Consortium; SiCC (a network focusing on PV research); and BE-Basic, an international PPP involving some 40 companies and knowledge institutions focusing on biobased solutions.

Linking up with the Dutch National Research Agenda
The partnership with scientists in various NWO (Netherlands Organisation for Scientific Research) programmes is already tackling basic questions regarding future energy supplies. These include gas extraction in relation to subsoil organisation (where the larger number of desired applications such as oil and gas extraction, CO2 storage, infrastructure, deep geothermal energy and water extraction make the situation more complex); exploration of future trends and new sustainable materials for solar power; looking into artificial photosynthesis and reliable, smart energy infrastructure and new business models for system integration. It is also important to successfully accommodate the social consequences and acceptance of the energy transition. These topics continue to require basic, innovative knowledge for the future, and this need for knowledge links up with the development of the Dutch National Research Agenda: themes such as energy and sustainability are of major relevance to society and have been common threads in the process so far.

Website
The complete Knowledge and Innovation Agenda for the Energy top sector can be found at http://topsectorenergie.nl/gereed-de-kennis-en-innovatieagenda-2016-2019

Themes	Societal challenges	Cross-sector	Strategic public-private (PPP) programmes
Urban Energy	Secure, Clean and Efficient Energy	Sustainable Mobility (HTSM, Logistics)	CO2 Storage and Valorisation
Offshore Wind	Climate, Resource Efficiency and Raw Materials	Materials Studies, Nanotechnology and Solar Power (HTSM)	System Integration Consortium (power-2heat, power2products)
Gas	Smart, Green and Integrated Transport	Energy and ICT (ICT)	BioSolar Cells
ISPT (process technology)		Sustainable Urban Delta (Water, Logistics, ICT)	CATO
Biobased Economy		Design, Market Launch (Creative Industries)	Solliance
System Integration		InnovationLink (Chemicals)	BE-Basic