

R&D plan 2016 - Storage and Integration of Renewable Energy

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External developments

- System integration in the Netherlands is recognized as a key enabler for the transition to a sustainable energy system. This is reflected in the continuation of the R&D tender System Integration in 2015 under the Topsector Energy.
- In the European framework, system integration and its underlying technologies are well embedded in the H2020 program. Next to that, the EERA JP Energy Systems Integration has just passed its first gate to become a full JP.
- System integration has the potential to lower societal costs, to maintain the high level of reliability of the current energy system, and to enable integration of high shares of renewables.
- In the Netherlands, the current focus within the area of system integration is on:
 - Power to X
 - Energy storage and storage management systems
 - Demand response 'behind the meter'

Internal developments

- ECN has recognised that renewable energy technologies for energy supply and technology for energy efficiency alone will not lead to a full transition to a sustainable energy system. In addition to energy generation and energy saving technologies, proper integration methods need to be developed. Therefore, in 2012 an evaluation project on energy storage and flexibility was started.
- This evaluation led to the definition of a cross-cutting research program on Storage & Integration of Renewable Energy with program lines on the following area's:
 - System studies and market analyses
Long-term optimization of the energy system, including flexibility needs. Analysis of markets and prices, and potential of technologies
 - Policy instruments
Development of new market/business models, policy instruments, and study of customer behaviour
 - Energy storage technology
Battery systems and components, kinetic energy storage and conversion of electricity into heat, gas or chemicals
 - The role of the processing industry in the energy system
Process and system analyses, process integration of storage and conversion technologies, new business models
- This program crosses all technology fields within the Top Sector Energy, and has links to the Top Sectors Chemistry and HTSM.

Programme line 1. System studies and market analyses

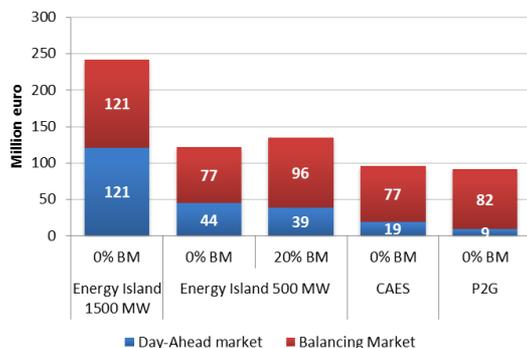
Fit to the Topsector Energy

Program System Integration of the Topsector Energy in 2014 was strongly focused on system studies and integration of renewables. In 2015, focus has shifted to technology specific areas. It is expected that the system level approach will again be important in 2016.

Example result: value of large scale storage

- Analysis of large-scale storage economics in the day-ahead and balancing electricity markets
- Technologies compared are Energy Island, CAES, and power-to-gas
 - Revenues for all large-scale storage options are substantial
 - Reserving capacity for the balancing market increases revenue
 - Revenues per unit of power capacity drop for larger storage systems

**Yearly revenues storage options,
2023 NL**



R&D Targets 2016

Overall target

Facilitating the energy transition and lowering societal costs, by creating an integral perspective on technologies, infrastructure, markets, and policy.

- Develop an integral perspective on a sustainable energy system by back-casting
 - Back casting from after the transition to renewables (beyond 2050)
 - Green-field approach, integrating infrastructure and conversion options and assuming competitive costs for renewables
- Determine economics of storage and conversion processes
 - Analysis of flex-requirement in time (2030, '50, and beyond)
 - Compare storage and conversion to DSR, flexible generation, and infrastructural measures.

Targets are subject to successful project acquisition

Key projects

- FLEXNET – TS Energy System Integration project on flexibility needs in the electricity system
- Quantifying demand for flexibility – TenneT study on flexibility needs, resulting electricity price levels, and possible flexibility providers.

Partnerships

- R&D partners: TNO, Ecofys, DNV GL, Energy Academy Europe
- Companies: Tenna, Energy Storage NL, Gasunie, Gasterra, Energy Valley

Programme line 2. Policy instruments

Fit to the Topsector Energy

Technologies that enable integration of renewable electricity and thus facilitate a sustainable energy system require a clear regulatory framework and stable energy policy.

This is reflected in the program System Integration, mainly in the non-technical paragraph required in proposals, as well as in the IDEEGO and STEM programs

R&D Targets 2016

Overall target: Analyse current and future policy measures and propose instruments that facilitate integration of renewable energy.

- Policy needs for maximising flexibility
 - Clarify the role of energy storage in the regulatory framework and propose instruments
 - Evaluation of instruments that facilitate flex (e.g. electricity price, capacity mechanism)
- Role of consumers
 - Evaluate consumer behaviour on flexible price mechanisms
 - Determine the potential for decentral initiatives and their needs (local self-sustaining communities)

Targets are subject to successful project acquisition

Partnerships

R&D partners: TNO, PBL, TUDelft, RUG/Energy Academy Europe

Companies: t.b.d.

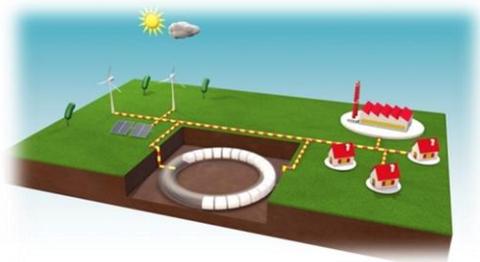
Programme line 3. Energy Storage Technology

Fit to the Topsectors Energy, Chemistry, and HTSM

- Technologies that enable integration of renewable electricity and thus facilitate a sustainable energy system require a clear regulatory framework and stable energy policy. This is reflected in the program System Integration, mainly in the non-technical paragraph required in proposals
- Large-scale storage technologies also have links to the program Wind at Sea, whereas small-scale storage links to the IDEEGO program.
- Energy conversion technology has interlinks with the TKI Gas for power-to-gas and with the TKI ISPT for both power-to-gas and power-to-heat.
- Energy storage hardware has a clear link to the manufacturing industry united in the Topsector HTSM

Example result: Energy Train

- The Energy Train is a large-scale kinetic energy storage system, based on MagLev and electromagnetic propulsion. ECN launched the concept in 2015. Next steps are a feasibility study, engineering of technology aspects, and detailed evaluation of the economics of a large-scale storage system in the electricity system

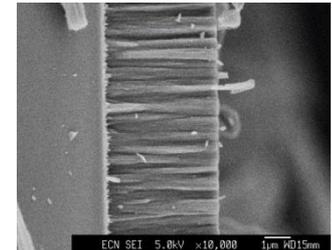


R&D Targets 2016

Overall target: Development of low-cost energy storage and conversion technologies suitable for grid integration

Proposed activities 2016

- Electrolyser development: the aim is to provide the manufacturing industry with concepts for low-cost electrolysers, both devices and components.
- Demonstration of large-scale electrolysis e.g. in refining (with technology providers and end-users)
- Offshore Wind-P2G: targeting the economic potential for wind energy far offshore and make economic use of existing infrastructure
- Energy Train: Large-scale energy storage concept that will be further developed in an open innovation consortium.
- Li-ion battery technology: developed from thin-film PV technology, with an equipment manufacturer. The current target is scale-up and industrial validation.



Partnerships

R&D partners: DNV GL, Solliance, DIFFER, TUDelft

Companies: Hydron Energy and other electrolyser manufacturers, Machine builders, Refineries

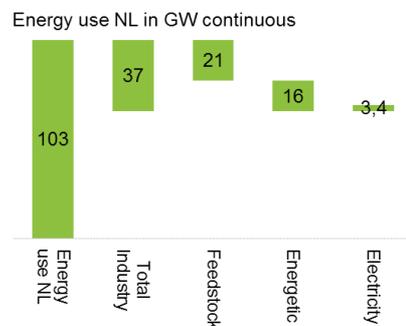
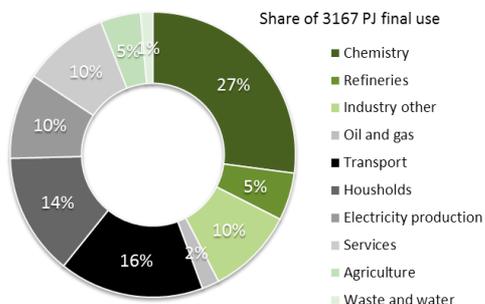
Programme line 4. The role of the processing industry in the energy system

Fit to the Topsectors Energy and Chemistry

The Topsector Chemistry has commissioned a program on Electrification of the chemical industry, based on a growing share of renewables and on decarbonisation targets for the sector. The Topsector Energy (TKI ISPT and program System Integration) has identified opportunities to use chemical processes as variable load in the electricity system. Therefore, there is a potential fruitful synergy between the two sectors.

Example result: fit between chemical sector and energy sector

- Chemical and refineries are the largest energy users in the Netherlands (32% of total use)
- Electricity is a minor energy source in the chemical sector
- The power demand (37 GW continuous) and total demand in chemical processes are much larger than the renewable supply in 2030 (7.5 GW continuous)



R&D Targets 2016

Overall target: Enable the role of the processing industry as integral part of the energy system (sink and source) via technologies, business models, and regulatory framework.

Proposed activities 2016

- Develop hit-list of electrification opportunities in the chemical industry
 - Top-down potentials based on technical assessment of individual process options, with an industry validation
 - Framework for smart integration of infrastructure: feasibility study of integration of industrial infrastructure and the electricity, gas, and heat grids.
- Power-to-H₂: feasibility study of electrolytic H₂ in refineries, demonstration of 10-20 MW electrolysis in refinery
- Power-to-heat: feasibility of retrofitting electrical heating, development of low-cost flexible electrical heat pumps and integration options
- Build a consortium and secure finance for the follow-up of VoltaChem

Key projects

- VoltaChem – TNO and ECN program on Electrification of the Chemical Industry (power to heat, hydrogen, and fine chemicals)
- FLEX-P2G – development of a water electrolysis stack and efficient methaniser coupled to business models for grid integration.

Partnerships

- R&D partners: TNO, DIFFER, TUDelft
- Companies: t.b.d.

Voor meer informatie kunt u contact opnemen met:

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