

Smart Grids Rotterdam

Introduction

Background

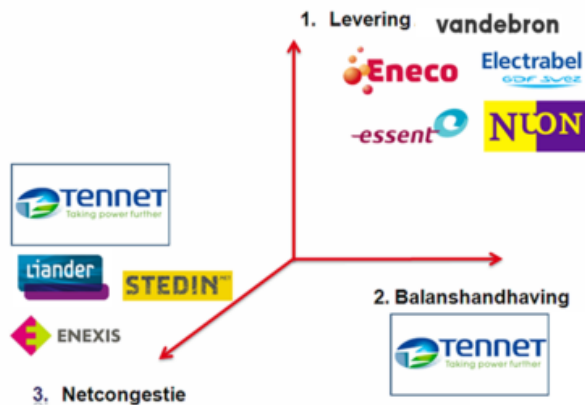
The energy landscape is changing dramatically. Over the past century, energy production was centralized. Energy was delivered to energy users via centrally supplied energy networks (electricity, gas, and heat). This is currently changing in various ways resulting in a more varied and decentralized energy landscape:

- Energy production is becoming more and more sustainable, to combat climate change.
- (Renewable) energy is more and more locally produced.
- The production and supply of renewable energy such as wind and sun is more volatile. This is resulting in bigger peaks in energy production, that are more often occurring.
- Energy consumption is electrifying. Heat supply and mobility will (partially) electrify over the next decade. (Part of) businesses and homes in the region will electrify fully in the next decade(s). In addition, electrical vehicles are expected to use about as much energy as an average Dutch household: around 10 kWh/day (2017). In areas with electrification and electric vehicles, the average electricity consumption per household could triple: from 10kWh per day now to 30 kWh per day.
- The user side of energy consumption had always had a volatile character. Without additional efforts in the field of Smart Grids, this is expected to increase even further because of electrification of energy consumption.

Smart Grids

In the near future, there is a need for services that enable existing players in the energy market to successfully fulfil their role. This is illustrated in the figure below:

1. **Energy supply – new price mechanisms (suppliers, including local prosumers):** it is desirable to balance supply and demand through price mechanisms, and with this support the increased efficiency of the energy system as a whole (trading value flex market).
2. **Net balancing (national grid operator Tennet):** it is desirable to allow the national grid operator to balance the national high-voltage network in an efficient way. For example, in Germany, grid operators already have had to request shut down of large-scale wind parks. This is to be avoided.
While net balancing is an important topic, it does not fall within the scope of this business case because of the different dynamics on the national grid (macro level).
3. **Congestion management (local grid operators):** it is desirable that supply and demand can be “matched” instantaneously and location-dependently. This makes it possible to reduce peaks on the local medium- and low-voltage networks and optimize the use of existing infrastructure (peak shaving).



Strategic partnership and Smart Grid program in Rotterdam

On 7 April 2016 Siemens, Stedin and the city of Rotterdam signed a “Cooperation Agreement Smart Grids Rotterdam” with a duration of 4 years. With this, partners started a **strategic partnership**. Main objective of the partnership is to establish an international showcase **Smart Grid program** in the greater Rotterdam Area, making Rotterdam a front-runner for Smart Grid development. Indicative objective is a Smart Grid with around 200 thousand connections in 2025, for electricity and other commodities such as heat. The program will consist out of a range of Smart Grid investment projects as well as research and education programs. It is envisioned to be expanded in the region (Metropolitan Area Rotterdam-The Hague) and to be connected with Smart Grid initiatives in other regional cities such as Den Haag (scalable, replicable). New partners are envisioned to join the partnership soon.

In parallel these partners, together with Omnetric and Lyv-Smart Living have started the Smart Electricity Grid project (SEG) with the objective to reach a large scale smart electricity grid in 2020 (~ 20 thousand connections). With the SEG project, partners are already putting their ambitions into practice. This means that besides technology development (market push), partners have started to develop Smart Grid services that match the need of existing market players (as explained under “challenges” above).

Purpose of this paper

This position paper introduces the business case for the Smart Grid program, including estimated investments and need for public support to further develop the program.

Strategic objectives

The Smart Grid program aims to implement Smart Grids on a large scale. With this it is an enabling program for the Energy Transition and Roadmap Next Economy (RNE: pathway “Smart Energy Delta”). It also contributes to RNE pathway “Digital Gateway to Europe”. The program results in an enabling infrastructure and services for the energy transition and makes it possible to meet Paris obligations (COP).

Lessons learned can be shared and used to improve the approach in Rotterdam and other European regions (replicability).

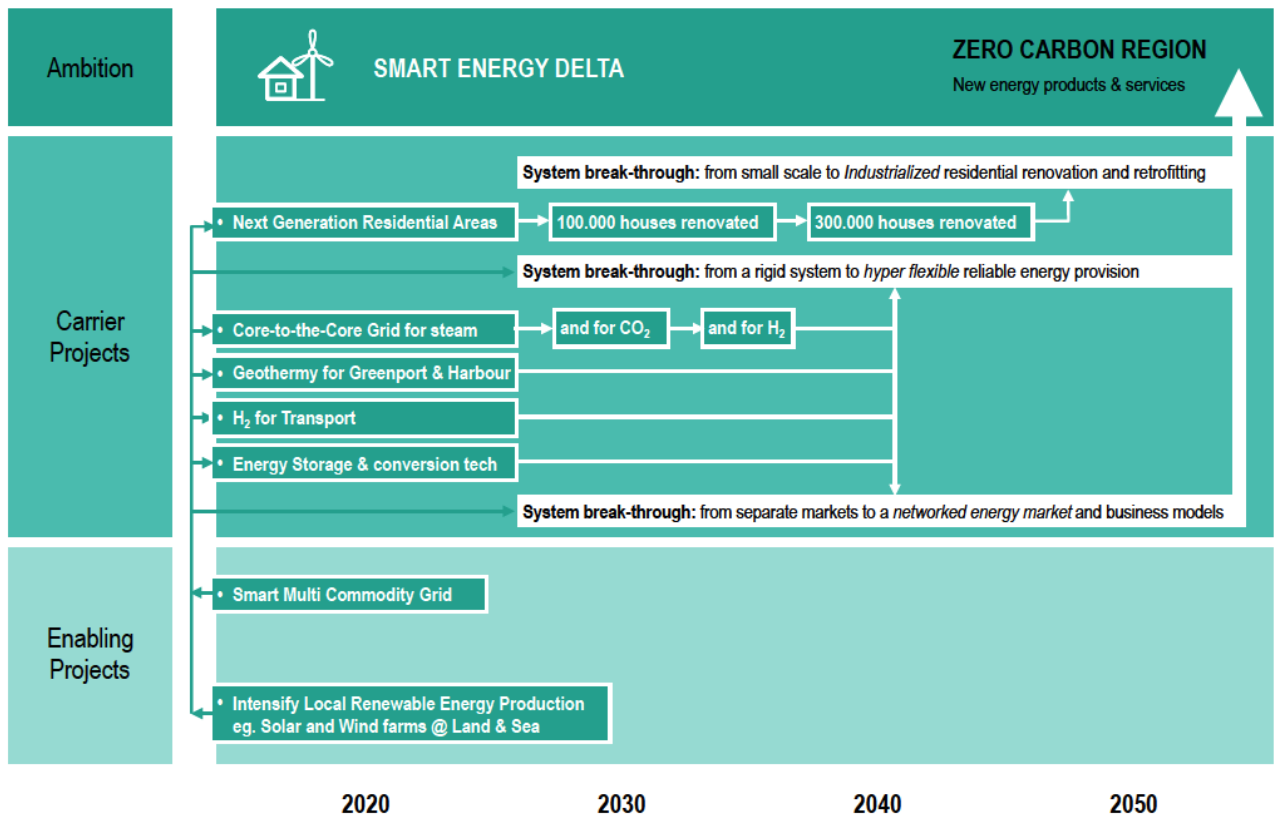


Figure: Smart Energy Delta, RNE (2016)

Strategic objectives are:

- Accelerated sustainable urban transformation:** the development and implementation of a Smart Grid IoT (Internet of Things) platform and Smart Grid services (demand response, Virtual Power Plant, peak shaving) for electricity and possibly heat, is at the core of this program. The program will contribute to urban transformation, because of projects for connecting "Applications" to the Smart Grid. "Applications" are for example: local renewable energy production (solar, wind), sustainable transformation of real estate (homes, commercial real estate), energy storage and conversion, smart mobility/ electric vehicles. Smart Grid services make investments in "Applications" more attractive and (financially) feasible. Investments in "Applications" are expected to accelerate because of the opportunity to be connected to the Smart Grid. As such Smart Grids contribute to economic development in the field of urban transformation.
- Economic development and jobs:** Rotterdam intends to be at the forefront of Smart Grid development in Europe. The accelerated development of Smart Grids and related sustainable urban transformation is envisioned to result in the establishment of an economic cluster of companies that offer products and services that contribute to this. The program will create jobs in the field of IoT Smart Grid technology and services, and sustainable urban transformation. For example, software development and tailored smart grid services for various applications like amongst others Mobility, Power to Heat. But also in the engineering and construction sector.
- Market enabling and energy security:** volatile sustainable energy sources as wind and solar power are rapidly introduced both at a large scale single spot (wind at sea) and large scale multiple spots (PV on roofs of households). Smart grids are the answer to the demand for energy

trading and the need for reliable energy system in an ever more advanced way to manage demand and supply of energy. This is necessary to prevent local congestion and loss of valuable (sustainable) energy.

Smart Grids contribute to a clean, reliable and affordable energy for all.

- **Knowledge development and education:**

- Research and development supporting the commercial development of Smart Grid technology (IoT) and business models, for example in the field of technology development for Smart Grid services, energy market development and design of Smart Grid services from a technical and market perspective.
- Development of education programs. Education programs will be developed both on the academic level as vocational education. This is to ensure there will be enough workers on all levels to facilitate the development of Smart Grids.

Contribution to goals of Europe and RNE

The Smart Grids program contributes to the goals of Europe and the Roadmap Next Economy (RNE).

- **Accelerated implementation of sustainable urban transformation:** the program contributes to increased data productivity (IoT Smart Grids), increased energy productivity (renewable energy, energy storage and conversion), increased mobility productivity (smart mobility/ electric vehicles), increased resource productivity (renewable energy production facilities don't need to be shut down to reduce peaks on (high-voltage) energy networks).
- **Economic development and jobs:** the program contributes to regional employment opportunities.
- **Market enabling and energy security:**
 - The program results in decreased poverty and income inequality because it ensures a reliable and affordable energy system for all.
 - The program contributes to the sharing economy and local consumption and production because of the nature of a Smart Grids (enabling local energy producers, consumers and prosumers to be part of the energy market place).
- **Knowledge development and education:** this program results in new research and education opportunities.

Scope

Under the Smart Grid program, a range of projects will be realized:

- **Investment projects:** direct contribution to Smart Grid development.
- **Research projects:** research, relevant to accelerate investments.
- **Education projects:** education, relevant to accelerate investments (at scale).

Partners in the “Cooperation Agreement Smart Grids Rotterdam” will focus on projects and activities that accelerate investments and are additional to other ongoing projects and activities.

The figure below further illustrates the scope of the Smart City program. The Smart Electricity Grid project (SEG) is the starting point of the program. In order to accelerate its development, it will be crucial to also invest in “Applications” that make it possible to connect the Smart Grid to:

- **Sustainable urban transformation (built environment):** such as amongst others energy efficient smart homes, rooftop solar PV, electric boilers.
- **Smart mobility:** such as electric vehicles and charging stations.

- **Local renewable energy production and storage:** such as solar, wind, energy storage and conversion installations.

Over time, also other commodities such as district heating/ geothermal (high- and low temperature), H₂ and CO₂ can be connected.

Geographically, the Rotterdam program can be connected to other Smart Grid initiatives in the region (The Hague, others).

Also, while net balancing is an important area of interest, it does not fall within the scope of this business case because of the different dynamics on the national (high-voltage) grid (macro level). However, it can possibly be included at a later stage.

Strategic partners in the Smart Grid program aim to align the program with national and European energy policies and will take this into account when updating this business case over the coming months.

