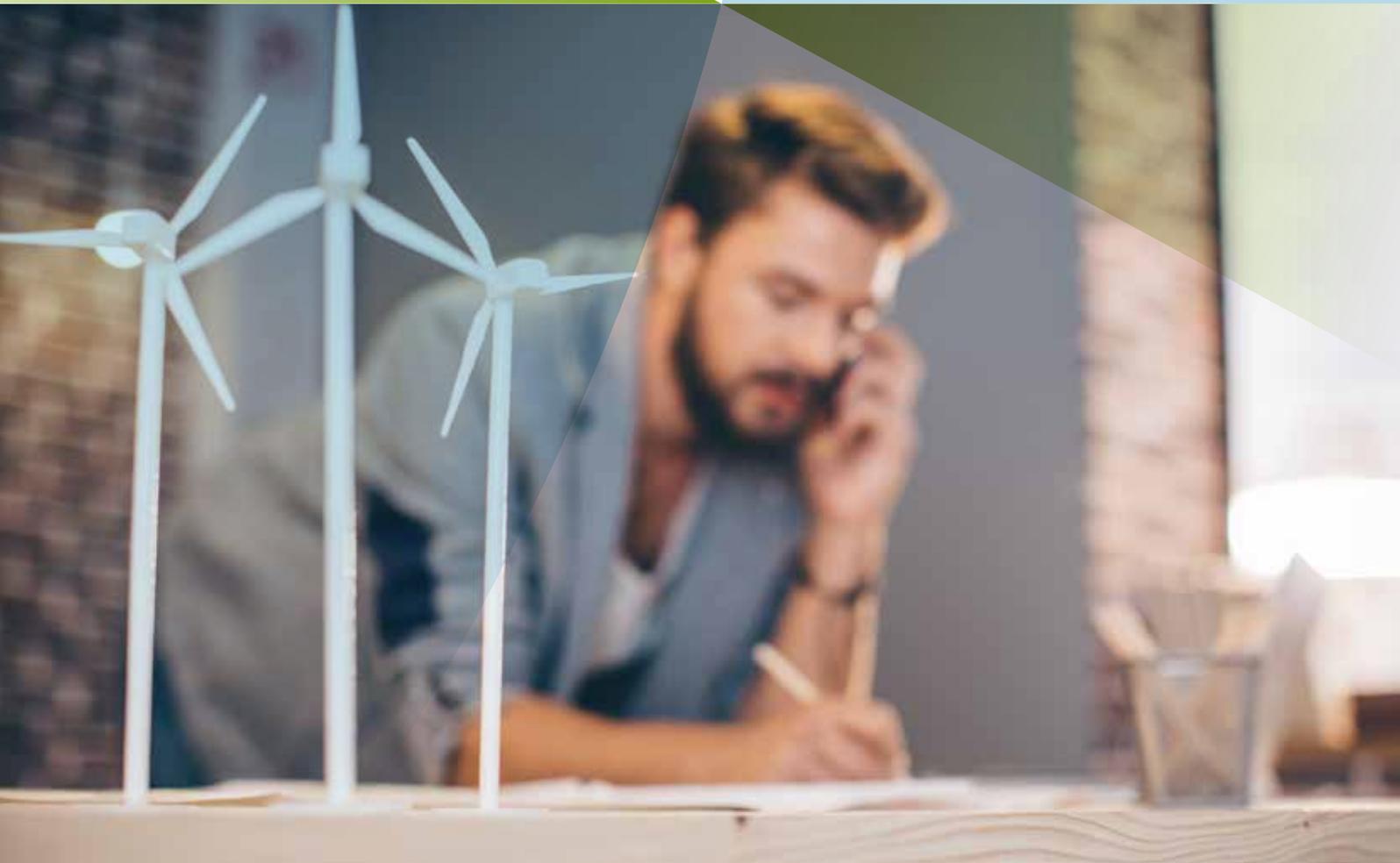


Energy Systems

Embracing the Energy Transition



A global energy system

Across the globe, industry faces a huge challenge in the need to be able to provide the energy required to support a growing global population, without damaging our environment beyond repair.

Traditionally, industry has adopted a linear approach to energy, relying on traditional power sources which just aren't sustainable any more.

Royal HaskoningDHV, a leading independent international engineering consultancy, has over 20 years' experience in the energy industry. We are committed to improving energy services to fuel economic development and ensure energy security across the globe.

The shift to renewable energy

If we talk about the term 'Energy Transition', generally we are defining a long-term structural change in energy systems.

Typically, this means moving from a reliance on fossil-based energy systems to those that use renewable energy. And that means taking a totally new approach, including embracing new production methods.

There are three main market drivers which are leading our clients to embark upon the Energy Transition:

1. Greater demand to enforce Corporate Social Responsibility (CSR) policies
2. The need to guarantee the security of energy supply to enable effective operations
3. Increased regulation in force to reduce CO₂ emissions and thus fossil fuel usage

And it is this last point which is dictating the rate at which industry makes the transition to renewable energy.

European roadmap

Industry across Europe faces numerous regulations which mean that the energy efficiency and sustainability measures enforced are becoming more and more severe.

The European Commission has put in place a goal to cut greenhouse gas emissions by 80-95% by 2050 – and this has serious implications for our energy system. About two thirds of our energy will need to come from renewable sources, and the time is now to start embracing this technology in our operations today.

Alongside the Dutch MJA3 and MEE covenant, the European Energy Efficiency Directive and renewable energy goals, industry will need to put in place an action plan to ensure long-term production.

Our approach

Royal HaskoningDHV has a long track-record in the energy industry. Over recent years, we have developed our capabilities to become an integral advisor to clients for the entire value chain with our expertise now taking an integrated energy system approach – covering energy production, distribution and use.

There are two steps to our approach to ensure we find the best solution for each client:

1. **Strategic consultancy** – first, we identify the path towards the energy transition by understanding your production processes and related energy consumption profiles, before looking at potential technologies and business cases. We prioritise measures by level of impact, investment costs or realisation complexity.

2. **Engineering consultancy** – once we have a plan in place, our team will oversee the entire value chain. Our job is to manage all project activities – whether that's business case development, feasibility studies, identifying financing schemes, internal and external stakeholder engagement or even design and engineering. We will manage the process from beginning to end.

Given our extensive experience in the energy industry, you can rest assured that Royal HaskoningDHV understands your individual requirements. Unlike our competitors, we provide strategic advice based on technical project expertise, which helps prevent problems arising in future phases of the development.

We also understand the risks – an integral part of the energy transition process. Whilst we do everything we can to ensure a smooth implementation of new solutions, we will be transparent on the risks throughout the process.

Together with our clients, we are making the change towards a more future-proof business, providing a sustainable future via a long-term vision for energy usage.

In order to deliver this, you need to have the support of a trustworthy partner. Our '4 Questions' approach means that we work towards enhancing society together by asking ourselves, our clients and their stakeholders four key questions – an integral part of the process.



Stakeholders

Does the output meet the requirements of most stakeholders involved?



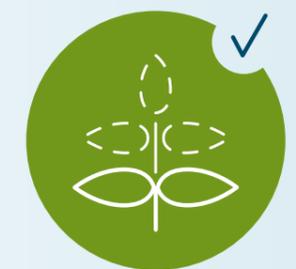
Add value

Does the output serve additional added value for the client and society as a whole?



Future-proof

Is the result lasting, is it future proof?



Resources and Energy

Can we meet the client's demand while using a minimum of natural resources and energy?





Project overview

Ensuring a reliable energy supply for VU and VUmc, Amsterdam

2014-ongoing

Vrije Universiteit and its associated Medical Centre in Amsterdam have a distinct requirement to future-proof their energy systems. Not only do these institutions require a reliable energy supply, they also have an ongoing need to reduce operational costs and have big ambitions to reduce their CO₂ footprint over the coming years.

In close cooperation with client representatives, Royal HaskoningDHV developed an Energy Master Plan positioning their long-term ambitions to develop a sustainable, resilient and feasible energy provision up until 2035. Our experts also compiled an investment plan taking the client to 2021, enabling them to make an

immediate start in solving short term problems in line with their long term vision.

One of the main challenges we have faced is the need for the campus area to be kept operational during the development phases. This must be taken into account as part of the Master Plan to ensure that the needs of students and patients alike continue to be met.

Our team has also provided future demand modelling, system engineering, financial and strategic support to ensure that the client can realise a futureproof development and a sustainable source of reliable 'green' energy into the future.

Join us in making the energy transition happen

Changes across the energy system are undoubtedly taking place – but it is a slow process. Just how can the industry overcome the gap between fossil and renewable energy, and meet its sustainability goals whilst keeping position in what is often a slow economy, facing increasing price pressures?

We understand that changing markets require changing roles and business models, and certain industries are undoubtedly being hit harder by the shift. The petrol chemical industry, steel, power and manufacturing industries will all face tough decisions over the coming years – to name just a few.

Energy is a hugely important resource for the industry and will be vital to Europe's success on a global scale. Work with us to ensure a successful energy transition, whilst simultaneously working towards a sustainable future.

Assessing Power-to-Gas energy storage for Groningen Seaports

2013

Groningen Seaports is the port authority and commercial operator of the port of Delfzijl, Eemshaven and its adjoining industrial sites. In order to attract new users to the industrial facilities, Groningen needed to future-proof its energy system and ensure reliability for its customers' operations.

Royal HaskoningDHV completed a study of various energy storage systems, with a particular focus on Power-to-Gas energy storage.

In partnership with INTIS, a German company specialising in the provision of sustainable integrated engineering services, our team conducted a comparison of various storage systems including CAES, pumped hydro and batteries.

Our study also included a high level business case for Power-to-Gas, making it possible for the client to utilise excess wind offshore power in the near future.



Providing steam power in IJmond

2016

In a project sponsored by Alliander-DGO, NUON Vattenfall had the intention to supply steam to the paper production plant of Crown van Gelder based in IJmond, an area situated in the province of North Holland.

Due to the removal of steam from the NUON turbine and the subsequent integration with the Crown van Gelder energy system, the technical configuration of this project was very complex.

In preparation for the client's final investment decision, Royal HaskoningDHV completed the following work:

- Conceptual design and feasibility study
- Basic design, including mass and energy balances, process calculations, control strategy, routing of steam and condensate piping, as well as all interfaces with existing installations
- Consultations with stakeholders with regard to the pipe routing
- Estimate of investment budget (CAPEX)
- Preparation of tender documents for the steam convertor, pipelines and back-up steam boilers

Our multi-disciplinary approach meant that our team was able to execute this project in an integrated manner. Short communication lines within Royal HaskoningDHV made it possible for us to process and apply new information very effectively.

Whilst the client has not yet implemented steam power, our work on this project means that they are ready to act in the future when markets change, meaning that they are well-placed to be ahead of their competition in completing the energy transition.

Analysing sustainable energy for the liquid bulk sector

2012

VOTOB, a liquid bulk organisation based in the Netherlands, wanted to gain a better understanding of its options in terms of energy infrastructure in order to ensure that its selection best matched terminal operations.

The project was executed with support from the Ministry of Economic Affairs, Agriculture and Innovation, and our remit was to focus on analysing the feasibility of solar (electric and thermal), wind, biomass and algae.

To work efficiently, we divided the project into two phases: first comparing different available options (including proven, developing and innovative technologies), before going on to develop business cases for the most promising techniques. As a result, a more detailed business case was produced for a biomass fired boiler.

The integral expertise of the project team – including technical, financial and market intelligence – facilitated effective project execution and provided the client with both high-level insights as well as a detailed basis for efficient decision-making.

Moerdijk Energy Program

2015-ongoing

Moerdijk is a sea harbour and industrial area situated in the South of the Netherlands. With an energy consumption exceeding 60 PJ/a and in line with the pressure being faced by the industry, it has the ambition to reduce its fossil-based energy consumption at least in line with the national policy (Energie akkoord).

As such, Royal HaskoningDHV is working on a study to determine what the harbour's energy infrastructure could look like in the future.

The harbour authority supplies services to companies based in the industrial area in the harbour, and it's therefore imperative that it adds value to its customers in order to ensure longevity and attract new companies to be situated there in the future.

Industry and authorities such as this are increasingly being challenged to make the next step in the energy transition. This study is unique in that the harbour has adopted a collective approach with the companies based in the industrial area in order to ensure that the vision represents their needs.

This integrated approach and the willingness to share information will be key in ensuring success in this project in terms of renewable energy adoption and energy conservation.

Developing a utilities masterplan for Eemsdelta

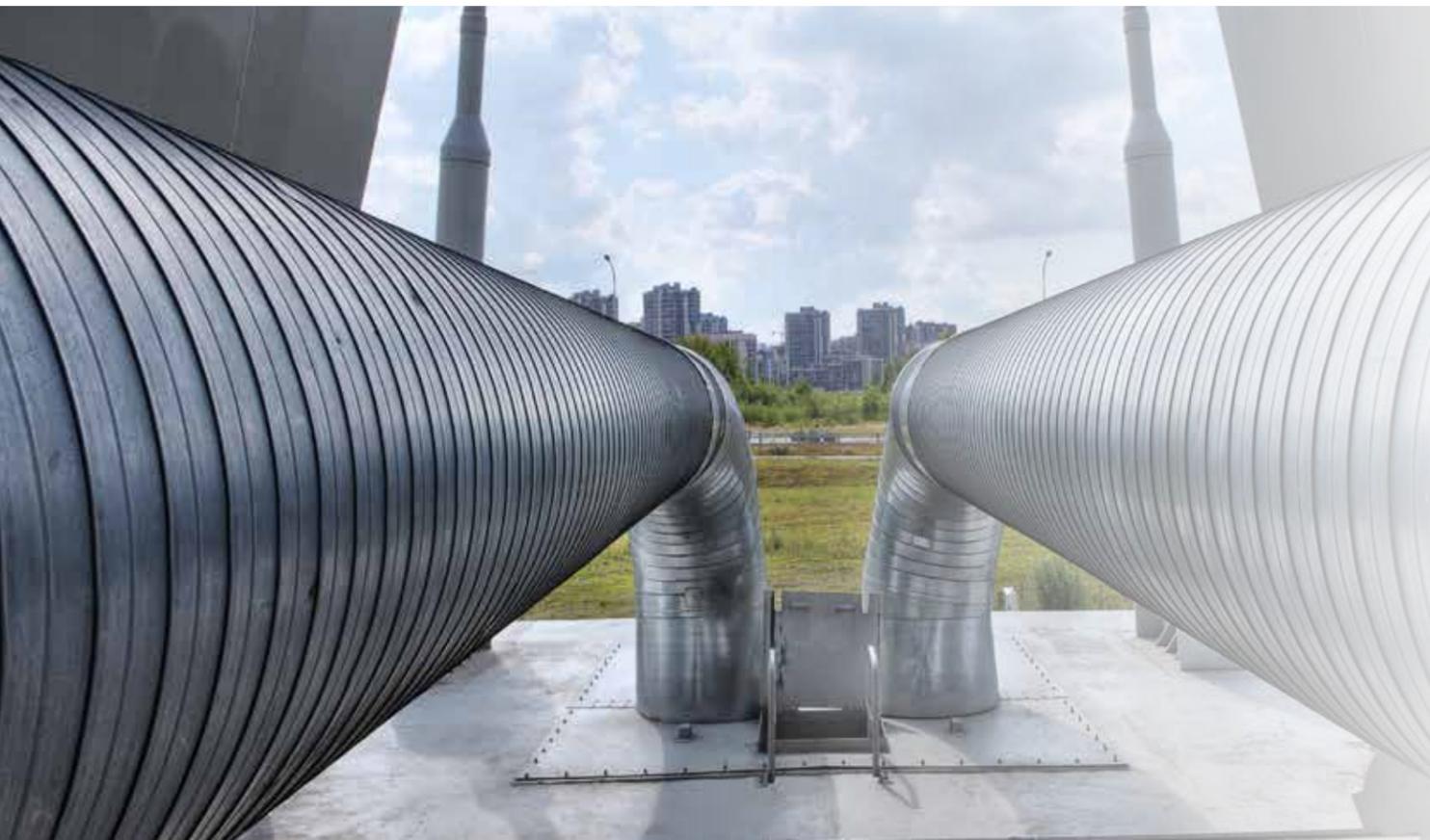
2013

Following the assessment of Power-to-Gas energy storage for Groningen Seaport, Eemsdelta – a cluster of the chemical and power industries in the area – faced the challenge of making its utility infrastructure future-proof and sustainable.

The seaport and major companies based in Eemshaven wanted to understand which changes in energy infrastructure were likely to take place in upcoming years, and how they can facilitate such change in an optimal way whilst retaining low cost and high system reliability.

Royal HaskoningDHV's experts identified and ranked opportunities for each utility type – covering water, heat, power, gas and solid – and a transition path was developed for the client.

As a result of our creation of a utilities masterplan, Eemsdelta is now using steam production as an alternative energy system, reaping the benefits of our personalised and integrated approach.





Royal HaskoningDHV is an independent, international engineering and project management consultancy with 135 years of experience. Backed by the expertise and experience of more than 6,000 colleagues all over the world, our professionals combine global expertise with local knowledge to deliver a multidisciplinary range of consultancy services for the entire living environment from over 150 countries.

By showing leadership in sustainable development and innovation, together with our clients, we are working to become part of the solution to a more sustainable society now and into the future.

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