



Strategy
H2GO
PROGRAMME

Towards a sustainable
energy supply with
electricity and hydrogen

H2GO



Introduction

As a signatory to the Paris Climate Agreement, the Netherlands has committed to reduce CO₂ emissions to almost zero by 2050. This is an enormous challenge, strengthened by the Dutch governmental decision to cease natural gas extraction in Groningen by 2022.

QUESTIONS FOR THE FUTURE

What does this mean for Goeree-Overflakkee? Can the island really become completely fossil fuel free in terms of its own energy use by 2030? What is needed to create a balance between the production of renewable energy and energy demand? How can we ensure that energy supply remains guaranteed for every day of the year during this transition?

BROAD COLLABORATION

In 2017, thirty partners and project participants joined forces in the H2GO Programme. Together, government bodies, academic institutions, businesses and other organisations are researching these important questions. In a range of projects, they are exploring the possibilities for production, distribution and use of hydrogen. This is how we are working to define a clear strategy as we approach a renewable hydrogen economy.



Why hydrogen?



The wind farms and solar parks in Goeree-Overflakkee produce more renewable electricity than it uses itself. Conversion of this excess renewable electricity into hydrogen creates new opportunities because hydrogen (H₂) is an energy carrier that can be stored and used for applications where electricity is unsuitable. Hydrogen is always available, e.g. during the winter when solar parks do not produce much electricity. This buffer function, the presence of gas distribution networks and low costs on the customer's premises make hydrogen an extremely good candidate for replacing natural gas in urban areas. In addition, hydrogen also offers solutions for the sustainable energy needs of heavy transport by road and water.

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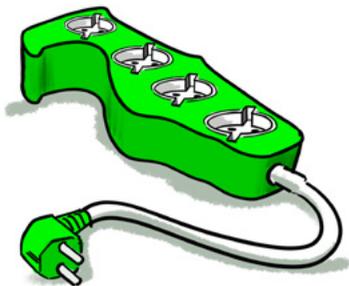


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Goeree-Overflakkee in 2020 an energy neutral island



MISSION

Participants in the H2GO Programme share the belief that hydrogen is going to play an essential role in the energy transition, both in energy management and in increasing the sustainability of our materials and hence our economy as a whole. The partners in this unique collaboration between the market, governmental bodies and academic institutions are standing behind an accelerated nationwide introduction of the hydrogen economy.



VISION

The H2GO Covenant aims for Goeree-Overflakkee to achieve total CO₂ reduction of its energy supply using a combination of electricity and hydrogen. This combination is increasingly being spoken of as a workable solution, but has not yet been put into practice. Goeree-Overflakkee will act as an 'Energy Island', forming a demonstration area for this combination. It is a clearly defined area where we can learn if switching to hydrogen and electricity is realistic in practice, in financial and concrete terms, as well as in terms of gaining public support.

Hydrogen programme

Supply and demand

Currently Rotterdam's Port Industrial Complex (HIC) produces large quantities of hydrogen for industrial purposes, still using natural gas as a source of energy. This presents a major opportunity to increase sustainability. H2GO aims to demonstrate that renewable hydrogen also makes important developments possible for the energy transition beyond the field of industry.

EXCEPTIONAL OPPORTUNITIES FOR GOEREE-OVERFLAKKEE.

Due to its spatial planning, type of buildings and its location close to Rotterdam, Goeree-Overflakkee occupies a special position. Add to this is its overproduction of renewable electricity. Renewable hydrogen seems a logical alternative to many kilometres of expensive heating pipelines in a sparsely-populated area. As soon as a guaranteed hydrogen supply is

GREY – BLUE – GREEN

At the moment, hydrogen is usually produced using natural gas, so-called grey hydrogen. The first major step towards increased sustainability is blue hydrogen where 90 % of CO₂ emissions will be captured and stored underground. Hydrogen can only be called renewable when it has been produced solely by wind and solar power.

available, this provides freedom of choice, offering the possibility of finding the best combinations of energy carriers.

BALANCING SUPPLY AND DEMAND

Both supply and demand of renewable hydrogen need to undergo development and be linked to each other. A gas infrastructure is required for this. This can be achieved by converting existing natural gas pipelines on the island. Moreover, a connection to Rotterdam has the advantage that supply and demand can develop at their own pace and renewable hydrogen from the island can be supplied for industry. Conversely, it provides security of supply for customers, even without local seasonal storage capacity. This approach forms the core for further implementation, on the island and beyond. There is national and international interest in this.

H2GO's structure

The H2GO Programme is based on the idea that the combination of electricity and hydrogen brings energy demand and supply into balance. The hydrogen economy is unknown territory for everyone. This means there are many questions about supply, demand, distribution and transport of hydrogen. The programme consists of various projects that explore these questions within their own field. Each project currently forms an independent building block within the programme. The goal is for each project to gradually develop from being a showcase into a viable business case.

PRINCIPLE 1: PRODUCTION ENERGY PARK OUDE-TONGE

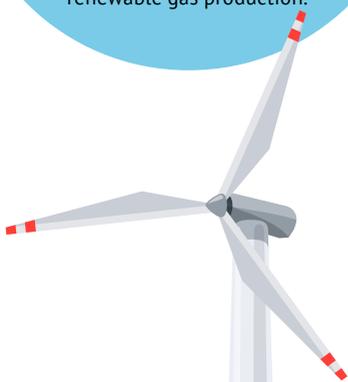
The aim of this project is to transform Business Park Oostflakkee into Energy Park Oude-Tonge where renewable energy carriers will be produced: renewable gas, hydrogen and ammonia. This local production will also create immediate opportunities for improved sustainability for the area directly surrounding the energy park.

Originally this project consisted of the realisation of a demonstration factory for hydrogen and renewable ammonia. Since then the plans have been extended to include transforming the area into an energy park. Above all its advantageous location provides potential customers for renewable hydrogen, including Stad aan 't Haringvliet and hydrogen refuelling station Greenpoint. At the same time, it provides interesting opportunities for exploring the interaction between existing facilities in and around Energy Park Oude-Tonge. For instance, will it be feasible to use the residual heat created during hydrogen production to heat the neighbouring greenhouse complex? Can the large production unit for renewable gas at the energy park profit from the arrival of a hydrogen demonstration factory? And is the same true in reverse? Are there sufficient potential customers for renewable ammonia?



HEATED GREENHOUSES WITHOUT NATURAL GAS

There is a great demand for heating in greenhouse horticulture. To make this sector natural gas free, other heating, energy and CO₂ sources are required. Residual heat is released during hydrogen production: a sustainable alternative for greenhouse horticulture. This can be combined with sustainable CO₂ released during renewable gas production.



PRINCIPLE 2: TRANSPORT, DISTRIBUTION AND STORAGE REGIONAL HYDROGEN ROUNDABOUT

After hydrogen has been produced, its supply, storage and delivery are crucial. Storing hydrogen creates a buffer for times when insufficient wind or solar power is being produced. The hydrogen roundabout is a regional exchange system, a hub for transport, distribution and storage of renewable hydrogen.

The regional hydrogen roundabout project explores the technical and economic feasibility of a local infrastructure for transport and distribution of hydrogen. This can be partially achieved by converting existing natural gas pipelines.

One aspect being explored is a link between the local hydrogen network and that of the Port Industrial Complex in Rotterdam, which requires coordination with the Gasunie. It is this link with the 'mainland' in particular which increases this project's chances of success. A regional hydrogen roundabout provides opportunities for exchange, offering security of supply, hydrogen storage and back-up facilities. For the grid operator, these are important prerequisites.

PRINCIPLE 3: DEMAND

How does renewable hydrogen help to increase sustainability? In which areas do we foresee opportunities? H2GO is carrying out concrete research in four separate projects into the demand for and applications of hydrogen.

Heating the urban environment – Is it possible to heat 550 existing residential buildings with hydrogen using the existing gas network? In the village Stad aan 't Haringvliet, all the necessary partners are participating, including the village residents' committee, the housing corporation, but also hydrogen production and distribution partners. Apart from the logistical challenges (installation of a hydrogen pipeline, connection to the existing natural gas network), this project's success relies on the support of the village's residents.

FIRST OF ITS KIND IN THE NETHERLANDS

Converting all residential and other buildings in Stad aan 't Haringvliet to hydrogen supply could become the first such project in the Netherlands. This route has not yet been taken at this scale for existing buildings.

Mobility – This project concerns the realisation of a refuelling point at the Greenpoint hydrogen refuelling station. From 2020, an electrolyser (2.5 MW) at the refuelling station will produce renewable hydrogen and be available there for road users. Excess renewable hydrogen will be transported by tube trailer to other refuelling points, but in due course will also be capable of supplying sufficient hydrogen for Stad aan 't Haringvliet's needs. In a later phase, Energy Park Oude-Tongue can take over this production function.

Shipping – Hydrogen is an interesting proposition for increasing the sustainability of shipping. Can a fishing boat sail with zero CO₂ emissions using renewable hydrogen? Hydrogen provides a good range and moreover, since the space on a sea-going vessel is meant for the catch or the freight, the compactness of hydrogen is a better solution than electric power using bulky batteries. Apart from the technological developments required, additional legal and regulatory challenges have to be addressed.

Agriculture – A number of arable farmers are researching the possibilities of using mobile solar panels on fields when they are fallow. Is it possible to convert this solar power imme-



SMART WATER

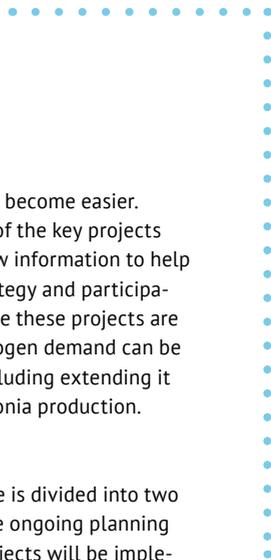
In the Smart Water strategy, entrepreneurs, educational and government bodies formulated their vision for the regional economic development of Goeree-Overflakkee until 2050 with an implementation agenda. One of the results of this is the building of a Vocational Education Campus in Middelharnis, for high quality, excellent and innovative vocational education.

diately into hydrogen? Which applications can the hydrogen then be used for on farms? How much public support is there? And what effect does it have on ecology? This project focusses on creating a new demand for hydrogen with the goal of getting arable farmers to generate their own hydrogen and hence become self-sufficient. Eventually, connection to the hydrogen roundabout will also become possible.

EDUCATION

As the hydrogen economy develops, so the need for technical staff grows. Goeree-Overflakkee can fulfil an important role in training hydrogen engineers, for instance by offering courses and internships or by organising education in consultation with a centre of expertise. This fits in perfectly with the development of the Vocational Education Campus in Middelharnis and the region's Smart Water strategy.

Strategy & timetable



STRATEGY

A hydrogen economy on Goeree-Overflakkee requires the development of renewable production, good distribution and storage and sufficient demand for hydrogen. Without a demand there is no supply, but without supply there can be no demand. A consistent, logical framework is therefore necessary for a successful implementation of the H2GO Programme on the island.

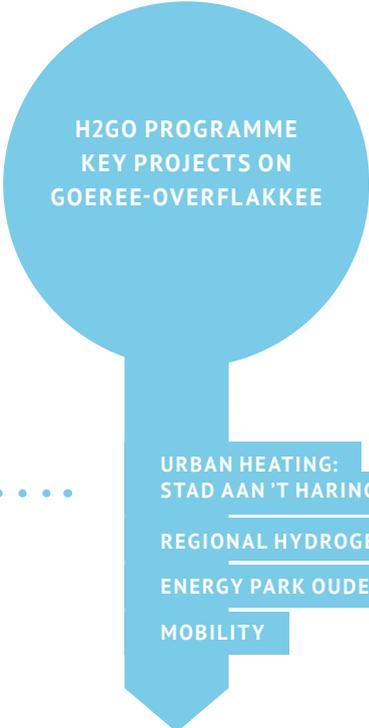
It is strategically important to produce visible results within a short space of time. In addition to the hydrogen refuelling station soon to be delivered, implementation of a hydrogen transport pipeline to Rotterdam's Port Industrial Complex (HIC) can play an important role in achieving this. When the hydrogen supply and back-up facilities for Goeree-Overflakkee can be guaranteed,

subsequent steps will become easier.

The implementation of the key projects below will deliver new information to help determine future strategy and participation by residents. Once these projects are operational, the hydrogen demand can be expanded further, including extending it to shipping and ammonia production.

TIMETABLE

The H2GO Programme is divided into two phases. In phase 1 the ongoing planning related to the key projects will be implemented in concrete terms. Phase 2 focusses on the development of a hydrogen infrastructure covering the whole island.



**H2GO PROGRAMME
KEY PROJECTS ON
GOEREE-OVERFLAKKEE**

**URBAN HEATING:
STAD AAN 'T HARINGVLIET**

REGIONAL HYDROGEN ROUNDABOUT

ENERGY PARK OUDE-TONGE

MOBILITY



PHASE 1: ENERGY PARK OUDE-TONGE (2019-2025)

Within the next five years, after all the go-aheads have been given, Stad aan 't Haringvliet will be the first place in the Netherlands to switch over from natural gas to hydrogen. This important key project is closely connected with the development of other projects, located on the island within a radius of 2.5 km.

The Energy Park Oude-Tonge will play a central role. Eventually a 26 MW hydrogen production unit will be situated in this park. This plant will have sufficient capacity to meet a larger demand from not only Stad aan 't Haringvliet, but also refuelling station Greenpoint as well as adjacent greenhouse horticultural businesses.

THE NEW SITUATION

If the island fully transitions to hydrogen and electricity, the new hydrogen production unit should be able to supply a quarter of the total demand for hydrogen. Stedin's transformer station receives electricity generated by wind-power from the island. A connection with the 26 MW production plant seems to make sense. This would make Oude-Tonge the centre of hydrogen production on Goeree-Overflakkee. The current central manure processing plant already gives this site a its green credentials and provides opportunities for collaboration.



Top: the regional hydrogen roundabout

STEP 1

Deployment will start at the Greenpoint hydrogen refuelling station near Oude-Tonge. In 2020 a 2.5 MW electrolyser will be producing renewable hydrogen.

STEP 2

Connecting the hydrogen production unit at the Greenpoint hydrogen refuelling station to Stad aan 't Haringvliet via Energy Park Oude-Tonge (on the nearby Business Park Oostflakkee).

STEP 3

Construction of a 26 MW hydrogen production unit in Energy Park Oude-Tonge. Additionally, a local unit for production of renewable ammonia can be realised.

PHASE 2: CONVERSION TO HYDROGEN NETWORK (2025-2030)

Phase 2 focusses on conversion of Goeree-Overflakkee's current natural gas network to a network for hydrogen. This phase puts the emphasis firmly on coordinating the Regional Energy Strategy (RES), the Transition Vision for Heating and the H2GO Programme.

Experience gained in phase 1 will show how realistic a prospect this is. Ultimately the government will determine which policies Goeree-Overflakkee will implement for the energy transition.

Good preparation

Phase 1 forms the foundation for the scaling up phase. This means we have to make strategic choices now for future developments such as the choice of locations and the construction of a hydrogen pipeline to Rotterdam. Experience gained on a smaller scale such as during transition at local level are extremely valuable in developing realistic planning.

Decisive choices

This demands a more in-depth analysis in order to develop a clear picture of the possible options and problems. This will enable policy makers to underpin their decisions better in the future. For instance, what are the spatial and financial consequences if the production of renewable hydrogen largely takes place on the island itself? Or does it make more sense to do this in the Port Industrial Complex (HIC) using renewable electricity from the island? Gaining more insight helps in setting requirements for facilities for infrastructure, the need for storage capacity, etc. It also enables us to better predict integral chain costs that will also prove useful information for other regions in the Netherlands.



Conclusion

We have only just started out, but we already have firm ambitions. To make the H2GO Programme possible in practice, we have formulated a number of prerequisites:

- An important requirement is the close involvement of government bodies, grid operators and entrepreneurs who must make a long-term commitment to the programme and make resources available.
- There is a need for more regulation related to the application and storage of hydrogen. Higher government authorities can provide the necessary space to make local developments possible.
- As long as the consumer price of hydrogen (renewable or otherwise) is higher than that of natural gas, government subsidies are desirable.
- High-risk investments in hydrogen innovation by entrepreneurs deserve financial support from the government.
- A connection with the HIC is an important innovation in the infrastructure required to accelerate the transition to hydrogen.
- The current natural gas network will also have to be accessible for grid operators in the future for distribution of hydrogen.
- Finally, creating public support amongst residents and local stakeholders is an important prerequisite for the success of the demonstration area.

IN SHORT:

Goeree-Overflakkee offers many opportunities for analysing all the possibilities, whether that be for hydrogen production, storage, distribution or possible markets. The stakeholder collaboration also provides the island with a crucial role to play in the energy transition in the Netherlands.

Let's GO!

