Building blocks for a sustainable energy supply

Hydrogen

1. What are the main forms of hydrogen and how do these differ in efficiency and emissions?



SMR input includes a fraction of electricity. In the case of ATR input, the fraction of electricity is slightly higher compared to the SMR process. This explains the higher volume of natural gas..

2. From which sources does the Netherlands produce hydrogen, and how much?



3. What is the final natural gas demand in the sectors and how much hydrogen does this correspond to?

Industry	Built environment	Mobility	🛞 Agriculture			
301 PJ of natural gas	390 PJ of natural gas J 3246 million kg	3 PJ of natural gas 🔑 25 million kg	34 PJ of natural gas 🔑 280 million kg			

4. How much renewable electricity is needed to produce this hydrogen, and how does this relate to current renewable electricity production in the Netherlands?

Current renewable electricity production	Amount needed to replace final natural gas demand	Volume of hydrogen with corresponding amount of energy				
81 PJ	<pre>1090 PJ = 13.5x current renewable production 44444</pre>	6057 million kg of hydrogen				

Green Gas

5. How is biogas and green gas production developing in the Netherlands and how does this relate to the target for green gas set out in the Climate Agreement?

PJ														70 PJ	
70															
60 50 40 30	Biogas is the product that results from fermentation or gasification of biomass. Compared to natural gas, it contains less methane and more carbon dioxide. Green gas is the product that is created when the biogas is upgraded to a higher methane percentage and lower carbon dioxide percentage, so that it has the same properties as natural gas.														
20										· · · · ·					
10									- 						
0 2000	2002 2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2024	2026	2028	2030	

Electricity

6. How is renewable electricity production developing in the Netherlands and how does this relate to the target set out in the Climate Agreement?



7. How does the production of electricity from wind and solar vary throughout the year?



Heat



9. How is renewable heat production developing in the Netherlands?



Storage

10. How does storage of hydrogen, green gas, heat and electricity work?

Hydrogen and green gas



Electricity



Heat

11. What is the natural gas storage capacity in the Netherlands?

- Norg gas field 197 PJ
- Grijpskerk gas field 102 PJ
- Alkmaar gas field 18 PJ
- Bergermeer gas field 175 PJ
- Zuidwending salt caverns 11 PJ

Aquathermal and geothermal heat

nbient energy from, for example, waste water or the shallow surface which is produced by means of an electric heat pump.

Solar thermal energy

Heating of tap water or a space by means of sunlight.

Other sources

Other sources of renewable heat include combustion of renewable gases and conversion of renewable electricity (no complete data available).

> 12. Different types of storage are needed to meet the diversity of energy demand What storage techniques are there (for the future)?



UGS: Underground natural gas storage UHS: Underground hydrogen storage **CAES:** Compressed air energy storage OPAC: Underground pump accumulation HTO: Underground high temperature storage LNG: Above ground storage of liquid gas BATTERY: Above ground storage of electricity

n water or

nolten salt

ebn

TOO MUCH TIME TO FILL SUSTAINABLY?

Will the Netherlands have round-the-clock renewable energy in 2030?



Where does the Netherlands want to be, and how is the country doing?

1. How are greenhouse gas emissions developing in the Netherlands and how does this relate to the reduction targets set out in the Climate Agreement?



2. What proportion of greenhouse gas emissions do the sectors account for?



3. What proportion of greenhouse gas emissions do economic activities in European countries account for?



4. What are the per capita emissions in the Netherlands compared to European countries?



How many hours a day does the Netherlands live on renewable energy? On average, the Netherlands lives on renewable energy for 1 hour and 49 minutes per day. So, for the remaining 22 hours and 11 minutes the Netherlands uses fossil energy that it produces and imports. Biomass: 1 hour and 13 minutes 19 minutes 9 minutes Ambient energy: minutes

5. What types of energy does the Netherlands use and how much?





7. To what extent can the Netherlands produce its own energy during the energy transition?



2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 Offshore wind
 Onshore wind and solar
 Ocourse Geothermal
 Green gas
 Offshore natural gas
 Onshore natural gas
 Primary energy demand

8. What types of energy does the Netherlands import and export and how much?





9. From which sources does the Netherlands produce electricity, and how much?



10. From what sources do European countries produce electricity?



11. How efficient is Dutch electricity production?





14. How does the proportion of renewable energy in final demand develop in the Netherlands in comparison with other European countries?





