

An aerial photograph of a dense urban area, likely a city center, featuring a mix of residential and commercial buildings, a prominent river, and a canal. The buildings are mostly multi-story structures with varied roof colors. The river and canal are dark blue, and there are green spaces and trees interspersed among the buildings. The overall scene is a vibrant, high-density urban environment.

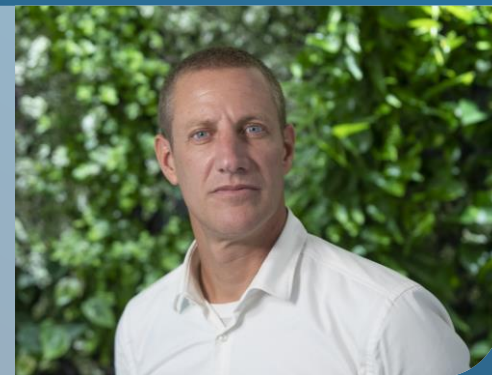
ebn

Geothermal energy and the heat transition

Road to accelerate investments

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Senior research fellow TU Delft



Ministry of Economic Affairs
and Climate Policy



**FORTIS
BANK**

Solid partners. flexible solutions.

ebn

 **TU Delft** Delft
University of
Technology



Mission

Energising the transition

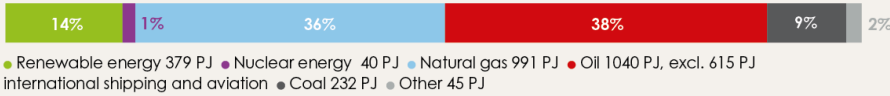
Energie Beheer Nederland is a public energy company. **Together with our public and private parties** we invest our knowledge, expertise and financial resources to help build a sustainable energy system

ENERGY IN NUMBERS 2024



THE ENERGY SYSTEM NOW...

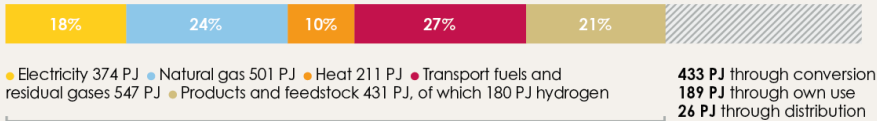
THESE ARE THE SOURCES OF OUR ENERGY (PRIMARY DEMAND)



2712 PJ*

24% is lost
648 PJ

THIS IS HOW ENERGY REACHES THE CONSUMER (FINAL DEMAND)



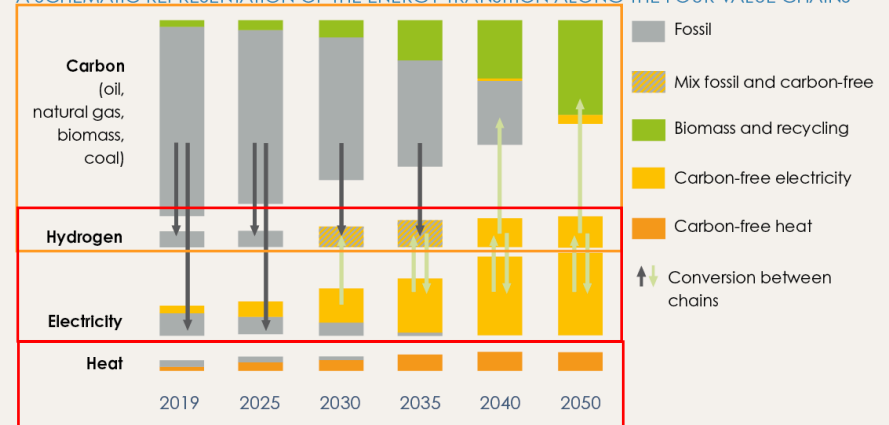
2064 PJ

433 PJ through conversion
189 PJ through own use
26 PJ through distribution

* excl. 15 PJ export of electricity

... AND IN THE FUTURE

A SCHEMATIC REPRESENTATION OF THE ENERGY TRANSITION ALONG THE FOUR VALUE CHAINS



ENERGY IN NUMBERS 2024



ENERGY IN NUMBERS 2024



SUFFICIENT FLEXIBILITY

Source: Entrance (2022), TU Delft (2023), IJ3050 (2023)

VARIABILITY IN DEMAND AND GENERATION OF SUSTAINABLE ELECTRICITY

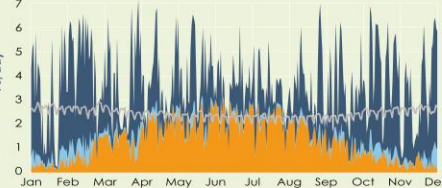
Installed solar and wind capacity in 2022

- Solar: 19.1 GW
- Onshore wind: 6.3 GW
- Offshore wind: 2.6 GW
- Electricity demand (2050 scenario TU Delft)



x27 x2 x8
PJ/day

Forecast 2050

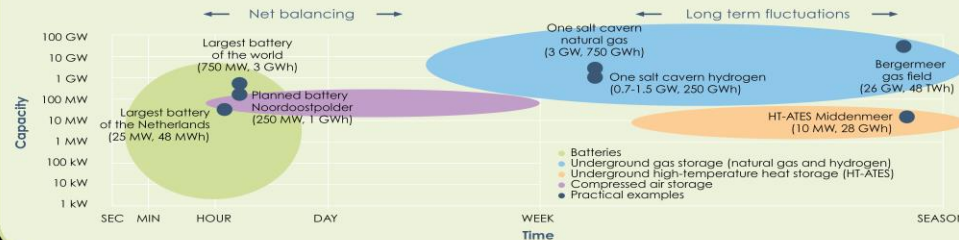


OPTIONS FOR FLEXIBILITY

- Adjustment of the demand profile**
For example: smart charging, flexibility in the industry or the transport sector
- Adjustment of the supply profile**
For example: interconnectivity (import and export) and curtailment
- Storage**
Short term (electrons)
Long term (molecules)
- Conversion to other energy carriers**
Heat, electricity, natural gas and hydrogen
- CO₂-free adjustable power**
Power generation on biomass, hydrogen or natural gas+CCS

THE MOST IMPORTANT STORAGE TECHNIQUES

EXPRESSED IN MAXIMUM CAPACITY, STORAGE VOLUME AND TIME

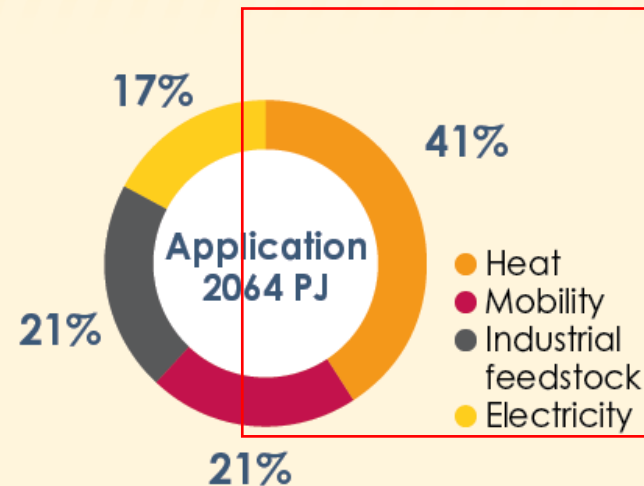
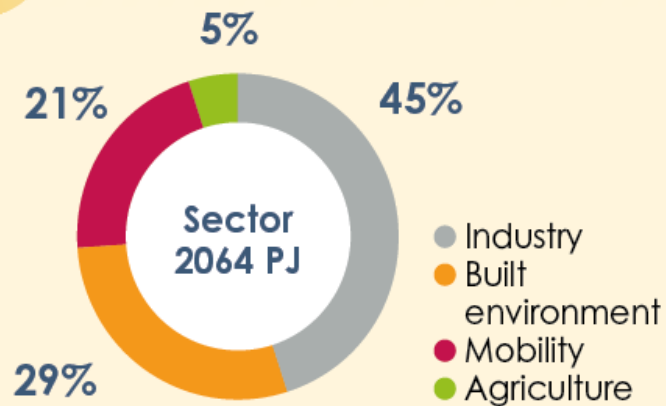


Source: TNO, IAOA, CoalLine, ECW Energy, Vana, Gigastore, Beigo Energy

ENERGY IN NUMBERS 2024



FINAL DEMAND PER SECTOR AND PER APPLICATION



Together with public and private partners we invest



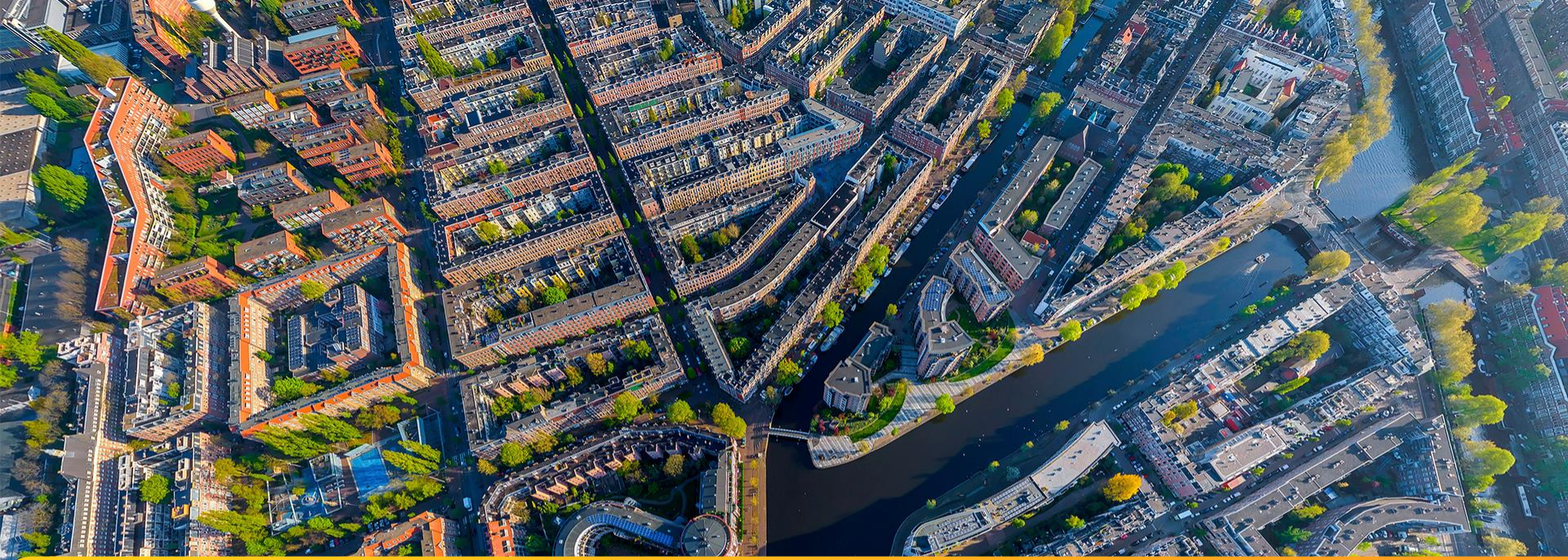
Together with public and private partners we invest

ebn

**Public
framework:
regulation,
taxes,
subsidies**

**Private
partners
investment
projects**





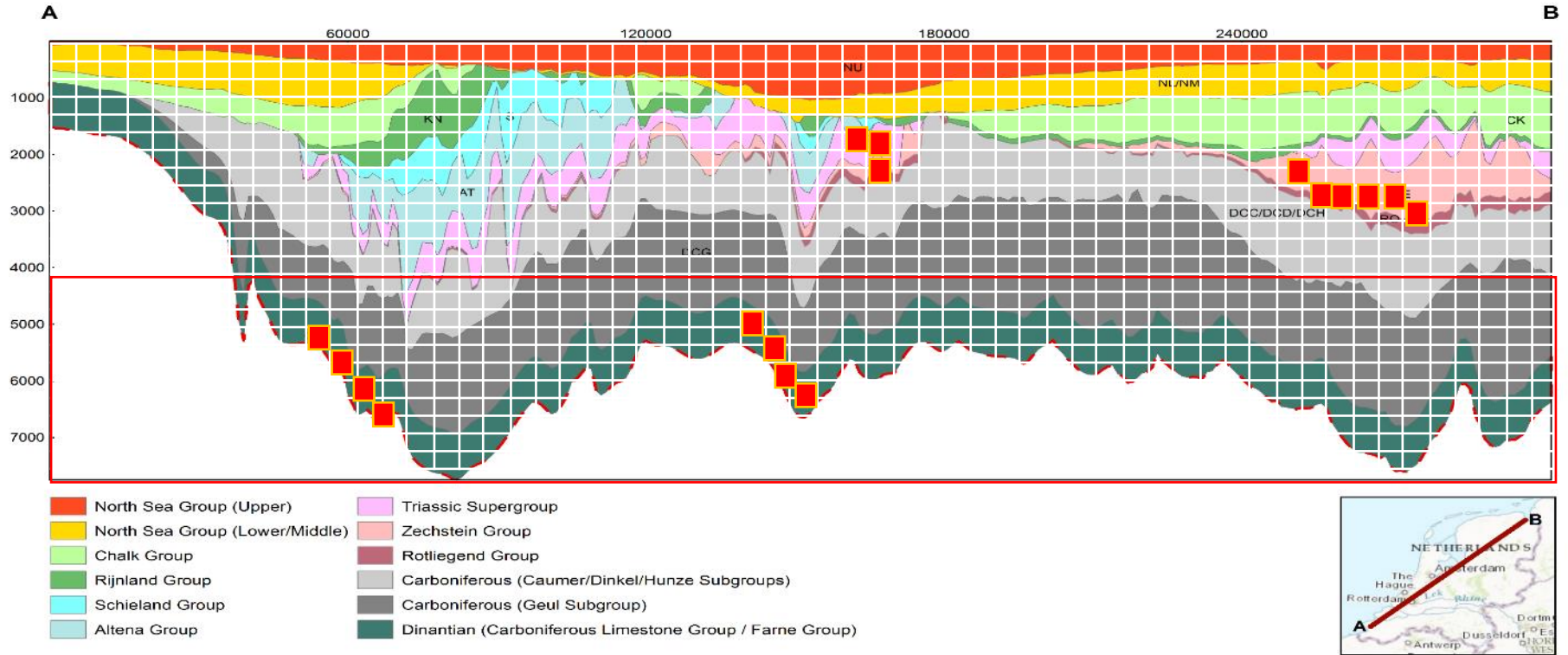
Road to accelerate investments in geothermal energy

Geothermal developments in the Netherlands

ebn



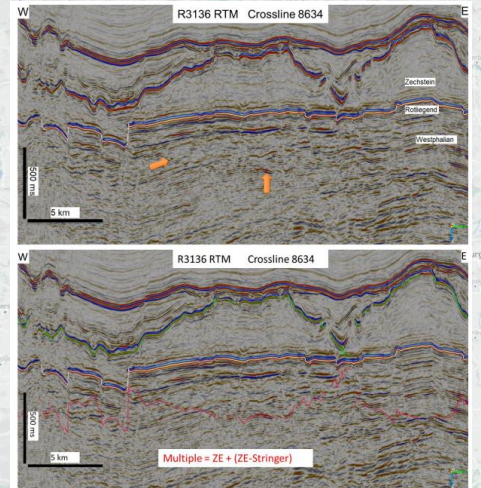
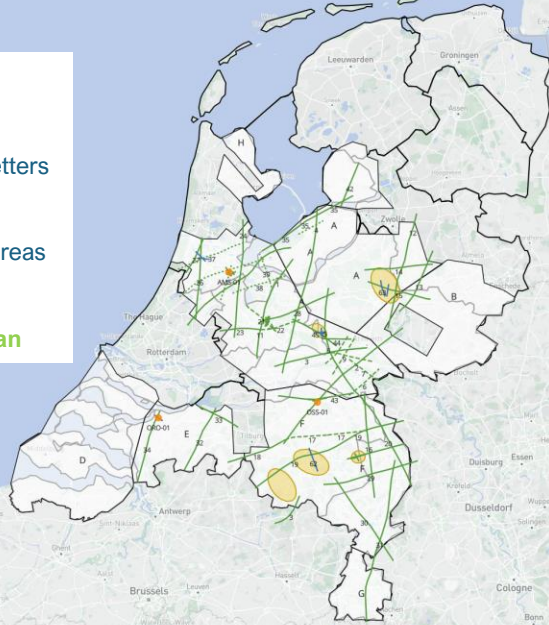
Play-based portfolio approach



Seismic campagne geothermal energy

- To date > 1950 km new 2D seismic data
- SCAN acquisition is combined with local seismic acquisition programs for UDG and MRA
- Visited > 165 municipalities, distributed > 130.000 letters into the neighbourhoods prior to acquisition
- Reprocessed vintage data 451 lines (7500 km)
- Acquisition additional 2D/3D seismic data in urban areas
- Drilling of 6-7 research wells for data acquisition

All data available for free on NLOG www.nlog.nl/scan



Play-openers

ebn



Permit

Subsurface guarantee (FNES)

Subsidy (SDE++)

Permit

Permit

1. Studies

3-4 months

- Warmtevraag
- Haalbaarheidsstudie
- Quick scan ondergrond
- Play analyse
- Minimale eisen subsidies
- VGM-zorgsysteem
- Benodigdheden opsporingsvergunning & aanvraag opsporingsvergunning
- Communicatie stakeholders
- Algemene organisatie en project organisatie
- Plan van aanpak vervolg
- Indicatief businessplan

2. Exploration

6-9 months

- Quickscan vergunningen
- Eventueel seismiek acquisitie/reprocessen
- Gedetailleerde geologische studie
- Regionale geologische studies
- Reservoir engineering studies
- Stimulatie concept
- Energetische inpassing
- WABO vergunning aanvragen
- Overeenkomst landeigenaar, aankoop gronden
- Risico matrix maken
- Seismiciteits studie en bodemdaling
- Voorontwerp put en bovengrondse installatie
- Prelim financiële haalbaarheid
- Contractering warmteafname
- Financiering en SDE aanvraag
- Final Investment Decision (FID)

FID

3. Development

12-18 months

- Definitief boorplan
- Ontwerp boorlocatie
- Detail ontwerp bovengrondse installatie
- Update risico matrix
- Vergunningen & meldingen
- Eventueel aanvraag wijziging bestemmingsplan
- Business case en financiering
- Contractering warmteafname
- Aanbestedingen en contracting strategie
- Update VGM zorgsysteem, QRA, HAZID
- Communicatie stakeholders
- Algemene organisatie en project organisatie
- Financial close (FC)
- Communicatie stakeholders
- Algemene organisatie en project organisatie

FC

4. Realisation

12-18 months

- Contractering contractors
- Vergunningen en meldingen
- Materiaalaanschaf
- Uitvoering 1^{ste} boring en testen
- Uitvoering 2^{de} boring en testen
- Water analyse
- Update reservoir model
- Monitoring seismiciteit indien noodzakelijk
- VGM zorgsysteem productiefase incl. QRA
- Definitief ontwerp bovengronds
- Aanleg faciliteiten bovengronds
- Communicatie stakeholders
- Algemene organisatie en project organisatie

5. Production

30 jaar

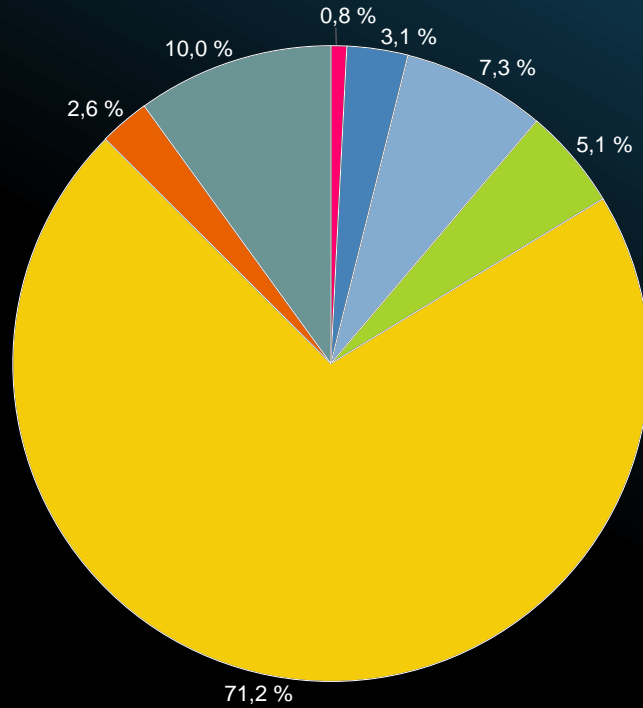
- Ontwikkeling van de putten
- Vergunningen en meldingen
- Meetprogramma tijdens productie: monitoring debiet, pompdruk, temperatuur, casing, waterkwaliteit, corrosie, afgenomen elektrische energie, bovengronds systeem
- Beheer en onderhoud
- Corrosie en scaling
- Inhibitor
- Monitoring seismiciteit
- Verzekeringen
- Communicatie stakeholders
- Algemene organisatie en project organisatie

6. Abandon

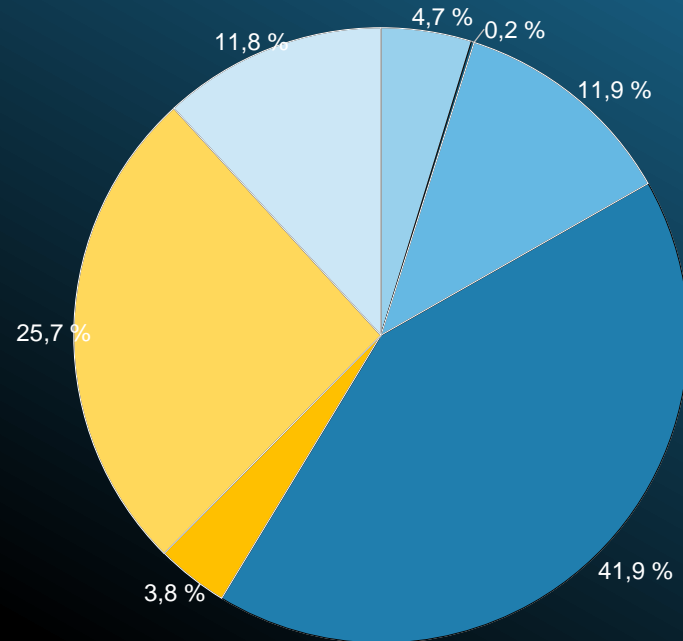
6-9 months

- Reservering financiële middelen voor opruiming installatie en put
- Sluitingsplan
- Werkprogramma opstellen
- Vergunningen en meldingen
- Opruimactiviteiten per doublet
- Communicatie stakeholders
- Algemene organisatie en project organisatie

Cost analysis

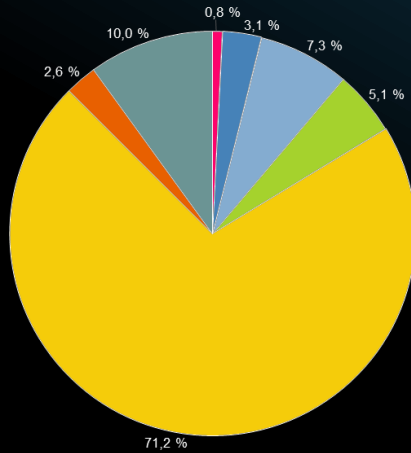


CAPEX

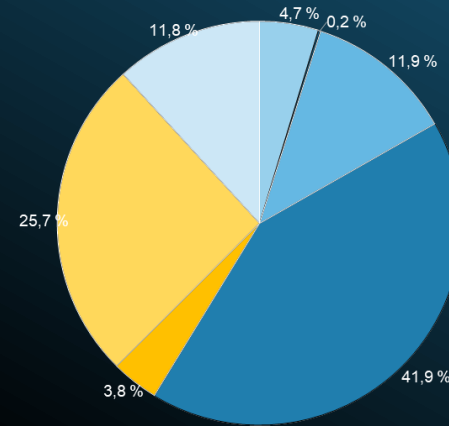


OPEX

Cost reduction

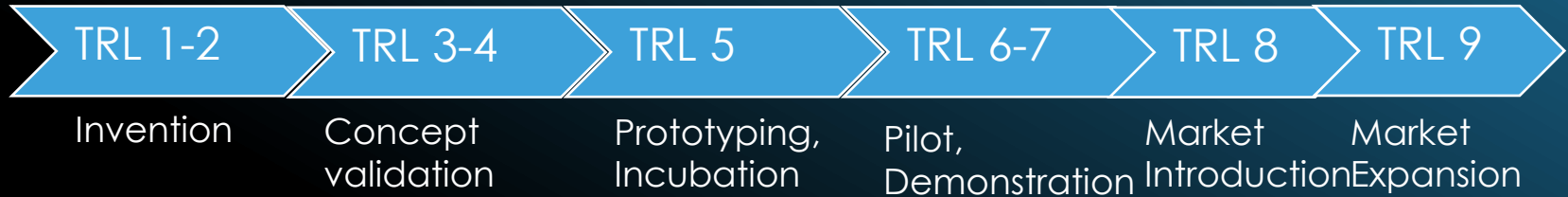


CAPEX

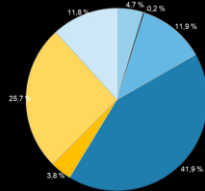
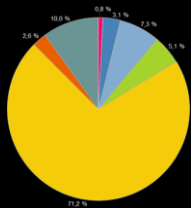


OPEX

Technology and innovation lifecycle

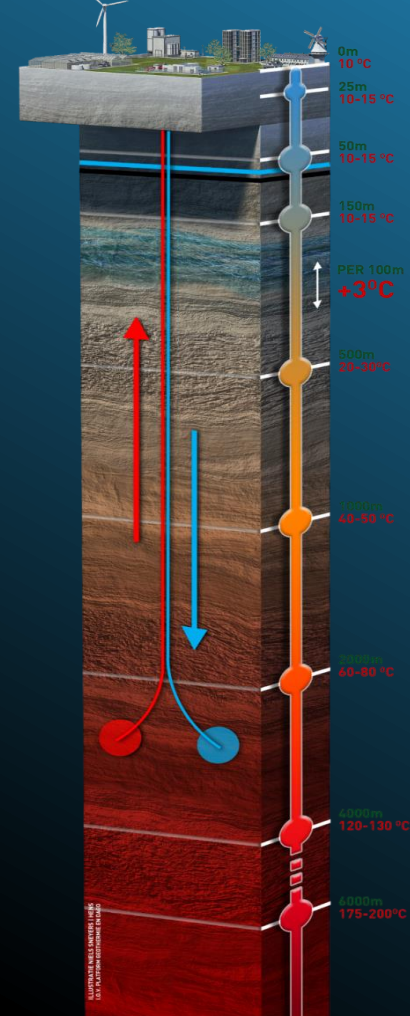


- Identify opportunities R&D and innovation in life cycle
- Risk reduction, cost reduction (CAPEX, OPEX), **increase REVENUES**



Master Plan Geothermal energy in the Netherlands

A broad foundation for a sustainable heat supply



ebn

Public and private sector cooperation

ebn



ebn



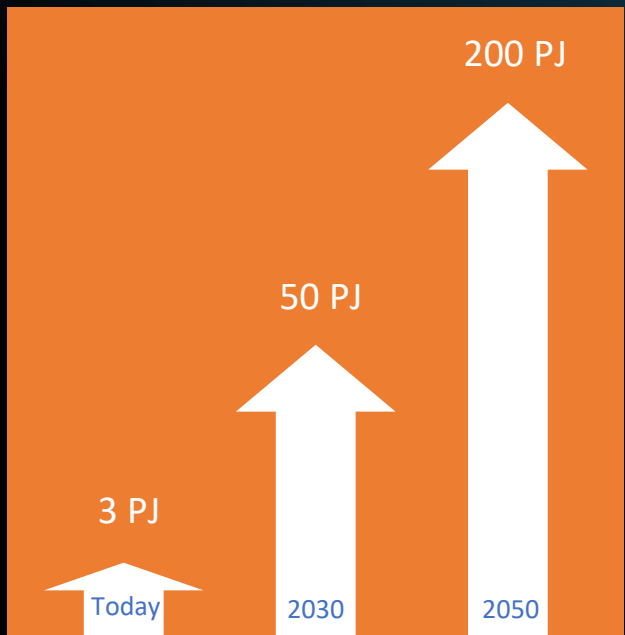
Platform
Geothermie







- Broad group of partners and stakeholders involved
- Masterplan forms common foundation to build upon for the coming years
- Masterplan is a plan to continuously develop and improve together with all stakeholders

Ambition is 50 PJ geothermal energy in 2030, 200+ PJ in 2050

Our ambition

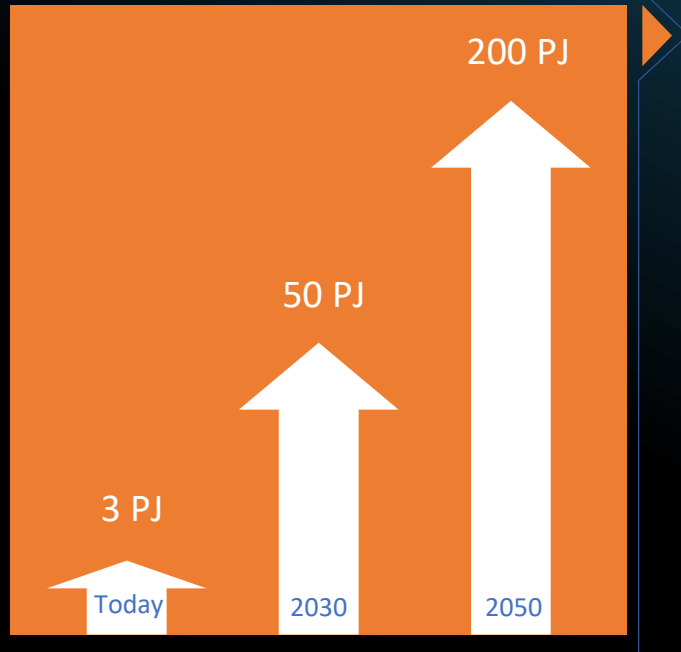


Consequences of ambition

	2018	2025	2030	2050
Number of doublets (#) 	17 1-2 new a year	75 10 new a year	175 20 new a year	700 25 new a year
Number of houses connected to heat networks 	0	140k 5 PJ	570k 20 PJ	3,8m 135 PJ
Surface area required (ha) 	10 17 football fields	50 Efteling	110 Volendam	450 Centre of Rotterdam
Employment (FTE) 	240	1320	2400	3400
	direct 70	direct 380	direct 700	direct 1000
	indirect 170	indirect 940	indirect 1700	indirect 2400

Private sector actions

Our ambition



Actions

2018

2025

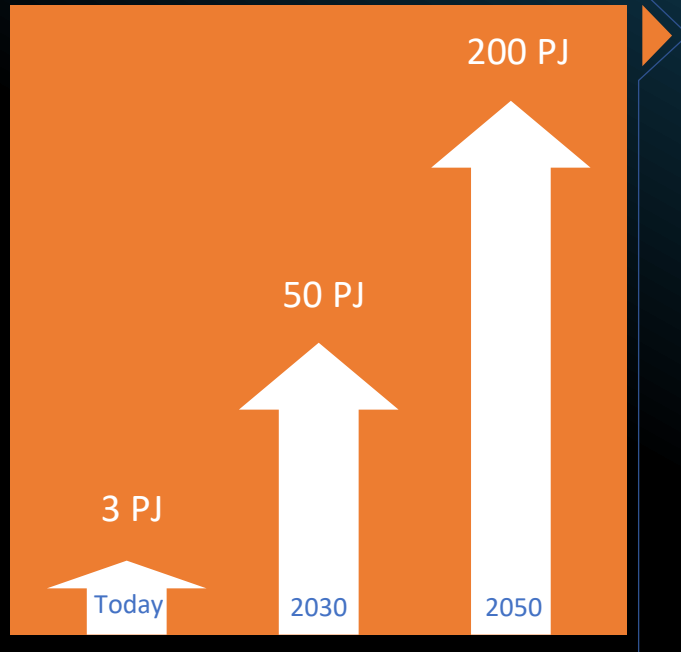
2030

2050

- Develop a **geothermal heat proposition** with **heat companies, Expertise Centre Heat, and decentral governments**
- Broaden **basis of the sector, grow and learn**, with participation of **EBN**
- Further **professionalise** sector **throughout the value chain** by developing **industry standards, knowledge exchange and transparency**
- Engage in local and national **dialogue** with all **stakeholders** in the **energy transition**

Public sector actions

Our ambition



Actions

2018

2025

2030

2050

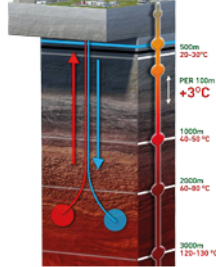
- **Invest in exploration of subsurface**
- **Come with a new Mining Law including a new permit system**
- **Adapt SDE-subsidies**
- **Consistent policy with appropriate execution and supervision**
- **Based on Climate Agreement decide how to choose the optimal sustainable heat technology**

AARDWARMTE IN 2023

DE CIJFERS

In Nederland zijn 27
aardwarmtelocaties
met in totaal
39 doubletten
(aardwarmteputten)

39



TOTAAL
6,8 PJ
(PETAJOULE)
AARDWARMTE

ER ZITTEN **100** PROJECTEN
MEER DAN IN DE PIJPLIJN



Lees meer over het gebruik van aardwarmte
op www.allesoveraardwarmte.nl

Aardwarmte en de
energietransitie

CO₂



DIT BESPAART

365.000

ton CO₂ en

193 mln

m³ aardgas

DIT STAAT GELIJK AAN HET
JAARLIJKS VERBRUIK VAN

165.000

HUISHOUDENS

ONGEVEER GELIJK AAN DE STAD UTRECHT
Uitgaande van het gemiddelde gasverbruik voor 2023



Bron: Geothermie Nederland productiecijfers 2023

www.geothermie.nl



ebn



**Road ahead to accelerate investments
in the heat transition**

Large potential of collective heat systems

ebn

Present heat networks: 25 PJ

Potential heat networks: 270 PJ

Heat pumps



Business case logic

ebn

REVENUES

CAPEX

OPEX

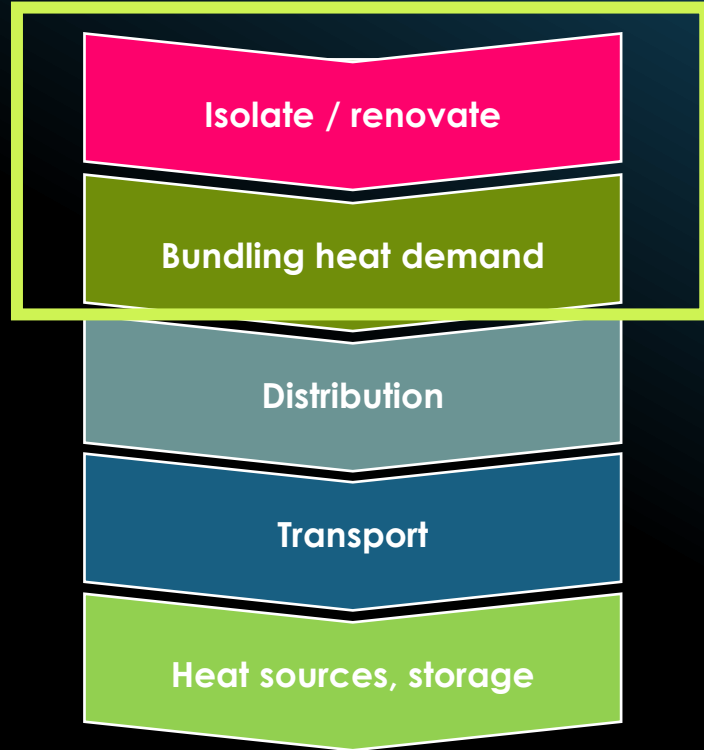
NPV

RISK

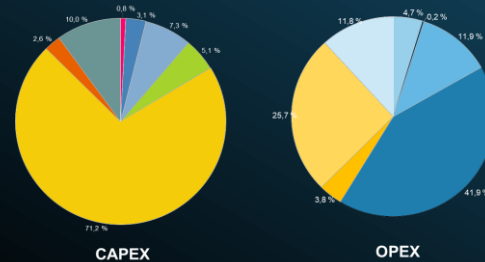
Connections to houses, utilisation



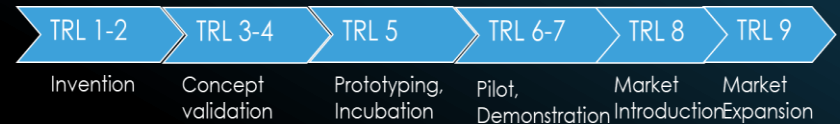
Value chain analysis: focus on demand



DEMAND = REVENUES

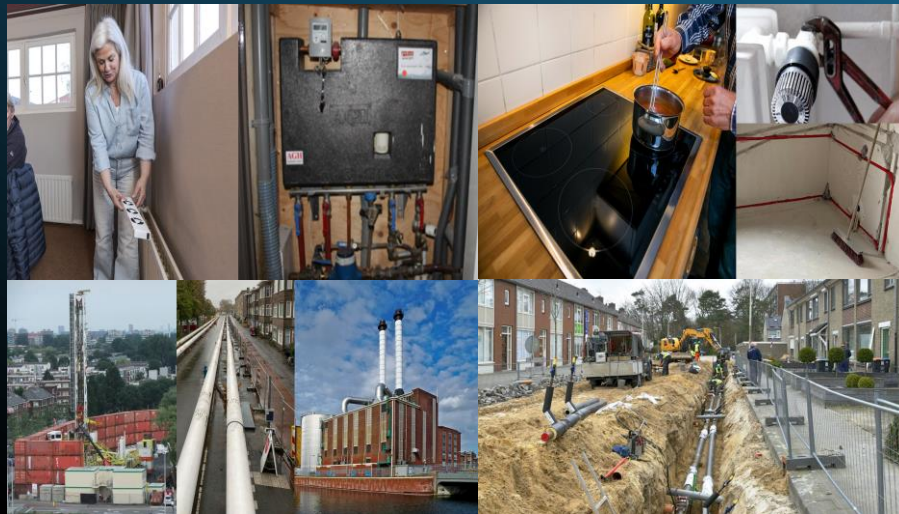


Technology lifecycle



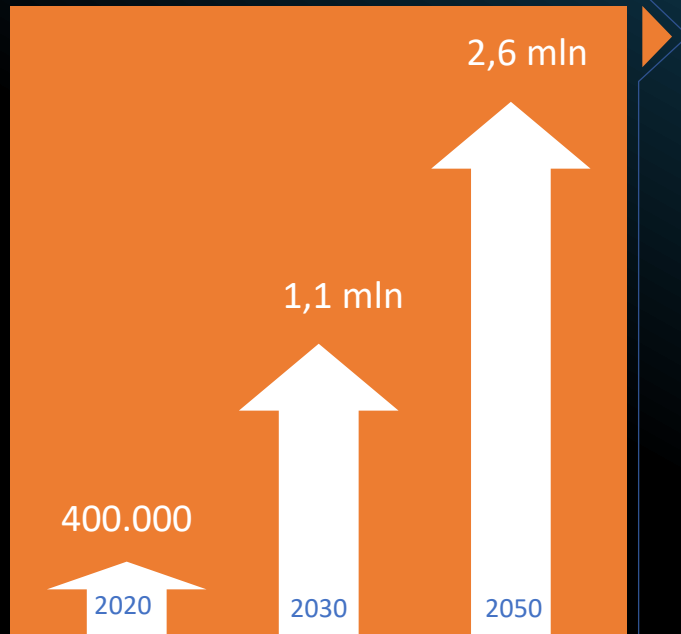
Master Plan Heat Transition in the Netherlands

An integral framework to
develop sustainable heat
demand



Ambition is 1,1 mln houses in 2030 and 2,6 mln houses in 2050

Our ambition



Public and private sector cooperation

2018

2025

2030

2050

Public
framework:
regulation,
taxes,
subsidies

Private
partners
investment
projects



References

Play-based portfolio approach

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- www.ebn.nl/wp-content/uploads/2022/10/Rapport-Opshaling-aardwarmte-in-warmtenetten.pdf

Seismic campaign geothermal heat in the Netherlands

- www.scanaardwarmte.nl/english

Masterplan Geothermal Energy in the Netherlands

- www.geothermie.nl/images/bestanden/Masterplan_Aardwarmte_in_Nederland_ENG.pdf