Energy Hubs

Key for a successful energy transition

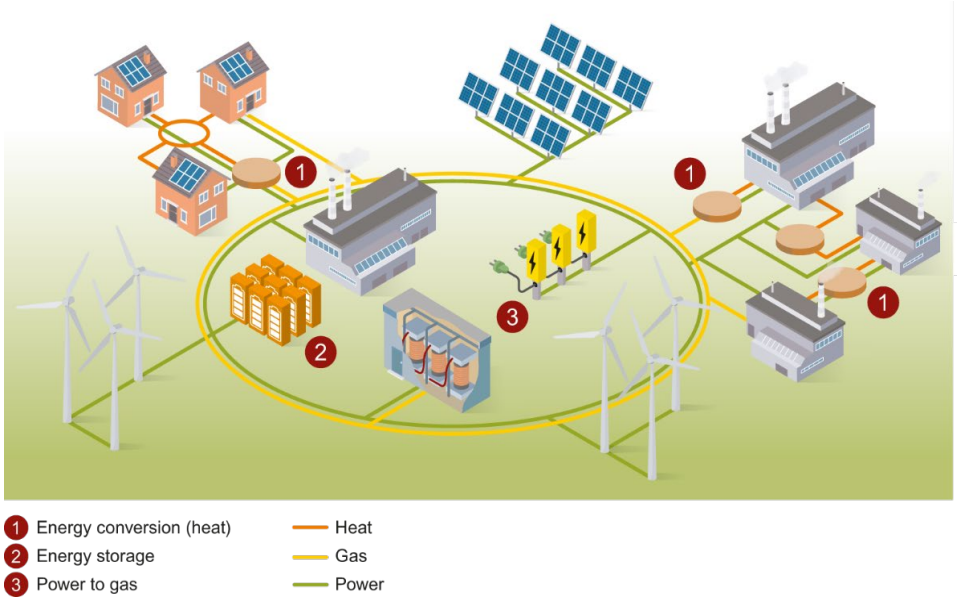
Mart van Bracht

October 2022

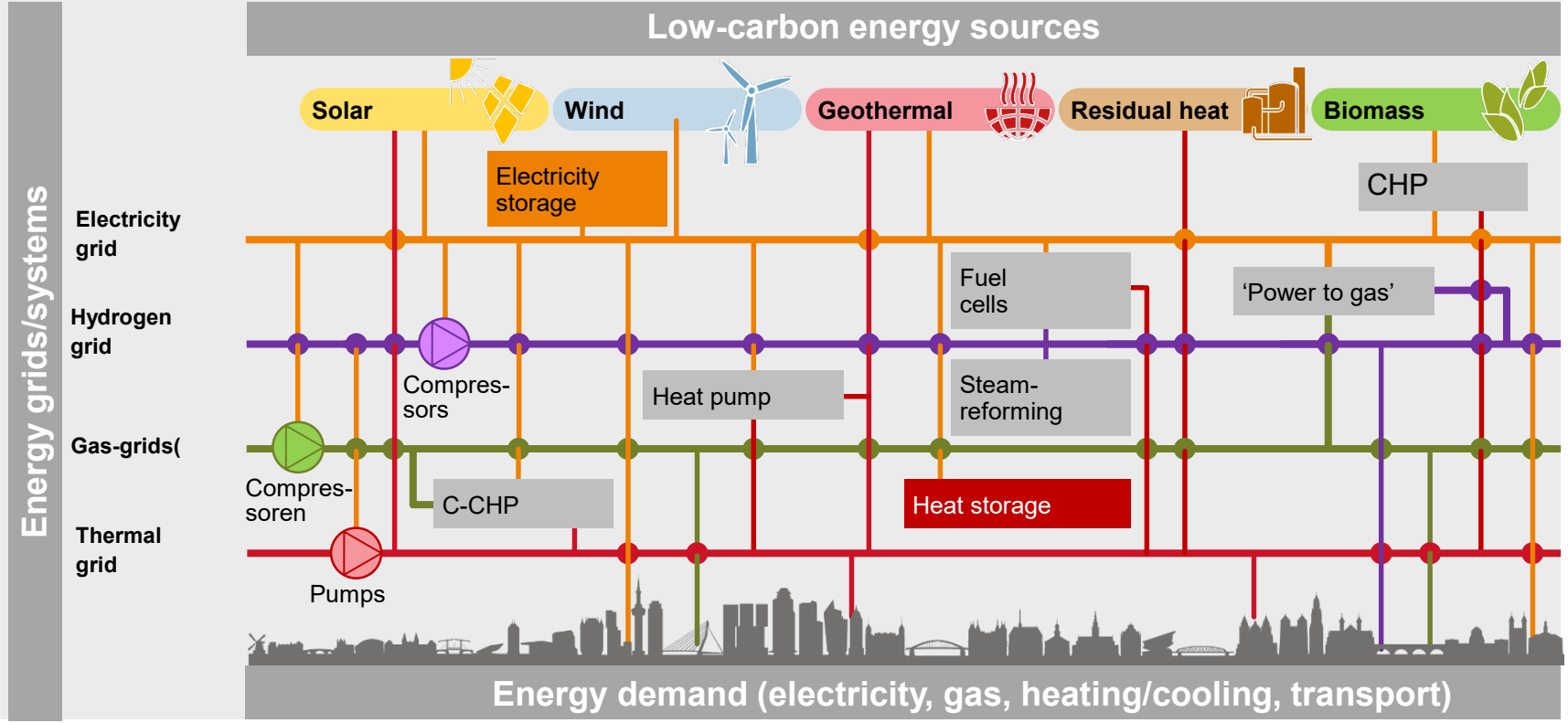
TOPSECTOR ENERGIE
Empowering the new economy

Shape of future energy system:

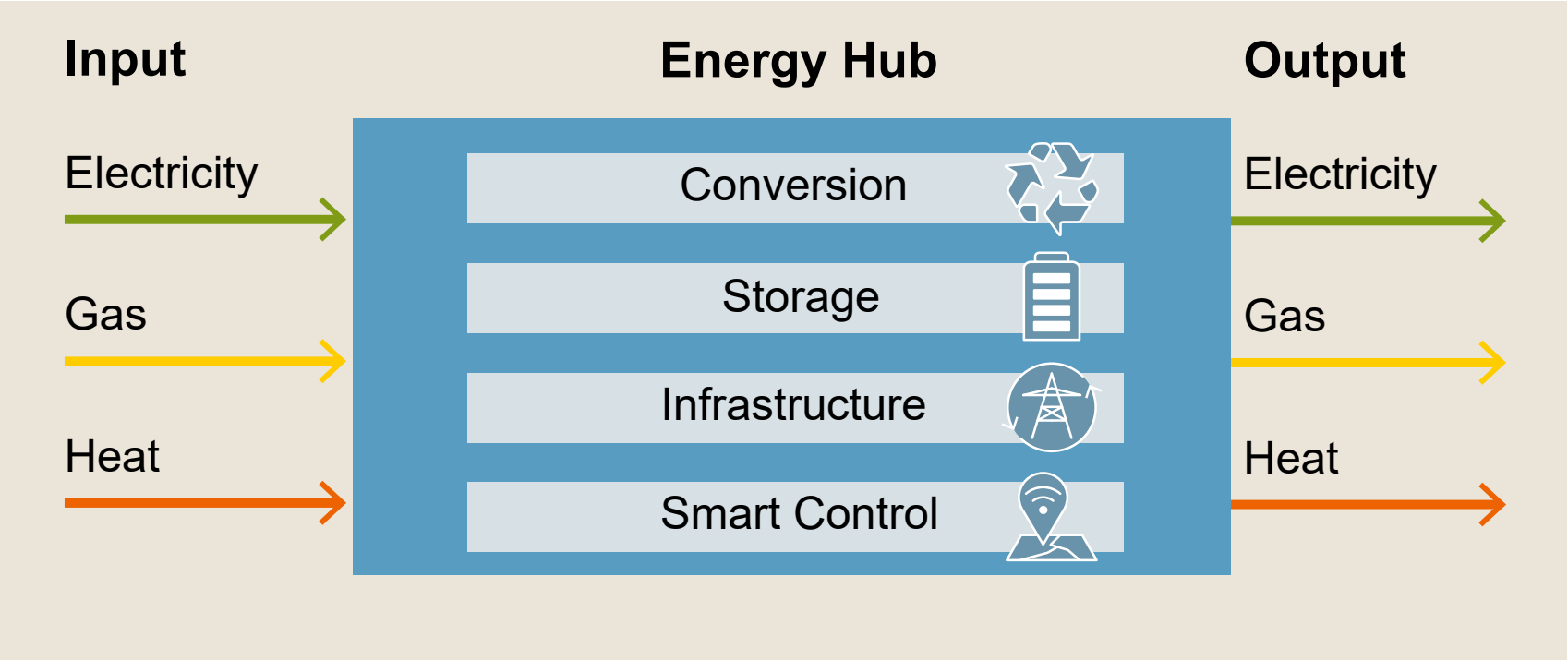
- Massive penetration of renewable energy sources (weather dependent)
- Centralised and distributed production
- Multiple energy carriers
- Unlocking flexibility
- Cyber-physical systems
- Fit for purpose, business models, laws and regulation

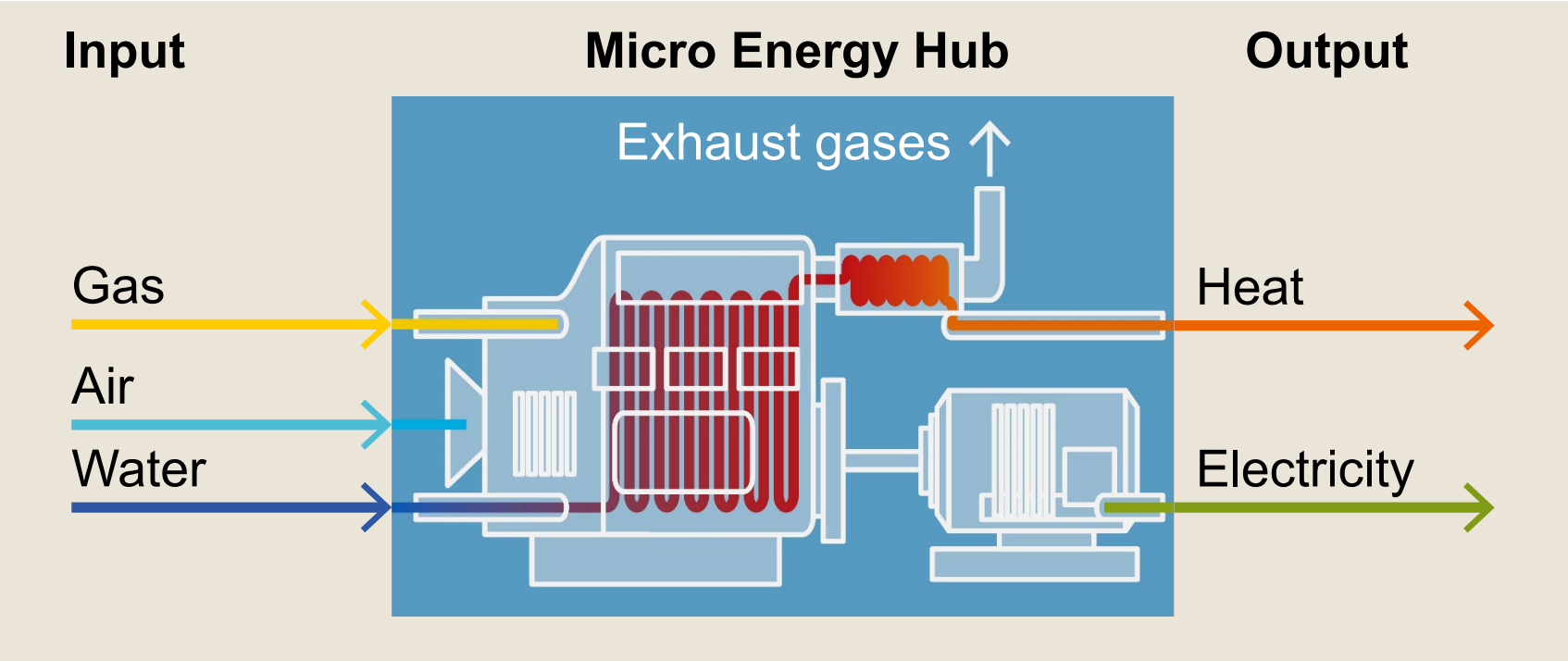


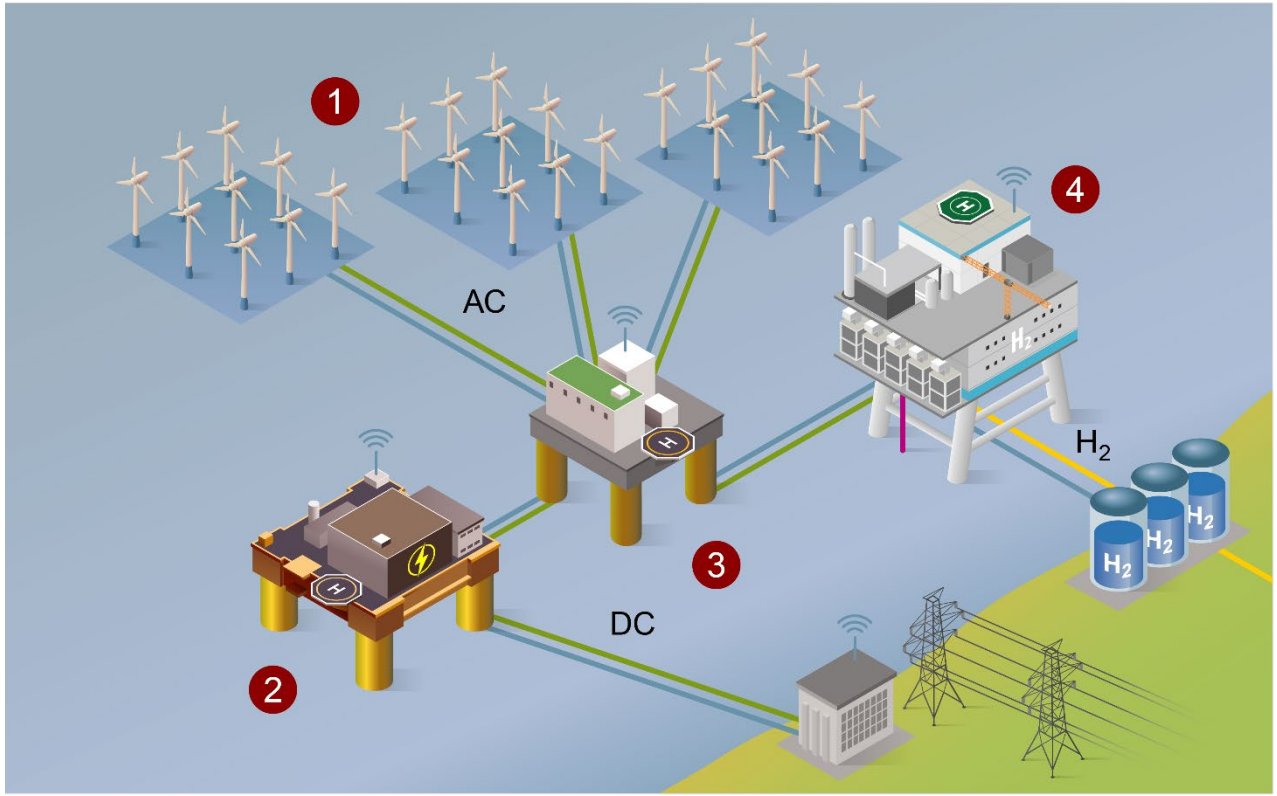
The energy system is becoming complex: Integrated infrastructure



The energy system is becoming complex: Energy Hubs

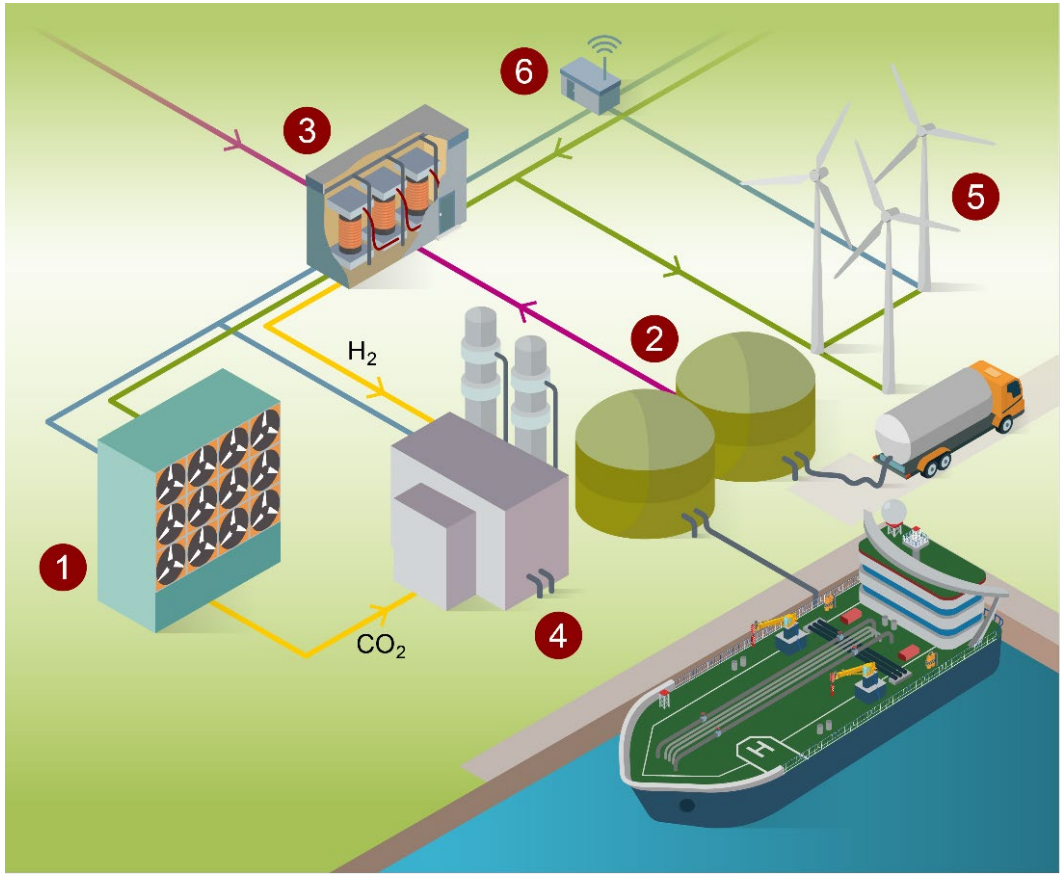



Input
Micro Energy Hub
Output
Exhaust gases
Gas
Air
Water
Heat
Electricity



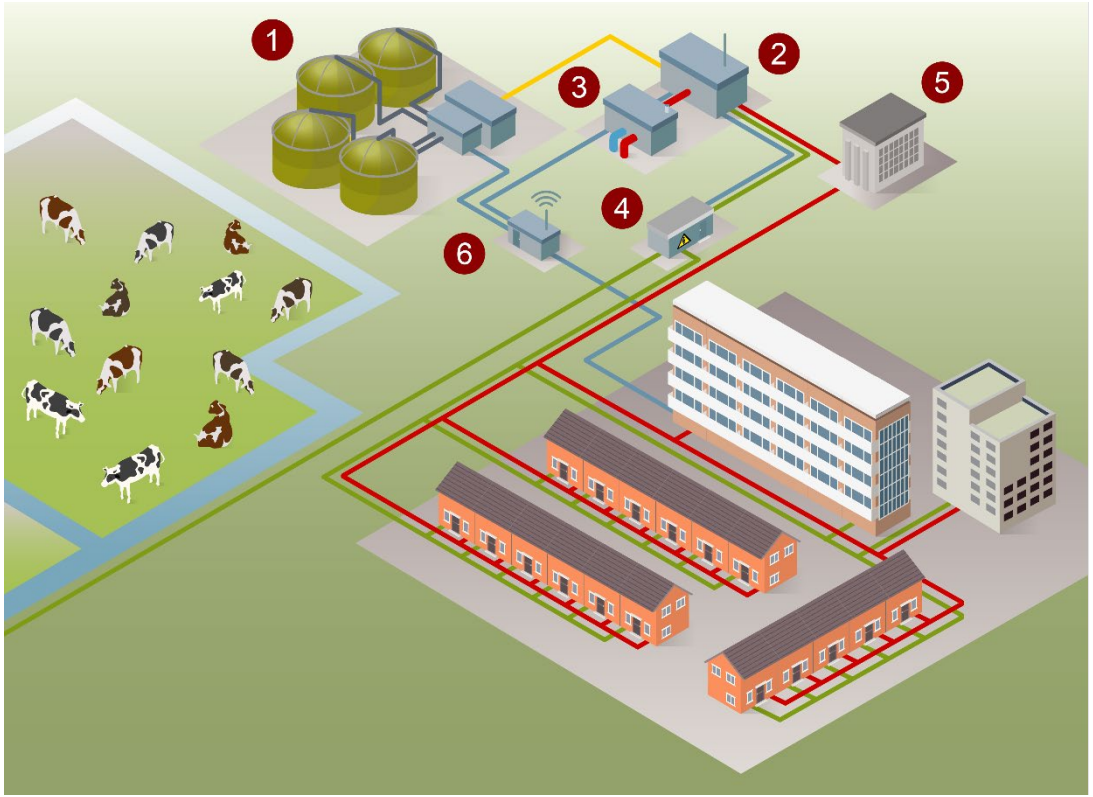
1. Wind farms
2. Converter (AC/DC)
3. Substation
4. Electrolyser

- Data
- Gas
- H_2O
- Electricity



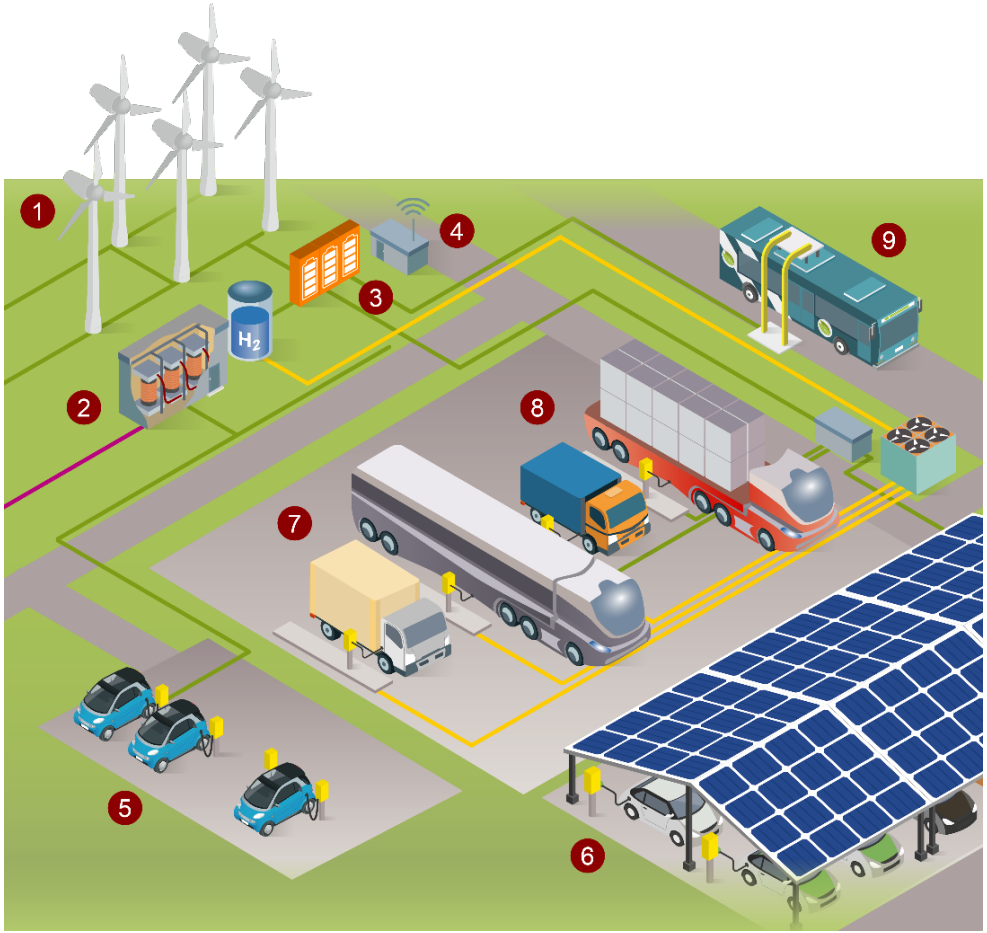
1. Direct Air Capture (DAC)
2. Green feedstock
3. Electrolyser
4. e-Refinery
5. Wind farm

- Data
- Gas
- H_2O
- Electricity



1. Biogas plant
2. Heat plant
3. Geothermal energy
4. Transformer
5. Heat transfer station
6. Smart Control

- Data
- Gas
- H_2O
- Electricity



1. Wind farms
2. Electrolyser
3. Battery storage
4. Smart Control
5. Short distance e-transport (‘last mile’)
6. Electric charging plaza for passenger cars
7. Hydrogen fueling station
8. Electric charging plaza for heavy duty vehicles
9. Charging facility for buses

- Gas
- H_2O
- Electricity

It’s beyond traditional sector coupling

TOPSECTOR ENERGIE
Empowering the new economy

Mobility Hub

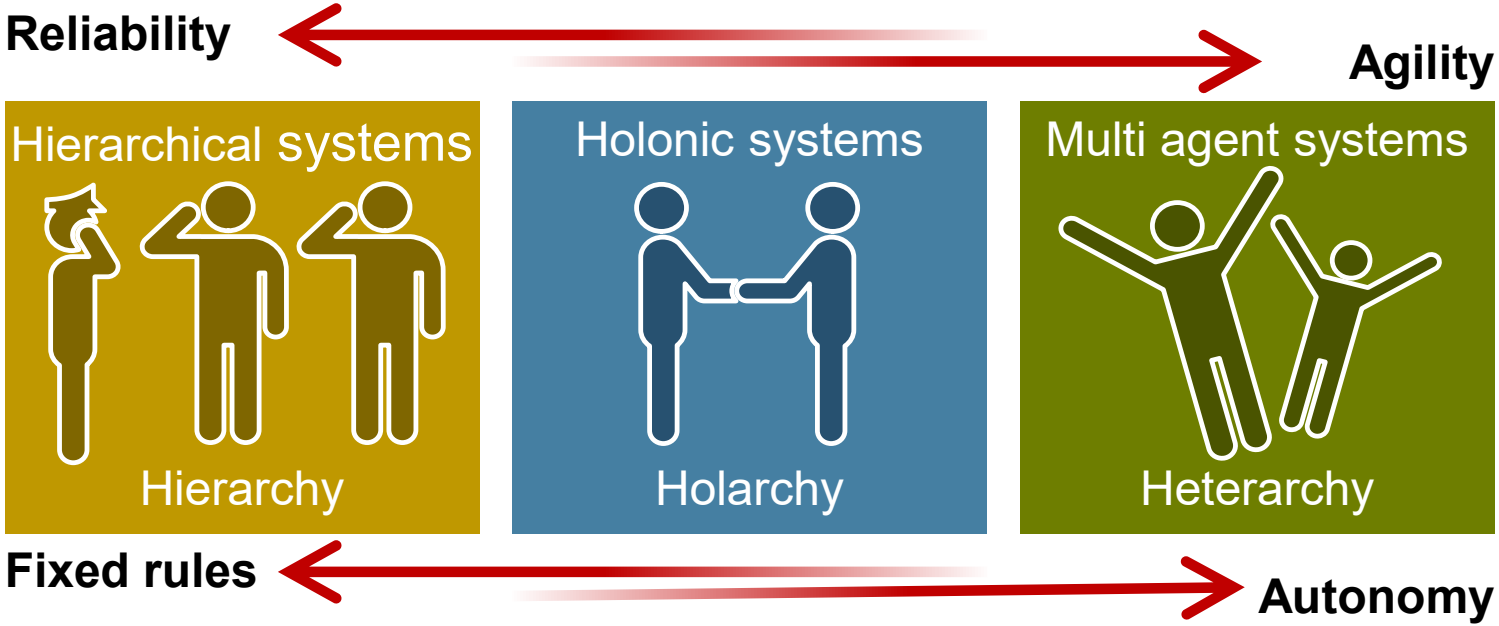
1. Parking
2. Train station
3. Bus station

Mobility hub

Energy hub

Governance model supporting Energy Hubs

- Supporting both central orchestration by the state and decision space at local and regional levels.

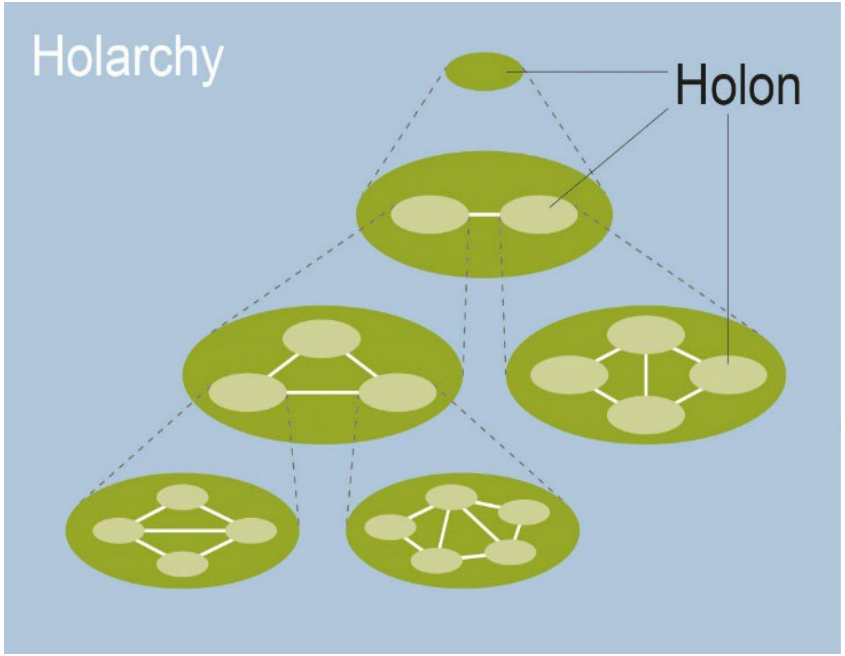


What is a ‘holarchy’?

- **Holon:** an entity being simultaneously a whole and a part. Holons are self-reliant units that possess a degree of autonomy but are also simultaneously subject to control from one or more higher levels.

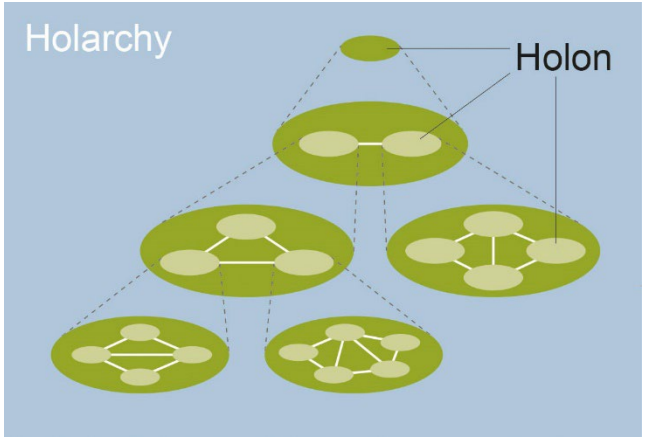
- **Holarch**y: a hierarchy of self-regulating holons that function:

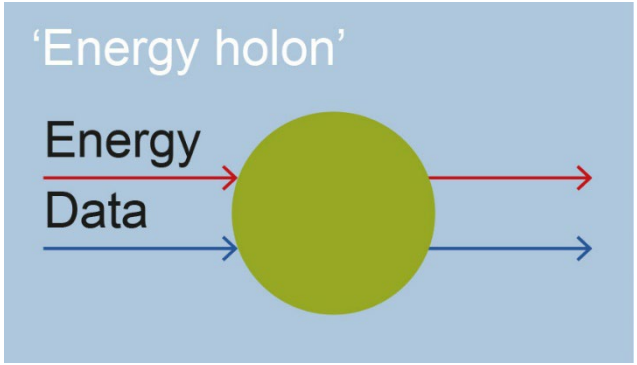
  1. As autonomous wholes in supra-ordination to their parts
  2. As dependent parts in sub-ordination to controls on higher levels,
  3. In coordination with their local environment.



Characteristics energy holarchy (1/2)

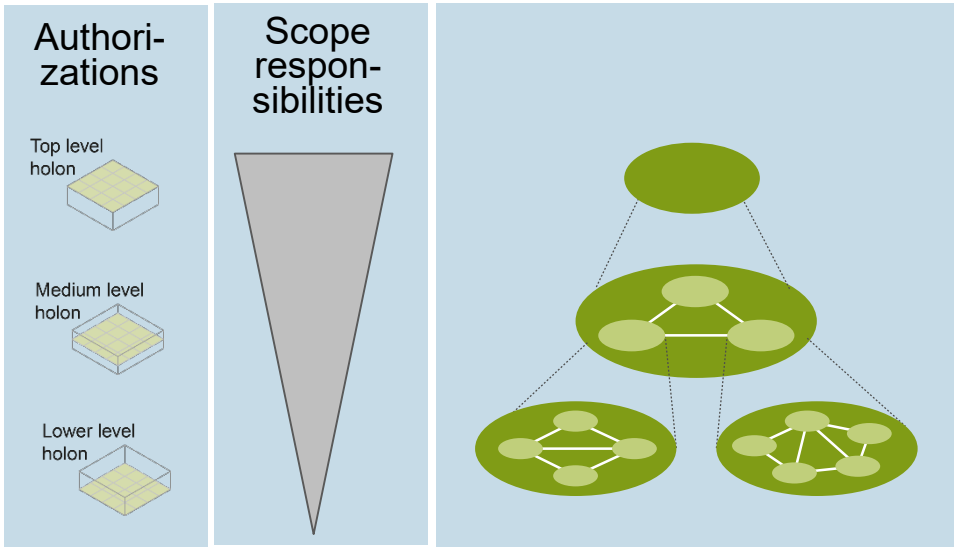
- Self-organizing/ optimizing and adapting
- Combines as much as possible demand and production of energy
- Efficient use of distributed energy sources
- Each holon with a certain degree of autonomy
- Energy flow without specific routes





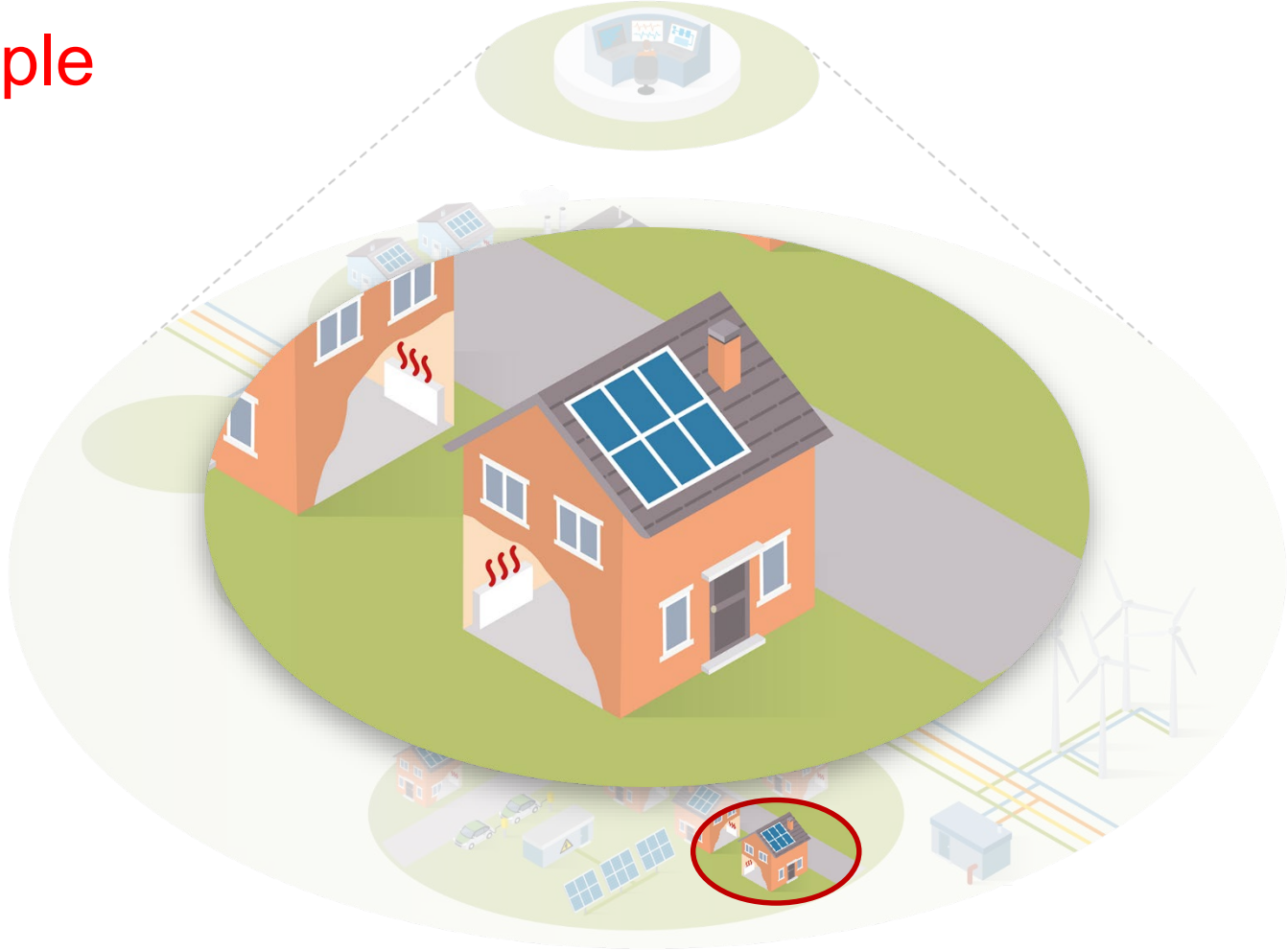
Characteristics energy holarchy (2/2)

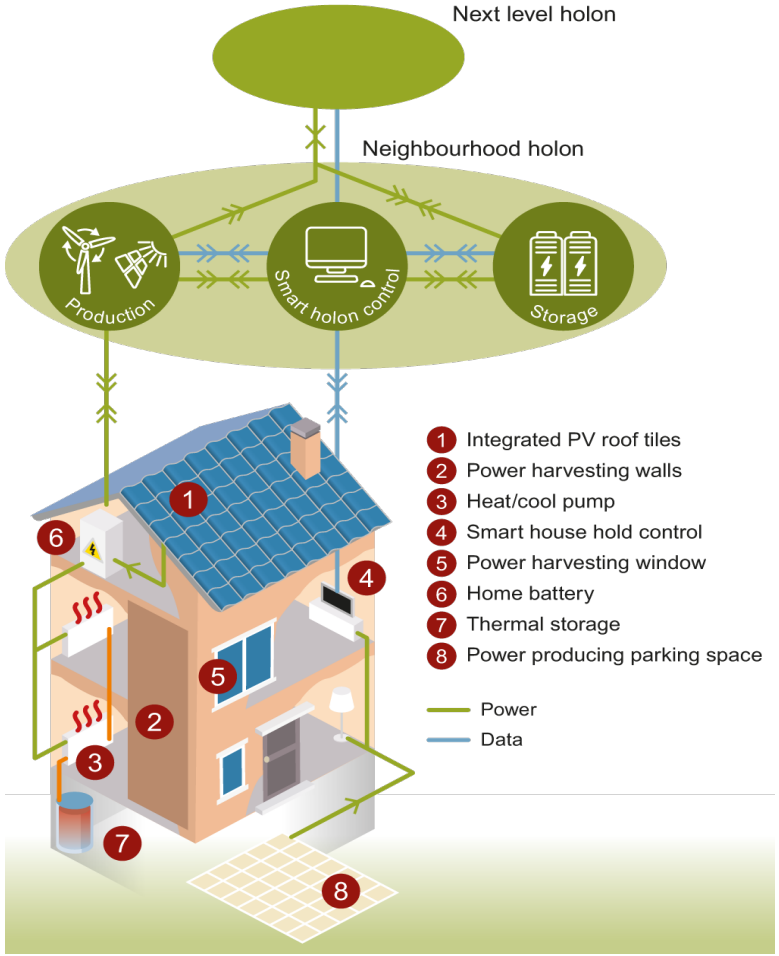
- Cascaded decision-making
- Tailored decision-making possible (e.g. cooperative community)
- Data-driven
- Many opportunities for citizen participation
- Different business models possible




Higher level holon
Heat
Gas
Power

Example





Source: TUDelft

Requirements

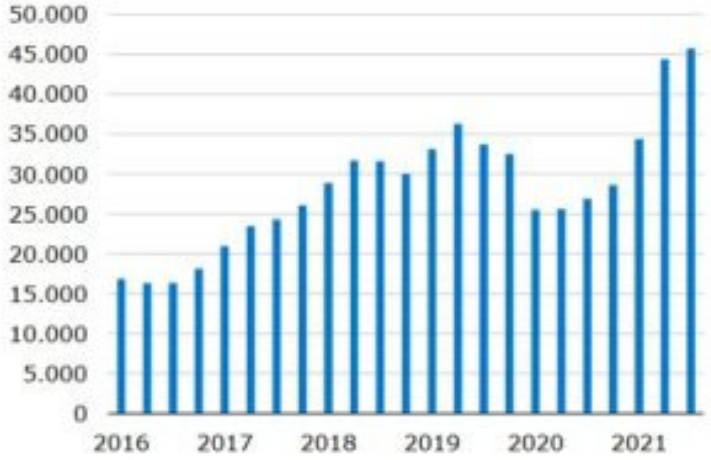
- Technical proven and tested systems (hardware and software)

  → Pilots and demo’s

- Business models supporting investments in and use of Energy Hubs
- Legislation and regulation supporting semi-autonomous systems (Holonic model)
- Skilled labour force on academic, higher professional and secondary vocational education

Labour force: present state

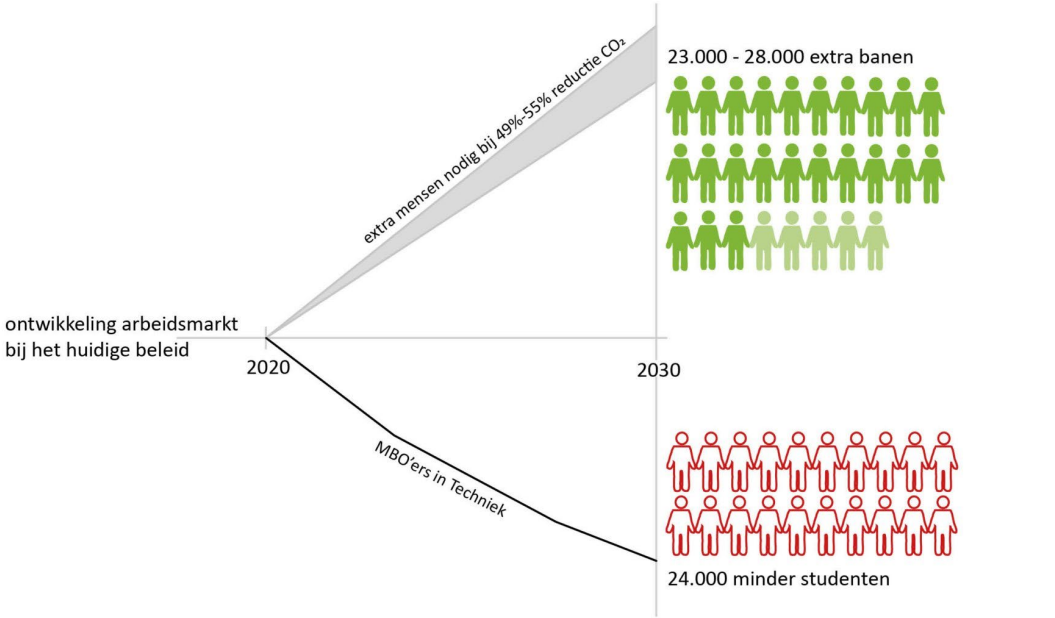
Aantal openstaande vacatures voor de relevante technische beroepen in de gebouwde omgeving
2016 – 2021 (per kwartaal) en aantal vacatures 2021 3e kwartaal



	Beroepen met de meeste vacatures	Aantal
1	Werkvoorbereiders en calculatoren bouw en installatietechniek	4.700
2	Loodgieters, installateurs gawalo	4.600
3	Timmerlieden burgerlijk en utiliteit	4.400
4	Elektriciens en monteurs elektrische bedrijfsinstallaties	4.400
5	Ingenieurs werktuigbouw	2.500
6	Installateurs luchtbehandeling en koeltechniek	2.100
7	Timmerlieden werkplaats en interieur	2.000
8	Uitvoerders bouw en installatiewerk	1.800
9	Tekenaars en constructeurs bouwkunde	1.600
10	Managers bouw en installatiewerk	1.400

Labour force: future prospect

10.000en vakmensen nodig voor energietransitie

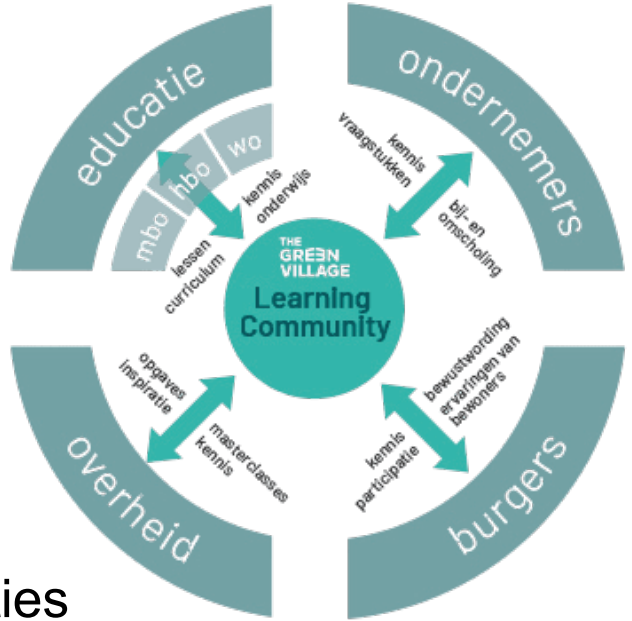


bron: Klimaatbeleid en de arbeidsmarkt, verkennende studie naar de werkgelegenheidseffecten van CO_2-reductiemaatregelen (feb 2021, Ecorys), visualisatie NVDE

Worrisome situation calls for unorthodox measures

- Education
- Retraining
- Digitization
- Innovative methods to reduce labour force (plug & play solutions)
- Innovative training and education methods

→ Learning communities



Thank you for your attention!

Graphic design:
Rietstap Vormgeving http://rietstapvormgeving.nl/

TOPSECTOR ENERGIE
Empowering the new economy