

Energy Storage Theory & Practise

Koninklijk Instituut Van Ingenieurs (KIVI)

SEMINAR ENERGY STORAGE AND CONVERSION:
DEVELOPMENTS AND INNOVATIONS

June 2022

Jos Blom, Strategy, Koolen Industries



Jos Blom



life

Info



Energy



€



CAN I DO IT AGAIN?

- Former CEO of Booking.com
- Key-role in Uber' s international growth
- Current CEO of Koolen Industries

Booking.com

Uber



KOOLEN INDUSTRIES
SMART ENERGY





Driving the **rapid transition** to a clean energy future

Vision

Enable everyone to contribute to the energy transition.

- Small and large end users of energy,
- Neighbourhoods,
- Cities, Regions
- Industrial area's,
- Landowners
- Countries





CLEAN ENERGY GENERATION



CLEAN ENERGY STORAGE



CLEAN MOBILITY



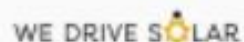
DIGITAL PLATFORMS



INHOUSE ENGINEERING AND MANUFACTURING

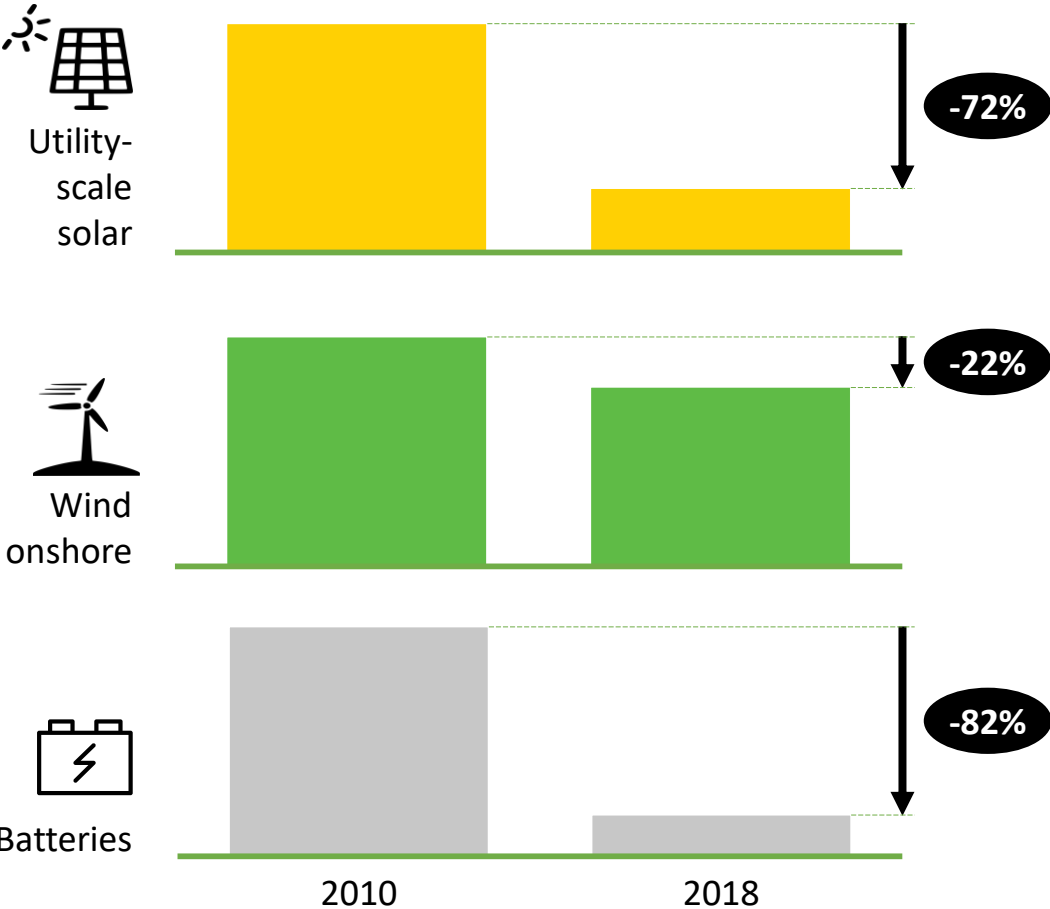


ENERGY INNOVATORS



Mass production

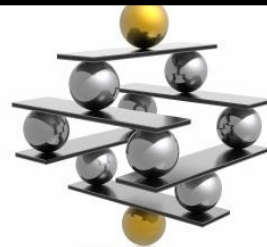
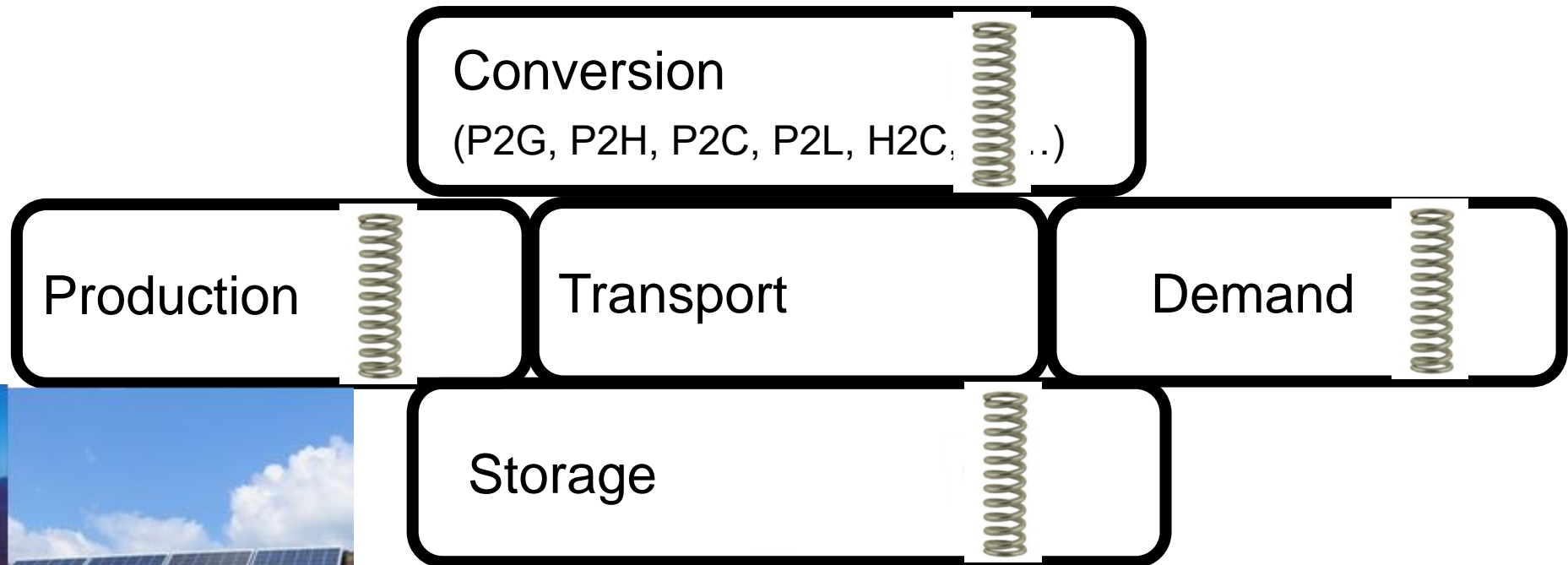
Renewable technologies LCOE¹ in Germany, Index of 2010 value



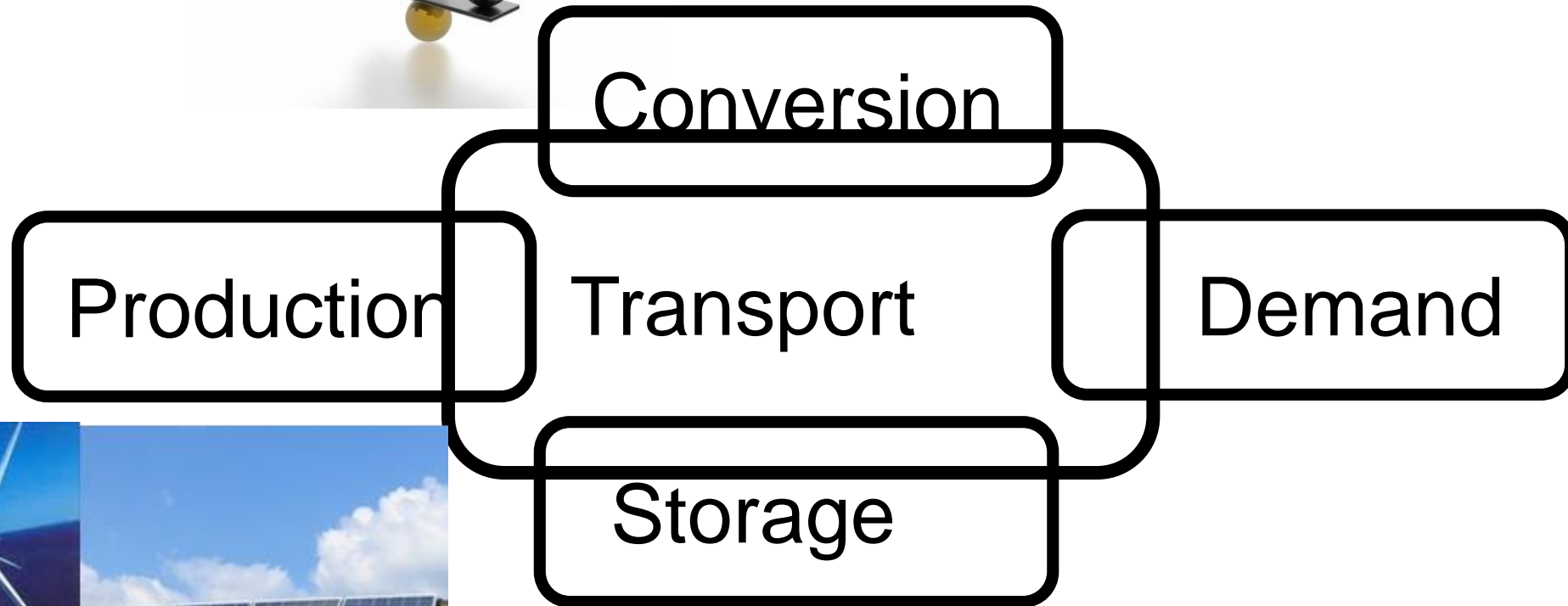
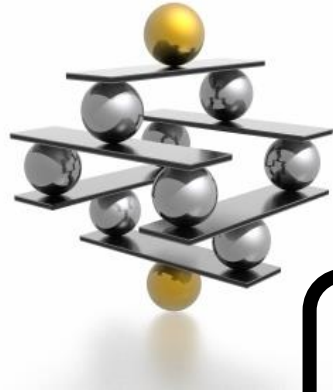
¹ Levelized Cost of Energy



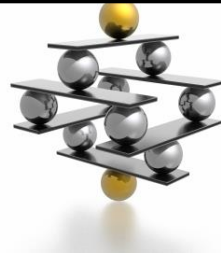
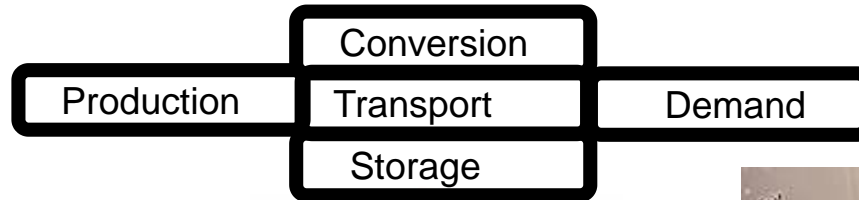
Flexibility - Balance



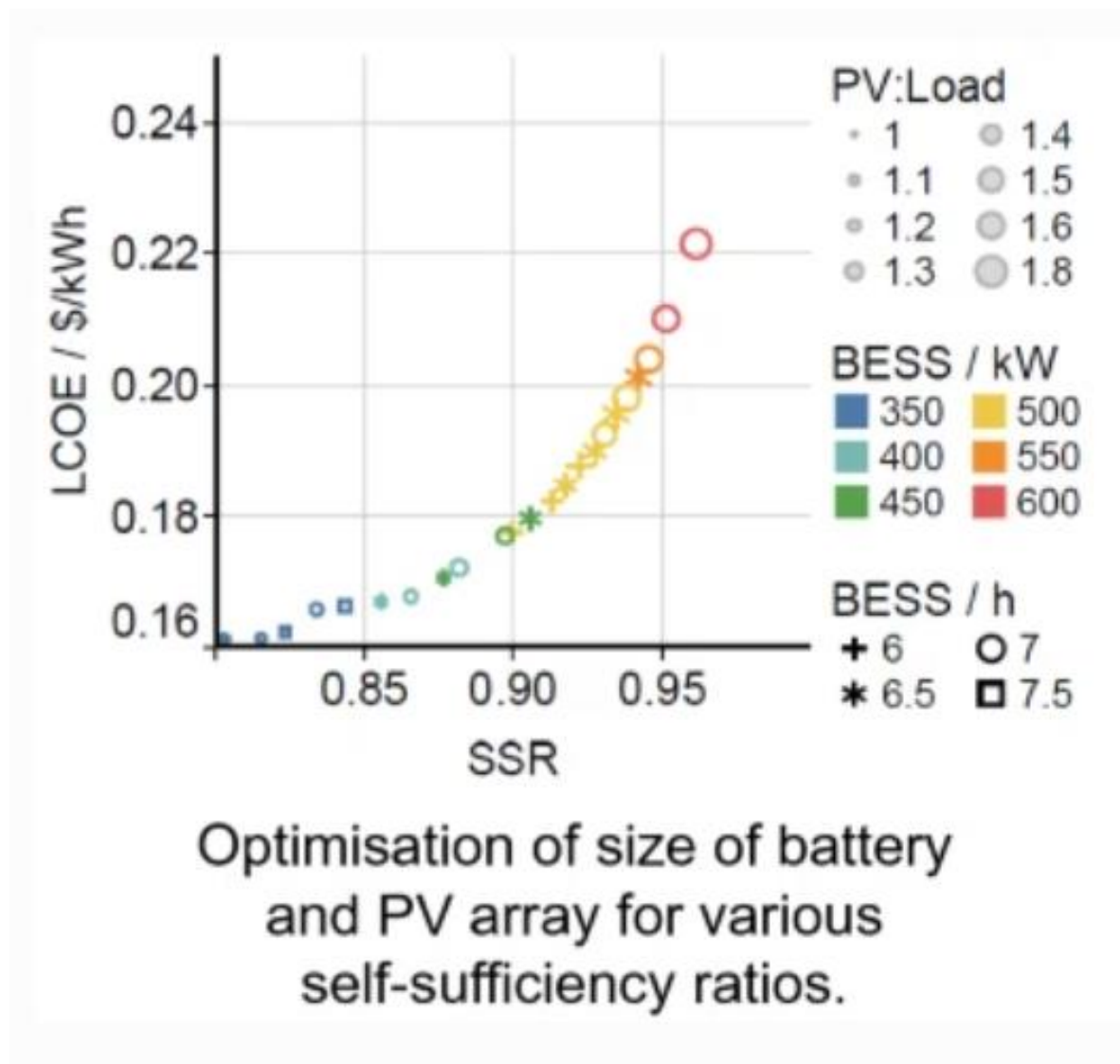
Flexibility - Balance



Flexibility - Balance



Self Sufficient Ratio



The Dutch high-voltage grid

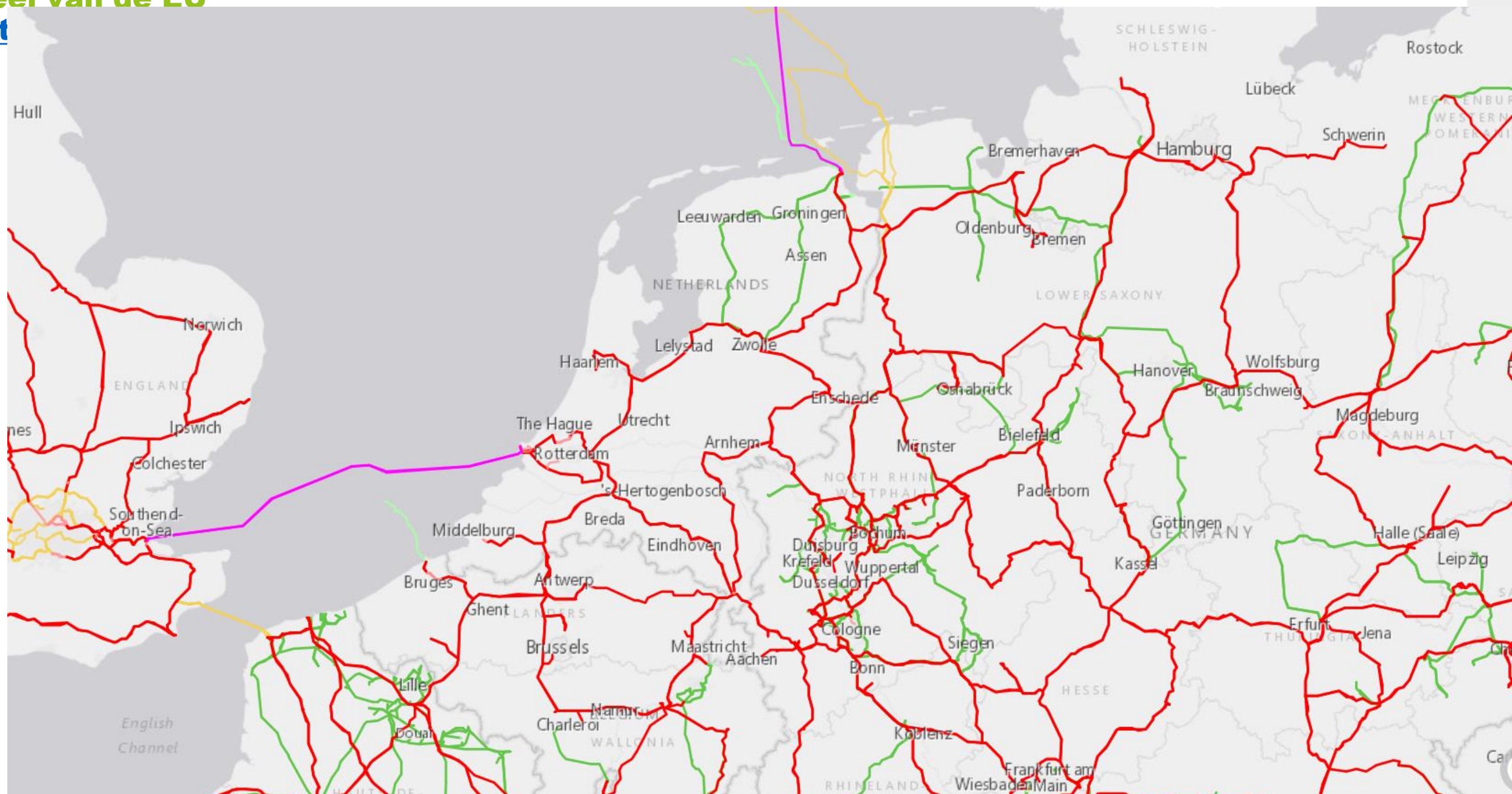
as at 1 January 2004

-  380kV tenner
-  220kV tenner
-  150kV regional grid administrator
-  110kV regional grid administrator
-  380kV cross-border interconnection
-  switching and/or transformer substation
-  name of 380kV or 220kV substation
-  tenner National Control Centre
-  grid openings
-  generating unit 60-250MW
-  generating unit ≥ 250 MW



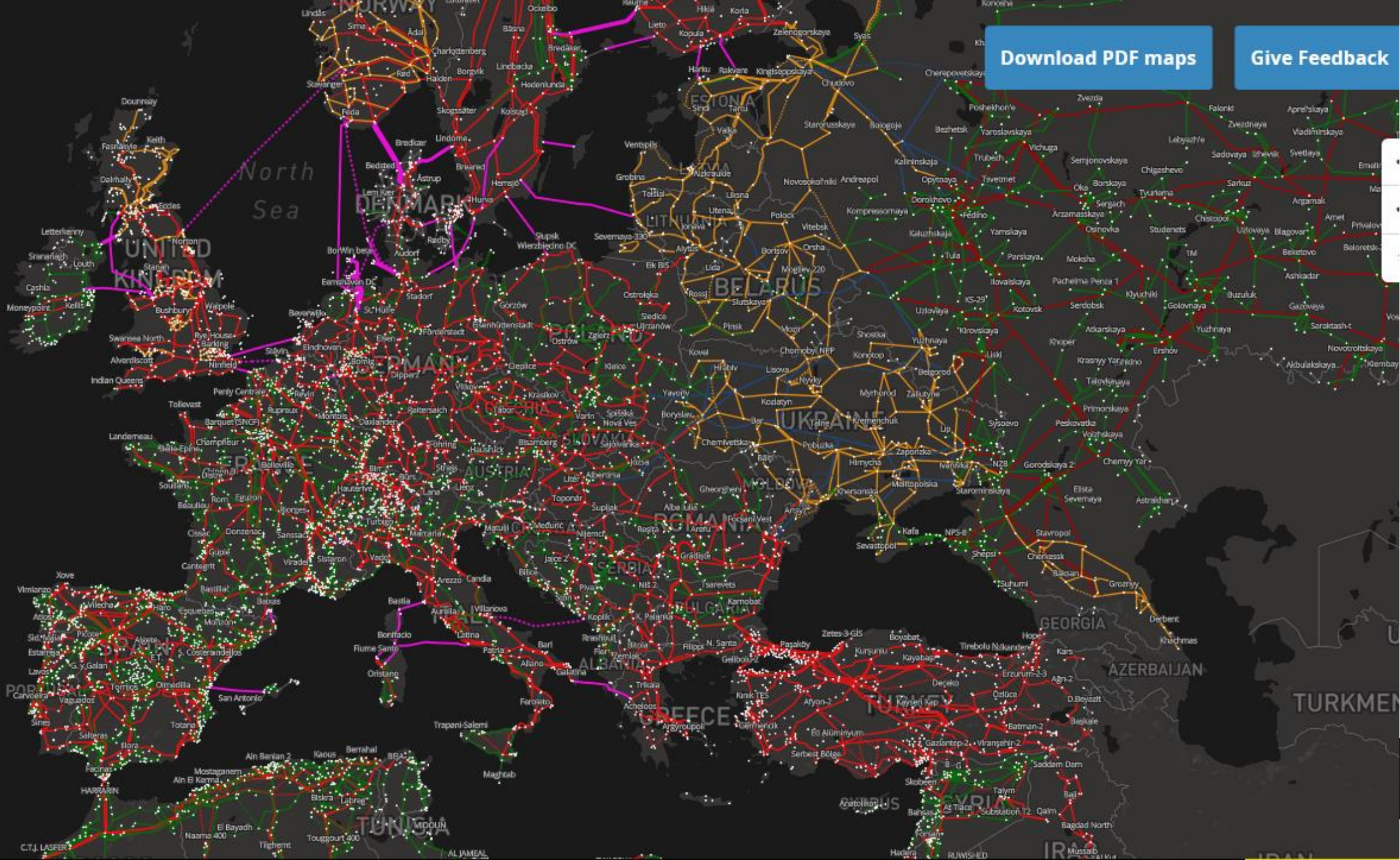
Deel van de EU

[ht](#)



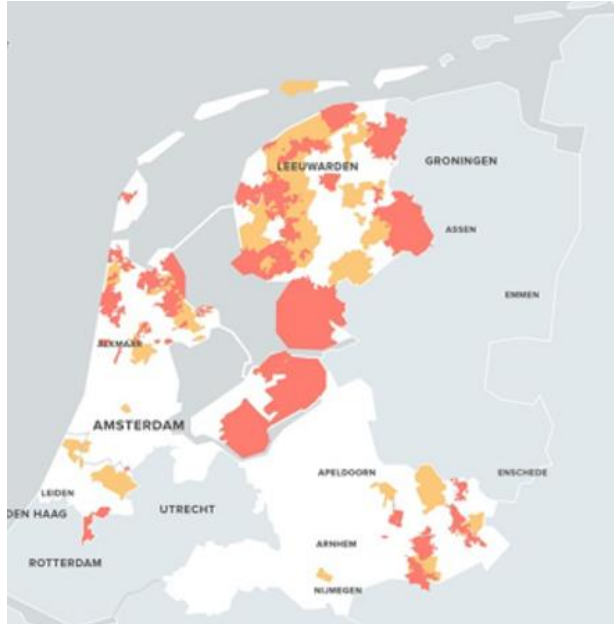
[Download PDF maps](#)

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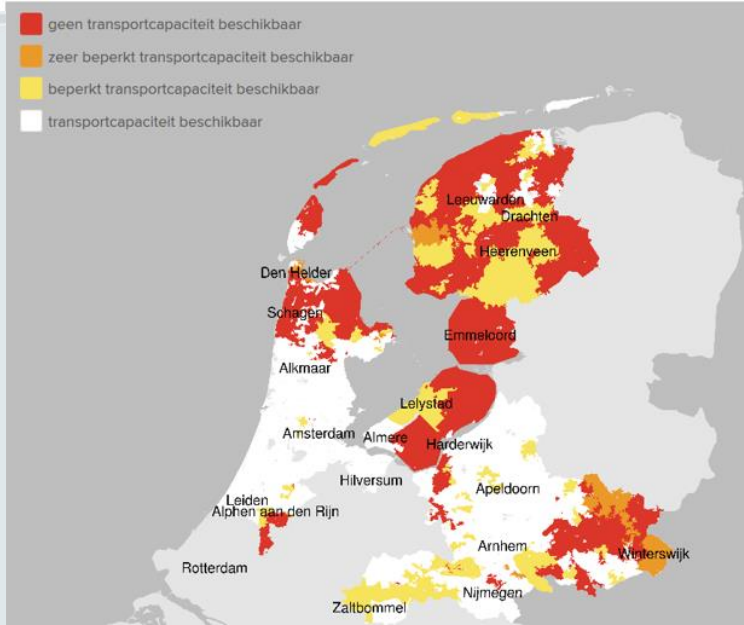


Congestion

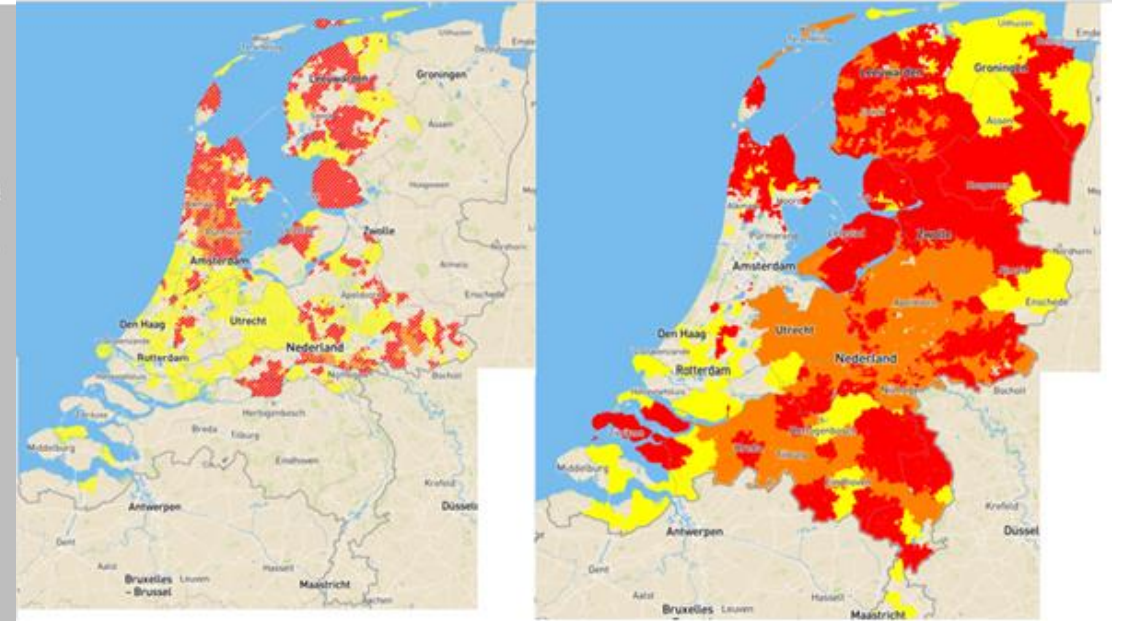
September 2019



Oktober 2020



Feb 2022



Energy production

Congestie afname stroom

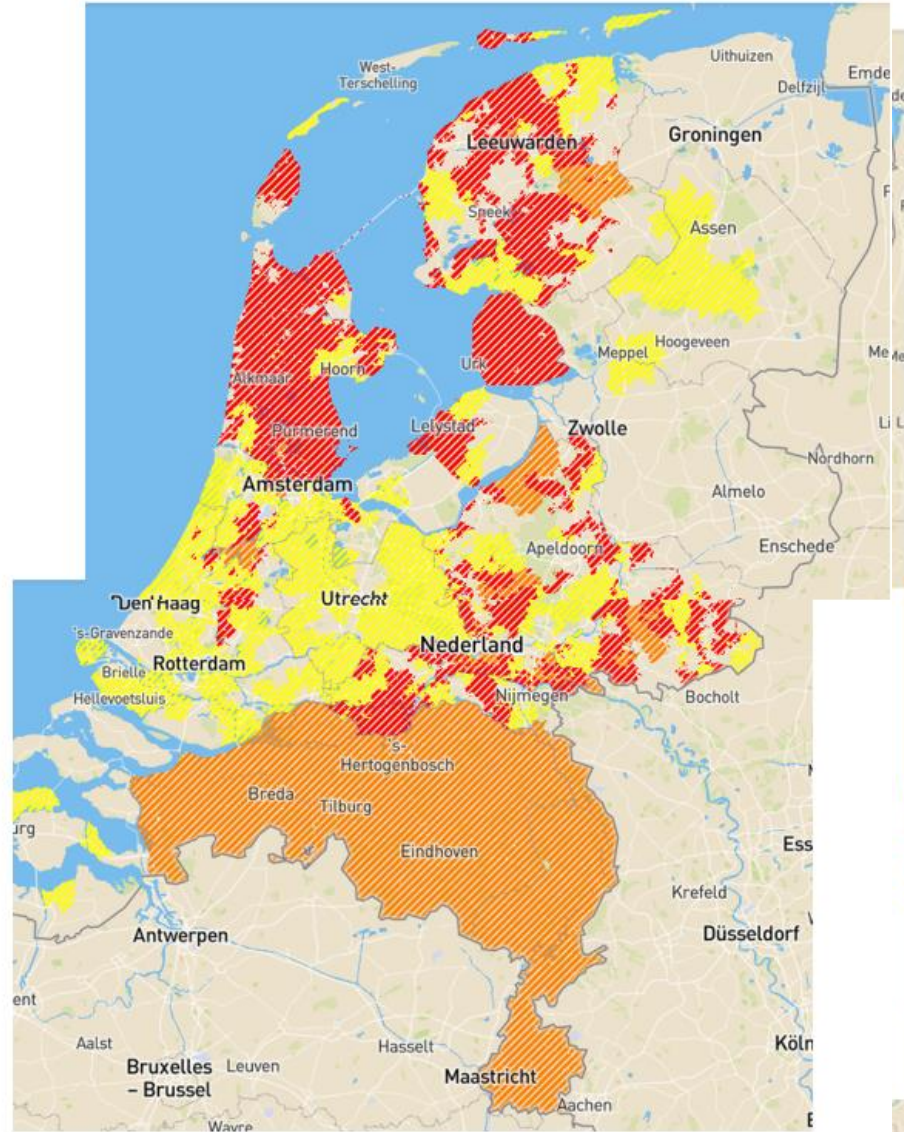
Congestie opwek stroom

NL congestion

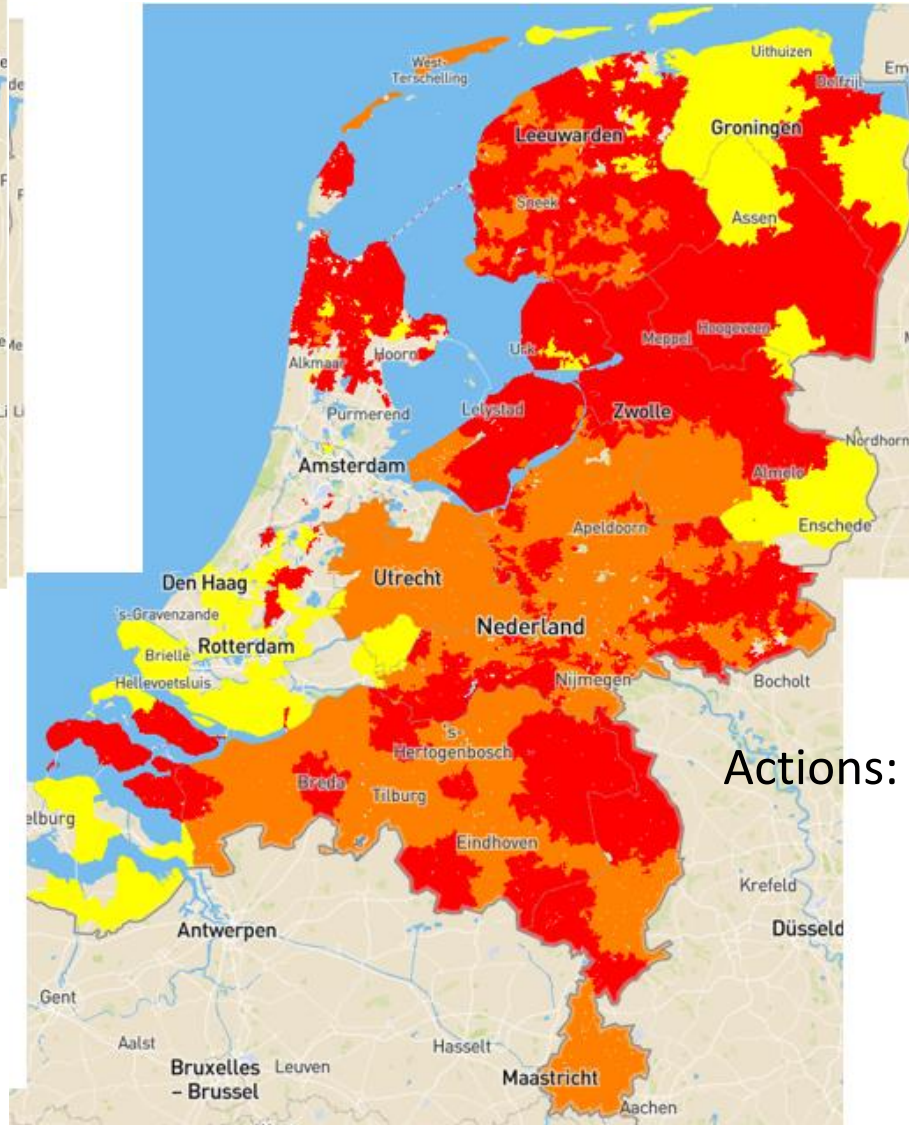


Congestion June 2022

Energy usage



Energy production



Actions: Congestion management
Solar parks on 50 % capacity
Non firm contracts
Use it or lose it





Welcome to Global Solar Atlas v2.6 released in July 2021. What's new? X

- Site
- Area
- Region
- Distance

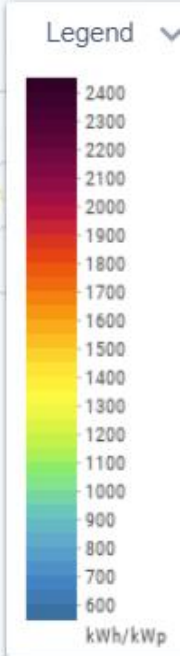
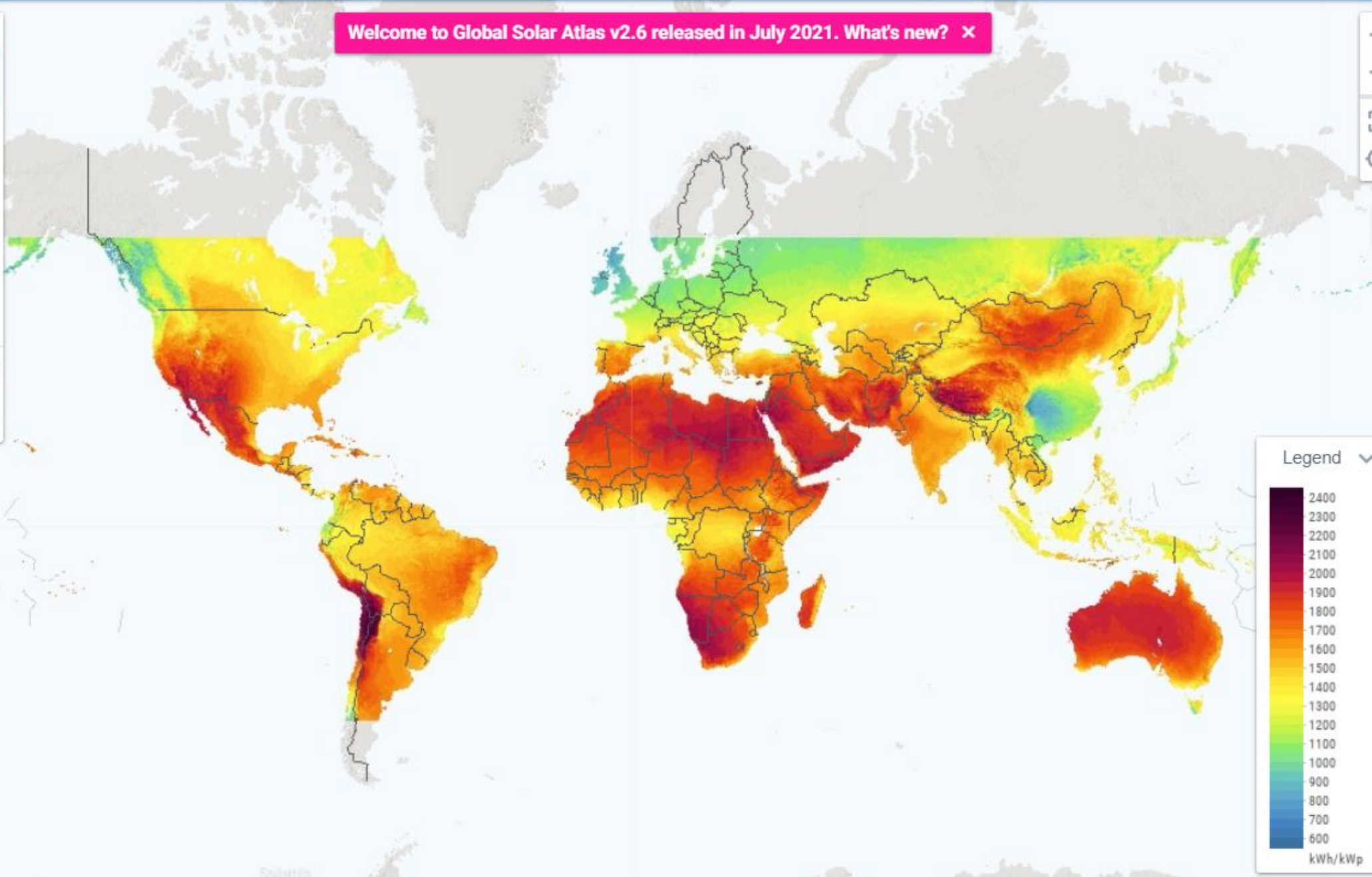
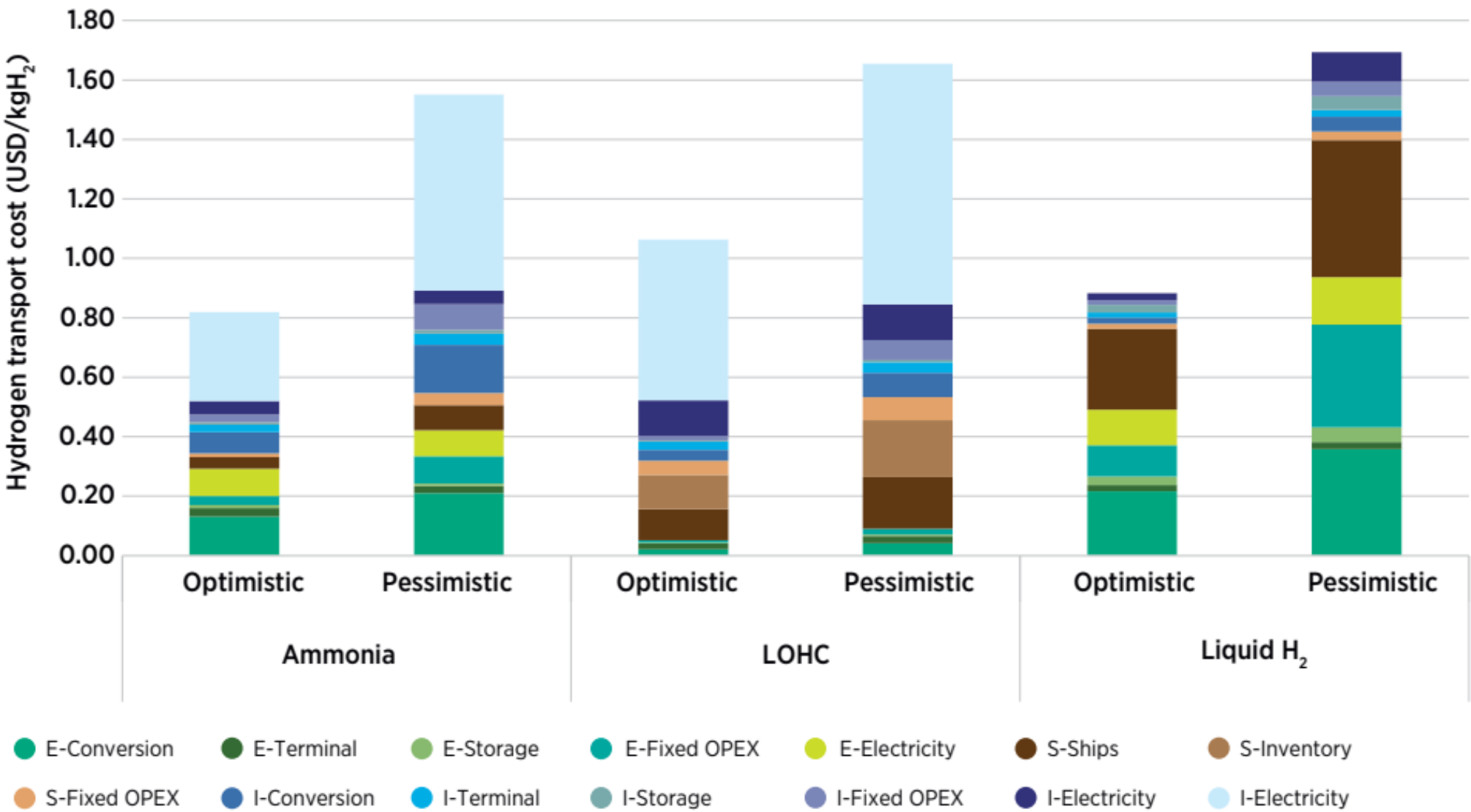


FIGURE 6.1. Transport cost breakdown by hydrogen carrier, scenario and cost component in 2050



1 KG H₂ = 34 kWh

Making 1 KG H₂ = 49 kWh

€ 1 / kg H₂ transport = € 0,02 / kWh

Notes: Costs are for a 1 MtH₂/yr export flow and a distance between ports of 10 000 km. Cost components are divided by part of the value chain: E = exporting country; S = ships; I = importing country. Refer to Figure 1.3 for the scope of these costs.



Values electricity storage



Motorisation hybride Toyota Prius



TRONQ Jean-Marc



Optimizing production



Customer Values

- Own PV Energy
- €: Smaller connection
- Autonomy → Grid defection
- No Breaks: Medical, safety, ICT
- €: Tax
- €: Trading
- Local community green
- Support local DC net
- Optimizing production



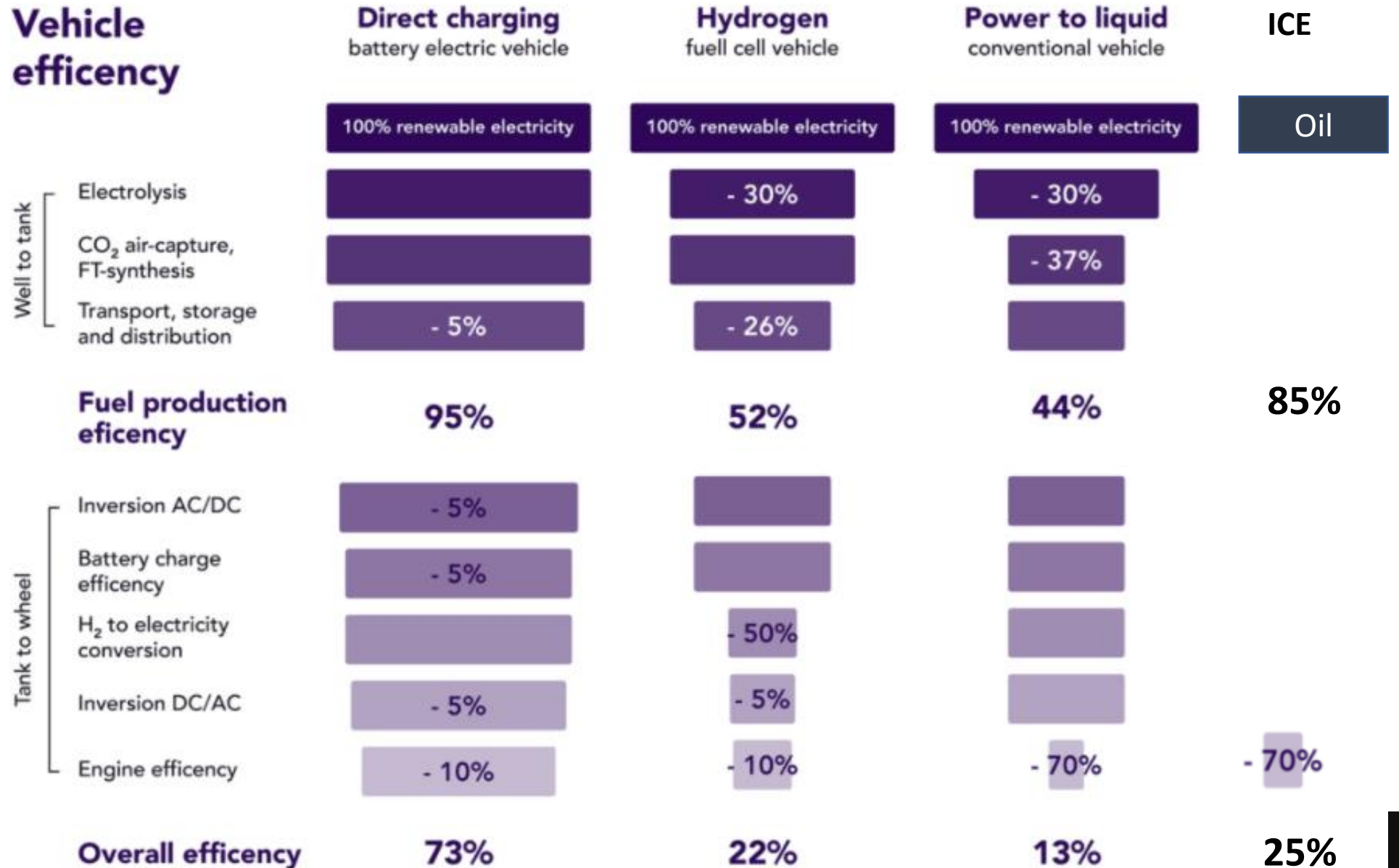
Energy Markets

1 Quarter / Month	Endex, energy
2 Hour, 15 minutes	APX → EPEX energy
3 15 minutes	Secondary reserve, aFRR, energy + capacity
4 4 Hours / Seconds	Primary control, frequency FCR, capacity
5 OTC	Bilaterally contracts
<i>6 Congestion</i>	<i>Gopacs</i>



Mobility

Vehicle efficiency



Source: WTT (LBST, IEA, World bank), TTW, T&E calculations



Optimizing production electricity



Diesel generators are used:

- Festivals
- Islands
- Remote locations
- Mines



With batteries:

- Optimize production
- Less (-30%) diesel → cheaper
- Diesel is out in NL

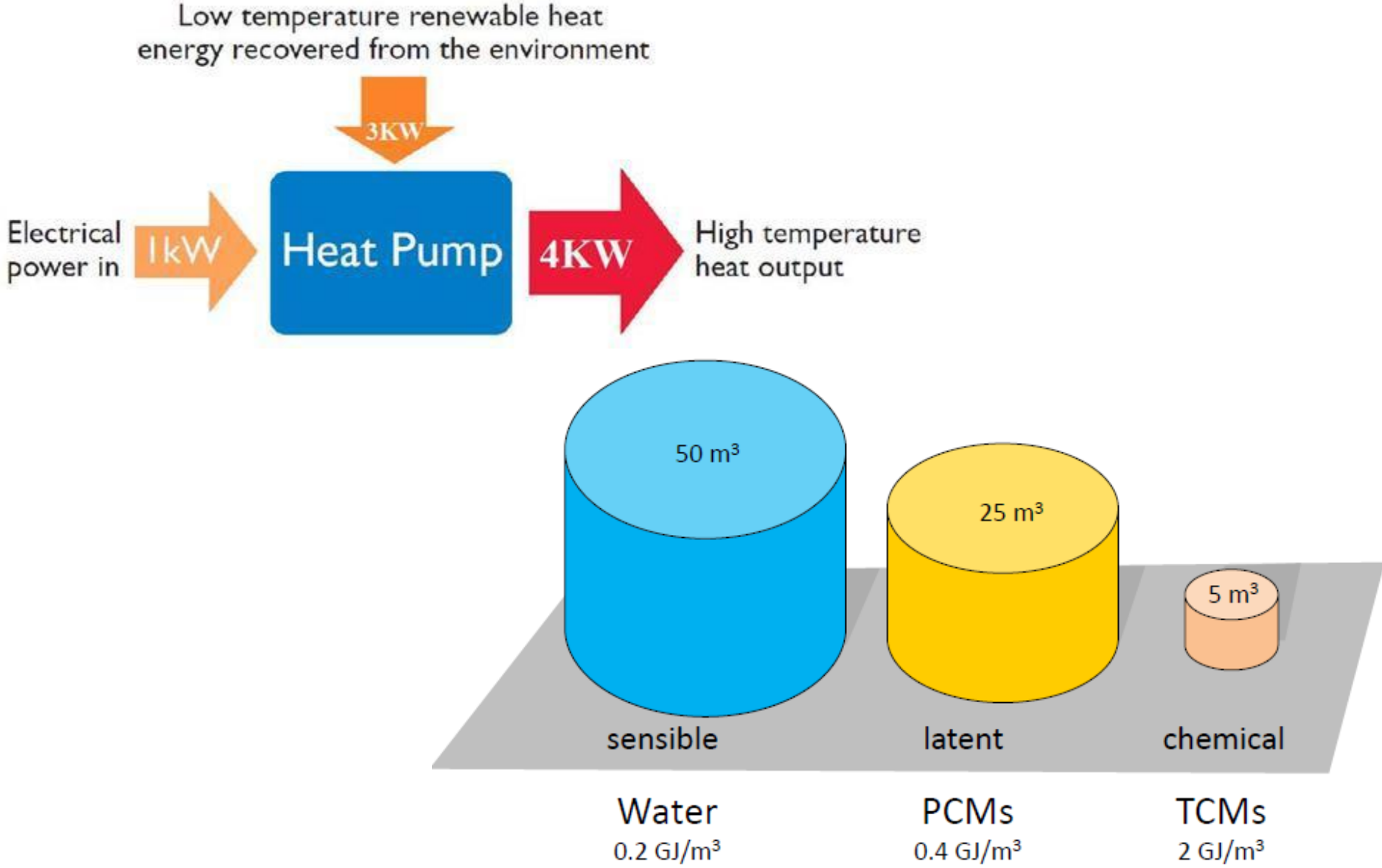


PV can easily integrate when batteries are there

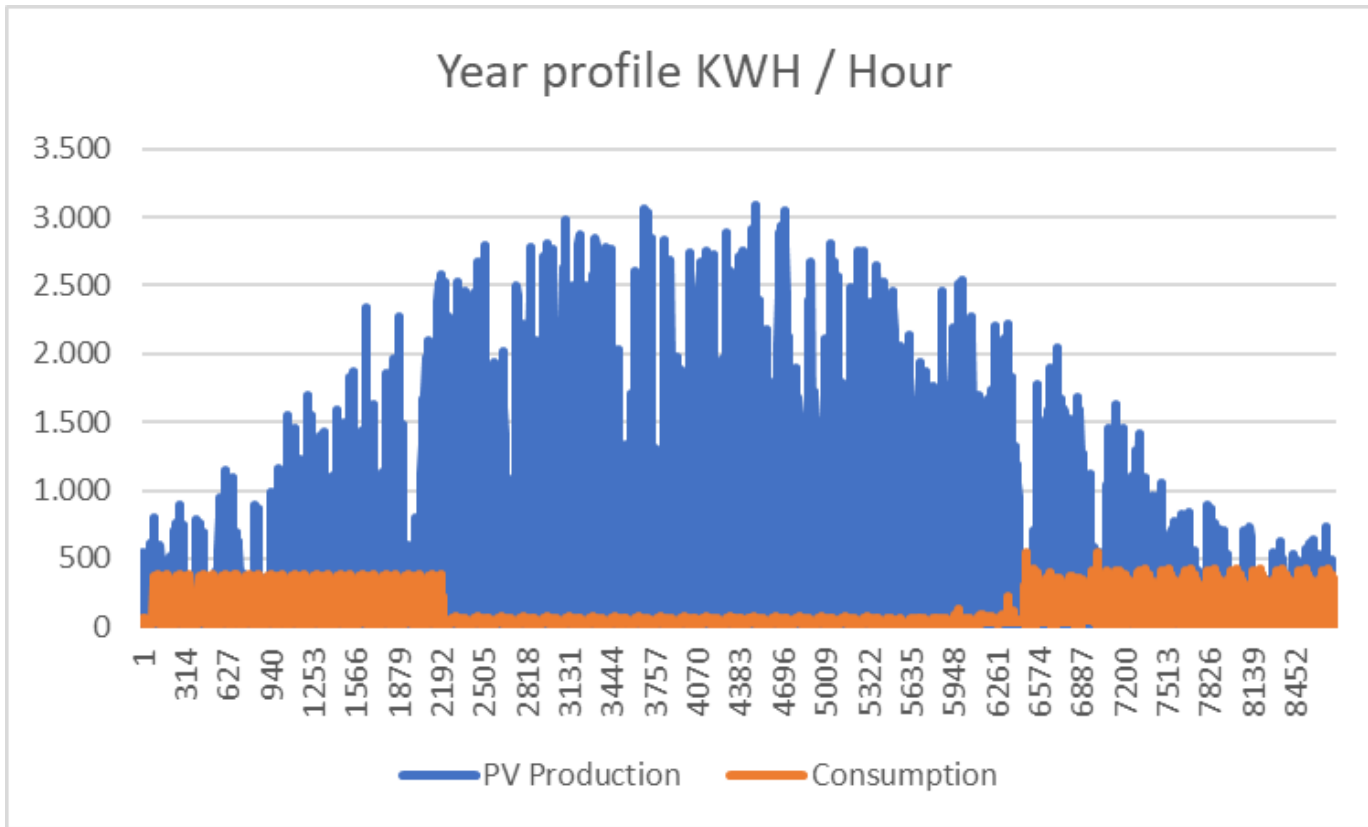
- Phase out diesel



Heat Pumps & Heat Storage



Practice: Usage, PV, Congestion, Battery

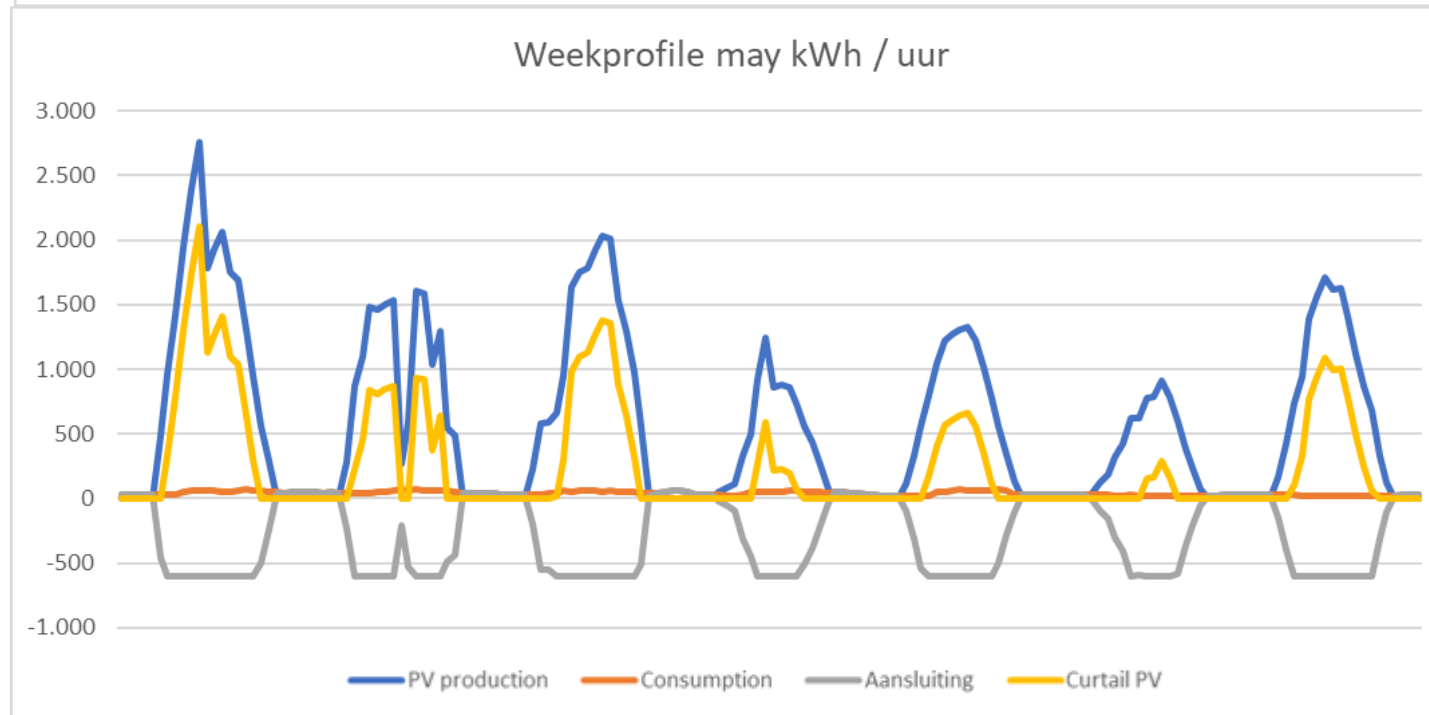
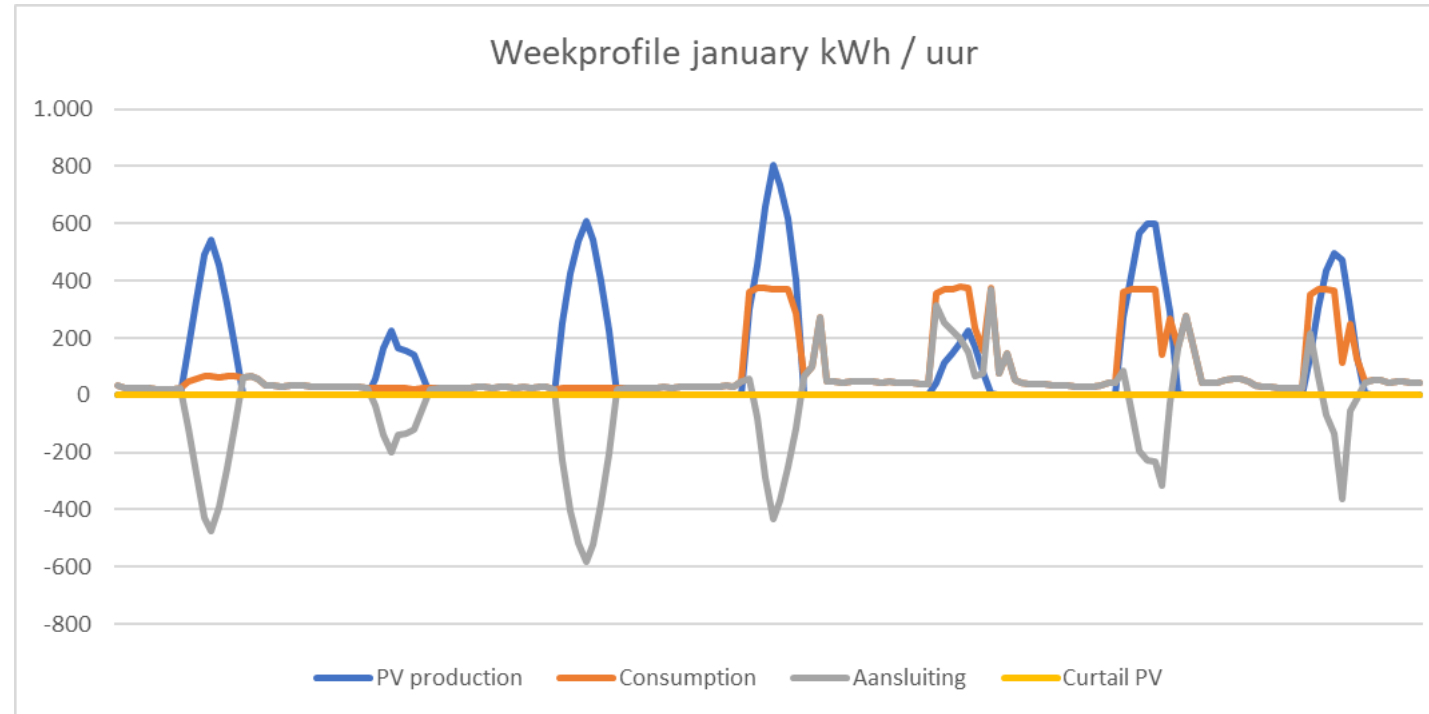


Connection from grid	2.000	KW
Connection to grid	600	KW
PV	4.102	KWp
Year production PV	3.676	MWH
Consumption	708	MWH

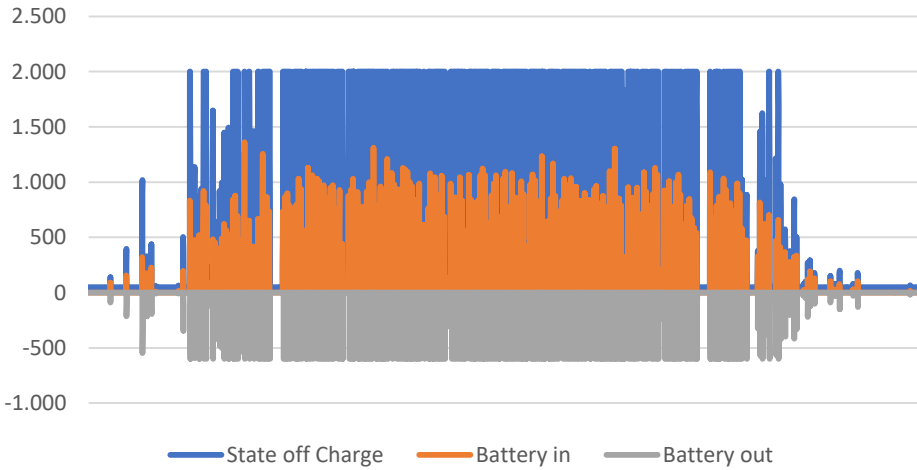
Consumption	708	MWH
PV production	3.676	MWH
PV to Consumption	337	MWH
Grid to consumption	371	MWH
PV to grid	1.689	MWH
PV Curtail	1.650	MWH



Practice:



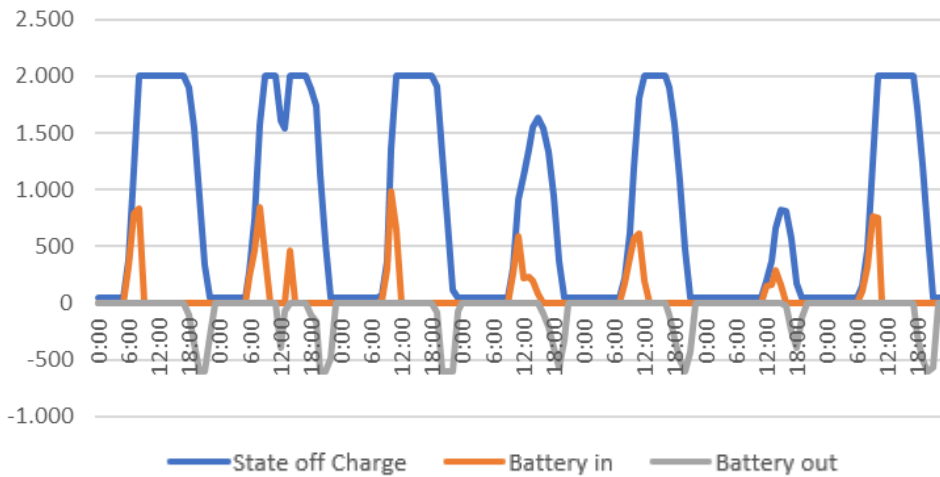
With Battery year profile



2 MWH Battery regime:

Charge with curtailment
Discharge when possible

Week End May



Battery	0	1	2	4	MWH
PV to grid	1.689	1.906	2.097	2.427	MWH
PV Curtail	1.650	1.433	1.242	912	MWH
Battery usage		217	408	738	MWH
LCOS		€ 100	€ 100	€ 100	MWH
SDE++ (max subsidie)		€ 30	€ 30	€ 30	MWH

Market Value: ??????:

Stacking Values

