

# Fast Track Insights

Kansen en risico's in het verduurzamen van  
de industrie!



# INDUSTRIËLE TRANSFORMATIE: HET GLAS IS HALFVOL

# AGENDA



- 1. Dit moet je weten over de EU Green Deal**
- 2. State of Tech: Industriële transformatie**
  - Energie
  - Circulariteit en CO2 opslag
  - Mineralen en metalen
- 3. Samenwerken en versnellen**

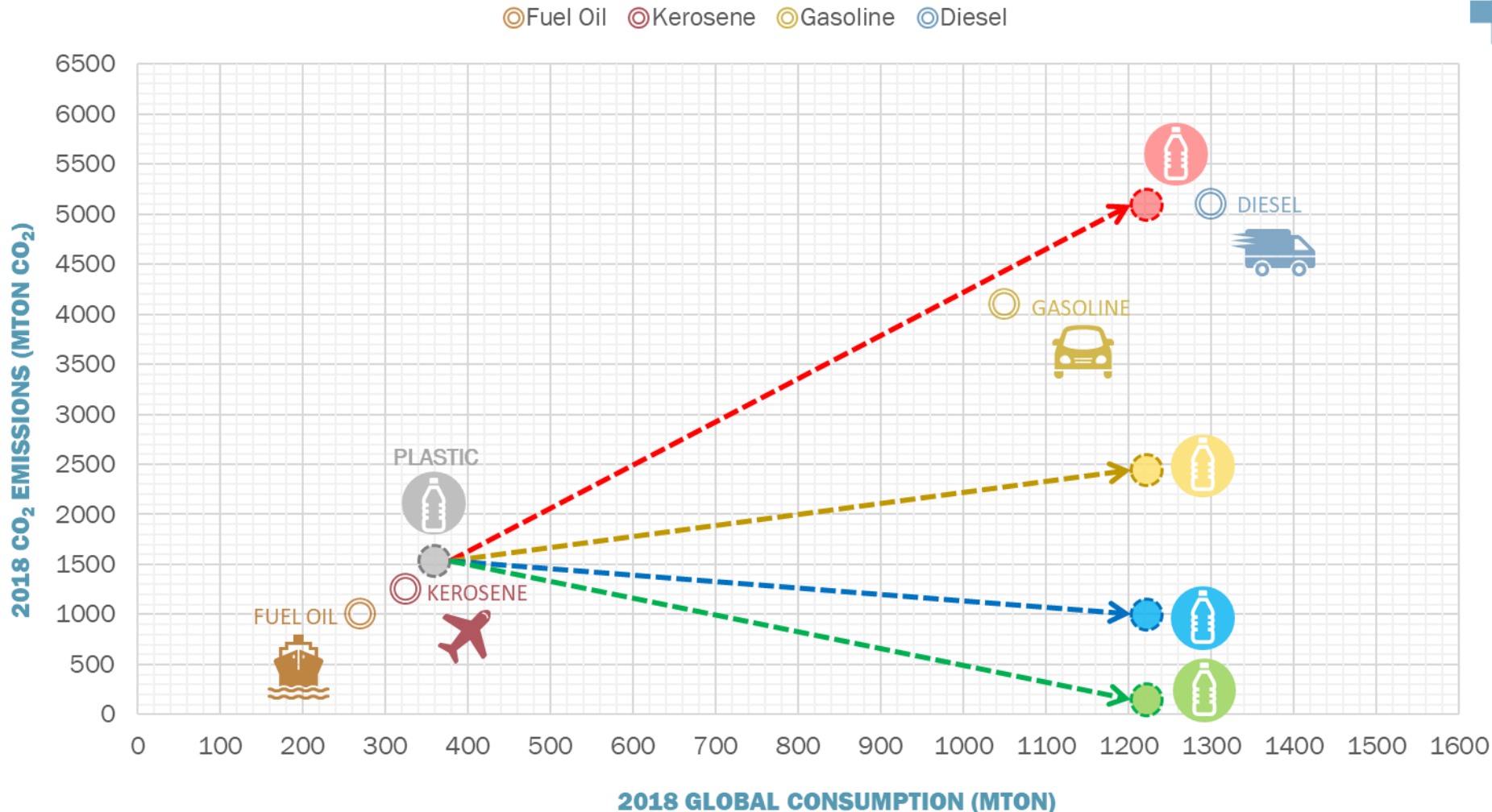
# EU Green Deal







# WAAROM EEN INDUSTRIËLE TRANSFORMATIE?



Fuels volume and well-to-wheel emissions are estimates from TNO analysis<sup>1</sup>. In a Net Zero 2050 scenario, plastics will be 1200Mtona<sup>2</sup>.

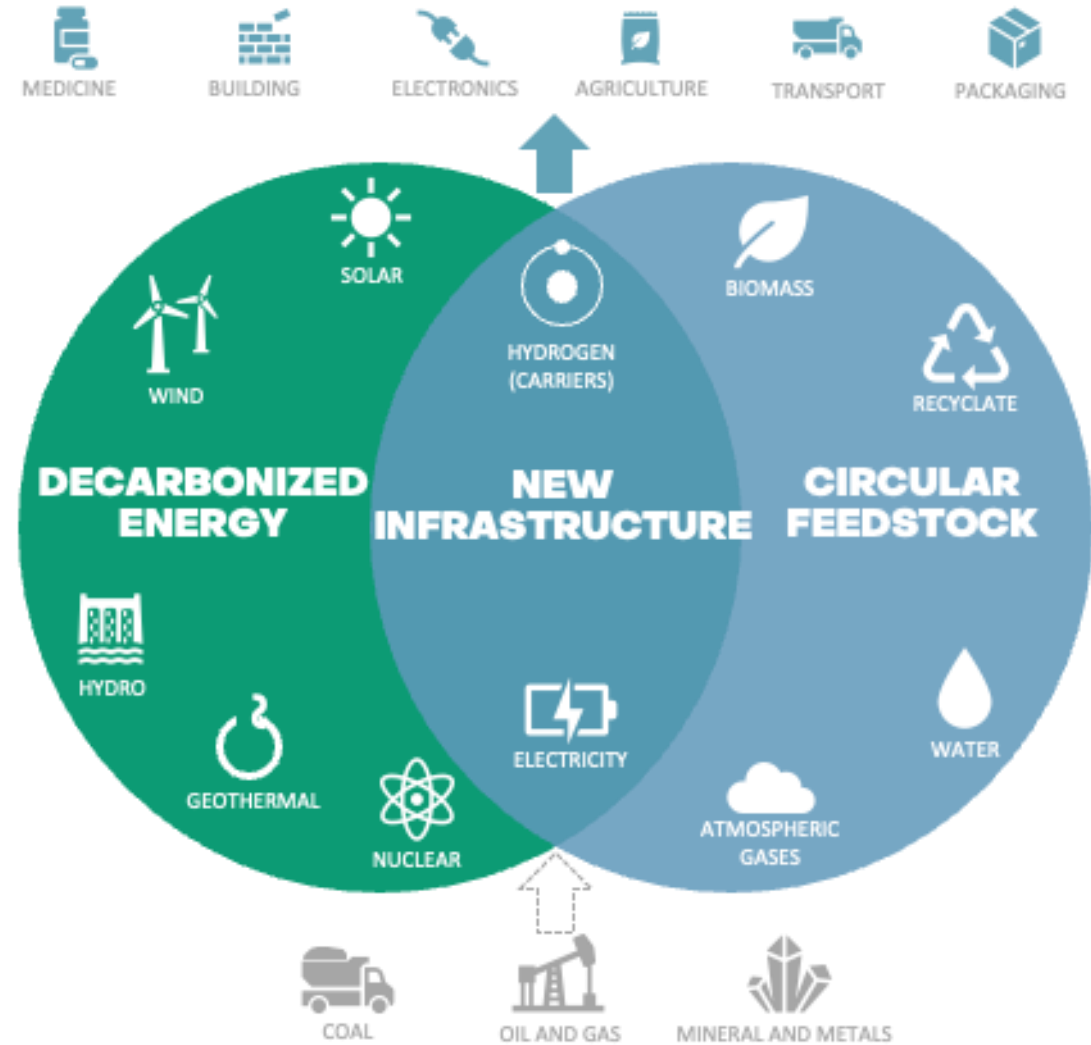
## PLASTICS 2018 TO 2050

- 100% EoL Incineration
- Recycling (63% yield)
- Recycling (63% yield) + CCU (26%)
- Recycling (63% yield) + CCU (26%) + Bio Feedstock (11%)

<sup>1</sup> Personal analysis based on public data and 2050 fuels data derived from Irena Global Energy Transformation Report 2018

<sup>2</sup> Plastics 2050 volumes and scenarios taken from Nova Paper #12, Nova Institut.

# VERDUURZAMING VAN DE INDUSTRIE



# DRIVERS & UITDAGINGEN



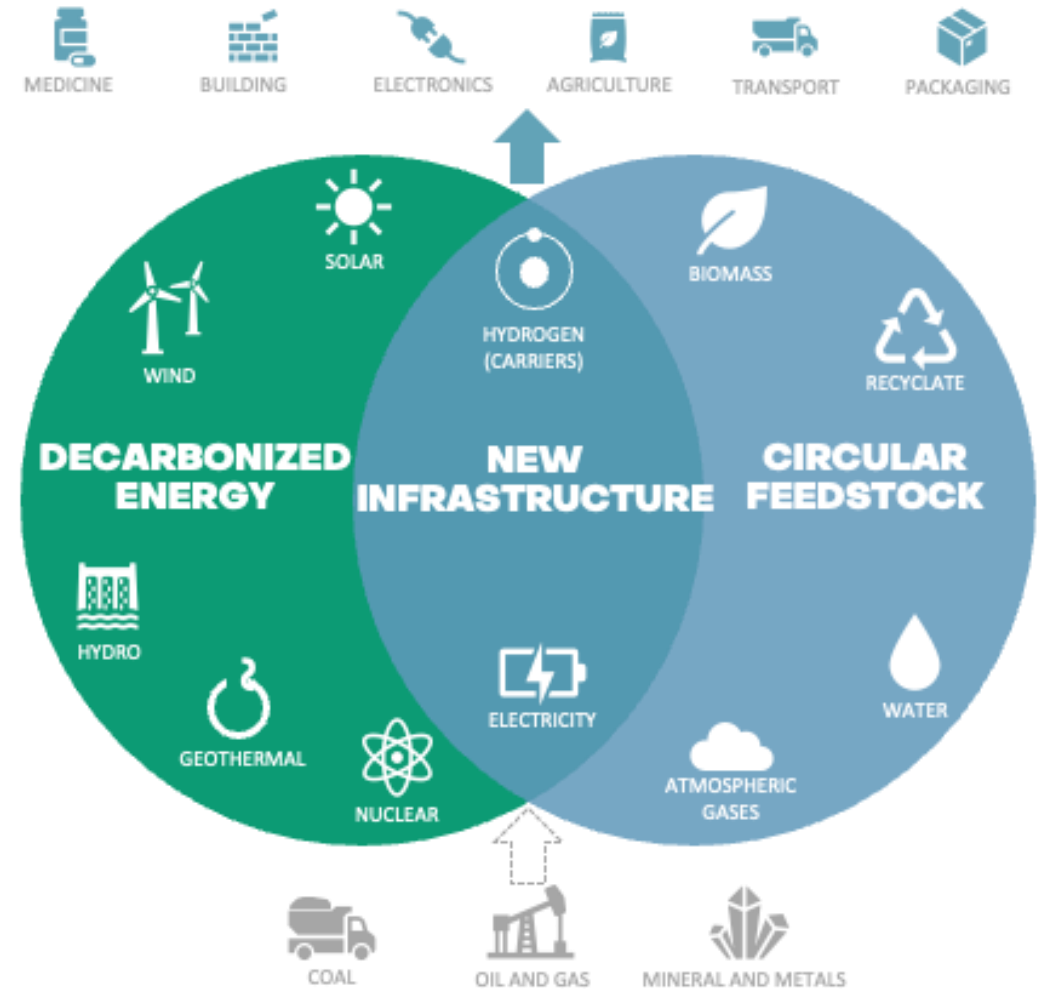
**DRIVER: EU GREEN DEAL**



**TECHNISCHE UITDAGINGEN**



**ANDERE UITDAGINGEN**



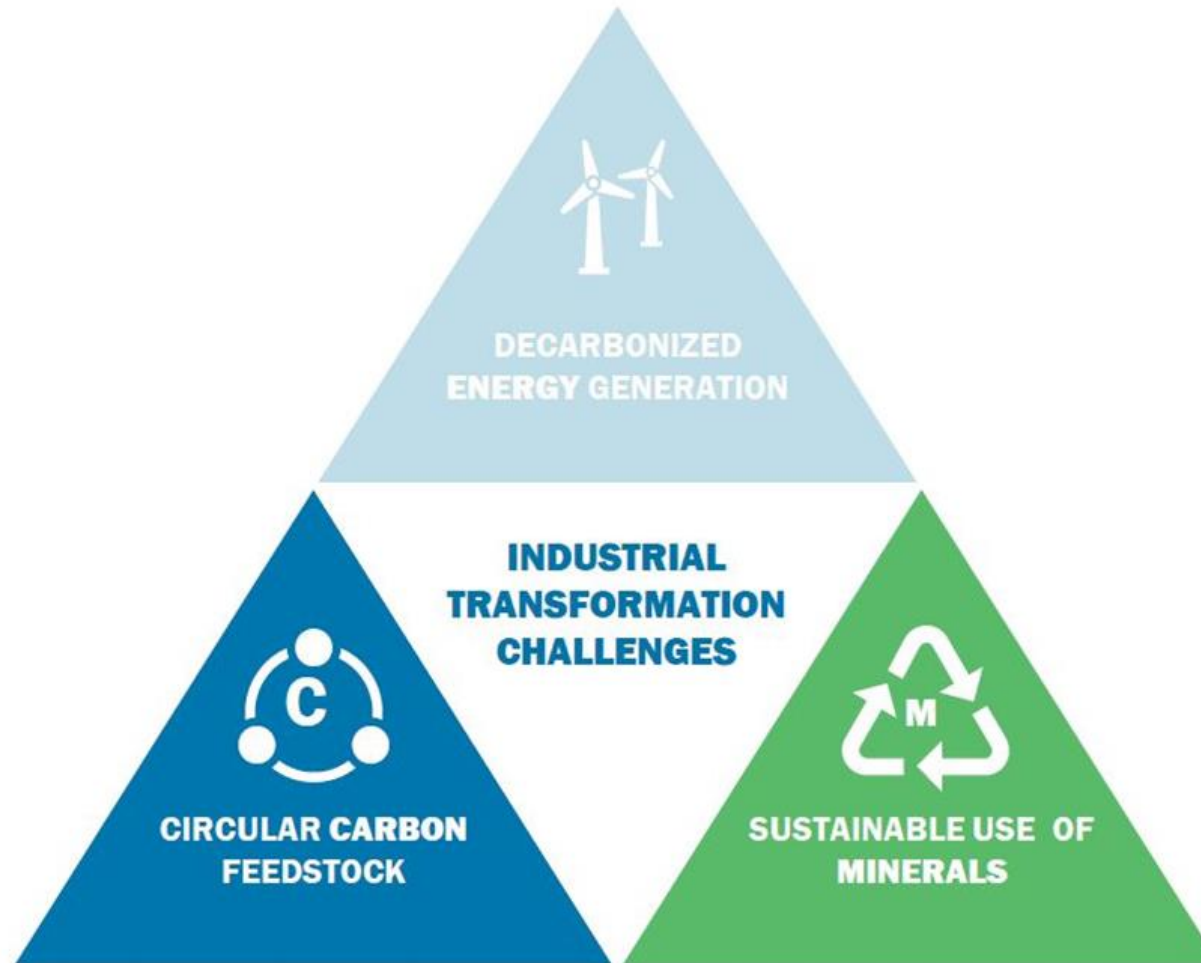


# State of Tech

Energie, koolstof opslag & circulariteit en mineralen

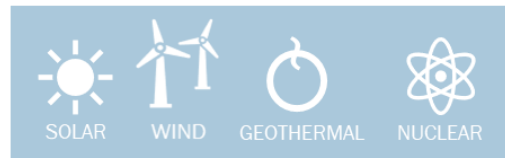


# SCHAARSTE DRIEHOEK VAN DE INDUSTRIËLE TRANSFORMATIE



# RISK MANAGEMENT: VRAAG & AANBOD EN INNOVATIE MOGELIJKHEDEN!

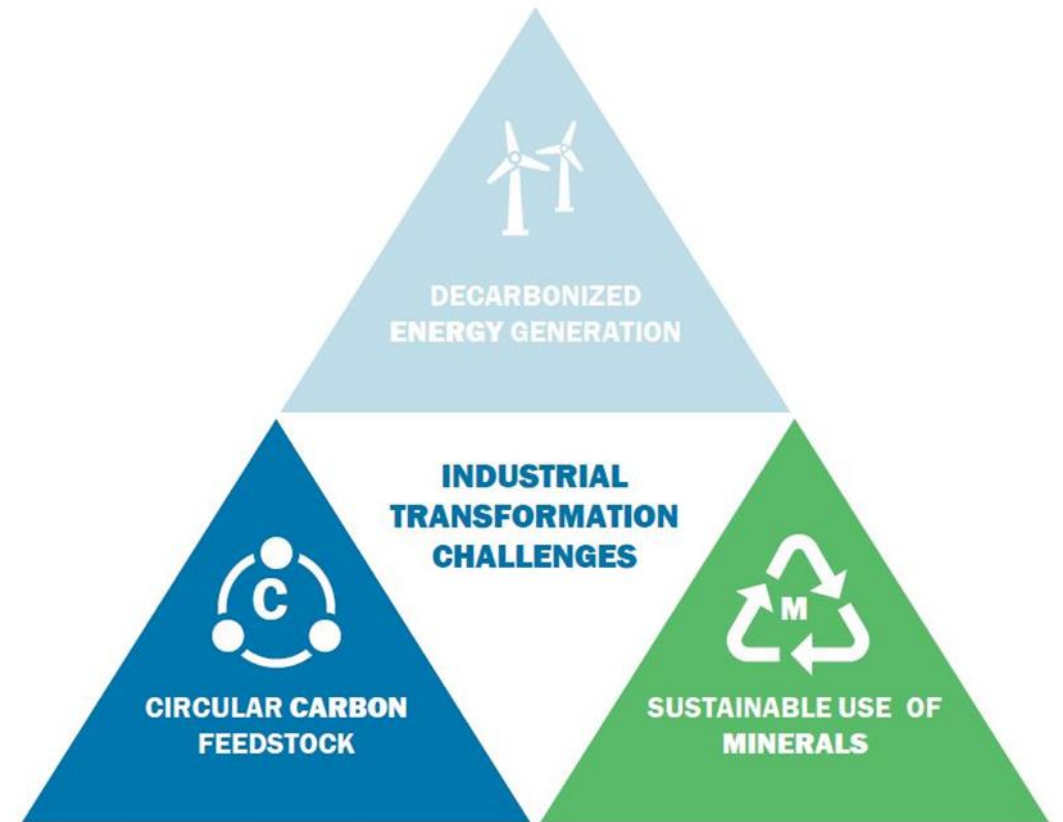
## DECARBONIZED ENERGY



## CIRCULAR CARBON FEEDSTOCK



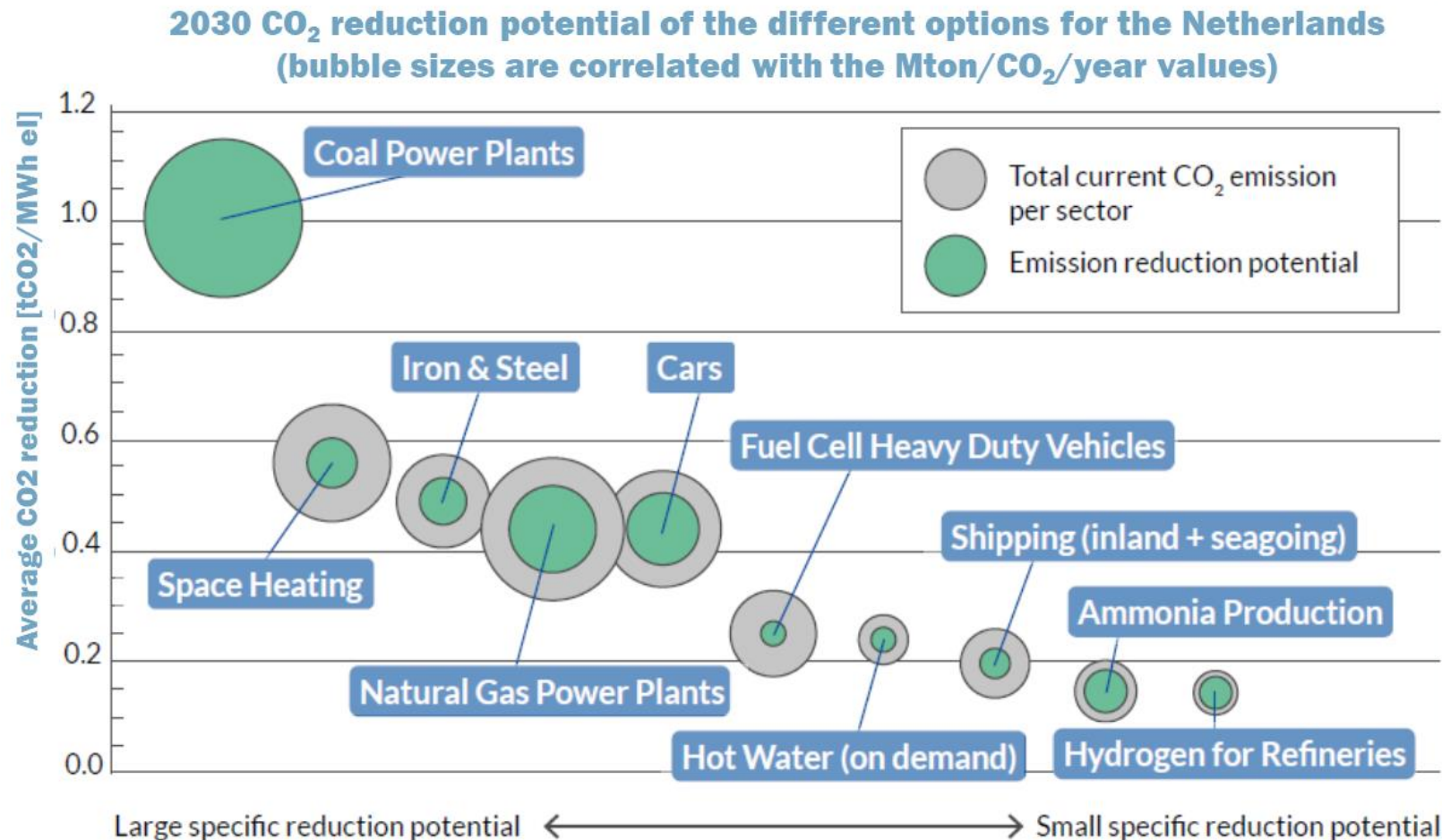
## SUSTAINABLE USE OF MINERALS



# Koolstofarme Energie



# GROENE STROOM PRIORITEREN VOOR MAXIMALE EMISSIEREDUCTIE IN NEDERLAND





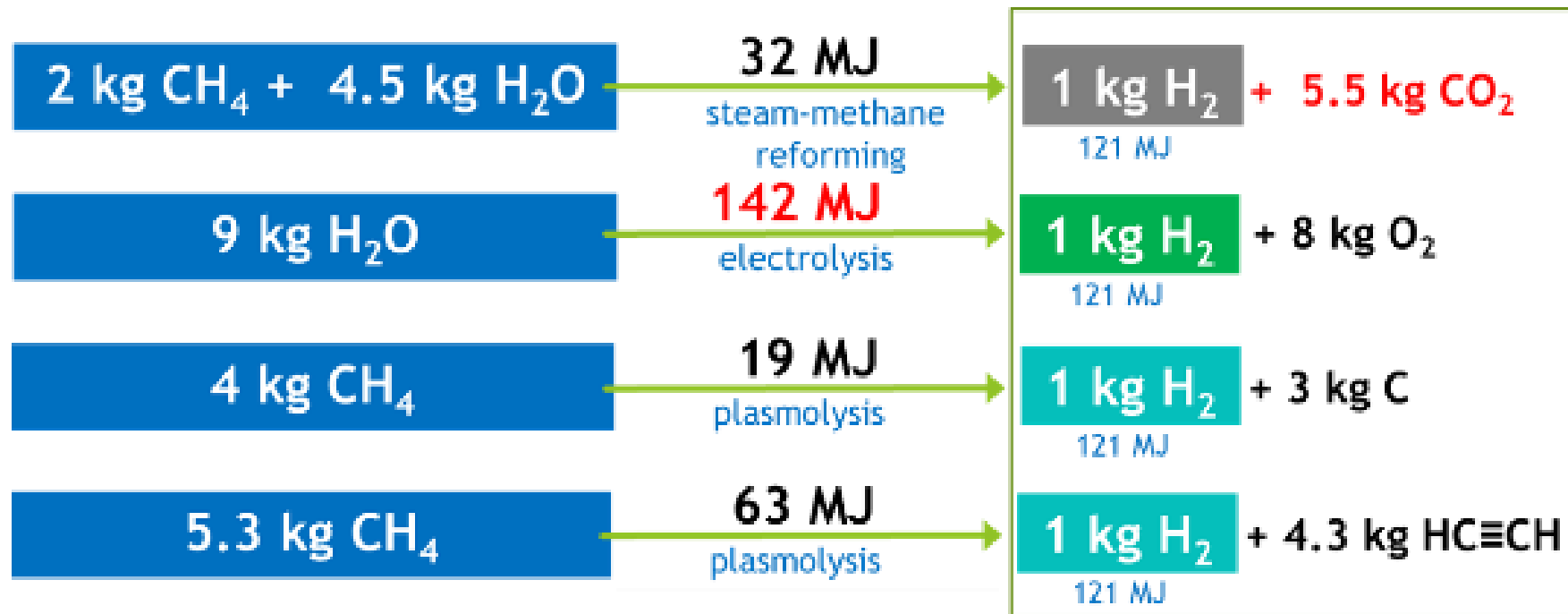
# RANGORDE VAN ELEKTRIFICATIE OM DOELEN TE BEHALEN

- 1** **Uitfaseren** kolen en gascentrales
- 2** **Verwarming** middels warmtepompen ipv gas
- 3** **Groene waterstof** voor duurzaam ijzer & staal (H-DRI)
- 4** **Personenauto's elektrisch** ipv verbrandingsmotoren

Verdubbeling van de (groene!) elektriciteitsproductie vereist om 50% emissiereductie te halen in 2030!

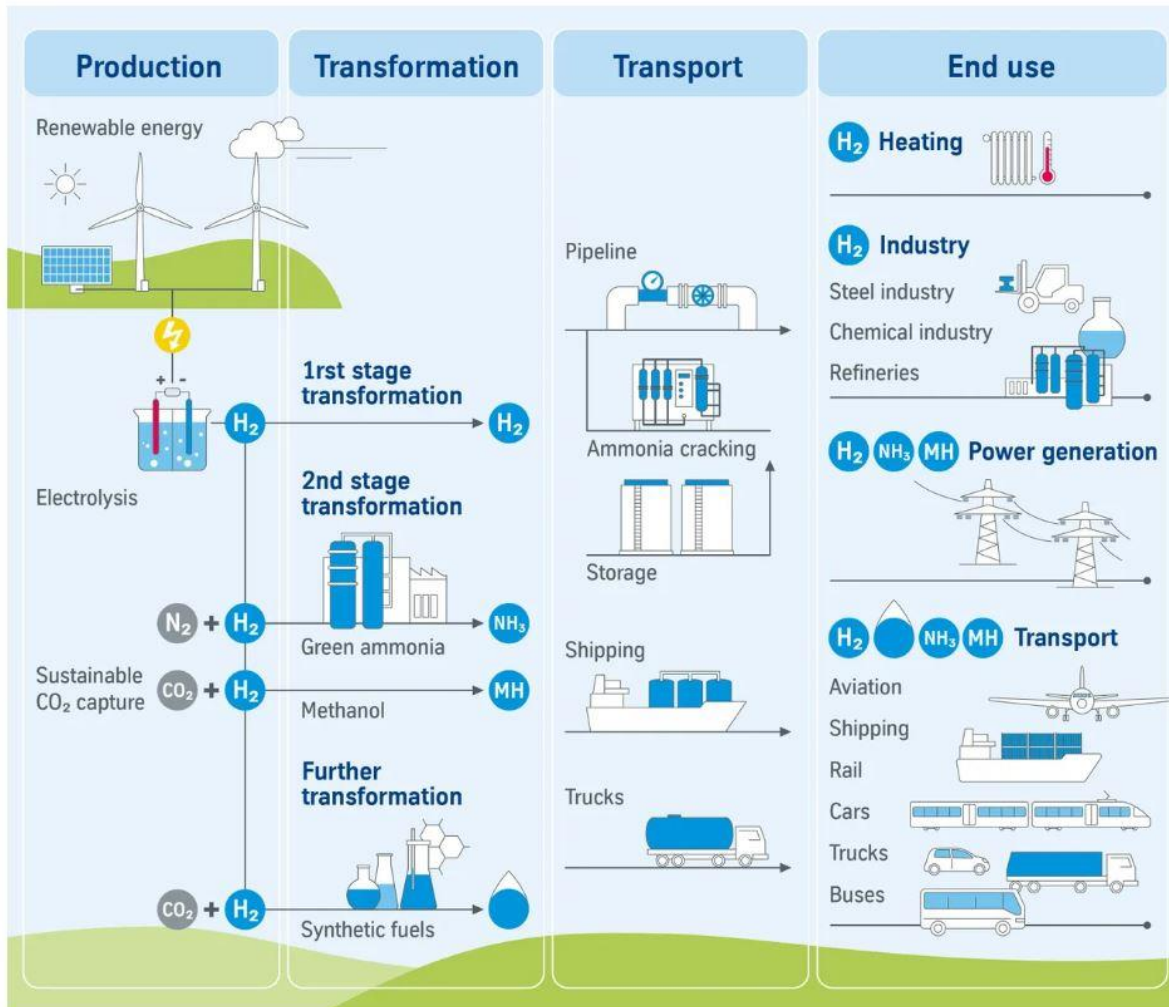


# ENERGIE-EFFICIËNTIE & NEVENPRODUCTVALORISATIE IN WATERSTOF



**Brightsite**  
Transforming industry

# OPSLAG EN TRANSPORT VAN WATERSTOF VERMIJDEN



1

**Lokale productie** past bij lineaire schaal karakteristiek van elektrolyse

2


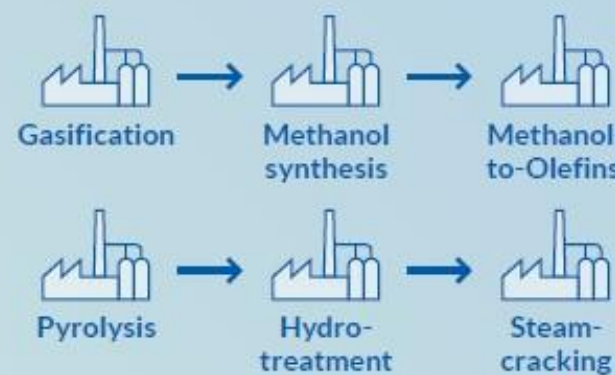
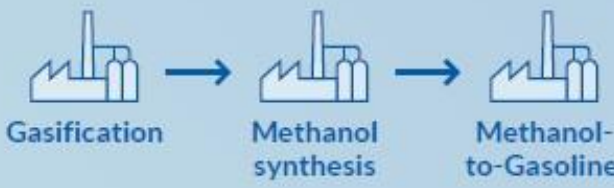


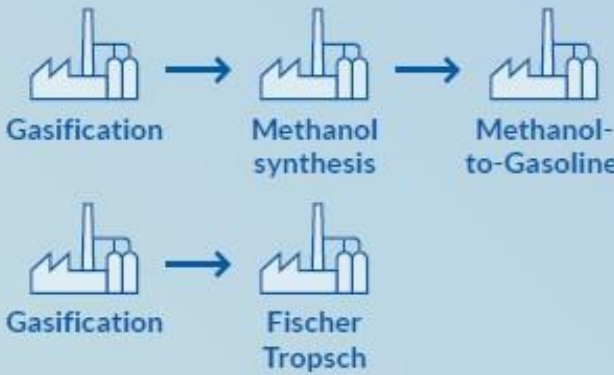
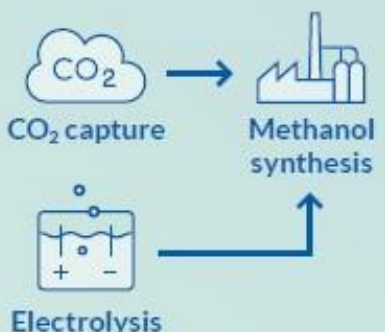
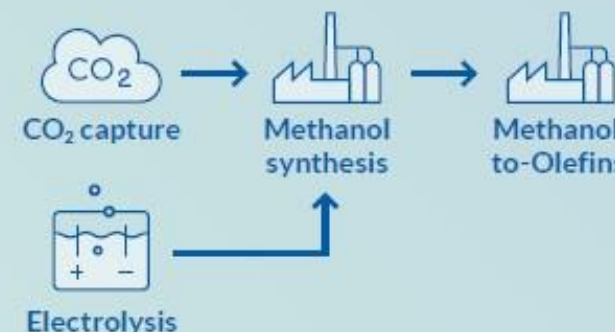
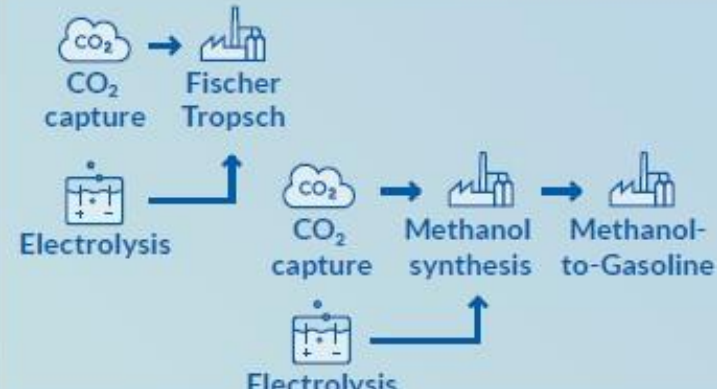
**Vermijd waterstoftransport en -opslag** zoveel mogelijk vanwege inefficiëntie (kosten) en veiligheidsrisico's

3

Transport en opslag van waterstof in de vorm van methanol en ammoniak is **bewezen technologie**

# Circulariteit & CO2 opslag

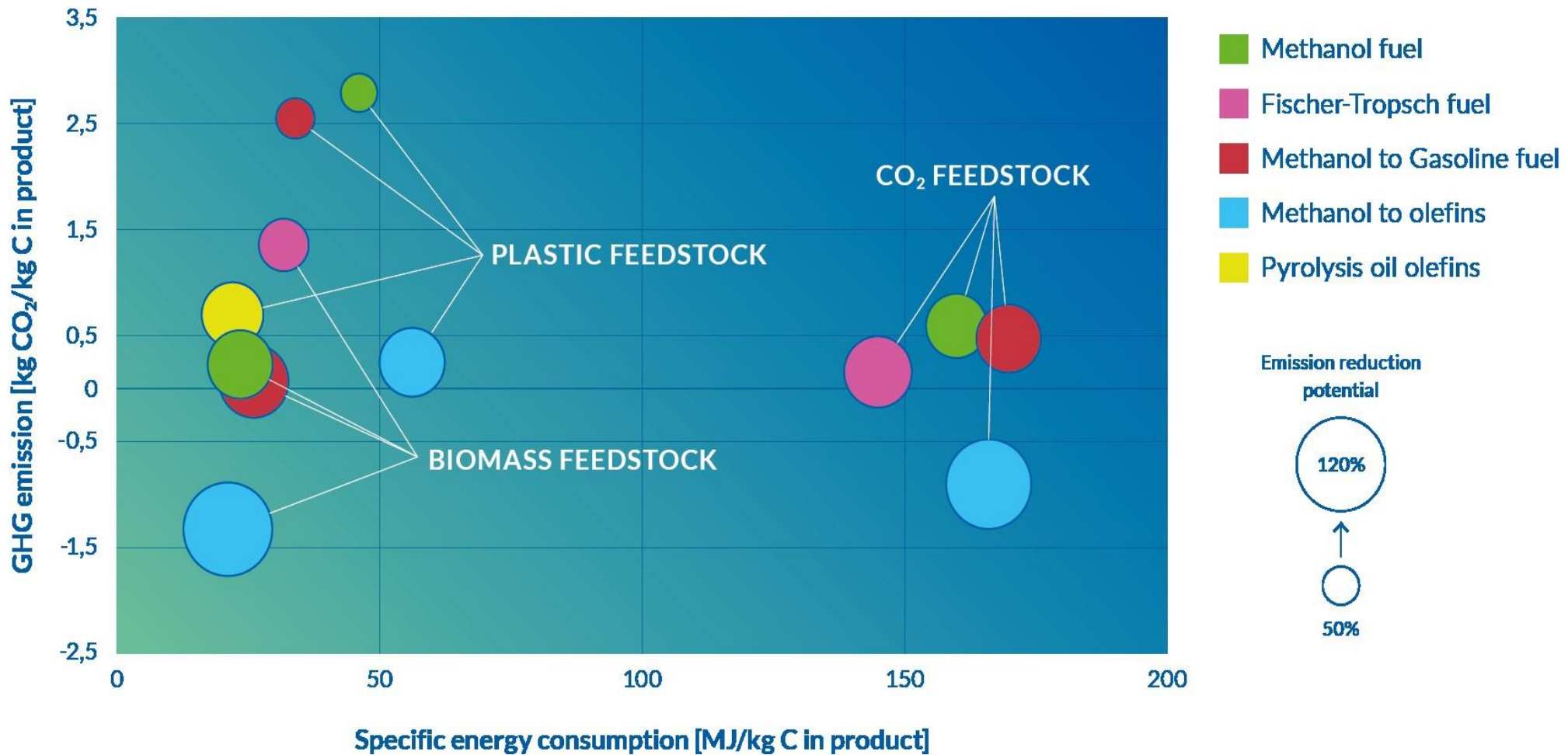


Product → ↓ Carbon Feedstock	Methanol	Olefins	Synthetic Fuel (gasoline or kerosene)
Plastic waste	 <p>Gasification → Methanol synthesis</p>	 <p>Gasification → Methanol synthesis → Methanol-to-Olefins  Pyrolysis → Hydro-treatment → Steam-cracking</p>	 <p>Gasification → Methanol synthesis → Methanol-to-Gasoline</p>
Biomass	 <p>Gasification → Methanol synthesis</p>	 <p>Gasification → Methanol synthesis → Methanol-to-Olefins</p>	 <p>Gasification → Methanol synthesis → Methanol-to-Gasoline  Gasification → Fischer Tropsch</p>
Carbon dioxide	 <p>CO<sub>2</sub> capture → Methanol synthesis  Electrolysis</p>	 <p>CO<sub>2</sub> capture → Methanol synthesis → Methanol-to-Olefins  Electrolysis</p>	 <p>CO<sub>2</sub> capture → Fischer Tropsch  Electrolysis → CO<sub>2</sub> capture → Methanol synthesis → Methanol-to-Gasoline  Electrolysis</p>

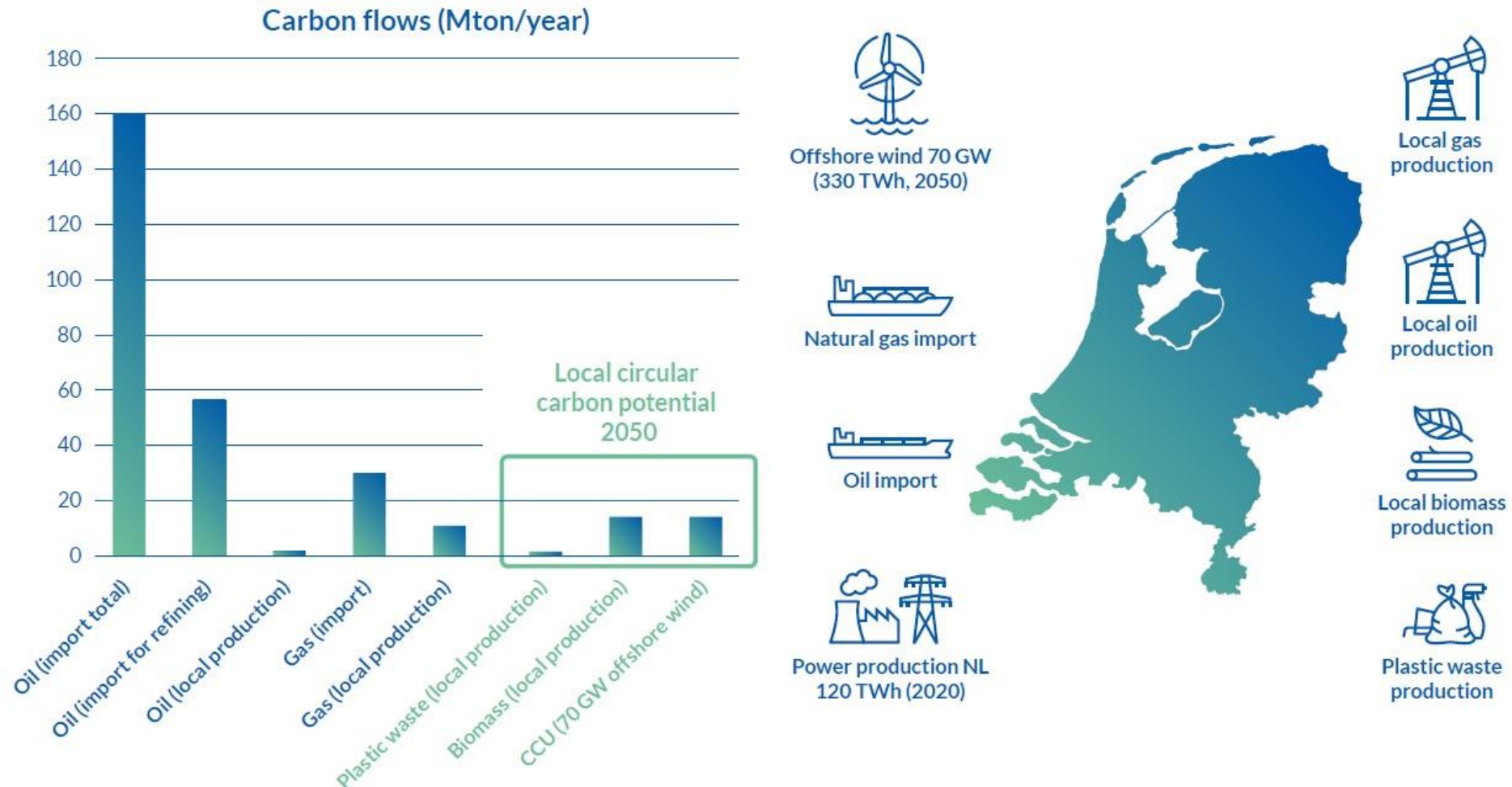


# RANGORDE DUURZAME INZET KOOLSTOF

## GHG LIFE CYCLE EMISSIONS VERSUS SPECIFIC ENERGY



# LOKALE BESCHIKBAARHEID CIRCULAIR + INVOER NODIG VOOR VERVANGING FOSSIEL



\*Source: Infographic – EBN and TNO estimates

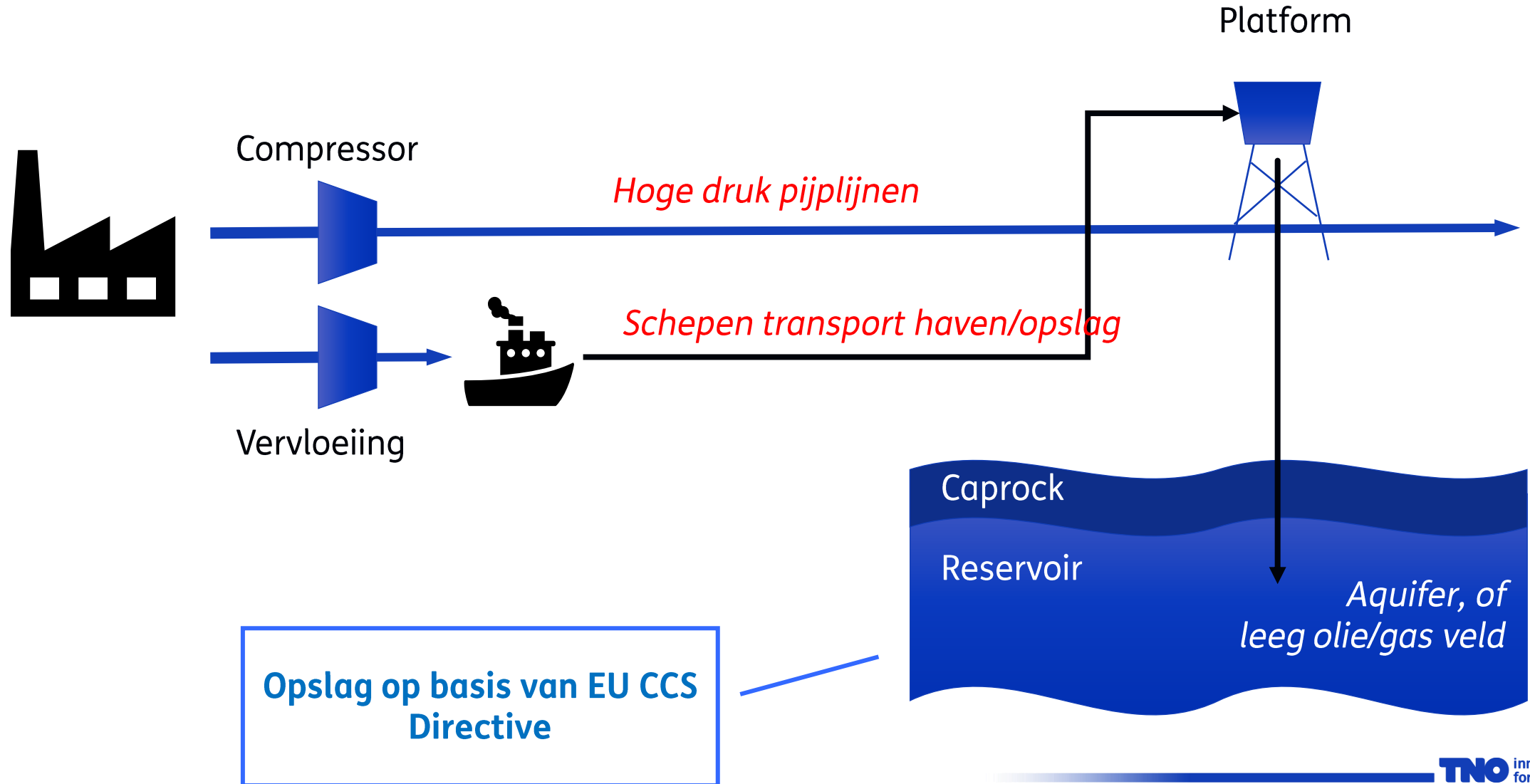


A stack of large metal pipes, likely for CO2 transport, arranged in a circular pattern. The pipes are stacked in a way that creates a central opening, through which a bright, yellowish light is visible. The pipes have a metallic, slightly rusted appearance. The text "CO2 OPSLAG EN TRANSPORT" is overlaid in white, bold, sans-serif font across the center of the image.

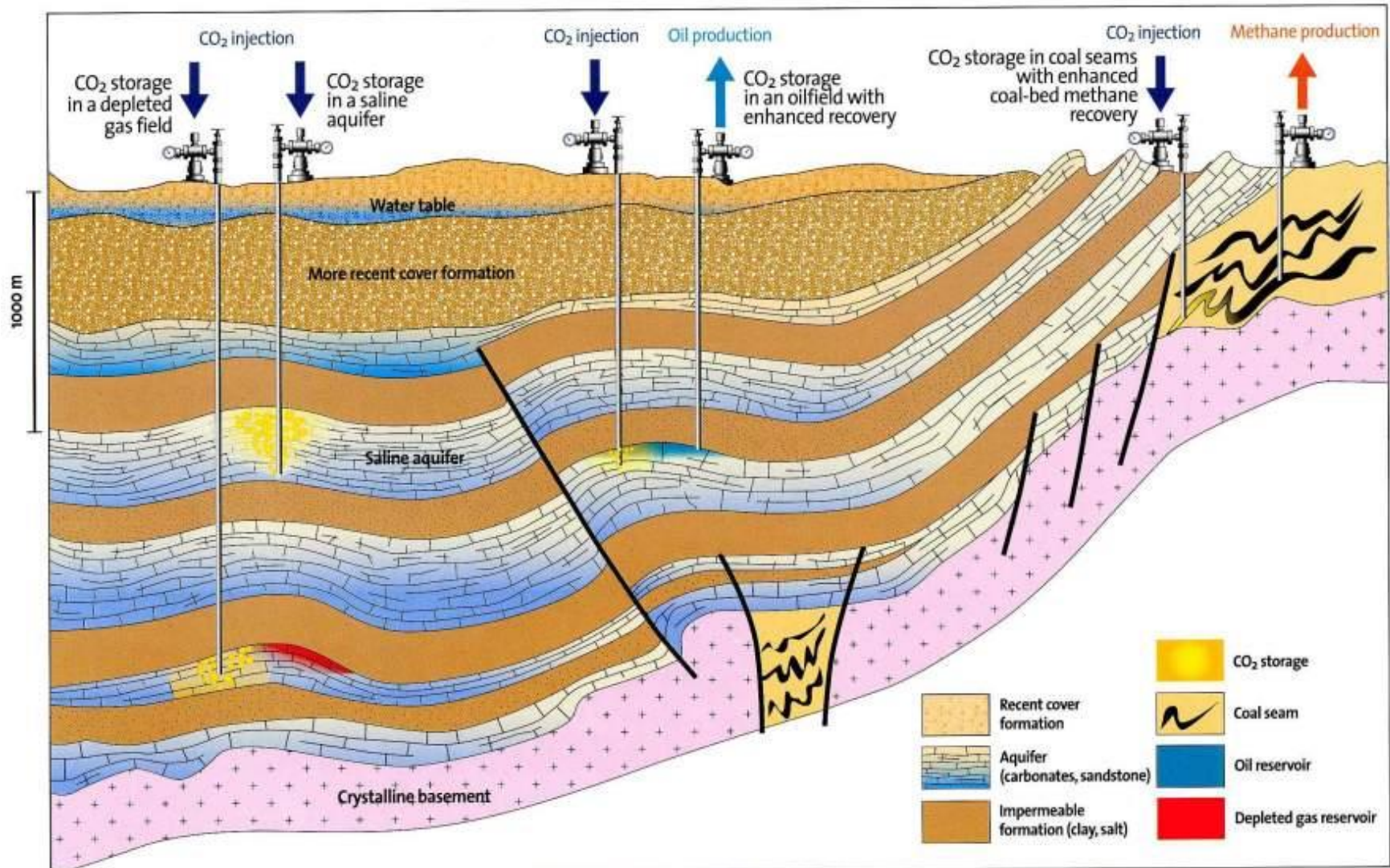
# CO2 OPSLAG EN TRANSPORT



# TRANSPORT & OPSLAG SYSTEEM



# GEOLOGISCHE OPSLAG VAN CO<sub>2</sub>







# Mineralen & Metalen



# DUURZAAM GEBRUIK VAN MINERALEN EN METALEN MET NIEUWE MIJNEN

## FOSSIL FUELS



### Large mining quantities

In 2021, 15 billion tonnes of fossil fuels were extracted.<sup>1</sup>



### Generate huge rents

Oil and gas exports alone represented a value of USD 2 trillion in 2021.<sup>3</sup>



### Combusted as fuel

Fossil fuels are primarily burned as fuel, accounting for approximately 94% of their usage.<sup>5</sup>



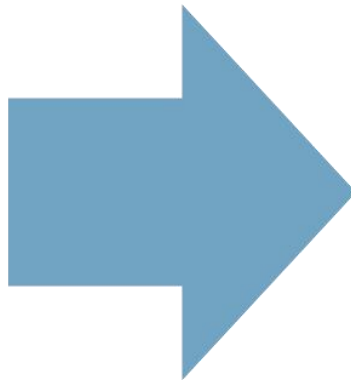
### Energy security risk

A disruption in the supply of fossil fuels can lead to immediate energy shortages and price spikes.



### Not recyclable

Fossil fuels are primarily consumed through combustion and cannot be recovered or repurposed.



## CRITICAL MATERIALS



### Low mining quantities

Some 10 million tonnes energy transition minerals were produced in 2022 for low-carbon technologies.<sup>2</sup>



### Generate smaller profits

Exports of copper, nickel, lithium, cobalt and rare earths generated 96 billion in 2021.<sup>4</sup>



### Input to manufacturing

Critical materials are housed within energy assets that typically have a 10–30 year lifespan.



### Energy transition risk

Disruptions in the supply of critical minerals can delay the construction of new clean energy assets, but do not affect current energy prices or supply.



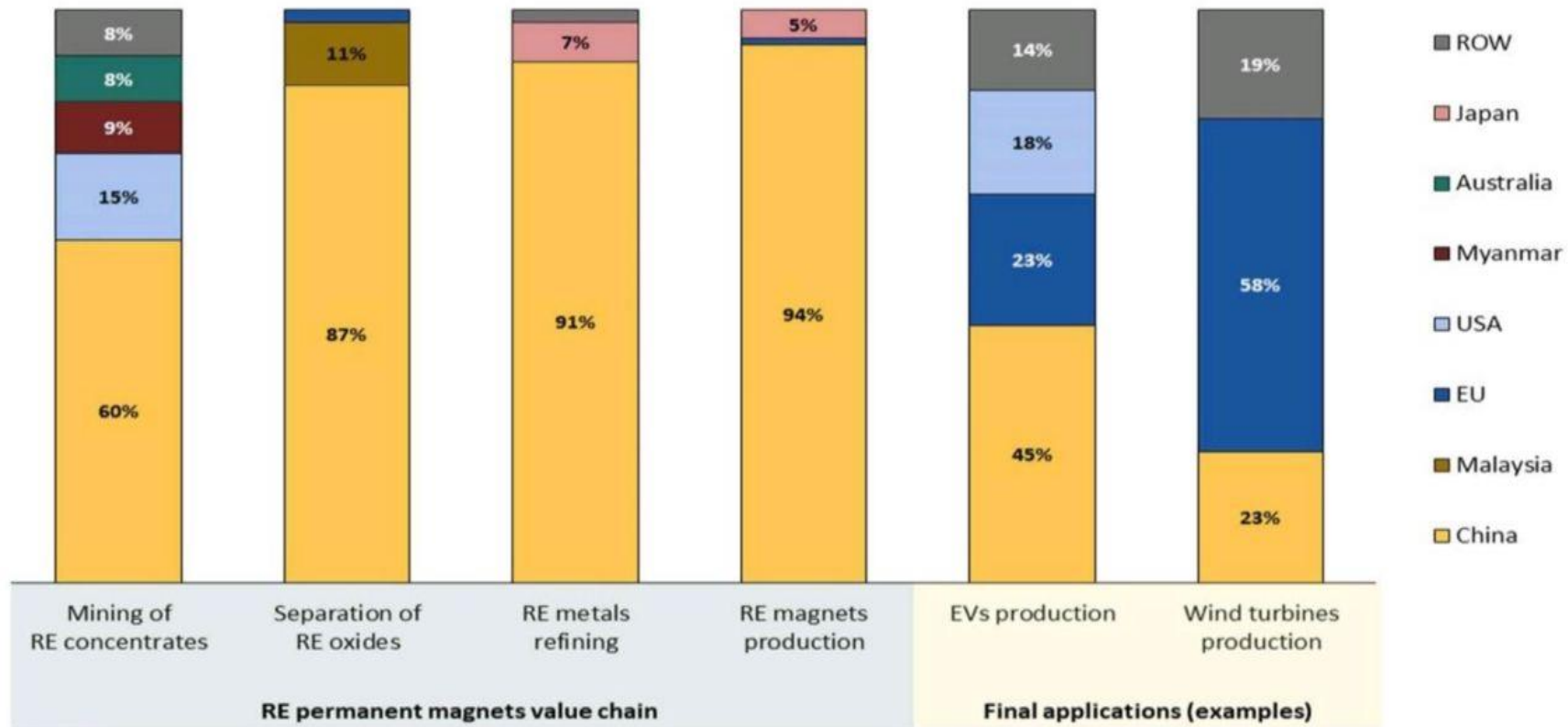
### Reusable and recyclable

High potential for reducing use, reusing and recycling.



# GEOPOLITIEK UITDAGENDER DAN OLIE EN GAS - BEHANDELD IN EU CRMA

## Rare Earth Permanent Magnet Value Chain and Final Application, Geographical Concentration



# HET GEBRUIK VAN KRITIEKE MATERIALEN VERMINDEREN BIJ PEM ELECTROLYSERS

Amount of iridium required annually for various applications, ton/year

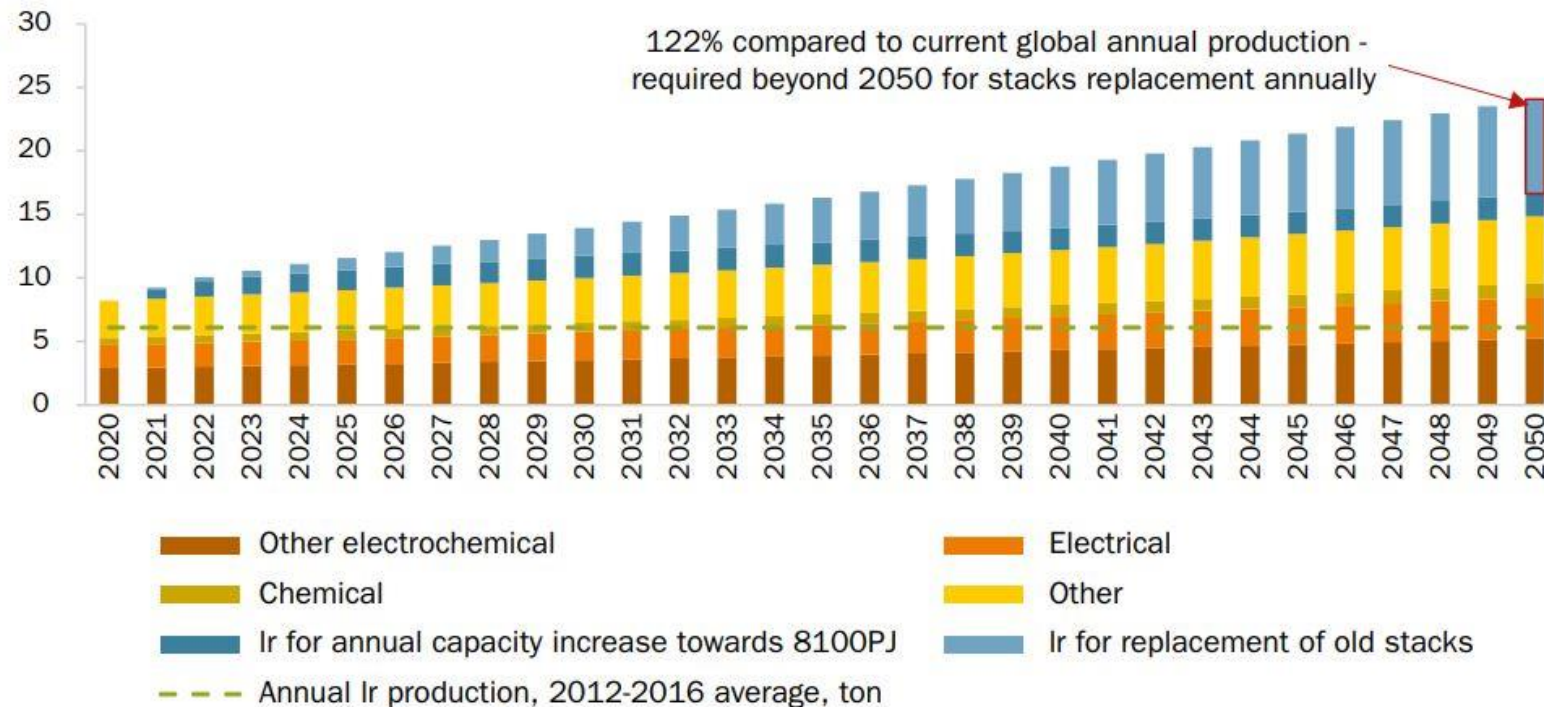
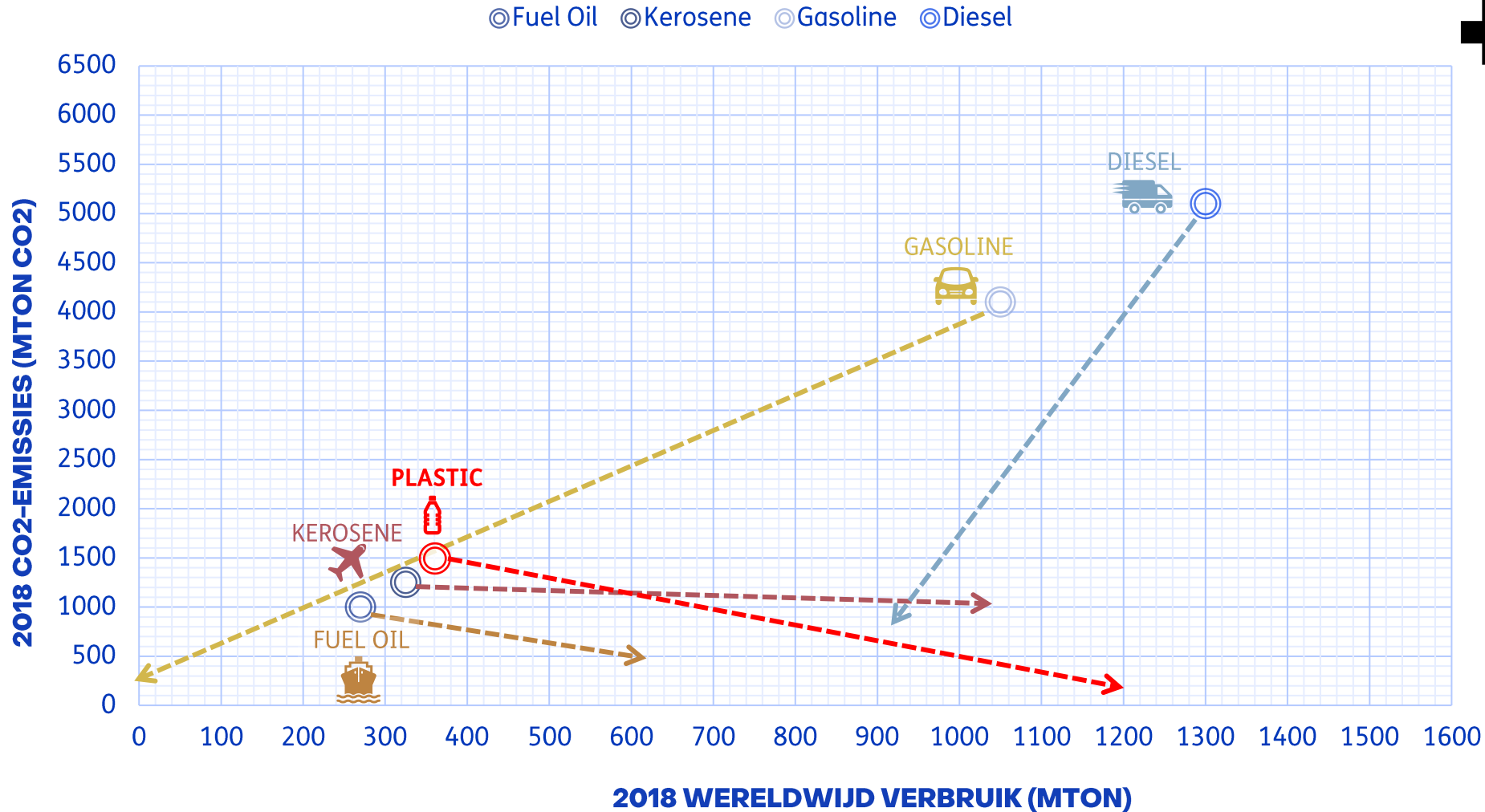


Figure 2 Amount of iridium required annually to upscale green hydrogen production and for other uses<sup>25</sup>

# HOE ZIET SUCCES ERUIT?



Raffinaderijen zullen hun productie moeten verschuiven van 80/20 in 2018 naar 20/80 in 2050 (verhouding brandstof/grondstoffen)

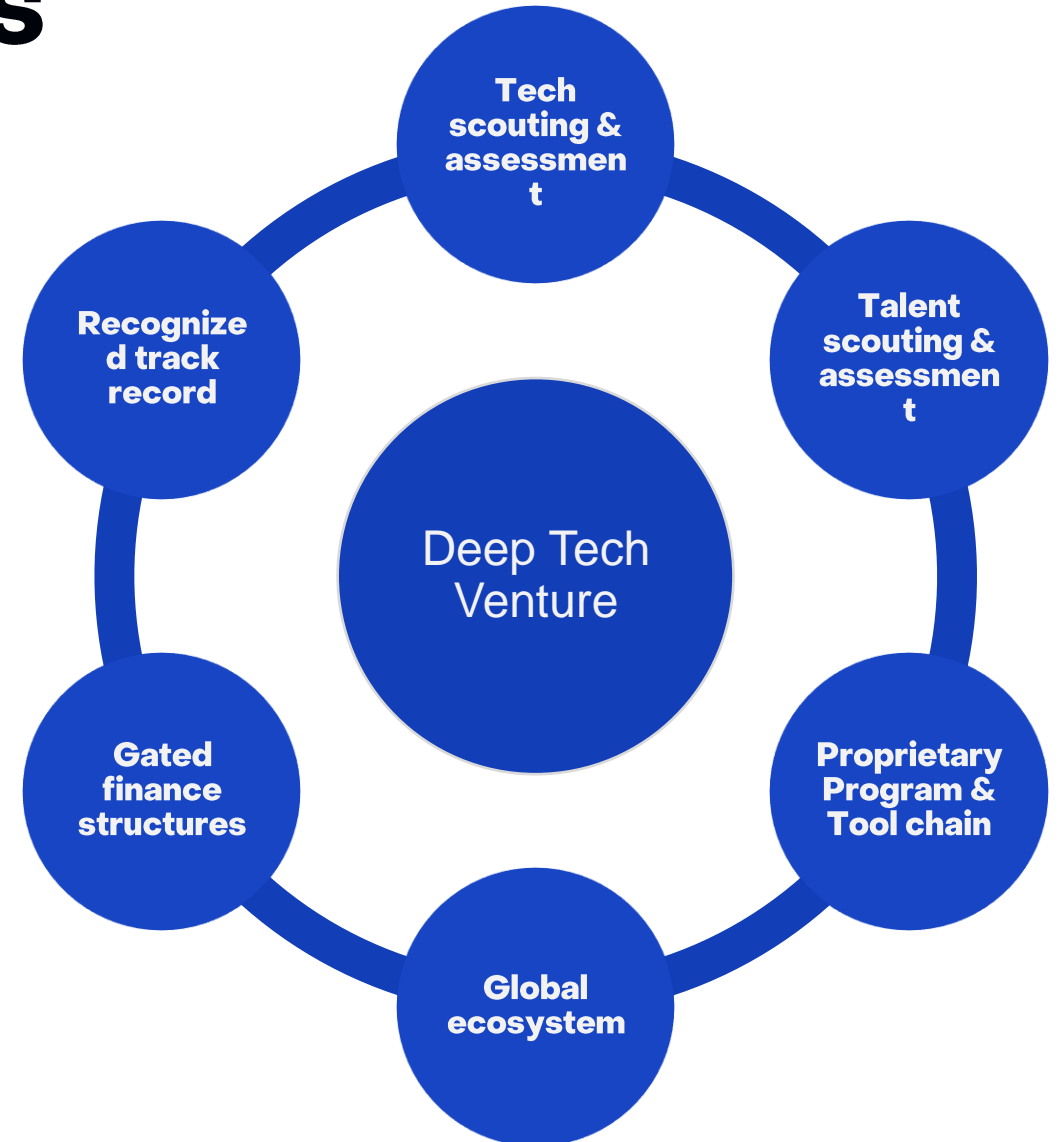
- > **CARS: 2018→2050**  
 100% electric
- > **AVIATION: 2018→2050**  
 25% bio-fuel, 75% e-fuel
- > **TRUCKS: 2018→2050**  
 70% electric, 20% bio-fuel, 10% e-fuel
- > **SHIPPING: 2018→2050**  
 50% bio-fuel + 50% e-fuel
- > **PLASTICS: 2018→2050<sup>2</sup>**  
 Recycling (63%) + CCU (26%) + bio-feedstock (11%)

# Samenwerken & Versnellen



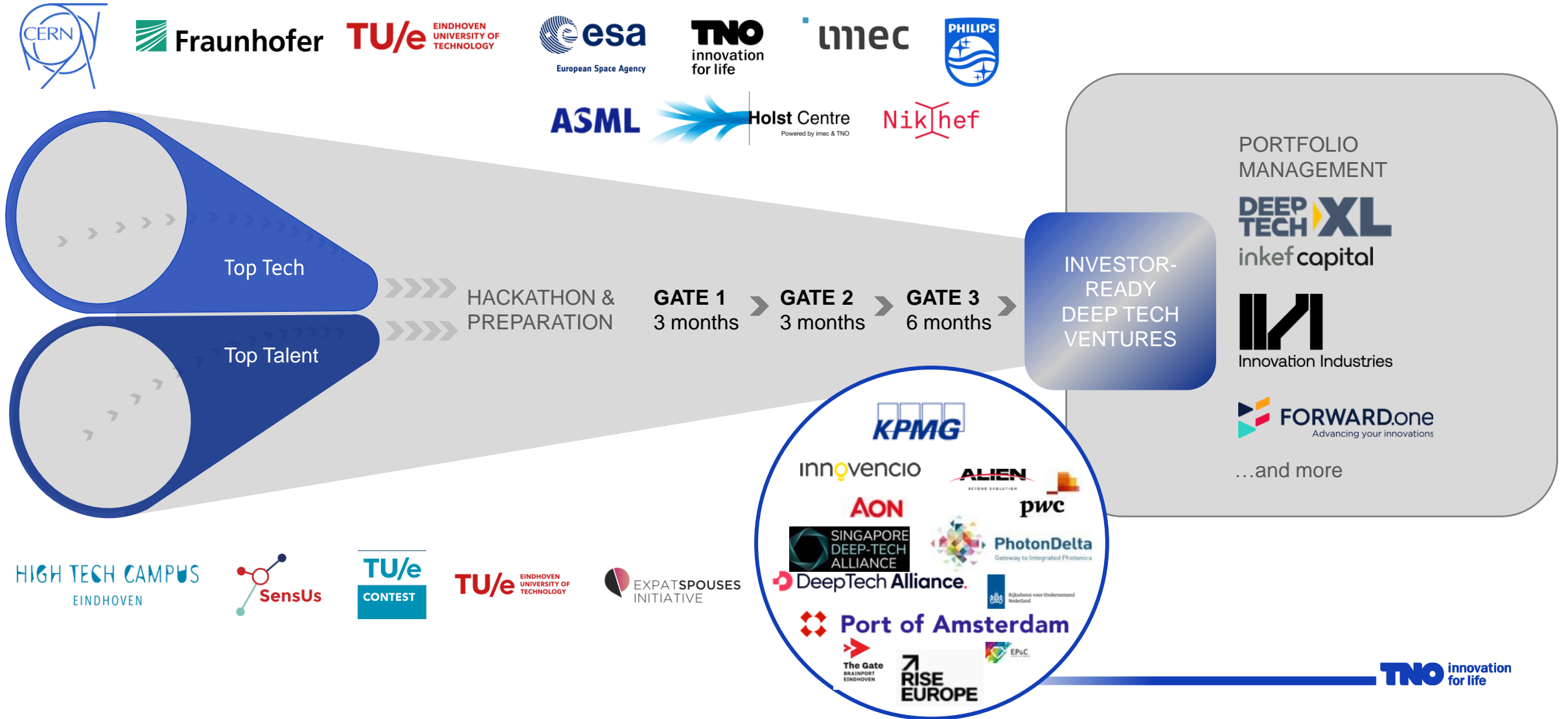
# INDUSTRIELE TRANSFORMATIE VRAAGT OOK OM NIEUWE ONDERNEMERS

Bouwen aan impactvolle deeptech ventures met behulp van een wereldwijd platform voor ondernemers, technologieleveranciers en bedrijven





# DEEPTECH VENTURE BUILDING AANPAK



# QUICKSCAN



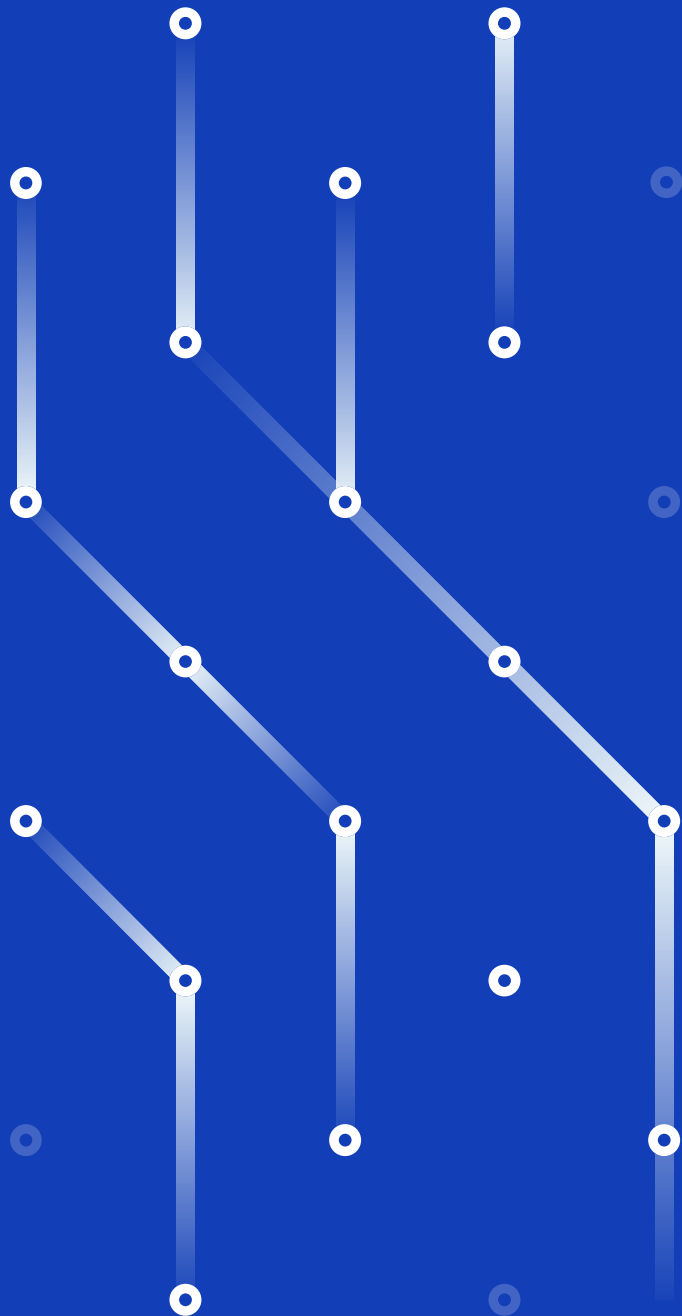
Screening van risico's en kansen van het effect van de schaarste driehoek op jouw bedrijf

[Via: TNO.nl/fasttrack](https://www.tno.nl/fasttrack)

# Wrap up



- Risico's en kansen voor de Europese industrie:
  - a. Emissiearme elektriciteit
  - b. Circulaire koolstof
  - c. Duurzame mineralen/metalen
- Massale elektrificatie zal de vraag naar (kritische) mineralen/metalen sterk doen toenemen
- Een innovatieve industrie zal zowel onze EU Green Deal doelstellingen halen EN een wereldwijde markt bedienen



**TNO** innovation  
for life

[tno.nl/fasttrack](https://tno.nl/fasttrack)