# Technology and industrial development for the energy transition

Acutec
Vlaardingen, 11 September 2019

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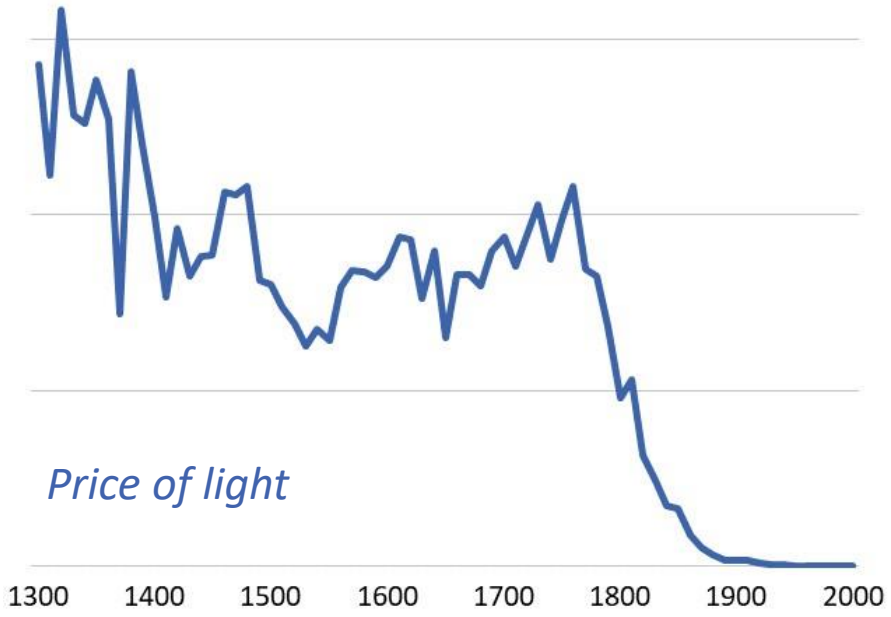
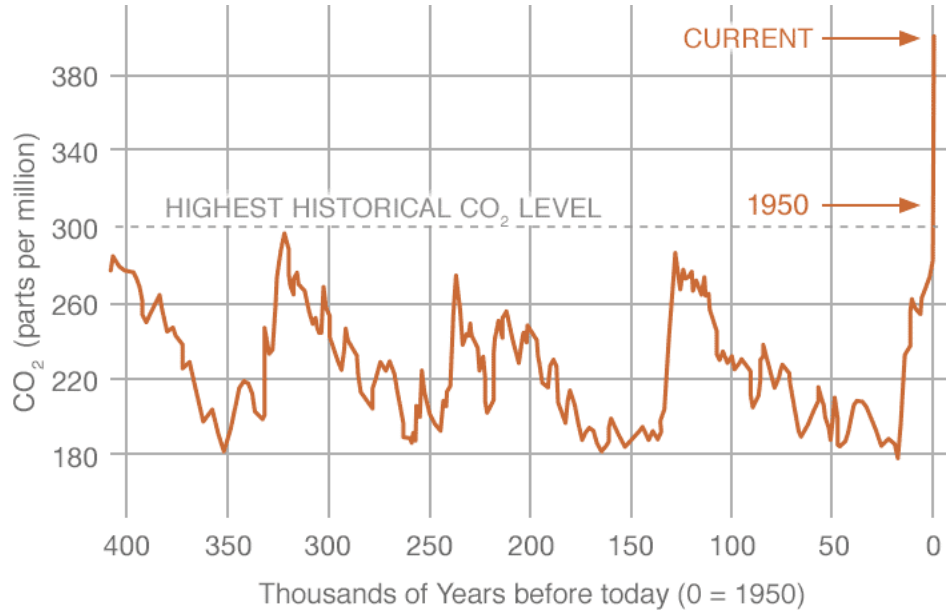
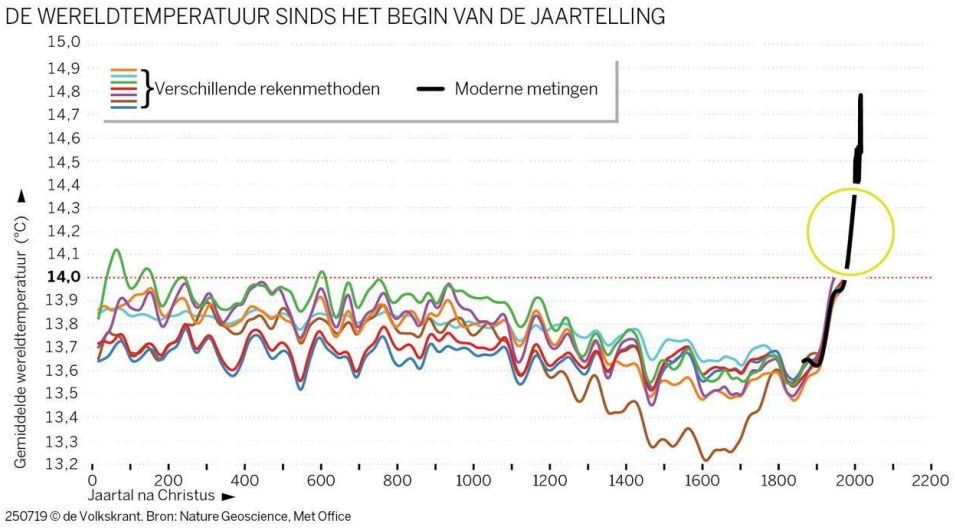
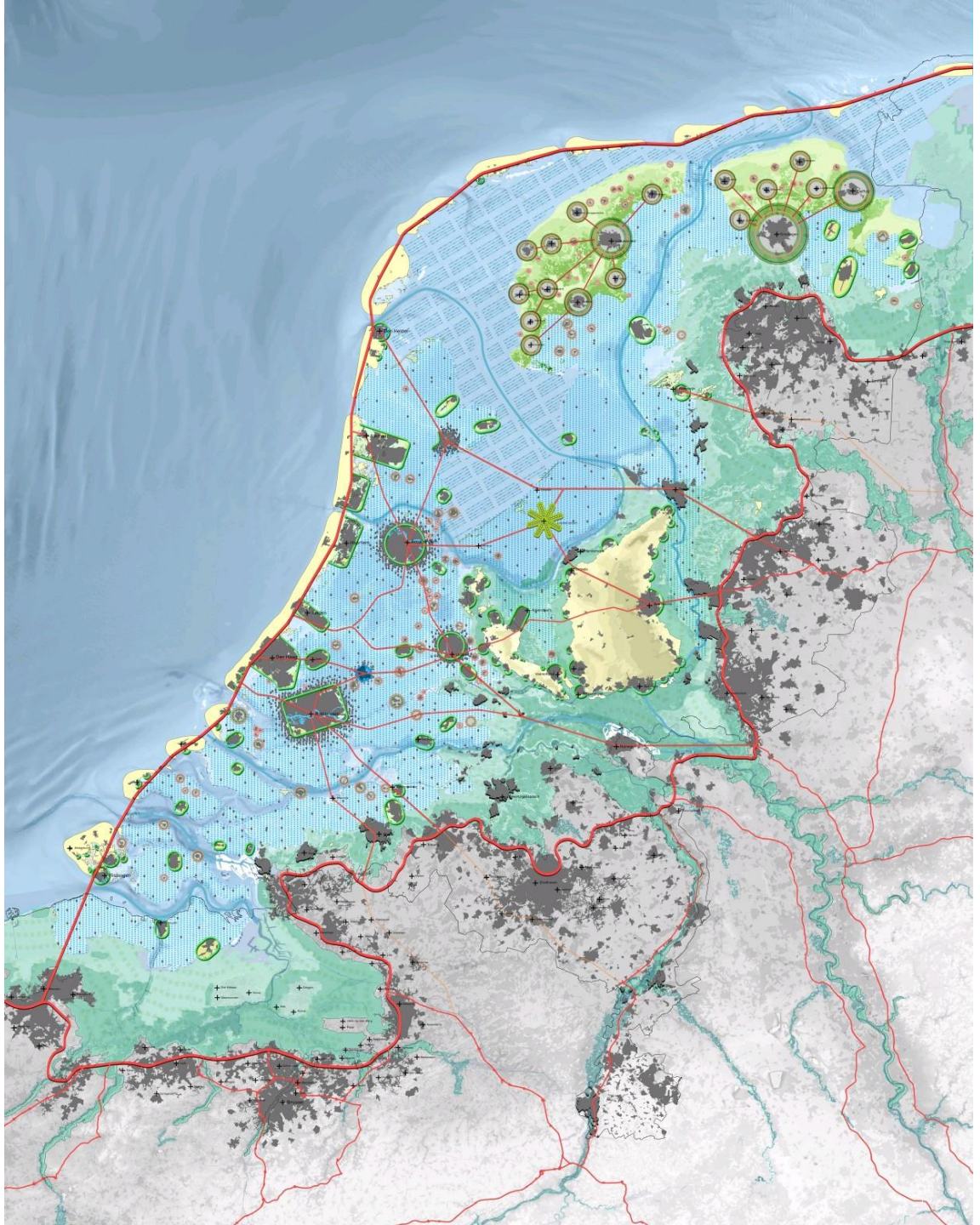
Koios strategy
www.ariebleijenberg.nl



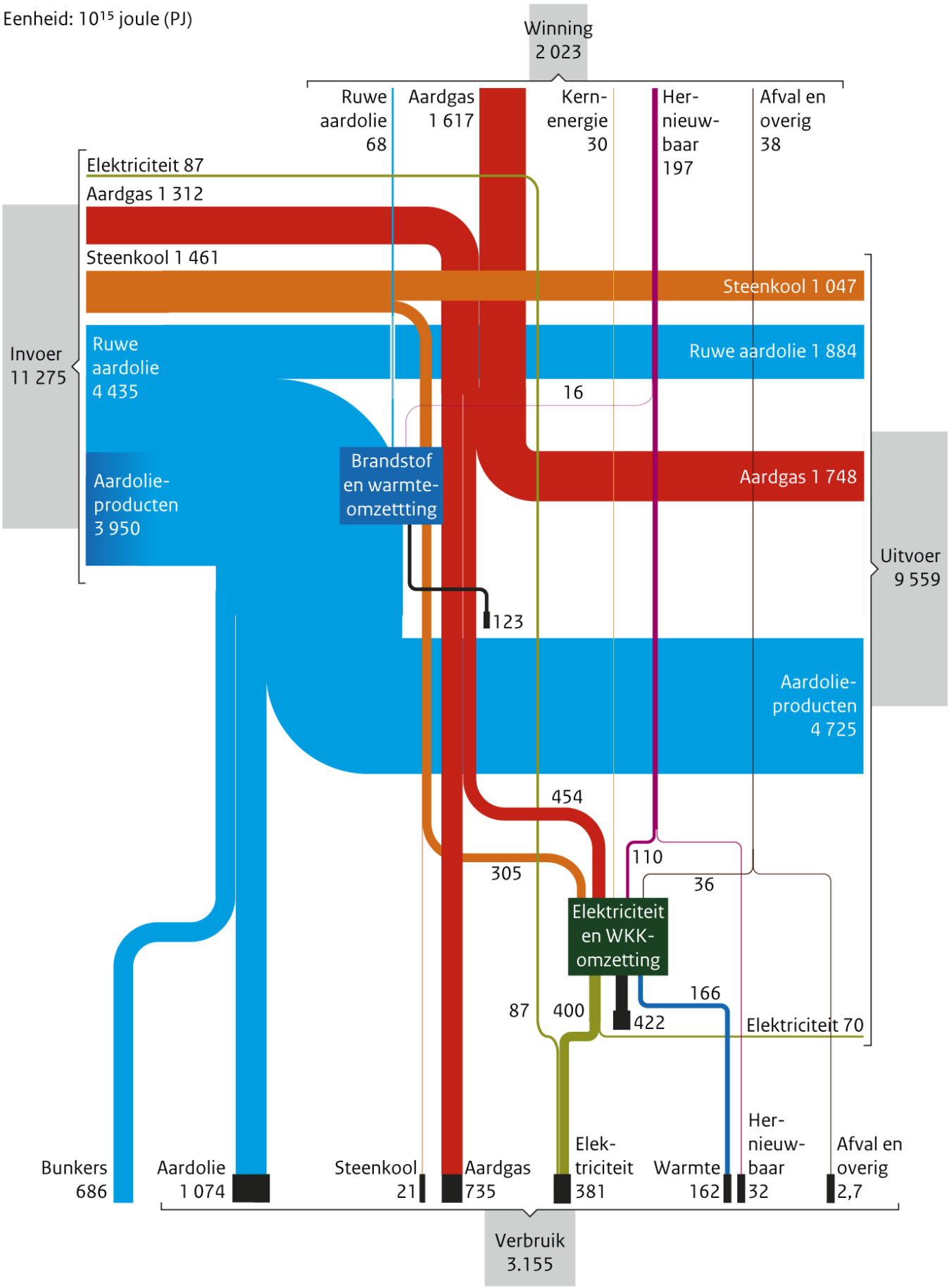




NASA 2018, Met office 2019, LOLA 2019

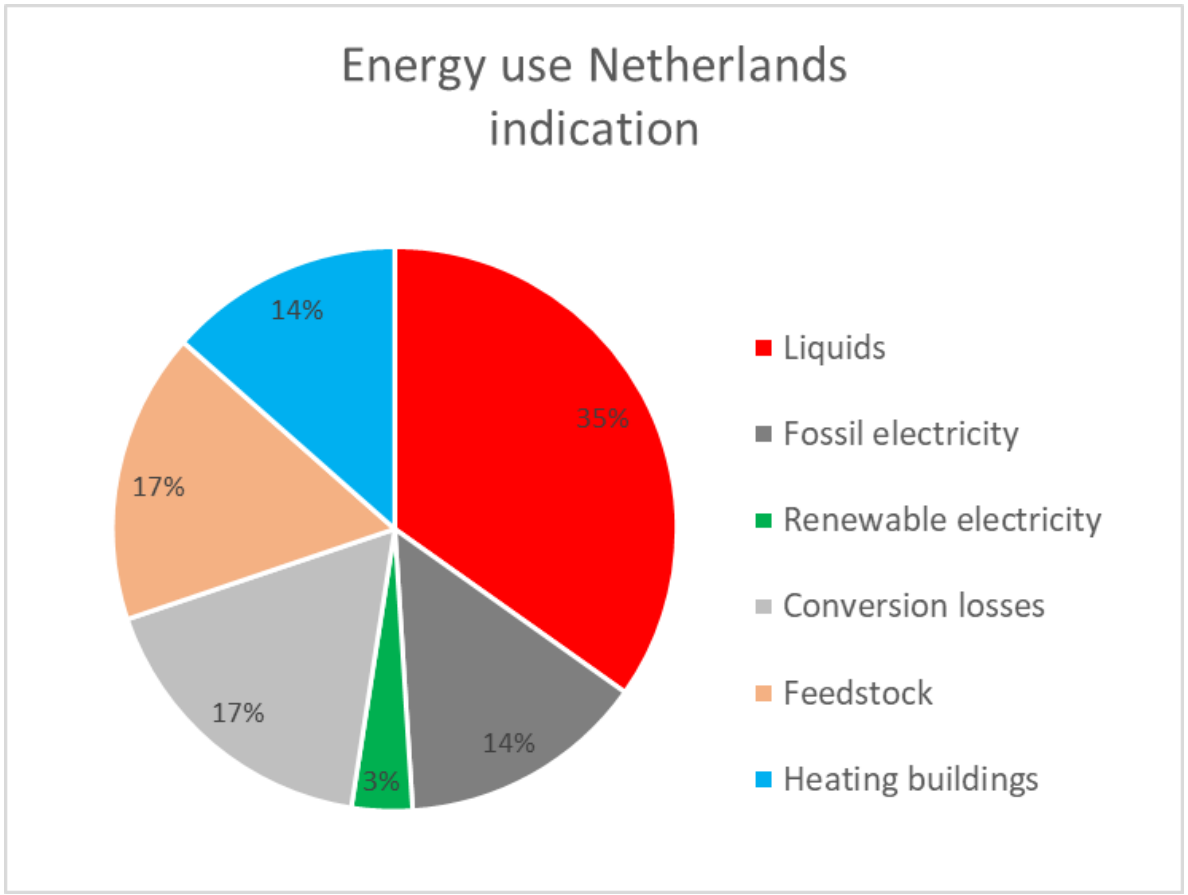


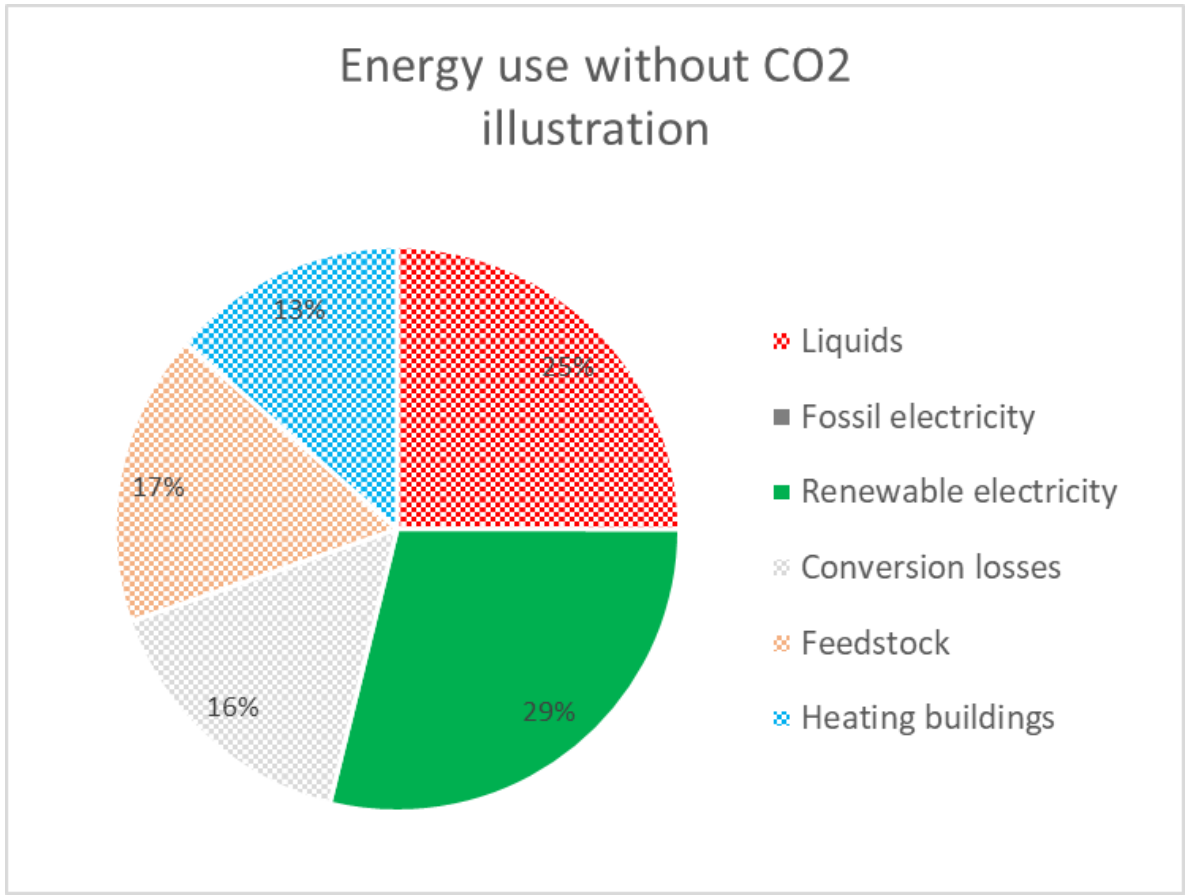
## Energiestromen, 2016**

Eenheid: $10^{15}$ joule (PJ)

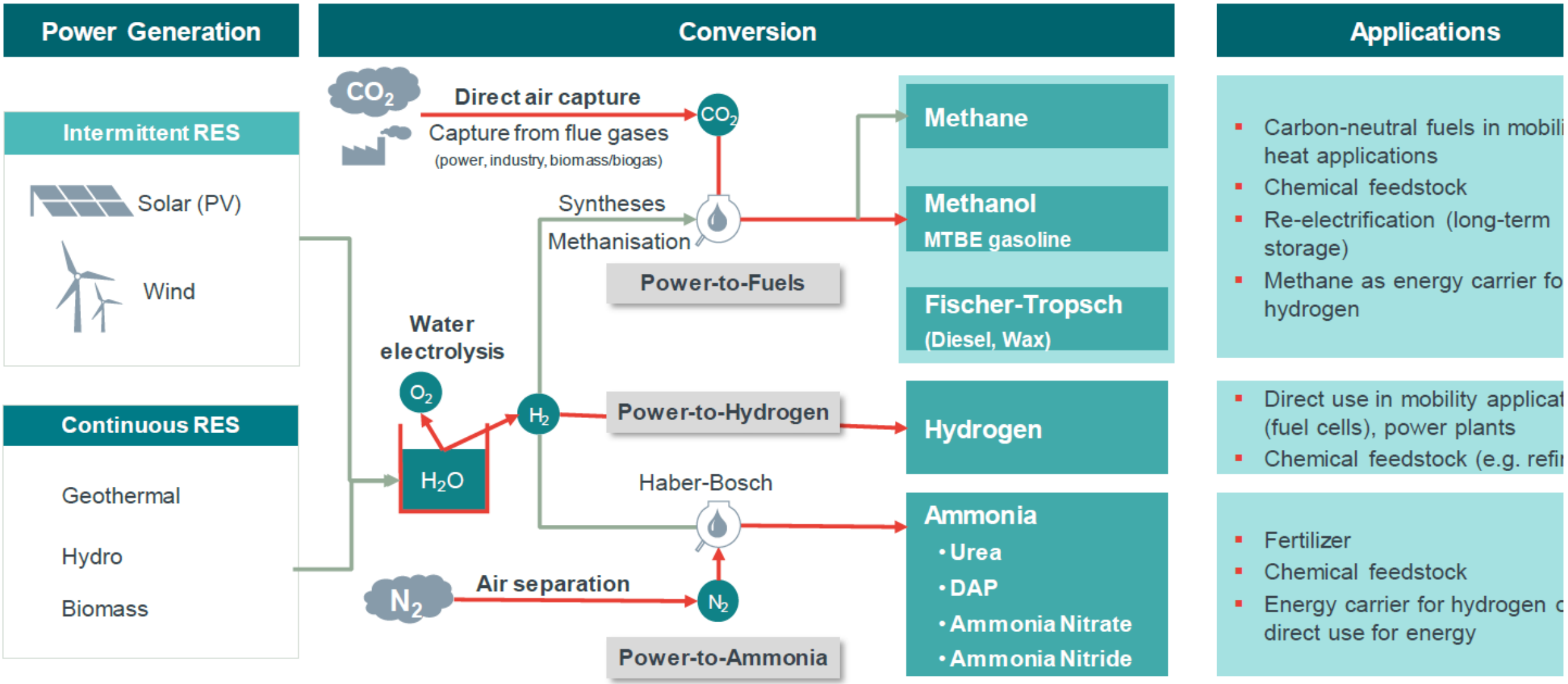


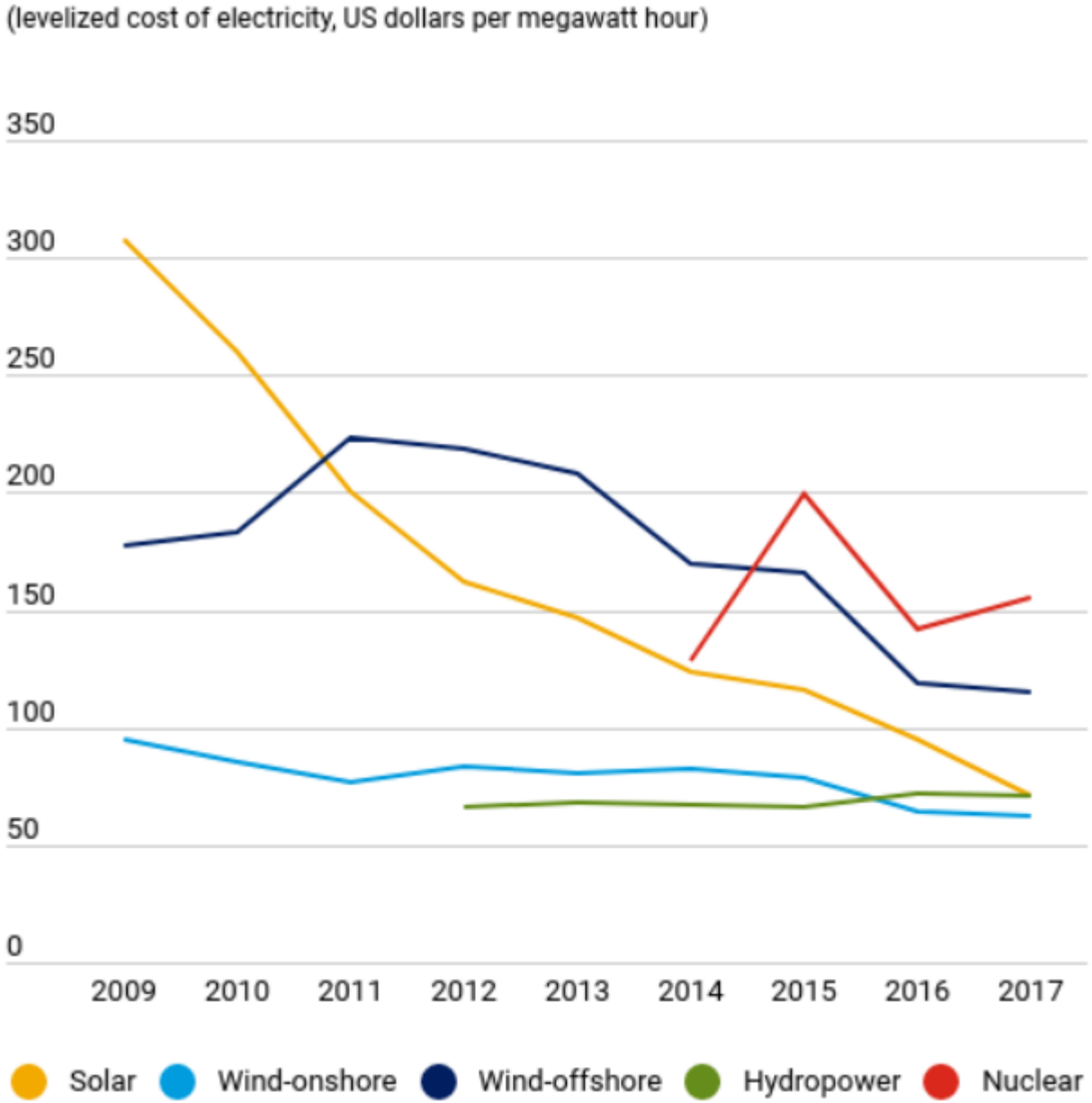

CBS 2018

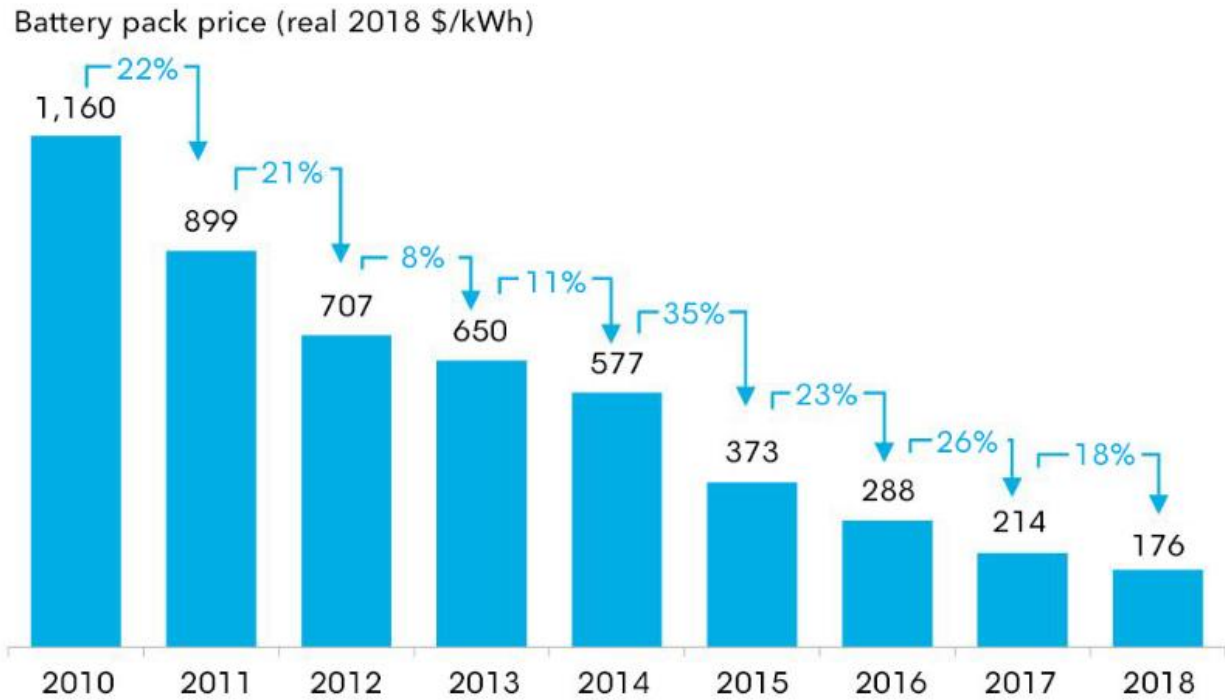


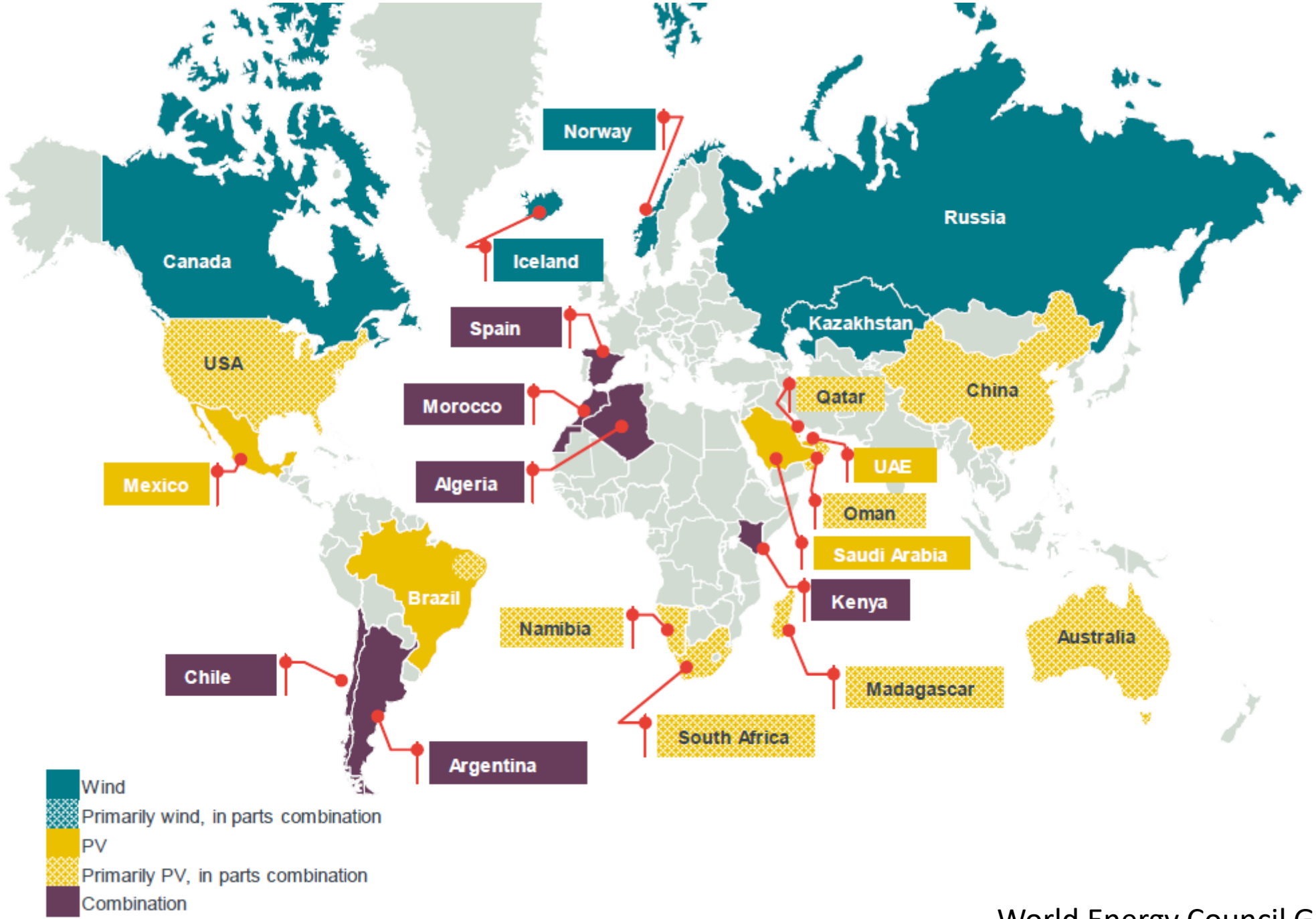

CBS 2019, own estimates


Power Generation
Conversion
Applications
Intermittent RES
Solar (PV)
Wind
Continuous RES
Geothermal
Hydro
Biomass
CO2
Direct air capture
Capture from flue gases
(power, industry, biomass/biogas)
Syntheses
Methanisation
Power-to-Fuels
Water electrolysis
O2
H2O
H2
Power-to-Hydrogen
Haber-Bosch
N2
Air separation
Power-to-Ammonia
Methane
Methanol
MTBE gasoline
Fischer-Tropsch
(Diesel, Wax)
Hydrogen
Ammonia
• Urea
• DAP
• Ammonia Nitrate
• Ammonia Nitride
Carbon-neutral fuels in mobili
heat applications
Chemical feedstock
Re-electrification (long-term
storage)
Methane as energy carrier fo
hydrogen
Direct use in mobility applicat
(fuel cells), power plants
Chemical feedstock (e.g. refi
Fertilizer
Chemical feedstock
Energy carrier for hydrogen c
direct use for energy




IMF 2019, BloombergNEF 2019




World Energy Council Germany 2018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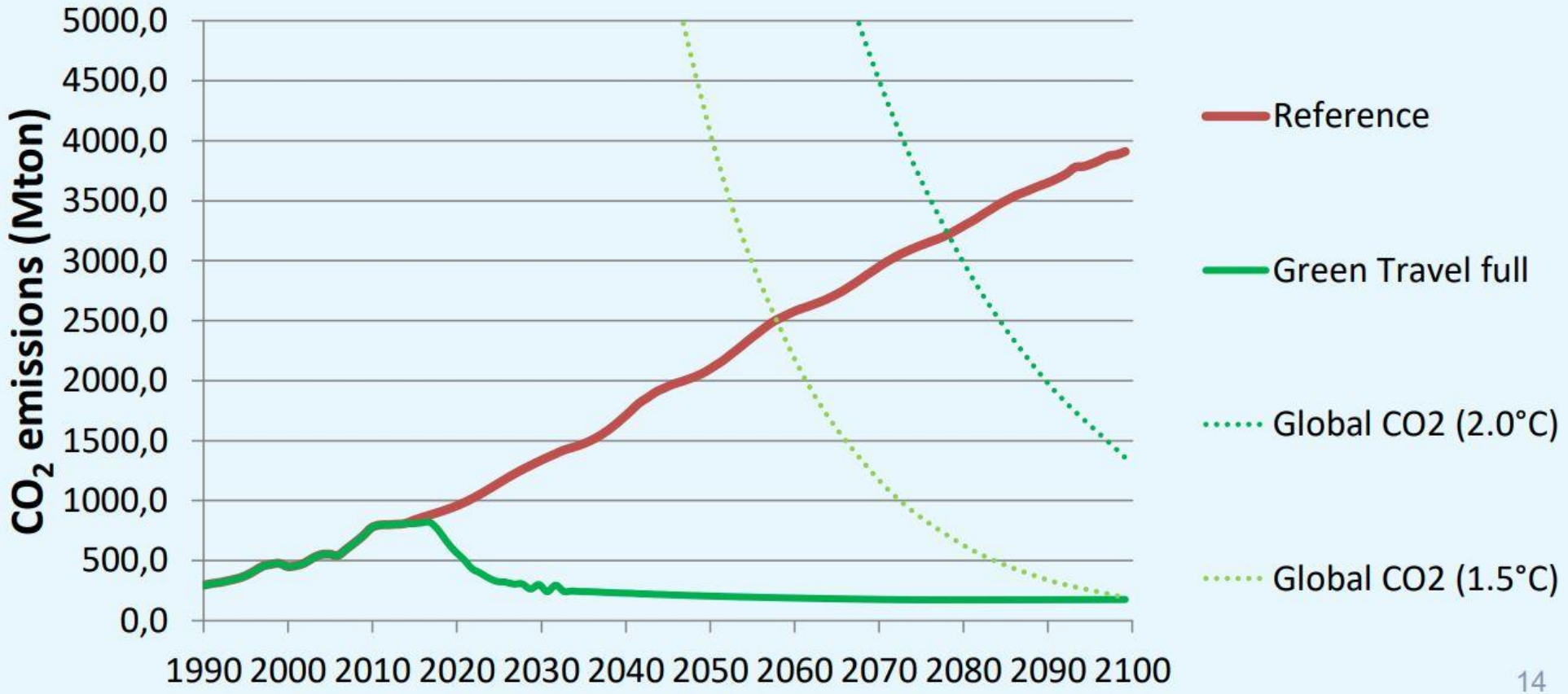
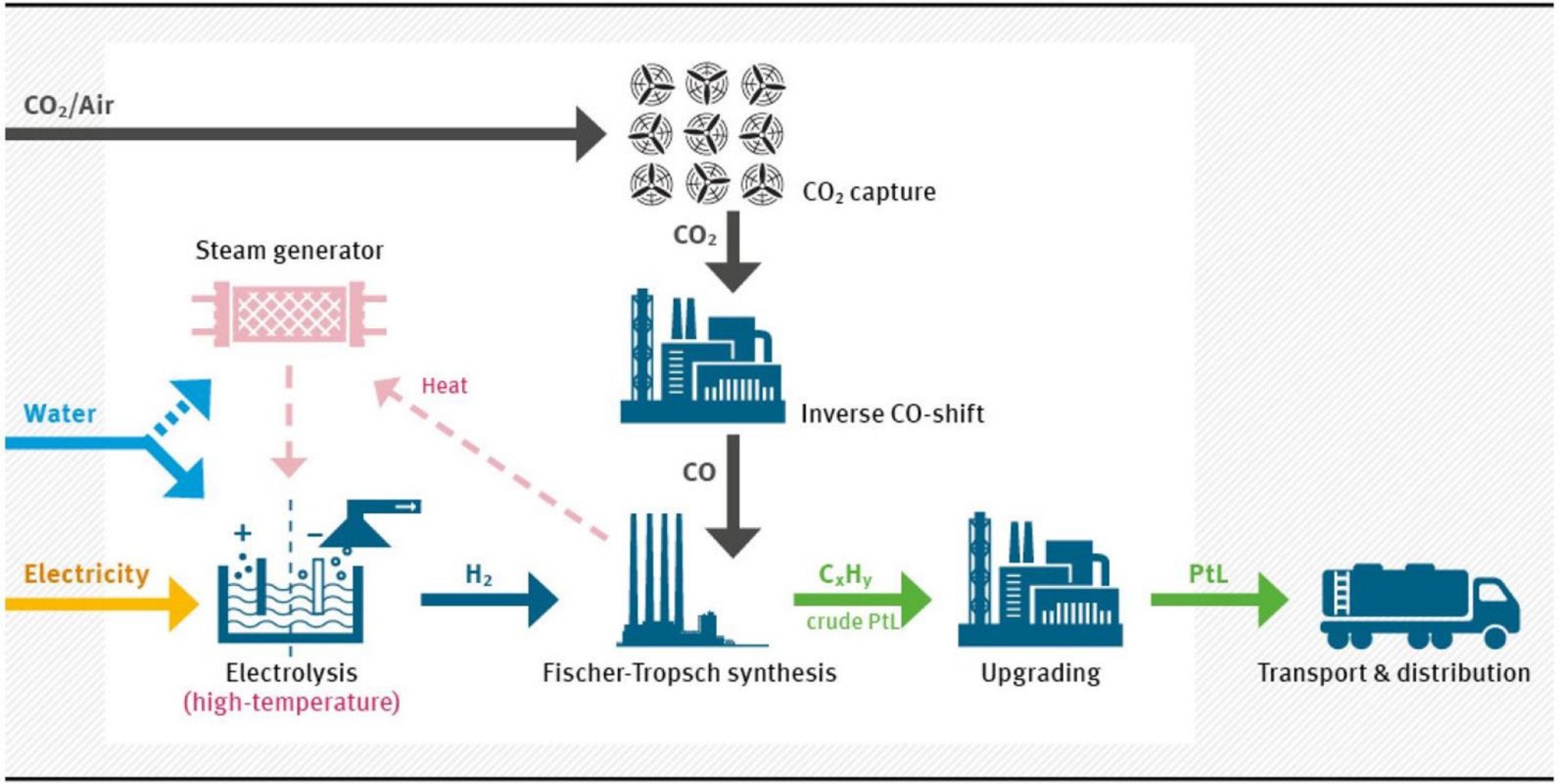
# *Green travel* scenario






Peeters 2018

## PtL production via Fischer-Tropsch pathway (high-temperature electrolysis optional)




Umweltbundesamt 2016

# Cost and impact of green synthetic kerosine

- Blending fossil kerosine
- No fleet renewal needed as with electric planes
- No use of scarce bio mass
- Price 2050: ≈ 1,50 €/l
- Ticket price 2050: ≈ + 50%
- Price 2025: ≈ 3,00 €/l

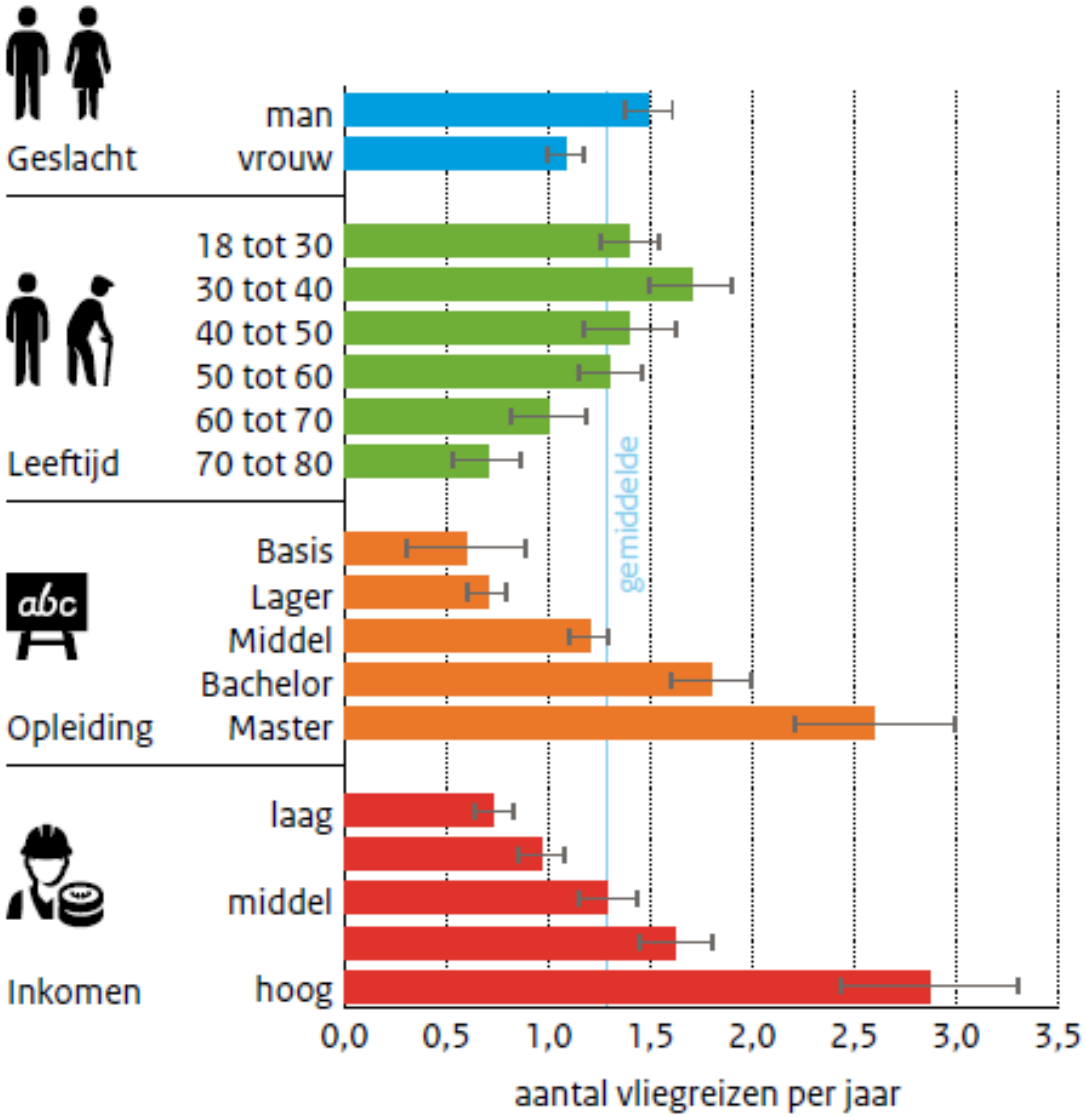
- No $CO_2$ emissions
- Less soot
- Improvement of energy efficiency (aircraft and operational)
- Improved competetiveness of electric planes and train travel
- Reduced growth in aviation volume; 20-40% below trend
- Energy storage in liquids required in zero $CO_2$ energy system

Bleijenberg 2018

# Policy measures are crucial!

| Policy options with indication of impact relative to growh trend | CO2 | Price ticket | Volume |
|---|---|---|---|
| Expected policy: ETS++ en ticket 5% | - 11% | + 7% | - 6% |
| Blending mandate green synthetic kerosine 4,5% | - 11% | + 3% | - 2% |
| | | | |
| Pricing policy: Ticket 21%, fuel duty 0,33 €/l | - 32% | + 34% | - 21% |
| Blending mandate green synthetic kerosine 17% | - 32% | + 10% | - 7% |
| | | | |
| Blending mandate green synthetic kerosine 28% | - 50% | + 17% | - 12% |
| | | | |
| Sustainable: 100% green synthetic kerosine | - 100% | + 50% | - 30% |
| Sustainable and fair taxation: 100% green and ticket 21% | - 100% | + 84% | - 39% |

# The high income consumer will pay the price




KiM 2018


# AARDGAS, belofte voor de huisvrouw

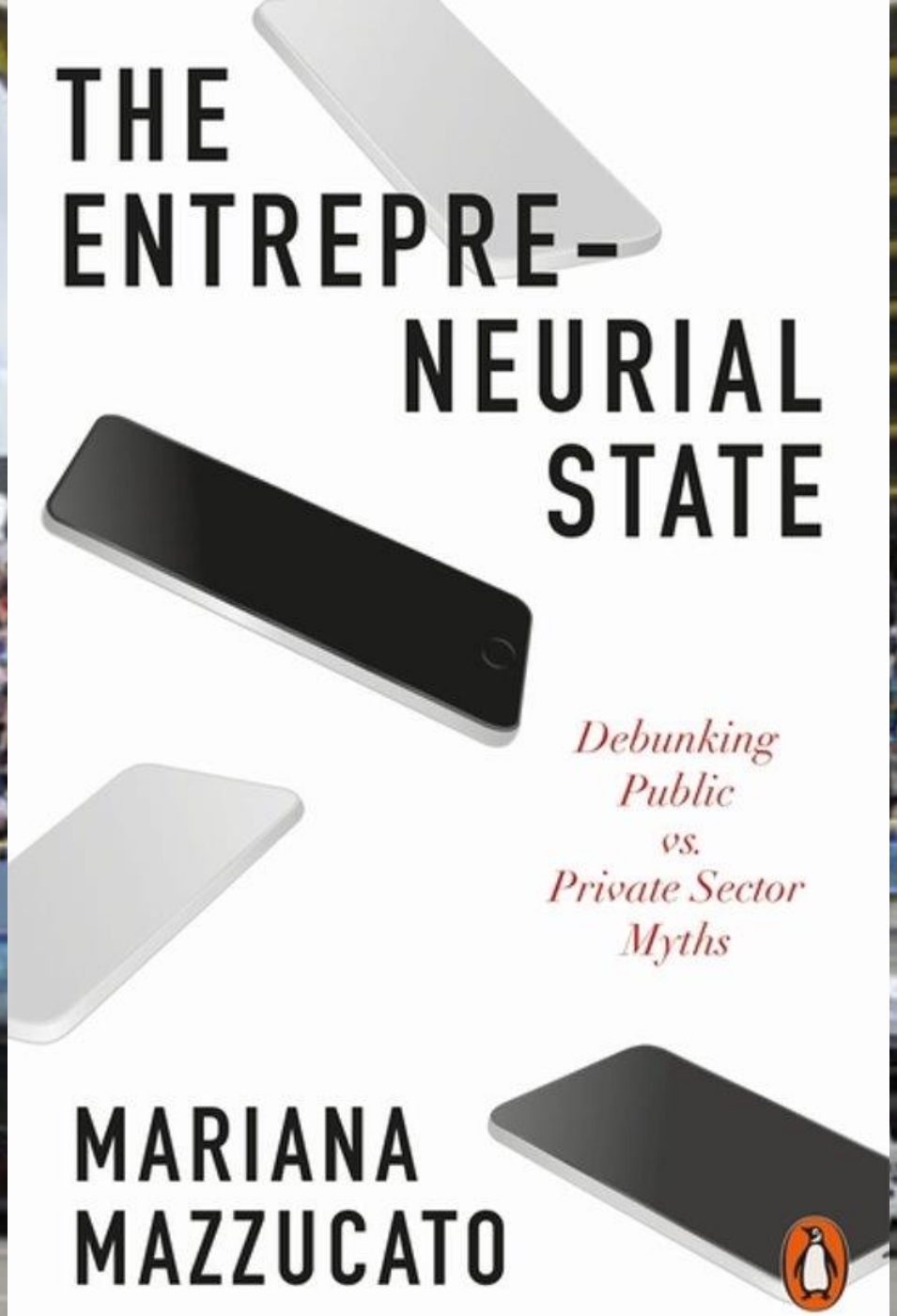
## *Verwarming met aardgas*

DE TELEGRAAF
ZATERDAG 31 AUGUSTUS 1963

- **LAGE AANSCHAFKOSTEN**
- **GEEN KOLENBERGPLAATSEN**
- **„ECHTE" SCHOORSTEEN OVERBODIG**


# THE ENTREPRE-NEURIAL STATE

*Debunking Public vs. Private Sector Myths*



MARIANA MAZZUCATO

# Leading Innovation

## *Promoting Creativity and Discipline*

## An Innovation Check-Up


**TNO Built Environment and Geosciences**

**June 12 & 13, 2007**

***Prof. Jean-Philippe Deschamps, IMD***





IMD

# Understanding the Drivers of Innovation

## *Innovation generally occurs under two complementary modes*

# *Characterizing innovation leaders*

## The courage to stop projects, not just to start them…

3rd trait

… and discernment on when to persist vs. pull the plug!








IMD

# Nett zero $CO_2$ in 2050

- World energy market, mainly based on solar and wind energy
- World energy market, Europe large importer
- Technical improvements in solar, wind, energy storage, hydrogen as intermediate fuel and many technologies for energy conversion into green hydrocarbons, methanol, ammonia (feed stock)
- Technical improvements at end users: isolation, hydrogen in gas grid, solar energy, all electric buildings and cars, heat pump, …
- Major investments in appliances, installations, proces technology and energy storage and distribution
- Technical feasible and affordable
- Innovation = creativity + selection, innovation = technology push + market pull
- Government policy is key!