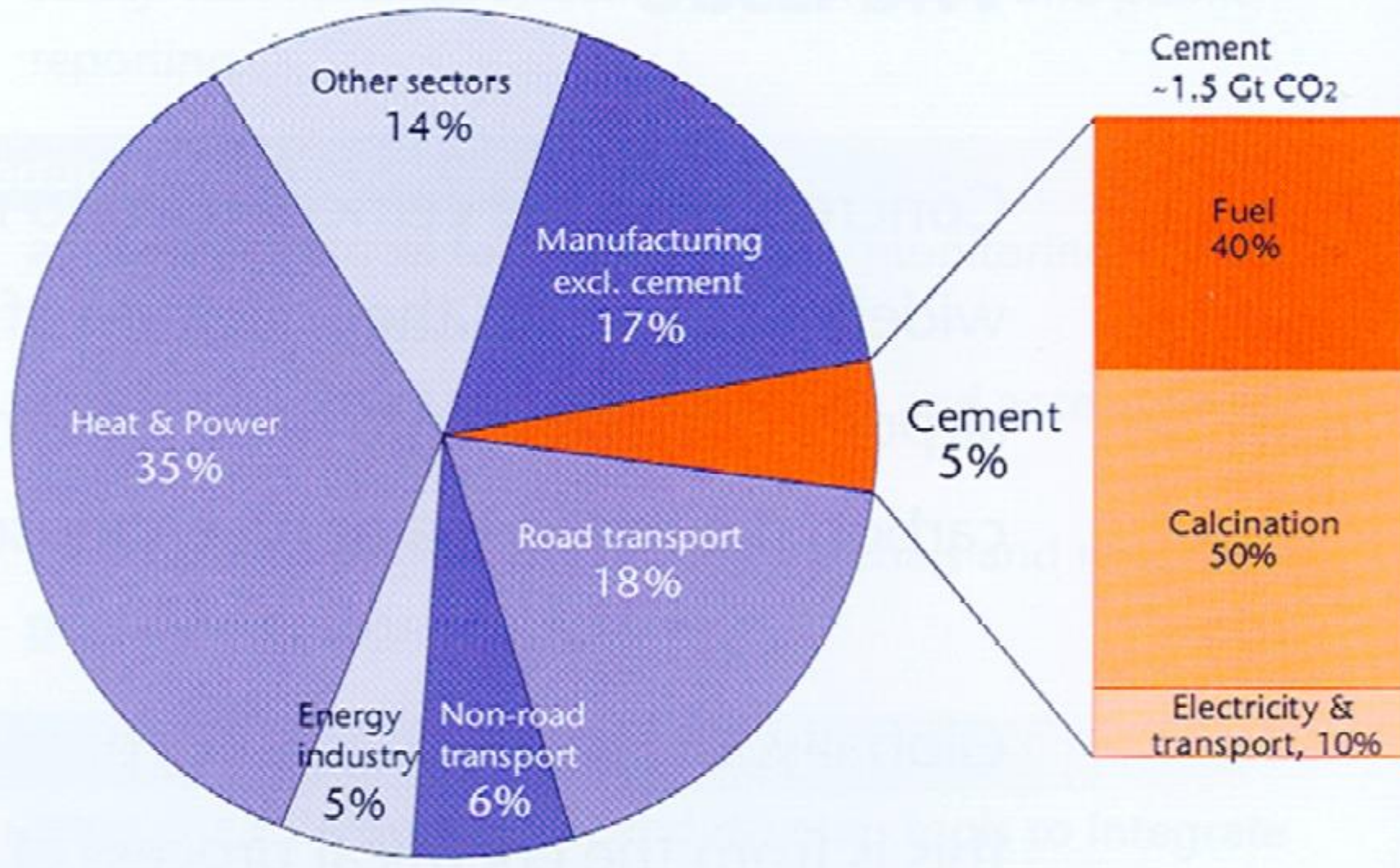




# Cement industry and its carbon-neutrality by 2050

Prof.dr.sc. Neven Duić

Madrid, March 21, 2023, CAETS Towards Low-GHG Emissions From Energy Use in Selected Sectors

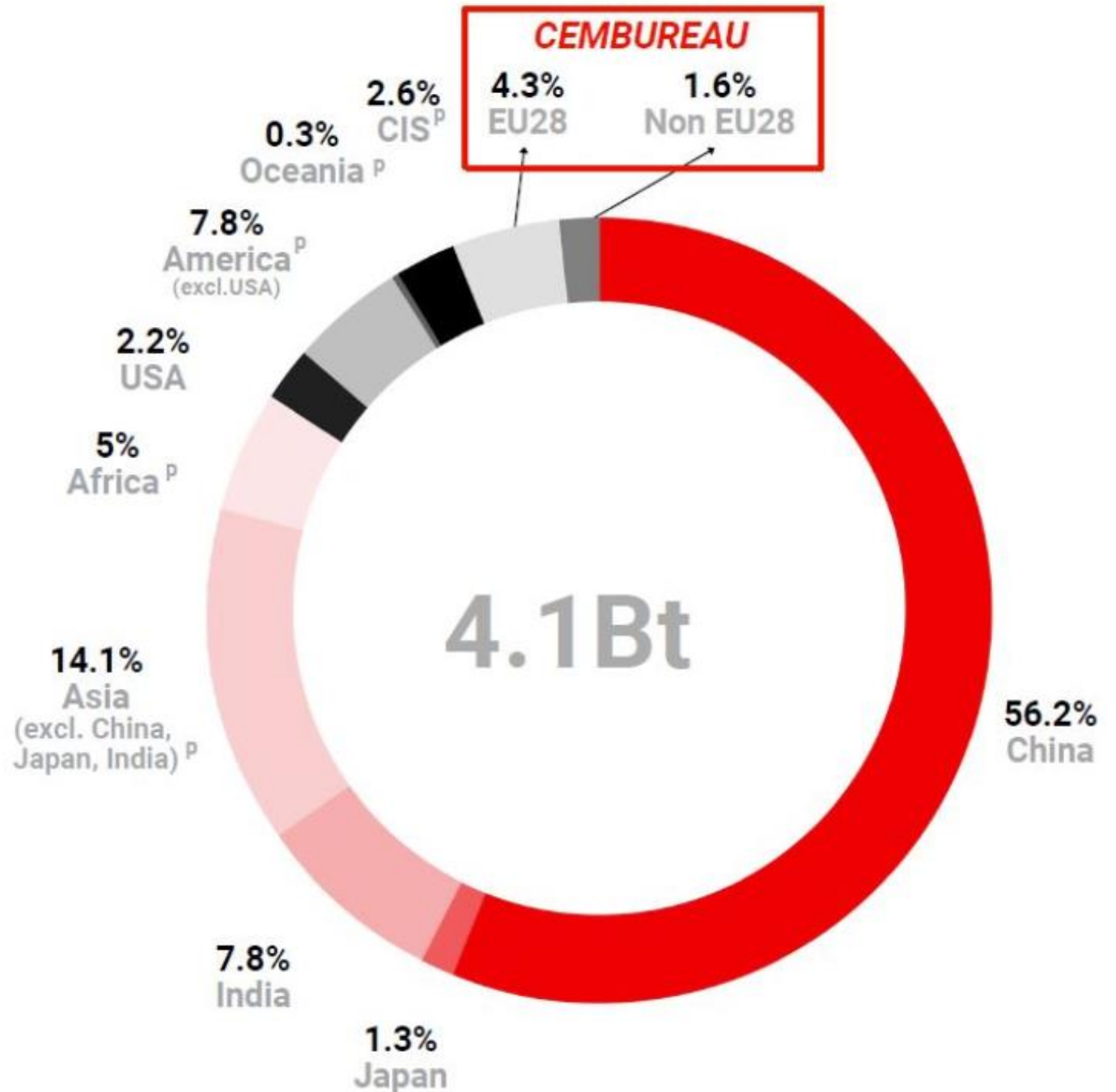


**30Gt CO<sub>2</sub>**

Cement  
~1.5 Gt CO<sub>2</sub>

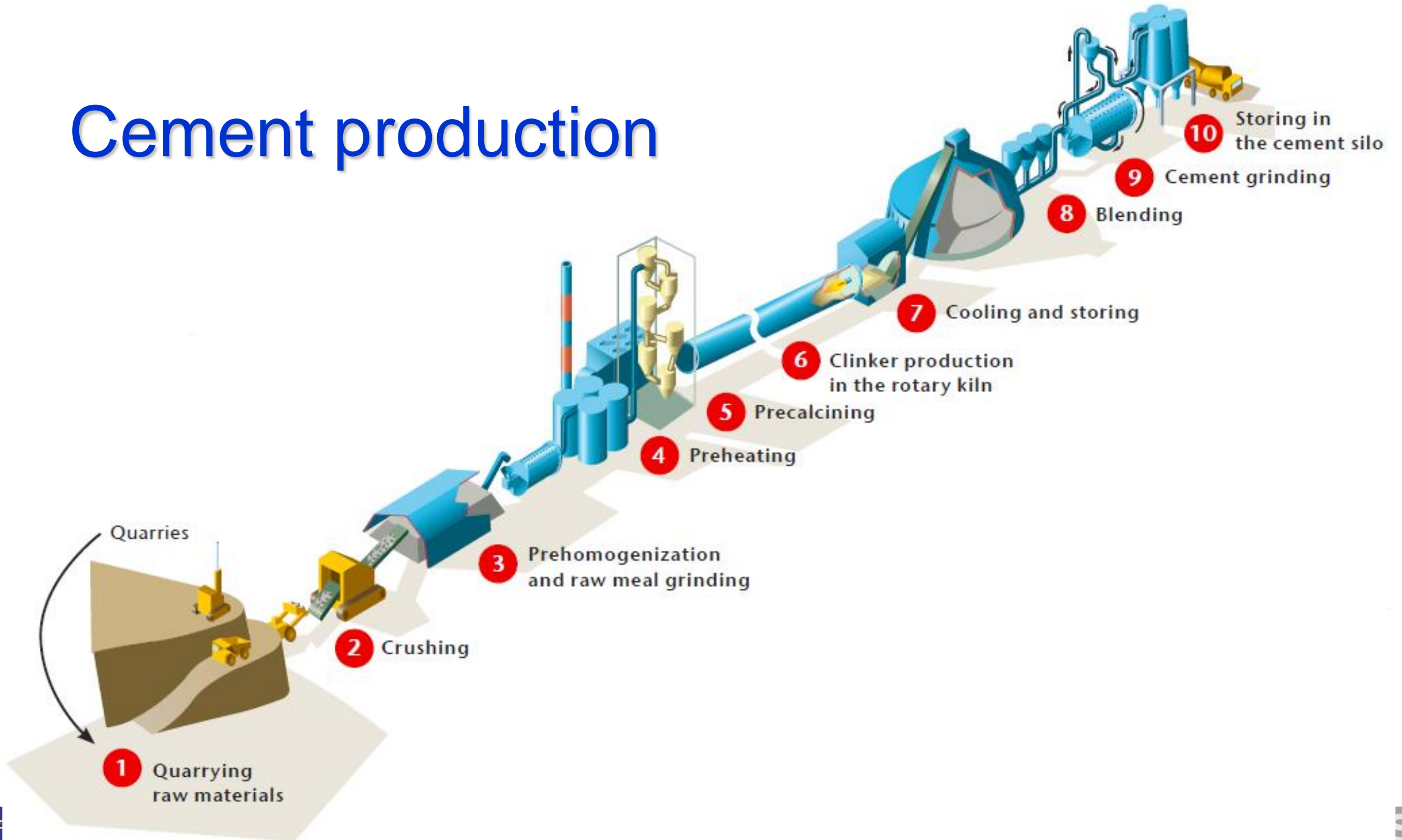
**Cement industry today**

# Cement industry today

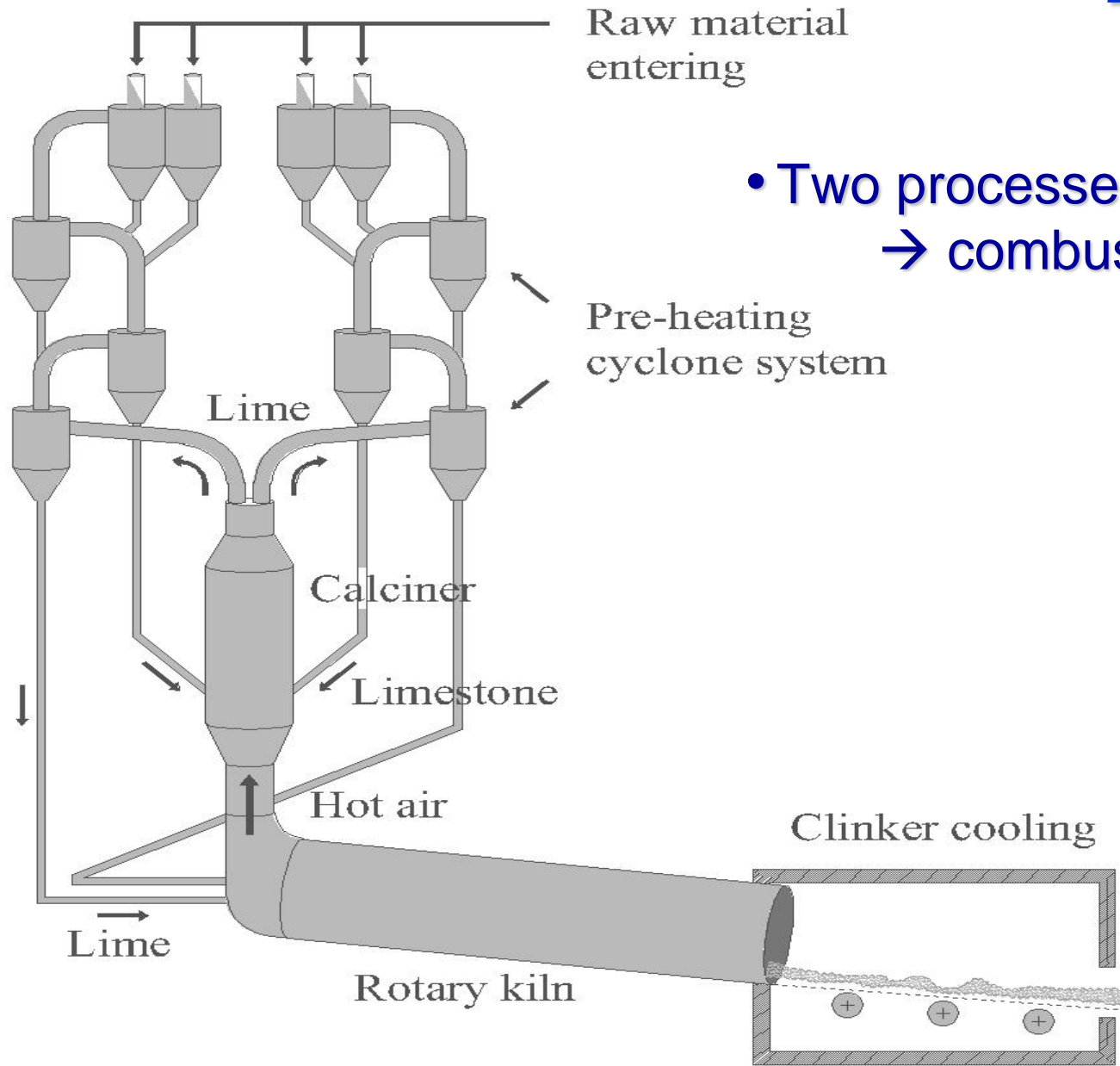




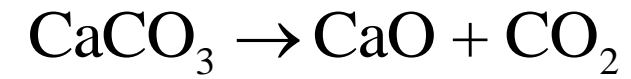
# Cement production



# Sources of CO<sub>2</sub> emissions



- Two processes from which carbon dioxide is produced  
→ combustion and calcination process



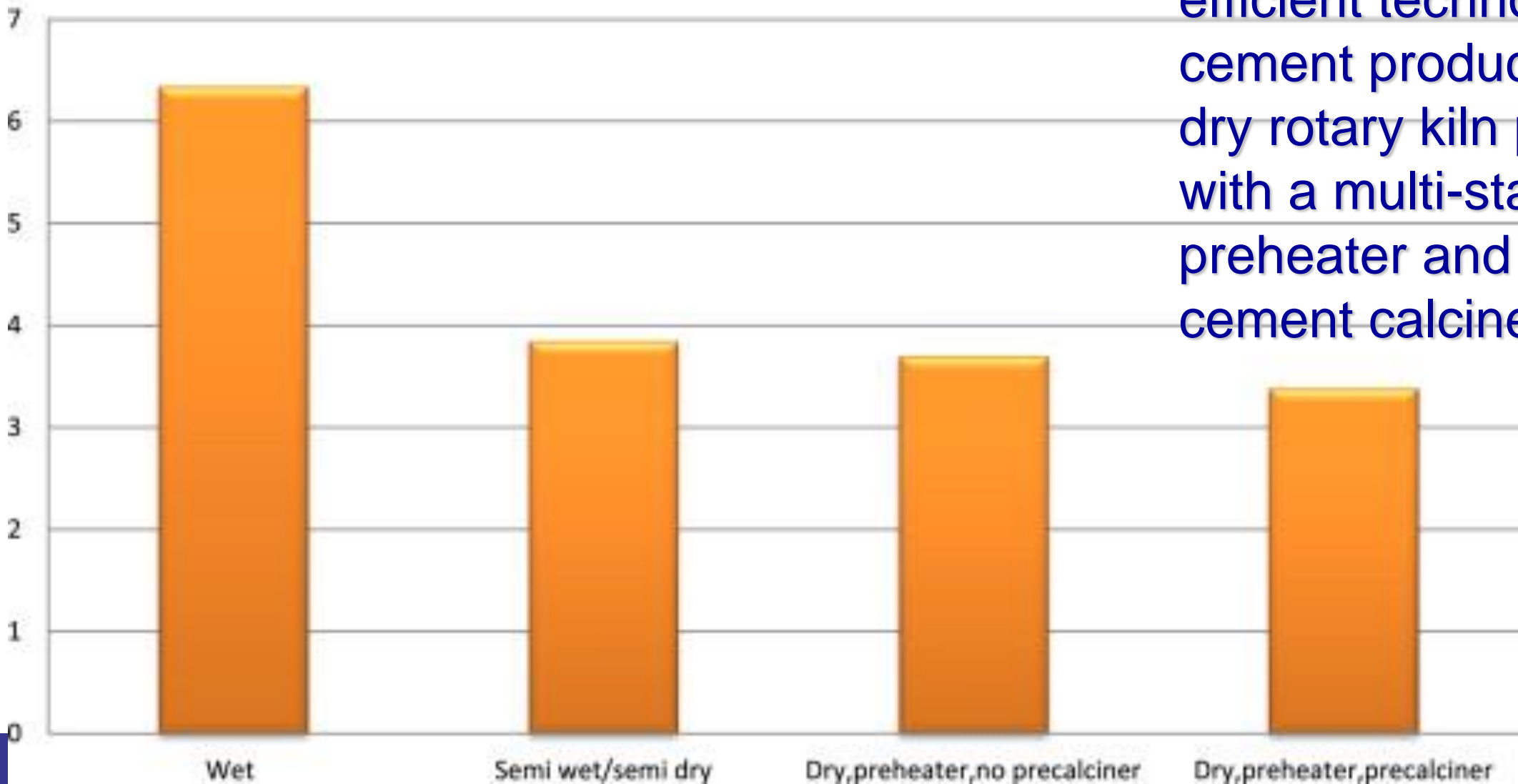
# Cement industry CO<sub>2</sub> emissions

- Cleaner and more sustainable production is becoming increasingly important
- Cement industry is among the largest carbon emitting sectors
- It accounts approximately for **4%** of **EU's**, **15%** of **Chinese\***, and around **5%** of **world's** anthropogenic CO<sub>2</sub> emissions

- *\*Chen, W., Hong, J., Xu, C., 2014. Pollutants generated by cement production in China, their impacts, and the potential for environmental improvement. J. Clean. Prod. doi: 10.1016/j.jclepro.2014.04.048*

# Cement industry energy efficiency

Energy consumption (GJ/t-clinker)



The most energy efficient technology for cement production is a dry rotary kiln process with a multi-stage preheater and a cement calciner

# Increase use of SRF/RDF

- Combustion of SRF/RDF in cement units has one major advantage over regular SRF/RDF in incineration
- Cement industry → no liquid or solid residue to contend with
- Incinerators → still a solid residue to contend with
- Better waste (SRF/RDF) to cement than waste (SRF/RDF) to energy



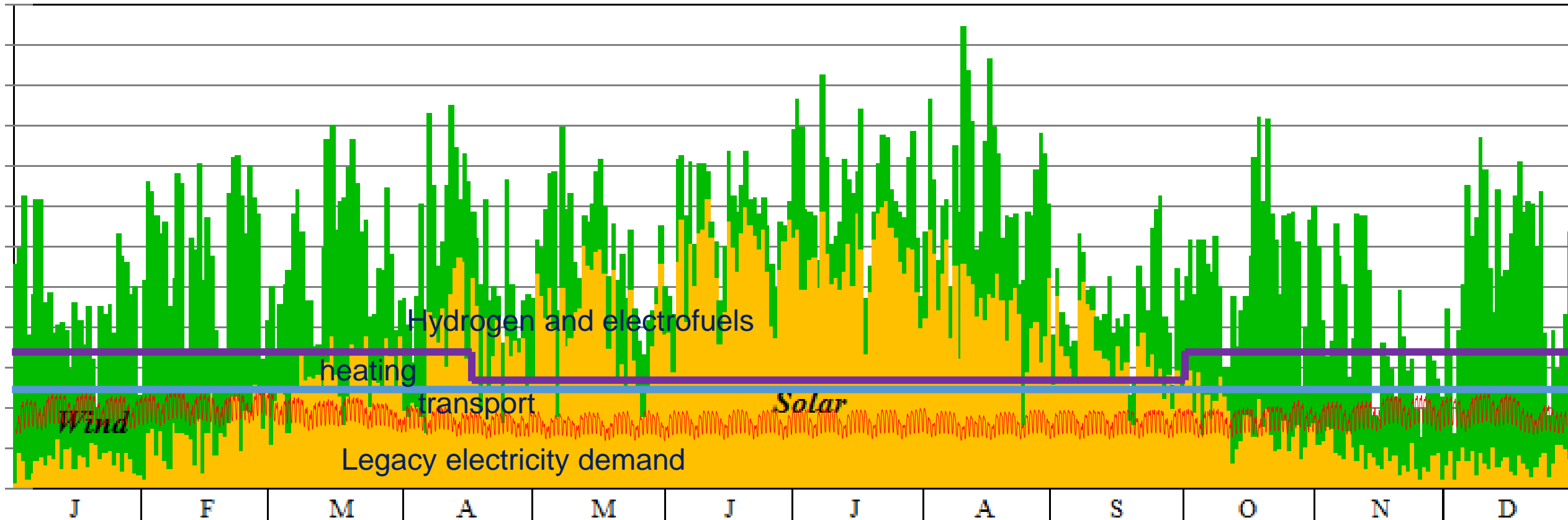
# Use of biomass

- Use of chips from wood trunks should be avoided
- Waste biomass should be used
- Biomass used has to have high calorific value

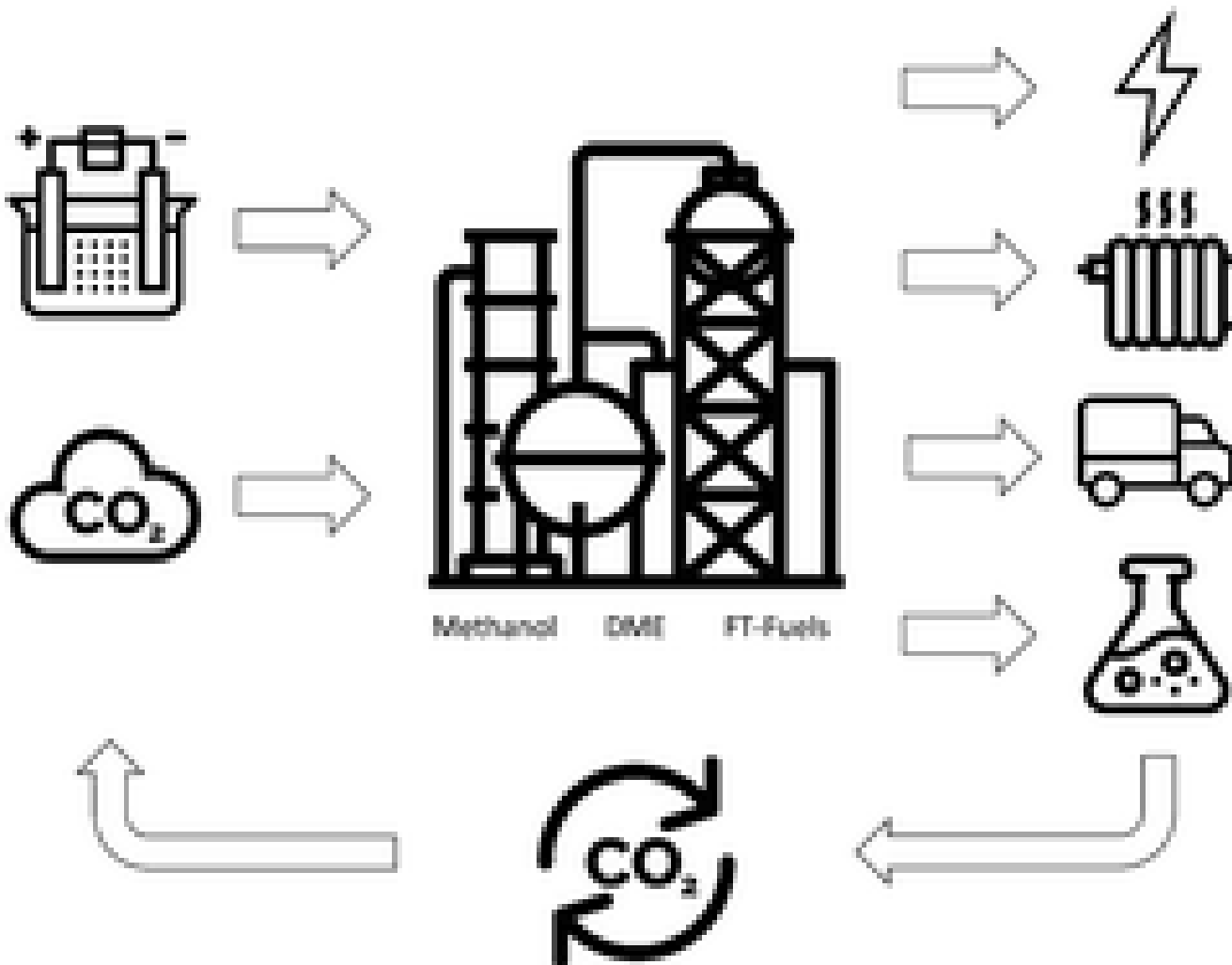
# Use of hydrogen

- Fuel is needed to obtain high temperature, so hydrogen is a possibility
- In order to achieve decarbonisation must be **low carbon** hydrogen

# Where will hydrogen come from?



# Use of electrofuels? Carbon capture and utilisation

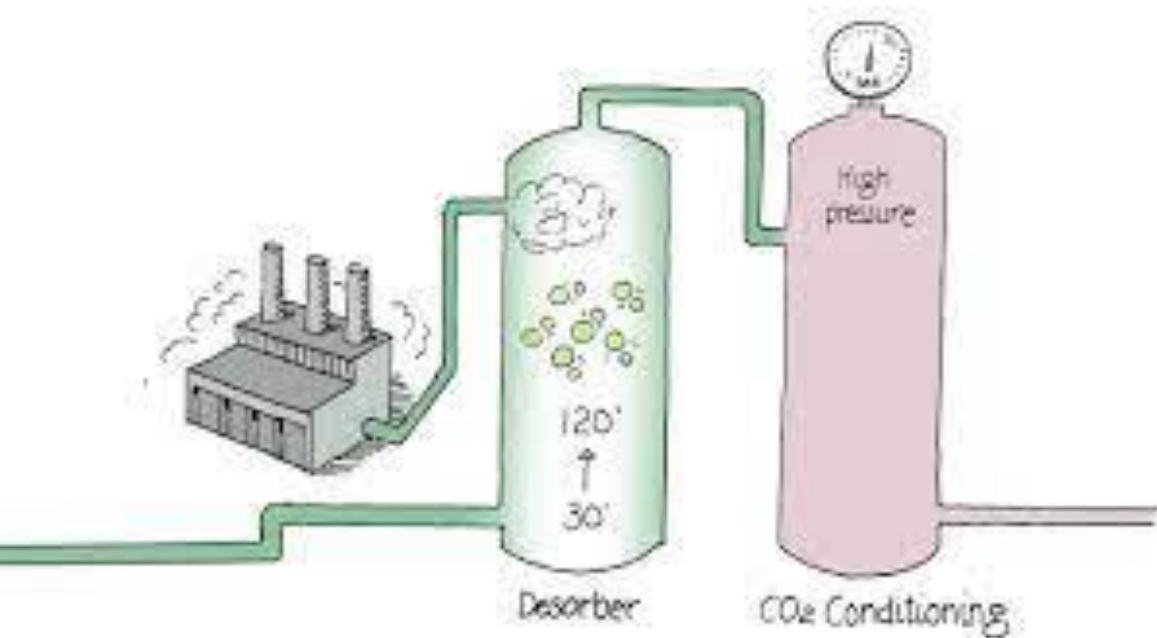


- Production of synthetic electrofuels?
- Electrofuels from cement production could be reused as fuel, or sold for transport use.
- Theoretical carbon efficiency is 50% since as fuel  $\text{CO}_2$  gets released
- Enhanced Oil/Gas Recovery (EOR/EGR) does not count as CCU



# Carbon Capture and Storage

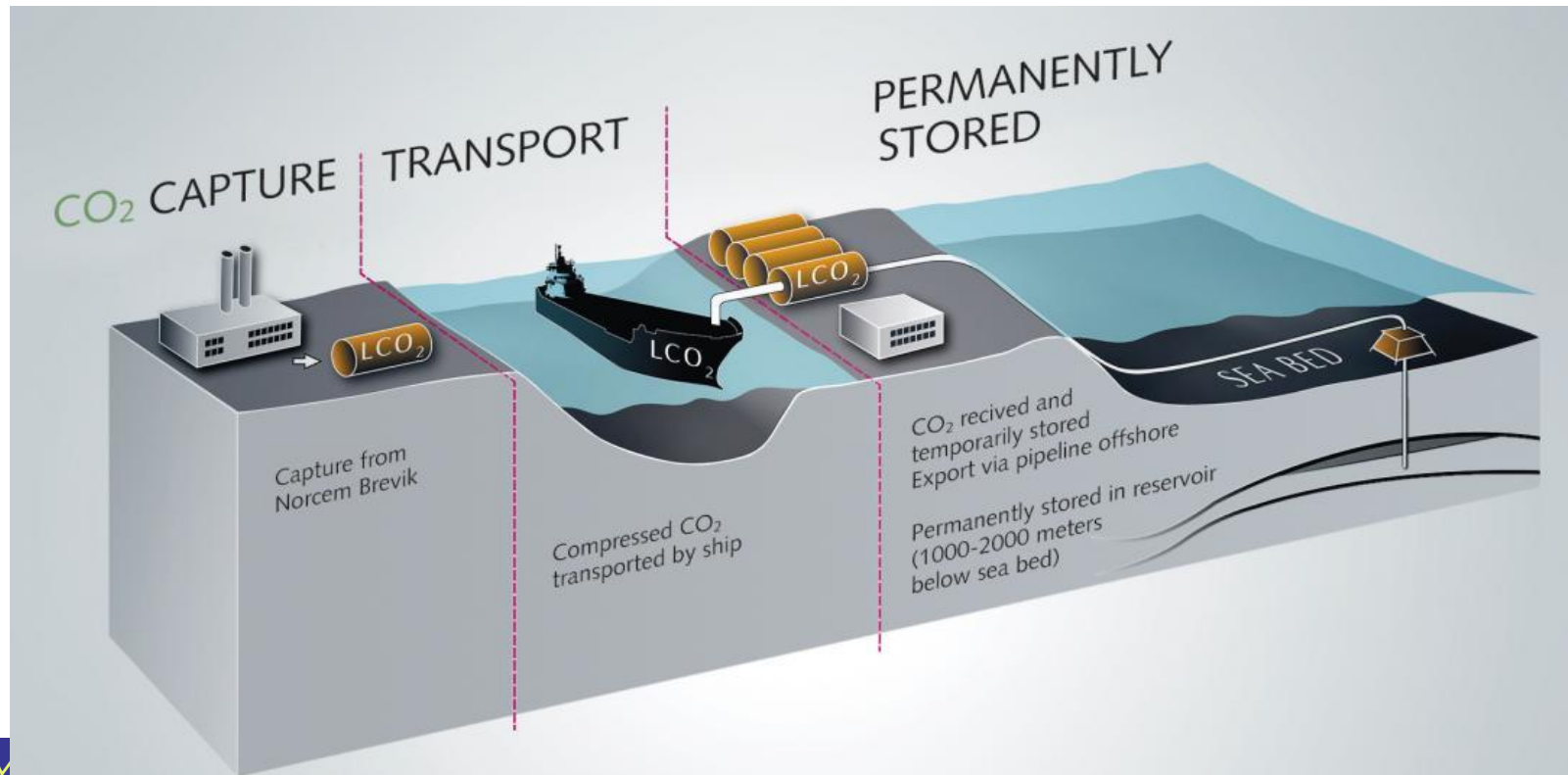
- Carbon from the ground has to be returned to the ground.
- For process CO<sub>2</sub> emissions CCS technology is probably only option to meet the carbon neutrality target.
- Enhanced Oil/Gas Recovery (EOR/EGR) does not count as CCS



- HeidelbergCement Norcem plant in Brevik, Norway

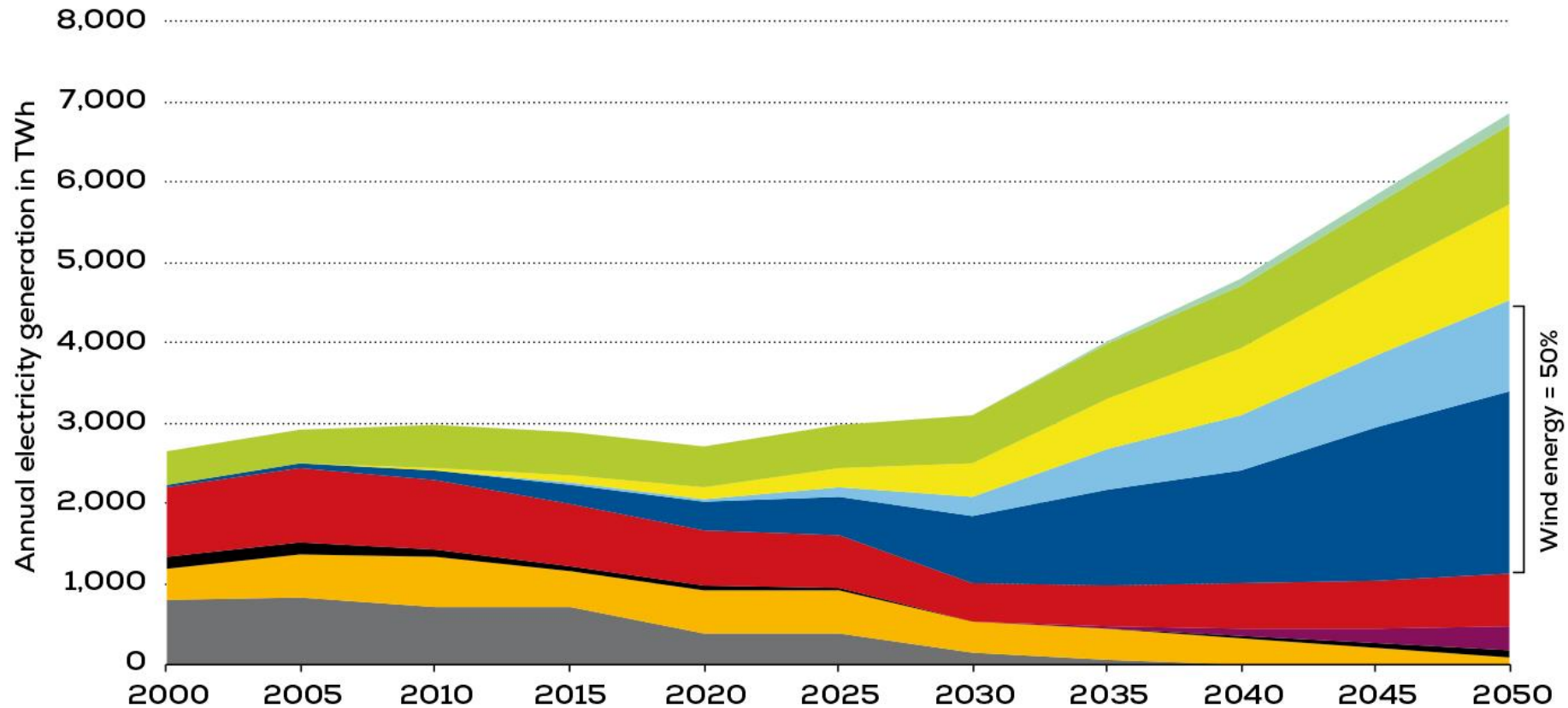
# Carbon capture and Storage

- HeidelbergCement Norcem plant in Brevik, Norway
- Capture of 400,000 tonnes of CO<sub>2</sub> per year and the transportation for permanent storage, making it the first industrial-scale CCS project at a cement production plant



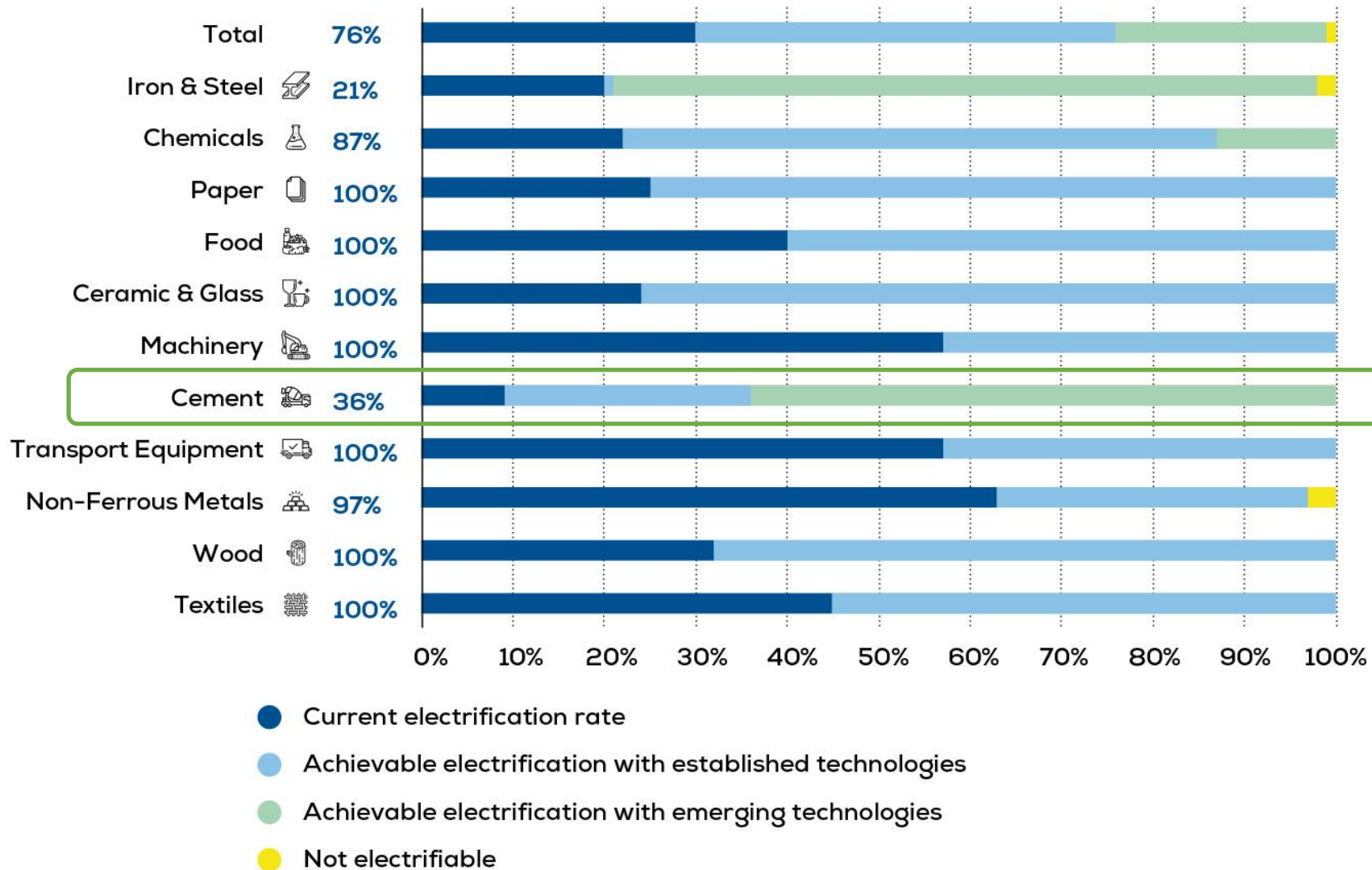
# Electrification of cement industry?

Europe's electricity mix to 2050



# Electrification of cement industry?

Achievable rate of direct electrification of EU industrial energy demand





# Reducing embodied carbon

- **Reuse buildings instead of constructing new ones**
- **Specify low-carbon concrete mixes**
- **Choose lower carbon alternatives**
- **Choose carbon sequestering materials**
- **Reuse materials**
- **Maximize structural efficiency**
- **Minimize waste**

# Carbon pricing

- High carbon price is crucial for cement and construction industry transition towards decarbonization
- CO<sub>2</sub> cost is significant part of cement cost, so it will help fast development of solutions
- Free allowances do not help!
- Carbon border adjustment mechanism (CBAM) should solve the leakage problem, so free allowances should be phased out



Thank you for your attention

[neven.duic@fsb.hr](mailto:neven.duic@fsb.hr)