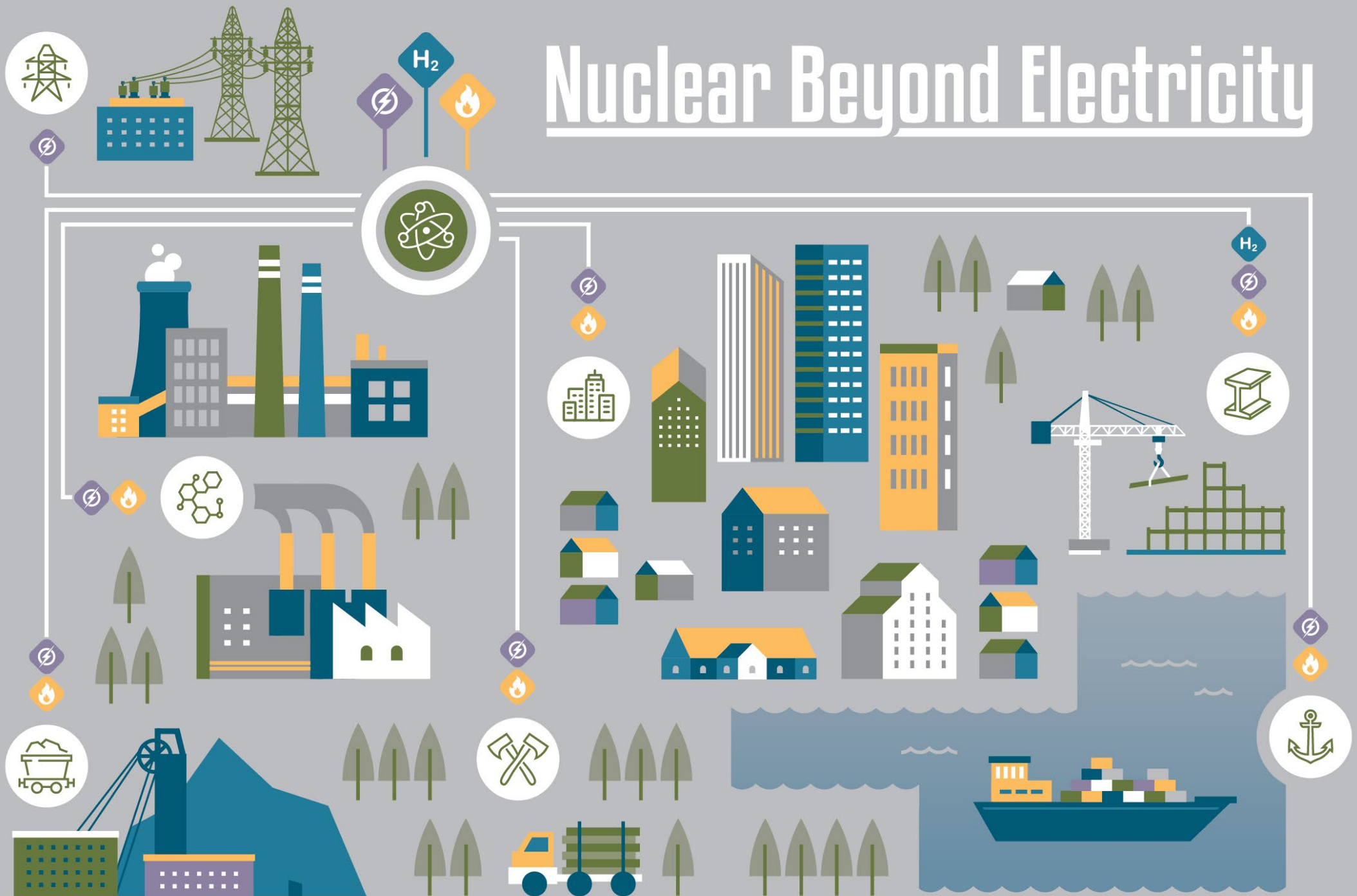


Nuclear Beyond Electricity



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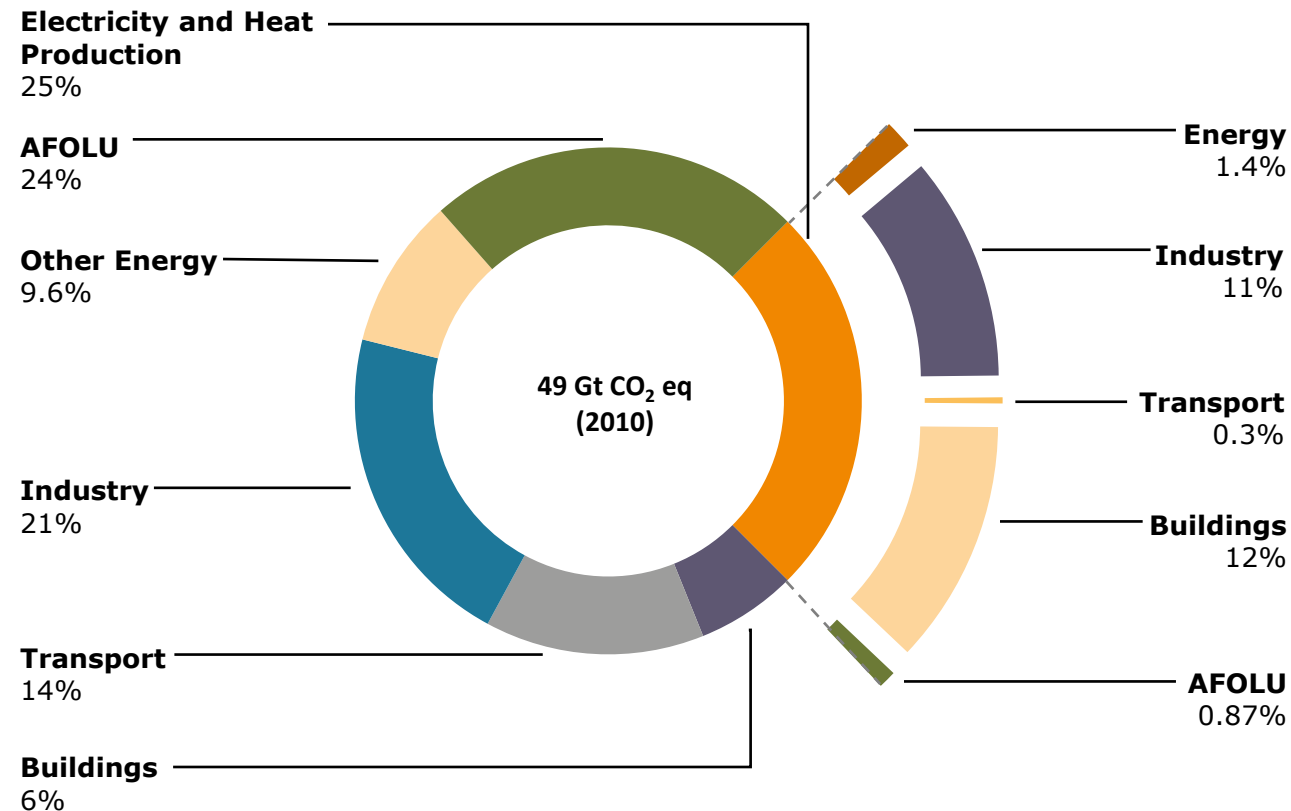
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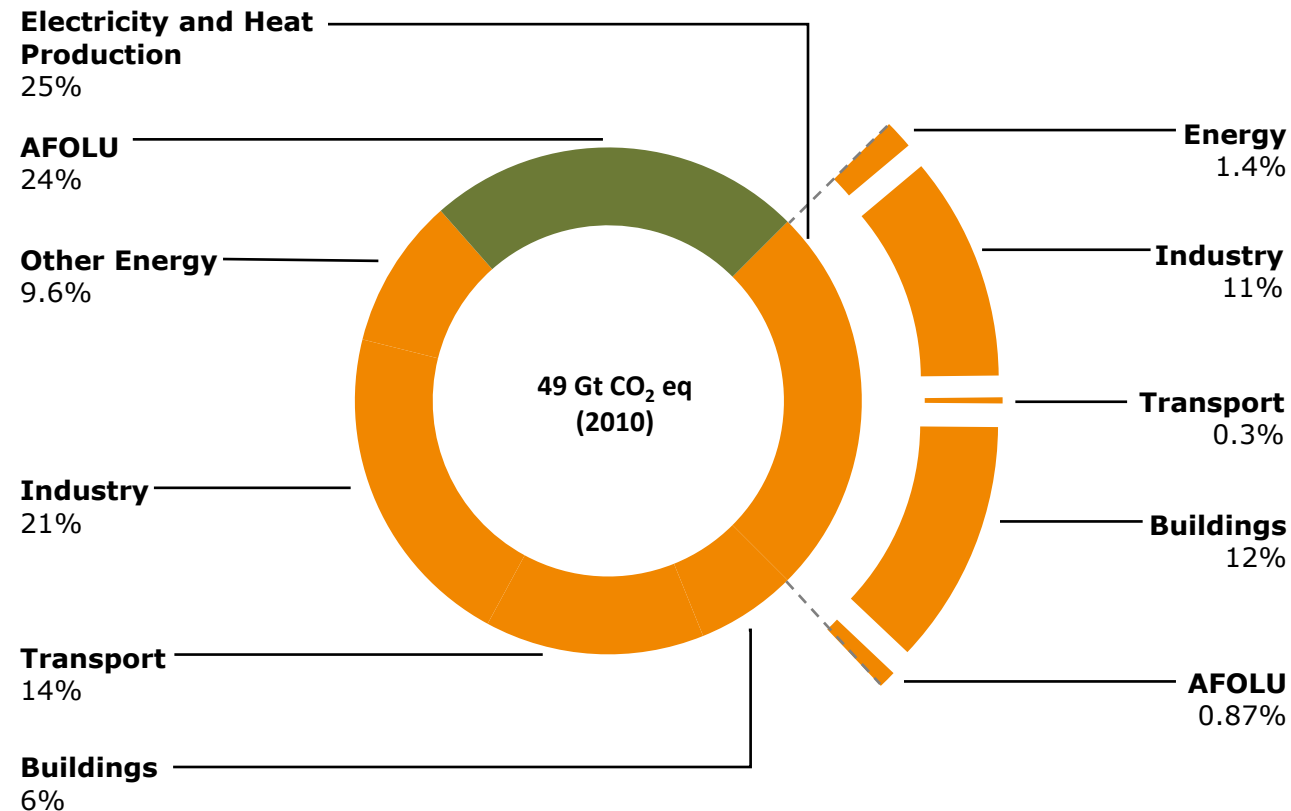
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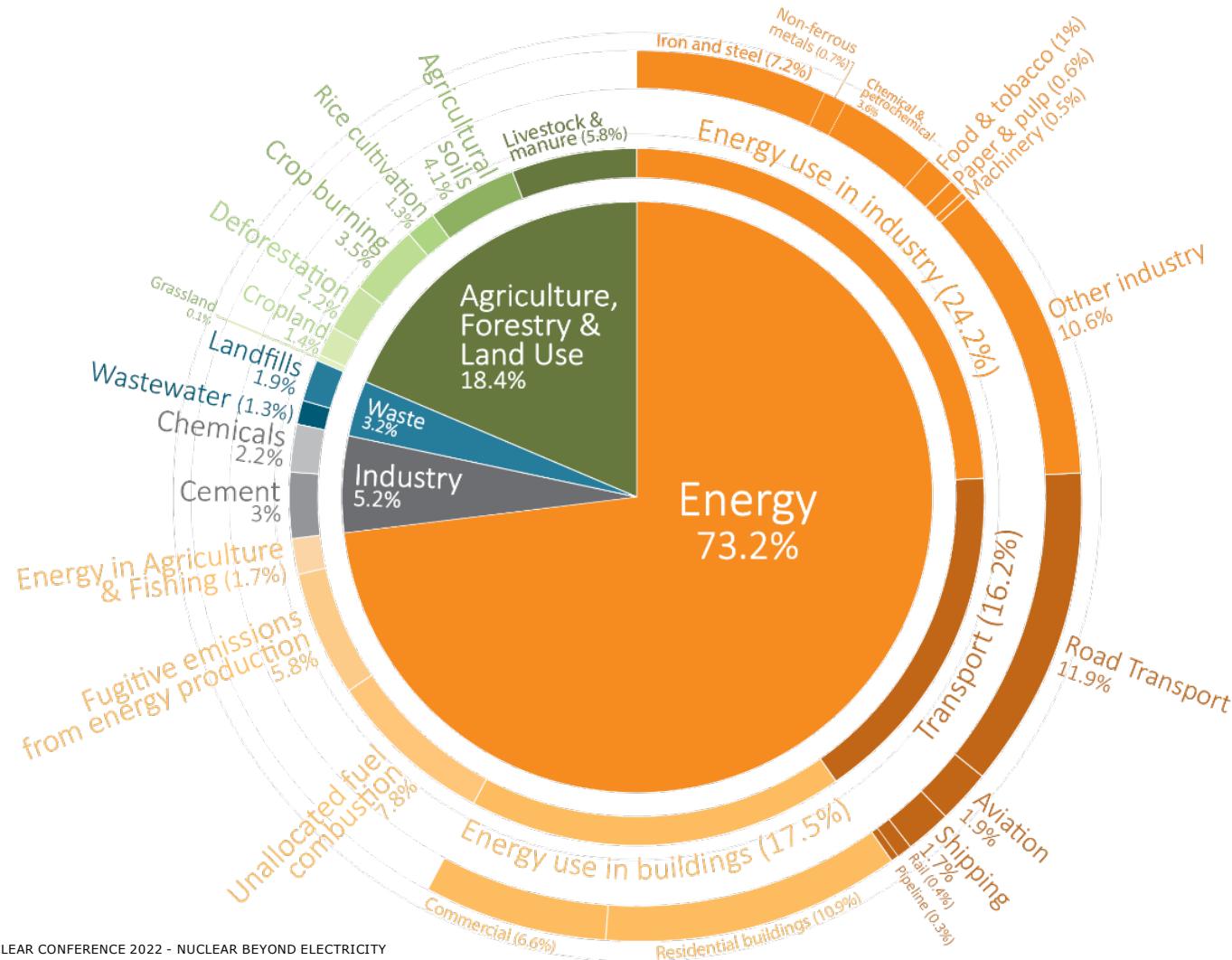
Pressing urgency of the climate challenge demands swift action



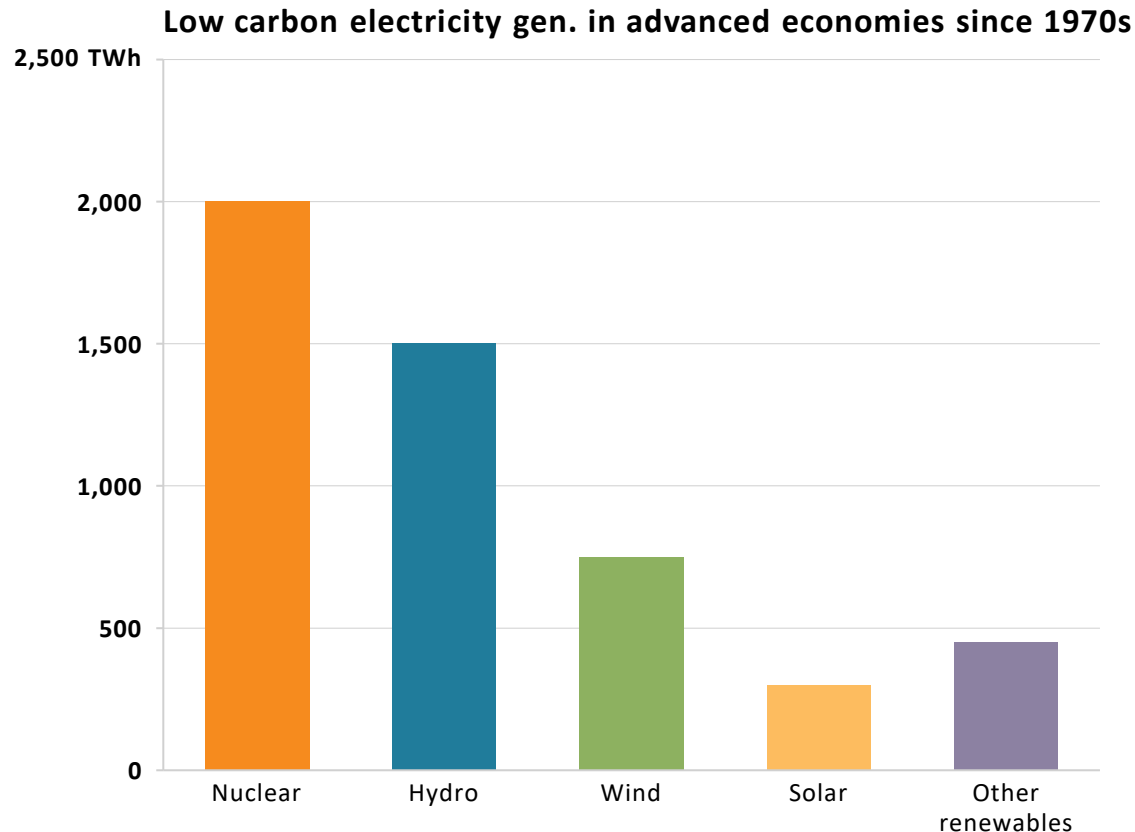
Energy is at the heart of the climate challenge (1/2)



Energy is at the heart of the climate challenge (2/2)



Nuclear already plays a significant role - in electricity



Nuclear...

... supplies 10% of electricity globally

... is the EU's main source of electricity, supplying $\frac{1}{4}$ of the EU's electricity, ...supplies $\frac{1}{5}$ of U.S. electricity

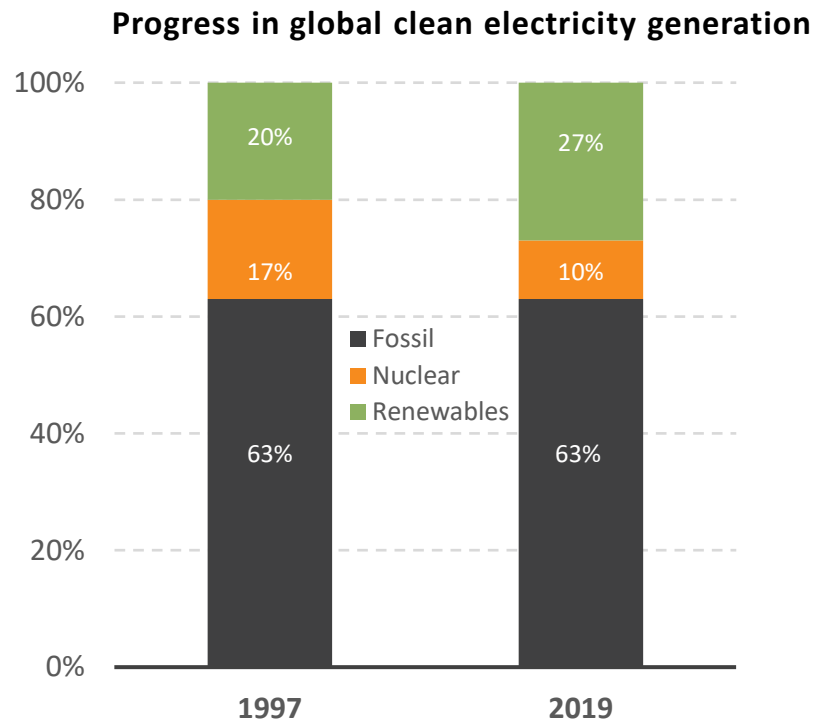
... is the second largest source of fossil free electricity, after hydro

... is the main source of fossil free in advanced economies, providing 40% of fossil free electricity in advanced economies overall and approximately half of fossil free electricity in the EU and the USA.

... together with hydro has supplied 90 % of all fossil free electricity in advanced economies since the 1970s

All from approximately 440 nuclear reactors.

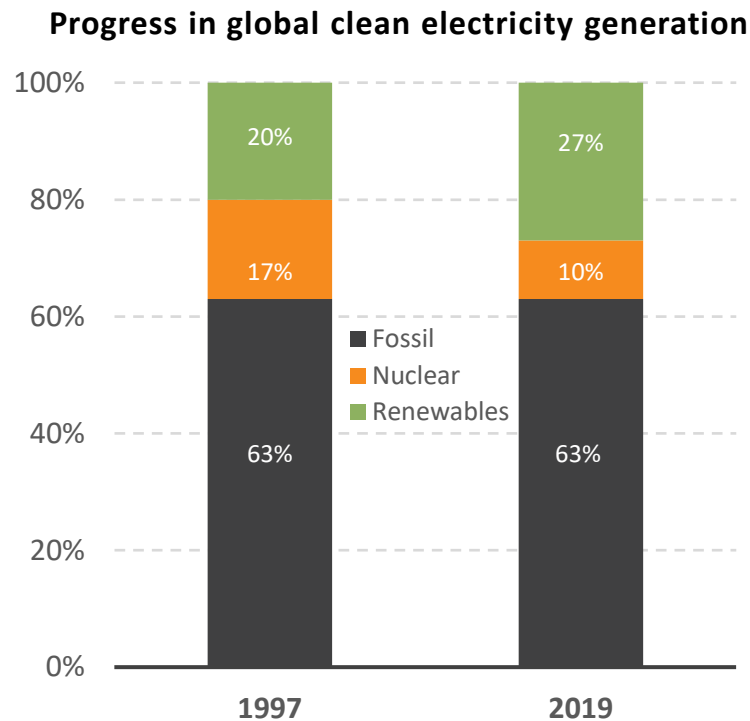
Clean electricity generation must increase, dramatically



Since 1997...

- ... global electricity demand has more than doubled
- ... global energy demand has increased more than 50%

Clean electricity generation must increase, dramatically (also in the Nordics)



Although electricity supply in the Nordics is on its way to become fossil free, vastly more clean electricity is needed.

Estimated 310 TWh electricity demand in Sweden by 2045



+ 170 TWh
(200-250 TWh new production)

Estimated 135 TWh electricity demand in Finland by 2050



+50 TWh from today
(100 TWh new production)

Still not net-zero...

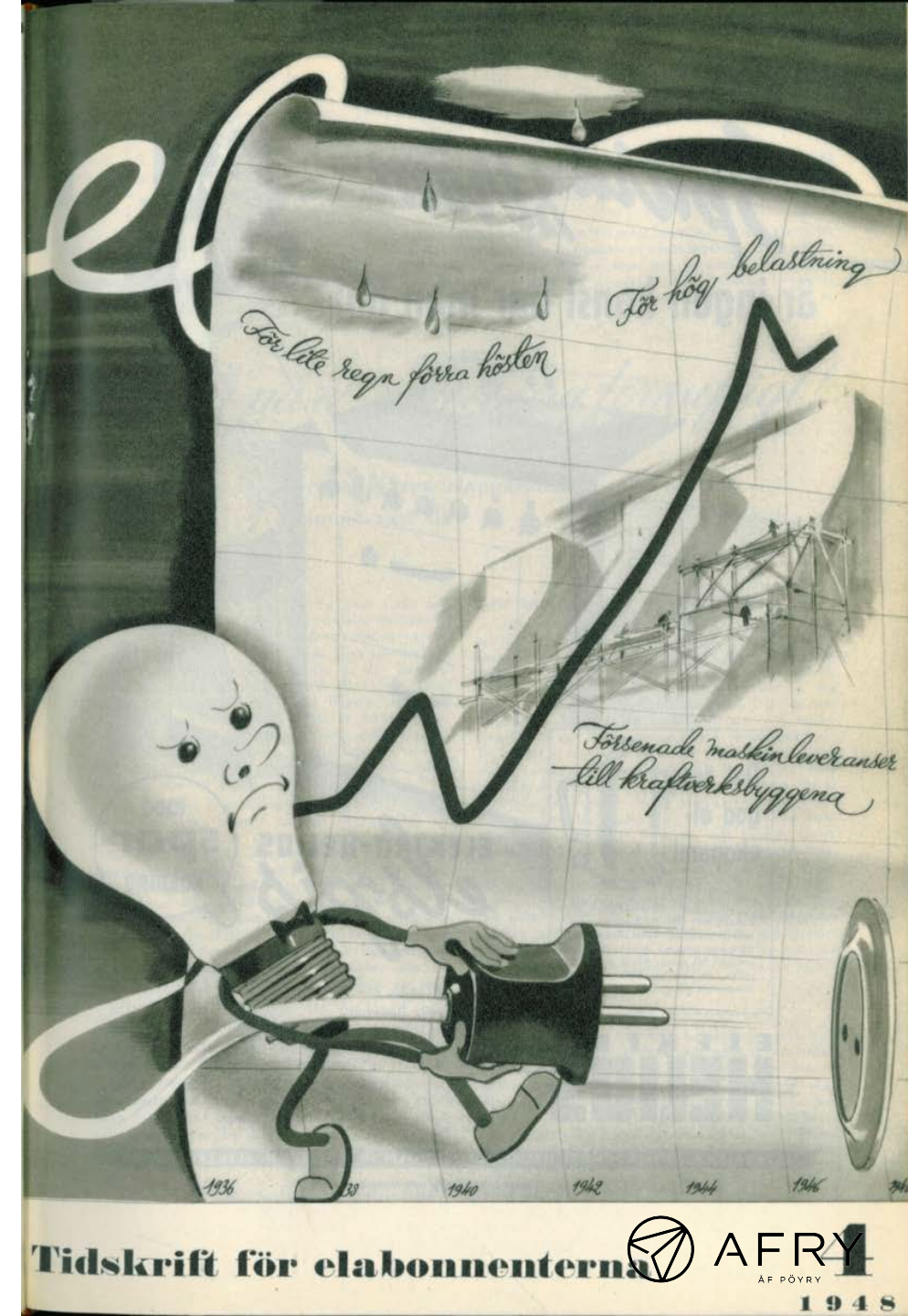
A (very) significant challenge...



Electricity rationing

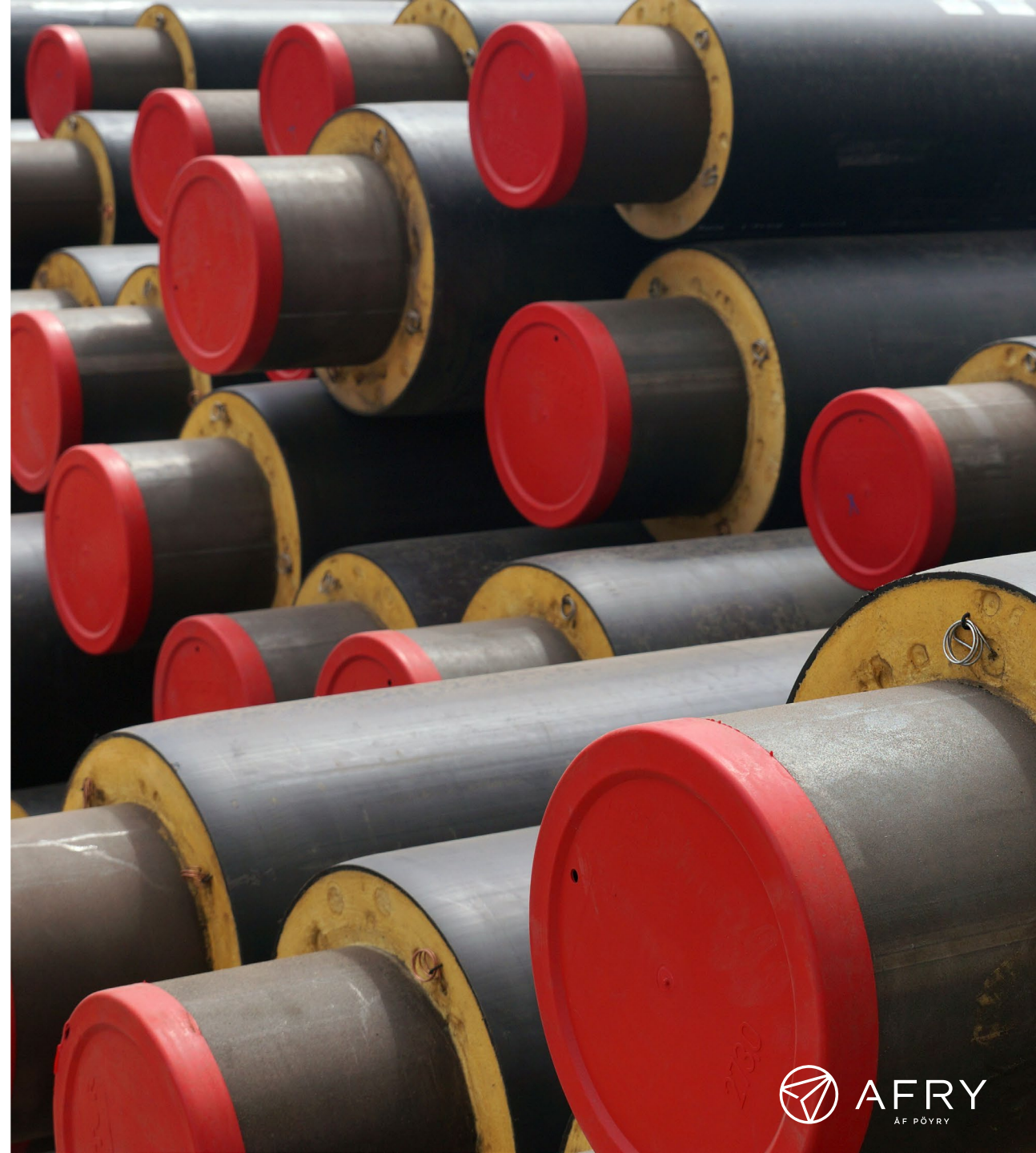
Three reasons, compounded by urbanisation:

- Demand growth
- Delays in construction of power stations and power lines
- 1947 was an exceptionally dry year



Insurance policy and diversification

District heating
(and nuclear)



A recurring problem

More drought in 1955/56

Suez crisis in 1956, fuel shortages for DH plants

Snow and rain eases the situation in 1959, enough to cover a year with exceptional drought.

Ten years later, the “unthinkable” happens – two drought years in a row – and rationing is introduced again



Nuclear Beyond Electricity

Electricity demand increasing rapidly

Sector coupling, new consumption patterns

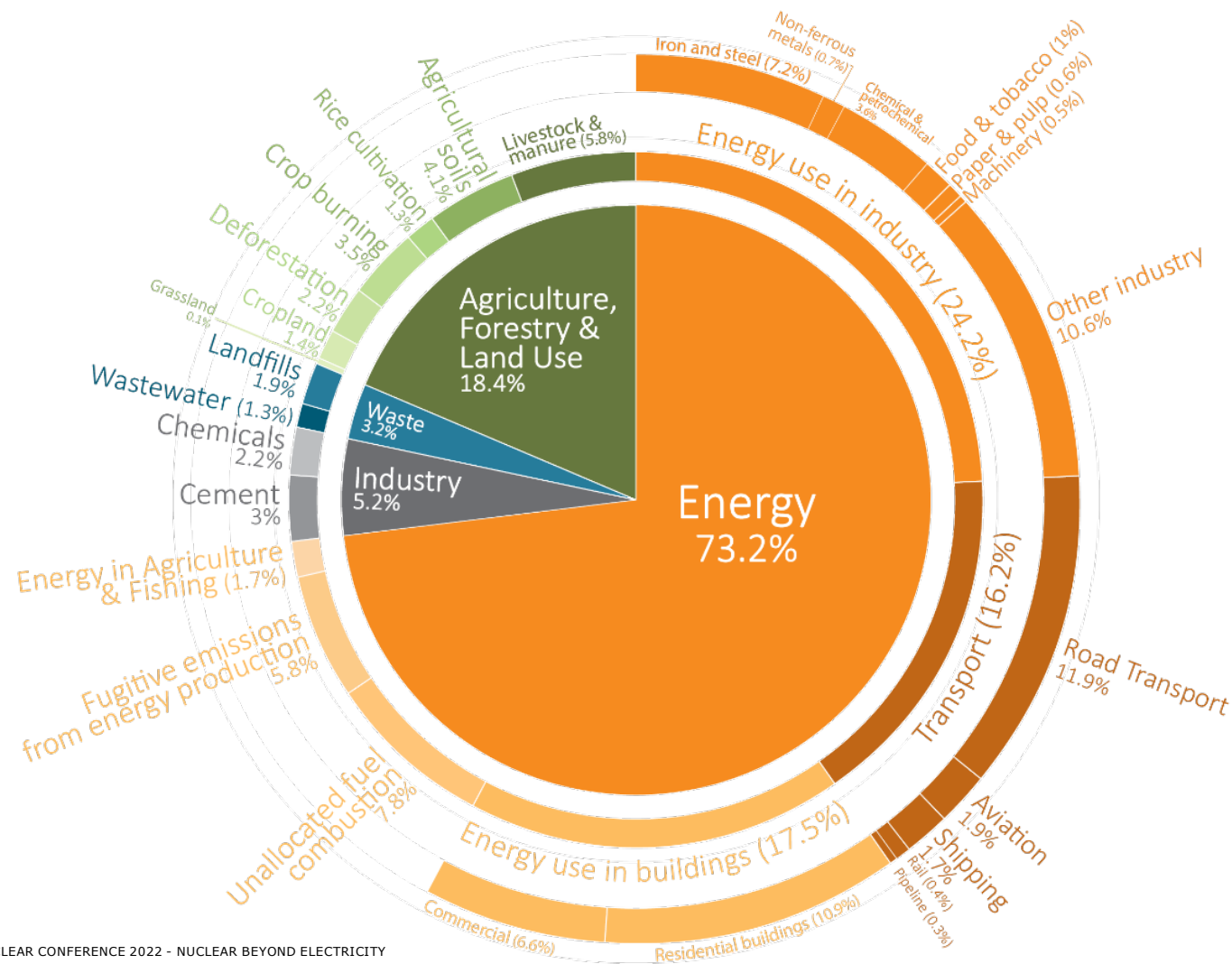
Possible shortages or situations with scarcity and conflicts of interests

Global markets

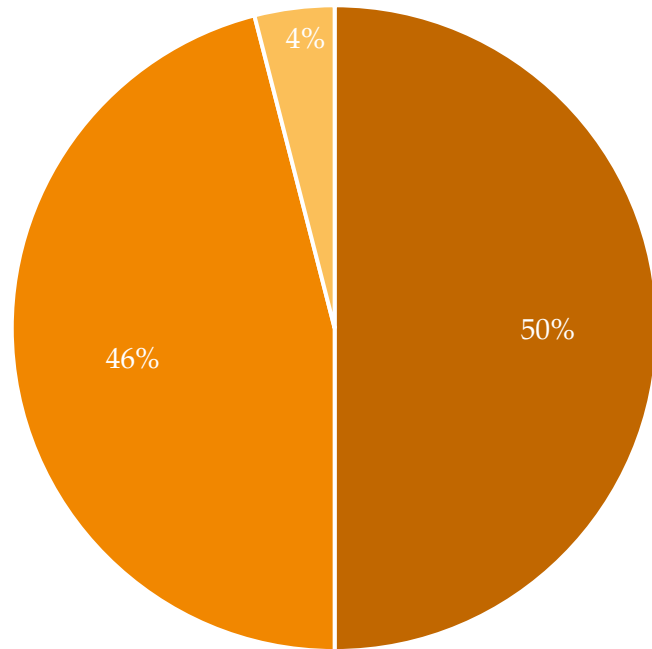
Other factors and uncertainties/dependencies (e.g. fuels, countries)



Energy is at the heart of the solution to the climate challenge



Heat is the largest energy end-use



- Industrial processes
- Space and water heating in buildings (incl. cooking)
- Agriculture

Energy is more than electricity



The share of electricity in total final energy consumption is only 20%



Heat is the largest energy end-use and contributes 40% of global carbon dioxide emissions

Nuclear Beyond Electricity

Background

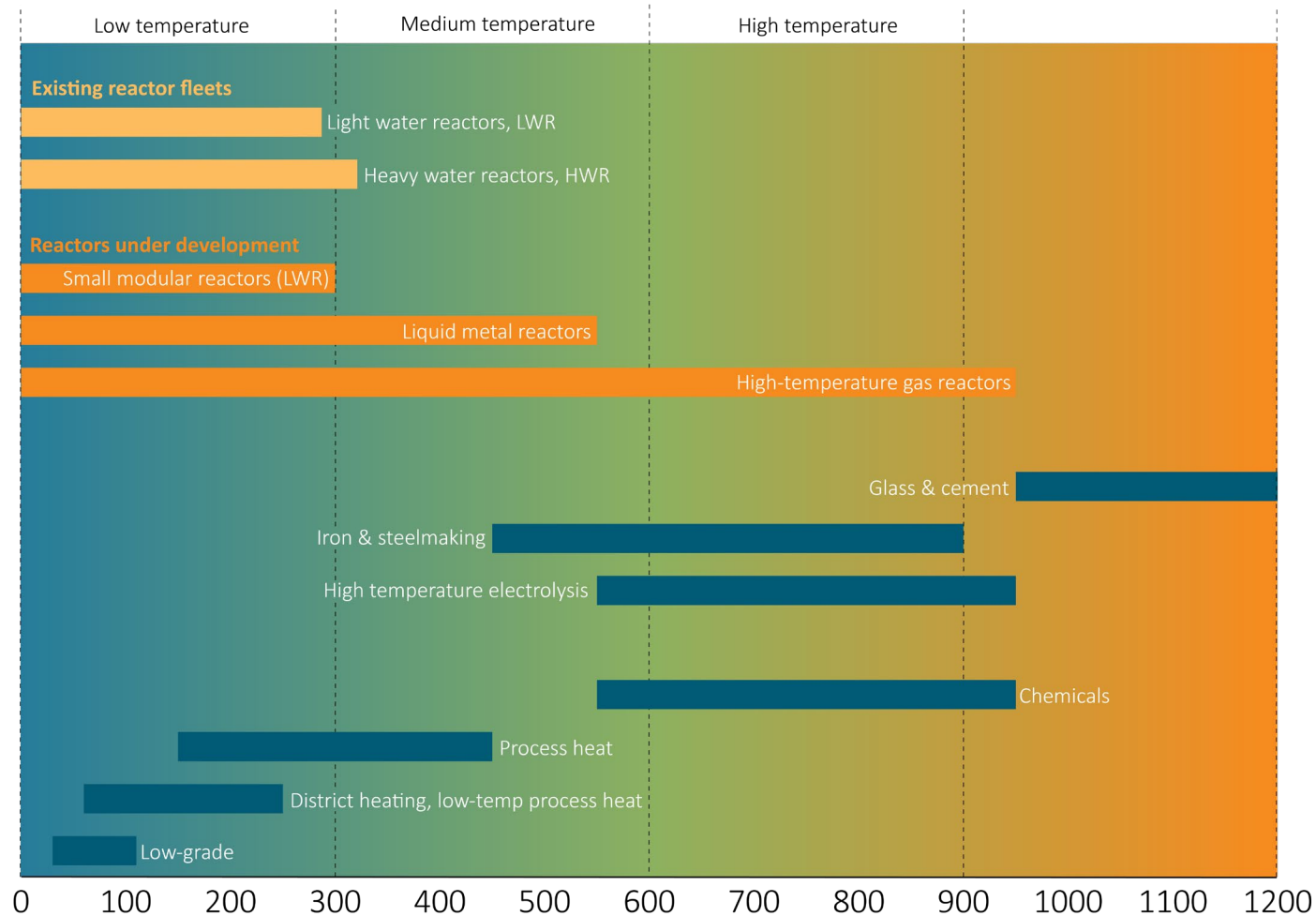
- Initiatives and activities
- Technology, nuclear heat
- Steam extraction
- Applications
 - District heating
 - Synthetic fuels
 - Desalination

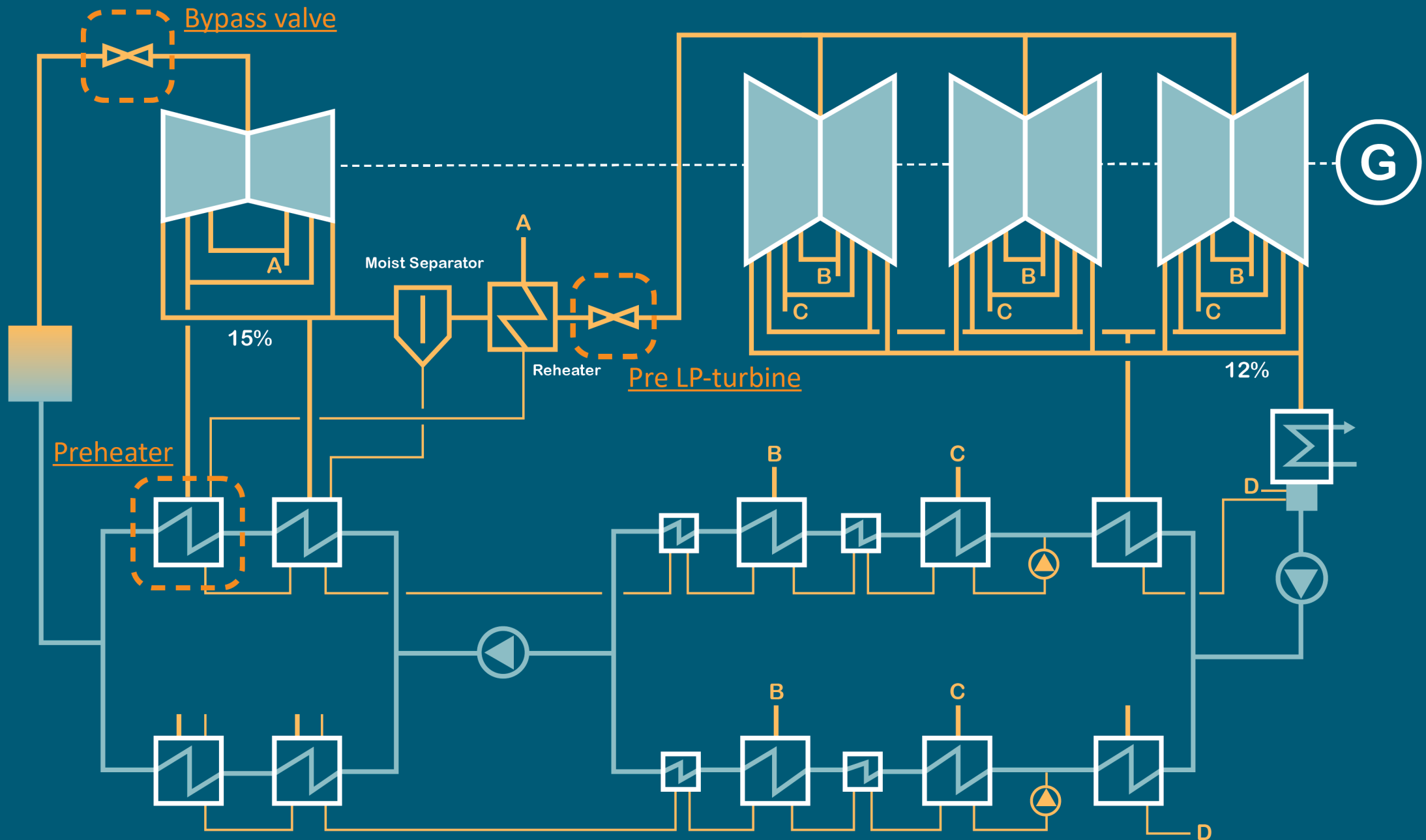
More detailed studies

- Direct air capture, DAC
- Hydrogen production
- Integration of SMRs in steel production
- Uses for existing nuclear power plants



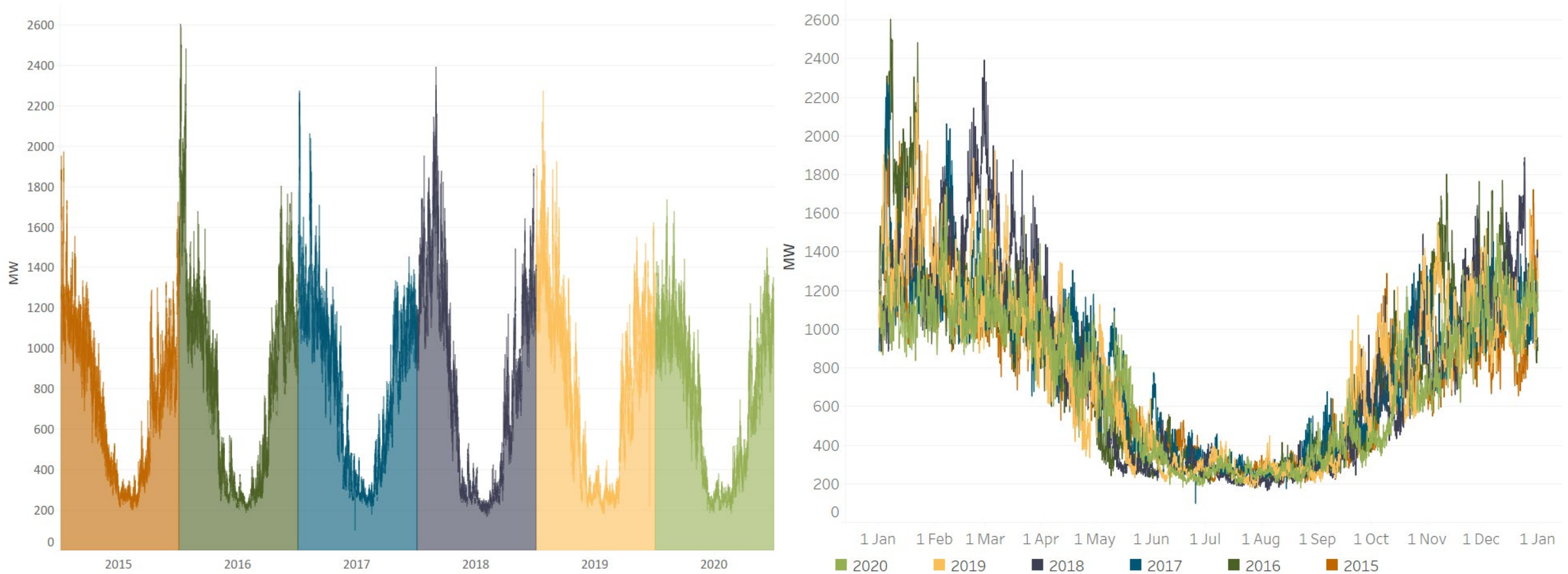
Reactors produce heat, and lots of it



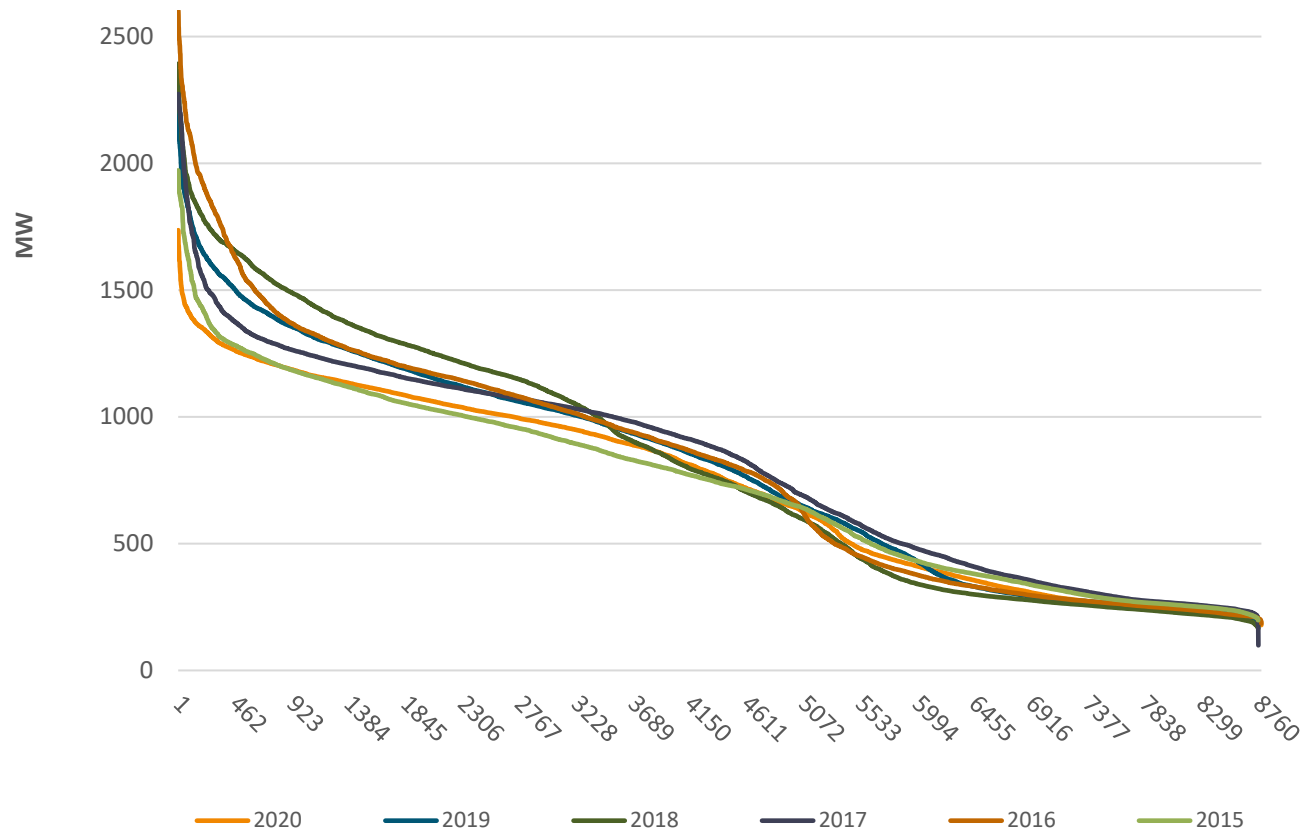




Stable supply trend, high annual variability

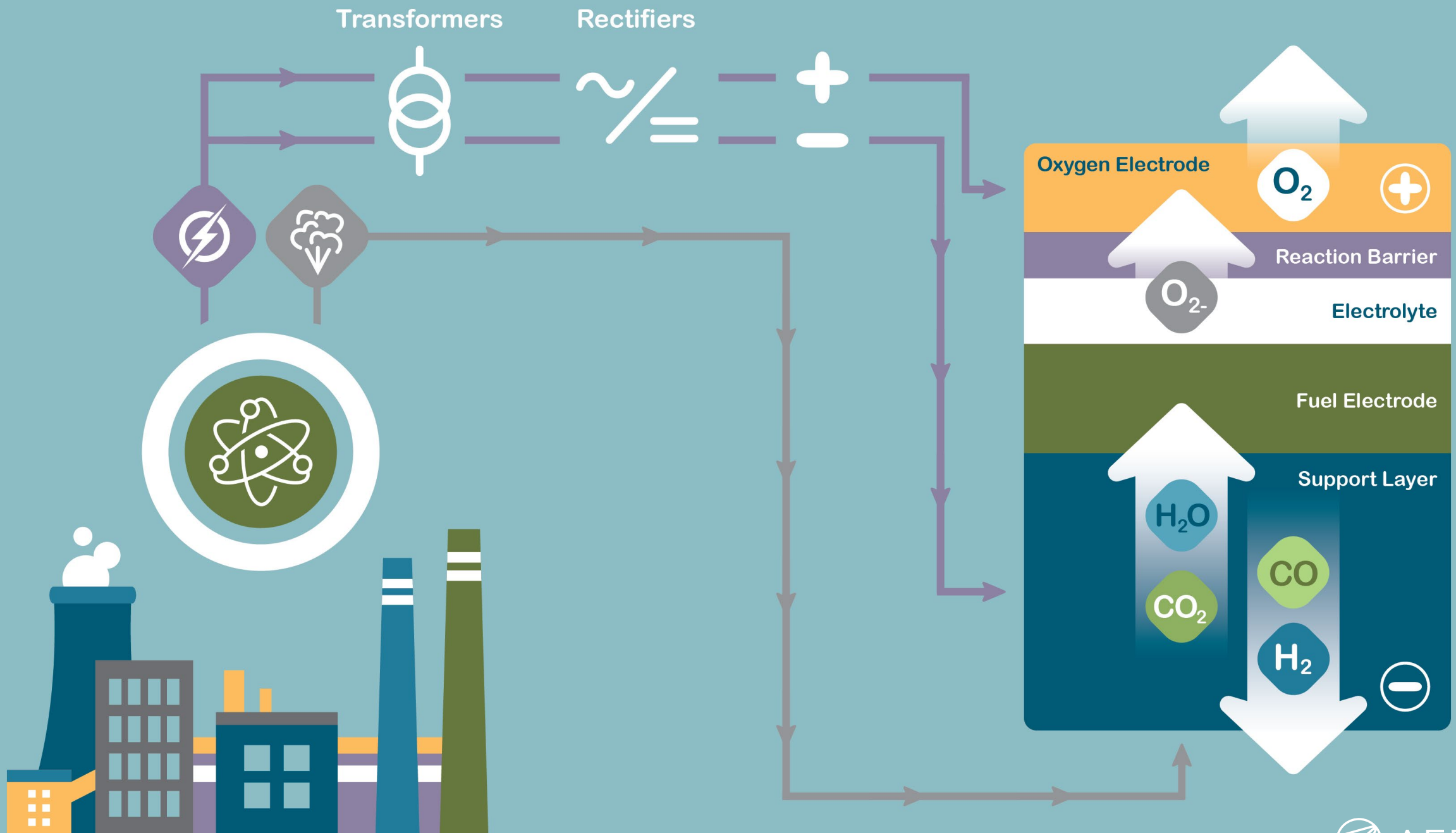


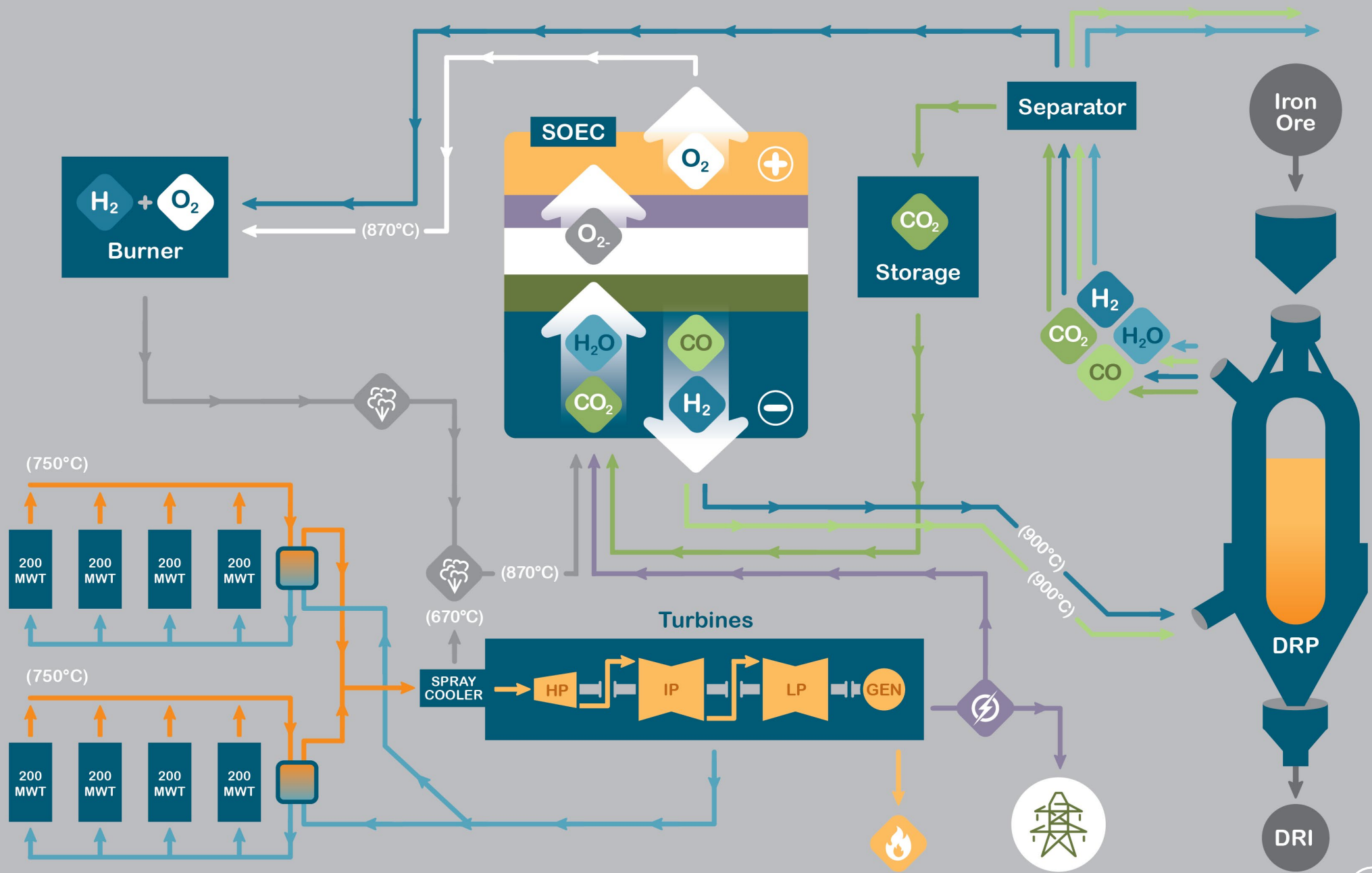
Winter demand 10x larger than summer

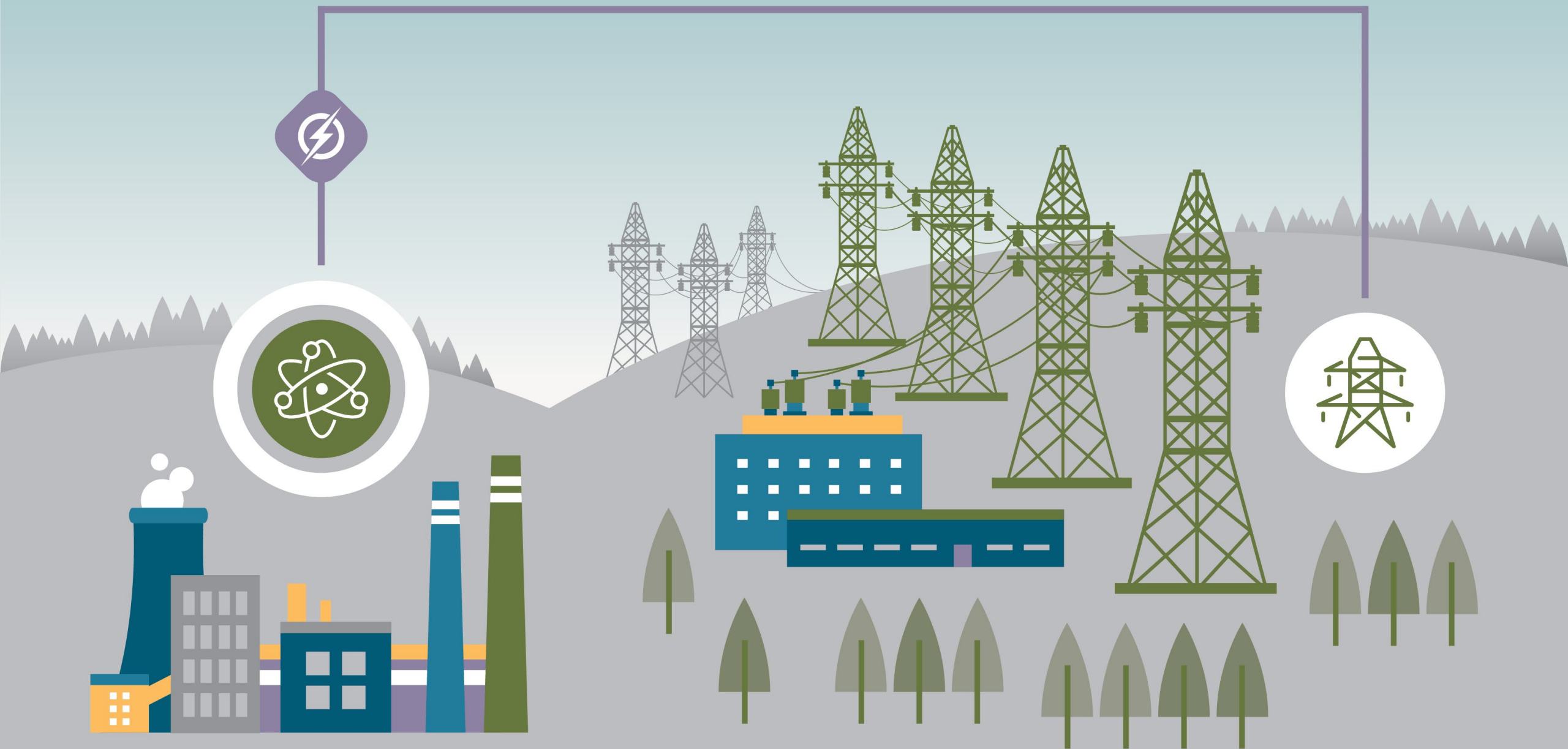


- Seasonal variability is a major problem but may be overcome with storage.
- Storage cost for heat approx. 1/100 of storage cost for electricity.
- Market dependent on number of grids with sufficient demand for required operation time. Only a few cities with enough demand.
- Estimates around 20 EUR/MWh for cogenerating SMRs and early estimates (targets) for pure DH-only reactors around 30 EUR/MWh.









Nuclear can play a significant role also in heat



PLANNED DEPLOYMENT OF SMRs

Several small modular reactors (SMRs), both conventional and advanced reactors, have planned deployment of FOAK units before or around 2030. Smaller reactors with higher temperatures are well suited for a range of industrial applications, both financially and technically.



DE-RISKING DECARBONISATION

Countries and companies face a serious challenge reducing emissions, and especially decarbonising heat. The scale and challenge is immense and for many industrial applications nuclear may be the only credible non-carbon option.

Nuclear energy can help de-risk the decarbonisation journey.



REALISING THE POTENTIAL OF NUCLEAR ENERGY

Nuclear can help ensure an orderly transition while maintaining security of supply, competitiveness and while delivering on environmental ambitions.

These are largely demonstrated technologies, which exist as pilot projects and full scale commercial projects since several decades. With the right environment to enable deployment, e.g. through international cooperation and harmonisation, the potential of nuclear heat can be realised at scale.

Making Future