Nordic Energy Technology Perspectives

Catalysing Energy Technology Transformations

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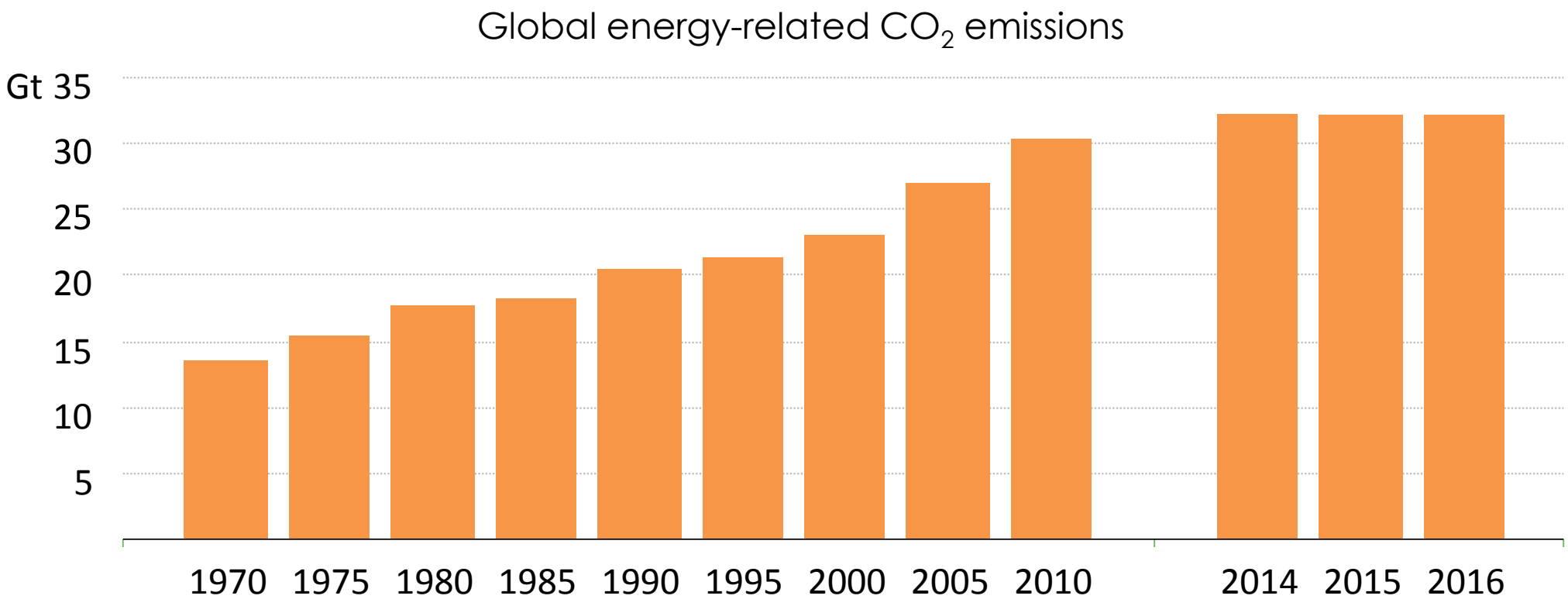
IEA

Key points of orientation

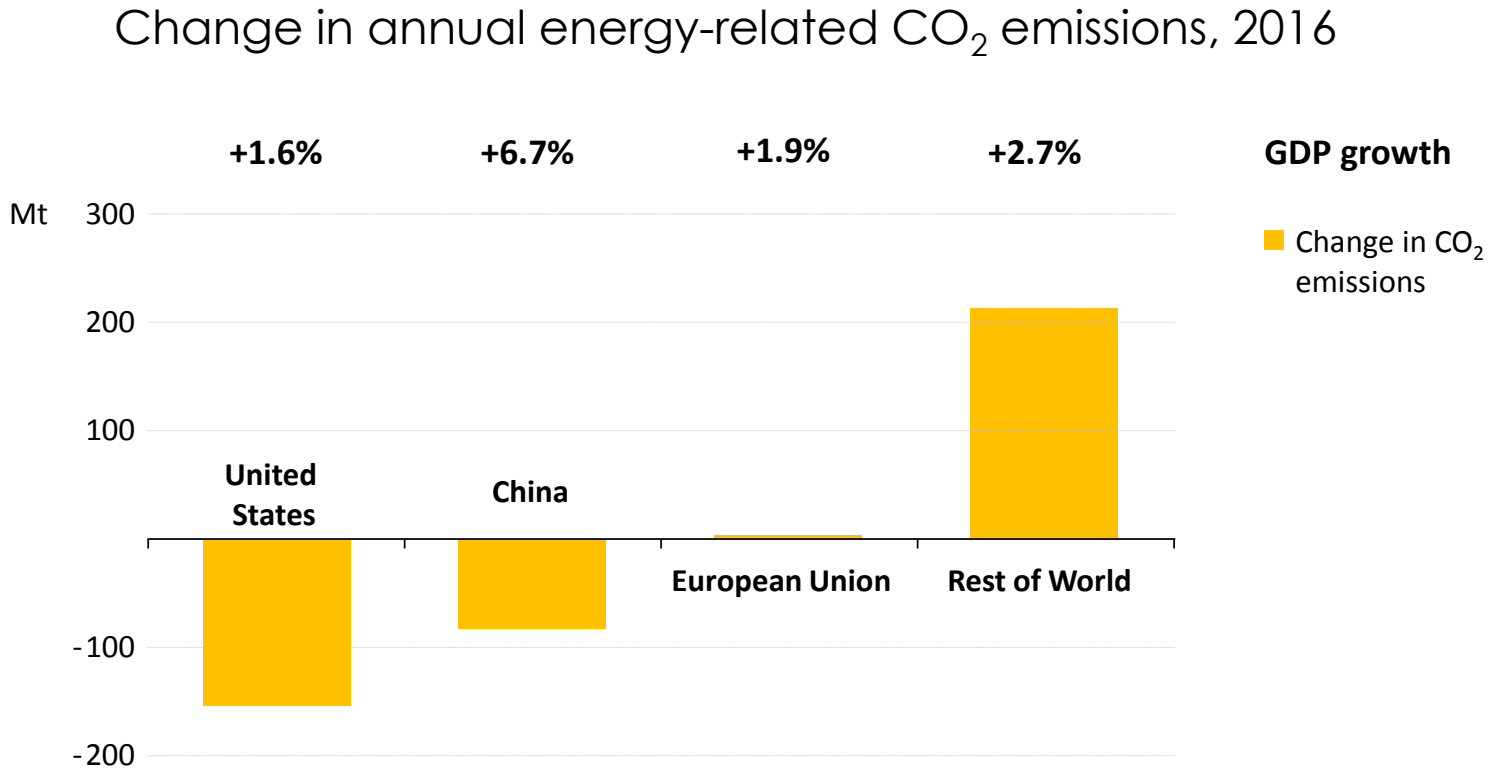
- Global energy markets are changing rapidly
  - *Renewables supplied half of global electricity demand growth in 2016, and increase in nuclear capacity reached highest level since 1993*
  - *Global energy intensity improved by 2.1% in 2016*
  - *Electric car sales were up 40% in 2016, a new record year*
- The energy sector remains key to sustainable economic growth
  - *1.2B people lack access to electricity; 2.7B people lack access to clean cooking*
  - *Largest source of GHG emissions today, around two-thirds of global total*
  - *Largest source of air pollution, linked to 6.5 million premature deaths per year*
- There is no single story about the future of global energy
  - *Fast-paced technological progress and changing energy business models*

Global CO_2 emissions flat for 3 years – an emerging trend?



IEA analysis shows that global CO_2 emissions remained flat in 2016 for the third year in a row, even though the global economy grew, led by emission declines in the US and China.

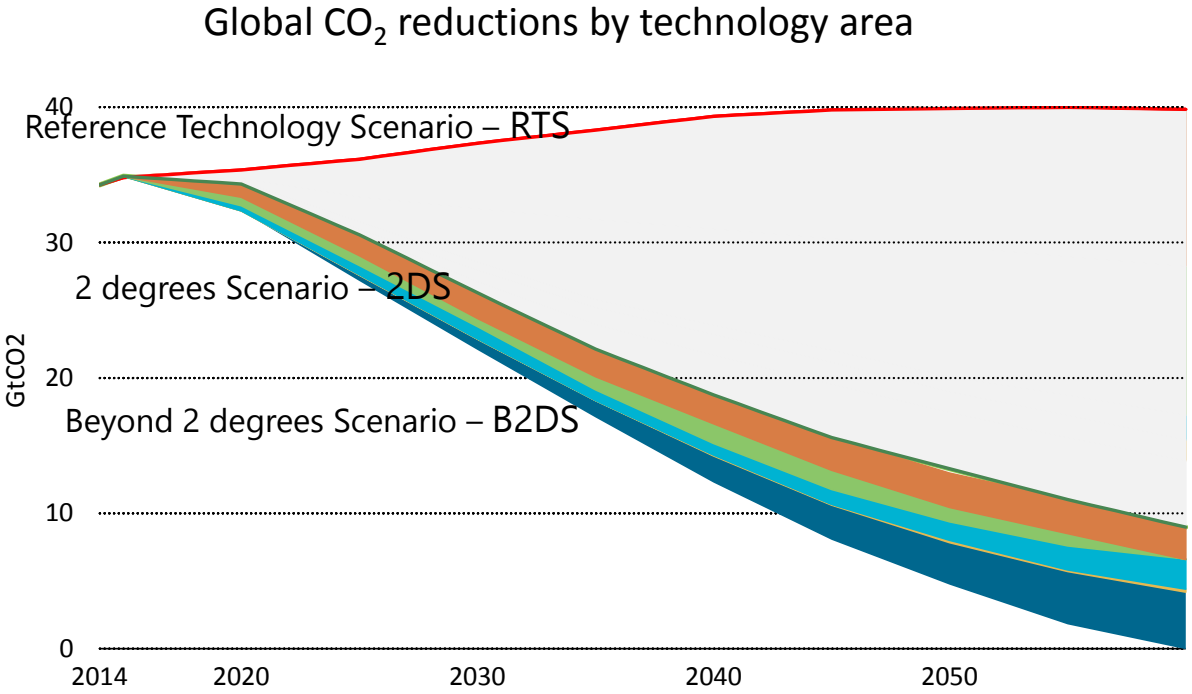
Global emissions stagnate, but there are regional variations

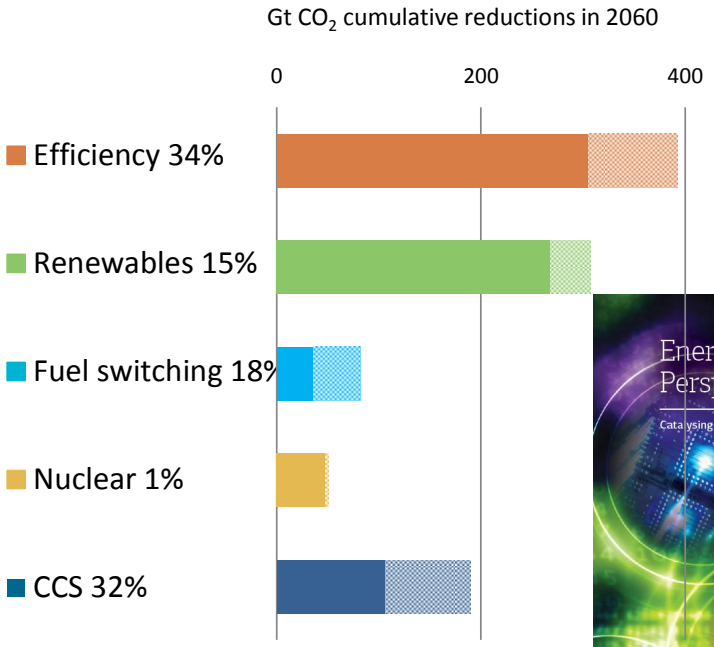


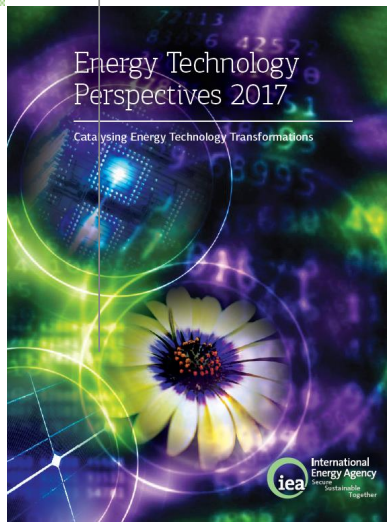
CO2 emissions declined in the US & China and stalled in the EU, offsetting an increase in most of the rest of the world.

How far can technology take us?

Technology area contribution to global cumulative CO_2 reductions

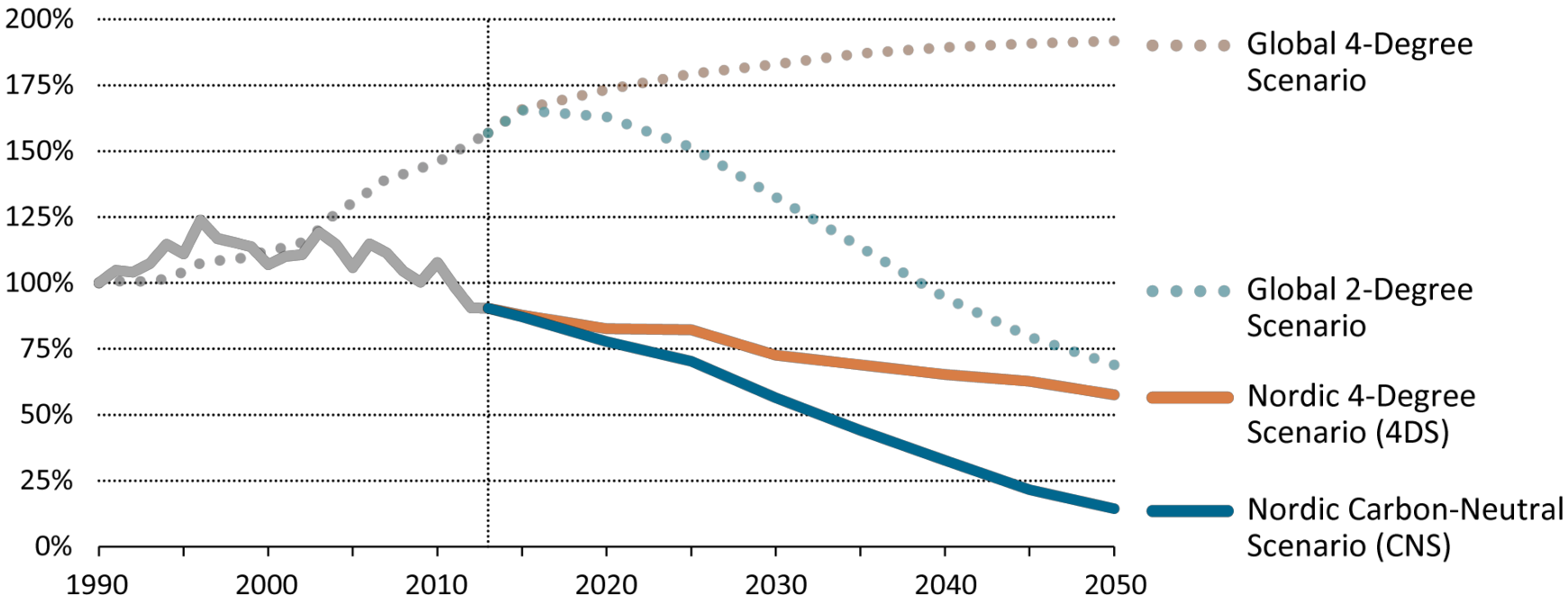






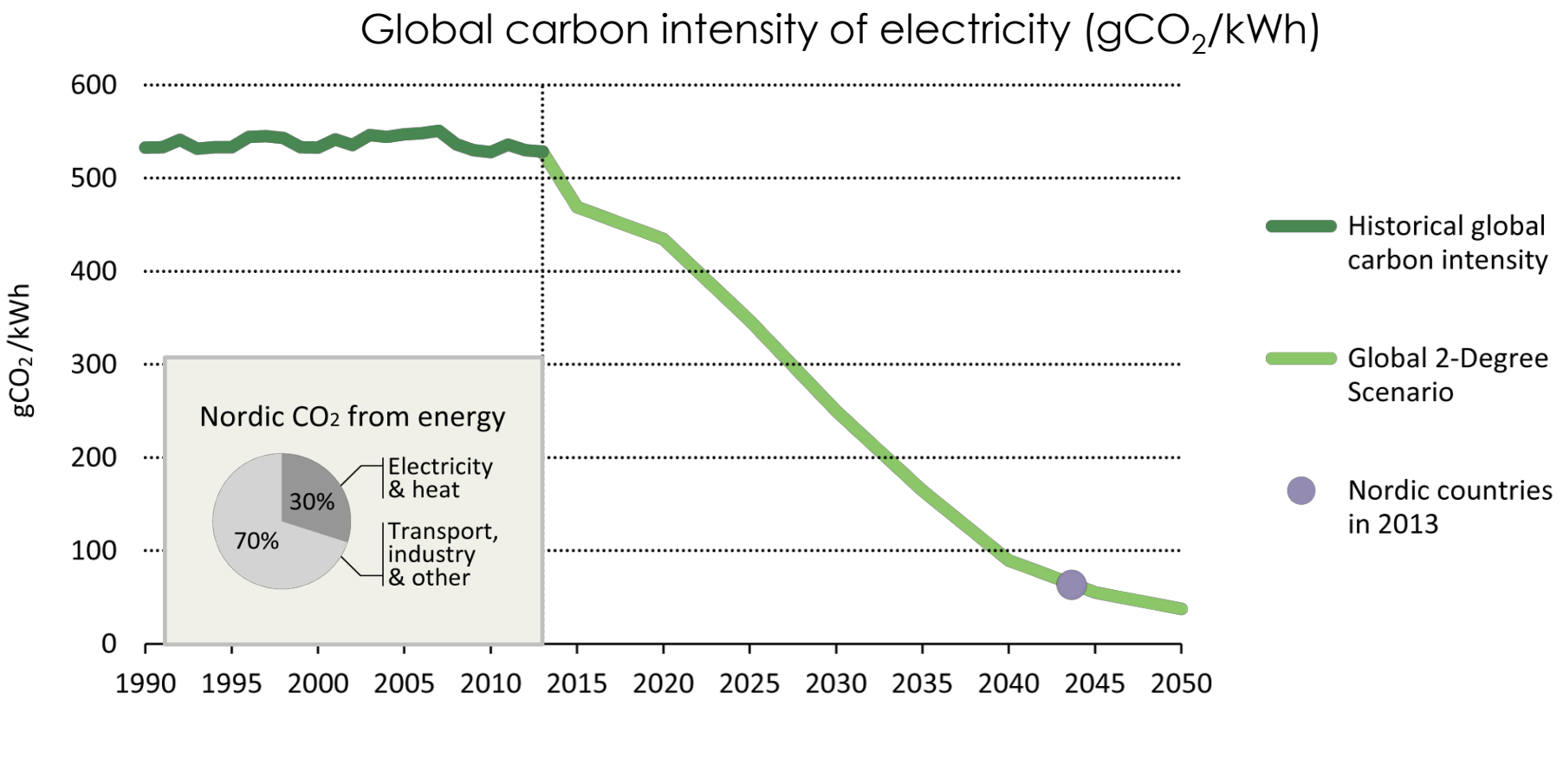
Pushing energy technology to achieve carbon neutrality by 2060 could meet the mid-point of the range of ambitions expressed in Paris.

Global and Nordic scenarios in CO2 emissions



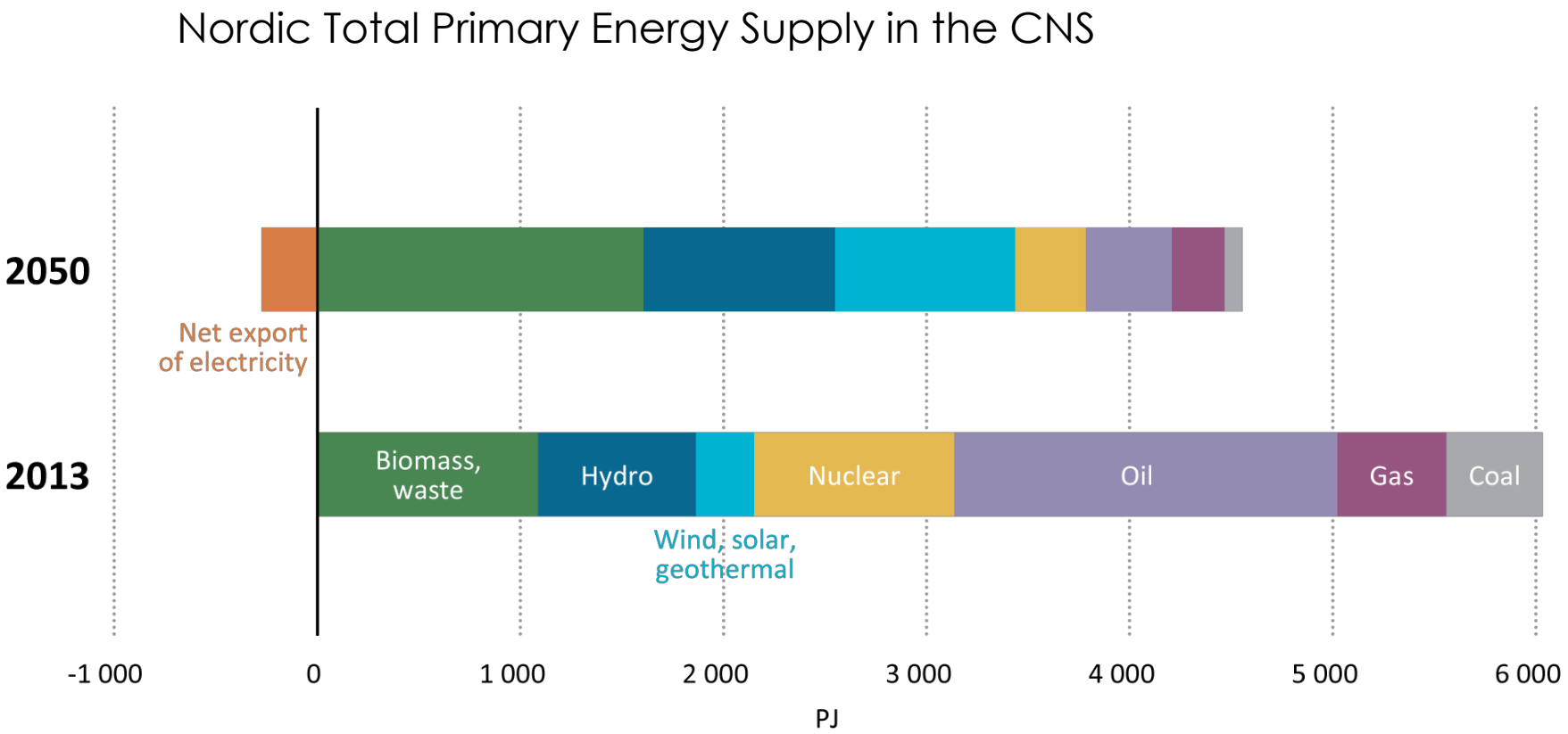
In the Carbon-Neutral Scenario (CNS), Nordic CO2 emissions drop by 85% in 2050 compared with 1990 levels

30 years ahead on electricity decarbonisation



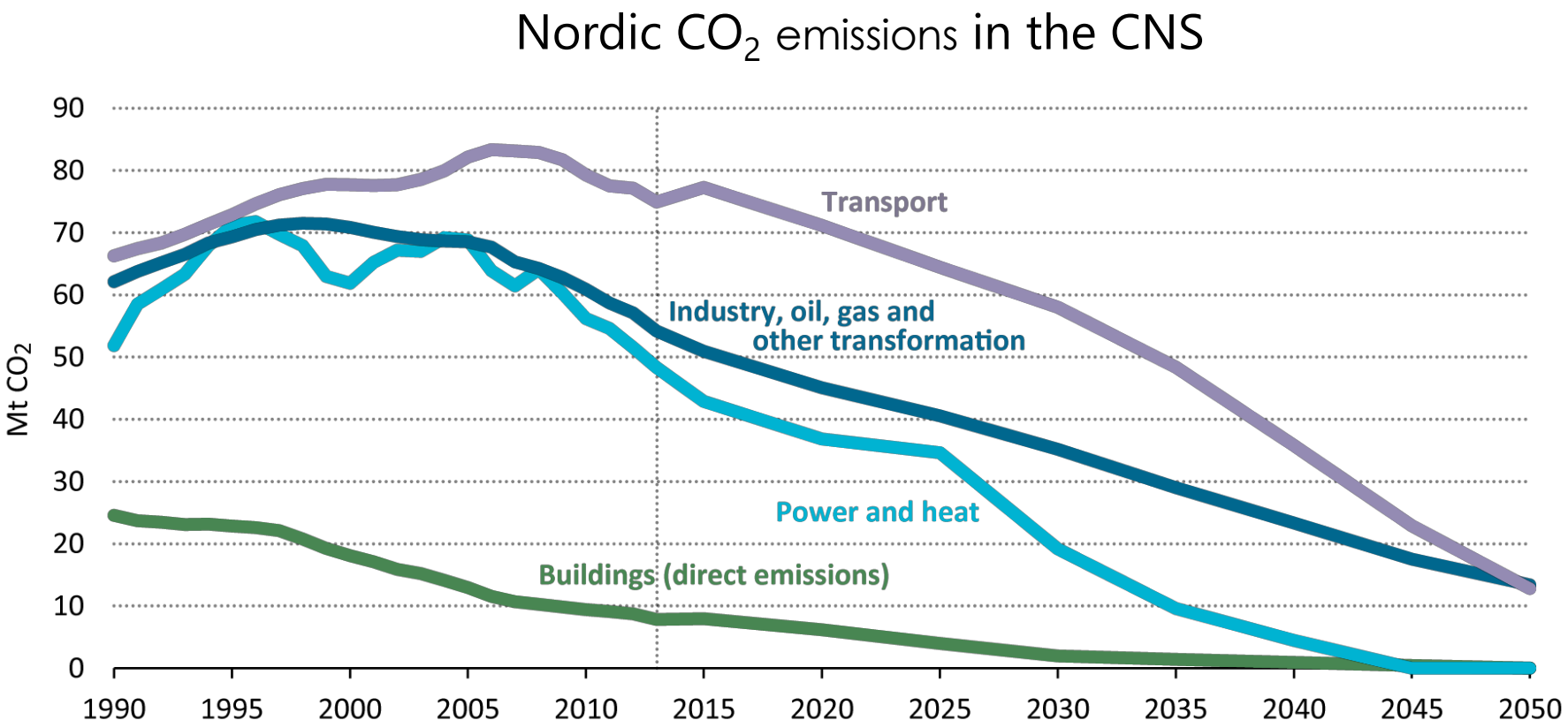
The Nordic carbon intensity of electricity supply of 59 g/kWh in 2013 was where it will be in 2045 in the global 2DS scenario.

Transforming the energy system



The CNS requires a dramatic change in the composition of primary energy supply, coupled with aggressive energy efficiency policies that substantially reduce demand

Demand sectors are the most challenging



Emissions have already been decoupled from Nordic GDP across all sectors, but this must accelerate in order to achieve the CNS, most notably in transport and industry.

Three strategic actions

1. Incentivise and plan for a more distributed, interconnected and flexible energy system

2. Tap into the positive momentum of cities in transport and buildings

3. Ramp up decarbonisation of long-distance transport and the industrial sector

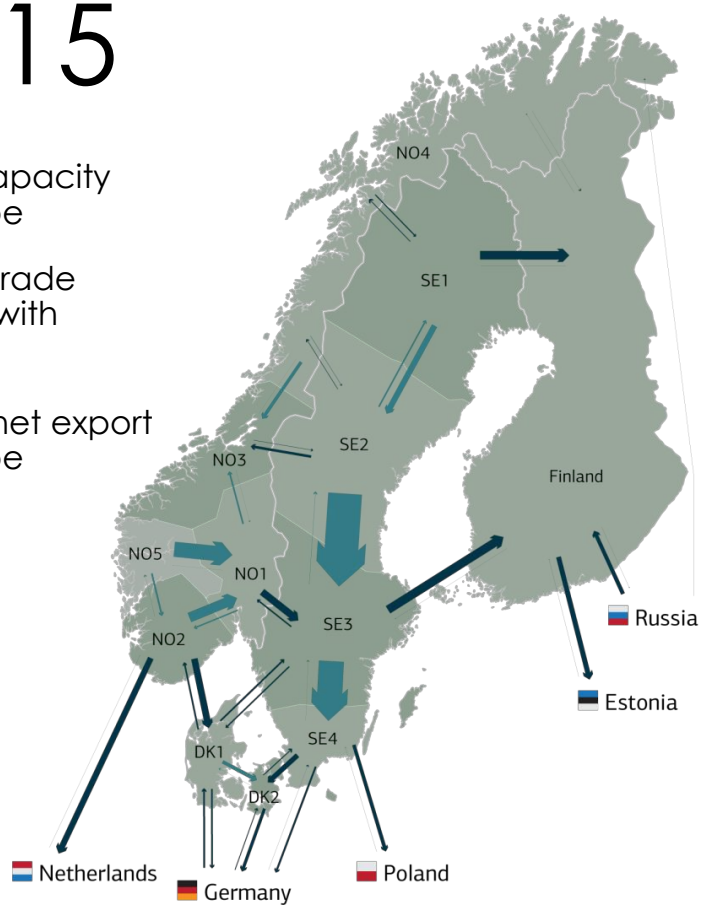
Electricity trade

2015

5 GW capacity to Europe

28 TWh trade activity with Europe

14 TWh net export to Europe

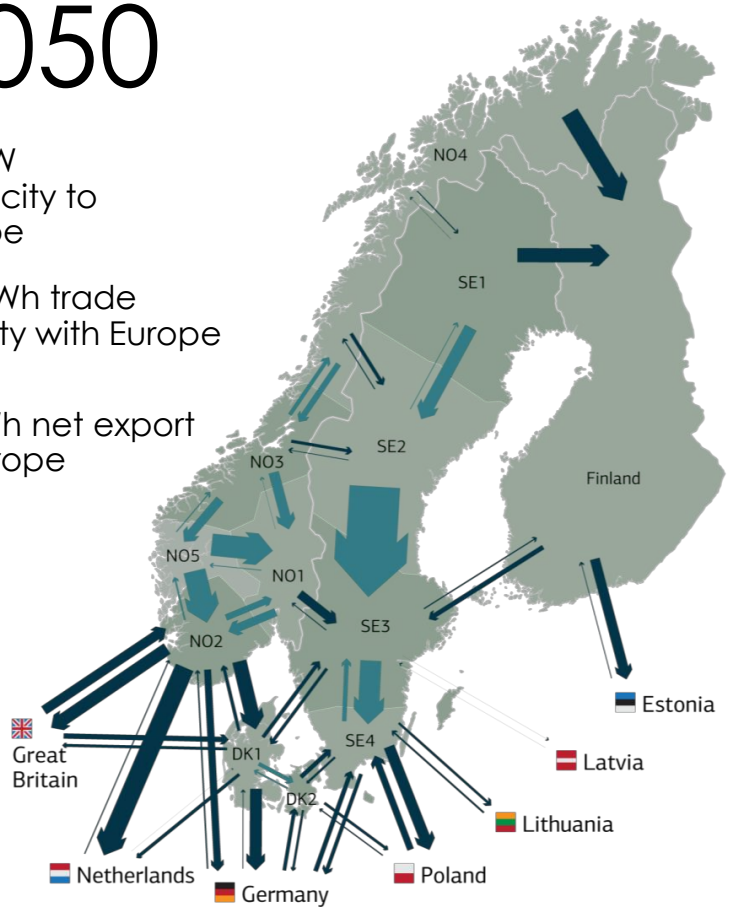


2050

23 GW capacity to Europe

125 TWh trade activity with Europe

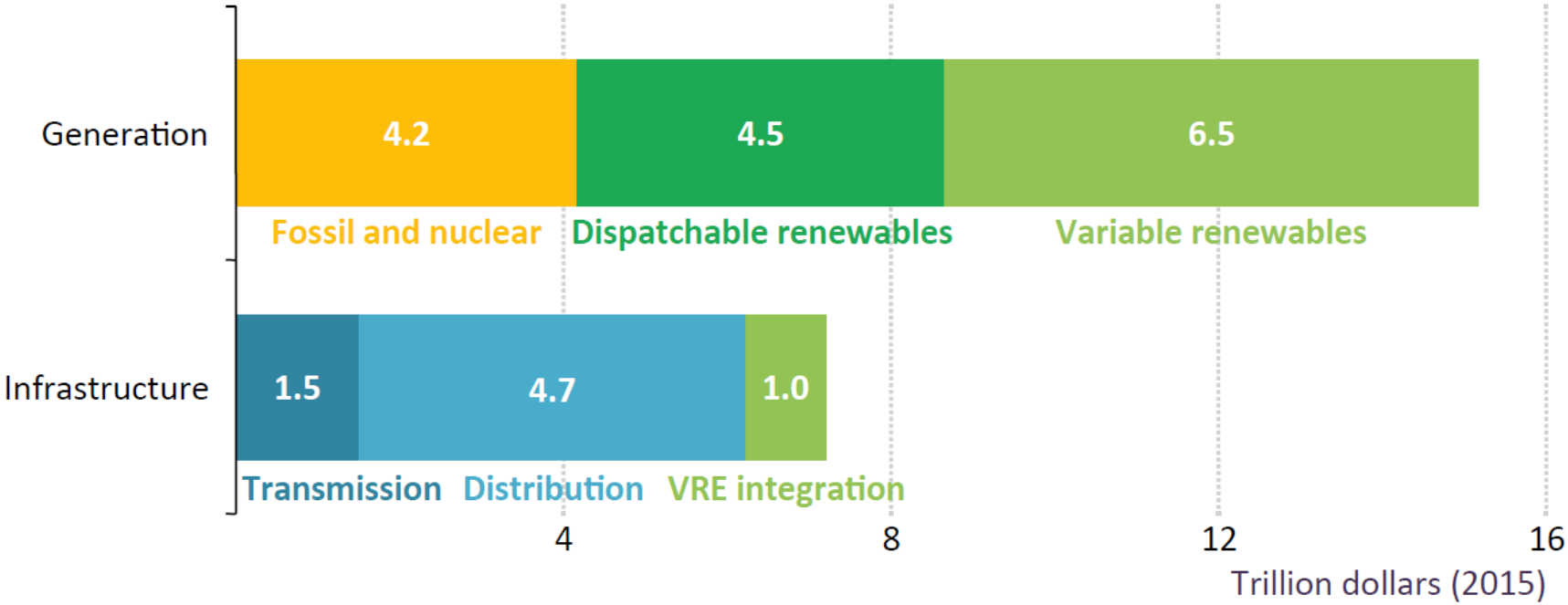
53 TWh net export to Europe

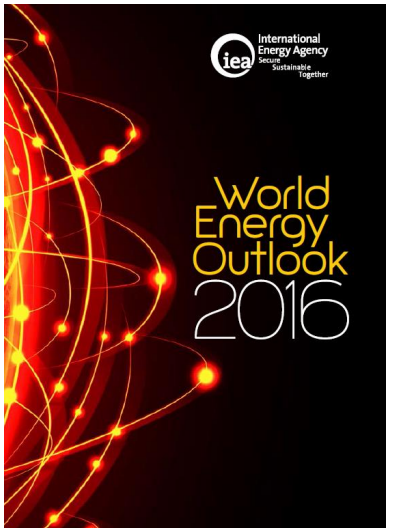


Expansion of variable renewables and interconnector capacity could lead to net Nordic exports of over 50 TWh in 2050.

Investment in electricity grids needs to accelerate

Total global power generation and T&D investment in the 450 Scenario 2016-2040





Investments in transmission and distribution grids for integrating VRE are a small portion of the total investments in the power sector

Urban opportunities: Space heating in buildings

Space heating energy intensity in Nordic buildings

126

kWh/m^2 in 2013

0.8%

annual improvement, 1990-2013

60

kWh/m^2 in 2050

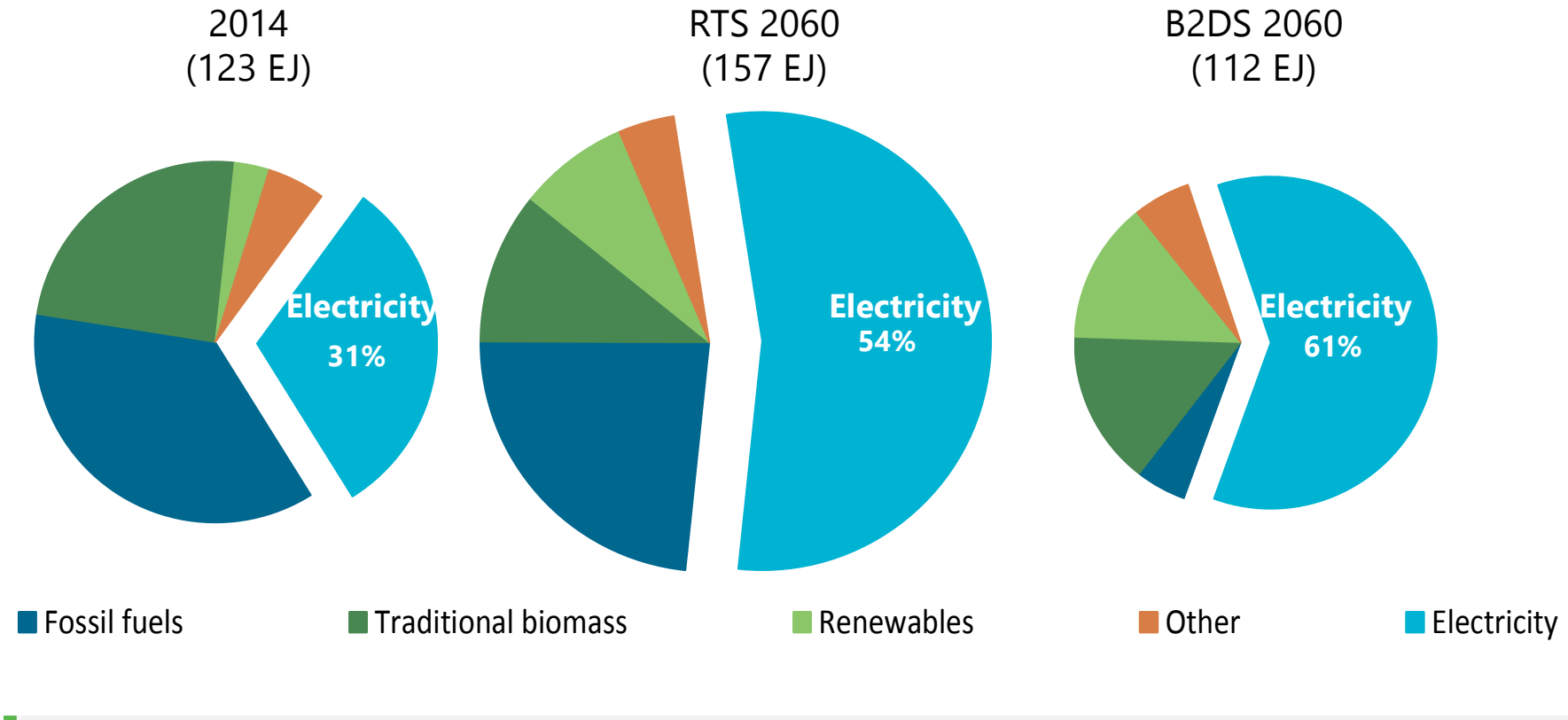
2.2%

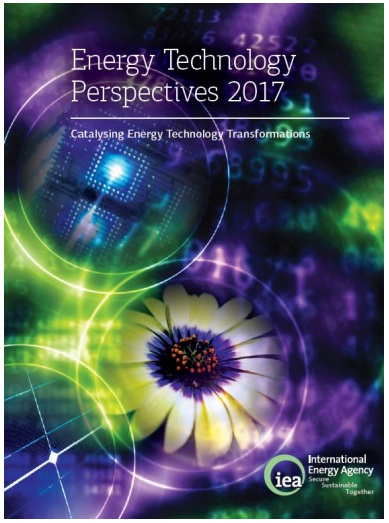
annual improvement, 2013-2050

Nordic building energy demand is reduced by 27% under the CNS, compared with 2013, and average space heating energy intensities are improved by 55%

Enhanced buildings efficiency could also improve system flexibility

Energy use in the buildings sector under different scenarios

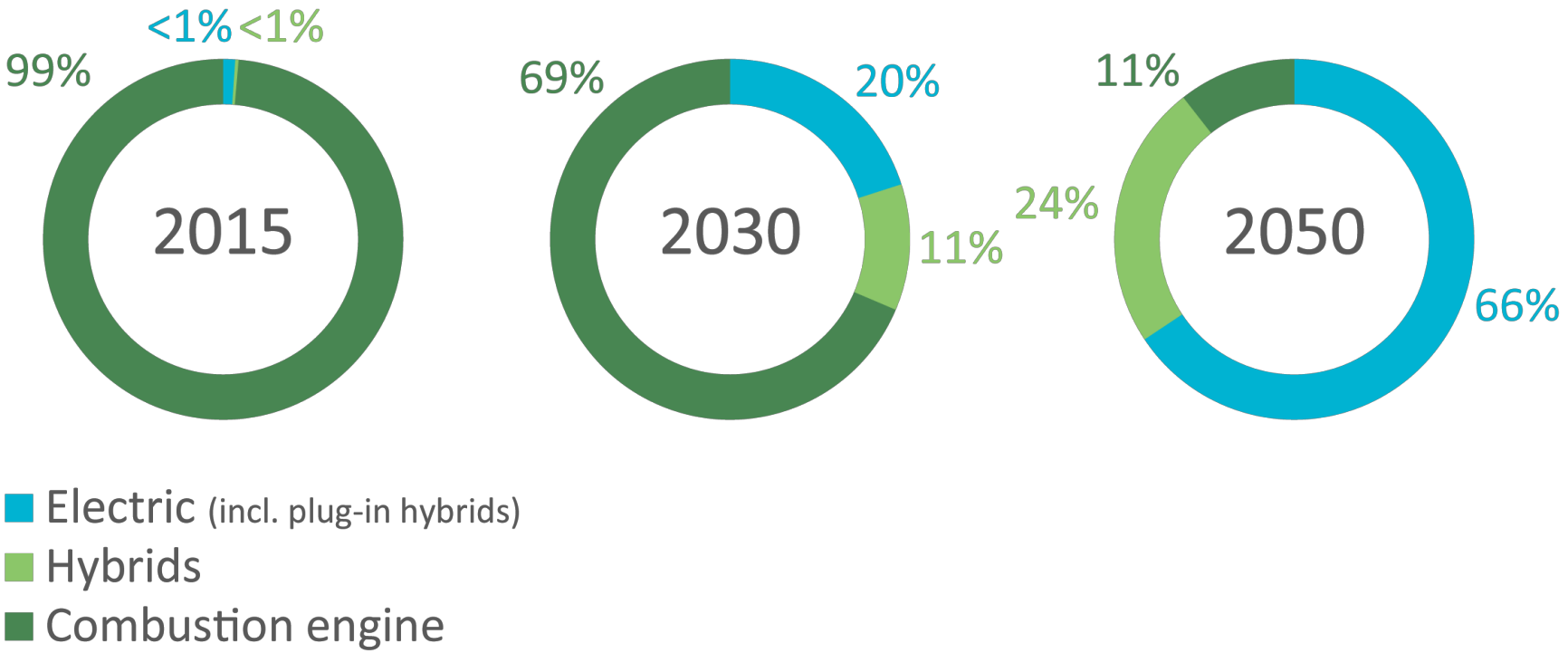




Efficiency technologies can provide the same level of comfort while reducing energy demand despite doubling floor area.

Urban opportunities: Rapid electrification of transport

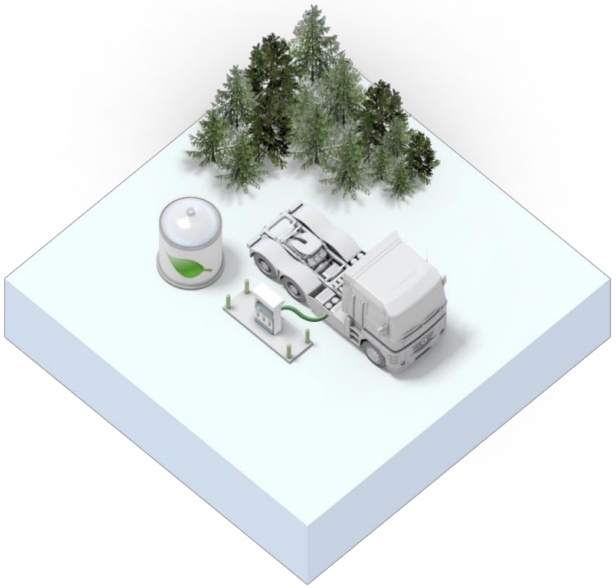
Nordic stock of cars and light commercial vehicles in the CNS

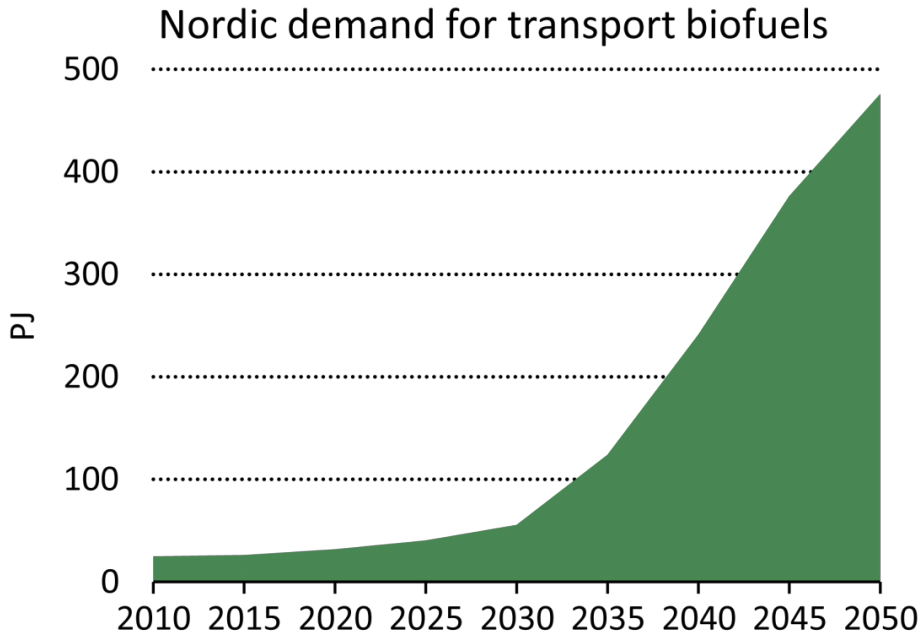


The CNS requires an almost complete phase-out of fossil-fuelled cars and a rapid roll-out of EVs, especially in urban areas.

Long-distance transport has less options

15% import dependency for biomass in 2050, up from 8% in 2013

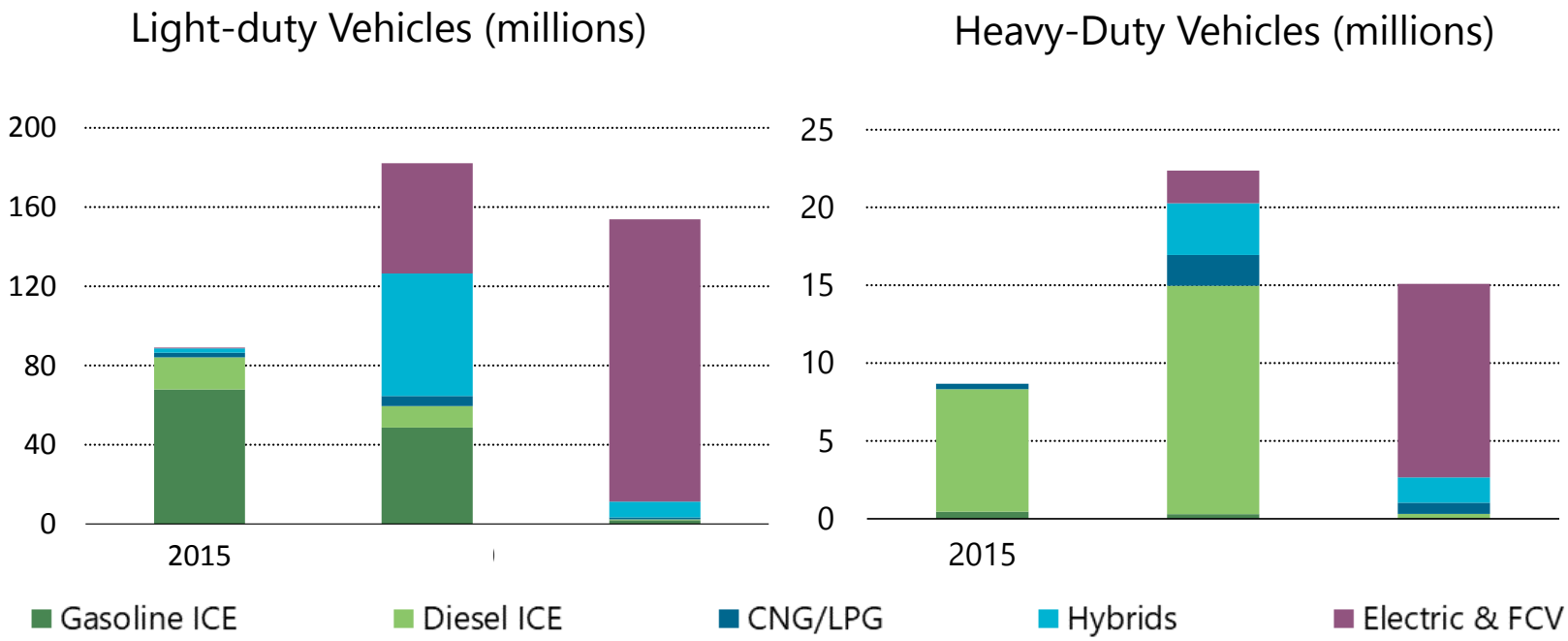


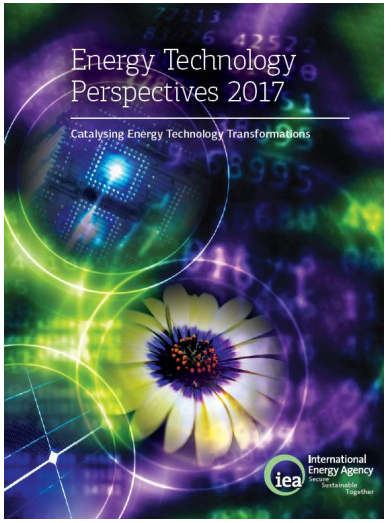


Biofuels comprise nearly two-thirds of total final energy use in transport in 2050, and will need well-functioning international markets, sustainable production and distribution, and politically acceptable trade partners.

Can we change the landscape of transport ?

Vehicle sales and technology shares under different scenarios



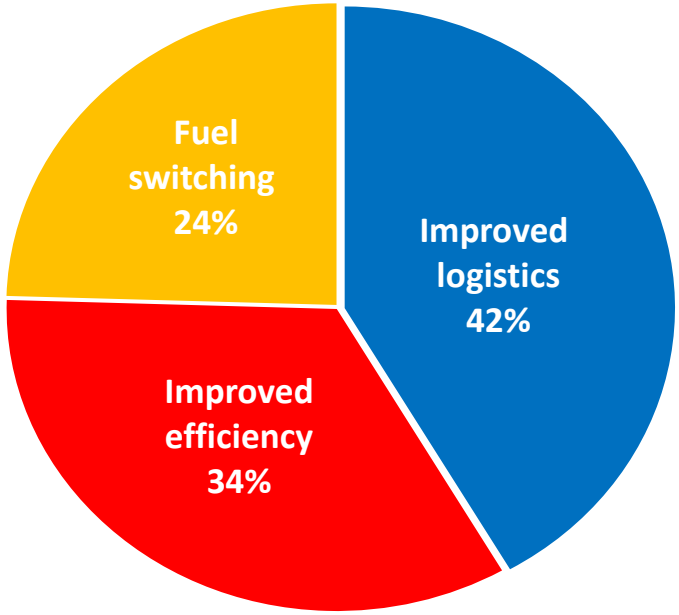


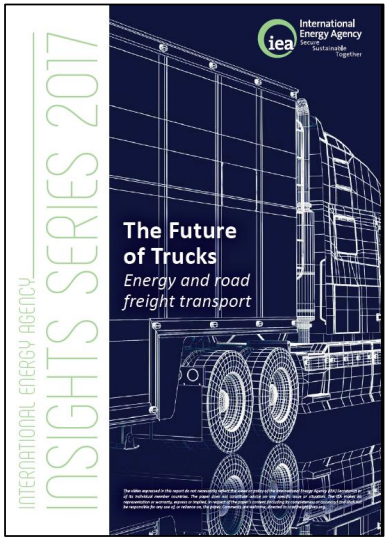
The transportation sector already experiences technological change, but won't shed its oil dependency without assertive policies.

An achievable, yet ambitious, vision for the future of trucks

Fuel demand saving in the Modern Truck Scenario relative to the Reference Scenario, 2050

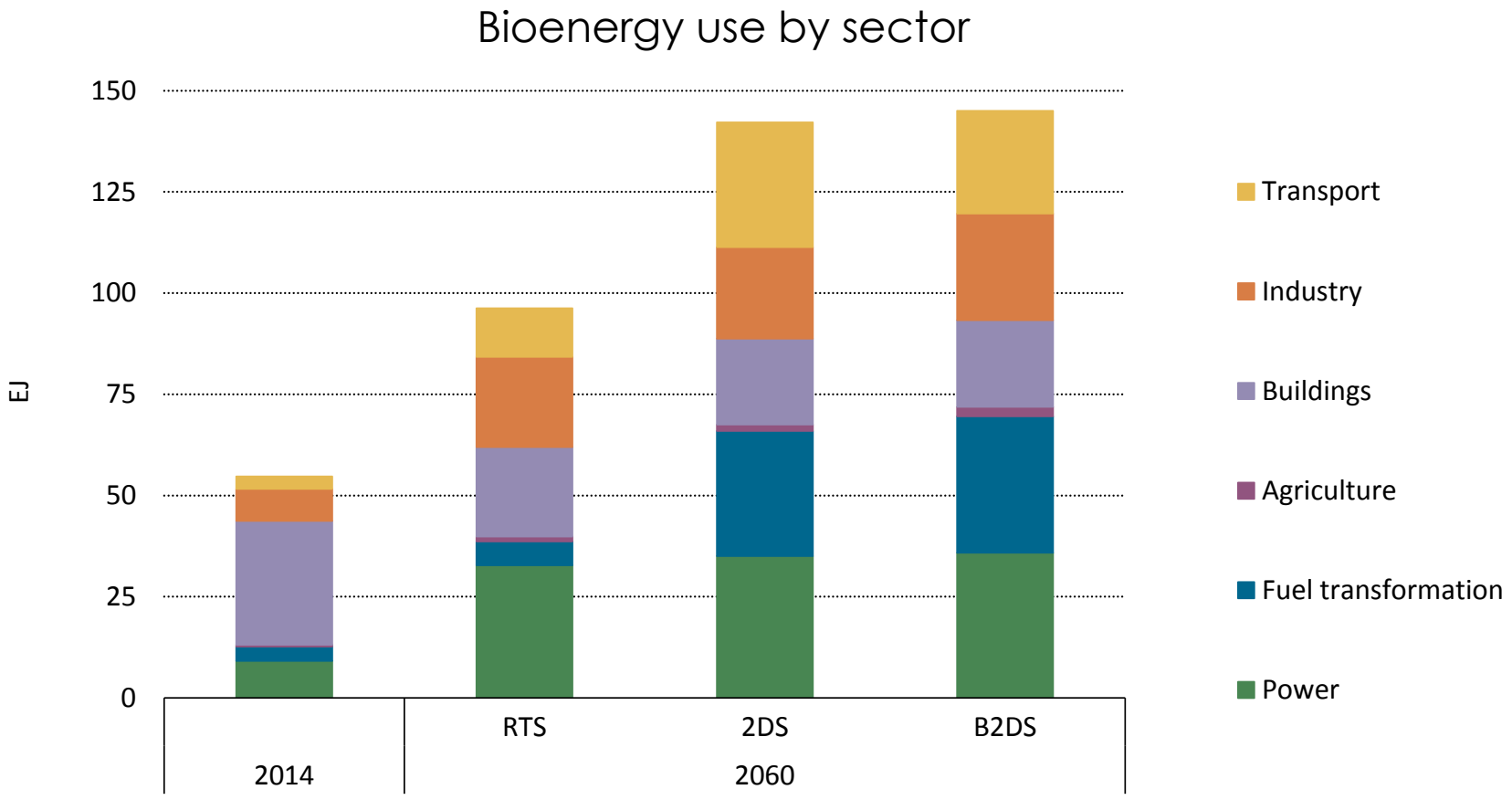
13.5 mb/d

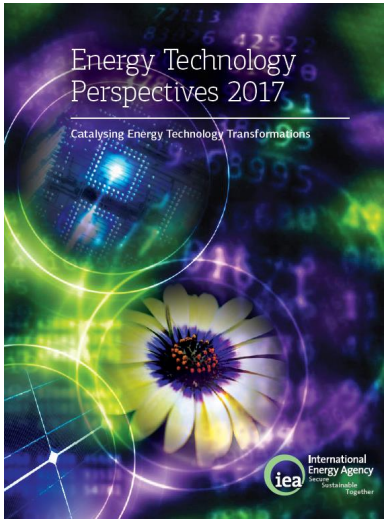




Modernising trucks and systems operations could reduce global truck fuel demand by 50% in 2050 and emissions by up to 75%, with benefits for energy security and environmental goals

Optimising the use of sustainable biomass

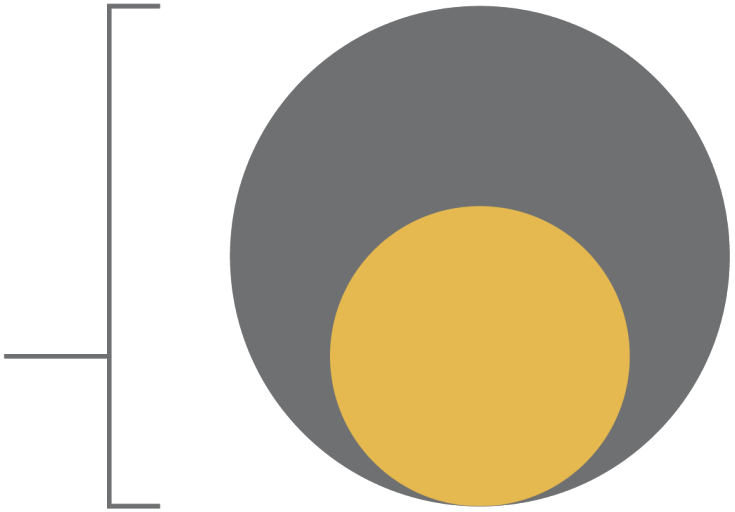




Around 145 EJ of sustainable bioenergy is available by 2060 in IEA decarbonisation scenarios, but gets used differently between the 2DS and the B2DS.

CCS will be critical in industry

Nordic industrial emissions in 2050

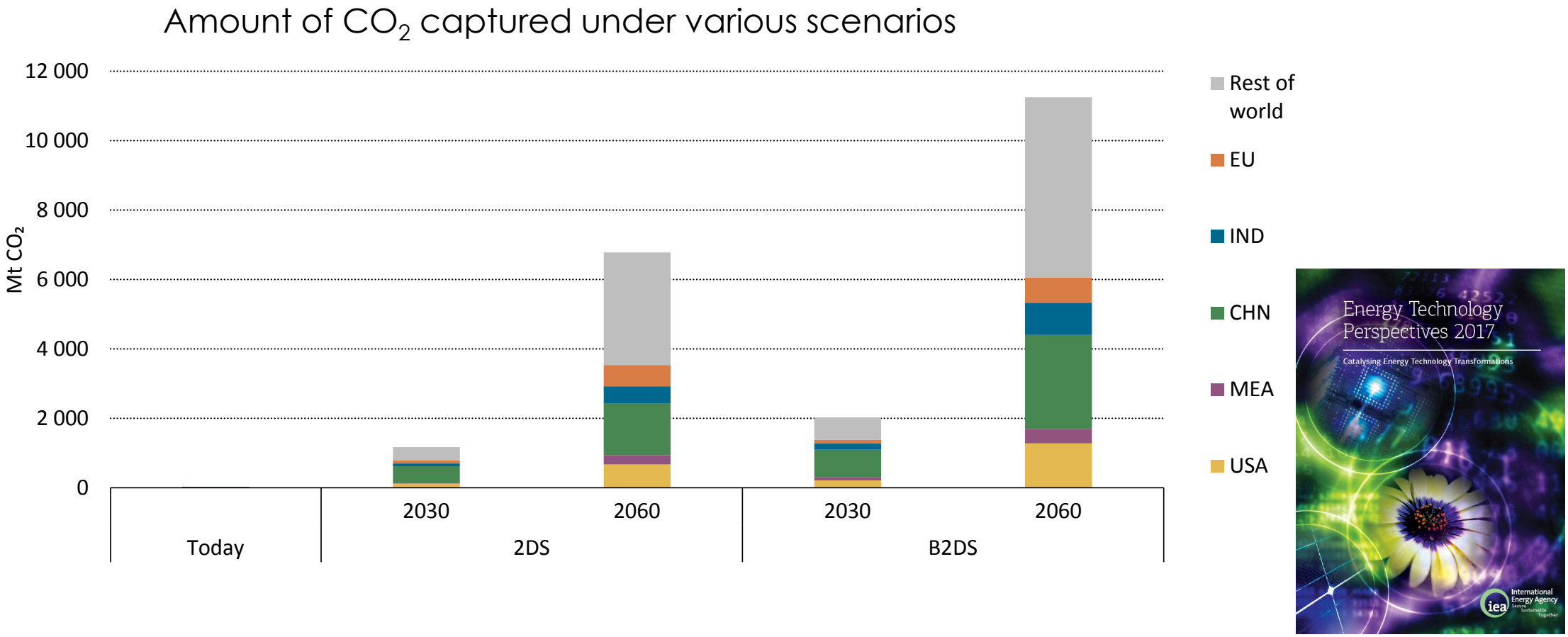


Total
20 Mt CO_2

Captured
7 Mt CO_2

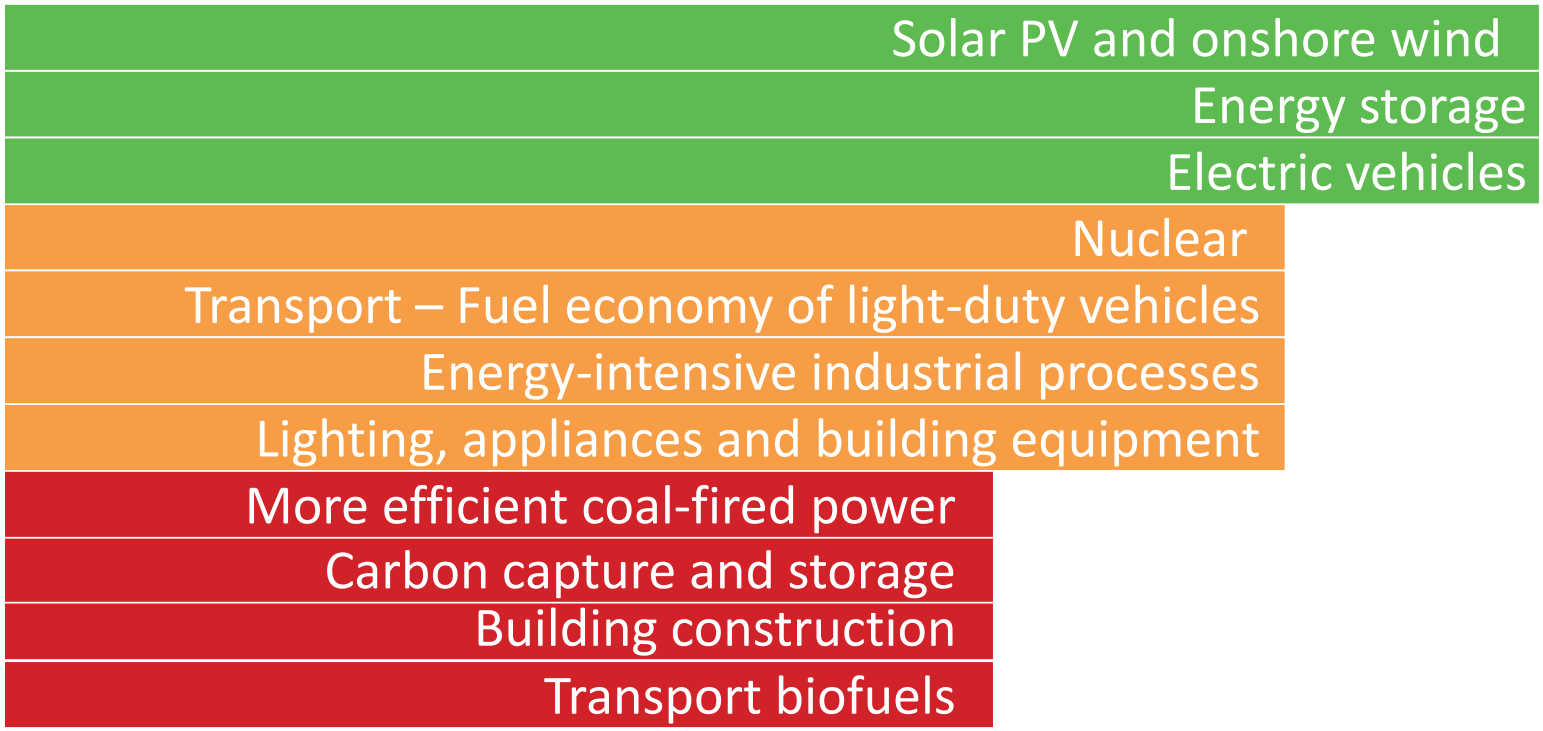
The lingering challenge of process-related emissions in industry necessitates broad deployment of innovative low-carbon processes, and notably CCS, in the CNS.

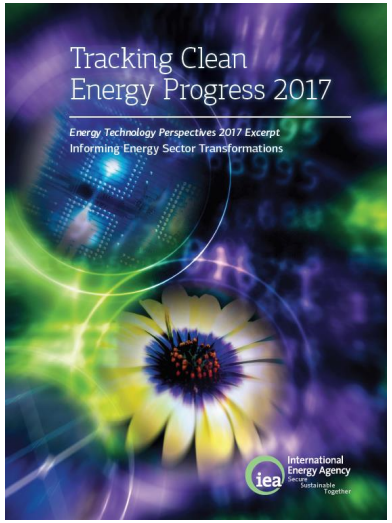
A challenging task ahead for CCS



CCS is happening today, but needs to be ramped up hundreds of times to achieve long-term goals. The role for CCS varies based on local circumstances.

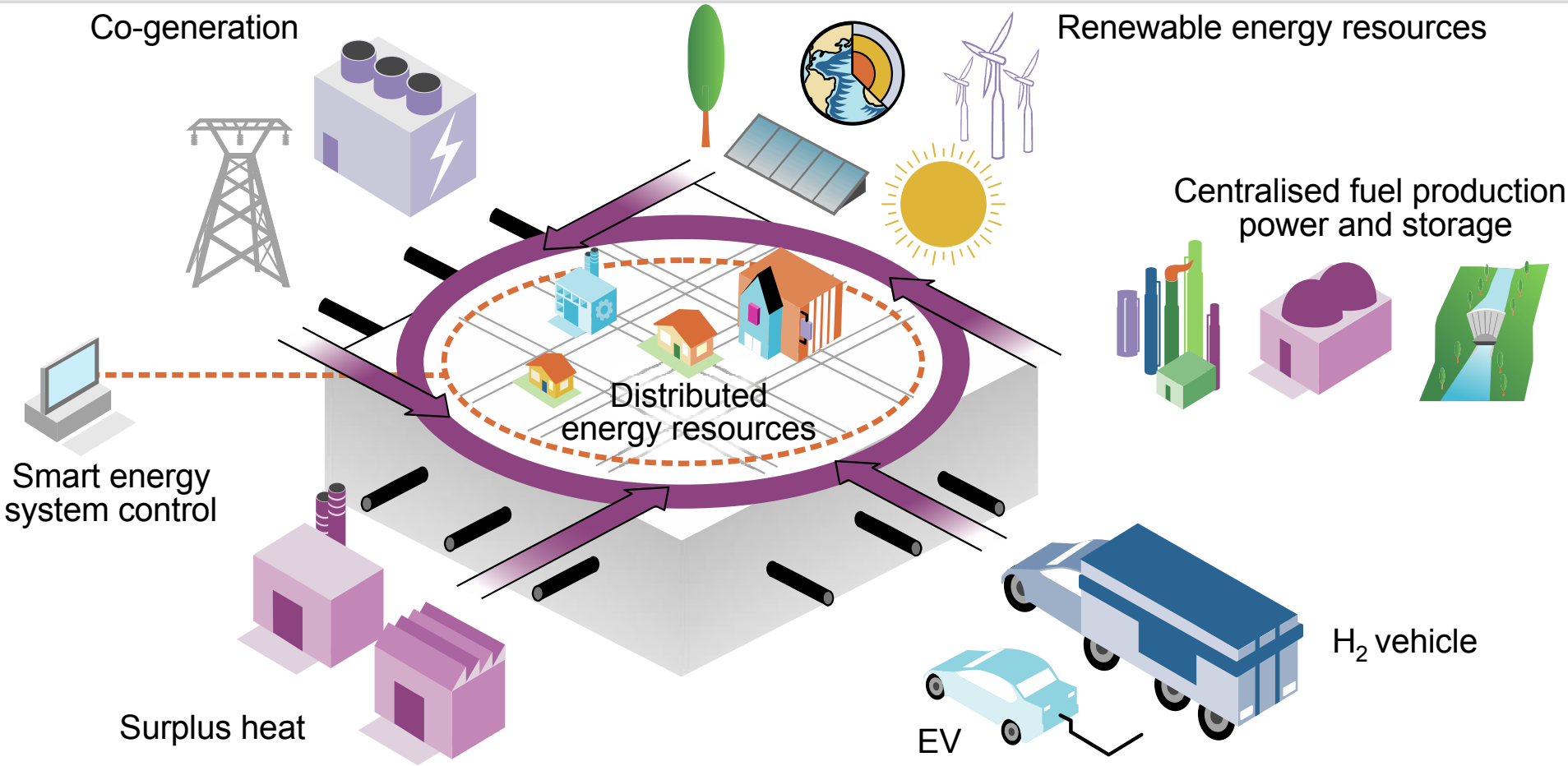
The potential of clean energy technology remains under-utilised





Recent progress in some clean energy areas is promising, but many technologies still need a strong push to achieve their full potential and deliver a sustainable energy future

Systems Integration is essential for a sustainable energy future

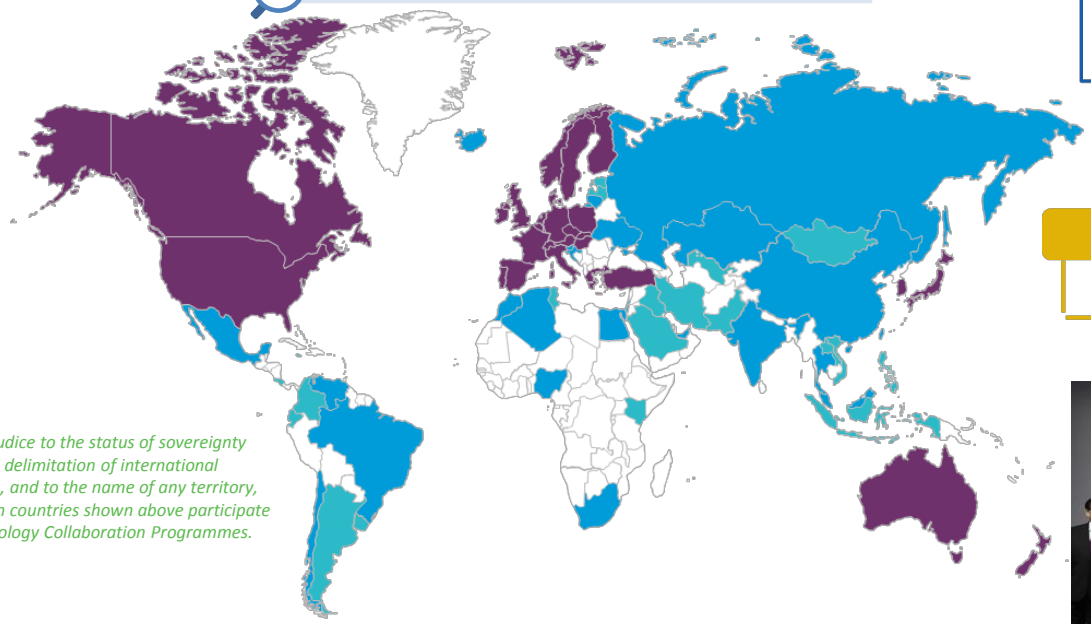


We need to move away from a one-directional energy delivery philosophy to a digitally-enhanced, multidirectional and integrated system that requires long-term planning for services delivery.

Collaboration is key to accelerating innovation

1975 - 2015 iea Energy Technology Network
Accelerating results for 40 years

- Close to 6,000 experts
- 39 TCPs
- More than 1,900 topics to date
- 52 countries
- About 300 public or private entities
- 4 regional or international organisations



This map is without prejudice to the status of sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area. Experts from countries shown above participate in activities of the Technology Collaboration Programmes.

Entities participating From IEA countries

Entities participating from partner countries

Entities from countries considering participation

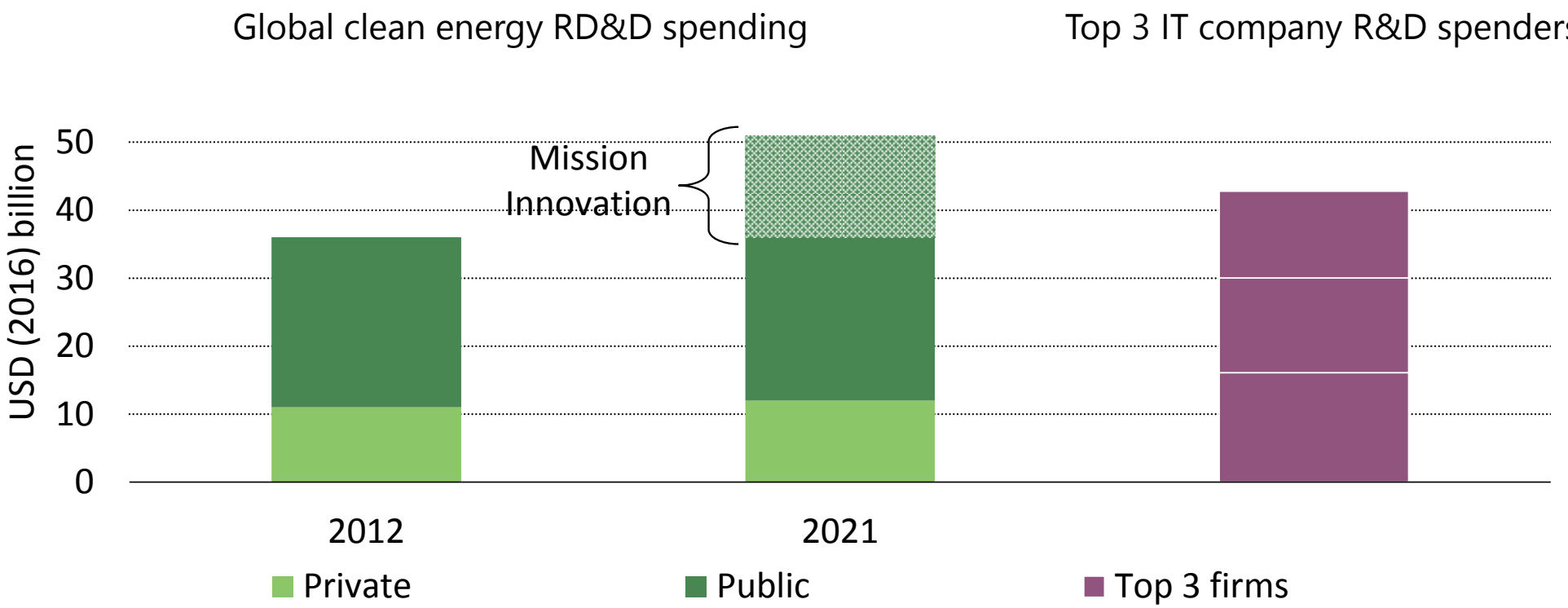
CLEAN ENERGY MINISTERIAL
Accelerating the Global Clean Energy Transition

Energy Demand	Energy Systems & Integration	Energy Supply
Appliances (SEAD)	21st Century Power (21CPP)	Solar and Wind
Buildings and Industry (EMWG)	Energy Access (Global LEAP)	Bioenergy
Electric Vehicles (EVI)	Smart Grids (ISGAN)	Hydropower
	Smart Cities (GSCN)	

Cross-Cutting Support

- Women in Clean Energy (C3E)
- Clean Energy Solutions Center

Global clean energy RD&D spending needs a strong boost



Global RD&D spending in efficiency, renewables, nuclear and CCS plateaued at $26 billion annually, coming mostly from governments. Mission Innovation could provide a much needed boost.

Conclusions

- Early signs point to changes in energy trajectories, helped by policies and technologies, but progress is too slow
- An integrated systems approach considering all technology options must be implemented now to accelerate progress
- Innovation can deliver, but policies must consider the full technology cycle, and collaborative approaches can help
- Achieving global carbon neutrality by 2060 would require unprecedented technology policies and investments
- Together, the Nordic countries can send a strong signal to the global community on the value of coordinated ambitious goals.

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