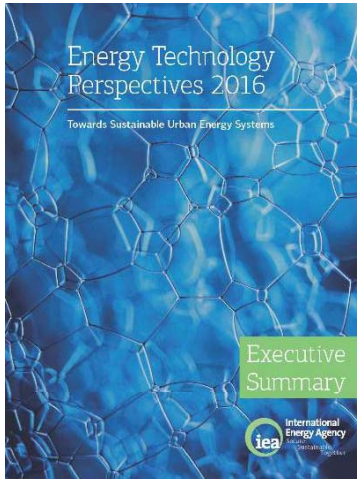
Tracking Clean Energy Progress: The gap towards two degrees

Luis Munuera, Power grid technology lead
EnerClub, Madrid

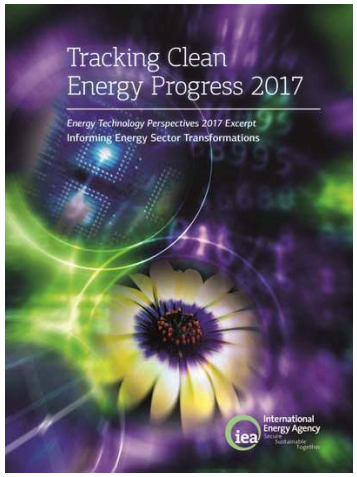
IEA

IEA's focus on energy technology

1. Where do we need to go?



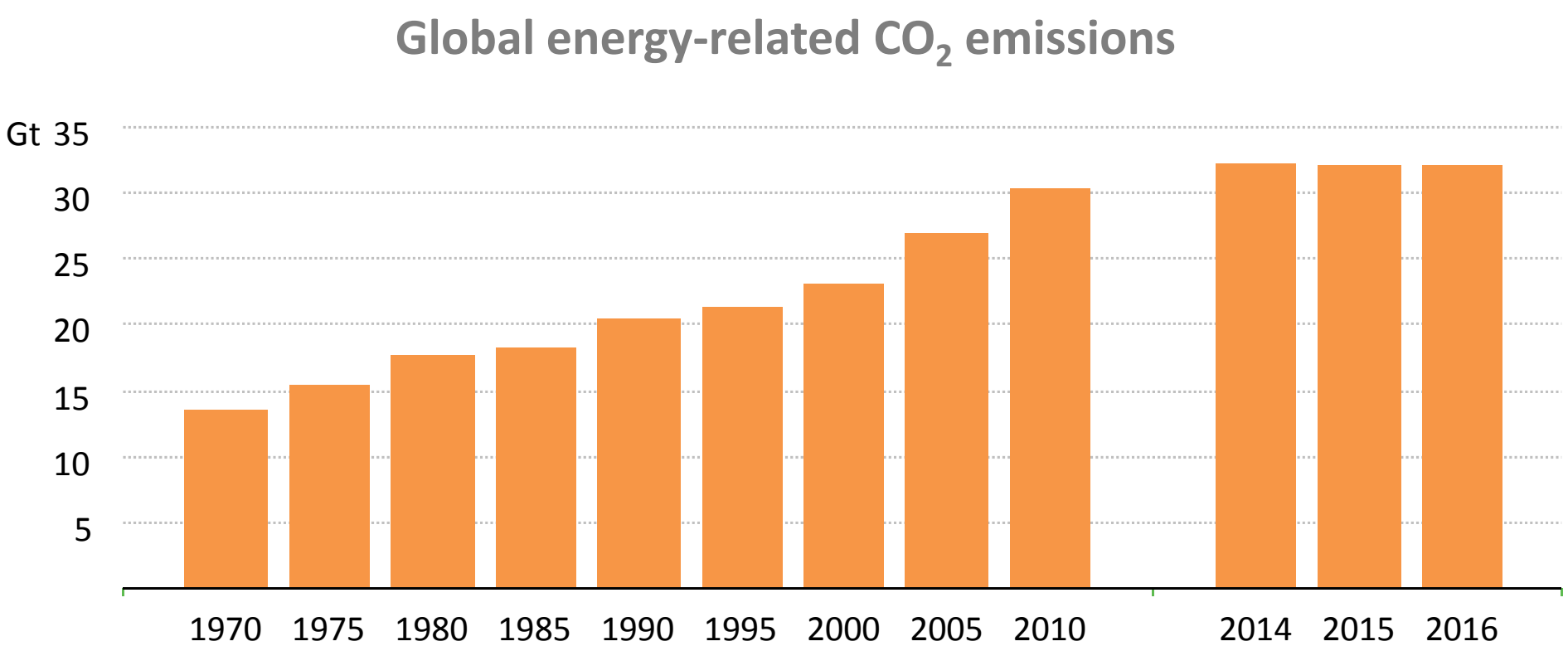
2. Where are we today?



3. How do we get there?

iea Energy Technology Network

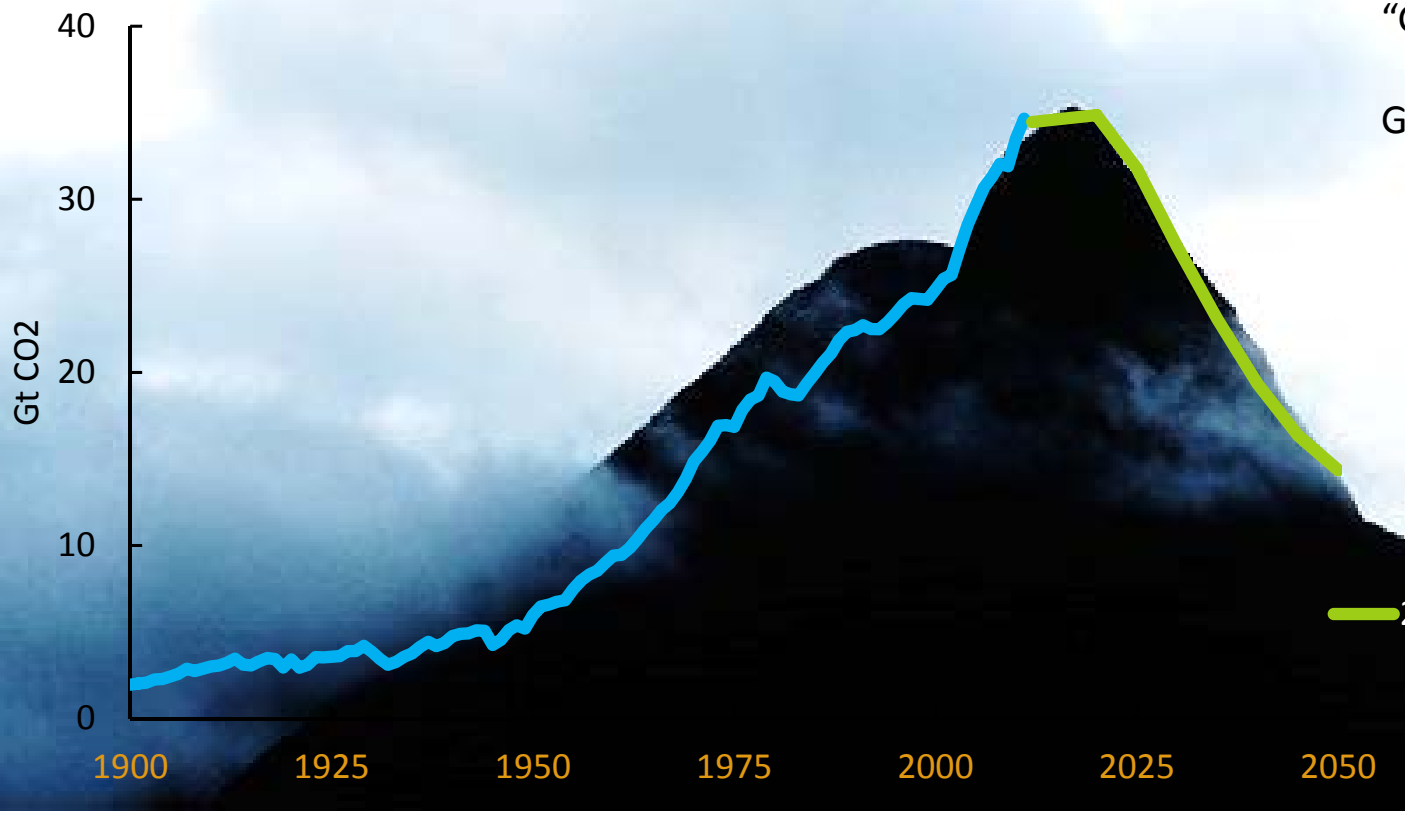
Tracking energy and energy emissions data



IEA analysis shows that global CO2 emissions from energy remained flat in 2016 for the third year in a row, even though the global economy grew

Where do we need to go?

The global challenge: Climbing down the mountain

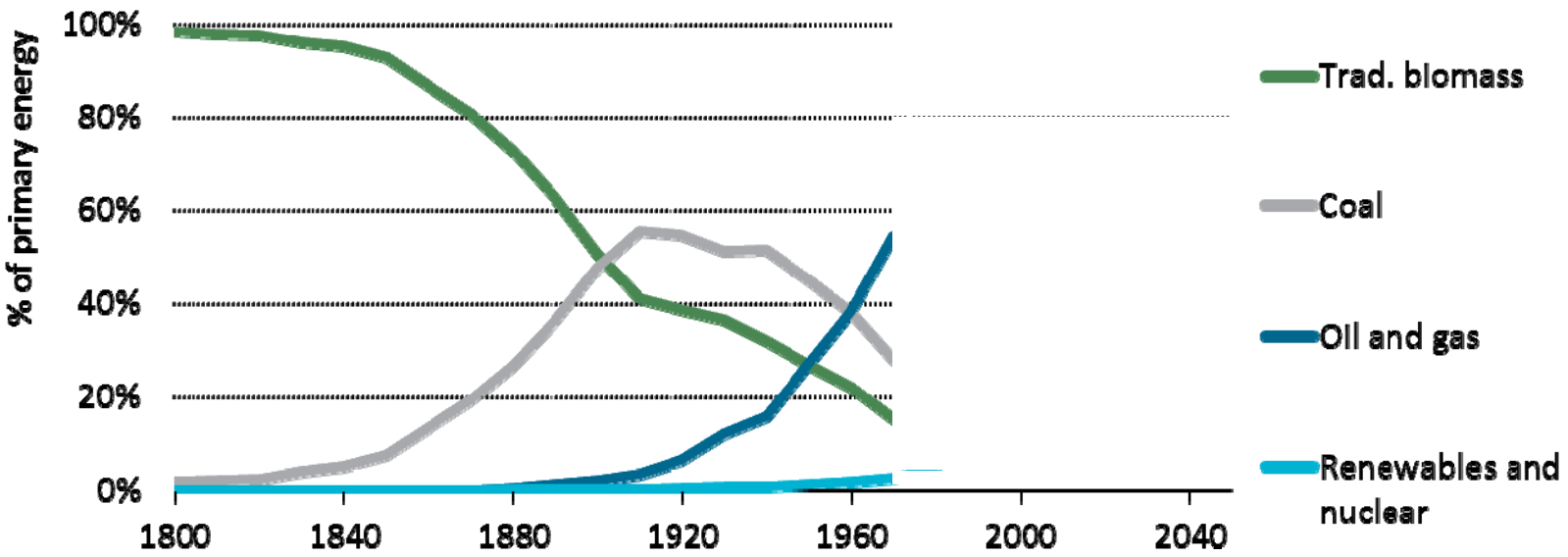


"Getting to the top is optional.

Getting down is mandatory."

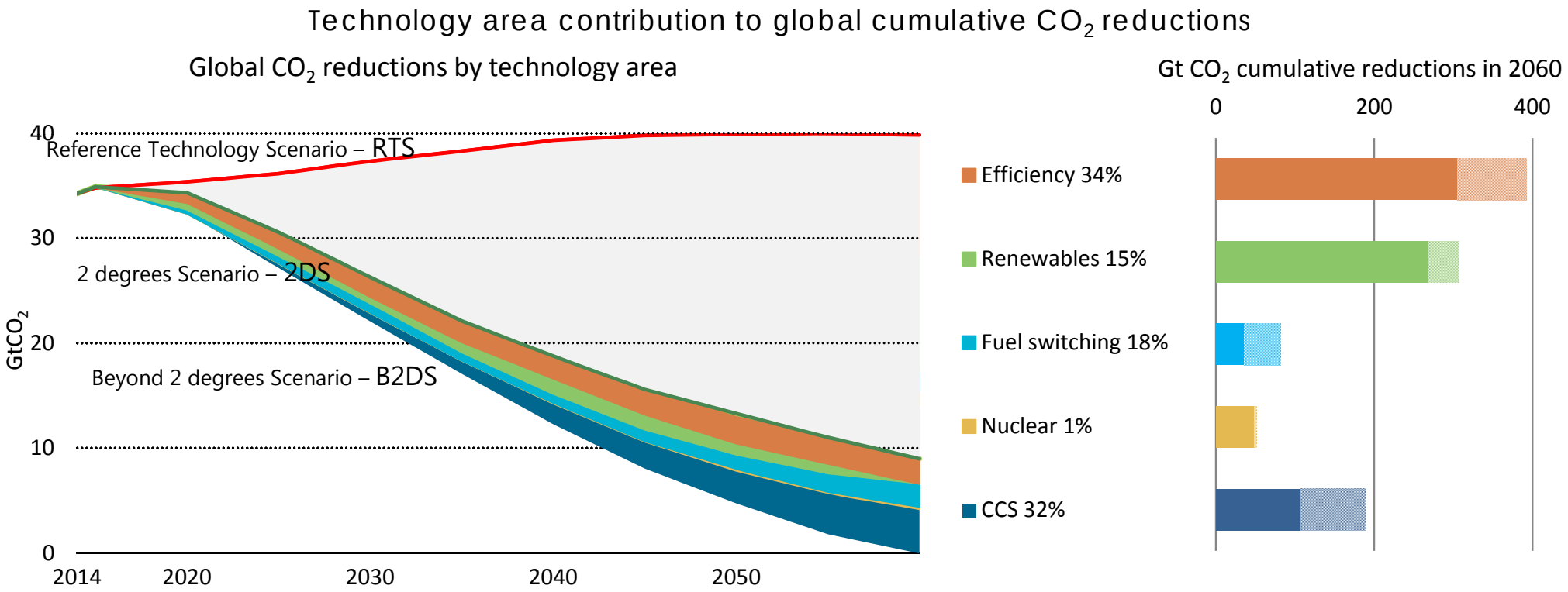
- Ed Viesturs

And technology transitions in the energy sector are slow



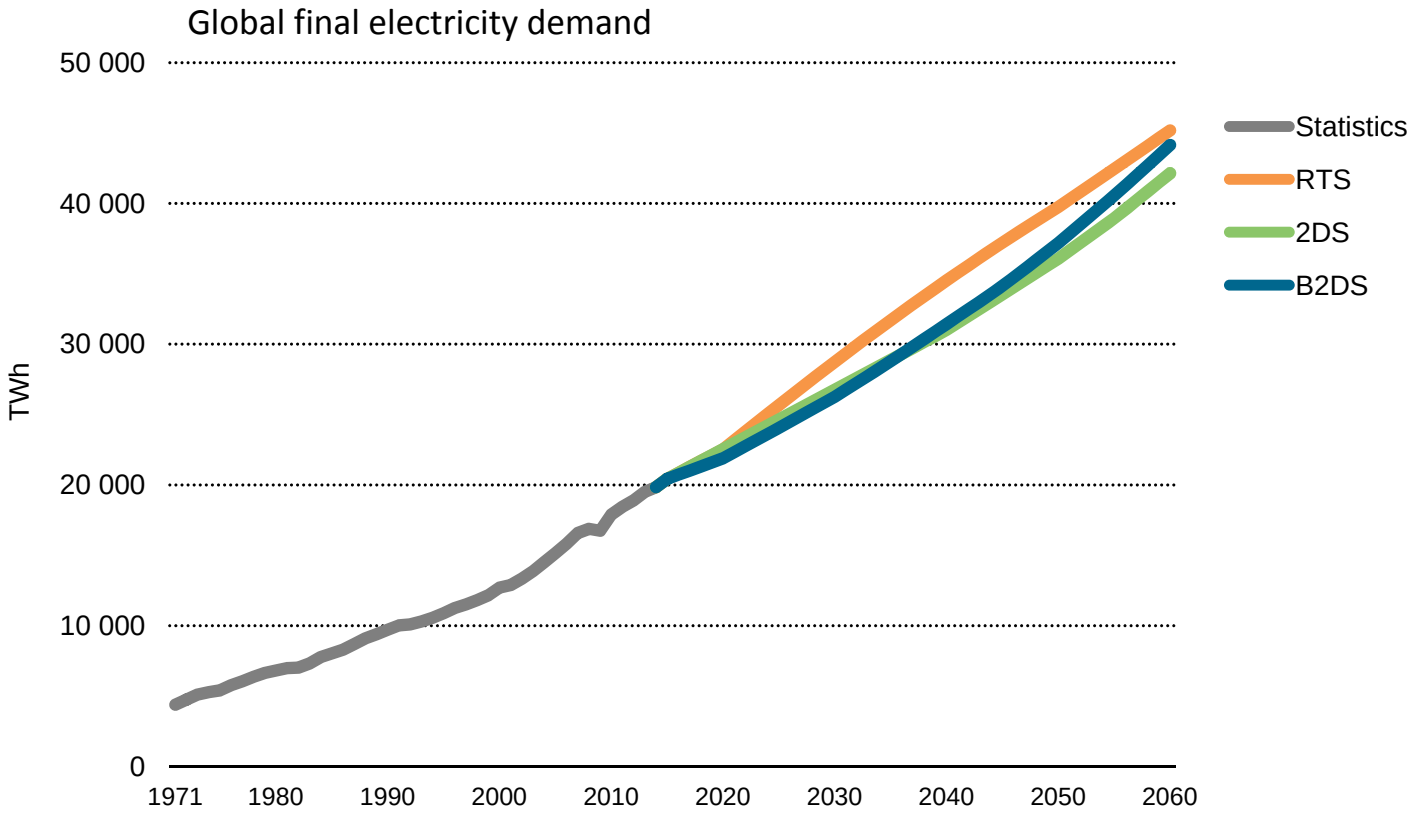
Data from Smil (2010) and IEA (2015), 2DS scenario

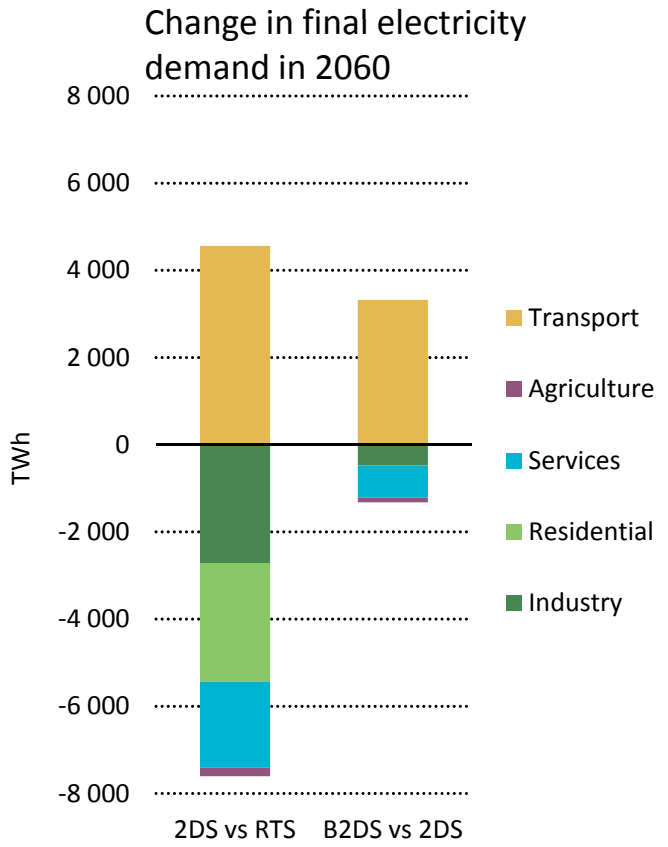
How far can technology take us?



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

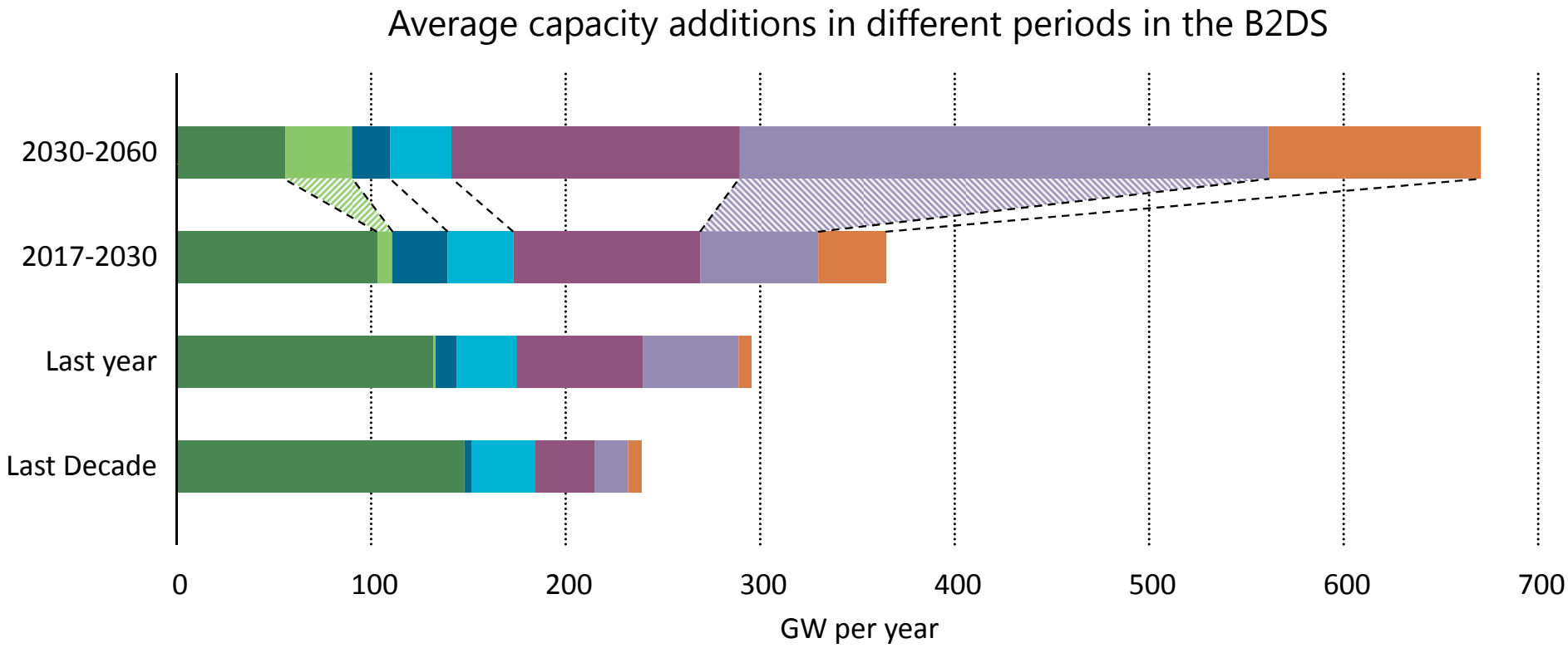
The future is electric





In every scenario, whether reference (RTS) or low carbon (2DS and B2DS), the electricity share in final energy use more than doubles compared to today

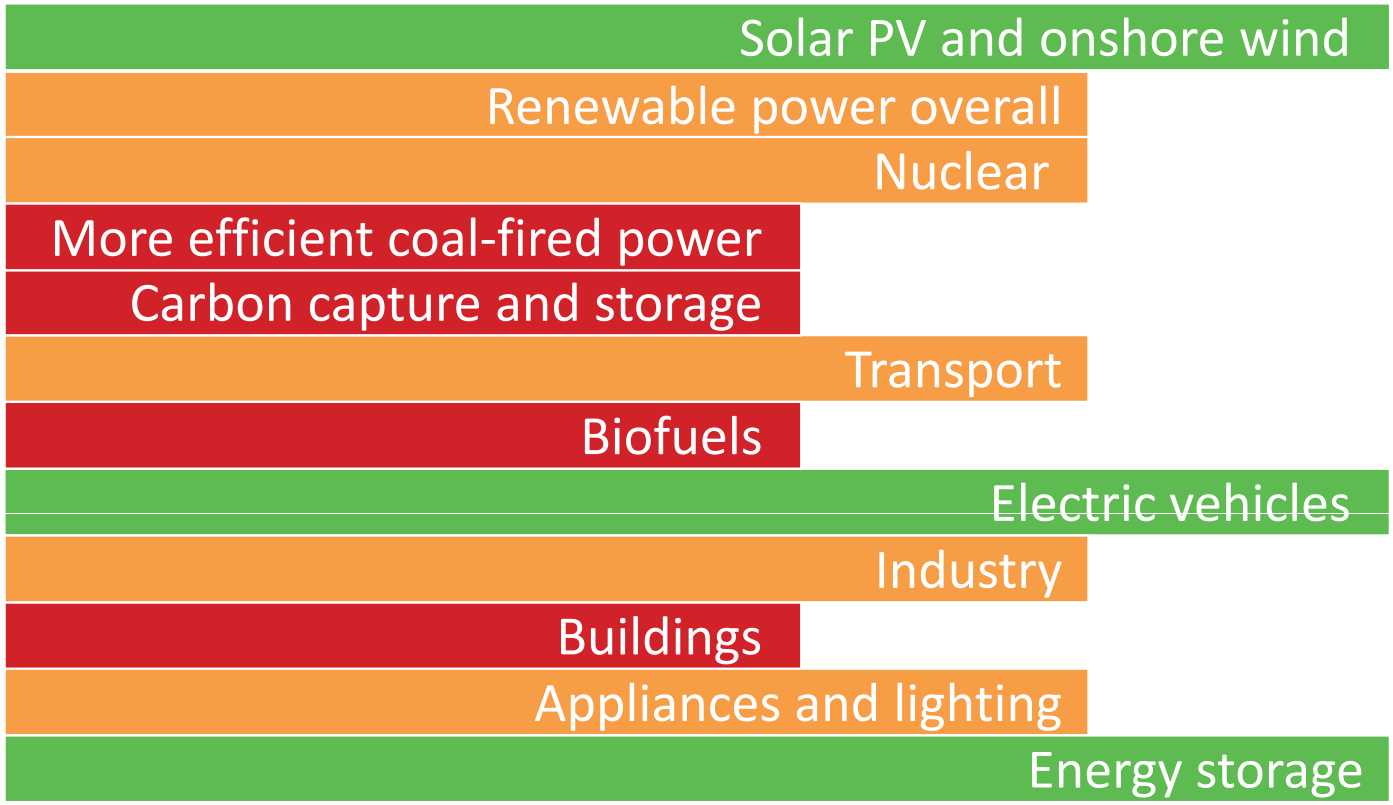
How difficult is it?

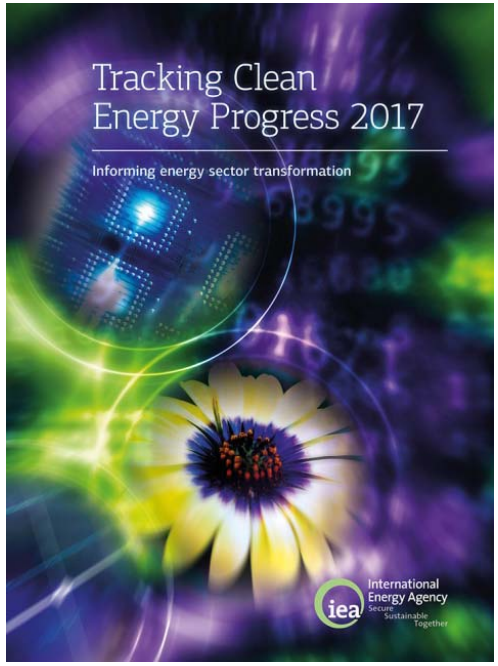


Recent successes in solar and wind
will have to be extended to all low-carbon solutions, and brought to a scale never experienced before

Tracking technology development

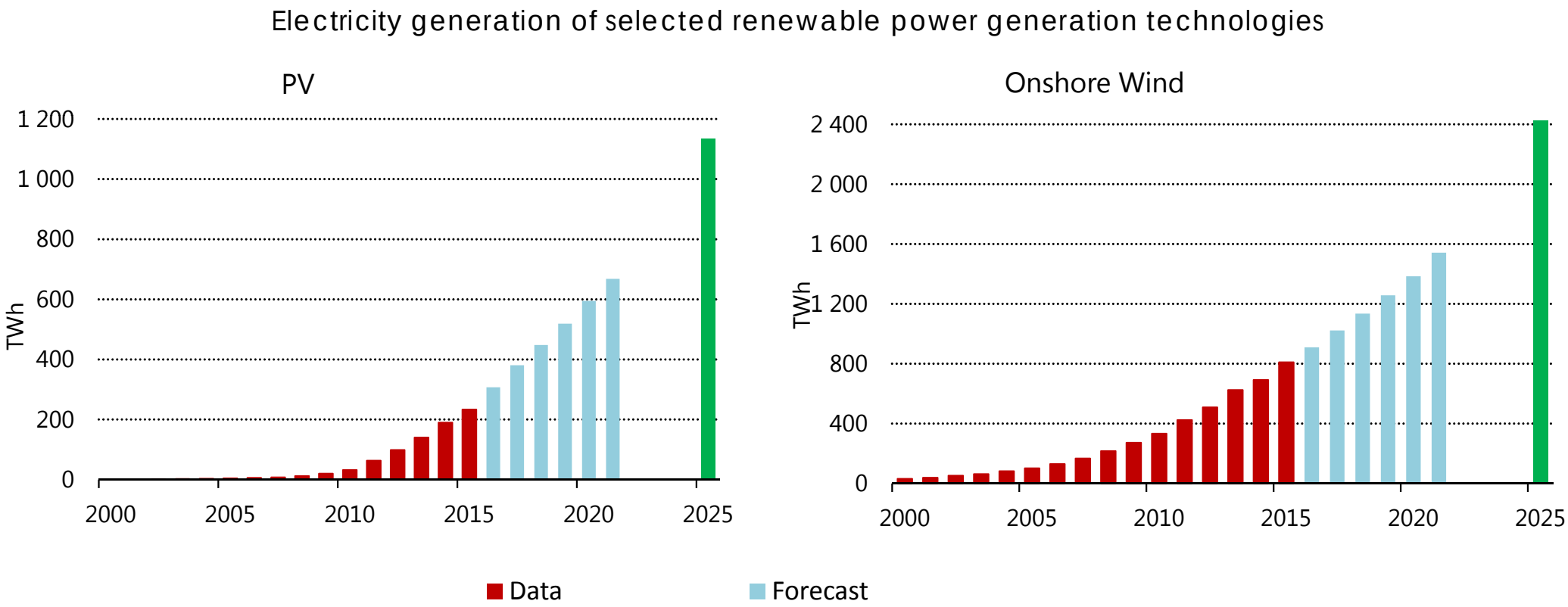
Technology Status today against 2DS targets





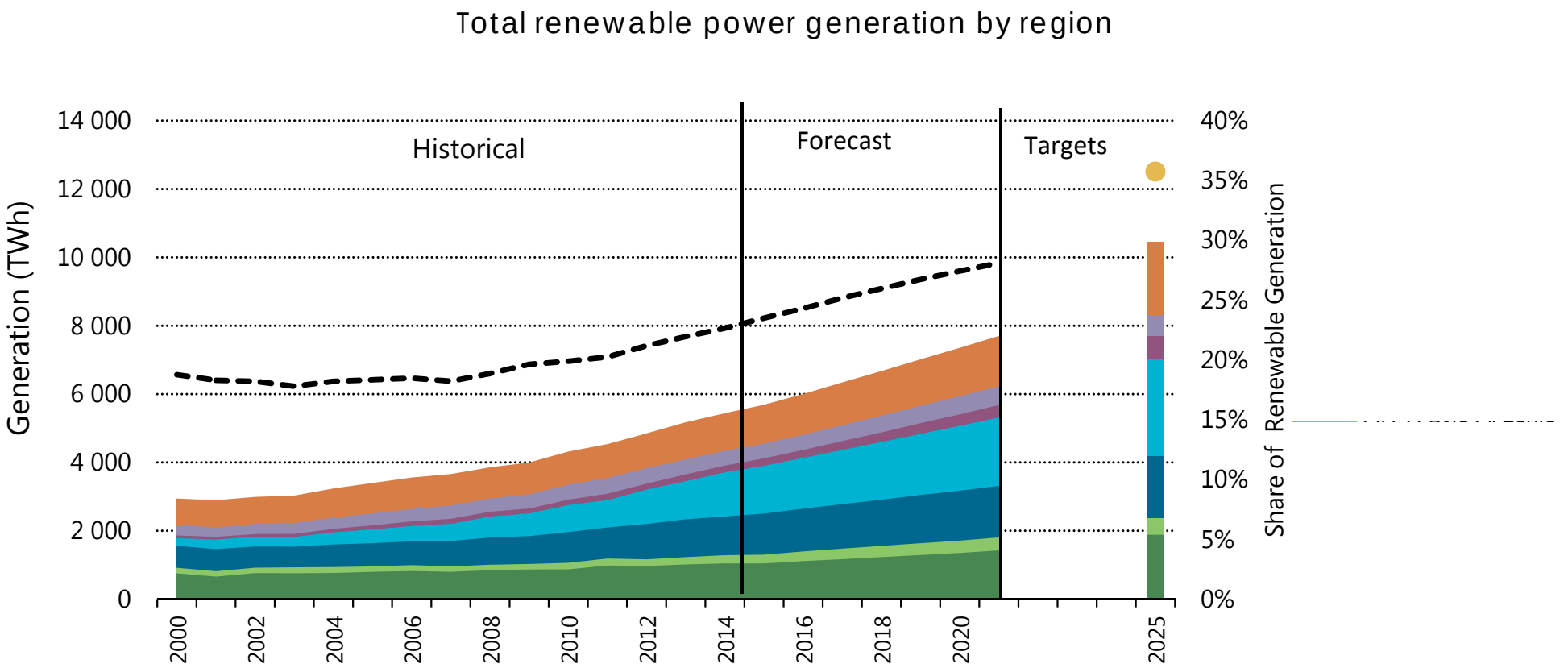
***Tracking Clean Energy Progress* (*TCEP*) highlights the overall status and recent progress in key clean-energy technologies as well as providing insights to achieve their full potential**

Solar PV and Wind are still leading the transition…



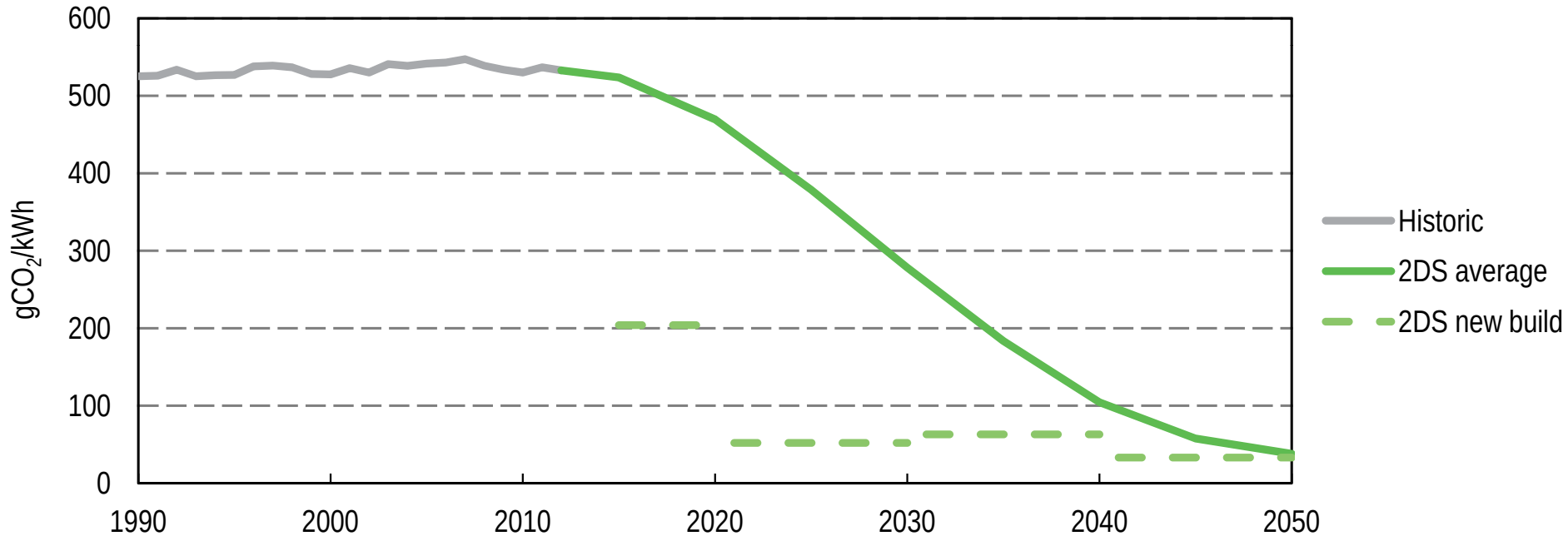
Solar PV and onshore wind electricity generation are expected to grow by 2.5 times and by 1.7 times, respectively, over 2015-20.

… but can't make up for other low-carbon generation sources



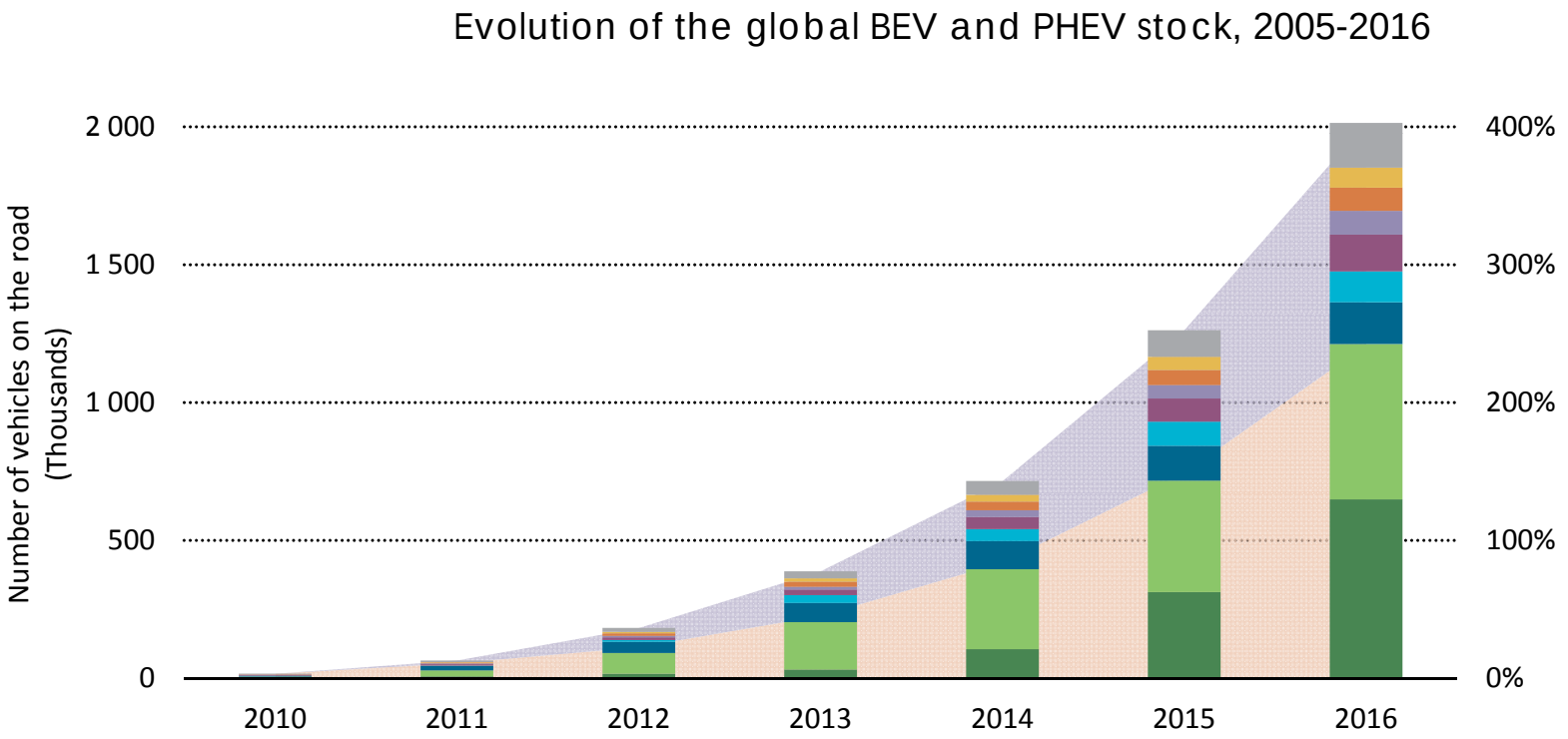
While renewable power additions keep breaking records, they need to grow much faster to reach the 2DS electricity generation targets. Progress on early-stage technologies also needs to accelerate.

Decarbonising power lagging behind



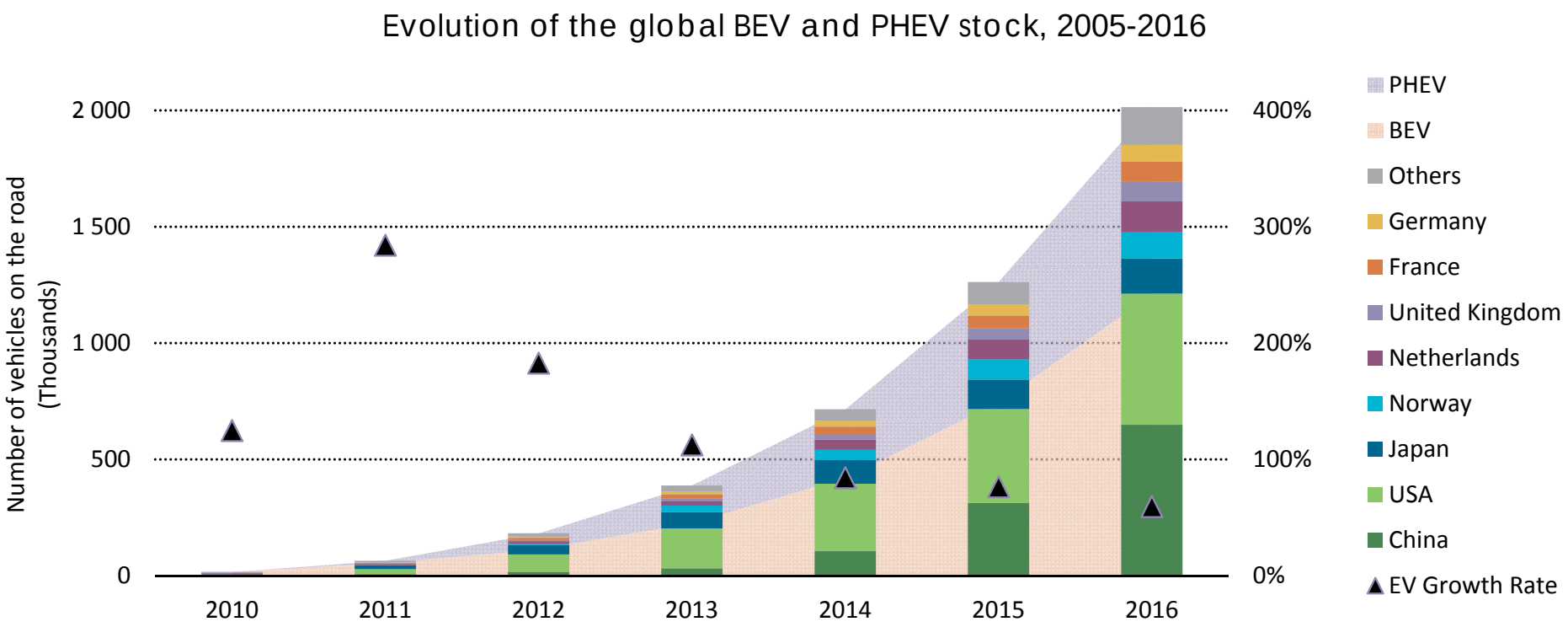
Phase out construction of subcritical plants; encourage carbon pricing, maximum emission caps, strict pollution regulations to incentivise lower carbon generation

- EVs are still on track,



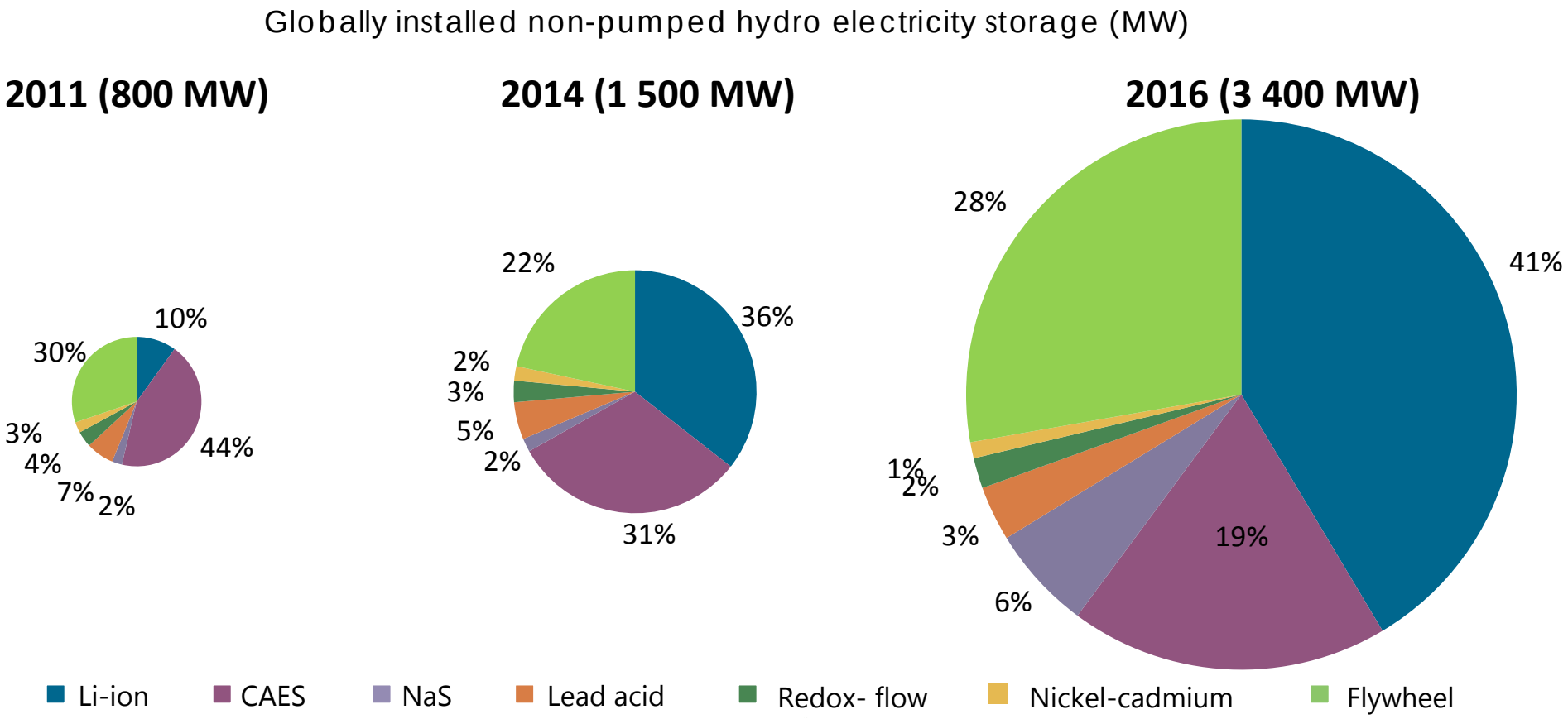
The global PEV car stock has reached 2 million units in circulation last year,

- EVs are still on track, but are losing momentum



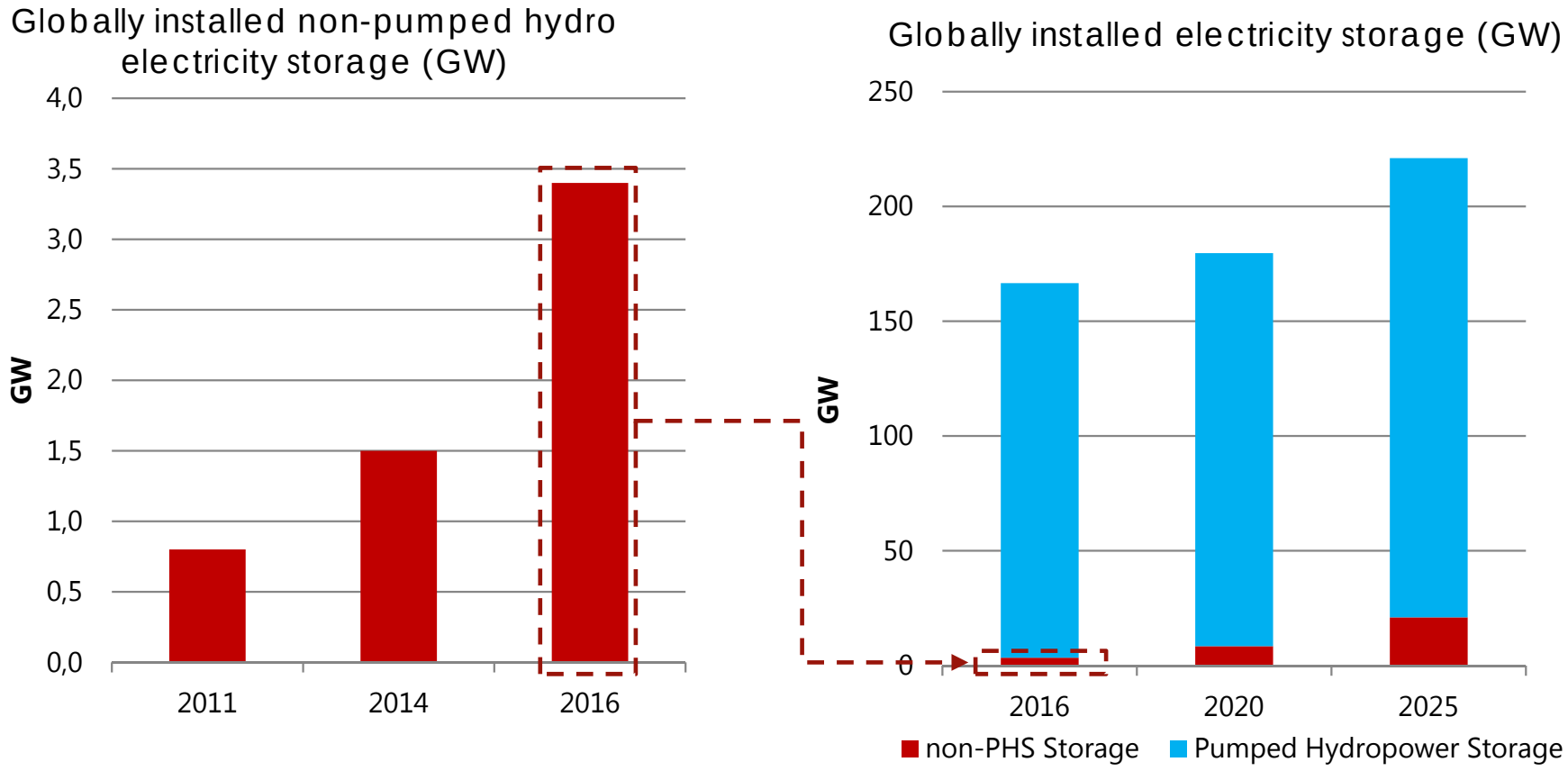
The global PEV car stock has reached 2 million units in circulation last year, but sales growth went from 70% last year to 40% this year, suggesting an increasing risk to start diverging from a 2DS trajectory.

- The value of storage is starting to get clearer



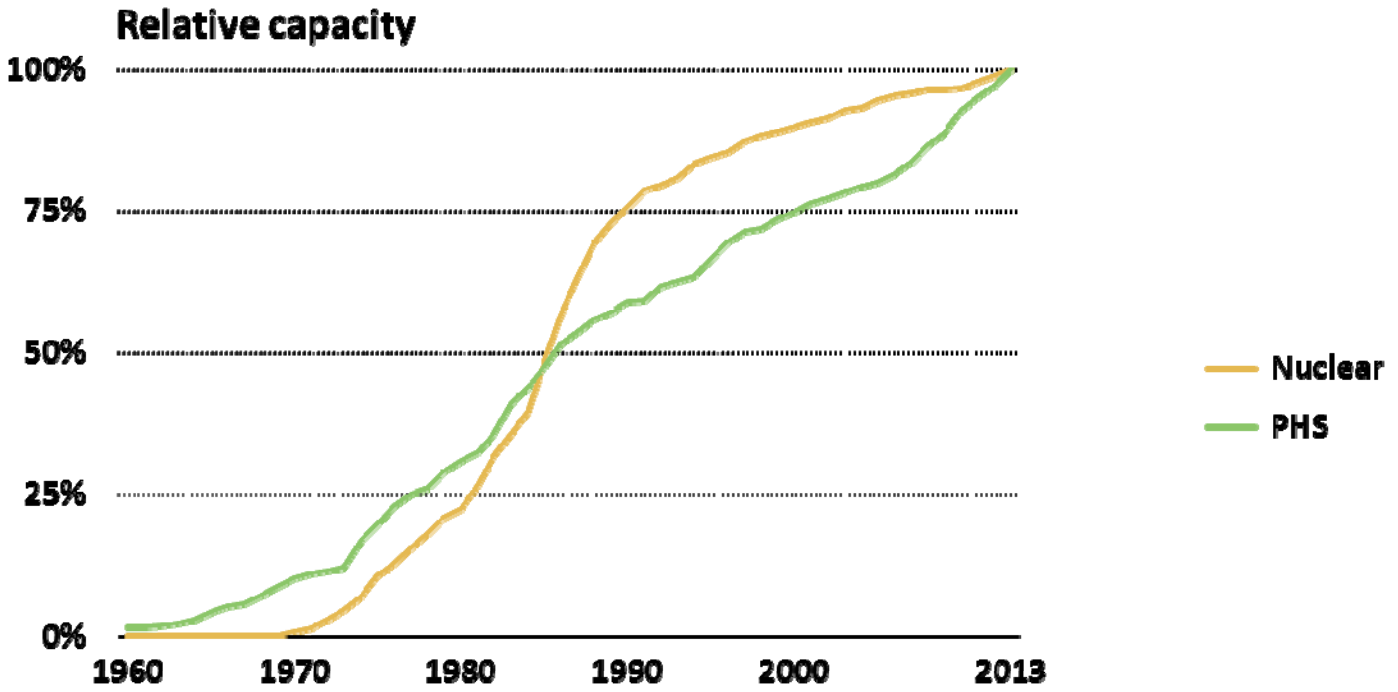
Positive market and policy trends supported a remarkable year-on-year growth of over 50% for non-pumped hydro storage.

Storage growing quickly as an option for accommodating renewables



Positive market and policy trends supported a year-on-year growth of over 50% for non-pumped hydro storage
But near-term storage needs will remain largely answered by existing or planned pumped hydro capacity

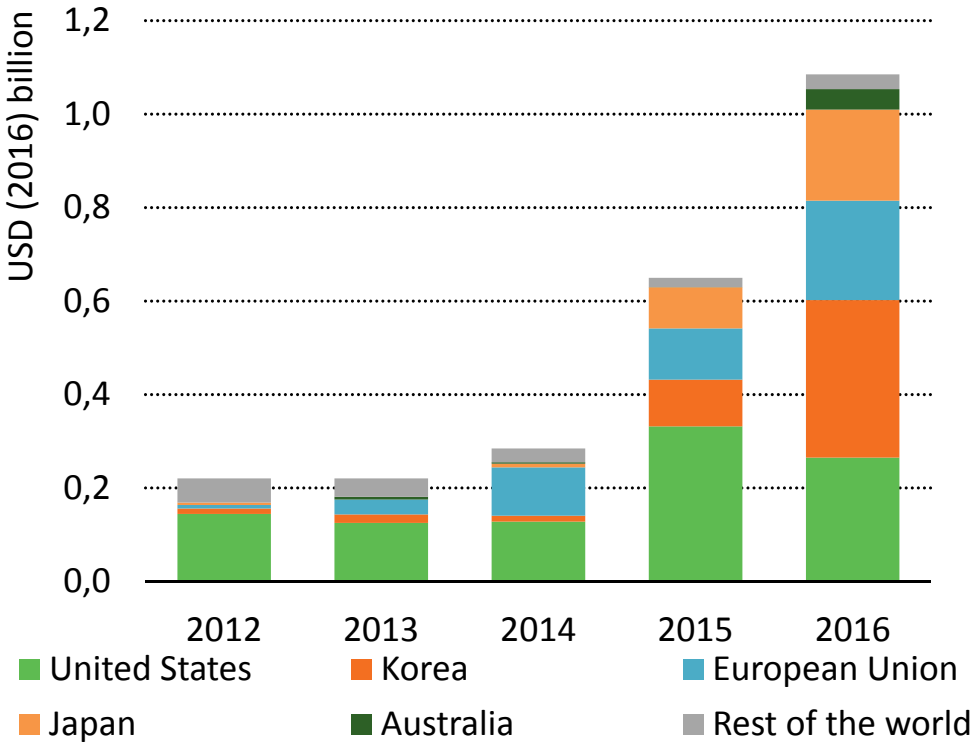
Most of storage has been built for one purpose by centralised utilities…



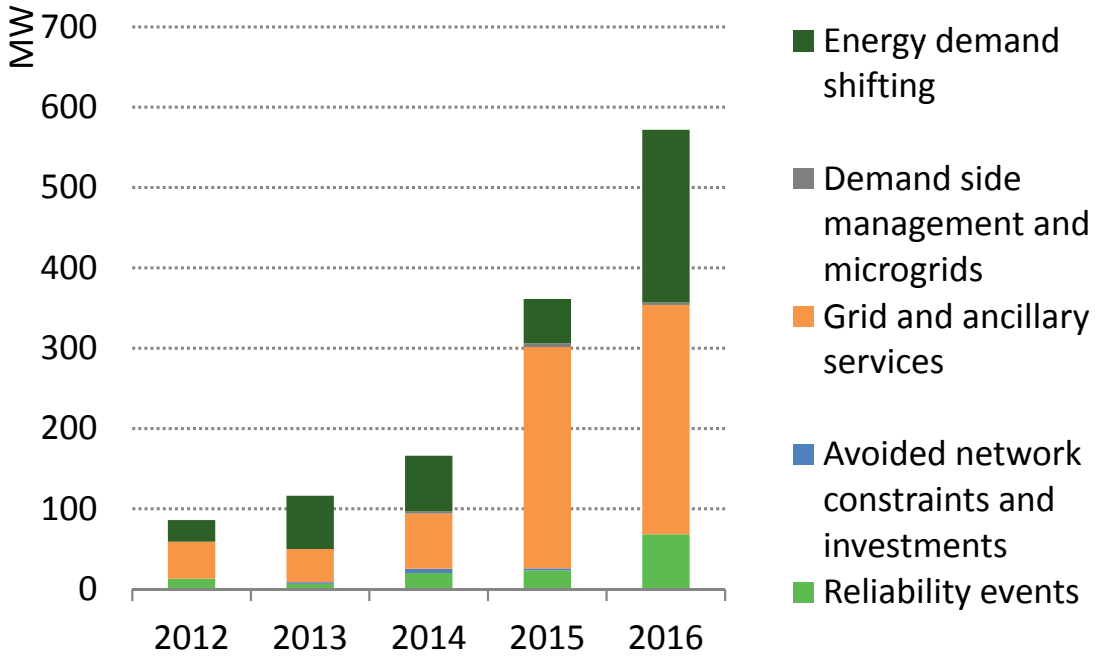
Vast majority built as a cost-saving measure to shave demand peaks and shift loads, by public, vertically-integrated utilities, mostly during the rapid nuclear growth era

...but renewables and distributed energy resources demand new market designs and new applications

Grid-scale battery storage investment by region



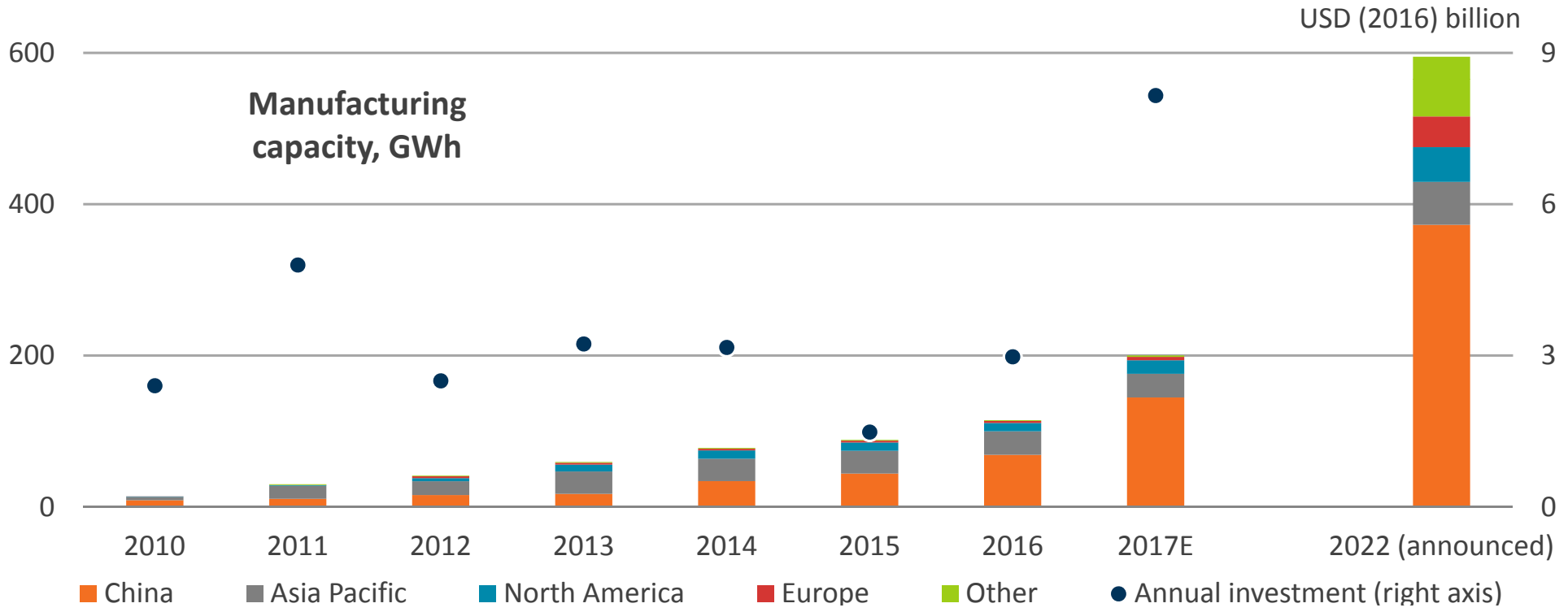
Main applications of world battery storage investment



Source: IEA World Energy Investment 2017

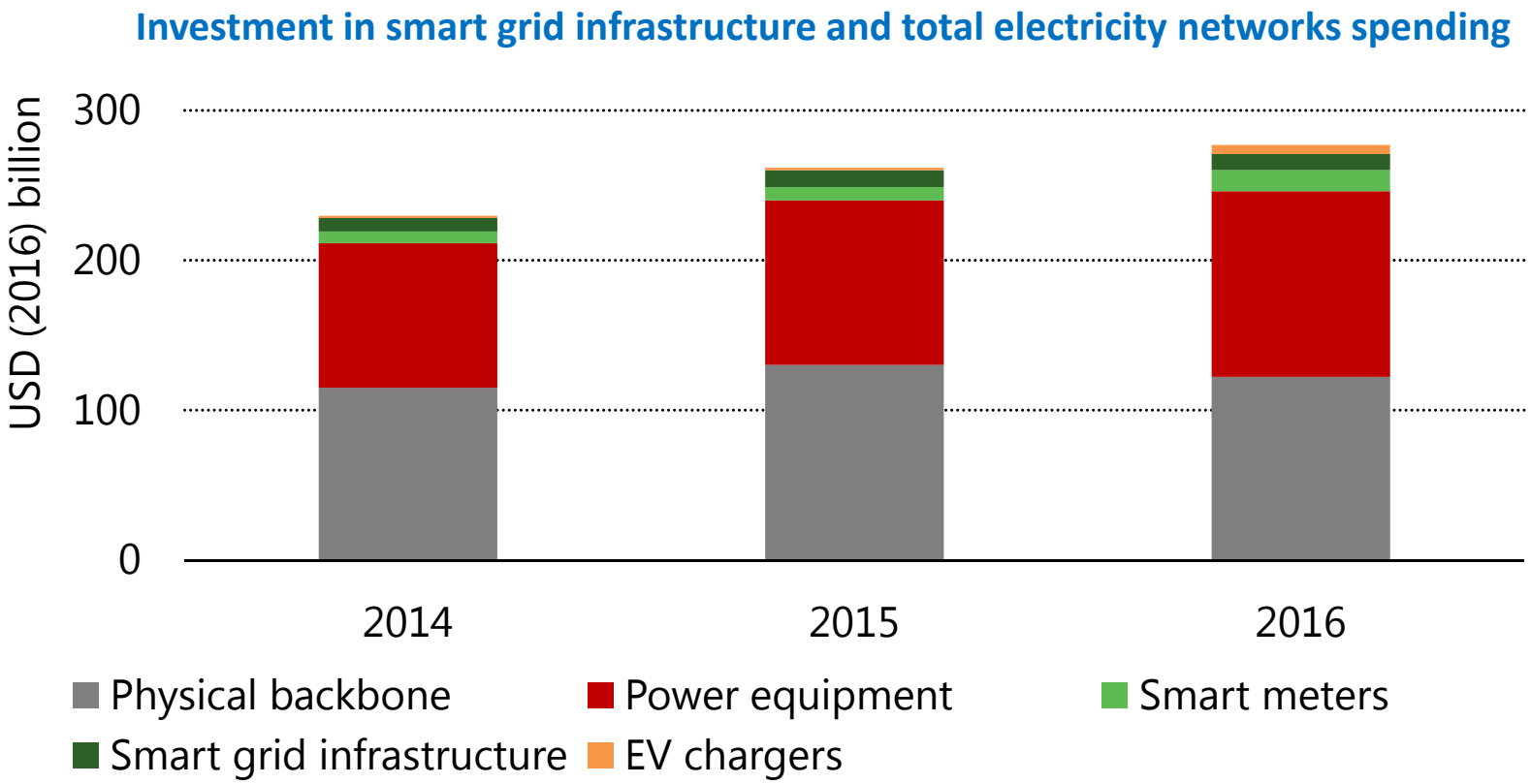
The expansion of grid-scale batteries, which are used mainly for frequency regulation and demand shifting, will hinge on market design –
Markets that reward additional capacity, flexibility or avoided grid cost services.

A huge scale-up in batteries coming – high profile announcements only part of the story



With China particularly taking big leaps in manufacturing output, the PV story could be repeated for storage

Digital grid transformation supports more electrification and renewables

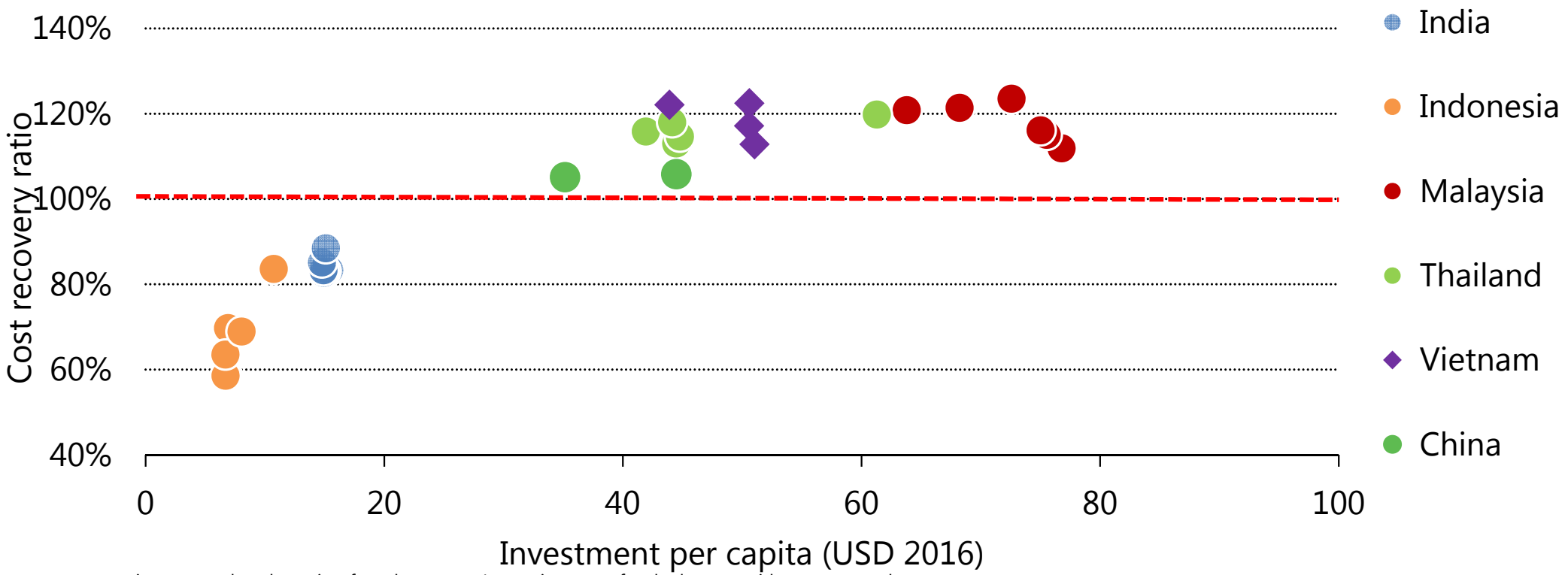


Source: IEA World Energy Investment 2017

Grid spending is dominated by traditional lines and equipment, but digital smart grid infrastructure – with advanced connectivity and communication - now accounts for over 10% of networks investment.

Grid modernization underpinned by regulatory framework & market design

Electricity grid investment per capita versus system cost recovery ratio (most recent five years)

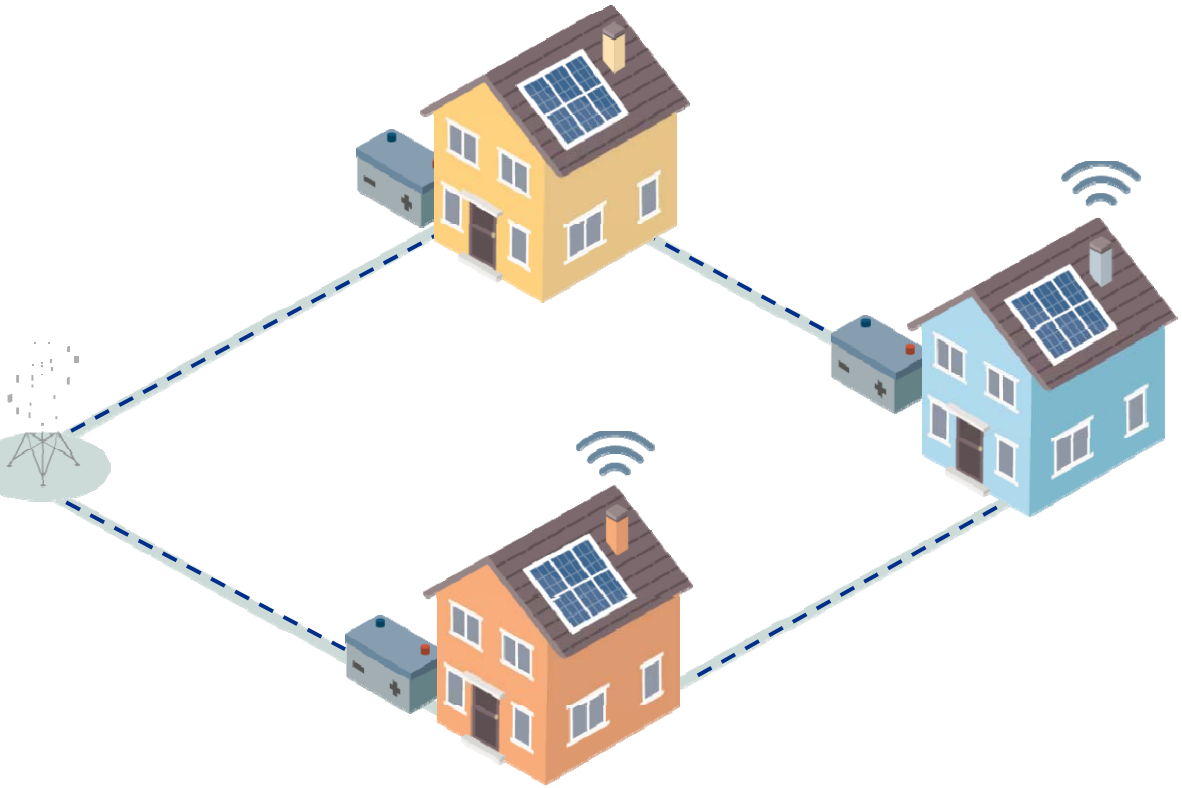


Note: cost recovery is measured as the ratio of total revenues/operating costs for the largest grid company and excludes subsidy payments; data points reflect 3-year trailing average

Source: IEA World Energy Investment 2017

60% of 2016 investment was made in single buyer markets (e.g. China, India, SE Asia). Investment depends on regulatory models that address cost recovery, tariff design and key performance metrics.

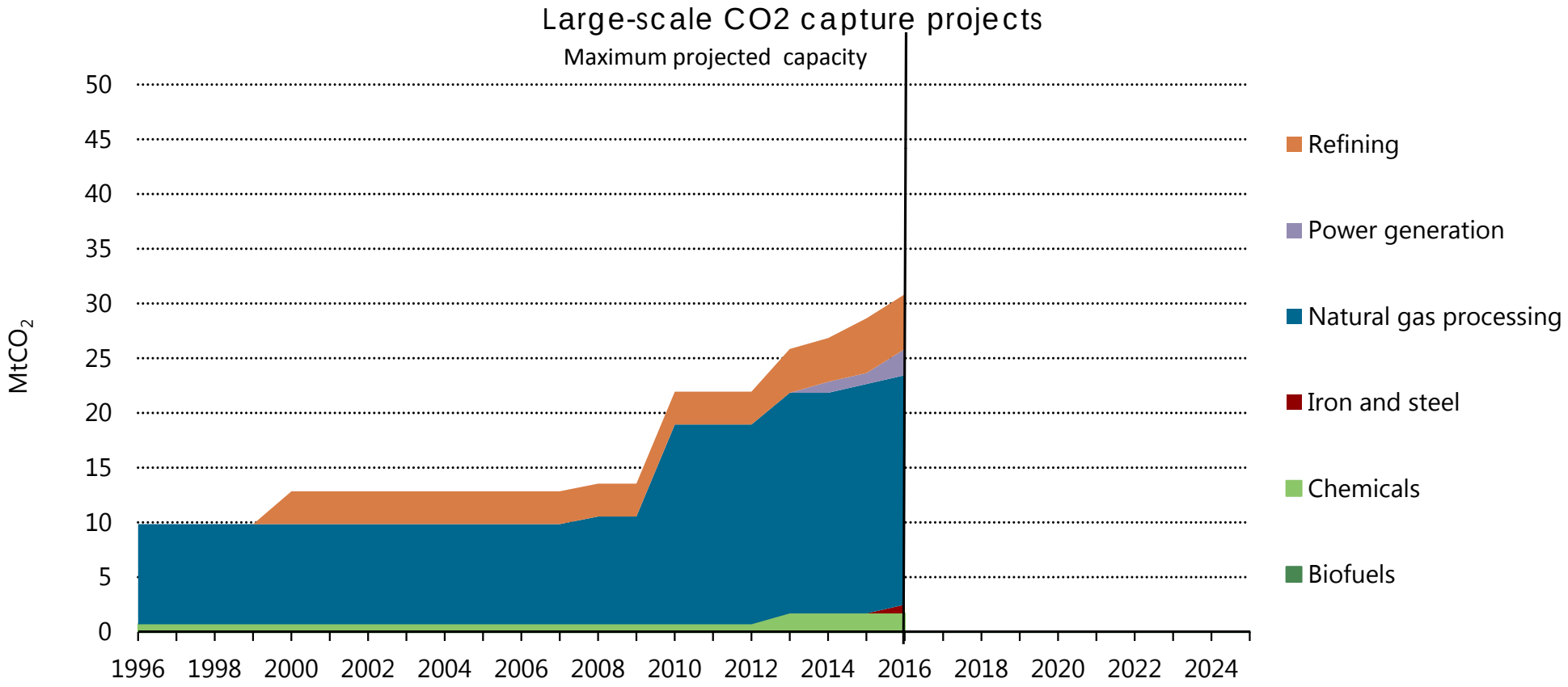
Distributed energy resources scaling up



Digital technologies like blockchain could accelerate deployment (LO3; Power Ledger AU; Investments in startups)

Accelerated deployment of residential solar PV and storage reaching 1 GW annual installations in 2017

- The necessity of CCS is still not understood



The global portfolio of large-scale CCS projects continued to expand, with the first steel plant CCS and the first (BECCS) plant being deployed,

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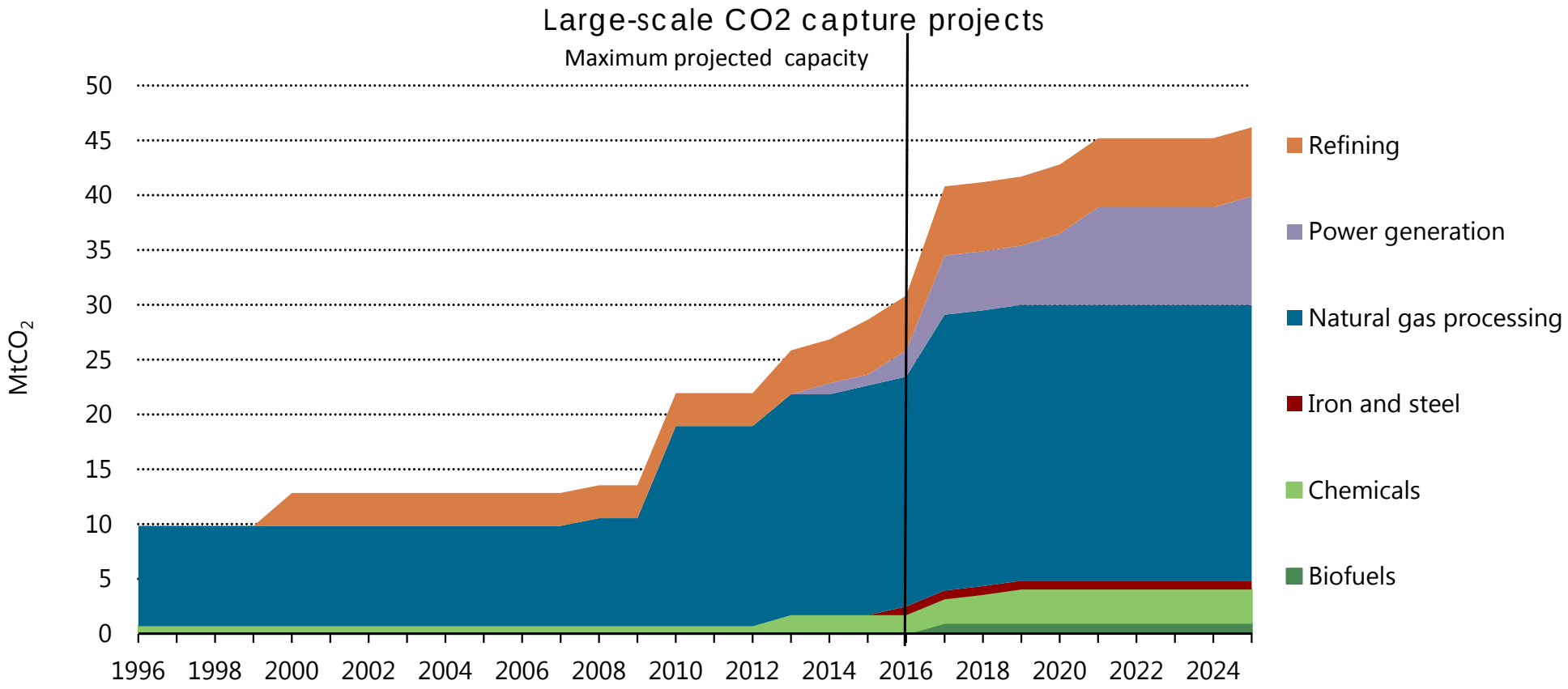

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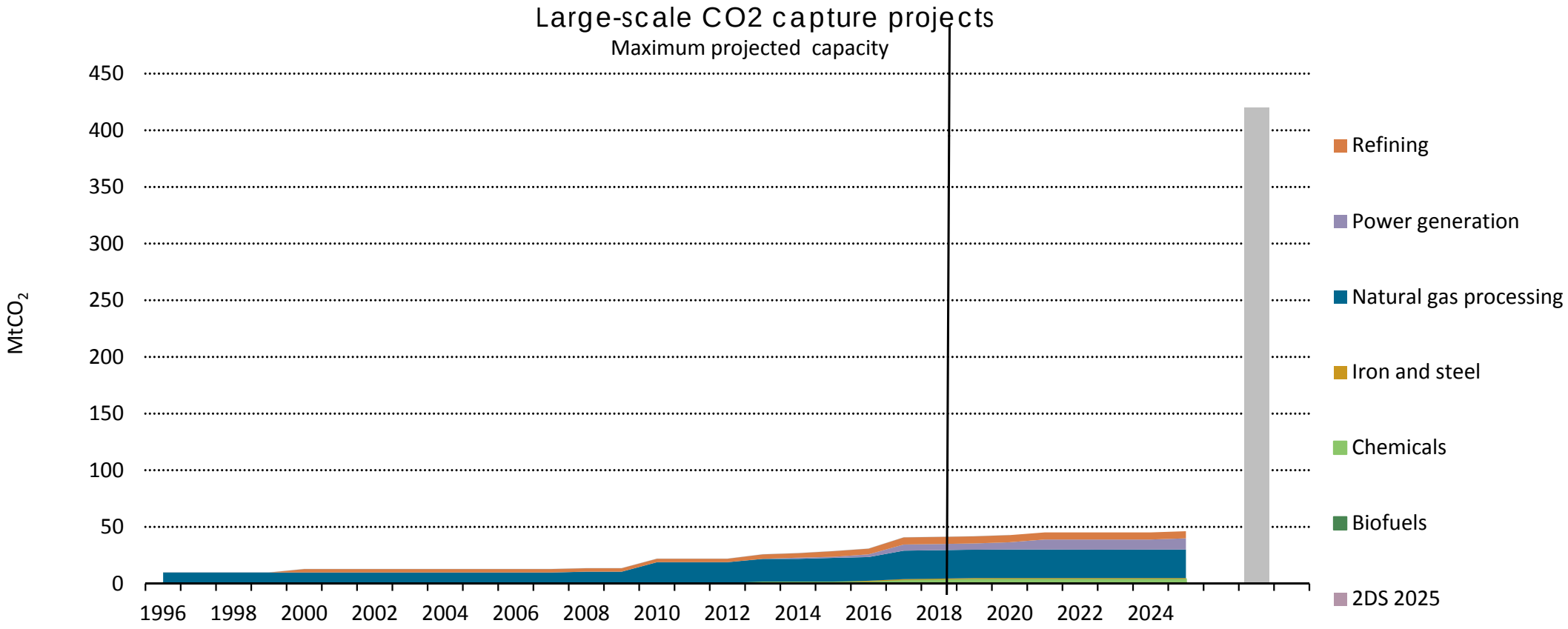

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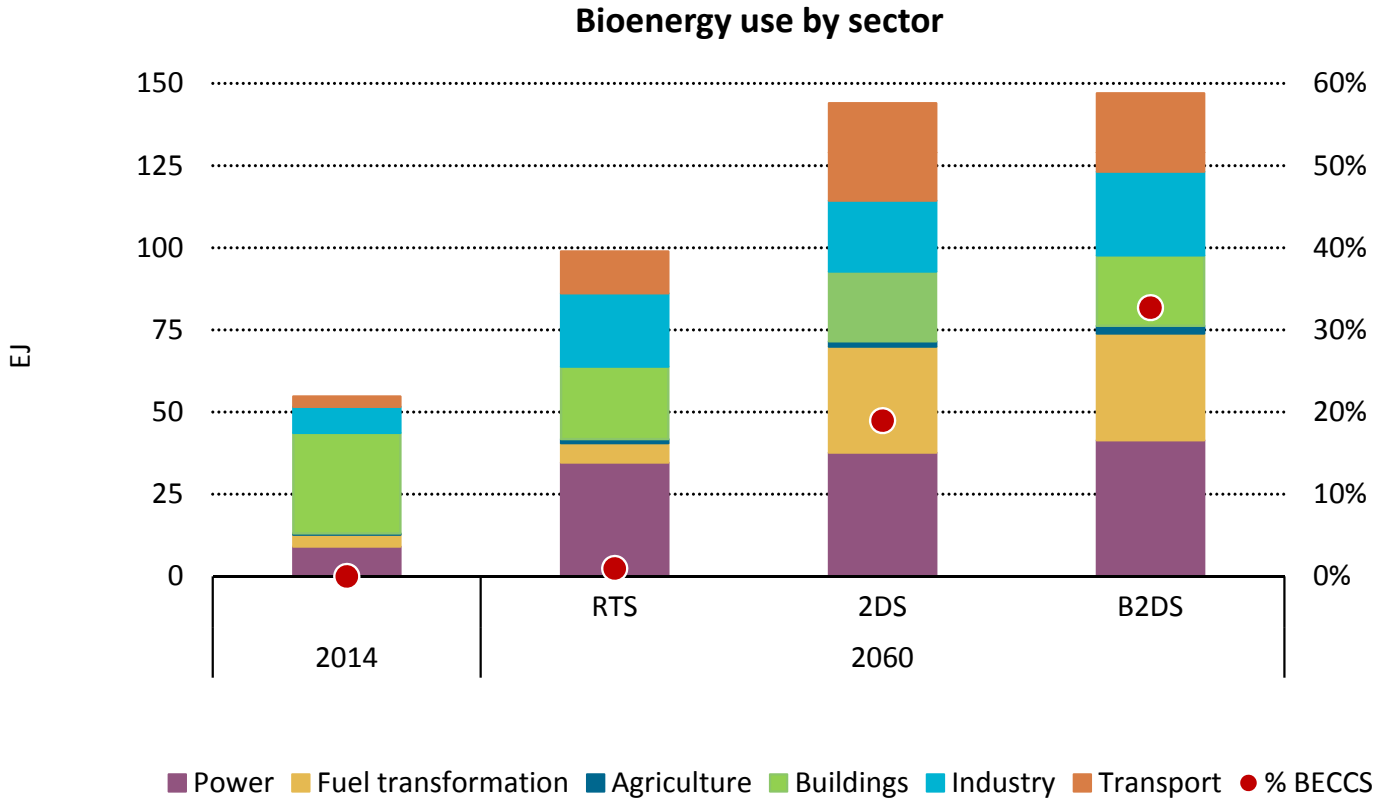
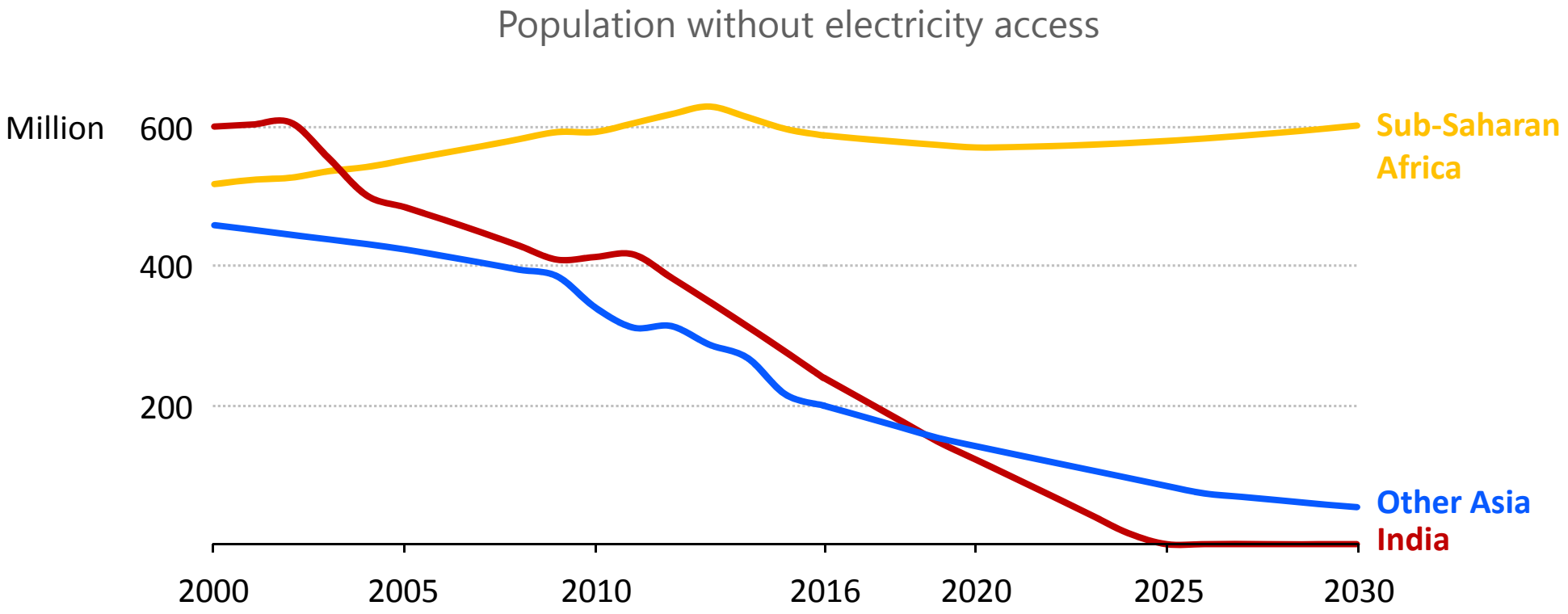
Negative emissions compensate for other sectors/end uses



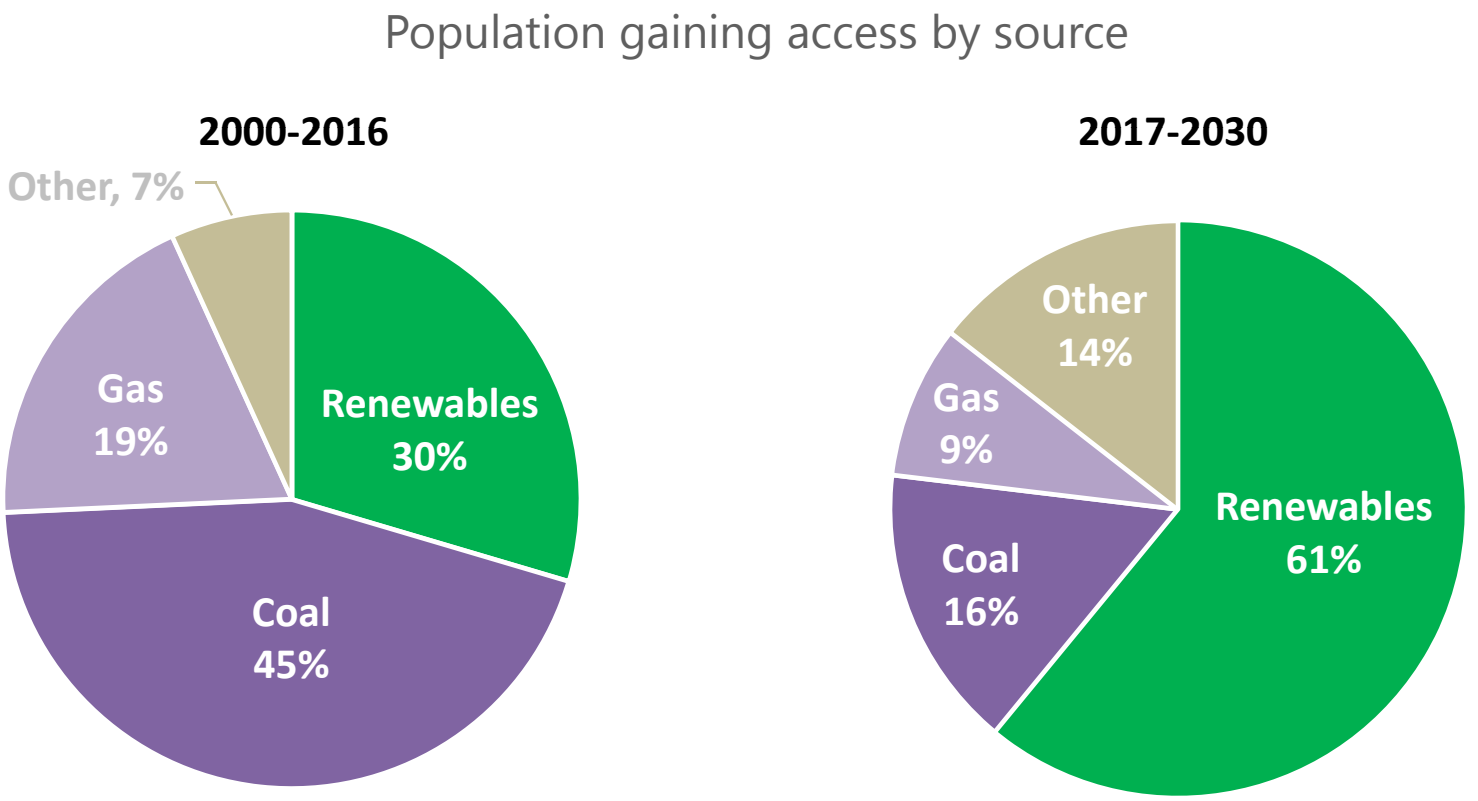
Around 145 EJ of sustainable bioenergy is available by 2060 in all decarbonisation scenarios, but in the B2DS a lot more goes to negative emissions technologies (BECCS)

Progress in electricity access is seen in all world regions, but sub-Saharan Africa lags behind



Many countries, led by India, are on track to achieving full electrification by 2030, but – despite recent progress – efforts in sub-Saharan Africa need to redouble

A shift in the electricity access paradigm



Declining cost of renewables and innovative off-grid business models are transforming the way access is delivered, especially in rural areas

Tracking energy access

Additional impact of the Energy for All Case relative to the Central Scenario, 2030

1.9% Increase in global energy investment

1.8 Million deaths avoided annually

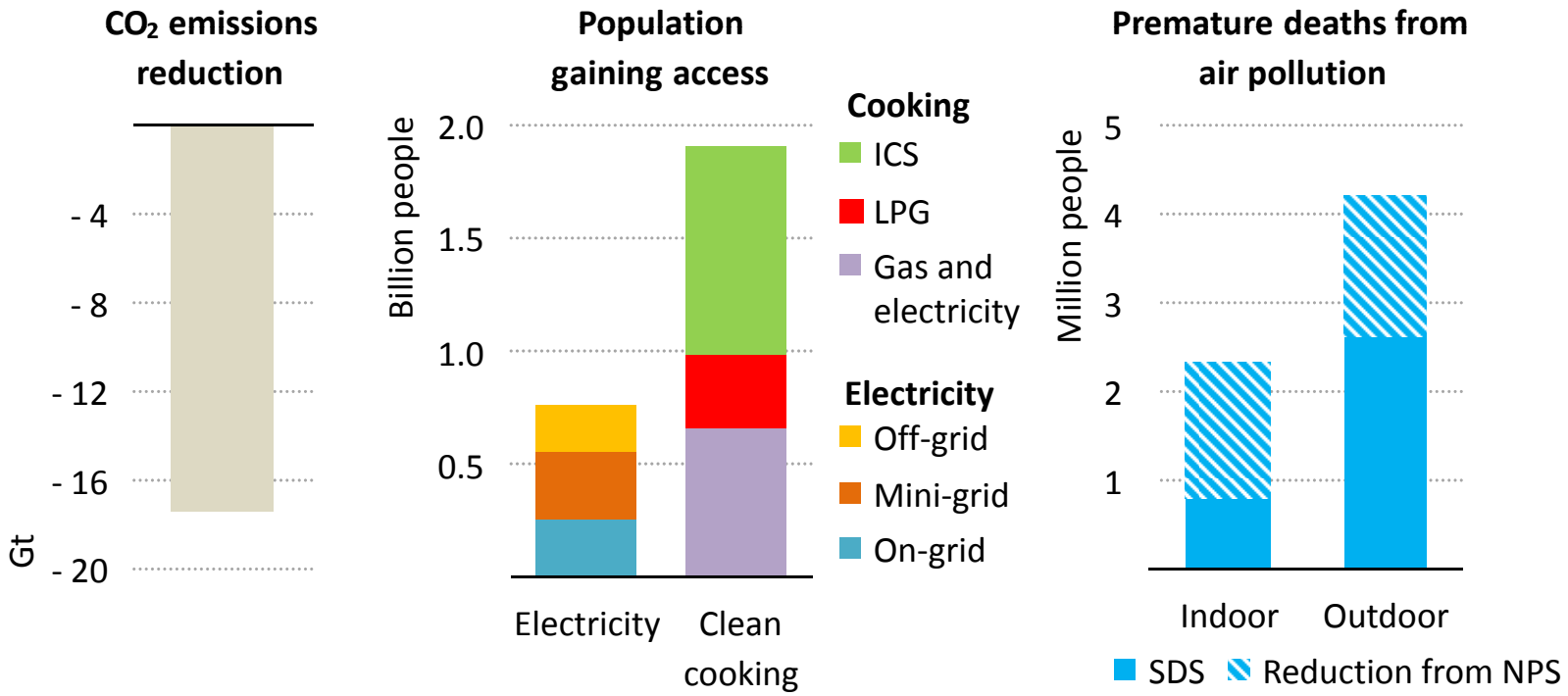
2 Months of work saved annually per woman

0% Net increase in greenhouse-gas emissions

The benefits of achieving universal energy access by 2030 far outweigh the costs

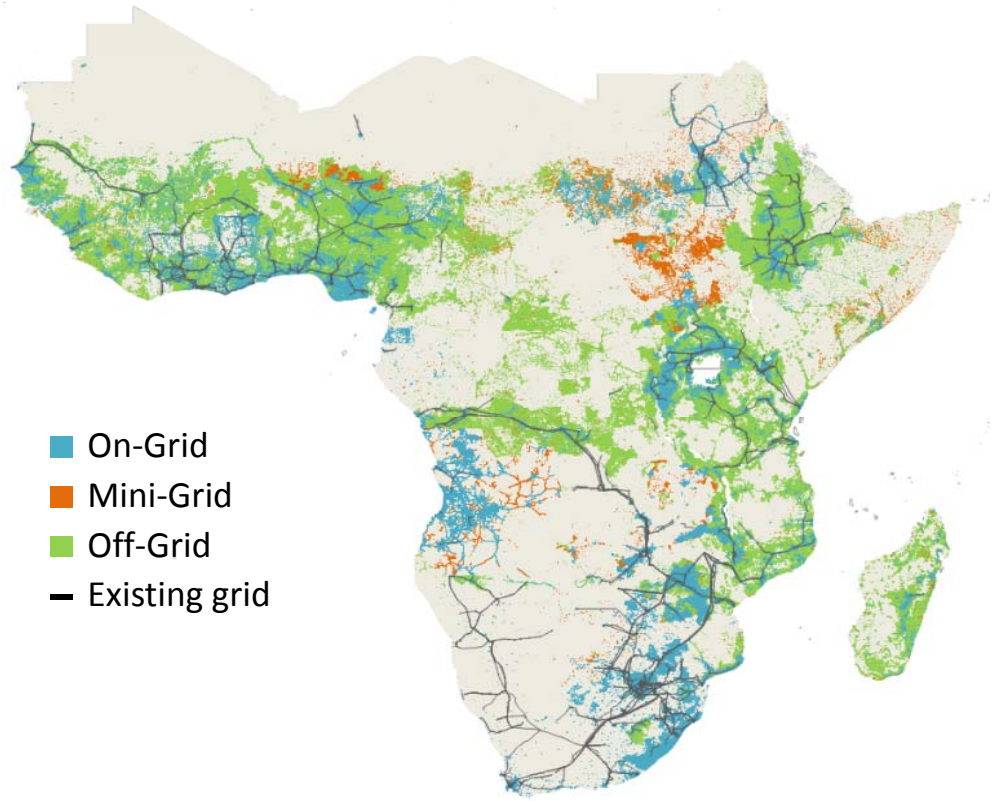
A whole new sustainable energy world

Impacts of the Sustainable Development Scenario relative to the New Policies Scenario, 2040

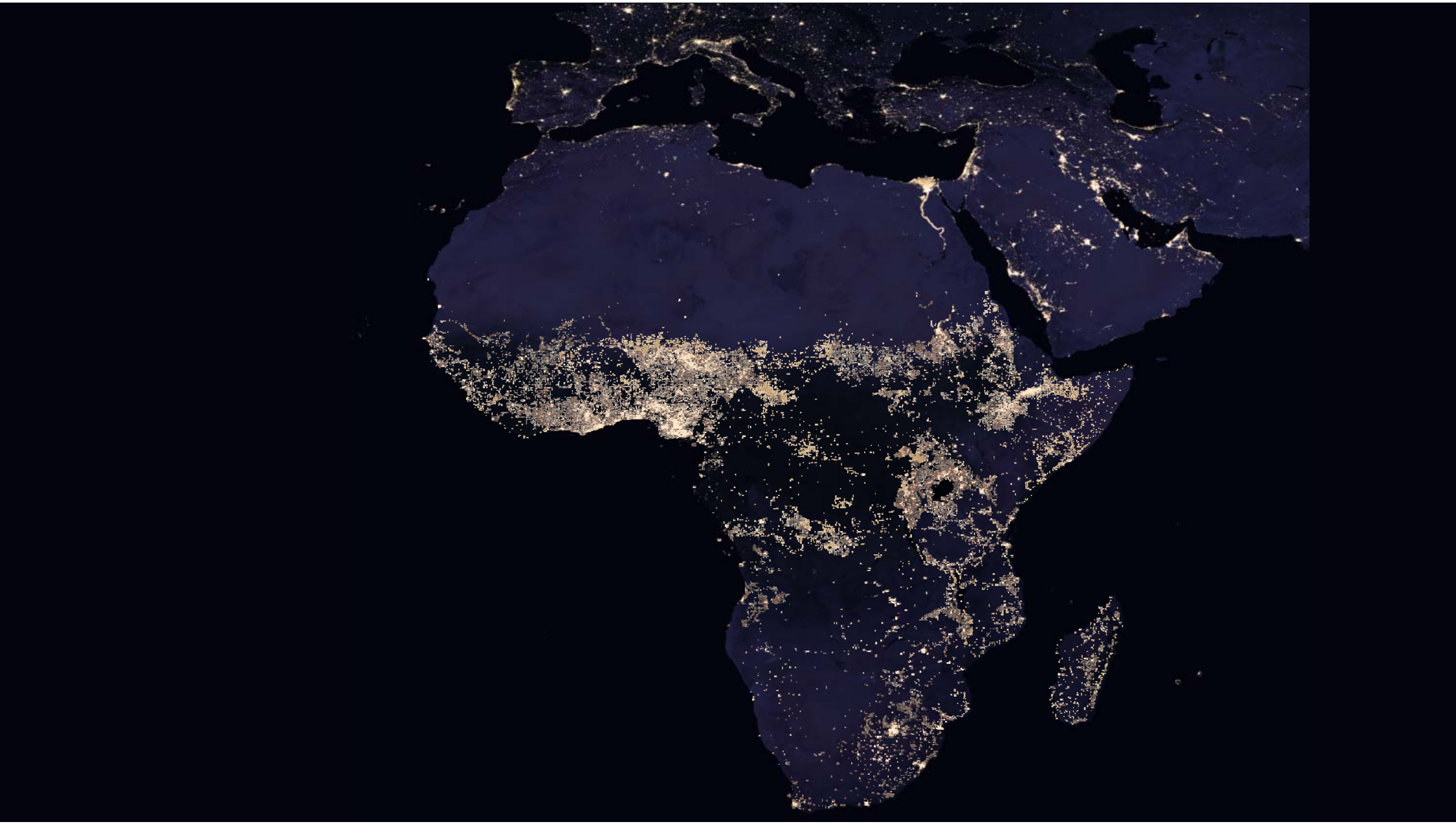


Policies of the Sustainable Development Scenario contribute to increasing energy access, improving human health and addressing climate change

An IEA strategy to universal electricity access

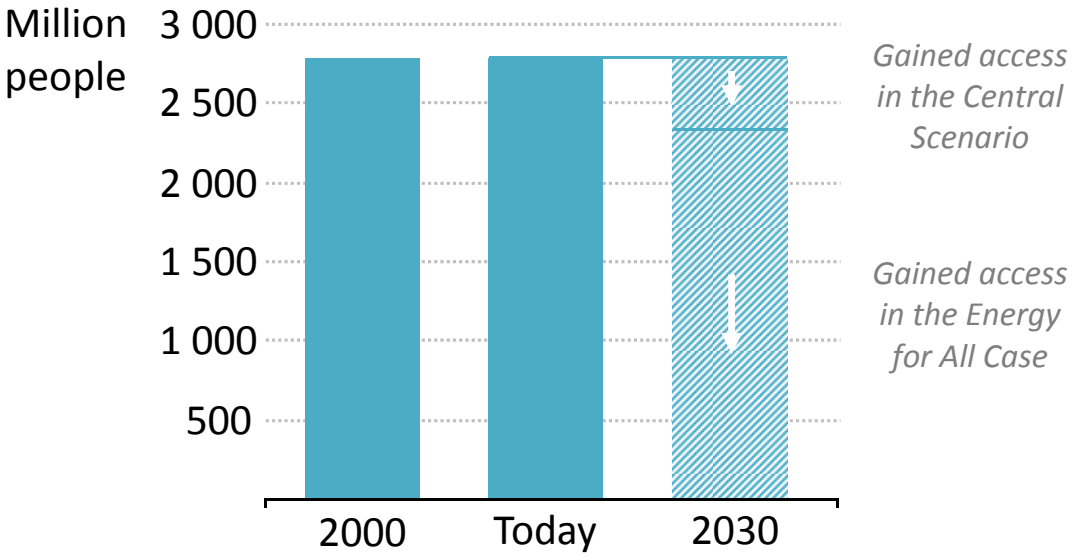


- **Grid extension for 150 million additional people, with hydro accounting for the lion's share**
- **Decentralised solutions, mainly solar PV, for the remaining 450 million people in rural areas**
- **An additional $26 billion per year is needed in electricity generation and grids**

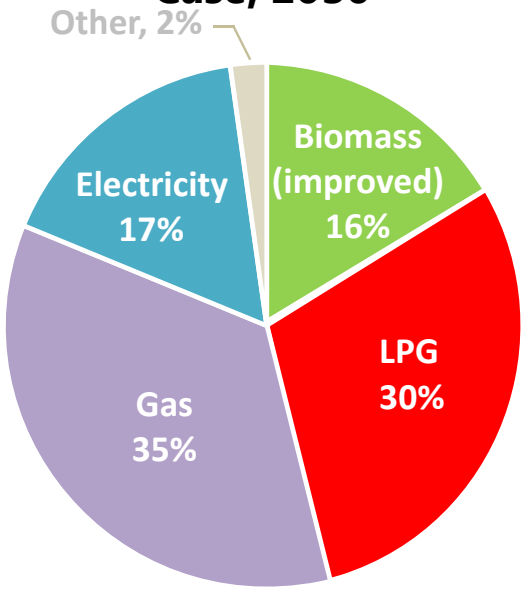


Clean cooking for all: what will it take?

Population without access to clean cooking

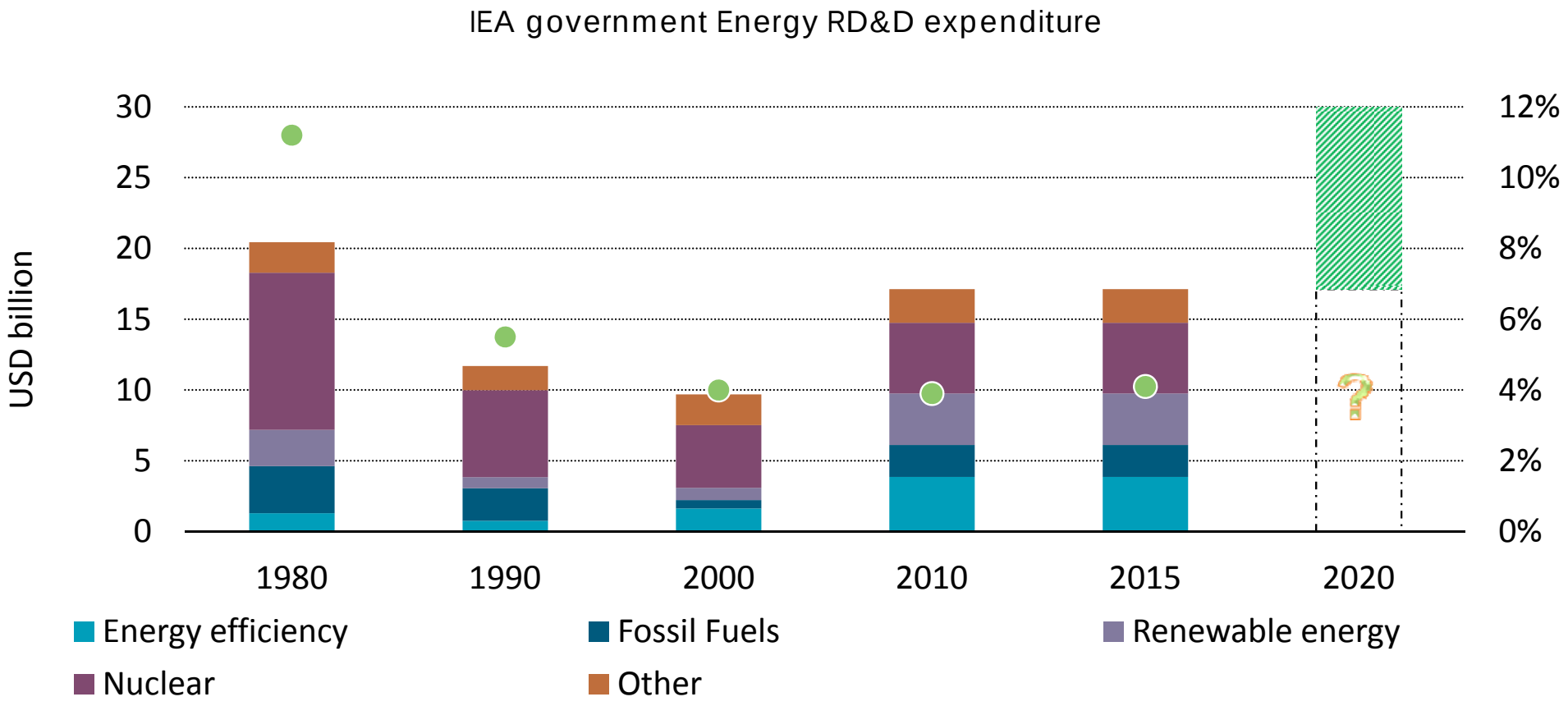


Clean fuels and technologies used for cooking in developing countries in the Energy for All Case, 2030



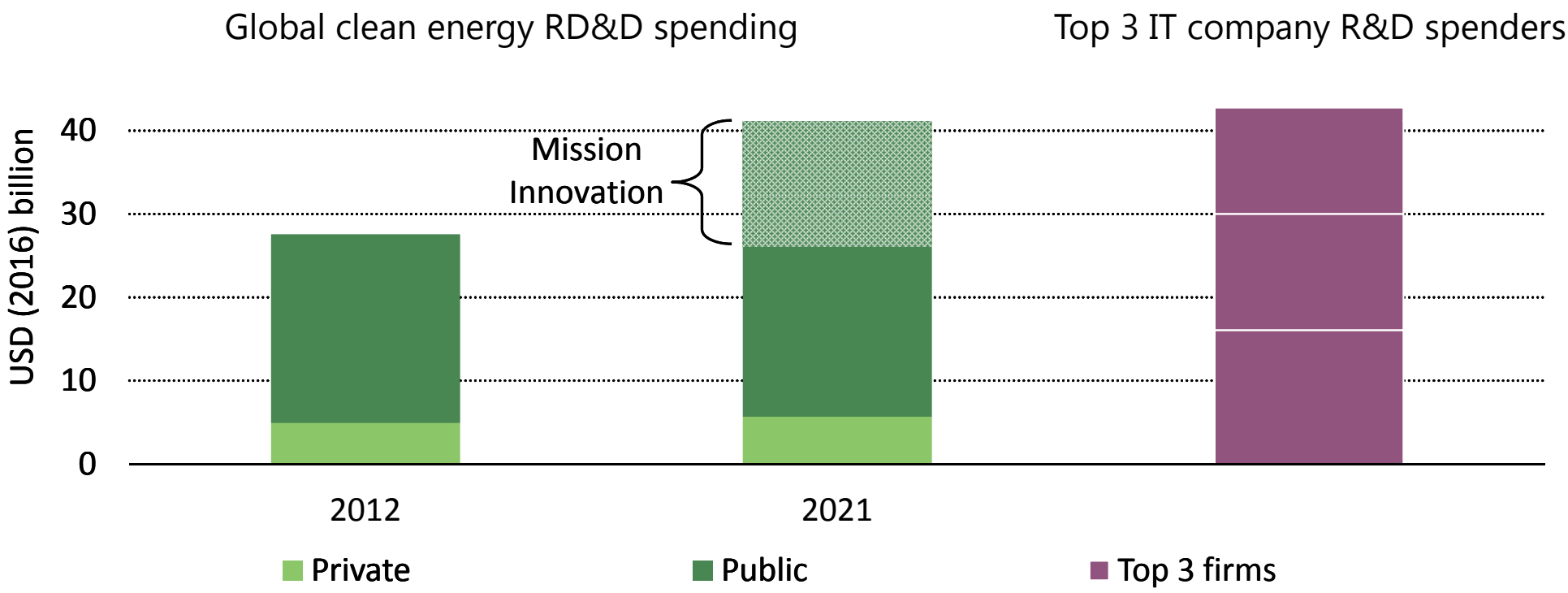
The deployment of a range of clean fuels and technologies can lower premature deaths related to household air pollution from 2.5 to 0.7 million in 2030

- Innovation and RD&D – is it on track?



Energy RD&D spending should reflect the importance of energy technology in meeting climate objectives

… however a strong boost is needed going forward

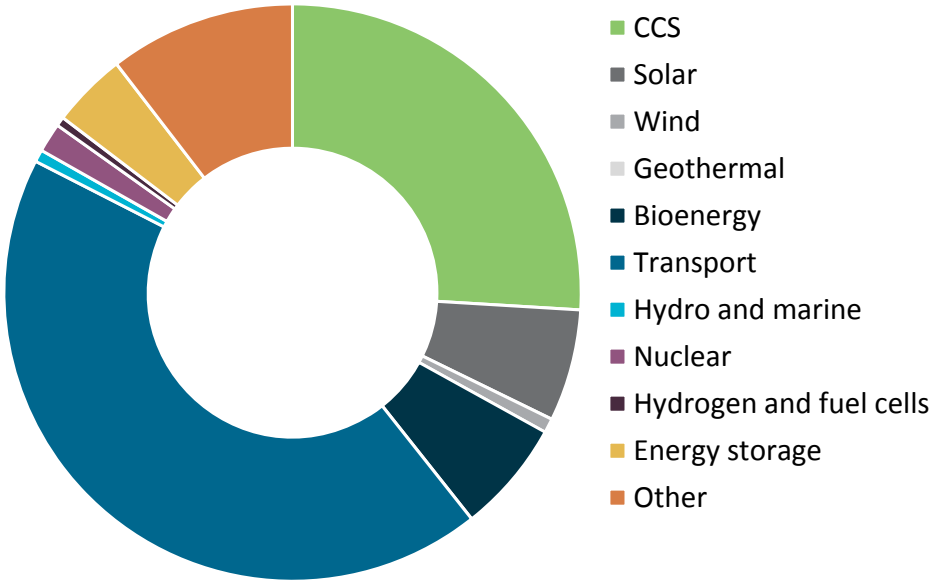


Global RD&D spending in efficiency, renewables, nuclear and CCS plateaued at $26 billion annually, coming mostly from governments. Mission Innovation could provide a much needed boost.

Public and private RD&D spending

Relative shares of clean energy technologies in venture capital (VC) and public RD&D funding

VC breakdown (2016)

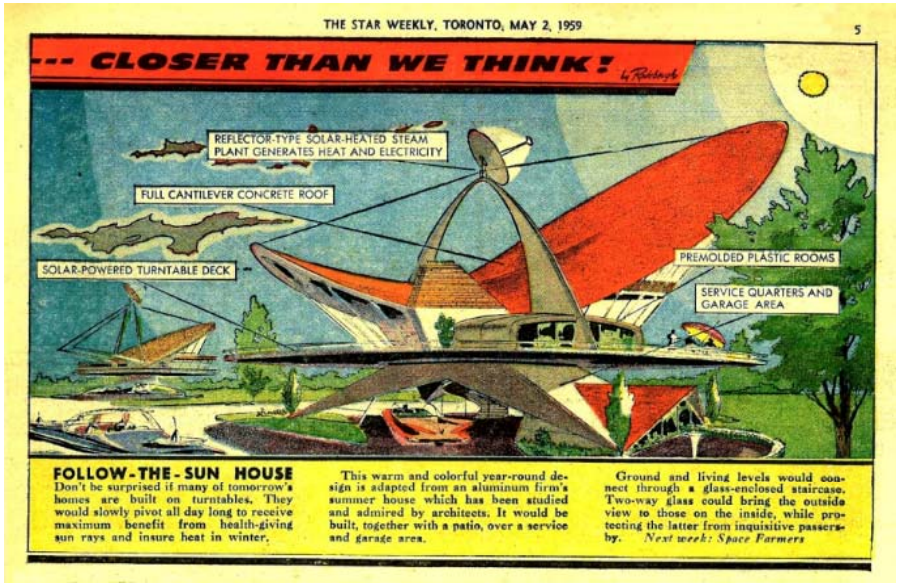


IEA member country spending (2016)

Source: Cleantech Group, 2017

Public and private sector invest in different areas and innovation stages.
Public spending supports technologies that are further from the market or have high development and demonstration costs, including nuclear, CCS and ocean energy.

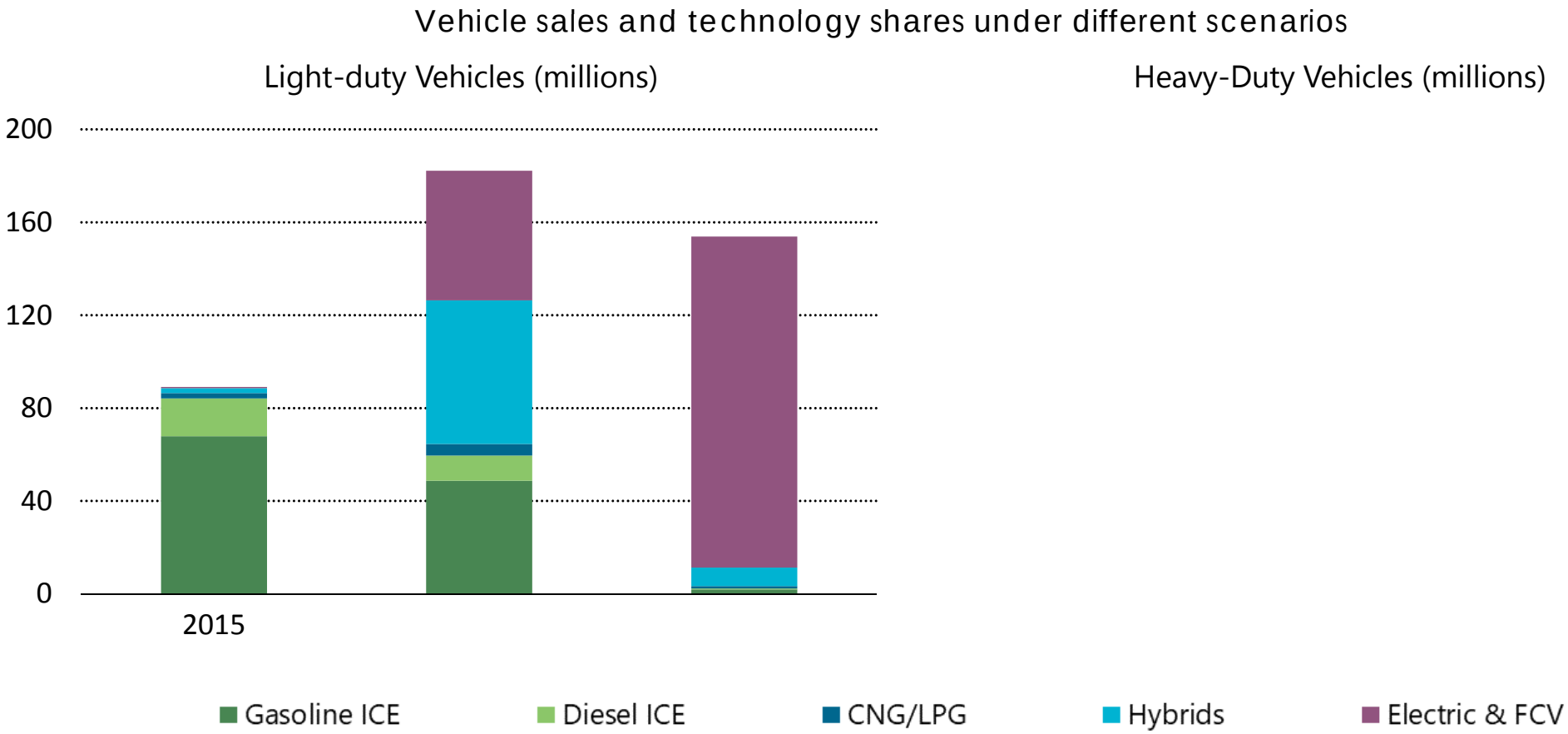
Thanks for listening. Questions?



1959 → 2017 → 2050?

Additional material

Much greater electrification of the transport sector

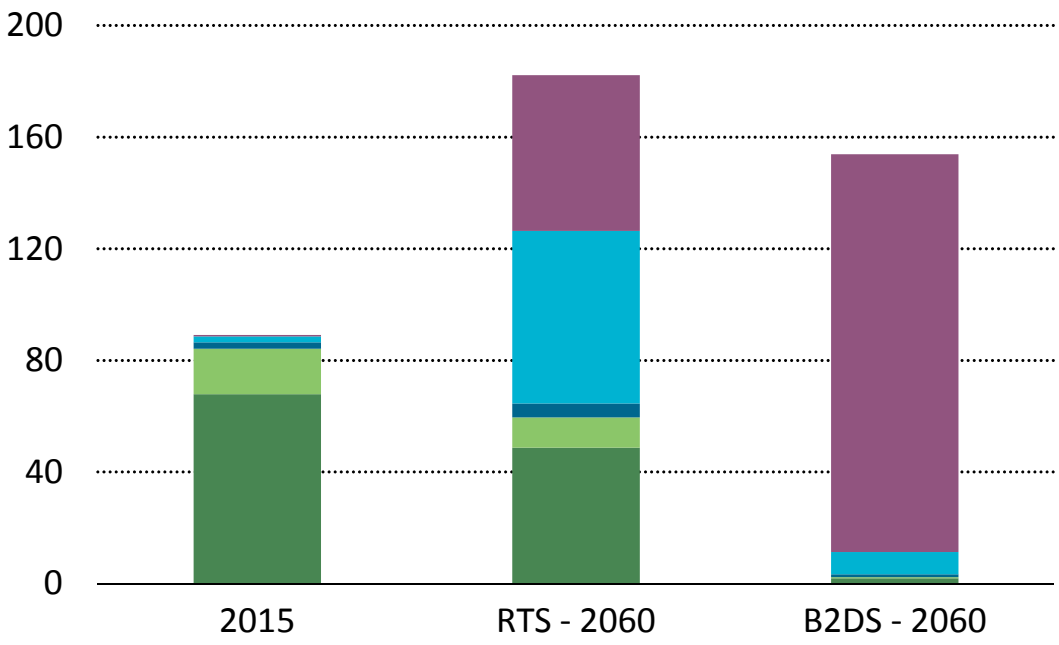


The transportation sector already experiences technological change, but won't shed its oil dependency without assertive policies.

Much greater electrification of the transport sector

Vehicle sales and technology shares under different scenarios

Light-duty Vehicles (millions)

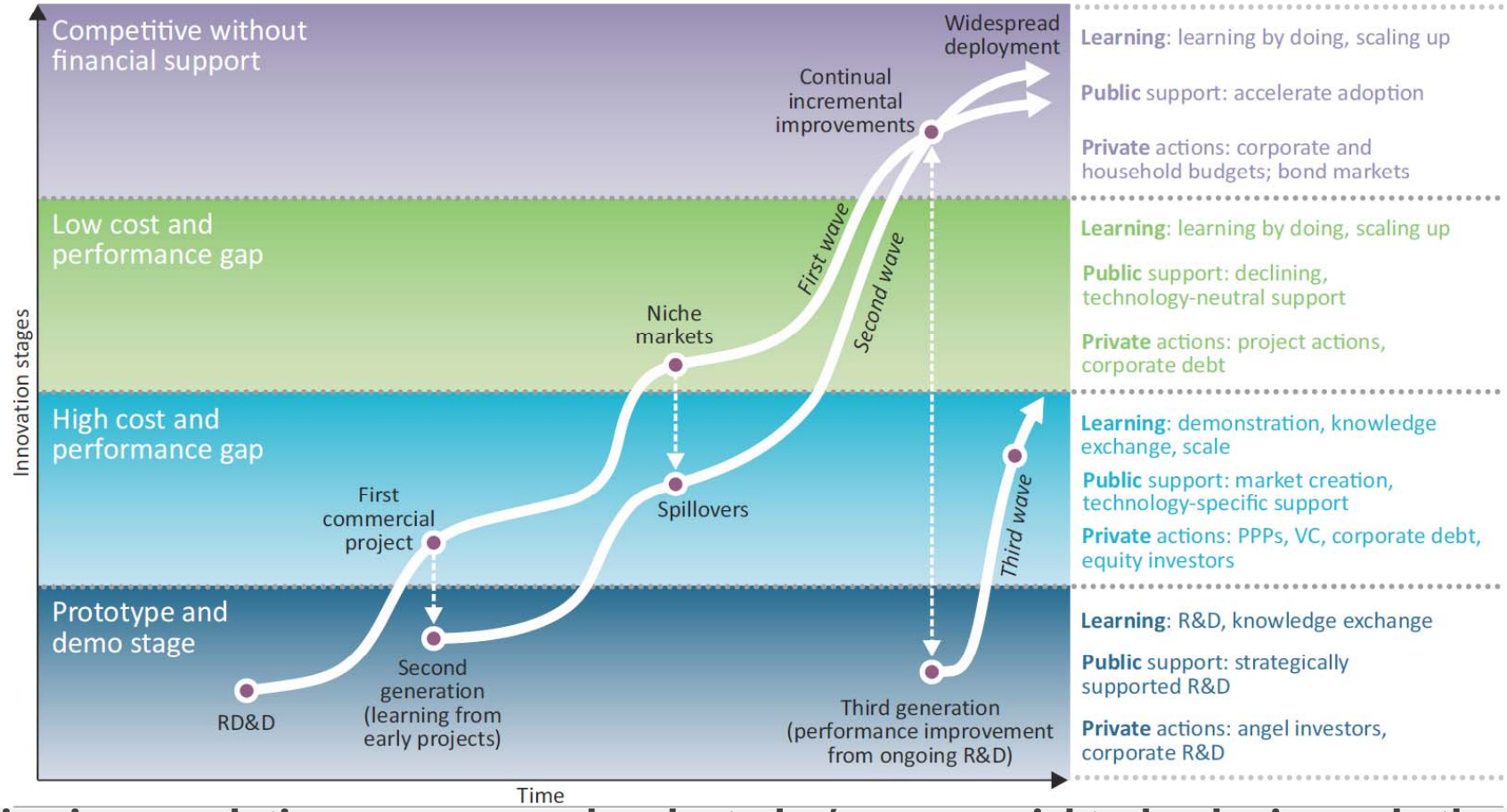


Heavy-Duty Vehicles (millions)

Gasoline ICE Diesel ICE CNG/LPG Hybrids Electric & FCV

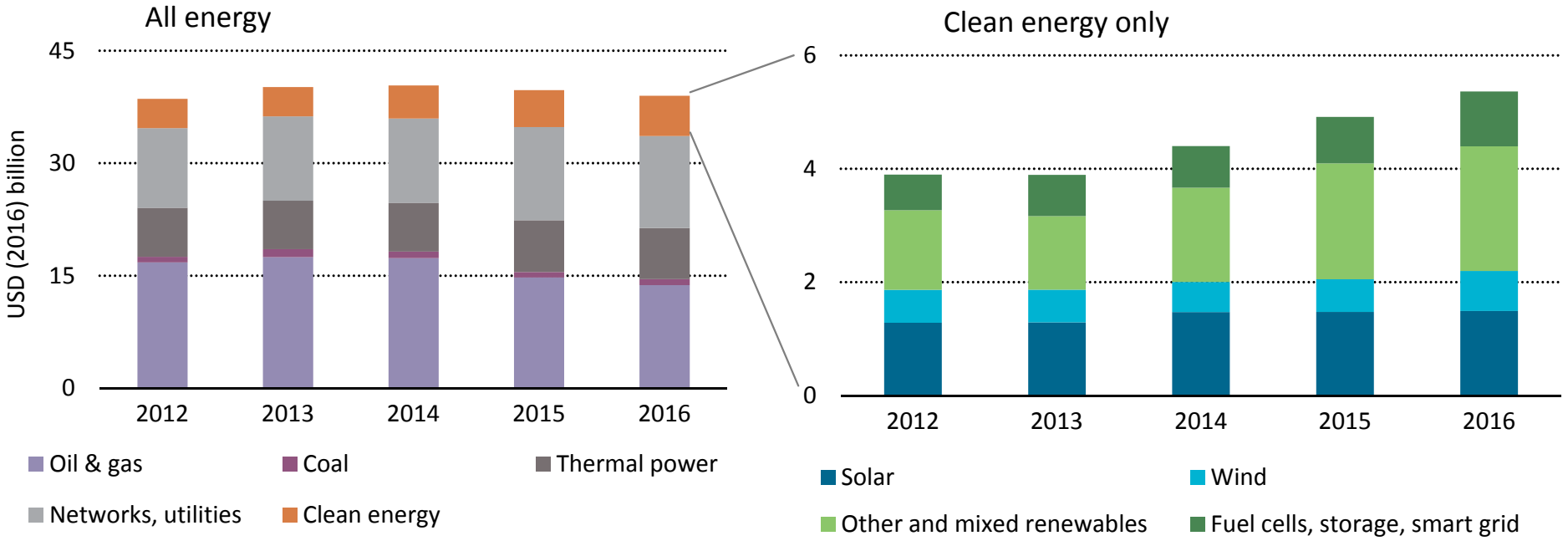
The transportation sector already experiences technological change, but won't shed its oil dependency without assertive policies.

Innovation stages require different public and private models



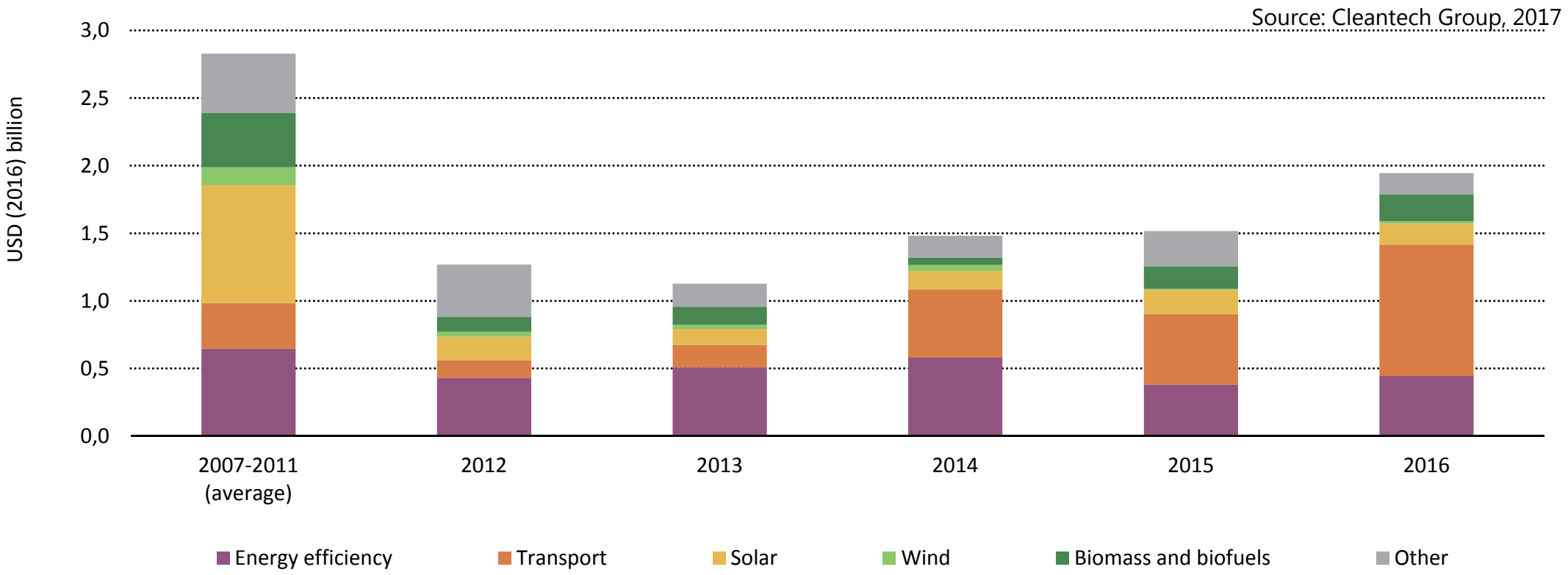
Innovation is an evolutionary process whereby today's commercial technologies – whether low-carbon or high-carbon – can be out-competed by solutions that are currently at the prototype stage if conditions are right.

Clean energy remains a small part of all corporate R&D



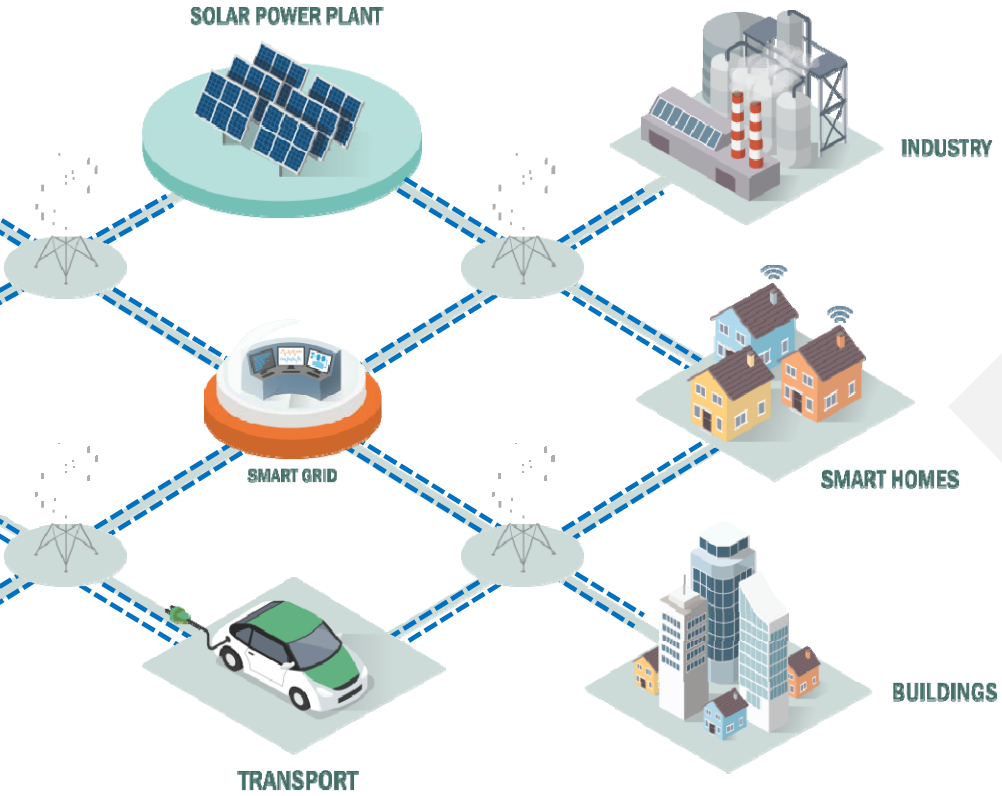
Clean energy spending is growing in absolute terms and represents ever larger share of all corporate R&D spending.

Early-stage VC investment in clean energy topics



Early-stage VC funding for clean energy has grown at 20% per year since 2013, but the technology mix has become more "capital light".

System integration through smart demand response

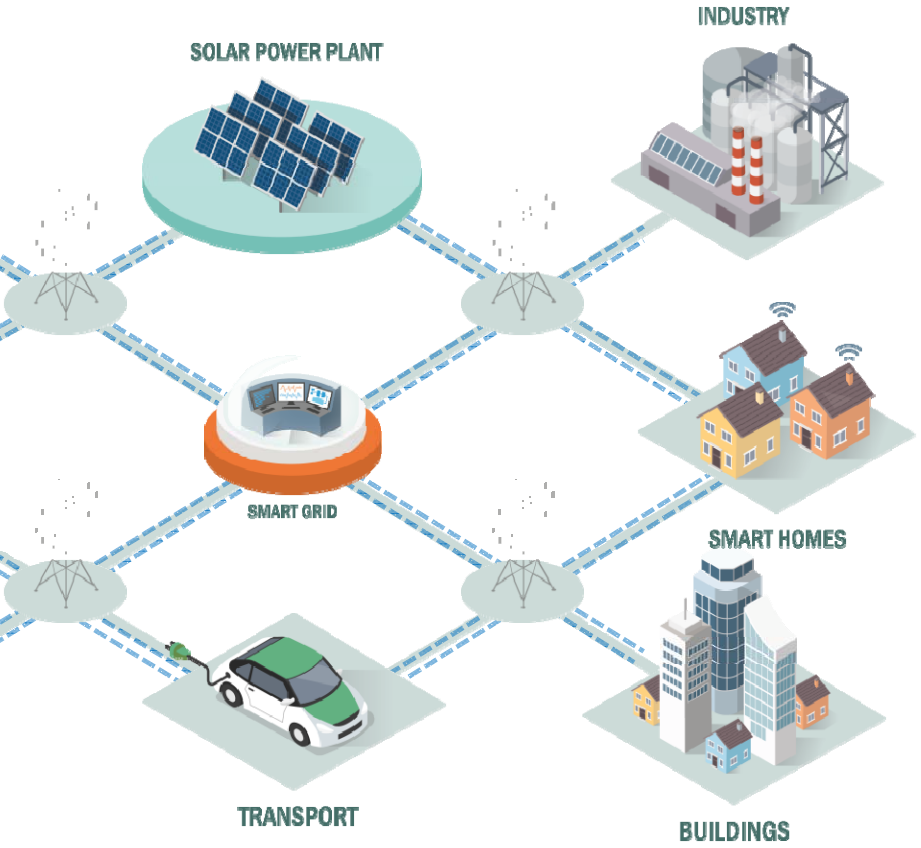


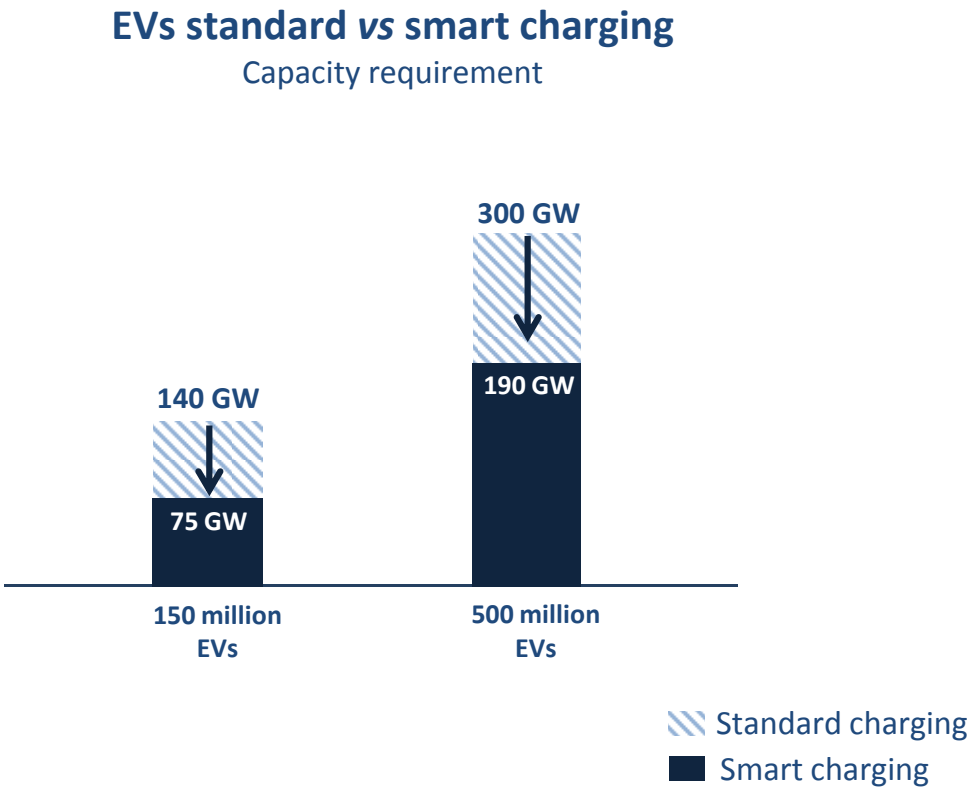
Residential sector

1 billion households and
11 billion smart appliances
could actively participate in interconnected electricity systems

Demand response programs – in buildings, industry and transport - could provide 185 GW of flexibility, and avoid USD 270 billion of investment in new electricity infrastructure

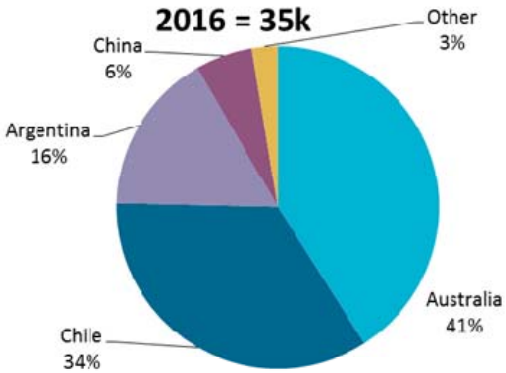
Smart charging of electric vehicles

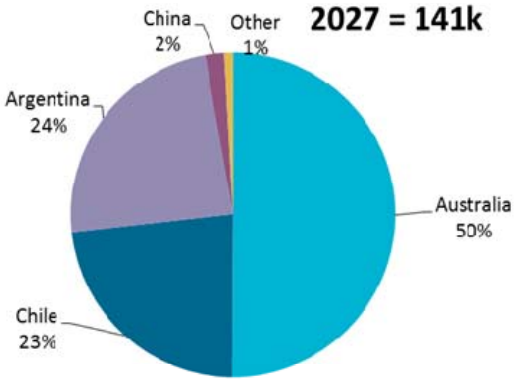




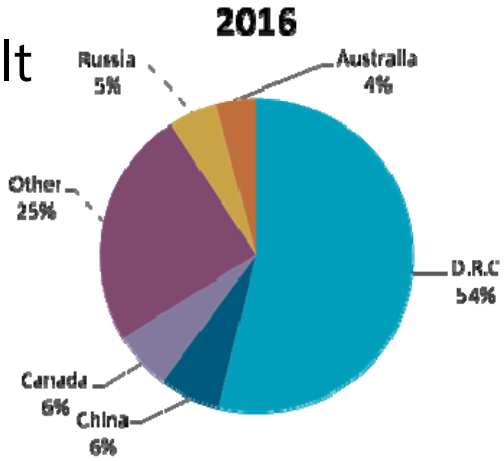
EVs smart charging would provide further flexibility to the grid saving between USD 100-280 billion investment in new electricity infrastructure

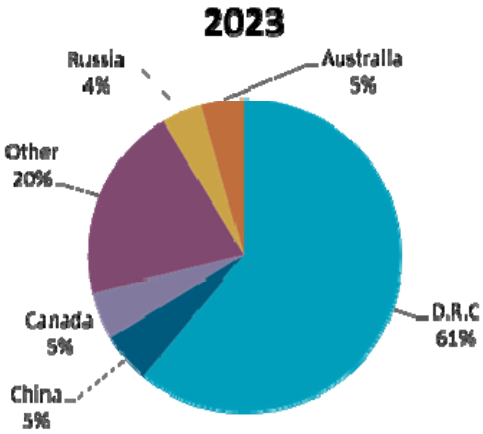
Lithium



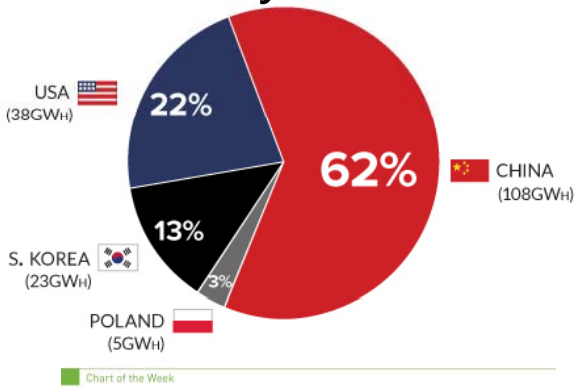


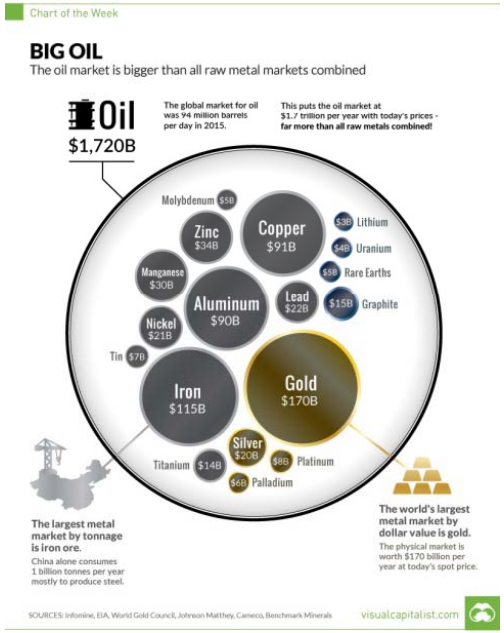
Cobalt



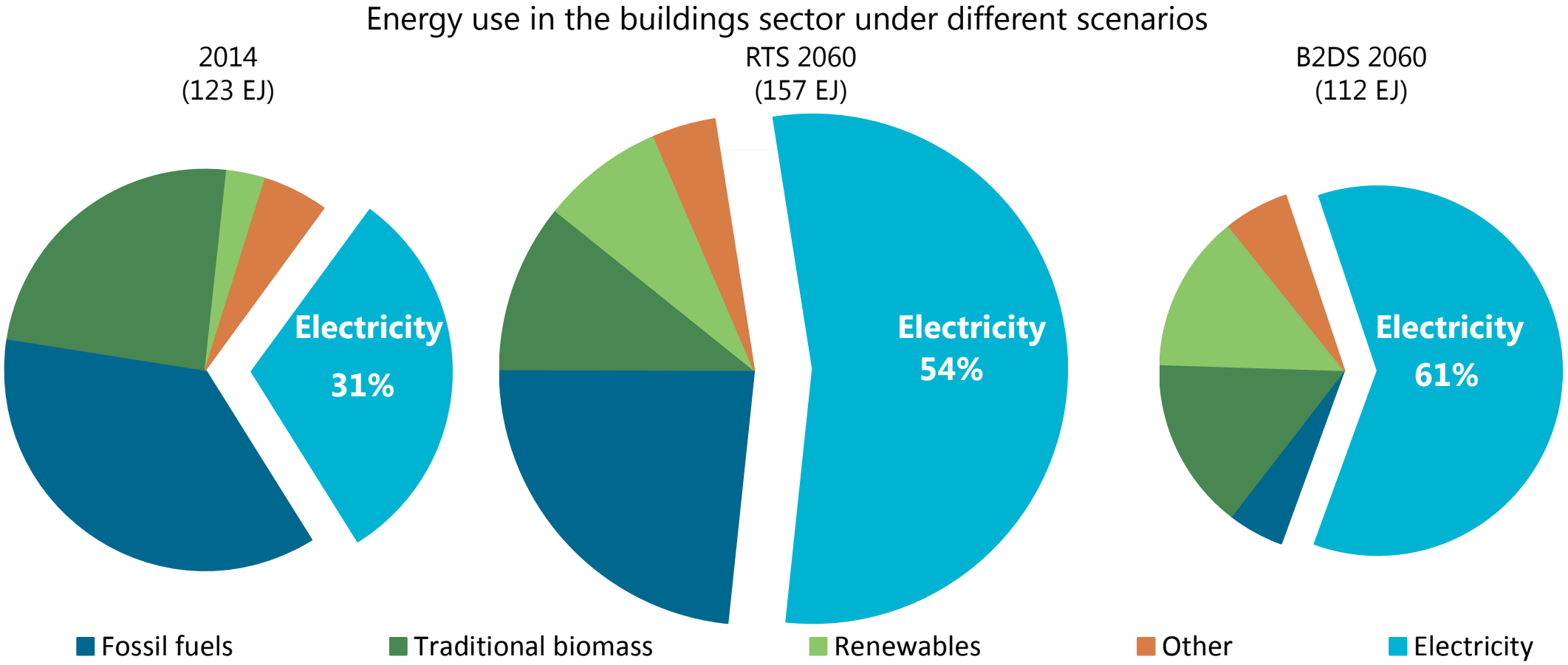


2020 battery manufacturing



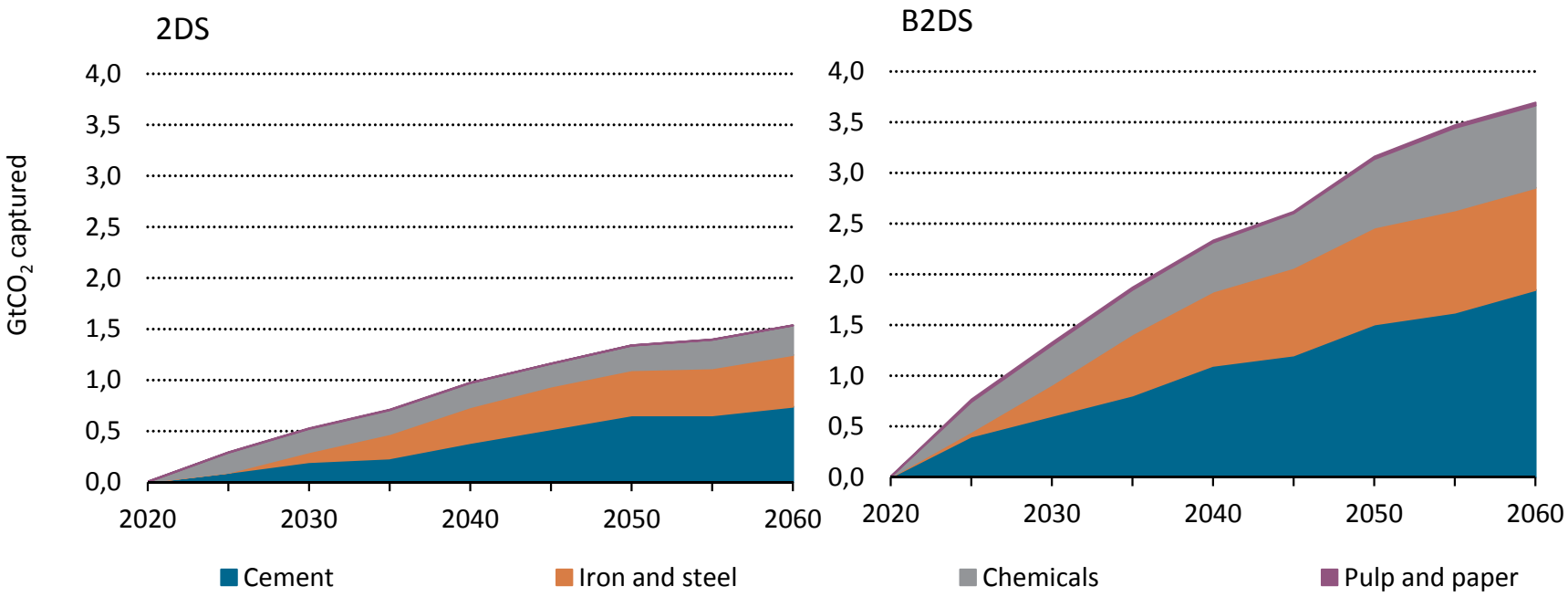


Push for efficiency and electrification in buildings



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

Industrial applications of CCS



CCS in the industrial sector more than doubles when moving to a 2DS as other options are increasingly exhausted