ENERGY TECHNOLOGY

Opportunities and Challenges for More Ambitious Decarbonisation Paths

Power sector break-out group

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International Energy Agency

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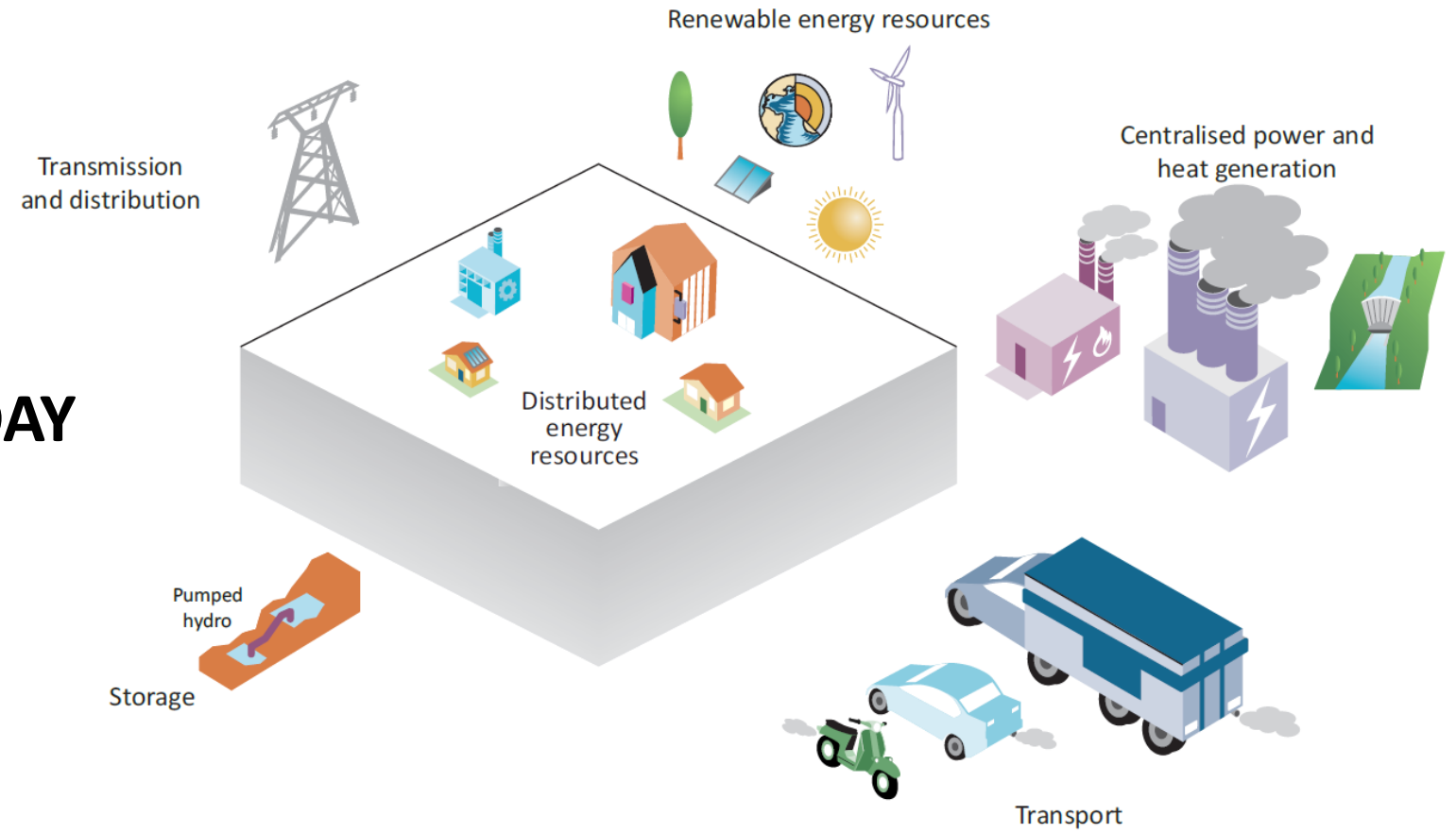
Integrated and intelligent energy system of the future

TODAY



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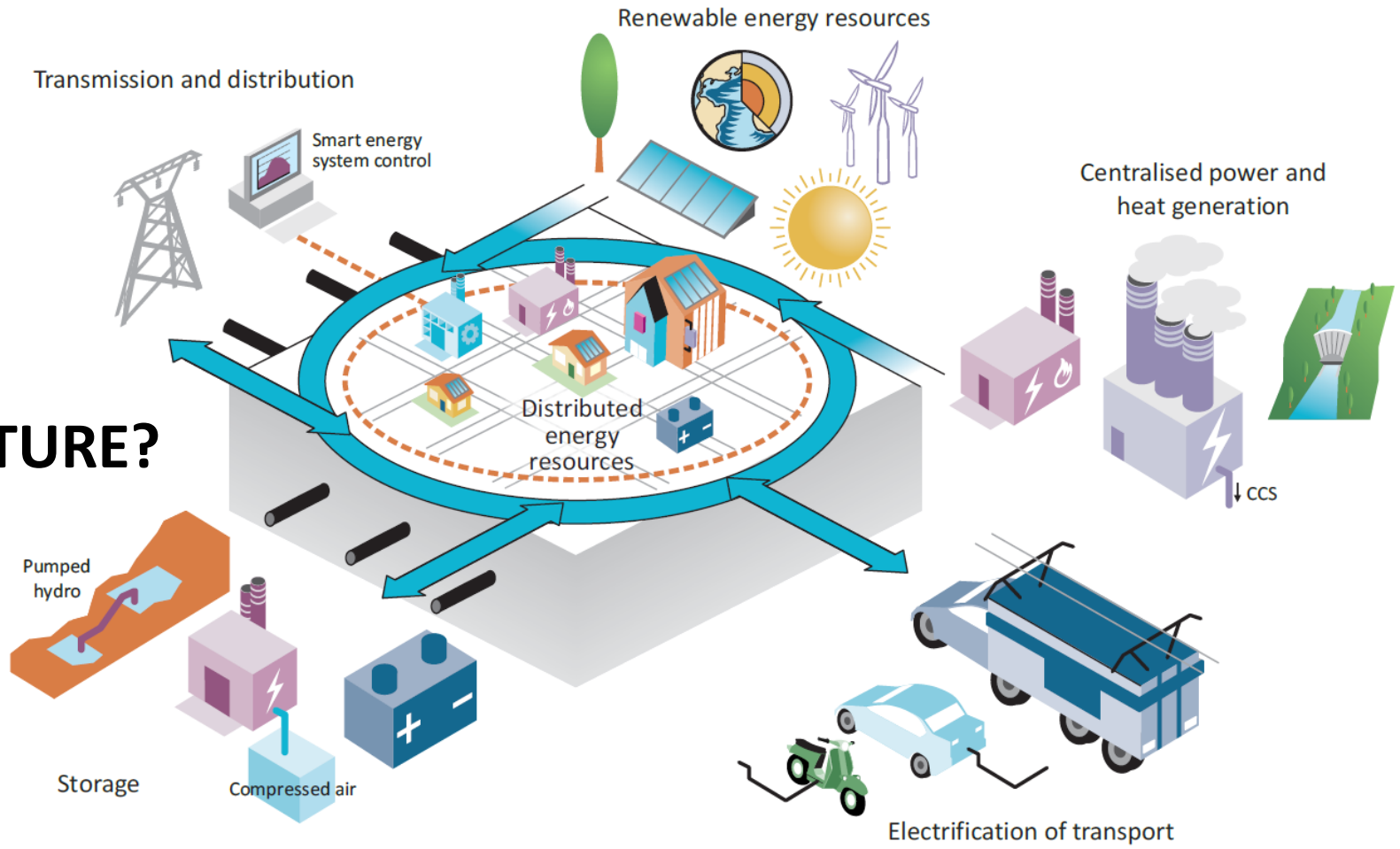


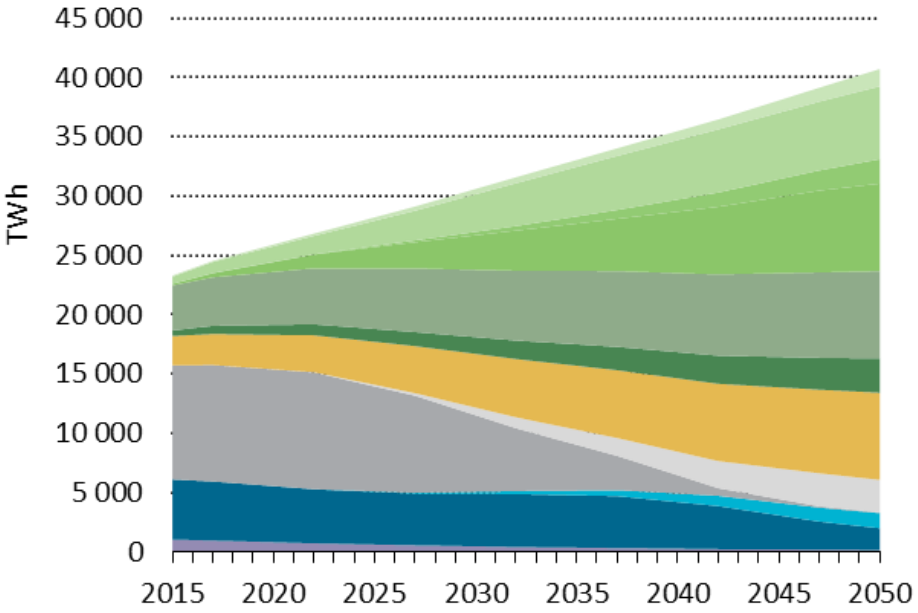
FUTURE?

TOPICS

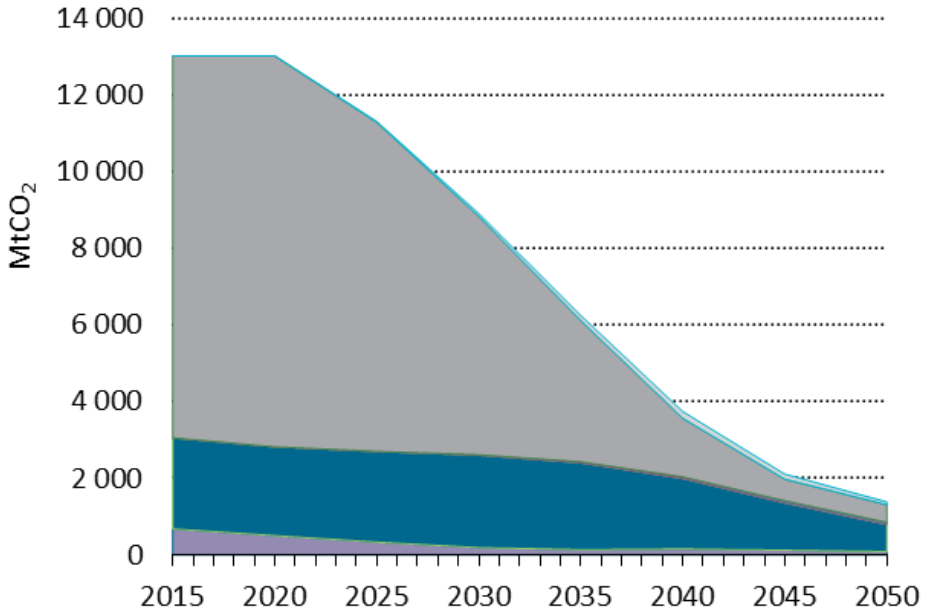
- **What** would a “well-below 2 degree” electricity system look like?
- **How** do we get there? What are challenges in the transition?
- **Cross-cutting aspects**: Linkages of the power sector with other energy sectors

Technologies and strategies towards a decarbonised power system

Global electricity generation



Global CO_2 emissions



Oil | Natural gas | Natural gas with CCS | Coal | Coal with CCS | Nuclear | Biofuels and waste | Hydro | Solar PV | STE | Wind | Other

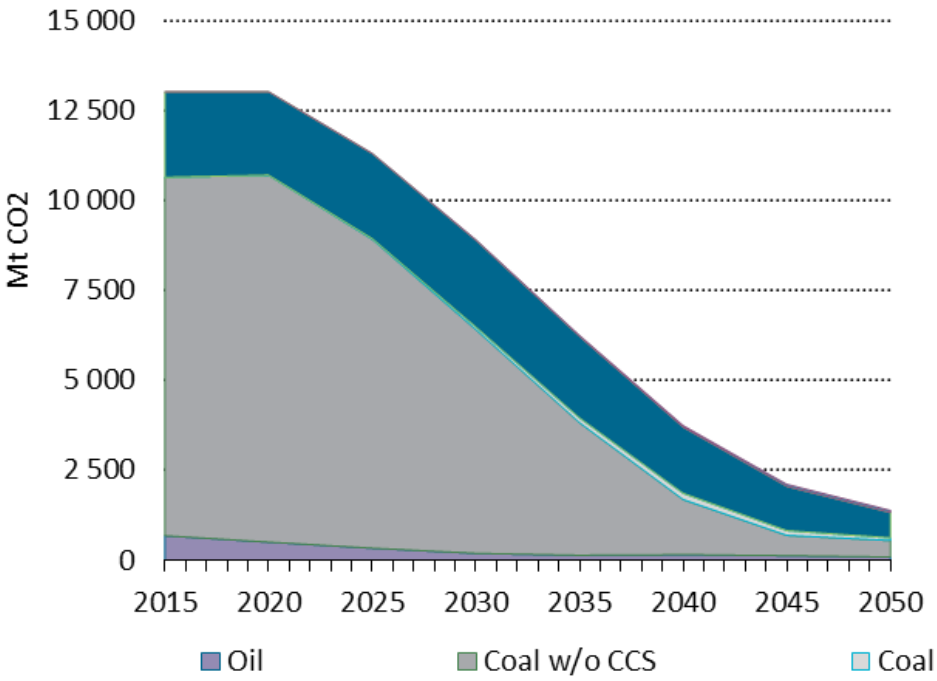
- 95% of the generation in 2050 is from low-carbon technologies (CCS, nuclear, renewables)
- Remaining fossil generation w/o CCS largely natural gas
- CO_2 intensity of global electricity generation falls to around 40gCO_2/kWh by 2050

Technologies and strategies towards a decarbonised power system - Questions

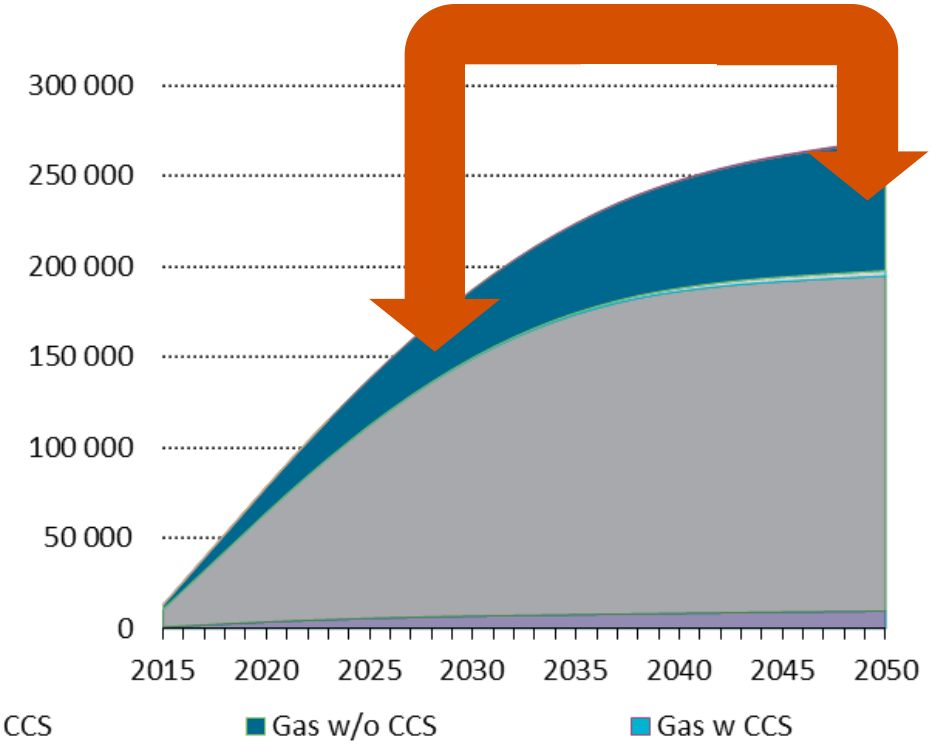
- Should one **aim for net zero emissions in the power sector**, or allow for remaining emissions to be offset elsewhere (e.g. negative emissions from BECCS in biofuel production)?
- **Are new technologies are needed**, not playing a prominent role under a 2 degree scenario (e.g. hydrogen fuel cells with hydrogen also being a storage option for variable renewables and fuel in industry, buildings and transport)?
- Which **technologies/fuels used in a 2DS may face challenges** with more ambitious reduction targets, e.g.:
  - Remaining emissions of **fossil power plants with CCS** in a net-zero power sector too high for a well-below 2 degree world? Should one look at higher capture rates? Co-firing with biomass to offset the remaining emissions?
  - Is **natural gas without CCS too carbon-intensive, even for providing flexibility** to the electricity system?

How do we get there?

Global CO_2 emissions power sector in 2DS



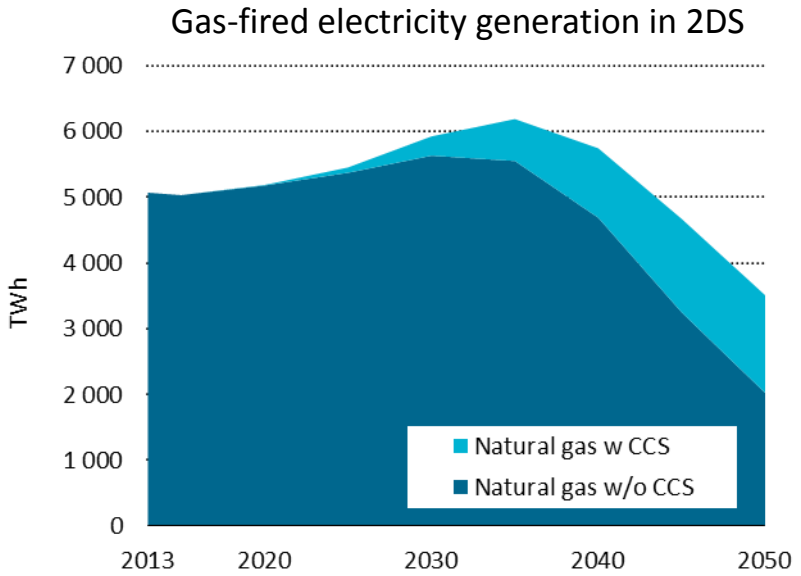
Accumulated global CO_2 emissions in the power sector(2015-250)



- Next 20 years critical in the power sector for further reductions in cumulative CO2 beyond 2DS:
  - By 2025, already 50% of the cumulative emissions of the power sector over the period 2015-2050 have been emitted.
  - By 2035, the amount increases to 80% and to 90% by 2040.

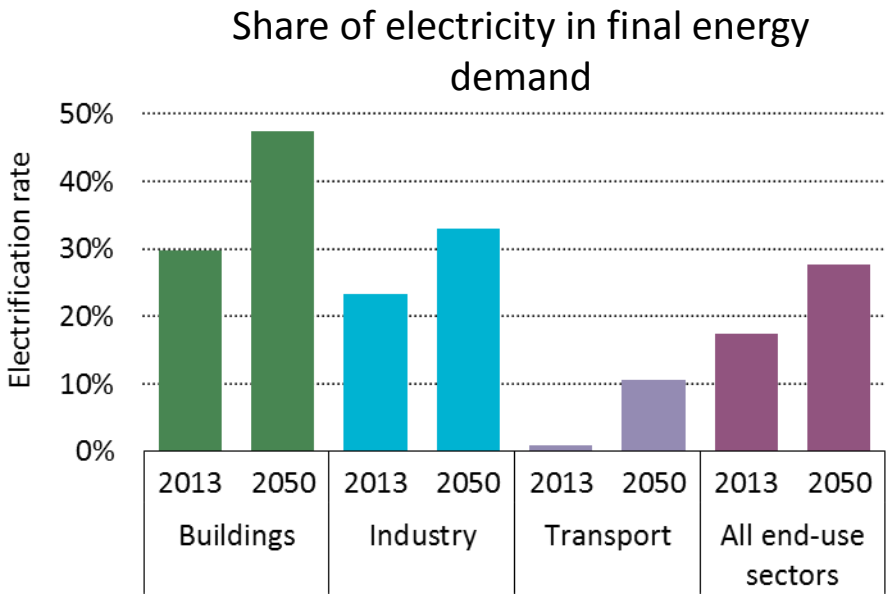
How do we get there? Questions

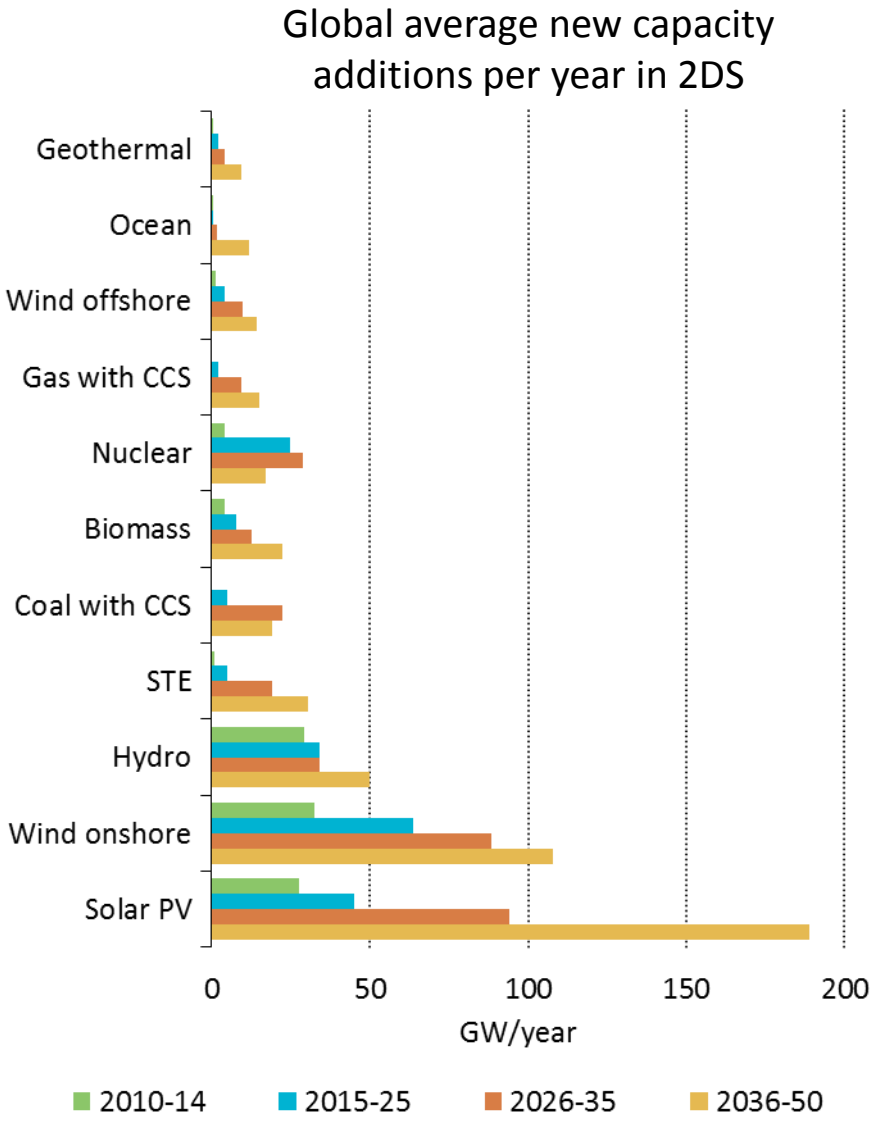
- **Scope for further reductions over the next 20 years to achieve significant reductions in cumulative emissions?** Leading to more and earlier stranded assets in electricity generation?
- Technology solutions **to avoid early retirements** (e.g. retrofit with CCS, co-firing with or complete conversion to biomass)?
- Looking rather into ways to **reduce electricity consumption** (efficiency, renewables) in the end-use sectors to reduce cumulative emissions in the power sector?
- What are the **consequences of a more stringent long-term CO_2 target (2050) on new capacity additions in the next 20 years**, given the long lifetime of power technologies? For example, more rapid decline of gas-fired generation without CCS and earlier and more rapid deployment of low-carbon technologies needed?



- What **policy efforts and regulatory instruments** needed for reaching reductions beyond a 2 degree scenario?

Beyond the electricity sector
Electrification

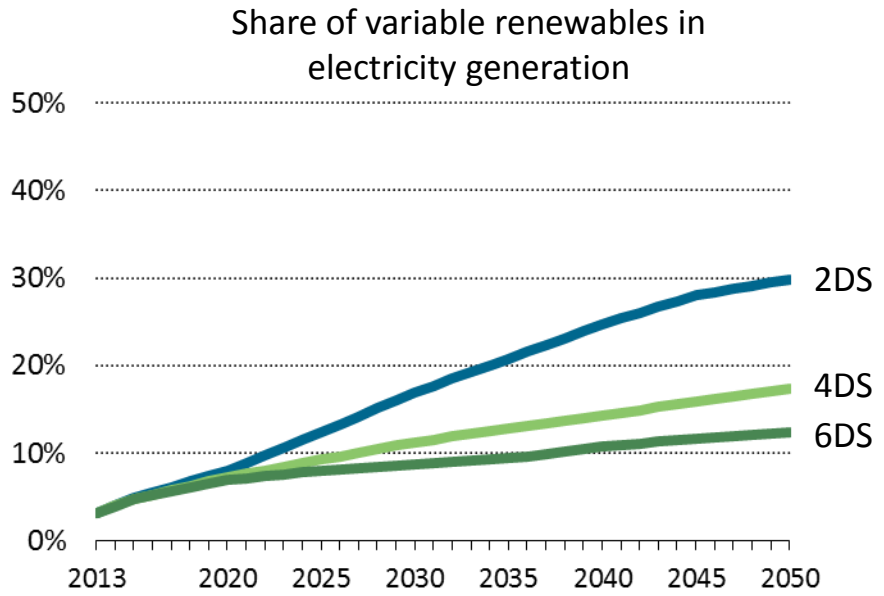




- How much electrification is possible?
- Example: *Fully electrifying space and water heating in buildings as well as all light-duty vehicles in transport would increase share of electricity in final demand to 36% and increase generation by 15% or around 6,000 TWh.*
- Any limitations on the generation side, e.g. deployment rates or system operation, and risks from electrification?

Beyond the electricity sector
Further questions

- **Increasing generation of variable renewables** requires a more flexible electricity system. Keeping gas, despite its CO_2 emissions and offset them, or explore much more other flexibility options (e.g. demand response, storage, interconnections dispatchable renewables)?



- **Biomass use in the power sector**: should it be rather saved for other sectors, where it is needed more desperately, e.g. biofuel production for aviation and shipping?