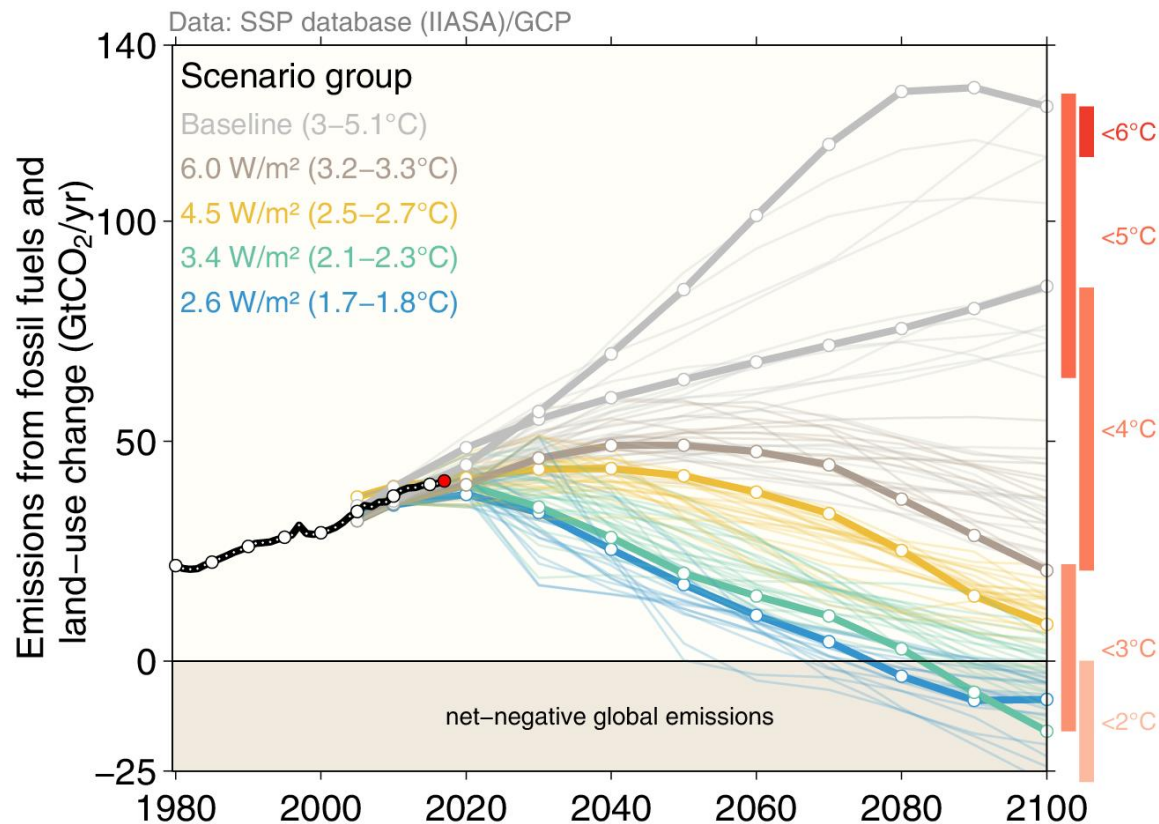


Deep Decarbonization Initiative (D2I)

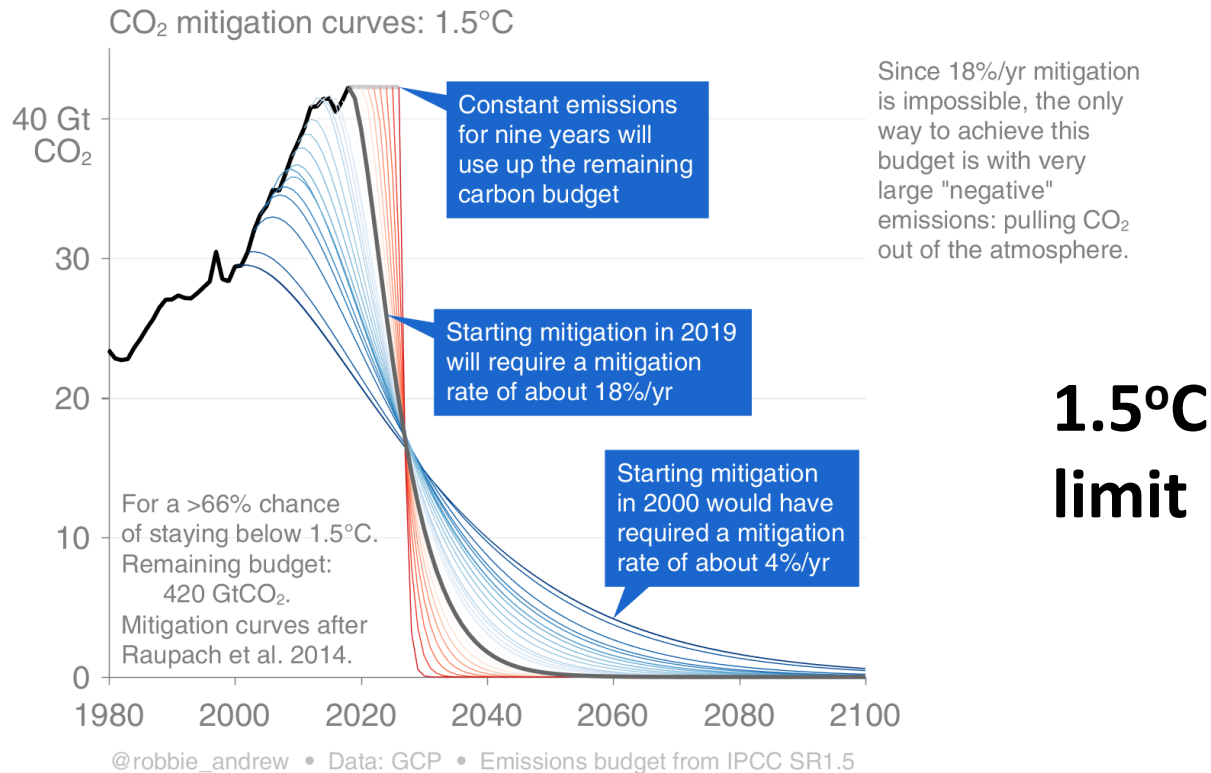


Getting to zero carbon emissions in the **real world**, where economic, political, and behavioral constraints must be taken into account.

Emissions must go to ~zero



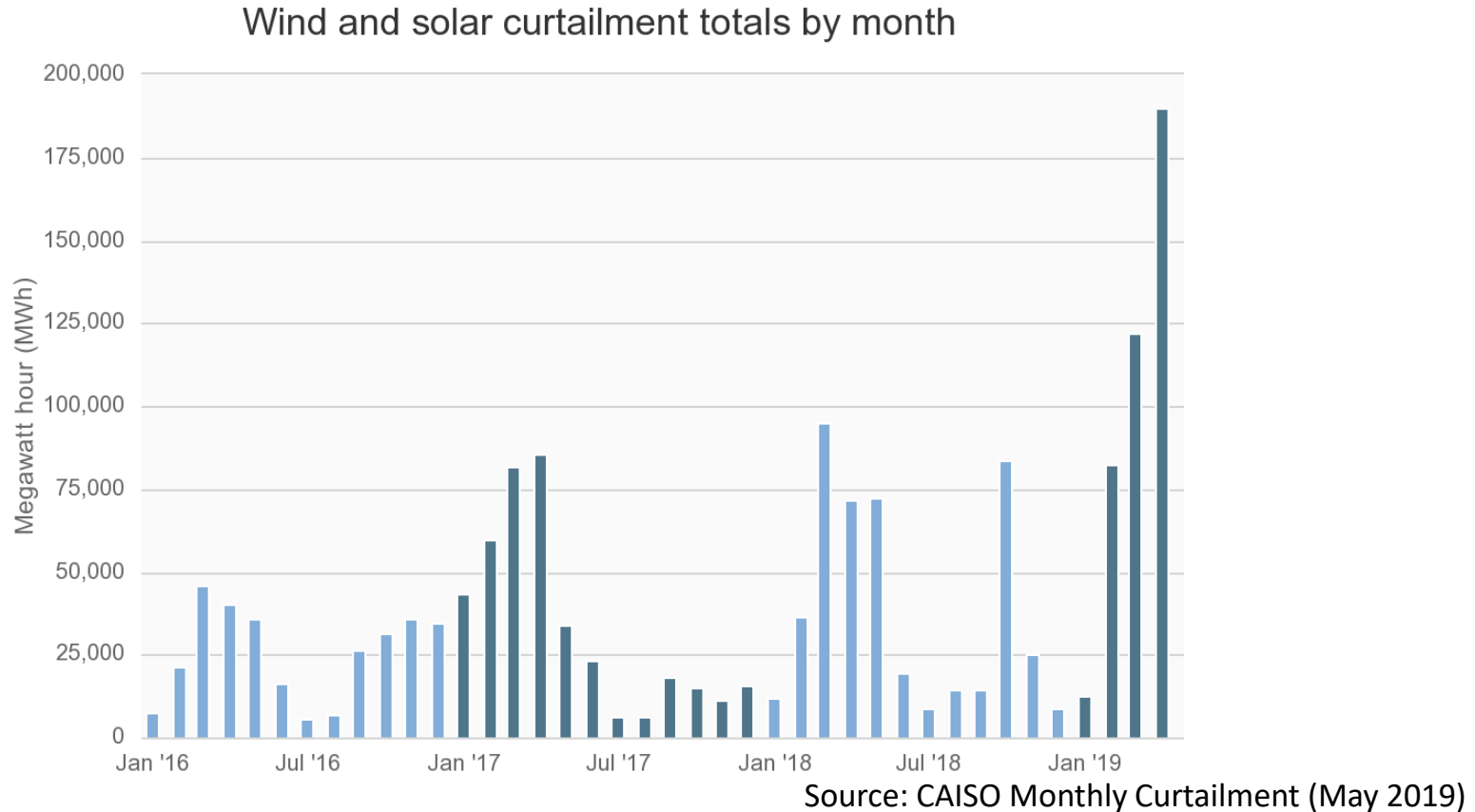
When we start the transition and what the final target is has profound effect on the trajectory



Renewabilization or Decarbonization?

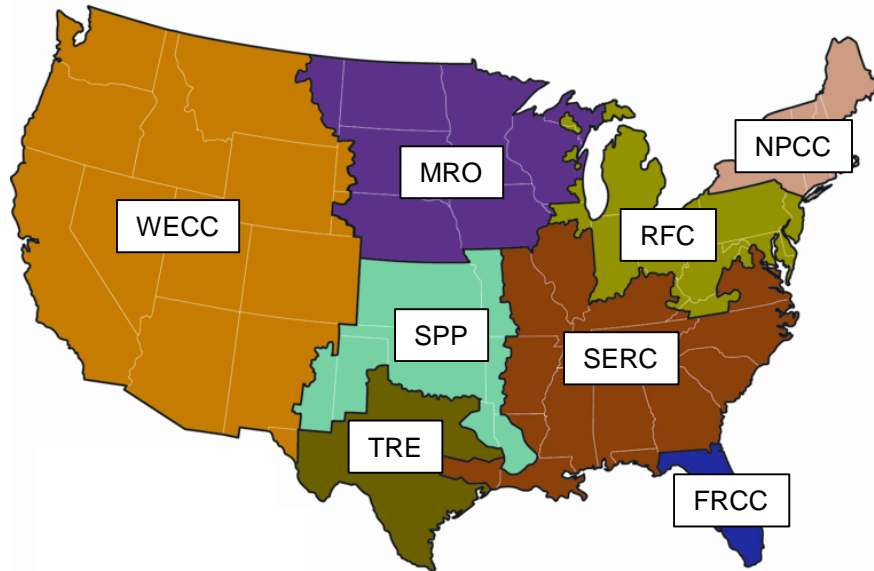
The Dark Side of Solar:

Rising Curtailment With Constrained Gas



Is Grid Edge good for decarbonization?

Systematic, U.S.-wide study on residential batteries



NERC, GA, USA

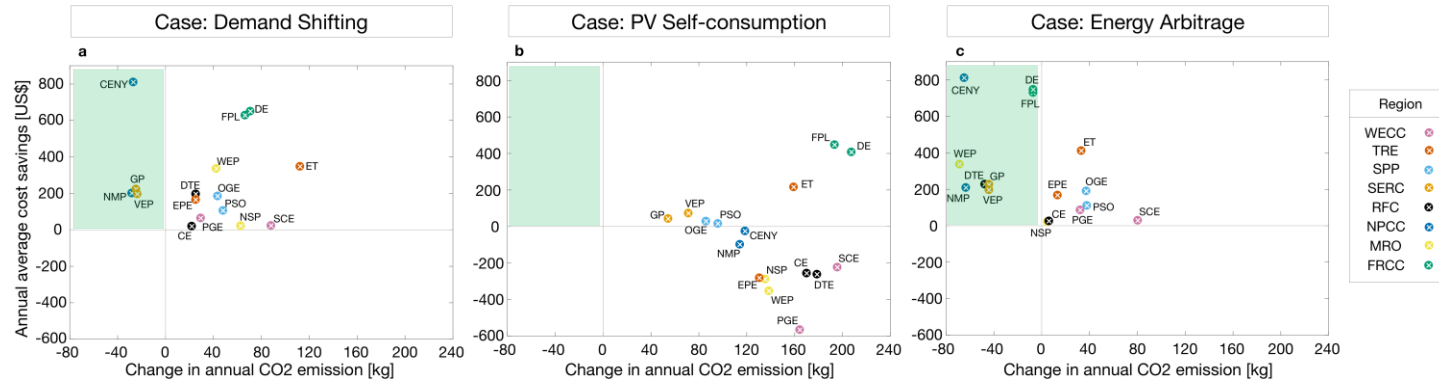
North American Electric Reliability Corporation

covering interconnected grids in CA, US, and MX

Different **generation mixes**
(emissions factors)

We choose the 2 largest utilities in each that offer time of use tariffs (TOU), which are becoming widely available and allow batteries to operate flexibly

RES systems more often increase emissions if minimizing cost

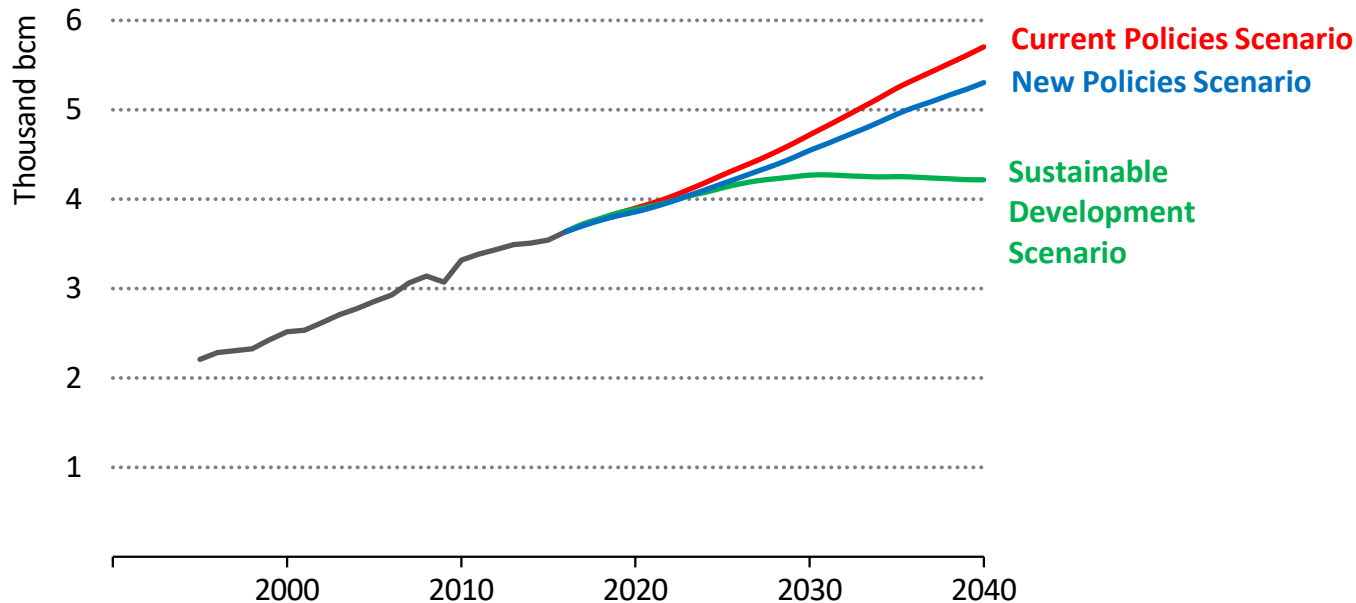


- **Energy arbitrage:** most effective at achieving the dual benefits of reducing electricity cost and emissions: 8 out of the 16 region-territories.
- **Demand shifting:** 4 of the 16 achieve cost and emissions reductions.
- **PV self-consumption:** unable to simultaneously reduce cost and emissions anywhere.

Source: Babacan et al ES&T (2018)

Is Gas Ordained?

Most Studies See a Bright Future for Gas



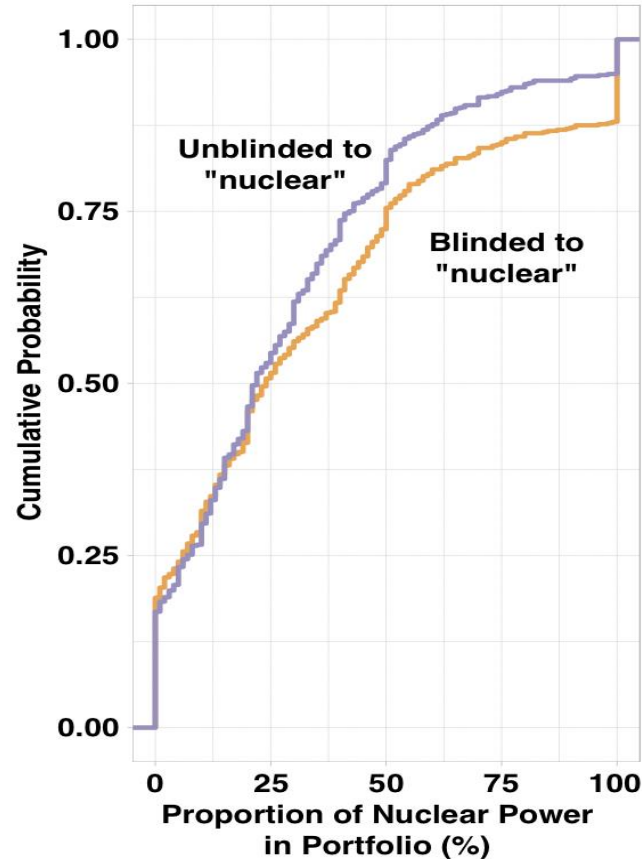
Source: IEA WEO (2017)

Rising Attention to Fugitive Methane



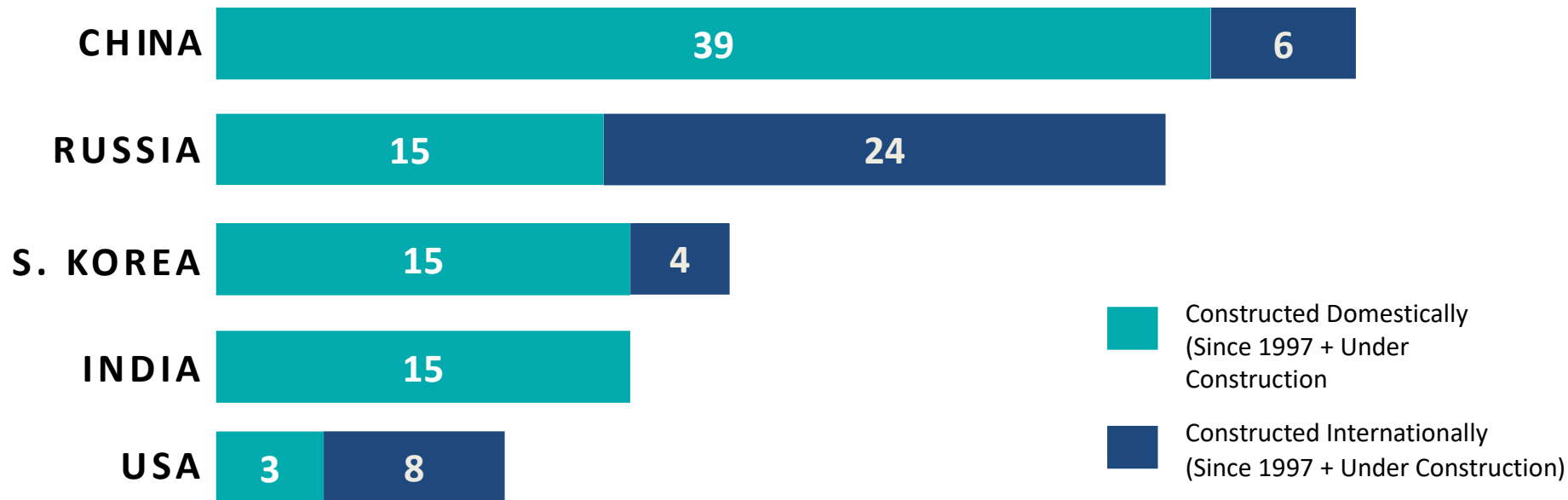
A Future for Nuclear?

Political Support for Nuclear: “Dread Risk”



Source: Abdulla et al (in review)

The Other Geographical Shift: Overseas Construction

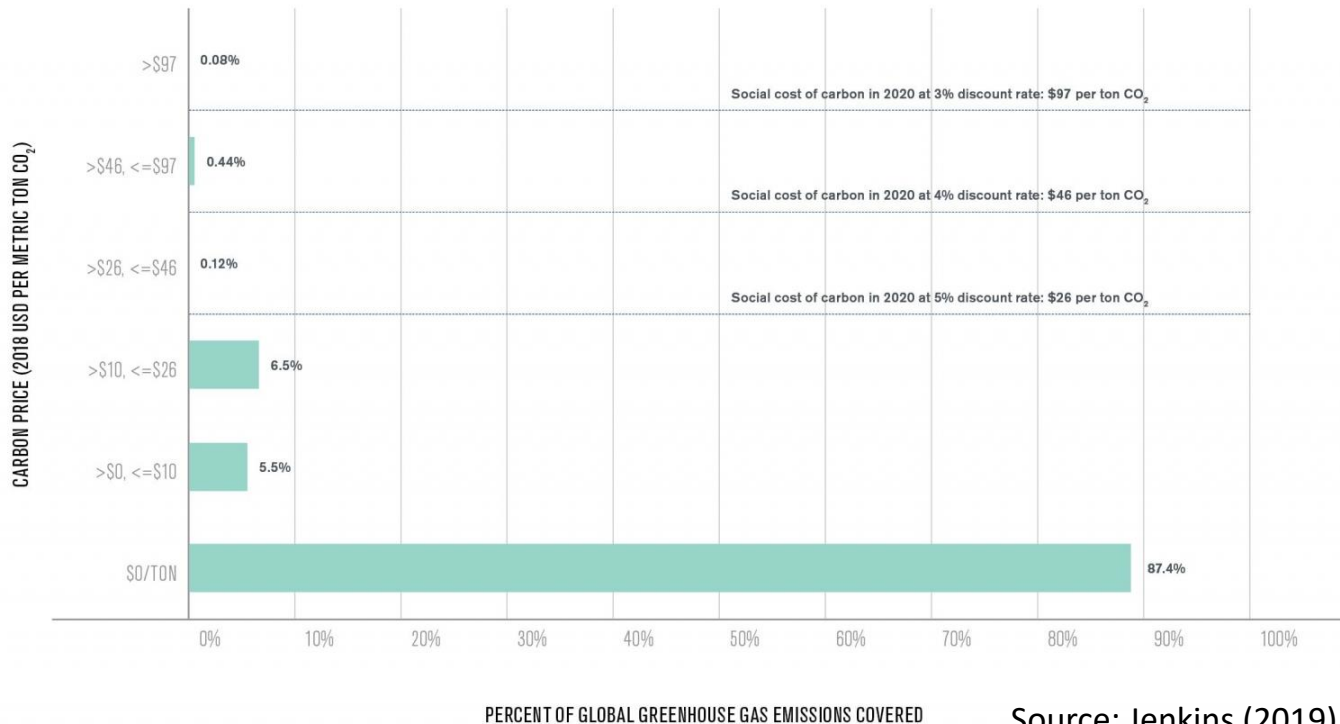


Source: IAEA PRIS Database; NEI

Future for Market Policies?

~SCC Prices at <1% of Global Emissions

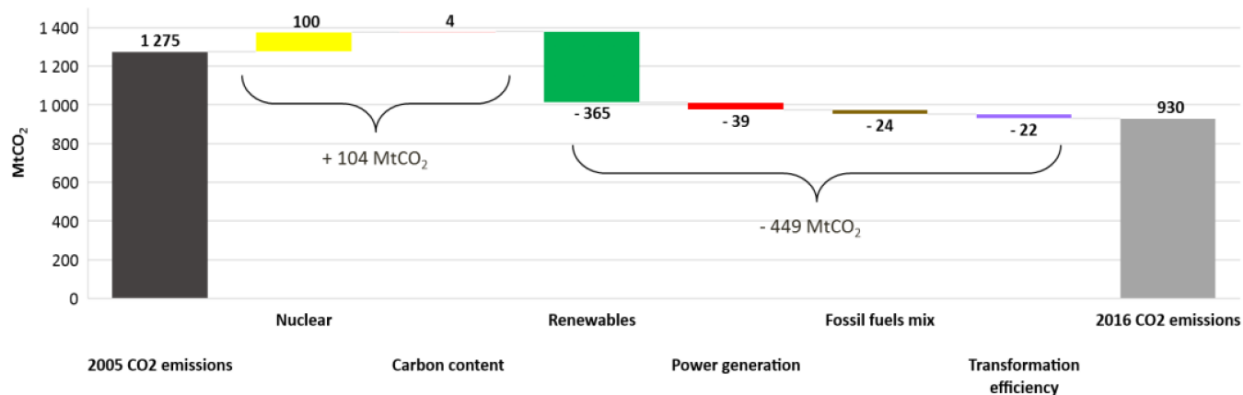
FIGURE 1: THE CARBON PRICE GAP: COMPARISON OF ESTIMATED SOCIAL COST OF CARBON (UNDER VARIOUS DISCOUNT RATES) AND CARBON PRICES FACED BY GLOBAL GREENHOUSE GAS EMISSIONS⁴



Source: Jenkins (2019),
UPenn Kleinman Center

Why European Power Sector Emissions are Declining

Figure 10: Drivers of emissions variations in the power sector in the EU (2005-2016)

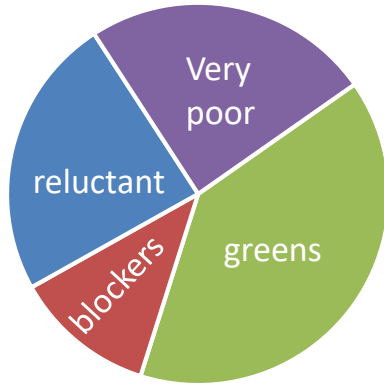


Source: I4CE elaborations Eurostat, 2019 and the IPCC, 2019

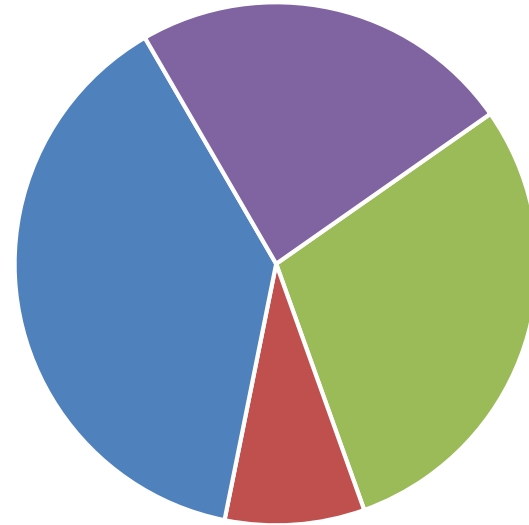
Source: Marcu et al (2019) "State of the EU ETS", ERCST (Brussels)

Thank You

Rethinking Leadership



1990 (38 Gt)



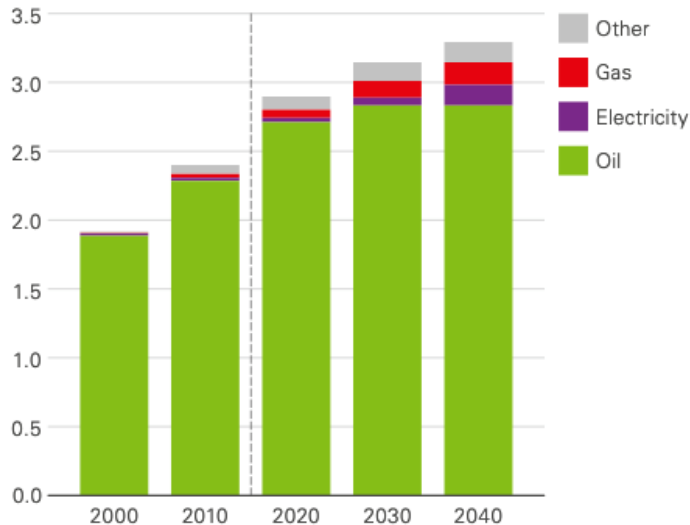
2014 (55 Gt)

Source: Victor and Jones, Brookings Institution (2018)

Transport demand continues to be dominated by oil, despite increasing use of natural gas, electricity and biofuels

Final energy consumption in transport:
Consumption by fuel

Billion toe



Other includes biofuels, coal and hydrogen

Final energy consumption in transport:
Growth by fuel and mode, 2017-2040

Mtoe

