Nuclear Energy,Climate Change, and Human Health

Demonstration against Indian Point shutdown
Apr. 30, 2020

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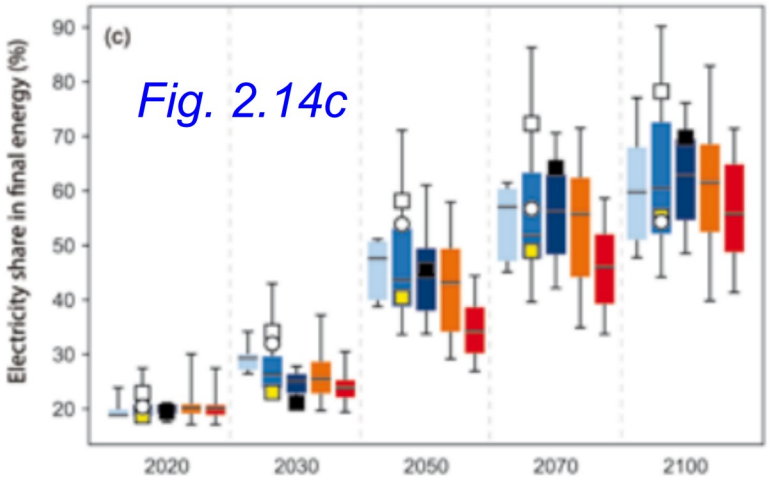
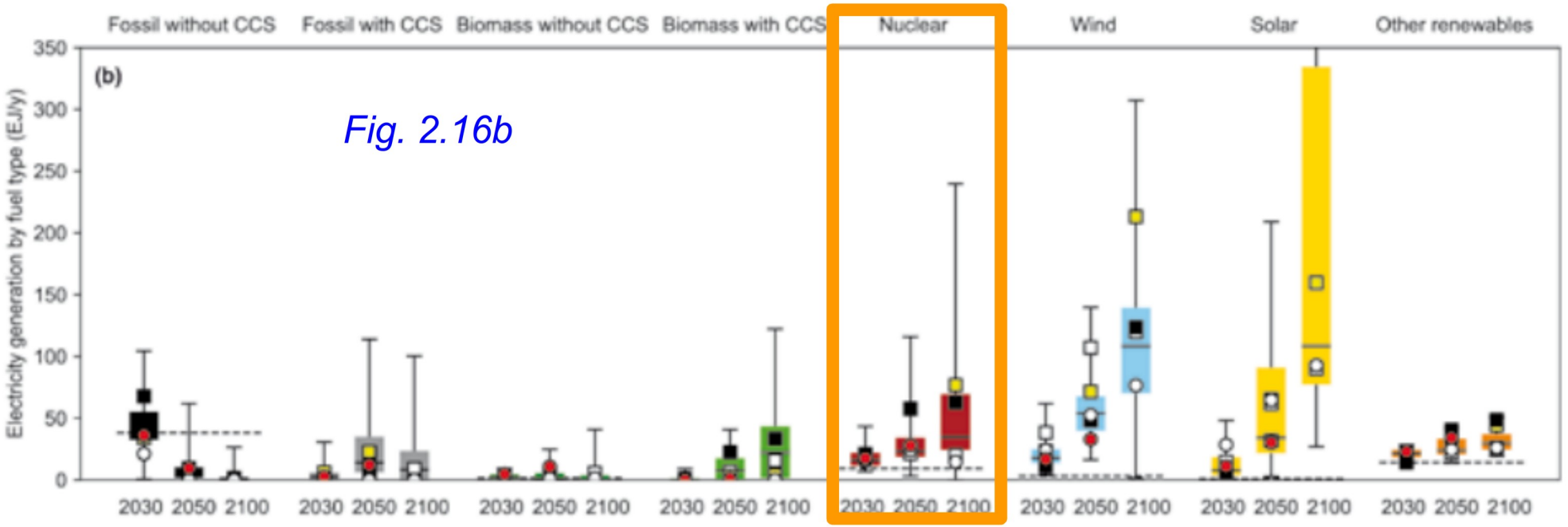
IPCC Special Report on 1.5°C pathways

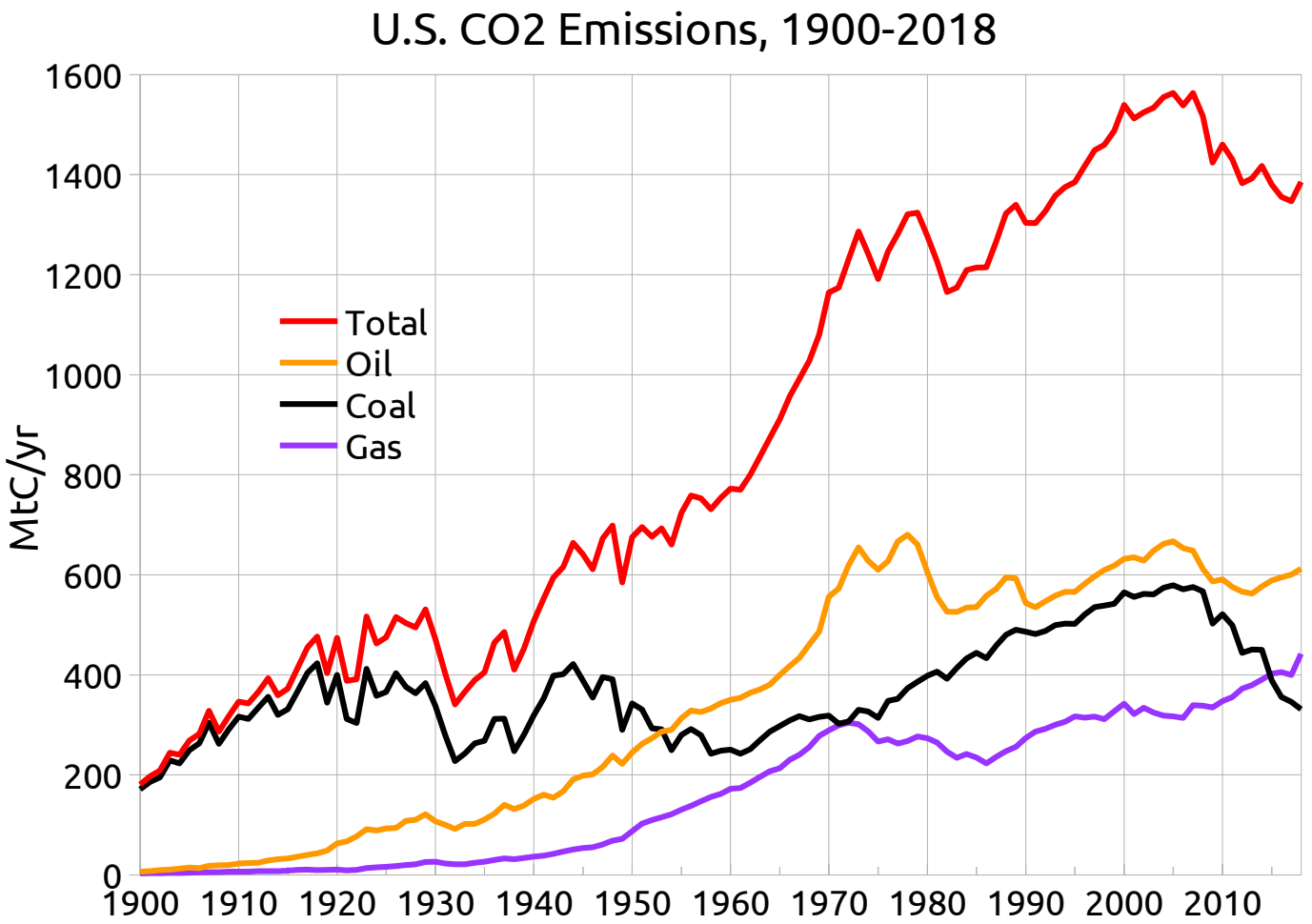


- Electricity generation increases significantly in 85 analyzed scenarios
- World energy becomes ~3x more electrified



- Nuclear energy ~doubles in most scenarios, but share of total electr small (<10%)
- Solar + wind far outpace all other sources . . . realistic??

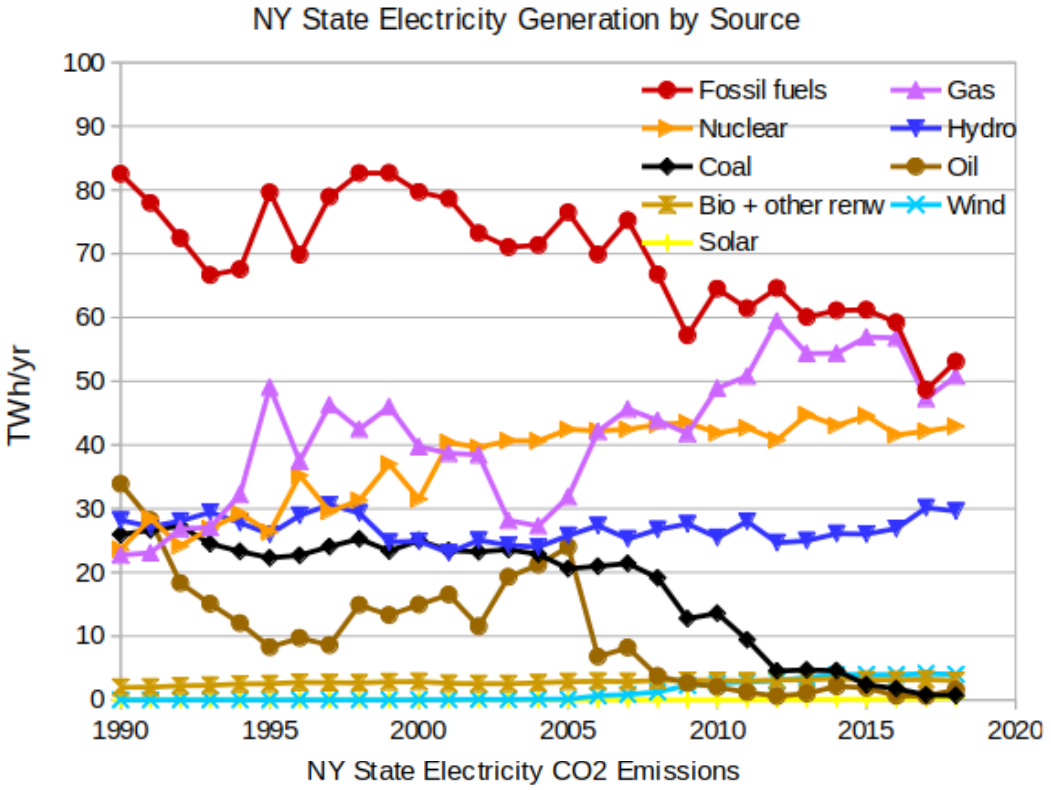
U.S. Fossil fuel use

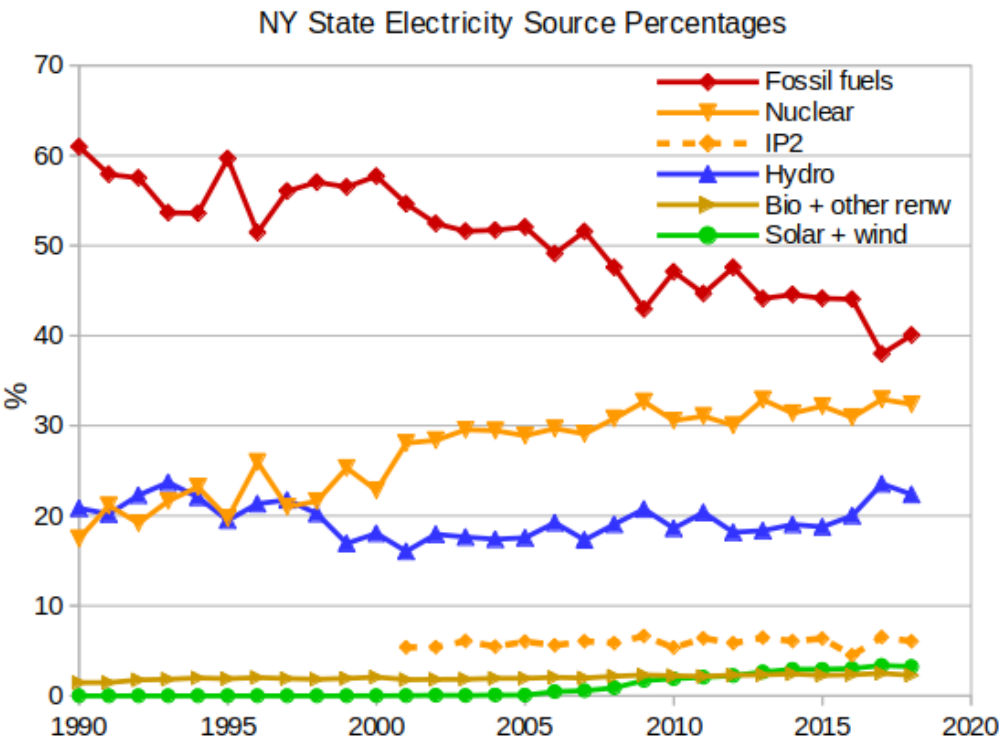


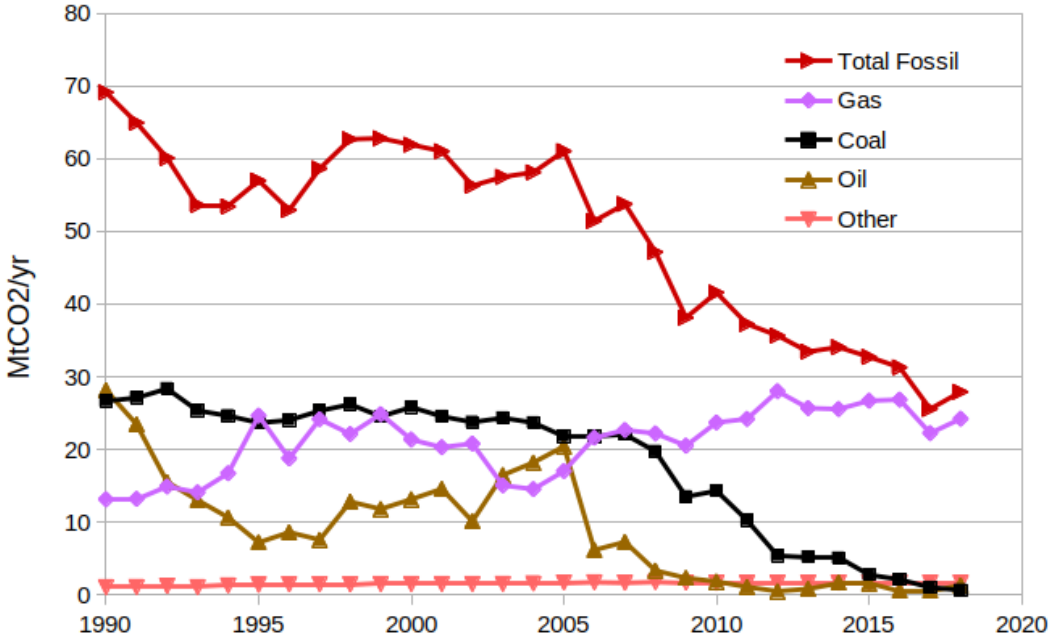
Source: M. Sato, CU website

- CO_2 emissions have decreased last 10 yr
- ...BUT **FFs** 84% energy, 63% electr;
  solar+wind+biomass only 5% energy, 10% electr

NY Electricity Generation and CO_2 Emissions







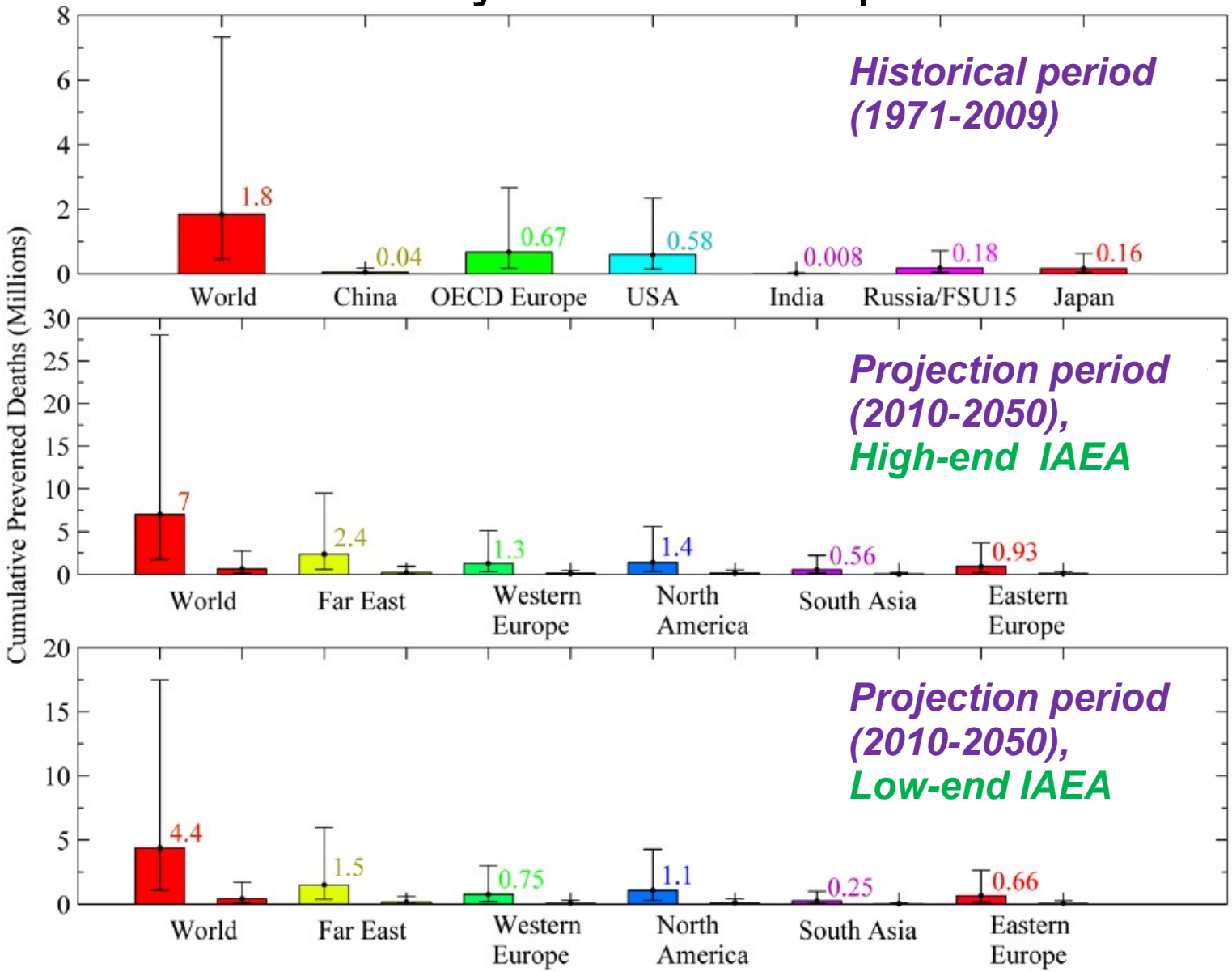
NY electricity (2018):
38% gas, 2% oil/coal;
32% nucl, 28% renew (22% hydro)

--> IP: 38% of nucl, 12% total

--> If IP replaced fully by gas, adds ~8 $MtCO_2$/yr (+30%)!

Source: US EIA website

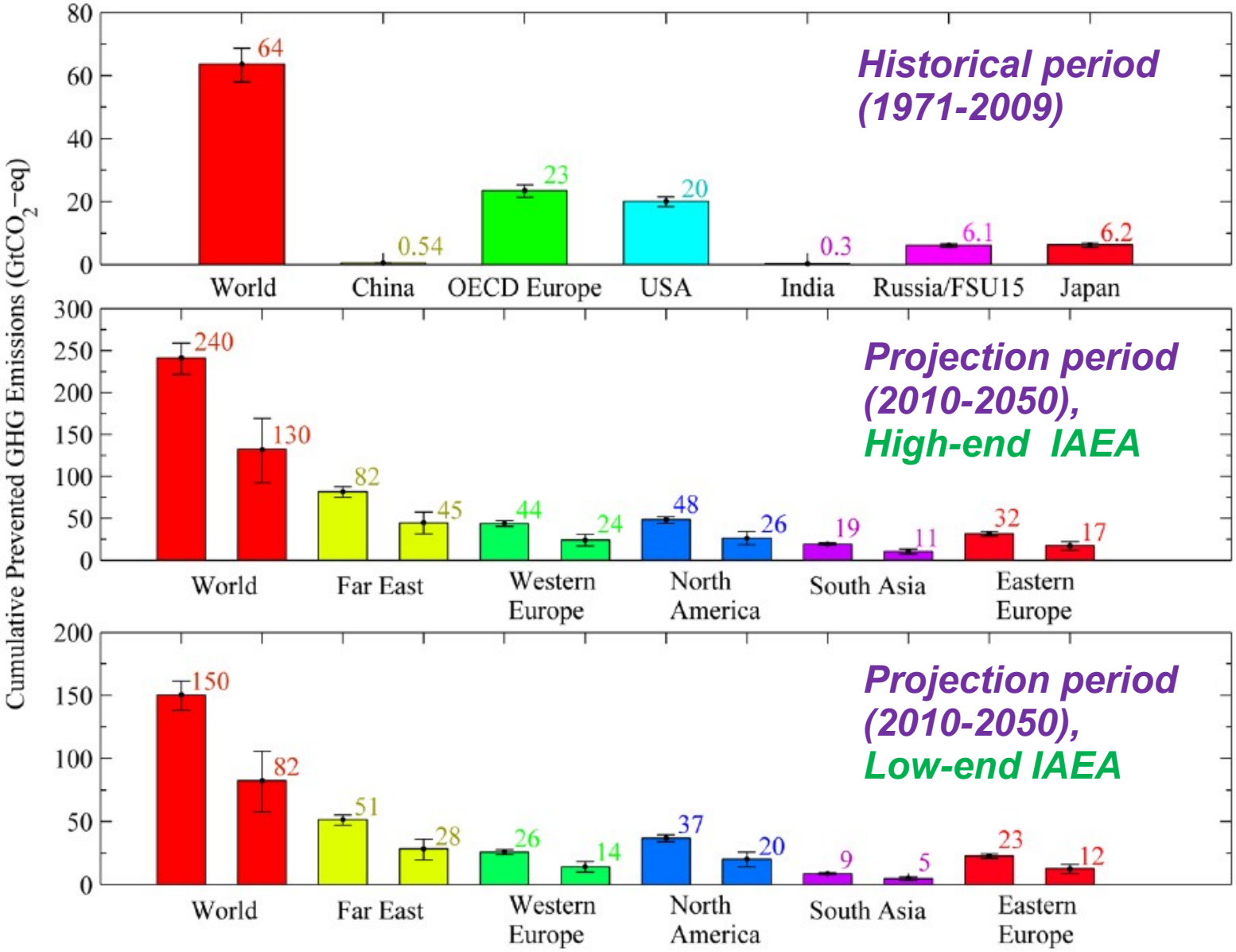
Why is nuclear important?



From Kharecha & Hansen 2013, ES&T

- From 1971-2014, nuclear power **prevented** average ***2.2 million deaths*** **globally**
  ---> ***thousands x more than it caused*** *in its whole 60+ year history*
- Through 2050, nuclear power could prevent up to **additional *7 million deaths***
- Prevention of serious illnesses ~10x higher

Why is nuclear important?



From Kharecha & Hansen 2013, ES&T

- From 1971-2014, nuclear power **prevented** an average ***77 $GtCO_2$-eq GHG emissions*** globally --> equivalent to over **400 large coal plants**, past **45 yr of coal burning in USA**
- Through 2050, nuclear power could save up to **additional *240 $GtCO_2$-eq GHGs***

Post-Fukushima changes in Japan and Germany

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Implications of energy and CO_2 emission changes in Japan and Germany after the Fukushima accident

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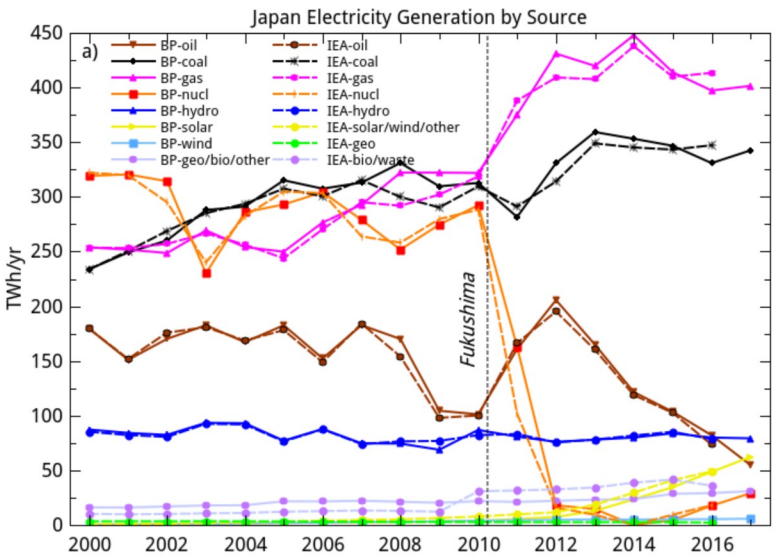
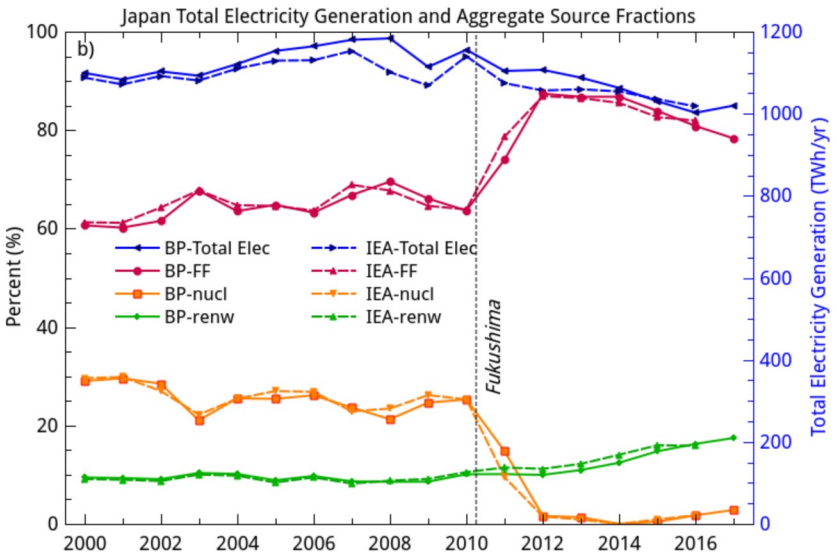
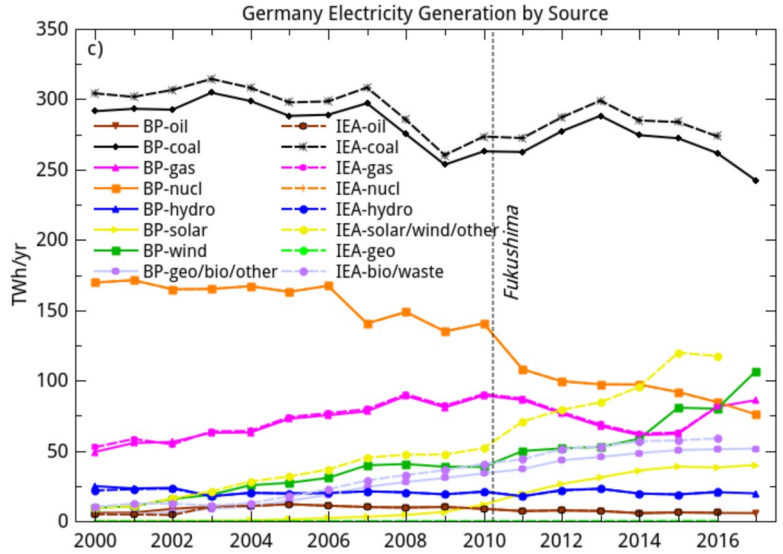
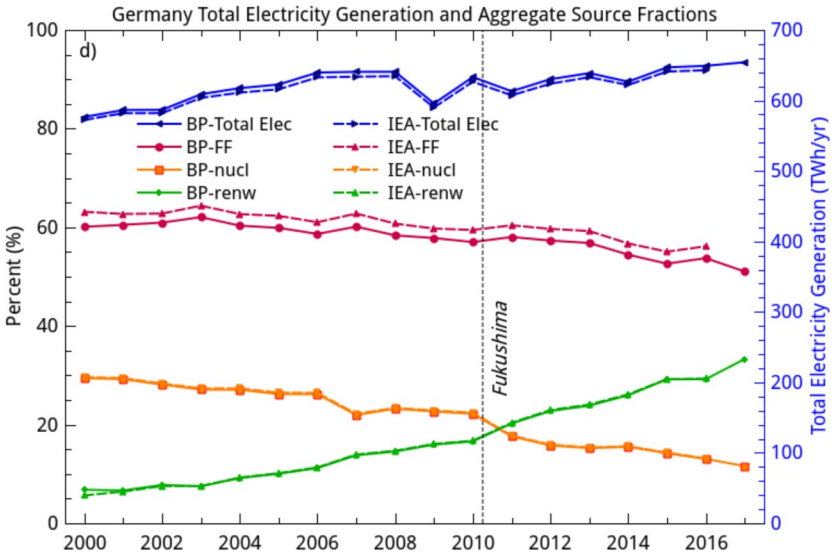
- Examined energy, electricity, and CO2 emissions since 2011 Fukushima accident in Japan
- What if both countries had instead reduced fossil fuels by the same amounts as nuclear?
- What if the US and rest of Western Europe eliminate their remaining nuclear power?

Post-Fukushima Japan and Germany





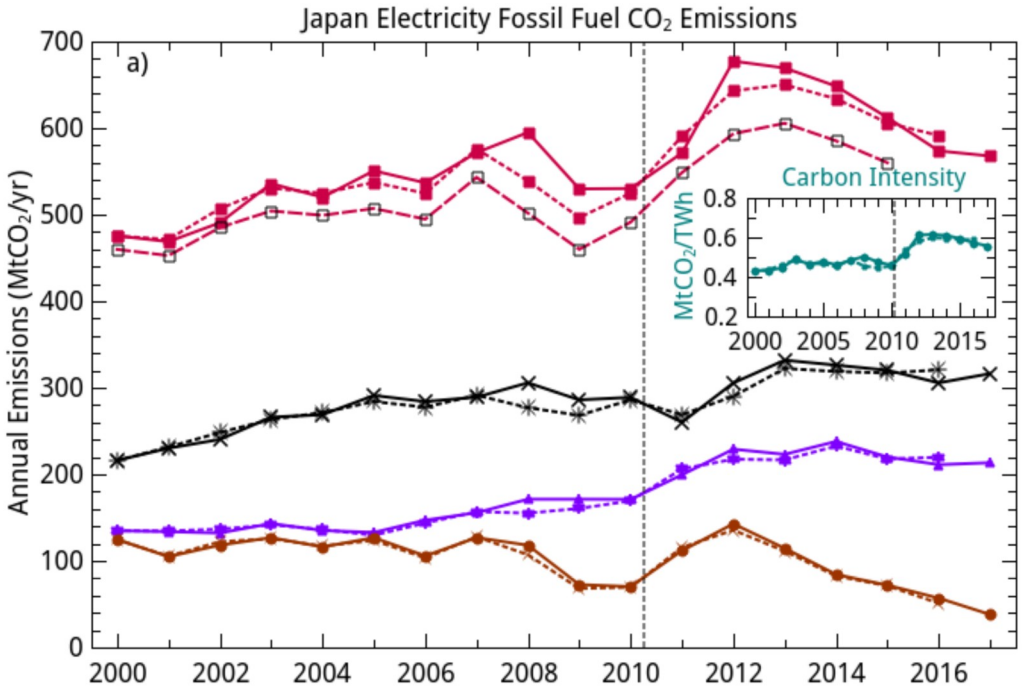


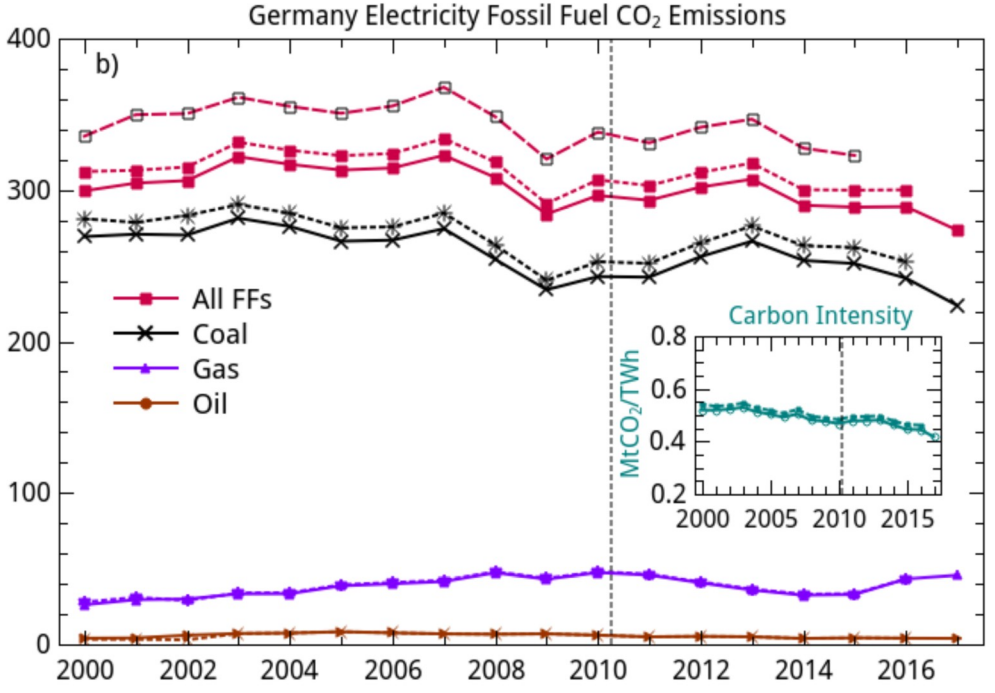


Source: Kharecha & Sato, 2019, Energy Policy

- Drastic, sudden reductions in nuclear output
- Lost nuclear replaced mainly by fossil fuels in Japan, coal + renewables in Germany

Post-Fukushima Japan and Germany



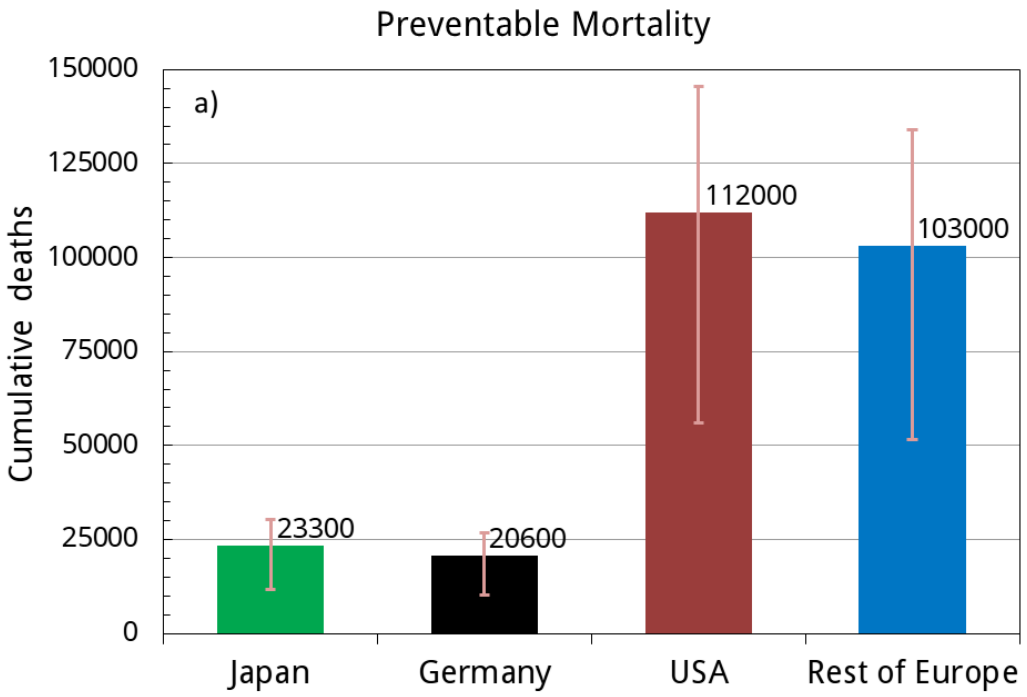


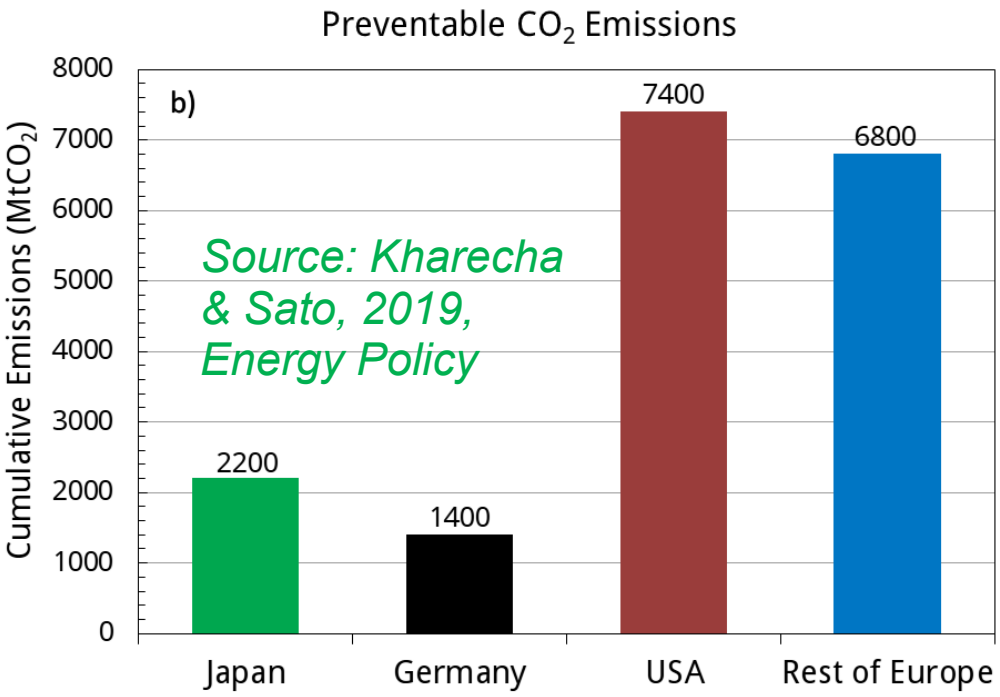
Source: Kharecha & Sato, 2019, Energy Policy

The good news....

- Emissions in both countries increased until 2013 due to increased fossil fuel power....but steadily decreased since then
- Reasons: Reduced overall energy/electricity use in Japan; surge of wind + solar in Germany

Japan and Germany: Lost opportunities

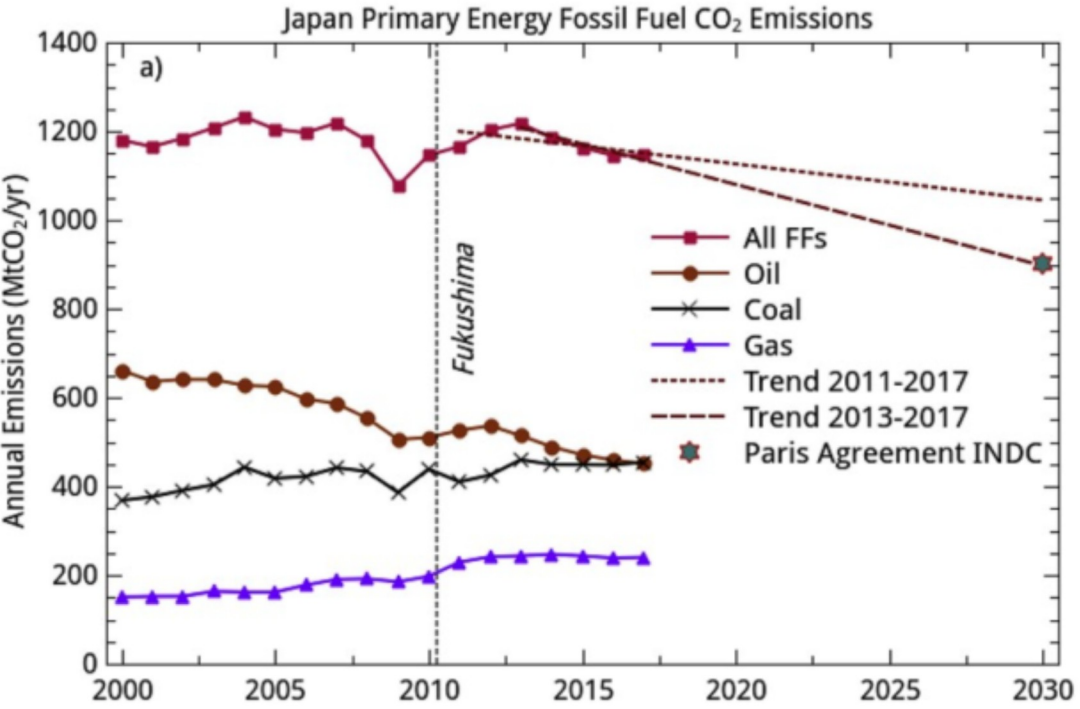


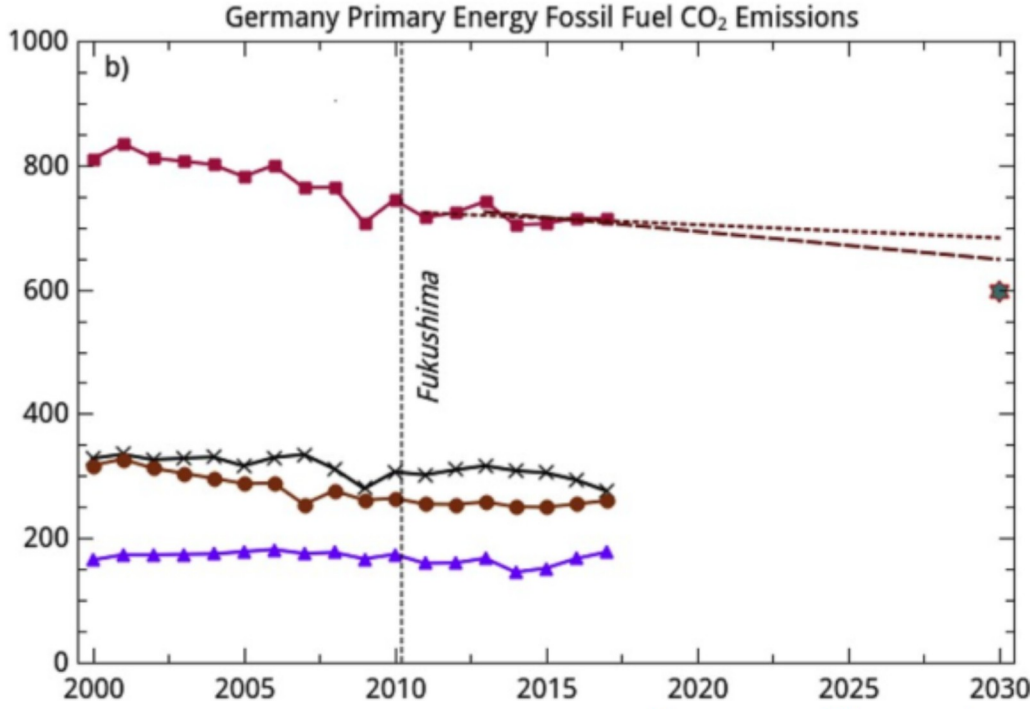


The bad news....

- Between 2011-2017, if **Japan** reduced fossil fuels and not nuclear, could have prevented **>23,000 deaths** and **2200 MtCO2 emissions**
- **Germany** could have prevented **4600 deaths, 300 MtCO2 emissions;** can still prevent **16,000 deaths, 1100 MtCO2 emissions** by 2035
- **US**, rest of **Western Europe** can each **save >100,000 lives and ~7000 MtCO2 emissions** by 2035

Post-Fukushima Japan and Germany





Source: Kharecha & Sato, 2019, Energy Policy

- Japan appears on course to meet its Paris Agreement climate targets, while Germany might fall short
- However these and other Paris commitments are **insufficient for climate stabilization**
- Lost opportunities to prevent CO2 emissions will complicate these already insufficient goals

Energy solutions: success stories

- In one decade (1977-1987), **France increased nuclear power by 15-fold, proportion of electricity 8% –-> 70%**

- In 19 yr (2000-2018), **Germany increased solar and wind electricity proportion 2% ---> 24%; reduced fossil fuels 62% ---> 49%**

- World investment in non-fossil energy sources (renewables, nuclear) continues to increase...However so does fossil fuel use

  –-> *We need* ***all available*** ***non-fossil*** *energy sources! (Renewables or nuclear by themselves not enough)*

Energy solutions: Key lessons

---> Counterproductive to oppose a **proven** low-carbon source like nuclear since **every** source has pros and cons

---> No “universal” energy solution (e.g. only renewables, only nuclear, etc)....***Energy mix must be customized to each region***

---> **Before or instead of cutting nuclear output** in near future, countries should reduce fossil fuel use!