

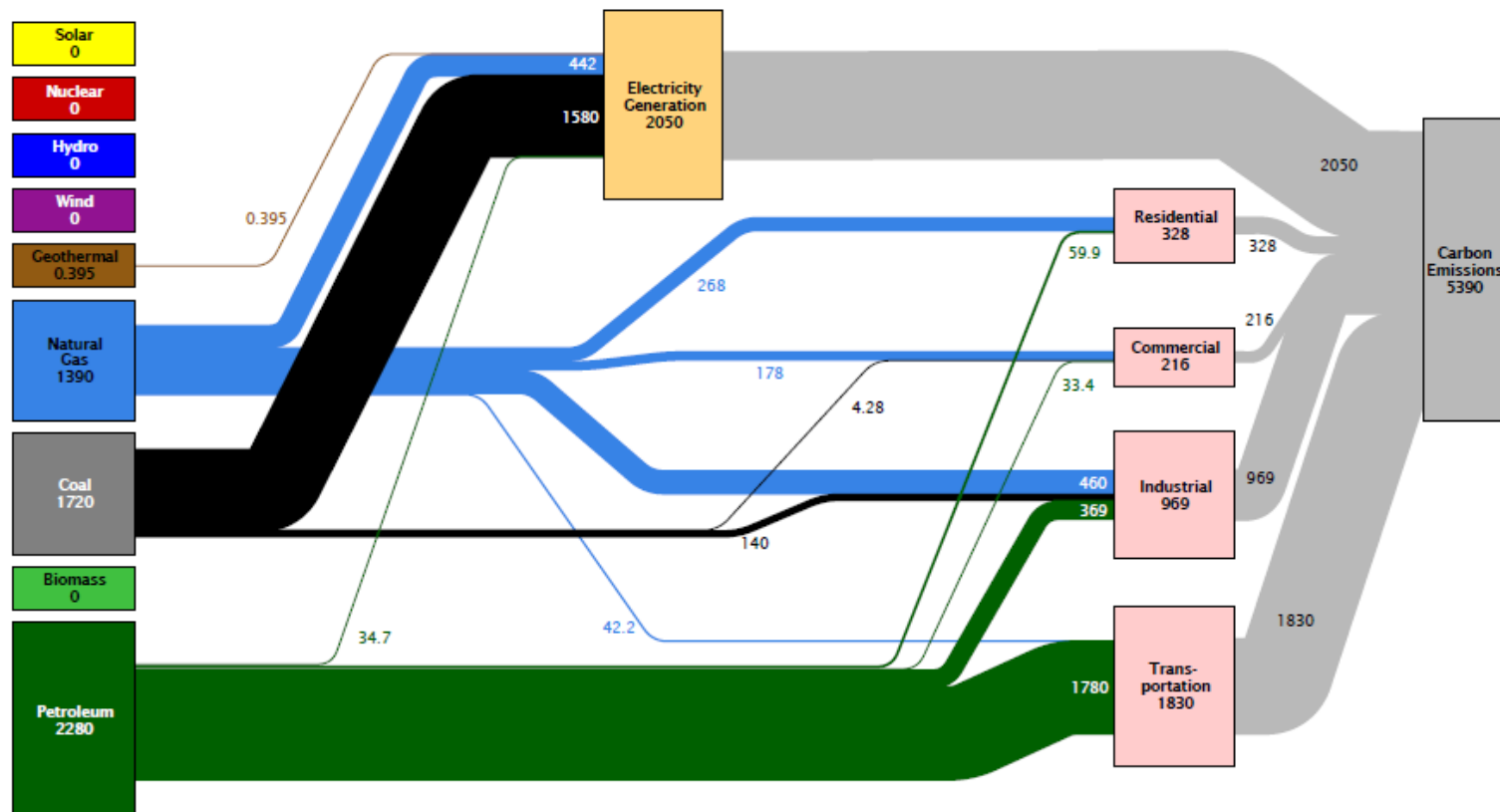
# Renewables & Carbon: Taking the Long View

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# How to Make Major Global Carbon Emissions Cuts by 2050 Despite Growth in Energy Services?



- Lower energy use/GDP everywhere via increased efficiency
- Replace as much oil in transportation as possible – with electricity?
- **Drastically reduce carbon emissions per kWh of electricity generation**

## This Will Likely Require Lots of Renewables by 2050

- A recent IEA study, *Energy Technology Perspectives 2014*, gives scenarios to 2050 with cuts in CO<sub>2</sub> emissions aimed at holding warming to 2 degrees C
- Electricity satisfied 17% of final energy demand in 2011, satisfies 26% in 2050; LOTS more wind & solar globally:

	% of electricity generated by			
	solar	wind	hydro	nukes
2011	0.3	2	16	12
2050 2d Scenario	17	18	18	17
2050 2dR Scenario	27	21	19	8.5

- Wind increases 16-18x, solar 106-165x, hydro 2x, nukes 1.3-2.6x – transforming power systems!

# How to Start Down That Long(ish) Road

- Clearly a case for pre-commercial R&D on wind, solar, and nuclear – usual spillover argument plus potential importance
- Clearly there should be a sensible price on CO<sub>2</sub> emissions
- If both, should renewables (& nuclear?) deployment be supported?
  - No emissions gain (as in the EU) under a cap; some under a tax
  - Raises the cost of meeting the constraint under a cap; raises the cost per ton of emissions reduction under a tax
  - Some support might nonetheless make sense to encourage industry to do applied R&D on technologies currently out of the money if they are likely to be important in later years

# Without a Carbon Price or Broad Policy...?

- There is still a good case for pre-commercial R&D on renewables and nuclear
- Could well-designed subsidies for renewables be part of an N<sup>th</sup>-best strategy to control CO<sub>2</sub> emissions subject to political constraints?
  - Very hypothetical: most US RPS statutes don't mention climate
  - Depends on what is ruled out as politically infeasible and on other policies in force – e.g., increased coal in the EU
  - Optimal renewables subsidies are probably less efficient than gas for coal, efficiency standards, other policies
  - One could argue for maintaining capability & encouraging industry R&D to prepare for a shift in the political climate

# Not the Current US Subsidy Regime!

- US ITC and PTC require accessing the tax equity market, which skims off a significant fraction of the subsidy
  - Many state & local policies also work through the tax code
- The ITC rewards investment, not output; leads to transfer price gaming
- The PTC rewards output at all times equally (even when  $P < 0$ ); instability has inhibited planning & investment
- 29 States and DC have RPS policies, all different
  - All treat all kWh the same, regardless of timing
  - All but two limit interstate trading & thus restrict siting
  - Many tilt for or against particular technologies; e.g., swine waste & poultry waste requirements in North Carolina

**Thank You!**