Recent Solar Bids Have Broken Record After Record

- March 2016, Mexico: USD 3.6 c/kWh
- August 2016, Chile: USD 2.91 c/kWh
- March 2017, Dubai: USD 2.42 c/kWh
- October 2017, Saudi Arabia: USD 1.79 c/kWh (!)
Solar and wind expected to represent over 70% of total electricity generation worldwide by 2050

Source: https://eto.dnvgl.com/2017/#Energy-Transition-Outlook
This should not be surprising:

Rear cubes: The natural availability of renewable energy is extraordinarily large. Front cubes: The technically available energy in the form of electricity, heat, and chemical energy carriers exceeds the present-day energy demand (grey cube, left) by a factor of six.

Source: DLR 2007
And yet, transitions take time

Timeframe over which a new technology goes from emergence to near-100% penetration

It took several hundred years for coal to surpass wood

Understanding Energy Transitions

- Grubler (2012) posits that European energy transitions all followed a basic pattern:
  - a “core” or center (where a tech innovation began)
  - A set of “rim” countries who followed quickly afterwards (the early adopters)
  - A set of “periphery” countries (the late adopters)

- Energy transitions spread unevenly from the core to the periphery → institutions matter; leadership matters

- Large amounts of labor, capital and effort are “sunk” into existing systems, creating inertia, “lock-in”, and path dependency

- The result is resistance to change

Coal Phase-out in Ontario, Canada: it is possible!

- In 2003, Ontario committed to phase out coal
- Health concerns were the primary driver
- A major study by energy and health experts estimated that the total health impacts of coal-fired generation were costing the economy $4.4 billion CAD/year (EUR 2.74 Billion/year)
- The last coal-fired plant was phased out in April 2014
- The economy grew by over 17% over this period
Discussion needs to shift from costs and burdens, to growth and opportunities.

No fewer than 35 countries worldwide have decoupled economic growth from the growth in emissions.
Example: CA’s economy grew 80% and population grew by 30%, while emissions remained flat.
Concluding Remarks

1. Coal is becoming uninsurable (FT, Jan 8 2018): both existing and new projects: increasingly unbankable for traditional lenders and un-investable for the private sector

2. Lesson from US/CAN Renewable Portfolio Standards (RPS) and RFS: compliance is effectively 100% (!): How?
   a) Devolve the target(s) onto national actors (e.g. utilities)
   b) Make the targets legally binding
   c) Introduce clear compliance framework, incl. penalties
   d) Make the penalties high, but credible (for RES-E: in $/MWh shortfall, or $/day of non-compliance)

Thank you.
Questions?

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