Transitioning to Renewables in the Energy Community

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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 (!)

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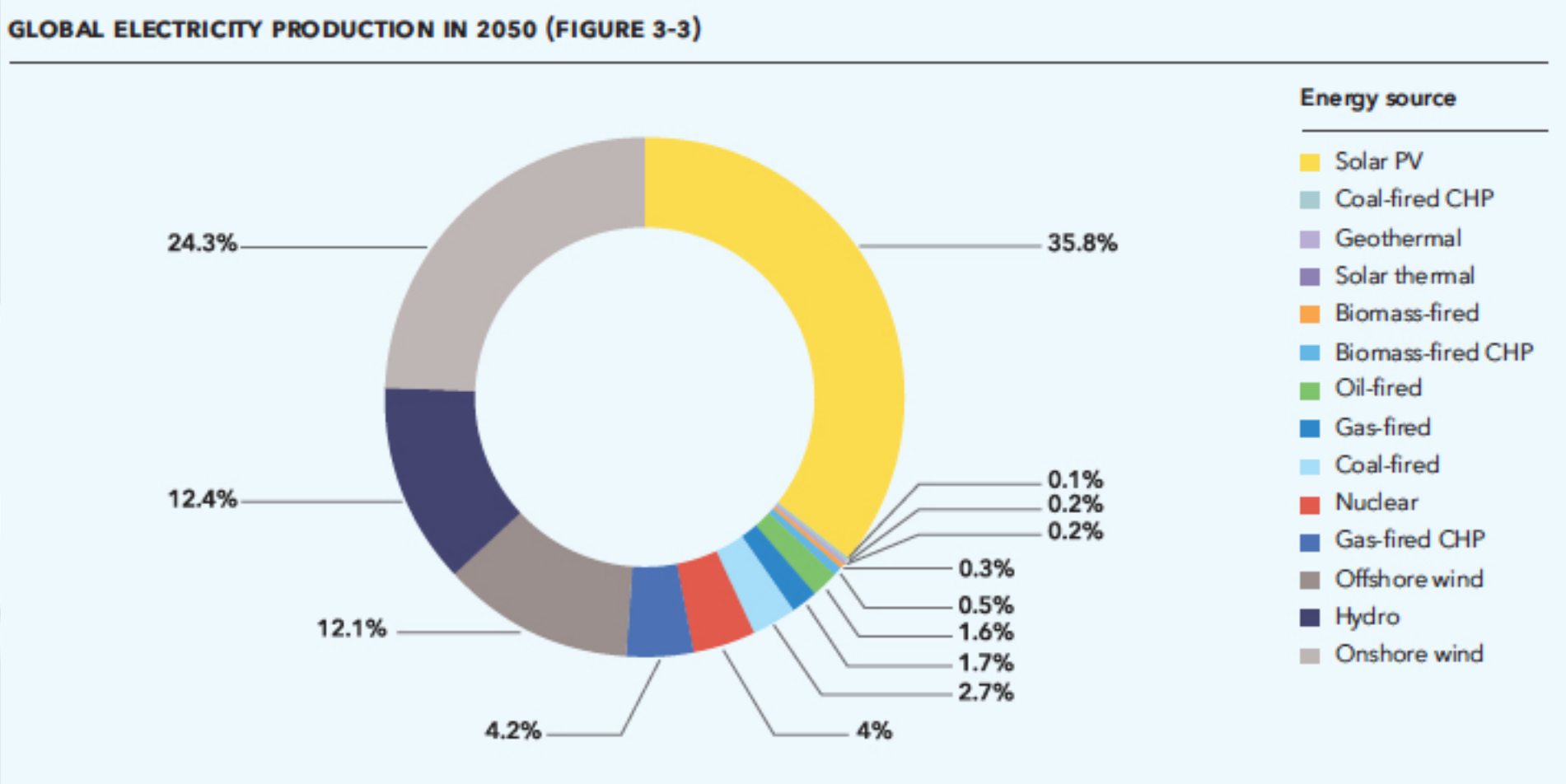
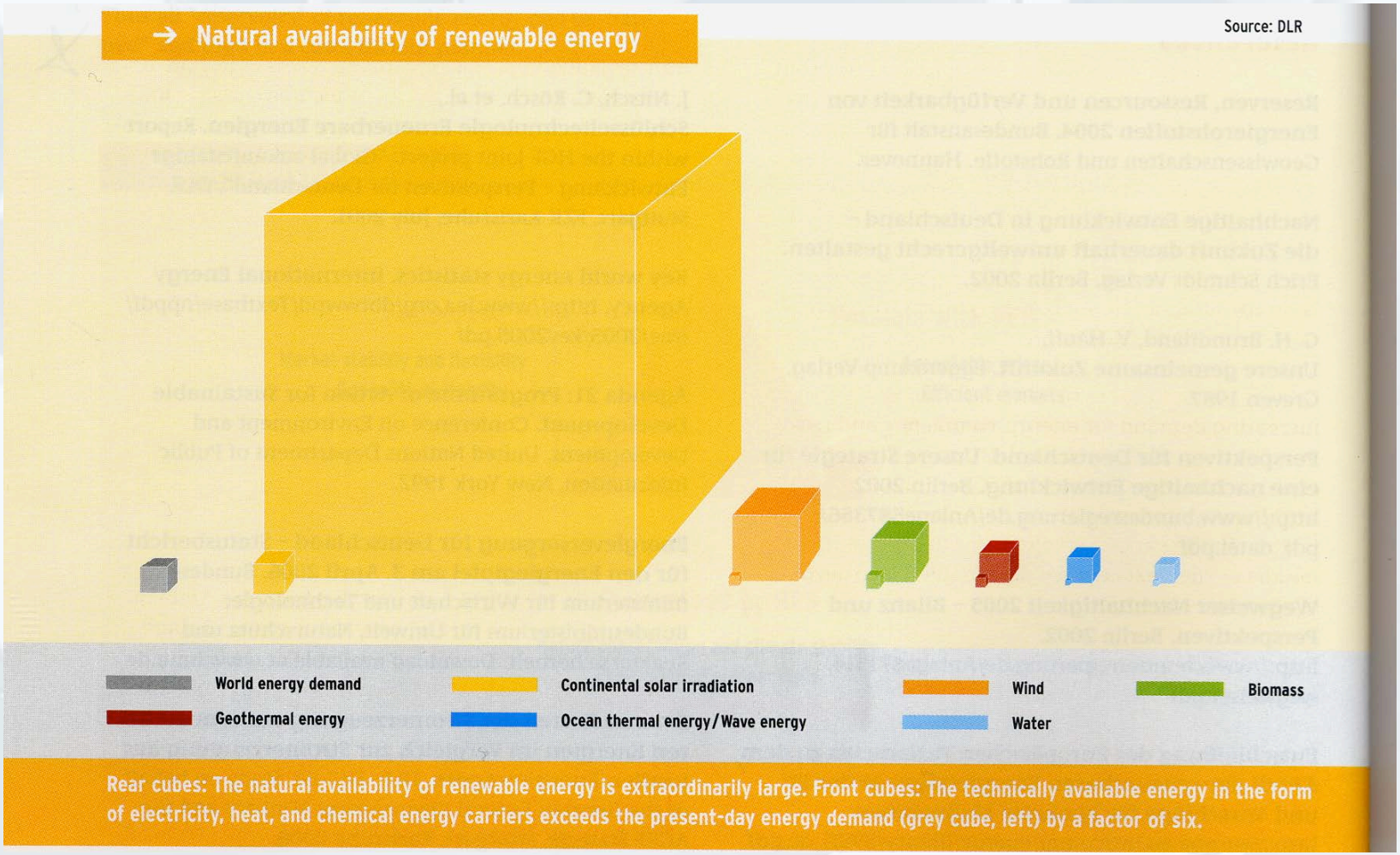
Solar and wind expected to represent over 70% of total electricity generation worldwide by 2050



E3 ANALYTICS Source: https://eto.dnvgl.com/2017/#Energy-Transition-Outlook

This should not be surprising:



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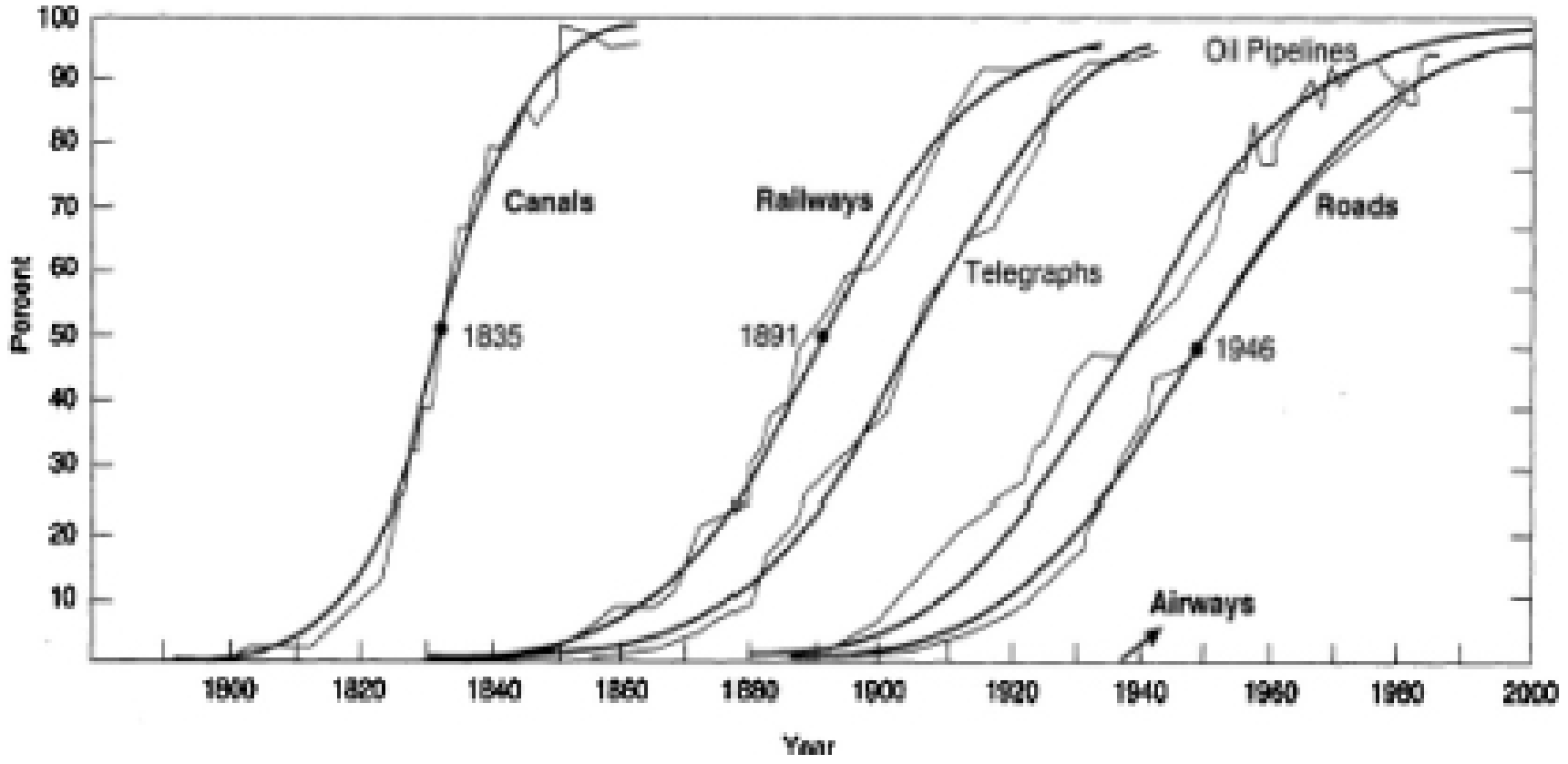
Source: DLR 2007

And yet, transitions take time



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

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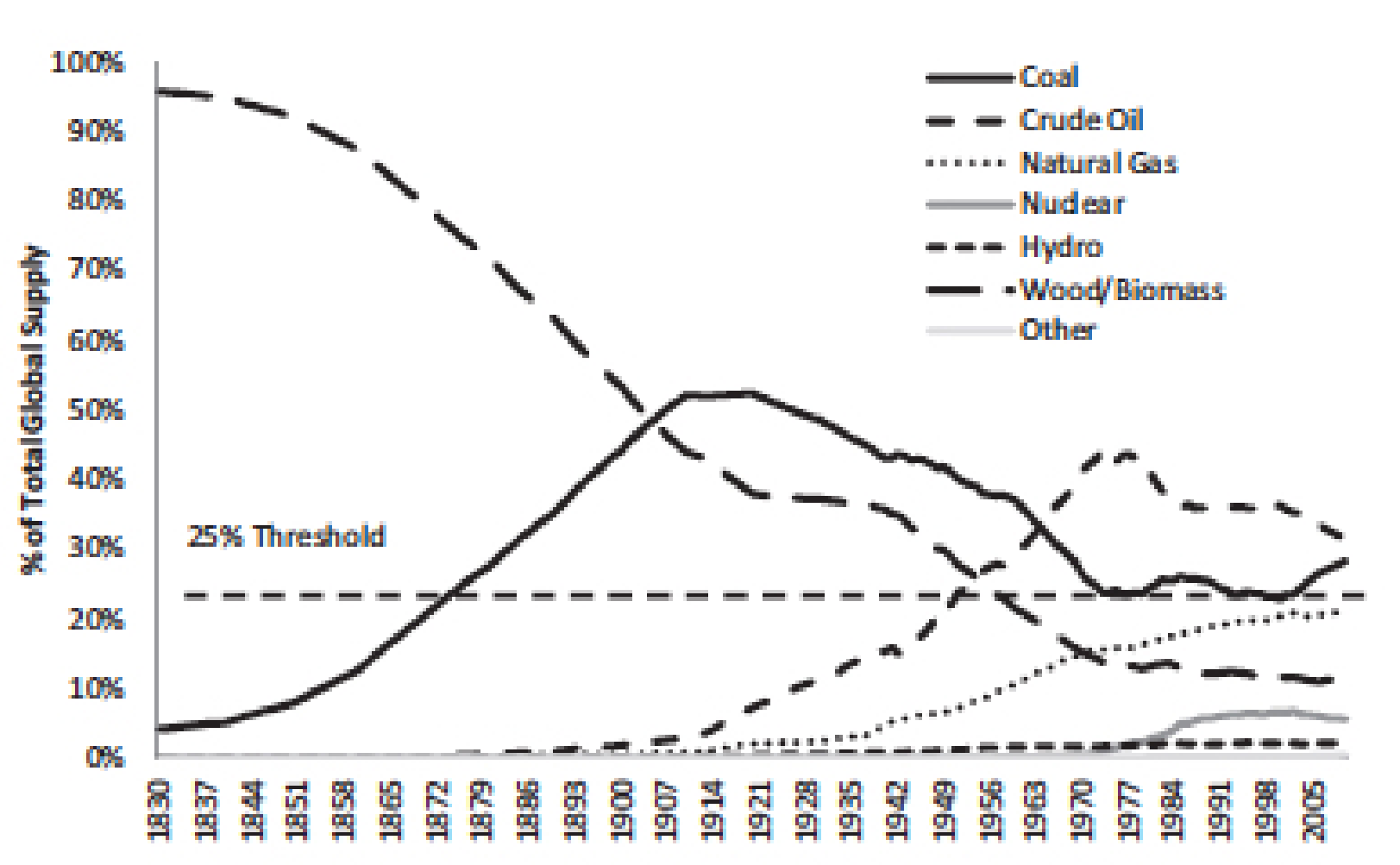
Sovacool 2016: https://www.sciencedirect.com/science/article/pii/S2214629615300827

It took several hundred years for coal to surpass wood



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Sovacool 2016: https://www.sciencedirect.com/science/article/pii/S2214629615300827

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

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https://www.sciencedirect.com/science/article/pii/S0301421512002054

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

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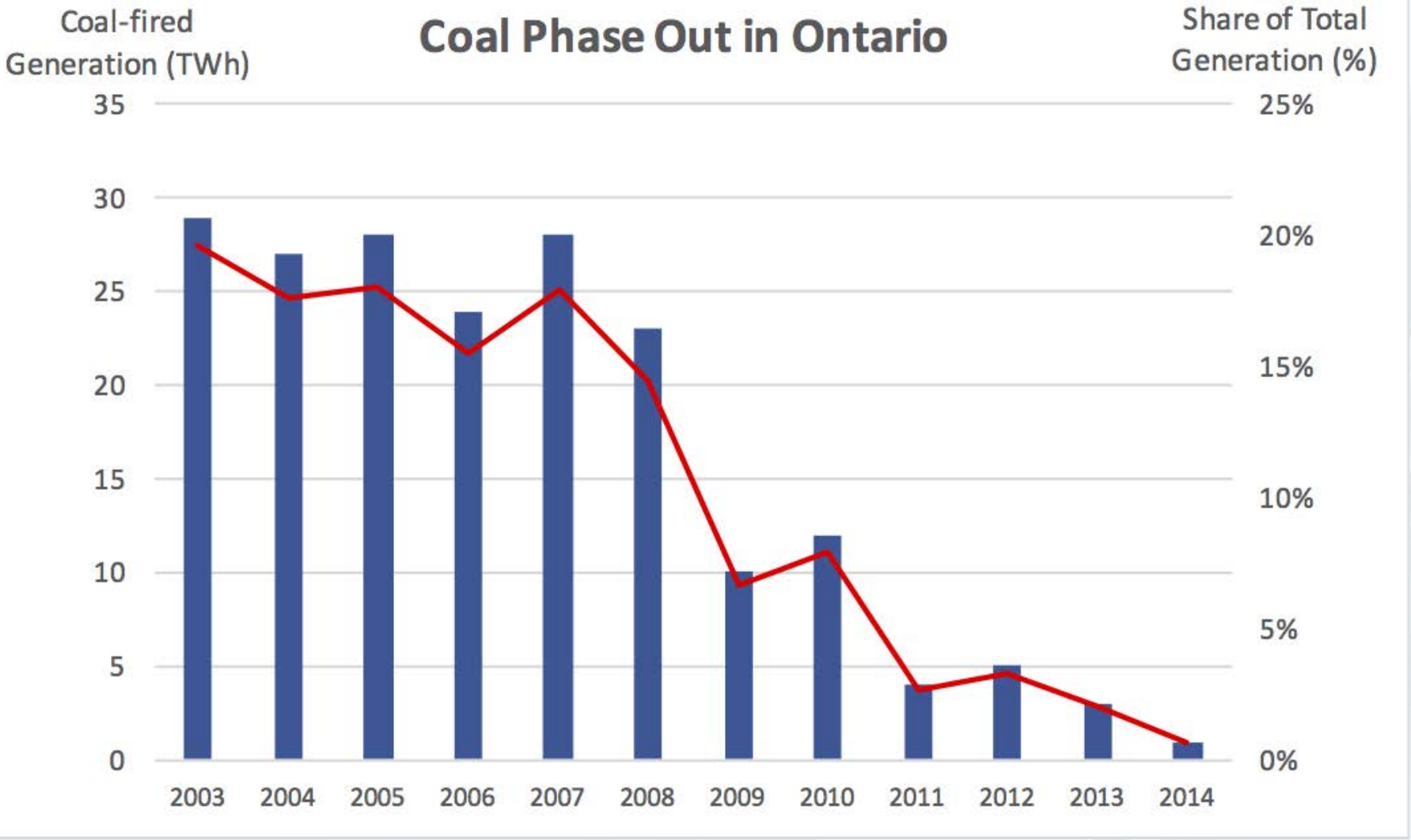
Coal Phase Out in Ontario



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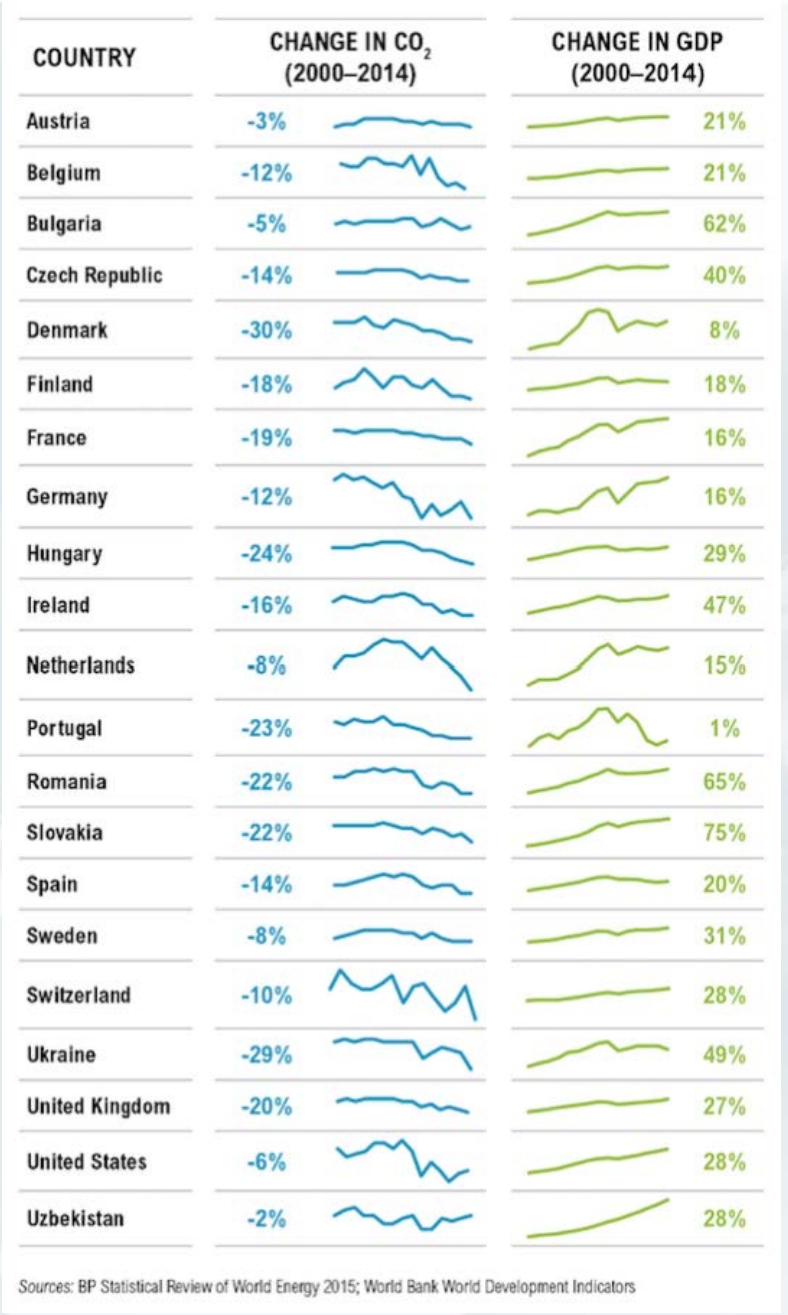
Discussion needs to shift from costs and burdens, to growth and opportunities

No fewer than 35 countries worldwide have decoupled economic growth from the growth in emissions



COUNTRY	CHANGE IN CO_2 (2000–2014)	CHANGE IN GDP (2000–2014)
Austria	-3%	21%
Belgium	-12%	21%
Bulgaria	-5%	62%
Czech Republic	-14%	40%
Denmark	-30%	8%
Finland	-18%	18%
France	-19%	16%
Germany	-12%	16%
Hungary	-24%	29%
Ireland	-16%	47%
Netherlands	-8%	15%
Portugal	-23%	1%
Romania	-22%	65%
Slovakia	-22%	75%
Spain	-14%	20%
Sweden	-8%	31%
Switzerland	-10%	28%
Ukraine	-29%	49%
United Kingdom	-20%	27%
United States	-6%	28%
Uzbekistan	-2%	28%

Sources: BP Statistical Review of World Energy 2015; World Bank World Development Indicators

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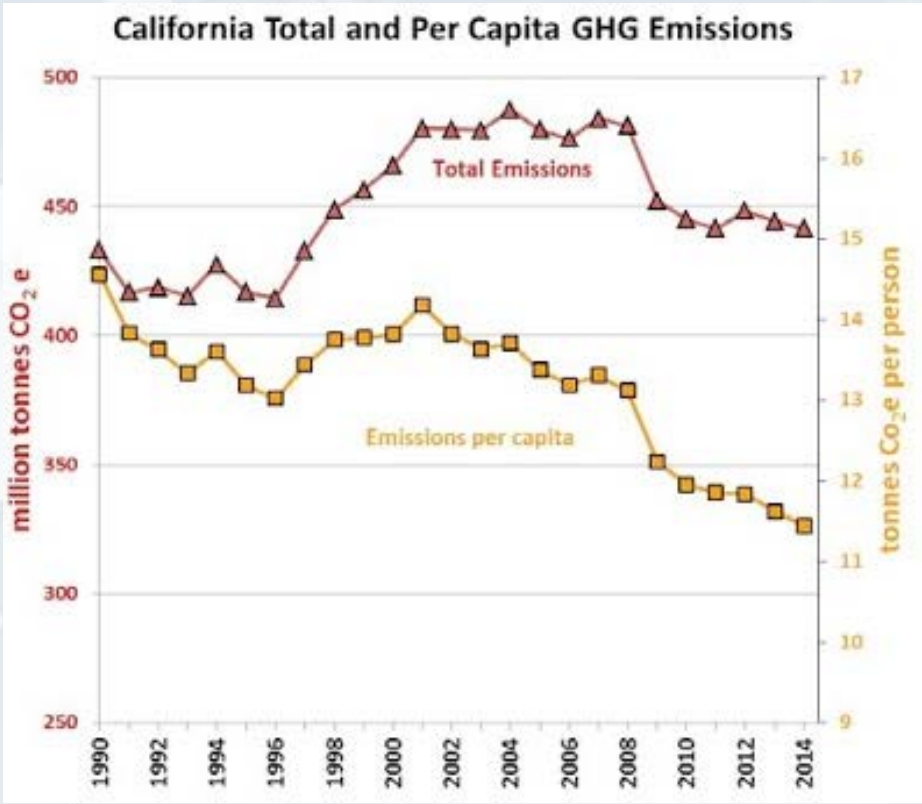
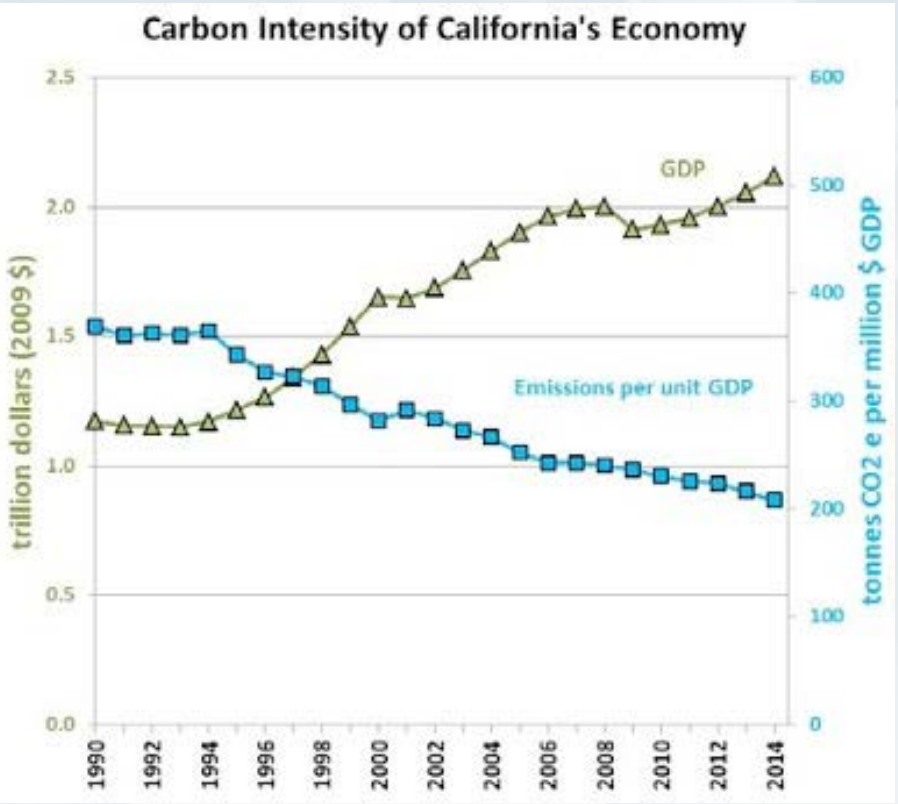
https://www.carbonbrief.org/the-35-countries-cutting-the-link-between-economic-growth-and-emissions

Example: CA's economy grew 80% and population grew by 30%, while emissions remained flat





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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)

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Source: Kiefer, G., Couture, T. D., (2015). Renewable Energy Target Setting, (IRENA). http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Target_Setting_2015.pdf

Thank you.
Questions?

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