The Economics of Steering the Transition to a Low Carbon Economy

Monday 20th October: Understanding Climate Risk		
10.30 – 11.30	**Session 1:**	**A framework for the economics of low-carbon change**
11.30 – 12.00	*Break*	
12.00 – 13.00	**Session 2:**	**Exploring the Apparent Trade-Offs Between Reducing Climate Risk and Fostering Growth**
13.00 – 15.00	*Lunch*	
15.00 – 16.00	**Session 3:**	**The Dynamic Net Economic Costs of Transition**
16.30 – 17.00	**Session 4:**	**Wrap-up and Open Discussion**

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Dynamic Net Economic Costs of Transition

Dimitri Zenghelis

Monday 20th October

Session Three

Dynamic Net Economic Costs of Transition

Part I: Understanding the Dynamic Net Economic Costs of Transition

Part II: Political economy

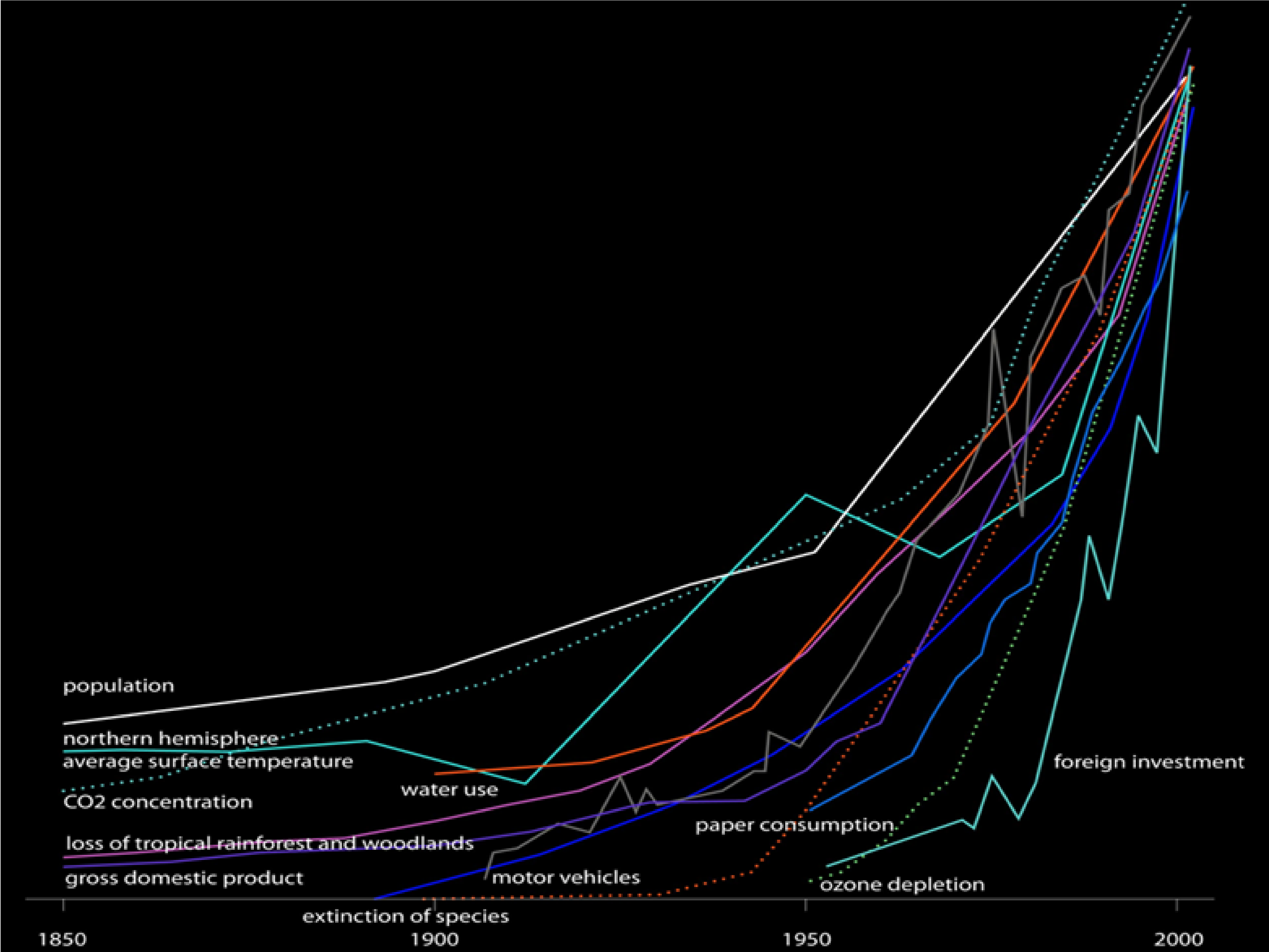
Part III: What makes the problem ‘wicked’?

Part IV: The size of the ‘green’ opportunity

Part V: Policy

Part VI: Why metrics need to be broadened

Part VII: How history can help us when conventional analysis reaches its limits.


population
northern hemisphere
average surface temperature
CO2 concentration
water use
loss of tropical rainforest and woodlands
gross domestic product
motor vehicles
extinction of species
paper consumption
ozone depletion
foreign investment
1850
1900
1950
2000

Part I: Understanding the Dynamic Net Economic Costs of Transition

Pick up discussion about TFP from session I

Ability to achieve absolute decoupling and growth depends on innovation and substitution opportunities

Scope for substitutes? **Energy easy** electrons ultimately from **sun**.
Moore's law in renewables; competitive soon; shale gas in transition

But essential 'elements' (minerals like phosphorus, potassium, arable land, soil, biodiversity, water) **hard to substitute**

Until a decade ago, there appeared to be empirical support for the view that commodities were becoming more economically abundant (Johnson, 2000), given the long-term trend of declining commodity, food, mineral, energy prices over the 20th century (Dobbs, Oppenheim and Thompson, 2011)*

Past decade: **reversal of century long commodity price declines**

Supply increasing to meet demand but prices likely to remain higher: **the characteristics of this resource crunch differ from previous periods**

*D. Johnson, 'Population, Food, and Knowledge', *American Economic Review* 2000. R. Dobbs, J. Oppenheim and F. Thompson, 'A new era for commodities', *McKinsey Quarterly*, November

Part I: Understanding the Dynamic Net Economic Costs of Transition

- But **greater efficiency** can reduce pressure on these prices. (King 2012, HSBC 2012)
- McKinsey&Co (*Resource Revolution* 2011) show **15 areas with great scope for improvement in efficiency**, including: energy efficiency in the built environment; increasing yields on large-scale farms; reducing food waste; reducing municipal water leakage; increasing transport fuel efficiency; reducing land degradation; improving irrigation techniques; and improving the efficiency of power plants
  - See also, e.g. "Sustainable Materials - with Both Eyes Open: Future Buildings, Vehicles, Products and Equipment - Made Efficiently and Made with Less New Material" http://withbotheyesopen.com/
- Population control? Better addressed through education and empowerment of girls/women

Part I: Understanding the Dynamic Net Economic Costs of Transition

- Rising prices of resources have derailed many past recoveries and growth episodes
- But **greater efficiency** can reduce pressure on these prices. (King 2012, HSBC 2012)
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NOT COMPELLING ENOUGH FOR COORDINATED EARLY ACTION? WHY?

Part II: Political economy

- Action involves **radical change**; there will be **dislocation** – not all ‘win-win’
- **Losers** easier to identify; will **lobby hard** against action. Winners potential and diffuse. Asymmetry in political influence
  - **Vested interests** will **oppose change**: “merchants of doubt” industry
  - First-mover risk: highest cost and lowest returns
- Policy must practically manage change; support, **re-skill and retool**
- **People ready to act responsibly** if they understand the scale of risks to future generations and have clear sight what can be done (leadership and expectations)
- It is vital therefore to **understand the political economy of change**, problems in **communication** and misinformation, and the role of public opinion
- **Open public discussion and engagement** and building a common understanding is essential for democratic choice, functional governance and the sustainability of actions – role of functional **democracy** and accountable representatives
- Policies must be made attractive and convenient rather than coercive and complex for households
- Many barriers to early action are **cultural, institutional, political** not technological or economic. **Changing social norms** means resource-efficient activities will be accepted in time (witness initial response to smoking, seatbelts and drink driving)

Part III: What makes the problem 'wicked'?

'Hot air' – much talk; little action. Fundamental essence of the problem we face:

- Global commons: incentives to free ride
- Uncertainty
- Long term and gradual
- Pervasive, non-marginal and irreversible impacts
- Subject to lock-in and path dependent dynamics
  - Technologies; infrastructure; mind-sets and behaviours
- Network externalities

Leads to:

- Incentives for delay; fear of early moving
- Large critical masses and thresholds effects

How can policy be designed to escape the deadlock?

Part III: Managing change: tough love

Change is a fact of life:

- Comparative advantages always shift reflecting technology breakthroughs and evolving tastes and preferences
- Human and physical assets can be left stranded
- Economies that embrace and manage change prosper
- Lax regulations can be detrimental to firms and countries over the long term
- Regulations impact firms asymmetrically and often raise competitiveness concerns
- Economic reasoning and empirical evidence suggest that such concerns are often overplayed
- ‘Tough love’ enhances productivity and drives vital structural change

Part IV: The size of the 'green' opportunity

- **Even in the present uncertain global green policy environment** with lack of ambitious, coordinated policy response:
  - Renewable energy generation and energy efficiency investment has **quadrupled since 2004** according to Bloomberg New Energy Finance (BNEF);
  - New investment in **clean energy surpassed investment in conventional energy** generation in 2010, rising to between US$180 and US$200 billion

- HSBC forecasts the global low-carbon energy market (revenues) will **triple** to US$ 2.2 trillion p.a. **by 2020** (HSBC, 2010):
  - Around US$10 trillion in cumulative capital investments required 2010-2020;
  - **Energy efficiency themes will surpass low-carbon power** as the major investment opportunity by 2020, including, electric vehicles;

- Investors have to take a medium to long term view and high-carbon investments are looking ever riskier

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Part V: Policy - pricing

- **Pricing – transparent and efficient; broad and non-discriminatory**:
- **Under-valuing natural assets ➔ over-consumption and depletion of scarce resources**, especially ones owned in common, such as fish in the ocean or clean air. **Distorted the development of advanced economies** (price creates value)
- **Pricing staunches 'rebound effect'** from policy induced efficiency gains
- Price internalises environmental externalities and non-discriminatory signal/incentives to change behaviour. Efficient.
- Limits 'rent-capture' by vested interests seeking to influence policy-makers (Helm 2010)*

*Dieter Helm, 'Government failure, rent-seeking, and capture: the design of climate change policy', *Oxford Review of Economic Policy*, 2010

Part V: Policy – beyond pricing

- Different **market failures** point to different policy instruments, but the collection is mutually reinforcing (Bowen et al 2010):
  - ***Mispriced resources*****:** carbon taxes / cap-and-trade / regulation / fish;
  - ***R,D&D*** (research, development and deployment): tax breaks, research grants, feed-in tariffs (FIT) for deployment;
  - ***Imperfection in risk/capital markets*****:** risk sharing/reduction through guarantees, equity, feed-in tariffs, floors on carbon prices. FIT straddles first 3 imperfections;
  - ***Networks*****:** electricity grids, public transport, broadband, community-based insulation schemes. Government frameworks needed;
  - ***Efficiency*** – some real costs, but many structural barriers
  - ***Information*****:** labelling and information requirements on cars, domestic appliance, products more generally. Awareness of options;
  - ***Co-benefits*****:** valuing ecosystems and biodiversity, valuing energy security, regulation of dirty and more dangerous technologies

- **Institutional arrangements** can play a major role in combatting some of these failures. For example, a Public Investment Bank can reduce policy risk (governments become more reliable) and enhance the sharing of risks (convening power from trusted institution)

Part V: Policy – strategic choices

- Innovation does not happen in a vacuum
- More than correcting market failures. About governments helping to create **new markets** through clear policy signals. Not picking winners but making **strategic choices**
  - E.g. space race, military-industrial commitment or the “war on cancer” induced innovation.
  - So the setting of resource efficiency or green innovation challenges can be expected to create substantial knowledge-spillovers, boosting Schumpeterian innovation and productivity across a broad number of sectors
  - Help firms reap increasing returns to scale by supporting **new networks**
  - **Shift tax base** towards materials and resources, and away from intellectual activity

Key point: should not see these policies and institutions in terms only of static re-allocations or corrections: **policy concerns the dynamics of change and learning**

Part VI: why metrics need to be broadened

Gross domestic product (GDP) – a measure of market value.

Excludes:

- Some consequentialist **non-market value** welfare, (e.g. environment and health);
- Non-consequentialist welfare, e.g. **security, rights, opportunities, fairness and equity.**

Not a measure of wealth or assets (physical or natural)

- Earthquakes boost GDP; so climate disasters!

But **is a known quantity**, understood, consistently measured

Evidence suggests **GDP gains correlate with (if not cause)**:

- **happiness** (Coyle 2010)
- **reduction in poverty** (Kanbur 2001 Collier, 2007)
- gender equality, **tolerance**, social mobility, physical/**mental health** and education opportunities, rule of law, lower crime/conflict

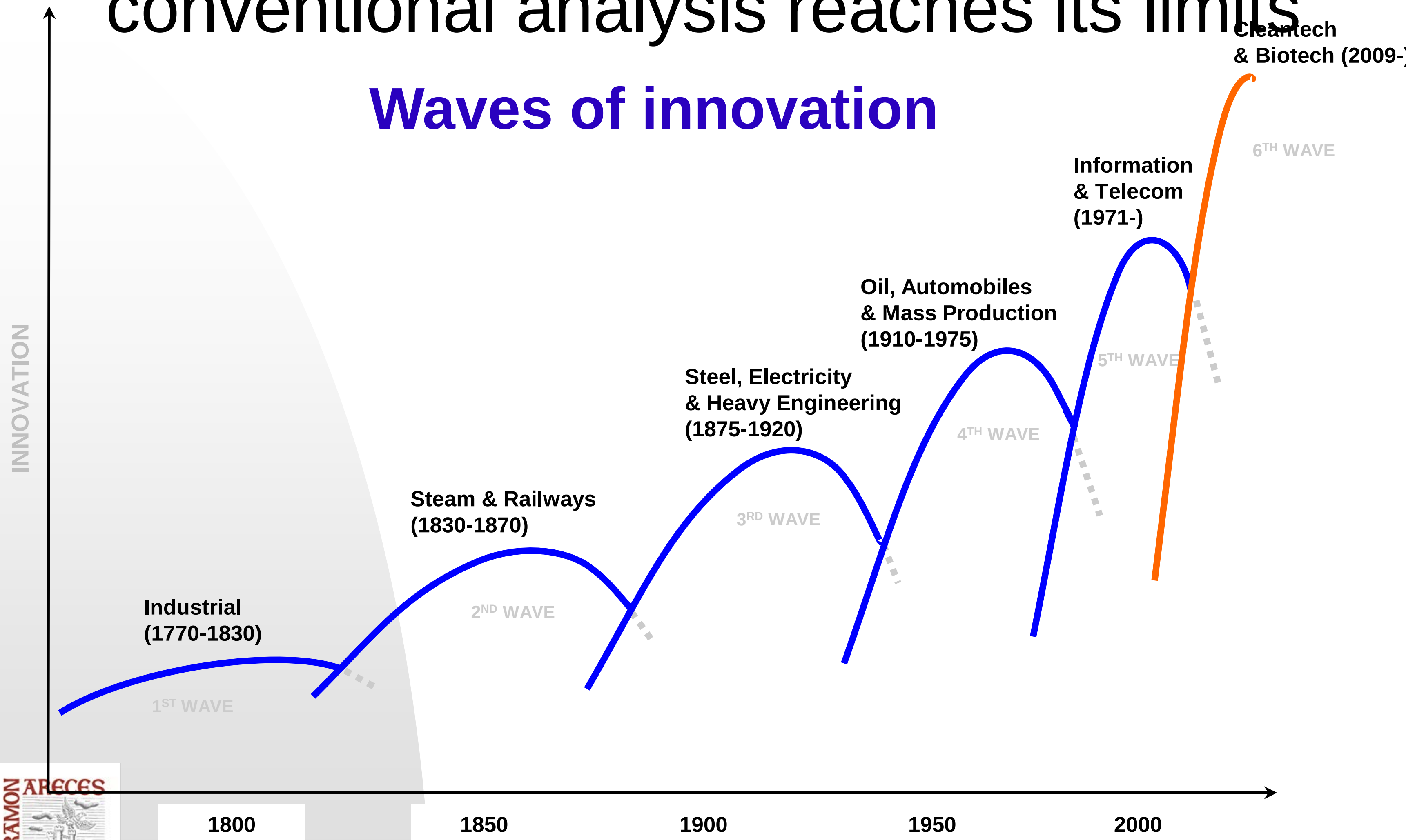
No informative assessment in a single dimension/metric such as output/happiness. Need **“dashboard”** of human development indices such as GDP, health, education, environment, happiness, freedom of expression, and transparency…

Part VI: why metrics need to be broadened

- England's Natural Capital Committee (NCC) is tasked with advising on how to integrate natural capital into National Statistics
- Valuing natural capital in government accounts would enable a more comprehensive assessment of the total wealth of a country, and better identify policy to improve the environmental quality*
- In parallel, better measures of exposure to climate and other environmental risks are also needed
- Corporate natural capital accounts that document an organisation's ownership and extended reliance on natural capital, together with related assets and liabilities, allow for a more comprehensive assessment of the value of corporate assets and enable better management of business
- The financial statements produced by firms fail to provide all the information investors need so they can assess risks and opportunities and allocate their capital efficiently and limit systemic risk

*Office for National Statistics (ONS), 2014. *UK Natural Capital: Initial and Partial Monetary Estimates.* Available at: http://www.ons.gov.uk/ons/dcp171766_361880.pdf.
Natural Capital Committee (NCC), 2013. *The State of Natural Capital: Towards a framework for measurement and valuation*. Available at: https://www.naturalcapitalcommittee.org/state-of-natural-capital-reports.html.
NCC, 2013. The State of Natural Capital: Towards a Framework for Measurement and Valuation.
Bloomberg, M. and M. Schapiro, 2014. Give investors access to all the information they need. In: *Financial Times*, 19th May 2014. Available at: http://www.ft.com/cms/s/0/0d9ccea6-db66-11e3-94ad-00144feabdc0.html#axzz32fJkv7y7.

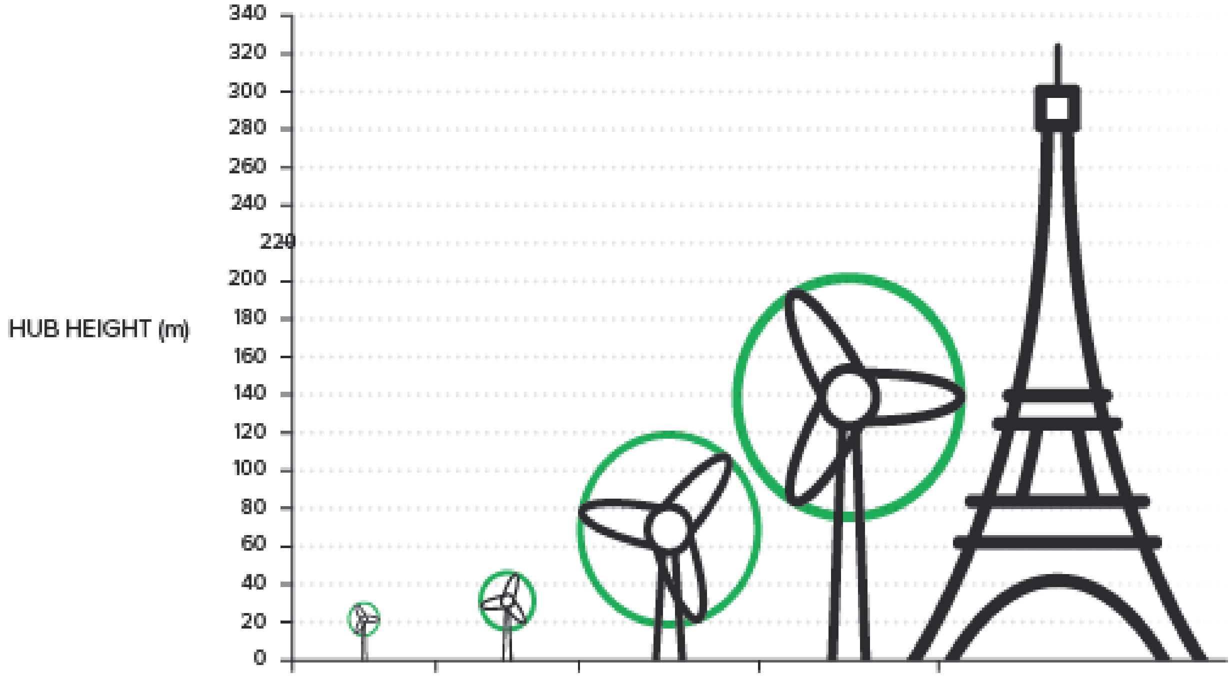
Part IV: how history can help us when conventional analysis reaches its limits



Source: DONG Energy (2009); diagram based on Perez (2002) drawing on report by Merrill Lynch (2008) (schematic not precise quantitative vertical axis).

Part IV: how history can help us when conventional analysis reaches its limits

Wind turbines can generate 100 times the power of 30 years ago



YEAR	1980 – 1990	1990 – 1995	2000 – 2005	2011	Eiffel Tower
ROTATOR DIAMETER	17 m	30 m	100 m	126 m	324 m
RATING	75 kW	300 kW	3,000 kW	7,500 kW	

Part VII: how history can help us when conventional analysis reaches its limits

- In the last 10 years, new and improved materials have driven down the cost and improved the performance of wind and solar energy
- In the US, over 30% of new electricity generation capacity added in 2010–2013 involved solar and wind power, up from less than 2% in 2000–2003.
- Advances in materials have also facilitated large improvements in the efficiency of lighting and appliances, including the rapid emergence of light-emitting diodes (LEDs)
- Enabled a broad array of technologies that improve the energy efficiency of the building envelope, and they have enabled continual improvements in the fuel efficiency of vehicles.

US Energy Information Administration, 2014. EIA projects modest needs for new electric generation capacity. *Today in Energy*, 16 July. Available at: http://www.eia.gov/todayinenergy/detail.cfm?id=17131.
International Energy Agency (IEA), 2013. *Technology Roadmap: Energy Efficient Building Envelopes*. Paris. Available at: http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapEnergyEfficientBuildingEnvelopes.pdf.
Sperling, D. and Lutsey, N., 2009. Energy efficiency in passenger transportation. *The Bridge*, 39(2). 22–30. Available at: https://www.nae.edu/File.aspx?id=14867.

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Part VII: how history can help us when conventional analysis reaches its limits

- **Networked technologies** are also gaining traction through a range of new business models that reduce capital- and energy intensity across the economy
- ‘**Smart grids’ and ‘smart cities’** allow resources to be monitored and managed
- **Earth observation**: a combination of digital, terrestrial and satellite data and cloud computing can also help communities to manage resources
- **Digital technologies** at the individual level facilitate behaviour change: car- and ride-sharing schemes, guide riders through public transit, and help motorists avoid congested roads and find parking more quickly, data-rich systems to control heating and lighting
- In some cases, these technologies have the potential to scale rapidly: China has already installed nearly 250 million smart meters*.

*Bloomberg New Energy Finance, 2014. China Out-spends the US for the First Time in $15bn Smart Grid Market. 18 February: http://about.bnef.com/press-releases/china-out-spends-the-us-for-first-time-in-15bn-smart-grid-market/.

Part VII: how history can help us when conventional analysis reaches its limits

- Quantitative models are one part of the tool-kit required to understand the relationship between growth and climate policy
- Deal badly with structural change
- History can also help to better understand the long-run transformation story described in this chapter and report, providing valuable insights on managing change
- We have the advantage of learning from several transformations since the industrial revolution, including the current information and communications technology (ICT) revolution, and there is a rich Schumpeterian tradition of analysis on medium- to long-run technological transformations.
- The potential of ICT to transform industries and activities has barely been realised.

Crafts, N., 2010. The contribution of new technology to economic growth: Lessons from economic history. *Journal of Iberian and Latin American Economic History,* 28. 409-440. Available at: http://rhe-jilaeh.com/?page_id=380.
Pearson, P. and Foxon, T., 2012. A low carbon industrial revolution? Insights and challenges from past technological and economic transformations. *Energy Policy,* 50. 117-127. DOI: 10.1016/j.enpol.2012.07.061.
Perez, C. 2010. Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics*, 34(1). 185-202. DOI: 10.1093/cje/bep051.
Freeman, C., 1994. The Economics of technical change. *Cambridge Journal of Economics*, 18(5). 463-514.
Schumpeter, J.A., 1939 (1982 edition). *Business Cycles*. Philadelphia: Porcupine Press.

Conclusion

- Uncertainty is a reason to act
- Innovation is the key to decoupling growth from resources
- Innovation depends on history and expectations
- Lock in and path-dependency are features of long-term growth because:
  - Spill-overs complement learning = networks and scale economies
  - Technological, infrastructural and behavioural lock-in make for path dependency
- Standard models assume all this away and therefore of limited use
- History can also help to better understand the long-run transformation
- Barriers are not economic, technological; they are political, institutional and cultural
- But path dependency and growing case for action means likelihood of tipping dynamics: once the system tips it will tip fast.

Key reading

Ackerman, F. and Daniel, J., 2014. *(Mis)understanding Climate Policy: The role of economic modelling*. Synapse Energy Economics, Cambridge MA. Prepared for Friends of the Earth and WWF-UK. Available at: https://www.foe.co.uk/sites/default/files/downloads/synapse-misunderstanding-climate-policy-low-res-46332.pdf.

Aghion, P.; Howitt, P.; (2009) *The economics of growth*. Massachusetts Institute of Technology (MIT) Press: Cambridge, US. http://discovery.ucl.ac.uk/17829/

Aghion, P., Hepburn, C., Teytelboym, A., and Zenghelis, D., (2014). *Path-dependency, innovation and the economics of climate change*.

Simon Dietz & Nicholas Stern, (2014). *Endogenous growth, convexity of damages and climate risk: how Nordhaus' framework supports deep cuts in carbon emissions*, GRI Working Papers 180, Grantham Research Institute on Climate Change and the Environment. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/06/Working-Paper-159-Dietz-and-Stern-2014.pdf

Global Commission on the Economy and Climate, 2014. *Better Growth, Better Climate: The New Climate Economy Report,* Chapter 5, Available at http://newclimateeconomy.report

Mazzucato, M. (2011), *The Entrepreneurial State*, London: Demos.

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