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# Can innovation lead the economy out of the Crisis?

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**An ill wind:** How the on-coming climate disaster **may** rescue the demand side by changing the direction of technological development.

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## Ill wind\*: Outline

- Using labour to save greenhouse emissions: the optimistic Obama-Schumpeter narrative.
- The Sudden Brake: why it is likely
- Why suddenness is dangerous: the roundaboutness problem.
- Roundaboutness in labour; roundaboutness in emissions. Roundaboutness in innovation.
- How one **might** save the world – and escape from recession/depression by reducing roundaboutness.
- \* ‘It’s an ill wind [that] blows nobody good’: = even bad events have good consequences for somebody.



# The optimistic Obama-Schumpeter narrative.

- Greenhouse gas emissions (GGe) and climate change....
- Low GGe capital goods versus High GGe capital goods.
- Assume most existing capital is HGGe
- Then HGGe becomes economically obsolete (maybe due to a carbon tax). What follows?
  
- LoGGe uses more labour in production+use.
- HiGGe uses more natural resources (C) in production+use.
  
- LoGGe is 'front-loaded' – more capital (mostly stored labour), less running cost.
  
- Premature scrapping of HiGGe leads to more investment overall



# Obama-Schumpeter and innovation

- Returns to innovation depend on the maturity of a technology.
- Standard HiGGe equipment uses very mature technology:  
coal: steam turbines; gas: gas turbines + steam turbines.
- Wind, photovoltaic, even nuclear: very immature technology.
- Likewise smart grids, long-range electricity transmission, advanced batteries for renewable energy storage....
- So a shift to LoGGe must increase the quantity of profitable innovation.
  
- The energy market – including the production and distribution of fuels and electricity – is huge (estimated at \$6trn. per annum – 10% of the world's economic output - Economist 2008) yet it is still based on technologies which were familiar in the 1960s at latest.



## And now the bad news: the sudden brake

- 2012: ca. 440 ppm CO<sub>2</sub>e\*; adding ca. 2.5% p.year, and rising.\*\*
- That implies by 2020 about 465ppm. Most climate scientists regard >500ppm CO<sub>2</sub>e as very dangerous. If net emissions settle at 3% per annum we pass that around 2032.
- And Durban follows Copenhagen – and there is no change in policy. EU price of carbon <\$10.... Developing countries mostly subsidise energy...
- The nearer we come to the mouth of hell, and the faster we are moving, the more sharply we must brake.

\*Carbon dioxide equivalent – which includes other GGs like methane

\*\*Stern, Blueprint, 2009, p.150.



# The roundaboutness problem

- We owe this to the Austrian economist Eugen von Böhm-Bawerk.
- **Roundaboutness**, or *roundabout methods of production*, is the process whereby goods are produced from or with the help of other goods (components and capital goods), which in their turn have been produced ditto ditto..... A steel ladder, for example, will be produced and brought to market only after the digging of iron ore, the smelting of steel, the making of machines that press that steel into ladder shape, the making of machines that make and help maintain those machines, etc.



## The roundaboutness of newness

- Roundaboutness can be a historical curiosity: we are where we are (with lots of good A) because we made A with B which had been made with C....
- It is only problematic when we decide to make A and find that we have to make B first, but can't until we have begun by making C – for which we need some D, and find we haven't enough..



## But roundaboutness can be very low

- Suppose a developing country decides to shift to renewables by building lots of small earth dams to generate hydro-electricity. Suppose that the dams are made by fairly low-skilled workers with general-purpose tools – picks, shovels, barrows. The rest of it is the making of the turbines – which are an established type, for which there is spare capacity. So, as soon as we decide to get the electricity this way we can get straight on with building the dam and making the turbines: *we don't have to do anything else first.*
- **General purpose tools** (dam); **spare capacity** (turbines).
- Roundaboutness of newness is very low when you can **switch the use of what you have already.**
- The devil is in the specificity.





# Roundaboutness: labour, time and emissions

- Original emphasis on labour: use labour, then use more labour, then more, then (after a long time) you have a machine that will save labour.
- And/or one that will reduce emissions. After a long time.
- Cf. wind turbines, photovoltaics: first invent, then innovate, then make the machines that will make the components.....
- Thus the problem of **delay**.
- At times over the last few years the ramping up of wind turbine production has been delayed by the shortage of a few crucial components for which there simply was not enough production capacity in the world.
- **Because of their specificity**.



## Roundaboutness and emissions

- If we track the process of getting photovoltaics or wind turbines to the point of operation:
- Produce emissions, then produce more emissions, then (after a long time) you have a machine that will save emissions.
- Nuclear power stations: first pour a lot of concrete, make a lot of steel, dig uranium, refine it, smelt it, enrich it..... Similarly for wind turbines.
- These are both technologies with a high degree of specificity: for example, you cannot use just any centrifuge to enrich uranium.
- Meanwhile the coal-fired power stations which need to be replaced, will go on emitting as before – in fact more than before, to produce electricity to make the extra steel and aluminium for the pressure vessels and turbines....



# Carbon taxation and emissions roundaboutness

- Note that if we trust to the market mechanism to do our emissions-saving job, with carbon taxes, the emissions roundaboutness of a sudden brake will be reflected in the cost of the new nuclear and wind capacity: it will be extremely expensive.
- Much of the expense comes from the **premature** scrapping of HiGGe equipment. So the emissions from the making of the new LoGGe equipment are largely additional to, not instead of, those from making the HiGGe equipment.
- Similarly the shift from suburbs and ex-urbs to urbs.



## Getting out of jail.

- Innovate along the lines of general competences and general-purpose equipment.
  - Develop technological competences which have a diversity of uses, and can be switched to emissions-saving innovation once this is made profitable. Do this particularly where those innovations will/can use general-purpose equipment, or at least equipment *made* with general-purpose equipment and materials.



# Getting out of jail: the biotech example (1)

- Chemicals that are traditionally made by synthetic chemistry (HiGGe) can be made by (genetically-modified) micro-organisms (or plants) (LoGGe).
- You make them in fermentation tanks: **general-purpose equipment**.
- So you just need the (g-e) organisms first.
- Now synthetic biology has the ambition to apply engineering principles to genetic modification.
- So here are your **general technological competences**.
- The money now is mostly on the pharma side: e.g. engineer a phage (virus) to knock out MRSA.
- But competences built in one sector can be switched to another.



## Getting out of jail: the biotech example (2)

- Annual crop plants that are currently grown with lavish watering, fertiliser, pesticides etc.
- Can be made **perennial, drought (or salt-) tolerant, leguminous** (self-sufficient for nitrogen), **pest-resistant**.
- General-purpose competences?
- General-purpose equipment?



## Getting out of jail with ICT.

- The widest-spread general technological competences are in ICT.
- Example: Smart grids and smart appliances.
- The future environmental intelligence of your dishwasher.



# Where was I? Oh, the recession/depression

- So the planet can/could be saved after all.
- But it will require an extraordinary burst of innovation across a very broad front – mostly using g-p competences and equipment. That will indeed generate much employment. The g-p competences will need to be nurtured.
- That innovation will have to be steered by (a guarantee of continuing) very high carbon prices.
- A sudden shift to v high carbon prices would knock out more HiGGe investment than it encouraged LoGGe ditto. See Machiavelli.
- So we do need a big policy shift in good time.
- Pray for....