Perverse Incentives and Outcomes

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Theme

• The Law of Unintended Consequences
• Aluminium and Steel Production
• Other energy-intensive industries
• Intermittency and energy storage
• Biofuels and biomass
• Fuel Poverty
• How can we learn from our mistakes?
Aluminium Properties

- *Global aluminium production* ~ 50M tonnes /year
- Aluminium is only 1/3 the density of steel
- Does not rust or corrode easily
- Easy to form by a wide variety of methods
- Easy to recycle and re-use – requires only 5% of the energy needed for primary production
- Large energy savings by use in transportation (~130kg in an average European car – claimed to save up to ~6x more energy during life of vehicle than required to produce the original metal)
- Aluminium *usage* regarded positively in the UK
Aluminium production is very energy intensive (>200GJ/tonne)
• The energy used in smelting is mainly electrical
• ~14,000 kWh of electricity per tonne of metal
• Current market price of metal is ~ £1200/tonne
• Price paid for electricity ~1/3 total metal price
• Production also generates directly about 1.2 tonnes of CO2 per tonne of metal produced
• Aluminium production regarded negatively in UK
Aluminium in the UK

- High UK energy prices have decimated UK capacity
- Historically, UK produced ~300k tonnes / year
- Anglesey smelter (145k tonnes / yr) closed 2009
- Lynemouth smelter (178k tonnes /yr) closed 2012
- Only Lochaber (45k tonnes / yr) remains open
- Knock-on effects throughout supply chain – casting, rolling, forging, extrusion, drawing, etc
- Estimates suggest up to 10,000 jobs lost in UK manufacturing industry as a result of this collapse
- UK consumption of aluminium remains buoyant
- Consequently, most UK aluminium now imported
Aluminium – Global Balance Sheet

• Aluminium production in China has quadrupled
• UK has exported CO2 production to Asia
• Product transport requires additional energy
• UK production used a significant proportion of nuclear electricity, China still uses mainly fossil fuel for electricity generation
• Outcome of UK policy counter-productive – more CO2 produced globally than before.
“Aluminium Deep Dive”

Competitiveness impacts of carbon policies on UK energy-intensive industrial sectors to 2030

Report prepared for Committee on Climate Change (2017)

“Primary production capacity in the UK plummeted following the closure of the Anglesey smelter in 2009, having failed to secure a new long-term electricity contract, and the closure of the Lynemouth smelter in 2012, attributed to rising energy costs and increasing global competition. Indeed, both closures followed a sharp rise in electricity costs in the UK over 2004-09, amid weak UK and EU demand for aluminium during the economic downturn. In contrast France and Germany, which faced lower industrial electricity costs, have kept stronger levels of primary production, though they have seen closures of smaller, less efficient smelters”
Steel in the UK (and Europe)

- Global steel production ~ 1,500 million tonnes per year
- UK Steel production ~10 million tonnes /year
- £1.1 billion / year industry in the UK
- Current price of basic steel ~£400 / tonne
- Energy consumption ~ 50-60 GJ per tonne
- ~1.5 tonnes of CO2 produced per tonne of metal
- Energy prices critical to survival of industry
- 78 European steel companies recently wrote jointly to Brussels asking for help with their rising energy costs
- Demand for steel products is high in Europe, but steel production may increasingly be exported elsewhere
- Profit margins tight – every penny counts
- Steel production in UK has survived mainly because of fall in £
Energy Costs in the Steel Industry

The proportion of the total costs of steel production that are attributable to energy vary significantly, from site to site and from country to country. The World Steel Association has recently estimated it as high as 20-40% with the split of energy consumption at an integrated site (blast furnace) being 50% coal, 35% electricity, 5% natural gas and 5% other gases. For an electric arc furnace the figures are approximately 75% electricity and 25% gas.

*World Steel Association (2015) Energy use in the steel industry*
Other Energy Intensive Industries

• The whole of the European chemical industry is under pressure from high energy prices
• Other industries such as glass-making, ceramics, brick-making, paper-making and cement production are also affected
• The situation in the UK is especially serious, because of our high energy pricing policy
• Efforts to support energy-intensive industries in the UK remain insufficient
Intermittency and Energy Storage

• The UK is committed to spending up to £100 billion to build offshore wind installations
• Historically, UK investment in energy storage technology lags behind investment in wind power
• Long term reliability of offshore wind turbines is questionable – e.g. Corrosion fatigue problems with gearboxes and bearings operating in salt spray environments. Winter maintenance difficult
• Premature investment in immature technology?
First Generation Biofuels

• >30% of American maize used to produce bioethanol
• ~45% of all palm oil consumed in Europe used to produce biofuels
• Millions of hectares of land in Africa, Central and South America and Asia now used for biofuel production instead of food. Mature forests destroyed and burned
• Profound moral, ethical and environmental issues
Biomass Issues

• The Drax power station consumes ~7.5 m tonnes of wood pellets per year, nearly all imported from North America. How much from unregulated sources?

• Wood burning stoves now regarded as source of pollution, rather than environmentally friendly

• Biomass from plant waste often contains significant trace amounts of Na, K, Ca, P, S and / or Cl – leads to enhanced rates of corrosion in boilers, reduced boiler lifetime and increased costs of energy production

• Have these programmes been fully thought through?
Fuel Poverty

• Strong evidence that elderly people in the UK on low incomes are having to choose between heating their homes during the winter and eating proper, regular meals.

• Is the UK’s policy of high energy prices doing more harm than good to individuals, as well as to energy-intensive manufacturing industry?

• Serious debate needed on these issues.
Reprise of Theme

Law of Unintended
– but (in hindsight)
largely predictable-
Consequences
What Are We Doing Wrong?

• “More haste, less speed”
• Search for “silver bullets” - over-simplified approaches, difficulties underestimated
• Difficult problems require subtle solutions
• Complex systems = multiple feedback loops
• Strongly interconnected global society
• Local actions unlikely to make much impact
• Assessment models fail to identify key issues
A Suggestion

“The Mackay Institute for the Study of Energy Options”

Dedicated to the rational analysis of energy production, distribution and usage options, taking into account the widest possible range of scientific, technical, economic, environmental, human, social political and ethical issues.