UK NATIONAL CARBON FOOTPRINT CALCULATOR- ASSUMPTIONS

ENERGY SUPPLY

Energy supply assumptions have mostly been approximated using info in David MacKay's book: [http://www.withouthotair.com]
There may be further zero carbon projects (e.g. large scale on-shore wind - in Scotland), tidal lagoons, which we may be able to add.
The extension to this model would be to add CO2 emissions (gCO2/kWh) approximate investment cost/GW and real levelised electricity cost/kWh for all types of energy.

ENERGY DEMAND

Specific estimates made for the personal sector and thus it exceptionally difficult to reduce emissions from 10 to 1 tonne of CO2 per person.
Other

CONVERTING TO ELECTRICITY

- Energy comes in two forms, fossil fuels and electricity. 1kWh of electricity produces as much heat in a resistive electric fire as 1kWh of gas does when you burn it (ignoring latent heat of water generated).
- It takes ~2.5kWh of fossil fuels to produce 1kWh of electricity. Use kWh(e) to describe electricity and kWh(th,f) to describe fossil fuels in their final form.
- Investment in low-carbon electricity generation (renewable/nuclear/coal with CCS) initially replaces fossil fuel electricity.
- Once fossil fuel electricity sector is replaced we assume that electricity replaces fossil fuels in the ratio of 1kWh(e) : 1kWh(th,f). 1kWh of electricity is usually at least as useful as 1kWh of fossil fuels (transportation being an exception).
- Some sectors (aviation, national sea transport, miscellaneous) cannot be converted.
- I've assumed that heavy goods vehicles can be converted to rail transport, or lighter electric trucks.
- Information about conversion efficiency of electric cars, electric heating (e.g. using heat pumps) on a practical aggregate scale might help refine the model.
- In the case of nuclear and coal with carbon capture, I've also assumed that little use can be made of the waste excess heat (desalination/industry/district heating?).

APPROXIMATIONS

For simplicity the exact calculations are in addition summarised by a single factor for each project. An investment ordering is assumed: nuclear baseload-ccs-renewables-more nuclear for new infrastructure. The intermittency of renewable generation requires effective storage; however effective storage (e.g. electric cars) is likely to be un-environmental and uneconomic (because of efficiency losses) until the electricity system is decarbonised (a sort of catch-22 situation). I've retained the exact calculation. This ordering also gives time for plans to be made, which might be changed prior to investment, e.g. in the eventuality of the 'hydrogen economy' becoming viable.

EMISSIONS FACTORS

Energy Source	gCO2/kWh	Mt CO2 per year / GW
	33	2.8
Coal (thermal)	0	9
	25	2.1
Oil (thermal)	0	9
	19	1.6
Gas (thermal)	0	6
	1	0.1
UK Zero carbon electricity (lifecycle)	6	4
	15	1.3
UK Coal with carbon capture electricity	0	1
	63	5.5
UK Fossil electricity average (using aggregate data)	6	7
	47	4.1
UK Electricity overall average	2	4
	22	2.0
UK Fossil Thermal average UK Composition	8	0
UK emissions from fossil fuels per kWh of energy in	26	2.3
final form (including e.g. refining emissions)	5	3
Excess Electricity/Exports, offset (usually amounts to a limit on Carbon Capture storage)	-150	-1.31

ENERGY USE REDUCTIONS- SECTORS COVERED

Electricity	Domestic Electricity	13.3	0.2
	Public administration Electricity	2.5	0.3
	Commercial Electricity	8.6	0.3
	Industry Electricity	13.5	0.3
	Agriculture/Fish/Forests Electricity	0.5	0.3
	Other Electricity	5.5	0.0
Fossil Fuel Non-Convertible	Domestic Fossil Fuel	48.3	0.4
	Public administration Fossil Fuel	6.4	0.3
	Commercial Fossil Fuel	4.5	0.3
	Industry Fossil Fuel	27.9	0.3
	Agriculture/Fish/Forests Fossil Fuel	0.7	0.3
	Rail Transport Fossil Fuel	1.2	0.0
	Road Transport (Cars) Fossil Fuel	32.6	0.8
	Road Transport (Other) Fossil Fuel	13.5	0.0
	Road Transport (HGV) Fossil Fuel	10.1	0.0
	Sea Transport Fossil Fuel	1.8	0.0
	Air Transport Fossil Fuel	18.4	0.8
	Miscellaneous Fossil Fuel	2.9	0.0

The yellow cells show those sectors covered by the energy reduction options, the beige cells are not currently covered.

ENERGY SUPPLY

	CAPACITY (GW)			
	IAG (economic-<7p/kWh)	IEE (theoretical)	MacKay (maximum)	Covered?
Onshore wind power	6.5	5.0	50	**n**
Offshore wind power	11.4	16.0	40	y
Solar Thermal				y
Solar Photovoltaics	0.1	30.0	13	y
Geothermal				**n**
Tidal power	(false)	6.0	35	Severn Barrage only
Hydro		-	5 15 (total)	**n**
Energy Crops	3.8	22.5		y
Agricultural and Forest Residues	2.2	-		**n**
Landfill gas	0.8	-		**n**
Municipal solid waste	0.8	-		**n**
Wave power	3.8	5.8	4	**n**
Nuclear fission				y
CCS				y