Transition to 100% Renewable Energy and a Zero Carbon Society

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Transition to 100% Renewable Energy and a Zero Carbon Society

Part of Proceedings of INFORSE-Europe Seminar on 21/9 2020
Transition to 100% Renewable Energy and a Zero Carbon Society (Examples from UK, France, Denmark):
http://www.inforse.org/europe/seminar.htm#INFORSEEuropeSeminar100RE21092020
Where we are now –

Figure 3.1: UK Greenhouse gas emissions in 2017, including international aviation and shipping, and the enhanced effect of emissions from aviation (BEIS, 2019).
Power-down & Power-up

Through integrating a smart approach to energy use we can Power-down demand & Power-up 100% clean energy supply for buildings, transport, energy & land-use - the UK’s greenhouse gas emissions can be rapidly reduced to net zero.
Figure 3.4: Total annual energy demand by sector in the UK in 2017 (BEIS, 2018) and in our scenario.
Figure 3.7: measures that reduce building’s heat loss and heating demand.

- An average UK house: Fabric heat loss: 200 W/°C
  Ventilation heat loss: 50 W/°C
  Total heat loss: 250 W/°C
  Heating demand: 10,000 kWh/yr

- Insulate walls, roof and floor
  Better windows and doors
  Fabric heat loss: 85 W/°C
  Ventilation heat loss: 50 W/°C
  Total heat loss: 135 W/°C
  Heating demand: 6,000 kWh/yr

- Reduce draughts and air leakage
  Fabric heat loss: 85 W/°C
  Ventilation heat loss: 35 W/°C
  Total heat loss: 120 W/°C
  Heating demand: 5,000 kWh/yr

- Better controls and lower internal temperatures
  Fabric heat loss: 85 W/°C
  Ventilation heat loss: 35 W/°C
  Total heat loss: 120 W/°C
  Heating demand: 4,000 kWh/yr
Figure 3.12: Average distance travelled per person per year by various modes of transport in 2017 (DfT, 2018) and our scenario.
Figure 3.13: Reduction in energy demand for transport in our scenario, shown in two stages: firstly with only the impact of reduced distances travelled and higher occupancy levels; secondly, adding the impact of higher vehicle efficiencies (initial figures from BEIS, 2018; DfT, 2018).
Powering up Britain with 100% renewables:

Can we “keep the lights on”?
Yes we can!

The ZCB Energy Model is based on ten years of real-world hourly data from 2002 – 2011

87,648 hours
Synthetic gas storage meets demand 100% of time

Figure 3.20: From surplus electricity and biomass to synthetic fuels for industry, transport and energy system back up. - Losses are not shown in this figure.
Management of supply & demand in a 100% renewable energy system is possible with existing technology.

74% of the time, supply *exceeds* demand.
26% of the time, supply does not fully meet demand.
Short-term storage & load shifting reduces this to 11%.
Carbon-neutral synthetic gas power stations cover this.

But this requires re-thinking land-use…
Figure 3.3: Approximate land use today (not including water courses and coastal areas). Based on data from Morton et al. (2008), Forestry Commission (2007), DEFRA (2012), NERC (2008), Bain et al. (2011) and Read et al. (2009).
Fig 3.29: Government recommendations for a healthy balanced diet. Both today’s average diet and the average diet in our scenario are shown (outside circle) relative to the Eatwell guide recommendations (central circle).
Switching to a healthier ZCB diet can free up lots of land!
Figure 3.28: The area of cropland and grassland used for agriculture today (DEFRA, 2012) and in our scenario.
Growing energy and making synthetic fuel

**Land use today**

- Grassland for livestock
- Miscanthus grass
- Other mixed grasses
- Short Rotation Forestry (SRF)
- Short Rotation Coppice (SRC)

**Land use in ZCB**

- Biomass
  - For heat (41 TWh/yr)
- Biomass (+waste)
  - For synthetic gas/biogas (74 TWh/yr)
- Biomass
  - For synthetic liquid fuel (115 TWh/yr)

Figure 3.30: Area of land used today (DEFRA, 2012) that is used for energy crops in our scenario, the types of crop grown, and the amount and use of the biomass produced.
Capturing carbon - ecologically

- Double forest area.
- Increase use of wood products.
- Restore 50% of peatlands.

Balance GHG emissions of

\(~ 47 \text{ MtCO}_2\text{e/year}\)

Figure 3.34: Area of land used for capturing carbon in our scenario, the methods, and how much carbon is captured as a result.
So we can go from this...

Figure 3.1: UK Greenhouse gas emissions in 2017, including international aviation and shipping, and the enhanced effect of emissions from aviation (BEIS, 2019).
Figure 3.35: Carbon captured and greenhouse gas emissions for the UK in our scenario relative to 2017, including international aviation and shipping and the enhanced effect of emissions from aviation. Total emissions sum to net zero. #ZeroCarbonBritain
Multi-solving – maximising the benefits beyond carbon
The trick is to identify synergies between changes to reach net zero & those which also:

* Create jobs & build a sense of purpose
* Improve our diets, health & wellbeing
* Increase active mobility / reduce unnecessary travel
* Enhance space for biodiversity
* Restore UK soils
* Reduce fuel poverty
* Re-boot our economy
* Increase resilience to climate & other emergencies!

Let’s open new conversations…
Local councils can play a key role in leading the climate emergency response. Write to your Councillor & sign a petition.

Click to sign the Petition: Declare a Climate Emergency, end fossil fuel use and build community resilience.

Switch to renewables and take your money out of fossil fuels.

Local Council News
Declare a Climate Emergency
Go Zero Carbon by 2030

Local Councils
Zero Carbon Britain
Climate Change
Resources
Solutions
Policy

UK Government & Parliament
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RENEWABLE ENERGY
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UK Government & Parliament

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UK Government & Parliament

Local Council News
Zero Carbon Britain Hub and Innovation Lab

CAT's new Zero Carbon Britain Hub and Innovation Lab helps turn climate emergency declarations into action, sharing zero carbon solutions to help build resilience where you live.

We provide local authorities, businesses, institutions and community groups with the confidence, skills and understanding to help achieve net zero greenhouse gas emissions by 2040.

With technical solutions readily available, the momentum coming from towns and cities to get to net zero is the political and cultural challenge of our generation.

The Zero Carbon Britain Innovation Lab tackles the specific barriers to transforming the complex economic, social and political dynamics here in the UK, and beyond. Working with others, we test and prototype solutions, and create routes for a sustainable future for all.
- Zero Carbon Britain reports
- Hub and Innovation Lab
- Postgraduate degrees
- Short courses
- Free information service

www.cat.org.uk

Sustainability and Ecology
Sustainability and Adaptation
Sustainability and Behaviour Change
Sustainability and Adaptation Planning
Sustainability and Adaptation in the Built Environment
Sustainability and Energy Provision and Demand Management
Sustainable Food and Natural Resources
Green Building
MArch Sustainable Architecture