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NATURAL ENVIRONMENT RESEARCH COUNCIL

Regulatory and Commercial Drivers – an environmentalist's perspective

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Energy from Waste:
Advanced Thermal Technologies

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Outline

- Introduction
  - My perspective & terminology
- Energy scenarios to 2050
  - Where waste sits
- How to improve waste energy uptake
  - In the model
  - In reality

Definitions

Waste is *any materials unused and rejected as worthless or unwanted;*

UK produces over 100 million tonnes of organic waste material per year:

- 12-20 million tonnes of food waste
- 90 million tonnes of agricultural waste;
- 1.73 million tonnes of sewage sludge.

Government will provide the leadership through an economic and regulatory framework. **Regulators** apply the framework making sure that it is both cost effective and beneficial to the environment.

•**Commercial drivers** are factors influencing sectors using waste for energy technology. These include:

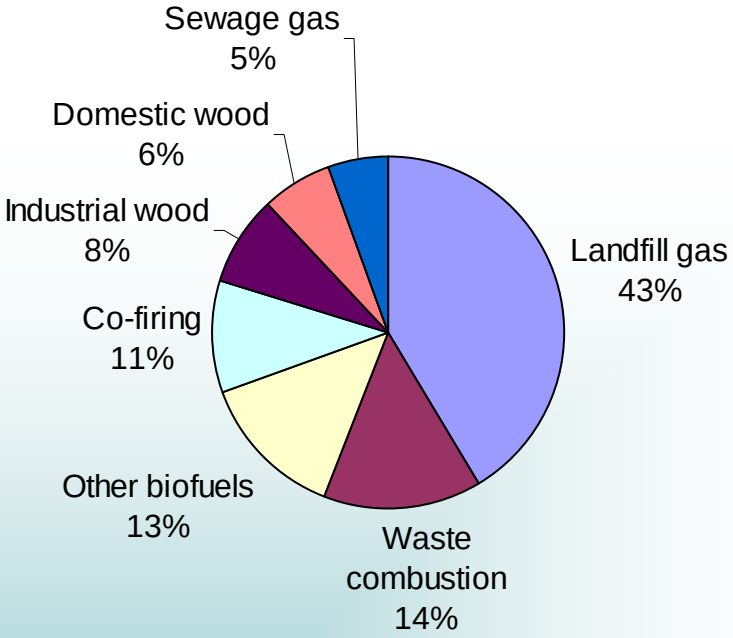
- Energy
- Transport
- Waste management
- Water

Environment Agency

OFGEM

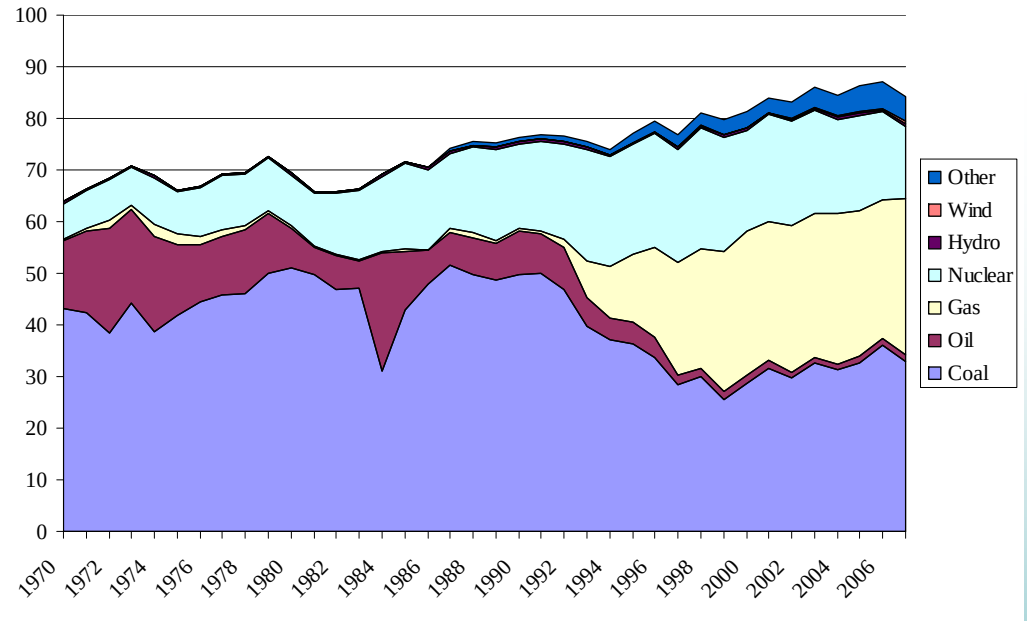
Context

Bioenergy



Source: DUKES

- UK total electricity



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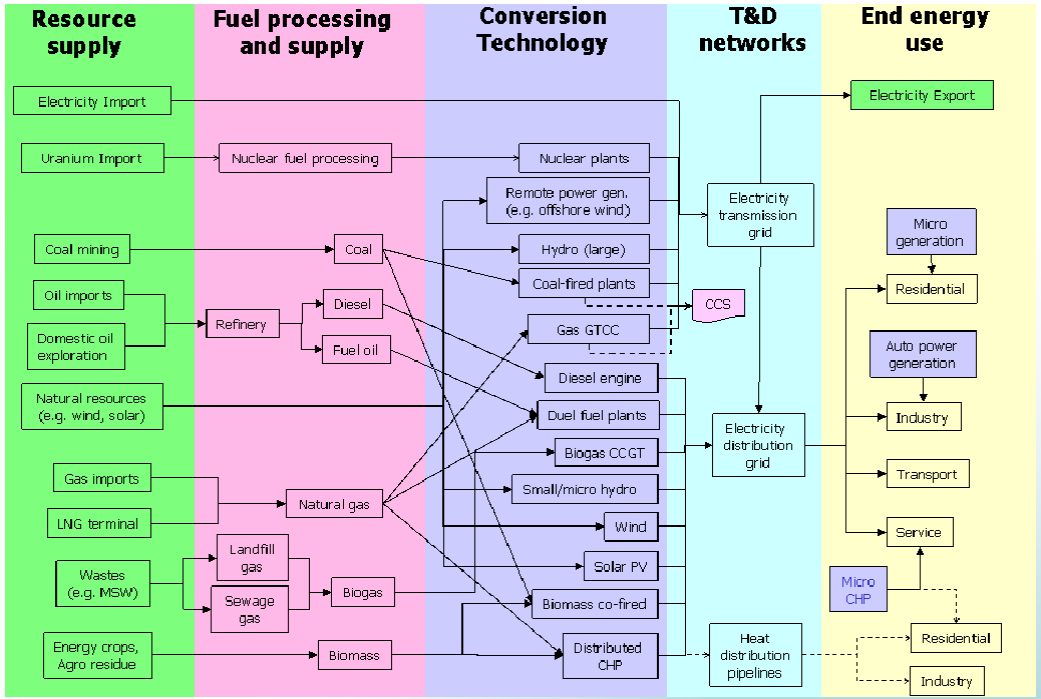
Whole System Modelling

- Describes UK 2000 – 2050
- Economic model (MARKAL)
- Balances dynamic, elastic demand with time and magnitude constrained resource
- Technology rich
- Scenario driven



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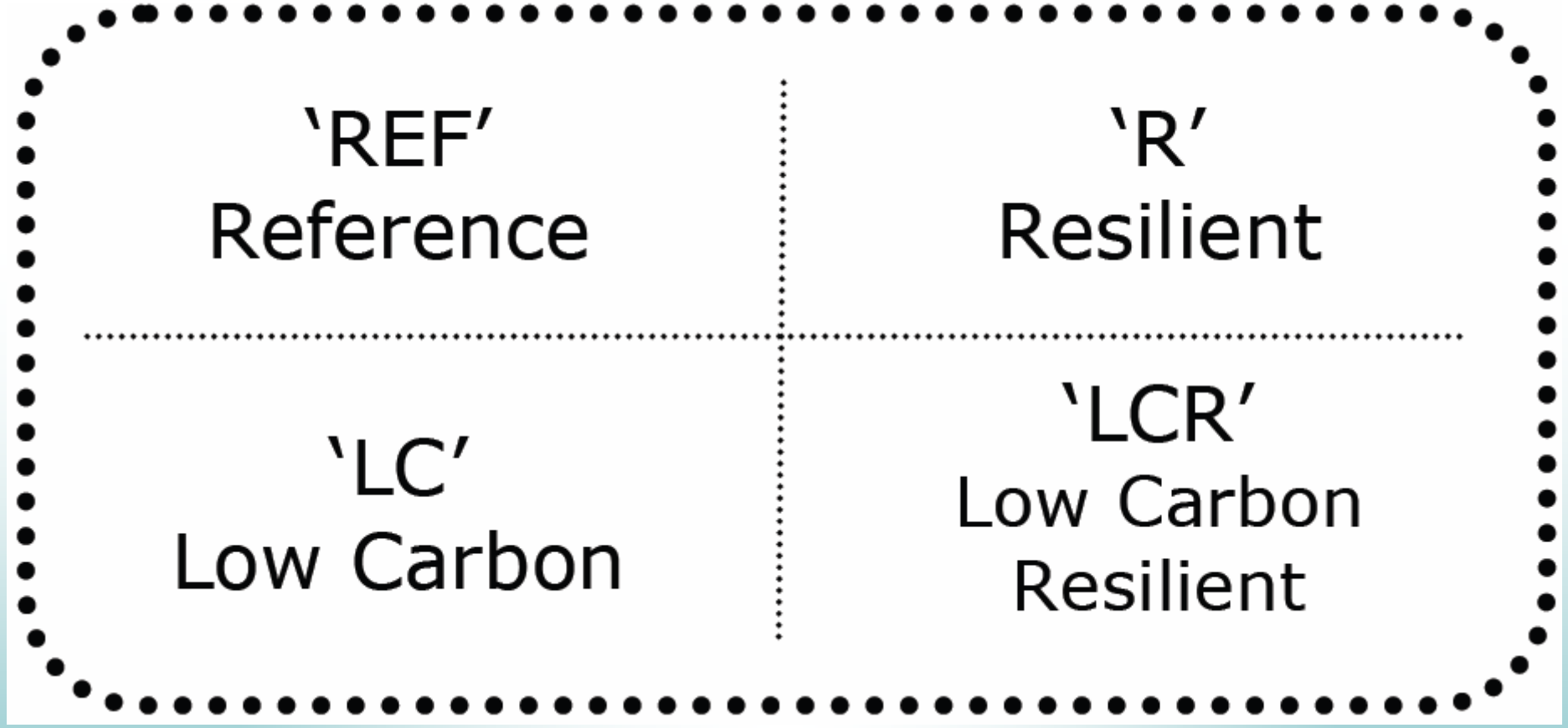
Core Scenarios



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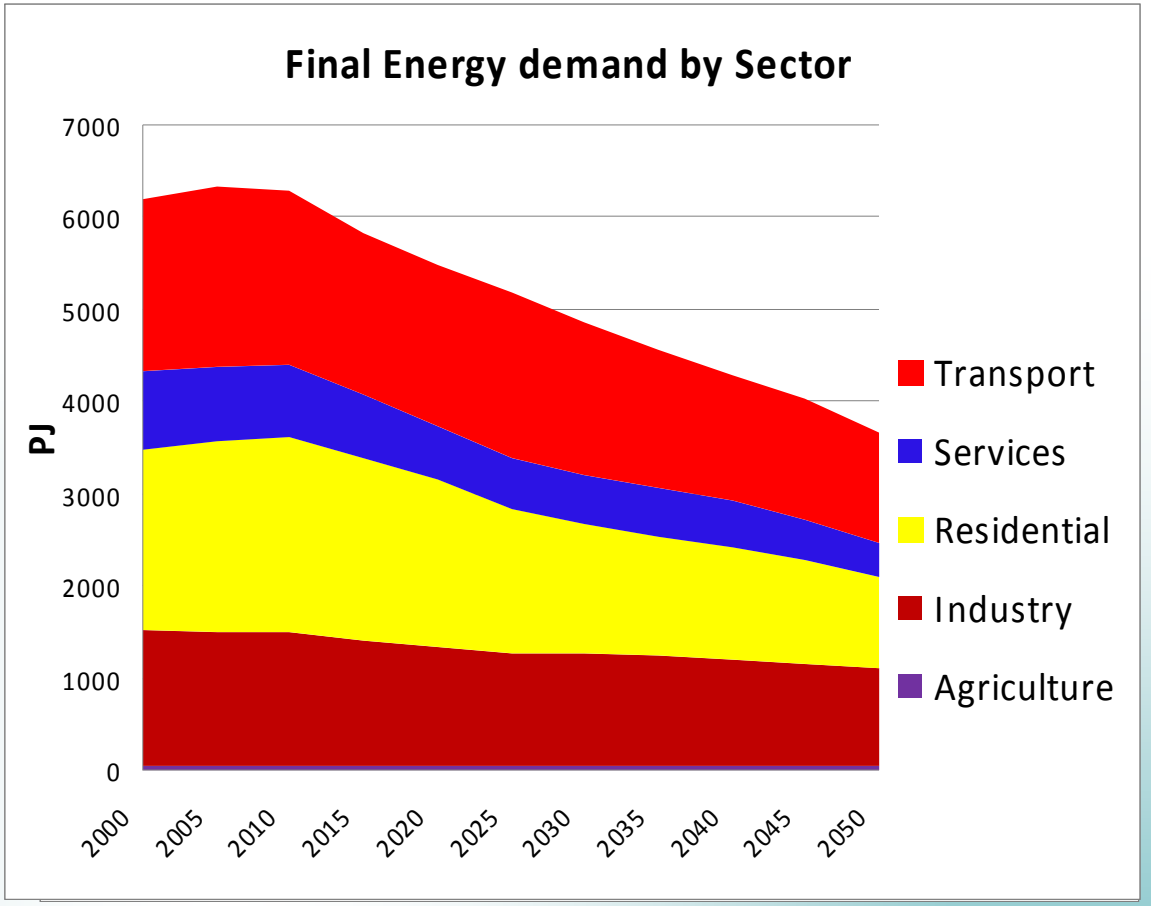
Energy 2050
Low Carbon (CAM) Core Scenario

- **coal-fired CCS** grows
- **combined cycle gas-fired plant** declines
- One period of change
- new **nuclear plant** after 2035
- **wind power** split evenly between onshore and offshore
- Use of Open Cycle Gas Turbine, storage heaters, pumped hydro and (after 2030) plug-in hybrids for storage and balancing



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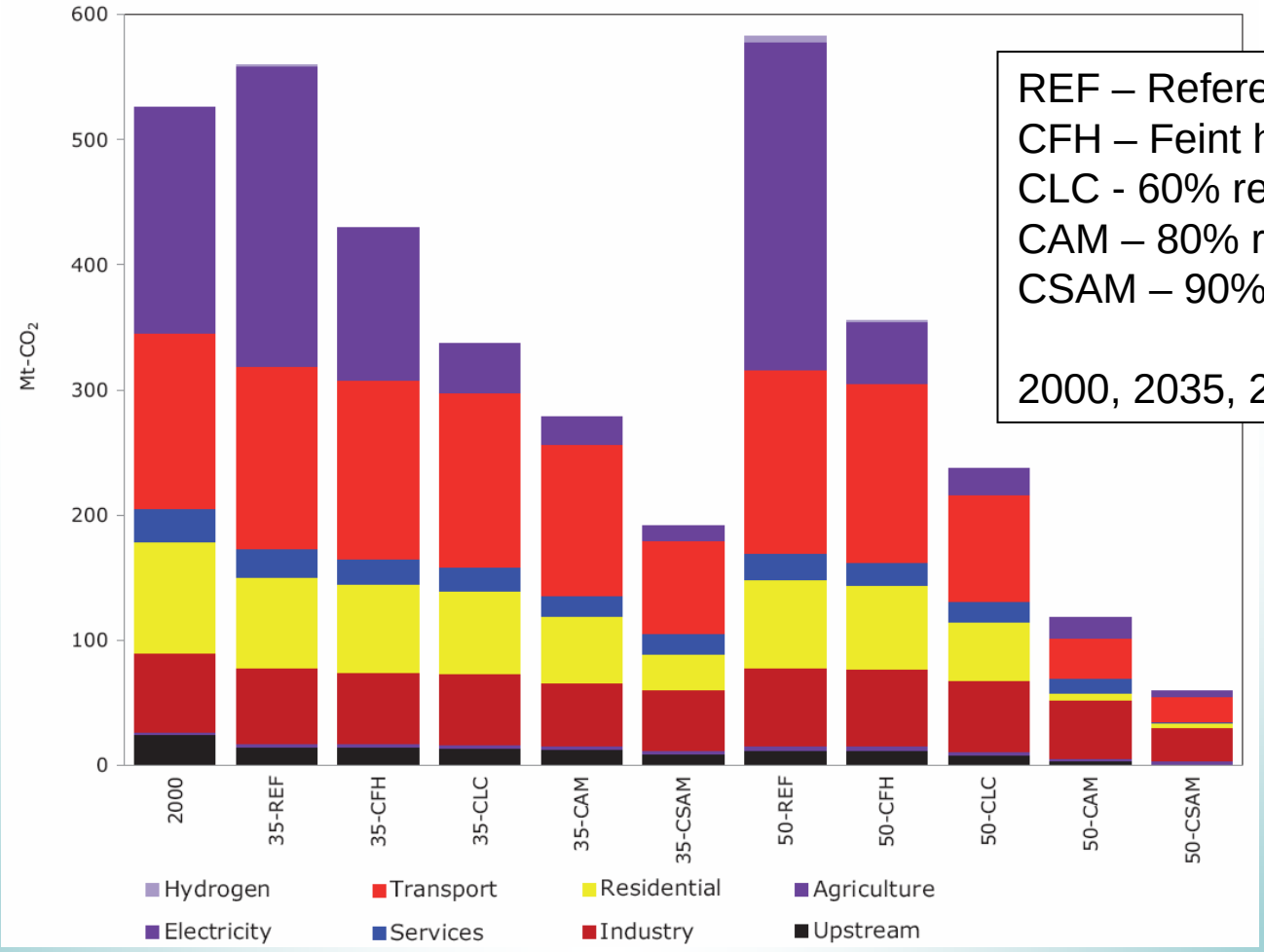
Scenario variants

CORE SCENARIOS	4
CARBON REDUCTION	7
ACCELERATED TECHNOLOGY DEVELOPMENT	8
ENVIRONMENTAL SENSITIVITIES	4
ENERGY LIFESTYLES	3

CO_2 Emissions



REF – Reference
CFH – Feint heart
CLC - 60% reduction
CAM – 80% reduction
CSAM – 90% reduction

2000, 2035, 2050

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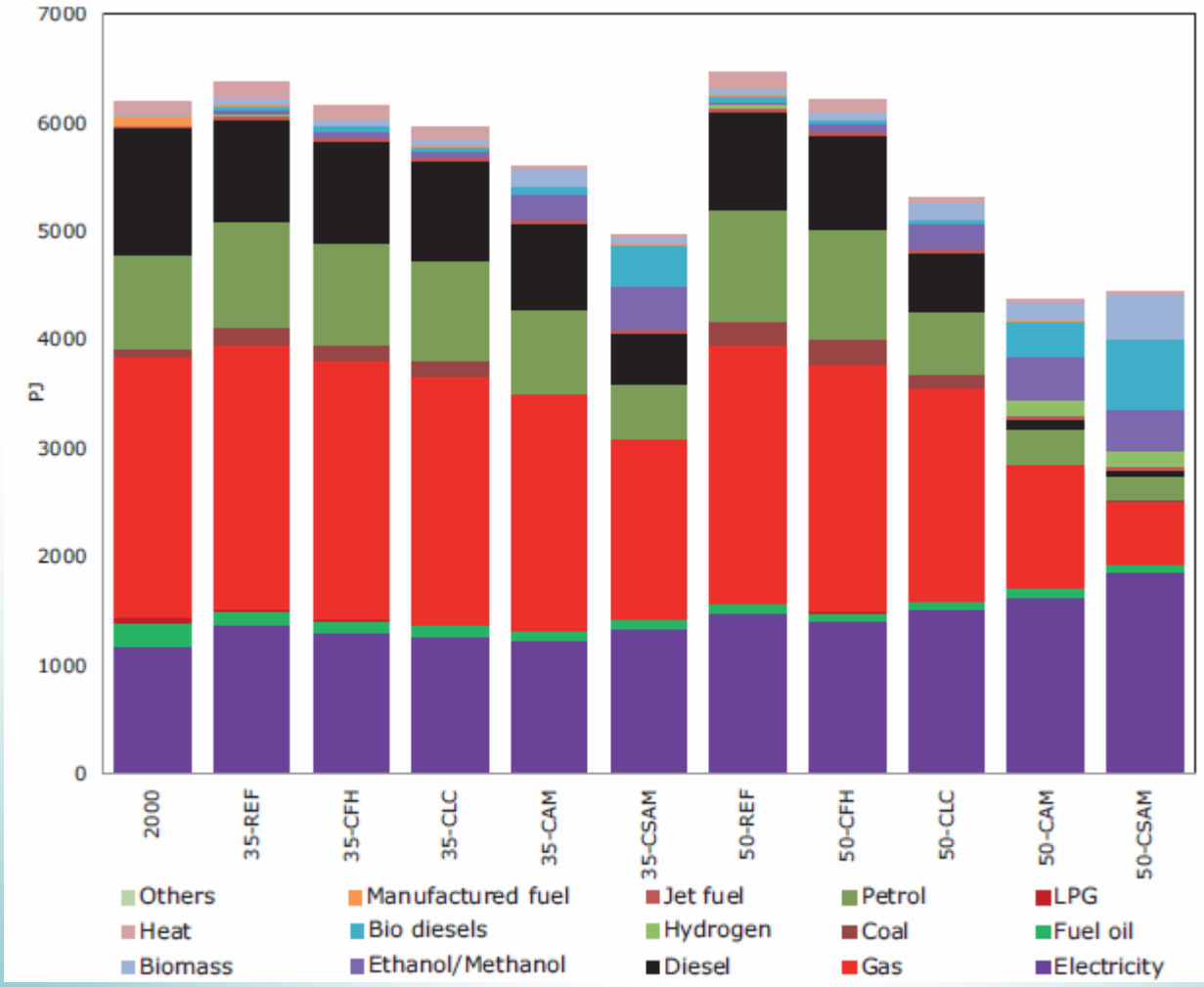
Where is waste energy?

Biomass waste	Agriculture wastes	Slurry digester	Electricity
		Steam turbine	Electricity
	Landfill gas	CHP	CHP
		IC & Reciprocating Engines	Electricity
	Municipal solid waste	Steam turbine	Electricity
	Sewage gas	IC engine	Electricity

Final energy demand



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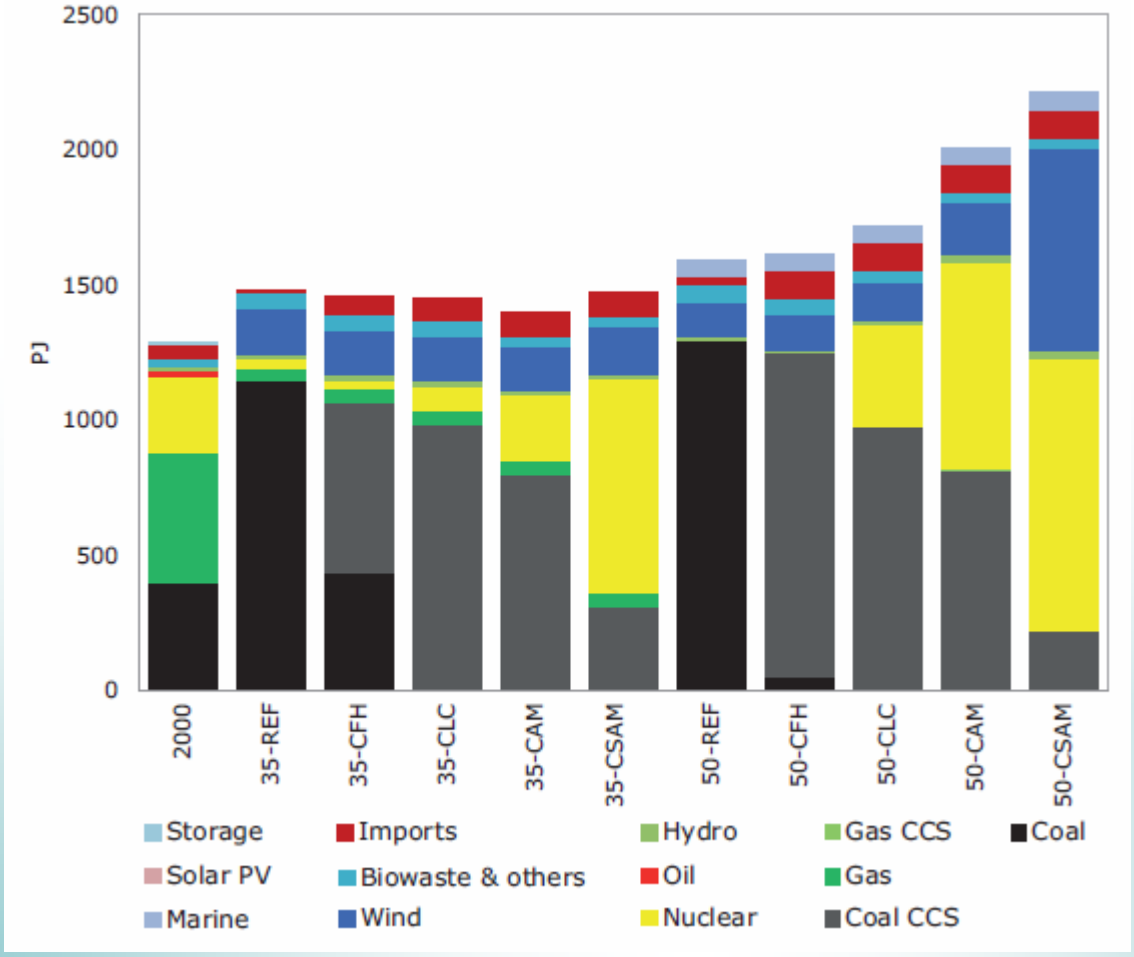
Electricity mix for carbon reduction



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2000, 2035, 2050

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Indicators 2025

REFERENCE (REF)	
Primary energy demand:	-7%
Final energy demand:	+2%
Electricity demand:	+14%
Residential demand:	+5%
Max primary share (gas):	38%
Max generation share (coal):	54%
CO_2 emissions[1]:	-12%
CO_2 intensity power:	513g/kWh
Energy system costs:	£0bn
Welfare costs:	£0bn

RESILIENT (R)	
Primary energy demand:	-20%
Final energy demand:	-16%
Electricity demand:	+1%
Residential demand:	-23%
Max primary share (gas):	38%
Max generation share (coal):	40%
CO_2 emissions[1]:	-19%
CO_2 intensity power:	464g/kWh
Energy system costs:	-£2bn
Welfare costs:	-£19bn

LOW-CARBON (LC)	
Primary energy demand:	-13%
Final energy demand:	-2%
Electricity demand:	+6%
Residential demand:	0%
Max primary share (gas):	41%
Max generation share (gas):	31%
CO_2 emissions[1]:	-36%
CO_2 intensity power:	188g/kWh
Energy system costs:	+£2bn
Welfare costs:	-£4bn

LOW-CARBON RESILIENT (LCR)	
Primary energy demand:	-20%
Final energy demand:	-16%
Electricity demand:	-8%
Residential demand:	-20%
Max primary share (gas):	38%
Max generation share (coal):	40%
CO_2 emissions[1]:	-36%
CO_2 intensity power:	360g/kW
Energy system costs:	-£2bn
Welfare costs:	-£19bn

Note 1): CO_2 emissions reductions are measured with respect to 1990

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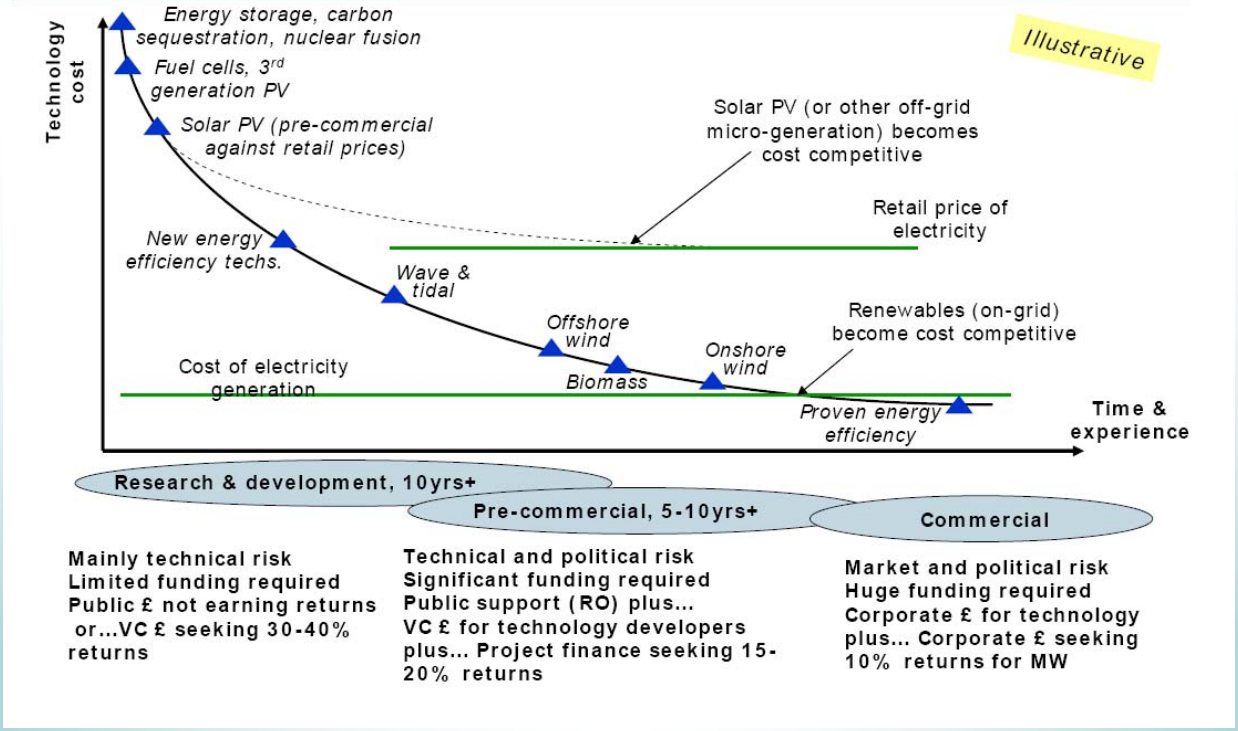
How to increase energy from waste

- Increase capacity
  - New resource
  - Greater efficiency
- Lower costs
- Speed up development
  - Learning rates

Accelerated Technology Development

Idealised movement of new technologies down the cost curve – it can happen but not always
and the policy problem is change of "ownership"



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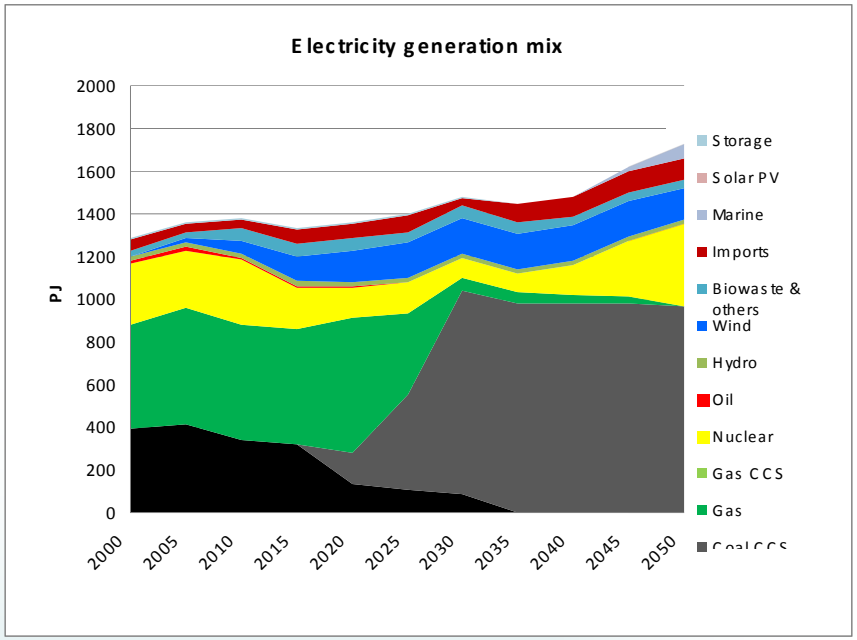
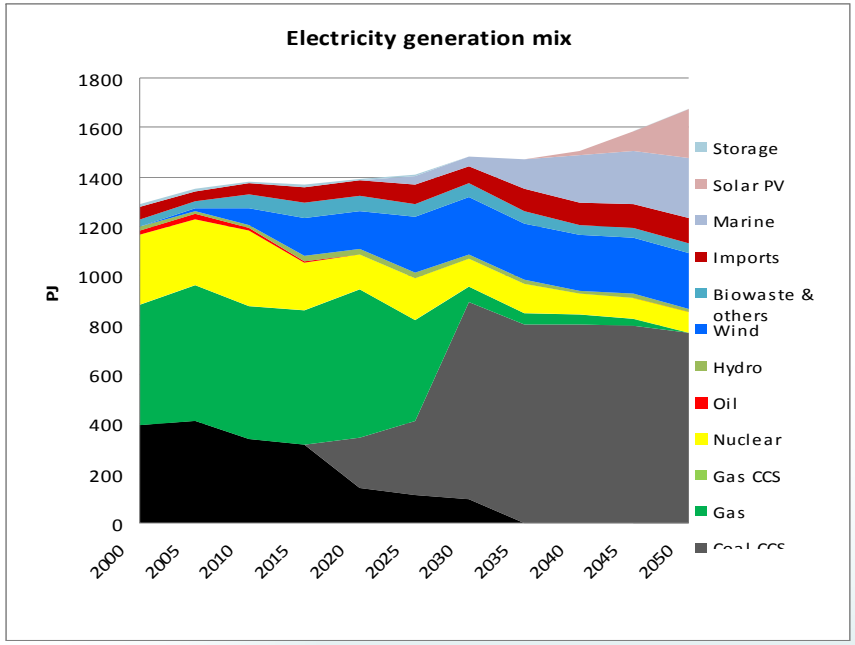
Source: Michael Grubb, 2006

But…ATD Scenario: LC-Renew





- Wind, marine and solar PV grow
- Wind after 2020, marine after 2030, solar PV after 2040
- Nuclear power and Coal-CCS are displaced
- No resurgence of nuclear after 2040

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Barriers to Deployment

- ~~Regulation~~
- ~~Finance~~
- ~~Technology~~
- ~~Demand~~
- ~~Resource~~
  - ~~Skilled workers~~
  - ~~Feedstock~~
- Public perception
- System inertia

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http://www.ukerc.ac.uk/Downloads/PDF/09/0904Energy2050report.pdf

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Thanks to Jim Skea, Paul Ekins and a cast of thousands...

THANK YOU!

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