University of BRISTOL

Sustainable Development

In an Engineering Context

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The aim of this lecture is…..

- *To help you to develop an understanding of the requirement for engineering activities to promote sustainable development and an ability to apply quantitative techniques where appropriate.*

Acknowledgements

- Much of the material from the lecture has come from the following;
  - Dr Marcelle McManus (University of Bath)
  - Professor Stuart Burgess (University of Bristol)
  - Professor Chris McMahon (ex University of Bristol)
  - Engineering Council and Royal Academy of Engineering Guidance

What is sustainable development?

- “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

Brundtland 1987

- “Where there are threats of serious of irreversible damage, lack of full scientific certainty shall not be used as a reason for taking measures to prevent harm.”

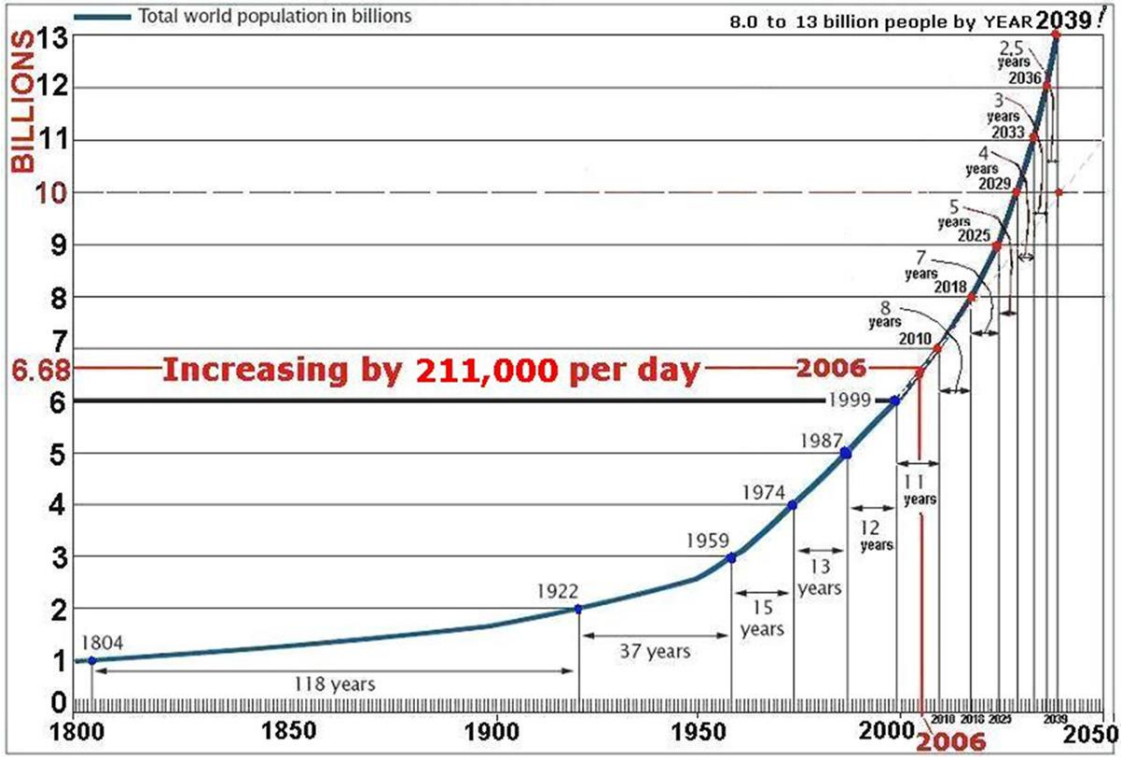
Engineering Council Guidance on Sustainability for the Engineering Profession

- “Professional engineers are increasingly required to play a leadership role in sustainable development, overcoming global challenges such as depletion of resources, environmental pollution, rapid population growth and damage to ecosystems”

The Engineering Council says Engineers should…

- Contribute to building a sustainable society, present and future
- Apply professional and responsible judgement and take a leadership role
- Do more than just comply with legislation/codes
- Use resources efficiently and effectively
- Seek multiple views to solve challenges
- Manage risk to minimise adverse impact to people or the environment.

Putting the problem into context



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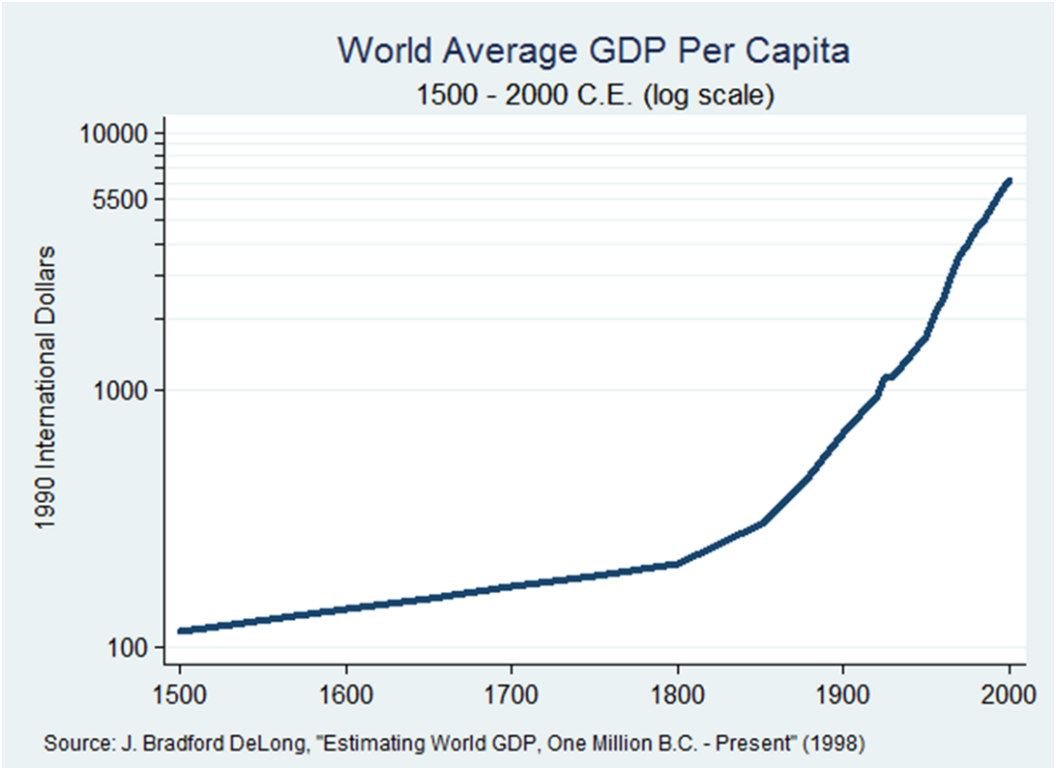

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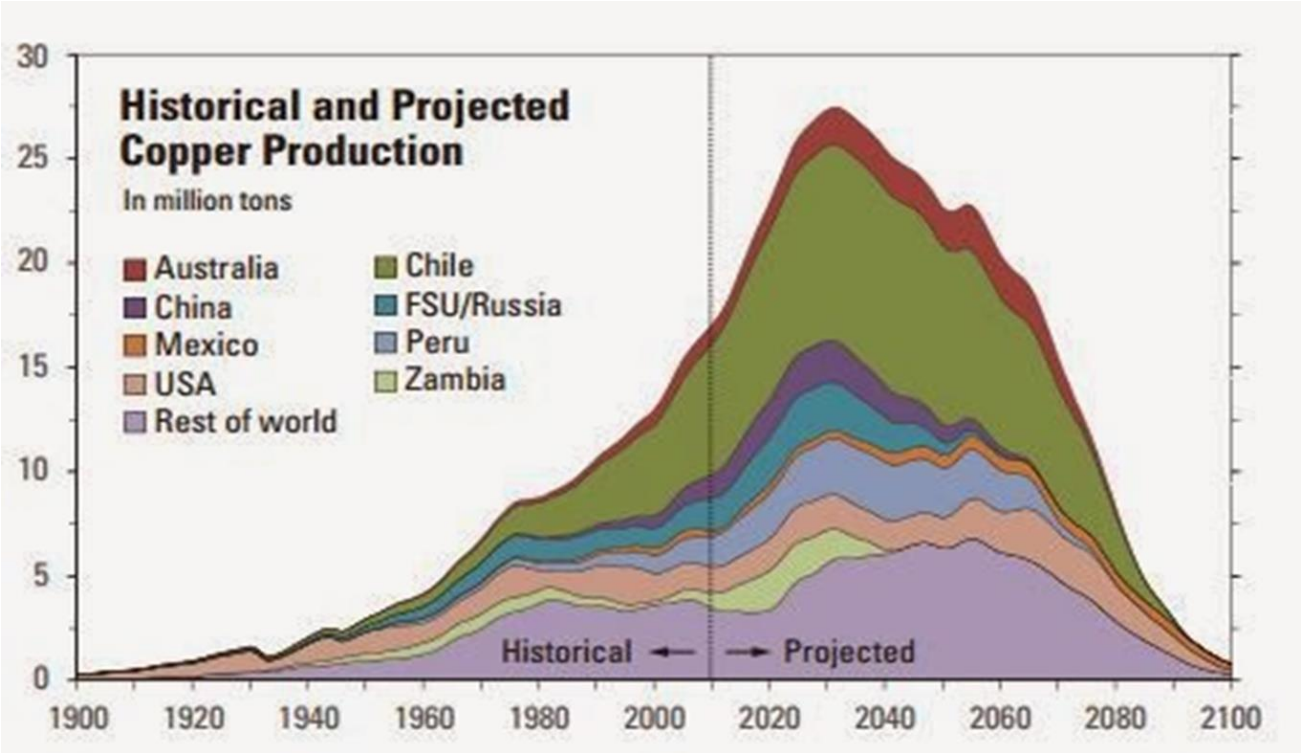

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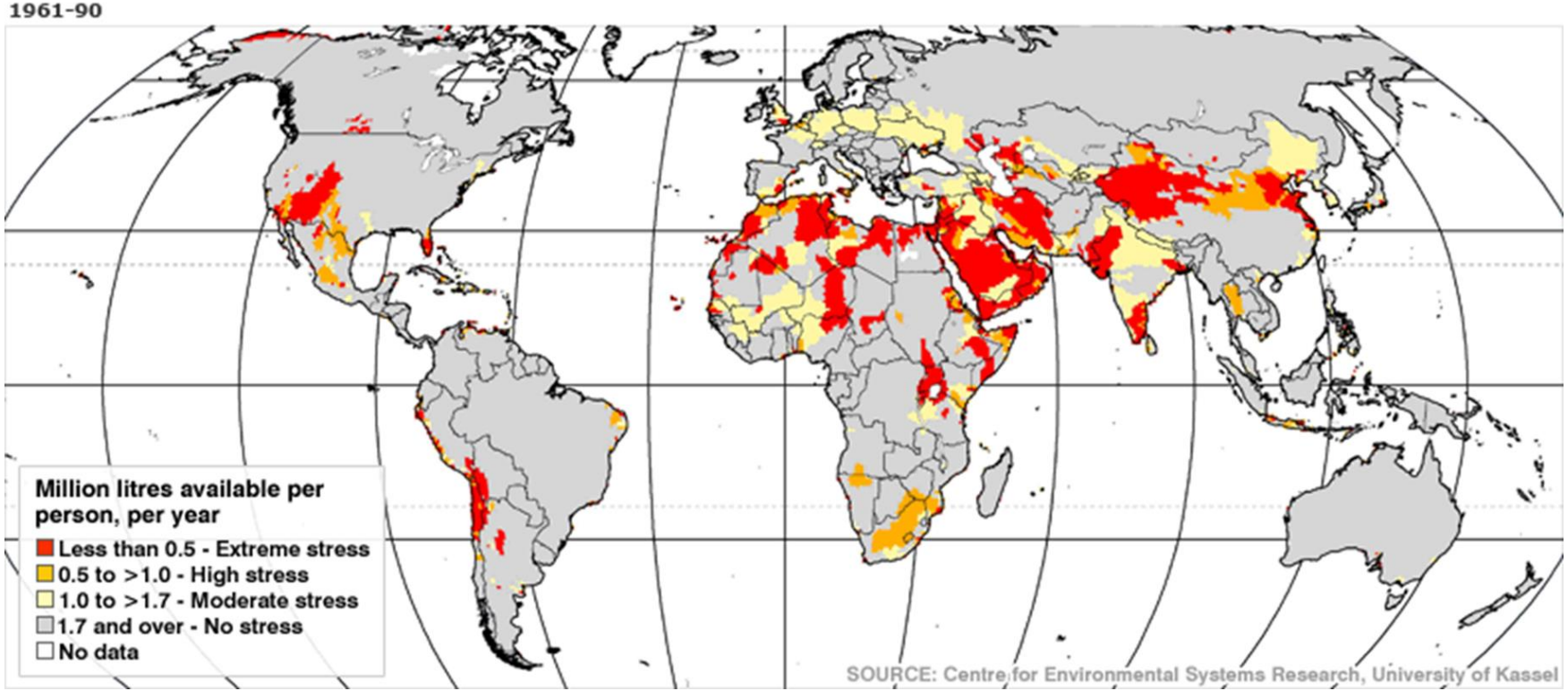

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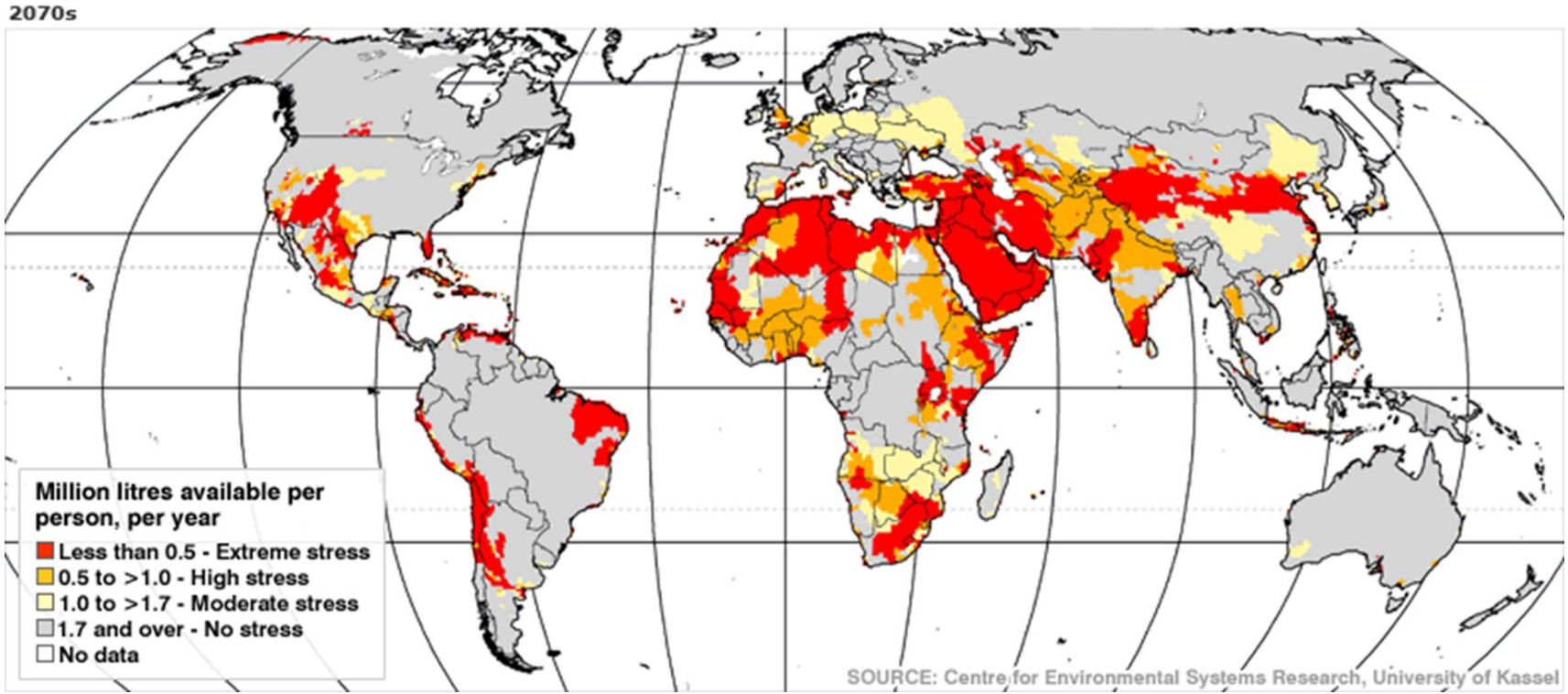
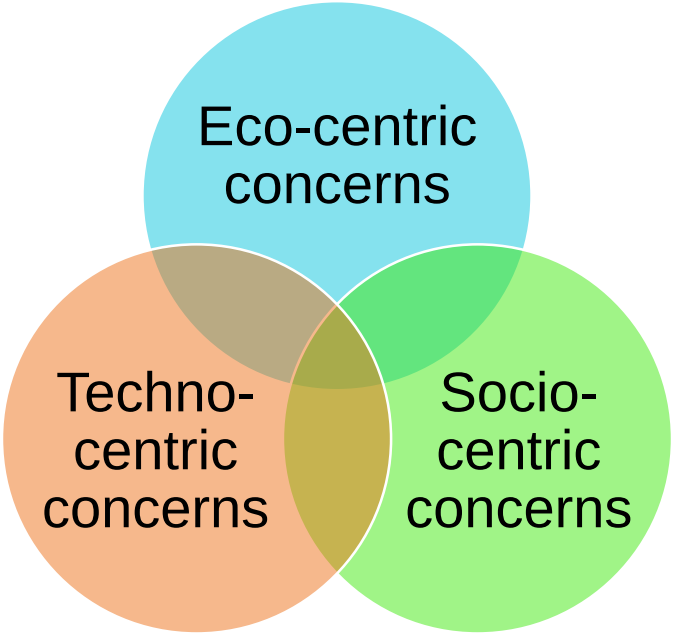


Optimist or Pessimist?

Three dimensions of sustainability



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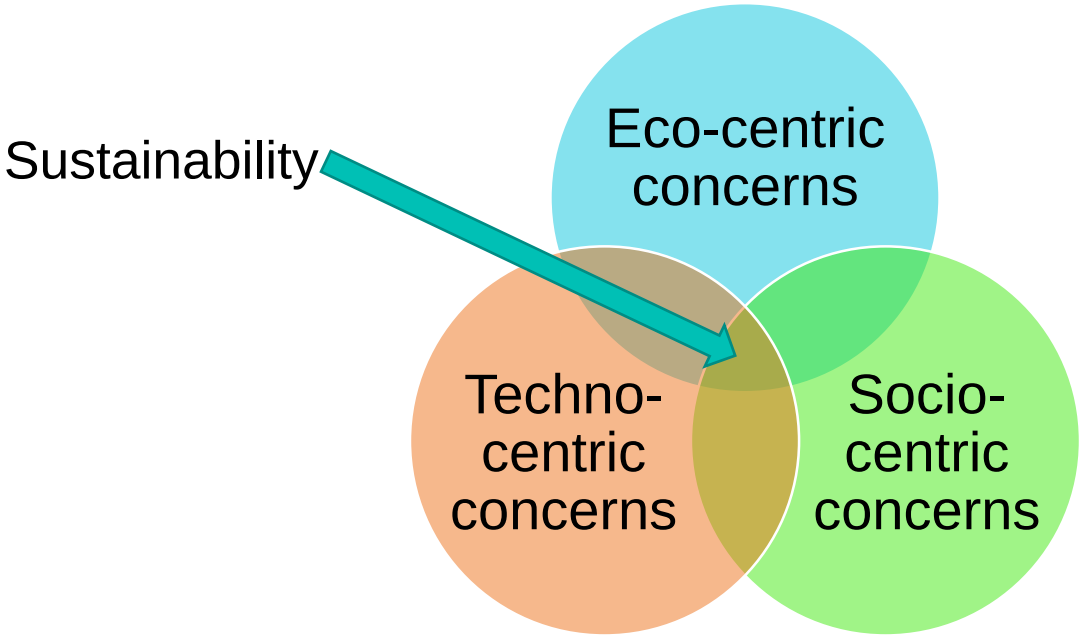

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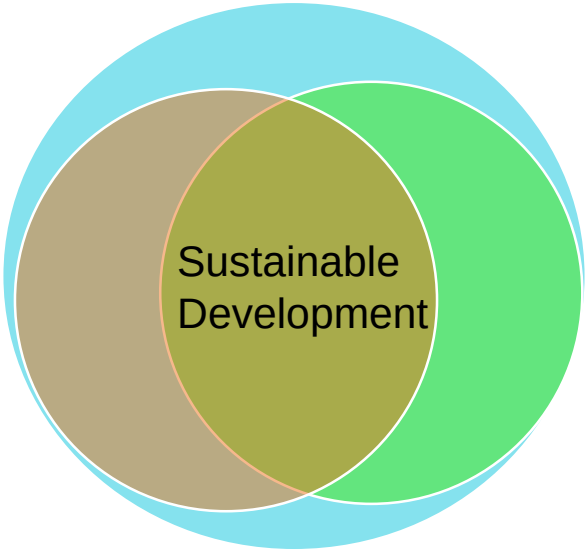
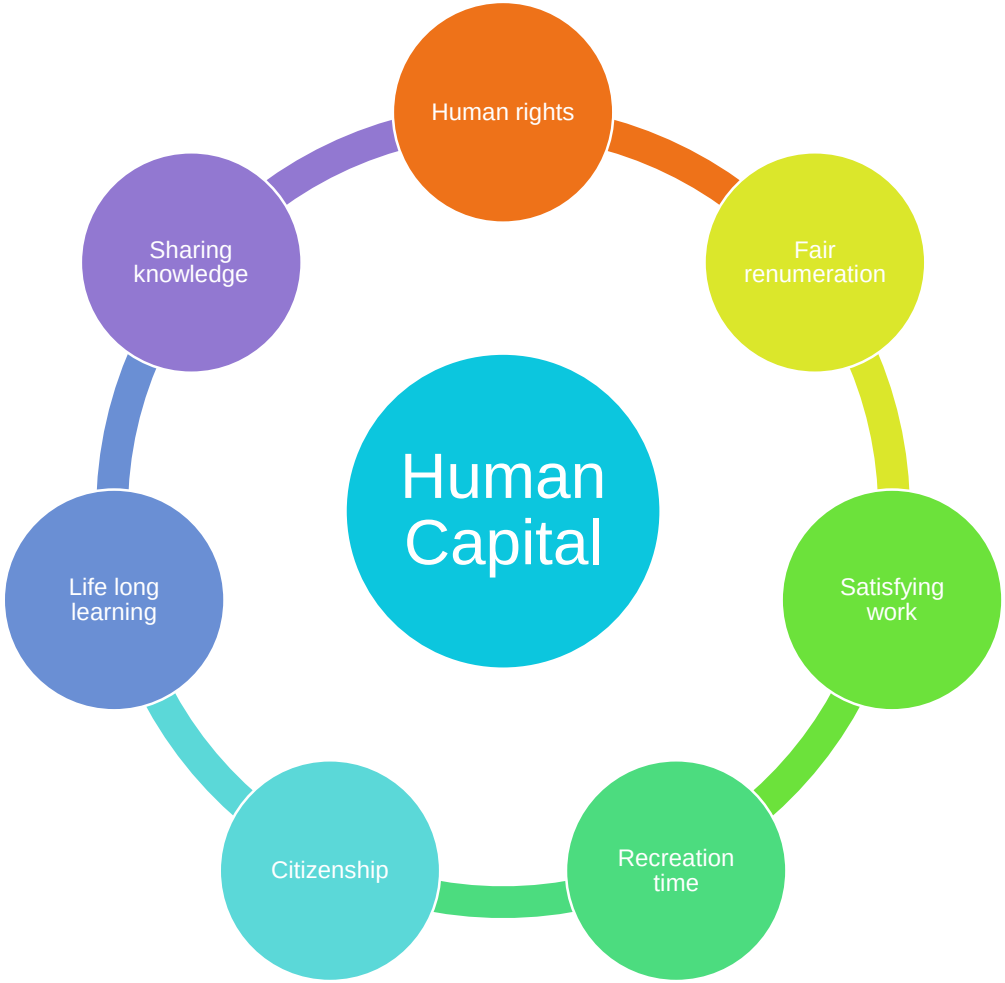
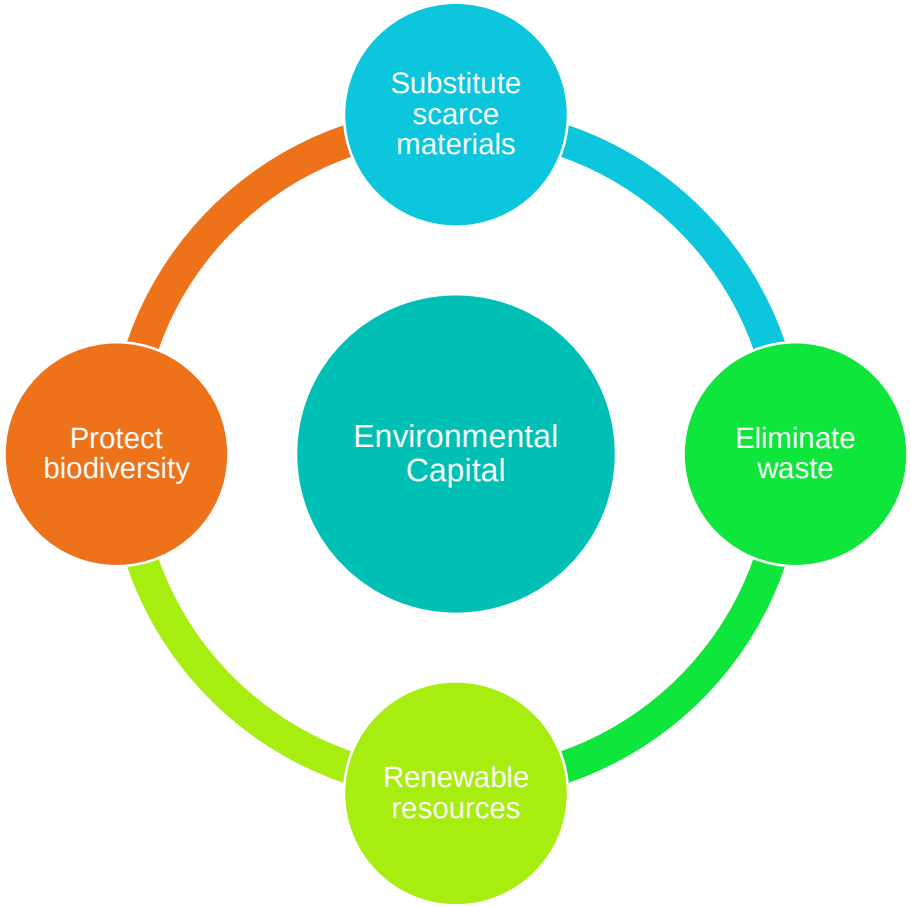


Five pillars of sustainability

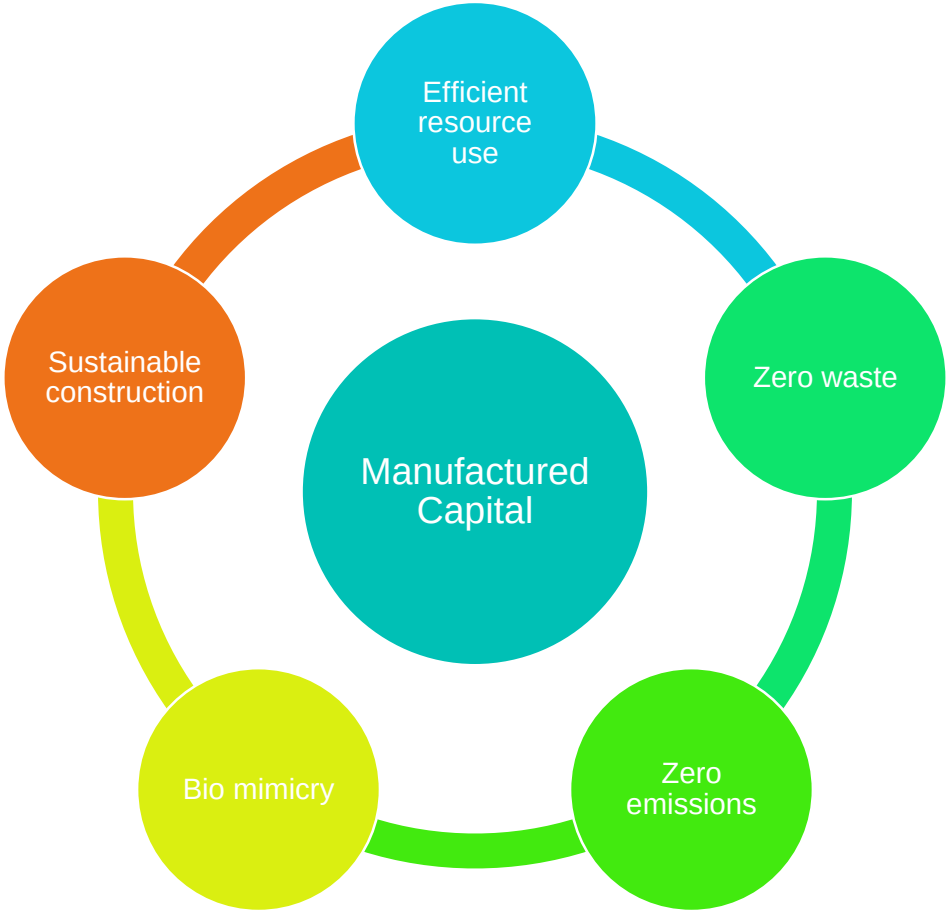
- Human
- Environmental
- Social
- Financial
- Manufactured


Human rights
Fair renumeration
Satisfying work
Recreation time
Citizenship
Life long learning
Sharing knowledge
Human Capital


Substitute scarce materials
Eliminate waste
Renewable resources
Protect biodiversity
Environmental Capital


Supportive working conditions
Family friendly policies
Ethically sourced materials
Prompt and full payment
Minimise negative impacts
Community Development
Social Capital


Value reputation
Financial value to reflect assets
Fairly distributed wealth
Effective risk management
Financial Capital


Efficient resource use
Zero waste
Zero emissions
Bio mimicry
Sustainable construction
Manufactured Capital

The 12 principles of Engineering for sustainable development

1. Look beyond your own locality and the immediate future
2. Innovate and be creative
3. Seek a balanced solution
4. Seek engagement from all stakeholders
5. Make sure you know the needs and wants
6. Plan and manage effectively

The 12 principles of Engineering for sustainable development

7. Give sustainability the benefit of any doubt
8. If polluters must pollute… then they must pay as well
9. Adopt a holistic, 'cradle-to-grave' approach
10. Do things right, having decided on the right thing to do
11. Beware cost reductions that masquerade as value engineering
12. Practice what you preach

UN Sustainability Goals

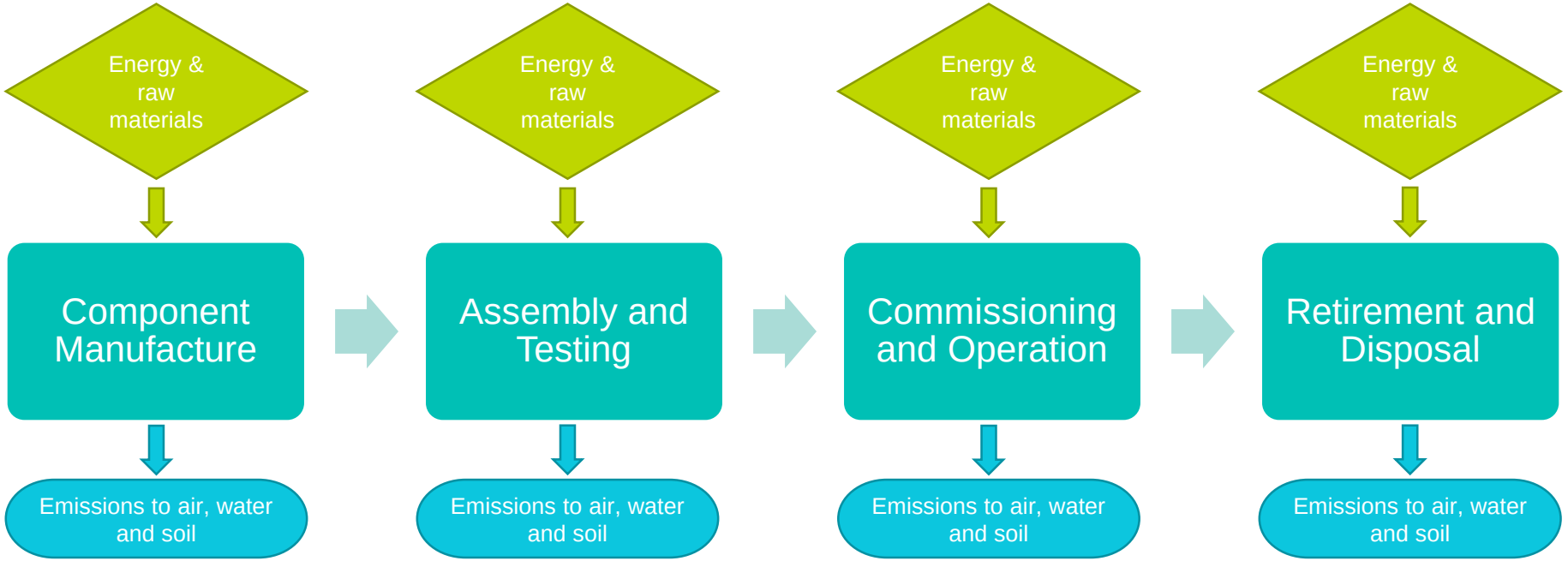
Tools we can use

- Life Cycle Analysis (LCA)
- Environmental Impact Assessment (EIA)
- Environmental Management Plan
- BREEAM / LEED Assessment (for Buildings)

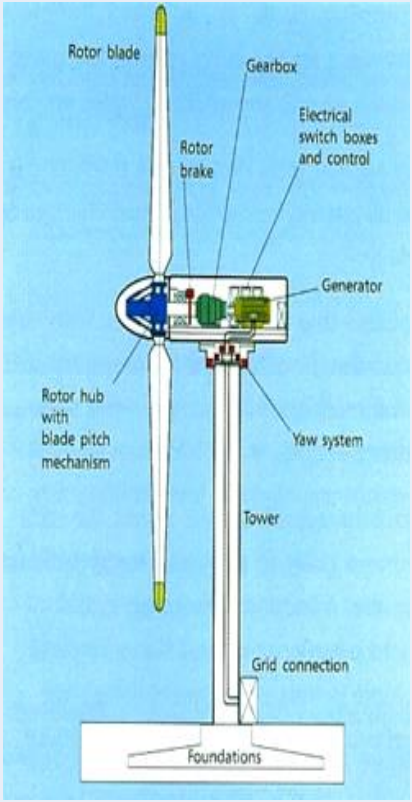
Life Cycle Analysis

- Life-cycle ‘thinking’ considers the environmental impacts of a product or system *throughout its lifespan*
- Framing the requirements – often completed in a Feasibility Study
- Scoping the decision – often made in a Project Definition Study
- Planning and Design – decisions made in the detailed design stage
- Implementation, Delivery and Operations
- End of usable life

What needs to be considered in an Product/System LCA?



PRODUCTION

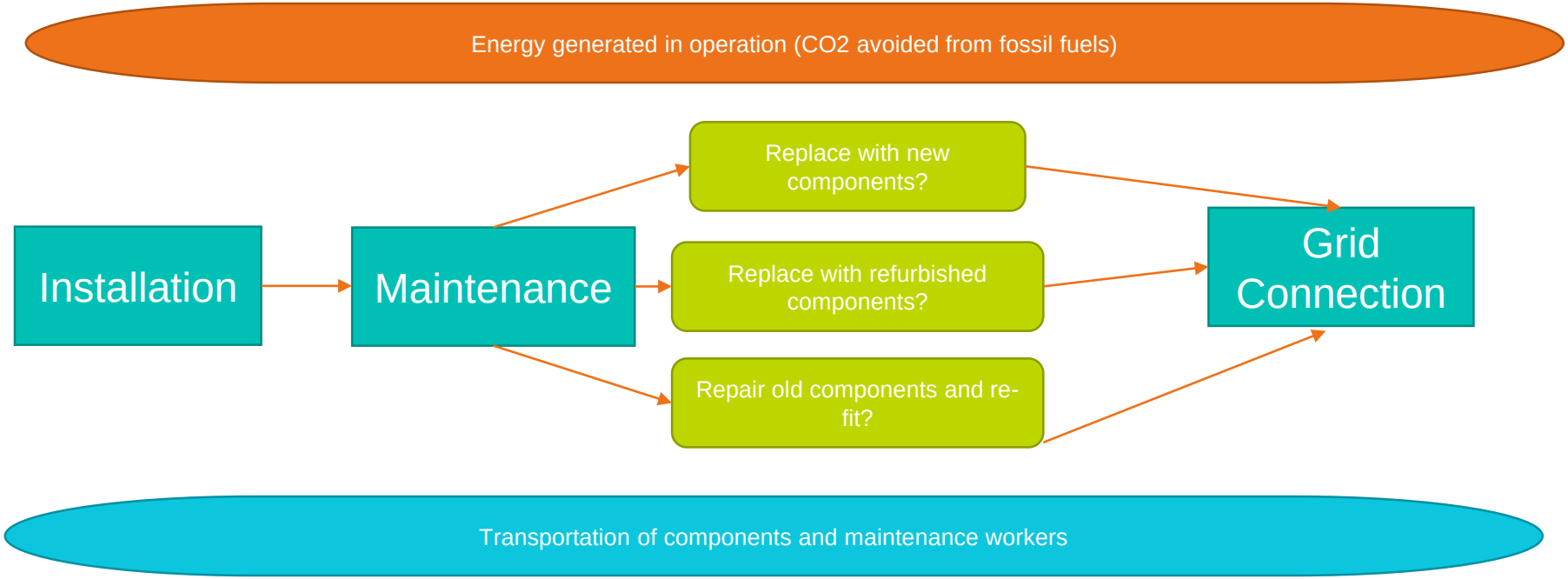


- Battery bank
- Cooling System
- Anemometer and wind vane
- Invertor (dc to ac)
- Controller

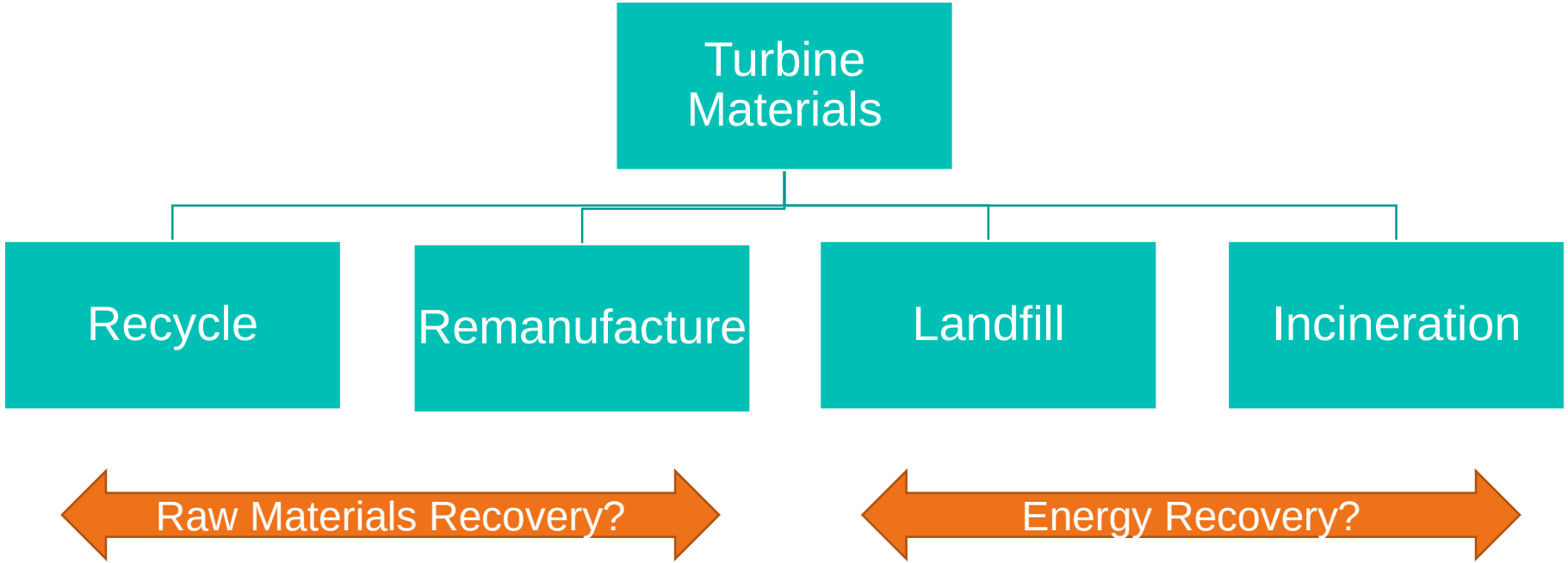
Material production, processing and component manufacturing. Transportation of materials, components and final wind turbine. Energy use in production and waste products made during the manufacturing stage. Any emissions to air, water or land during the manufacturing, transportation or assembly stage

Source: http://www.kidwind.org/materials/sciencefairideas.html

Wind Turbine Operation



Wind Turbine Disposal



Environmental Impact Assessment

- Similar process to other risk assessments
- Evaluates the likely environmental impacts of a proposed project, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.
- Identifies impacts and mitigations

Environmental Management Plan

- Identify issues and their associated aspects and impacts
- Identify legal requirements and assign significance to aspects
- Set objectives and targets for a project (KPI’s)

Regulations and Legal Framework

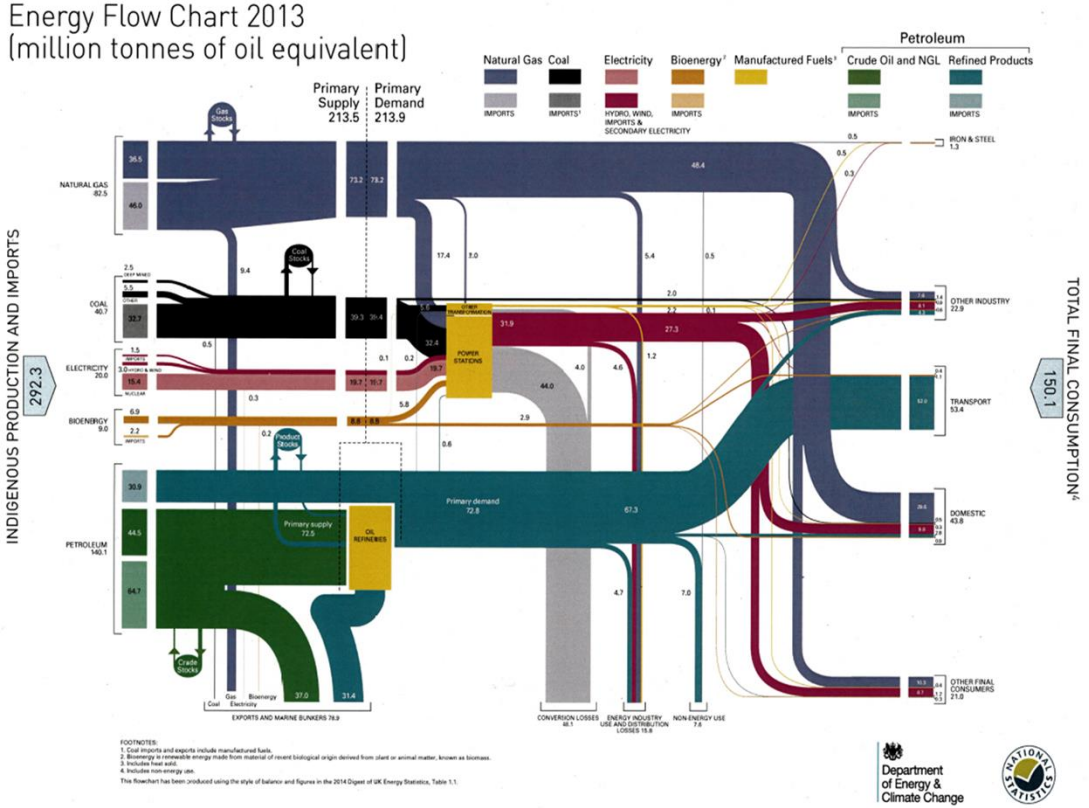
- Environmental law is increasingly a European and International issue
- UK law – Clean Air Act 1956, Control of Pollution Act 1974, Wildlife & Countryside Act 1981, Environmental Protections Act 1990
- European – Water framework directive, WEEE directive
- International – Montreal Treaty, Kyoto Protocol, Paris Agreement

Summary

- Sustainable development is often talked about but in practice is difficult to achieve
- Engineers need to be fully aware of environmental legislation but need to go further – they need to understand the impact of material flows, and need to be the drivers behind de-materialisation and de-carbonisation.

Supplementary information

Putting the problem into context



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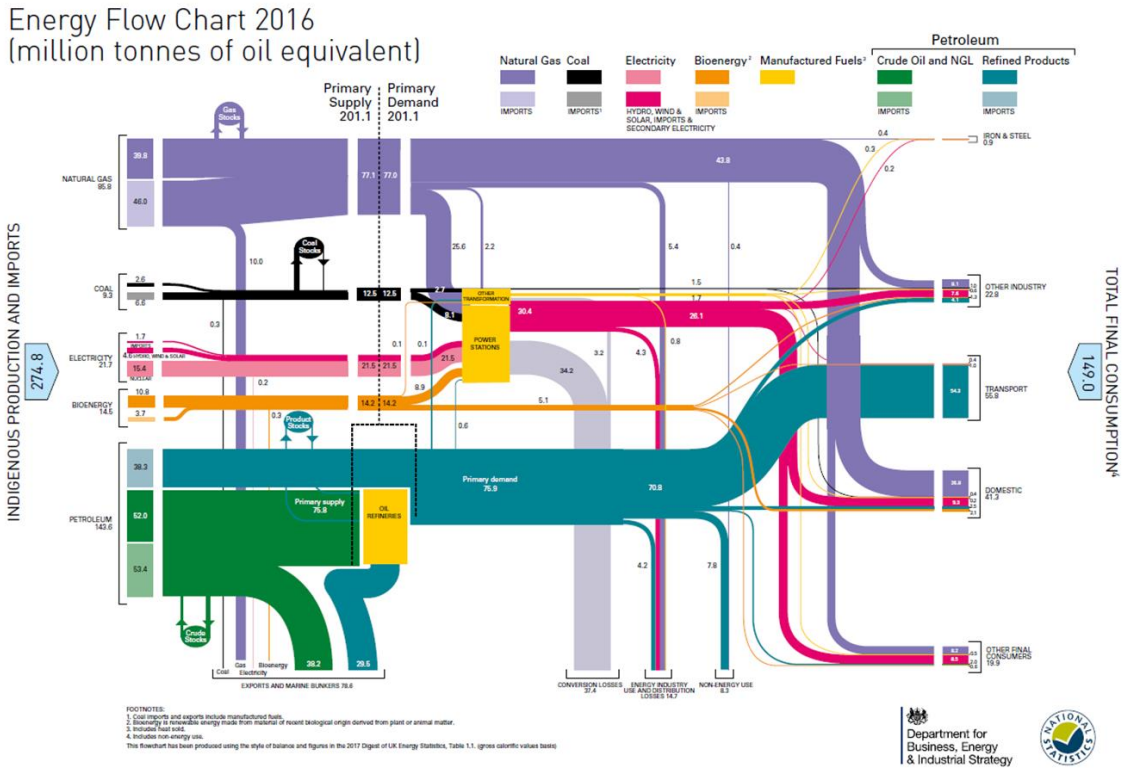

Raworth Doughnut