



# ABSOLUTE ZERO EMISSIONS BY 2050

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 ADVANCED  
PROPULSION  
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Department of Engineering

# From 80% to 100% cut in greenhouse gas emissions



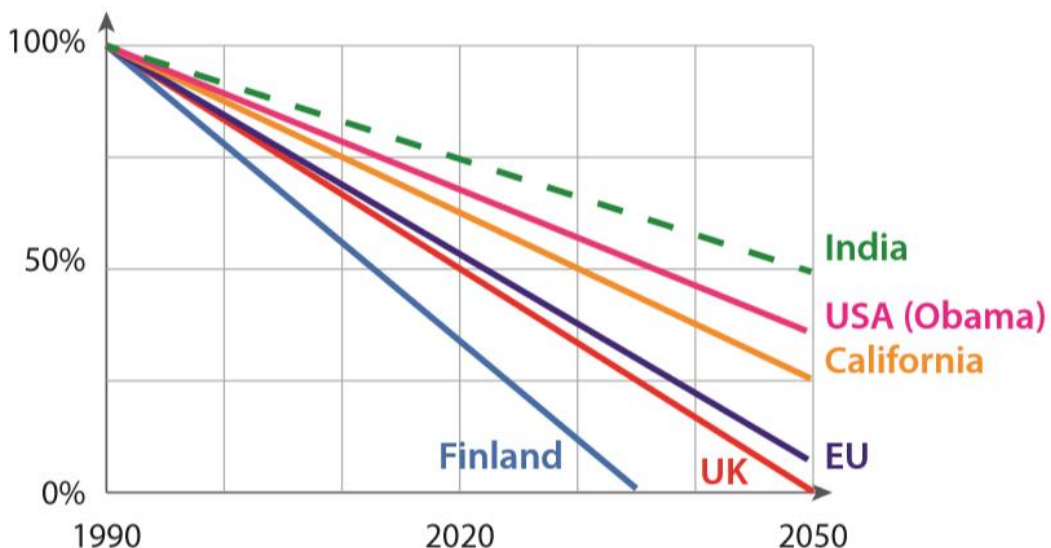
Climate Change Act:

*"It is the duty of the Secretary of State to ensure that the net UK carbon account for 2050 is at least ~~80%~~ lower than the 1990 baseline."*  
100%

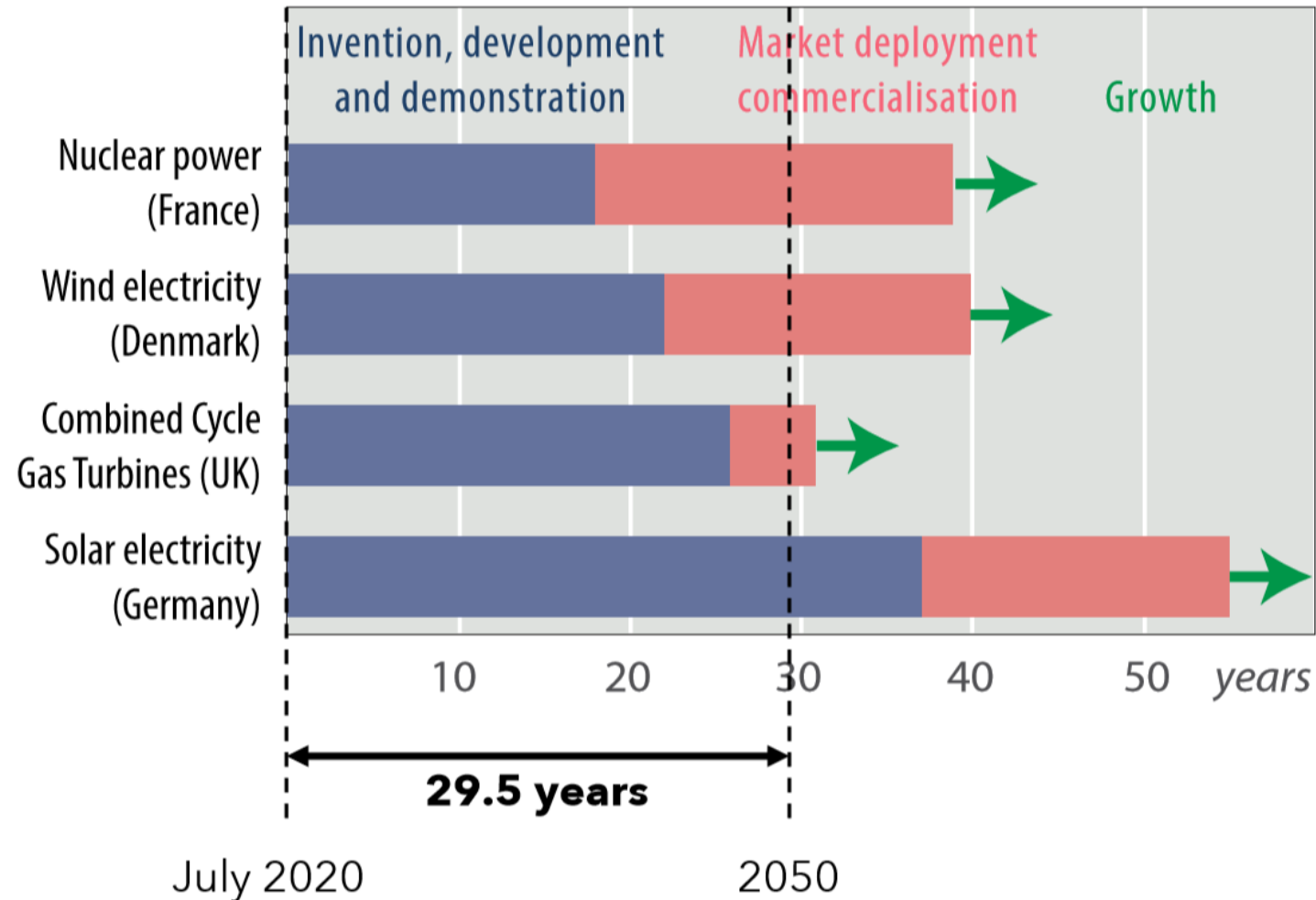
- **Net Zero** is likely to mean **Absolute Zero**:

- Carbon removal must always take more energy than carbon emission
- Doubling UK forest would only offset 2 years of UK emissions

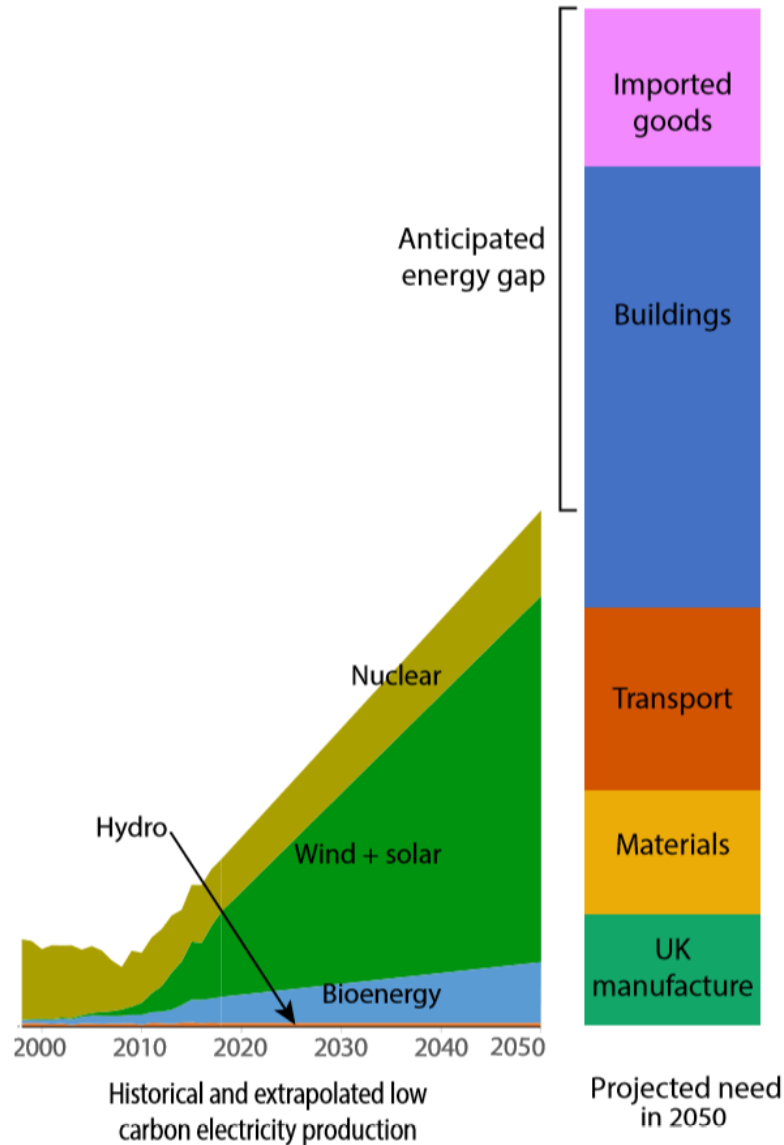
- "80%" meant that everyone thought they were in the 20%. "100%" sets an agenda.



# The reality of the pace of technology implementation



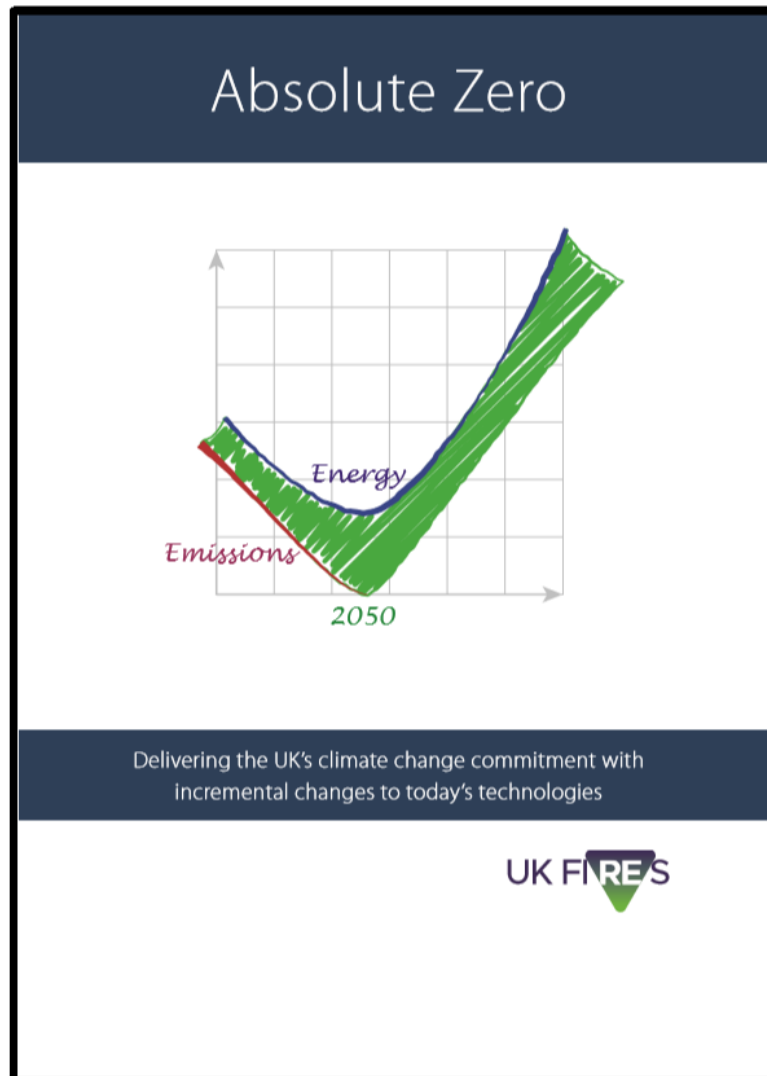
# Closing the gap



- Expanding renewable energy capacity takes time. Nuclear energy even more time!
- Deployment of negative carbon technologies will take time.
- As a result, there will be a gap between available zero-carbon energy supply and energy demand.
- This gap is expected to be half of energy demand in 2050 – this is a very big gap!



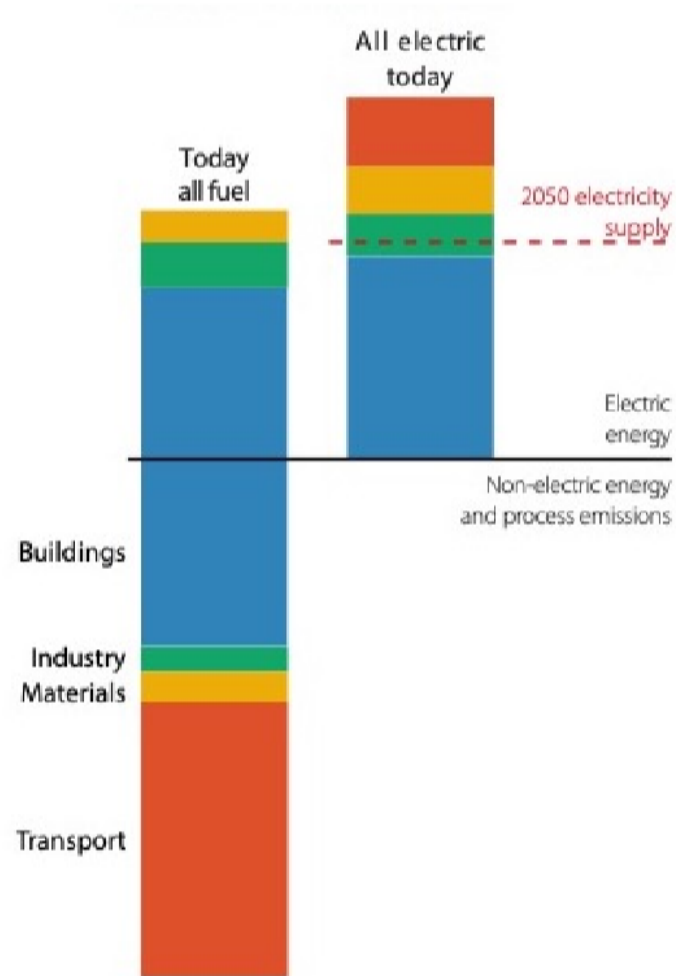
# Closing the gap



- We don't have time to wait for negative carbon and breakthrough technologies to close the gap.
- But we can plan to respond to climate change with today's technologies with incremental change.
- This requires a public discussion about the future of industry and lifestyles!

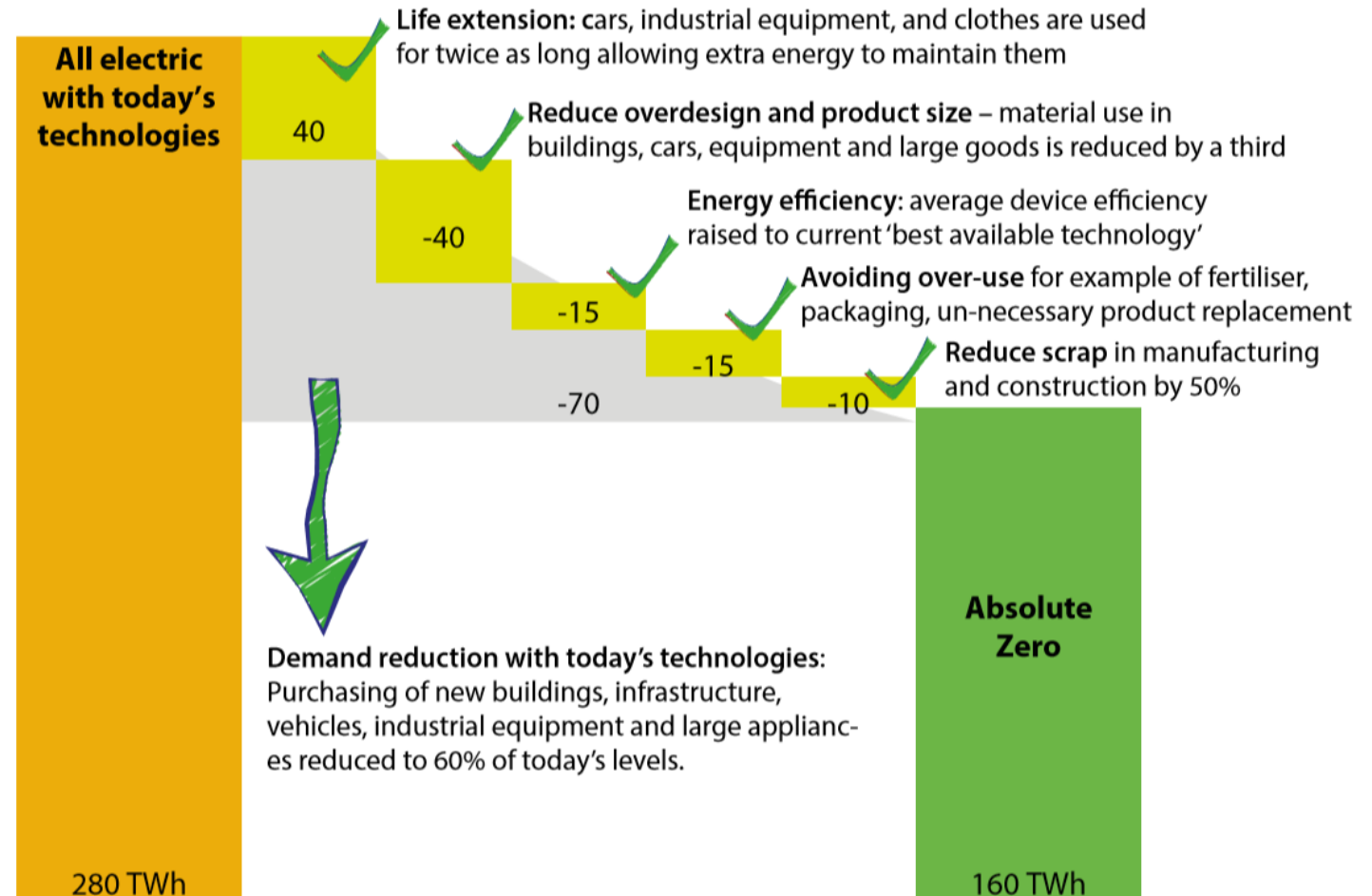
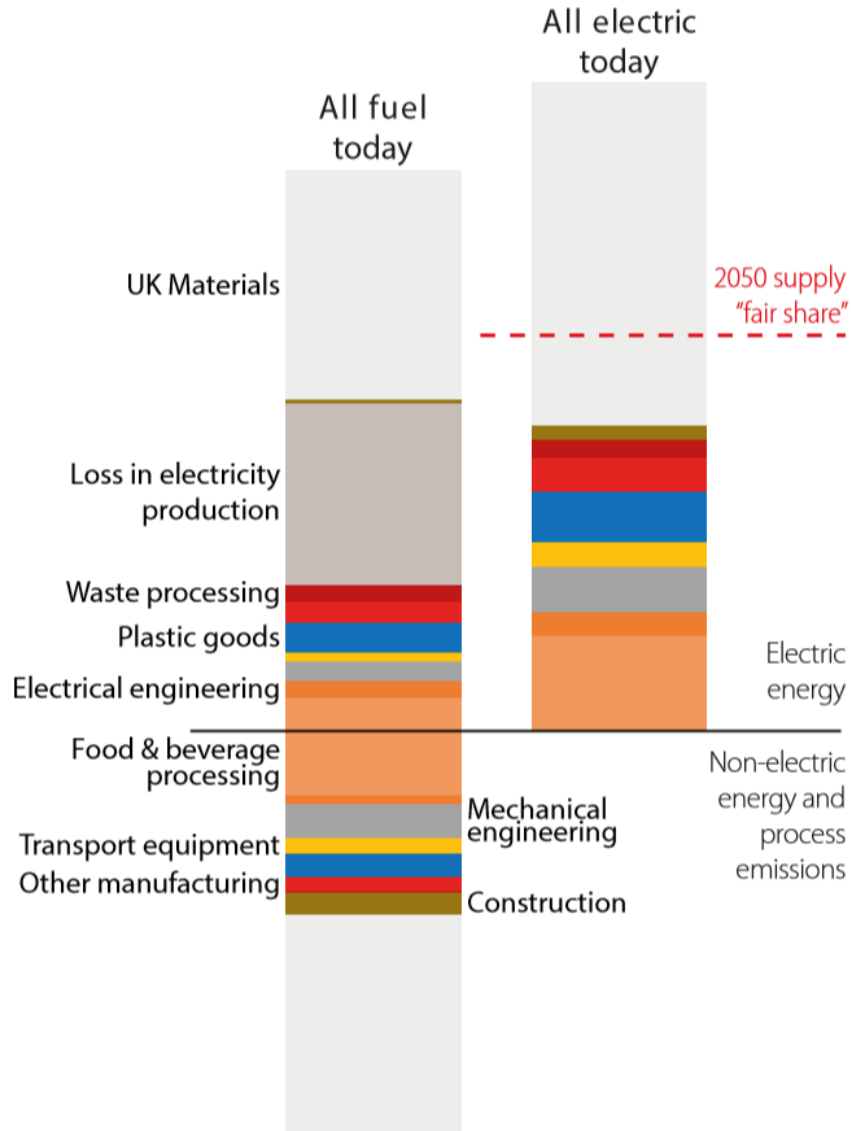
<http://ukfires.org/absolute-zero/>

# Innovations to make more use of less energy

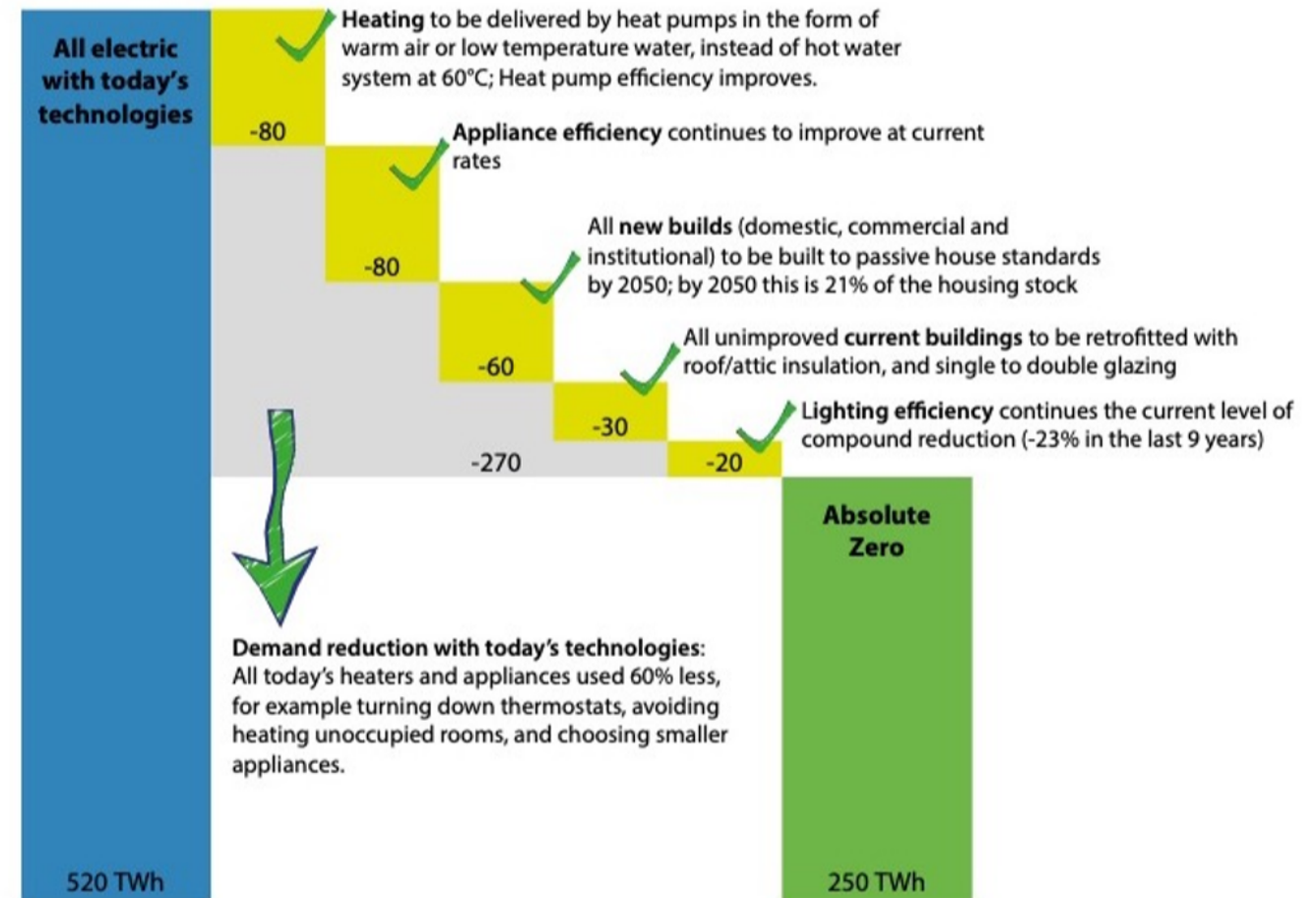
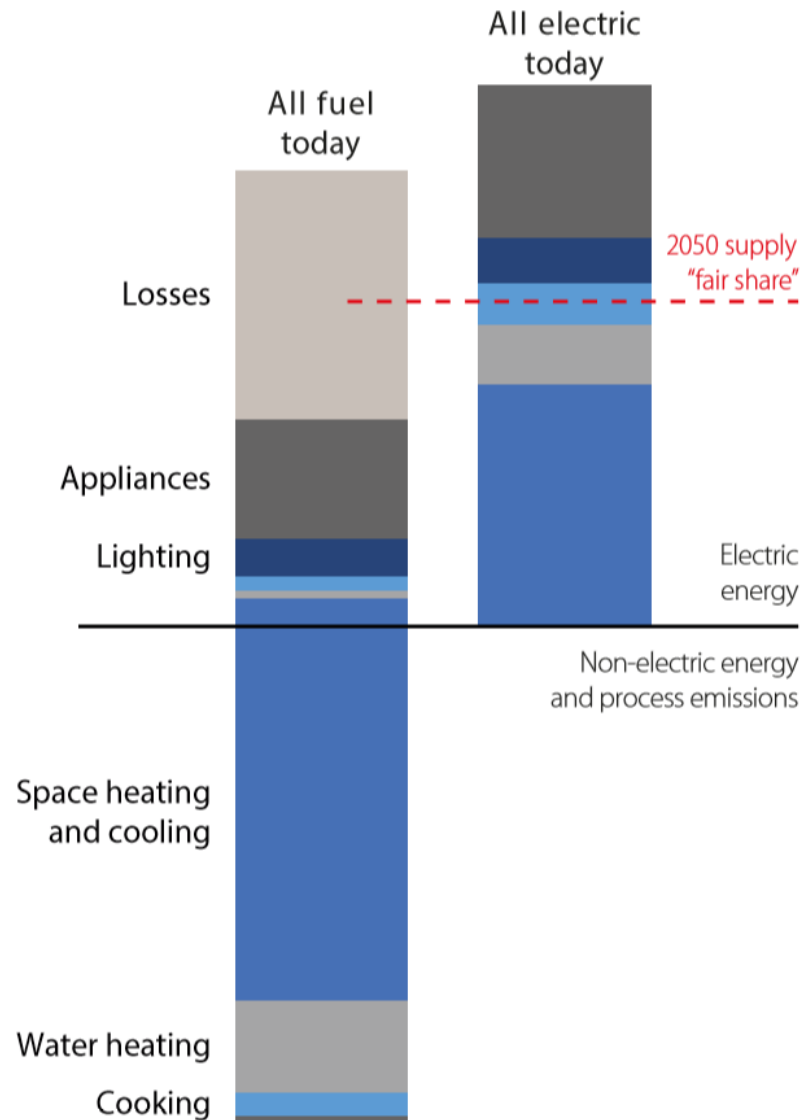


- All energy uses will have to be electrified.
- We will only have zero-carbon electricity to supply ~60% of our projected needs.
- But we can find ways of make more of less use of energy.
- This will be challenging for all sectors, but particularly hard for transport.

# Innovations to make it easier: industry

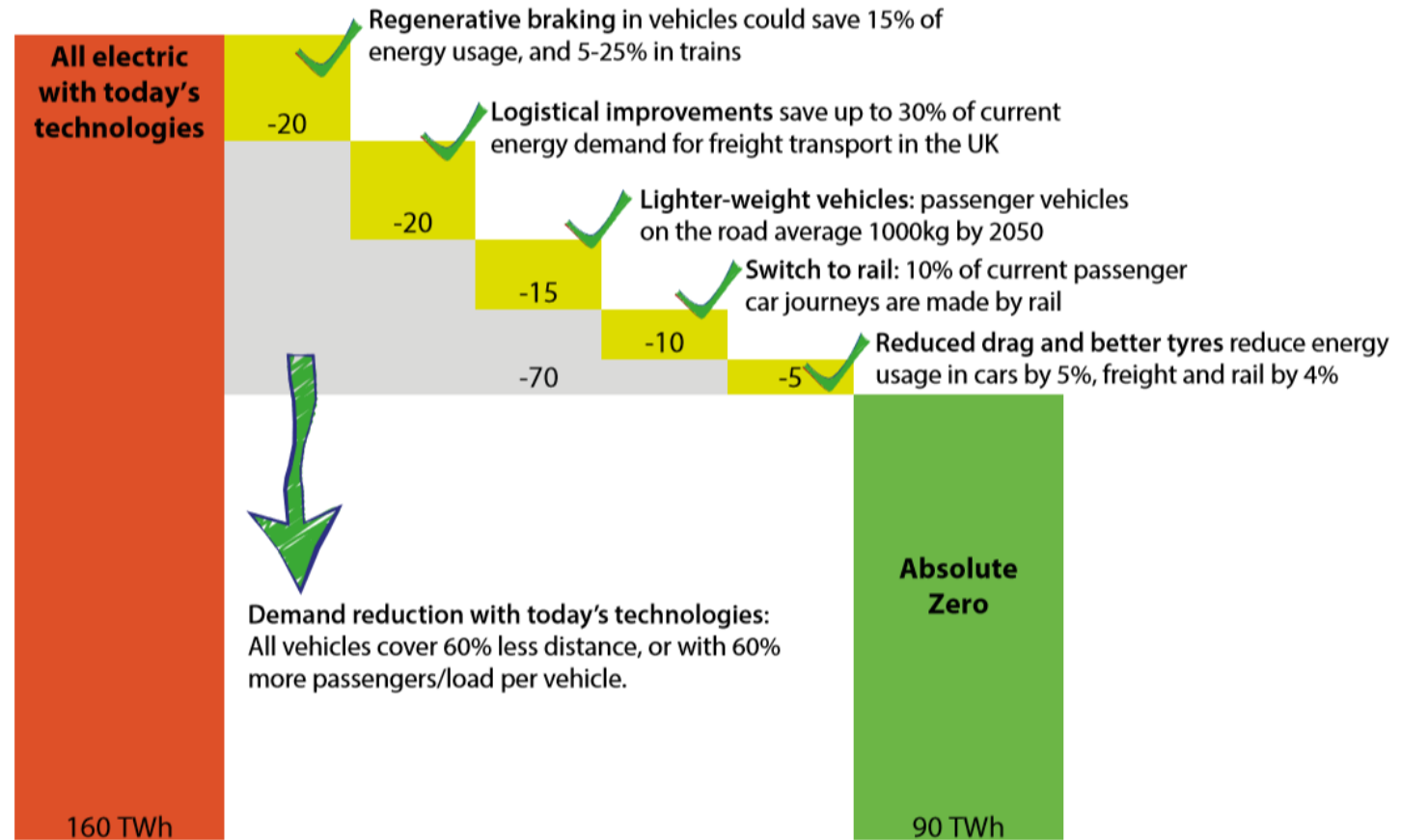
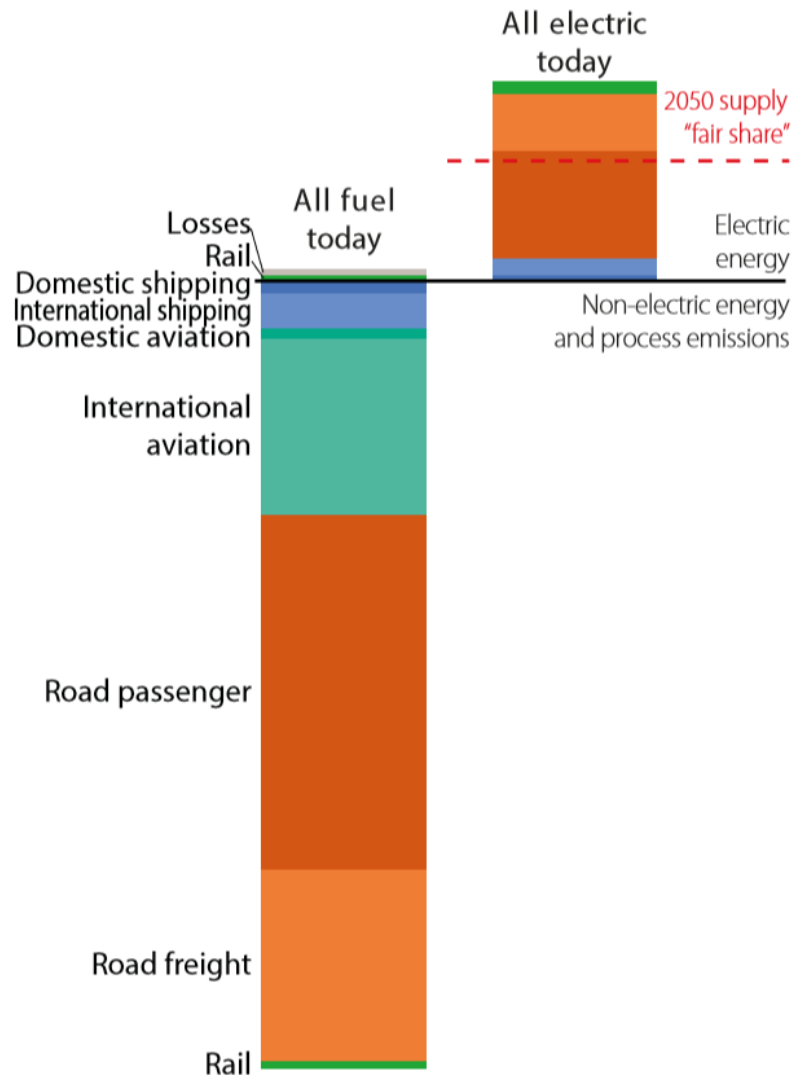


# Innovations to make it easier: buildings



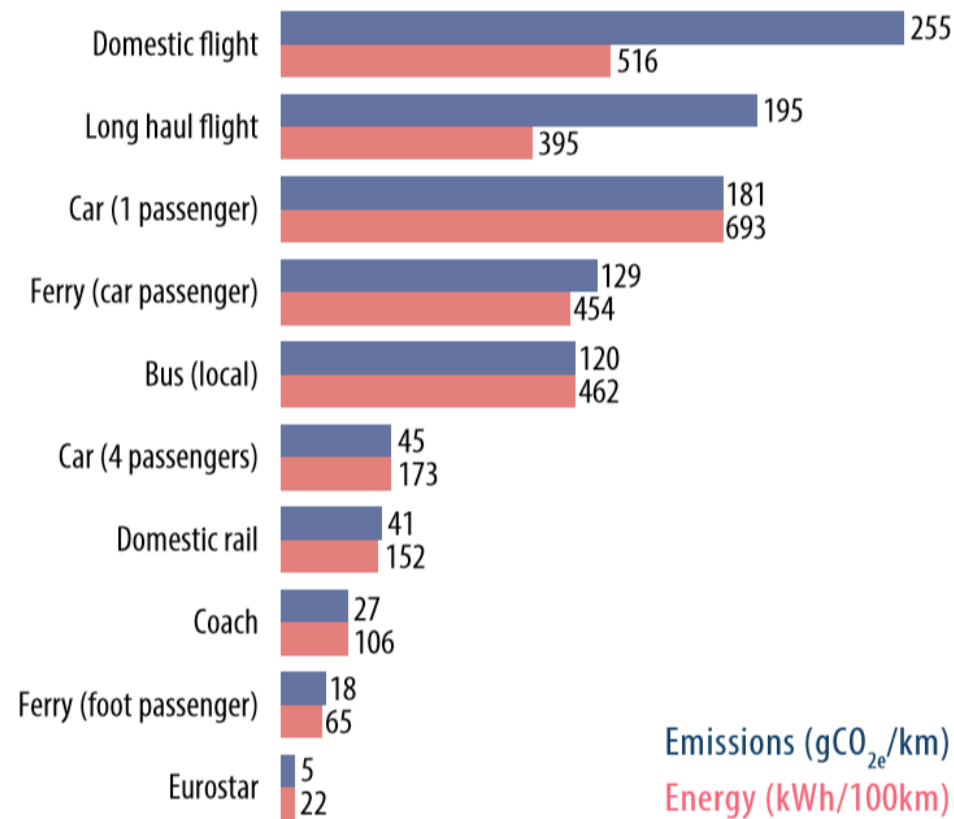


# Innovations to make it easier: transport

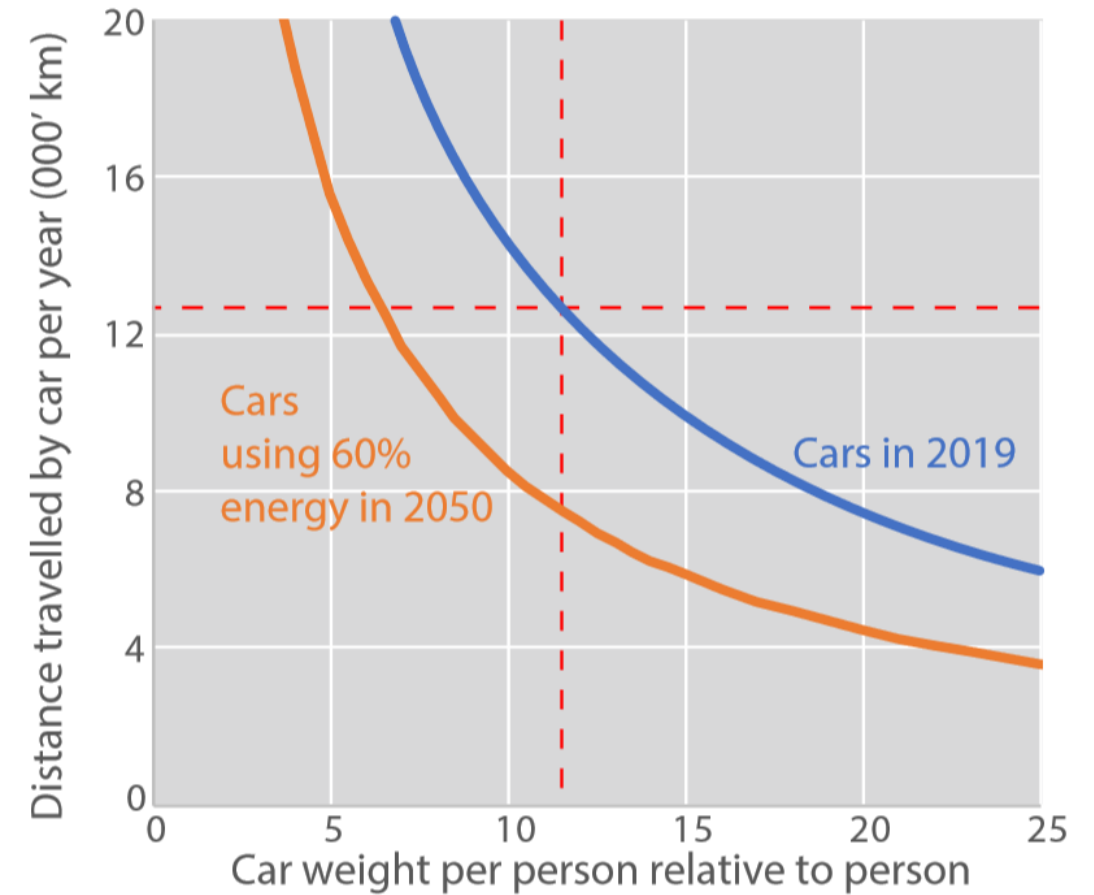


# Innovations to make it easier: transport – two key challenges

## Mode shift



## Weight /mobility reduction



# Four key activities without substitutes

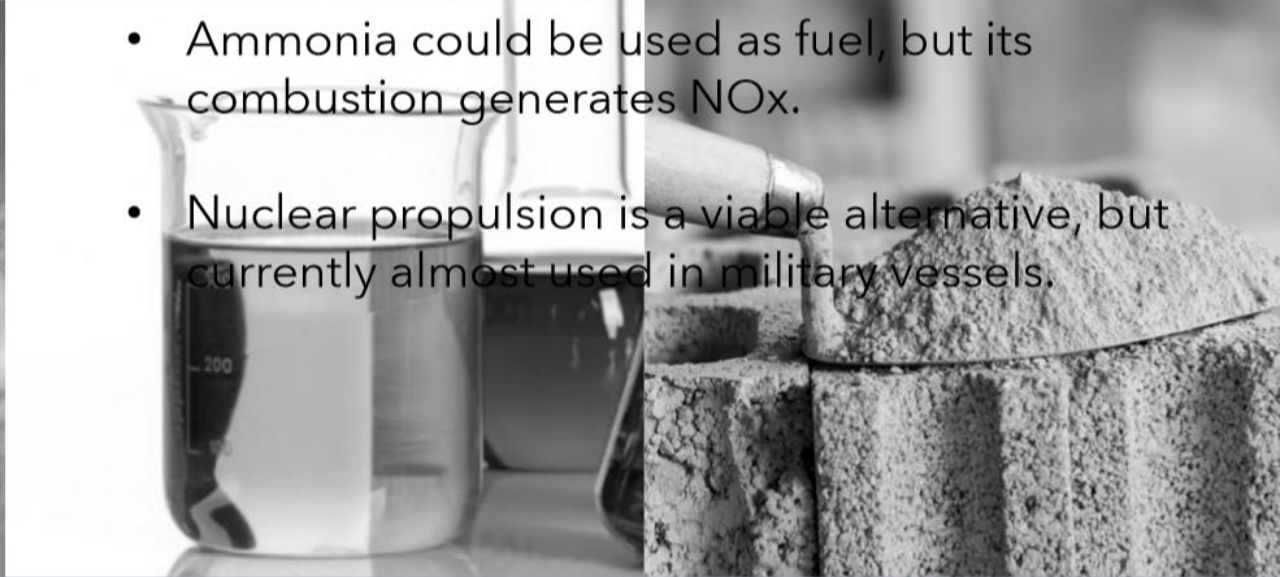




# Four key activities without substitutes

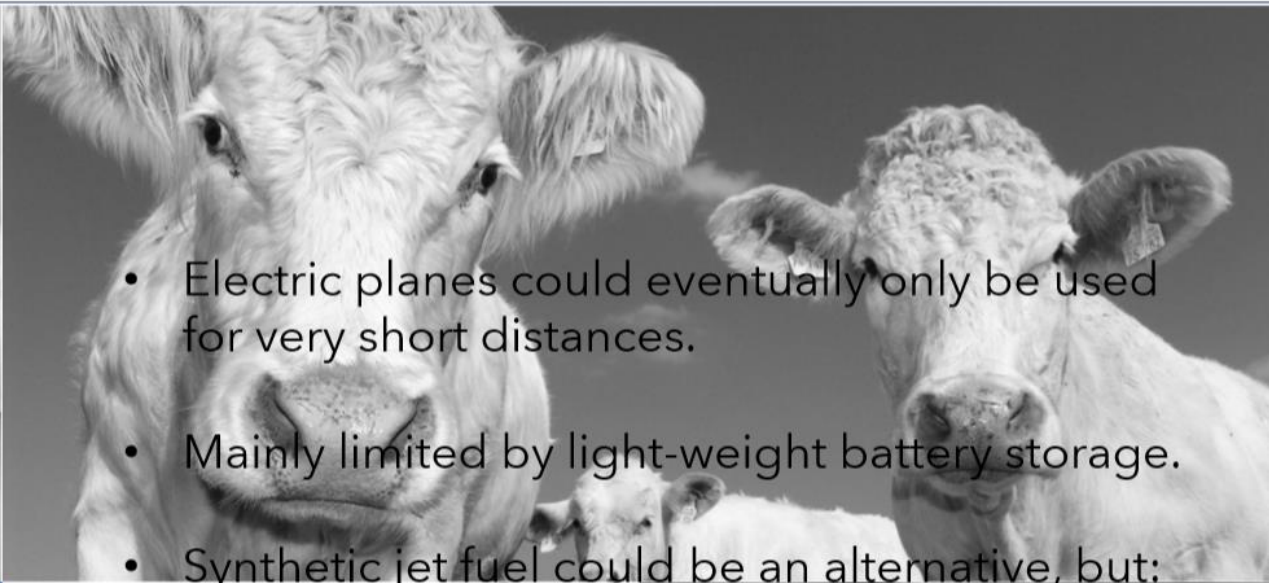


- Battery electric ships can't cover long distances.
- Hydrogen for fuel cell ships needs to be produced from carbon-neutral sources.

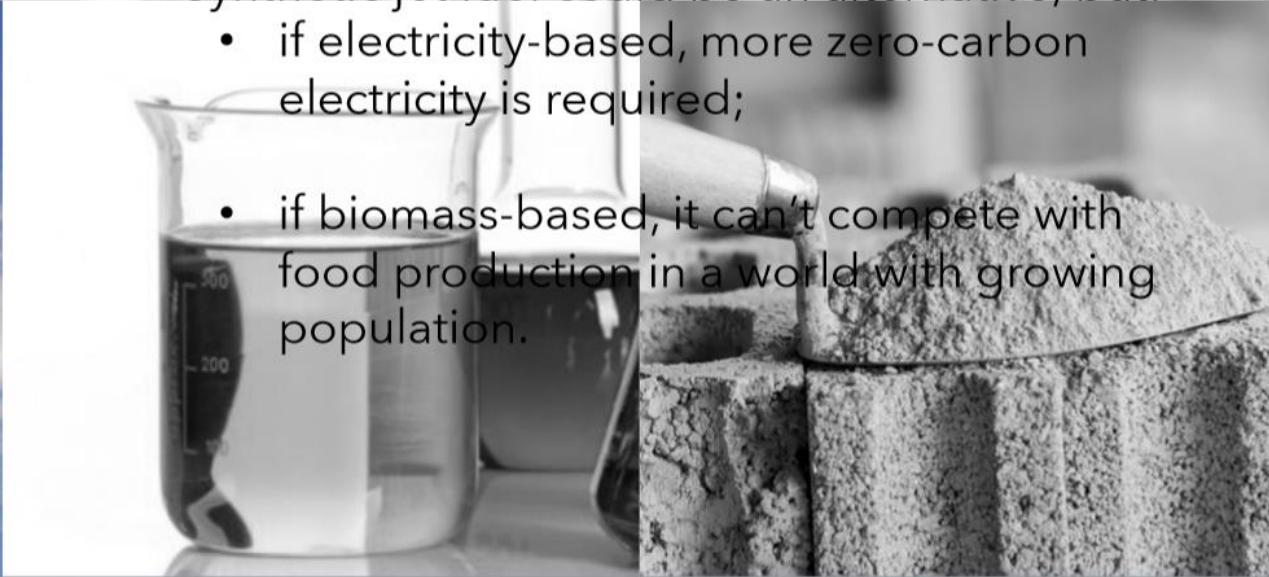


- Ammonia could be used as fuel, but its combustion generates NO<sub>x</sub>.
- Nuclear propulsion is a viable alternative, but currently almost used in military vessels.

# Four key activities without substitutes



- Electric planes could eventually only be used for very short distances.
- Mainly limited by light-weight battery storage.
- Synthetic jet fuel could be an alternative, but:
  - if electricity-based, more zero-carbon electricity is required;
  - if biomass-based, it can't compete with food production in a world with growing population.





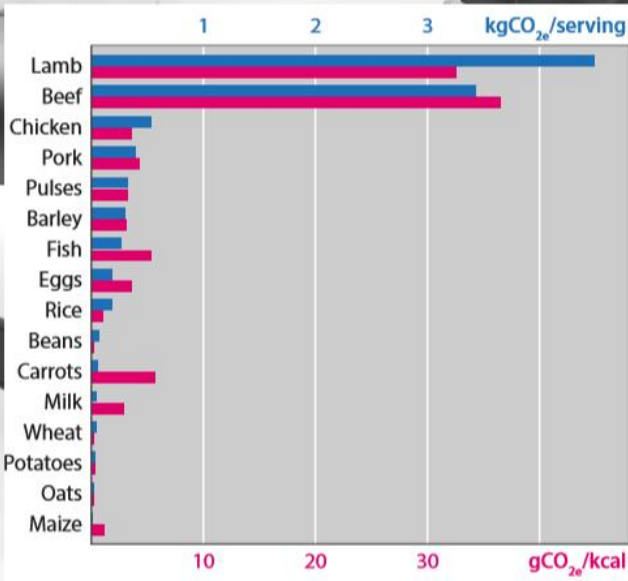
# Four key activities without substitutes

- Chemicals and cement generate  $\text{CO}_2$  as the product of chemical reactions required to produce them.
- Chemicals: improve efficiency of use of fertilisers.
- Cement: explore opportunities to reduce its use in construction by avoiding overdesign.






# Four key activities without substitutes

- Change in diets: avoiding beef and lamb





# Pathway to Absolute Zero

	2020-2029	2030-2049	2050 Absolute Zero	Beyond 2050
<b>Road vehicles</b>	Development of petrol/diesel engines ends; Any new vehicle introduced from now on must be compatible with Absolute Zero	All new vehicles electric, average size of cars reduces to ~1000kg.	Road use at 60% of 2020 levels - through reducing distance travelled or reducing vehicle weight	New options for energy storage linked to expanding non-emitting electricity may allow demand growth
<b>Rail</b>	Growth in domestic and international rail as substitute for flights and low-occupancy car travel	Further growth with expanded network and all electric trains; rail becomes dominant mode for freight as shipping declines	Electric trains the preferred mode of travel for people and freight over all significant distances.	Train speeds increase with increasing availability of zero emissions electricity
<b>Flying</b>	All airports except Heathrow, Glasgow and Belfast close with transfers by rail	All remaining airports close		Electric planes may fly with synthetic fuel once there are excess non-emitting electricity supplies
<b>Shipping</b>	There are currently no freight ships operating without emissions, so shipping must contract	All shipping declines to zero.		Some naval ships operate with onboard nuclear power and new storage options may allow electric power
<b>Heating</b>	Electric heat pumps replace gas boilers, and building retrofits (air tightness, insulation and external shading) expand rapidly	Programme to provide all interior heat with heat pumps and energy retrofits for all buildings	Heating powered on for 60% of today's use.	Option to increase use of heating and cooling as supply of non-emitting electricity expands
<b>Appliances</b>	Gas cookers phased out rapidly in favour of electric hobs and ovens. Fridges, freezers and washing machines become smaller.	Electrification of all appliances and reduction in size to cut power requirement.	All appliances meet stringent efficiency standards, to use 60% of today's energy.	Use, number and size of appliances may increase with increasing zero-emissions electricity supply
<b>Food</b>	National consumption of beef and lamb drops by 50%, along with reduction in frozen ready meals and air-freighted food imports	Beef and lamb phased out, along with all imports not transported by train; fertiliser use greatly reduced	Total energy required to cook or transport food reduced to 60%.	Energy available for fertilising, transporting and cooking increases with zero-emissions electricity
<b>Mining material sourcing</b>	Reduced demand for iron ore and limestone as blast furnace iron and cement reduces. Increased demand for materials for electrification	Iron ore and Limestone phased out while metal scrap supply chain expands greatly and develops with very high precision sorting	Demand for scrap steel and ores for electrification much higher, no iron ore or limestone.	Demand for iron ore and limestone may develop again if CCS applied to cement and iron production
<b>Materials production</b>	Steel recycling grows while cement and blast furnace iron reduce; some plastics with process emissions reduce.	Cement and new steel phased out along with emitting plastics. Steel recycling grows. Aluminium, paper reduced with energy supply.	All materials production electric with total 60% power availability compared to 2020	Material production may expand with electricity and CCS, CCU, hydrogen may enable new cement and steel.
<b>Construction</b>	Reduced cement supply compensated by improved material efficiency, new steel replaced by recycled steel	All conventional mortar and concrete phased out, all steel recycled. Focus on retrofit and adaption of existing buildings.	Any cement must be produced in closed-loop, new builds highly optimised for material saving.	Growth in cement replacements to allow more architectural freedom; new steel may become available.
<b>Manufacturing</b>	Material efficiency becomes prominent as material supply contracts	Most goods made with 50% as much material, many now used for twice as long	Manufacturing inputs reduced by 50% compensated by new designs and manufacturing practices. No necessary reduction output.	Restoration of reduced material supplies allows expansion in output, although some goods will in future be smaller and used for longer than previously.
<b>Electricity</b>	Wind and solar supplies grow as rapidly as possible, with associated storage and distribution. Rapid expansion in electrification of end-uses.	Four-fold increase in renewable generation from 2020, all non-electrical motors and heaters phased out.	All energy supply is now non-emitting electricity.	Demand for non-emitting electricity drives ongoing expansion in supply.
<b>Fossil fuels</b>	Rapid reduction in supply and use of all fossil fuels, except for oil for plastic production	Fossil fuels completely phased out		Development of Carbon Capture and Storage (CCS) may allow resumption of use of gas and coal for electricity

# Change is happening



Controversial plans for a third runway at Heathrow Airport have been thrown into doubt after a court ruling.

- Heathrow's 3<sup>rd</sup> runway was cancelled by court ruling, because it was incompatible with the Climate Change Act.
- This and possible future similar actions will have substantial financial impact across all industries and business.
- However, by starting to think about to reach zero emissions, we can make sensible strategic recommendations.





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# A VALUE RETENTION LANDSCAPE

Owain Griffiths – Head of Circular Economy Strategy

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Oakdene Hollins is a technical, science-led, circular economy consultancy that delivers creative, strategic, practical solutions to support clients to be environmental and sustainability leaders in their field.

Oakdene Hollins is responsible for:



UK Delivery

EMF member



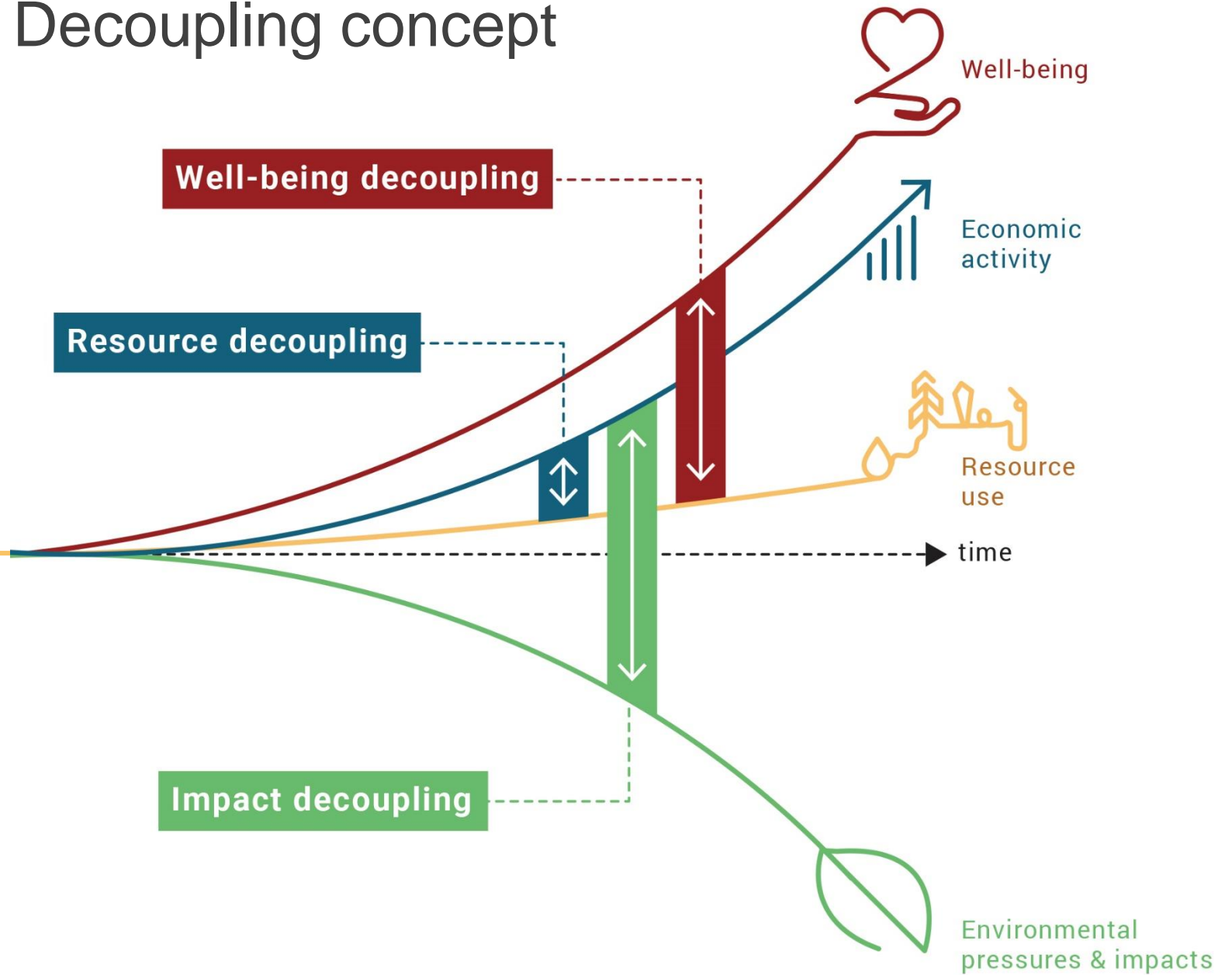
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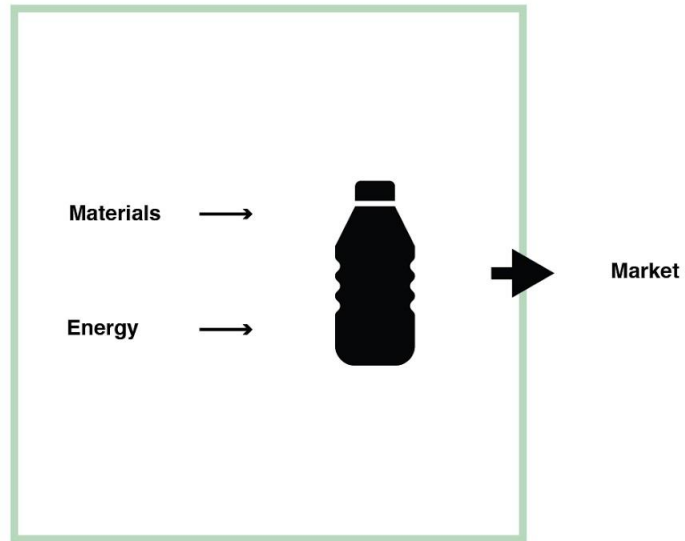
Member of Global Future Council on  
Advanced Manufacturing and Production



# Decoupling concept



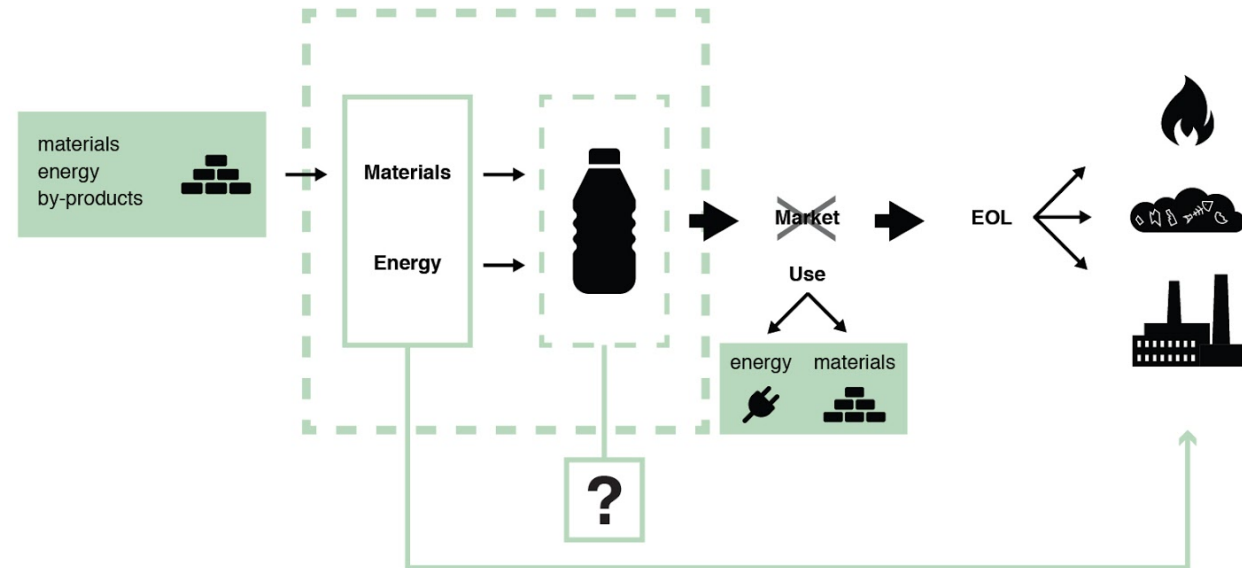
## Traditional Boundaries of Companies' Sustainability Interventions



## Traditional Boundaries of Companies

VS

## Extended Boundaries of LCT

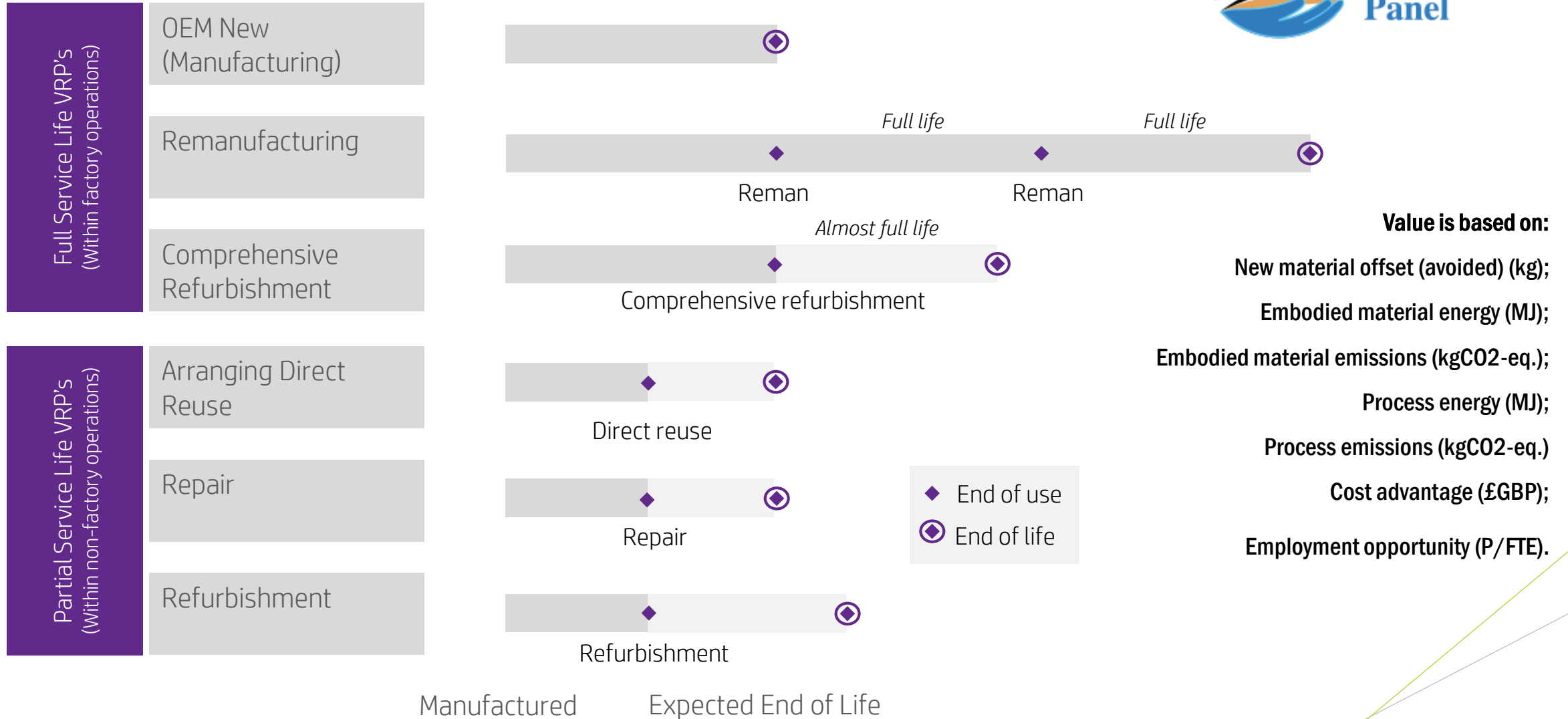


Life cycle thinking is the aim but drawing the frame is the challenge.

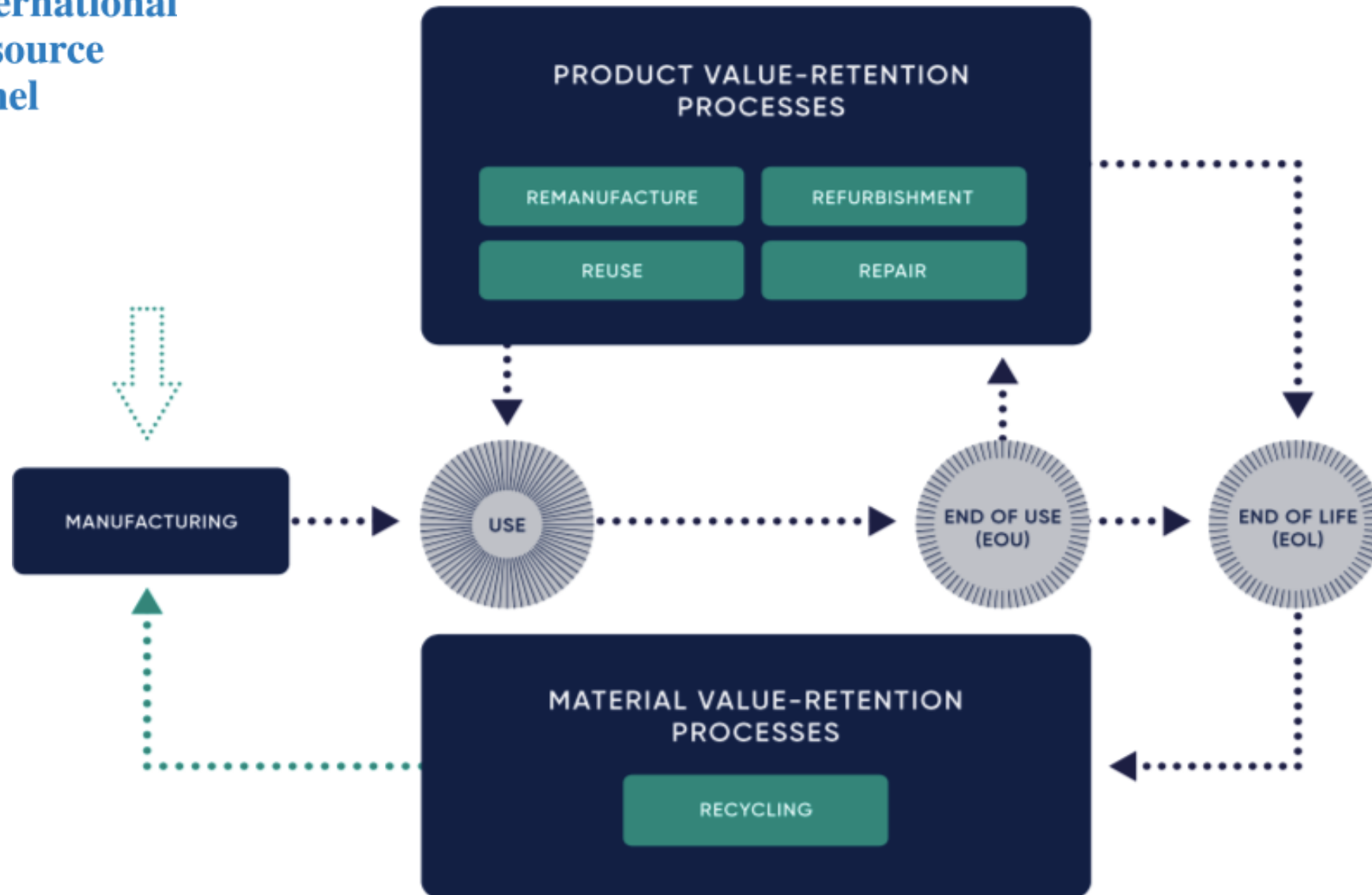
Global toolkits and metrics are still being developed:



## Categories of value retention processes







Adapted by Oakdene Hollins



Organisations applying advanced product retention technologies (ART)



Global best practice (engines)



Value led strategy



Servitisation business models



Organisations applying advanced material retention technologies (ART)



Advanced integrated smelting



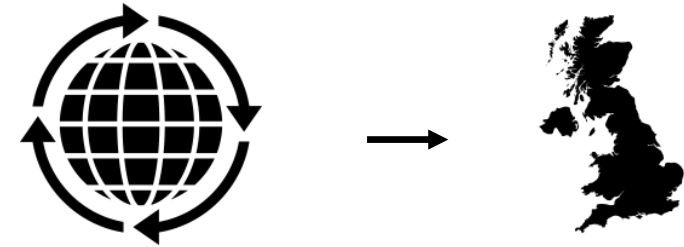
Advanced disassembly



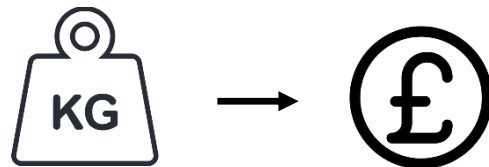
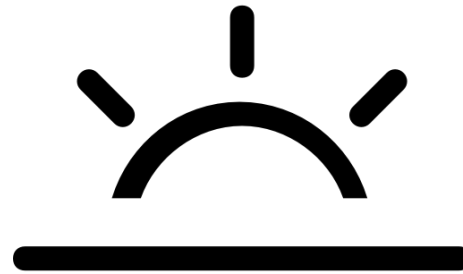
Targeted recycling



Review of waste shipment  
regulations



Local resilience



Weight to value based targets  
(EVs requiring Content)



Department  
for Environment  
Food & Rural Affairs

Waste prevention



# HOW THE INVESTMENT COMMUNITY CAN ACCELERATE A ZERO EMISSION FUTURE

Emmett McNamee

**LowC<sup>VP</sup>**  
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 ADVANCED  
PROPULSION  
CENTRE UK

 **PRI** | Principles for  
Responsible  
Investment



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# The PRI

Investor-led, supported by the United Nations since 2006

The PRI works with its international network of signatories to put the six Principles for Responsible Investment into practice.

Its goals are to understand the investment implications of environmental, social and governance issues and to support signatories in integrating these issues into investment and ownership decisions.



**2**

**UN PARTNERS:**  
UNEP FINANCE INITIATIVE  
UN GLOBAL COMPACT



**3000+**

**SIGNATORIES:**  
ASSET OWNERS  
INVESTMENT MANAGERS  
SERVICE PROVIDERS



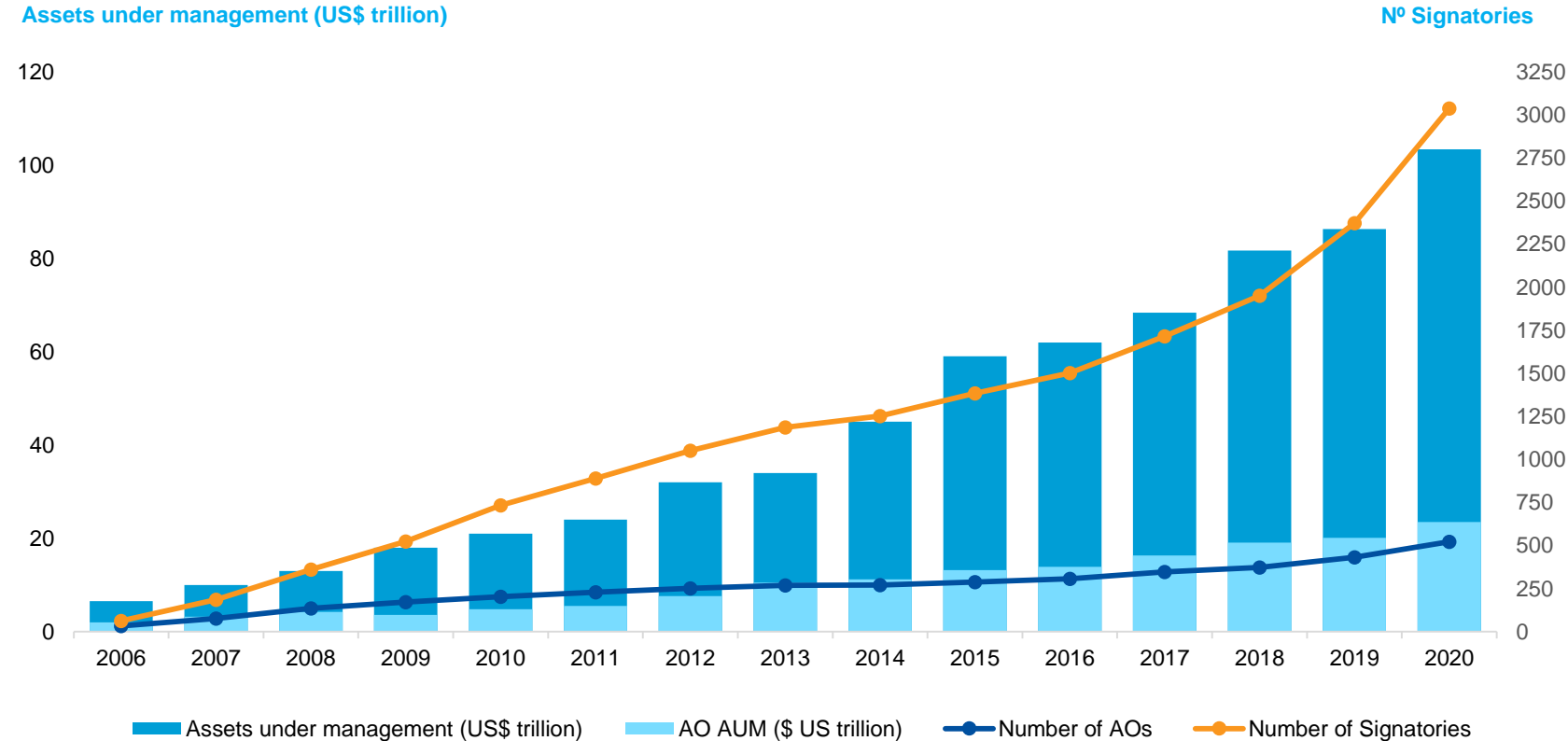
**100+**

**US\$ trn**  
**ASSETS UNDER  
MANAGEMENT**



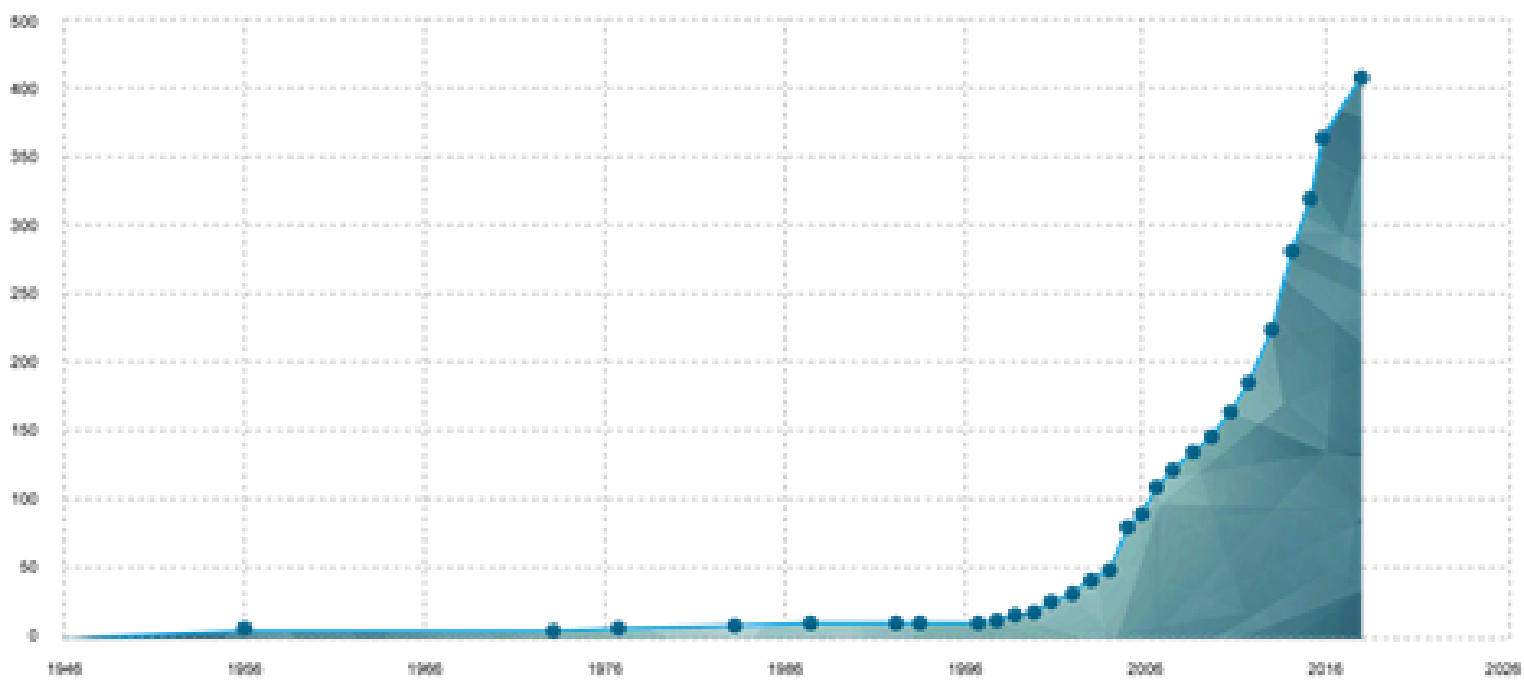
# The rise in responsible investing

PRI's growing signatory base



\*Total AUM include reported AUM and AUM of new signatories provided in sign-up sheet that signed up by end of March of that year.

# Increasing pace of responsible investment-related regulation





## Specific regulations driving investor behaviour

**TCFD recommendations** - the de facto disclosure framework, and are expected to be required for investors and companies going forward in the UK.



**EU taxonomy** - a classification tool to help investors and companies make informed investment decisions on environmentally friendly economic activities.



## Responsible investment in practice

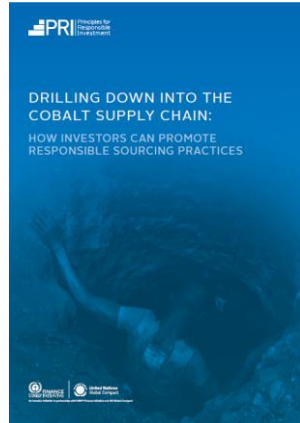
Climate = #1 concern



[Climate Action 100+](#) wants to ensure that **160** of the world's largest corporate greenhouse gas emitters take necessary action on climate change.

So far, more than **450 investors** representing **\$41trn** have signed up to **lobby for reforms, push companies to meet 2050 net-zero targets and engage on TCFD implementation.**

# Cobalt supply chain engagement



**47 investors**  
collectively representing  
**USD \$ 3.8**  
**trillion**  
of assets under management

Investor expectations of companies:

- i. Human rights risk assessments and comprehensive due diligence efforts – following the OECD 5-step framework for risk-based due diligence process in mineral supply chains
- ii. Provision of remedy on the ground
- iii. Active participation in collective and multi-stakeholder initiatives

## Benefits for sustainable companies of growth in responsible investment

- Long-term shareholders
- More engaged shareholders
- More support for company stakeholders
- Easier access to capital
- Support for progressive policy reforms



## Shifting focus to real economy policy

Four priority areas for engagement, consistent with a green COVID-19 recovery. For each area we have identified specific policy asks and how investors can contribute – more info [here](#)

1. **Transport:** accelerating the shift from traditional to electric vehicles through intermediate sales targets, subsidies and investing in charging infrastructure.
2. **Power:** boosting low-carbon power generation with higher ambition 2030 targets while redesigning the electricity market for flexibility.
3. **Land use:** setting up a market mechanism to leverage private investment for afforestation while respecting biodiversity requirements.
4. **Energy efficiency:** requiring a low carbon standard for new homes while investing in a major retrofit programme across the country.

