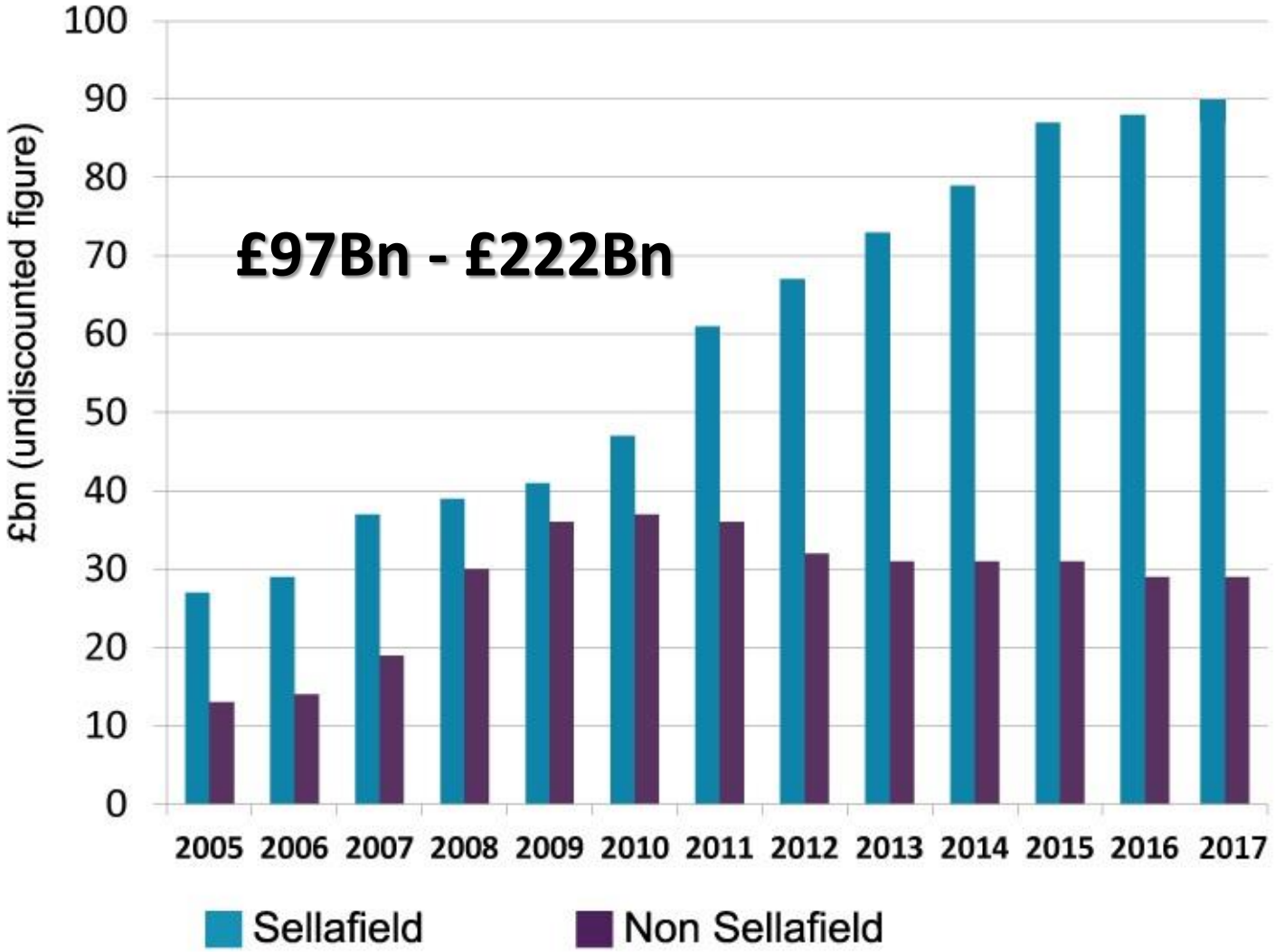
Developing technology, approaches and business models for decommissioning of low-carbon infrastructure: E^{4}LCID

Draft proposal introduction:
Prof. Phil Purnell.

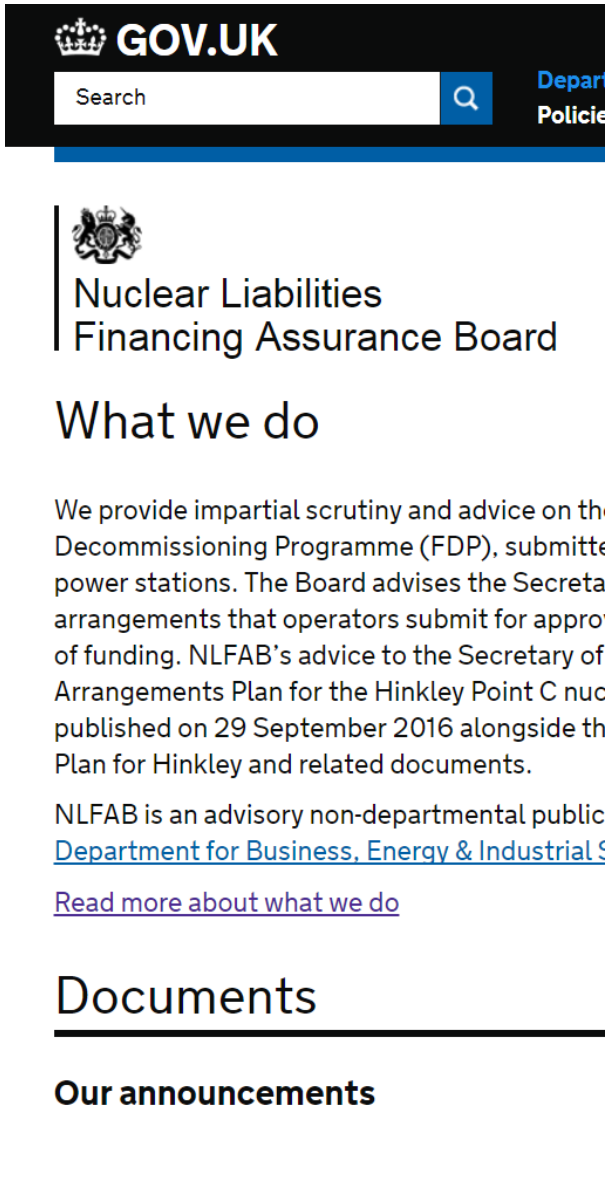
Leeds, Jan 2018.

Nuclear



https://www.gov.uk/government/publications/nuclear-provision-explaining-the-cost-of-cleaning-up-britains-nuclear-legacy/nuclear-provision-explaining-the-cost-of-cleaning-up-britains-nuclear-legacy

Stable Door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Nuclear Liabilities
Financing Assurance Board

What we do

We provide impartial scrutiny and advice on th
Decommissioning Programme (FDP), submitte
power stations. The Board advises the Secreta
arrangements that operators submit for appro
of funding. NLFAB's advice to the Secretary of
Arrangements Plan for the Hinkley Point C nuc
published on 29 September 2016 alongside th
Plan for Hinkley and related documents.

NLFAB is an advisory non-departmental public
Department for Business, Energy & Industrial S

Read more about what we do

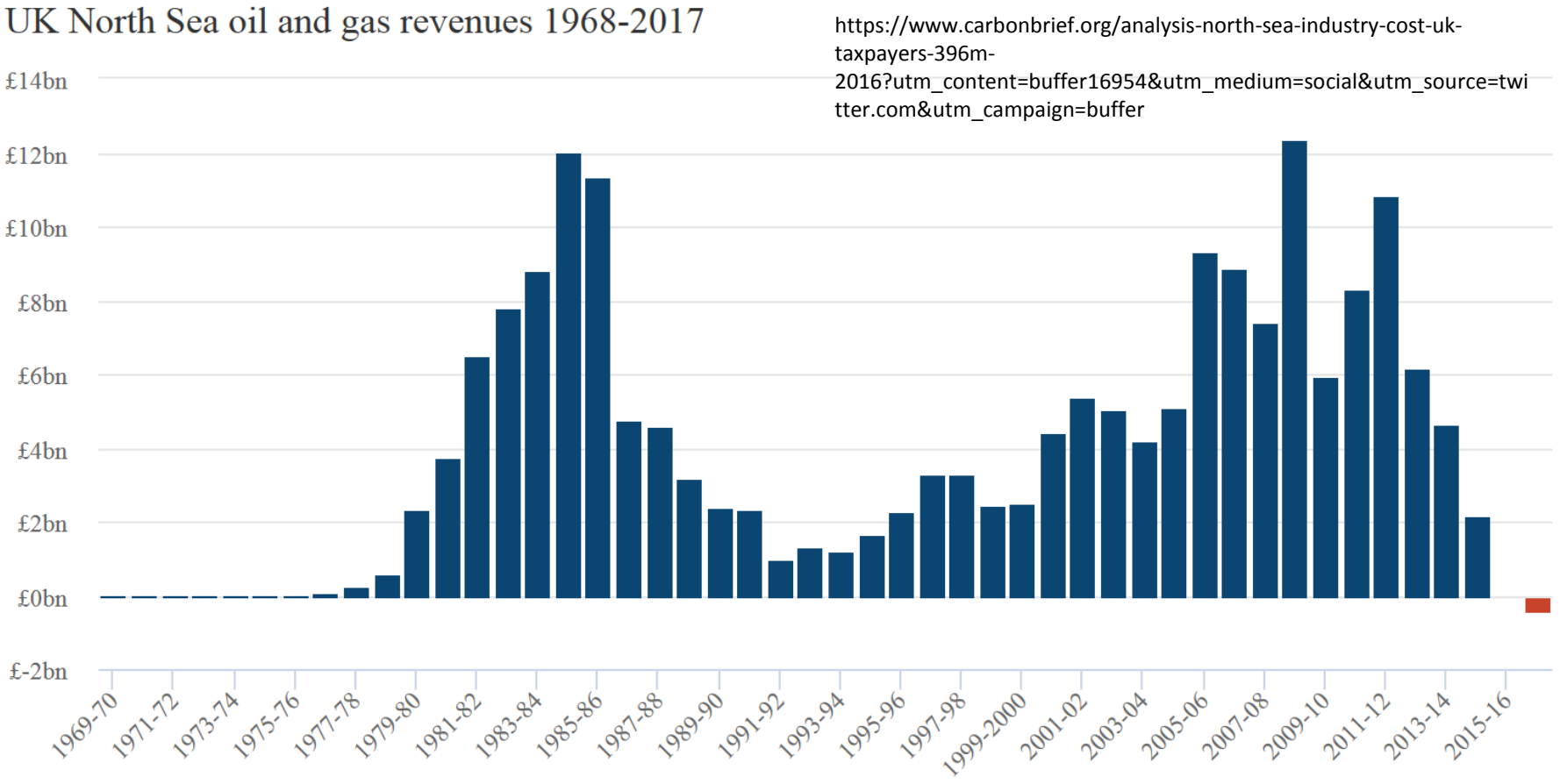
Documents

Our announcements

- *"Operators [must] make full provision for: the full costs of decommissioning; and their full share of the costs of safely and securely managing and disposing of their waste and that in doing so the risk of recourse to public funds is remote at all times. "*

Oil & Gas

"The sector **received £396m** in 2016… Carbon Brief analysis shows oil majors BP, ExxonMobil and Shell [have] received hundreds of millions of pounds to cover the costs of decommissioning old oil and gas fields."



https://www.carbonbrief.org/analysis-north-sea-industry-cost-uk-taxpayers-396m-2016?utm_content=buffer16954&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

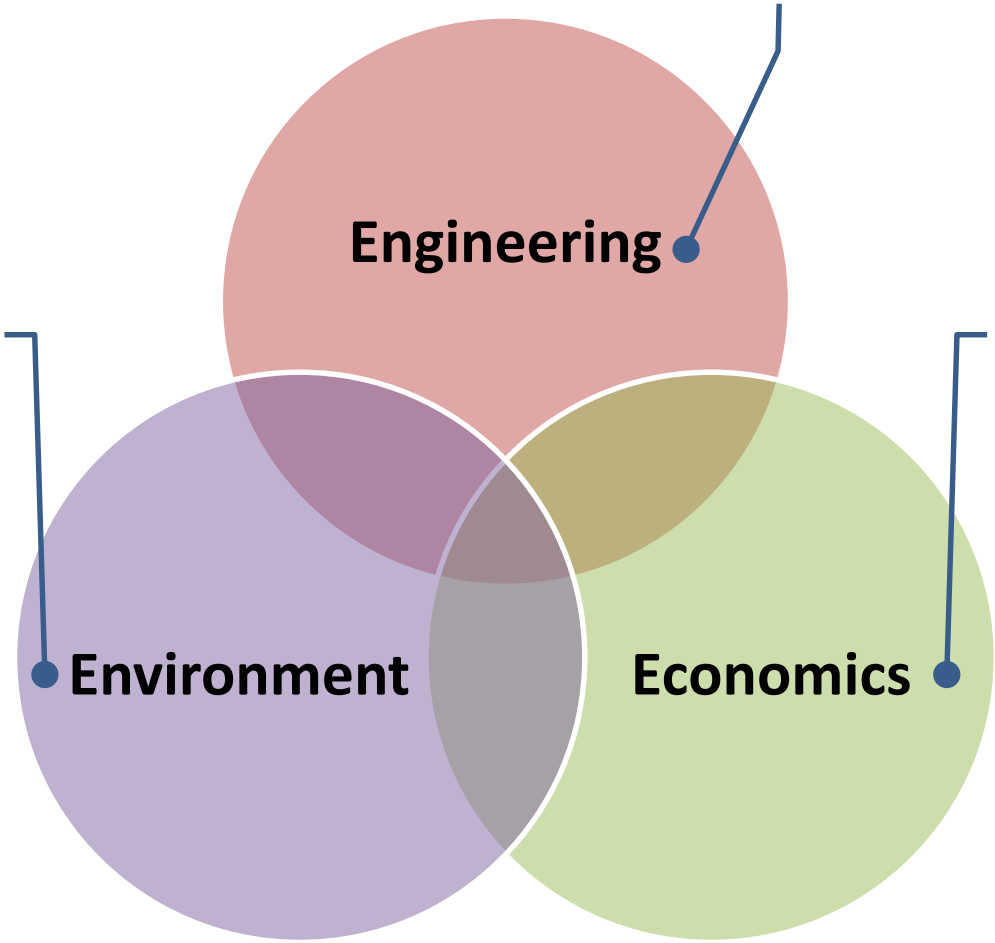
No stable door

9 Jan 2017

- Oil companies are forecast to spend £53 Bn from this year winding down their North Sea operations and almost half that sum is expected to be **recouped from the Treasury through tax relief**.

- The analysis predicted this burden will **exceed the remaining net tax revenues, meaning the North Sea will become a net drain on the public purse**, and warned of a "domino effect" as fields begin to shut.

- scale and complexity of decommissioning; Mt of materials, 100s of installations;
- harshness and inaccessibility of locations (particularly for offshore oil and gas);
- lack of initial design for deconstruction.



- prevent catastrophic environ-mental damage (particularly re nuclear);
- disruption of established ecosystems;
- returning sites to their 'natural' state.

- lack of financial and fiscal planning;
- impacts on the public purse (state as 'decomm-issioner of last resort';
- loss of jobs & associated welfare costs.

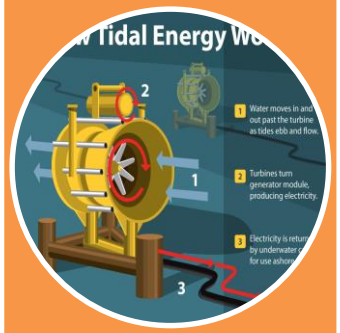
Low-C infrastructure & AT

On/Off-shore Wind

Storage

Solar PV

Evs



Wave, tidal…

Grid, Resource Recovery from Waste, heat networks…

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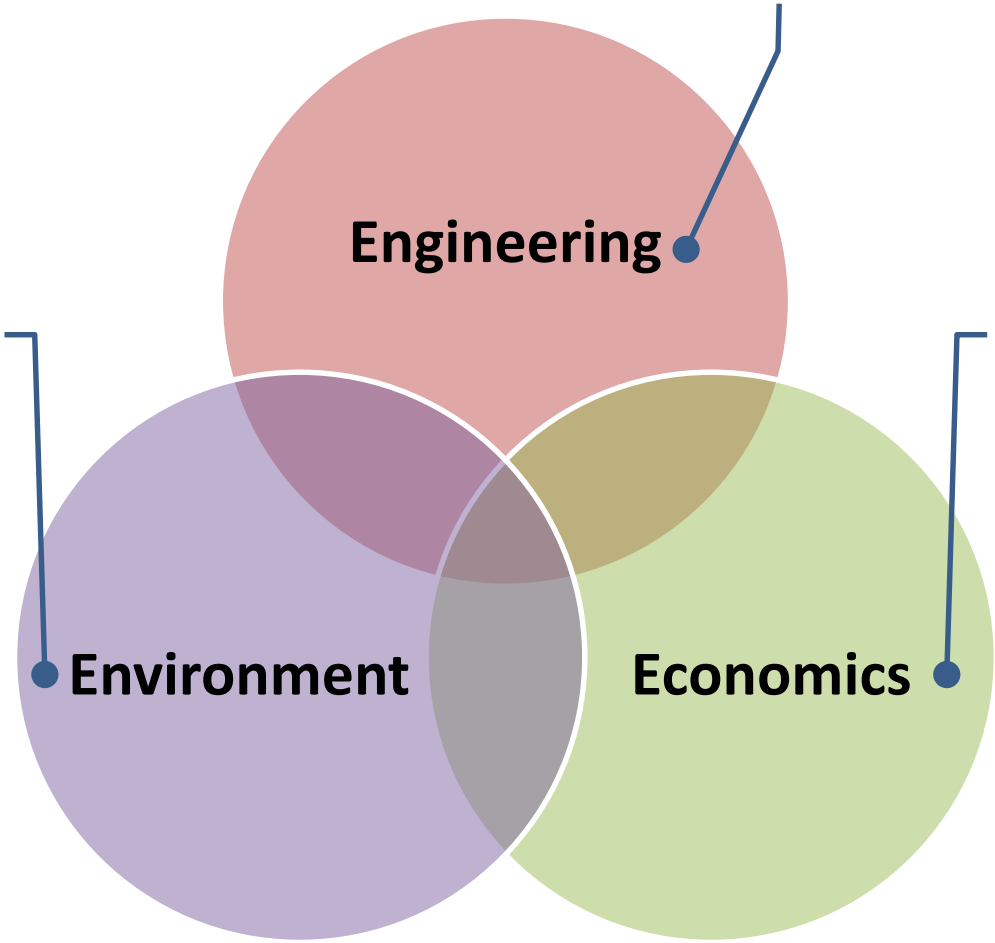

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Two extra problems…

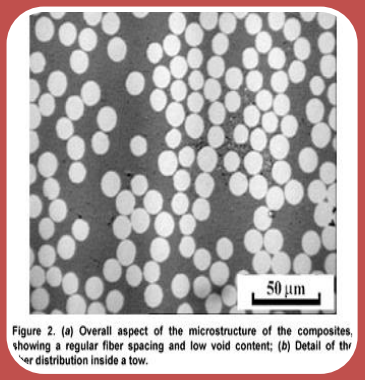
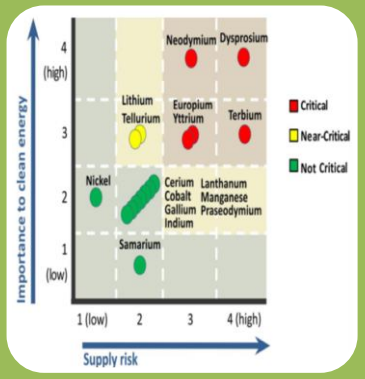


Figure 2. (a) Overall aspect of the microstructure of the composites, showing a regular fiber spacing and low void content; (b) Detail of thr ber distribution inside a tow.

Composites

- Structural and functional
- Deterioration rates unknown
- Limited recycling routes



Critical & near critical materials

- Li, REM, Co, Ga, In, Ni, Cu, composites…
- Step-changes in requirements
- 100% importer – materials security

So this is all in the plans, right?

- Protecting the public purse: All ~100 OSW decommissioning plans have essentially one of three financial plans

Initial research: costs often 4-5x original estimate excluding RRfW costs

8 Financial Security

See appendix 5.

It is understood that an industry-wide Trust may be set up to cover all monitoring obligations post-decommissioning plus any other obligation decommissioning. Subject to a review of the details, TOW would intend to participate in such a scheme should it be established.

[redacted] would prefer to secure its decommissioning obligations through a mid-life accrual fund, paid into a dedicated and restricted Escrow account. If this was acceptable, [redacted] would commit one tenth of the expected net decommissioning costs to the escrow account following the tenth year of operation tenth year of operation beginning 1st January 2010, the first year of complete operation following commissioning (currently expected to be approx £1.2m pa). In the event of a replanting of the WTGs at Year 20 [redacted] would request that these funds were released back to [redacted] and that a separate accrual is started again on the same principles at Year 30.

So this is all in the plans, right?

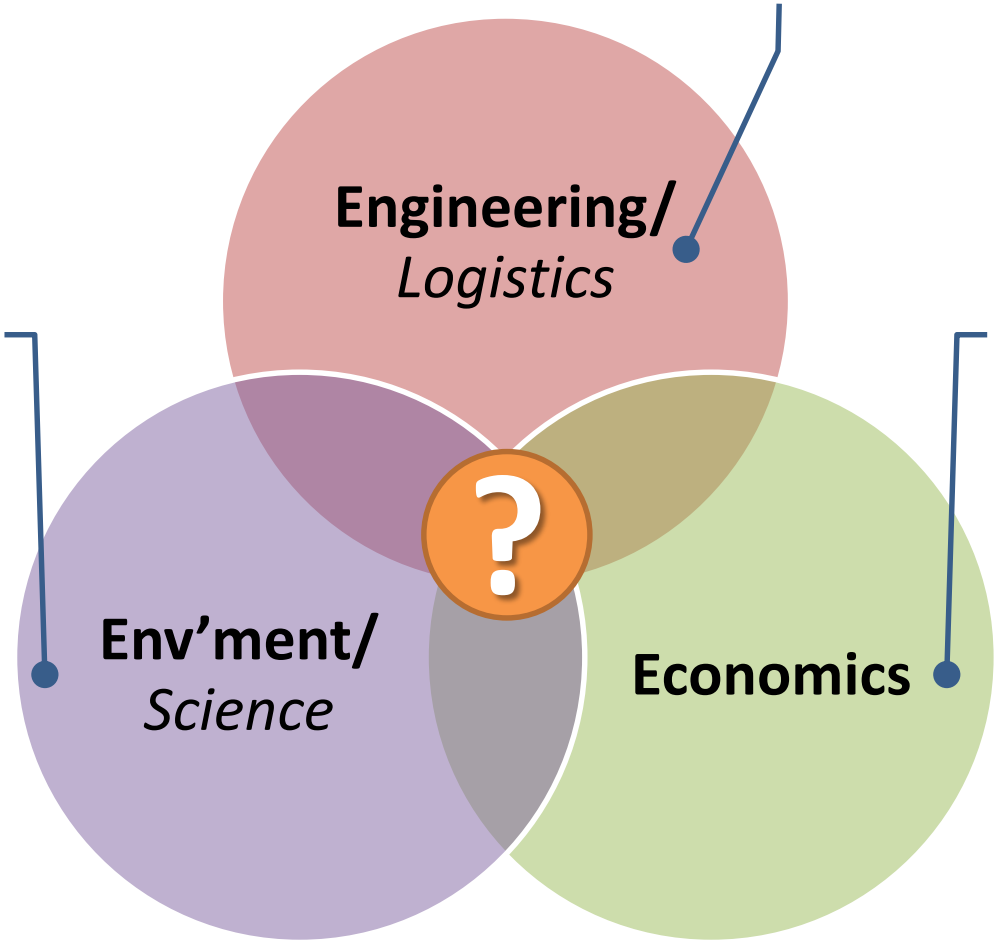
- Recycling
  - “the possibility of recycling material and/or reuse of plant elements will be considered”
  - “It is intended that the vast majority of all elements of the offshore wind farm will be taken back to land for reuse and recycling.”
- GRP recycling in the UK currently remains limited to small volumes of in-house activity; 1 SME recycling CFRP (Composites UK)
- 140 turbine wind farm = 8000 tonnes GRP/CFRP

So this is all in the plans, right?

- Critical materials
  - 140 **turbines** contains >100 tonnes REM: 2-3% of current UK pa consumption;
  - **EV**: REM demand will approach 20% of supply by 2020; Stock of Li/REM in scrap will exceed current supply by 2020/2040.
  - **EV**: Demand for cobalt and lithium will exceed supply by 2020.
- No recycling routes: business opportunity

- Design for recovery and whole-life systems issues
- Durability and lifetime prediction
- Shipping (recovery), waste management and manufacturing (skills & supply chains)

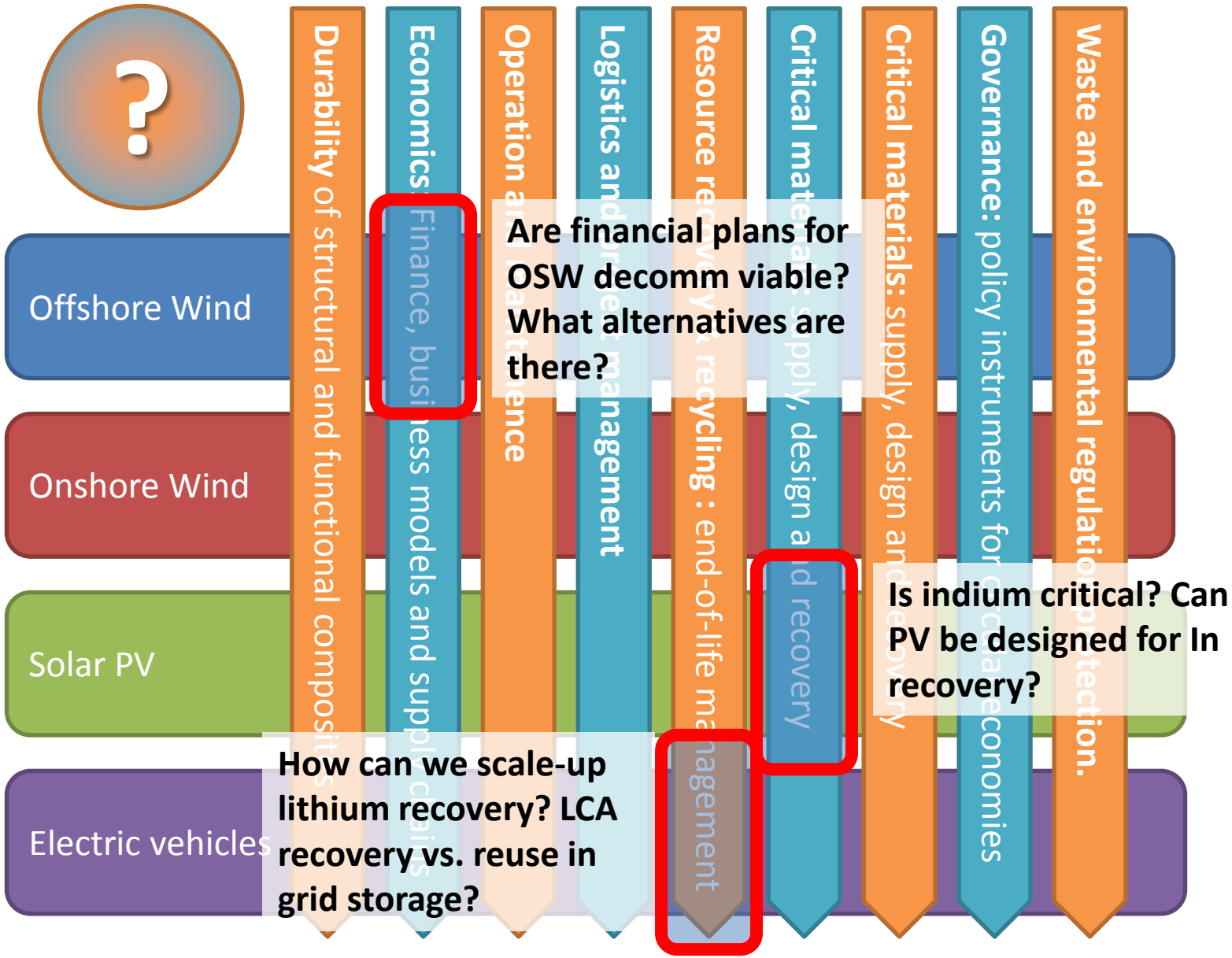
- Scale-up recovery and recycling processes
- Establish environ-mental impact of decom-missioning



- Business models for decom-missioning and materials recovery
- Materials security
- How to minimise impact on public purse

Challenge questions

- How do we design our new low-carbon infrastructure for decommissioning?
  - How do we avoid a repeat of the £300Bn+ bills facing the taxpayer for decommissioning nuclear and North Sea oil infrastructure?
  - How do we recover the critical materials embedded in low-carbon infrastructure and components to protect UK materials security?
  - What disruptive new science, technology and industry do we need to develop in a sector where there is a global need but no expertise?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Offshore Wind
Onshore Wind
Solar PV
Electric vehicles
Durability of structural and functional composites
Economics: Finance, business models and supply chains
Operation and maintenance
Logistics and project management
Resource recovery & recycling : end-of-life management
Critical materials: supply, design and recovery
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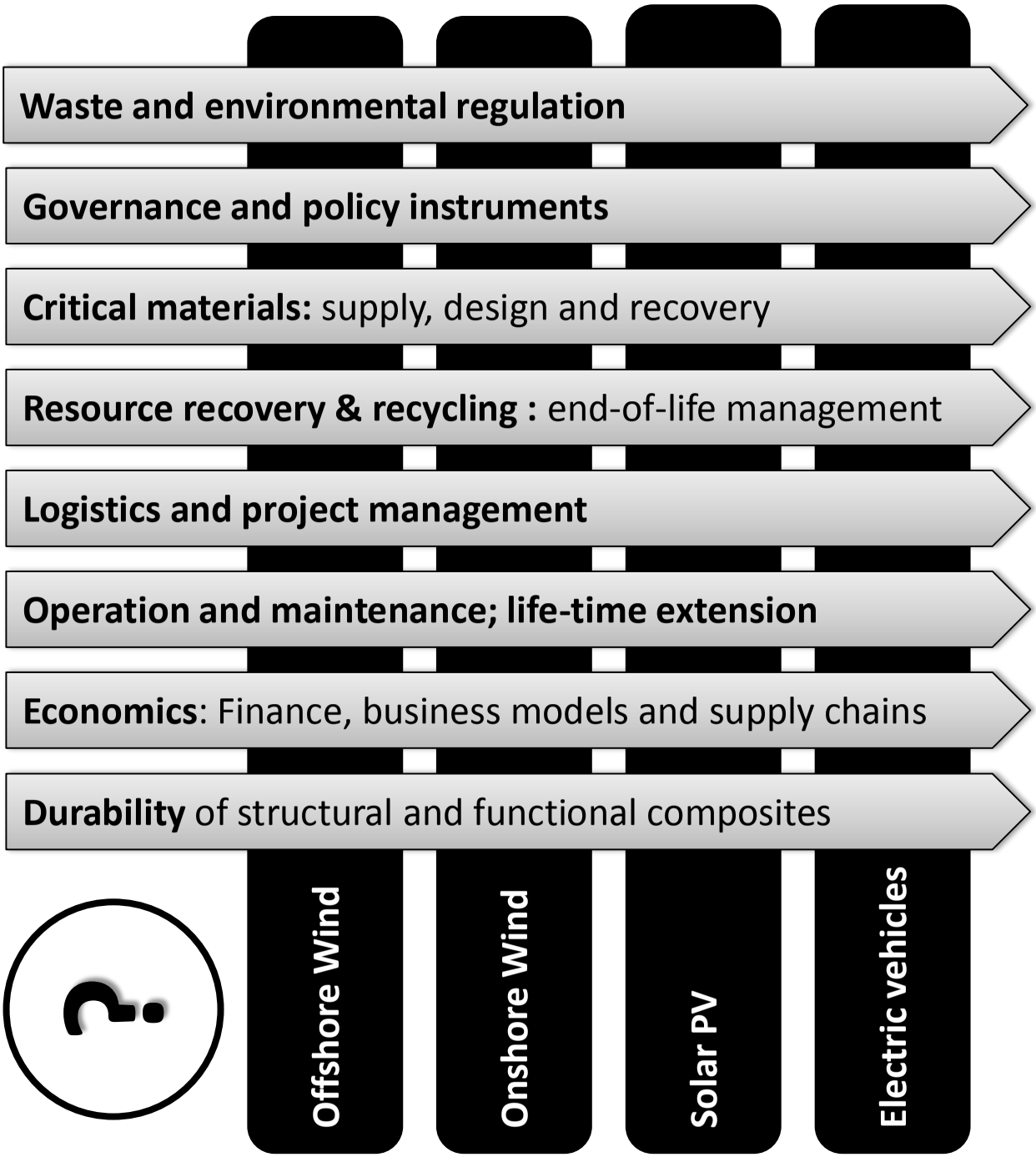
Governance: policy instruments for circular economies
Waste and environmental regulation protection.
Are financial plans for OSW decomm viable? What alternatives are there?
Is indium critical? Can PV be designed for In recovery?
How can we scale-up lithium recovery? LCA recovery vs. reuse in grid storage?

What are today's deliverables?

- Scope: breadth and depth
  - Programme or projects? What's missing?
- Partners: stakeholders and expertise
  - Who else do we need?
- Old vs new
  - What's been done already (TRL, i.e. Innovate vs RCUK), what's novel?
- Tensions
  - How do we manage conflicting interests?


Waste and environmental regulation
Governance and policy instruments
Critical materials: supply, design and recovery
Resource recovery & recycling : end-of-life management
Logistics and project management
Operation and maintenance; life-time extension
Economics: Finance, business models and supply chains
Durability of structural and functional composites
?
Offshore Wind
Onshore Wind
Solar PV
Electric vehicles