EGU 2020

EOS 5.1

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Meeting our future mineral resource needs sustainably: A socio-technical transitions perspective

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An update on my PhD project - work in progress…

…with special thanks to my friends in the geoethics community for their support and encouragement

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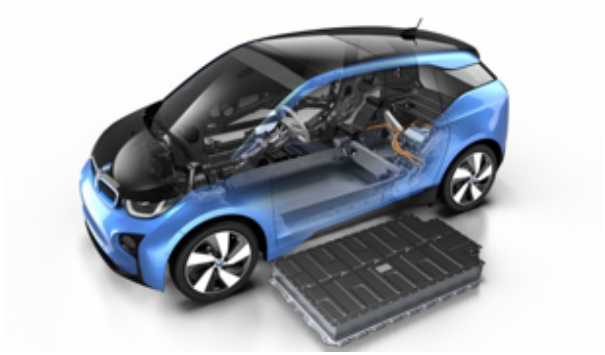
We will continue to need metals and other mineral resources…



…for low-carbon energy and transport, smart technologies, global development…

…but the social and environmental impacts of mining can be enormous

Mineral supply chains are long, complex and opaque – so how can miners, manufacturers, investors and consumers cooperate?

Responsible mining → ? ← Responsible sourcing

Many responsible mining/supply schemes…

Cobalt Institute

ICMM
International Council on Mining & Metals

Towards Sustainable Mining
Vers le développement minier durable

ALLIANCE FOR RESPONSIBLE MINING

EITI Extractive Industries Transparency Initiative

MMSD

EQUATOR PRINCIPLES

IRMA
Initiative for Responsible Mining Assurance

LME
An HKEX Company

eg PLUS
A Framework for Responsible Exploration

Responsible Mining Index

Responsible Steel standards & certification

asi Aluminium Stewardship Initiative

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…but these are rarely visible far down the supply chain, let alone by consumers!

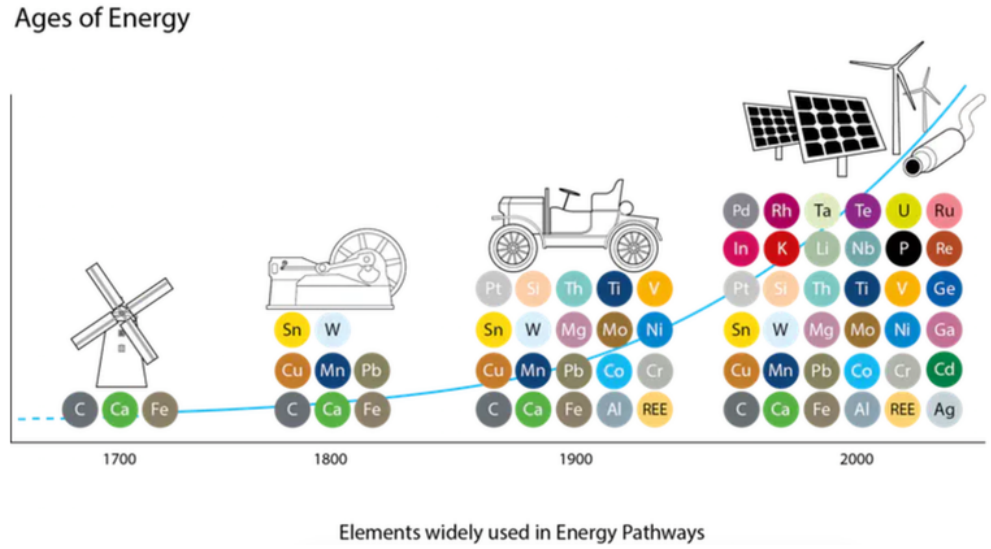
Responsible sourcing

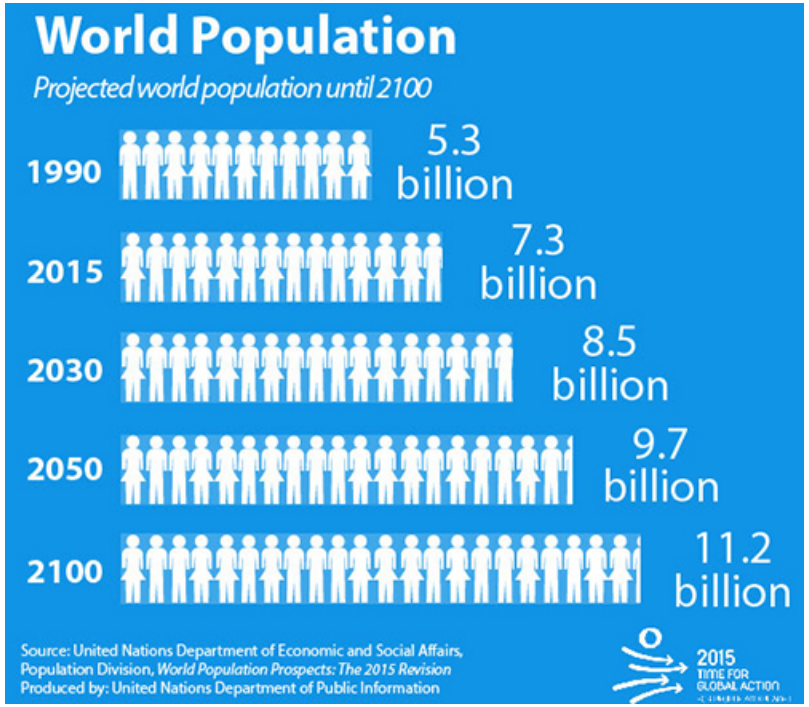
- Manufacturing companies looking to de-risk their supply chains ('supply chain due diligence') – or even to leverage them to effect wider positive change
- Upstream intermediaries put under pressure to meet customer demand for higher standards
- An emerging shared priority – but not (usually) joined up with responsible mining
- Should include 'secondary resources' (from recycling, etc) – but rarely considered together

A circular economy?

Clue: something is missing from this picture!

So why not just recycle?





Ironbridge, 1781 – residence time of resources in infrastructure can be long!

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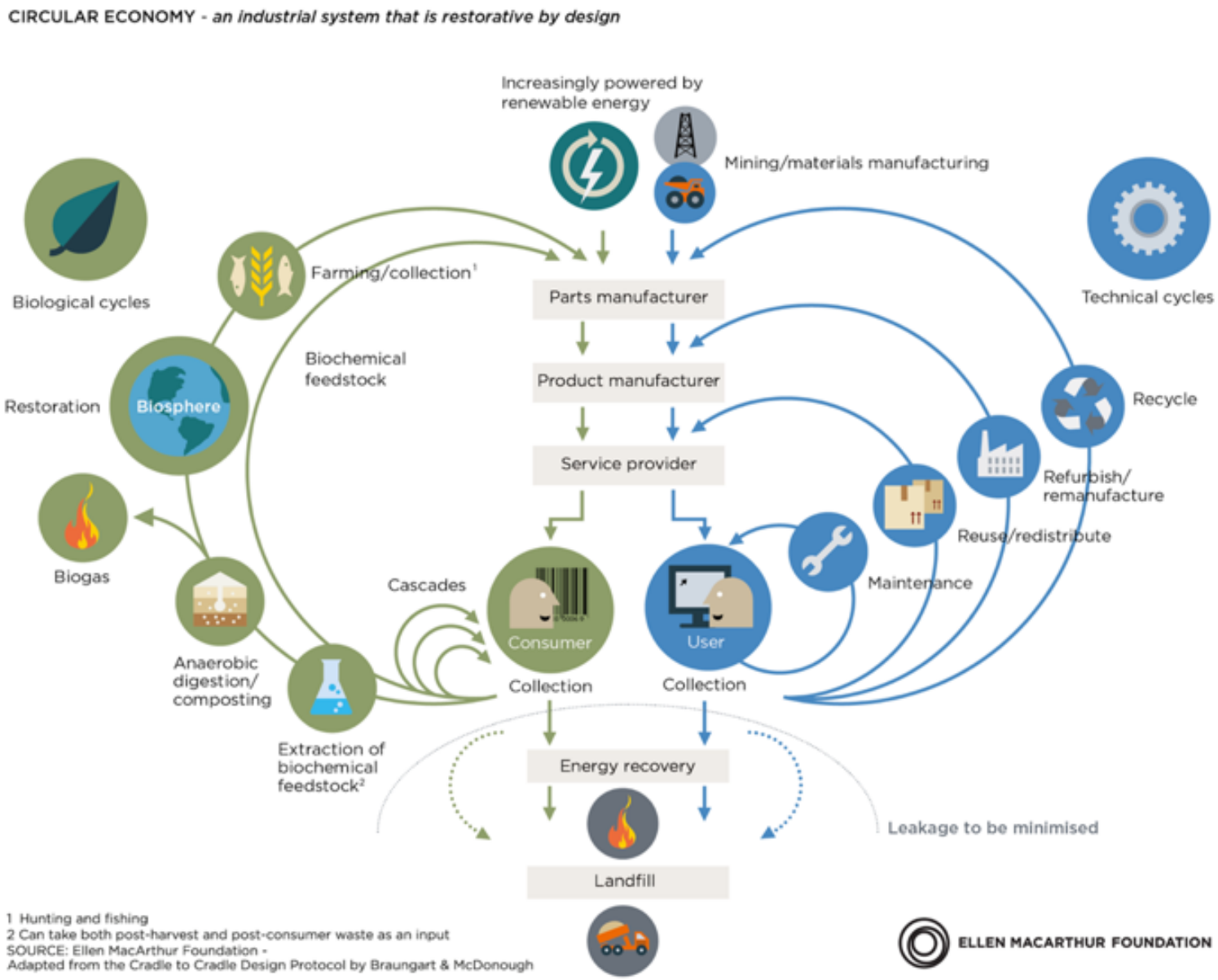
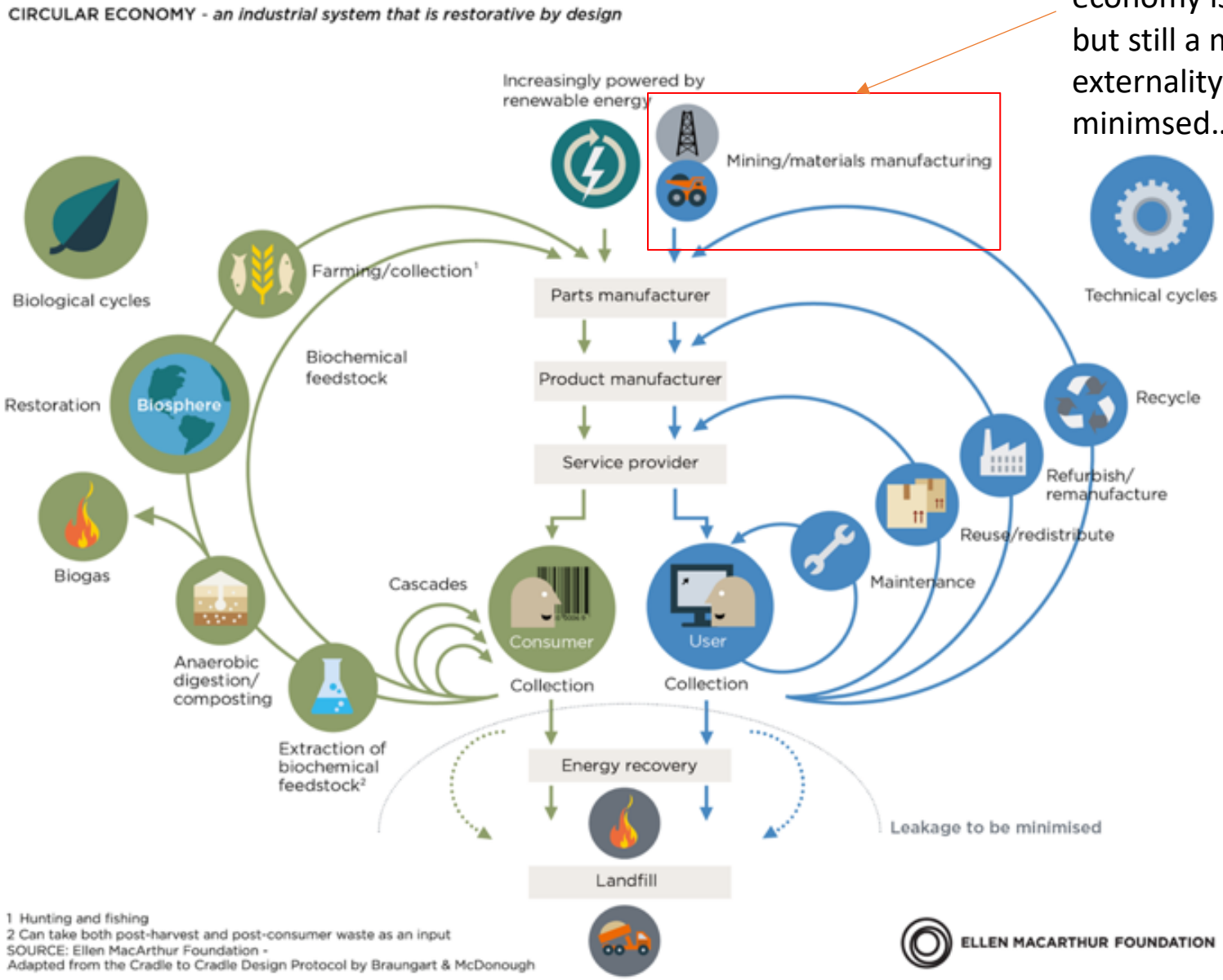
…achieving these goals will require minerals resources too!

A (more) realistic circular economy model



A (more) realistic circular economy model

Aha! The need for material inputs to the circular economy is recognised – but still a marginal externality to be minimsed…



Moving towards a circular economy

Core principles:

- Preserve and enhance natural capital
- Optimise resource yields
- Foster system effectiveness

Building blocks or stumbling blocks?

- ‘Circular design’
- Transforming business models
- Decoupling value creation mechanisms from consumption of finite resources

Responsible mining and the circular economy – shared principles and drivers

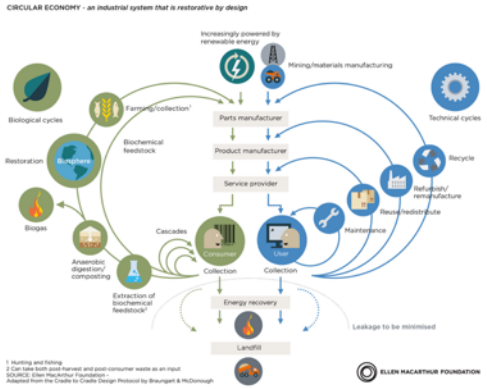
- Maximising resource efficiency (including energy and water inputs, resource recovery rates, benefit derived per unit of resource)
- Minimising waste (and its impacts), and extracted resources from waste streams
- Material stewardship – from the ground, through the supply chain and (multiple loops of) usage to end of life
- Common need for traceability and certification of materials
- Decoupling resource-dependent products, services and activities from their (negative) social, environmental and economic impacts
- Need to rethink traditional business models and identify new value creation opportunities
- Need to match (business-oriented) actor objectives with (sustainability) system objectives

Responsible mining and the circular economy – shared opportunities

- Extraction of resources from mine wastes (including tailings, waste rock, mine waters) ‘in real time’, i.e. as they are produced
- Extraction of resources from legacy mine wastes
- Applying mining know-how to ‘end-of-life’ resource recovery (e.g. the ‘urban mine’)
- Co-production of mineral resources with other resources (other metals, energy…)
- Co-processing of multiple waste/resource streams, e.g. CEReS project – exploring opportunities to use acidic metal-rich run-off from coal mining waste to recover copper from e-waste
- Innovation in energy and water efficiency, waste minimisation, etc…

A holistic view of responsible mineral resource management – can we bring these elements together?

Circular economy / secondary resource production / recycling etc



Responsible supply → ? ← Responsible sourcing

Linear supply chains / primary resource production / mining

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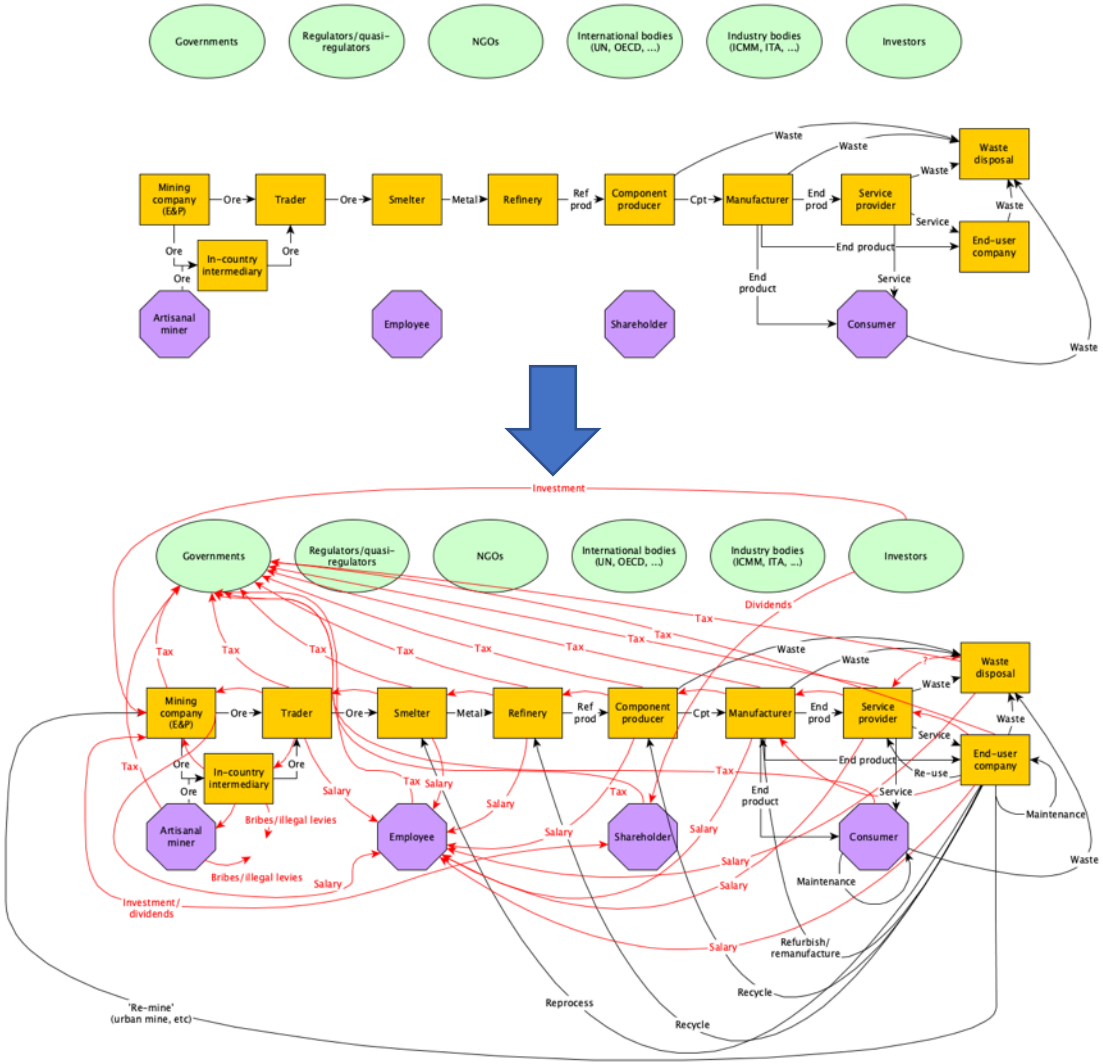
My theoretical and structural framework

- Socio-technical sustainability transitions
- ‘Multi-level perspective’ (MLP – see next slide) – but with an open mind about structures and mechanisms, given this is a novel area of application
- ‘Toolbox’ of themes and concepts from multiple literatures – socio-technical transitions (including re linked/nested transitions), circular economy, sustainable supply chains, sustainable mining
- Initial mapping of what the transition to a (more) sustainable new minerals economy should look like, and system-level drivers and objectives (sample images only shown here)



Socio-technical transitions and the multi-level perspective

- Socio-technical configurations – technologies embedded with actor practices, regulation, industry networks, markets, meanings…
- ‘Lock-in’ and path dependency – how can radical new technologies emerge and break through?
- Multi-level perspective (MLP) – interaction of protected innovation 'niches’, which are shaped by (but may break through into) socio-technical regimes, which in turn interact with wider political, social and economic landscapes – see Geels (2002) and many subsequent publications
- Initially mostly applied to energy and transport
- More recent work has broadened this focus, questioned (over-specified and under-determined) mechanisms, and considered additional factors and alternative modes of change
- Health warning – not previously applied to mineral resources, so some mechanisms/theory may not apply…

Geels, F (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy, 31*, 1257-1274.

Research approach

- 3 case studies – organisations in different parts of the ‘resources ecosystem’ with a commitment to responsible/sustainable sourcing and supply of minerals (metals) from mined and CE sources:
  - A mining company (also involved in developing CE activities)
  - A global technology (services and manufacture) company
  - Aluminium Stewardship Initiative (certifies sustainability standards across the whole supply chain, including reprocessing/recycling)
- How are they working towards more sustainable sourcing, supply and stewardship of mineral resources (current and planned activities)?
- What are the drivers, barriers, dependencies, opportunities and risks?
- Interviews within lead organisations and across their networks; documentation

Abductive analysis

- Combines deductive and inductive approaches
- Iterative…
  - …emergent concepts and themes from my data
  - …a priori concepts and themes from literature (socio-technical transitions, but also from other relevant bodies of literature, e.g. circular economy, sustainable production and consumption, supply chain due diligence)
- ‘Pattern matching’ or ‘double-fitting’ of observations and elements of theory
- Feed back to further data collection (new and existing interviewees), further data analysis, further theory searching
- How can emerging theory inform understanding of observations and cases?
- How can observations, and concepts and themes derived from these, inform theory?

Expected outputs

- Theoretical:
  - Initiate development of a socio-technical sustainability transition framework for mineral resources, to support future research and practice
  - Contribute to wider theoretical and methodological debates in transitions scholarship, especially with respect to novel areas of application
- Practical:
  - Refine ‘mapping’ of the transition to a sustainable new minerals economy – an empirically and theoretically informed picture of what it should look like and how we should be trying to get there
  - Improve understanding of potential transition pathways for case study organisations and relationship to emergent system-level transition pathways

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