Project 3: Electric cars – Handout

The project

The global production of cars in 2011 was 60 million per year, growing at 3.3% per year. Cars account for 74% of production of motor vehicles and are responsible for about 20% of all the carbon released into the atmosphere[1]. National governments implement policies to reduce this source of emissions through taxation and incentives. One of the incentives is to subsidise electric vehicles (EVs).

The Nissan Leaf, an electric vehicle (EV). Makers claim 0 grams $CO_{2/}$ per km.

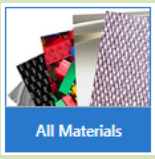
From a materials point of view, the major differences between electric and internal combustion (IC) cars are the replacement of the IC engine with electric motors that, at present, use Neodymium-Boron permanent magnets and the replacement of gasoline or diesel fuel by batteries. It is estimated that the global production of electric cars – either hybrids (HV), plug-in hybrids (PHV), or fully electric (EV) – will exceed 16 million per year in 2021 and will account for 20% of all vehicles manufactured[2]. EVs, particularly, are seen as the way to decarbonise road transport. France, Germany and the UK all have target EV sales of around 10% of all car sales by 2020. Is this a realistically achievable sustainable development on a global scale?

Background information.

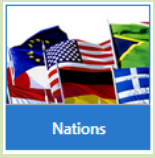
- Today's electric cars have 16 kWh batteries and a claimed range of up to 100 km between charges.
- An EV with this range requires about 1.5 kg of Neodymium for the motors[3] and 7.3 kg of lithium, (equating to 0.46 kg Lithium per nominal kWh) for the rechargeable batteries[4].
- The at-wheel energy required to propel a small car is between 0.6 and 1.0 MJ/km (0.17 and 3 kW.hr/km)[5].
- Delivered electric power from a gas-fired power station has a carbon footprint of 500 g/kW.hr, or 140 g/MJ[6]; that from a coal fired power station has larger carbon footprint.

[1] www.epa.gov/climatechange/ghgemissions/sources.html
[2] http://imsresearch.com/news-events/press-template.php?pr_id=2135
[3] www.reuters.com/article/2009/08/31/us-mining-toyota-idUSTRE57U02B20090831
[4] Tahil, W. (2010) "How Much Lithium does a LiIon EV battery really need? www.meridian-int-res.com and http://www.google.co.uk/search?sourceid=navclient&ie=UTF-8&rlz=1T4ADBR_enGB321GB323&q=how+much+lithium+is+in+a+battery
[5] Telens Peiro, L. Villalba Mendez, G. and Ayres, R.U. (2013) "Lithium: sources, production, uses and recovery outlook" JOM Vol 65, pp. 896 – 996.
[6] See, for example, www.defra.gov.uk/publications/files/pb13773-ghg-conversion-factors-2012.pdf Table 3c

Where can the CES EduPack Sustainable Development Edition help with Fact-finding?



The Materials data-table contains property data for bio and oil-based polymers. It also contains eco-data for embodied energies and carbon footprints.

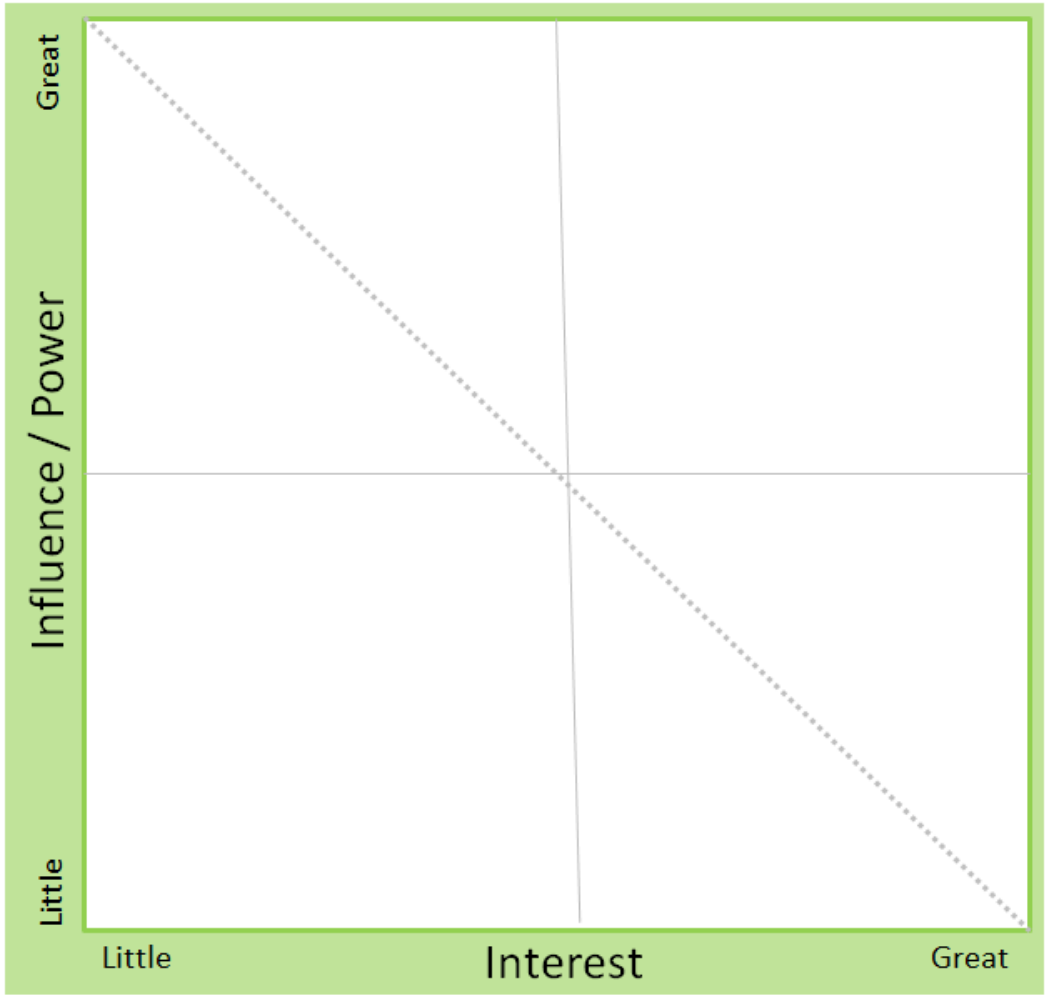


The Nations data-table provides background on the prosperity, environmental performance, and governance of countries from which feedstock for biopolymers might be sourced or biopolymer production located.

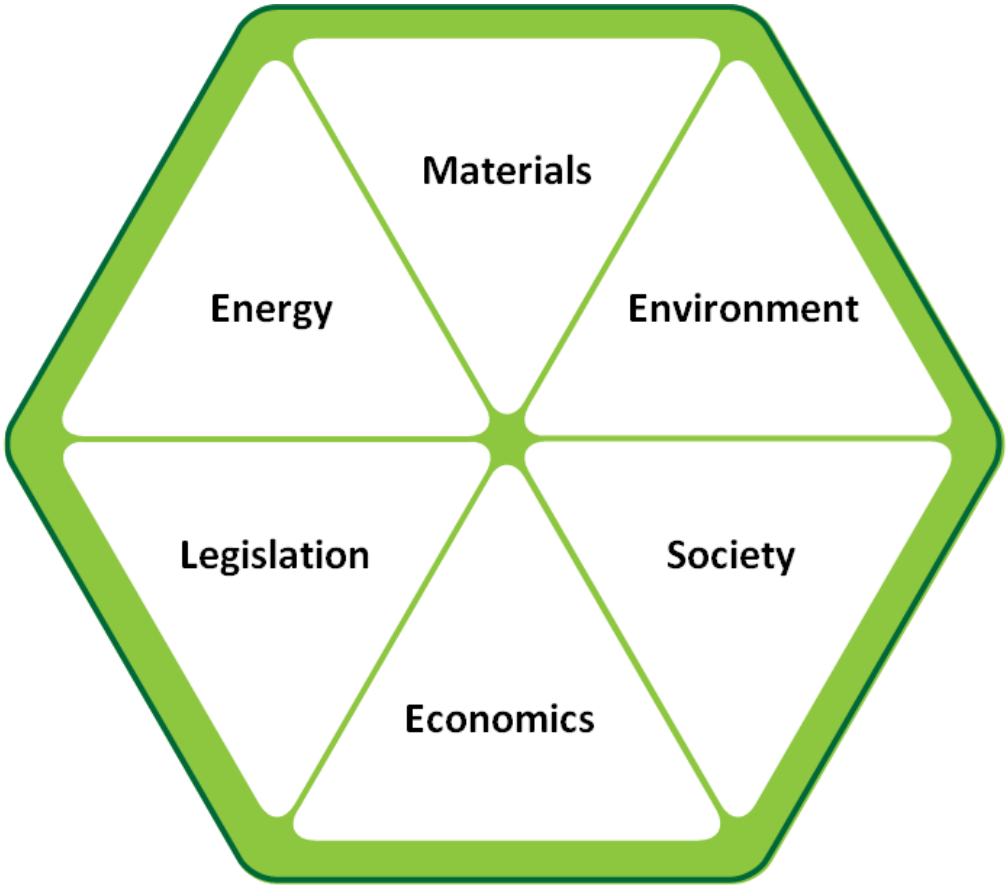
The Regulation data-table identifies government incentives and restrictions that relate packaging, waste, and the use of chemicals.

The Power Systems data-table contains data for the carbon footprint of both fossil fuels and low carbon electricity generating plants.

Stakeholder diagram



Fact-finding

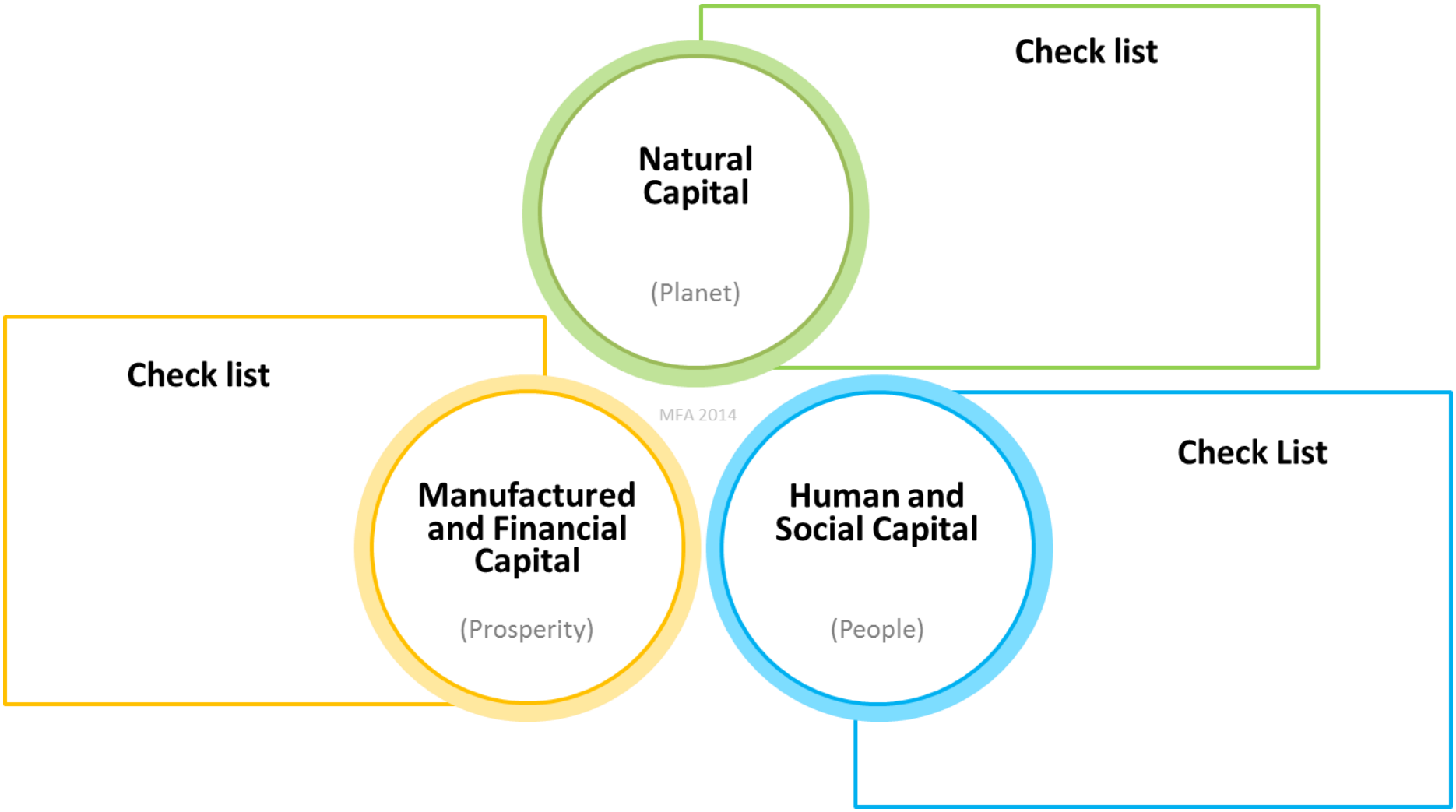


MFA 2014

Synthesis

	Human and social capital - People Health? Wellbeing? Convenience? Culture? Tradition? Associations? Perceptions? Equality? Morality?	**Natural capital - Planet** *Can prime objective be met? Are stakeholder concerns addressed? Are there unwanted consequences?*	**Manufactured capital - Prosperity** Cost – Benefit? (Cost facts vs. Eco facts) Legitimacy? Conformity with law?
Materials			
Energy			
Environment			
Legislation			
Economics			
Society			
Synthesis (the most telling facts)			

Synthesis (summary)



Sustainable Development Projects

- **Projects**
  - Project 1 : Greener Beer Cans
  - Project 2 : Expanding Biopolymer Production
  - **Project 3 : Electric Cars**

- **Resources**

Students

- **Problem statement**
- Templates
- Assessing Sustainable Development

Educators

- Summary
- Sample Analysis
- Related Projects

A White Paper called Materials and Sustainable Development and a book of the same name describe this methodology and the rationale behind it in more detail.

http://teachingresources.grantadesign.com/Type/Papers/PAPSSDEN13

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Accuracy

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