

Sustainable Development Projects

Project 1: Greener Beer Cans

Mike Ashby, 2014

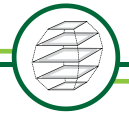
The Articulation

The Beneficial Brewing Corporation markets beer in 16 ounce (473 ml) aluminum cans. Their sales average 500 million cans per year, roughly 1% of the US beer market. At the Annual General Meeting (AGM) a group of eco-minded shareholders propose that the company should use steel cans instead of aluminum because steel has a lower embodied energy and carbon footprint than aluminum. The CEO of Beneficial Brewing is thereby presented with an articulation for a sustainable development. How is he or she to assess it?

This simple example shows how the steps of the 5-layer method work but is not otherwise to be taken seriously. Projects 2 and 3 go into much greater depth.



Figure 1. An aluminum beer can



The Assessment

The numbering of the sections corresponds to those of the 5 steps of the analysis. The CES EduPack Sustainability database helps with fact-finding in ways described in the blue boxes.

1. Clarify the Prime objective and scale

The Prime objective is defined in the project-statement: it is to reduce energy demand and carbon emission by replacing aluminum cans by cans made of steel. The size scale, too, is defined: 500 million cans per year. The time scale is less clear, but the shareholders will expect some sort of response by the time of the next AGM in one year's time.



2. Stakeholders and their concerns.

The CEO of Beneficial Brewing asks: who is interested or affected if we change from aluminum to steel cans? The shareholders have urged the change and are in a position to exert

pressure on the company to adopt it: they are stakeholders with both interest and influence. The makers of aluminum cans may not wish to lose trade, but the makers of steel cans may be happy to get it – both are interested parties. Surveys suggest that most beer drinkers do not know or care what the cans are made from – they are stakeholders with little interest or influence so long as they get their beer. Law makers could, if so motivated, pass legislation mandating the use of steel cans but there is little reason to think that they would; they have influence but no interest. The important stakeholders are those above the diagonal (dotted) line. This is useful information, focusing the attention of the CEO on the key players and their concerns. Their views must be recognized in seeking the best path forward.



Figure 2. The stakeholder diagram for the CEO of the Beneficial Brewer, with paths of influence.

3 Fact-finding

What information does the CEO need to support or refute the claims made by the shareholders in his company? What additional facts do we need for a rational discussion of the Prime Objective? Figure 3 summarizes the issues needing research. No judgements yet; just facts.



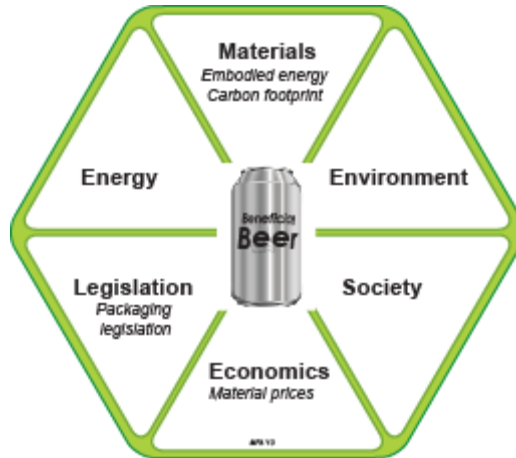
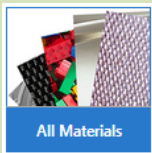


Figure 3. The fact-finding summary.

Material, Environment and Energy. It is true, as the shareholders of the Beneficial Brewing Co claim, that steel has a much lower embodied energy than aluminum for virgin material – it is about 25 MJ/kg for steel, 200 MJ/kg for aluminum, a factor of 8 larger. Cans are not made from virgin stock but from stock with a considerable recycle content. The embodied energy of typical grades of can stock are about 18 MJ/kg for steel and 110 MJ/kg for aluminum, a factor of 6. Does this mean that the embodied energy of the two sorts of can differ by the same factor? The answer is no – a 5000-series aluminum 440 ml can weighs 13 grams; the equivalent steel can weighs 44 grams (Figure 4), so the embodied energies per can differ by much less – that of the aluminum can is just 1.7 times more than the steel one.

The forming energies to make the cans also differ. To make a valid comparison the CEO of Beneficial Brewing needs a Life Cycle Assessment (LCA) for the production of each type of can. A detailed LCA from 2002¹ reaches the conclusion that the differences both in energy and in carbon emissions for the two types of can are so small that, given the inherent uncertainty in all embodied energy data, the energies and carbon emissions of the two are not significantly different.



All information were found using the Materials data-table of the Sustainability database of the CES EduPack, which contains data for mechanical, thermal, and electrical properties for bio and oil-based polymers.

Legislation and Regulation. Much regulation, easily found in CES EduPack, now applies to packaging such as cans. The UK Packaging (Essential Requirements) Regulations of 2003 is typical. It applies to any company that makes, fills, sells or handles packaging. It aims to minimise waste and ensure that packaging can be reused, recovered or recycled. To comply, a producer must join a registered compliance scheme. The legislation applies equally to aluminium and steel cans.

¹ <http://www.apeal.org/uploads/Library/LCA%20study.pdf>

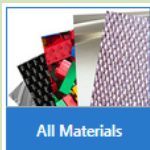


The Legislation data-table assembles information about material-related regulations, including that relating to packaging.

Economics. Can-grade steel costs about \$0.4/kg; so the material cost for 500 million steel cans is about \$8.8 million. Can-grade aluminum costs about \$1.7/kg, making the material cost for 500 million cans \$11.0 million. There could, therefore, be a possible saving of \$2.2 million in changing to steel.



Figure 4. 440 ml aluminum (left) and steel (right) cans



The Materials data-table contains data for the embodied energy, carbon footprint and typical recycled fraction in current supply of materials, including steel and aluminium alloys. The same data-table has data for material price.

Society. Are steel cans as acceptable to the beer drinking public as aluminum cans? Surveys suggest that most don't care, and the fact that the two competing brands pictured in Figure 4 use different can materials reinforces this perception.

4. Synthesis with the three Capitals

The CEO can now present the facts to the Brewery Board and initiate a discussion of their impact on the three capitals.

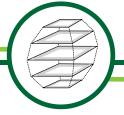


Natural capital. Contrary to the intuition of the shareholders, the facts suggest that the differences in embodied energy and carbon footprint of steel and aluminum cans are too small to be significant.

This is because of the high recycle content of can-stock, because aluminum cans are much lighter than those made of steel and because (according to the LCA) the deep-drawing of aluminum to make cans is less energy intensive than the equivalent process for steel. The supply chains for both metals are robust with no global or national shortages (indeed at the time of writing there is over-capacity). Beneficial Brewing requires only 1% of the can market and cans account for about 10% of the global aluminum consumption so the impact of material choice by Beneficial is very small.

Human capital. A can iswell....just a can. The material of which it is made carries no emotional, cultural or (since it is decorated) intrinsic aesthetic baggage that needs unpacking. No significant impact here.

Manufactured and financial capital. If the prices of steel and aluminum are directly reflected in can prices, a switch to steel could provide an annual saving of about \$2 million. At a (guessed) shipping price of 50¢ per filled can, Beneficial's revenue stream from beer is of order \$250 million, so this saving is about 0.8% of turnover. But against this must be set the cost of re-equipping the brewery's production line to deal with steel cans and the possible disruption of production while this happens. The CEO and the Board take the view that the risks exceed the benefits.

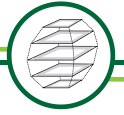


5. Reflection on alternatives

Is the shareholders' "articulation" a sustainable development or not? Taken together, the impacts on the three capitals suggest that it is not. But the shareholders are stakeholders with both interest and influence. Their views must be respected.



This is the moment to return to the Beneficial Brewery, pour a glass of beer, and ponder on alternatives – preferably those that do not require re-equipping the production line. The Prime Objective was to reduce depletion of natural capital associated with beer cans. Could aluminum cans be made thinner and thus less energy intensive? Aluminum can-makers have already thought of that. Increase the recovery of aluminum cans for recycling by charging a deposit? That will work only if it is mandated nation- or state-wide, something the brewery cannot do by itself. But the brewery could lobby for such legislation, thereby demonstrating to shareholders its commitment to the environment without the disruption of changing material.

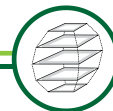


Related Projects

These projects draw on some of the information assembled in the Greener Beer Can analysis, but the prime objective, the stakeholders, the operating requirements and expectations of users are all significantly different.

PI. Glass or plastic? Oliver's Oriental Orange juice is marketed in glass bottles. Shareholders in the company point out that polyethylene bottles are much lighter; a switch from glass to PE would save energy in transport to market – on average 250 km from bottling plant to supermarket shelves – and contribute to the sustainability profile of the company. Explore this claim, using measurements from real supermarket orange juice for the bottle weight. The CES EduPack Eco-audit tool allows an analysis of the energies and carbon footprint of materials, processes and transport.





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 Presentation
- ▶ **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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