Total CO2/Environmental Footprint – Car Example

Design and Production	Operation	Recycling / Disposal

Design and Production

- Designing a car is a multi-billion business
- Production process
- Raw materials (steel, aluminum, etc)
- Half-product (paint, plastics)
- Components (seats, tires)

Operation

- Gallons of gasoline per mile
  - CO2 from burning gas
  - CO2 from producing and delivering gas to car
- Service
- Parts (tires, batteries)

Recycling / Disposal

- Recycling (steel, aluminum)
- Disposal (paint, battery, tires, plastic)

As Snow White's dilemma illustrated, it is important to consider all the dimension which may have an impact on the carbon footprint.

Hummer vs. Prius

Now, let's have a look at another popular consumer product: the automobile. The debate of what is the "better" car is often reduced to a single dimension, the miles-per-gallon number.

There are two major issues with this approach. There is an opinion piece[1] comparing the Hummer with the Prius which, while not scientifically investing the topic, certainly helps illustrating the issues.

Entire lifecycle

For a having meaningful comparisons of the environmental impact of products it is important to measure and aggregate the impact across the entire lifespan of goods and services. Important work has been done by William McDonough and Michael Braungart published in their book "Cradle to cradle"[2]

We see there three major phases:

- Design and production
- Operation
- Recycling and disposal

The car example shown above illustrates this nicely.

Global warming vs. other environmental impact

The other important issue is to not limit the view on CO_2 and Greenhouse gases. While it is useful to have the public debate focused on these parameters, it is important to look at all the parameters which have an environmental impact.

Proposed research

We intend to study the following problems in this context

- Software support for tracking environment impacting parameters
- A taxonomy for comparing different types of environmental parameters

[1] http://greenmesh.com/2007/03/unraveling_the_hummer_vs_prius.php
[2] http://www.mcdonough.com/cradle_to_cradle.htm

Average vs. dynamic
carbon label
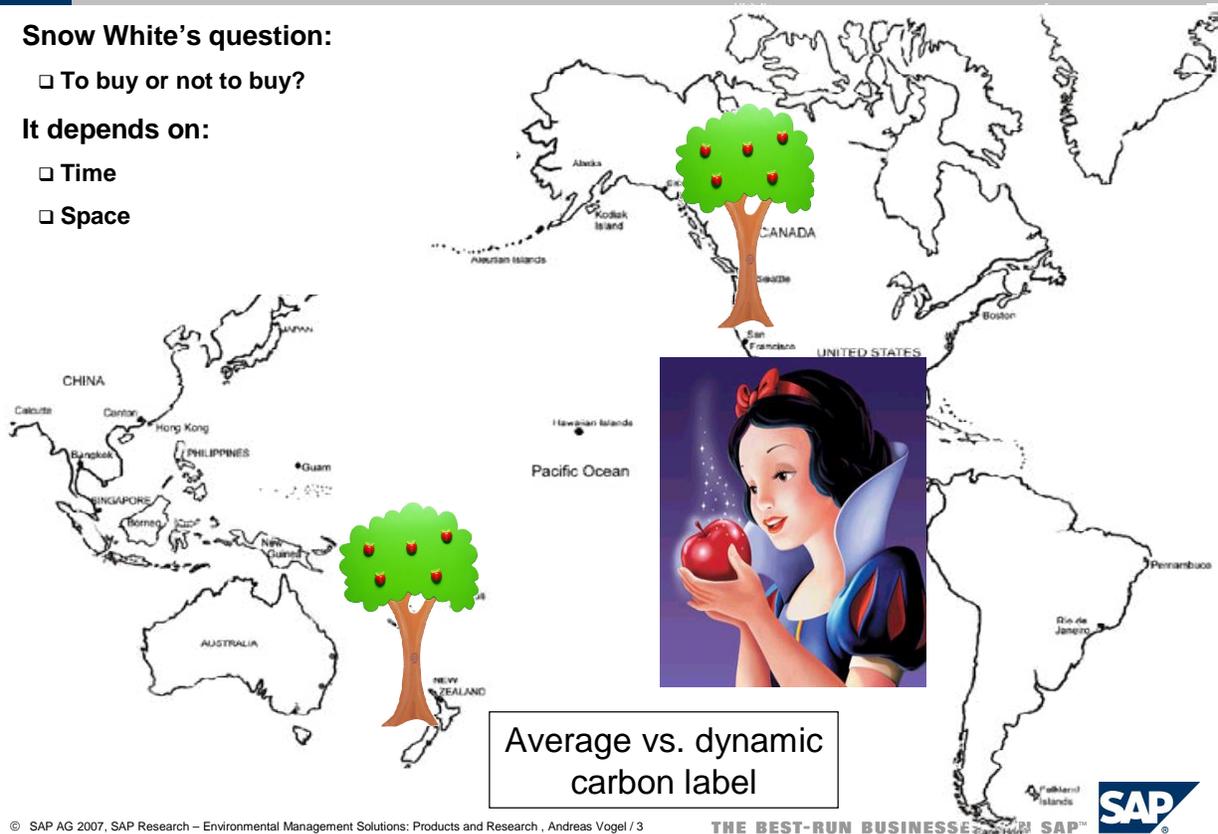
Snow White's Dilemma[1]

Snow White's dilemma illustrates the complexity of the carbon label concept. Snow White's problem is to choose between an apple grown locally (in California) and one from New Zealand from carbon footprint perspective.

Space dimensions

We assume that all parameters of the growing and harvesting the apples are the same in both locations. So the first and obvious differentiator is the space dimension. Shipping an apple from New Zealand to San Francisco has a larger carbon footprint than shipping one from a nearby orchard. So the decision seems to be clear.

Time dimension

Well, don't rush to the check-out line yet. There is also the time dimension to be considered. When do you buy the apple?

In the Northern hemisphere's fall, your local apple comes straight from the tree to the produce store's shelf.

But what happens when you buy the apple in the spring? Your local apple spend about half a year in a chilled warehouse and the air conditioning uses a lot of energy with it's (energy source depending) carbon footprint.

Spring would be of course fall in the Southern hemisphere and the apple would come straight from the tree on to the ship and from there to the store.

We know have the trade-off between the six month storage and thousands of miles transportation and the outcome isn't that clear anymore.

Conclusions

Don't buy apples in spring, buy seasonable local produce.

Carbon footprints of goods and services are complex and dynamic.

[1] The more dramatic dilemma involving an apple and a woman would be Eve's, but we felt it was unsuitable due its religious and sexual content and nudity

working with
the Carbon Trust
= 294g*
innocent
CO2

* mangoes & passion fruits 250ml smoothie

Problems encountered

- Accuracy of models and measurements
- Data aggregation across the supply chain

Tens of thousands of suppliers

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Retailers' rivalry

UK based retailer Tesco announced in early 2007 that it plans to put carbon labels on all its 70,000 food lines. Tesco is using a methodology called Life Cycle Analysis, putting a greenhouse gas cost on every element of a product's move from farm to plate.

Wal-Mart announced to assess and manage the energy footprint of its suppliers. It will be assisted by UK based Carbon Disclosure Project (CDP).

Mark&Spencer and other retailers made noise about similar activities.

UK based CarbonTrust has created a CarbonLabel[2] for publishing the CO_2 footprint of consumer goods.

Impossible dreams?

The company quickly realized that the stated goals were very ambitious and started to rethink their plans.

Problems encountered

Chris Goodall of the Carbon Commentary provides an excellent analysis[1] of the issues:

- Accuracy of models and measurements
- Data aggregation across the supply and delivery chain

Research proposal and SAP value add

The first type of problems are related to natural science and measurement methodologies and measurement equipments. SAP does not have expertise in this area.

Managing large amounts of data within companies and between companies is a core competency of SAP.

We plan to investigate how existing SAP technology, specifically Supply Chain Management and Product Lifecycle Management, can be applied to these problems and what modifications and extensions will be needed to handle environmental parameters.

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working with
the Carbon Trust

C 100g
CO2

Step 1	Analyse Internal Product Data
Step 2	Build Supply Chain Process Map
Step 3	Define Boundary Conditions and Identify Data Requirements
Step 4	Collect Primary and Secondary Data
Step 5	Calculate Carbon Emissions by Supply Chain Process Steps

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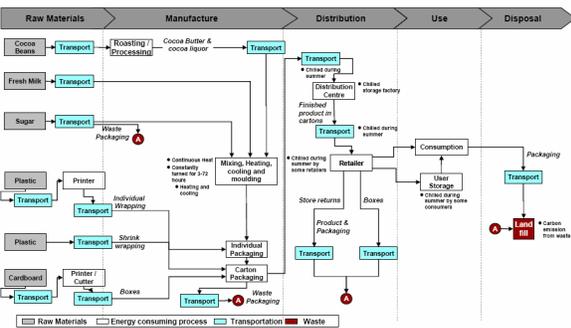
Assets

❑ Methodology
❑ Models
❑ Process maps

Proposed extensions

❑ Creating templates for industries and / or classes of products, e.g.
  ➢ Food products
  ➢ Drugs
  ➢ Motor vehicles
❑ Consider operational phase in selected industries (fuel and energy consuming products and services)
❑ Extend beyond carbon footprint, consider wider range of environmental parameters (other air and water emissions, heavy metals, recyclability, etc)
❑ Software tools for managing and analyzing process maps (across enterprise boundaries)

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CarbonTrust defines the baseline

UK based CarbonTrust has announced the creation of a CarbonLabel and has published the Carbon Footprint Measurement Methodology[1]. This paper sets the baseline for determining the carbon footprint of goods and service.

Specifically, the paper provides a five step methodology as shown above. The key tool for analyzing the footprint is the process map which identifies all the steps from raw materials to finished products and the associated carbon footprint of each step.

Opportunities to build on

The CarbonTrust methodology does not consider the operational phase of products due to differences in usage, e.g. bread vs. automobile, which would make it difficult to compare products of different characteristics.

We propose the introduction of templates for different classes of products (by industry). We expect a twofold benefit:

❑ A more detailed defined template supports the accuracy and auditability of the carbon footprint measurement and aggregation

❑ It enables the consideration of the operational phase for classes where it is appropriate and enables meaningful comparisons within these classes

Furthermore we would like to expand the methodology by tracking and aggregating other environmental parameters such as air and water emissions, heavy metals, recyclability.

Software Solutions

We are also interested in creating software tools for managing and analyzing process maps. A particular interesting aspect is the management of the process across enterprise boundaries.

On the one side we are investigating the retrofit of existing technology such as SCM[2] and PLM[3 for] such purposes. On the other side we are exploring the use of advanced, Web2.0 inspired collaboration technologies.

[1] http://www.carbon-label.co.uk/pdf/methodology_full.pdf
[2] Supply Chain Management
[3] Product Lifecycle Management

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