A Proposal on Reducing Total Energy consumption

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***Abstract*—At present businesses and individuals are not fully informed and don't understand about the carbon effects of their daily activities. In particular, there is no fully reliable methodology of carbon emission calculation. In addition, there are no clear guidelines on the allocation of responsibility for different types of emissions. In this paper we propose new research to tackle these two issues.**

***Keywords*-carbon emission calculation; methodology; responsibility.**

I. Challenge to Address

The adage says You cant manage what you cant measure and at the moment we cannot properly measure our energy consumption. We argue that the energy used by a business is the sum of three components:

- direct use, where energy is used explicitly to support a process, e.g. for heating a furnace or lighting a workbench;
- embodied use where energy has been used to create materials that are used in the process;
- and indirect use through activities that are needed to enable a process, but are not part of it (e.g., travel of business employees to their workplace, called 2nd order consumption here).

Today, direct consumption can be measured via various meters; embodied consumption is estimated using Life Cycle Assessments or Input/Output statistics or a combination of both [2], [1]. Embodied energy estimates are derived from these are rather broad averages, often inaccurate and based on static estimates using historical data; and 2nd order consumption cannot be accurately quantified.

We propose to:

1) Develop an accurate, context-specific methodology for data collection on embodied (e.g. was the iron used in the given process re-cycled/newly mined locally/or imported?) and 2nd order energy consumption.
2) Develop models to support process re-engineering using the obtained data.
3) 3) Conduct evaluation of the developed models with a case study from an industrial partner (or using the case of a local cement producing company).

In turn this will support detailed process reengineering to minimizes CO2 outputs throughout businesses.

II. Transformative Idea

The aim of this proposal, as discussed above, is to develop a methodology that ensures all three counterparts of energy and carbon are effectively considered. The transformative nature of this proposal is in presenting forecasts of energy use and CO2 emissions associated with a particular business processes. These forecasts will take into account direct, embodied, and 2nd order energy consumption.

Thus, the businesses and products could be truly energy/ CO2 efficient by design. For instance, if all businesses consider their total impact including the travel energy used by their employees, such needs/expenses will be reduced across society.

One intended outcome of the project is a collection of business process protocols for responsible energy utilization. This could potentially become an input into informing local/-national policy on this issue (as several influential industry participants are engaged in this project).

In addition, the understanding the issue of allocating responsibility for 2nd order energy consumption is not only a major challenge but also adventurous. While in some cases, such as internal business process design, it is clear who should accept the responsibility; in others it is uncertain (e.g., in case of employees travel to work who should shoulder responsibility for respective emissions - individuals, businesses, or governmental/legislative bodies?).

A. Innovative steps

We propose the following innovative steps:

- consideration of 2nd order energy use and carbon emissions, that are incurred as a result and throughout the lifetime of product/process use. To the best of our knowledge, this issue has not been researched previously;
- consideration of local/specialist factors in estimation of embodied energy used throughout business processes. Although several references of embodied energy calculation exist today, as noted in part B, they are

misrepresenting real facts. In addition, there is little, if at all, work on applying such indexes to business process improvement and product design;
- study of the responsibility allocation for reduction of 2nd order energy use/ CO2 emissions.

III. Impact of Proposal

The project will enable businesses/regulators/individuals to make a fully informed decision on business process design and transformation. For example, what alternative materials can be used for ice-cream manufacturing at a specific location? How will location of these ice-cream facilities affect energy use/CO2 emissions throughout their lifetime? Such a local example is that of Wallings Farm ice cream at Lancaster: what is the carbon impact of customers travelling to the farm shop located outside the city, would the overall carbon footprint reduce if shop was relocated in Lancaster?

In addition, we will research the responsibility allocation problem in tackling 2nd order energy consumption: whose responsibility is it to reduce use effects from products and related processes: business vs. individual vs. legislative vs. alternative (e.g., should it be up to business or individuals to minimize their energy use/ CO2 emissions in travelling to work?)?

References

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