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Towards Sustainable Production and Consumption: A Novel Decision-Support Framework Integrating Economic, Environmental and Social Sustainability (DESIREs)

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Abstract

The idea of sustainable production and consumption is becoming a widely-accepted societal goal worldwide. However, its implementation is slow and the world continues to speed down an unsustainable path. One of the difficulties is the sheer complexity of production and consumption systems that would need to be re-engineered in a more sustainable way as well as the number of sustainability constraints that have to be considered and satisfied simultaneously. This paper argues that bringing about sustainable production and consumption requires a systems approach underpinned by life cycle thinking as well as an integration of economic, environmental and social aspects. In an attempt to aid this process, a novel decision-support framework DESIREs has been developed comprising a suite of tools, including scenario analysis, life cycle costing, life cycle assessment, social sustainability assessment, system optimisation and multi-attribute decision analysis. An application of the framework is illustrated by a case study related energy.

Keywords: decision-support framework, energy, life cycle sustainability assessment, sustainable production and consumption, systems approach; system optimisation.

1. Introduction

It is becoming increasingly apparent that the lifestyles and practices of modern society cannot be sustained indefinitely, with growing scientific evidence showing that we are exceeding the Earth's capacity with respect to resource use and environmental pollution (IPCC, 2013; UNEP, 2012). One of the many challenges of moving towards sustainable production and consumption is finding out which options are sustainable and balancing a plethora of disparate economic, environmental and social aspects. The challenge is exacerbated by the complexity of production and consumption systems as well as a large number of different stakeholder groups, often with conflicting interests. It is also often unclear what sustainability criteria are relevant for which alternatives. An additional difficulty is related to the need to consider both quantitative and qualitative criteria, often based on imprecise (fuzzy) or subjective information. However, probably the greatest challenge is that sustainability problems are "wicked" problems which are intractable and highly resistant to resolution (Rittel and Webber, 1973; Azapagic and Perdan, 2014). Among other characteristics, wicked problems are typically ill-defined and have no well-described potential solutions. Examples of wicked problems include climate change, energy provision and waste disposal. Take, for instance, the issue of climate change: there is still no universal agreement about 'the problem' or 'the solution'. This is due to the problem being highly complex, involving various stakeholders from individuals to national government to international bodies with different perspectives and goals. Furthermore, as our knowledge about climate change develops, 'the problem' also changes. Various solutions to address the problem of climate change have been proposed but, as there is no possibility of testing them by trial and error, they may lead to unintended consequences (Azapagic and Perdan, 2014).

Different approaches have been proposed for dealing with "wicked" problems (e.g., Roberts, 2000; Brown et al., 2010). This paper argues that the best way is adopting a systems approach and considering simultaneously all three aspects of sustainable development - economic, environmental and social - on a life cycle basis. The main reason for this is that such an approach treats sustainability issues as complex systems, and instead of focusing just on 'cause and effect', recognises their complexity and interrelationships, acknowledging that technological solutions must be considered in a wider social, environmental, economic, regulatory, political and ethical framework (Azapagic and Perdan, 2014).

In an attempt to facilitate the process of better understanding and solving "wicked" sustainability problems and helping towards sustainable production and consumption, this paper proposes a decision-support framework which is underpinned by a systems, life cycle approach that integrates all three aspects of sustainable development. The

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