Editorial

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1 Introduction

The issue of climate change has been on the agenda among world leaders, governments, industry, research and community for a number of years and it is shaping as one of the main challenges of the 21st century. Today, climate change is coupled with the increasing consumption of natural resources by human race due to the world's population growth and improvement of living standards. Recent international meetings and initiatives have demonstrated that it has become harder to reach and implement international agreements on climate change mitigation (WEF, 2013). At the same time while there is no consensus on how fast and how much our climate is changing, there is a growing acceptance that some degree of climate change is inevitable and that climate change is increasing the likelihood and intensity of extreme events. With failing international effort and mitigation policies (Bošnjaković, 2012), the urgency of adaptation to climate change is increasing and many countries focus their effort on adaptation measures.

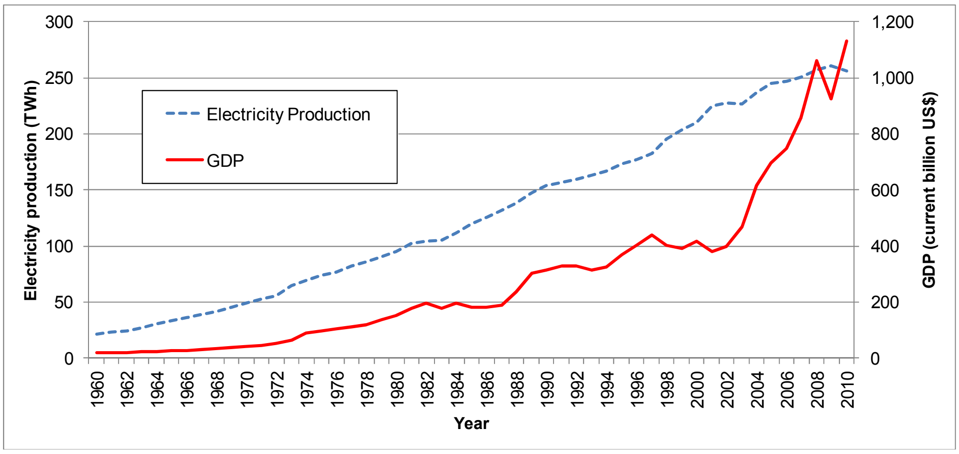
Since 1987 when the principles of sustainability were clearly spell out by the United Nations World Commission on Environment and Development (WCED, 1987), sustainable development is widely accepted as a key concept for the human future (Will, 2008). While the overarching principle of sustainable development is to meet human needs and at the same time to preserve the environment for future generations, it is worthwhile to list all critical objectives as they were specified by the WCED's report titled *Our Common Future* (WCED, 1987):

- reviving growth
- changing the quality of growth
- meeting essential needs for jobs, food, energy, water, and sanitation
- ensuring a sustainable level of population
- conserving and enhancing the resource base
- reorienting technology and managing risk
- merging environment and economics in decision making.

Since the time of the Brundtland Commission our concern for sustainable development has broadened to include deep cuts of greenhouse gas (GHG) emissions and step change improvements in resource efficiency, so the demands on innovation have become more profound and pervasive (Smith, 2010).

In particular, energy consumption, which on average contributes around 50% of the total GHG emissions, is becoming one the most critical sustainability issues that has significant social, environmental and technical impacts. There is a close relationship with positive feedback between energy consumption and economic development, which is demonstrated in Figure 1 for the case of electricity production and gross domestic product in Australia, based on data from World Bank (WB, 2012). Hence, it is important to carry out research that focuses on energy efficiency innovation and sustainable energy supply and use. Through their research and innovation effort, the authors of the papers in this special issue have contributed to sustainable development.

Figure 1 Annual electricity production and GDP for Australia (see online version for colours)



2 Papers contributing to this special issue

Jemala (2013) considers a hypothesis that the recent technology and economic development of a specific region and in a combination with a certain style of ecological policy and planning can partially affect regional environmental sustainability. The paper aims to study several key aspects of regional sustainability. It provides a comprehensive insight into environmental foresight projects all over the world and it outlines a methodology for identifying regional hot spots in terms of environment and sustainability. Foresight methods are intended to understand likely trends in society, technology, science and economy in the mid to long-term (Will, 2008) and can work at regional, national, sector, corporate or other levels. Foresights are not forecasting tools, instead they are more scenario building exercises related to strategy settings and planning. Contemporary forms of foresights were initiated more than 60 years ago by the US Department of Defence, which led to so called Delphi technique, developed by RAND Corporation (Will, 2008).

Adopting renewable energy resources is a key to achieving sustainability (Heydt et al., 2012). Many countries have accepted renewable energy targets, e.g., percentage of total electricity generation, say by 2020, to be provided by renewable generation such as wind, hydro, geothermal, solar and biomass. For example, Australia has committed to a 20% or 41 TWh renewable energy target by 2020 (CER, 2012). Many other countries around the world have adopted more or less ambitious targets. A major disadvantage of renewable energy resources such as wind and solar is their variable output or intermittence, which creates problems for reliable operation of electricity grids (Heydt et al., 2012), specifically at higher levels of penetration of renewable resources.

One way to mitigate the intermittence of renewable generation is to utilise energy storage systems (see Schaede et al., 2013). As the authors explain, energy storage systems can also be used in transportation and to smooth electricity consumption at the demand side, not only at the side of electricity generation. The focus of this paper is on a systematic methodology for specification, design and assessment of kinetic energy storage systems. The methodology aims to consider technical, economic and environmental issues of energy storage in an integrated way. Schaede et al. (2013) are trying to convince the reader that the development of efficient energy storage systems needs to address the specific requirements of the application area to be successful.

An innovative example of applying renewable energy resources in practice in combination with new materials is discussed in Gupta et al. (2013). This paper presents a study of a solar dryer for drying fruits, vegetable and other food products, integrated with phase-change material (PCM) storage. A mathematical model of heat and mass transfer in the material on the drying medium has been developed and solved. The PCM storage can help to smooth the temperature variations and sustain appropriate drying temperatures for longer. This aspect of temperature stabilising may prove to be important in low cost food preservation applications as the performance of solar driers is usually very temperature sensitive. Potential impact of this type of research is not only related to renewable energy use and innovative application of PCM, but also to food preservation, which is another important sustainability issue.

Kampanartkosol's paper (2013) is a good example of a possible adaptation strategy to reduce the impact of potential future flooding events in the Bangkok region. This paper studies the flooding event in Thailand in 2011, which caused an estimated economic loss of US$30 billion (WEF, 2013) and analyses the possibility of creating new flood preventing infrastructure in Bangkok. Adaptation to climate change and variability is an alternative and complementary response to 'mitigation' – a policy response aiming to reduce GHG emissions (Smit et al., 2000). The meaning of 'mitigation' is to abate, moderate or alleviate GHG levels, while the meaning of 'adaptation' is to alter, adjust or modify activities in the socio-economic environment related to GHG emissions and climate change. Adaptation is a set of responses to actual or expected climatic stimuli and their impacts (Smit et al., 2000). Adaptation can be characterised by answering the following four questions:

- Adaptation to what?
- Who or what adapts?
- How does adaptation occur?
- How good is the adaptation?

Mo and Sen (2013) describe a demonstration project, which investigates how new solid state lighting based on LED technologies could be used to provide a cost effective sustainable solution for lighting of existing rooms and buildings. They describe a retrofitting of a lighting system in a university meeting room with DC electronics and LED luminaries. In preparing an efficient design for the new system, detailed monitoring of the required energy is performed and the data is carefully analysed. The complete retrofit solution for the existing lighting system including light fixtures, switchgear and lighting circuits with dimming options produced very encouraging outcomes with energy savings in the order of 65%. Another important aspect of this retrofitting project is that there was virtually no re-wiring in the process so the refurbishment work was done with minimal disruption to the operation of the meeting room and other facilities in the building and in a short period of time. A key message from a recent comprehensive study is that retrofitting to high energy efficiency standards is possible and often environmentally desirable (GEA, 2012). For example, a holistic retrofit (not step-wise) can achieve 50-90% final energy savings in existing buildings.

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