



Cleaner energy for sustainable future

Vincenzo Giorgio Dovì^{a,*}, Ferenc Friedler^b, Donald Huisingh^c, Jiří Jaromír Klemesš^d

^a DICheP, Università di Genova, Dipartimento di Ingegneria Chimica e di Processo, via Opera Pia 15, 16145 Genova, Italy

^b Department of Computer Science, Faculty of Information Technology, University of Pannonia, Egyetem u. 10, 8200 Veszprém, Hungary

^c The Institute for a Secure and Sustainable Environment, University of Tennessee, Knoxville, 311 Conference Center Building, Knoxville, TN 37996-4134, USA

^d EC Marie Curie Chair (EXC) "INEMAGLOW", Research Institute of Chemical and Process Engineering, FIT, University of Pannonia, Egyetem u. 10, 8200 Veszprém, Hungary

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ABSTRACT

This special issue of the *Journal of Cleaner Production* focuses on "Energy for Sustainable Future". It is designed to mirror the increasing relevance of renewable energy sources and improved efficiency as crucial topics for practitioners in industry, for governmental policy makers, as well as for civic service providers, researchers, and educators. The purpose of this special issue is to serve as a catalyst for dialogue. The global warming related to CO₂ emissions, coupled with steeply rising energy prices and the recent global financial institutional melt-down are causing massive societal concerns and give rise to increasing demand for ways to improve societal and individual energy efficiency and for ways to shift increasingly to alternative, low or non-carbon based energy systems.

Until recently, industrial energy efficiency improvements have focused on improvements on efficiency rather than on the integration of renewable sources. The aim of this special issue is the identification of policies to support the development and implementation of technologies and management approaches we can employ to make the transition to more sustainable societies. The collection of papers in this special issue provide a foundation for students, researchers, scholars, practitioners and policy makers interested in making sustainable development more than a metaphor.

The papers include focus upon ways for:

- Improving industrial process to achieve improvements in energy efficiency.
- Minimising waste disposals and reducing their impact through better management.
- Reducing CO₂ emissions by making progress toward lower carbon, renewable energy based systems,
- Improving production of biofuels and hydrogen production systems, facilitated by employing cleaner production and novel LCA tools.
- Improving integration of advanced materials and energy efficient equipment in different industrial sectors.

Current and future developments in national and world economies are closely connected to sustainable, efficient and safe usage of raw materials and upon energy based on cleaner production concepts and approaches that are ecologically and economically appropriate for the short and for the long-term future of society.

These challenges have received considerable attention in the media and scientific journals over the last several years. The idea of developing a specialised conference focussed upon them was put forward on various occasions. Focus upon them became reality on the 5th and 6th May 2008 in the historic Castle of Veszprém, Hungary, the current premises of the Hungarian Academy of Science which hosted the Workshop.

The Workshop was a stimulating event and an overwhelming success, with nearly 100 contributors from Africa, North America, Asia and Europe, representing 28 countries. After a comprehensive selection and thorough reviewing procedure 11 papers were selected for this special issue.

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* Corresponding author. Tel.: +39 10 353 2927; fax: +39 10 35 32586.

E-mail addresses: dovi@istic.unige.it (V.G. Dovì), friedler@dcs.vein.hu (F. Friedler), DonaldHuisingh@ln.utk.edu (D. Huisingh), klemes@cpi.uni-pannon.hu (J.J. Klemesš).

1. Introduction

The development and application of cleaner environmental technologies offer multiple benefits such as: reduced emissions, less waste and cost savings from reduced energy & resource use during production as well as due to improved systems of recycling and waste management. Many participants were concerned that cleaner technologies and cleaner production, in general are diffusing comparatively slowly, in spite of the great benefits that have been documented in systems that have implemented them.

There are numerous questions to be answered. In this special issue, the following issues are addressed:

- (i) Is wide-spread application of biofuels thermodynamically sensible and can it really lead to progress toward sustainable societies?
- (ii) What is the potential of the application of the environmental performance strategy map: an integrated LCA approach to support the strategic decision making process for cleaner production?
- (iii) What potential can the new EU supported energy efficient technologies tool EMINENT offer in comparison with other energy technology assessment tools?
- (iv) How can new reliability, availability and maintenance software tools contribute to improved and more efficient waste and emissions minimisation?
- (v) What can/should be done to accelerate the implementation of novel, SuperSmart Grid system technologies designed to manage the collection of renewably produced electricity from multiple, decentralised sources, and its safe and efficient transmission over long distances?
- (vi) What are key advances in 'waste to energy,' technologies and what is their place in perusing the transition to sustainable regions?
- (vii) How can the 'pinch analysis,' energy saving methodology that has been applied to total sites [1] and industrial, civic and agriculture sectors [2] be used for carbon-constrained planning for sustainable power generation?
- (viii) How can improved heat storage provide a cleaner and economically more sound option for the minimisation of energy use in multipurpose batch plants?
- (ix) What cleaner production and energy efficiency improvements can be achieved by using improved 'plate heat exchangers' in phosphoric acid production?
- (x) What are the most economical raw materials for fermentative hydrogen production and how clean are these processes?
- (xi) Industrially, how widely applicable is the novel, non-equilibrium – biosorption column modelling on porosity effects?

A selection of papers presented at the conference was performed to provide suggestions and answers to these and related questions in this special issue.

At the start of the 21st century, rising energy costs coupled with increasing concerns about global warming related to CO₂ emissions, resulted in increasing interest in alternative, low and non-carbon based energy sources. In addition, there has been renewed interest in energy efficiency improvement methods compared to only a few years ago when energy was relatively inexpensive and abundant. Although, some small scale renewable energy systems have been developed to help satisfy industrial and municipal heating and cooling demands, most such efforts have been focused on individual family dwellings.

Improving energy use efficiency is becoming increasingly important for combating rising energy costs and for fulfilling carbon emission tariffs in the industrial sector. Additionally there is

increasing interest in improving energy use efficiency in the domestic sector, with most investments on insulation, energy efficient lighting, and energy efficient appliances. Although these efforts are helping societies to make slow progress towards a lower level of carbon based energy use and consequently to some reductions of CO₂ emissions, there has been little effort at systematic planning for producing an integrated energy system that includes industrial and domestic supply and demand. The design and implementation of combined energy systems for industrial, business and residential buildings has been limited to a few, isolated cases in which systematic design techniques were employed to produce a symbiotic energy grid system. One of the articles in this special issue addresses these challenges and opportunities.

2. Research opportunities highlighted in this special issue

Although there are several renewable energy sources that can provide individual family heating and cooling, and thus reducing the level of greenhouse gas emissions in comparison with fossil fuel based systems, the focus of this special issue is on sources that have been demonstrated or are operational on a regional scale. Domestic and industrial solid waste, after the recyclables have been removed, can be used as a valuable source of electricity and heat energy via CHP systems. The example of energy from sludges and solid waste demonstrates this. The CHP options, although not new are significant in multiple ways. Because in many cases waste contains a considerable proportion of biomass the use of waste helps society to reduce its greenhouse gas emissions due to reduction in usage of carbon based fuels.

A brief overview of keywords of the articles in this special issue, provides an overview of the topics addressed:

2.1. Energy/heat/power/electricity

Sustainable energy [3], energy efficiency [4], energy technologies [5], energy models [5], renewable electricity [6], electricity networks [6], waste to energy [7,8], power sector planning [9], clean electricity [9], heat integration [9], energy saving retrofit [10], heat recovery [10].

2.2. Cleaner production/LCA/sustainability/waste/CO₂

LCA [4], sustainable environmental performance [4], footprints [4], environmental burden reduction [4], early stage technologies [5], Smartgrid [6], SuperSmart Grid [6], thermal waste treatment [7], waste treatment technologies [7], carbon capture and storage [9], carbon footprint [9], CO₂ capture and sequestration [9], cleaner production [10].

2.3. Biofuels/hydrogen

Biofuels [3], biomass [3], hydrogen [12], hydrogen fermentation [12], biomass utilisation [12], biosorption column [13].

2.4. Production, industrial plants and advanced processing equipment

Supergrid [6], plate heat exchangers [11], phosphoric acid production [11], hydrogen fermentation [12], biosorption column [13].

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