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DUBROVNIK CONFERENCE ON

**SUSTAINABLE DEVELOPMENT
OF
ENERGY, WATER AND ENVIRONMENT SYSTEMS**

June 2-7 2002, Dubrovnik, Croatia



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Conference venue: Dubrovnik

*"Those who seek paradise on Earth
should come to Dubrovnik and see Dubrovnik."*

(George Bernard Shaw).

Dubrovnik is situated in the southernmost part of the Republic of Croatia. Founded in the 7th century, Dubrovnik is rich with cultural and historical monuments and is included in the UNESCO World Heritage list. The city is surrounded with the walls built between the 11th and 17th century. Its cultural and scientific institutions include Museum at Rector's Palace, Cathedral Treasury, Pinacotheca, Franciscan monastery and cloister, with one of three oldest pharmacies in Europe (14th c.), the Cathedral (initial funds given by King Richard the Lionheart), one of the European oldest Synagogues, Marin Držić Theatre, Dubrovnik Symphony Orchestra, Interuniversity Center. Nature lovers can find here true Mediterranean landscape, and "enjoy the cleanest sea in the Mediterranean" (Jean Jacques Cousteau). Dubrovnik International Airport is situated 22 km from the city center.



Scope and Objectives

Throughout history Dubrovnik has been the place where prominent individuals and luminaries in different fields have come to exchange ideas, money, and merchandise. In modern times, it has hosted many distinguished guests attending different gatherings. In particular in the field of energy and environment, Dubrovnik has become known as a center of excellence and its many Conferences have produced new ideas and scientific, as well as technological, breakthroughs. The "Dubrovnik Conference on Sustainable Development of Energy, Water, and Environment Systems" is devoted to the ultimate goal of modern society: sustainable development of energy, water and environment systems.

Energy, water and environment are commodities essential for continuous development of human society. The concept of "sustainable resource use" is a challenge that we must meet, if the present development of modern society is not to compromise the rights of future generations to natural resources. The Conference will focus on the following objectives:

- a. To discuss sustainability concept of energy, water and environment and its relation to the global development
- b. To analyze potential scientific and technological processes reflecting energy, water and environment exchange
- c. To present energy, water and environment system models and their evaluation
- d. To present multi criteria assessment of energy, water and environment systems taking into a consideration economic, social, environmental and resource use aspects.

Conference Programme

Hall A		Hall B	
Monday, June 3.			
9:00 - 9:30	Opening ceremony		
9:30 - 10:30	Lecture, Sustainability Concept, N. Afgan, Instituto Superior Técnico, Lisbon, Portugal		
10:30 - 11:00		Coffee break	
11:00 - 13:00	Sustainability Concept 1	11:00 - 13:00	Sustainable Development of Environment Systems 1
13:00 - 15:00		Lunch break	
15:00 - 16:00	Lecture, The Innovation Process in the Energy Field, R. Vidil, CEA, Grenoble, France		
16:00 - 16:30		Coffee break	
16:30 - 19:00	Sustainability Concept 2	16:30 - 19:00	Sustainable Development of Environment Systems 2
Tuesday, June 4.			
8:30 - 9:30	Lecture, New and Renewable Energy Systems, M.G. Carvalho, Instituto Superior Técnico, Lisbon, Portugal		
9:30 - 10:00		Coffee break	
10:00 - 13:00	Sustainability Development of Water Systems 1	10:00 - 13:00	Thermo-economic Analysis of Energy, Water and Environment Systems 1
13:00 - 15:00		Lunch break	
15:00 - 16:00	Lecture, Water Demand and Water Desalination Technologies, N. Lior, University of Pennsylvania, USA		
16:00 - 16:30		Coffee break	
16:30 - 19:00	Sustainability Development of Water Systems 2	16:30 - 19:00	Thermo-economic Analysis of Energy, Water and Environment Systems 2

Hall A	Hall B		
Wednesday, June 5.			
8:30 - 12:00	<p>Panel: Sustainable Development of Energy, Water and Environment</p> <p>The Club of Rome 1972 Scenario Revisited, R.Blinc, Slovenia, Round Table Intervention</p> <p>L.Serra, Spain</p> <p>M. Darwish, Kuwait</p> <p>Oil for Water, Water for Oil, K. Brendow, Switzerland, Round Table Intervention</p> <p>Globalisation and Sustainability Development, I.Slaus, Croatia, Round Table Intervention</p> <p>Round Table Moderator, N.Afgan, Portugal</p>		
12:00 - 15:00	Lunch break		
Thursday, June 6.			
8:30 - 9:30	Lecture, Dynamic Simulation of Pollutant Dispersion over Complex Urban Terrains: a Role for Sustainable Development, Control and Management, K. Hanjalic, University of Delft, The Netherlands		
9:30 - 10:00	Coffee break		
10:00 - 13:00	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Modelling and Simulation of Energy, Water and Environment Systems 1</td> <td style="width: 50%; background-color: #e0e0e0;">10:00 - 13:00 Sustainability Related Research in Fundamental Sciences 1</td> </tr> </table>	Modelling and Simulation of Energy, Water and Environment Systems 1	10:00 - 13:00 Sustainability Related Research in Fundamental Sciences 1
Modelling and Simulation of Energy, Water and Environment Systems 1	10:00 - 13:00 Sustainability Related Research in Fundamental Sciences 1		
13:00 - 15:00	Lunch break		
15:00 - 16:00	Lecture, The World Renewable Water Resources and Ice Sheets, L. Serra, University of Zaragoza, Zaragoza, Spain		
16:00 - 16:30	Coffee break		
16:30 - 19:00	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Modeling and Simulation of Energy, Water and Environment Systems 2</td> <td style="width: 50%; background-color: #e0e0e0;">16:30 - 19:00 Sustainability Related Research in Fundamental Sciences 2</td> </tr> </table>	Modeling and Simulation of Energy, Water and Environment Systems 2	16:30 - 19:00 Sustainability Related Research in Fundamental Sciences 2
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Friday, June 7.			
10:00 - 13:00	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Sustainability Assessment Methods</td> <td style="width: 50%; background-color: #e0e0e0;">10:00 - 13:00 New and Renewable Energy Sources for Water and Environment Sustainable Development 1</td> </tr> </table>	Sustainability Assessment Methods	10:00 - 13:00 New and Renewable Energy Sources for Water and Environment Sustainable Development 1
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**To this Book of Abstracts a CD Proceedings is enclosed,
containing all the papers mentioned in full.**

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Sustainability Concept

Naim H.Afgan, FIAS
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ABSTRACT

This review is aimed to introduce historical background for the sustainability concept development. Special reference is given to the resource depletion and its forecast. In the assessment of global energy, water and environment resources attention is focussed in on the resource consumption and its relevancy to the future demand. In the review of the sustainability concept development special emphasize is devoted to the definition of sustainability and its relevancy to the historical background of the sustainability idea. The recent assessment of sustainability is reflecting the normative and strategic dimension of sustainability.

Special attention is devoted to the most recent development of the concept of sustainability science. A new field of sustainability science emerging that seeks to understand the fundamental character of interactions between nature and society. Such an understanding must encompass the interaction of global processes with the ecological and so characteristics of particular places and sectors.. With a view toward promoting research necessary to achieve such advances, it was proposed an initial set of core questions for sustainability science.

The definition of sustainability concept involves an important transformation and extension of the ecologically-based concept of physical sustainability to the social and economic context of development. Thus, terms of sustainability cannot exclusively be defined from an environmental point of view or basis of attitudes. Rather, the challenge is to define operational and consistent terms of sustainability from an integrated social, ecological, and economic system perspective. In this respect the weak and strong sustainability concept are discussed.

In order to introduce measuring of sustainability the attention is devoted to the definition of respective criteria. There have been a number of attempts to define the criterions for the assessment of the sustainability of the market products. Having those criterions as bases, it was introduced a specific application in the energy system design. Measuring sustainability is a major issue as well as a driving force of the discussion on sustainability development.

Special attention in this review is devoted to the potential sustainable development options. In this respect a following options are taken into a consideration: prevention of the energy resource depletion with scarcity index control; efficiency assessment;; new and renewable energy sources; water pollution mitigation, water desalination technologies environment capacity for combustion products; mitigation of nuclear treat to the environment

The Innovation Process in the Energy Field

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ABSTRACT

Part 1 : Introduction. Representation of the energetic system and typology of different innovations

The first part of this paper reminds of the energy rational use context. What is the representation of the energetic system and what are the different scientific disciplines in which knowledges to make progress are required ? The typology of the innovations (incremental, major and radical) in the energy field is described as well as some specific examples of the French and European context : refrigeration equipments , fuel cells and hydrogen , compact heat exchangers,.. Three different examples are then described in more details in this paper.

Part 2 : An incremental innovation of year 90 in the industrial thermal equipments : compact heat exchangers
This second part of the paper describes the different industrial sectors, in which thermal equipments play an important part. More generally, it concerns the industrial sectors associated to the rational use of energy . Markets in electric and non electric areas are recalled as well as the position of the European and French heat exchanger industries.

The main innovation described concerns compact heat exchangers : what are the main innovative technology stakes from an economic, environmental and energetic point of view . How the different actors of industry have tried to use this technology . How did research laboratories people use experimental and numerical approaches in order to improve the technology of compact HE

Part 3 : A generic technology in a great number of different industrial sectors : the equipments for refrigeration production

We describe in this part of the paper the different applications of the refrigeration in terms of technology and market evolution. The energetic efficiency in this refrigeration sector is one of the major stakes for the future as well as the reglementation of therefrigerants. We remind of the problematic of the ozone layer destruction and of the reduction of the emissions of the greenhouse gases in order to show the direct and indirect effects of the refrigeration equipments.

The major innovations of these recent years concern new refrigerants, compressors, heat exchangers and complete refrigeration systems. Different examples of innovation are described in details as well as the technological researchs in progress, which are dedicated to answer to the energetic stakes for tomorrow.

Part 4 : To morrow ? A radical innovation in the production of energy : fuel cells and hydrogen

The last part of the paper described the production of non centralized energy : what are the different technologies and the power associated.

What is the social demand, what is the economic maturity and what is the price for these different alternatives

The fuel cells and hydrogen are one of the radical innovation for the future . We describe in details the fuel cell network starting in 99 and supported by the French government. We give illustrations of the potential markets for the three applications : transportation, telephon and domestic production . In each case, we identify the technological ruptures and the main actors (Industry and research laboratories) who can contribute to the emergency of this new technology.

New and Renewable Energy Sources for Sustainable Communities

Maria da Graça Carvalho, Gonçalo Gonçalves and Luís Alves
Instituto Superior Técnico, Portugal

ABSTRACT

The objective of this presentation is to demonstrate the possibility at reasonable cost to make RES decentralized generation the main energy source to satisfy the needs of a community. A community is a group of people living and/or working in a limited area. For this presentation three different types of communities are considered: islands, isolated rural areas, and non-isolated urban areas. Examples of implemented activities and ongoing projects are presented: (1) an action in Cabo Verde Islands which analyzed most important blocking factors for RES integration, evaluated the RES potential and identified a framework for the introduction of innovative EU technologies in the country; (2) a pilot scale installation at Porto Santo Island, aiming mainly at increasing the market penetration of new energy systems combining fuel cell, renewable energy sources and hydrogen to boost intermittent renewable energy supply and innovative decentralized power system in a small grid; (3) a demonstration project for the integration of self supply into end use for sustainable tourism, where a sustainable community is created in a new hotel resort and marina to be built in a remote area of the east coast of Madeira Island, through the implementation of an integrated efficient energy system (integration of renewables and fuel cell) and water production and management system (renewables for water desalination and wastewater treatment and recycling, rainwater catchment), waste management and mobility plan; (4) demonstration project to integrate RES (solar, wind, biomass) and new (fuel cell, hydrogen) innovative technologies in rural tourism in Alentejo; (5) demonstration activities to integrate renewable (solar) and new (gas, hydrogen) sources of energy in new buildings at Tagus Parque in Oeiras and at Madeira Tecnopolo in Madeira Island.

Water Demand and Water Desalination Technologies

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ABSTRACT

Rising population, standards of living and water pollution are gradually diminishing the amounts of naturally available fresh water of good quality while the demand is increasing relentlessly. Water consumption and its trends are reviewed. Without any real growth of available water resources "Manufactured water," in the form of water recycling (reuse) and desalination is today making a considerable contribution to the world's potable water supply as well as water for industry, ranging from boiler feedwater for the power industry to ultra-pure water for the electronics industry. Some desalinated water is also used in agriculture but to a limited extent because of cost. The technology is improving both in cost-performance and reliability, as evidenced not only by the rapid growth in worldwide desalination capacity, but also by the encouraging observation that costs of desalted water have remained the same despite inflation. The commercial and promising desalination processes, and their typical costs and energy consumption, are described

Much progress has been made in desalination technology, but all desalination processes remain energy-intensive. Though energy costs have prompted the consideration of renewable energy resources as sources for desalination, these sources are unlikely to become significant in the near future, except in certain limited circumstances, unless there are significant unforeseen breakthroughs in either energy conversion or desalination technologies.

Despite the cost of desalination technology, it has made water available in places where it was not before. Not only has water become available in these places, but the quantities available have also opened prospects for industrial development. This has led to important improvements in the standard of living with prospects for even further improvements in countries fortunate enough to afford the technology.

Dynamic Simulation of Pollutant Dispersion over Complex Urban Terrains: a Tool for Sustainable Development, Control and Management

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ABSTRACT

We present computer simulation and animations of diurnal air movement and pollutant dispersion over complex terrain with heat and emission islands. The method, based on numerical solution of momentum, energy and concentration equations in time and space using an algebraic turbulence closure for subscale (unresolved) motion, can account for terrain topography and dynamics of meteorological synoptic conditions. The case study presented is a realistic scenario over a medium sized town situated in a mountain valley during windless winter days when the lower atmosphere is capped by an inversion layer preventing any escape of pollutants. The air movement and pollutant dispersion are governed primarily by the day ground heating and night cooling and by the terrain configuration. The results include the predictions of local values (and their time and space variation) of air velocity, temperature and pollutant concentration. The approach can be used for regulation of emission during critical weather periods, as well as for long-term planning of urban and industrial development, for optimum location of industrial zones and for design of city transportation and traffic systems.

The World's Renewable Water Resources and Ice Sheets

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ABSTRACT

A thermodynamic approach is proposed to measure the physical value of the world's renewable water resources and Antarctica and Greenland ice sheets. This involves the Exergy Replacement Cost, defined as the energy required by the best available technologies to return a resource to the same conditions as it was delivered by the ecosystem(s). The replacement cost of the world's renewable water resources varies between a minimum of 3,592 Mtoe/year and a reasonable value of 53,304 Mtoe/year. Thus, each year we would need between 0.4 to 6.4 times more fossil energy than consumed in 1997, to replace only part of the functions of the hydrological cycle. In the case of ice sheets, its minimum physical replacement cost is $3.840E+08$ Mtoe, being the actual exergy replacement cost near of 20 times higher, that is $7.210E+09$ Mtoe. If all existing ice sheets melted, the required exergy for recover them in the same conditions that are now in nature would be around 9,000 times greater than the total amount of fossil fuels reserves in the Earth. Accordingly, Earth's ice sheets correspond to our most important global exergy reserve.

Round Table Intervention

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L.Serra, Spain

M. Darwish, Kuwait

The Club of Rome 1972 Scenario Revisited

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ABSTRACT

A critical discussion of the Club of Rome 1972 Scenario “Limits to Growth” is presented in the light of the new indicators and data from the 2001 Club of Rome meeting in Valdivia, Chile. The new energy and material resources which have been discovered and the new technologies introduced into practice result in a significant shift of the time scale of certain scenarios, but do not qualitatively alter the predictions of the model. It is stressed that an extrapolation of the present data shows that there will be not enough food produced to feed the increased world population (8.5-10 billion) in 2050 at a socially acceptable level. The necessary increase in food production cannot be achieved with the present technologies without critically damaging water supply and environment.

We also investigate the question how the world is likely to look like in 2050 if the present trends persist. What can science and technology do to alter the current trends?

It is also pointed out that though the world is not running out of energy as yet it is running out of cheap oil, environmental carrying capacity and time for the discovery of new technologies and a smooth transition to better governance. Most important the world is running out of tolerance for inequity, which may speed up some of the more catastrophic scenarios.

Oil for Water, Water for Oil

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ABSTRACT

Are oil export revenues of Middle East oil producers sufficient to finance the rising needs of population for water in that region up to 2020 and 2050? In a business-as-usual scenario funds from oil (and gas) exports would suffice, but in an ecologically constrained scenario financing of both hydrocarbon development and water supply would be tight. In any case, related business opportunities would foster interdependence and diversification of trade between oil-poor but water-rich Europe and oil-rich but water-poor Middle which so far is too much based on one trade commodity - oil.

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Sustainable Energy Path

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ABSTRACT

Fossil fuel, being consumed on a large scale by industrial countries, will make problems of global warming as well as resource exhaustion. Therefore, the world started measures to reduce CO₂ emissions and to promote renewable energy. It is difficult to reduce fossil fuel consumption and CO₂ emissions drastically in the near future. However, we must achieve sustainable energy systems without fossil fuel and CO₂ emissions in the distant future. The purposes of this study are to prospect energy systems in the long future and to find a path toward the sustainable energy systems. In order to realise the purposes we develop a global land use and energy model (GLUE). GLUE consists of a land use part and an energy part. The land use part evaluates supply potentials of bioenergy and photovoltaic cells considering land use competitions, biomass supply and demand, and biomass chains. The energy part minimises the costs of the whole energy systems and describes the shape of the energy systems and the contributions of renewable energy and innovative energy technologies. Using the model, we evaluated the energy systems until 2200 and show the sustainable energy path quantitatively. In addition we evaluate the key technologies and the system costs to achieve the sustainable energy systems.

Improving the Sustainability of Complex Energy Systems by Increasing the Hydro/Coal Ratio

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ABSTRACT

The present share of energy sector in the emissions of environmental pollutants in R. Macedonia is by far the largest one (e.g. for greenhouse gases it amounts over 80%, the rest being sheared almost equally by industrial processes, waste and agriculture). Within the energy sector, the contribution of power generation to polluting emissions is prevailing (about 73% for GHG emissions, while heat and transport cover 17% and 10%, respectively). The main reason for this situation is the domination of coal, which is the sole indigenous fossil resource.

In this paper, some solutions for effective abatement of environmental impacts from the power generation are proposed, accounting simultaneously for economic indicators and technological limitations.

In particular, techno-economic enhancements of new hydroplants are defined, thus considerably reducing the pollutants from other types of power plants. Besides the environmental benefits, the improvement of efficiency in national hydropotential use by transforming some projected plants from classical into pump-storage, brings their optimal introduction from the end to the first half of the study period. In this way, the share of coal for power generation is decreased, and the introduction of gas fired plants in the national power system is postponed for a few years compared to the base case with classical hydroplants; at the same time the need for nuclear power is shifted beyond the year 2020.

As an example, a detailed analysis of the present situation (baseline scenario) is performed, and an optimal possibility (mitigation scenario) for the abatement of specific GHG emissions in the development of national power system during 2001-2020-2030 is presented.

For the period 2001-2020 the mitigation scenario implies 3,370 kt less emissions, but it is 20.26 million dollars more expensive than the baseline scenario, resulting in the abatement cost of 6.01 \$/t CO₂-eq. which is still acceptable. On the other hand, comparing the two scenarios over a longer term (2001-2030), when contribution of the new hydro plants is piling up and their investment costs become valorized in a longer period, the mitigation scenario implies 6,491 kt less emissions and is even 81.79 million dollars cheaper than the baseline scenario. In this case the abatement cost becomes negative (-12.06 \$/t CO₂-eq), being actually transformed into benefit.

Implementation of the EU Legislation on Romanian National Electricity Industry

Romanian Legislation: Achievements and Shortcomings

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ABSTRACT

Romania still has a long way to go before being in line with the EU provisions in the field of environmental policy: the overall level of transposition and implementation of the environmental ‘acquis communautaire’ still needs further developments.

Romania has drawn up directive specific approximation and implementation programmes for all main sectors (excluding noise). Progress can also be noted with regard to transposition programmes where new legislation has been adopted. Important steps have been also made towards the preparation of framework legislation for air, waste, water quality and industrial pollution. Romania has also made progress with the transposition of the Environmental Impact Assessment Directive. However, these positive developments need to be materialized through a realistic plan for financing investments and through an increased environmental administration capacity to enforce recently passed legislation.

The paper aims to present (1) the main Romanian pieces of legislation regarding the interaction between energy conversion technologies and environment; (2) the evolution trends of the environment pollution generated by thermal power units; (3) the difficulties encountered in the process of alignment to the EU provisions.

Sanitary Solids: Assessing the Relative Sustainability of Management Solutions Using Multi-Criteria Analysis

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ABSTRACT

The SWARD (Sustainable Water industry Asset Resource Decisions) project has developed a set of decision support processes (DSP) to assist Water Service Providers (WSPs) to assess the relative sustainability of water/wastewater system asset development decisions. The selection of criteria, data assembly and the use of multi-criteria analysis (MCA) and other techniques to assess the relative sustainability of different options under consideration are presented in the SWARD Guidebook. Several demonstration case studies are also included in this Guidebook. One of the major case studies is that of gross sanitary waste (SW) disposal via the WC, a practice commonly undertaken in Western Europe. It has been estimated that 2.5 million tampons, 1.4 million sanitary towels and 700,000 panty liners are disposed of in this manner every day in the UK. This method of disposal causes major problems for the operators of UK wastewater systems (e.g. blockages, deposition and sludge disposal problems) and leads to significant impacts on the environment via overflow discharges and 'escape' through screens. A case study has investigated six possible options for dealing with the problem of sanitary waste escape. These include end of pipe solutions, input reduction solutions and in-sewer storage solutions.

SWARD sustainability criteria and indicators have been determined, and qualitative and quantitative data assembled for each of these options. The definition and inclusion of the criteria was determined through a series of seminars with a number of WSPs. A wide range of techniques have been used to collect the information required, including Life Cycle Assessment (LCA), hydraulic modelling and surveys of public attitudes. The case study ultimately uses multi-criteria analysis (MCA) software, including ELECTRE, PROMETHEE and SMART, to compare the relative sustainability of these six diverse approaches to the problem of sanitary waste escape to the environment. The findings of the MCA show that the general inference of the order of preference of the six options is steady and robust.

Methodology to Construct Material Circulatory Network in a Local Community

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ABSTRACT

In order to realize a social system with sustainable development, it is necessary for local communities to construct inter-industries material circulatory network. In this aspect, wastes evolving from the industries are defined as unused materials. This study develops a methodology of constructing circulatory networks among different industries for reusable materials. Two types of databases are made by means of industrial surveys. One of the databases reveals information about raw materials, products and wastes, received from or emitted to each company of industries in a subject community. The second database defines conversion technologies that enable transformation of wastes into reusable materials. Based on these databases, material flows in the community are analyzed by a network simulator program.

In this study, the methodology is tested on application to Toyohashi city in Aichi Prefecture. First of all, the databases of the industries, wastes treatment companies and waste conversion technologies were prepared. In order to propose one example of proper material circulatory network, the material flow was analyzed by the Network Simulator based on following 3 steps. In this analysis, each network was evaluated in terms of amount of materials that were emitted from the region.

- i) Analyzing material circulatory networks among companies in the same industry.
- ii) Correcting the best network, and defining the I-O amounts as whole of the industry.
- iii) Analyzing material circulatory networks among different industries.

As a results, an optimum hypothetical material circulatory network among different industries is proposed, which enable to reduction of the amount of material emission from the region accounting to 10,899 ton of raw material, 8,666 ton of products, and 2,233 ton of wastes. Moreover, upscale method of the database is also predicted and described.

Contrasting Scientific Paradigms with Maori Indigenous Views of Water in Aotearoa New Zealand.

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ABSTRACT

The attitudes of the early European settlers and their descendants towards water and land in Aotearoa New Zealand contrasted sharply with those of Maori indigenous culture. In the Maori worldview, everything in nature (including people) possesses mauri (physical and spiritual life force), and all forms of life are related and interconnected. Water is seen as containing life-giving properties, and thus has spiritual importance as well as practical use in everyday activities (e.g., as a food source, transport route, etc.). For the European settlers to New Zealand, the waterways they encountered were clean, abundant and navigable. Yet their cultural views led to the treatment of waterways as ‘disposal sinks’ where untreated industrial, municipal and agricultural effluent were dumped “out of sight, out of mind.” With environmental awareness, this attitude has changed significantly so that now legal measures are in place to ensure wastes are treated before disposal into waterways. Still, for Maori, the ‘mixing of waters’ and especially the disposal of human wastes into water is grossly offensive; both culturally and spiritually. Improved cross-cultural understanding of these worldviews (NZ European and Maori) with respect to water is only now taking place.

The attitude of New Zealand Europeans’ to water (and nature in general) is largely influenced by the Western scientific view. However, science is not a homogeneous body of knowledge and may, for the purposes of this paper, be approached as three distinct epistemological strands. One approach is reductionistic, whereby nature is divided into its constituent parts and water resource management is treated in an ad hoc and fragmentary manner. Another approach is generalistic and emphasises water management in terms of whole, bounded catchments (e.g., the ecosystem as a closed ‘unit’). A third approach is holistic or systemic and views nature as a dynamic and interrelated whole. This latter approach has recently emerged in science in the form of complex systems thinking, which asserts an awareness of nature as nonlinear, unpredictable, interconnected, complex and dynamic.

The holistic or systemic understanding that underpins the emerging complex systems science is by no means a new perspective. For many cultures, their relationships with nature (for example, Maori indigenous culture) reveal an appreciation of the interrelatedness of all life and, furthermore, these relationships are expressed through complex social arrangements which have been passed on over a number of generations. The holistic understanding that underpins complex systems approaches to water resource management has the potential to provide a common conceptual grounding on which mutually-beneficial relationships between complex systems scientists and indigenous peoples may be forged. These concepts will be discussed with examples from water resource management in Aotearoa New Zealand and illustrations drawn from the Maori indigenous culture.

Sustainable Development and Civil Engineering: Providing Infrastructure for Future Society

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ABSTRACT

Engineers are key contributors to the process of development. Their understanding and commitment will be crucial for the application of the concepts of sustainable development. This paper outlines ongoing work to develop a method of allowing engineers to make iterative improvement, from one project to another, by drawing on a body of data gathered from a range of similar schemes. Examination of a number of water supply projects serving similarly sized populations, to ensure continuity of issues, but in a variety of places will allow a demonstration database of information to be developed, which can be referred to when planning future similar schemes. Common fundamental issues are encountered in a range of projects and places. Therefore, it is feasible that knowledge can be exchanged usefully between them. If sustainable development concepts are to be incorporated into practical civil engineering, engineers must be involved at the earliest stages of project proposal.

Energies - Environment - Sustainable Development

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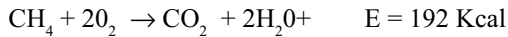
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ABSTRACT

The industrialisation of Algeria was done on the basis of energy supply made up ' ' mainly by oil and the natural gas, non-renewable and polluting resources (excessive quantity of CO₂ in the atmosphere, effect tightens and risks of climatic changes).

Currently, the authorities concerned, estimate the lifespan of these resources at approximately 50 years. But is there the right to exhaust them? Not, because of the rights of the future generations! Then two possibilities arise for the future if a sustainable development is maintained for our country: either the discovery of new fields (research are in hand) or the use of other resources energy, known as " alternative ", nuclear energy being eliminated.

The various needs for our country as regards of development and its situation close to Europe gave place to the direct supply of part it by natural gas (two gas pipelines in service, the third in project), the temporary transfer of L.N.G. comes in complement for other more distant countries. In the aggregate, one notes a clear progression of the natural gas use, justified by a context determined by the international market, but also by a limitation of the risks related to the Environment pollution (atmosphere) compared to the other conventional resources. Indeed, the reaction of methane combustion, the main constituent of the N.G., is written:

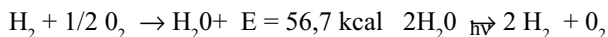


either 1 mole of CO₂ only for 2 moles of water, one is polluting but the other is essential to any life, and it is the resource which is provided to rarefy in an immediate future, for our country. Therefore the N.G. is the least polluting resource of non-renewable energies of which pumping not controlled risk to mortgage the sustainable development of the country. To limit the risks, it is necessary to develop in parallel the CO₂ traps which can be made up naturally by the biomes in accordance with the photosynthesis reaction:

It is also another energy resource considered as ecological (clean, renewable) allowing the satisfaction of the food needs for the man and other energetic needs, in multiple forms and thus a sustainable development.

The biomass which is essential to any form of life, must be promoted in parallel. By referring to the biomes, it is all the biodiversity, world-wide inheritance, which must be safeguarded in our country and even reconstituted.

In addition for the generalisation of the hydrogen use (derivative of the H.C. or solar) makes it possible to carry out the water cycle.



In addition, one should not forget the possible waste valorisation, which can solve local energy needs, while solving the environmental problems.

Lastly, the aspect ' ' energy savings in ' ' should not be occulted, because such a disposition showed its evidence (particular example of the USA).

Global Energy Scenario Meeting Stringent CO₂ Constraints - Trading with the Annex 1 Former Soviet Union Carbon Surplus

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ABSTRACT

There is wide uncertainty relating the costs of meeting the Kyoto protocol, estimates range between marginal abatement costs close to zero and as high as 300 USD tC⁻¹, although modelling studies typically suggest that the cost will end up in the range 25-300 USD tC⁻¹.

However, due to the withdrawn of the US, the price of emission permits is expected to drop rapidly. The US was expected to be the largest buyer of emissions permits, and with the large excess of emission permits (mainly caused by the collapse of the Soviet system) in Russia and the Ukraine, it is even a risk that overall Annex-1 emissions will not exceed the overall Annex-1 target for 2010 even if nothing is done to reduce the emissions. Thus, there is concern that the permit prices will collapse to near zero levels.

We have developed a regional energy economic linear programming optimisation model to analyse different strategies preventing the permit price from collapsing. First of all, Russia and the Ukraine can and probably will act as oligopolies, i.e. they are the price makers and not the price takers, so as to maximize their revenues from selling the carbon surplus. The permit price is increasing, and in our model the Annex 1 Former Soviet Union maximize their revenues when the permit price is approximately 20-50 US\$ tC⁻¹ and the amount carbon traded is approximately 200-250 MtC yr⁻¹ during the first commitment period (2008-2012). However, without any decrease in the energy intensity in Russia and Ukraine the coming years, it is not likely that they can sell this amount of carbon during the first commitment period. But the potential for energy savings are huge. However, the financing of the energy saving is unclear. Secondly, it is not likely to be politically acceptable in some EU countries to meet the Kyoto targets merely by buying emission permits from the east, in particular due to the large money flow to Russia and Ukraine and since these emission permits do not correspond to real reductions. Therefore, Russia and the EU discuss a program, the 'Green Investment Scheme' (GIS), where the revenues from the trading are re-invested in the Russian and Ukrainian energy sector for e.g. energy saving programs etc that will reduce the CO₂ emissions in Russia. Our preliminary analysis shows that this can be a rather good option, under the condition that the revenues are effectively re-invested. Without any efficiency improvements, the CO₂ emissions in Annex 1 Former Soviet Union are reaching the Kyoto targets around 2015. While with GIS, the emissions can still be 25% from the Kyoto targets by 2020. However, it is likely to be more stringent targets after the first commitment period. Thus, without GIS it is likely that it will be more difficult to meet the targets for Russia and Ukraine in the coming commitment periods compared with an introduction of GIS.

Study of Environmental Sustainability: The Case of Portuguese Polluting Industries

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ABSTRACT

Globalization of economy is a reality that every region, country and company are facing. One of the globalization's perspectives is the environment, where all the economic agents are present and mutually interact.

Consumers and ecological lobbies are requiring from industry the implementation of clean production processes and they are also forcing governments to respect anti-pollution laws, namely the principle of the polluting-payer. (Brockhoff et al, 1999; Commission Européenne, 2000; Whalley and Whitehead, 1994). So, industries need leadership that also consider in its strategic plan, models of good environmental practices in order to obtain competitive advantages (Klassen and McLaughlin, 1996; Roy et al, 2001).

Therefore the environmental management also involves the accountability of environmental facts that are due to the utilization of natural resources by industries, what generates additional social responsibilities, since environment is a public good. This environmental social responsibility is demonstrated through the internalization of externalities, using the financial accounting and its financial statements.

The majority of developed countries follow financial accounting harmonization made by international organizations, namely European Union, (EU), United Nations Organization (UN) and International Accounting Standard Committee (IASC).

The present paper analyses the results of a study done among the most polluting Portuguese industries and it gives special attention to the difficulties linked to the accounting harmonization of environmental facts. In order to achieve our goal we will analyze standards, recommendations and directives that are issued by the previously mentioned international organizations.

Indeed, some industries are not yet presenting in their financial statements the release of environmental externalities, although there are tools for it. In this paper we will also present a model that will show how companies can release environmental facts through balance sheets and income statements.

Predicting and Reduction of Environmental Effects of Mining Activity in the Polish Part of Carpathians

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ABSTRACT

Polish part of the Carpathians occupies about 6 % of the territory of Poland, and is under various forms of legal protection, due to unique natural-landscape values, a necessity of protecting balneological waters, main ground water reservoirs as well as forest complexes. There are also more than 350 mineral deposits in this region: tens of small oil and gas deposits, and many deposits of common raw materials such as: natural aggregates, clays for brick production and building stones. This fact rises some problems related to exploitation and management of mineral deposits, particularly in the aspect of sustainable development. The presented paper describes some of its, shows how to forecast the extend and scale of negative effects of the mining activity on the environment, and finally indicates how to reduce them.

The relationships between scale and type of mining activity, and its influence on the environment, with reference to some of selected deposits are determined by using matrix methods, and presented on geologic-ecological maps, generated by using GIS methods.

One of more important alterations caused by open-pit mining and quarrying, are the landscape and terrain morphology changes, which are associated with stripping of raw materials and redeposition of the overburden. They are associated particularly with exploitation of building and road stones, especially in several large and medium size quarries. Due to the geologic structure of the Carpathians, the majority of stone deposits are established at hills slopes, and quarries are well visible even from a distant place. The exploitation of sandstones in such areas causes the deforestation and alterations of ecosystems as well.

Some other influences are generated by natural aggregates mining. Deposits of natural aggregates are located mainly in narrow river valleys, and are related to Quaternary terrace sediments, which are regional main groundwater reservoirs. This rises an important problem - protection of water quality, because of surface isolation's of water horizons lack.

A method to reduction negative effects of mining activity in terms of sustainable development and land planning, is working out by the complex strategy of ultimate management of mined terrains. It should be a compromise between the extend of manner and planned exploitation and state of environment which will be left after finish of the mining activity.

Combined Use of Coal as the Basis of Environmentally Friendly and Wasteless Technologies in the Power Industry

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ABSTRACT

Presently, coal is extensively used for producing electricity in many countries, such as the USA, China, the South African Republic, Russia, India, etc. This is accompanied by pollution of the environment by the wastes of thermal power stations and coal washing enterprises. The technologies implemented to reduce these emissions are very expensive and often inefficient. For example, there are no means to efficiently catch natural radionuclides containing in fly ash.

During the entire Twentieth Century, the only requirements on solid fuel were to increase its carbon content and to decrease the content of inert material in it. Nevertheless, in reality, coal is a raw material that can be used for many purposes. Besides carbon, it contains polymetals and has many useful components in its mineral part. All of these so-called wastes are high-quality raw materials for the construction industry, metallurgy, and other branches of the economy. Moreover, special deposits are developed for mining these materials. To ensure high long-term competitiveness of solid fuel, the concept of using solid fuel in the fuel and energy balance of the economy should be revised. This should be accomplished by implementing new non-traditional multi-purpose coal technologies.

The enterprise OAo NIIPE (the city of Rostov-on-Don) has developed a unique project for an environmentally friendly, wasteless pilot-commercial installation for gasification and combustion of coal in an air-slag melt, which is bubbled by steam-oxygen blow. This project was developed in accordance with the Program for "Environmentally Friendly Energy" within the framework of the Federal Program "Fuel and Energy."

The steam output of the installation is 200 t/h. It is now being commissioned at the Nesvetai district power station of the Rostovenergo power system. By means of this technology, when combusting coal, it is intended to obtain broken slag (slag devitrified glass), polymetals, nitrogen, argon and other products, along with producing electricity.

As compared with existing technologies at TPSs, the proposed one completely excludes the necessity of having equipment for fuel preparation and pulverization, coal dust transportation, burners, a system for cleaning the gases from nitrogen oxides, a system for slag transportation, slag dumps, slime settlers, etc.

Implementation of this new technology will make it possible to radically reconstruct the power industry on the basis of multi-purpose usage of coal of any grade. This will make it possible to consider coal as a basic strategic fuel, whose large resources in Russia and other countries will enable us to work out the long-term concept for developing the environmentally friendly coal-based power industry, ensuring profitability and competitiveness of the coal industry.

The Development Department of Hrvatska Elektroprivreda Promotes the Activities Associated with Sustainable Development of Electricity Industry

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ABSTRACT

The energy sector reform is being implemented pursuant to the package of five acts adopted by the Croatian Parliament on its session of 19 September 2001. Energy Act, Electricity Market Act and Act on the Regulation of Energy Activities govern new relations in the electricity industry.

The provisions of these acts change the role of Hrvatska Elektroprivreda completely. Until now, Hrvatska Elektroprivreda has had monopoly in electricity and heat generation, transmission and distribution across the territory of Croatia. From now on, Hrvatska Elektroprivreda will be a market-oriented organization that has to perform successfully and keep up and capture as many customers as possible. On the other hand, the above acts steer the Croatian energy industry towards European energy standards, a bulk of which were defined in the Final Act of the European Energy Charter Conference of 1994 and EU Directives relating to energy industry (92/75/EEC and 96/57/EEC). Among other things, the standards promote environmental protection measures; application of energy efficiency measures and use of renewable energy sources within economically justified solutions that safeguard consumers' interests. In a larger sense, these activities are in line with the sustainable energy perspective that promotes the E3 concept - Energy x Economy x Ethics.

Hrvatska Elektroprivreda undergoes the process of restructuring. In such conditions, and taking into account the aforementioned legislative regulations, the development activities carried out in the Development Department of Hrvatska Elektroprivreda have been directed towards the encouragement, preparation and implementation of activities aimed at achieving sustainable development of electricity industry. These activities include the following:

- formulating the strategy and implementing environmental protection measures in all business units of Hrvatska Elektroprivreda, in compliance with the relevant legislation and standards
- preparing and implementing renewable energy projects and promoting new technical solutions
- promoting energy efficiency measures through the identification, preparation and implementation of projects that achieve savings of electricity and heat by end users
- preparing and completing the funding plan for those projects pursuant to different models, depending on project type, its profitability and potential implementation partners.

This paper gives an outline of current work being performed in the Development Department of Hrvatska Elektroprivreda with regard to the mentioned activities and the plan for the subsequent period.

Brown Coals Suitable for Environmental Products Manufacturing

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ABSTRACT

In the last decades, there has been a considerable interest in the use of activated carbon for environmental application.

The nature of precursors has a strong influence on the structure and properties of the activated carbons. At the same time, their sorption capacity is determined by the condition of manufacturing during the thermal processes.

This study was undertaken to provide some new data on the estimation of some Romanian activated brown coals. A summary of the experimental conditions used in this work are included, concerning the influence of different parameters on the activated carbons specific surface area, as: coal rank, grain size, burn-off, carbonization and activation temperature.

The activated carbons from the lower rank coal A posses larger volume of pores, with a prevalence of micropores and large BET surface area (320 m²/g).

Environmental Aspects of Socio-economic Changers for Industrial Region in Russia in Transition Economy

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ABSTRACT

In spite of the sharp decrease of industrial production output in Russia in the last decade, environmental contamination levels and the intensity of resource use remain high.

The main scientific objective of this work is to diagnose the sustainability of the present socio-economic configuration of the old industrial region of Russian Federation in transition economy and to analyze tendencies to describe possible changes of the regional sustainability in the future. Sverdlovsk Oblast as the most industrialized Oblast of the Ural Region of Russia was chosen for a case study.

By the number of population Sverdlovsk Oblast ranks fourth in population among 89 Russian administrative units. The Oblast is highly urbanized: 87 % of population lives in towns.

The economy of the Oblast is based on rich mineral resources. Sverdlovsk Oblast represents 23% of Russia iron ore output, 71% in bauxite, 6% in copper ore, 20% in fire clay and 97% in asbestos output. The industrial specialization of the Oblast was traditionally in the field of heavy industry: ferrous and non-ferrous metallurgy, diversified mechanical engineering, chemical, timber, woodworking, pipe and paper industry. Sverdlovsk Oblast is among the most environmentally unfavorable regions of Russia. The main reason for this situation is the extremely high concentration of environmentally dangerous industries. The other reasons are that the majority of the region's vast mining and metallurgical combines are outmoded, a lack of pollution control technologies, and poor exploitation of existing equipment for pollution control.

In the result of drastic drop in industrial production output during last ten years emission of pollutants in the environment has significantly decreased too. This is a positive tendency.

But during the same period the most part of region's mining and metallurgical combines became more outmoded because of lack of funding for reconstruction.

The second negative tendency is that the structure of regional economy becomes more and more "heavy": the quota of raw materials and semifinished products has increased. The share of the most environmentally dangerous industries in the total industrial production output continues to grow.

The third negative tendency is the dynamics of specific expenditures of energy and resources per the unit of industrial production output.

To diagnose the present socio-economic and environmental situation from the viewpoint of sustainability and to analyze tendencies to describe future which might be more sustainable or not an indicative approach was selected. The Core Set of environmental indicators developed by the Organisation for Economic Co-operation and Development was used to show and interpret

tends in the environment and related human activities in Sverdlovsk Oblast and provide a basis for international comparison. It was founded that many environment impact and environmental quality indicators for Sverdlovsk Oblast seems to be less than expected and are quite comparable with the same of OECD countries which usually are considered to be environmentally successful. But economy-environmental indicators (such as emission of pollutant per capita or per the unit of Gross Domestic Product demonstrate that the environmental effectiveness of regional economy is very low in comparison with the most developed countries.

The main tasks of Oblast's (and Russian) industry now are to move towards the challenge of new century and to establish the concept of sustainable development to make the coordinated progress of both economic growth and environmental protection.

Multi-Criterial Optimization of Construction Technology of Residential Building Upon the Principles of Sustainable Development

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ABSTRACT

This paper aims to give model for optimization of construction technology of residential building upon main principles of sustainable development, as multi-criteria:

- life cycle assessment of energy use, toward the energy saving purpose,
- reducing of mineral resource use,
- reducing of harmful impact on the environment.

Basic assumption is: there are many possibilities (variants) to fulfill the human housing demands in any society / country. Between various building materials and technological solutions for structural and architectural realization of residential building (house, apartment) as well as various effects in period of use, we do not know which of variants gives the best performance from sustainable development point of view.

We also, would to optimize residential building system by use multi-criterial compromise ranking, as one of operational research methods. As a result we take the rank-list of "compromise" solutions and we can choose the best ones or several better variants. These variants of residential building solutions should be environmentally acceptable and give chance to promote sustainable development of construction industry and housing, especially in poor developing countries (as Bosnia and Herzegovina). The savings of energy and natural mineral resources in housing branch they can use to develop other more profitable sectors.

Sustainable Management of Water Resources

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ABSTRACT

The purpose of this study is to evaluate water as natural resource and to analyze its management in a specific area by emergy analysis.

Emergy analysis is a methodology based on thermodynamics which considers economic and environmental aspects of a system by converting all inputs to the common denominator of solar emergy. Products and services are evaluated on environmental efforts necessary to generate them.

Sustainability applied to water resources should consider efforts toward reducing pumping from natural storage, toward reintroducing water as near as possible to its extracting zones and with characteristics as similar as possible to its natural ones.

The first part of this study is focused on natural resources analysis. We evaluated the emergy flow that supports local surface water, calculating the local renewable environmental inputs that are necessary to sustain three different Italian rivers.

The second part of the study consists on evaluation of the domestic water distribution system of the water supply system of a specific area (the province of Bologna, Italy) in order to underline the role of non renewable inputs in producing potable water. We consider all products and services necessary to extract water from reservoirs, to treat it and, finally, to provide it to consumers.

Results obtained provide a evaluation of input necessary to support the water cycle. It is important to underline the strict correlation between energy cycle and water distribution. Nonrenewable inputs represent 80% of the final total emergy value necessary to provide water to consumers, therefore reducing consumption of drinking water means, not only preserving the natural resources, but also preventing waste of energy and of nonrenewable resources.

Sustainable Use of Water in Croatia

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ABSTRACT

The paper analyses the present of water use in Croatia. The security of water supply is satisfactory. Croatia's surface comprises of 56,538 km². In 1996 the population equalled 4,784,000, with the density of 84.6 persons/km². The quantity of combined renewable endogenic and exogenic water resources in Croatia amounts to 169,000 x 10⁶ m³/year, or 35,300 m³ per person annually. The problem analysis of sustainable water use is based on the application of the European Environment Agency (EEA) framework for environment assessment: driving forces, pressures, states, impacts and responses. Driving forces affect the hydrologic cycle, which also results in water resources pressures, such as water abstraction, etc. Climatic changes have been analysed as well. The status of water resources is evaluated both in relation to quantity and quality.

The basic source for water use in Croatia is surface water, which equals approximately 75 % of the total abstracted water quantities for all purposes, followed by groundwater with appr. 25 % and marginal quantities of desalinated and recycled water. In Croatia, 38 % of water is used for urban purposes, 60 % in industry and energetics, and 2 % in agriculture. The quantity of water used for electrical power production is not included in these indicators, for which purpose Croatia uses 33.5 x 10⁶ m³ of water per year.

The prediction of climatic changes warn of a rise in air temperature from 1 to 3.5 oC and a reduction in precipitation of appr. 10 %. Freshwater resources in Croatia vary significantly, from 650 mm in eastern parts of the country to 1,500 mm or higher in certain parts. Croatia possesses sufficient resources to meet the country's needs.

The purpose of this paper is to supplement the data for future research and decision-making in relation to sustainable water use. The problem of excessive use of water resources is extremely complex, not only from hydrological viewpoint, but also with regard to socio-economic and political condition. The solution must be environmentally acceptable and socially feasible. The major findings of the paper indicate that water is a key to development and quality of life in Croatia. Water security in Croatia is on good level.

Sustainable development of China, India and Indonesia: Trends and Responses

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ABSTRACT

This paper provides an overview of trends, of policies already established and of new policy directions related to critical socio-economic and environmental issues identified in Agenda 21. It covers both positive trends pointing towards greater sustainability and negative trends or issues in which progress has proved more elusive. It also identifies policy gaps and trade-offs and suggests options for future policy directions. A special perspective of this seminar is its integrated approach to social, economic and environmental issues. Though the paper focuses mainly on China, India and Indonesia, in some cases, it extends the analysis to cover few other large developing countries. The topics were chosen to reflect critical issues unique to the large developing countries in terms of size, population and resource endowments. It covers a broad range of topics critical to sustainable development, including population growth, urbanisation, human development, long-term growth, Green GDP, sustainable agriculture, sustainable industrialisation, energy management, natural resource management, and environmental conditions.

With large in size, population and resource endowments, the decisions made by countries such as China, India and Indonesia will have major ramifications on the world's markets, resource base, and environment. And what is learned from these development experiences will also give a valuable insight for other developing countries for moving towards environmentally sustainable development. In this context, the time has come for a comparative assessment of different strategies for advancing economic development of these countries, while mitigating the negative environment impacts over long-term time horizon. Moreover, the paper may be useful in the context of the forthcoming the World Summit on Sustainable Development (also known as Rio + 10) in Johannesburg, South Africa as this summit also aims to review of progress towards sustainable development by countries, regions and the world.

During the last 50 years, China, India and Indonesia have travelled a long way in their drive towards modernisation of the economy. All three countries are transforming themselves from a largely agrarian economy into one based on a fairly developed and diversified industrial economy. These countries also changing from a planned and essentially supply-driven economy into a more market oriented and demand-driven economy. Population continued to grow in these countries but the growth rate of the population is declining. An important dimension of demographic transition in these countries has been the process of urbanisation. Although more than two-thirds of the population still lives in the rural areas, these countries have experiencing a rapid urbanisation in recent decades. These countries also experiencing a rapid economic growth. Consequently, the population living under poverty line declined significantly from about 60-70 % to 15-25 %. Life expectancy at birth has been increased by 25 years (about 50%). Adult literacy rates have also been increased substantially. Though these countries are still regarded as low-income countries, their economic reforms and progress on human development are expected to a base for sustainable economic and human development.

However, the rapid paces of urbanisation, industrialisation and commercialisation of agriculture have led to significant changes in the stock and the quality of the environment and natural resources. It is true that this is general phenomenon in many developing countries. Perhaps

these trends are far more visible in these countries than other developing countries because of substantial increase in population. For these poor countries with large population, economic growth remains the paramount goal of all policies and actions. It would be naïve to suggest that growth should be halted merely so that these countries have time to improve and rebuild the conditions and quality of natural resources. Moreover, this would not also possible as any improvement or rebuilding natural resources requires substantial financial and human resources. In this context, there is a need for some innovative policies that can be put in place immediately for timely and desirable results.

These countries (China, India and Indonesia) have already taken various measures to promote sustainable development. First of all, there is a growing use of economic instruments for environmental management. Secondly, these countries are eliminating or reducing subsidies to activities or sector that are environmental unsound. Thirdly, these countries allow public participation in decision making in selected cases. Recent planning documents place great emphasis on integrating energy, environment and economic policy decisions for sustainable development. Environmental concerns are being integrated into development projects through mandatory Environmental Impact Assessments. But, it is obvious that the Government alone cannot protect the environment and promote sustainable development. There has to be meaningful participation from the public as well as the business community. Industry can play a vital role in protecting the environment as well as promoting social and human development. Measures for improving productivity by more efficient energy use, recycling of wastes etc can lead to savings, besides yielding environmental benefits. There is a need to undertake awareness and training programmes to promote the concept of sustainable development. These countries also are developing an environmental publicity and educational campaign. These countries have actively playing a constructive role in international arena by signing a number of international environmental conventions and agreements. However, lots need to be done.

Mitigating widespread environmental problems requires a broad array of actions. First of all, setting priorities across a wide range of problems and options. In this context, accounting the environmental cost of economic activities will be important as this help in ranking of alternative policies and expenditures. Second, policy makers, at various levels, need support in developing a better understanding of the causes and cumulative effects of population, development and environmental linkages. Third, the participation of NGOs needs to be encouraged and strengthened. Fourth, partnerships between public and private organisations for urban environmental management need to be intensified. Fifth, a system must be established to ensure integration of environmental consideration into the development process. Sixth, more transparency and accountability are needed in establishing as well as implementing environmental laws and policies. Seventh, an overarching co-ordinating agency is needed to coordinate the work of various ministries and agencies to reduce overlapping and contradictions as well as to maximise synergies.

Management of Steady Development: Growth of the Population, Pollution of Water and Economy

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ABSTRACT

Possible aspects of realization of Maltus law energy analog are considered when not food but energy consumed by man will be limiting factor. Values obtained by changing the quantity of population as well as the consumed fuel quantity in the 21st century have been analyzed. The period was defined (2005-2085) when energy hunger is possible due to a higher rate of human reproduction comparing to the rate of energy consumption. From a new position, the laws of the Earth population growth are analyzed, based on the equality of the quantity of dying people to the quantity of those born τ years ago, where τ is life expectancy. The original model of birth- rate is offered which enables to operate by growth of a population. The relationship between main parameters of economics and entropy have been investigated on the base of the second law of thermodynamics. A general correlation between S and M is proposed: $dS = \chi(HV/T)dM$. This equation shows the direction of the spontaneity development of economical processes as part of a general Universal law. The equation of interchanging of money for actual economy is deduced from which the known Fisher equation is evident as a particular case. The equation takes into account value of the prices for true cost water and overstated price indexes. The equation corresponds to one of catastrophes known as a fold. The criterions allow to discover numerical values of a stock of money, true cost water, velocity of money, value of the taxes, which ensure sustainable development. The original equation of removing from information to matter yields a line of attack on the problem of control of GNP in terms of financial ecology expenses. These equations enable to control output natural resources by economic laws, and to control activities for the restoration of wrecked nature.

Local knowledge on the Concept of Sustainable Energy, Water and Environment - the case of Bangladesh

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ABSTRACT

The paper shows why the mystic Baul philosophers who possess local knowledge and wisdom reveal that the sustainability of Bangladesh is not yet at risk. They hold the Green Revolution (GR) responsible for the apparently unsustainability trend in Bangladesh. Energy shortage, arsenal contamination of underground water and environmental degradation such as desertification and depletion of biodiversity are taking place in Bangladesh since GR has emerged in 1960s. Baul Philosophers' views on the reversal of the current situation are examined. It is suggested that local knowledge and wisdom as to sustainability are religiously believed and practised by Bangladeshi village people in the one hand; and the practice of acculturation, over-exploitation of renewable resources, and economic dependence in contrast to traditional self-reliance living are utterly facilitated by the elite of Bangladesh, on the other.

The paper also reveals the Baul views as to sustainable solution of the problems. Renewable energy system (RES) and self-reliant living are suggested as the panacea. Finally, it is argued that about 85% of Bangladesh's 130 million people who live in villages are inherently environmentally conscious and regard energy, water and the environment as the essential objects for their survival. Bangladesh being a country of abounding renewables is required to integrate local knowledge and RES to synergistically empower the village households to enhance productivity without harming the resources base.

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Research on Woods as Sustainable Industrial Resources - Evaluation of Tactile Warmth for Woods and Other Materials -

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ABSTRACT

Although environment, resources and energy are basic needs for continuous development of human society, now we face to the serious global environment problem, i.e., the global warming and we have the resource problem that we would mine all up some of minerals in the near future. So the concept of sustainable development has been taken seriously.

The global warming is caused by several gases with greenhouse effect such as carbon dioxide, chlorofluorocarbons, methane, nitrous oxide and so on. The carbon dioxide is a main greenhouse contributor in so-called greenhouse gases. The forests are expected against the global warming because woods grow up with fixing carbon dioxide. We also know that the young forests are more active to fix carbon dioxide than the old ones. It suggests that it is better to cut down the old trees and to replace them with young seedlings in order to keep the forests young and active to fix carbon dioxide. On the other hand, the cut down trees are prospective sustainable resources. Horyu-temple, which is the world's oldest wooden surviving structure and the Japan's first world cultural heritage of UNESCO, gives us the hint for the sustainable development on the cut down trees. The wooden main pole of the temple's five-story pagoda was cut down in A.D. 594. It means that the main pole has stored the carbon dioxide fixed while the growing for over 1400 years. We know that the long use of wood is the long store of carbon dioxide. The use of woods as industrial materials will also save the limited mineral resources. Researches to use woods as substitute of mineral resources, to use worthless woods, to recycle wastes of woods, ... are expected.

The good tactile warmth is one of the advantages of wood. This paper treated the engineering evaluation of tactile warmth for industrial materials. The quantitative comparison of tactile warmth between wood and other industrial materials is expected to enhance the use of wood as substitute of mineral resources. It would give us the longer use of wood and the save of mineral resources. The main heat transfer phenomenon of tactile warmth is modelled as unsteady one-dimensional heat conduction caused by the contact of two semi-infinite bodies with different initial temperatures and thermal properties. The contact surface temperature and the thermal effusivity are proposed as engineering measures to evaluate the tactile warmth for various materials after the analysis. It is found that the sensory warmth of wood has a high and positive linear correlation with the logarithm of the contact surface temperature and that the material with a lower thermal effusivity feels warmer than the material with a higher one. The relation between the contact surface temperature and the thermal effusivity explains quantitatively the large difference of tactile warmth not only between woods and metals but

also between a species of woods and another one. It also explains the seasonal difference of tactile warmth between woods and metals. The thermal effusivity gives us the correct order of sensory tactile warmth for the woods containing the end face contact and the longitudinal face contact. The contact surface temperature and the thermal effusivity are concluded to be a good measure to evaluate the tactile warmth of wood and other materials.

Are Attitudes to Contemporary Drainage Systems Unsustainable?

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ABSTRACT

Attitudes to drainage systems are cultural and geographical. Arid Regions require utilisation of all waters, whereas temperate regions encourage the belief that water supplies are 'sustainable'. These attitudes prevail not just with the general public (consumer) but also in the behaviour and form of institutions. In the UK, the prevailing attitudes are that water is a 'right', largely free and once flushed away 'out-of-sight'. Inherited dense, paved surfaces, dominate our urban landscapes, interspersed by limited green space. In these areas, urban watercourses have been culverted or 'sewered' and have contributed to the successful maintenance of public health for more than a century. So why is there a need to change what we are doing? Equity, arguably, quality of life and sustainability are the reasons. Key to changing attitudes is the realisation that all wastes are in fact resources. How can we best promote this concept in our specialist area of drainage? New global as well as national initiatives require much greater consideration of the acceptability of future system changes to all of the actors involved. The World Water Council, European Commission, National and Regional Governments and others are all compelling the use of technologies and approaches which will be more sustainable. Sustainable technologies can only be so if the users adopt them. Even the UK economic regulator (OFWAT) has 'woken up' to the need for consideration of sustainability to be criteria for planning future investments.

This paper addresses these ideas by illustration of attitudes and behaviour of the various actors (legal, political, professional, local, public etc.) involved in the following: use of WC's; general household waste disposal; attitudes to the results from drainage research; the retrofitting of at-source control of urban drainage systems (ponds, rain water barrels and other devices) and the definition of criteria for sustainability. Guidance will be provided on how public attitudes may be assessed (together with appropriate warnings).

It is clear that perception problems exist in all of the actors who participate in the creation and use urban drainage systems. This is partly cultural and partly educational. Water Service Providers and others, such as developers, are in business to provide what the customer wants. Unfortunately customers are often not best placed to make informed choices about 'wants' due to lack of knowledge. Even where the knowledge exists, customers may choose to ignore externality considerations if this compromises ease of living. Few people actively consider the implications of life style and 'quality of life' on environmental degradation. In many European countries, education and media information presentation helps to ensure that (the majority of) those living in the society behave responsibly in terms of environmental systems. Inevitably this has implications for the 'freedom of the individual' and the so-called 'quality of life'.

Identifying the Factors which Affect the Decision to Attain ISO 14000 & the Role Played by Environmental Concerns During the New Product Development Process

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ABSTRACT

Formally adopted in 1996 by the International Organization of Standardization, ISO 14000 represents a new voluntary international environmental standard which will likely be adopted by the vast majority of corporations. Its major focus is on the structure, implementation, and maintenance of a formal environmental management system. While the literature is clearly divided in its assessment of ISO 14000, an underlying common theme is that the decision to achieve ISO 14000 certification constitutes a major undertaking for most firms. Such an undertaking, it is argued, does not take place in a vacuum. Rather, it is a response to a number of factors or influences. However, no research to date has empirically identified these factors and explained how they can be leveraged into a competitive advantage and sustainable development. In this study, we use qualitative case studies to identify which factors affect the decision to attain ISO 14000 certification and we also explain how these factors can influence the level of success achieved during the certification process.

The second study focuses on the product design process and the role played by environmental concerns during this critical stage. Specifically, we explore Environmental Management Systems (EMS) as perceived and acted on by two critical groups within this design process. The first consists of the champions and supporters of EMS. These are the people who either formally or informally act as advocates of EMS within the organization. The second consists of the users of EMS tools and procedures. Typically, these people consist of product designers and design engineers. We study these two groups by means of an exploratory research project that focuses a sample of firms drawn from the "best-in-class" environmental leaders. An interesting finding involves the existence of a strong gap between the EMS supporters and the users of EMS tools. The two sides were found to be separated by expectations, perceptions and orientations towards EMS principles, practices and tools. By understanding this gap, we may begin to better understand the difficulties that firms experience in trying to create more environmentally friendly designs and products.

Proper Scale of Recycling Based Society from Viewpoint of Regional Material and Energy Flow

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ABSTRACT

One of methods to establish a new society with low environmental load, so called recycling-based society, is to recycle waste. The waste recycle consists of several processes such as recovery process, transportation one, material conversion one and so on. In the material conversion process it is required to consume much energy. If energy used in the conversion process is derived from virgin resource, the recycle process takes energy more than non-recycle process. This leads that to establish the recycling based society is nonsense. However if the energy used in the process could be derived from recycle resource, for example, heat by waste incineration, it is easier to establish the new society.

The objective of this research is to develop a method to analysis relationship between energy supply by waste incineration and energy demand in recycle process from view point of regional material and energy flow.

First we make spatial distribution of waste discharge using statistical data. Second we a capacity of incineration plant. Then we could calculate recover scale of waste for incineration. At the same time we could know quality and quantity of energy generated by the incineration plant. Third we select target waste which should be recycled and investigate quality and quantity of energy which needs to recycle the waste. Then we could calculate how much the waste could be recycled and recover scale of waste for recycle

We apply the method to Aichi Prefecture in Japan as one example, and effective industrial waste transport system in this Prefecture is proposed. The energy generated by municipal waste incineration is more than the energy demand to recycle waste paper in the prefecture. By using this method, we could propose proper scale of recycling based society.

Sustainable Disposal of Waste from Olive Oil Production

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ABSTRACT

From an environmental sustainability viewpoint the olive oil industry shows great importance due to hazardousness and quantity of related waste. The industrial sector of olive oil production, in fact, is characterized by relevant amounts of by-products derived from specific manufacturing processes, namely liquid and solid pressing residues. Liquid wastes, usually named olive mill wastewater (OMW), present a high biological and chemical pollutant load; solid flow instead, constituted by olive husk (OH), is characterized by a fairly high heating value in the range 14-18 MJ/kg. According to the technology used in olive processing, batch-pressure or continuous-centrifugation systems, the amount of produced residues with reference to the treated olive mass are 40% OH and 40% OMW and 50% OH-95% OMW respectively. Waste quality and composition significantly differ depending on oil production technology.

In this industrial sector, both scattering of small sized mills over the territory and production seasonality introduce economical, technical and organizational constraints that make difficult adoption of environment-compatible and effective approaches for a sustainable wastes disposal. More specifically, at present olive husk are processed in seed-oil factories, in order to extract the low percentage of contained residual oil. However, market request of such a low-quality product is declining, introducing the problem of olive husk disposal. The most common way to dispose OMW, instead, is soil spreading. Even though the OMW are often improperly drained directly into surface rivers, with corresponding adverse effects on the environment, in terms of land, groundwater and running water contamination, due to the high organic load and to the presence of toxic substances including poliphenols.

In order to overcome this problem, waste treatment technologies aimed at energy recovery represent an interesting alternative for a sustainable disposal of residues from olive oil production able to reduce the environmental impact and to partially cover the highly energy needs of oil mills.

Having this in mind, in this paper a technical and economical analysis of different disposal plant solutions has been carried out with reference to two main technologies: gasification and combustion. Energy recovery sections based on combined gas-steam cycle, steam or gas turbine cycle and internal combustion engine, have been considered. As a reference scenario for the study a basin constituted by 194 mills equivalent to 500 105 kg of milled olives with a production of OH and OMW around 190 105 kg and 250 105 kg respectively, has been analysed.

Results are compared by using economic performance measures such as Net Present Value (NPV), Pay Back Time (PBT) and Profitability Index (PI), taking into account capital investments, operating costs and revenues from energy and avoided disposal costs. Furthermore, in order to assess from a stochastic point of view the economic profitability, a sensibility and risk analysis has been also performed.

The most promising solution is represented by a gasification plant with gas-steam turbine combined cycle.

Environmental, Energy and Economic Aspects and Sustainability in Thermal Processing of Wastes from Pulp Production

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ABSTRACT

Pulp and paper plants produce large amount of sludge. Environmental problems connected with this waste were not solved satisfactorily in the past. Landfilling is not a suitable way from the environmental point of view. A thermal treatment process proved itself to be the most appropriate solution.

Let us show a concrete way how to solve the above-described problems with emphasis on sustainable aspects. A thermal treatment unit with a capacity more than 100 tons of wet sludge per day had been built in one large pulp and paper plant some years ago. This pulp and paper plant is located in mining area. When built, this unit was quite modern. However, because of more and more sweeping environmental laws affecting the process industry, the unit needed a complete retrofit. The retrofit has been realized in three stages.

A brief description of the unit for the thermal treatment of sludge is as follows [1]: The waste sludge (after a transport from a sludge storage system) is burnt in a multiple hearth incinerator with

a fluidized-bed chamber. Then the flue gas enters a secondary combustion chamber (afterburner chamber). During the first stage of retrofit only a part of heat from flue gas was utilized for heat recovery (pre-heating air for combustion and fluidization) and a contact cooler was involved into the unit. The second stage of retrofit can be characterized as a "waste-to-energy" one. The contact cooler was replaced by a system for preheating water for steam generation. Off-gas cleaning system consists of a filter for particulate removal and a three stages scrubber system. (Several alternatives of retrofit were considered and simulated and the most promising one was selected.)

The third stage of retrofit consists in substituting the currently used fuel by mining gas containing approximately 50 to 60% of CH₄. Utilizing this waste gas represents an important contribution from both environmental and economic points of view. Last but not least removing the gas from mines decreases risk of creating an explosive mixture with air and thus it is also important from safety reasons.

The unit for thermal treatment of sludge after retrofit can be considered as one of the most up-to-date incinerators with waste-to-energy system at present. Landfilling of sludge costs approximately

US\$0.5 mil. per annum (and in case of high ambient temperatures when biological processes in sludge are more intensive even US\$1.4 mil.). If we have not considered the waste-to-energy system, incineration would be more expensive than landfilling. However, after installing heat recovery and steam generation system we can save US\$0.16 mil. per annum. Using mining gas as a primary as well as stabilizing fuel represents another savings. Moreover, fuel gas emissions from the local power and heating plant are reduced due to the above-described complex approach.

The Environmental Evaluation of the Impact of Electronic Commerce - Different Dimensions and Scenarios

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ABSTRACT

Electronic commerce (E-commerce) use has accelerating trends in the global market, and yet with unknown type and amount of impact on environment in terms of energy use and material consumption. While still being in the early stage of implementation, E-commerce is expected to variably intrude the markets within the next ten years among the different merchandises, and to influence the logistical and distribution forms of products. This paper critically reviews some of the current studies and discusses the different dimensions and scenarios of E-commerce impact on environment, where we find a few number of studies and few scientific published results. Some of the current interesting studies utilise different approaches and tools, like LCA and GIS system. The results vary among these studies from positive to negative impact, based on a group of assumptions and limitations. This paper presents a dimensional map of the different components of E-commerce to understand where do those previous approaches lie. This explains the different possible ways to approach the evaluation of the environmental impact of E-commerce, from a micro level up to a macro level. According to the conflicting results of those previous studies, an approach to be selected is questionable and there is a need for finding a model for studying the total impact of E-commerce on environment, especially that E-commerce is a topic of the future and did not yet dominate the market communications.

Worldwide Use of Ethanol: A Contribution for Economic and Environmental Sustainability

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ABSTRACT

The use of ethanol from biomass for gasoline substitution for cars and light trucks is possibly one of the most attractive and feasible alternatives to deal with global warming to contribute to alleviate countries' trade balance by cutting oil imports. Ethanol consumption of 4 billion gallons annually helps Brazil to avoid nearly 26 million metric tons of carbon dioxide emissions. As environmental concern grows - see the Convention of Climate Changes in the Kyoto Protocol, signed in December of 1997 - many countries have increased their efforts to consolidate bio-ethanol processes and supply. Annual world production of bio-ethanol fuel is about 7 billion gallons, from which Brazil is responsible for about 60% of global production, followed by the U.S. and China. Roughly 60 percent of world ethanol is produced from sugar crops, mainly cane and some beet; the remainder comes from grain, with maize (corn) as the principal. This paper aims to show the state of art of ethanol use around the world, researches and programs. The United States of America uses ethanol as fuel since at least 1908, though its production increased after oil supply disruptions in the Middle East during the Eighties. Ethanol production grew from 175 million gallons in 1980 to 2 billion gallons in 2000, with support from Federal and State ethanol tax subsidies. Demand of ethanol could increase further after methyl tertiary butyl ether (MTBE) be eliminated from gasoline, which was already announced to be phaseout in the State of California by 2002 - this state alone uses 25 percent of the global production of MTBE.

Brazil uses ethanol as fuel in large scale. In 1975 the Brazilian government launched its unique "Proalcool" program. In the late 1980s about 95% of new passenger cars were powered by ethanol. The country has carried out a large R&D program to modify the Otto engine to ethanol fuel, accumulating expertise and know-how in its production, supply and applicability. Its productivity increased from 3,900 litres/ha in 1980 to nearly 5,600 litres/ha in 2001. Annually, Brazil produces about 4 billion gallons of ethanol and has the world lowest production costs per gallon with perspectives to even reduce costs about 13% within the next six years.

Europe too is very concerned with the greenhouse effect and has been increasing its efforts to use renewable fuels. France is producing ethanol from plants containing sucrose, such as beet, or from plants containing starch, as cereals and potatoes. The resulting ethanol can be added to the fuels in a pure form or as ETBE, a chemical composition obtained from the reaction of ethanol (45%) and isobutylene (55%). Sweden government has spent over US\$ 4 million in the last three years to demonstrate the advantages of renewable fuels; By 2010, Sweden will have 15% of its transportation fleet using fuels produced from biomass. The Sweden Foundation for the Development of Ethanol - founded over 15 years ago - is working on different projects for producing ethanol from residues from paper, forests - from which raw material could be extracted - and tracktionaty projects - fuel mixture of ethanol/diesel, called ETAMIX.

China is already investing on ethanol production with 0.7 billion gallon/year and will reach 1 billion gallon - short term - to be used as additive to gasoline in 10%. Most of its ethanol is produced from sugar crops, corn and some beet. Countries from different parts of the world, such as Argentina, Colombia, India, Mexico among others - are introducing smaller scale ethanol fuel programs.

The continuous growth of ethanol use requires well planned and reasoned development programs to assure the many environmental, social and economic concerns are addressed adequately. The key for making ethanol competitive as a gasoline additive is the ability to produce it from low-cost biomass. Brazil has continually decreased its costs for ethanol production from sugarcane. The U.S. has also done efforts to reduce its costs to produce ethanol from corn and Europe from beet. Most of the mentioned countries as well as others around the globe are working extensively to find new technologies to offer ethanol use from biomass, from which cellulose conversion and different feedstock seem to be the most promising ones.

ArcheoRisk: a Decision Support System on the Environmental Risk for Archeological Sites in the Venice Lagoon

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ABSTRACT

Nowadays, more than 250 submerged archeological sites were identified in the Lagoon of Venice, which represent an historic and artistic heritage of extraordinary value. These sites are endangered by several environmental and human factors: erosion, chemical pollution, organisms (mainly wood borers), motor-boat traffic, fishery activities, robbers.

A Decision Support System (DSS), named ArcheoRisk, was developed to include the safeguard of archeological sites within environmental management of the Venice lagoon and to select most effective safeguard/rehabilitation interventions, whenever needed.

The DSS relies on a Geographical Information System platform (Archview) and is composed of two modules: (1) assessment of archaeological risk, (2) selection of interventions.

An environmental-archaeological geo-referenced database was constructed and an environmental risk assessment methodology for archaeological sites has been developed, which is based on the conventional source-pathway-receptor scheme. The two-steps procedure includes (1) Screening Risk Assessment and (2) Site Risk Assessment. Screening Risk Assessment provides risk maps and priority of intervention based on risk sources and archaeological sites location and value. Site Risk Assessment is a ranking procedure requiring the user to fill a scoring questionnaire about type of risk sources, exposure and material vulnerability of artifacts present at the site.

Based on risk assessment, the selection of intervention (investigations and safety measures) is supported by a Intervention Selection Matrix, i.e. environmental features vs. risk types, and an archive of intervention costs.

In its prototype format, the ArcheoRisk DSS is being submitted to a wide testing activity and will be adopted by the Cultural Heritage Authority in Venice for communication, programming, and planning of interventions. It can be easily applied to different case studies and environments, thus providing a promising reference of GIS-based DSS and risk analysis application for the integrate management of environmental and cultural heritage.

Water Use and Quality Impacts on Watershed Economics

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ABSTRACT

Efficient use of water depends on net benefits obtained from that use. Benefits of using water is function of the value of water which affected by its quality. Inefficient irrigation negatively affects agricultural output. Efficient allocation differs from surface water to groundwater. Generally, surface water is a renewable resource while groundwater aquifer can be renewable or non-renewable. Surface water use should provide adequate protection for the beneficial uses include in-stream uses such as habitat for wildlife or for fishing and direct contact. Withdrawal from groundwater should not exceed recharge to avoid exhaustion or increase in marginal cost of pumping. Pumping of groundwater can cause a decrease in stream flow because of lowering the water level at wells, changes the slope of the water table and either decreases the quantity of water entering the river, or increases the loss of water from the river.

The objectives of this study were to compare the efficiencies of allocating surface water and groundwater and examine water exploitation in the Big Lost watershed, south-central Idaho. In this study, the water budget for the whole watershed was calculated. An input-output table and a cost benefit analysis were conducted to calculate how much water contributes to watershed economy and to evaluate the water saving schemes and the economic benefits obtained from raising the efficiency and conserving biodiversity. In addition, a developed water use was used to evaluate water exploitation in the watershed. The study showed the spots in the watershed that have not utilize their water efficiently and others that have not received enough water that makes it difficult to achieve the social purpose for which they are devised.

Hydropower Potential in Sudan

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ABSTRACT

Sudan has a plenty of water resources to produce electricity. An overview of the electricity situation in Sudan is introduced with reference to hydropower potential and distribution. Hydropower utilisation in Sudan is now a major issue. Sustainable low-carbon energy scenarios for the new century emphasise the untapped potential of hydro-energy resources. The increased availability of reliable and efficient energy services stimulates new development alternatives. It is concluded that hydropower environmentally friendly energy must be encourage, implemented and demonstrated by full-scale plant for rural electrification.

Equivalent Work Consumption by Different Desalting Methods: Case Study for Kuwait

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ABSTRACT

Kuwait depends on desalting seawater to satisfy its fresh water needs by using Multi Stage Flash (MSF) desalting method, usually combined with steam power plants. The MSF consumes thermal energy (about 300 kJ/kg of desalted water) in the form of moderately low-pressure steam at 2-3 bar, beside mechanical energy, (about 4.5 kWh/m³) to run its pumps. The steam supplied is extracted from a cross pipe connecting the MP (medium pressure) and LP (low pressure) steam turbine cylinders. When no extracted steam is available, steam is directly supplied from boilers. This is a wasteful process. Here, the steam generated at high pressure and temperature to feed HP turbine is throttled (rather than expanded in the HP and LP turbines to produce work) to suit the condition required by the desalting plant. The use of extracted steam saves about 50% fuel energy compared to steam directly supplied with from boiler(s).

In Kuwait, the average annual increase of desalted fresh water production during the last 6 years is 7.6%. The required redoubling period of installed seawater desalting plants is about 9.5 years. In 2000, the daily consumption was 241.7 MGD as an average and 278.5 MGD as maximum, while the installed capacity is 286.6 MGD. So, the installed capacity should be at least 557 MGD by 2010, and more desalting units need to be added the operating units. Different types can be considered for addition to the existing power plants such as:

1- More MSF desalting units.

2- Reverse Osmosis RO desalting units that consume only pumping energy. This may be the best solution with no interference with power plant operation. However, the reliability of seawater pretreatment seawater for large capacity plants is still questionable. The problem of seawater pre-treatment should be solved in small plants at different locations before embarking on large capacity plants.

3- Multi Effect Boiling MEB desalting system delivered in modules and can be operated with steam extracted from turbine. If the steam is at relatively high pressure the system operates as thermal vapor compression system TVC. When the low pressure steam is used, it can operate as conventional multi-effect boiling CMEB.

The energy consumed by any of these desalting systems is to be evaluated and compared with each other for as one of the main factors that decide the final choice of any system. Since the availability of thermal energy supplied to desalting systems may be different from one to another, the thermal energy should be evaluated by its equivalent mechanical energy. This gives unified method compare energy consumed by any desalting method based on its work or (equivalent work) consumption, better evaluation of the performance of cogeneration power-desalting plants CPDP; and gives rational method to charge desalting process system with its share of fuel cost. The idea of equivalent work is based on the work loss by the CPDP due to the extraction of steam from its turbines to the desalting plant: or the work produced by the fuel charged to the desalting plant if its supplied with steam directly from boiler. Pumping energy is to be added to the work equivalent to thermal energy (if any) to obtain the total equivalent work consumption. A preliminary comparison based on this analysis for commercially available desalting system is given in the following table

The table shows, for example, that although the MEB system consumes more thermal energy than the TVC, the consumed equivalent mechanical energy of MEB is lower than that of TVC. This is understandable since the MEB uses lower availability steam. It is also easy to compare the total equivalent mechanical energy for any of these systems with the mechanical work applied to mechanically driven desalting systems such as reverse osmosis or mechanical vapor compression system.

Integrated Water Management at Hlobane Colliery

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ABSTRACT

Hlobane Colliery is situated near Vryheid, in northern Kwa-Zulu Natal, South Africa. After over 100 years of mining at the site, Hlobane Colliery faced the prospect of closure. The development of an Integrated Water Management Plan (IWMP) was initiated at Hlobane Colliery, in order to create a practical and defensible strategy, that would optimise the allocation of a finite financial resource by applying management actions that gave the lowest possible risk of unacceptable impacts on the water resource both now and in the future. The IWMP that has been developed and is being implemented has been approved in principle by the Department of Minerals and Energy (DME), Department of Water Affairs and Forestry (DWAF) and Department of Agriculture and Environment Affairs (DAEA).

In order to remain financially competitive, this work challenged the traditional rules applied by the regulators. This was successfully achieved by developing new technologies and integrating existing analytical tools (hydrological, geohydrological and geochemical modelling and spatial analysis) to apportion the available budget for water management and for final closure. Once a water and salt balance had been developed, it was possible to model the impacts of mine discharges to the receiving environment and quantify the significance of these predictions over the next 100 years. The greatest impacts were then identified and a range of innovative management strategies were developed and evaluated in consultation with all Interested and Affected Parties (I&APs). Due to an exceptionally steep learning curve experienced by Iscor employees, consultants and I&APs, the process has taken almost 2 years to complete. However, the greatest challenge still lies ahead: Will the lessons learned at Hlobane, (groundbreaking scientific research, procedure and process development, technical expertise developed in Kumba Resources employees), be effectively employed at all current and future Kumba Resources sites. Furthermore, it is crucial to the long-term sustainability of all new ventures, that an IWMP and legally compliant environmental practice must be implemented at the inception of a new project, not as an afterthought at the end of the life of mine.

Sustainability Issues as Applied to Irrigated Agriculture - Experience from Irrigation Systems in Greece

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ABSTRACT

Irrigation systems that are able to satisfy the changing demands placed on them, now and into the future, without system degradation, can be called sustainable. Professionals in the Irrigation industry have an obligation to design and manage Irrigation systems which can contribute to less environmental impacts. The objective of this research is to examine many of the major issues and challenges raised by the concept of sustainability applied to Irrigation system design and management. It reviews various guidelines that have been suggested for achieving a greater degree of sustainability and the extent to which they have been applied. The authors outline some approaches for measuring and modeling sustainability and illustrate ways in which these measures might be used when evaluating alternative operating policies in Greece. Sustainable criteria are presented for irrigation management under competing and conflicting use of water. In this case irrigation management must be compatible with long term sustainability and conservation goals. The criteria representing the above goals are the economic effect of management on yield reduction, sustainability referring to plant growth and the economic effect. Social criteria as equity in allocation of agricultural water as well as resource sustainability are also taken into consideration. Environmental indices expressing in quantitative terms the above criteria and are used as an interpretation of the management goals to the decision maker are selected. Characteristic examples from irrigation systems in Greece are presented as well as conclusions of indices applicability.

Global and Conceptual Models to Determine the Water Balance of Aquifer

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ABSTRACT

A new approach to groundwater resources, which is based on a multi-criteria decision aid methodology, is presented. The method couples a hydrologic and hydrodynamic groundwater flow simulation model with the decision aid one. Mathematical models are developed to solve flow computations in surface and groundwater by the functions of production, transfer and the Darcy equations.

These models differ by the chosen method of computation and discretization. Water cycle simulation inside a given basin with connected reservoirs (rainfall, evapotranspiration, efficient rainfall, infiltration, percolation...) allows to modelize groundwater table, discharge flow and evaluate the aquifer recharging. Groundwater modelling in aquifers is done with an implicit finite difference approach.

These methods have been applied, with existing code, to modelize the Habibia perimeter in the North of Tunisia, using recent hydrological and hydrogeological data (1966-1998). The calibration of the mathematical model is carried out under a permanent regime by changing the equivalent hydraulic conductivity. Simulation of groundwater table of 1998 proves to be reliable.

The calibration of the mathematical model is carried out under a permanent regime by changing the equivalent hydraulic conductivity. Simulation of groundwater table of 1998 proves to be reliable. Permanent and transient simulations of piezometric heads during years 1965 and 1990 appear to be reliable. The simulation of a further state in year 2015 is proposed.

The paper presents a method to compute regional information on water resources, using a geographic information system. A test study of a regional approach towards assessment of water resources was carried out using recent hydrological data. The paper shows how GIS can be coupled with simple hydrologic models to simulate the major hydrologic processes inside a large basin. Best use of available information (GIS and hydrologic data) is made to generalise the hydrologic information. The model will eventually be used to help regional water resources planning by addressing problems like water exchanges between administrative or political entities.

Management of Energy in Water Production and Electrical Energy Generation in GCC Countries

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K U W A I T

ABSTRACT

Electrical energy generation and water production are responsible for a substantial consumption of energy resources. These two sectors consume 50-60 % of the total energy requirement in the GCC countries. The increase in energy consumption will continue due to rapid development in the GCC countries. This paper assesses the techniques that can be applied in the field consumption of electrical energy and water production, to save energy, power and capital costs. The State of Kuwait is taken as a model for saving energy in electrical generation and water production.

The EnergyPLAN Model an Energy System Analysis Model with Focus on Management of Fluctuations in Wind Power and Electricity Production from CHP

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ABSTRACT

Both CHP (Combined Heat and Power Production) and Wind Power are important elements of Danish Energy Policy. Today, approximately 50% of both the Danish electricity and heat demand are produced in CHP and more than 15% of the electricity demand is produced by Wind Turbines. Both technologies are essential for the implementation of Climate Change Response objectives, and both technologies are intended for further expansion in the coming decade. Meanwhile, both technologies are subject to fluctuations in electricity production. Wind turbines depend on the wind, and CHP depends on the heat demand.

The main purpose of the EnergyPLAN model is to design suitable national energy planning strategies from analysing the consequences of different national energy investments. The Model emphasises the analysis of different regulation strategies. The analysis is carried out in hour by hour steps. And the consequences are analysed of both different technical regulation strategies and different market economic optimisation strategies. The model is divided into two sections. The first section makes a technical analysis based on demands and capacities. The second section makes an economical optimisation of the behaviour based on further inputs of marginal costs and hour by hour price-assumptions on the international electricity market.

The model has been used to design sustainable development strategies in the energy sector and results from such analyses are included in the paper.

Electric Power System Expansion Planning

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ABSTRACT

Electric Power System Expansion Planning is very important not only for the state economy but also for the overall social development. The paper presents some models which are in use in the world and also in domestic practice with special attention on ENPEP (Energy and Power Evaluation Program) applications. The paper is done with respect of the fact that a central goal of sustainable development is: “ Maintaining and increasing the overall assets available to future generations” and “Energy is essential for sustainable development”.

Development of an Air Staging Technology to Reduce NO_x - Emissions in Grate Fired Boilers

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ABSTRACT

In order to reduce CO_2 emissions the distribution of decentralised biomass fired systems is supported by local governments and the European Commission. Apart from traditional wood fuels, coming up by wood-processing, more and more types of wood fuels with very different characteristics are used, for example forestry and agricultural residues or energy plants. The use of biomass for decentralised heat generation instead of fossil fuels may not cause environmental damages by higher emissions.

Within the scope of an European research project, titled Optimised Combustion of Wood and Wood-waste Fuels in Stoker Fired Boilers, the Institute of Process Engineering and Power Plant Technology investigated and optimised grate firing systems in view of their operation with different forestry residues and their emission behaviour.

A 240 kW test firing was installed in the IVD laboratories. Concepts to operate the system adapted on the fuel, as well as a multi-air-staging technique to reduce NO_x -emissions have been developed. These concepts have been implemented in a commercially operated 450 kW firing system. The concept is based on an optimised primary and secondary air distribution on 3 stages. The primary air was reduced in favour of the secondary air as far as the burnout of the fuel on the grate is sufficient. The secondary air was shared according to the impulse ratio between secondary air and flue gas, in order to guarantee a good mixture of gases and air by a high injection velocity.

The potential of the air staging concept has been investigated with a number of fuels of different moisture and nitrogen content in the test firing and in the commercially operated plant to show the potentials and the limitations of the air staging technology.

Depending on fuel characteristics and the operation settings, a reduction of NO_x -emissions in an order of 20% can be expected. The potential of the NO_x -reduction is limited by a changing fuel quality, leakage air and peak load fluctuations. The optimised operation with regard to NO_x -reduction is particularly necessary for dry fuels. To guarantee the complete burnout of wet fuels, higher amounts of primary air are essential. Since wet fuels are less critical in NO_x -emissions, the primary air flow can be increased. The fuel water content, determined with an online measuring system, as an additional control parameter could help to burn both types of fuels, dry and wet, in an optimal way.

Optimal Sizing and Economic Analysis of Low-Cost Domestic Solar Water Heaters for Zimbabwe

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ABSTRACT

The technical and economic performance of low cost domestic solar water heaters, earmarked for widespread manufacture and distribution in Zimbabwe, is studied. A simplified model, that is adaptable to hand or spreadsheet computations, is described and used for performance simulation of solar systems connected to auxiliary electric geysers. Optimal areas of two different collector designs, that should be used for 50 or 100-litre systems, for presumed hot water demand patterns, are determined through performance simulation and economic analysis. The systems analysed were found to be economically viable for a wide range of solar fractions (40% to 100%) and corresponding collector areas. Maximum present worthy is attained at very high solar fractions (above 90%), favouring the use of more solar energy than conventional electricity, for this hybrid application, under the environmental and economic conditions in question. Optimally sized systems have a dynamic payback period ranging from 6 to 8 years and an acceptable internal rate of return of about 11%. Some presently installed systems are not optimally sized to yield maximum economic benefits. Future systems should be sized, following the approach of this study, to maximise lifecycle solar savings, giving due respect to practical constraints that might be associated with deviating from standard construction. Using the collector design that utilises more local materials results in more economical systems despite the inferior technical performance characteristics of the collector, for the sizes of systems analysed. However, technical superiority may prove more important for larger systems.

Systemic Approach for Techno- Economic Evaluation of Triple Hybrid (RO-MSF and Power Generation) Scheme Including Accounting of CO₂ Emission.

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ABSTRACT

In recent years one can see the growth of scientific, engineering and commercial interest to sustainable technologies being characterized by low values of fuel consumption and CO₂ emission. Specific fuel consumption and CO₂ emissions can be considered as indicators of technological sustainability. New generation of co-generative technologies, namely, triple hybrid including power generation, MSF and RO desalination is becoming an attractive alternative to conventional technologies. Some authors state that the RO can successfully coexist with MSF rather than a process that should replace it. Analysis of published data confirms that the potential advantages of triple (RO-MSF-power generation) hybrid system are still not materialized. It can be explained by low degree of hybridization and low level of integration between operating subsystems. Existing MSF-RO-power plants are characterized by simple integration without hybridization of operating regimes, in particular, by blending distillate and using common intake system, while many essential technological aspects are beyond the scope of published studies.

Proposed manuscript is focused on development of systemic methodology for techno-economic evaluation of triple hybrid desalination scheme. Triple hybrid desalination system has to be considered as an array of submodels of various hierarchy levels. They are: (1) technological submodel, (2) fuel or energy submodel, (3) ecological submodel and (4) economic submodel. (1) Technological submodel is focused on calculation technological characteristics at different operating load of generating systems; (2) Fuel or energy submodel covers calculation of fuel influx into power generating systems at different operating load; (3) Task of ecological submodel is estimation of CO₂ emissions at different operating regimes; (4) Economic submodel gives values of economic indicators such as (a) discounted cash flow (b) NPV, (c) cost of water and, (d) cost of energy, and (e) accounting of CO₂ emissions through imposed carbon tax, (assuming rates of environmental taxes recommended by EU tax legislation) The model allows analysis of behavior of economic and ecological indicators at various technological parameters and economic assumptions such as: (1) Load, specific fuel consumption and efficiency of energy generating system, (2) Specific energy consumption for desalination, (3) Specific emissions of CO₂, (4) Bank interest on borrowed capital, (5) Taxes on CO₂ emissions.

Submitted model can be applied for analysis of schemes where seasonal surplus of unused power is utilized by RO which are characterized by higher efficiency of fuel consumption and decreasing specific CO₂ emissions. Proposed manuscript contains calculated projections of techno- economic indicators over life cycle of capital.

New Fossil Fuel Energy Technologies - A Possibility of Improving Energy Efficiency in Developing Countries

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ABSTRACT

The energy intensity in developing countries, especially in Eastern Europe and Former Soviet Union countries, is considerably higher than in industrialized countries. The development of new fossil fuel energy technologies might be a possibility to improve the energy efficiency and that way reduce the energy intensity in developing countries. Some of these new energy technologies: combustion in the pressurized fluidized bed, integrated combined cycle with coal gasification, combined cycle with natural gas as a fuel and fuel cell are shortly described. The principle of work for the facilities based on the above-mentioned technologies is described, and the basic characteristics and state of development are given. It has been emphasized that the facilities with those technologies have higher efficiency compared to classic thermal power plants, and that they pollute considerably less the environment. The short overview of primary energy consumption, the share of different resources and the estimation of saving which might be realized by using new technologies are given.

Water Management of the Small River Basin in the Direction of Sustainability (on the Example of the Slovenian River Paka)

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ABSTRACT

The Šalek Valley (middle part of the Paka river basin) is overloaded with different human activities as coal-mining, electricity production, industry, land farming and it is also overpopulated. The area is of the great importance for the Slovenian economy and it is one of the most developed parts of Slovenia on the industrial and energy field. Velenje is 5th town in Slovenia according to the number of inhabitants. The river Paka is the main water stream in the Šalek Valley and together with its tributaries too small for a coal-mine and the industrially intensive area. The average flow of the river in the town Šoštanj is only 2.6 m³/s with a big difference between max. and min. flow. If number of inhabitants of the Velenje is compared with average water level of the Paka the result shows that the flow of the Paka is less than 0.09 l/s per inhabitant. At the low water level of the river Paka, the flow per inhabitant is only 0.005 l/s.

Not only pollution of water, but also changes in the river net enlarged sensitivity of the water bodies. Due the coal-mining the surface of the Šalek Valley has subsided for around 110 million m³ until now. The subsidence area amounts to approximately 6 km² of the valley surface. The most remarkable consequence of coal-mining are subsidence lakes. The surface of lakes is over 2 km², and their volume is approaching 36 million m³ (the coal-mining has been still in the progress and the lakes have been growing all the time). Higher degree of environment protection measures is necessary for preventing the lakes from pollution as for running waters. The quality of all water bodies in the Paka river basin has been monitored since 1987 on eight sampling points along the Paka, on 21 sampling points along its tributaries and on four sampling points in lakes. The monitoring is carried out four times a year on each sampling point (the quality of water in lakes is monitored on each meter of the lake profile from 7 to 50 parameters on each point). Due to poor quality of the river Paka in the beginning of nineties the Water Improvement Programme was adopted in the Velenje Community. Later the municipalities of the area adopted a Water Improvement Programme for the river Paka, its tributaries and the Šalek lakes (the Velenje municipality was divided into three municipalities). The main goal of the programme is to improve Paka to the 2nd quality stage. The sewage system and the stage one of the municipal waste water treatment plant (WWTP) have been built to prevent the Paka from pollution.

The WWTP and the sewage system have not been completed yet. The Paka used to be partly in the 4th quality stage, but now it is at least in the 3rd (Rošer-Drev, Bole, 1997). A lot of environmental improvements has been carried out, such as the close loop system for ash transport in the Šoštanj Thermal Power Plant, reduction of water use and upgrading of the industrial waste water treatment plant in the Gorenje enterprise (kitchen appliances, the biggest slovenian net exporter). Due to upgrading of the sewage system in the Šalek Valley more waste water is entering the municipal WWTP. It is obviously that the WWTP has become the main polluter of the river Paka. Upgrading of the WWTP is the main unrealised aim of the Water improvement programme. However, the project has already been started. The local communities Velenje and Šoštanj with the help of Slovenian Ministry of Environment and Physical planning have awarded (50%) financial support of the European Union fond ISPA for carrying out a project.

An Approach to the Ecologically Acceptable Flow in Rivers Downstream of a Water Intake Structure

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ABSTRACT

Although determination of minimum water quantities, called ecologically acceptable flow (EAF (Q_0)), which will be flowing in a natural river bed downstream of a water intake structure, presents a multidisciplinary problem, it is not dealt with adequately. In spite of complex interactions of various biological factors in each river, the EAF is mostly regulated administratively or based on undefined minimum water flows. But after the concept of environmental protection has changed considerably, which can be seen in the protection of overall biological and landscape diversity by the interaction of nature and human activities, undesirable consequences of such an approach require a new many-sided and comprehensive approach to defining the use of water flows. Therefore, defining the EAF requires a selective approach, taking the existing changes of physical, chemical and biological variables from the water-spring to the river mouth into consideration as well as natural and social factors of the river-basin. The key point is that satisfying human needs related to water management should be acceptable to the environment too, i.e. it is essential to respect the principles of sustainable development and so enable future generations to satisfy their needs as well.

This paper presents an overview of basic methods and a proposal of factors needed for defining the EAF in rivers downstream of a water intake structures.

The Electricity Sector and Water Management in Brazil

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ABSTRACT

In Brazil ninety percent or more of the total electricity production is generated by hydroelectric power installations. Starting in 1997 the sector for water resources was restructured and the National Water Agency was created [Agência Nacional de Águas (ANA)], together with the State Water Agencies. The water potential of the country was divided into Hydrographic Basins. This fact changed the priorities for the utilization of the rivers. These were managed by the electricity sector, which had total power of decision over the use and purpose of its' waters, after the creation of ANA the priority has changed to become the multiple utilization of water. The importance of hydroelectric energy generation is of prime importance in the Brazilian energy matrix. This fact does not exhaust the Brazilian water potential for electricity generation, which comes from dams and waterfalls, because in fact this only takes advantage of 25% of the national hydraulic potential.

The viability of the construction of new installations, is closely linked with the preservation of the environment and its' habitat. At present in Brazil one needs the authorization of the National Environment Council, and the National Water Agency for approval by the National Electricity Energy Agency to construct any type of hydroelectric plant. .

This article pretends to discuss the relationship between water utilization and the generation of electric energy and its' sustainability.

SWARD: Decision Support Processes for the UK Water Industry

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ABSTRACT

In developed countries WSPs (Water Service Providers) must provide an appropriate level of service with an acceptable performance at an acceptable cost to customers. WSPs therefore have to balance the needs of society, economy and the environment, and in so doing, make decisions on infrastructure development that can be sustained over time. In the UK a move towards sustainable development is now a major goal for WSPs. However, the imposition of institutional systems and regulatory targets are often of such localised scope (both temporally and spatially), that they still encourage the adoption of less sustainable technologies or solutions by the water industry. WSPs around the world are now operating in a global economy and the way in which they make asset management decisions is fundamental to the attainment of more sustainable water systems. The adoption of transparent and stakeholder sensitive decision-making processes will be crucial for future changes to water/wastewater service provision.

It is within this context, that the SWARD (Sustainable Water industry Asset Resource Decisions) project has developed a set of decision support processes that allow Water Service Providers (WSPs) to assess the relative sustainability of water/wastewater system asset development decisions. These decision support processes comprise of seven major phases, ranging from the definition of decision objectives, through to post-project monitoring and feedback. The SWARD project has been multi-disciplinary and multi-institutionary in nature, with the project team including researchers from five UK Universities, together with collaborators from the Scottish Water Authorities, English Water Companies and water professionals from Romania and Australia.

A SWARD Guidebook has been produced that takes the WSP and its stakeholders through the processes essential to incorporating sustainability in asset investment decision-making. It

provides a transparent process for the incorporation of sustainability criteria, which is open for all stakeholders to contribute their judgement of the relative importance of different criteria. The information is presented in a user-friendly format that should be readily accessible to all stakeholders. The Guidebook includes detailed reviews of the constituent tools required for the processes, for example, demonstrating the use of life cycle assessment (LCA) and multi-criteria analysis (MCA) to assess the relative sustainability of different options. A list of primary criteria, in the categories of environmental, social, economic and technical, has been developed to be used generically to support the decision process. The Guidebook has been designed to be dynamic, and with experience and increased knowledge, the methodology should be revised and updated. Several case studies that demonstrate the SWARD principles in application are included within the Guidebook.

Water Shortage and Sustainable Development: Development Process Analysis and It's Impact on Future Water Supply in the Developing Countries

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Malaysia

ABSTRACT

This paper addresses the issue of water resources in the developing countries taking Malaysia as a case study. Malaysia which is one of the developing countries has embarked on a massive development program. The blue print of the development program is known as the Vision 2020 which would turn Malaysia into a developed nation by 2020. One of the immediate environmental hazard faced by the country is the occasional shortage of water supply. The high rate of rainfall, which is typical of any equatorial countries lately is unable to compensate for the water lost during the dry season. The phenomena is associated with the inability of the water catchment areas to hold rain water and consequently the rapid reduction of the water level in the water reservoir. One of the factor associated with the phenomena is the massive logging carried out in the forests especially those forest near to the catchment area and also urbanisation. Rain water make it's way directly to the tropical drains and finally to ocean. Another factor which leads to the shortage of clean water is chemical and organic substance by the industrial sectors. There are a number of rivers which are heavily polluted both by chemical as well as organic substance. The issue on water resources is an issue of development and it is very close to the way the development program is carried out so it has to be tackle through education. Water pollution can be overcome through educating the people and through technology but the lost of water due to deforestation could only be overcome through educating the people. This paper would report a research findings carried out on the attitude of the people to water resources, shortage and pollution in the urban area and subsequently an education design for the secondary and tertiary level to impart an awareness to the people of the importance of sustainable development in term of water resources. It would also include the future projection of water supply relative to the population increase and it's implication to the development program.

The Sustainability of Waste Disposal: Pollution of Underground Water by Leachates from Old Burdens (Dumpsites)

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ABSTRACT

The sustainability of the disposal of wastes and pollution are major problems plaguing megacities of developing nations like Lagos.

Environmental pollution especially from domestic and industrial waste is increasing daily due to increase population, urbanization and industrialization. Waste is haphazardly dumped and carted to dumpsites which are situated within thickly populated human settlements as seen at Ojota, Igando and Ojo dumpsites.

Underground water pollution by leachates as shown in the occurrence of heavy metals in soil and water around the dumpsites beyond WHO acceptable limits constituting health hazards for occupants who reside around these areas and are dependent on underground water for sustenance. Further, the incidences of skin related disorders was high compared with adjoining areas. The attainment of acceptable levels of these metals, its abatement and the provision of alternative sources of drinking water for occupants of these area is ideal as it would eradicate the vagaries associated with old burdens around human settlements.

Energy Accounting of Italian Electric Power Production

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ABSTRACT

80% of Italian electric power production comes from termoelectric power plants using fossil fuels. A so relevant utilization of these fuels makes the Italian system dependent on imports and not environmentally sustainable. So it becomes necessary to find out how and with which kind of alternative energies to replace fossil energy in the future. This work tries, using an energy evaluation on the entire Italian power production, to assess the different degree of sustainability among the various kind of alternative productions (hydropower, geothermal power, wind power and photovoltaic power) and thermal power [1]. The analysis was made in two ways: once using “classical” transformities of fossil fuels derived from H.T. Odum works [2]; then the calculations were repeated using a new set of transformities for fuels calculated in a different way, more consistent with the energy “algebra” [3]. The new transformities, in our opinion more reliable, are up to 70% greater than the previous ones. This fact dramatically changes the classification obtained with the first analysis, showing better the unsustainability of termoelectric production in comparison with renewable energy production. Assigning production costs on the ground of real investement of natural resources needed to obtain a product, we have the result that, with the only exception of photovoltaic power, award the utilization of renewable energies [4].

Clean Energy Solutions for Sustainable Rural Electrification

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ABSTRACT

Sustainable energy use requires that current use of energy does not compromise the well being of future generations. This notion clearly requires that we eventually move away from fossil fuels, which are dirty and unsustainable, to renewable energy sources. In the transition, electricity generation is a prime candidate for using renewable energy. Now an estimated 2 billion people do not have electricity in the developing world and many of the rural inhabitants without electricity are far from the existing centralized electricity grid. Wind, solar and hybrid systems are often good candidates for these situations, but often they face large barriers to entry. These barriers include lack of knowledge for these technologies, misconceptions about the true economic costs of providing them, and social resistance to change from time honored practices. Vested interests in existing non-sustainable centralized technologies in government owned enterprises, government regulatory agencies, and the private sector may also act as an impediment to the deployment of renewables.

The use of hybrid systems for patrons far from the grid in developing countries with the above barriers to renewables could be a suitable transitional approach to all-renewables power supply solutions. Hybrids in the form of wind, solar and diesel generation offer optimum power supply solutions that could not be achieved through single-source or single technology energy solutions. The diesel back up is a known technology that will be available when wind and solar are not, and diesel generators can be used to keep batteries at an optimal charge level. The movement from diesel to renewables can be gradual allowing local expertise to develop. Further, such a decentralized, clean-energy experience should foster proprietary feelings for the technology and a desire to improve the technologies. They should raise awareness and speed the social acceptability both at the grass roots level and for government policy makers.

To illustrate the economic benefits of hybrid systems, that will lead to clean, sustainable electricity, we present a case study in a project area in the southwestern desert of Egypt. Optimization software developed by the National Renewable Energy Laboratory is applied to identify the optimal hybrid system. Various barriers are identified and policy reforms are recommended that would contribute to the adoption of optimal hybrid power systems in this and similar projects and areas. The results from the study will be used to educate the stakeholders in the project. They should lead to prototype studies and projects that help electrify other communities that are far from the electricity grid and trigger a transition to sustainable energy.

The Economic Calculating Information as Basis for Decision Making Process About Investment in New Electro Power Objects - Small Hydropower Plants

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ABSTRACT

Today one quarter of the primary energetic resources (coal, gas, petroleum and water power) are utilizing over electrical energy. Electro power system of BiH based on generation electricity from two types of plants: thermal power plants, hydro power plants and small hydropower plants.

In this paper, through example of the small hydro power plant, will be done basic conditions in investment decision making process for construction of these plants. The goal of this research work is to give a comparative analysis in choosing process of the favorable economic characteristics of generation electricity in plants with the same starting points.

During decision making process for new plant construction, it is necessary to carry out an analysis of the plant construction costs and annual amount of generation energy. An index which indicates this ratio is generation electricity price in power plants. In addition, except this price as basic index in new plant construction, going process of applying new technologies, coordination with EU norms, in such a way that constructed plant have not environmental impacts, or at least as possible.

Today ongoing process of small hydro power plants construction around the world can not be evaded in our country.

The small hydro power plants installed capacity 1000 kW provides electrical power needs for 1800 householders (example from Germany).

On this way generated electrical energy decreasing harmful gases emission for:

- 3 500 tone CO₂
- 2 200 tone NO
- 1 600 tone SO₂
- 400 kg CO.

Combined Cycle Installation with Steam Injection and Heat Supply

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ABSTRACT

Combined cycle installations is a very promising way to increase efficiency of power generation and reduce a cost of electricity. Among different types of combined cycle installations those with steam injection into combustion chamber of the gas turbine (STIG technology) appear to be very attractive because of their simplified technological scheme due to absence of steam turbine, condenser, and cooling-water system (the scheme comprises a compressor, a turbine, a heat-recovery boiler, and certain auxiliaries). This considerably (by 10-12%) reduces capital outlay into the power station and the cost of electricity production (by 8-10%) as compared to those for binary-type combined cycle installations. Moreover, steam injection into combustion chamber makes it easier to ensure low NO_x emissions into environment with stack gases.

For the above reasons, in Russia, intensive R&D work is presently undertaken to develop modern efficient STIG-installations of different capacity for different applications, including those based on air-derivative gas turbines. As an example, in the paper, the characteristics of the turbine and the installation as a whole, which is based on the AL-21STE engine manufactured by the Moscow Salyut Works are presented.

In Russia, municipal systems of centralized heat supply are widely used. Therefore, it is interesting to modify the STIG installation in such a way that provides supply of a large amount of heat for district heating, as is presently done by cogeneration power stations. This aim can not be attained only by means of utilizing sensible heat of the waste gases. It is necessary to use latent heat of the steam earlier injected into the combustion chamber. Therefore, downstream of the heat-recovery boiler, the contact-type condenser is installed, in which the heat of condensation of the steam is spent for heating the circulating water. To increase the potential of the heat (the temperature of the condensate) up to the level that is sufficient for district heating, the heat pumps are used. As a result, we obtain sufficient amount of hot water of the required temperature.

Simultaneously, we exclude losses of water injected into the working medium. The coefficient of using the heat of the fuel increases up to 95-97%.

Modelling of Energy and Environmental Costs for Sustainability of Urban Areas

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ABSTRACT

At present, urban areas concentrate a large number of activities and population. This implies the importation and use of massive energy resources. The majority of the imported resources are not renewable and a huge quantity of waste is generated. Large imbalances are caused by the inflows and outflows of materials, altering seriously the ecosystems where resources are taken. Due to the exploitation of resources and the discharge of waste these ecosystems are doubly damaged.

The control of energy and environmental costs in the urban areas represents, therefore, an essential instrument in order to achieve the correct resource planning. Resource modelling provides a global vision of the real operation and the technological basis for the sustainable management of urban areas.

In the article, the results obtained by energy modelling of three urban areas of different sizes are presented. The analysis, done during a biannual R&D Project financed by the Spanish Ministry for Science and Technology, were based on two interrelated concepts: energy costs and environmental costs. The article's principal aim is to present the simulation obtained by using energy modelling and the results achieved by the practical application of the modelling to three urban areas. The simulation shows the potential improvements that can be achieved by the correct application of resources planning. The application of modelling demonstrates as well the benefits that arise from energy saving, improvement of process efficiency, an adequate social awareness campaign and the promotion of renewable energy. The simulation facilitates the introduction of energy and environmental costs elements in urban planning.

Through the proposed modelling, the energy flows of the three analysed urban areas have been quantified and classified. In addition, the energy and environmental costs have been aggregated for each productive sector. Using the methodology proposed in the article, innovative solutions could be specially designed for different areas in order to ensure the sustainable development of Municipalities.

The final part of the article presents the most important conclusions of the analysis and shows how the methodology can be successfully applied to a large variety of different scenarios and locations.

Effect at Rapidly Expansion Through High Temperature Turbine on Exhaust Gas Composition in Closed Gas Turbine System

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ABSTRACT

Hydrogen fueled Closed gas turbine system is favorable for protect the environment because of its very high system efficiency without any emission except for water. But, in the actual operation, the purity of Oxygen is not sufficiently high according to the plant cost and system efficiency. So, the investigation method including the effect of chemical kinetics, expansion in the turbine and the impurity on reaction products such as NO_x in high temperature combustion has been needed. We made the investigation for the effect of O_2 purity on formation of intermediates and the effect of expansion process in turbine on suppress of there formation reaction. We also adapted this analysis for the CO_2 recovering closed gas turbine system with $\text{CH}_4\text{-O}_2$ firing. Because the main components of H_2 fueled system could be convert for the CH_4 system. The effects of O_2 purity, expansion pattern and fuel on NO_x emission were clarified.

Decentralized Energy Supply for Buildings with Double-Skin Facades

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ABSTRACT

Looking back on developments in architecture during the last decade, especially at administration buildings in Central Europe, there is a more and more obvious trend in installing so called “double-skin” façade systems. What architects are seeing in these fully transparent façades primarily is a designing element, simply making it possible to give a filigree and gentle appearance to nearly every construction by emphasizing the outer glass hull, whereas the shape of the proper building recedes into the background. Furthermore, “double-skin” façade systems are propagated by architects in connection with so-called “sound, ecological administration buildings”, that are branded by a at least partially natural ventilation system and an extremely low energy consumption rate. Double-skin façade systems are characterized by an air-permeable second façade level, which is placed in front of the primary façade of the building.

In the last years, double-skin facades were not only considered for providing an alternative ventilation, but also for integrating systems supplying the neighbouring rooms with heat and cooling capacity, respectively. The focus in developing decentralized energy supplying units integrated into facades is to replace centralized building supply plants for the sake of an intelligent conditioning of single parts of the building, meeting individual requirements and also to significantly economize space for distribution facilities.

Possible installations for decentralized energy supplying units integrated in the parapet region of pre-manufactured façade elements are for example both solar thermal collectors and photovoltaic systems, as well as shading elements that can be designed as rollable photovoltaics or also as matrix air collectors, respectively. Considering also the cooling capacities in administration buildings, small absorption chilling units operated by solar vacuum tube collectors at a temperature level of 120°C can be installed. Talking about the conventional (i.e. non solar) part of providing electrical power and heat for both heating and cooling, the use of small co- and trigeneration units based on fuel cells is not only taken into account but already under investigation. Especially high-temperature fuel cells MCFC and SOFC with a high exhaust temperature level of 450°C to 600°C have the potential of effectively running 2- and 3-stage absorption chillers working with LiBr/H₂O as cooling media.

Summing up, it may be said that decentralized supplying units run by solar energy and highly effective equipment such as fuel cells together with advanced insulation materials for buildings is not only to reduce their energy consumption significantly, but helps also to reduce ambitious CO₂-reduction goals.

On the Solar Experimentation Field of the Technische Universität München, three different double-skin test units are installed together with PV- and collector testing facilities. During the last years, extensive experimental and analytical research was done on heat transfer and air flow in double facades, heat transfer in matrix collectors, solar absorption chilling and advanced

insulation based on microporous materials for minimizing heat losses in buildings. The objective of the present study is to give an overview over research activities and results on the experimentation field with a focus on actual studies on matrix collectors. Furthermore, prospects of future building supply concepts using sustainable decentralized energy systems in facades, that are also under investigation on the experimentation field, shall be discussed.

Alteration of the Chemical Disinfection to Environmentally Friendly Disinfection by UV-Radiation

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ABSTRACT

The water works Ponikve distribute daily in the summer season approx. 7000 m³ of treated lake water "Jezero" through the complex drinking water distribution system of the northern part of island Krk, Croatia. Until 2000. disinfection was done by chlorine and chlorine dioxide which may be hazardous to human health by itself or by its by-products. In order to avoid problems with disinfection by-products of both chlorine and chlorine dioxide that were present due to presence of natural organic matter in lake water, in 2000. was started with the large-scale pilot test of UV irradiation for disinfection of drinking water for the part of distribution system. Four microbial groups, total coliforms, fecal coliform, fecal *Streptococcus* and total microbial count group have been used as indexes to test disinfection efficiencies. Samples were taken prior and after the irradiation and at the point of use from distribution system \approx 2000 m far from the UV-disinfection unit. This paper presents the results of 10 months investigation period that includes different seasonal quality of raw water. During the test period intensive bacteriological monitoring showed that microbial water quality standards could be held. Despite very high summer temperatures of water - up to 30°C and quite a complex distribution system, disinfection process was successful with the UV-radiation. The water works Ponikve continues to change chemical disinfection equipment to UV-radiation.

Burners with Reduced Emissions Production as Important Contribution in Industrial Application

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ABSTRACT

Possible ways to reduce harmful emissions production in case of gas fuel combustion are described. We have focused on low-NO_x burners operation in relation to process parameters, type of fuel and especially the design of burners. Two types of burners – the first one with the air staging and the dual one - were installed into experimental facility and important parameters measured.

Using the dual burner represents an important contribution in various industrial applications. One of them is demonstrated in this paper. A special burner has been developed for using in the process for thermal treatment of wastes sludge in one large plant for pulp production. Natural gas is substituted by waste gas from closed mines. This gas contains approximately 50% of methane and 40% of nitrogen.

Research and development of burners like these is shown including mathematical modelling providing us with a possibility to predict various parameters including the NO_x emissions concentration.

Intoruction in Motive Thermodynamics of Light

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ABSTRACT

The purpose of this communication is to firstly unite the thermal and mechanical descriptions of sunlight powered direct energy conversion systems at an elementary level. By this approach, any element of new mechanical energy by conversion from thermal one is considered to be as the result of work conducted by two motive forces in multiphase systems, which are principally equal in magnitudes and have opposite directions according to the law of momentum conservation. The novel complex format of work to unite mechanics and thermodynamics on motive thermodynamic concept is introduced to right explain the mechanisms of gigantic motive forces firstly created experimentally. By using both laser and solar optical pumping, the new vibration and capillary motive forces for mechanical propulsion were created to transport liquids directly by continuous light to serve as experimental basis to formulate First and Second Laws of motive thermodynamics. The outline of both branches of motive thermodynamics is given within the laws of energy and momentum conservation and non-equilibrium entropy of sunlight having terms responsible for both 1) renewable and 2) non-renewable processes to solve the fundamental problem of maximum light available for conversion. The elements of renewable motive thermodynamics are experimentally found by acting CW lasers for effective generation of vibration and capillary propulsive forces in multiphase liquids by renewable volume of system as a whole for next solar application [1]. There are two branches of application of renewable motive for engineering: a) direct conversion of light with high effective up to 100g acceleration of bodies for elevating and vibration engineering [2] and laser capillary extraction purposes [3] building new kinds of renewable power plants. The principles of non-renewable out-Carnot thermodynamics is introduced for using laser light as energy for mechanical propulsion (SP) with non-renewable volume, when production of mechanical energy is due to non-renewable flows induced by energy of light in new kinds of liquid fuels.

Fundamentals points of motive thermodynamics to discuss will include but not limited to::

1. Light as a motive power in motive thermodynamics may dramatically change reversible approach applicable earlier for motive power of Heat.
2. The postulate of additivity of both entropy and energy is not applicable in motive thermodynamics of light because it leads to a mathematical paradox described in paper. [1]
3. There are two principally different mathematical tools - variational (analytical) applicable for reversible thermodynamics and vectorial (actual) applicable for motive thermodynamic of light.
4. There would be two problems by conversion of light into mechanical power: 1) to product energy at all (by a non-renewable way) and 2) to product energy by keeping mass and volume (by renewable way) of system as a whole.
5. Theorem of Carnot of equilibrium thermodynamics is applicable only for renewable cycles. The role of heat sink (either in a phenomena or in an engine) is to create condition to return system (including a work substance) back.
6. In case of non-renewable out-Carnot motive thermodynamics, a new mathematical body is necessary to find the restriction for actual efficiency.
7. The basis of First and Second Laws of motive thermodynamics is two measurable quantities - thermal energy in its calorimetric meaning (E -internal, Q -transferred, both: $J=E+Q$) and mechanical one (H). Work (W) is to define a path (cycle) for conversion $J \rightarrow H$

Combustion and Emission Control by Combustion Modeling: an Application of Transient Laminar Flamelet Model and Its Further Development

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ABSTRACT

Combustion at a technical level generally means, that the flows of fuel and oxidant, entering the combustor either premixed or as separate flows are turbulent. So mathematical modeling of combustion means to model turbulent reacting flows. In order to simplify the task of simulating chemical reacting flows different models have been developed for certain combustion regimes only. One of them is the steady laminar flamelet model that could be described briefly as follows.

The averaged Navier Stokes equations with modelled turbulence are solved together with a transport equation for mixture fraction. The transport equation for sensible heat (temperature) is transformed into the mixture fraction space. The source term in this transport equation is created under assumption, that each point in this mixture fraction space is behaving like a laminar diffusion flame, with a certain strain rate. Therefore it can be taken from a flamelet library, a set of exact solutions of such laminar counterflow flames. As the temperature has a strong influence on the flow field this set of equations has to be solved iteratively. As all the detailed information about species concentration is available in the library, it can be used for post processing of pollutant formation, like NO_x or soot.

If the flow is sufficiently premixed it is required that the flame front is thinner than the smallest eddies for the flamelet model to be valid. In a non-premixed flow the mixture fraction gradients have to be sufficiently large to separate the single combustion regimes. In both cases it is necessary to resolve the structure of the thin flame front. As chemistry is always assumed to be infinitely fast, which means that the flamelet is always in its equilibrium state according to the local strain rate, there are limits to the applicability of this model.

To overcome those limits and shortcomings a new transient laminar flamelet model has been developed. Besides the equilibrium flamelet some solutions of a few time steps before reaching the equilibrium state are stored in the flamelet library. The flamelet is then correlated with the turbulent flow not only by mixture fraction value and the dissipation rate but also an additional time constant, which is taken to be k/ϵ .

This paper deals with the application of the transient laminar flamelet model as a tool for combustion and emission control.

Estimation of Technogenic Loading on Environment System of Donbas and Prognosis of Its Slowing Down

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ABSTRACT

Donbas is situated in the Eastern Ukraine and it is the biggest coal-production region of country. There are so many coal mines, metallurgical, coke-chemical, mechanical industries and others manufacturing business. The extraction of coal is carried and by the subterranean method, which explains the evolutions of cities besides, the premises of coal mines, which at present have concentrated into huge and highly diffused terms of, occupied areas of agglomeration. At present in Donetsk and Lugansk regions are living 90 % and 86 % of urban population respectively. Resulting, it is large density of the population at the limited possibilities of self-support. Within the last 100 years (and in period after the second world war especially) the landscapes of eastern part of Ukraine test significant of technogenic load and intensively store toxic of substance. The fast development of industrial production has reduced in growth, and in subsequent and junction of separate occupied points in cities and creation of agglomeration. Outcome of industrial activity in Donbas has become expressed, and in a number agglomeration and excessive negative effect over an atmosphere, hydrosphere and lithosphere of locale. Significantly the unfavorable effect on biosphere of the industry and transport system provide also the requirement of Donetsk and Lugansk areas .

In last 10 years in Donbas there was a sharp reduction of air pollutant emissions of toxic substance in atmosphere. Total amount of pollution for 10 years has decreased to 37%. Thus, in structure of air pollutant emissions has changed the ratio between pollution from fixed and movable sources. In last 5 years is characterized more than double reduction of a volume of pollution from fixed sources, but the transport pollution have increased 1,2 times. Donbass is the region of Ukraine, which is unsufficiently supplied with a natural water. The water supply is done by local nature. river drain makes about 190 m³ on one inhabitant per one year. It is 5 times less than those of average of Ukraine. There is lack of the large rivers and natural lakes in the Donbas region. The economical crisis have been minimised the drinking water from surface water source upto 26 %. The total volume of throwing of sewage water in this period minimised upto 20 %. The heat pollution of environment forms heating water in water reservoirs which is used for colding system of electrical station except of this the happening of water in Azov sea, where it falls technical water from metallurgical plants "Azov Steel". Energetical effect have air environmental of central Donbass.

Now in Ukraine the tighter ecological legislation is entered. For its performance in Donbas in 1998-2000 years is realized the program of social and economic development of Donetsk and Lugansk regions. There has 30 means of protection been inserted. The volume of pollution have reduced, almost to 100 thousand m³. The perspective "Program of an environmental protection and maintenance of ecological safety in 2001-2005 years" is designed. Prognosis of slowing down of air and water pollutant emissions is overall fruitful in modern time. During the last 5 year the work have been active by reconstruction of collector and cleaning water complex and dredge of small rivers in several towns (Krasnoarmeisk, Konstantinovka, Drudzkovka, Donetsk). The sum of expenditure over natural protection is \$ 12,7 million (1998-2000 years).

Combustion Behavior of H₂/Air and CH₄/Air Mixtures at Low Concentrations

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ABSTRACT

The use of the hydrogen as an energy carrier for the future, is also conditioned by its safety. People incorrectly perceive the hydrogen as a gas more dangerous than methane, which is widely used and so accepted.

In this paper deflagration of H₂/air and CH₄/air mixtures at low concentrations (close to the lower flammability limits) will be analyzed. In particular the focus will be the phenomenology and dangerous aspects of this kind of combustion and the related possible accidents, which involve closed environments (garages, laboratories, services rooms, internal volumes of buses and cars, etc.) and where ignition sources are present. In these cases a combustion takes place as soon as the fuel concentration reaches the lower inflammability limit.

The two gasses will be compared on the basis of general energetic characteristics and theoretical examination on the main parameters related to the combustion phenomenon, as well as on the basis of the experimental results of LARGEVIEW apparatus, where more than 300 combustion tests have been made with both gases.

The test facility LARGEVIEW is designed to withstand a maximum internal overpressure of 300 kPa. The vessel consists of a square parallelepiped made up of rectangular panels fastened to a steel framework. The inner dimensions of 0.68 x 0.68 x 3.2 m lead to a total volume of 1.48 m³. The frontal and upper panels are made of high-strength stratified glass (40 mm thick); the other panels are made of enhanced carbon steel. The ends are closed by two steel plates; the left-hand end is provided with a large opening to allow the venting of burned gases during deflagration.

The test facility LARGEVIEW was design to studying "slow" deflagrations of hydrogen-air and methane-air mixtures in a partially confined environment. The apparatus makes possible to visually observe the flame propagation. Besides the acquisition of pressure and temperature transients in both chambers which the facility is divided into and the video-recording of the phenomenon, measurements of gas velocity in the ignition chamber have been carried out through a laser-Doppler velocimetry.

An Innovative Sustainable Process for VOCs Recovery from Spray Paint Booths

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ABSTRACT

Many manufactured items receive surface coatings for decoration and/or protection against damage. In general terms, the surface coating process comprises several distinct steps: surface preparation, application of coatings, and curing of coatings. Air emissions from surface coating operations result from the evaporation of the organic solvents in the coatings and consist primarily of volatile organic compounds (VOCs). These VOC emissions can occur in a number of places along the production line: during atomization and application of the coating, during initial air drying of the part after it leaves the spray paint booth, and, eventually, in the bake oven.

In order to limit VOCs emissions, two possible actions are today foreseen: VOC destruction or VOC recovery.

VOC destruction results from the oxidation of VOCs to produce carbon dioxide and water. This can be accomplished via heat from incineration which is a rapid, exothermic oxidation process that destroys organic material in the off-gas.

In general, costs of incineration can go up dramatically as the temperature required to accomplish the complete burn are raised. This is only partially related to fuel costs. The larger reason is the costs associated with handling the different types of byproducts produced by non combustibles associated with high incineration temperature VOCs such as chlorofluorocarbons or halogens. The costs can also rise, if auxiliary fuel is required to accomplish the incineration. This can happen if the concentration of VOCs in the air stream is below 1000 ppm.

There are two major types of VOCs recovery: refrigerated condensation and adsorption, followed by refrigeration.

In refrigerated condensation, the VOC air streams are brought to the saturation point and the liquid is collected for further processing.

Although there are several types of condensation systems the most common adopted is a reverse Rankine cycle where a closed-cycle heat pump with a separate working fluid is used to condense VOCs.

Adsorption is a process whereby the VOCs in the air stream are captured physically on the surface of a solid such as carbon. Steam or inert gas is then used to regenerate the solid beds by stripping the concentrated VOCs from the surface before it becomes saturated

Continuously operated, onsite regeneration bed systems have a minimum of two adsorption beds. One is desorbing while the other set is adsorbing.

Recovery of a solvent is justified if the value is significantly above fuel value and the process lends itself to high capture efficiencies.

Aim of this paper is to present an innovative and sustainable process based on VOC absorption. An absorption tower is fed on the top by oil which efficiently absorbs at low temperature the VOCs contained by the off-gas which enters the tower at its bottom. The mass ratio between oil and gas is approximately around 1, so that a tray configuration results more efficient than an alternative packed column. Saturated oil from the column is then stripped at high temperature in a vacuum system which condenses VOCs at a temperature slightly below the ambient temperature. Stripped oil is then recycled to the absorption tower. Special utilities are foreseen

to reduce the water content in the gas and for energy recovery all over the plant. An industrial site located in Italy, works at 14000 Nm³/hr off-gas absorbed with slightly more than 10 m³/hr of oil. VOCs content in the off-gas ranges daily from 1200 ppm to 2500 ppm; an average efficiency of approx. 90% recovery is presently obtained. A further reduction to an expected value of about 95-98% will be achieved in the next months.

The paper will provide a complete description of the plant including operating conditions and economic evaluations.

Modelling the Geographic Distribution of Scattered Electricity Sources

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ABSTRACT

Denmark has an ambitious energy policy aimed at curbing CO₂ emissions by 20% relative to 1988 before 2005 and a long term target of halving emissions. Important measures include expansion of both wind power and CHP (cogeneration of heat and power). Of these two, wind power alone supplied nearly 14% of the Danish electricity consumption in 2001. As expansion will continue and as consumption is relatively stable, the share of both wind power and CHP is projected to increase. Apart from fuel savings this also introduces a geographically scattered electricity production system.

Transmission systems have traditionally been designed to accommodate a radial electricity flow from a few points of production to a multitude of points of consumption. The development towards a geographically scattered production system has generated a need to look thoroughly into the geographic distribution of production and consumption and the lay-out of the transmission system. This need is underlined by the fact that transmission lines increasingly are on the political agenda due to visual impacts on the landscape.

Previous analyses have demonstrated how power balance may be maintained locally through intelligent regulation of most notably CHP plants. This paper addresses methodology and results for modelling the impact of geographically scattered electricity production on transmission grid requirements.

Slagging and Fouling in Biomass Co-Combustion

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ABSTRACT

The growing interest in global warming due to carbon dioxide emissions has drawn attention to the use of biomass as fuel for power and heat production. Deposits formation on heat transfer surfaces (referred to as slagging and fouling) is one of the biggest problems for all solid fuel fired boilers, especially in biomass combustion. Reducing slagging and fouling will lead to reduced investment and operational costs, increased performance efficiency and reduced emissions.

Methods for an on-line detection of slagging are currently not available; operators have to rely on their operation experience and on the off-line analysis of deposits. Prediction and on-line detection of slagging will help to optimise plant operation, increasing plant availability and reducing maintenance requirements. Research is conducted at the TU Delft, Thermal Power Section, to develop a system (model and measurement method) for slagging on-line monitoring. Heat transferred from the furnace to the heat exchanger will be conducted through the deposits as they form and then to the water/steam flowing inside the tubes. The effect of deposits to reduce heat transfer rates to furnace walls, superheater tubes and other heat transfer surfaces is studied in this work to monitor slagging and fouling.

Research involves both the development of a model and of novel experimental techniques. An on-line monitoring model to visualise slagging/fouling tendencies in a real power plant and an experimental method to establish the relationship between deposits and heat transfer, are being developed. The model applied is developed with the Aspen Custom Modeller (ACM) program and consist of the major part of the water/steam circuit. The model has been tested offline as well as online. It is appropriate for visualising deposit tendencies under all load conditions. The experimental method aims to measure the "effective thermal conductivity" of ash deposits as they form in an on-line probe. A prototype of the on-line probe has been designed, constructed and tested in co-operation with the IVD, University of Stuttgart, showing that it is possible to determine the heat transfer through an air-cooled probe and that the influence of the deposit can be detected. Recommendations for a better probe design and testing facility are given. Further research on the influence of slagging and fouling on heat transfer parameters can result in a tool for on-line slagging monitoring.

Modelling of Non-Stationary Temperature Stresses in Steam Turbine Casings

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ABSTRACT

All the more extensive usage of steam turbines for ensuring variable part of electric load is characterised by requirements for high manoeuvrability of operation (rapid starting, stopping and change of power). In these conditions safe work of turbine is not possible without the usage of different expert systems for on-line control (e.g. for the estimation of strength margin and the remaining useful life of parts), which demands knowledge about temperature stresses state in steam turbine elements. The additional attention is dedicated to thermally most loaded thick walled parts, as steam turbine casings, in which the intense space and time dependent temperature gradients cause high non-stationary temperature stresses. Non-stationary temperature stresses are also determined in the design of new turbines for solving different problems (e.g. optimisation of geometry of turbine elements). In the present time non-stationary temperature stresses (clearly as well as the state of total stresses) are efficiently calculated by modelling by means of the user software programs (software packages) which are based on numerical methods. The paper will present the procedure and the results of non-stationary temperature stresses modelling in steam turbine casing by means of the user software package. Also for modelling of temperature stresses (i.e. of temperature fields and deformations) along with the mechanical boundary conditions it is necessary to know thermal boundary conditions and the convective heat transfer coefficients. Because the calculation accuracy of the temperature stresses (i.e. of the temperature fields) strongly depends on the validity applied thermal boundary conditions, the special attention will be dedicated to defining and determination of the convective heat transfer coefficients on surfaces of different spaces inside the turbine casings (e.g. in inlet casings, in exhaust casings, in spaces between external and internal casings, in channels of system for preheating of flange joint, in spaces of steam extractions and cross-over pipelines, in spaces inside valves). In the paper will be presented the original generalized statistical correlations for determining of the convective heat transfer coefficients on provisionally mentioned locations. These correlations were just used at calculations which results will be shown in the paper.

Dynamic Stock Modelling: A Method for the Identification and Estimation of Future Waste Streams and Emissions Based on Past Production and Product Stock Characteristics

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ABSTRACT

The extraction, use and discarding of materials gives rise to environmental problems. A relatively new field of research, industrial ecology, is concerned with studying society's metabolism to analyse the cause of these problems and possibilities for a more sustainable management of materials. Substance flow analysis (SFA) is one of the main analytical tools within the industrial ecology research field. The purpose of SFA is to support resource management or pollution policy. So far, the attention in the SFA community has been focused mainly on drawing accounts and on comparative static modelling. Dynamic models are scarce, but there is an increasing demand for them. The main value of dynamic SFA models lays in the possibility to predict future resource and waste streams of products and materials which is relevant information for recycling and in turn the demand for primary materials. Recently, it is acknowledged that the main difference between static and dynamic modelling lies in the inclusion of stocks in the society.

The mechanism determining stock dynamics can be classified into three levels: stocks of products, handled by producers and consumers, stocks of materials that those products are composed of, and stocks of substances, contained within these products and materials. Stocks on these three levels have their own characteristic and different behaviour.

In a cooperation project between CML and Vito, a dynamic SFA model is being developed taking these three levels into account. For each level, the inflows and outflows of societal stocks are determined.

The inflow of new applications into the stock is mainly determined by economic factors such as substitutability, the price of the product, income, etc. and socio-economic factors such as population size, welfare, GDP or technological developments. The outflow out of the stock concerns either emissions during use (corrosion or volatilization) or the discarding of products. The outflow thus on the one hand related to the chemical and physical properties of the substance which determine whether emissions from the stock may take place (e.g. volatility) or whether the substance may be extracted from the discarded product and recycled. On the other hand, the life span of the products is of crucial importance.

The model has been applied for two applications of lead in the EU (SLI batteries and Cathode ray tubes). The results of the two lead applications will be presented in details in the paper.

The model shows that an accurate function of the inflow in combination with an appropriate life span distribution have the major influence on the model outcome.

A Computational Model of an Aerodynamically- Valved Pulse Combustor

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ABSTRACT

It has been known for long that pulse combustors offer a number of advantages as compared with conventional steady-flow burners (e.g Beer 1974, Putnam 1986). Major features are the efficient combustion and enhanced heat transfer at contact surfaces as a consequence of higher turbulence level and mixing, as well as of pulsation of the velocity of combustion gases. Periodic interchange of rapid combustion and quenching lowers the averaged combustion temperature. Also, the reverse flow of combustion products from the exhaust pipe into the combustion chamber during the low-pressure period in the cycle enables the burning of unburnt fuel residual. Both of these effects contribute to the reduction of NO_x emission and to favourable conditions for the reduction of SO_x from the exhaust gases. Selfpumping mechanism eliminates the need for an external energy supply to pump in air for combustion, as well as a need for a chimney to generate draft for exhaust of combustion products. Pressure pulsations together with consequent vibrations of bounding solid surfaces reduce the ash deposition and fouling.

These advantages have inspired extensive research and development activities in the past, resulting in a variety of proposed designs of pulse combustors, both with mechanical and aerodynamical valves (e.g. Putnam et al. 1986). However, because of some shortcomings, only few types with mechanical valves reached the stage of commercial application. The main deficiency is a very high noise level, which deters a wider use of pulse combustors in residential space heating and similar applications. Of course this shortcoming may be converted into advantage when the strong acoustic waves are to be used for reducing the fouling of exposed surfaces, loosening and removing a deposit, or to enhance heat and material transport (drying and conveying of loose material). A reduced maneuverability and control of the process, as well as a lack of flexibility in operation, particularly in the case of aerovalved combustors (too narrow range of operating conditions) have also been listed in literature as shortcomings, though some designs have achieved wide ranges of loading in which the combustors could operate in a stable self-pumping regime (e.g. Smajević and Hanjalić, 1993).

The paper outlines the rationale and presents some results of computational modelling of a gas-fired pulse combustor with aerodynamic valves. The development of the model followed experimental investigations during which the combustor geometry and operating conditions were defined and basic parameters correlated. A simple 'tank and tube' approach was adopted by decomposing the combustor into several elements which were modelled separately, together with the interconnecting processes. The solution was obtained by marching integration in time over several cycles. The model reproduced reasonably well the recorded time history and averaged values of all basic parameters. Subject to further refinement, the model is expected to complement the experiments and to serve the purpose of further optimization of design and operating parameters of the combustor.

Sustainable Energy Systems for Tropical Villages Using a Combination of Gasifier, Fuel Cells, Micro Turbines and Cooking Gas Supply

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ABSTRACT

Producer gas generated in gasifiers can be used as a fuel in Solid Oxide Fuel Cells and the high temperature waste heat generated in the fuel cell shall be used in a gas turbine. The biomass, which is now used for cooking in tropical villages with a very low efficiency, can be gasified and the produced gas shall be supplied for cooking. The biomass saved when using this mode of cooking which has a much higher efficiency can be used for electricity generation with integrated fuel cell-gas turbine systems. The high efficiency and low emissions of such systems are highly attractive and hence offer a promising technology for sustainable distributed energy systems in the future.

A study of the conversion of biomass into electricity and heat using systems with biomass gasifier, solid oxide fuel cells and micro turbines is carried out. Thermodynamic modeling is done for such systems and a preliminary economic analysis is conducted. The techno-economic potential of such systems combined with producer gas supply for cooking, for sustainable energy generation in developing tropical countries was explored and expected problems in the realization of such systems and possible solutions are discussed

Open Recirculating Cooling Systems Cooling Water Chemical Treatment at INA Naftaplin, CPS Molve III

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ABSTRACT

Open recirculating cooling system principles and problems that may occur as the consequences of the implementation of such concept are presented. The solution and characteristics of cooling system at INA NAFTAPLIN, CPS Molve III have been described with detailed study of the cooling water chemical treatment, choosing the problem solving program and application of automatic feeding control as well as treatment results. Measurements of water flow on critical heat exchanger have been performed. During the testing a failure of cooling unit operation has occurred. Establishing the planned solution procedure (congruently with the ISO), the team of experts has defined the causes and implemented the correct cooling water program and methods of continuous monitoring and control.

A General Mathematical Model of Solid Fuels Pyrolysis

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ABSTRACT

The aim of this work is to present and discuss a detailed kinetic model able to describe the devolatilization process of solid fuels, under pyrolysis conditions. The major reason of this interest in a better understanding of pyrolysis and combustion of coal, biomasses and solid fuels lies in the increasing concern of the environmental impact of large scale combustion processes. The common chemical and structural aspects of the different fuels are singled out and used as the starting point to define this mathematical model. The formation of light gases and liquid tars is the first step in the pyrolysis process. A particular attention is also devoted to the generality and flexibility of numerical and mathematical methods. Two major critical points are present inside this model: the former is related to the definition of the initial structure of the fuel and the latter is constituted by the set of reference kinetic parameters of the different reactions. Several comparisons with experimental data are analysed and the molecular weight distributions of the tar from different coals evolved at different temperatures are also discussed.

Analysis of Sustainable HVAC Systems in Adriatic Tourism Facilities

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ABSTRACT

World and Mediterranean trends in tourism growth are followed by energy consumption growth. Bearing in mind that heating and air conditioning accounts for almost half of the energy consumption of many hotels, necessary infrastructure to meet growing demand with minimal impact to natural resources and environment should be provided. Paper deals with sustainable solutions for cooling and heating of tourist facilities on the Adriatic coast. Analysis of two systems utilizing renewable energy sources is made with simulation program Trnsys. Cooling systems utilizing seawater as “free source” of cold energy, and absorption system utilizing solar thermal energy are compared with conventional vapor compression system. It was showed that significant savings in energy consumption and CO₂ emissions could be accomplished. At the same time systems provide water conservation measures, negligible visual and noise pollution.

Comparison of Fouling from Alternative Cooling Water Sources

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ABSTRACT

Large amounts of potable water are used by the UK process industry as a cooling medium. The amount of water used is increasing but the amount available is not. If this trend continues, sources will become depleted and could eventually run dry. In some parts of the country the industrial demand dominates the quantity of water supplied. Reducing industry's reliance on potable water in these areas would ease the burden on local supplies and release water to be used elsewhere. As part of a project funded by the UK government, National Engineering Laboratory (NEL) examined the potential for the use of alternative water sources as cooling water.

The quality of potable water has improved with every new piece of relevant legislation, but the changes tend to focus on human health so are of little benefit to industry. Since cooling is usually achieved by indirect contact between the process and cooling streams, changing the cooling water quality will have no direct effect on the hot stream. However, severe disruption can occur, if the cooling water quality is poor, as a result of heat exchanger fouling. Thus, a critical part of the project was an assessment of thermal fouling potential.

Investigations were carried out on secondary sewage effluent and canal water in an evaporative cooling circuit. The existing potable supply was used as a benchmark. Fouling was measured in NEL's Portable Fouling Assessment Unit, which measures fouling on the inside of a heated tube. This unit allowed parametric assessment of the waters, so the effects of fluid velocity and tube material on fouling were examined. The water was tested in the circuit at two different cycles of concentration.

The sewage effluent caused very rapid and severe fouling at low cycles of concentration and would be unsuitable for use without further, substantial, treatment. The canal water showed more promising results. Although fouling was observed, this was not as severe as was experienced with the effluent and reached an asymptotic level quite quickly. No significant increase in fouling was experienced when operating at higher cycles of concentration. With a treatment regime similar to that used currently, the canal water could be a viable alternative source of cooling water.

Temperature of the Coal Particle During Processes of Heating, Drying and Devolatilization in Fluidized Bed

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ABSTRACT

The results of experimental and theoretical investigations for processes of heating, drying and devolatilization of the coal particle in fluidized bed are presented in this paper.

The original physical and mathematical model was made that describes unsteady behavior of the coal particle during heating, drying and devolatilization in fluidized bed. It was supposed that the shape of coal particles is spherical with constant diameter during drying and devolatilization, without particle fragmentation. The mathematical model enables analysis of the particle temperature profile using different relations for thermal conductivity and specific heat capacity.

Temperature changes in the coal particle were determined numerically solving differential equations for heat and mass conservation. The boundary conditions of third kind took into account fluidized bed conditions. Convective heat transfer coefficient between the coal particle surface and the fluidized bed is described with correlation obtained on the basis of our prior experimental investigations.

Parameter analysis of model showed remarkable temperature gradient within a large particle during processes of drying and devolatilization.

The experimental measurement was done with two coals, lignite and brown. The coal particles were shaped into spherical form at diameter 5,7 and 10mm. The coal particle temperature was continuously measured by inserting thermocouple in its center. For each experiment only one coal particle with thermocouple was introduced into fluidized bed.

The thermal properties that were used in model and compared with experimental results were determined on the basis separate experimental measurement with dried of coal particles and their comparison with devolatilization model.

Influence of the Critical Sticking Velocity on the Growth Rate of Particulate Fouling in Waste Incinerators

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ABSTRACT

Fouling of heat transfer surfaces introduces a major uncertainty into the design and operation of heat exchange equipment. Gas side fouling of waste-heat recovery boilers is mainly caused by deposition of particulate matter. Fouling layers as observed on the tube bundles of the economiser in a Dutch waste incinerator were thin and powdery. The fouling layer showed an asymptotic growth rate with a levelling off thickness.

In this paper the influence of the critical sticking velocity on the growth rate of fouling layers is studied. The critical sticking velocity of an incident particle hitting a powdery layer is defined as, the minimum impact speed by which a particle can rebound from a surface. Since the critical sticking velocity is a key parameter for the deposition mechanism, a well-defined experimental set-up has been built to assign it. Experimental results showed that the critical sticking velocity increases with the porosity of the fouling layer. A correlation is done between the critical sticking velocity and the fouling layer thickness. This correlation is based on the experimental results and the variation of porosity with the thickness of powdery fouling layers in waste incinerators. Consequently this correlation is used as an input to the numerical deposition model developed by van Beek et al. (2001). The numerical deposition model consists of a transport model and a sticking model. Based on the critical sticking velocity of the incident particle, the sticking model determines whether the particle sticks or rebounds. The deposition model showed that the asymptotic growth rate is due to the decrease in the critical sticking velocity as the fouling layer builds up. Further progress is to study the influence of the particle's diameter and material on the critical sticking velocity and consequently on the growth rate.

Heat Transfer Comparison in Coaxial Tube in Tube Heat Exchanger Operating with Refrigerants R407C and R22

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ABSTRACT

Due to hazardous environmental impact of the CFC and HCFC refrigerants that are currently used in R&AC systems, in accordance with the Montreal Protocol, actual is exchange of those by new, ecologically acceptable, HFC refrigerants. Therefore system performance analyses was made where the single component refrigerant R22 was replaced with zeotropic mixture R407C.

In the system operating at the same conditions, a comparison of heat transfer in coaxial exchanger for R22 and R407C is performed. Experimental data are presented in the form of average heat transfer coefficients as a function of heat flux and mass flux. Results have showed that in the heat exchange process with R407C refrigerant heat transfer coefficient is lower (10-35 %) than for R22. As R407C is a blend of three pure refrigerants (R32, R125 and R134a) with temperature glide of 5-7 °C, the concentration shift occurs during two-phase flow in the condenser and evaporator.

Numerical and Experimental Holographic Investigation of Natural Convection in Square Enclosures with Localized Heating from Below

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ABSTRACT

Natural convection of air in square enclosures with a localized heat source represents an interesting problem in numerous engineering applications. The interest in such problems stems from their importance in such areas as convective heat loss from solar collectors, energy conservation in buildings, air conditioning, and the cooling of electronic components by natural convection.

Natural convection heat transfer in enclosures heated from below has been extensively investigated in the past. However, comparatively a short literature review shows a relatively recent interest in the study of natural convection heat transfer in enclosures with a localized heat source from below. Aydin et al. numerically studied the convection of air in a rectangular enclosures with localized heating from below and symmetrical cooling from the sides; Ntubarufata et al. investigated numerically the natural convection in partitioned enclosures with localized heating from below and the study of Raji et al. had as objective to gain some insight into fluid motion and heat transfer phenomena in the case of a finite number of cavities covered by a cold plate and connected by adiabatic walls; the effects of the confining adiabatic walls and the connecting walls heights was investigated.

The aim of the present study is a numerical and experimental investigation of natural convection of air in square enclosures heating from below and symmetrical cooling from the sides. Symmetrical cooling from the sides is expected to be an efficient cooling option while partial heating at the lower surface simulates the electronic components such as a chips.

The experimental apparatus consists of a test cell and an holographic interferometer. The test cell is a square enclosure filled of air with isothermal side walls at equal temperatures T_c ; the remaining vertical walls are realised with glass to allow optical access to the cavity. The top and bottom surfaces of the enclosure are made of plexiglass and, except for the heated section, are considered to be adiabatic. The lower wall has a centrally located heat source which is assumed to be isothermally cooled at a constant temperature T_h .

The temperature distribution in the air is measured by an holographic interferometer. The experimental data obtained by measuring the temperature distribution in the air layer by real-time and double-exposure holographic interferometry are compared with the numerical results obtained by the investigation with the commercial finite volume software Fluent 6.0.

The heat source was placed on the bottom wall and was maintained at constant temperature; its length varied from $2/5$ to $4/5$ of the wall. Equations of the momentum, of "Poisson-type" for pressure correction and of energy were sequentially solved using an implicit segregated procedure, with both a steady and an unsteady solver. Up-wind second order and QUICK methods were employed for discretization; the diffusion terms were central-differenced with a second order accuracy. Pressure was interpolated with the PRESTO! Scheme while SIMPLEC and PISO algorithms provided a pressure-velocity coupling. Convection was studied for Rayleigh number from 103 to 106. Different convection forms were obtained depending on Ra and on the heat source length. Periodicities were not detected and motion was always bidimensional;

The Nusselt number was evaluated on the heat source surface and it showed a symmetrical form raising near the heat source borders. Graph with relations between average Nu, Ra and the heat source length are finally presented.

Towards a Sustainability Measure using Information Theory

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ABSTRACT

Information theory has many applications in Ecology and Environmental Science, such as a biodiversity indicator, as a measure of the rate of evolution, a measure of distance from thermodynamic equilibrium, and as a measure of system organization. Here, we explore the use of Information Theory as a basis for a measure of sustainability. Sustainability usually refers to a human preference for one particular dynamic regime of an ecosystem versus another, and whether that regime is relatively robust to the human and natural perturbations exacted on the system. As ecosystems experience perturbations of varying regularity and intensity, they may either remain within the state space neighbourhood of the current regime, or transition into the neighbourhood of a regime with different (viz. less desirable) characteristics.

Information theory has significantly advanced our ability to quantify the organizational complexity inherent in systems in spite of imperfect observations or $>signals=$ from the source system. Fisher Information (FI) is one of several metrics developed under the rubric of estimation theory. FI can be described in three ways: as a measure of the degree to which a parameter (or state of a system) can be estimated; as a measure of the relative amount of information that exists between different states of a system; and as a measure of the disorder of a system. Highly disordered, chaotic systems have a low probability of being observed in any one particular state, and therefore have low information. Conversely, systems that are more ordered and follow a regular or repeating trajectory have higher information.

We have defined the FI for a class of dynamic systems based on the probability of finding the system in a particular state. The Fisher Information calculation is demonstrated on a ten-compartment food web model with five functional groups: detritus, primary producers, herbivores, carnivores, and omnivores. Fisher Information is shown to be sensitive to transients in model generated data induced through parameter variation. Our next step is to use this sensitivity to develop a measure of the degree to which a system is at risk of transitioning into a different steady state. Such a measure would permit a response to ecosystem regime changes before such changes become problematic.

Method of Allocation of the Weights by Fuzzy Logic for a Sustainable Urban Model

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ABSTRACT

The environmental indicators, which the scientific community has, are characterized by a low degree of aggregation and a high amount of information. An indicator must show a synthetic representation a real environmental, by using a value or a parameter, so that they can be easy used by policy maker. It is necessary to connect, therefore, the various systems of the environment in a just integrated system.

A possible model of ecosystem-city is illustrated in this work, using the environmental indicators, so as to define a model that allows us to estimate the sustainable city, that it is to organize the environmental data of the cities. But the indicators are not aggregated, seeing that the various structures of the some ones, then for every indicator a weight is assigned with reference to an other weights indicator, for the calculation of which has been used a procedure based on logic fuzzy.

The final result will be, therefore, a combination of values assigned by various judges for various criteria, processed through fuzzy logic, so that to obtain a major objectivity.

A Fuzzy Cost-Recovery Criterion for Sustainable Rural Water Supply Systems

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ABSTRACT

Rural water supply systems, in developing countries, often fail before the end of their design life and the repercussions in terms of public health and economic development can be significant. Planning for sustainability in rural water supply systems in developing countries, therefore, is required to ensure that the projects exist, and maintain their design specifications, throughout their design life. Historically such projects have been designed according to developed nations standards and so have often neglected the socio-economic realities of the context in which they are implemented. Thus, socio-economic project design features play an important role in ensuring project sustainability. One such area that has been found to significantly influence project sustainability in rural water supply is the level of demand responsiveness in the project design. That is, the level to which a system caters to the actual needs of the users. Numerous components contribute to the level of demand responsiveness of a project. One such component is the tariff charged for provision. If the tariff is too high, or level of service too low, in relation to the demands of the users, the revenue raised will be less than anticipated. As project sustainability is interlinked with the ability of the project to meet its financial obligations, an overestimate in the revenue available can result in a lack of financial sustainability of the system. It is therefore imperative to ascertain the expected revenues of the system. Current practice relies upon an iterative bidding game contingent valuation method to assess willingness to pay for project benefits. Statistical regression techniques are used to predict the demand relationship and the expected project revenue. Here, due to the inherent imprecision in surveyed values and willingness to pay bids, fuzzy regression methods are used to develop the demand relation. From this fuzzy demand curve, a possibility distribution representing the expected revenues of the proposed system is created. Hypothetical cost functions are considered and various assumptions used to develop possibility distributions describing the true cost of a proposed project. Using interval analysis, a fuzzy distance measure is developed to quantify the distance between the costs and revenues of an improved water system. This fuzzy cost-recovery function predicts, in part, the demand responsiveness of various alternatives and as such is representative of the predicted sustainability of the feasible alternatives. The fuzzy cost-recovery criterion developed here can be incorporated into a multiobjective decision making framework, enabling sustainability to become an explicit design parameter in rural water supply planning in developing countries.

Application of the Possibility Theory and Fuzzy Logic to solve problems of Risk Assessment

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ABSTRACT

In the process of analysis of the risk is common to use the probability to determine the degree of occurrence of an event. In most cases the individuation of main factors of risk in an industrialised area is afflicted by great errors caused by the non complete knowledge either the behaviour or the relations among the parameters involved.

If the target is to reach a description more precise of phenomenon, we can use fuzzy set to describe the parameters of the problem and fuzzy measures to growth the knowledge of the problem.

The quantities that the Theory of Possibility employs to decrease the ignorance related with this kind of problems are Necessity, Possibility, Belief and Plausibility.

These quantities, when the ignorance associated to a problem is zero, are equal to the classical probability; thus the substance of these quantifiers is to characterise a complex problem decreasing the uncertainty associated.

When the uncertainty is zero, the problem isn't uncertain but only imprecise and the probability is enough for a complete description of the phenomenon.

For example if we consider the problem of the calculus of the temperature in an area with nonhomogenous morphology of the land, variability of atmospherics conditions and so on, the ignorance isn't zero and then the characteristics of the parameters of the problem is more precise utilising an possibilistic approach.

The paper will illustrate in which area of the industrial risk assessment, and related case studies the Possibility Theory can be applicate with advantage.

Optimal Water Management in Small-scale Tank Irrigation Systems

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ABSTRACT

The global water situation is becoming critical, as the scarcity of resources and the increase of demand are advancing simultaneously. The agriculture sector, which is the largest user of water resources, is required to reduce its water consumption, even though the augmentation of food production is very urgent in many parts of the world.

Small-scale tank irrigation systems focussed on here are expected to provide feasible measures to prevent catastrophic events due to agricultural water use. Tank irrigation has been practiced for long time in some countries such as India and Japan. A tank irrigation system includes irrigation tanks, which may have their own catchment basins to harvest rainwater, channels to convey water, and the command area cultivated by limited number of farmers. If the scale of such a system is so small that the conveyance loss of water is little, then it is possible to implement flexible water management that takes both supply and demand of water into account. In order to investigate optimal strategy for water management in small-scale tank irrigation systems, an optimal control problem in mathematical sense is formulated in the framework of variational calculus, assuming that the temporal variations in the storage volumes of the irrigation tanks and the water content in the command area are governed by a deterministic ordinary differential equations system. The optimal control problem is to find an optimal release strategy of irrigation water in the channels to maintain the required water content in the command area and to prevent the irrigation tanks from drying up. The minimum principle that characterizes the optimal strategy is deduced using the adjoint system of the governing system.

The optimal management strategy is practically examined in two example systems. The first system extends in a hilly region of Japan and contains three irrigation tanks with their respective catchment basins and the command area of 53.3 ha paddy fields for rice cultivation. The catchment basins are covered with forest and a first order runoff model is identified from observed data to estimate the inflow discharges into the irrigation tanks. The optimal strategy allocates constrained discharges to the channels in a drought period so as not to empty the irrigation tanks as long as possible. The second system is the one under an ongoing development research project in a semi-arid region of Ghana. It consists of an irrigation tank, its catchment basin, a channel, and the command area of 2.0 ha fields for a variety of crops. Almost all the water in a rainfall event runs off from the catchment basin into the irrigation tank at once, and thus no inflow is expected in dry seasons. The optimal strategy is considered especially when the required water content in the command area alternates between two values.

The proposed approach serves as a theoretical background for assessing optimality of small-scale tank irrigation systems. The simplicity and feasibility of the optimal strategies shown in the examples suggest that well-managed tank irrigation is an effective option as a water saving technology under critical agricultural water situations.

A Simplified Model for Long Term Prediction on Vertical Distributions of Water Qualities in Lake Biwa

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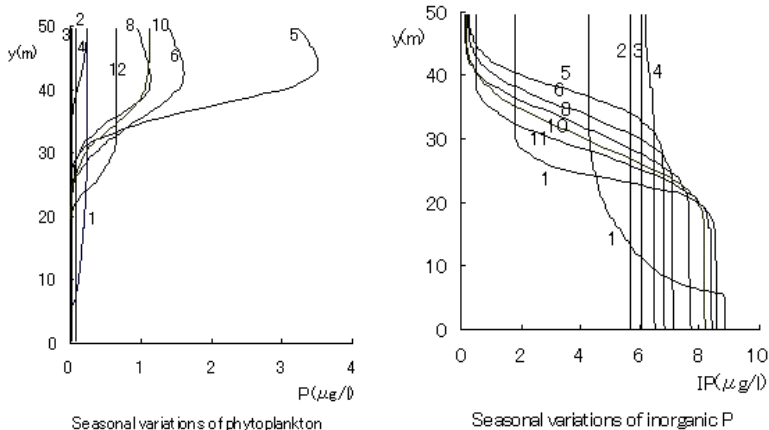
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ABSTRACT

This paper describes a one-dimensional simplified model to predict the vertical temperature and water quality distributions through a year in Lake Biwa, which is the largest lake in Japan, using the monthly averaged meteorological data. The temperature and flow velocity equations the thermodynamic exchange at a water surface were firstly tested to calculate seasonal variations of temperature distributions in the vertical direction. It is shown that the typical patterns of temperature distribution with stratification and de-stratification processes can be reproduced numerically through a year, if thermal convection during the period of heat radiation is considered in a 1-D simplified model.

Then the water quality parameters such as Phytoplankton (Chlorophyll a), Zooplankton, Organic and Inorganic nutrients, DO are combined with the water temperature prediction model, using a standard modeling of ecological processes. The long term calculations were carried out for ten years, and the results show the periodic year-by-year changes, because the inorganic nutrients are supplied due to the release from sediments. The limitation on Inorganic Phosphorus during a summer can be simulated in a surface layer in calculated results, and Inorganic nutrients in a epilimnion are supplied from a hypolimnion by both the thermal convection in an autumn and the large eddy diffusivity in a winter because of no-stratification. (A part of calculated results are shown in Figures.)

Since it was shown that the calculated water quality distributions agree with the observed ones qualitatively, the model was applied to simulate the response of water quality parameters to the global warming. It was pointed out that when air temperature increases 3 C, DO concentration will be almost 0 at a bottom layer in the lake.



The Surface Water Retention Bazins as a Tool for New and Renewable Water and Energy Sources

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ABSTRACT

In our days economically usable water reserves are decreasing from overexploitation and over consumption and this aggravates existing problems of water resources. Studies of the Hydrological cycle showed us the inequality of yearly rainfall, to the different departments in regional, local and global level. This brought the necessity for the creation of retention basins and artificial lakes, to stop the rejection of precious surface water flows, through the hydrographical network to the sea. World's runoff is estimated if evenly distributed, to support a world population perhaps ten times larger than today's.

Water needs are distinguished to, water supply, irrigation, industry, fire purposes, environmental necessities and others. Hydrogeological studies are necessary for searching the suitable drainage basin, for surface water collection from drainage pattern and the creation of a retention basin. Hydraulic calculations will give the capacity of collected water quantities and the basin sizes according to water requirements. Water quantities for households' needs and other uses (if it is a multipurpose storage basin) when added will give the total amount to cover faced requirements and the necessary area. Also by adding the other areas to sustain construction and operational works, there will be estimated the total occupied area by the storage basin (according to a rule of thumb it is estimated the flooding area of the basin as 1/10 of the drainage basin area).

We mention also the efforts exerted to collect in storage basins, treated water from secondary or advanced treatment plants and its use for indicated uses. We extend our study for hydraulic technology for power production, when a fall exists, for renewable energy possibilities use (electricity and heating purposes).

We present a case study for the creation of a storage basin intended to cover water supply and irrigation needs. Water collection is realized with an earth dam construction that leaves behind it a storage basin. In the same time the existing fall is used for power production, to cover internal energy necessities, for the operation of the aiding building, that service the installation. At last we present our conclusions for the main role, and the fundamental importance of water retention basins, in the collection of precious water flow, transferred through drainage pattern in the opposite case toward the sea. Also the possibilities of energy production, looking to the sustainable development, that is first in the hierarchy of world water requirements.

Solar Photocatalytic Oxidation: a Sustainable Tool for Reclaiming Biologically Treated Municipal Wastewater for High Quality Demand Re-Use?

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ABSTRACT

Water scarcity in many regions of the world requires the exploitation of uncommon water sources. One of these sources is secondary effluent of municipal wastewater treatment plants. However, the effluents contain residual organics - among them many of unknown nature and action toward human health. Therefore, advanced removal of organics is an important prerequisite for reuse of the reclaimed wastewater. A suitable process for removing low concentrations of organics from wastewaters is the photocatalytic oxidation which can be operated in a sustainable way by utilizing sunlight.

For getting informations about the dimension of lagoons (with mechanic agitation) which can be used as simple reactors for photocatalytic oxidation, laboratory scale experiments were performed in a stirred bowl with 350 ml of secondary effluent of a German municipal wastewater treatment plant. In the effluent the photocatalyst titanium dioxide ("P25") was suspended in concentrations of 1 or 10 g/l and the suspension was irradiated with a UV-A radiator (a face tanning unit) with known UV light intensity. In order to obtain kinetic data over a broad TOC concentration range, the secondary effluent has been concentrated by means of freeze concentration and the concentrate has been diluted with different amounts of deionized water prior to photocatalytic oxidation experiments.

Also the original secondary effluent (TOC: 10.7 mg/l after addition of titanium dioxide) has been investigated in these experiments. The following equation for design of photocatalytic oxidation sequential batch reactors has been used (Gulyas et al. 2001):

$$\frac{\Delta m_{TOC}}{\Delta E} = -k_{TOC} \cdot V_L \cdot c_{TOC}$$

The amount of a TOC mass m_{TOC} mineralized by irradiation with the light energy E depends on the TOC concentration and the liquid volume in the reactor. The product $k_{\text{TOC}} \cdot V_L$ is a constant for the organics being present in the particular wastewater and depends on photocatalyst concentration. For the investigated secondary effluent it has been determined as 62.6 l/kWh (10 g TiO₂/l) and 87.3 l/kWh (1 g TiO₂/l), resp. With the data for a photocatalyst concentration of 1 g/l, a UV-A light energy demand of 175 kWh has been calculated for the reduction of the TOC of 10 m³ of a secondary effluent from 10 to 2 mg/l. Taking into consideration that only about 5 % of the entire sky and solar radiation is UV irradiation (i.e. light with wavelengths below about 400 nm which is suitable for photocatalytic oxidation), about 3500 kWh of sunlight must be absorbed by a photocatalytic oxidation reactor. Taking into consideration minimum values for sky and solar radiation, an area of about 10,600 m² would be necessary in Hamburg/Germany [minimum sky and solar radiation in December: 0.33 kWh/(m²·d)], but only 870 m² in the Northern Province in South Africa [minimum sky and solar radiation in June: 4.03 kWh/(m²·d)] in order to achieve the TOC decrease from 10 to 1 mg/l within one day. By distributing a volume of 10 m³ on such large areas, the depth of the titanium dioxide suspension in secondary effluent would be far below 1 cm or in the range of about 1 cm. This would cause problems with evaporation. Therefore, longer solar irradiation periods will have to be selected reducing the required area and increasing the depth of the suspension. Moreover, covering the lagoons e.g. with UV-translucent Plexiglass plates would be helpful in preventing evaporation losses.

With biologically treated greywater it has been demonstrated that photocatalytic oxidation is also acting disinfecting. *E. coli* have been reduced in the effluent of a constructed wetland for greywater treatment 1 to 2 logs and total coliforms by 2 to 4 logs during a three hour UV-A irradiation of 1 l in the presence of 10 g TiO₂/l. Adsorption of micro-organisms to photocatalyst has been shown to contribute to the disinfection.

The application of the sunlight-operated photocatalytic oxidation will be restricted to areas with relatively high sky and solar irradiation. It may be applied as a sustainable process for improving quality of biologically treated municipal wastewater, because it will not require high inputs of energy except the renewable solar energy.

Development of Own Solar Testing Station for Flat-plate Water-cooled Solar Collectors

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ABSTRACT

Work on solar energy utilization in BiH has been started last year at the Mechanical Engineering Faculty in Sarajevo. As the first step in this direction a Solar testing station was designed, constructed and erected.

This facility would allow thermal tests conducting to predict the main working characteristics of plat-plate water-cooled solar collectors that determine a performance quality of collectors. Crucial working characteristics of solar collectors are as follows: Instantaneous thermal efficiency, Incident angle modifier and Time constant.

Information on these solar collector-working characteristics is a key factor for proper sizing of total aperture area of collectors to be installed according to heat demand.

Theoretical aspects of thermal processes in solar collector operation under steady state working conditions have been shortly elaborated as a background of Testing Methods given in ASHRAE standard 93-86 and European standard EN 12975-2.

A short technical description of operational flow diagram including data acquisition system and its "interconnection" with Labview software for result evaluation, for the Solar Testing Station, will be presented. Measured thermal efficiencies of some solar collectors produced in B&H and Slovenia will be shown, also.

Comparative Analysis of the Solar Dish Electricity Production

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ABSTRACT

Round parabolic solar mirror is often called solar or sun dish. Even when the dish is faceted into several smaller dishes that are all focusing the sunlight in a single point (focus), it is called a solar dish. When heat to electricity converter is mounted into the dish focus and the sun-tracking system is provided it could be named Solar Dish Concentrating Electricity Converter System. Depending upon the sort of the converter it could be pointed out two promising systems that are approaching the commercialization. These are solar dish Stirling system and solar dish photovoltaic (PV) system. In this paper, technical and economical aspects of the two systems are examined and compared. For that purpose several representative systems are chosen: Stirling sun dish DOE and SES solar dish representing Stirling converter, and SS 20 represented concentrated PV converter. It is concluded that concentrated PV converter could have better cost/performance ratio. But it is pointed out that recently introduced thermoacoustical converter concept could be even better.

Tidal Power Generation: A Sustainable Energy Source?

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ABSTRACT

The Annapolis Tidal Generating Station has been operating successfully since 1984. The station is the first and only active tidal generating station in North America and one of only three stations worldwide. Located in Annapolis Royal on the Bay of Fundy, the station takes advantage of the world's highest tides (up to 9 m) to generate 30 Gwh of electricity per year. The station uses 7.6m diameter Straflo turbine and produces power for an average of six hours in each tidal cycle.

The production of electricity through tidal generation involves some of the environmental challenges associated with hydro-electric dam projects. As with hydro projects, tidal generation requires the construction of large structures to direct tidal water flows. This may interfere with local biological activity and influence water levels in the tidal basin. It has not been environmental issues however, but economic considerations which have limited the construction of additional tidal generating stations in the Bay of Fundy region. Numerous locations have been identified as having desirable tidal qualities, however the cost of constructing large tidal generating stations has been prohibitive. Traditional energy sources such as coal, oil, and natural gas are easily accessible on the Eastern Seaboard of North America. Thermal generating technology is relatively inexpensive and makes up the majority of energy production in the region.

Operation of the Annapolis facility has demonstrated numerous technical advances in turbine and powerhouse construction, remote control plant operation, environmental assessment, project planning and implementation. The Annapolis Tidal Generating Station has been in continuous operation for 17 years, producing clean, emission-free electricity. The station demonstrates that tidal generation is both sustainable and profitable, and offers numerous advantages over other means of electricity generation. As global energy demand rises and energy sources such as coal, oil, and natural gas become less desirable the argument for consideration of tidal generation grows with each passing wave.

Fusion, a New Energy Source for a Sustainable Future

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ABSTRACT

Energy is a key sector in attaining a sustainable development. The reasons for this are twofold. On the one hand energy provision is essential for both the continuation of the industrialised world and the development of the developing and third world. On the other hand, energy production is one of the main causes of environmental degradation. Attaining a sustainable

energy system for the future is therefore a sine qua non condition for a sustainable growth of the world.

In this context, fusion appears as a long-term alternative for energy provision. Controlled thermonuclear fusion is one of the few energy options with potential to supply energy at great scale. Fusion is the energy that makes the sun and the stars shine and on Earth the equivalent reaction is the union of two hydrogen isotopes, Deuterium and Tritium with the subsequent formation of Helium and the liberation of energy. Some of the inherent characteristics of fusion energy -its safety, cleanliness and inexhaustibility- qualify it as a sustainable energy option. The objective of this paper is to ascertain the possibilities of fusion to become a sustainable energy source for the future.

Among the different approaches to achieve the paradigm of sustainability, the quantification of externalities, the social costs of environmental damage, and their internalisation into prices has been proposed. The objective of this internalisation is disincentive further damage to the environment and incentive a cleaner energy production.

We present here an application of this economic sustainability criterion to energy generation, the quantification of the external costs of the fusion energy chain compared with other present and future sources of energy. The work has been performed in the framework of the Socio-Economic Research on Fusion (SERF), which is jointly conducted by Euratom and the fusion associations within the Fusion Programme of the EU from 1997.

The study uses a methodology for evaluating, in a standardised way, the external costs of electricity generation by different fuel cycles previously developed for the Commission of the European Union in the frame of the "ExternE" project. The ExternE methodology is a bottom-up methodology, with a marginal and site specific approach. Quantification of impacts is achieved through the damage function or impact pathway approach that follows the sequence of events linking a burden, to an impact and subsequent monetary valuation. This means that it involves siting a power plant, and calculating its contribution to the environmental and health situation locally, regionally and globally.

Within the projects SERF1 and SERF2, the whole life cycle of different fusion plant models was analysed considering different presently available and future technological options. Results obtained were in all cases below 4 m²/kWh. The major contribution to the external costs of fusion arises from the global effects of C-14. Compared to other energy options fusion was shown to be an energy source with low external costs, in the range of the external costs of renewable energies below external costs of nuclear fission power plants and well below those obtained for fossil-fuelled power plants. These results confirm the capability of fusion to play a role as a sustainable energy-source in the long term.

The Role of the Renewable Energy Sources in the Energy Strategy of Russia

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ABSTRACT

The objective of the Energy Strategy of Russia till 2020 is not only increase in the energy consumption per capita but a development and mastering environmentally friendly, safe, reliable, and economically acceptable power installations. One of the ways to solve the problem is wide using nontraditional renewable energy sources (NRES).

Presently, in Russia, essentially entire spectrum of the high-performance equipment for using NRES is developed. Several demonstration centers are in operation in Moscow (Fili-park, All-Russia Institute for Agriculture Electrification), Barnaul, Novosibirsk, St.-Petersburg, Buryatiya Republic, and other regions of Russia.

The following equipment is mastered for commercial using NRES:

Wind - wind power installations with a capacity of 0.04 to 1000 kW (Tushino Machine Building Works in Moscow, TsNII Elektropribor in St.-Petersburg, Vetrotok Co. in Ekaterinburg, Rybinsk Instrument Works in the city of Rybinsk, and other);

Sun - photovoltaic modules with a capacity of 3 to 70 W (Metokom Co., VIESKh Institute, AO Elma in Moscow, Krasnoye Znamya Works in the city of Ryazan, OAO Saturn and NPF Kvarts in the city of Krasnodar, and others);

Solar collectors for heating and hot water systems (Kovrov Mechanical Works in the city of Kovrov, NPP Konkurent in the city of Zhukovskii, NPO Mashinostroenie in the city of Reutov, and others);

Hydraulic turbines of small capacity of 1 to 90 kW for installation on small rivers (Kebren Enterprise and MNTO INSET in the city of St.-Petersburg, NPK Energetika i Ekologiya in the city of Novosibirsk) and those of 100 to 5000 kW capacity for hydraulic power stations of small capacity (NPO RAND in the city of St.-Petersburg and the Russian Association MATI in Moscow);

Biomass - individual biogas installations of different capacity for treating wastes of the cattle-breeding farms (EkoRos Center and VIESKh Institute in Moscow);

Thermochemical gas generators with a capacity of 0.1 to 3.0 MW (OAO Energotekhnologiya in the city of St.-Petersburg);

Geothermal sources of the Earth - modular geothermal power stations of small (0.5-4.0 MW) and moderate (6-23 MW) capacity (Kaluga Turbine Works in the city of Kaluga, AO Geoterm in Moscow).

There are several private enterprises, which develop installations of different kinds for using NRES.

Presently, several measures are under development in the legislative, standard, taxation and other fields, which are aimed to promote using NRES.

The Application of Solar Radiation for the Treatment of Lake Water

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ABSTRACT

The topic of this research work is the use of solar radiation for reduction of Natural Organic Matter (NOM) content in surface waters, which are prepared to drinking water quality. The NOM in drinking water could cause several health problems, especially after contact with disinfecting chemicals. To be closer with ecological principles, it is tried to involve the ultraviolet part of solar radiation, which amounts only 3-5 percent of the global solar radiation, but still presents a respectable potential for the use at water treatment. Solely solar radiation has not enough energy for sufficient degradation of NOM, but in combination with heterogeneous photocatalyst - titanium dioxide (TiO_2) the degradation potential rises.

Experimental part of this work involves number of the tests with the lake water exposed to solar radiation in a non-concentrating reactor and studying kinetics of photodegradation of NOM for various combinations of doses and crystal structures of TiO_2 (anatase and rutile) with various doses of hydrogen peroxide (H_2O_2).

Irradiation intensity was estimated from daily global radiation and UV index measurements. Results of the research showed that the best performance for the NOM degradation had combination of 1g/L TiO_2 both anatase and rutile + solar radiation. It is interested that the addition of economically acceptable doses of H_2O_2 decreases the efficiency of photocatalytic degradation process. Only very high dose of H_2O_2 has positive impact on the degradation rate of NOM.

Environmental Impact and Life Cycle Assessment of Solar Energy Systems

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ABSTRACT

Life-cycle analysis (LCA) has become one of the most actively considered techniques for the study and analysis of strategies to meet environmental challenges. The strengths of LCAs derive from their roots in traditional engineering and process analysis. Also vital is the technique's recognition that the consequences of changes in technological undertakings may extend far beyond the immediate, or local, environment. A technological process or a change in process can produce a range of consequences whose impacts can only be perceived when the entire range is taken into consideration. The application of LCA promises to change the treatment of environmental considerations within the larger concerns of modern technological society. However, as the technique becomes more popular, it is becoming clear that some of the problems LCA is expected to solve lie outside its practical and conceptual boundaries. Potential users of this technique span a wide spectrum of interests. Process and product developers view the LCA as a way to incorporate environmental considerations into design process, making it possible to anticipate and avoid potential pitfalls. Consumers and consumer interest groups see LCA as a way to better inform the consumers of the relative environmental impact of alternative technologies (or products).

During the design process of solar energy systems, the designer must analyse various factors in order to determine the best design options. Therefore, the environmental aspects of a product should be included in the analysis and selection of design options if an environmentally - aware design is to be produced. If one wishes to assess a product's environmental impact, its whole life cycle must be studied. The Life Cycle Assessment (or LCA) methodology is an example of one kind of environmental analysis which included the entire life-cycle of a product. However, this method has some limitations. It is unable to tackle the total total environmental impact on a number of different levels (e.g. materials, energy, waste) at the same time. To overcome some problems in the LCA method, an alternative method, the so-called Eco-Indicator method has been proposed. Since it is based on a weighting method, only a single score for the total environmental impact is calculated. The application of this method for the optimisation of solar energy systems is presented in this paper.

Implementation of a Vertical Type Banki Wind Turbine in Electricity Generation and Water Desalination

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ABSTRACT

An experimental investigation of a multi-blade vertical type wind turbine and its implementation in electricity generation and water desalination in remote areas of the Eastern Jordanian Desert is presented. The turbine presented is new in the essence that it is a reformed design of the Banki water turbine. The optimum blade angles and the inner to outer diameter were found analytically. On the other hand, the optimum number of blades and the height to width ration of the turbine were found experimentally. Many favourable characteristics of this turbine were found including its relatively high efficiency, which reached up to 38%, low cut in speed of 1 m/s, its high relative torque, among all the other common characteristics of other types of vertical type wind turbines (e.g. its independence of wind direction). The structure of such a turbine can be easily manufactured using inexpensive materials.

An electric generator (LMW 150 DC Generator) was coupled to the shaft of the wind turbine to investigate its implementation in electricity generation. The investigation was based on real wind data of Eastern Jordanian Deserts. A medium size (3X2 meters) turbine is considered for electricity generation and water desalination form a salty water well. Different types of DC generators were investigated. In addition various type of water desalination procedures were also investigated. Feasibility analysis of the project is conducted based on output and distance from the national grid is calculated. The analyses demonstrate that the project is feasible for a moderated duration of usage.

HeliNet Energy Subsystem: An Integrated Hydrogen System for Stratospheric Applications

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ABSTRACT

HeliNet is a telecommunication infrastructure based on HAVE - High Altitude (17 km) Very long (6 months) Endurance - unmanned solar aerodynamic platforms, named HELIPLAT[™] (Helios Platforms).

Its main expected outputs, from the platform point of view, are the aerodynamic and structural design of the HELIPLAT[™] platform, the design of the energy subsystem, including solar cells, fuel cells and electrolyser and the design and realisation of a scaled size prototype. Besides, from the payload side, the main output is the study of pilot applications in the fields of localisation, environmental data processing and transmission, broadband services.

HELIPLAT[™] is a monoplane driven by eight brushless motors, twin-boom tail type. Its energy subsystem is based on a closed loop Hydrogen cycle. The platform surfaces are covered with photovoltaic arrays; during the day, the solar power is used to supply the electric motors of the propellers and to feed an electrolyser which produces hydrogen and oxygen. The gases are stored at high pressure (120 bar) and used during the night to feed the fuel cells which supply the motors; the water feeds the electrolyser to close the cycle. Mass and heat balances are presented and discussed.

The main challenges of this project are: the need for very high power density and the severe external temperature (-60°C). In order to pressurise the gases and to avoid the adoption of hydrogen compressors (too demanding for the energy balance), the “in-vessel” electrolyser solution is proposed: the equipment is immersed into the water tank (carbon fibre wrapping and aluminium liner), so that it doesn't need to withstand the full line pressure. The electrolyser weight and volume become compatible with the aeronautical application requirements and far reduced compared to those of existing high-pressure electrolyser solutions.

The key features of this hydrogen-based propulsion system are the cost-effectiveness infrastructure (compared to satellite systems), and the relationship with the environment: it does not induce atmospheric and electromagnetic pollution.

Posibilities for Utilization of Renewable Resources for Electricity Generation in Bosnia and Herzegovina

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ABSTRACT

According to current processes of restructuring of the electric power system and liberalisation of the electricity trade market, beside rehabilitation and modernisation of existing power plants and investments in environment protection, Bosnia and Herzegovina must turn to utilising of renewable resources in reasonable rhythm as well. Respecting to this, initial investigations on possibility of wind energy utilisation in Sarajevo area are performed. Some results of these investigations are presented in this paper, as well as other aspects of utilisation of renewable resources in Bosnia and Herzegovina.

Waste Incineration in Swedish Municipal Energy Systems - Modelling the Effects of Various Waste Quantities in the City of Linköping

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ABSTRACT

In Sweden, waste management and the energy system are linked since waste is widely used as fuel in the district heating supply. New regulations and taxes concerning waste disposal have come into effect in Sweden and more will be introduced in the near future, resulting in increasing costs especially for landfills. This will impact heavily on the energy systems.

This article presents a study with the objective to analyse the consequences for municipalities to use waste in their energy systems, with the city of Linköping, Sweden used as a case study. In Linköping, a large waste incineration facility is the base supplier of heat to the city's district heating grid. The plant can also provide electricity when integrated into a hybrid cycle with an oil-fired gas turbine. The impacts on the district heating and electricity production in Linköping of different amounts of waste used in the waste incineration plant are studied regarding system costs and carbon dioxide emissions.

The study is carried out using a simulation model, MODEST, that optimises the operations of the plants in the energy system to fulfil the desired heat demand.

The study shows that it is economically favourable for Linköping to use waste as a fuel for district heating purposes. One of the reasons for this is the economic incentive provided by a landfill tax. Decreasing waste incineration leads to a decrease in carbon dioxide emissions, since the main replacement for the waste in this energy system is biomass fuel. An increased electricity price leads to more locally produced electricity, resulting in a lower cost for the district heating production in Linköping. It also means lower carbon dioxide emissions globally since assumption is made that the locally generated electricity replaces electricity produced in coal condensing power plants.

Measurement of Selenium in PM_{2.5} by INAA at a Urban and Industrialised Area of Portugal

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ABSTRACT

Although rarely found native, selenium is a major constituent of 40 minerals and a minor constituent of 37 others, mainly sulphides. Its greatest abundance is in sedimentary rocks and there is a wide range of Se content in fossil deposits. It is involved in some important specialist uses due to some specific physical and chemical properties of some of its compounds (e.g. semiconductors, photoelectric cells, infrared optic materials due to asymmetrical conductivity; lubricants in vacuum or high temperatures as solvent; among others). More than other nutrient, selenium illustrates the dichotomy between essentiality and toxicity. PM₁₀ and PM_{2.5} Se values at two urban and industrialised areas of Portugal are of the order of magnitude of 0.1-1 ng/m³ (data collected since 1995). Suddenly, the Se contents in PM₁₀ and PM_{2.5} increased by a factor of 1000 from November 2001 in the Lisbon northern area. There is no legislation on Se for outdoor ambient and the indoor ambient points threshold limit values (US and Germany legislation) which are still 100 times higher than the abnormal values we found this winter. In spite of that, we found extraordinary such an increase and this work discusses the possible causes for such high Se concentrations, based on the local and remote emission sources. One factor, which might have also contributed to the Se increase, is the unusual meteorological conditions of this winter without precipitation and predominant winds from the north-east. This wind direction addresses the atmospheric emissions of the local industries to our air samplers, when usually they are mainly addressed to the Tagus estuary. The increase was also visible for mercury although not in such an extent. Correlation with Hg and other chemical elements determined simultaneously by INAA are discussed.

The Use of Waste Food Like Adsorbent Material in Wastewater Treatment Processes

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ABSTRACT

An efficient proceeding to treat wastewater from chemical, petroleum and food industry is adsorption with or without chemical / biochemical reaction.

The adsorbent material, porous solid phase, must present some characteristics, like a great adsorption capacity, size and porosity adequate to pollute component in liquid phase (wastewater), easy regeneration and a low cost.

In this paper we propose using waste food (fruit peel and kernel) before the thermo treat by pyrogenation, to obtain an adsorbent material for the treatment of wastewater with variable phenol, benzene and toluene content.

For this propose we determinated experimental adsorption isotherm (liquid $\text{\textcircled{D}}$ solid equilibrium) for biphasic system:

- solid phase (peel of nuts);
- liquid phase: aqueous solution by phenol, or aqueous emulsion by benzene and toluene with variable initial concentration.

The experimental data was proceeded like a dimensional relation from: $C_z^n = a \cdot C_L^m$

Where: C_z^n = pollute component concentration in solid phase, mg/g;

C_L = pollute component concentration in liquid phase, g/l;

a, m = empirical constants, specific for a system biphasic.

The experimental study show the utilization possibilities of this adsorbent material for decreasing the pollution rate, with next advantages:

- waste food utilization;
- low investment and operation cost;
- regenerate adsorbent material by pyrogenation, combustion oxygen free, with unpolluted gases generation (that generates unpolluted gases).