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ABSTRACTS for PARALLEL SESSIONS 1-2-1 and 1-2-2

TECHNOLOGICAL RESPONSES TO CLIMATE CHANGE

CHAIRPERSONS: ***Dolf Gielen and Atsushi Kurosawa***

Negative Emissions Energy and CO_2 Levels

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Simulation modelling with FLAMES demonstrates BECS technology in reducing Carbon in atmosphere (C_{at}) towards pre-industrial levels under strong land use change policy e.g. motivated by Abrupt Climate Change (ACC) precursor signals [1]. An important limitation of the analysis is that the response of the carbon cycle to net emissions is represented as relaxation, with single time constant, to pre-industrial levels. This limitation was noted and it was suggested, on the basis of comparing earlier studies of emission reductions, that the differences could be significant [2]. The present paper gives a more comprehensive analysis of the issues and gives an approximate recalculation of the results in [1].

[1] Read, P., and Lermit, 2004. Bio-Energy with Carbon Storage (BECS): a Sequential Decision Approach to the threat of Abrupt Climate Change. *Energy*. In press (www.sciencedirect.com EGY1413).

[2] Parshotam and Read, 2005. CO_2 levels under BECS (Bio-Energy with Carbon Storage) with improved C dynamics. Submitted to *Mitigation and Adaptation Strategies for Global Change,* Special Issue "Abrupt Climate Change and Greenhouse Gas Emissions: contributions to the Expert Workshop, Paris, 30.ix.04 – 1.x.04.

Keywords: bio-energy, abrupt climate change, BECS, FLAMES

Towards Construction of a Global Energy System Utilizing Carbonized Biomass

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A global energy system utilizing carbonized biomass is proposed. In the proposed system, biomass is pyrolyzed to produce carbonized fuel which is easy to transport and is shipped to energy-consuming countries. The proposed energy system needs no plants such as electrolysis and methanol synthesis as well as CO_2 capturing system, being different from other global energy systems that use renewable energy such as solar energy or wind power. Hence its economical feasibility is expected to be very high. The proposed system has the following features: sustainable, CO_2 neutral, making it possible to use a large amount of biomass energy from overseas.

Keywords: Global energy system, Biomass, Carbonization, Global warming, Sustainable society

Optimum Type of Biomass for Global Energy Transportation

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Although we have a huge amount of world biomass resource, the biomass resources are often restricted to local usage because the biomass is too bulky to transport efficiently. The pretreatment of the crude biomass for energy-densification sometimes results in a big energy loss. As for many bio-fuels, the authors pointed out a trade-off relationship between (A) energy density and (B) energy recovery ratio. From this point of view, the comparison was carried out among following materials: Green wood /air dried wood /chip/pellet /semi-carbonized wood /char /wood tar /bio-methanol /bio-ethanol.

Keywords: biomass, wood, pellet, semi-carbonized wood, char, energy recovery, densification

Renewable Energy Policy Analysis in Japan: A Simulation with a Computable General Equilibrium Model

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Second generation model for Japan (SGM-Japan) is a computable general equilibrium model for estimating the abatement cost of carbon mitigation policies in Japan. This study provides the abatement costs of renewable portfolio standards (RPS), which is current renewable energy policy in Japan, and other policies such as renewable energy feed-in tariffs (REFIT) through the analysis by the extended SGM that can model renewable energies explicitly. And then the best combination of renewable energy policy and other carbon mitigation policies such as carbon tax is proposed.

Keywords: renewable energy policy, computable general equilibrium model

Prospects for Renewables in a CO_2 Constrained World

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The IEA has updated its renewables policy analysis, based on the Energy Technology Perspectives (ETP) model. This presentation will discuss the future role of renewable energy vs. other options in meeting CO_2 policy targets in the electricity sector, with special emphasis on CO_2 capture and storage. The importance of renewables technology learning and the choice between deployment and R&D strategies will be elaborated. Sensitivity and scenario analysis results provide insights regarding the best policy strategy. The analysis shows that technology prospects differ by world region. Therefore a regionalised approach is needed for proper analysis of cost-effective emission mitigation strategies.

Keywords: renewables, policy analysis, modeling, ETP, technology learning

Virtual Power Plants across Energy-Autonomous Regions

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Across Europe, national as well as enterprise strategies for energy supply are currently being re-adjusted to meet a set of objectives: emphasizing renewable sources of energy, minimizing dependence on imports, meeting emission reduction targets and limiting long-distance transmission. Distributed generation, an 'intelligent' mix of energy sources and sophisticated control strategies are required to move towards autonomous regions with minimal dependence from outside energy supplies and long-range transmission.

The concept of a 'virtual power plant' covering a region's energy needs starts from a fully distributed GIS-based demand and load forecasting model. Due to disparities and high temporal variability of energy demand, the flexible energy provision is a challenging task. Most renewable sources like wind or solar provide highly variable outputs and are difficult to forecast. Biomass and hydropower as well as (a minimum of) fossile thermal are the only currently available technologies to balance variable generation and to meet current demand.

GIS-based models are an indispensable method for surveying and developing the renewable energy potential of regions, and subsequently the foundation for short term generation forecasts. Combined with demand forecasts, grid control strategies can only be implemented with balancing capabilities from e.g. hydropower with pumping capability into reservoirs. The traditional inter-regional balancing relies heavily on centralized generation and requires high transmission capacities, which are expensive and increasingly difficult to build, e.g. as high voltage corridors face strong public opposition.

The concept of autonomous energy regions with a maximum of renewable sources is aiming at meeting objectives of sustainability, climate protection and security as well as stability. While this sounds like an uncontested strategy, implementation requires highly sophisticated spatialized modeling as well as revised approaches to risk management and quality of service. Temporally dynamic maps of demand, generation potential and balancing needs are the foundation of intra-regional planning, forecast and control strategies leading towards new paradigms in sustainable and largely autonomous regions.

Keywords: virtual power plant; sustainability; autarky; renewables; GIS (Geo Information System)

Modeling Electricity Sector in India with Sub-regional Details

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Since India is a geographically large country the interregional dynamics play an important role for electricity sector policy. Typically, the models of electricity sector in India deal with whole country as one. This paper discusses the development of a state-of-the-art technology model for electricity sector in India with sub-regional detail and several policy simulations are run. The model explicitly treats transmission lines between the sub-regions. The paper discusses implications of regional distribution of investments and technologies for regional development and CO_2 emission profiles in electricity sector. Utilization of regionally available resources is an important factor in development of power sector in a region. Investments in new capacities depend not only on the regional resources but also on demand patterns which are also different in different regions. The analysis of regionally-varying opportunities for CO_2 emission mitigation in electricity sector and issues for modeling sub-regional details are discussed.

Keywords: Electricity sector, India, Sub-regional, Policy, CO_2 emissions

Optimal Design and Economic Effects of Renewable Energy System for Effective Utilization of Animal Manure and Wood Biomass in Rural Areas in Japan

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The main objective of this paper is to design the renewable energy system and to analyze the economic effects for installing the energy system in rural areas in Japan, using an optimization model and input-output technique. The cost of the disposal of animal manure and the collection of woody biomass are also considered in the study. The energy system consists of wind, animal manure, wood biomass, and solar as renewable energy resources, and conventional energy resources (see figure). Besides the configuration and operation of the system taking into account hour-by-hour energy availability, the model will show the energy system configuration and its cost in the long-term for future prospects to promote the effective utilization of renewable energy resources.

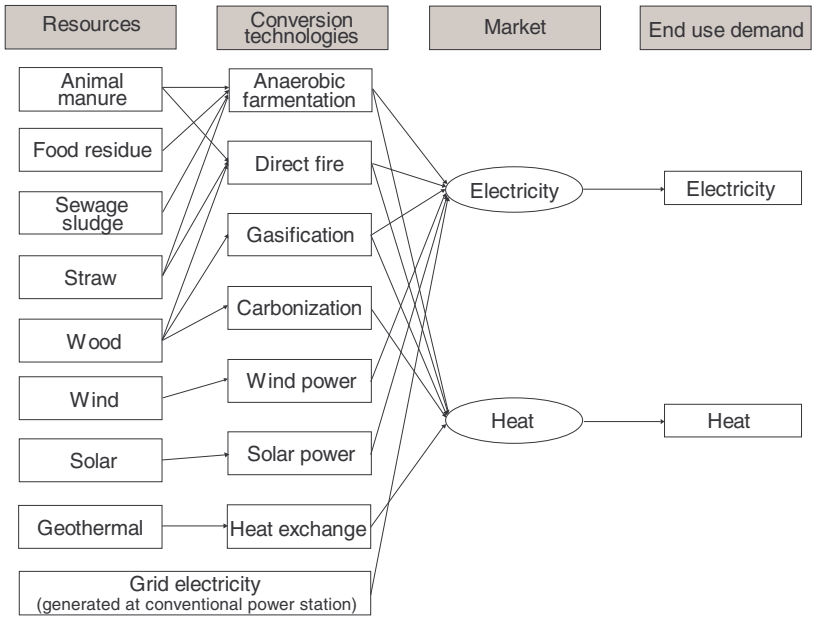

Figure: Energy flow of renewable energy system in rural areas

Sustainable Development Options for Turkey: A Real Options Projection under Technological Learning

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This study explores the diffusion prospects for new renewable power generation technologies in Turkey under a real options evaluation using a dynamic programming model formulation. The model recursively evaluates investment alternatives on a year-by-year basis, thereby taking into account that the flexibility to delay an irreversible investment expenditure can profoundly affect the diffusion prospects of renewable power generation technologies. Price volatility is introduced through stochastic processes for the average electricity price and for fuel prices. Demand for peak-load capacity is assumed to be increasingly price-elastic and linearly dependent on the extent of market opening. Apart from general implications for policy-making, the empirical analysis provides insights about the impact of uncertainty on the diffusion of various emerging renewable energy technologies. Several aspects make the Turkish electricity supply situation a particularly interesting subject of study, including the significant domestic renewable energy resources and market potentials for emerging renewable energy technologies, the ongoing market liberalization process, high pollutant emission levels, a pressing need for further electric capacity expansion, and the still very low share of new renewable energy technologies (< 0.3% of total electricity production). The results show that, in the absence of subsidies or other promotion policy instruments, market players can hardly be expected to invest in relatively expensive renewable energy technologies. This finding points out the importance of the Kyoto flexibility mechanisms which would feature clean development projects to be realized through emission certificate trading.

Keywords: Real options, Dynamic programming, Technological learning, CDM projects, Sustainable development.