

Paper 09GM 0159

International Practices in Biomass—Theory, Case Studies, Power Plant Components and Plant Overall Performance

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Working Group European Electricity Infrastructure

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Chairs: Tom Hammons, University of Glasgow, Scotland, UK
Niko A Iliadis, Energy Consultant, Attiki, Athens, Greece

Track 4: *Going ‘Green’*

INTRODUCTION

On behalf of the Energy Development and Power Generation Committee, welcome to this Panel Session on International Practices in Biomass.

The 21st century is characterized by an increased conscience with respect to the selection of fossil fuels as means of power and thermal generation. Numerous countries have implemented and improving various techniques for the utilization of all available types of solid biomass for thermal and electric energy generation. Beginning with the most conventional solid biomass, wood and its residues, moving to waste and ending with agricultural and its residues, research laboratories, scientific centers and companies are investing heavily on the development of the technology that is related to this area. The focus is on the areas of boilers, varying from different types of biomass utilization through combustion, gasification and pyrolysis, heat exchangers according to the biomass used, turbines related to the process and overall power plant design including the feeding technology, the ash disposal and valorization, the emissions filtering and the operation planning of the asset.

In this session, we have invited presenters both from academia and industry in order to present their professional and scientific advances through theory and case studies. We will not focus on the

technical and material details of the power plant's components but on their contribution to the plant's overall performance.

PRESENTATIONS

1. Sergio Granville, Priscila Lino, Francisco Ralston, Luiz Augusto Barroso, and Francisco Ralston (PSR, Brazil). *Sweet Dreams are (still) made of this: Recent Advances of Sugarcane Cogen in Brazil* (Invited Panel Presentation Summary 09GM0781).
2. Bill Carlosn (Carlson Small Power Consultants, USA). *Biomass Power as a Firm Utility Resource: Not Just a Little Coal Plant* (Invited Panel Presentation Summary 09GM0935).
3. Nikolaos Danalatos (University of Thesaly, Greece). *Solid Agricultural Biofuels: The Case of Cynara Cardunculus* (Invited Panel Discussion).
4. Valentino Tiangco (California Energy Commission, USA). *Biomass Developments in California* (Invited Panel Discussion).
5. Thomas Elsenbruch (GE Jenbacher GmbH & Co OHG, Austria). *Lastest Developments in the use of Wood Gas in Gas Engines* (Invited Panel Discussion).
6. Niko A. Iliadis (Energy Consultant, EnerCoRD, Athens, Greece) and N. Danalatos (University of Thessaly, Volos, Greece). *Biomass Development*

and Potential in South East Europe (Invited Panel Presentation Summary 09GM0899).

7. Invited Discussers

Each Panelist will speak for approximately 20 minutes. Each presentation will be discussed immediately following the respective presentation. There will be a further opportunity for discussion of the presentations following the final presentation.

The Panel Session has been organized by Tom Hammons (Chair of International Practices for Energy Development and Power Generation IEEE, University of Glasgow, UK) and Niko A. Iliadis (EnerCoRD, Athens, Greece).

Tom Hammons and Niko A. Iliadis will moderate the Panel Session.

ABSTRACTS: INVITED DISCUSSIONS

Valentino Tiangco (California Energy Commission, USA). Biomass Developments in California

ABSTRACT: California has large untapped biomass resources from forestry, agriculture and municipal solid wastes (over 80 million bonedry tons per year). Managing this biomass resources produced annually in California presents clear challenges and opportunities for technology, policy, and economic development. In April, 2006, Governor Schwarzenegger issued his Executive Order S-06-06 calling for California to greatly increase its share of biofuels production and the generation of electricity from biomass. The order stemmed from the following concerns; intensifying public concerns over escalating fuel costs and heavy reliance on petroleum; strong state agency advocacy and commitment for improving resource management and mitigating climate change; legislative actions promoting growth in renewable energy and control of greenhouse gas emissions; pronouncements at the federal level signaling greater support for bio-energy; and the promise of new technologies for stimulating economic development, improving environmental performance, and realizing the potential offered by biomass in meeting an increasing share of the state's energy demand. The governor's executive order proclaimed the benefits and potentials of bio-energy in helping to meet the future needs of the state for clean, renewable power, fuels, and hydrogen, and called for the state to meet the following targets for biofuel and biopower development. The order also specified certain actions by the agencies of the state through subsequent Bio-energy Action Plan that the governor authorized to achieve the targets, including coordination on the development of research and development plans. This discussion presents the policy drivers, current status of biomass development (biopower and biofuels), benefits, barriers, overview

of the Public Interest Energy Research Program, and some biomass research activities.

Thomas Elsenbruch (GE Jenbacher GmbH & Co OHG, Austria). Latest Developments in the use of Wood Gas in Gas Engines

ABSTRACT: In this discussion, the results from various wood gas sites in Austria, Denmark and Switzerland will be presented. As of March 2009, the sites have reached up to over 100.000 operating hours and therefore allow the respective estimate of the potential in regard to the long term achievable power output and efficiencies as well as the expected operating and maintenance costs.

Based on the cumulative experiences of various customers and operators of over 10 installed wood gasification sites over the last 10 years, the individual criteria and their effects on engine operation can be identified and simple concepts to improve the site installation and operation can be presented.

The gasification of biomass and the use of this gas in gas engines represent an efficient site concept in terms of electrical total efficiency. Turbocharged 4 stroke lean gas engines show high specific power output and good efficiencies. With the very good lean combustion capability of hydrogen rich gas mixtures, very low NOx emissions can be achieved. GE Jenbacher is intensively involved in the utilization of so-called special gases and first experiences from engines fuelled by wood gas have already been collected on several installed sites. With sufficient gas cleaning, wood gas is very well suited for combustion in gas engines. Via modern control technology, the fluctuations in the gas composition can be handled without problems. Furthermore the low lower heating values from pyrolysis gases for charged 4 stroke lean burn engines do not present any problems.

This discussion reports on the effects of these concepts on engine operation and takes a look at the future potential of the use of wood gas in gas engines as a means of energy.

PANELISTS

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BIOGRAPHIES



Thomas James Hammons (F'96) received the degree of ACGI from City and Guilds College, London, U.K. and the B.Sc. degree in Engineering (1st Class Honors), and the DIC, and Ph.D. degrees from Imperial College, London University. He is a member of the teaching faculty of the Faculty of Engineering, University of Glasgow, Scotland, U.K. Prior to this he was employed as an Engineer in the Systems Engineering Department of Associated Electrical Industries, Manchester, UK. He was Professor of Electrical and Computer Engineering at McMaster University, Hamilton, Ontario, Canada in 1978-1979. He was a Visiting Professor at the Silesian Polytechnic University, Poland in 1978, a Visiting Professor at the Czechoslovakian Academy of Sciences, Prague in 1982, 1985 and 1988, and a Visiting Professor at the Polytechnic University of Grenoble, France in 1984. He is the author/co-author of over 400 scientific articles and papers on electrical power engineering. He has lectured extensively in North America, Africa, Asia, and both in Eastern and Western Europe.

Dr Hammons is Chair of International Practices for Energy Development and Power Generation of IEEE, and Past Chair of United Kingdom and Republic of Ireland (UKRI) Section IEEE. He received the IEEE Power Engineering Society 2003 Outstanding Large Chapter Award as Chair of the United Kingdom and Republic of Ireland Section Power Engineering Chapter (1994~2003) in 2004; and the IEEE Power Engineering Society

Energy Development and Power Generation Award in Recognition of Distinguished Service to the Committee in 1996. He also received two higher honorary Doctorates in Engineering. He is a Founder Member of the International Universities Power Engineering Conference (UPEC) (Convener 1967). He is currently Permanent Secretary of UPEC. He is a registered European Engineer in the Federation of National Engineering Associations in Europe.



Niko A. Iliadis received his Diploma in Civil engineering from EPFL (Swiss Institute of Technology of Lausanne) with specialization hydraulic structures and in energy systems management. He has conducted his diploma thesis research in EnergyLab of MIT within an ABB project.

He has conducted his PhD in EPFL on energy systems optimization subject to financial risk constraints. In 2005 he has earned an executive certificate in Financial Engineering from HEC Business School in Lausanne Switzerland.

He has worked for Energie Ouest Suisse (EOS Holding) in Switzerland as an analyst and trader. He has continued as a portfolio manager of the French Generation assets for Energy Suez Europe of GDF-Suez Group in Belgium. He then worked for Power Systems Research (PSR) in Rio de Janeiro Brazil as a senior engineering analyst and consultant on energy systems projects. Since 2007 he works for EnerCoRD as a senior engineering analyst and consultant on Energy Systems.

He is a member of IEEE, Informs, SIAM, TEE and COSP. He has a series of publications in the fields of operational research, hydrothermal optimization, risk management and Power Systems Development.