

# Table of contents

ChangE - NGO Presentation, Vuong Binh . . . . .	iii
Exploring a possible energy transition in Vietnam; Scenarios for the electricity sector and cost assessment of de-carbonisation., Thanh Dang Van [et al.] . . . . .	iv
Institutional change and market conditions for low-carbon electricity transition in Vietnam, Hoang Anh Nguyen Trinh . . . . .	vii
Perspective of CO <sub>2</sub> Capture & Storage (CCS) development in Vietnam: Results from expert interviews, Hoang Anh Nguyen [et al.] . . . . .	viii
Potential for production and application of bio-carbon in Vietnam, Khanh-Quang Tran [et al.] . . . . .	ix
Service issues: overview of electric vehicles use in Vietnam, Quang Hung Nguyen [et al.] . . . . .	x
The impact of hydrogen technology into power storage, Stephan Astier . . . . .	xi
A brief introduction to the European research activities related to the uncertainty reduction in smart energy systems, Phuong H. Nguyen . . . . .	xii
Computational Fluid Dynamics for Assessing Urban Wind Energy Potential in Vietnam, Jörg Franke . . . . .	xiii
Microgrids Optimal Power Flow through centralized and distributed algorithms, Eleonora Riva Sanseverino [et al.] . . . . .	xiv
New technologies in photovoltaic technology: electrical energy production from vertical walls, Fabio Viola . . . . .	xv
New technologies in photovoltaic technology: reconfiguration systems for photovoltaic plants, Romano Pietro [et al.] . . . . .	xvi

Power control of a photovoltaic system connected to a distribution grid in Vietnam, Nguyen Xuan Truong [et al.] . . . . .	xvii
Simulation of MPPT control system with DC/DC bidirection converter in boost mode for PV system, Vu Minh Phap [et al.] . . . . .	xviii
A critical look at dryers, Hélène Desmorieux . . . . .	xix
A critical look at rice husk gasification in Cambodia : technology an sustainability, Nam Nguyen Hong [et al.] . . . . .	xx
Air gasification of acacia woodchips in an downdraft gasifier, Dinh Quoc Viet [et al.] . . . . .	xxi
Feasibility and Sustainability of Co-firing biomass in coal power plants in Vietnam, An Ha Truong . . . . .	xxii
Sustainability assessment of biomass-to-energy processing chains scenarios: a necessity for decision makers, Didier Lecomte . . . . .	xxiii
Use of industrial wastes as alternative fuels in Vietnam cement industry corporation, Trong Hoang . . . . .	xxiv

**Author Index**

**xxiv**

# ChangE - NGO Presentation

Vuong Binh \* <sup>1</sup>

<sup>1</sup> ChangE NGO – Vietnam

ChangE is a local NGO who focuses in employing innovative communications, community engagement and policy advocacy to campaign for sustainable changes regarding urgent environmental and developmental issues in Vietnam. since its official registration under VUSTA (Vietnam Union of Science and Technology Association) in 2013, ChangE has partnered with WildAid to protect endangered species like rhinos and pangolins; and with 350.org to organize climate change action.

Identifying energy as a priority issue in its climate change campaign, in the past 3 years ChangE has organized youth-led campaigns to raise awareness on the connections between energy and climate change, to push for fossil fuel divestment, and to lobby the government in choosing sustainable energy options for a low-carbon economy.

A condense list of ChangE's campaigns is as follow :

- In 2013, the key campaign was Vietnam Power Shift, which comprised of the national climate leadership workshop I am a Climate Citizen, the National Day of Action for Energy and Climate, and the video art project "Pink and Black", all of which raised awareness on climate impacts and introduced to locals the sustainable energy solutions through exciting creative activities and arts.

- In 2014, the key campaign was People's Climate March, which comprised the photographic campaign "I Can't..." and the Day of Action "Black Day", both sending strong images of coal effects on the daily lives of bottle. The Sun in a Bottle proved much needed solutions for families lacking electricity to generate adequate lightning. The Climate Camp brought corporations to rural areas heavily affected by climate change to brainstorm mitigation solutions.

- In 2015, ChangE targeted universities and banks for the Global Divestment Day, calling for divestment from coal altogether. The EACLC gathered participants from five East Asian countries and trained them on regional issues induced by climate change. The POWER UP festival in November does not only celebrate the Vietnamese message to COP 21, but also launches a year-long campaign well into 2016 with solutions encouraging renewable energy.

---

\*Speaker

# Exploring a possible energy transition in Vietnam; Scenarios for the electricity sector and cost assessment of de-carbonisation.

Thanh Dang Van \* <sup>2,1</sup>, Jean-Christophe Simon <sup>2,1</sup>, Patrick Criqui

<sup>2</sup> Politiques publiques, ACtion politique, TErritoires (PACTE) – Université Pierre Mendès-France - Grenoble II, Université Joseph Fourier - Grenoble I, CNRS : UMR5194, Institut d'Études Politiques [IEP] - Grenoble, Université Pierre-Mendès-France - Grenoble II – IEP - BP 48 38040 Grenoble cedex 9, France

<sup>1</sup> Economie du développement durable et de l'énergie (EDDEN) – CNRS : FRE3389, Université Pierre-Mendès-France - Grenoble II – France

As an emerging country in Southeast Asia, Vietnam has been experiencing strong economic growth over the past decades. Its rapid development is characterized by industrial and urban transformations which translate into sustained demand for energy, and particularly electricity. Electricity production grew 14,1% over 1990-2010, and per capita consumption jumped from 93 to 999 kWh/habitant.

These trends for electricity sector expansion are to be considered in a policy and regulatory framework with strong State intervention. Public intervention is proactive for the upgrading of the national capacity and the orientation of the electricity mix. The national electricity plan is considering a tremendous expansion of the national electricity capacity by 2030. By that time, the electricity capacity would be increased sevenfold (20.000 MW in 2010 upgraded to 146.800 MW in 2030), according to official sources. The seventh Masterplan envisages a mix where hydropower accounts for 11.8%, energy storage hydropower 3.9%; coal thermal power 51.6%; and gas fired power 11, 8%; power using renewable energy 9.4%; nuclear power 6.6% ; and imported power 4.9%.

This is a considerable challenge in terms of investment, technology choice and prospects for reconciling energy, environment and climate policies. In this context, our research mobilizes economic analysis to investigate current trends with a view of characterizing a possible electricity transition in Vietnam.

We have carried out, over the past two years, an investigation covering three complementary fields:

- First we consider prevailing policies for the electricity sector, their priorities, measures and instruments to promote expansion of the electricity sector.
- Secondly we build scenarios for the electricity mix, taking into account fundamental parameters of capacity, demand management, electricity mix.
- Thirdly we analyse cost effect of various scenarios, with a specially adapted Elecsim Model (which is currently developed at EDDEN Laboratory), in order to make an assessment of policy options in the middle and long run.

---

\*Speaker

At this stage we can present a characterization of selected scenarios:

- Scenario including and increased share of nuclear energy is favourable in terms of overall costs – i.e. production and distribution costs, and reduction of CO<sub>2</sub> emissions from electricity sector. This is however to be considered with political debate and environmental issues.
- On the other hand scenario based on high share of renewables is attractive politically with up to 40% of new renewables (and a total of 50%) considering hydro-electricity. But constraints and costs for deployment of new sources should not be overlooked.
- Scenario including CCS is not satisfactory either in terms of investment costs or even for emissions reduction –this is because of technological uncertainty.
- Last scenario, with a balanced mix of energy sources, bears the highest cost, but minimizes dependency on one technology, thereby increasing security of supply for the country.

The scenario selection is a first step for further analytical work on economic evaluation of electricity system options. This scientific approach offers a sound approach of electricity sector development at national level, and it highlights options for mix selection as a means to initiate an energy transition.

*Major References :*

Asia-Pacific Economic Cooperation (APEC) 2009 Peer Review on Energy Efficiency in Vietnam.

Energy Alliance. (2012). Case study power sector reform in Vietnam.

IEA. (2013). Southeast Asia Energy Outlook.

Kyoto University (KU), (Coordinateur), (AIM), et al. 2012 A Low Carbon Society Development towards 2030 in Vietnam.

Nhan Thanh Nguyen and Minh Ha-Duong (2009). "Economic potential of renewable energy in Vietnam's power sector." *Energy Policy*, 37 (5):1601-1613, May 2009.

Soussan, J., & Nguyen, T. T. H. (2012). Internalizing the Externalities: SEA of the Viet Nam Power Development Plan VII.

WB. (2009). Vietnam power sector: Generation options— La Banque Mondiale.

World Bank Group. (2014). Exploring a Low Carbon Development Path for Vietnam.

Wu, Y., Shi, X., & Kimura, F. (2012). Energy Market Integration in East Asia: Theories, Electricity Sector and Subsidies.

The Vietnamese government service

2006 Chng trình mc tiêu quc gia v s dng năng lng tit kim và hiu qu (giai on 2006-2015)

2007a Chiến lược phát triển năng lượng quốc gia của Việt Nam đến năm 2020, tầm nhìn đến năm 2050

2007b Chương trình mục tiêu quốc gia ứng phó với biến đổi khí hậu giai đoạn 2012 - 2015

2011a Chiến lược phát triển ngành Du lịch đến năm 2020

2011b Chiến lược quốc gia về biến đổi khí hậu

2011c Quy hoạch phát triển điện lực quốc gia giai đoạn 2011-2020, có xét đến năm 2030

2012 Quy hoạch phát triển ngành than Việt Nam đến năm 2020, có xét đến năm 2030.

Ministry of Natural Resources and Environment (MONRE) (Vietnam)

2010 Vietnam's second national communication to the United Nations Framework Convention on Climate change.

# Institutional change and market conditions for low-carbon electricity transition in Vietnam

Hoang Anh Nguyen Trinh \* <sup>1,2,3</sup>

<sup>1</sup> Université des Sciences et des Technologies de Hanoi - USTH (VIETNAM) (USTH) – Vietnam

<sup>2</sup> Clean Energy and Sustainable Development Lab (CleanED) – Vietnam

<sup>3</sup> Centre International de Recherche sur l'Environnement et le Développement (CIRED) – AgroParisTech, École des Ponts ParisTech (ENPC), Ecole des Hautes Etudes en Sciences Sociales (EHESS), CNRS : UMR8568, Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] : UMR56 – 45 bis, avenue de la Belle Gabrielle - 94736 Nogent-sur-Marne Cedex, France

The paper develops a mesoeconomic approach to the low-carbon electricity transition in Vietnam. We argue that political will is a necessary but insufficient condition for such a change. In this perspective, we identify key players, and point out the institutional and structural characteristics of the electricity market which may impede the takeoff of renewable resources. Indeed, the transition process depends on interdependent organizational decisions and implies a fundamental transformation of the stakeholders' positions and relations. In particular, it necessitates the existence of a critical mass of initiating actors that perceive the benefits of investing in renewables and have the leverage to redefine the rules of the game, therefore modifying the institutional framework and enabling the constitution of new structural interdependencies inside the electricity system. During the current period, the conditions of the wholesale market appear as a determining factor in relation to the pace of the low-carbon transition. Then, we propose an analytical grid to apprehend the change path by following the trend in some focal variables. Among others, feed-in tariff and subsidies to the single-buyer indicate the balance of power between the major stakeholders and reflect the stages of the transition process.

---

\*Speaker

# Perspective of CO<sub>2</sub> Capture & Storage (CCS) development in Vietnam: Results from expert interviews

Hoang Anh Nguyen\* , Minh Ha-Duong † <sup>1</sup>

<sup>1</sup> Centre International de Recherche sur l'Environnement et le Développement (CIRED) – AgroParisTech, Ecole des Ponts ParisTech, École des Hautes Études en Sciences Sociales [EHES], CNRS : UMR8568, Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] : UMR56 – 45 bis, avenue de la Belle Gabrielle - 94736 Nogent-sur-Marne Cedex, France

This paper summarizes expert opinions regarding crucial factors that may influence Vietnam's future use of carbon capture and storage (CCS) based on face-to-face interviews in December 2013 with 15 CCS-related experts from the Vietnamese government, research institutes, universities and the energy industrial sector. This study finds that financial incentives and climate policy are the most important factors for the development of CCS technology in Vietnam. Financial incentives involve direct subsidies from the government, such as tax exemptions for land use and the importation of CCS-related equipment. In addition, all the experts agree that international financial support is important to initiate a large deployment of CCS technology in Vietnam by implementing demonstrative/pilot projects to prove CCS's working efficiency.

---

\*Corresponding author:

†Speaker



# Potential for production and application of bio-carbon in Vietnam

Khanh-Quang Tran <sup>\*</sup> <sup>1</sup>, Øyvind Skreiberg <sup>2</sup>

<sup>1</sup> Department of Energy and Process Engineering, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway – Norway

<sup>2</sup> Department of Thermal Energy, SINTEF Energy Research, NO-7465 Trondheim, Norway – Norway

Bio-carbon is charcoal produced from plant biomass via carbonization processes and has a wide range of applications including the use as: fuels for heat and power generation; reductant in the metallurgical industry; activated carbon; and agricultural fertilizer for soil conditioning and carbon sequestration. Using bio-carbon as fuel is considered as a sustainable energy alternative due to its zero net contribution to CO<sub>2</sub> emission and that biomass is a renewable resource. A land-use system that incorporates tree-growing on agricultural land offers an opportunity to remove CO<sub>2</sub> from the atmosphere by storing it in tree biomass and soil organic matter. This, coupled with the potential to deliver a range of benefits including improved productivity, greater food security, reduced poverty and increased resilience to climate change, has garnered it increasing international attention. This contribution will present an overview of different carbonization processes for production of bio-carbon from different biomass resources and their potential applications relevant to Vietnam, one of the agricultural countries susceptible to climate change. The presentation is related to SINTEF's *BioCarb+* project <http://www.sintef.no/biocarb>.

---

\*Speaker

# Service issues: overview of electric vehicles use in Vietnam

Quang Hung Nguyen \* , Nguyen Xuan Truong <sup>1</sup>

<sup>1</sup> Université des Sciences et Technologies de Hanoi (USTH) – R.807-USTH building; 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam, Vietnam

Due to the problems caused by the gasoline engine on the environment and people, the automotive industry has turned to the electrically powered vehicle. Electric Vehicles (EVs) such as electric two-wheelers and electric cars provide convenient local transportation and are becoming popular means of transport in Vietnam in recent years. Electric bicycles, electric motorbikes and electric cars appeared in Vietnam since the early 2000s and are growing very quickly. As of September 2015, Vietnam's EV market has grown to an estimated 2.5 million e-bike units and over 1000 electric cars. However, electric vehicles, as a competitive solution for *green transportation*, are yet to be bettered off. Lead poisoning, traffic accidents, lack of charging facilities, lack of policies and regulations to ensure safe and effective usage for a better environment and sustainability, in general are the elements that affect and restrain the further development of the Vietnamese market. In this paper, we present an overview of EV use in Vietnam, as well as the benefits and limitations of EV use, especially the many existing issues, and some recommendations to manage the development of these new modes of transport.

---

\*Speaker

# The impact of hydrogen technology into power storage

Stephan Astier \* <sup>1</sup>

<sup>1</sup> Laboratoire Plasma et Conversion d'Énergie [Toulouse] (LAPLACE) – Université Paul Sabatier  
(UPS) - Toulouse III, CNRS : UMR5213, Institut National Polytechnique de Toulouse – 118 Route de  
Narbonne 31062 TOULOUSE CEDEX 9, France

Stephan Astier

---

\*Speaker

# A brief introduction to the European research activities related to the uncertainty reduction in smart energy systems

Phuong H. Nguyen \* <sup>1</sup>

<sup>1</sup> Technische Universiteit Eindhoven, Electrical Energy Systems – Netherlands

As part of the overall EU renewable energy policy goals, the Netherlands is committed to produce 14% energy from renewable energy sources (RES) by 2020, and has the ambition to reach 16% in 2023. Most of the renewable energy will be produced small-scale, close to the consumers and fed directly into the distribution grid. Consequently, the management of the grid can no longer be based on the traditional top-down approach but will need a more bottom-up approach and a larger involvement of the regional (local) grid operators. To achieve the energy efficiency and sustainability goals of society, Smart Energy Systems (SES) with a multi-disciplinary nature via the merging and interaction of the electricity grid and ICT infrastructures are emerging. However, the development and operation of SES are facing challenges in both balancing energy supply and demand and securing the electricity networks (i.e. keeping them stable and reliable). In this report, several on-going SES related research projects in Europe, especial in the Netherlands, have been discussed to realize potential of distributed energy resources in offering energy/power flexibility to cope with such uncertain for the SES development.

---

\*Speaker

# Computational Fluid Dynamics for Assessing Urban Wind Energy Potential in Vietnam

Jörg Franke \* <sup>1</sup>

<sup>1</sup> Vietnamese-German University (VGU) – Le Lai Street, Hoa Phu Ward, Binh Duong New City, Binh Duong Province, Vietnam

Urban areas contribute substantially to the global energy consumption and it is expected that with increasing urbanization their contribution will continue to rise. This is one reason why currently a lot of research in Built Environment Wind Energy Technology is conducted internationally. This research focuses on one hand on the design of small and medium scale wind turbines which efficiently use the urban wind with its low mean wind speed and high turbulence levels. On the other hand methods are investigated that enable an accurate estimation of the wind energy potential at specific locations in specific urban areas. In the presentation the general methodology for using Computational Fluid Dynamics to predict urban wind energy potential will be introduced and exemplified with initial simulations of the wind in the central business district of Ho Chi Minh City. Open issues for the effective use of this methodology in Vietnam will be addressed.

---

\*Speaker

# Microgrids Optimal Power Flow through centralized and distributed algorithms

Eleonora Riva Sanseverino \* <sup>1</sup>, Gaetano Zizzo <sup>1</sup>, Maria Luisa Di Silvestre <sup>2,1</sup>, Ninh Quang Nguyen <sup>2</sup>, Romina Badalamenti

<sup>1</sup> Department of Energy engineering, Information technology and Mathematical models - University of Palermo (DEIM - UNIPA) – viale delle scienze 90128 Palermo, Italy

<sup>2</sup> Department of Energy engineering, Information technology and Mathematical models - University of Palermo (DEIM) – Viale delle Scienze 90128 Palermo, Italy

In this paper, the microgrids technology is outlined. Special attention is paid to the hierarchical control architecture and to the tertiary level regulation, which may also be able to coordinate the output or input power injections from the different energy resources, based both on technical as well as on economic objectives. Both centralized and distributed approaches for minimum power losses management are here presented and summarized results are given.

---

\*Speaker

# New technologies in photovoltaic technology: electrical energy production from vertical walls

Fabio Viola \* <sup>1</sup>

<sup>1</sup> Dipartimento di Energia, ingegneria dell'Informazione e modelli Matematici [Palermo] (DEIM) – Viale delle Scienze, edificio 9 90128 Palermo, Italy

In this article the preliminary evaluation of the performance of a photovoltaic window is presented. The aim is to trace the behavior of next-generation systems, which favor architectural integration. Three different systems have been taken into account: a dye sensitized solar cell (DSSC), blue and grey caved silicon panels. The systems can be placed behind a window or behind a wall of glass blocks.

---

\*Speaker

# New technologies in photovoltaic technology: reconfiguration systems for photovoltaic plants

Romano Pietro \* <sup>1</sup>, Fabio Viola \*

, Eleonora Riva Sanseverino \* <sup>†</sup>

<sup>1</sup> DEIM Palermo University (DEIM) – Viale delle Scienze, Edificio 9, 90128 Palermo, Italy

In this work, a reconfiguration system designed to maximize the output power from a partially shaded photovoltaic (PV) system is presented. The first measures derived from an optimized photovoltaic installation on the roof of our electrical engineering department are shown. Such measures show the output of a novel monitoring system that estimates the irradiation based on temperature, current and voltage measurements. The estimated irradiation is used as input for a reconfiguration hardware installation that provides optimized interconnecting configurations, thus giving rise to the output power maximization in partially shaded conditions.

---

\*Speaker

<sup>†</sup>Corresponding author: [eleonora.rivasanseverino@unipa.it](mailto:eleonora.rivasanseverino@unipa.it)



# Power control of a photovoltaic system connected to a distribution grid in Vietnam

Nguyen Xuan Truong \* <sup>1</sup>, Nguyen Quang , Tran Tung

<sup>1</sup> NXTRUONGUSTH (NXT) – R.807-USTH building; 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam, Vietnam

The demand for electrical energy is increasing in Vietnam in recent decades; which has motivated the use of renewable energy sources (RES). Among them, Photovoltaic (PV) energy is becoming a promising energy sources because of their advantages. The connection and use of PV in distribution grid in Vietnam should be in line with the framework of sustainable energy development worldwide. The different techniques of modeling and control of grid connected PV system with objective to help intensive penetration of PV electricity into grid have been proposed so far in different literatures. The current methodologies for optimizing of generation power of PV system are not completely efficient. Therefore many researches are required for overall configuration of the grid connected PV system, the Maximum Power Point Tracking algorithm, the synchronization of the inverter. This paper presents a control technique of the PV generation power by shift of phase angle of the inverter output voltage and grid voltage. In order to synchronize an alternative current output of the PV system's inverter into grid, the proposed method has been described, simulated in MATLAB/Simulink. The work helps to give a study results about interconnection standard, power generation optimization method of PV system into power grid.

---

\*Speaker

# Simulation of MPPT control system with DC/DC bidirection converter in boost mode for PV system

Vu Minh Phap \* <sup>1,2</sup>, Naoki Yamamura <sup>1</sup>, Junji Hirai <sup>1</sup>, Muneaki Ishida <sup>1</sup>

<sup>1</sup> Department of Electrical and Electronic Engineering, Faculty of Engineering, Mie University – 1577 Kurimamachiya-cho, Tsu City, Mie Prefecture, Japan 514-8507, Japan

<sup>2</sup> Institute of Energy Science, Vietnam Academy of Science and Technology – No 18, Hoang Quoc Viet street, Hanoi city, Vietnam

As energy demands around the world increase, the need for a renewable energy sources that will not harm the environment has been increased. Solar power system is one of the most promising as a future energy technology but solar panels are dependent on sunlight to effectively gather solar energy. Since the conversion efficiency of photovoltaic (PV) arrays is very low, it requires maximum power point tracking (MPPT) control techniques. The purpose of the MPPT is to adjust the solar operating voltage close to the MPP under changing atmospheric conditions. This paper presents a simulation model of PV module and DC/DC bidirection converter with the Perturb and Observe (P&O) technique of MPPT in PSIM software.

Keyword: PV, P&O MPPT, DC/DC bidirection converter

---

\*Speaker

# A critical look at dryers

Hélène Desmorieux \* <sup>1</sup>

<sup>1</sup> Laboratoire d'automatique et de génie des procédés (LAGEP) – CNRS : UMR5007, Université Claude Bernard - Lyon I (UCBL), École Supérieure Chimie Physique Électronique de Lyon – bât 308G  
ESCPE-Lyon, 2ème étage 43 bd du 11 Novembre 1918 69622 Villeurbanne Cedex, France

Hélène Desmorieux

---

\*Speaker

# A critical look at rice husk gasification in Cambodia : technology an sustainability

Nam Nguyen Hong \*<sup>1,2</sup>, Minh Ha Duong<sup>1,2,3</sup>, Laurent Van De Steene<sup>1,2,4</sup>

<sup>1</sup> Université des Sciences et des Technologies de Hanoi - USTH (VIETNAM) – Vietnam

<sup>2</sup> Clean Energy and Sustainable Development Lab (CleanED) – Vietnam

<sup>3</sup> Centre International de Recherche sur l'Environnement et le Développement (CIRED) – AgroParisTech, École des Ponts ParisTech (ENPC), Ecole des Hautes Etudes en Sciences Sociales (EHESS), CNRS : UMR8568, Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] : UMR56 – 45 bis, avenue de la Belle Gabrielle - 94736 Nogent-sur-Marne Cedex, France

<sup>4</sup> Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Centre de coopération internationale en recherche agronomique pour le développement [CIRAD] – 42, rue Scheffer 75116 Paris, France

In recent years, many Cambodian enterprises have installed rice husk gasifiers to substitute diesel in the electricity production to run rice mills machinery, or to provide electricity for villages. This study provides a critical look at rice husk gasification by assessing the sustainability of deploying this technology in Cambodia, expressed through environmental, economic and social impacts, and evaluates if it can be applied in Vietnam. Results show that gasification technology works in Cambodia and contribute to the development of the rice-milling sector, however environmental issues are severe and should be treated. We observe that increase in rice husk demand also leads to increase in price of rice husk, therefore new investors should consider the effect of new rice husk market for their activities. We conclude that this technology would not be suitable for Vietnam and suggests studying other alternative technologies to convert rice husk into energy, such as steam engine or steam turbine, gasifier stove, briquetting or co-firing.

---

\*Speaker

# Air gasification of acacia woodchips in an downdraft gasifier

Dinh Quoc Viet \*<sup>1</sup>, Nguyen Tien Cuong<sup>2</sup>, Pham Hoang Luong<sup>3</sup>, Van  
Dinh Son Tho<sup>1,3</sup>

<sup>1</sup> School of Chemical Engineering – Vietnam

<sup>2</sup> School of Heat Engineering and Refrigeration Hanoi University of Science and technology – Vietnam

<sup>3</sup> Vietnam Japan International Institute for Science and technology – Vietnam

Producer gas from biomass gasification can be used to produce chemicals or generate power. The fuel properties of acacia woodchips such as ultimate, proximate, heating values were investigated. Acacia woodchips gasification was investigated by downdraft gasifier at HUST. Main composition of producer gas include hydrogen, carbon monoxide, carbon dioxide was analyzed in gas chromatography with TCD detector. It was found that H<sub>2</sub>, CO, CO<sub>2</sub> composition was about 14-20%, 11-22% and 13-18%, respectively. The producer gas calorific value was about 3,5 - 5,4 MJ m<sup>-3</sup>. The air flow rate was controlled ER from 0,24-0,34 and it influence on both the combustible constituents of producer gas, calorific value and gasification efficiency. The result showed that the calorific value of producer gas was 5.4 MJ m<sup>-3</sup> and gasification efficiency attained 65,8 % with ER equal to 0,34. Acacia woodchips could successfully be used as feedstock for downdraft gasifier.

---

\*Speaker

# Feasibility and Sustainability of Co-firing biomass in coal power plants in Vietnam

An Ha Truong \* <sup>1</sup>

<sup>1</sup> Université des Sciences et des Technologies de Hanoi - USTH (VIETNAM) – Vietnam

La technologie de la co-combustion de biomasse avec le charbon est prête à l'utilisation comme il est démontré dans beaucoup de centrales électriques en Europe et aux États-Unis. On considère que c'est une technologie relativement bon marché que d'utiliser la biomasse pour produire de l'électricité et pour réduire les émissions de gaz à effet de serre ainsi que la consommation de charbon dans les centrales électriques à charbon. Au Vietnam, les facteurs qui attirent l'attention vers la co-combustion de biomasse incluent l'indépendance énergétique et la souveraineté nationale, les questions de changement climatique et d'environnement. Pour assurer la capacité des centrales électriques au charbon, le Plan prévoit de la développer jusqu'à 75 GW en 2030, ce qui implique 57% de la production électrique totale. Cela augmentera les émissions de gaz à effet de serre et posera la question de ressources en charbon pour le Vietnam. Notre recherche veut évaluer la possibilité et la durabilité de la co-combustion de biomasse dans les centrales électriques au charbon au Vietnam. Pour cela, on envisage une série d'indicateurs qui couvre les aspects technique, économique, environnemental et social. Ces indicateurs sont calculés pour deux cas, une centrale récemment construite, à charbon fluidisé de 1080 MW, et une centrale à charbon pulvérisé de 100 MW. Dans ces études de cas, la technologie de co-combustion directe avec 5% de biomasse est sélectionnée pour l'évaluation des indicateurs. Les résultats montrent que la co-combustion est techniquement réalisable mais pas encore profitable économiquement pour les deux centrales si on emploie cette technologie sans mécanismes pour la soutenir. Cependant, du point de vue environnemental et social, la co-combustion peut offrir des bienfaits comme la réduction de gaz à effet de serre d'environ 10-11%, un revenu supplémentaire pour les fermiers et la compagnie d'exportation du charbon ainsi que des créations d'emplois. Ainsi, on recommande que la co-combustion soit une option à considérer, comme un moyen de réduire l'émission de gaz à effet de serre et un moyen d'utiliser les ressources de biomasse pour produire de l'électricité au Vietnam. On peut ainsi également réduire la pollution de l'air causée par l'incinération des déchets agricoles en plein champ. C'est une option qui mérite d'être étudiée davantage.

---

\*Speaker

# Sustainability assessment of biomass-to-energy processing chains scenarios: a necessity for decision makers

Didier Lecomte \* <sup>1</sup>

<sup>1</sup> Institut de Technologie du Cambodge (ITC) – BP 86, Russian Conf. Blvd. Phnom Penh, Cambodia.,  
Cambodia

Biomass-to-energy can take various forms as biomass to gas or liquids, power production, heat production or combined heat and power production. Biomass-to-energy can be issued from different origins like agricultural activity, food processing industry, or waste treatment. Assessing a biomass-to-energy processing chain can be very difficult to achieve. For example:

- the conversion of biomass into energy may be in competition with other conversions scenarios as biomass-to-products where the products can have low or high values.

- the composition and properties of the biomass is a key factor to its valorization: water, oxygen, heavy metal, pops contents are highly discriminating for biomass to energy use.

- the sustainability assessment should include both economical and environmental aspects which may be difficult to achieve, either because information may be unavailable or available at small scale.

- biomass-to-energy is influenced by the mass balance and energy efficiencies of the processing chain e.g. crop yields, dewatering or drying efficiency, ...

- a biomass-to-energy processing chain is highly sensitive to the scenario chosen: storage, transport, distributed or concentrated.

The presentation will show some examples of energy processing chains, scenarios associated and sustainability assessments related to these scenarios.

---

\*Speaker

# Use of industrial wastes as alternative fuels in Vietnam cement industry corporation

Trong Hoang \* <sup>1</sup>

<sup>1</sup> Center for High Technology Development (HTD, VAST) – 18 Hoang Quoc Viet, Ha Noi, Vietnam,  
Vietnam

Vietnam Cement Industry Corporation (Vicem) has many plants with the general capacity of 20 million metric tons of cement per annum, taking 34% of the cement market share in Vietnam. The Vicem's plants use 3 million tons of coal per annum. In Vietnam, the amount of industrial wastes (IW) every year is from 6 to 7.5 million tons and up to 2020 will be from 9 to 13.5 million tons. The IW has been processed primarily by incineration and landfill with high costs and causing environmental pollution, adversely affecting the life of communities and ecosystems... The kinds of high calorific IW, which take 30% amount of IW, can use to replace coals and oils in the cement plants. The use of IW as alternative fuels in Vicem's plants, which contributes to the environmental protection, economic - socio development and avoid wasting "valuable resources" in Vietnam.

---

\*Speaker



# Author Index

- Astier, Stephan, 10
- Badalamenti, Romina, 13
- Binh, Vuong, 2
- Criqui, Patrick, 3
- Cuong, Nguyen Tien, 20
- Desmorieux, H el ene, 18
- Di Silvestre, Maria Luisa, 13
- Franke, J org, 12
- Ha Duong, Minh, 19
- Ha-Duong, Minh, 7
- Hirai, Junji, 17
- Hoang, Trong, 23
- Ishida, Muneaki, 17
- Lecomte, Didier, 22
- Luong, Pham Hoang, 20
- Nguyen Hong, Nam, 19
- Nguyen Trinh, Hoang Anh, 6
- Nguyen, Hoang Anh, 7
- Nguyen, Phuong H., 11
- Nguyen, Quang Hung, 9
- Phap, Vu Minh, 17
- pietro, romano, 15
- Quang Nguyen, Ninh, 13
- Quang, NGUYEN, 16
- Riva Sanseverino, Eleonora, 13, 15
- Simon, Jean-Christophe, 3
- Skreiberg,  yvind, 8
- Son Tho, Van Dinh, 20
- Tran, Khanh-Quang, 8
- Truong, An Ha, 21
- Tung, TRAN, 16
- Van de Steene, Laurent, 19
- Van, Thanh Dang, 3
- Viet, Dinh Quoc, 20
- Viola, Fabio, 14
- viola, fabio, 15
- Xuan Truong, NGUYEN, 9, 16
- Yamamura, Naoki, 17
- Zizzo, Gaetano, 13