Vienna Conference Overview

The 15th IAEE European Conference was organized by TU Vienna, Energy Economics Group in cooperation with Austrian Association for Energy Economics from 3rd to 6th September 2017.

Held at Hofburg Congress Center, Vienna, Austria.

The conference title "Heading Towards Sustainable Energy Systems: Evolution or Revolution?" and topics discussed during the conference reflected the changes and challenges currently under way in the energy systems of many countries. The conference focused on new developments of energy conversion technologies, energy policies and their effects on individual countries as well as at a global level, the efficient use of different types of primary energy resources and possible solutions to stop global warming. Speakers also discussed which new technologies are required and which role they may play in a future supply system consisting of decentralised and central supply units (power plants, refineries, pipelines ...). The main question of this conference was: In heading towards sustainability - is an evolutionary continuous development possible or is a revolution necessary?

The conference was well attended with more than 400 participants. The Conference's opening address was given by Fatih Birol from IEA and was aimed at global energy markets in transition and the implications for the economy, environment and geopolitics.

Conference presentations were scheduled within the eight plenary sessions (including opening and closing plenary sessions), 64 concurrent sessions and two poster sessions. Conference also included special activities for young researchers, such as a PhD Day/Presentation Workshop and Student Happy Hour at Café "Das Möbel" which created the opportunity not only to presents their research, but also to exchange opinions, and last but not least to do networking as the basis for potential future cooperation. Another special activity targeted at young researchers was a special concurrent session "Best Student Paper Award" where four qualified finalists presented results of their research and competed for the award.

The conference program also included various activities and social events which offered many possibilities for participants to exchange opinions, to discuss hot topics, to build new contacts. These special events and especially the Flying Dinner organized in Museumsquartier, and Award Dinner held in Heuriger Wolff, gave conference participants an unique chance to enjoy the spirit of Vienna, the city on "Blue Donau" which combines with numerous historical buildings, museums, cathedrals and churches and modern buildings including UNO city, headquarters of IAEA, etc. history and the modern era.

Two technical tours were organized succeeding conference events: to Nuclear Power Plant Zwentendorf (which was never been under operation and is the symbol of the alternative way of energy system development) and to Waste Incineration Plant Spittelau which is not only unique by its architectural design by well-known architect Hundertwasser but also as the successful example of trigeneration.

SUMMARY OF PLENARY SESSIONS

Special Address: Global Energy Markets in Transition: Implications for the Economy, Environment and Geopolitics

Opening Plenary Session: The Way to Paris: Climate Targets and Decarbonization Strategies

These opening parts of the conference were chaired by Hans Auer from the Viennese host. Fatih Birol, IEA; Pantelis Capros, Technical University of Athens, Greece; Michael Strebl, WIENENERGIE, Austria

After introductory speech and the invitation to all participants by Hans Auer, plenaries were opened with a special address by the director of the IEA, *Fatih Biro*l. Fatih started his presentation by focusing on the basics of research in Energy Economics, referring to his own PhD studies at Technical University of Vienna. His key message was that despite the worldwide stagnation in CO_2 emissions over the last three years urgent further action is needed.

The following presentation by *Pantelis Capros* focussed on the European efforts to meet the 2050 Greenhouse gas emission reduction targets with special emphasis on the 2017 ECs winter package. He presented the scenarios for energy and GHG emissions up to 2050 and the major necessary policy measures. Capros' main conclusions were that the role of electricity is central in the transition, and that the main two pillars are energy efficiency and renewables. In addition he stated that the energy efficiency improvement is ambitious and demands strong policies affecting consumers.

The final contribution in the first plenary was presented by *Michael Strebl.* He showed the point-of-view of an "energy service company of the future" with the major asset "Customer" respectively "Prosumer". He ended his presentation with the citation: "If the winds of change blow, some build walls, other set sails. It is WIENENERGIE's strong intention to be among the latter."

Dual Plenary Session I: Long-term Scenarios: New Challenges, New Approaches, New Results

The dual plenary session on long term scenarios of energy systems development was chaired by Christian von Hirschhausen, Berlin University of Technology and German Institute for Economic Research /DIW Berlin, Germany. He was joined by Klaus Mohn, University of Stavanger, Norway; Volker Krey, International Institute for Applied System Analysis; Claudia Kemfert, German Institute for Economic Research /DIW Berlin and Hertie School of Governance, Germany; Paula Ferreira, University of Minho, Portugal.

The objective of the dual plenary was to contribute to the debate with a discussion of both, political economy aspects of scenario making, but also on concrete scenarios on the longer-term energy and environmental future.

The first presentation by *Klaus Mohn* included a critical survey of long-term scenarios, in particular with respect to the macroeconomic assumptions. Mohn took as an example the World Energy Model which, in spite of presenting several scenarios, always maintains the same assumptions about economic growth. In addition, Mohn referred to very conservative assumptions about the development of low-carbon technologies. Mohn suggested to balance the policy advice emanating from the modeling and to improve the transparency of the process.

Volker Krey insisted on the link between two agendas, i.e., the Paris Climate Agreement and the Sustainable Development Goals (SDG). At first, Krey provided insights in the synergy between climate policy and air pollution actions, which results in less black carbon and sulfur emissions, when fulfilling the 1.5° or 2° targets. Furthermore, Krey elaborates the link between climate policy and the SDG for affordable and clean energy. Additionally, he emphasized on the impacts of climate change mitigation policies on food security and thermal water pollution.

The contribution of *Claudia Kemfert* and *Pao-Yu Oei* focused on a new approach in energy system modeling, i.e. "100% renewable" scenarios. They presented developed scenarios for a global decarbonization (1.5° - 2° targets), based on the Open Source Energy Modeling System (OSeMOSYS). The results presented by Kemfert and Oei suggest that in order to achieve the 1.5° or 2° targets, a combination of renewable energy sources provides the lowest-cost solution and is technically feasible.

How to implement the scenarios? *Paula Ferreira* presented how to model electricity supply and demand under new market designs. She elaborated the new market design and the resulting challenges for the power sector, e.g. rising energy demand due to increasing electrification of the economy and higher shares of distributed and variable renewables. She highlighted that modeling of electricity scenarios has to consider dynamics across the electricity value chain, as well as planning across time scales and including energy-related behavior and consumer participation.

Dual Plenary Session II: New Designs in Electricity Markets

The dual plenary session on new design in electricity market was chaired by Christophe Bonnery, French Association for Energy Economics, France. He was joined by Dominik Möst, TU Dresden; Audun Botterud, Massachusetts Institute of Technology, USA; Isabel Soares, University of Porto, Portugal; Markus Graebig, 50Hertz, Germany.

Speakers *Dominik Möst, Audun Botterud* and *Isabel Soares* aimed their presentations at new market design which would reflect quickly growing share of RES in power generation, long term target on decarbonisation and both changes in power generation structure and on side of power consumption. The issue of integrating renewable energy sources (RES) on power grids goes on par with the one of storage and of its rampant growth as a mechanism to create flexibility and contribute to adequate demand-side management. Mid and long-term perspectives to integrate RES and reduce network congestion ought to include interdependencies between grid extension, stronger market integration, and decentralized storage systems.

This is particularly true in the U.S., where low natural gas prices have triggered baseload retirements, and where windpower has sustained a surge in installed capacity over the past decade, thus generating oversupply and market distortions. Beyond storage systems, extra flexibility solutions for such power markets with high shares of intermittent RES may include dynamic operating reserves, in order to generate demand curves that would better reflect the uncertainty in electricity forecast prices, flexi-ramp capacities (adjustment of active power output), and trade-offs with other energy generation sources such as nuclear power.

Energy planning in a long-term perspective must not only be compatible with existing markets, but also ensure consistency between regulation, investments, and infrastructure goals. The new market design should include innovative solutions that such as: flexibility activation, sector coupling, trade-offs between regionalization and transmission, new market roles and business models for power grids through the use of intelligent infrastructures, effective use of data, as well as the involvement of all end users as fully-fledged stakeholders of these markets.

As highlighted by *Markus Graebig*, this may be well-observed in Europe, and most specifically in North Eastern Germany, where the energy transition has transitioned from integrating RES and de-carbonating the national economy, to now ensuring compliance between power and heat/transportation sectors at regional level.

Dual Plenary Session III: Geopolitics of Oil and Natural Gas in Europe

The dual plenary session on geopolitics aspects was chaired by Georg Erdmann, Berlin University of Technology, Germany. He was joined by Kostas Andriosopoulos, ESCP Europe, Paris; Manfred Hafner, Enerdata, France, Jim Smith, Southern Methodist University, USA

Kostas Andriosopoulos presented an interesting overview on new infrastructure projects, in particular in the Eastern Mediterranean. In spite of their often weak economic attractiveness no lack of financial resources seems to exist today.

Manfred Hafner showed that the traditional view of European dependency on Russia and the Middle East has shifted: The new view is bilateral dependency between exporters and importers. As a consequence a key motivation of the many weakly profitable infrastructure projects is securing the access to the European gas and oil markets.

Jim Smith underlined this view by the expectation of sustainable low oil and gas prices, due to the impact of technical progress on the supply side (shale oil, ...) and the demand side (de-carbonization, ...). To wrap up the session, the geopolitical focus has shifted from securing access to fossil resources to securing access to markets, but the fossil fuel suppliers are likely to miss the intentions of their investment efforts on the long run.

Dual Plenary Session IV: The Future of Transport and Electricity Systems

The dual plenary session on the future of transport and electricity systems was chaired by Amela Ajanovic, Vienna University of Technology, Austria. She was joined by Ben Schlesinger, University of Maryland, USA; Reinhard Haas, Vienna University of Technology, Austria, and Richard Green, Imperial Collage Business School, London, UK.

Ben Schlesinger presented an interesting overview on the developments in the gas industry in the U.S. focusing on the competitive aspects of natural gas and electric vehicles. He also discussed cost and value of electricity storage.

Reinhard Haas discussed how to integrate large shares of variable renewables into electricity systems as well as corresponding impact on prices in electricity markets. He analyzed the role of flexibility and sector coupling and provided ideas for the future market design.

Richard Green continued discussion on the future of electricity with the special focus on the renewables in a power market. He underlined that markets based on power will have volatile prices in a high-renewable world, and that storage can smooth these prices, creating markets based on energy.

During the discussion the role of electric vehicles and storage and its potential impact on the market was emphasized.

Dual Plenary Session V: Will Market Forces or Planned Economies Determine the Future Energy System?

The dual plenary session on the future of energy systems was chaired by Anne Neumann, University of Potsdam, Germany. She was joined by Nektaria Karakatsani, Greek energy regulator/RAE, Greece; Karsten Neuhoff, German Institute for Economic Research /DIW Berlin, Germany, Jean-Michel Glachant, European University Institute, Italy

During this session *Nektaria Karakatsani, Karsten Neuhoff* and *Jean-Michel Glachant* investigated the role of policies and market mechanisms for the transformation of the European energy system.

Nektaria first provided a view of the Greek regulator and CEER of the European Winter package in the light of stimulation competition and innovation in the short-term, while coordinating investments in the long-run. Although it contains several positive aspects there are still shortcomings in the proposed future design in particular increasing consumers' benefits. One of the main concerns voiced is the lack of the retail market to react to drops in wholesale prices. There will be a proposal of European regulators with according amendments to the current debate whilst avoiding over-regulation of the market.

Karsten Neuhoff then argued that the most important tool of the European energy system is the EU Emissions trading scheme. Strengthening this tool by including a consumption charge that should be levied to consumers will provide enough incentives for all players to dynamically adjust to the system.

Jean-Michel Glachant highlighted the new environment of the deregulated electricity market in which double unbundling and incentive regulation are the challenges. The pronounced role of institutions is the major obstacle of creating a truly European market. His vision entails strong decentralization forces and modularity which could make any future regulations on a European level redundant. These new "communities" of production and consumption in turn would become the new governance issue.

During the discussion the role of distribution companies was scrutinized and the role of storage was also highlighted.

Dual Plenary Session VI: Smart Energy Future ... Whatever that Means?

The dual plenary session on the smart energy systems was chaired by Johannes Mayer, E-Control Austria. He was joined by Peter Lund, Aalto University, Finland; Michel Derdevet, Enedis, France; Michael Merz, Ponton, Germany, Franz Strempfl, Energienetze Steiermark, Austria

Plenary session VI dealt with the vision of a smart energy future. The background of this session is the increasing intermittency of electricity production in Europe and elsewhere and as a consequence the need to better co-ordinate activities

of market participants.

Peter Lund presented flexibility options and diverse aspects of these options. Starting with the typical "duck curve" the net load of the Californian ISO exhibits, he presented technical options for increasing the flexibility in the system. In addition to curtailing intermittent generation he advocated the use of power-to-heat sector coupling as thermal heat dominates the energy used in cities. Under such circumstances the marginal value of power may be lower than the marginal value of heat, especially in an electricity system of high intermittent RES shares.

Michel Derdevet presented the challenges distribution network companies are facing nowadays. It is mainly the large number of small scale production units connected to their grid, the fact that more consumers become producers and the need for more data, which have to be generated, transmitted and consequently processed, which describes the new landscape of a DSO. He presented almost 20 examples of innovative demonstration projects. In terms of new major projects the roll-out of 35 mio. smart meters and a total cost of some 5 bln € over the next 6 years constitutes a veritable challenge to the company.

Michael Merz presented their blockchain platform "enerchain" and its use for peer-to-peer trading. In a vision for 2030 regionally hierarchical markets exist. In a more functional ordering of markets separate blockchains may serve these markets from P2P trading and local as well as wholesale markets, to flexibility and markets for ancillary services. Mr. Merz concluded, at present blockchain technology is still looking for potential applications, reversing the traditional development cycle for software.

Franz Strempfl presented the changing energy flows in the electricity grid, which is more and more reversed from former times. The future production will mainly be connected to the DSOs, necessitating increased co-operation between DSOs and TSOs. He presented the Austrian data hub "EDA", a platform which exchanges commercial and metering data in the retail market in Austria, as a case in that respect. Projects using blockchain technology such as Gridchain (a solution for real time grid management) and LEAFS (a solution which allows customers to use central storage devices for private purposes) were presented. Finally he discussed regulatory challenges such as grid tariffs for storage and the question of ownership of storage by DSOs.

All four presentations have drawn a picture of revolution in the electricity system. Not minor adaptations but a major reversal of the functioning of the electricity system was presented.

Closing Plenary Session: Innovation in the Energy Sector: Which Technologies do we Need after 2030 and which Policies do we Need Now?

The Closing plenary session was chaired by Reinhard Haas, Energy Economics Group, Vienna University of Technology, Austria. He was joined by Pierre de Champs, European Commission, Nebojsa Nakicenovic, International Institute for System Applied Analysis, Austria, Georg Erdmann, Berlin University of Technology, Germany, Ricardo Raineri Bernain, Pontificia Universidad Católica de Chile.

The major focus of the Closing Plenary was to analyze the need for innovations to finally meet the Paris targets. In addition, proper policies should be identified to bring about these innovations.

Four different views were provided: the European standpoint vs. the view of developing countries, the technological and the energy economic views.

Pierre de Champs presented the of the European Commission's perspective. He showed the major features of the "Clean energy package" as well as the specific targets of the EC with respect to CO_2 reduction, renewables and energy efficiency.

Nebojsa Nakicenivic's contribution was focused on the technological aspects with respect to climate issues. He stressed that the achievement of technological learning effects is of high relevance for new technologies to enter the markets and dissemination.

Georg Erdmann added the economic view of learning rates, especially for the German case. He showed impressingly how the PV prices fell mainly due to the subsidies financed by German households.

Finally *Ricardo Rainieri* argued from the developing world's point-of-view. His major statement was that the rich countries have to be role models and conduct the investments in the new technologies.

The session concluded that the current actions are mainly focussing on short-term achievements. Yet, for meeting the long climate-targets up to 2050 long-term views and corresponding strategies are required. This has to be underlined by accompanying long-term policies.

Jaroslav Knapek