

SYSTEM RESILIENCY AND FLEXIBILITY



An event organised under the auspices of the

IEA Experts' Group on R&D Priority Setting and Evaluation (EGRD)

13 – 14 May 2019

Hosted by the Austrian Ministry for Transport, Innovation and Technology

Venue Day 1: Technologiezentrum Seestadt, Seestadtstraße 27, 1220 Wien

Venue Day 2: Austrian Ministry for Transport, Innovation and Technology (BMVIT), Raum EA08,
Radetzkystraße 2, 1030 Wien

Vienna, Austria

International Energy Agency (IEA)

The IEA is an autonomous agency established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy. The IEA carries out a comprehensive programme of energy co-operation among 30 advanced economies¹. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations, and other stakeholders.

Since the 1980s, the IEA has continued to build good working relationships with countries beyond its membership, in particular major energy consuming, producing and transit countries. Countries with which the IEA seeks enhanced engagement including Accession country Chile, Association countries China, India, Indonesia, Morocco, and Singapore. Co-operation with these and other partner countries cover a wide range of activities, from joint workshops to in-depth surveys of specific energy sectors or data exchange. Combined, the IEA co-operates with more than 69 countries worldwide.

IEA Energy Technology Network

The IEA Energy Technology Network is an ever-expanding, co-operative group of more than 6,000 experts that support and encourage global technology collaboration. At the head of this vast network is the Committee on Energy Research and Technology (CERT).

Committee on Energy Research and Technology

Comprised of senior experts from IEA member governments, the Committee on Energy Research and Technology (CERT) considers effective energy technology and policies to improve energy security, encourage environmental protection and maintain economic growth. Under the guidance of the IEA Governing Board, the CERT oversees the technology forecasting, analyses and the research, development, demonstration and deployment (RDD&D) strategies of the IEA Secretariat, notably through its flagship publication, *Energy Technology Perspectives*, and the series of energy technology roadmaps. The CERT also provides guidance to its working parties and experts' groups to examine topics that address current energy technology, or technology policy, issues. The CERT is being supported by four topical working parties, including the EGRD.

Experts' Group on R&D Priority-Setting and Evaluation (EGRD)

The EGRD examines analytical approaches to energy technologies, policies, and R&D on targeted, timely topics. The results and recommendations support the Committee on Energy Research and Technology (CERT), feed into IEA analysis, and enable a broad perspective of energy technology issues. Recent topics analysed include Future Energy Market Design, Water-Energy Nexus (2018), Blue Sky Research for Energy Technology (2017), Life in the Fast Lane: evolving paradigms for mobility and transportation systems of the future (2016), Space Cooling (2016), Island Energy - Status and Perspectives (2015).

¹ Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea (Republic of), Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States; The European Commission also participates in the work of the IEA.

System Resiliency and Flexibility

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Rationale

In the New Policy Scenario of the *World Energy Outlook 2018*, primary energy consumption is expected to increase by 27% by 2040, mainly due to the growing energy demand in developing economies (especially Asia). In 2017, energy-related CO₂ emissions rose by 1.6 % for the first time in three years. These forecasts point to a further increase by 2040 (+10 % compared to 2017). Despite the relative reduction of fossil energy in total energy consumption from 81 % to 74 %, total aggregate demand will presumably increase by 16 % by 2040.

Complementarily the Intergovernmental Panel on Climate Change (IPCC) special report *Global Warming of 1.5°C*² states that CO₂ emissions have to decline by about 45 % by 2030 (from 2010 levels) in order to reach net zero emissions by 2050. To limit global warming to well below 2°C CO₂, emissions need to decline by about 25% by 2030 and reach net zero around 2070.

This leads to one of the questions that are of utmost importance currently: How do we design energy systems, which enable us to reach the 1.5° target? An intelligent linking of generation, distribution and consumption is required. Connecting different parts and sectors of the energy system will play a crucial role in the process of a successful energy transition. Sector coupling is considered as a guiding principle in future energy research policy. Furthermore, also energy storage and 'power-to-X' technologies will play a key role in an energy system based on renewable energy sources (RES) such as wind and photovoltaics (PV). Ideally, technologies from different sectors such as power, heat or transport will work as combined, integrated and energy-efficient systems in future.

The existence of technologies and systems that allow system reliance and flexibility in a future energy system is decisive for the increase of RES in the energy system as well as the decrease of greenhouse gas emissions to meet the goals of the Paris agreement.

At present the main options for balancing supply and demand in the electricity system beside (fossil) power plants are transmission grids between countries/regions, energy storage, demand side management, powerto-X technologies and curtailment of RES.

The integration of variable RES requires flexibility in order to be able to compensate for possible imbalances between supply and demand in the future energy system. The high share of renewable energy sources in electrical power and district heating grids will force the transition from a purely demand-oriented energy production ("generation on demand") to a production-oriented demand, respectively consumption ("consumption on demand"). Energy storage (electricity, heat) is an essential building block for the implementation of the energy transition to ensure grid stability with increasingly volatile feed-in from RES.

The use of the storage capacity in electric vehicles will depend on attractive business models for car owners to a large extent. The potential for energy flexibility in buildings is determined by a number of factors such as heat storage capacity of building components, quantities and sizes of thermal storage tanks and batteries, quantities and the type of electrical devices and consumers such as heat pumps, the specifically utilized control systems, and the like.

² For the full report, see https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

The Change in the energy system from a fossil fuel based to a renewable energy production is linked to major challenges. Beside of a carbon free energy supply, resilient systems are mandatory in the future. A resilient energy system ensures a durable stable power supply even under extreme conditions.

In the course of this workshop, framework conditions for the minimisation of vulnerability on the one hand and maximisation of resilience of the energy supply on the other will be discussed.

Aims

This workshop aims to address the following issues:

- **What will the future energy system look like? What are the key challenges and main risks for energy systems with a high share of variable energy sources?**
 - Which RES are required to meet the goals of the Paris Agreement?
 - To what extent does the increase of RES require technologies to balance supply and demand?
 - Differing challenges in various countries: workshop 'One fits all' or unique solutions?
 - Are existing technologies sufficient to deal with the necessity of balancing supply and demand?

- **New technologies and new business models: where are we heading?**
 - Which technologies for the increase of flexibility are applied on a global scale?
 - Of the existent climate change adaption technologies, which are suitable and ready for the system of the next 50 years?
 - What are the possibilities and prospects of new technologies to balance supply and demand?

- **Best practice examples: Which lessons have we learned so far?**
 - Learning from showcase regions around the world: Necessity of individualised solutions for different needs?
 - Which lessons can be learned from regions with a high share of intermittent RES, and are there any further derived findings?

- **What are the resilient transformation paths for the future?**
 - Analysis: What are the system's weak points and which factors contribute to a high vulnerability?
 - What can be done in order to add a greater impetus to resilience and adaptive and capacity?

- **Which are the main factors to be considered regarding R&D policies and decision making?**
 - What potential lies in the transformation towards flexible energy systems to improve resilience?
 - Which questions need to be addressed in future R&D policies?
 - Which funding instruments will be required?
 - Which R&D programmes for the development of new technologies to increase flexibility and system resilience already exist?

Target audience

In addition to EGRD members and national experts, we are seeking input from social scientists, behavioural economists, RD&D decision-makers, strategic planners and programme managers from industry, academia, think tanks, national laboratories, NGOs and government. Participation is by invitation only.

Expected outcomes

The workshop will result in a summary report that identifies challenges and opportunities of resilient and flexible energy systems and present perspectives and best practice for R&D planners and strategists.

DAY 1 – Monday, 13 May 2019, Technologiezentrums Seestadt, Seestadtstraße 27, 1220 Wien

08:30 Registration

Welcome, introduction and setting the scene

Moderator: Herbert Greisberger

1	09:00	Opening remarks „System Perspective of the Austrian Energy Technology Policy“ <i>Sabine Mitter, Austrian Ministry for Transport, Innovation and Technology (BMVIT)/AUT</i>
2	09:10	Introduction to the EGRD <i>Birte Holst Jorgensen, EGRD Chair/DNK</i>
3	09:20	Energy flexibility in Austria - in the Framework of a European Energy Transition <i>Wolfgang Hribernik, Austrian Institute of Technology GmbH (AIT)/AUT</i>

Session 1: Flexibility in sustainable Energy systems

Moderator: Herbert Greisberger

4	9:45	Flexibility for a sustainable energy system: the outcomes of the recent IEA EUWP workshop (20-22 March 2019 Rome) <i>Michele de Nigris, Ricerca sul Sistema Energetico (RSE)/IT</i>
5	10:15	Energy Flexible Buildings – IEA EBC Annex 67 <i>Søren Østergaard Jensen, Teknologisk Institut/DNK</i>
	10:45	<i>Coffee break</i>
6	11:15	Flexibility needs in the future power system <i>Werner Friedl, ISGAN, Austrian Institute of Technology GmbH (AIT)/AUT</i>
7	11:45	Energy flexibility, a framework and use-cases <i>Bram Sieben, Advisor to the Board at Alliander NV/NLD</i>
	12:15	Discussion
	12:30	<i>Business lunch</i>

Session 2: Practical experience with building flexibility into systems

Moderator: Johannes Tambornino

8	13:30	Green Energy Lab: Demonstration projects and innovation paths for the flexible, customer-oriented energy system of tomorrow <i>Susanne Supper, Green Energy Lab/AUT</i>
9	14:00	The potential of flexible thermal grids to decarbonize the heating sector <i>Stefano Coss, Arbeitsgemeinschaft Erneuerbare Energie - Institut für Nachhaltige Technologien (AEE INTEC)/AUT</i>
10	14:30	Choice of flexibility sources towards a 100% renewable based Nordic energy system <i>Klaus Skytte, Technical University of Denmark (DTU)/DNK</i>
	15:00	<i>Coffee break</i>
11	15:30	Flexibility from the network: Puglia Active Network project <i>Michele Giovannini, E-Distribuzione/IT</i>
	16:00	Discussion
	16:30	Lab tour: Aspern Smart City Research https://www.ascr.at/en/about-ascr/ <i>Dr. Georg Pammer, CEO ASCR</i>
	17:45	Guided tour: Seestadt Aspern https://www.aspern-seestadt.at/en
	19:30	Self-paid group dinner (Restaurant "Am Nordpol 3", Nordwestbahnstraße 17, 1020 Wien)

DAY 2 – Tuesday, 14 May
Austrian Ministry for Transport, Innovation and Technology (BMVIT),
Raum EA08, Radetzkystraße 2, 1030 Wien

Session 3: Challenges, obstacles and risks on the way to a resilient energy system		
Moderator: Birte Holst Jorgensen		
12	09:00	Risk and resilience assessment: key challenges from the European experience <i>Marcelo Masera, European Commission</i>
13	09:30	Resilient Energy Systems: Risks and Challenges <i>Jessica Lau, National Renewable Energy Laboratory (NREL)/US</i>
14	10:00	Smart Grid Cyber-Resilience <i>Sebastian Lehnhoff, OFFIS e.V./GER</i>
	10:30	<i>Coffee break</i>
15	11:00	Britain's gas system, a case for reducing flexibility to increase wider system resilience? <i>Grant Wilson, University of Birmingham/GBR</i>
	11:30	Discussion
	12:00	<i>Business Lunch</i>

Session 4: Flexible and resilient energy systems: towards R&D policies and decision making		
Moderator: Atsushi Kurosawa		
16	13:15	Opportunities and challenges in the context of the coal phase-out in Germany <i>Arjuna Nebel, Wuppertal Institute/GER</i>
17	13:45	Learnings from the Hokkaido Blackout <i>Manabu Nabeshima, Electric Infrastructure Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (ANRE/METI)/JPN</i>
18	14:15	Risks of Natural Gas exploration as one of the drivers for the energy transition in the Netherlands <i>Frank Witte, The Netherlands Enterprise Agency (RVO)/NLD</i>
	14:45	<i>Coffee break</i>
19	15:15	Italian strategy towards Power System resilience and regulatory scenario <i>Emanuele Ciapessoni, RSE/IT</i>
	15:45	Discussion
Final discussion and wrap up		
Moderator: Per Widell		
	16:00	Discussion: Workshop summary and R&D recommendations
	17:00	End of workshop

DAY 3 – Wednesday, 15 May Members' meeting 9h-12h00 (by invitation only)

MEETING VENUE

Monday, 13 May 2019: Technologiezentrums Seestadt, Seestadtstraße 27, 1220 Wien

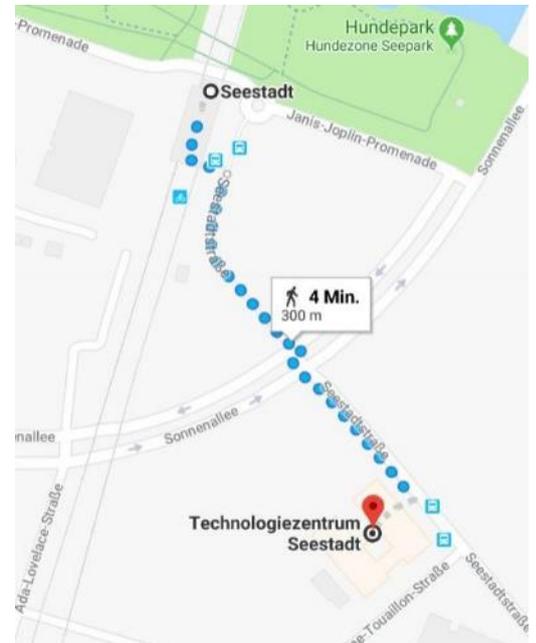
From Vienna Airport to Technology Centre Seestadt (Seestadtstraße 27, 1220 Vienna):



Source: <https://anachb.vor.at/>

1. **VAL3** (bus)
 - 1.1. start at station **Vienna Airport Busterminal**
 - 1.2. get off at station **Donaumarina**
2. 2-minute walk
3. **U2** (underground)
 - 3.1. start at station **Donaumarina**
 - 3.2. get off at station **Seestadt**
4. 4 to 5-minute walk
 - 4.1. start at station **Seestadt**
 - 4.2. get off at station **Technologie Centre Seestadt**

Duration: approximately 45 minutes



Source: Google Maps

From Vienna Central Train Station to (Wien Hauptbahnhof) Technology Centre Seestadt (Seestadtstraße 27, 1220 Vienna):

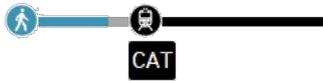


Source: <https://anachb.vor.at/>

1. **U1** (underground)
 - 1.1. start at station **Vienna Central Train Station**
 - 1.2. get off at station **Wien Praterstern**
2. 4-minute walk
3. **U2** (underground)
 - 3.1. start at station **Praterstern**
 - 3.2. get off at station **Seestadt**
4. 4 to 5-minute walk
 - 4.1. start at station **Seestadt**
 - 4.2. walk to **Technologie Centre Seestadt**

Duration: approximately 30-45 minutes

From Federal Ministry for Transport, Innovation and Technology (Radetzkystraße 2, 1030 Vienna) to Vienna Airport:



Source: <https://anachb.vor.at/>

1. 5 to 7-minute walk
 - 1.1. start at Radetzkystraße 2
 - 1.2. walk to station Tram 0 **Hintere Zollamtsstraße**
 - 1.3. get off **Wien Mitte-Landstraße**
2. **CAT** (City Airport Train)
 - 2.1. start at station **Wien Mitte-Landstraße**
 - 2.2. get off at station **Vienna Airport**



Source: Google Maps

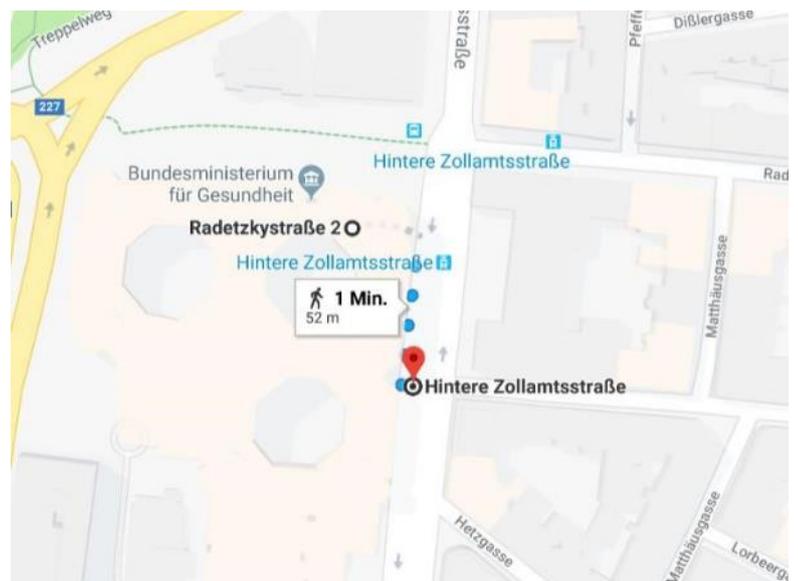
Duration: approximately 20-30 minutes

From Federal Ministry for Transport, Innovation and Technology (Radetzkystraße 2, 1030 Vienna) to Vienna Central Train Station (Wien Hauptbahnhof):



Source: <https://anachb.vor.at/>

1. 1 to 2-minute walk
 - 1.1. start at Radetzkystraße 2
 - 1.2. walk to tram station **Hintere Zollamtsstraße**
2. **1** (tram)
 - 2.1. start at station **Hintere Zollamtsstraße**
 - 2.2. get off at station **Schwedenplatz**
3. 3-minute walk
4. **U1** (Underground)
 - 4.1. start at station **Schwedenplatz**
 - 4.2. get off at station **Vienna Central Train Station**



Source: Google Maps

Duration: approximately 15 minutes

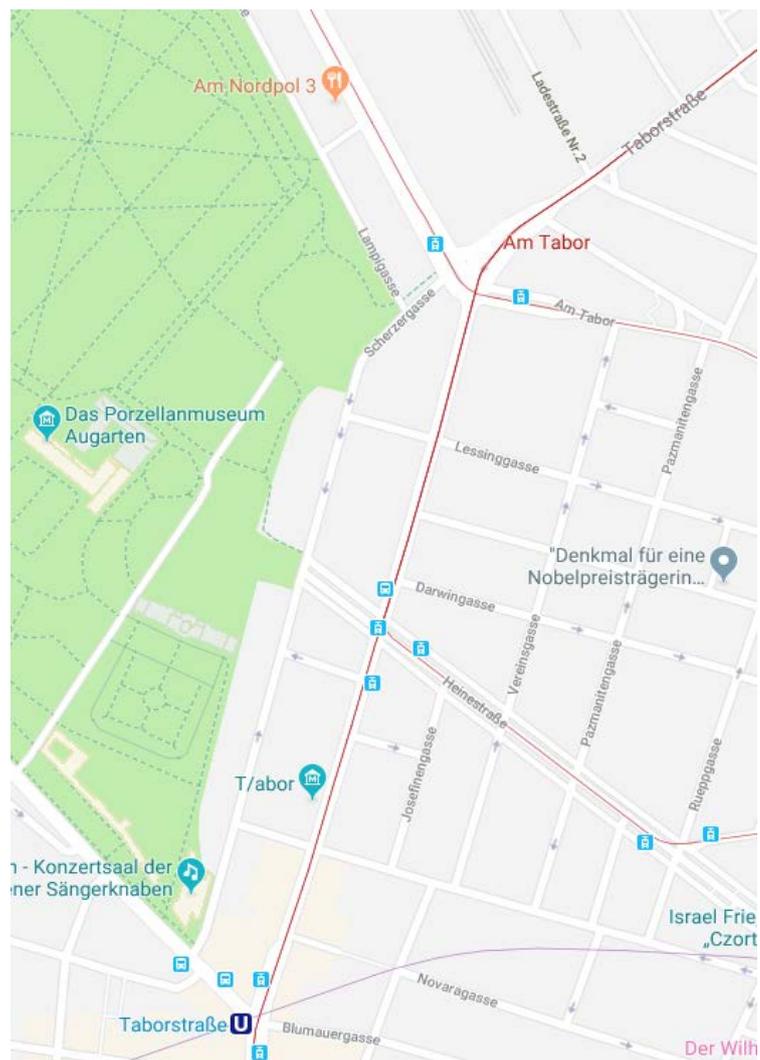
ACTIVITIES 13 May 2019

LAB TOUR	
16:30	Aspern Smart City Research https://www.ascr.at/en/about-ascr/ Dr. Georg Pammer, CEO ASCR
17:45	Guided tour: Seestadt Aspern https://www.aspern-seestadt.at/en

SELF-PAID GROUP DINNER	
Restaurant "Am Nordpol 3", Nordwestbahnstraße 17, 1020 Wien	
19:30	Dinner begins
22:00	Dinner ends

How to get there: **Metro U2**, station "Taborstraße". From there you can either walk (12 minutes) or take the **tram line 2** (direction "Friedrich-Engels-Platz") until station "Am Tabor".

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Hotel recommendations

Hotel Mercure Wien City (4 Sterne): <https://www.accorhotels.com/de/hotel-1568-hotel-mercure-wien-city/index.shtml>

Hotel Stefanie - Schick Hotels (4 Sterne):
<https://www.schick-hotels.com/hotel-stefanie/index.html>

Mercure Grand Hotel Biedermeier Wien (4 Sterne):
<https://www.accorhotels.com/de/hotel-5357-mercure-grand-hotel-biedermeier-wien/index.shtml>

Hotel Kärntnerhof (3 Sterne): <https://www.karntnerhof.com/>

Magdas Hotel:

<https://www.magdas-hotel.at/en/hotel/> (Austria's first hotel run as a social business)

Presentations will be available on the IEA website following the event at
<https://www.iea.org/workshops/eqrd-workshop-on-system-resiliency-and-flexibility.html>

For further information on EGRD activities, see <http://www.iea.org/about/structure/cert/eqrd/>

Image courtesy of [Fujitsu Journal](#)

Speakers & Moderators



Dr. Emanuele Ciapessoni graduated in Physics and Ph.D. in Computer Science at University of Milan. He joined CISE in 1990 and currently he is with “Ricerca sul Sistema Energetico S.p.A.” (RSE) in the Power Systems Development department. At present he is Leading Scientist and member of Scientific committee of RSE. His research activities concern defense, risk assessment and resilience of the power systems. He participated, also as coordinator, in several national and international UE Projects dealing with PS. He is Chair of Italian Electrotechnical Committee (CEI) CT65 and SC65A on system automation. He contributes to the National regulation authority, to several IEEE working group and to CIGRE C4.47 WG on resilience. He has published over 60 scientific papers and reports on power system.



DDr. Stefano Coss is a senior researcher and project manager at AEE - Institute of Sustainable Technologies in Austria. His interests in the energy field cover modeling and simulation (hybrid systems, energy hubs, power-thermal grid interconnection), sustainability (decarbonization, flexibility, smart operation) and innovation (new business models, user integration, thermoeconomics). He is currently responsible leading the flagship project ThermaFLEX, part of the program Vorzeigeregion Energie and a sub-project of Green Energy Lab, which drives the transformation towards flexible and smart thermal grids through large-scale industrial implementations. Stefano studied Energy Technology and Industrial Management at the Montanuniversitaet Leoben (Austria) and holds PhDs in Energy and Environment from IMT Atlantique (France) and Politecnico di Torino (Italy).



Dr. Werner Friedl is working for AIT Austrian Institute of Technology (since 2015) where he is heading and coordinating the research field “Integrated Energy Systems”. In parallel he is member of the Board of Directors of EUREC (The Association of European Renewable Energy Research Centres) and Operating Agent of ISGAN (The International Smart Grid Action Network). Furthermore, he is lecturer at Universities. After studies in Electrical Engineering with the focus on Energy Technologies, he worked at the Institute of Electrical Power Systems (TU Graz) in the fields of grid planning, safety and protection, decentralised generation and power quality and did his doctorate in grid planning and grid development. He achieved his expertise in energy policy and electricity market design during his time at Energie-Control Austria (from 2008-2015). His work at the Austrian regulatory authority included innovation, smart grids, quality of supply, balancing energy and energy control. From 2011-2015 he headed the working group “Electricity Quality of Supply and Smart Grids” at the Council of European Energy Regulators (CEER) and coordinated Smart Grids activities within CEER.



Dr. Birte Holst Jørgensen, Technical University of Denmark, is Chair of the IEA EGRD. She is an experienced researcher and practitioner in the field of new energy technologies and systems, where she has specialized in energy R&D strategies and technology policies at the national, European and international levels. She is Principal Coordinator in sustainable energy at the Sino-Danish Centre for Research and Education, a strategic co-operation between Danish universities, the Danish Ministry of Science, Technology and Innovation, and the University of the Chinese Academy of Sciences and the Chinese Academy of Sciences. Dr Jorgensen holds a PhD in Political Science (University of Copenhagen) and an MSc in Business Economics (Copenhagen Business School).



Michele Giovannini graduated in Nuclear Engineering and Master in Management and Controlling of Environment at Pisa University "Sant'Anna". Several years involved as researcher upon environmental topics (mainly: atmospheric pollutions characterization as PM10, PM1, submicronic and organic pollution, climate and receptor modelling development), he used to work in nuclear engineering area. In particular, he worked as Project Manager and Technical Director of several NPPs in Europe. Head of Nuclear Project and Technologies Development at Enel Group and Head of Nuclear Design Authority for some Nuclear Power Plant construction projects. After above experience in technology development, design/engineering and project management of very big projects, currently he is Head of Funded Projects in E-Distribuzione, the Italian largest DSO. The Funded Project Unit develops and manages all research and development project and manages deployment projects of advanced technologies on distribution network infrastructure (like Smart Grid).



Dr. Herbert Greisberger is the Managing Director of the Lower Austrian Energy and Environment Agency (eNu), where his projects focus on energy and innovation with a special focus on sustainable buildings and renewables. Dr. Greisberger is also Scientific Manager of the Austrian Futurelab focusing on long-term developments and their consequences for society. He was formerly the Senior Scientist on R&D, innovation and energy technologies for the Austrian Energy Agency and the Austrian Society for Environment and Technology. He is also a Lecturer at the Institute for Research and Education focusing on energy economy and energy management. Dr Greisberger holds a PhD (University of Stuttgart) and studied economics (Universities of Graz and Vienna).



Dr. Wolfgang Hribernik is Head of the AIT Center for Energy, responsible for its scientific, economic and strategic development. The research activities of the Center are addressing the restructuring of the energy system and the development and integration of the required technologies. Wolfgang Hribernik has been actively working in national and international boards. He is member of the VDE Association for Electrical, Electronic & Information Technologies, Senior Member of IEEE, designated Secretary General of the CIGRE (Conseil International des Grands Réseaux Electriques) Austrian national committee and member of the EERA (European Energy Research Alliance) executive committee. In the framework of the Austrian Flagship Region Energy Wolfgang Hribernik is the cluster coordinator of the research program NEFI (New Energy for Industry).

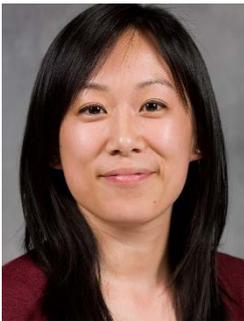


Dr. Rob Kool, former Chair of the IEA EGRD and formerly with the Netherlands Enterprise Agency, has over thirty years of experience with a broad range of topics in the energy field, such as municipal energy policy, the design of new efficient suburbs, district heating, the built environment, joint implementation, CDM and leading international collaboration projects. Rob has held leadership roles in many international fora, including the Association of European Energy Agencies (EnR), as Vice-President of the European Council for Energy Efficiency and as Chair of the Technology Collaboration Programme on Demand-side Management (DSM TCP). Rob holds a business degree (Netherlands Business School) and a degree in biology (University of Utrecht).



Dr. Atsushi Kurosawa is Director, Global Environmental Program, Research and Development Division, Institute of Applied Energy (IAE), where he has led many

energy-and environment-related projects. Currently his research focuses on integrated assessments of global climate change and energy R&D strategy through the integrated assessment model GRAPE and TIMES-Japan model. He has held visiting and fellowship positions at many universities and institutes including Stanford University, the Research Institute of Innovative Technology for the Earth, Kyushu University, Tokyo University of Agriculture and Technology, Japan Science and Technology Agency, New Energy and Industrial Technology Development Organization, and University of Tokyo. He holds a PhD in Electrical Engineering (University of Tokyo), a MSc in Nuclear Engineering (Tokyo Institute of Technology) and a BSc in Nuclear Engineering (Nagoya University).



Jessica Lau is a Sr. Technical Project Manager at NREL and has been a power system planner for 11 years in the U.S. She enjoys strategizing for future power systems in technical, economical, and policy challenges. Her expertise spans reliability and resiliency planning, wholesale electricity markets, T&D grid modernization, and next-generation modeling tool development. Jessica has been a bulk system planner at a system operator (ISO-NE) and a distribution system planner at a utility (Con Edison). She has a B.S. in Electrical Engineering and Math and a M.S. in Power Systems Management.



Dr. Sebastian Lehnhoff is a Full Professor for Energy Informatics at the University of Oldenburg. Prof. Lehnhoff is a member of the executive board of the OFFIS Institute for Information Technology and speaker of its Energy R&D division. He is speaker of the section „Energy Informatics“ within the German Informatics Society (GI), assoc. editor of the IEEE Computer Society’s Computing and Smart Grid Special Technical Community as well as an active member of numerous committees and working groups focusing on ICT in future Smart Grids. Prof. Lehnhoff leads one of the largest Energy Informatics research groups in Europe (~70 researchers). His research interests focus on the large-scale integration of decentralized, renewable energy sources into the electricity supply system in combination with the politically motivated reorganization of corporate structures and business processes.



Dr. Marcelo Masera is Head of the Unit “Energy Security, Distribution and Markets” at the Directorate “Energy, Transportation and Climate” of the Joint Research Centre of the European Commission. The unit is located in Petten, the Netherlands, and Ispra, Italy, and its main mission is to provide support to European policy makers and national authorities in relevant topics. The main lines of activity are electricity systems and markets, natural gas systems and markets, digitalisation of energy, and interoperability. Since 2000 he is officer of the European Commission, working at the Joint Research Centre. Between 2000 and 2010 he was responsible for the JRC group dealing with Critical Infrastructure Protection, theory of failures in cyber-physical systems and cybersecurity related aspects.



Sabine Mitter is senior expert for energy research at the Federal Ministry for Transport, Innovation and Technology (BMVIT) in Vienna and is in this function responsible for the IEA Research Cooperation (strategic planning, definition of call content, monitoring and evaluation and other fields of activity). She has been delegate of the IEA Committee of Energy Research and Technology (CERT) since 2009, delegate of the End Use Working Party and Vice Chair for Buildings since 2017, and is alternative delegate for a number of programmes (Solar Heating and Cooling

Programme, Heat Pumping Technologies, Energy Storage, Women in Clean Energy). She holds a master degree in Environmental System Science (focus on Business Administration).



Manabu Nabeshima, MPP LL.B. is Director for Electricity Supply Policy at Agency for Natural Resources and Energy (ANRE). As Director, he is responsible for designing Japan's new electricity markets including capacity market, balancing market, base-load market, and non-fossil fuel certificate market. He is also responsible for electricity demand and supply policy in Japan. Before taking his current position in 2017, he had experience in electricity policy as deputy director for 6 years. He joined Ministry of Economy, Trade and Industry (METI) in 2001. He received Master in Public Policy from University of California, Berkeley, and Bachelor of Laws from the University of Tokyo.



Dr. Arjuna Nebel is chief modeler at the Wuppertal Institute. He studied Power Systems Engineering at the Clausthal University of Technology and received his PhD from the University of Wuppertal in the field of energy system modeling. He has been working in the field of energy system analyses for about 10 years and currently coordinates the modeling work at the Wuppertal Institute. Additionally he contributes to research and policy advice projects in the field of scenario and infrastructure analysis as well as market analyses and digitalization.



Michele de Nigris has more than 35 years of experience in research, innovation, technology development, testing, certification and consultancies in the field of electricity and, more recently, integrated energy systems. He is the director of the "Sustainable Development and Energy Sources" department of RSE, a publicly owned research centre located in Italy. His present fields of activities include R&D, development and studies in the field of the environmental and economic sustainability of the energy system, the assessment of the potential of different energy sources in Italy, the evaluation of the interaction between the energy system and the environment. Michele owns the co-chairmanship of the European Set Plan IWG4 in charge of the development and implementation of the plan of energy systems. On the international level, he is the Italian national representative in the Committee For Energy Research and Technology of the IEA (International Energy Agency), Italian national delegate and Vice chairman "Electricity" of the End Use Working Party of the IEA (i.e. the committee in the IEA supervising fourteen technology collaboration programmes).



Søren Østergaard Jensen, M.Sc. Operating Agent of IEA EBC Annex 67 Energy Flexible Buildings and Project Manager at the Danish Technological Institute, has more than 35 years of experience in the fields of energy performance of buildings including solar energy. Currently his research is divided between low energy/energy neutral buildings and how buildings can help stabilize the future energy systems with a large amount of renewable energy sources. He has both nationally and internationally carried out research on how new and existing buildings can become low energy buildings and/or serve as distributed energy resources, which may provide flexibility services for the surrounding energy networks.



Bram Sieben, MscBA is advisor to the Board at Alliander NV and takes part in the Project Committee of EDSO. Bram is currently a Board Member for the USEF Foundation, a foundation that exists for the past 5 years, aiming to harmonize the European flexibility market(s) and its development. Within USEF and with most of his work of the past 3 years, Bram focused on the topic of flexibility. Next to flexibility, Bram has been involved in the topic of Smart Cities, Social Innovation, Market design and Innovation. Bram Sieben holds a business degree from the Rotterdam School of Management.



Dr. Klaus Skytte is head of Energy Economics and Regulation at DTU Management in Denmark. He is an energy analyst with strong academic profile and analytical skills with more than 17 years of experience in energy planning and system analysis. He holds a Ph.D. in economics and has coordinated several national and international research projects, e.g. the Nordic flagship project Flex4RES. His research activities are within energy economics, regulation, microeconomic modelling, economic policy instruments, energy market structure and subsidy instruments for renewable electricity. Klaus Skytte has been member of the managing board of EERA jp Wind Energy (EU) and of the steering committee of ETIP Wind (EU). He is appointed as national expert for Denmark in IEA ISGAN Annex 7 Smart Grid Transition.



Susanne Supper heads the office of the Green Energy Lab as Cluster Manager where she is responsible for the overall coordination of the entire project cluster as well as the Green Energy Innovation Lab. Before she was Senior Project Manager for Energy and Climate at the Energy and Environment Agency of Lower Austria. In this position, she was in charge of leading the pre-project phases of Green Energy Lab. As head of the department for energy and innovative buildings at the Austrian Society of Environment and Technology, Susanne Supper coordinated many national and international research projects. Supper is a certified energy consultant. She studied civil and water management (University of Natural Resources and Applied Life Sciences, Vienna), and graduated with an engineer's degree.



Dr. Johannes Tambornino is the head of the Energy Strategies and Systems Analysis Unit at Project Management Jülich, where he is responsible for the R&D program on energy systems analysis funded by the German Ministry of Economic Affairs and Energy. He is leading a group that covers a broad range of topics along the energy innovation chain and currently serves as the German representative in the IEA Experts' Group on R&D Priority Setting and Innovation. He holds a PhD in Mathematical Physics and has actively pursued research in quantum gravity and cosmology at different laboratories in Canada, France and Germany before changing fields and devoting his time to energy-related issues.



Per-Anders Widell recently joined the International Energy Agency (IEA) after working almost nine years in the Swedish Government. He holds a Master in Economics from Linköping University, Sweden. He has represented Sweden in many international fora such as the IEA, Clean Energy Ministerial and Mission Innovation, as well as in bilateral relations linked to climate/energy policy and trade promotion. Among other major responsibilities Per-Anders was the project leader for organising the Clean Energy Ministerial 9/Mission Innovation 3 taking place in

Copenhagen/Malmö in 2018, and between 2011-2014 he was co-ordinating the Swedish Government's Cleantech Strategy.



Dr. Grant Wilson is a Lecturer in Chemical Engineering at the University of Birmingham and board member of the IMechE's Energy, Environment and Sustainability Group. His research activities focus on energy system flexibility, and multi-vector, multi-scale data analytics. He recently led a work-package from the UK Energy Research Centre's FlexiNET project that is delivering new insights into sub-daily demand, demand variability and intra-day flexibility of local gas networks in Great Britain. He also leads the TeachEnergy project that aims to encourage interdisciplinarity and diversity in energy teaching in Higher Education. Additional research includes modelling the use of thermal energy stores for the UK's Active Building Centre project.



Dr. Frank Witte is manager Energy Innovation at the Netherlands Enterprise Agency (RVO.NL) which is part of the Ministry of Economical Affairs. Since ten years he is responsible for the energy innovation programmes in the Netherlands. At this moment the Climate policy is being renewed by het government and in its slipstream also the energy innovation is being newly programmed according to the mission statements in het Dutch Climate Agreement. Frank was educated as a chemist, got his PHD in chemistry and worked ten years for DSM chemical company before he got his public position in energy innovation.