



FOREWORD

We are in a time of unprecedented changes for the energy sector: climate change mitigation actions have to be implemented; CO₂ tax is to be reinforced, renewable energy has been largely developed, in particular in Germany. Moreover, decision-makers in cities and municipalities have to decide on their sustainable energy future, when the world is facing unprecedented urbanization.

For these reasons, having EIFER as an integrated actor in the energy transition in Germany is valuable for the EDF Group. EIFER has a strong research and innovation track record on topics related to energy in cities and territories, thanks to long-term studies on this topic, a close relationship with KIT, but also due to a rich ecosystem in Germany.

First of all, I would like to highlight that all this research has to be valorised. With innovative technological solutions and decision support concepts the EDF Group is now mature to help cities, an important stakeholder and customer, to face these new requirements. The EDF Group's main objective is now to deploy the innovative approach for sustainable city planning. However, the challenge for EIFER will be to pursue these developments, and, at the same time, anticipate new needs for new research questions in the field of local multi-energy systems and smart cities. I am confident that EIFER will meet this challenge.

Jacques Sacreste

Vice President EDF's R&D International & Partnerships,
Member of EIFER Board of Directors

WHAT'S UP AT EIFER?

DECEMBER 2016 | # 03/16

NEWSLETTER

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IN THE SPOTLIGHT

SUSTAINABLE DEVELOPMENT GOALS

Sustainable Development Goals and the Paris Agreement in Effect since November 4th, 2016

Ratified by more than 80 countries - including France, Germany, the US and China – the 2015 "Paris Agreement" by the United Nations Framework Convention on Climate Change (UNFCCC) sets the goals for a significant reduction of GHG emissions and for keeping the global temperature increase below 2°C. Most signatures of ratification were given during the New York Climate Week in September 2016, which allowed the Paris Agreement to take effect from 4th November 2016. This was presented during the COP22 conference in Marrakech just recently.

Moreover, the UN Sustainable Development Goals (SDGs) – also known as "Transforming our world: the 2030 Agenda for Sustainable Development" highlight the need for transition. Especially

SDG 11 "Sustainable Cities and Communities", SDG 7 "Affordable and Clean Energy" as well as SDG 9 "Industry, Innovation and Infrastructure" affect the strategy of EIFER and its members. SDG 11 consists of ten goals, including among others resilient housing situation, access to transport systems, reduced vulnerability of inhabitants and resource efficiency with regard to a changing climate.

EDF's Strategy CAP 2030 contains low-carbon growth goals in its energy efficiency concepts while KIT's Framework 2025 and Masterplan 2030 focus on sustainable design of energy, mobility and information. Therefore, EIFER, EDF and KIT pay respect to both, the Paris Agreement as well as the Sustainable Development Goals and already started their actions for a sustainable future.

Contact: Jeannette Sieber

WHAT'S UP AT EIFER ?



Continuous Simulation for Urban Energy Planning Based on a Non-Linear Data Driven Modelling Approach

PhD Thesis work by Andreas Koch

The above titled thesis develops the argument for scale sensitive local energy planning in order to combine energy demand simulation and the development of continuous benchmarks. The current state of urban energy simulation is described and a structure is proposed for classifying existing energy system models suitable for describing energy needs for urban neighbourhoods. Typical local energy planning tasks are described and linked to assessment methods and simulation models.

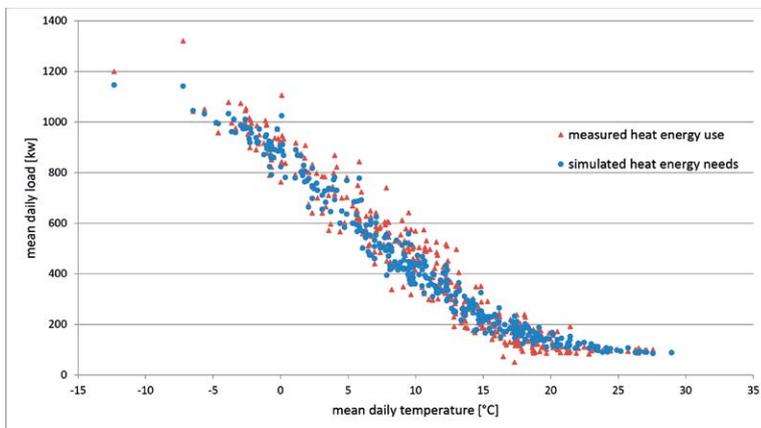
Based on this discussion, a data driven modelling approach is selected to represent daily and hourly space heating needs for existing and newly built urban areas. The model is applied to the scale of buildings, building clusters and neighbourhoods in order to test the application's robustness and its scalability. Comparison with measured energy needs from six case studies containing residential and non-residential users showed the applicability of the data-driven

approach to the scale of neighbourhoods or building clusters. Based on selected statistic tests, aggregation effects of heating energy needs that occur at the scale of building clusters and equalize individual user's specific thermal load profiles are discussed. To improve the simulation results a new set of parameters is proposed for the application in periods of very low temperatures for which the model in its current state shows distinct weaknesses. In addition, a modified simulation approach is developed, and adapted to the intermediate scale of neighbourhoods.

In the application, the model allows for an easy application yet delivers robust simulation results for daily and hourly heating needs in early stages of urban development projects. It is judged suitable to follow up performance in the form of continuous benchmarks with high temporal resolution.

The thesis was supervised by Prof. A. Wagner, head of the Building Science Group at the Department of Architecture at KIT.

Contact: Andreas Koch



Measured and simulated daily heating energy needs in blocks of multi apartment buildings.

Resource Urbanisms Project Workshop in Abu Dhabi and Kuwait City



The workshop presenters and the organization team in Kuwait City

Within the framework of EIFER-LSE Cities Resource Urbanisms Project, two workshops were organized at Abu Dhabi and Kuwait City on 26th and 28th September 2016, respectively. Both workshops aimed at bringing together institutional representatives, local experts, engineers, architects, planners, policy makers and academics to discuss the preliminary results of this project. In Abu Dhabi, the workshop was attended by about 25 participants and was held at the Paris-Sorbonne University Abu Dhabi. In Kuwait, it was organized at the Kuwait Foundation for the Advancement of Science (KFAS), where about 30 participants attended.

The Resource Urbanisms workshop explored how natural resources, urban form and infrastructure affect each other and potentially lead to the establishment of divergent forms of urbanism. The workshops were organized in three one-hour sessions, the first looking into the metropolitan scale of analysis, the second at the neighbourhood scale and the last session at the relationship between policy, land and energy using Kuwait, Abu Dhabi and Singapore as case study cities. EIFER presented the analysis of urban morphology, preliminary results of energy model and its implications in different typologies. Following the workshops, several meetings with local experts and field visits were organized.

For more information on the project please visit: <https://secities.net/objects/research-projects/resource-urbanisms>

Contact: Syed Monjur Murshed, Andreas Koch, Jochen Wendel

WHAT'S UP AT EIFER ?



Smart and Sustainable Cities at the Innov'Action Event in Brussels



On 28th September 2016, EIFER participated in the event “Innov'Action: which innovations will deliver the low-carbon economy?” organised by EDF (R&D and Brussels office) and EnergyPost. Jean-Paul Chabard (Scientific Director) led the R&D delegation. A varied and large public discovered EDF Lab Paris-Saclay and different achievements, notably concerning smart and sustainable cities projects, led by EIFER. A debate between executives from different institutions concluded the day.

Contact: Alberto Pasanisi

Link: <http://energypost.eu/innovation-16/>

Collaboration with the SIANI Institute

Since 2010, EIFER has been collaborating with SIANI, a research institute of the University de Las Palmas de Gran Canaria, Spain, focusing on artificial intelligence, modelling and simulation in Las Palmas. Monentia is a spin-off company of this institute which provides services related to these domains. Monentia/SIANI has been successfully collaborating with EIFER based on a multi-annual research partnership agreement that was signed in 2014 and has led to valuable outcomes in terms of complex systems simulation methods and tools. In this context, Monentia is providing and maintaining the open source tools JavaFMI, TAFAT, SUMUS and MasterSim. JavaFMI is a framework for integration into Java simulations based on the Functional Mockup Interface (FMI) standard. TAFAT is a modelling methodology and framework to develop complex systems simulations. SUMUS supports the analysis and visualization of complex data sets, coming from TAFAT



simulations or other large data sources. These software tools are applied on use cases in smart grid and urban energy modelling by EIFER and EDF's R&D. In the project Millener, demand side management on island systems was simulated. This work is currently being continued in the scope of an activity dedicated to support the developments of EDF's R&D smart grid simulation platform POMME. SIANI is also supporting EIFER in developing new simulation units for innovative co-simulations of urban energy systems.

Contact: Enrique Kremers

Links:

<https://bitbucket.org/intino/tafat-platform>
<https://bitbucket.org/intino/sumus-platform>
<https://bitbucket.org/siani/javafmi>
<https://bitbucket.org/siani/mastersim>

CELSIUS City Talk: Webinar with the City of Ljubljana on End-User Engagement in District Heating Projects

On 29th September, as a supporter of the CELSIUS-Smart Cities project, EIFER was asked to give a presentation on “Key success factors and barriers for end-user engagement in District Heating projects” during the “CELSIUS City Talk” with Ljubljana, the capital of Slovenia, and an audience made up of the other 50 cities of the Celsius network. The reasons why customers should choose district heating as their privileged heating option were highlighted together with several technical and marketing strategies to increase clients' awareness and engagement in respect of this technology. The speech and presentation will be available for registered users on the project's website.

Contact: Nicole Pini, Guillaume Bardeau

Link: <http://celsiuscity.eu/>

Another Success for EIFER in the Improvement of Reliability and Lifetime of Proton Exchange Membrane Fuel Cells

Last September, the French ANR funded project PROPICE ended. EIFER contributed to its success by co-financing a PhD thesis at the University of Franche-Comté and by developing innovative algorithms for PEMFC lifetime estimation. The PhD student performed long term testing of PEMFC stacks in μ -CHP and automotive profiles, providing useful data to other partners. In addition, EIFER's algorithms successfully predicted the future behaviour of PEMFC stacks and systems. A patenting process is ongoing.

Contact: Philippe Moçotéguy

WHAT'S UP AT EIFER ?



Solid State Protonic Conductors Conference in Oslo, Norway, 18th – 23rd September 2016



The 18th International Conference on Solid State Protonic Conductors (SSPC) was dedicated to Ceramic Proton Conductors, Low Temperature Conductors and Hybrid Ion Conductors. EIFER presented its last results on the reversibility approach using Ceramic Protonic Conductors (20cm² EIFER-made cell), showing good electrochemical performances ($P=235\text{mW/cm}^2$; $E=0.8\text{V}$; $T=700^\circ\text{C}$). A low electrical degradation ($<1.4\%/kh$) was measured under a dynamic reversible concept (alternative production of hydrogen and electricity) over a long term period ($>1,000$ hours).

Contact: Julian Dailly Link: <http://www.sspc18.com>

EIFER at the 21st World Hydrogen Energy Conference in Zaragoza and the 10th International Symposium on Electrochemical Impedance Spectroscopy in A Toxa, Spain

The 23,000 hour long-term test of a solid oxide electrolyser cell (see Newsletter March 2016) was presented in two scientific meetings in June this year.

The first meeting was the 21st World Hydrogen Energy Conference (WHEC2016) which took place in Zaragoza from 13th to 17th June. WHEC2016 counted some 600 scientific and technological presentations in nine parallel sessions and was attended by almost 1,000 participants from all over the world. The conference dealt with the hydrogen energy sector worldwide, covering all the aspects related to hydrogen energy such as the progress in hydrogen production, stor-

age, distribution and applications. One highlight was the 'Test & Drive' in Toyota and BMW Fuel Cell Electric Vehicles. The EIFER presentation was selected by the Scientific Committee for submission as a publication in the International Journal of Hydrogen Energy (J. Schefold, A. Brisse, H. Poepke, submitted October 2016).

The results of the EIFER work, more closely related to in-situ diagnostics, were presented at the 10th International Symposium on Electrochemical Impedance Spectroscopy in A Toxa from 19th to 24th June. This triannual symposium brought together about 200 scientists working on and with Electrochemical Impedance Spectroscopy.

Contact: Josef Schefold

Euroheat & Power District Energy Days



Since the publication of the first European Heating and Cooling Strategy in February 2016, district heating and cooling are finally at the forefront of the European Commission and Parliament.

At the beginning of October, Euroheat & Power and the DHC+ Technology Platform organized the District Energy Days in Brussels to assemble all the sector stakeholders and discuss the present challenging situation. EIFER, as a member of DHC+, took part in the event and in the Steering Committee to also present two ongoing project proposals to new potential research partners.

Contact: Nicole Pini, Guillaume Bardeau

European Geothermal Congress in Strasbourg

With the European Geothermal Congress and the Journées de la Géothermie, the Strasbourg Eurometropole was the hot spot of the geothermal community from 19th to 23rd September. Organized by the ES Group, the French Association AFPG and the European Geothermal Network EGEN, the event was an opportunity to assemble more than 800 participants to look at the main challenges of the branch, with sessions covering science, markets, social issues, an exhibition, courses, and side events. EIFER presented collaborative works on the material selection of the Rittershoffen plant and on the social acceptance of geopower projects.



Contact: Elodie Jeandel, Petra Huttenloch

Link: <http://europeangeothermalcongress.eu/>



WHAT'S UP AT EIFER ?



Develop methods to:

1. Assess vulnerability of forest resources due to an extreme winter storm

2. Analyse corresponding economic impacts over time and space

Develop a decision support tool to:

- Understand the evolution of impacts of an extreme winter storm, due to forest management decisions
- Organize marketing strategies

Methodological objective of the PhD thesis

Assessment of Impacts of Extreme Winter Storms on the Forest Resources in Baden-Württemberg - A Combined Spatial and System Dynamics Approach

PhD Thesis work by Syed Monjur Murshed

This PhD thesis investigates the impacts of extreme winter storms on the forest resources in the federal state of Baden-Württemberg in Germany. Such analyses can help private and public forest owners to identify whether and how much of their forest is vulnerable. It also allows them to understand what possible economic consequences might arise as a result of their decisions on forest management and salvage operations, considering the subsequent market conditions after a storm. Appropriate decision support tools, considering a combination of space and time, are largely missing in forest management practices. Such accessible knowledge would help the decision makers to evaluate their strategic decisions in the aftermath of a storm. Within this research, two models are therefore developed, in order to achieve these objectives.

The first Weight of Evidence (WofE) model is based on a combined Geographic Information System (GIS) and statistical analyses to illustrate the most vulnerable forest areas in the federal state of Baden-Württemberg. Multiple model runs with different combinations of factors are performed to evaluate and validate the reliability of the results. The WofE model produces a raster grid with cells in a one ha unit area representing the posterior probabilities of damage due to a stochastic winter storm for approximately 14 million ha of forests in the state of Baden-Württemberg. The outcome of the WofE model is used as an input into a system dynamics model to evaluate the economic impacts of a stochastic winter storm, under different forest management and salvage operation decisions. The model is able to demonstrate the changes in impacts over time across all of the 44 districts. It is

observed that although the extreme storm initially offers profits from the sale of the timber, it has a long term negative economic impact.

Afterwards, the model is validated by a series of structure and behaviour tests. Two strategic scenarios - immediate salvage operation and delayed salvage operation - are also examined to ascertain the likely impacts due to alternative salvage operation strategies. Four sensitivity analyses are performed to identify the effect of some of the most important economic parameters.

Finally, open research questions and further application possibilities of the findings are presented.

The thesis was supervised by Prof. Dr. Ute Werner, Department of Economics and Management at Karlsruhe Institute of Technology (KIT).

Contact: Syed Monjur Murshed



International Conferences on Sustainable and Resilient Urban Development

During the summer months, EIFER attended several conferences on the topic of "Resilient and Sustainable Cities", namely the 7th Forum on Urban Resilience and Adaptation in Bonn (D), the 6th International Disaster and Risk Conference in Davos (CH) as well as the 4th Annual International Conference on Sustainable Development in New York City (USA). The conference topics focused on risk management for resilient cities and resilient energy infrastructure, risk mapping and spatial assessment tools, local implementation of global frameworks and to identify and share best practice solutions to support the Sustainable Development Goals (SDG). In this respect, EIFER was able to present its work on climate resilient energy infrastructures and the connection to urban ecosystem services for the case studies of New York City, Singapore and Berlin in very different and interesting environments. While one event was influenced by practitioners, two conferences mainly addressed stakeholders and external financing sources.

Contact: Jeannette Sieber *Links: <http://ic-sd.org/> <http://idrc.info/> <http://resilient-cities.iclel.org/>*

WHAT'S UP AT EIFER ?



Environmental Costs due to Air Pollution and Greenhouse Gas Emissions in Germany Proposed to the German Federal Environment Agency

On 26th September, EIFER presented updated estimates of environmental costs due to air pollution and greenhouse gas emissions in Germany to a delegation of the German Federal Environment Agency (UBA) in Berlin. The work was carried out within a public funded project aiming to update the German Methodological Convention for Estimates of Environmental Externalities, used for instance in federal policy assessments. Based on the feedback obtained, the related status reports will be finalized and made publicly available afterwards by UBA.

Contact: Till Bachmann, Jonathan van der Kamp

Link: <https://www.umweltbundesamt.de/publikationen/economic-valuation-of-environmental-damage-0>

Women4Energy: A Powerful Contribution



The Federal Government of Germany has set the goal of promoting opportunities for women in education and research, in career and society and to achieve equality between women and men. Strengthening the participation of women in research and development and promoting their innovation potential are key factors for more gender equality in society.

In 2015, EIFER was asked by the Steinbeis-Europa-Zentrum (SEZ) Stuttgart to participate as a cooperation partner in the project GENERGIE, Gender in Energy Technology, funded by the Federal Ministry of Education and Research (BMBF) and led by Steinbeis. In the framework of this project, three workshops were organized, focusing on gender aspects in energy related research topics.

EIFER took part in the workshop "Integration of Gender in the Research and Development of Energy Relevant Topics" on 7th July 2016. As an institute with a high number of female employees working in the field of energy, EIFER contributed to this exchange with its rich experience. As an international institute, EIFER also represented different cultural points of view.

In the discussions during the workshop, important focal points were the working conditions for women in research, but also the question, if there are specific strengths of women in their research activities and/or female approaches to energy-related topics and to innovation. The GENERGIE project will be closed with a final conference on 8th February 2017 presenting the results of the different workshops.

Link: <http://www.genergietechnik.eu/>

As in the last few years, EIFER will also actively participate in the international "Women4Energy" conference organized by Steinbeis on 30th November 2016 with a scientific presentation entitled "Seeking for Sustainability beyond Climate". This year's topic is "Towards a Low-Carbon Economy" with special focus on the implications and conclusions of the Paris Agreement.

Contact: Joelle Franceschi, Pia Laborgne

Link: <https://www.b2match.eu/women4energy2016>



First Meeting of the Climate Protection Advisory Board of the City of Karlsruhe

This advisory board was created after a respective decision of the municipal council in November 2015. The city wants to mobilise the locally available competences as a support for its climate action plans. The advisory board will critically review existing activities and accompany new ones. It is composed of 17 representatives from research (including EIFER), local agencies, private initiatives and companies. It is complemented by members of the municipal council. In its first meeting on 20th October 2016 the priority areas were chosen. The bi-annual meetings will focus on city planning and district development as well as on the update of the current climate protection plan.

Contact: Ute Karl

Link: https://www.karlsruhe.de/b3/natur_und_umwelt/klimaschutz/beirat.de



SAVE THE DATE



FDFC from 31st January to 2nd February 2017

The DLR Institute of Engineering Thermodynamics is organising the 7th International Conference on "Fundamentals & Development of Fuel Cells", in Stuttgart, Germany, from 31st January to 2nd February 2017.

The main topics at FDFC2017 will address fuel cells and electrolyzers, ranging from fundamentals of electrochemistry to systems operation. Recent advances in materials, single cells, stacks and system development, as well as fuel cell diagnosis, power processing and control, characterisation of MEA, will also be presented during the conference.

For more information:
<http://www.nerghy.eu/7th-international-conference-on-fundamentals-development-of-fuel-cells-in-stuttgart-january-31-february-2-2017/>

Contact: Jeannine Eckstein

PUBLICATIONS

Book Contributions and Journal Articles:

Damblin, G., Keller, M., Barbillon, P., Pasanisi, A., Parent, É. (2016). "Bayesian Model Selection for the Validation of Computer Codes", *Quality and Reliability Engineering International*, 32(6), 2043-2054. <http://dx.doi.org/10.1002/qre.2036>

Häfele, S., Hauck, M., Dailly, J. (2016). "Life cycle assessment of the manufacture and operation of solid oxide electrolyser components and stacks", *International Journal of Hydrogen Energy*, 41(31), 13786-13796. <http://dx.doi.org/10.1016/j.ijhydene.2016.05.069>

Imbert, I., Sevenet, M., Nogues, P., Bahu, J.-M. (2016). "Messung von Energiearmut trotz Datenmangels – Vorstellung einer Methode zur Bestimmung des erforderlichen Energieverbrauchs." In K. Großmann, A. Schaffrin, C. Smigiel (Eds.), *Energie und soziale Ungleichheit – Zur gesellschaftlichen Dimension der Energiewende in Deutschland und Europa* (pp. 263-290). Heidelberg: Springer.

Pahon, E., Yousfi Steiner, N., Jemei, S., Hissel, D., Péra, M. C., Wang, K., Moçoteguy, P. (2016). Solid oxide fuel cell fault diagnosis and ageing estimation based on wavelet transform approach. *International Journal of Hydrogen Energy*, 41(31), 13678-13687. <http://dx.doi.org/10.1016/j.ijhydene.2016.06.143>

Sar, J., Schefold, J., Brisse, A., Djurado, E. (2016). "Durability test on coral Ce_{0.9}Gd_{0.1}O₂-La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-δ} with La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-δ} current collector working in SOFC and SOEC modes", *Electrochimica Acta*, 201, 57-69. <http://dx.doi.org/10.1016/j.electacta.2016.03.118>

Sieber, J. (2016). "Strengthening energy systems to enhance urban resilience: Climate resilient energy supply infrastructure and green spaces - Examples from three cities", *Online Proceedings of the Resilient Cities 2016 Congress: Article 2.*

"EIVIER" in Top Ten of Business Team Marathon Karlsruhe



On 25th September 2016, four EIFER sportsmen participated in the business team marathon which was part of Karlsruhe's "Baden Marathon". Jonathan van der Kamp, Régis Anghilante, David Colomar and Volker Schlabach who have participated in previous years, finished their marathon under 3:14 hours. This resulted in a fantastic 9th place out of over 300 participating teams. A success to be proud of!

Contact: Jonathan van der Kamp

IMPRESSUM

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