eceee Summer Study Proceedings

Online version

eceee 2024 Summer Study
Sustainable, safe and secure through demand reduction
10 – 15 June 2024
Center Parcs Lac d'Ailette
Chamouille, France

PROCEEDINGS PRODUCTION

Project managers
Therese Laitinen Lindström
Borg & Co, Stockholm, Sweden

Proceedings editing, layout and production
Therese Laitinen Lindström, Ylva Blume, Nina Hampus & Linnea Hampus
Borg & Co, Stockholm, Sweden

Conference graphics
Klas Björkman
Björkman & Mitchell, Stockholm, Sweden

ISSN 2001-7960
ISBN 978-91-988270-3-3

The proceedings are also available in a printed version
(ISSN 1653-7025, ISBN 978-91-988270-2-6).

Proceedings can be ordered from:
eceee secretariat
Sveavägen 98, 4 tr
113 50 Stockholm
Sweden

tel: +46 (0)8 673 11 30

eceee@eceee.org
www.eceee.org

Acknowledgements

The eceee board would like to convey a special thanks to the partners, whose support makes this event possible. The board would also like to thank all the authors and the panel leaders for their intense efforts to contribute to these proceedings. We gratefully acknowledge the support of all the anonymous helpers who have assisted in making the eceee 2024 Summer Study a success.

GOLD PARTNERS

ADEME
Swedish Energy Agency

SILVER PARTNERS

CLASP
Velux

BRONZE PARTNERS

IEA 4E, Smart Sustainability in Lighting and Controls Platform
Swiss Energy

PARTNERS

Efficient Buildings Europe
Eurima
Glass for Europe
Rockwool

SPECIAL PARTNERS

One session is arranged by the Energy Efficiency Watch 5 project, and one session is arranged by the ODYSSEE-MURE project, both co-funded by the European Union

CONTRIBUTORS

Energy in Demand

PANEL LEADERS

PANEL 1. **Dynamics of consumption**
Edouard Toulouse négaWatt Association, France
Florin Vondung Wuppertal Institute for Climate, Environment and Energy, Germany

PANEL 2. **Future and innovative policies**
Barbara Schlomann Fraunhofer ISI, Germany
Samuel Thomas Regulatory Assistance Project (RAP), Belgium

PANEL 3. **Policy, finance and governance**
Giulia Pizzini IEECP, The Netherlands
Nick Eyre University of Oxford, United Kingdom

PANEL 4. **Monitoring and evaluation in times of crises**
Iska Brunzema Fraunhofer ISI, Germany
Lea Gynther Motiva Oy, Finland

PANEL 5. **Sustainable communities**
Agneta Persson Anthesis AB, Sweden
Pedro Moura University of Coimbra, Portugal

PANEL 6. **Energy-efficient and low-carbon mobility and transport**
Malcolm Morgan University of Leeds, United Kingdom
Stefan Werland Wuppertal Institute for Climate, Environment and Energy, Germany

PANEL 7. **Policies and programmes for better buildings**
Jana Deurer IREES – Institute for Resource Efficiency and Energy Strategies, Germany
Mariangiola Fabbri BPIE, Belgium
Sibyl Steuwer BPIE, Germany

PANEL 8. **Products, systems and technologies to decarbonise buildings**
Michael Hörner Private Consultant, Germany
Corinna Fischer Agora Energiewende, Germany

PANEL 9. **Energy efficiency and sustainability of industry**
Anna Realini OMCD Group, Italy
Thomas Björkman Private consultant, Sweden

SUMMER STUDY CONFERENCE MANAGERS

Christel Broussous, Therese Laitinen Lindström, Nils Borg & Nina Hampus

SUMMER STUDY CO-CHAIRS

Sibylle Braungardt & Didier Bossebœuf

EXECUTIVE DIRECTOR

Nils Borg

ECEEE BOARD

Board members

Andrea Roscetti, Kyoto Club, Italy (eceee President)
Clemens Rohde, Fraunhofer Institute for Systems and Innovation Research, Germany (eceee Vice President)
Sibylle Braungardt, Öko-Institut, Germany (eceee Vice President)
Kurt Bisang, Swiss Federal Office of Energy, Switzerland
Didier Bossebœuf, French Agency for Environment and Energy (ADEME), France
Erwin Cornelis, Tractebel Engineering S.A., Belgium
Rod Janssen, Energy in Demand, France
Adrian Joyce, EuroACE, Pan-European organisation, Brussels-based
Vesna Kolega, Silvosus, Croatia
Jens Henning Laustsen, Danish Energy Agency, Denmark
Simon Minett, Challoch Energy, Belgium
Jan Rosenow, Regulatory Assistance Project (RAP), Belgium

Alternates

Lorenzo Pagliano, Politecnico di Milano, Italy
Barbara Schlomann, Fraunhofer Institute for Systems and Innovation Research, Germany
Samuel Thomas, Regulatory Assistance Project, (RAP), Belgium
Faye Wade, University of Edinburgh, United Kingdom

Table of contents

eceee 2024 Summer Study proceedings
These proceedings include the peer-reviewed papers from the eceee 2024 Summer Study. The accepted extended abstracts, also presented at the conference, can be found together with the online version of the proceedings at the eceee proceedings web site: https://www.eceee.org/library/conference_proceedings/.

PANEL 1. DYNAMICS OF CONSUMPTION

Introduction to Panel 1
Panel leaders: **Edouard Toulouse & Florin Vondung** 1

1-086-24 **Determinants of behavioral change: combining insights from digital tools, surveys, and smart meters to understand prosumers' energy choices**
Anne Kesselring & Sabine Pelka 3

1-087-24 **Impact of energy price rise on electricity use and indoor temperatures in UK dwellings retrofitted with heat pumps**
Rajat Gupta & Sahar Zahiri 13

1-139-24 **Designerly contributions to energy sufficiency – a narrative review and possibility exploration**
Helena Strömberg, Sara Renström, Katharina Merl & Maria Håkansson 25

1-163-24 **Staying cool in France: an extensive survey of summer comfort, natural home cooling practices and emerging air conditioning use in the French residential sector**
Mathieu Durand-Daubin, Marie-Hélène Laurent & Guillaume Binet 35

1-168-24 **Gender-blind energy poverty policymaking in Europe: risks and challenges for the private rented sector**
Manon Burbidge, Dimitris Papantonis, Saska Petrova, Akis Apostoliotis, Stefan Bouzarovski & Alexandros Flamos 47

1-212-24 **A behavioral economics approach to energy efficiency policies**
Denisa Diaconu 57

1-294-24 **The impact of nudges on prosumers with photovoltaics: survey results from Germany and Croatia**
Sabine Preuß, Sabine Pelka, Anne Kesselring, Stephanie van Hove, Emma Martens & Peter Conradie 65

1-310-24 **Causal stories on the energy poverty-health nexus: narratives from local stakeholders in France**
Ute Dubois 77

PANEL 2. FUTURE AND INNOVATIVE POLICIES

Introduction to Panel 2
Panel leaders: **Barbara Schlomann & Samuel Thomas** 87

2-034-24 **From policy deficit to implementation gap? Workforce developments in Germany**
Wolfgang Irrek 91

2-035-24 **Saving electricity quickly to avoid grid meltdowns**
Alan Meier, Caetano Abramsonward, Hayley Amo, Henrique Lopes Rosenbach, Isaac Loyer, Edison Ma, Sydney Ma, Arlo Novicoff, Brandon Roberson, Alex Sharp, Aria Zajec & Hideki Shimada 103

2-095-24 **Compensating domestic customers for electricity grid services: the challenge of allocating the costs and benefits of controlled domestic water heating**
Chris Granda, Helen Davis, Daniela Urigwe, George Chapman & Josh Butzbaugh 115

2-099-24 **From policy to action: assessing the effectiveness of heating and cooling plans – a case study on heating and cooling plans of municipalities in Baden-Württemberg, Germany**
Markus Fritz, Fabian Cloos, Anna Billerbeck & Ali Aydemir 125

2-111-24 **Bottom-up initiatives for co-designing energy efficiency policies to address energy poverty**
Mara Florina Oprea, Vlasios Oikonomou, Samuele Livarghi, Edoardo Pandolfi & Dimitris Papantonis 133

2-118-24 **Making EU policies fit for sustainable space cooling: first reducing the needs by adopting a systemic view**
Simon Pezzutto, Flavia Trovalusci, Jean-Sébastien Broc, Indriany Lionggo, Dimitris Athanasiou, Jérémy Clero, Giulia Conforto & Bruno Duplessis 143

2-186-24 **Sufficiency – from obligation to opportunity**
Birte Schnurr, Lotte Nawothnig & Meike Spitzner . . . 155
2-205-24 **The gas grid hurdle in the race to system efficiency**
Marc Stobbe, Veit Bürger, Sibylle Braungardt, Tilman Hesse, Malte Bei der Wieden, Carmen Loschke & Megan Anderson . . . 165
2-220-24 **Net zero building renovations: how can both climate justice and social equity objectives be achieved?**
Stefan Thomas, Birte Schnurr & Oliver Wagner . . . 177
2-243-24 **Catch me if you can: energy savings beyond the low hanging fruit**
Jörg Balsiger & Cédric Jeanneret . . . 187
2-297-24 **Flex-ability for all: pursuing socially inclusive demand-side flexibility in Europe**
Sophie Yule-Bennett & Louise Sunderland . . . 199
2-330-24 **"Now you're cooking with electricity" – healthier and more efficient kitchens in the EU**
Michael Scholand . . . 209

PANEL 3. POLICY, FINANCE AND GOVERNANCE

Introduction to Panel 3
Panel leaders: **Giulia Pizzini & Nick Eyre** . . . 221
3-012-24 **Just energy transitions in coal-intensive regions: a multi-impacts approach to quantitatively evaluate the Territorial Just Transition Plans (TJTP)**
Marco Peretto & Diana Süsser . . . 225
3-028-24 **Is the "heating hammer" hitting energy efficiency policy? Learnings from the debate around the German Buildings Energy Act**
Sibylle Braungardt, Friedhelm Keimeyer & Carmen Loschke . . . 235
3-059-24 **Implementing the energy efficiency first principle in European regions: insights from the REGIO1st Planning Framework**
Tim Mandel, George Konstantopoulos, Andriana Stavrakaki, Songmin Yu & Vlasios Oikonomou . . . 243
3-080-24 **Investments in energy efficiency measures in the residential sector in Central and Eastern Europe: The EE1st principle in practice**
Vlasios Oikonomou, Marco Peretto, Shima Ebrahimi & Christos Tourkolias . . . 253
3-101-24 **Multi-level governance: involving subnational authorities and other stakeholders in national energy and climate policy making**
Giulia Pizzini, Marine Perrio, Jérémy Clero & Thibaut Maraquin . . . 263
3-117-24 **Climbing a new hill: a review of Member States' strategies to meet their energy savings obligation for 2021–2030**
Jean-Sébastien Broc, Vlasis Oikonomou, Samuel Thomas, Danai Sofia Exintaveloni, Barbara Schlomann, Clemens Rohde & Dario Di Santo . . . 273
3-154-24 **White certificates, superbonus, and the new auction scheme**
Dario Di Santo, Cesare Negro, Jacopo Romiti, Daniele Forni & Livio De Chicchis . . . 283
3-176-24 **From scenarios to action – developing science based financing guidelines**
Ali Aydemir, Clemens Rohde, Maike Wilhelm, Markus Fritz, Stefanie Engstfeld & Sandra Lutz . . . 295
3-187-24 **Translating national net zero policy into local implementation: a UK case study**
Colin Nolden, Jake Barnes, Esme McMillan & Morag McDermont . . . 305
3-197-24 **EU-27 country mapping of financing schemes to decarbonize buildings, heating and cooling**
Giulia Conforto & Marcus Hummel . . . 317
3-208-24 **Theorising and developing political feasibility for energy demand reduction**
Marie Claire Brisbois & Janine Morley . . . 329
3-231-24 **Lighting and appliances for lives and livelihoods: a foundation for strategic energy efficiency policies in East and Southern Africa**
Karin Reiss-Haimbala, Theresa Grader, Monica Gullberg & Readlay Makaliki . . . 339
3-232-24 **Enhancing EU energy efficiency policy through Heat Pumps on Subscription (HPoS): a strategy for mobilizing private finance and optimizing public support**
Filippos Anagnostopoulos & Papadelis Sotiris . . . 347
3-238-24 **Accelerating NetZero: introducing a novel financial approach and new narratives for retrofit**
Marina Topouzi, Yekatherina Bobrova & Peter Mallaburn . . . 355
3-239-24 **Has the energy crisis polarized citizens views on energy efficiency policy? An analysis on the German discourse on X/Twitter**
Carmen Loschke, Sibylle Braungardt & Jonas Rieger . . . 365
3-246-24 **From conflicting agendas to cooperative sustainable urban development: the triple integration of sustainability in vertical, horizontal and sectoral structures**
Anja Bierwirth, Fiona Bunge & Steven März . . . 375
3-249-24 **Building fabric improvement and heat pump deployment: a set of policy conundrums**
Gavin Killip, Marina Topouzi & Tina Fawcett . . . 385

3-335-24 **Achieving successful intergovernmental collaboration: a case study in lighting**
Nils Borg, Michael Scholand, Peter Bennich & Georges Zissis. 395

PANEL 4. MONITORING AND EVALUATION IN TIMES OF CRISES

Introduction to Panel 4
Panel leaders: **Iska Brunzema & Lea Gynther** 407
4-046-24 **The impact of the 'cost of living crisis' in Britain: energy saving actions by fuel-poor households in winter 2022/23**
Clare Hanmer, Eoghan McKenna, Ellen Zapata-Webborn, Jessica Few & Martin Pullinger 411
4-047-24 **Behavioural measures for energy efficiency: key findings and policy advice from the NUDGE project**
Filippos Anagnostopoulos, Marta Gabriel, Merkouris Karaliopoulos, Peter Conradie & Anne Kesselring. 421
4-055-24 **The rule of thumb reigning over the lands of data scarcity: streamlining multiple impacts around energy savings as primary input**
Frederic Berger. 427
4-071-24 **Efficiency unleashed: evolution and impact of Germany's funding scheme for energy and resource efficiency in the economy**
Lisa Neusel, Simon Hirzel, Karsten Weinert, Stephan Heinrich & Anna-Maria Grodeke 435
4-081-24 **Ex-post energy savings assessment methodologies using smart-meter data: the case study of a switch from direct electric heating to an air-to-air heat pump**
Dominique Osso, G. Binet, B. Petiau & M-H. Laurent 445
4-142-24 **Urban heat island, the missing links: smart monitoring & evaluation and citizens engagement**
Ezilda Costanzo, Michele Zinzi, Primo Di Ascenzi & Danila Severa 457
4-146-24 **Crisis ready – how longitudinal data helps to make sense of crises and how to prepare for the next one**
Tina Fawcett, Eoghan McKenna & Phil Grunewald. 467
4-169-24 **But why? The need for a causal understanding of changes in energy use**
Phil Grunewald 477
4-247-24 **Crowd sourcing data collection for effective appliance policy – the case study of air conditioners in Indonesia**
Fiona Brocklehurst & Clara Camarasa. 487
4-254-24 **Data synergy in times of crisis**
Sarah Higginson, Catherine Jones, Marina Topouzi, Gesche Huebner & Michael Fell. 497
4-279-24 **The route to decarbonisation: are EU countries on track to reach 2030 energy efficiency and building targets?**
Daniele Paci, Carmen Maduta, Sofia Tsemekidi-Tzeiranaki, Delia D'Agostino, Enrico Clementi, Luca Castellazzi & Paolo Bertoldi. 509
4-312-24 **Monitoring and evaluating building stock decarbonisation progress across the EU during the crises 2020–2021**
Judit Kockat & Jerson A. P. Amorocho. 519
4-322-24 **Increasing energy performance for heating products through self-monitoring and reporting of real-world data**
Carlos Lopes, Ola Gustafsson & Emma Olsson 529

PANEL 5. SUSTAINABLE COMMUNITIES

Introduction to Panel 5
Panel leaders: **Agneta Persson & Pedro Moura** 537
5-013-24 **Barriers and solutions for homeowners' associations undertaking deep energy renovations of condominiums**
Ragy Elgendy, Erwin Mlecnik, Henk Visscher & Queena Qian. 541
5-024-24 **Lessons learned from innovative energy solutions to enable zero emissions areas**
Åse Lekang Sørensen, Synne K. Lien, Marius Aleksander Kolby, Anne-Lise Akervik & Vitalis Pavlovas 555
5-061-24 **Towards net-zero for hospital estates: stakeholder-led refurbishment strategies**
Kubra Doguc, Teresa Domenech Aparisi & Rokia Raslan. 561
5-063-24 **Cultural audience engagement for climate action**
Ezilda Costanzo 567
5-065-24 **Solar resource-efficiency gain for energy communities based on current solar energy system deployment**
David Lingfors, Joakim Munkhammar & Johan Lindahl 575

5-097-24 **Building sufficiency – five measures for an unerring and just transition of the building sector**
Patrick Zimmermann & Firdes Firat 585
5-109-24 **Factors affecting Norwegian households' adaptive energy performance upgrades in response to the energy crisis**
Yechennan Peng & Christian A. Klöckner 595
5-115-24 **A new area-based mapping approach to examine the heat pump suitability and readiness of UK dwellings**
Rajat Gupta, Chenfei Liu & Matt Gregg 605
5-148-24 **Positive energy neighbourhoods as drivers of local energy transitions**
Emily Bankert & Victoria Taranu 617
5-152-24 **From vision to reality – integrating energy goals in the development of a new urban district in Sweden**
Alexandra Calvén, Janneke van der Leer, Kerstin Sernhed & Wiktoria Glad 627
5-159-24 **Exergy communities – analyzing energy quality losses in local energy system solutions**
Magnus Åberg 637
5-183-24 **Approaching sufficiency measure integration in sustainability assessment of neighbourhoods**
Annika Hock 643
5-188-24 **Quantifying multiple benefits of sustainable plus energy neighbourhoods for investment and policy decision-making**
Victoria Taranu, Sheikh Zuhaib & Sriraj Gokarakonda 655
5-229-24 **Using transformative experiences to spur reflections on our role in the eco-system: a proof of concept**
Erica Löfström & Chiara Santandrea 667
5-271-24 **Heat transition cooperatives: a promising implementation model to decarbonise urban districts**
Klemens Leutgöb, Rachel Leutgöb, Mirjana Wissinger, Ella Jollands, Winfried Braumann & Gernot Tscherteu 677
5-323-24 **Developing a capability approach for place based interventions aiming to catalyse adoption of heat pumps**
Nicholas Banks 687
5-328-24 **Can x minute neighbourhoods save energy?**
Dan van der Horst 701

PANEL 6. ENERGY-EFFICIENT AND LOW-CARBON MOBILITY AND TRANSPORT

Introduction to Panel 6
Panel leaders: **Malcolm Morgan & Stefan Werland** 709
6-014-24 **Coherence of novel policies for lithium-ion batteries for electric vehicles: a multidimensional analysis of material flows and environmental impacts**
Robin Barkhausen 711
6-091-24 **Greening the drive: unpacking the impact and equity aspects of Germany's EV subsidy programme**
Swaroop Rao, Marc Blauert, Barbara Schlomann, Jan Stede & Julian Schaper 719
6-137-24 **Parking bikes in multi-dwellings and offices – a review of approaches in Swedish municipalities**
Frances Sprei & Devon McAslan 729
6-158-24 **Vulnerability structures across the EU-27: comparing 17 energy and transport poverty indicators using EU microdata**
Nelly Unger, Johanna Cludius, Viktoria Noka & Katja Schumacher 739
6-170-24 **Using impact chains for a feasibility assessment of sufficiency policies in the mobility sector**
Carina Zell-Ziegler, Johannes Thema & Kaya Dünzen 751
6-235-24 **Call for reinforcements: the impact of energy demand reduction policies on energy infrastructure needs**
James Dixon, Connor McGarry, Christian Brand, Waqquas Bukhsh, Keith Bell & Stuart Galloway 761
6-288-24 **Charging at the workplace: boosting acceptance for electric mobility on the go? Empirical evidence from a pre-post-design study in Germany**
Josephine Tröger & Sabine Preuß 773

PANEL 7. POLICIES AND PROGRAMMES FOR BETTER BUILDINGS

Introduction to Panel 7
Panel leaders: **Jana Deurer, Mariangiola Fabbri & Sibyl Steuwer** 783
7-007-24 **Moving new construction to net zero: progress and lessons from Europe and North America**
Steven Nadel & Rod Janssen 787
7-085-24 **The cumulative energy demand of buildings – a life cycle assessment**
Jana Deurer, Jan Steinbach & Lennart Bunnenberg 797

7-120-24 **Systematic review and meta-analysis of drivers for sustainable building**
Dilshi Dharmarathna, Peter Graham & Victor Bunster. 807
7-130-24 **iBRoad2EPC: enhancing EPCs with BRP elements to accelerate deep renovation – alignment with national plans and incentive programmes and implementation**
Peter Mellwig, Florian Maiwald, Sriraj Gokarakonda, Emily Bankert & Marianna Papaglastra 817
7-143-24 **Low carbon materials (steel and concrete) uptake in the built environment**
Sai Sri Harsha Pallerlamudi, Tarun Garg & Aun Abdullah 827
7-174-24 **MEPS for non-residential buildings: how to define the worst performing buildings in a heterogeneous stock?**
Malte Bei der Wieden, Sibylle Braungardt & Michael Hörner 835
7-180-24 **Energy performance certificates in Europe – their differences and why that matters**
Mahsa Sayfikar & David Jenkins 845
7-181-24 **Relight my fire or scatter the ashes? The economic and health costs of woodburning stoves**
Gesche M. Huebner & Donal Brown 855
7-189-24 **An installer survey of the state of the UK's private housing retrofit market**
Alice Owen & Gavin Killip. 867
7-215-24 **Better living from housing renovation? The perspective of tenants in Sweden**
Paula Femenias 875
7-228-24 **What's behind the label: how an EPC label change hides the full range of possible retrofits**
M-H. Laurent, Dominique Osso, N. Bouhi & C. Grandclément 883
7-260-24 **Building practices through the lens of sufficiency and adaptability**
Migena Sula, Krushna Mahapatra & Brijesh Mainali 893
7-263-24 **Energy performance certifications: current status, challenges, and opportunities**
Jerson A. P. Amorocho, Sheikh Zuhaib & Xerome Fernández Álvarez 905
7-266-24 **An innovative investment plan for decarbonisation of the European Union residential buildings**
Paolo Bertoldi, Carmen Maduta, Sofia Tsemekidi-Tzeiranaki, Luca Castellazzi, Daniele Paci & Enrico Clementi. 915
7-308-24 **Life cycle carbon emissions of the EU building stock: policy needs for embodied carbon reductions**
Zsolt Toth & Judit Kockat. 927

PANEL 8. PRODUCTS, SYSTEMS AND TECHNOLOGIES TO DECARBONISE BUILDINGS

Introduction to Panel 8
Panel leaders: **Michael Hörner & Corinna Fischer** 939
8-001-24 **Policy measures for energy efficiency of data centres**
Hans-Paul Siderius, Fiona Brocklehurst & Adriana Díaz 943
8-008-24 **Energy consumption in higher education buildings: bridging the performance gap using digital twin technology**
Laurence Peinturier & David Wallom 953
8-011-24 **Assessing building performance in a low carbon home: a comparative study of the energy modelling representing design and as-built phase**
Xinyi Zhang, Richard Fitton, Heidi Diaz Hernandez, Grant Henshaw, Anestis Sitmalidis, Christopher Tsang & William Swan 961
8-019-24 **Decarbonization of the construction sector in Sweden – exploring barriers to and drivers for increased use of wood-based materials in the construction industry**
Pardis Niknafs, Maria Johansson & Patrik Rohdin. 969
8-050-24 **Where and how do people live? Modelling the occupation of the German building stock by households**
Johannes Thema, Luisa Cordroch, Johannes Parschau, Georg Graser & Frauke Wiese 979
8-068-24 **Evaluating non-domestic building stock simulation based on single-zone models with multi-zone average usage profiles**
Christian Karczewski, Julian Bischof & Michael Hörner. 991
8-069-24 **Embodied and operational carbon of construction products: an evaluation of the impact of using double or triple glazed windows with coatings in the EU**
Justin Loup 1001
8-094-24 **The potential of wastewater heat recovery systems in reducing the energy need for water heating in the EU in a cost-efficient way**
Pavel Sevela, Johannes Frenger, Jürgen Schnieders & Rainer Pfluger 1009
8-135-24 **Taking a closer look at technical energy efficiency potentials using an integrated bottom-up and top-down model for the German tertiary sector: results and calibration issues**
Sonja Arnold-Keifer, Simon Hirzel & Clemens Rohde 1015
8-144-24 **Knowledge to action – strategies for market adoption of super-efficient fans**
Akhil Singhal, Tarun Garg & Aun Abdullah 1025

8-199-24 **Mapping and quantifying the impacts of digital applications on energy use**
Charlie Wilson, Hazel Pettifor, Maureen Agnew & Vlad Coroama 1033
8-230-24 **Demand and potential for seasonal heat storage in urban district heating systems in aquifer thermal energy storages**
Benjamin Köhler & Irina Ganal 1043
8-240-24 **Exploration of qualitative scenarios towards climate neutrality of the German building sector**
Mahsa Bagheri, Ewa Dönitz, Songmin Yu & Heike Brugger. 1053
8-261-24 **Can Swedes learn from North Americans?**
Åsa Wahlström & Maria Jangsten 1065
8-264-24 **Taking stock of our ability to project a consistent ecological transition of the French building stock**
Albane Gaspard, Yves Marignac, Thierry Rieser & Noé Delargillière 1077
8-278-24 **The role of biomass and synthetic energy carriers in the building sector – from a sectoral to a cross-sectoral perspective**
Charlotte Senkpiel, Connor Thelen, Hannah Nolte, Christoph Kost, Jana Deurer & Jan Steinbach. 1089
8-298-24 **What's the ETA for heat pump adoption? Assessing barriers and opportunities with the energy technology adoptability framework**
Sarah Outcault, Eli Alston-Stepnitz, Angela Sanguinetti & Emily Searl 1099
8-299-24 **Developing a regionalized representative building stock model for Germany**
Şirin Alibaş & Songmin Yu 1107

PANEL 9. ENERGY EFFICIENCY AND SUSTAINABILITY OF INDUSTRY

Introduction to Panel 9
Panel leaders: **Anna Realini & Thomas Björkman**. 1119
9-029-24 **Prospective life cycle assessment of renewable hydrogen import in the European political context**
Vanessa Schindler & Nele Friedrichsen 1125
9-037-24 **Evaluating net-zero emission pathways for China's cement industry**
Hongyou Lu, Hon Leung Curtis Wong, Nan Zhou & Xian Zhang 1135
9-044-24 **Highway to corporate energy efficiency: extending the VBN theory to predict leaders' sustainability behavior**
Maike Keil & Katrin Arning. 1147
9-057-24 **Beyond industrial energy efficiency: defining the multiple roles that businesses can play for climate positive action**
Hannah Bamford & Sam Hampton. 1159
9-083-24 **Resource efficiency: a new element in Germany's funding program for companies**
Karsten Weinert, Lisa Neusel & Simon Hirzel. 1169
9-122-24 **High-temperature heat pumps unleashed: cracking the code on waste heat recovery in industry and overcoming commercialization hurdles**
Ammi Amarnath, Baskar Vairamohan & Pradeep Vitta 1177
9-145-24 **Techno-economic analysis of the potential of hydrogen and electric heating technologies for the decarbonization of industrial processes: case study for downstream processes in metals industry**
Christian Schwotzer, Felix Kaiser & Herbert Pfeifer 1187
9-153-24 **Barriers and strategies in the engagement of SMEs in support and research projects on energy efficiency**
Marta Maia, Axelle Gallerand & Ivana Rogulj 1199
9-198-24 **Circular economy in hard metals production: energy and environmental impact of recycling processes**
Anna Realini, Gian Pietro De Gaudenzi, Mattia Garabelli, Gian Carlo Marcheselli & Gian Maria Passoni 1205
9-200-24 **What can the mandatory energy audit database tell us about the potential of energy efficiency in Germany?**
Paurnima Atul Kulkarni & Dominik Rau 1215
9-202-24 **Assessing the environmental impacts of policies on industrial electric motors: a stock model, material flow analysis and life cycle assessment approach**
Antoine Durand & Robin Barkhausen. 1223
9-210-24 **Fostering energy efficiency investments in SMEs: the multiple benefits approach for energy audits and energy management systems**
Ivan Sangiorgio, Garyfallos Fragidis, Ivana Rogulj & Antoine Durand. 1231
9-233-24 **Better together? Exploring what can be achieved through real-world examples of innovative knowledge exchange partnerships between SMEs and universities**
Richard Bull, Ana Rita Domingues, Muhammad Mazhar, Gamze Yakar-Pritchard & Kate Ling 1239
9-269-24 **Energy efficiency synergies in the dairy industry**
Beatrice Marchi & Simone Zanoni 1247

9-272-24 **A measure of control: about sensors, measurement and control equipment in German companies**
Simon Hirzel, Carmen Berger & Lisa Neusel 1255
9-313-24 **Increasing energy resilience, saving costs, and curbing emissions with systemic efficiency approaches**
Stefan M. Buettner, Janniko Czeschlik & Werner König 1265
9-314-24 **Multiple benefits of energy efficiency: methodology and preliminary application to Italian plastics industry**
C. Herce, E. Biele, A. De Santis, C. Martini, F. Martini, M. Salvio & C. Toro 1271
9-332-24 **The quintessential win-win: saving energy and eliminating PCBs in Southern Africa**
Michael Scholand, Haosong Jiao, Victor Hugo Estellano Schulze, Ludovic Bernaudat & Jitendra Sharma 1279

APPENDIX: **List of extended abstracts** 1289

AUTHOR INDEX 1293
KEYWORD INDEX 1297