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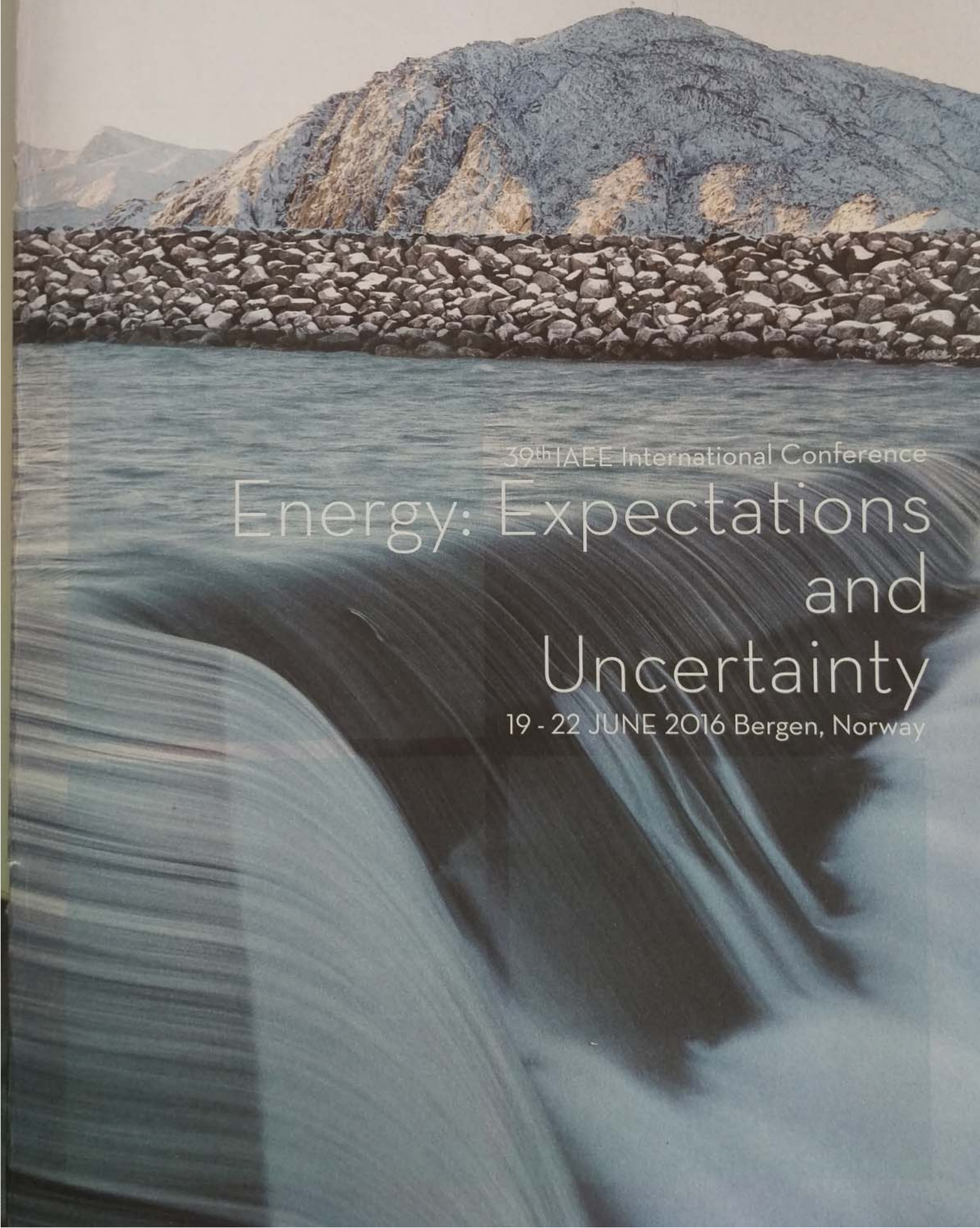

39th IAEE International Conference

Energy: Expectations and Uncertainty

19 - 22 JUNE 2016 Bergen, Norway

6. Intermittent Renewable Electricity Generation (Aud. Jan Massin)

Thomas Leautier, *Presiding*
TSE Researcher, Toulouse School of Economics

Comparative Scenarios in Islanded Systems: Energy Supply-storage Sizing Problem Applied to Electricity and Mobility
Rodica Loisel
Lionel Lemiale
Université de Nantes, IEMN-IAE

Solar, Wind and Market Power in a Hydro Based Grid
Stephen Poletti
Mina Gholami
University of Auckland

Impact of Variable Renewable Energy Production on Electricity Prices Through a Modeling Approach
Cyril Martin de Lagarde
Anna Creti
Université Paris-Dauphine
Christophe Bonnery
EROF
Frédéric Lantz
IFP EN, IFP School

Electricity Storage and Flexibility Requirements on the Road to Decarbonization in European Electricity
Clemens Gerbaulet
Casimir Lorenz
TU Berlin

Estimating Emissions Offsets of Intermittent Renewable Energy
Miguel A Castro
Michigan State University

7. Financial Risk and Electricity Markets (Aud. Agnar Sandmo)

Patrick Narbel, *Presiding*
Partner, ADAPT Consulting AS

Financial Arbitrage and Efficient Dispatch in Wholesale Electricity Markets
John E Parsons
MIT Sloan School of Management
Cathleen Colbert
California ISO
Erin Mastrangelo
Jeremy Larrieu
Taylor Martin
FERC

Zero-Varisble Cost Power Systems: Implications for Electricity Market Design and Capacity Investments
Jesse D Jenkins
Nestor Sepulveda
Massachusetts Institute of Technology
Fernando J de Sisternes
Argonne National Laboratory

Risk Exposure in Electricity Markets: The Need for Intra-day Hedging
Rashed Homayoun Boroumand
Associate Professor of Economics, PSB Paris School of Business

Market and Policy Risks for VRE Investment and their Impacts on Effectiveness and Efficiency of RES-E Policy Targets – An Agent-Based Modelling Approach
Matthias Reeg
German Aerospace Center (DLR) - Systems Analysis and Technology Assessment

The Corporate Social Responsibility of Hydropower Companies in Alpine Regions – A Welfare-economic Approach
Werner Hediger
HTW Chur

8. Innovations and Technologies (Aud. Terje Hansen)

Roger Fouquet, *Presiding*
Professor, Grantham Research Inst LSE

Life Cycle Analyses of End-User Electricity Generation in Ten Major European Countries
Gorkem F Uctug
Gizem Alevli
Bahcesehir University

The Welfare Effects of Energy Services and Technologies (1700-2010)
Roger Fouquet
London School of Economics and Political Science (LSE)

Technology Implications for an Integrated European Bioeconomy
Fabian Schipfer
Reinhard Haas
Lukas Kranzl
Energy Economics Group

Structuring Public Support for Radical Low-Carbon Innovation in the Materials Sector: Bridging the Valley of Death
Vera Zipperer
Karsten Neuhoff
DIW Berlin
Gregory Nemet
University of Wisconsin-Madison

Multinational Innovation, Product Life Cycles and Intellectual Property Rights Protection: Which is the Best Place to Invent Something?
Giulia Valacchi
IHEID

9. IAEE Best Student Paper Award Session (Aud. 24)

Knut Einar Rosendahl, *Presiding*
Professor, Norwegian Univ. of Life Science

Carbon Taxes, Oil Monopoly and Petrodollar Recycling
Waldemar Marz
Johannes Pfeiffer
IFO Institute for Economic Research at the University of Munich

Estimating the Potential for Electricity Savings in Households
Nina Boogen
ETH Zurich, Center of Economic Research (CER-ETH)

Reliability, Congestion and Investment in Electricity Transmission
Marten Ovaere
KU Leuven, Department of Economics

How to Sell Renewable Electricity - Interactions of the Intraday and Day-Ahead Market Under Uncertainty
Frank Obermüller
Andreas Knaut
Institute of Energy Economics, University of Cologne

10. Heat and Electricity (Aud. 23)

Benjamin Schlesinger, *Presiding*
President, Benjamin Schlesinger & Assoc LLC

CHP Plant Operation and Electricity Market Prices – Analytical Insights and Large-Scale Model Application
Björn Felten
Research Associate, University of Duisburg-Essen

Residential Energy Efficiency and European Carbon Policies: A CGE-analysis with Bottom-up Information on Energy Efficiency Technologies
Orvika Rosnes
Brita Bye
Taran Fæhn
Statistics Norway

Endogenous Power and Heat Generation Modelling in various CHP Plant Types
Andreas Bloess
DIW Berlin

Status-quo Bias and Consumers' Willingness to Pay for Green Electricity: A Discrete Choice Experiment With Real Economic Incentives
Fabian Grabicki
Roland Menges
Clausthal University of Technology

Technical-Economic Potential of PV Systems on Colombian Residential Sector
Rosa Esperanza González Mahecha
André Lucena
Alexandre Szklo
Raul Miranda
PPE/COPPE
Ferreira Paula
Universidade do Minho

11. Prospects for Nuclear Power (Aud. 22)

Christian von Hirschhausen, *Presiding*
Professor, TU Berlin

Phasing Out Nuclear Power in Europe
Rolf Golombek
Hilde H Le Tissier
Frisch Centre
Finn R Aune
Statistics Norway

Ambiguity Aversion and the Expected Cost of Rare Energy Disasters: An Application to Nuclear Power Accidents
Romain Bizet
François Lévêque
Mines ParisTech - CERNA Centre for Industrial Economics

Logistics of Dismantling Nuclear Power Plants - A Model-Based Analysis of Low- and Intermediate-Level Waste Management in Germany
Tim Scherwath
German Institute for Economic Research (DIW Berlin)
Roman Mendelevitch
Technische Universität Berlin (TU Berlin)

IS THE EUROPEAN BUILDING SECTOR ON THE WAY TO DECARBONISATION?

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Overview

European Union has set a roadmap for moving to a competitive low carbon economy in 2050, which provides a long term pathway to achieve an 80% cut in domestic emissions compared to 1990 by 2050 [1]. The European building sector (residential and services) can contribute to this goal by using two main instruments, energy efficiency measures and substitution of the fossil fuels with renewable energy sources.

The achievements of the CO_2-emission reduction differ from one European country to another in terms of the differences in the existing building stock characteristics, ambitiousness of the energy efficiency requirements for new construction and building renovation required in the national legislations as well as different energy fuel market shares for space heating and domestic hot water.

This paper aims at modelling what CO_2-emission reduction and energy demand reduction can be achieved until 2050 in France, Italy, Norway and Poland´s building stock, which makes up 34% of the total European building floor area (EU 28 and Norway) while considering the following parameters:

- Existing building stock characteristics (building thermal conductivities, user profiles and installed energy supply systems of the different building categories);
- Policies to reduce energy demand (Implementation of the European legislation: Energy Performance of Buildings Directive (EPBD) and Energy Efficiency Directive EED) [1] ;
- Energy fuel prices;
- Technological learning effects of the heating systems.

Methods

The calculation of the final energy demand for space heating and hot water is based on a bottom-up approach taking into account disaggregated building stock data. The building stock simulation tool Invert-EE/Lab is applied [2], [3]. Invert/EE-Lab is a dynamic bottom-up techno-socio-economic simulation tool that evaluates the effects of different policies on the total energy demand, energy carrier mix and CO2-emission reduction. Scenario modelling is based on two main approaches: the Weibull-distribution and investment-decision module with the nested logit approach. By using these approaches, building demolition and renovation rates as well as heating system change rates are calculated. Data on the building stock, national policy measures and energy fuel prices were collected in European research projects ENTRANZE and ZERBA2020 [4], [5].

Results

Fig. 1 shows the CO2-emissions caused by the building sector in France, Italy, Norway and Poland from 2012 until 2050. CO2-emissions polluted by the countries' building stock and its final energy demand for space heating and hot water is in 2012 89 Mt, 78 Mt, 7 Mt and 56 Mt in France, Italy, Norway and Poland respectively. The reduction of the CO2-emissions from 2012 and 2050 is as follows: 67%, 55%, 63% and 48% in France, Italy, Norway and Poland respectively. The main drivers of the reduction is the energy demand reduction, the heating system exchange rate, the substitution of the fossil energy used heating systems with the renewable systems and the electricity generation mix. The CO2-emission factor for electricity was derived by [6], who calculated the factor by using the electricity generation mix based on the reference scenario provided by the European Commision [7]. Final energy demand is expected to be reduced by 2050 in all investigated countries due to the building stock transition namely the new building stock with very high energy efficiency (nearly Zero Energy buildings), building renovation and demolishment of the old building stock. The final energy reduction from 2012 and 2050 is 14%, 30%, 44%, 48% in France, Italy, Norway and Poland respectively. The main drivers of the energy reduction are the renovation rate which is a result of the vintage of the building stock and the depth of renovation.

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1 Although no EU member state, Norway is following a similar approach to European legislation (EPBD, EED).

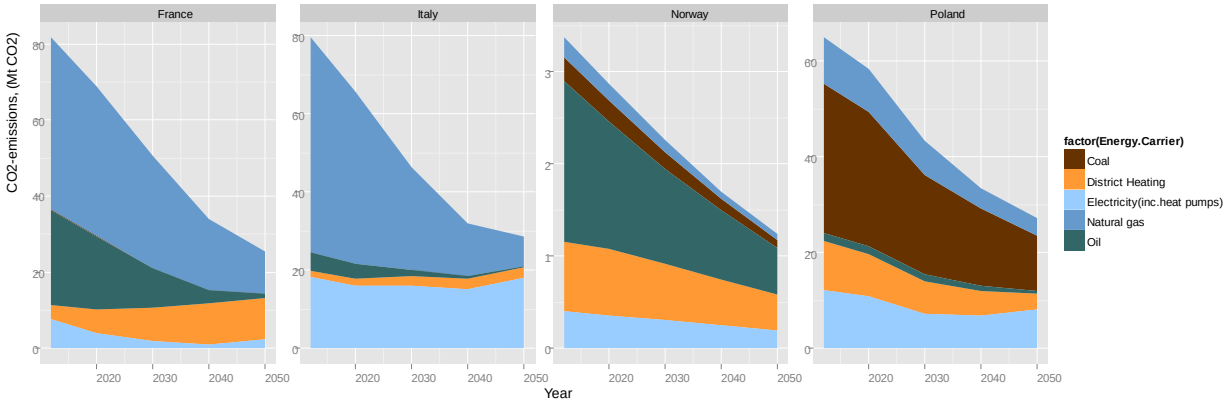

Fig. 1 CO_2-emissions by energy fuels caused by the building stock´s final energy demand for space heating and hot water in France, Italy Norway and Poland in 2012, 2020, 2030 2040 and 2050 in the BAU scenario

Conclusions

In the European roadmap for moving to a competitive low carbon economy in 2050 it is stated that electricity will play a central role in the low carbon economy. This might be a crucial condition for the decarbonisation of the European building sector. The scenario results have shown that in many countries the fossil fuels like oil and gas in Italy and particularly coal in Poland are substituted with the electricity, which energy mix is dominated by the fossil fuel and corresponding high CO2-emission pollution according to the BAU scenario. This leads to an untapped potential of CO2-emisson saving. Thus, these results call for a) an ambitious shift towards low-carbon electricity generation and b) in the light of climate change mitigation a binding United Nations CO2-emission reduction agreement.

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