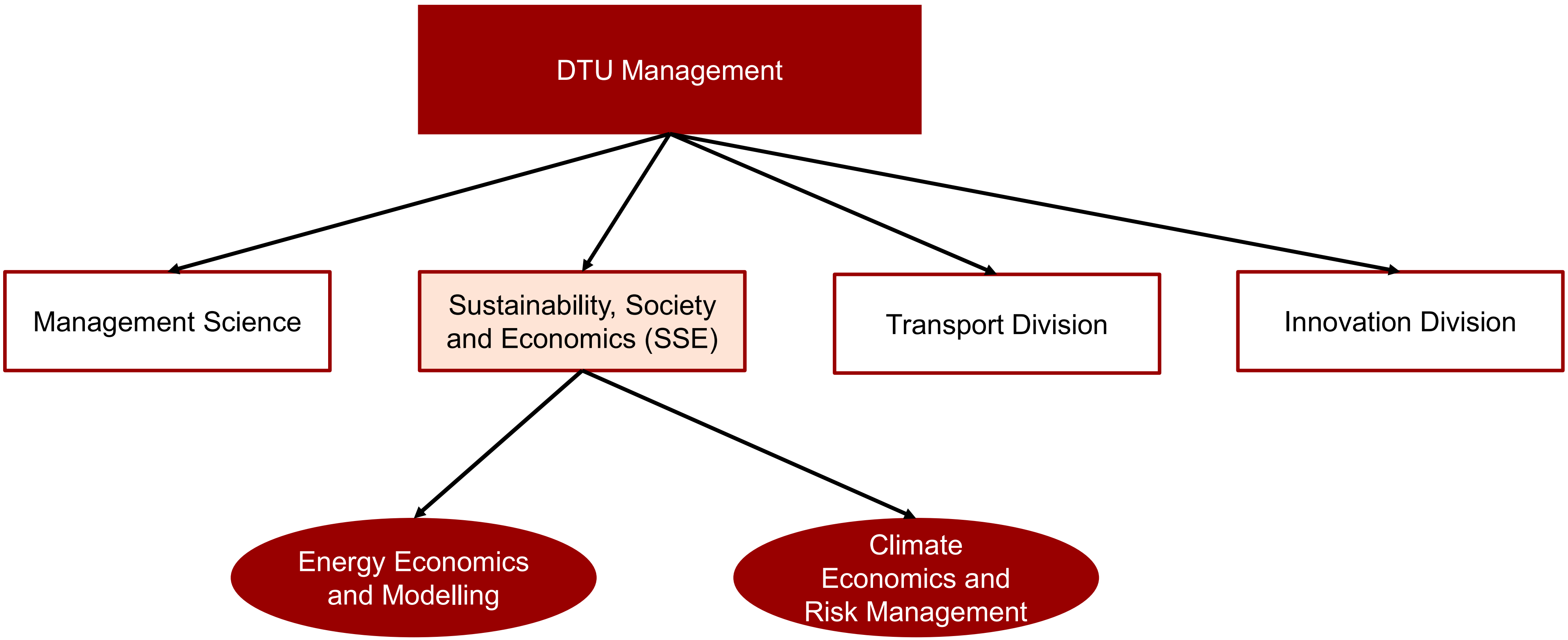
Energy Economics and Modelling (EEM)

Section at DTU Management



Vision of the EEM Section

Vision:

EEM is one of the main groups for quantitative energy systems, regulation and market analysis in Europe and continues to contribute to the successful implementation of the energy transition.

Implementation of the Vision:

1. Publishing in the best journals in the field (e.g. Energy Economics, Energy Policy, Nature Energy, Joule, The Energy Journal, OR journals, Economic Modelling, Env. And Resource Economics, JEEM, ...)
2. Extend international outlook (leading and participation in EU projects and conferences)
3. Impact on Society, Policy Making and Industry (e.g. via dissemination activities, stakeholder engagement, industry projects, …)

Who we are?

Energy Economics and Modelling (EEM)

Prof. Dogan Keles (Head)

Prof. Ramazan Sari

Prof. Marie Münster

Ass. Prof. Claire Bergaentzlé

Ass. Prof. Xiao-Bing Zhang

Ass. Prof Fabian Scheller

Ass. Prof. Rasmus Bramstoft

Dr. Per Sieverts Nielsen (Senior Researcher)

Dr. Xiufeng Liu (Senior Researcher)

Dr. Henrik K. Jacobsen (Sen. Researcher)

3 Postdocs, 10 PhD students and 4 research/student assistants

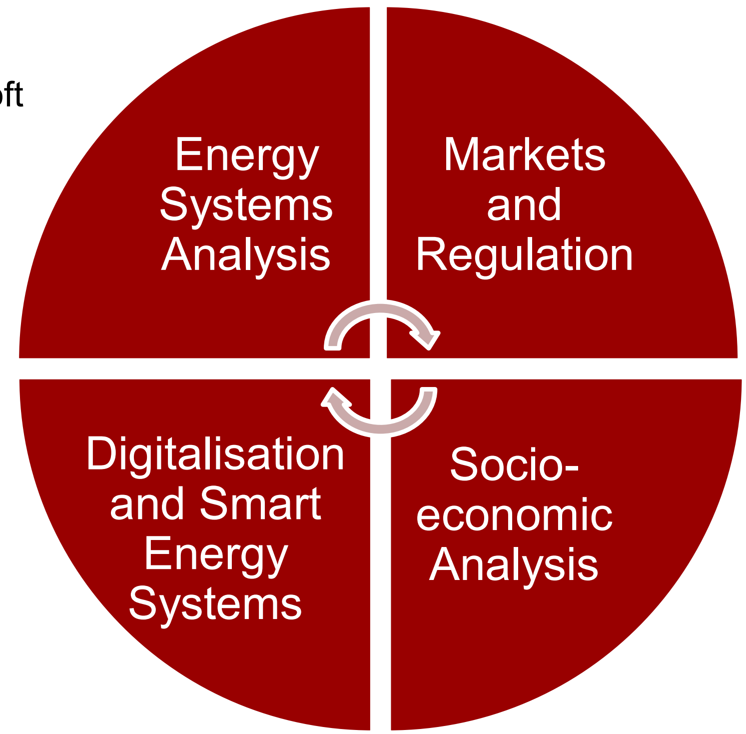
DK2

DK3

People on research areas

- Marie Münster
- Rasmus Bramstoft

- Dogan Keles
- Claire Bergàentzle
- Xiao-Bing Zhang



- Xiufeng Liu
- Per Sieverts

- Ramazan Sari
- Fabian Scheller
- Henrik Jacobsen

+ 10 PhD students, 2 postdocs, a RA and 2 student assistants

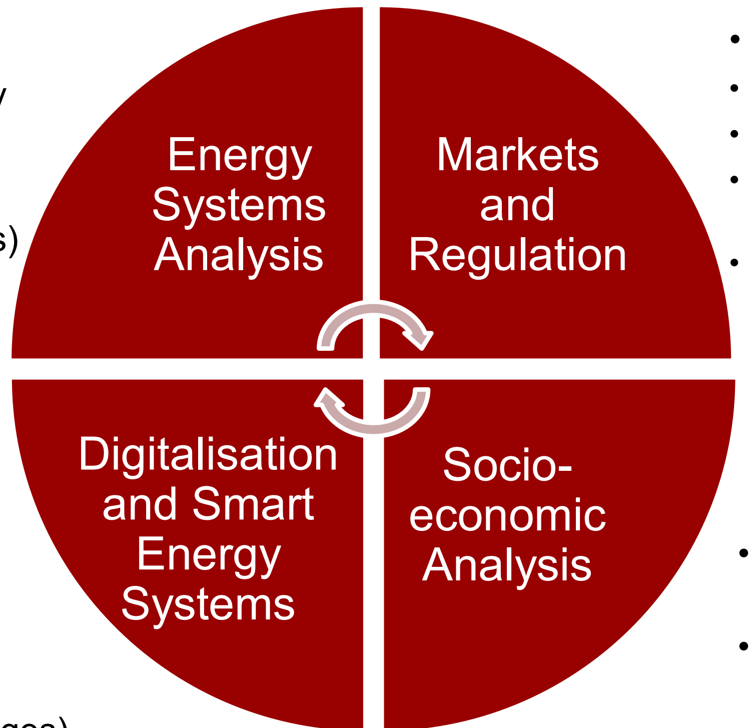
Slide 5

DK2 Dogan Keles; 25-10-2021

DK3 REplace the circle by group name
Dogan Keles; 25-10-2021

Future research areas of EEM

- Sector coupling
- Decarbonisation of all energy sectors
- Green fuels/ PtX
- Flexibility (grids and storages)

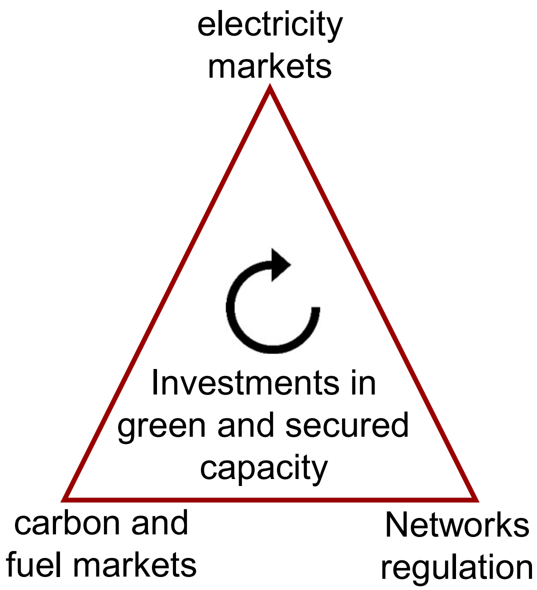


- Market design for 100% RES energy systems
- Energy price/demand projections
- CO_2 tax and markets
- Utilities (networks) regulation
- Tariff design
- Demand flexibility & energy savings programmes
- Market power and collusive behavior in energy markets

- Artificial Intelligence
- Smart Energy Control
- Demand projections
- Flexibility (grids and storages)
- District Heating development and optimisation

- social acceptance (passive, micro and macro view)
- residential adoption behavior (active, micro view)
- diffusion modelling and forecast (macro view)
- Reproducing historical diffusion curves
- Techno-economic effect modelling

Markets and Regulation



Vision: Energy markets and systems will be dominated by variable RES, energy storage and sector coupling. Market design and regulation must adapt to support efficient and fair transition.

Research questions:

→ How can markets be designed to incentivize low-carbon investments and what impact do they have on coupled European markets

→ How electricity grid tariff and investment incentives can evolve to send coherent signals for investment and flexibility and be inclusive of all grid users

→ Carbon markets and/or taxes: How will carbon markets/regulations interact with electricity markets? How to regulate carbon emissions in non-EU-ETS sectors on a market-based approach?

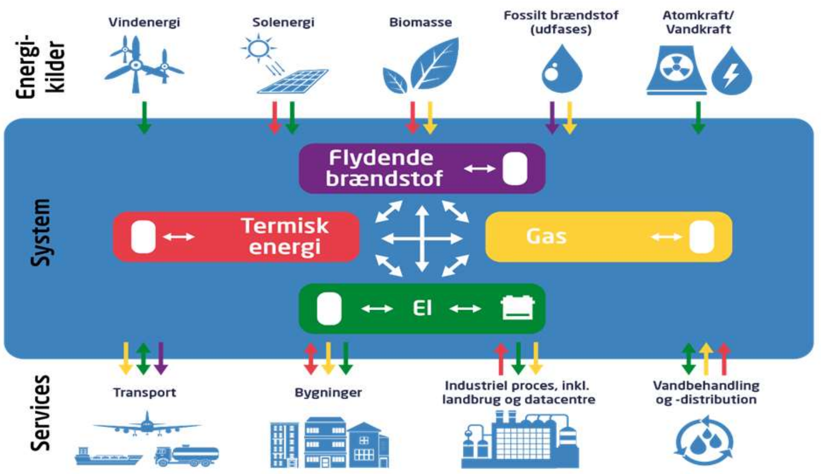
→ How to empirically estimate the market power and what are the role of government regulations?

Methods: Econometrics, Game theory, Dynamic optimization / OR

Energy System Analysis

Vision: Providing energy systems modeling for twenty-first century energy challenges

“ (1) resolving ***time and space****, (2) balancing* ***uncertainty and transparency****, (3) addressing the* ***growing complexity*** *of the energy system, and (4) integrating human behavior and social risks and opportunities."(Pfenninger et al. 2014)*



Research questions

- What are the **cost optimal investments and dispatch** of competing **flexibility** measures when integrating variable renewable energy including flexible demands (PtX, PtH and V2G), transmission of electricity and gas and energy storages?
- What role can **sector coupling and smart energy systems** - and **co-optimising grid infrastructures** - play for **green fuel production** - considering the local demands and availability of renewables?
- How can we integrate other **environmental impacts** than fossil CO2 emissions, when performing ESA - and contribute to certification of green fuels?
- How can we ensure **robust decision making** for future decarbonized energy systems, given the stochasticity and **uncertainty** regarding future developments?

Smart Energy Systems and Digitalization

Vision for the area:

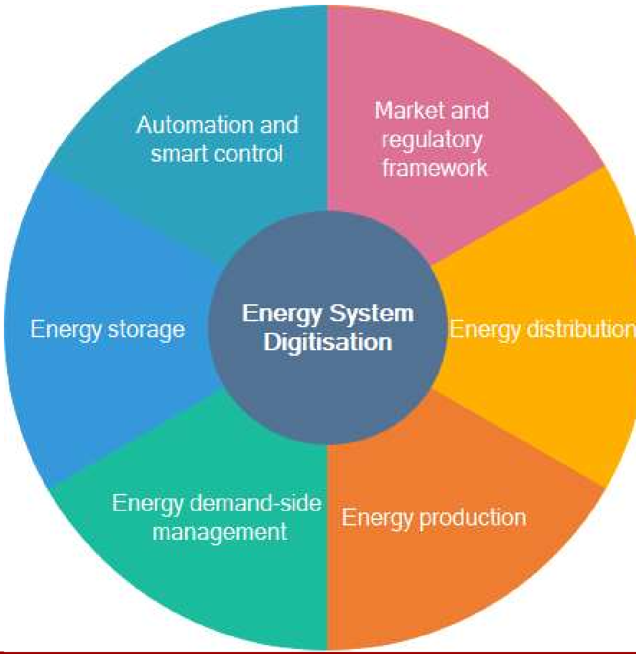
Digitalization is the enabler of the green transition and we need to find new and innovative ways to successfully deploy them.

Research questions:

- **RQ1:** How can data-driven approaches help digitalization of energy systems?
- **RQ2:** How can data-driven approaches assist interdisciplinary research on green transition?
- **RQ3**: How can digitalization make energy production, distribution and consumption more efficient?
- **RQ4**: How can digitalization benefit energy communities?

Methods:

Optimisations, Data-driven approaches, AI



Socio-economic Analyses

Vision for the area:

Besides traditional drivers, energy policy needs to take boundary constraints into account:

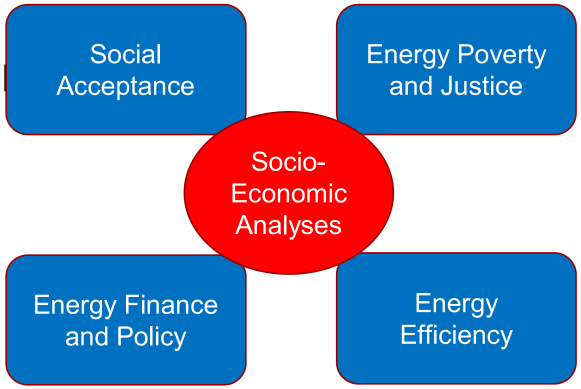
- social acceptance, adoption and behavioral change
- energy poverty and justice
- energy finance and policy
- energy efficiency (rebound effects)

By taking into account these constraints, we can guarantee the successful implementation of the green transition.

Research questions:

- How to increase social acceptance of low-carbon technologies and facilitate bel change needed for the transition?
- What are the social threats and challenges to combat climate change?
- What will be the level of energy poverty with rising energy prices?
- Is energy justice a threat for the sustainable energy projects?

Methods: Quantitaive (OLS, PLS-SAM, Time Series, Data Analytics, Messenger) Quantitaive(Semi-Structured Int., Sand-Pit, Story Telling, Focus Groups, etc)



Energy (system) modelling tools

BALMOREL

- Energy System Model focusing on the North and Baltic Sea countries, CWE and latest version with Southern Europe, sectors: electricity, heat, hydrogen
- focusing also on offshore grids (electricity and/or hydrogen grids)

EnerHub2X

- Optimal operation model of energy hubs focusing on PtX and hydrogen-based fuels.
- Operations on spot and reserve power markets

Optiflow

- Gas-flow model for DK focusing on green gases (biogas, hydrogen)

Price models

- Stochastic models of hourly price dynamics
- Neural network based price modelling

MCP hydrogen markets

- Equilibrium modelling of fuel sectors
- Mixed-coplementary problems (MCP) solved with MIP solvers

International collaboration

TOP TIER

MIT CEEPR – MIT Center for Energy and Environmental Policy Research	P. Joskow*
	W. Hogan*
Berkeley University of California	Shmuel Oren**
Imperial College London	Goran Strbac, Adam Hawks
UCL Institute for Sustainable Resources	Steve Pye
University of Oxford	Zac Cesaro***
DIW	Karsten Neuhoff
NUS	Jie-Sheng Tan-Soo
ETH zürich – Department of Humanities, Social and Political Sciences – Energy Politics Group	B. Steffen***, Russell McKenna
Duke University	Subhrendu K Pattanayak

INT'L PEERS

TU Wien – Energy Economics Group	R. Haas, Hans Auer, Christoph Kirchberger
University College Dublin	L. Ryan
University of Exeter	Richard Tol
TU Berlin	Tom Brown
UCC University College Cork, Ireland	Paul Deane, Olexandr Balyk
Universität Duisburg Essen – Lehrstuhl für Energiewirtschaft	C. Weber***
KIT Karlsruher Institut für Technologie	Wolf Fichtner***, Ehrhart
Technische Universität Dresden	Dominik Möst
TU Delft	L. de Vries
Erasmus University Rotterdam	Michael McAleer, Yashar Ghiassi-Farrokhfal
University of Sussex	Benjamin Sovacool

NORDIC

University of Gothenburg	Thomas Sterner, Jessica Coria
CBS Copenhagen School of Energy Infrastructure (CSEI)	T. Jamasb**'
Aalborg Universitet	Brian Vad Mathiesen
Chalmers	Erik Ahlgren
KTH	Francisco Gardumi
Københavns Universitet	Trine Boomsma*
Lund University	Martin Andersson
VTT	Peter Lund, Juha Kiviluoma
SFU Simon Fraser University	Mark Jaccard*
NMBU Norwegian University of Life Sciences	Torjus Folkesjö
NTNU	S.-E. Fleten**, Anne Neumann
RUC	Hua Lu
SDU	Bo Nørregaard

*** strong collaboration; **past collaboration; * weak collaboration

TOP 'APPLIED' ORGANISATIONS & COLLABORATION

APPLIED RESEARCH OGRANISATIONS

INTERNATIONAL ORGANISATIONS

DTU Compute
(H. Madsen)

DTU Elektro
(J. Østergaard)

DTU Wind
(J.C. Hansen, P. Sørensen, L. Kitzing)

DTU Energi

DTU Mechanical Engineering
(Brian Elmegaard)

NATIONAL SECTOR ORGANISATIONS

FIRMS

+ many more…