

e-Business Study:

ICT Impact on Energy Consumption: Desk Research

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**Energy & ICT Roundtable Discussion
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An initiative of the



**European
Commission**

RWTH Aachen University, E.ON Energy Research Center

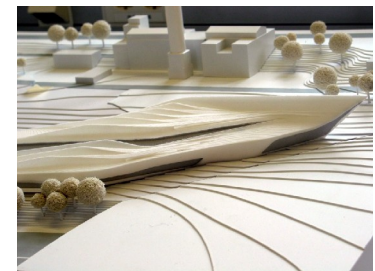
RWTH Aachen University

- Established in 1870, 8 faculties 30'000 students, 436 professors, 260 institutes
- One of the leading technical universities in Germany (Europe)
- 2020 Vision (Exzellenz-Initiative): Integrated and Interdisciplinary



E.ON Energy Research Center (ERC)

- Established in 2007
- 5 Full Professors / Research Institutes affiliated to 4 different faculties
- Center (building) to be erected 2008-2009
- Study team: R. Madlener and staff



E.ON Energy Research Center (ERC)

■ Partnership between RWTH Aachen University and E.ON (2006-)

- Presently the largest research co-operation in Europe between a private company and a public university

■ Five professorships in the field of energy technology and economics

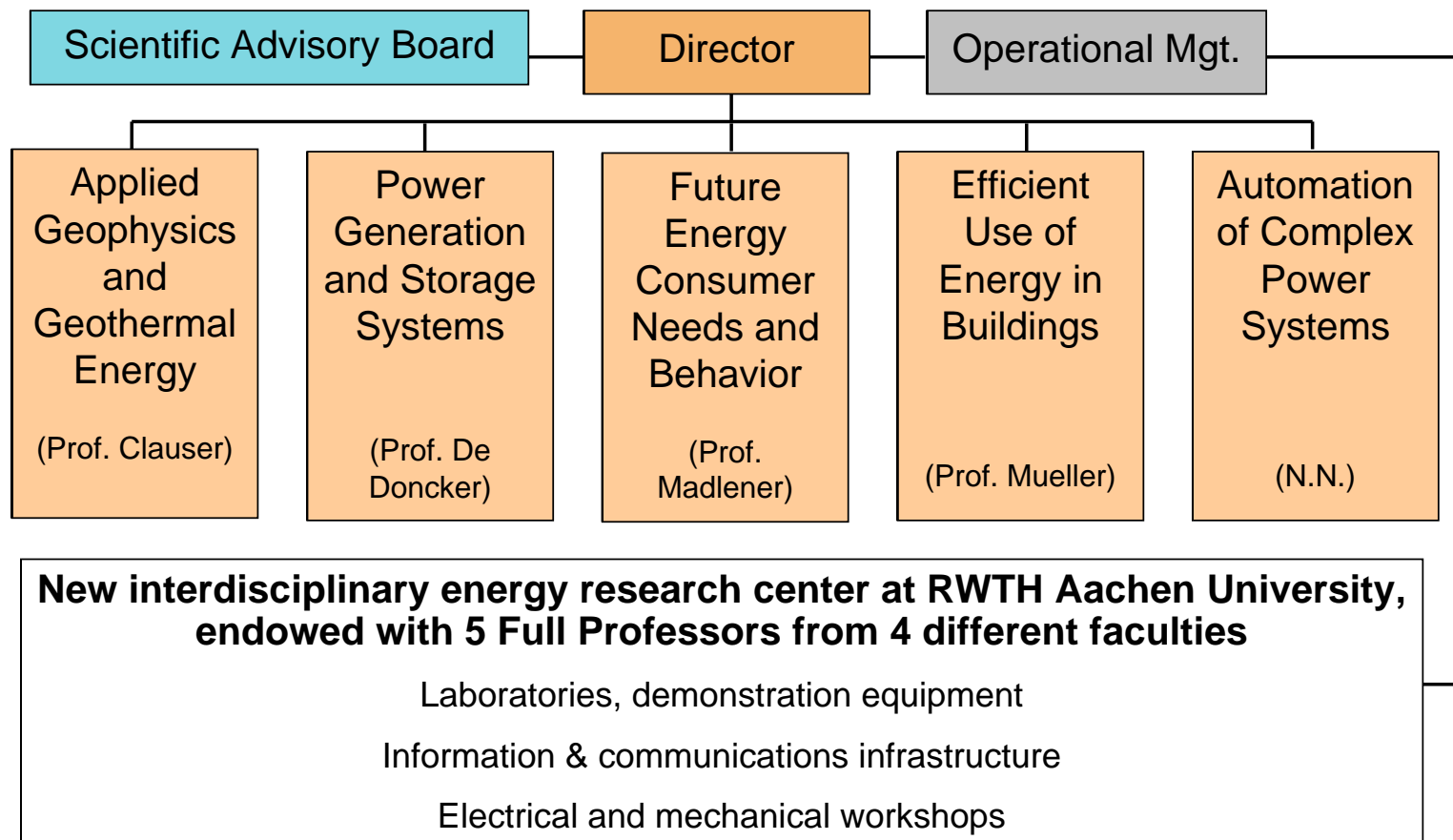
- 3 new chairs endowed by E.ON
- 2 existing chairs endowed by RWTH Aachen University

■ Main research areas covered

- “Power generation and storage systems” (Prof. De Doncker)
- “Applied geophysics and geothermal energy” (Prof. Clauser)
- “Future energy consumer needs and behavior” (Prof. Madlener)
- “Automation of complex power systems” (N.N.)
- “Energy efficient buildings and indoor climate” (Prof. Müller)

E.ON Energy Research Center (ERC)

Organizational Structure





Overview

1. Desk Research

1. Studies in Energy Economics

(very few empirical studies so far, although much research on ICT and growth and energy and growth)

2. Other studies

Studies in Energy Economics (1/3)

Collard et al. (Energy Econ, 2005)

- Study of relation between electricity consumption and ICT capital for the service sector in France
- Dynamic panel approach, 6 subsectors, data for 1986-1998 data (78 obs.)
- Key findings:
 1. Impact of the diffusion of ICT capital on electricity intensity differs greatly, depending on the type of ICT (“I” vs. “C”)
 2. Electricity intensity of production has increased (decreased) with diffusion of computers+software (comm. devices)
 3. Communication devices have, *cet. par.*, exerted greater impact on electricity intensity than computers+software

Studies in Energy Economics (2/3)

Takase and Murota (Energy Pol, 2004)

- **Impact of IT investment on energy consumption and CO₂ emissions for Japan and U.S.**
- **2 cases: BAU and stimulated IT investment**
- **Economic model, energy model**
- **Key findings:**
 1. Increasing IT lowers energy (CO₂) intensity
 2. Increase or decrease in energy consumption depends on which effect is stronger: the income or the substitution effect
 3. By promoting IT, Japan could conserve energy, while the U.S. would likely increase its energy use

Studies in Energy Economics (3/ 3)

Cho et al. (Energy Pol, 2007)

- **Impact of ICT investment and energy price on industrial electricity demand in S. Korea (11 sectors)**
- **Dynamic logistic growth model, data for 1991-2003**
- **Key findings:**
 1. ICT investment in electricity-intensive manufacturing industries promotes factor substitution away from labor to electricity
 2. ICT investment in some manufacturing sectors reduces electricity consumption, but in the service sector and most manufacturing sectors increases electricity consumption
 3. Electricity price affects electricity consumption critically only in half of the industrial sectors, but not in the other half

Other Economic Studies (1/2)

Laitner (J Ind Ecol, 2003)

- **Question addressed: Is the information economy an energy hog, productivity tool, or both?**
 - Criticizes the “highly limited and unsatisfactory review of many larger issues”
 - Argues that debate about direct energy requirements associated with ICT use may be “the wrong handle” (also consider grey energy, ancillary economic activities related to information economy, and energy use related to changes in wealth and output caused by ICT)
 - “The complexity and connectivity of the Internet, and more generally of the information society, yield a deep uncertainty about the eventual long-term impact on energy consumption.”
 - Conclusion: Interrelated trends will likely generate small decreases in energy intensity

Other Economic Studies (2/ 2)

Ishida and Yanagisawa (IEEJ report, 2003)

- **Macro impact assessment model for Japan**
- **Simulation study of impacts of an intensified ICT use on energy consumption in 10-20 years' time (Base Case, ICT Case)**
- **Key findings:**
 - TPES is reduced by 1.4% in the ICT case
 - Total final energy consumption decreases by 1.9% in ICT case
 - If ICT-induced extra economic growth is capped at ca. 0.3% p.a., total energy consumption would not increase