Another Case of “Same Bed, Different Dreams”?
Divergence in Energy Perspectives and Its Implications for Fuel Science Research

* Handout *

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The problem and its consequences

- High tech and complex innovation processes need to combine highly specialized expertise (e.g. coal gasification, CCS, fuel cells)
  - ‘Silos’ of experts develop own ‘culture’, ‘language’, and ‘world-view’
  - Call for interdisciplinary collaboration

- Add network products and/or infrastructure-based projects and/or national interests
  - Upsurge of stakeholders (often laymen) and influencing factors
  - Conflicts, negotiations, emotions, values, attitudes, ...

- Add democracy and the internet
  - Demand for transparency and participative decision making
  - Distrust in political, economic, and technological elites; small, but militant activist groups versus silent majority, ...

- Surprises, disputes, frustration, aggression - delays, compromises, ...
- Consideration of different perceptions, communication, persuasion, ...
Human challenges in the field of energy supply

- Energy is perceived as a free good like air and water
- Security of energy supply has to be warranted
- Energy costs are an important factor of economic competitiveness
- Risks and harms shall be marginal or accrue elsewhere (NIMBY, BANANA)

Efficient and sustainable energy sources and technologies

Social scientists and behavioral economists
Engineers and natural scientists
National and regional politicians
Media
Management of energy companies
Energy consumers
General public
Interdisciplinary research - Clash of two cultures?

<table>
<thead>
<tr>
<th>Management / Social Science</th>
<th>Engineering / Natural Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus</strong>: various social sciences, behavioral, dealing with more ambiguous problems, use of heuristics and qualitative methodologies / soft facts</td>
<td><strong>Focus</strong>: mathematics, logic, expertise in solving predominantly quantifiable, deterministic or stochastic problems / hard facts</td>
</tr>
</tbody>
</table>

- Need to collaborate in R&D project, but have divergent perspectives
  - “Same Bed - Different Dreams” Metaphor
  - However, except some large scale opinion surveys on general energy viewpoints *studies* regarding divergent perspectives of different energy sources are *missing*
  - Of special interest:
    - The role of *knowledge/education* and *gender*
Objectives

1. To prove the **influence of knowledge** obtained at tertiary education **on perspectives** regarding **different energy sources** (especially nuclear, coal, gas, and oil)

2. To prove a **moderating gender effect**

in order to further

- stimulate your thoughts about the interconnectivity of the whole system and its far-reaching consequences

- foster earlier and more intensive collaboration among engineers, social scientists and other important stakeholders in the field of energy technologies
Research model and methodology

- **Stimulus**
  - Energy source (nuclear, coal, gas, oil, wind, solar, biomass)

- **Mediator**
  - Education (engineering – social science – vocational)

- **Assessment**
  - Affective evaluation

- **Moderator**
  - Gender

- **Decision**

- **Word association technique**
  - Approved in psychological studies
  - Causes disclosure of actual affects
  - Emphasizes accessibility of attitudes
  - Reduces researcher bias

- **Additional parts of the survey**
  - Individual assessment of social, economic, and environmental harm and benefits
  - Knowledge of energy mix 2011 and individually desired mix 2030 (with & without nuclear)
  - Willingness-to-pay for desired energy mix and price sensitivity
Example

Think of **coal** as a mean to generate energy:

1) What three images come right away to your mind, while thinking of **coal**?

2) How do you assess these images on a scale from -3 (very negative) to +3 (very positive)?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Associations (COAL)</th>
<th>Frequency</th>
<th>positive</th>
<th>neutral</th>
<th>negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environmental pollution</td>
<td>134</td>
<td>1.5%</td>
<td>2.5%</td>
<td>96%</td>
</tr>
<tr>
<td>2</td>
<td>Availability</td>
<td>103</td>
<td>20.4%</td>
<td>11.6%</td>
<td>68%</td>
</tr>
<tr>
<td>3</td>
<td>Dirty</td>
<td>98</td>
<td>-</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>4</td>
<td>Open pit</td>
<td>41</td>
<td>24.3%</td>
<td>31.7%</td>
<td>44%</td>
</tr>
<tr>
<td>5</td>
<td>Efficiency</td>
<td>36</td>
<td>86%</td>
<td>-</td>
<td>14%</td>
</tr>
</tbody>
</table>

Total = 719 associations
Surveys and sample characteristics

- Period of surveys: May-June 2011 (*after Fukushima*)
- TUBAF & Freiberg Vocational School → Mean age: 21.9 years

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Discipline</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>University</td>
<td>Engineering</td>
<td>134</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Social Sciences</td>
<td>63</td>
<td>56</td>
</tr>
<tr>
<td>Non- University</td>
<td>General</td>
<td>52</td>
<td>41</td>
</tr>
</tbody>
</table>

- Total: 249 150 399
Impact of DISCIPLINES → Engineering vs. Social Sciences

Hypothesis 1: Students’ associations with nuclear and fossil energy sources are generally negative

Hypothesis 2: Engineering students’ associations … are more positive than that of their social science peers

Findings:
- H1 → supported; H2 → partly supported (only for nuclear)
- Both engineering and social science students assess COAL significantly less negative than OIL and more negatively than GAS. However, though social science students view COAL significantly less negatively than NUCLEAR, engineers do not.
Moderating Impact of GENDER

**Hypothesis 3**: After discounting for potential knowledge differences male and female students do not differ significantly in their assessment of nuclear and key fossil energy sources.

### Findings:
- H3 \( \rightarrow \) Support for social sciences, but: gender differences wrt engineering students.
- Male engineers do not differ significantly from their social science peers (males & females) in their assessment of COAL, but female engineers do.
Impact of HIGHER EDUCATION ⇒ University vs. Non-University

*Hypothesis 4:* Due to their greater factual knowledge, university students assess nuclear and key fossil energy sources less negatively than students of a vocational school.

**Findings:**
- H4 ⇒ Partly supported (for NUCLEAR and OIL)
- Both university students and vocational students assess COAL significantly less negatively than OIL and more negatively than GAS. However, there is no significant difference in their assessments of NUCLEAR and COAL.
Conclusion

- Results suggest that **discipline-specific knowledge** obtained **at tertiary education** level **matters in energy assessment**
  - There are **different dreams, i.e. visions** - however,
  - they are not straightforward, rather than somewhat contra-intuitive

- Interestingly, no general gender effects have been found
  - **No significant gender effect** for **social science** students
  - But, female engineering students assess all nuclear and fossil energy sources significantly more negatively than their male peers.

- **Considerable divergence** in how different energy sources are evaluated by **university** and **non-university students**
  - Pre-existing **more negative energy assessments of nuclear and fossils** are important **anchors for future judgments and decisions**
  - Negative images impact individual perception and information filtering ('tinted’ glass – cognitive dissonance)
Divergence in energy perspectives matters

**At the MACRO level:**
Organizations engaged in fuel science and energy technology research increasingly face reputation and acceptance problems that impact direction, funding, and realization of R&D activities. Persuasion tactics that focus at rational arguments fail to change affective-based attitudes.

**At the MESO level:**
Energy and R&D managers increasingly face the need for considering concerns of various stakeholders even in early phases of R&D processes.

**At the MICRO level:**
Fuel science and energy technology researchers have to realize that further entrenchment in expert circles will lead to even more frustration. Assessments are influenced by pre-existing, socialized beliefs and values.
A brief view of ongoing research on energy assessment

- Stability of energy judgment in the aftermath of extreme events → longitudinal study in Germany before, shortly after and one year after Fukushima.

- Role of institutional environment, social norms and level of economic development → International study with collaborators in China, Russia, Turkey.

- Linking associations, opinions, attitudes, and affective rationality with judgment and decision-making processes in the field of energy sources → Imagery and associated evaluation of nuclear, fossil and regenerative energy sources.

* Survey on the perception of multiple electricity generation sources (a copy in the conference folder) → Please drop completed surveys into the survey collection box at the registration table.
Ideas for potential future research (collaborations)

1) Investigate „what really matters“ to (e.g. COAL) stakeholders and their willingness to trade-off multiple risks and benefits
   AIM: provide input to facilitate strategic investment decisions by energy decision-makers early in the R&D cycle as well as the development of appropriate communication measures.

2) Develop an interactive „Energy Information & Education Platform“
   AIM: engage public attention and interest in energy issues and increasing knowledge of the interconnectivity of the energy system and the wide-ranging implications of individual actions.

3) Your ideas are highly welcomed:
Acknowledgments

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