Improving the efficiency of research & development in energy research policy by making use of innovation science insights

IEA-Workshop
"Using long term scenarios for R&D priority setting"
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Overview

1. Challenges & opportunities in energy-related research and technology markets
2. Objectives: develop a method for more efficiency of energy R&D funding
3. Methodological procedure of the EduaR&D project
4. Identify the stage of the energy technology within the technology cycle
5. Describe the major players of the innovation system of the technology
6. Lessons learned and Conclusions
Challenges & opportunities in energy-related research and technology development

Major challenges:
- Climate change
- Depletion mid-point of oil in 10 to 25 years? Severe energy price increases? Pressure on natural gas?
- Doubling primary energy demand by 2040?

Future energy systems need more efficiency, more flexibility, faster technical progress

However: Public funds are already constrained, private R&D funds are equally limited.
The Challenge of Energy R&D Policy:

- Is it feasible to reduce R&D time?
- Is it feasible to reduce failures?

Number of activities:

- 3,000 raw ideas
- 300 ideas submitted
- 125 small projects
- 9 early stage developments
- 4 major developments
- 1.7 launches
- 1 success

Time and stage in the technology cycle

Source: Stevens and Burley, Plotting the rocket of radical innovation, 2003
Objectives of the EduaR&D project

What **methods** are available to **achieve a more efficient and effective use of public funds** for research and innovation?

Is it possible to develop such?

*Or is allocation of research funds a process of chaos due to complexity?*

- Reduce recognisable risks, increase chances of success,
- Expose lobby groups to a broader discussion based on more information,
- Evaluate R&D topics not only from energy-economic and energy-technology perspectives, but also in their innovation and market diffusion context
- Work in the framework of technical competition, exports of manufacturing industries, division of labour of EU and national research, public/industrial
Methodological procedure of the EduaR&D project

Traditional procedure:
- mainly from an energy-economic viewpoint (often supply-oriented)
- technology-oriented, R&D hardly seen as part of an innovation process
- open R&D programme, assessment of submitted applications based on scientific and project management criteria

This EduarR&D project: procedure for four selected technology areas
- Future energy-economic significance of the technologies (2020 – 2030)
- Analysis of position in technology cycle (for individual technology elements)
- Analysis of the technology-specific innovation system (for individual elements)
- Get advice and tacit knowledge from experts by interviews
- International workshop to discuss methodology and results in February 2006
Basic Technology Cycle for macro-innovations

- **Level of Activity**
  - 1: Discovery and Exploration
  - 2: Euphoria
  - 3: Disillusion
  - 4: Reorientation
  - 5: Rise
  - 6: Diffusion

- **Scope of Research Activities/Possible Applications**

- **Science Push**

- **Demand Pull**

- **Time**
Example: Fuel Cells
SOFC patents at the European Pat. Office and publications of SCI

Source: EPPATENT, WOPATENT, SCI
Fuel cell citations in German popular literature

Hint for going down the stage of disillusion (economic journals loose interest first)
Example CO₂ Capture and Storage
Trends in scientific journals for CO₂ capture and CO₂ storage

![Graph showing trends in CO₂ capture and storage publications](image-url)
The CCS Innovation System in Germany (I)

• Industry: technology producers
  - World market for power generation technologies
  - Two large suppliers in Germany with domestic R&D and production:
    - To date: still co-operation for the development of CCS technologies as mainly fundamental problems are tackled
  - Openness/Uncertainty: technology producers tend to follow all technological routes

• Industry: utilities
  - Very low number of "customers" for CCS technologies
  - Utilities used to be a long time very reluctant towards CCS
  - Now: Pilot plant is built and demo plants are in planning phase
The CCS Innovation System in Germany (II)

**Public Research**
- High share of public funding and dependency thereon
- Low level of international co-operation and low interest to seek higher degree of international co-operation
- Institutes started to work on CCS with a delay compared to other industrialised countries

**Intermediaries, financial, educational institutions**
- Need for intermediaries low: large players
- Institutional adaptations started to train engineers
Lessons learned and conclusions

- Most of the new technologies emerging from R&D do have their traditional technological competitors – often no clear analysis of the competing technology
- New technologies often more costly than their traditional competitors due to almost individual manufacturing (lack of mass production, lacking learning effects). Cost reduction potential often not analysed (or too late)

- The analysis of the technology cycle identifies technical bottlenecks and avoids policy action not suited for the stage of the technology cycle
- The innovation system analysis identifies most knowledgeable players of the various components of the new energy technology and upcoming bottlenecks of the market diffusion phase
Innovation system, technology cycle, and policy options

Activity level

Policy options

1. Mix of instruments for phase 3
2. Mix of instruments for phase 6

Innovation Research
Conclusions

• Analysis goes beyond the technological bottlenecks; it identifies cost and systemic bottlenecks (looking ahead to diffusion)
  - Opens floor for a wider set of technology options (including technical competitors)
  - Focuses R&D funds and policy measures to the relevant bottlenecks
• Structuring the discourse of all stakeholders involved by referring to the stage in the technology cycle
• Approach seems to be flexible enough to match the requirements of almost any new energy-related technology
• Approach demands a major analytical and interdisciplinary effort
• Approach has good chances to improve efficiency of energy-related R&D
Thank you for listening!

The report on this project will be published as a book, tell me if you want to be informed when it is printed

Thanks again - also on behalf of Eberhard Jochem.

Developing an assessment framework to improve the efficiency of R&D and the market diffusion of energy technologies – EduaR&D

Report on a research project to the Ministry of Economics and Technology Berlin

(To be published by Springer this year)