16th International Conference on Engineering Design
ICED 07 PARIS
DESIGN FOR SOCIETY
Innovation, Sustainability and Knowledge


PROBLEM MAPPING FOR THE ASSESSMENT OF TECHNOLOGICAL BARRIERS IN THE FRAMEWORK OF INNOVATIVE DESIGN #368

Dmitry KUCHARAVY[1], Roland DE GUIO[1], Ludmila GAUTIER[2], Mathieu MARRONY[2]
[1]LGECO - Design Engineering Laboratory, INSA Strasbourg – Graduate School of Science and Technology
[2]European Institute for Energy Research (EIFER), Karlsruhe

Introduction & Objectives:

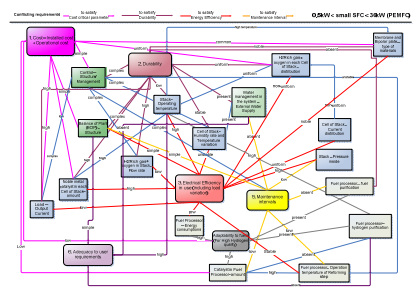
Main function of technological forecasting:

- to provide a consensual vision of the future science and technology landscape to decision makers.

How to assess the advantages and shortcomings of emerging technologies before having experienced them?

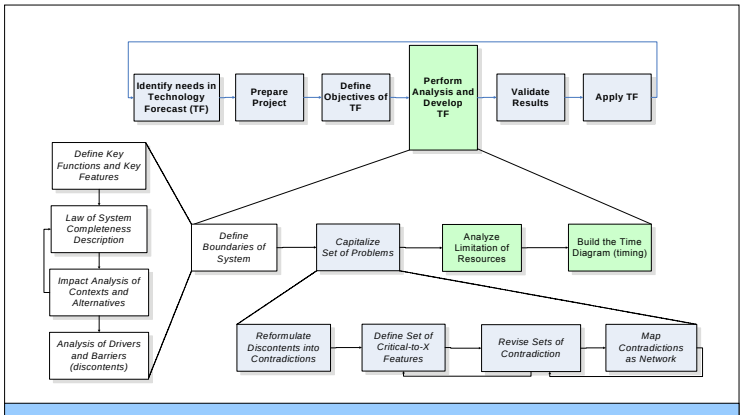
For the problem perception stage:

In order to decrease risks and make a trustworthy assessment, we should have knowledge;
however, we do not have the required knowledge, because the technology is emerging.

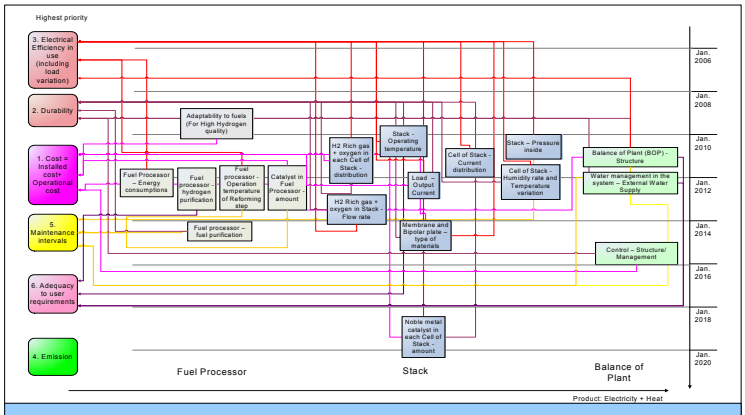


Element-Feature	Value 1, V	Value 2 (opposed), A	Limiting resources	S&T, R&D activities, Project names	Exploration, years	Experimentation & examination, years
Noble metal catalyst in each Cell of Stack - amount	Low	High	Platinum needed at low temperature (<400°C)	<Project 1 name>	<Project1 duration>	<Time for field tests>
<E2 – F2>	<V>	<A>	<Substance, Field, Time, Space etc.>	<Project 2 name>	<Project2 duration>	<Time for field tests>
<E3 – F3>	Present	Absent	<Time, Space etc.>	No specific project	<Project3 duration ??>	<Time for field tests ??>
<...>	<...>	<...>	<...>	<...>	<...>	<...>
<...>	<...>	<...>	<...>	<...>	<...>	<...>
Fuel processor - Quality of outlet gas	Low	High	complex fuel processing technology for NG and biofuels	<Project N name>	<Project N duration>	<Time for field tests>

Network of contradictions for PEMFC & Resource limitation assessment

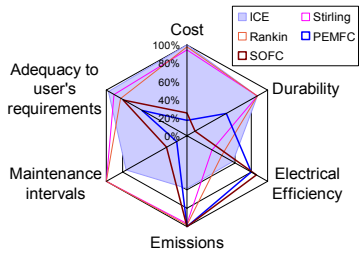


Process for performing the forecast

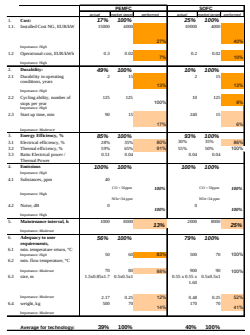


Map of problems of PEMFC on a time scale: technological context

Example of proposed analysis:



Larger gap between desired value of feature and actual one indicates more problems to be solved on the way to commercialize an emerging technology.



Critical-to-market features values for SOFC, PEMFC with Natural Gas as the fuel

Acknowledgements:

We wish to acknowledge the European Institute for Energy Research (EIFER), Karlsruhe for support of the research.

Results & Conclusions:

What are the reasons of the complexity of assessing resource limitations?

- *Dynamic nature of limited resources*;
- *Multiple contexts compatibility*;
- *Noise and Signal knowledge*;
- *Preconceived limitations, and biases of experts*;
- *Dynamics of necessary and sufficient description*.

Two studies performed in the period from Sep. 2004 to Dec. 2006:

Problem mapping and the assessment of scarce resources assists:

- in the assessment of technology barriers and opportunities in a *bias-free way*;
- in the accumulation of knowledge about limited resources in a *structured way*;
- in the recognition of the alternative pathways *independently from existing solutions*.

PROBLEM MAPPING FOR THE ASSESSMENT OF TECHNOLOGICAL BARRIERS IN THE FRAMEWORK OF INNOVATIVE DESIGN #368

Dmitry KUCHARAVY[1], Roland DE GUIO[1], Ludmila GAUTIER[2], Mathieu MARRONY[2]


[1] LGECO - Design Engineering Laboratory,
INSA Strasbourg – Graduate School of Science and Technology
24, Bd de la Victoire
67084 STRASBOURG, France
dmitry.kucharavy@insa-strasbourg.fr

[2] European Institute for Energy Research (EIFER), Karlsruhe,
Emmy-Noether Strasse 11,
D-76131 KARLSRUHE, Germany

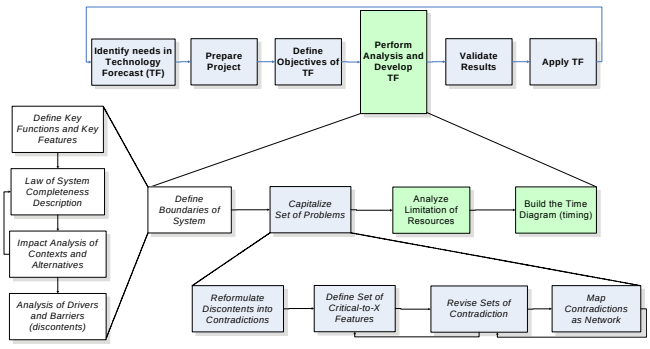
.Introduction & Objectives:

Main function of technological forecasting:

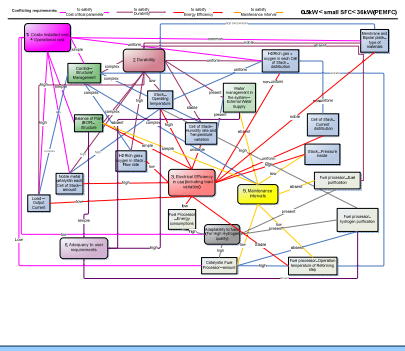
- to provide a consensual vision of the future science and technology landscape to decision makers.

High quality technological forecast:

- accurate, credible and visionary;
- to portray the evolving relationships with adequate breadth and depth;
- to provide a comprehensive description of the evolution and relationship of most critical sciences and technologies in the past, present and future;
- to provide a high degree of certainty, reliability and objectivity (bias-free).

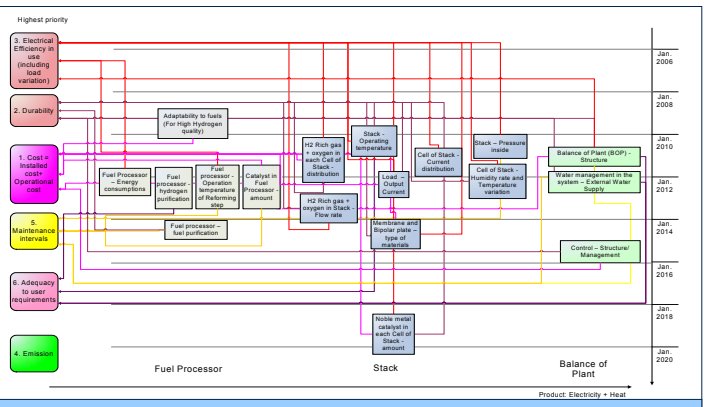


Process for performing the forecast



Element-Feature	Value 1, V	Value 2 (opposed), ^	Limiting resources	S& T, R&D activities, Project names	Exploration, years	Experimentation & examination, years
Noble metal catalyst in each Cell of Stack - amount	Low	High	Platinum needed at low temperature (<400°C)	<Project 1 name>	<Project1 duration>	<Time for field tests>
<E2 – F2>	<V>	</\>	<Substance, Field, Time, Space etc.>	<Project 2 name>	<Project2 duration>	<Time for field tests>
<E3 – F3>	Present	Absent	<Time, Space etc.>	No specific project	<Project3 duration ??>	<Time for field tests ??>
<...>	<...>	<...>	<...>	<...>	<...>	<...>
<...>	<...>	<...>	<...>	<...>	<...>	<...>
Fuel processor - Quality of outlet gas	Low	High	complex fuel processing technology for NG and biofuels	<Project N name>	<Project N duration>	<Time for field tests>

Network of contradictions for PEMFC & Resource limitation assessment



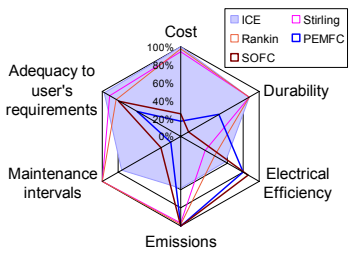
Map of problems of PEMFC on a time scale: technological context

How to assess the advantages and shortcomings of emerging technologies before having experienced them?

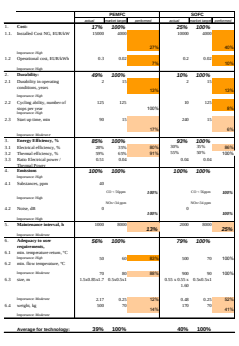
For the problem perception stage:

In order to decrease risks and make a trustworthy assessment, we should have knowledge;
however, we do not have the required knowledge, because the technology is emerging.

.Example of proposed analysis:



Larger gap between desired value of feature and actual one indicates more problems to be solved on the way to commercialize an emerging technology.



Critical-to-market features values for SOFC, PEMFC with Natural Gas as the fuel

.Results & Conclusions:

What are the reasons of the complexity of assessing resource limitations?

- at different stages of a system's evolution, different resources can be identified as 'scarce resources' - *Dynamic nature of limited resources*;
- it is necessary to take into account also economic, social and environmental resources. How to measure and unify all these resource limitations? - *Multiple contexts compatibility*;
- appropriate data should be collected - *Noise and Signal*;
- for emerging technologies it is necessary to work with experts to overcome knowledge shortages - the problem of *preconceived limitations, and biases* of experts;
- to identify a system it is necessary to define its boundaries, and its interaction with the environment in the dynamics – the *Dynamics of necessary and sufficient description*.

Two studies of the future of new energy conversion technologies performed in the period from Sep. 2004 to Dec. 2006:

Problem mapping and the assessment of limited resources assists:

- in the assessment of technology barriers and opportunities in a *bias-free way*;
- in the accumulation of knowledge about limited resources in a *structured way*;
- in the recognition of the alternative pathways from present to future technologies *independently from existing solutions*.