Anode Sub-System Development & Optimisation for SOFC Systems (ASSENT)

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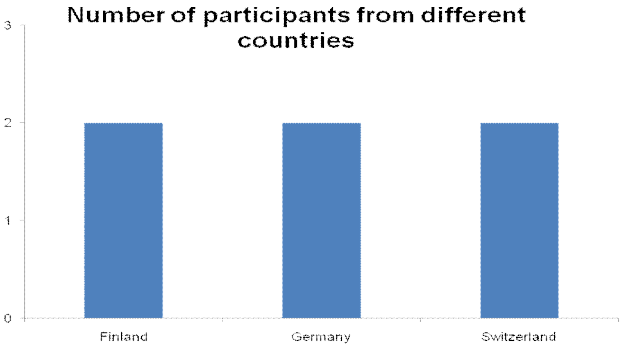
Consortium

- VTT Technical Research Centre of Finland
- HTceramix SA
- EBZ Entwicklungs- und Vertriebsgesellschaft Brennstoffzelle mbH
- Wärtsilä Finland Oy
- Hexis AG
- Forschungszentrum Jülich GmbH



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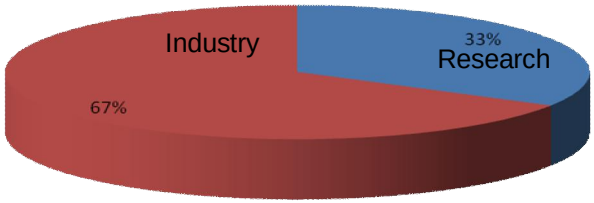
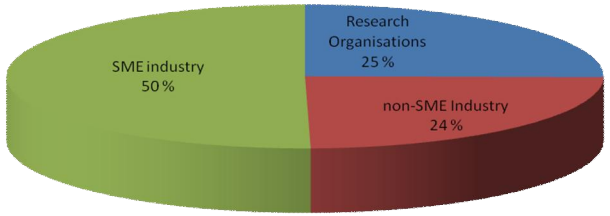
Facts about project

- 1.1.2010 - 31.12.2012
- Total costs 4 854 760 €
  - EU grant 1 954 675 (40%)
- Participation type:
  - Research organisations 2
  - Industrial partners 4
- Budget distribution:
  - Research organisation 1,22 M€ (25%)
  - Industry 3,63 M€ (75%)
- Person months ~ 370



Participation type



Budget distribution

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Objective and Concept

- **Objective: Optimal anode subsystem concept for SOFC**
  - Small-scale and large-scale stationary applications
  - Anode gas recirculation
  - Fulfil performance, lifetime and costs target (some day)
    - Electrical efficiency (> 45 - 60%)
    - Small-scale 40 000 and large-scale 60 000 h
    - Large-scale 1500 - 2000 €/kW_e and small-scale 3000 - 4000 €/kW_e

- **Concept: From many process options to optimal one**
  - Conceptual study for all possible layouts → the most promising ones
  - Detailed feasibility study for the most promising → One optimal subsystem
  - Validation of optimal subsystem
  - Proper controllability and safe operation of system → Good sensor and diagnostic solutions

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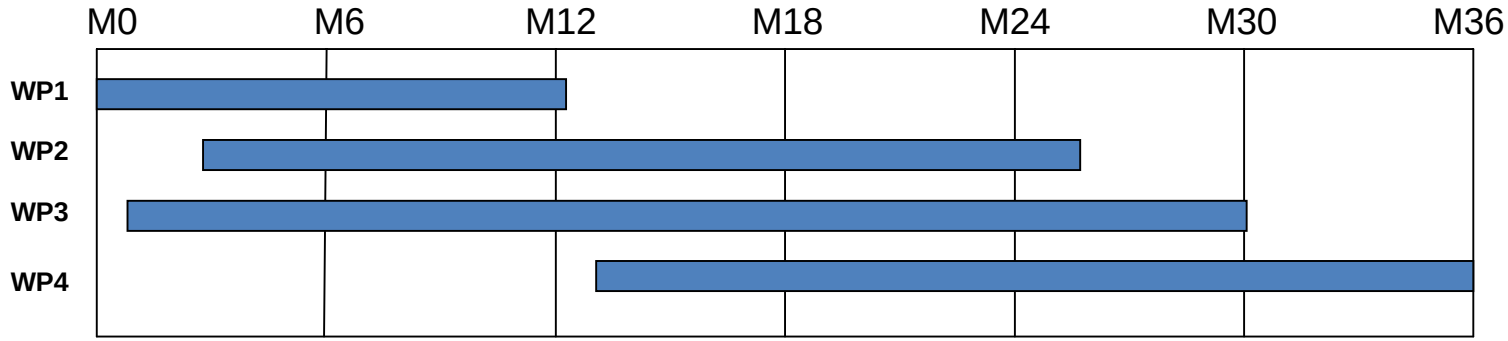
Implementation

- **WP0: Consortium management (3%)**
- **WP1: Conceptual design and scale consideration (7%)**
  - Conceptual study for different process options (lay-outs) → the most promising ones (fuel, recycling options, reforming, stack, soot formation limit, accumulated pressure drop)
- **WP2: Detailed analysis and component testing (31%)**
  - WP1 → evaluation and selection → The most suitable subsystem (optimal) (component reliability, diagnostic accuracy, controllability, safety issues, cost)
- **WP3: Sensors (24%)**
  - Evaluation of sensors and diagnostic techniques for controlling anode subsystem
- **WP4: Prototype design and testing (35%)**
  - WP2 →The most promising subsystem will be designed and validated



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Results (WP1)

- **Deliverable D1.1 - "System layout and nominal operation" (M8)**
  - Lay-out itself, fuel gas or cell type have minor effect on system efficiency
  - Other criteria like number of components, complexity of system, part load operation etc. are more important when choosing the most promising lay-out

Lay-out	Rec. cooled by	NG	BG	Power kW AC_net	Cell type	Rec. ratio	u_F stack	Pre-ref.	Water cond.	variants	Calc. by
Type 0.1 (Ref.): Water condens., no recycling	--	2 x	--	250 3	ASC ESC	0	80%	heated	Yes	4	Jülich
Type 1.1: Blower (hot)	anode off-gas	2 x	2 x	250 3	ASC ESC	50/60/70	60/70/80%	not heated	No	72	VTT
Type 1.2: Blower (< 200°C))	air	2 x	2 x	250 3	ASC ESC	50/60/70%	60/70/80%	heated	No	72	Jülich
Type 1.3a: Blower (< 100°C)	air + water	2 x	--	3	ESC	50/60/70%	60/70/80%	heated	Yes	18	Jülich
Type 2.1: Ejector steam driven	--	--	2 x	250	ASC	50/60/70%	60/70/80%	not heated	Yes	18	VTT
Type 2.2: Ejector Fuel driven	--	2 x	--	250 3	ASC ESC	50/60/70%	60/70/80%	not heated	No	36	Jülich

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Results (WP3)

- **Challenges for the sensors:**
  - High T
  - Toxic and explosive gases (safety)
  - Changing gas composition (H_2, CO, H_2O, CO_2, and CH_4)
  - Low cost… and low cost again
  - Failures may cause system damages (e.g. soot formation)

- **Sensor requirements for reliable system operation**
  - Accuracy
  - Long lifetime with minimum service and maintenance
  - Failure probability

- **Deliverable D3.1 – "Screening and evaluation of gas analysis techniques" (M8)**
  - Most promising sensor candidates to be tested in the next phase

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General observations

- **Small projects are flexible and efficient**
  - Coordinator friendly
  - Good for specific needs (applied research & component development)
  - Projects with large consortiums are needed (networking & information exchange)

- **The financing ratio is too small**
  - EU grant around 40% is near the pain-limit
    - Project office fee (minus 4% again)
  - National programmes can have better conditions
  - Matching: EU vs. Industry + Research organisations

- **FCH JU**
  - Topics of the calls well chosen
  - The evaluations made by experts in the field
  - The whole process time consuming (not a problem)
  - The performance of the Project Office
    - Instructions in good level
    - Helpful, skilful and friendly staff
    - NEF could be better (Negotiation Form Facility)

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Thank you very much for your time

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