Fuel cells and hydrogen

Joint undertaking

SCOTAS-SOFC

project presentation

Programme Review Day 2011

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New Energy World JU

fuel cells & hydrogen for sustainability

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SCOTAS-SOFC (256730)

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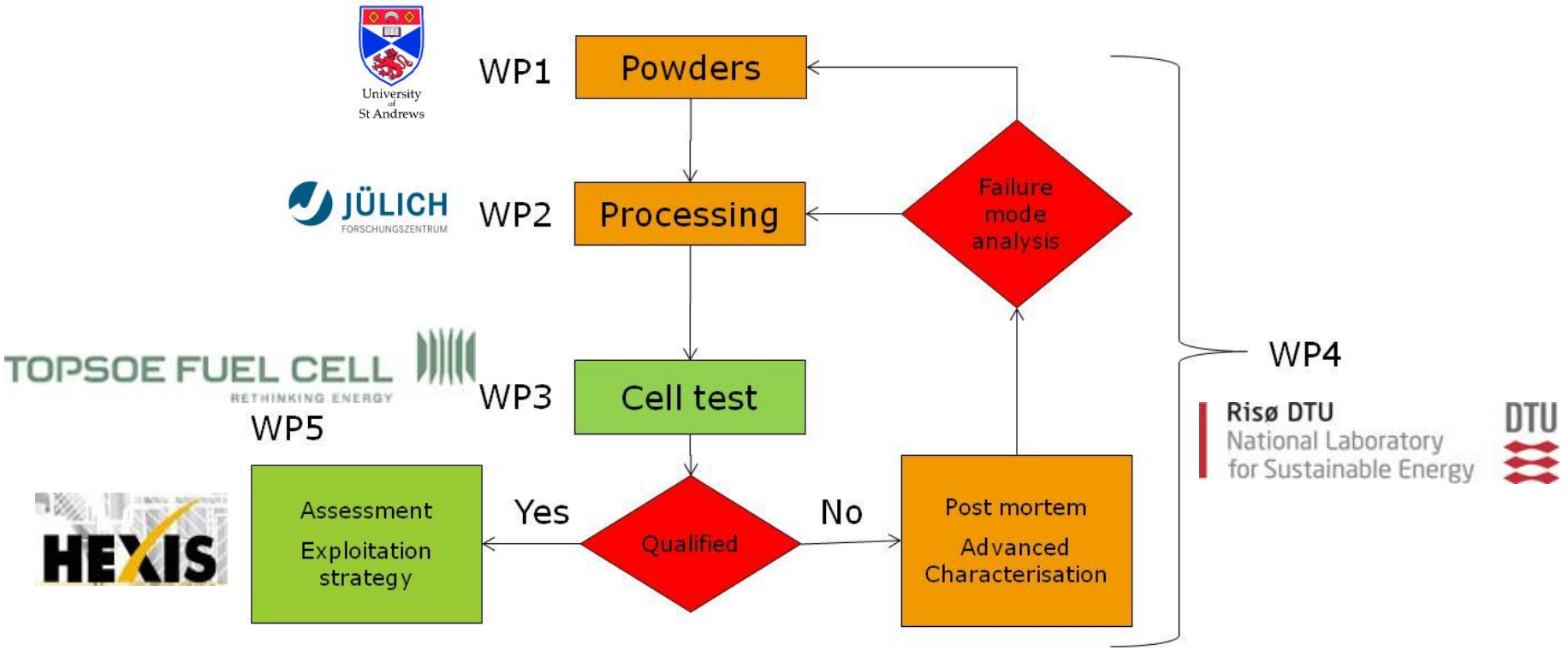
Objectives

- To demonstrate a new full ceramic SOFC cell with superior robustness compared to Ni-cermet based anodes and anode supports
  - Improved tolerance to sulphur, carbon deposition, & re-oxidation



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Targets & Milestones

- Start date: Oct 1st 2010, duration 36 month
- Materials based approach to
  - robust system, simplified operation strategy, reduced costs
- Technical targets:
  - full cells, area of 100-140 cm^2 / short stack level tests
    - Sulphur content up to 100 ppm
    - S/H/O ratios corresponding to partly reformed hydrocarbons
    - 50-100 redox cycles with 100% re-oxidation
- Important milestones
    - Prototype cells (M11)
    - Performance improvement 0.25 → 0.5 W/cm^2 (M15-M33)
    - 1 kW system test & assessment (M33)

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Approach

- The project is based on materials development in FP6 IP's Real-SOFC & SOFC600
- Small consortium with clearly focussed partners/ responsabilities
  - R&D: provide materials and prototype cells
  - Industry: test and evaluate the SOFC perform.

Project philosophie, role of partners

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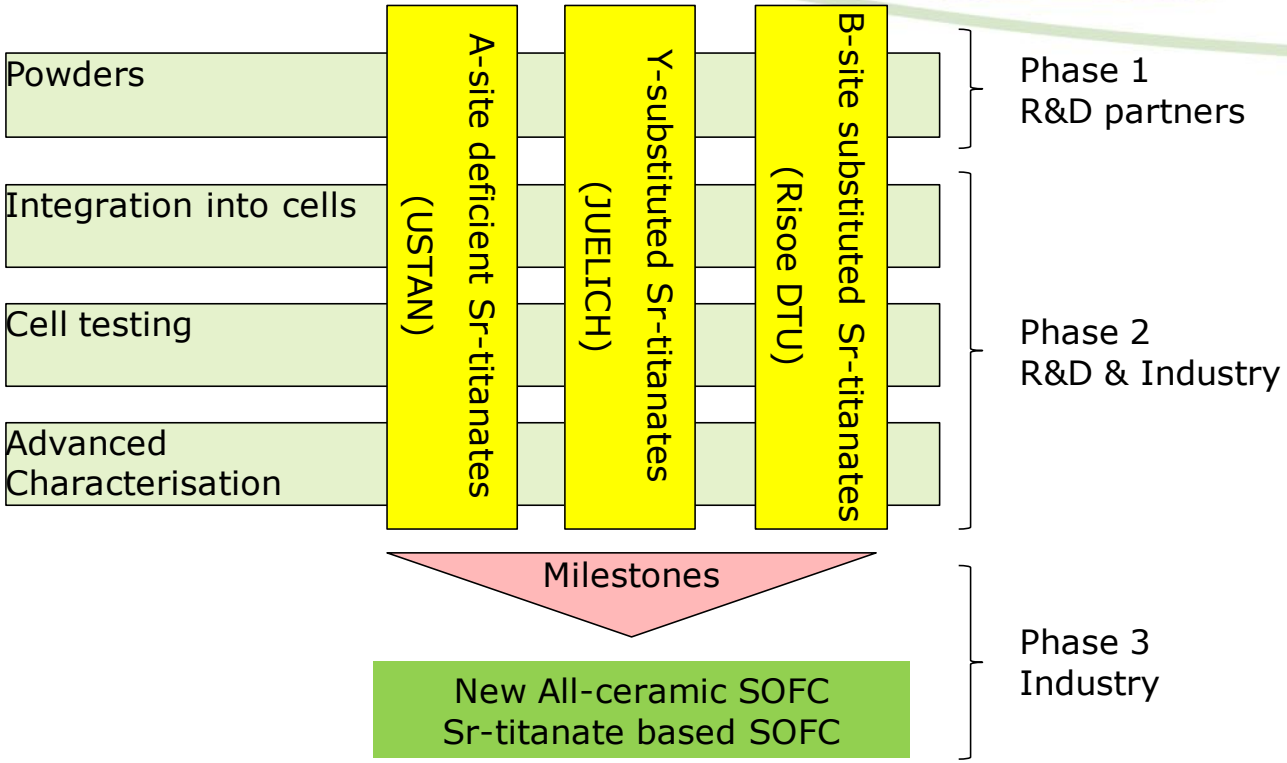
Approach



Milestones are adjusted to reporting periods and meeting schedule

Advisory board from industry

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Expected impact

	Ni-based anode	SCOTAS anode	Concluding Advantages	Impact
Thermal expansion coefficient	Higher than other stack components	Close to other stack components (zirconia electrolyte, metallic interconnect)	Reduced thermal stresses, high robustness against thermal cycling and high heating rates	Highly robust system → increased lifetime, simplified operation strategy
Chemical expansion during redox-cycling	Large expansion due to oxidation/reduction Ni ↔ NiO	Negligible chemical expansion	High-robustness against Redox-cycles, start-stop-cycles	Highly robust system → increased lifetime, simplified operation strategy
Sulphur tolerance	Sulphur contents in natural gas (few ppm) lead to significant degradation	Sulphur tolerant	No desulphurisation of natural gas and other fuels necessary	Reduced system costs and maintenance (saving 0.01 – 0.02 € per kWh)
Coking tolerance	Coking intolerant, coking leads to metal-dusting of the nickel → cell failure	Coking tolerant	Operation regimes, where coking occurs, can be tolerated for a limited time	Simplified operation strategy, heating up with gas possible

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Progress & achievements

- First 12 month of the project:
  - Materials for prototype cells have been defined
  - Cell development has started acc. to plan
    - Electrode fabrication lines: tape casting, screen printing
      - Substrates: commercial electrolytes (HEXIS), partners own anode supports
    - Substrate fabrication: tape casting (organic and water based),
    - Technical cell dimensions
  - First cells (25 cm^2) have been exchanged for testing (Jülich – Risø)
  - Test conditions identified by industry partners

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AA: Stationary Fuel Cells

- Application area: stationary fuel cells
  - 45% electrical efficiency
  - 80% CHP efficiency
  - Use of multiple fuels
  - 40000 life time
  - Competitive costs
  - materials R&D rel. to robustness, degradation and life-time under typical operation
  - component and subsystem development

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AA: Stationary Fuel Cells

- The project addresses critical issues related to the operation of micro CHP FCs
  - Start Up/Shut down
    - redox stability, C tolerance
  - Grid outage/system failures:
    - redox, sulphur, C-tolerance
  - Costs: replacement of Ni

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Activities vs MAIP/AIP

- Component development
  - new cell type
- Operation relevant performance
  - Short stack level testing
  - Specifications acc to industrial partners
  - Full system test (Hexis Galileo platform)
  - Industrial Advisory Board

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Gaps/bottlenecks

- The limited funding rate might bear a risk for some partners (esp. academic partners)

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Comments to MAIP/AIP

- The R&D on powders/materials could be emphazised more.
- It is questionable whether or not with respect to industrially relevant production all materials & powder properties are identified

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Training & Dissemination

- No particular training/education activities
- Expected to involve young, eraly stage researchers in the project
- Dissemination
  - Public reports on materials and electrode performance / cell tests foreseen
  - Publishabe results will be communicated to the scientific community
  - Advisory Board is expected to assists in identifying potentially interested other companies to be informed about the projects

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Beyond SCOTAS-SOFC

- The project aims at developing a prototype and demonstrate the potential a new type of SOFC cell
- Upscaling potential will be evaluated as a horizontal activity, however certain risks still expected to remain
- If demonstration is successful, a direct collaboration between powder supplier and SOFC manufacturer might be needed to further adapt to a more industrial production technology

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Useful References

- **Fuel Cells and Hydrogen Joint Undertaking (FCH JU)** – Programme Office
http://www.fch-ju.eu/

- FCH JU **reference documents** (incl MAIP/AIPs)
http://www.fch-ju.eu/page/documents

- European **Industry Grouping** for Fuel Cells and Hydrogen, **NEW-IG**
http://www.fchindustry-jti.eu

- European **Research Grouping** for Fuel Cells and Hydrogen, **N-ERGHY**
http://www.nerghy.eu

- **European Commission** non-nuclear Energy Research (incl FCH)
http://ec.europa.eu/research/energy/eu/research/index_en.htm