



# Stationary Power and CHP Session

15<sup>th</sup> October 2008

# Agenda

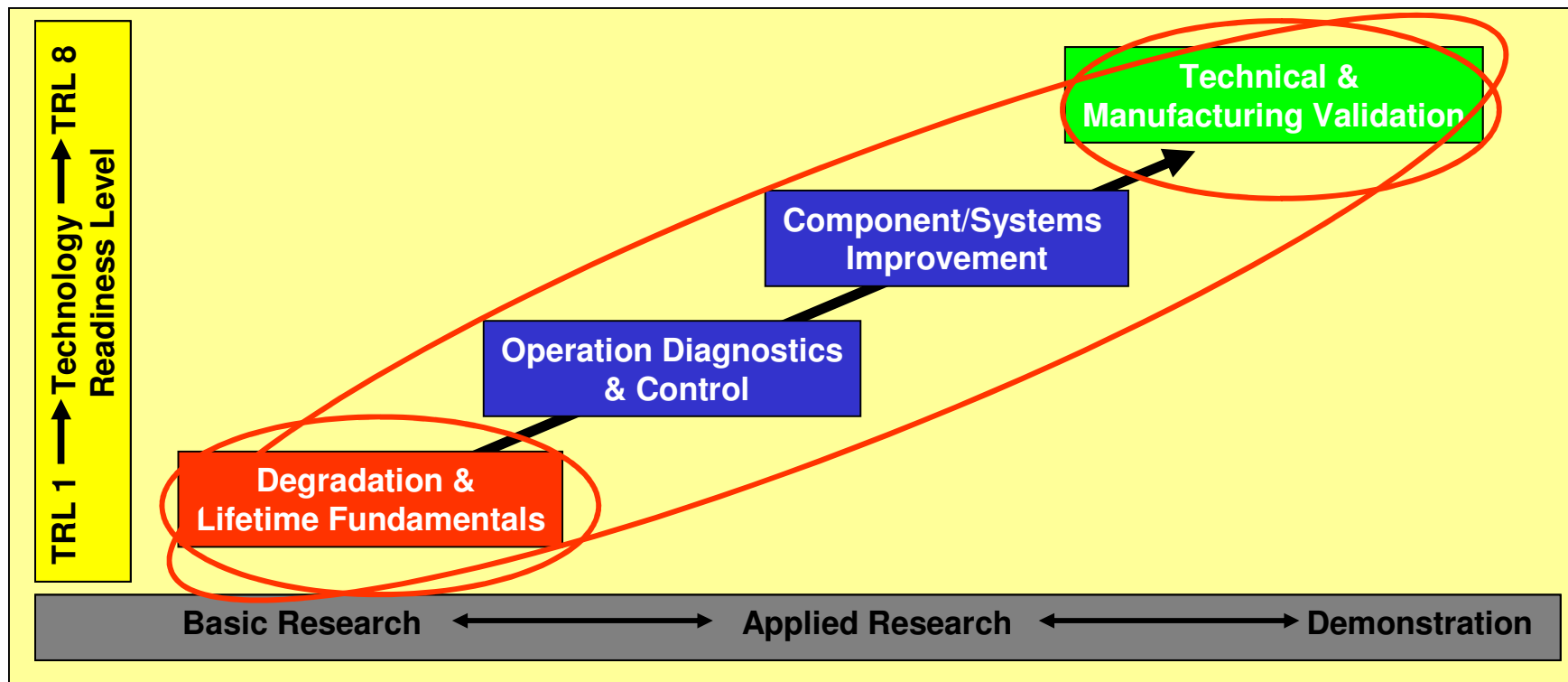
- Introduction and Welcome
- Background, MAIP and AIP overview
- MAIP 1 to 4, AIP 2008 1 and 4
- MAIP 5 to 8, AIP 2008 5, plus Supporting Actions
- Review
- Regional View
- Discussion
- Summary

## Challenges – Objective - Targets

- Europe's Energy Challenges – Energy Emissions, Efficiency and Security
  - 20-20-20 – efficiency, renewables, reduction in CO<sub>2</sub>
- Objective – successful commercialisation.
  - Efficiencies
  - Durability and lifetime
  - Economic and competitive costs
- Targets
  - 2010 – 3-7MW electrical capacity installed for pre-commercial demonstration
  - 2015 – 100MW electrical capacity installed
  - Costs – Micro CHP - €5,000 to €6,000/kW
  - Costs – industrial €1,500 to €2,500/kW
- Technical targets – eg efficiencies – vary by application and market – difficult to define
  - Systems fail to exceed current electrical efficiencies unlikely to be supported
  - CO<sub>2</sub> reductions will also depend on market eg France vs UK.

# Pathway to Commercialisation

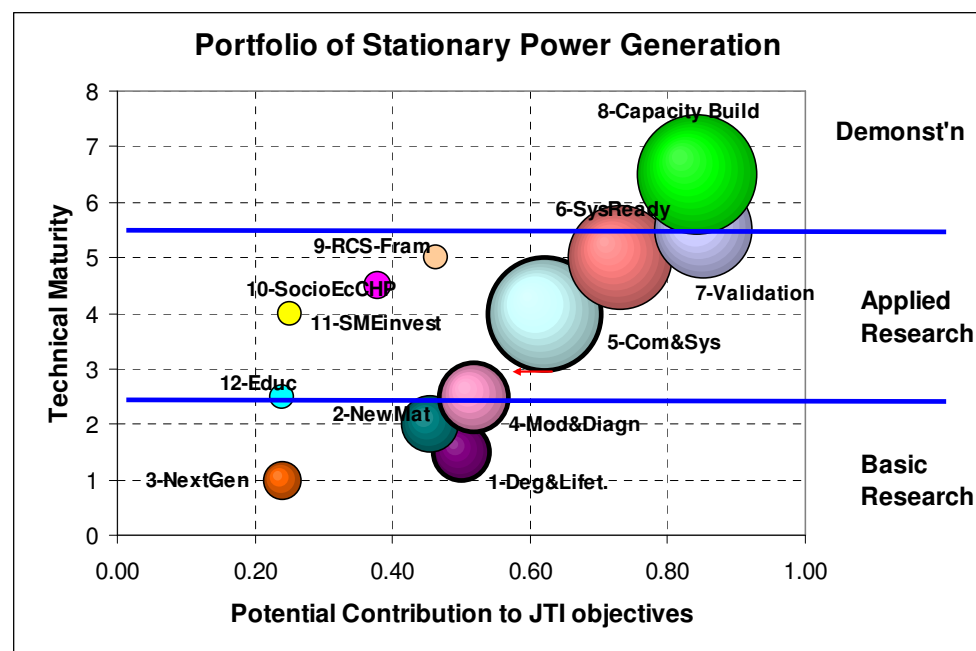
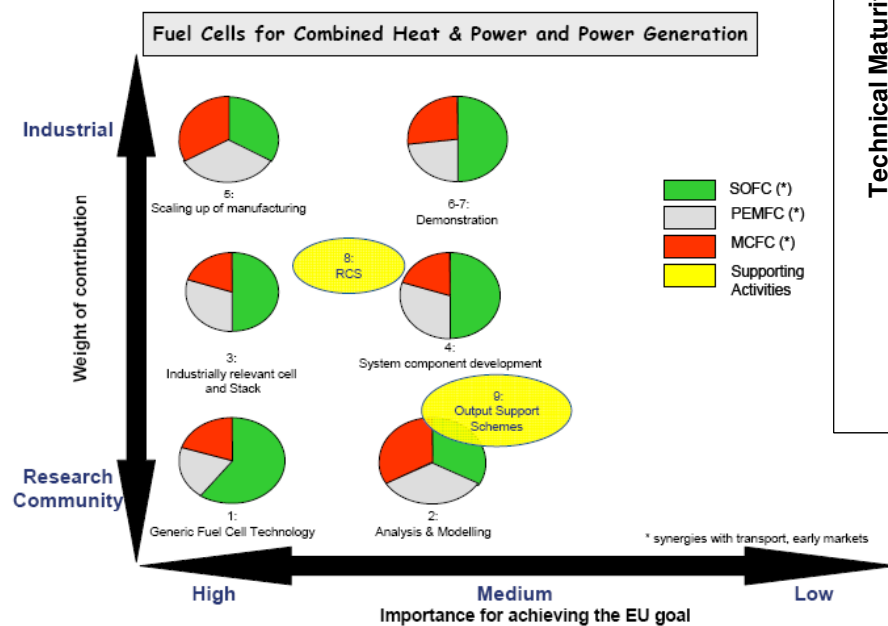
- Prioritisation of IDAs Actions/Themes
- Technologies Necessary to Push & Pull Commercialisation



- National/Regional funds expected to support Demonstration/Validation

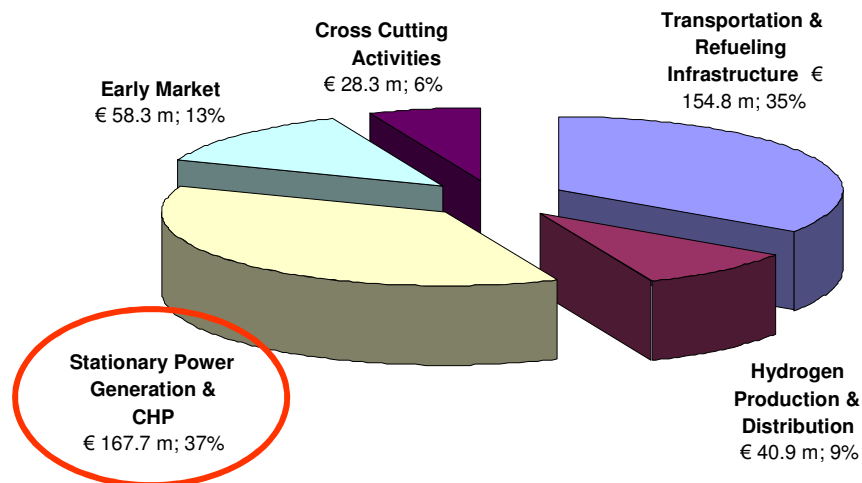
# Methodology

## HFP IP Stationary theme



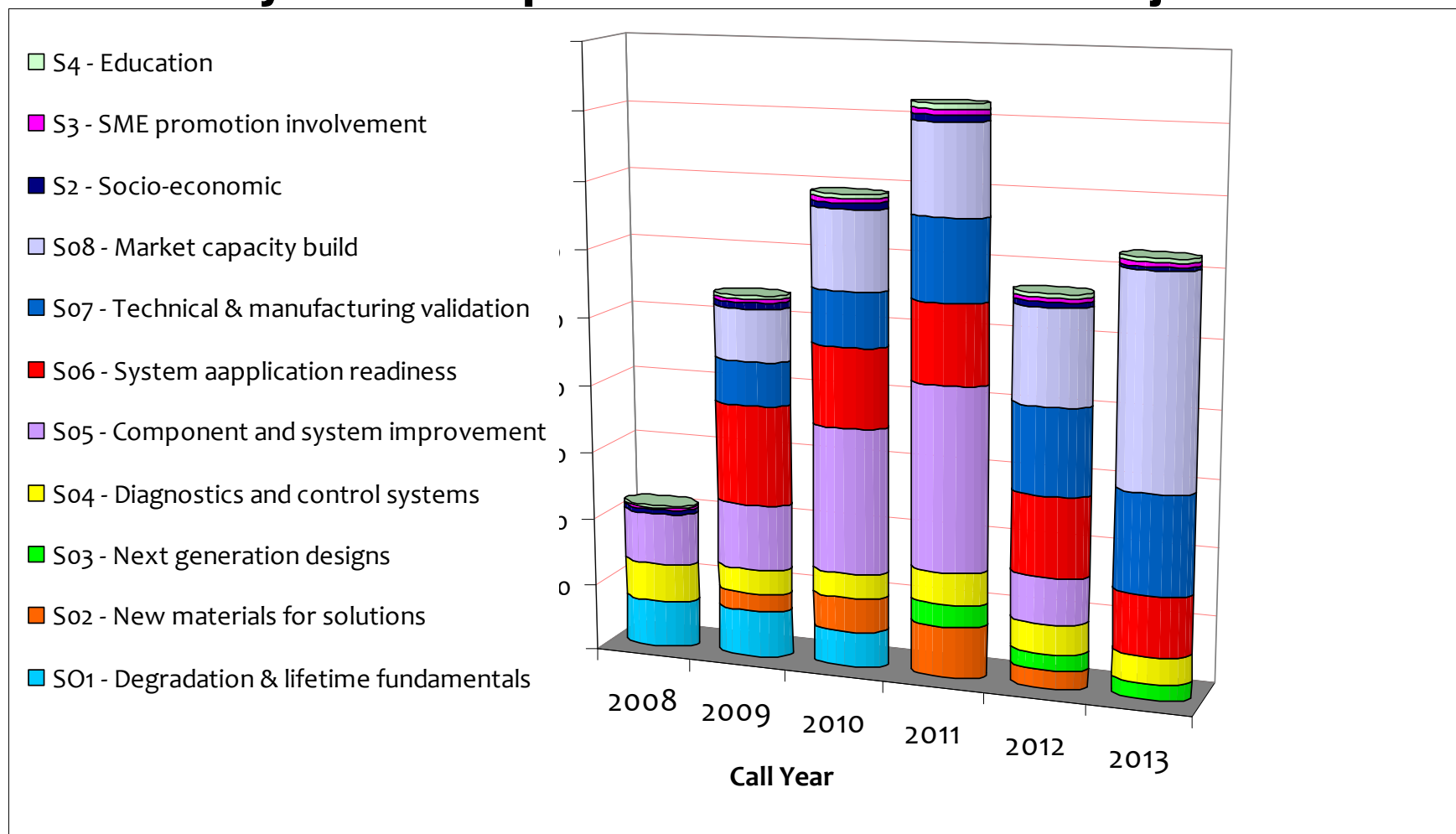
## IG Stationary themes

# Salient Numbers



FCH JU Funding	Break-through Research	Research & TD	Demo	Support Actions	TOTAL €m %		
Transportation & Refuelling Infrastructure	20.0	27.0	107.8	(6.9)	154.8	35%	
Hydrogen Production & Distribution	13.4	13.9	13.6	(3.0)	40.9	9%	
Stationary Power Generation & CHP	24.5	78.4	64.8	(3.0)	167.7	37%	
Early Market		12.8	45.5	(7.6)	58.3	13%	
Cross-cutting Issues				28.3	28.3	6%	
TOTAL	€m	57.9	132.1	231.7	28.3+(20.5)	450.0	100%
	in %	13%	29%	52%	6% + (5%)	100%	

## Stationary IG Anticipated Distribution of Project Effort



## MAIP and AIP 2008

- MAIP – Multi-Annual Implementation Plan
  - Strategy document of the JTI for Stationary Power and CHP.
  - Sets the activities to achieve successful commercialisation.
  - Revisions can be expected as technology challenges are met and reviews are undertaken
  - Objective remains acceleration of technology development for commercialisation
- AIP – Annual Implementation Plan
  - For each year of the JTI – 2008 to 2013
  - Prepared and developed annually based on the MAIP and results from projects – FP7 and JTI
  - Basis for Calls in year



# Overview of MAIP and AIP

## MAIP 2008

No.	Topic	Cat
S01	Degradation & lifetime fundamentals	BR
S02	New materials for cells, stacks and balance of plant (BoP)	BR RT
S03	Next generation stack and cell designs	BR RT
S04	Controls, modelling, diagnostics	RT
S05	Improvement of components and their interaction	RT
S06	System integration and proof of concept readiness	RT
S07	Validation of systems & manufacturing processes	RT
S08	Market capacity build and field demonstration	D
S09	Investigation of market application targets for best planning	S AR

## AIP 2008

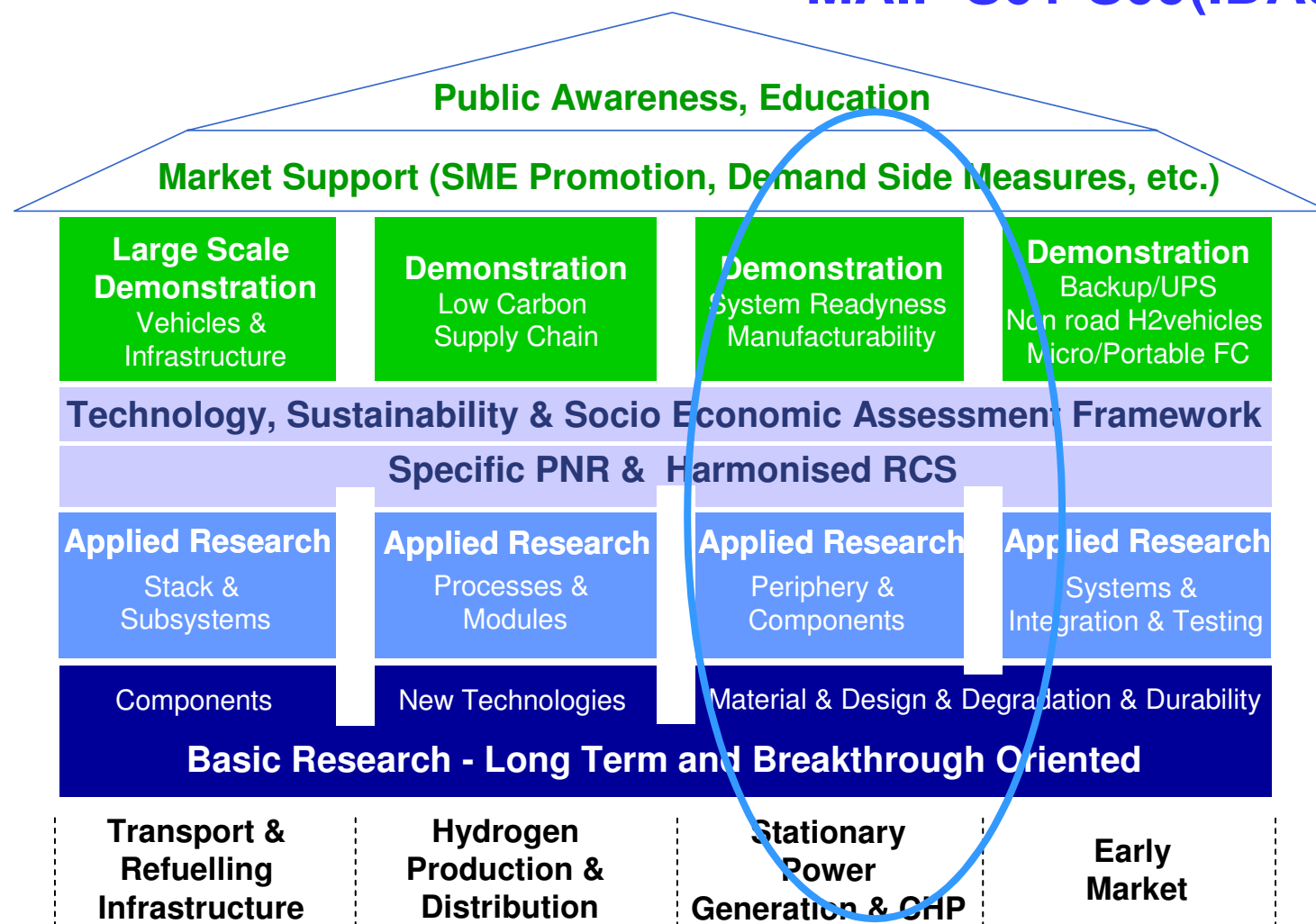
No.	Topic	Cat
S01	Degradation & lifetime fundamentals	BR
S04	Controls, modelling, diagnostics	RT
S05	Improvement of components and their interaction	RT



# MAIP SO1 to SO4, Discussion about AIP 2008

Rolf Rosenberg  
N.ENERGHY

## MAIP S01-S09(IDA3)



## MAIP S - Stationary Power Generation & CHP

	Topic	C at	Rationale	FCH JU
S01	Degradation & lifetime fundamentals	B R	Long-term and break-through oriented research to identify critical parameters and operating conditions of all power ranges that impact degradation and life time of cells and stacks including accelerated testing. Coordination with S02, S05 and S06 required.	€10.1 m
S02	New materials for cells, stacks and balance of plant (BoP)	B R R T	Development and design of new materials to improve performance including lifetime and degradation as well as mechanical, thermal and electro-chemical stability of single cells, stacks and BoP components of all power ranges. Coordination with S01 required.	€ 9.7m

## MAIP S - Stationary Power Generation & CHP

	Topic	C at	Rationale	FCH JU
S03	Next generation stack and cell designs	B R R T	Long-term and break-through oriented research on novel architectures for cell and stack design to provide step improvements over existing technology in terms of performance, endurance, robustness and cost targets for relevant applications.	€ 4.7m
S04	Controls, modelling, diagnostics	R T	Research and development to establish a scientific methodology including tools, controls and diagnostics for safe degradation and lifetime prediction of cells and stacks as well as safe control and operation of complete fuel cell systems.	€13.6 m

## **SP-JTI-FCH.3 Stationary power generation & CHP**

### **€12.0m for three topics**

<b>3.1.</b>	Operation diagnostics and control for stationary power applications	Development of control and diagnostics tools for operational performance including degradation and lifetime prediction (PEM, MCFC, SOFC technologies).
<b>3.3</b>	Degradation & lifetime fundamentals for stationary power applications	Research on factors impacting the degradation and lifetime of stacks (SOFC, PEM, MCFC technologies); exploration of synergies with back up and UPS units.

## The Perspectives of the Research Community

- Promote basic and applied research in FCH JU Governing Board
- Receive and Convey member's view to Governing Board
- Provide efficient and appropriate information about Calls
- Specific actions towards Members States and Regional grouping to increase BR+AR influence
- Provide some input to European Energy initiatives: SET-Plan, ALLIANCE ...



# **MAIP TOPICS & 2008 AIP**

## **Applied R&D and Demonstration**

### **STATIONARY INDUSTRY GROUP**

Alan Chapman. IG Secondee (Ceramic Fuel Cells Limited)



# Industry Grouping Priorities Programme Stages

- **Basic R&D (S01-S03)**
  - Steer scope to keep industrial relevance
  - Have generic data available **not** specific to one end user
  - POC projects – ‘small is beautiful’
  - Include R&D from industry
  - End user FC & BoP producers
- **Applied R&D (S04-S06)**
  - Active involvement of IG members
  - Active involvement of ROs
  - Steering from application industry (e.g. utilities, ESCOs, etc)
  - End user system integrator
- **Demonstration (S07-S08)**
  - Active involvement of IG members
  - Active involvement of application industry
  - Regional & member state
  - End user from system users (application industry)

## IG priorities – Approach to MAIP build

- Accelerate commercialisation
- Build supply chain
- Improve use of knowledge base in near-commercial designs
- Improve implementation of basic R&D into applied & demonstration
- Technical neutrality between FC-types
- Application/end-user driven
- Recommend ‘small-is-beautiful’ for collaborations but need coordination

## MAIP 2008

No.	Topic	Cat
S01	Degradation & lifetime fundamentals	BR
S02	New materials for cells, stacks and balance of plant (BoP)	BR RT
S03	Next generation stack and cell designs	BR RT
S04	Controls, modelling, diagnostics	RT
<b>S05</b>	<b>Improvement of components and their interaction</b>	<b>RT</b>
<b>S06</b>	<b>System integration and proof of concept readiness</b>	<b>RT</b>
<b>S07</b>	<b>Validation of systems &amp; manufacturing processes</b>	<b>RT</b>
<b>S08</b>	<b>Market capacity build and field demonstration</b>	<b>D</b>
<b>S09</b>	<b>Investigation of market application targets for best planning</b>	<b>S AR</b>

S	PNR on H2 devices for residential CHP	S
S	PNR on industrial H2 systems	S

## S05 - Improvement of components & their interaction

2008 AIP (MAIP '08-'12)

- Build supply chain, Novel technologies to support current stacks, improvement with current stack designs
- **Fuel cell components**
  - Power generation unit (integrated stack/ BoP)
  - Reforming and fuel processing
  - Humidification
  - Fluid supply and management including pumps, valves, flow meters, desulphurisation
  - Power electronics
  - Heat exchangers/thermal management
  - Exhaust cleaning and recovery
- **Novel designs solutions** components to be integrated with industrially relevant stacks
- **Manufacturing process/technologies**
- **Validation and testing of components lifetime**, durability/robustness according to different test regimes, in 'application' environment - life testing, failure mode analysis
- **Demonstration of end-of-life** rework for reuse, recycle, disposal consequence and costs
- **Comparative Life Cycle Assessment**

## S06 - System integration and proof of concept readiness

MAIP 2009-2013 calls

- **Proof-of-concept/prototypes** of FC-units combined with other technologies e.g. integration with renewable power or heat generation, cooling, fuel processing, etc.
- **Ensure the FC-unit is at a high technical readiness** more robust and adaptable FC-unit in existing or new uses. Failure minimisation through unit-based failure modes. Accelerated testing of FC-units
- **Increasing power or efficiency**
- **Maintenance and repair FC-generator**

### Expected Outcome

- **Prototype combined FC-systems** with:
  - Cooling systems
  - Fuel processing systems
  - Renewable heat &/or power with increased overall efficiency
  - Energy storage (heat and/or power)
  - Other stationary based uses
- **Robust FC-units** that allow tolerance to fluctuations in supply and demand without decrease in performance or life.
- **Maintenance and repair strategies** that help reliable introduction of systems.

## S07 – Validation of systems and manufacturing processes

MAIP 2009-2013 Calls

### Scope

- Technical and manufacturing solutions
- FC-based technology approaches to specific stationary applications
- Application needs fulfilled by FC-unit based systems in simulated environment
- System build and supply chain and costs validation
- QC procedures and techniques to ensure the quality of the systems
- Integration into power networks
- Scope is limited to simulated application environment or small scale in-application trials

### Expected Outcome

- **Technically mature and fully integrated systems** that are validated as ready to be used in application trials. With operating data that fulfil specifications defined by the end users

## S08 – Market capacity build and field demonstration

MAIP 2009-2013 Calls

### Scope

- **Demonstration of complete systems based on FC-units**
  - validated against the application's technical and economic target
  - demonstrate the supply chain and support activities necessary

### Expected Outcome

- **Successful demonstration in an application environment**
  - required efficiencies
  - cost and lifetimes
  - barriers to full implementation & eventualities to overcome them
  - Benefits to 20-20-20 goals

## S09 – Investigation of market application targets for best planning

MAIP 2009-2010

- Definition of application targets for each application area
  - Small/micro generators
  - Commercial
  - Industrial
- Distil down to technical targets, cost targets,
- Define how to measure (standards, techniques,...)
- Fit with geographical & political variations
- Techno-economic study of stationary industry to target market specific needs



## Support activities

- **Support activities for:**
  - Socio-economic
  - SME promotion
  - Education
- **Specific support activities for Stationary**
  - PNR on H<sub>2</sub> devices for residential CHP
  - PNR on industrial H<sub>2</sub> systems



# Stationary Fuel Cells

-

## Discussion of M/AIP

**Robert Steinberger-Wilckens**  
**N.ERGHY & FZJ**

# Structure

- general comments on the MAIP (~10 minutes)
- comments on the AIP 2008 (~5 minutes)
- comments and suggestions on the AIP 2009 (~5 minutes)

**\* please keep statements short and to the point \***

# Overview of MAIP

## MAIP 2008

No.	Topic	Cat
S01	Degradation & lifetime fundamentals	BR
S02	New materials for cells, stacks and balance of plant (BoP)	BR RT
S03	Next generation stack and cell designs	BR RT
S04	Controls, modelling, diagnostics	RT
S05	Improvement of components and their interaction	RT
S06	System integration and proof of concept readiness	RT
S07	Validation of systems & manufacturing processes	RT
S08	Market capacity build and field demonstration	D
S09	Investigation of market application targets for best planning	S AR

# Overview of AIP 2008

## AIP 2008

No.	Topic	Cat
S01	Degradation & lifetime fundamentals	BR
S04	Controls, modelling, diagnostics	RT
S05	Improvement of components and their interaction	RT