Fuel Cells and Hydrogen Joint Undertaking

European public/private joint support for fuel cells and hydrogen activities

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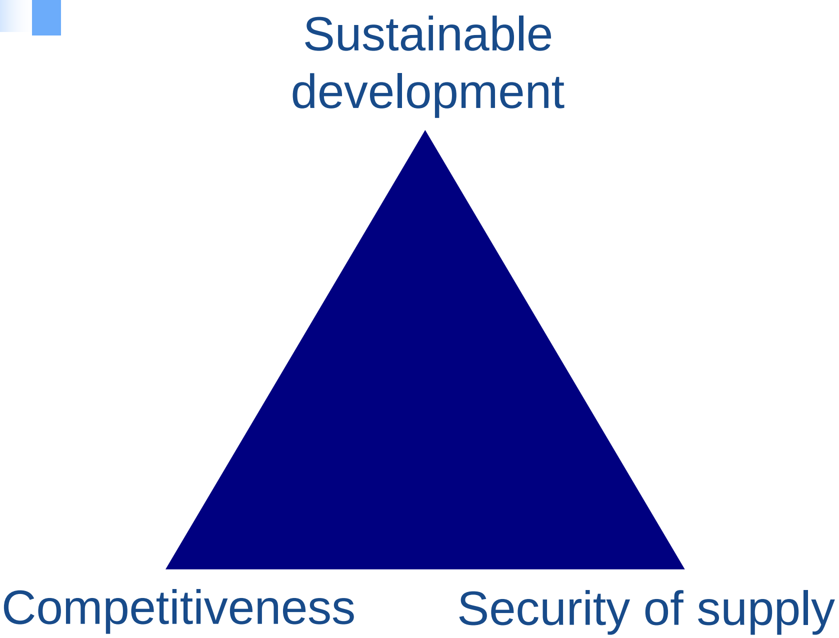
New Energy World JU
fuel cells & hydrogen for sustainability

4th IPHE Workshop – Stationary FC
1st March 2011, Tokyo - Japan

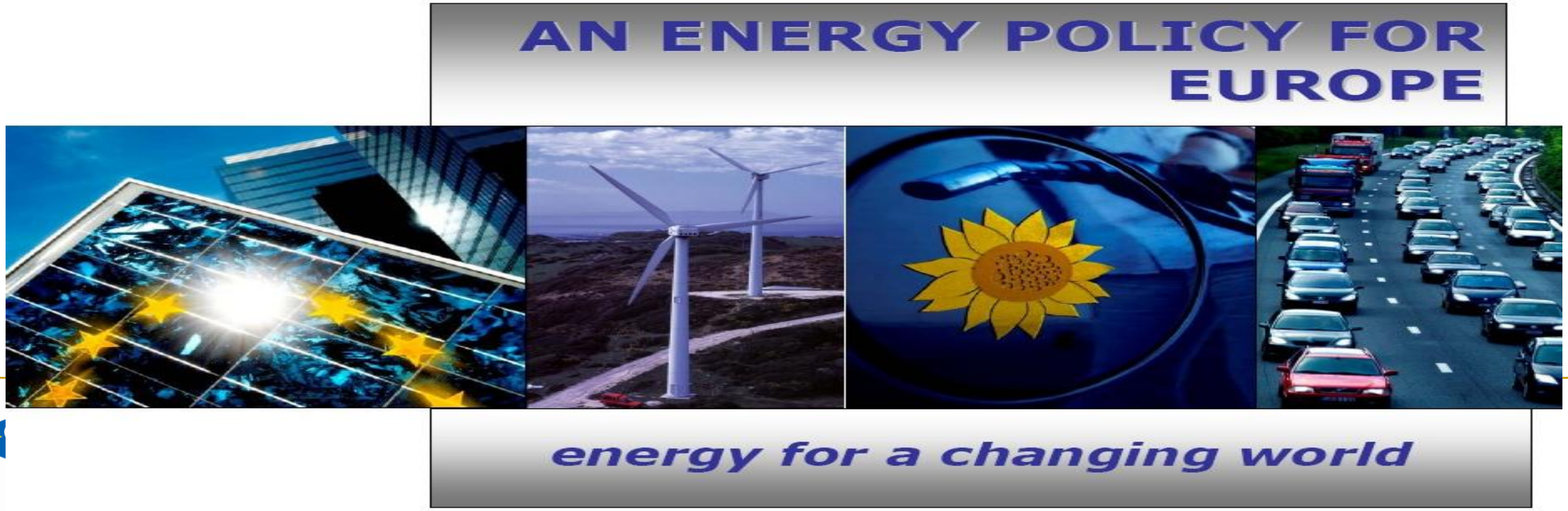
Overview

- EU Energy Policy Context
- Fuel Cells and Hydrogen Joint Undertaking (FCH JU)
- FCH JU current status of funding (focus on stationary applications)
- FCH JU future activities and perspectives

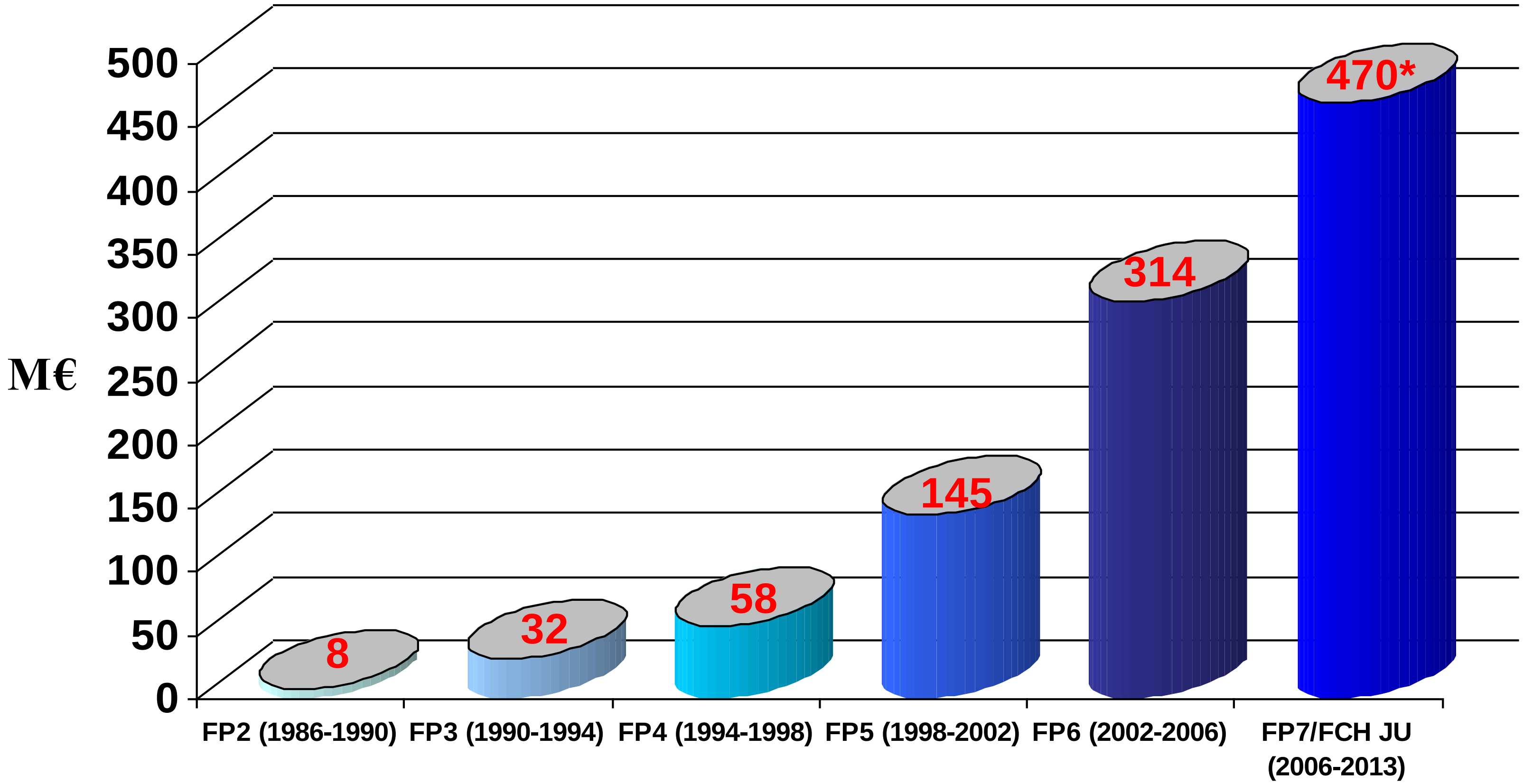
EU Energy Policy Context: Policy Challenges



The European Strategic Energy Technology (**SET**) Plan has **identified fuel cells as a key technology for Europe towards the 20-20-20 goal**



Continuous Support for Fuel Cells and Hydrogen in the EU Framework Programmes



** 470 mill Euro to be implemented by FCH JU + about 10 mill Euro already spent from 2007 budget, before FCH JU in place*

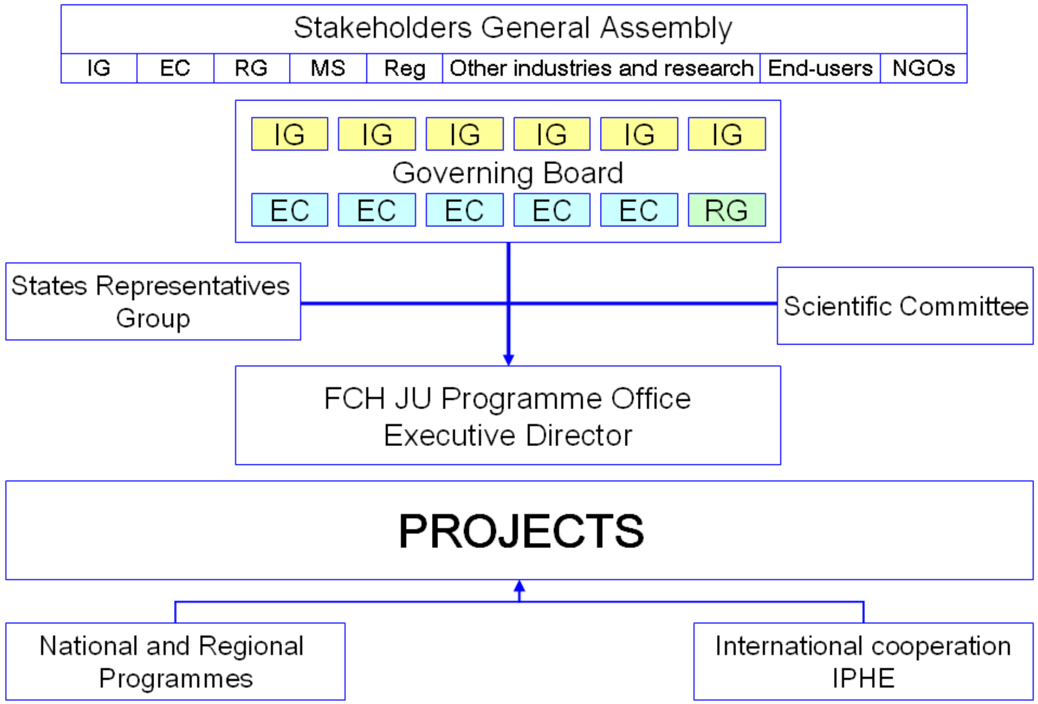
FCH JU : Strong Public Private Partnership with Focused Objectives

FCH JU - Objectives

- Bring resources together under a cohesive, long-term strategy : **public private partnership**
- Ensure **commercial focus** by matching RTD activities to **industry's needs and expectations**
- Scale-up and intensify links between Industry and the **Research Community**

To accelerate the development of technology base towards <u>commercialization from 2015 onwards</u>

FCH JU – Governance structure



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FCH JU : Establishing

Preparatory phase	JU Programme Office (in EC)	Autonomous JU Programme Office

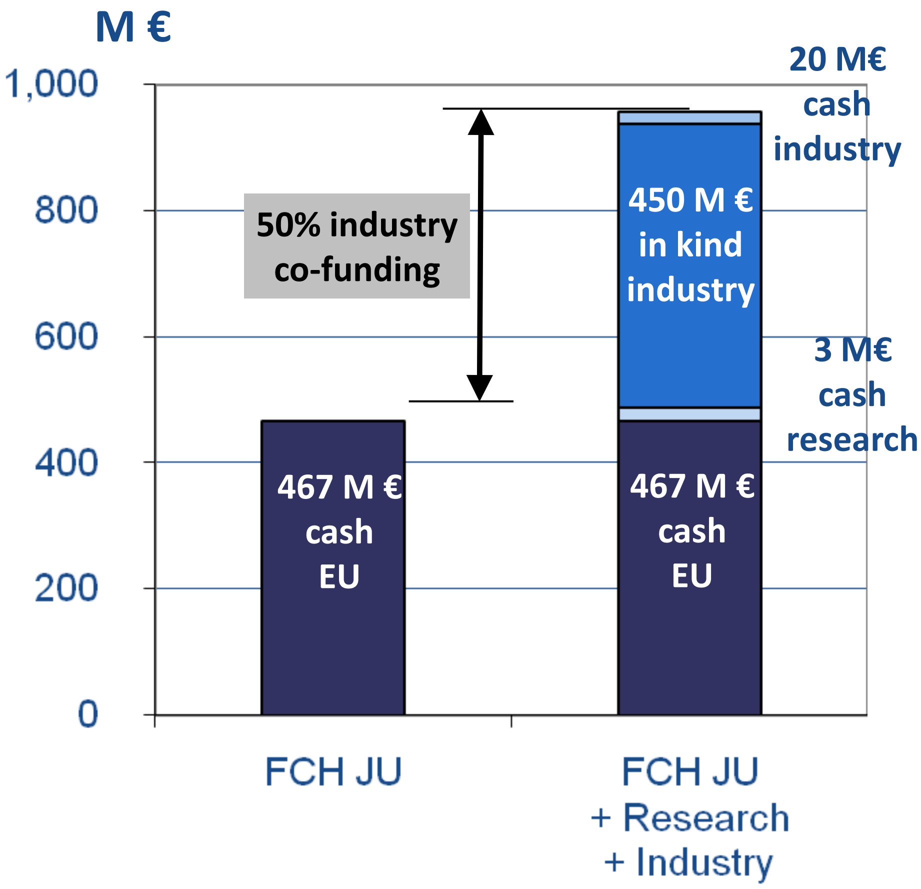
Sept '07 — **Dec '08** — **Nov '10 *(autonomy)*** — **Dec '17**

- **Transition** from Hydrogen & Fuel Cell Technical Platform
- Drafting strategic and operational **guides & plans**
- Hand over to **interim structure**

- Launch **first 3 calls**
- Establish the **Programme Office**
- Establish JTI official bodies
- Launch cooperation with **MS and regions**
- Recruit and train staff
- Achieve autonomy

- Implement **last 3 calls**
- Make operations efficient & effective: **simplify**
- Establish global ties
- Reinforce cooperation with **MS and regions**
- Learn and adapt activities to reality

FCH JU - Operational budget



Budget : 2008 ~ 2013 : **(min.) 940 M €**

Operations : to launch annual, open and competitive calls for project proposals

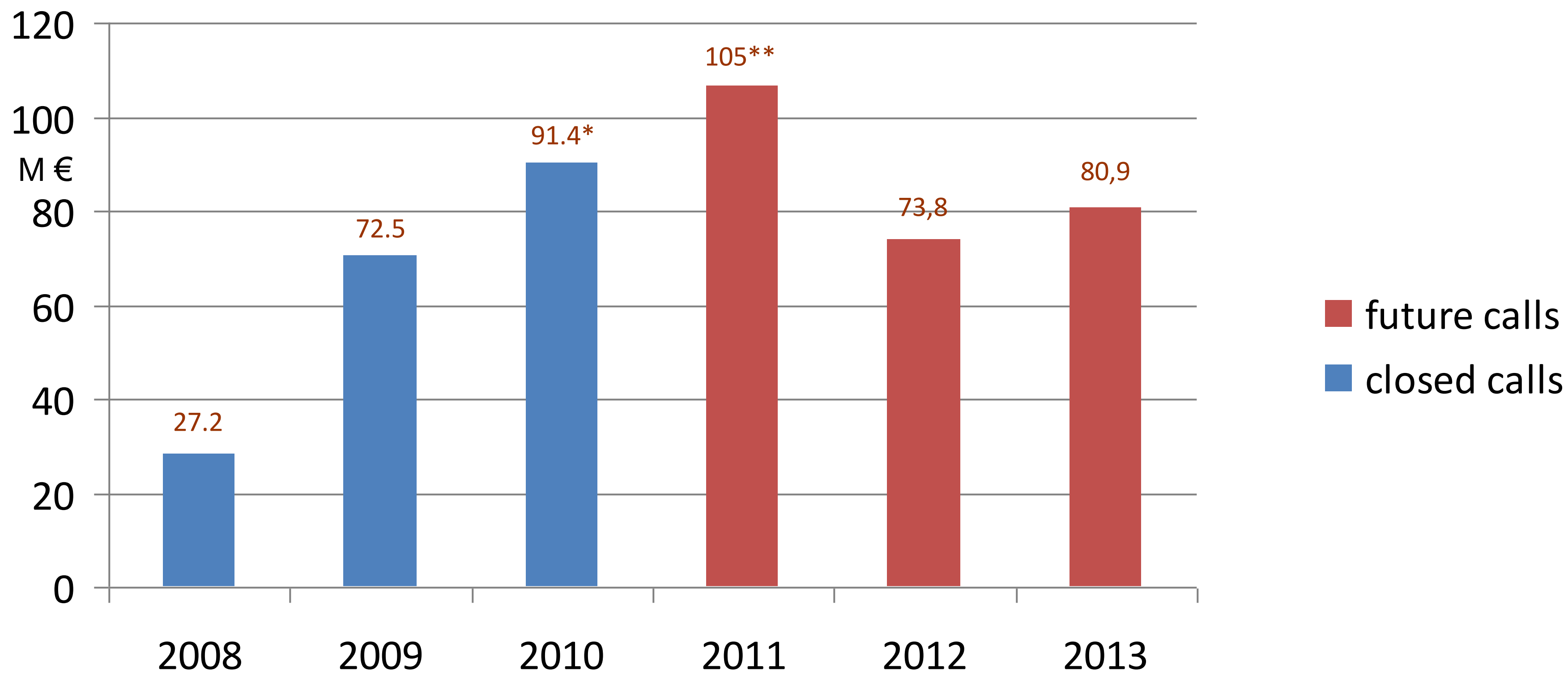
Principle : 50/50 cost-sharing between the EU and Industry

Limit : The requested FCH JU (cash) funding has to be matched by industry co-financing (in kind) at call level; in case of mismatching, the FCH JU funding is reduced.

Correction factor : in order to reflect the reduced FCH JU funding, a correction factor is applied to all funding schemes

(e.g. for the calls 2008 & 2009: 0.67)

FCH JU - Operational budget 2008 – 2013



* additional **2.8 mill Euro** in commercialisation plans for buses, cars and forklifts

** additional **1.5 mill Euro** in commercialisation plan for stationary applications (tbc)

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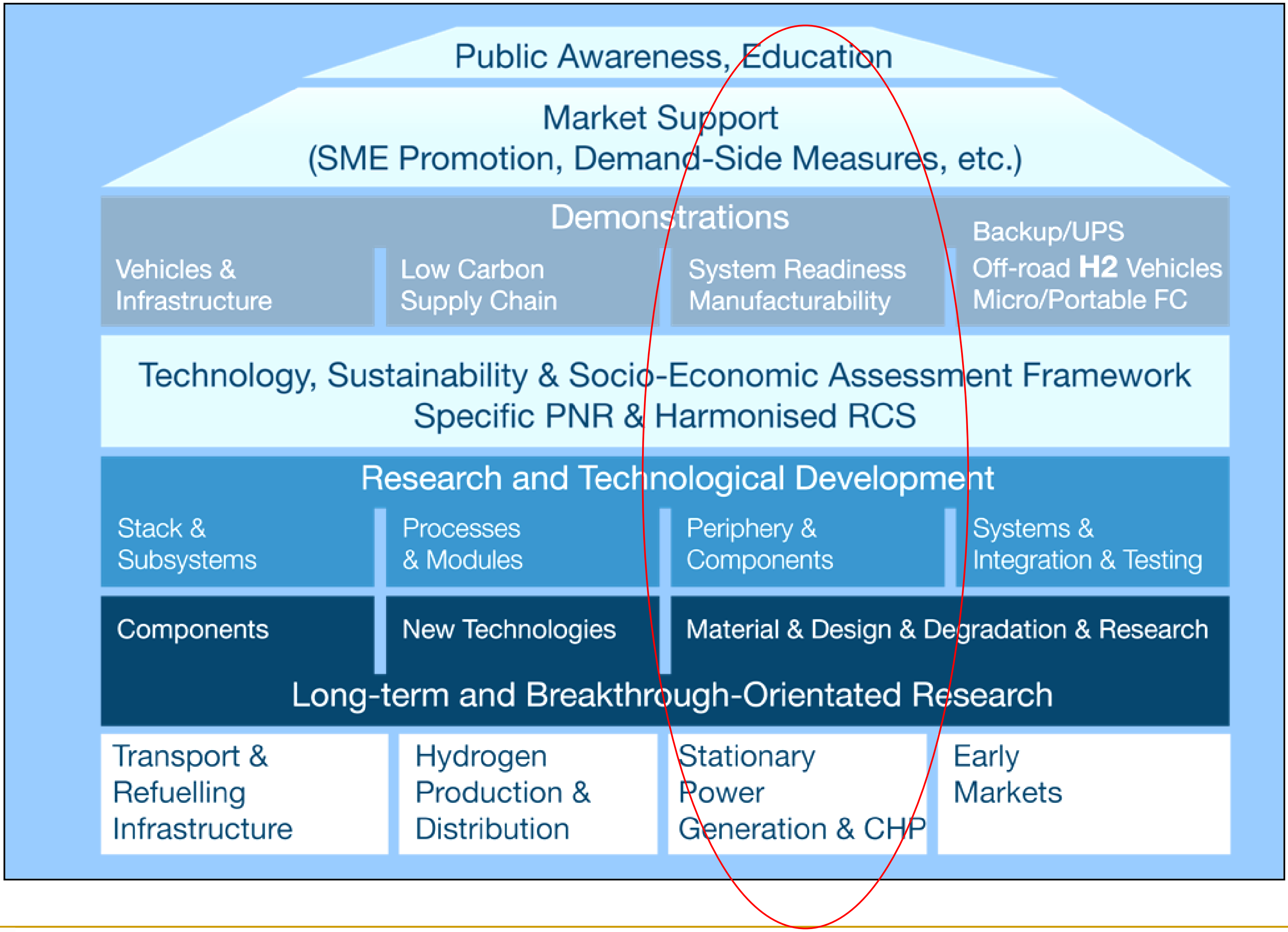
FCH JU Multi-Annual Implementation Plan

Adopted in May 2009

Currently under review



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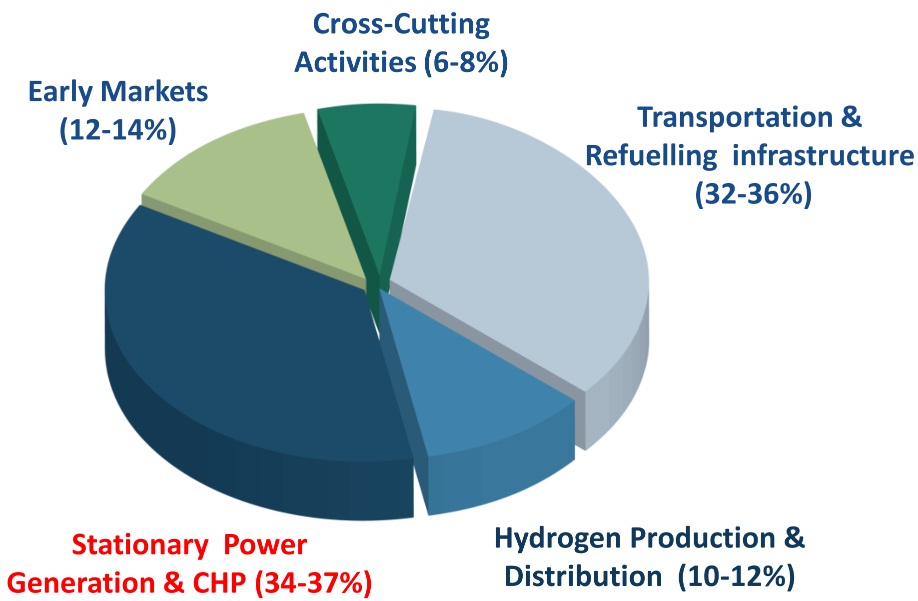
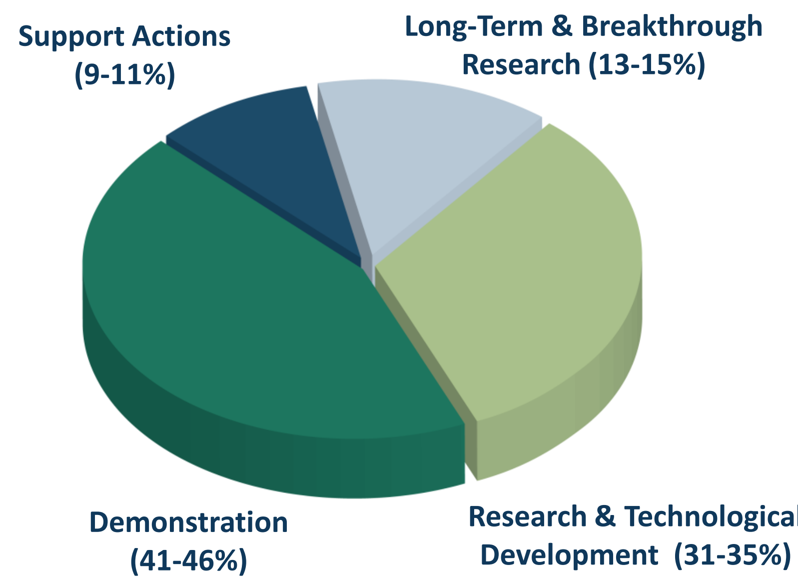
FCH JU Budget Breakdown 2008-2013

By Application Area



By Activity Type



Stationary applications targets *(currently under revision):*

''to achieve the principal technical and economic requirements needed to compete with existing energy conversion technologies, such as high electrical efficiencies of 45%+ for power units and of 80%+ for CHP units, combined with lower emissions and use of non-hydrocarbon fuels (lifetime requirements of 40,000 hours for cell and stack, as well as commercial target costs, depending on the type of application)"

By 2010: 3 - 7MW electrical capacity installed for pre-commercial demonstration phase

By 2015: 100 MW electrical capacity installed

Cost of 5 000 - 6 000 €/kW (Micro CHP FC) and 1,500 - 2,500€/kW for commercial/industrial units

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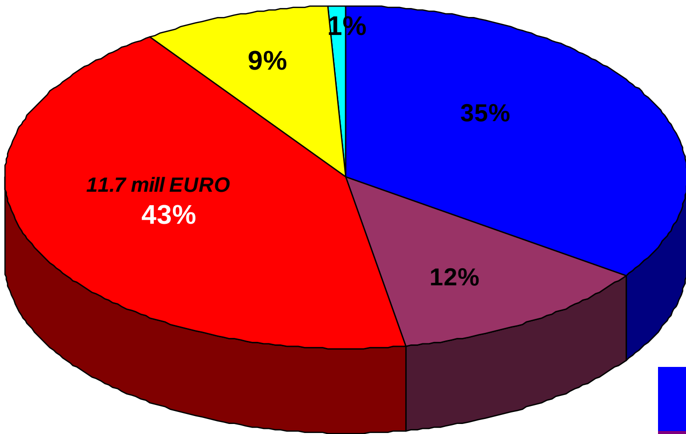
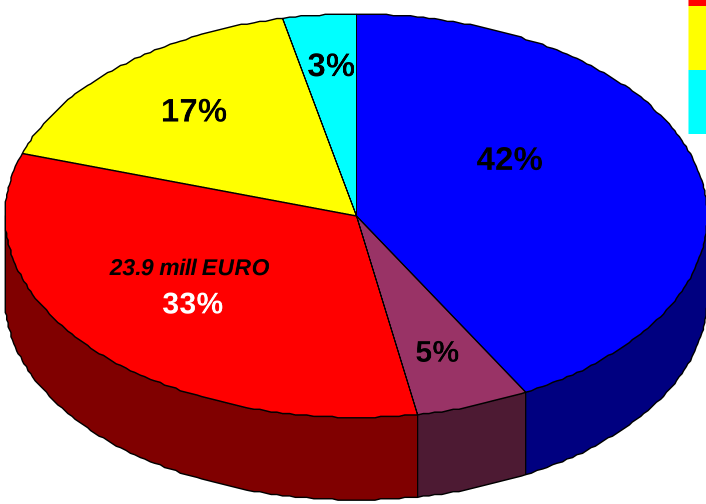
FCH JU Budget Breakdown – funded projects



Call 2008 :
Budget : 27.2 M€
16 projects granted
in December 2009
7 projects in Stationary

- Transportation and Refuelling Infrastructure
- H2 production and distribution (including storage)
- Stationary & CHP
- Early Markets (including forklifts, back-up systems etc)
- Cross-cutting issues (education, LCA etc)



Call 2009 :
Budget : 72.5 M€
28 projects granted
in December 2010
13 projects in Stationary

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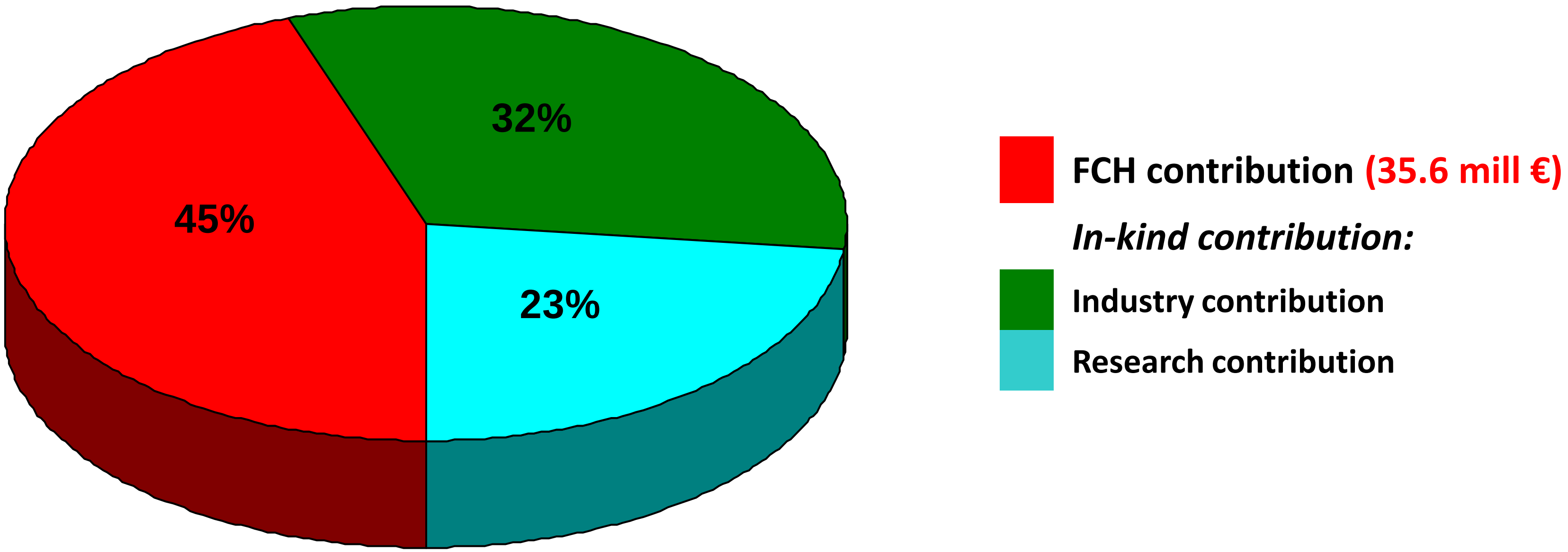
Stationary running projects – Contribution breakdown

20 running projects from 2008 & 2009 budgets



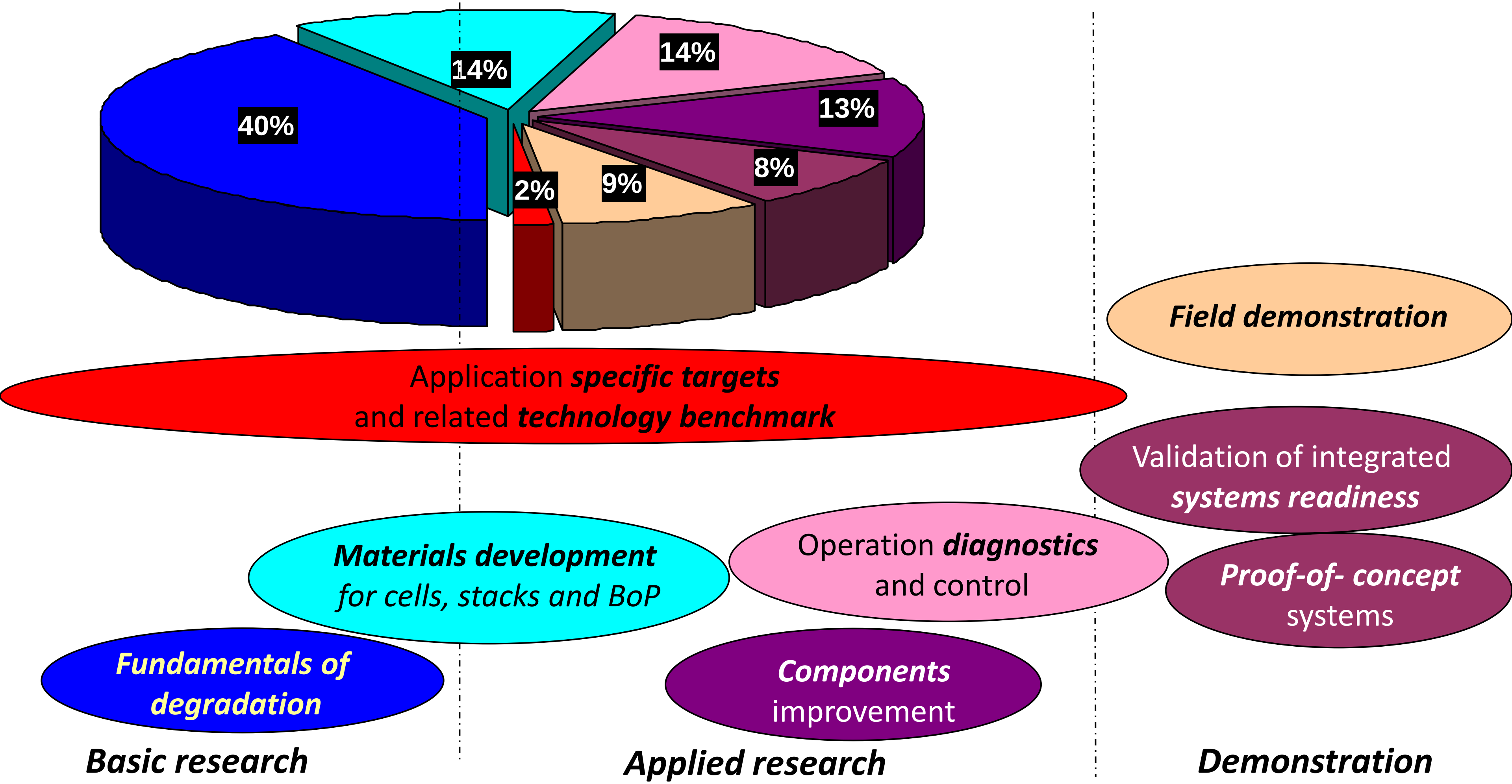
Total cost of projects: 80.15 mill EURO *(budget estimation)*

+ approx 33 mill EURO contribution proposed from 2010 budget (at least 10 more projects to be supported)

Stationary type of projects funded

Type of activities

Share in the 35.6 mill funding so far



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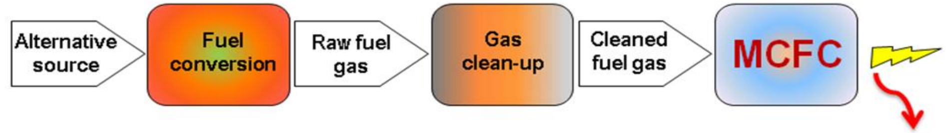
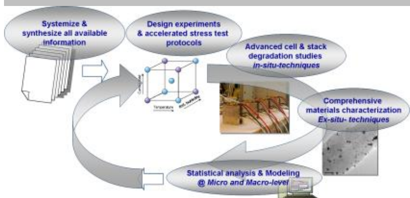
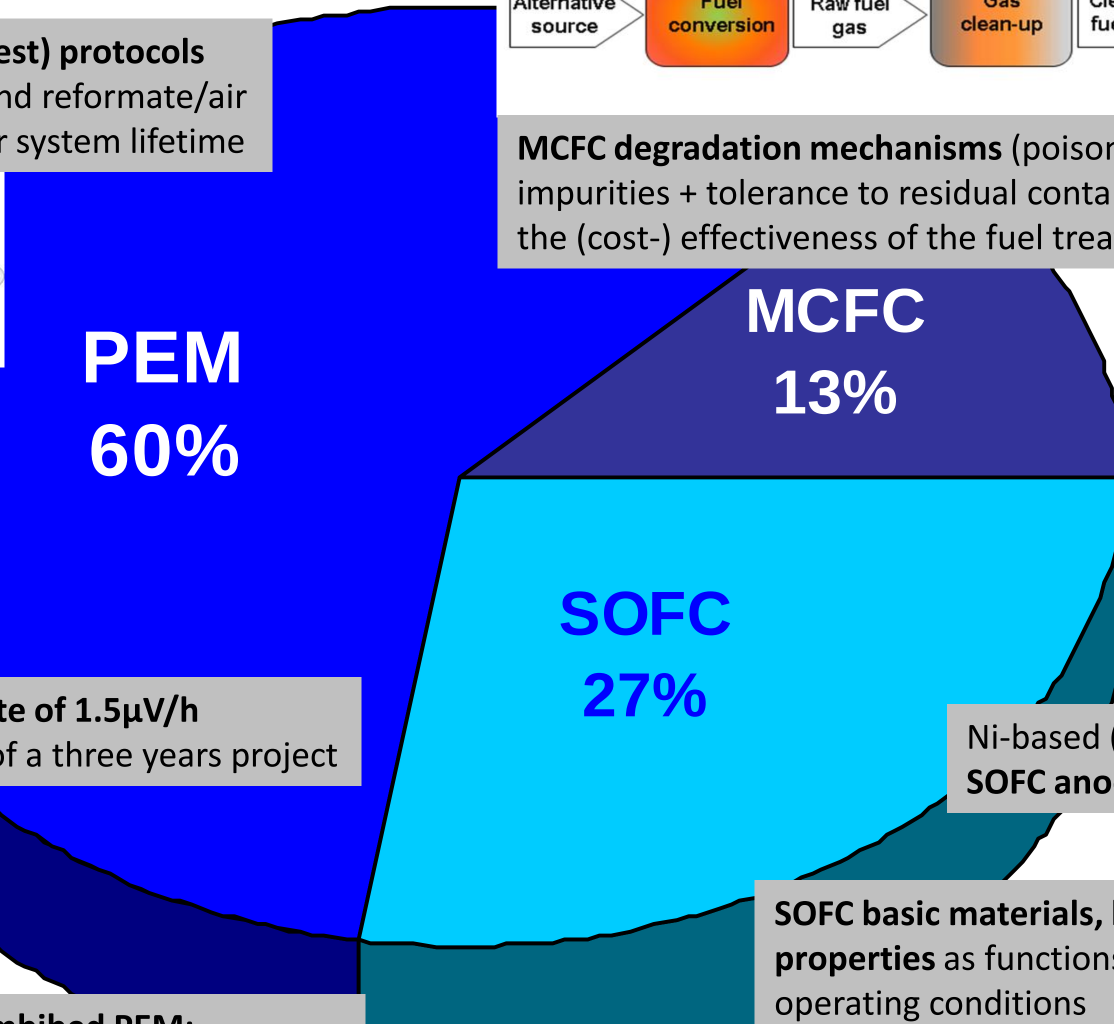
Fundamentals of degradation (basic research)

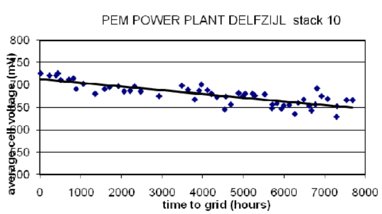


AST (accelerated stress test) protocols
for cells/stack in H2/air and reformate/air
+ predictive modelling for system lifetime

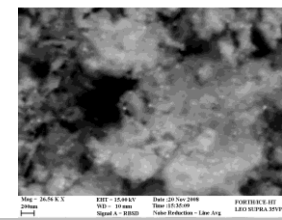


MCFC degradation mechanisms (poisoning by gas impurities + tolerance to residual contaminants) → improve the (cost-) effectiveness of the fuel treatment

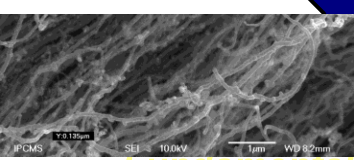




average voltage decay rate of 1.5µV/h
within the 26,000 hours of a three years project

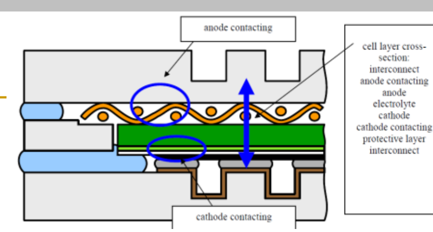


Ni-based (state-of-the-art)
SOFC anode degradation



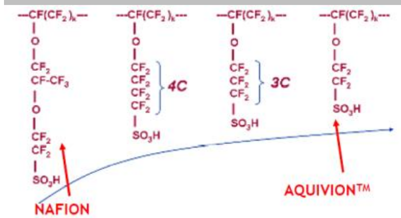
SOFC basic materials, layer and interface properties as functions of time and operating conditions

high temperature H3PO4 imbibed PEM:
degradation rate less than 5 µV/h at 200 mA/cm2

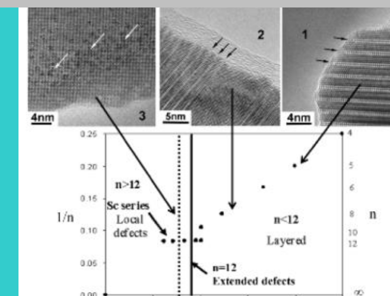


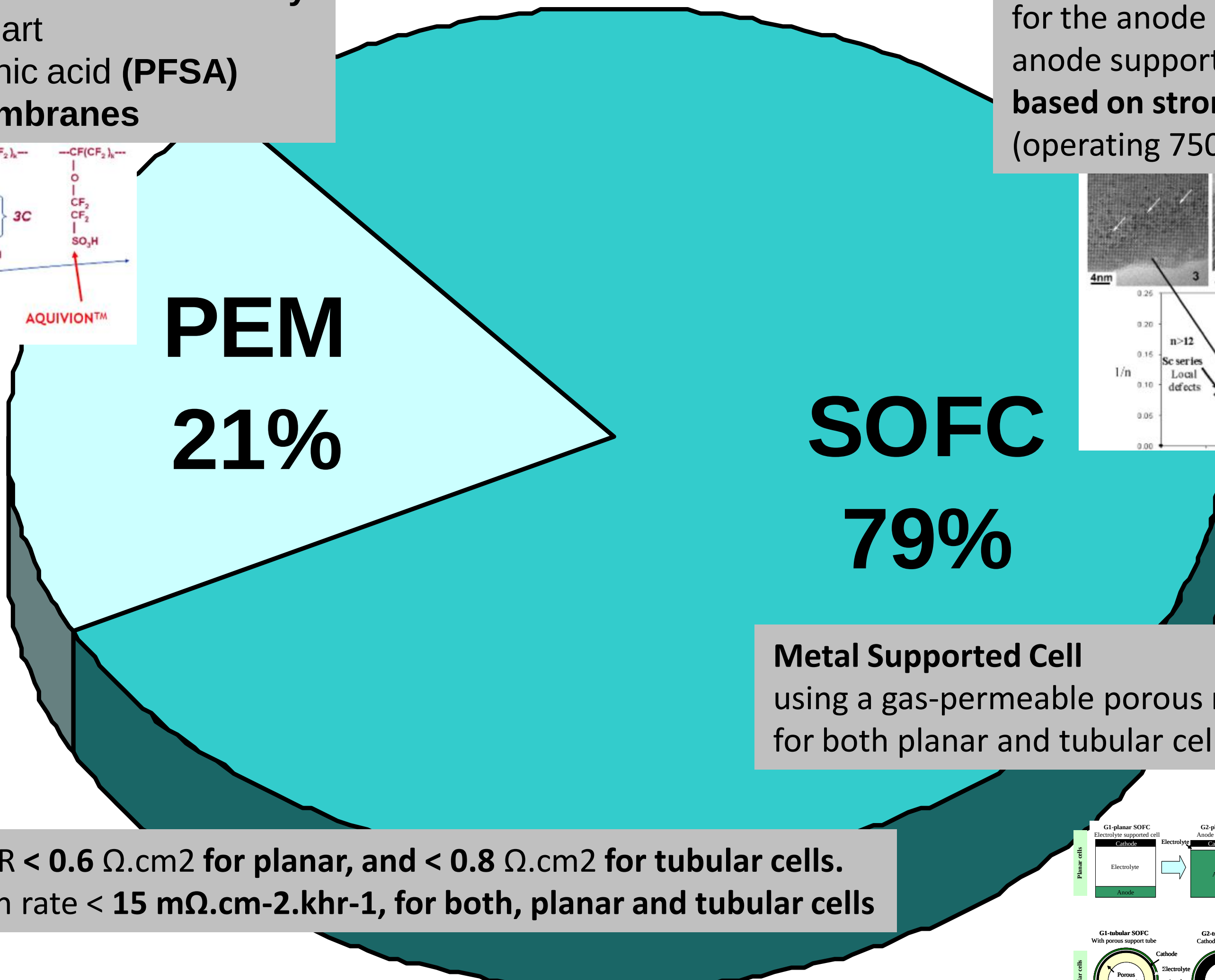
Materials development

improve the **mechanical stability** of state of the art perfluorosulfonic acid **(PFSA)** type **PEM membranes**

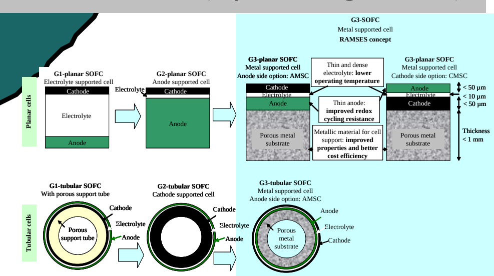


new designs
for the anode and
anode support layer
based on strontium titanates
(operating 750-920 C)





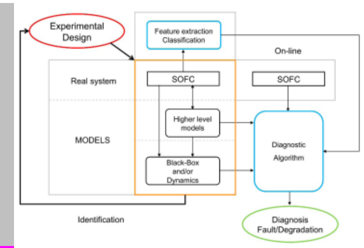
Metal Supported Cell
using a gas-permeable porous metallic substrate
for both planar and tubular cells (operating 600 C)



ASR **< 0.6** Ω.cm2 **for planar, and < 0.8** Ω.cm2 **for tubular cells.**
Cell degradation rate < **15 mΩ.cm-2.khr-1, for both, planar and tubular cells**

Operation diagnostics & Components

"GENERIC" tool to diagnose the health of a SOFC system
(no more than 1 maintenance/year, detect at least 60% of degradations with a rate > 0.5%/1000hrs, etc)



on-line electrochemical impedance spectroscopy (EIS) as an effective diagnostic tool - implemented on-board with a new DC/DC converter

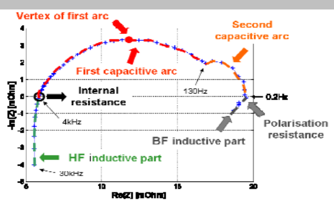
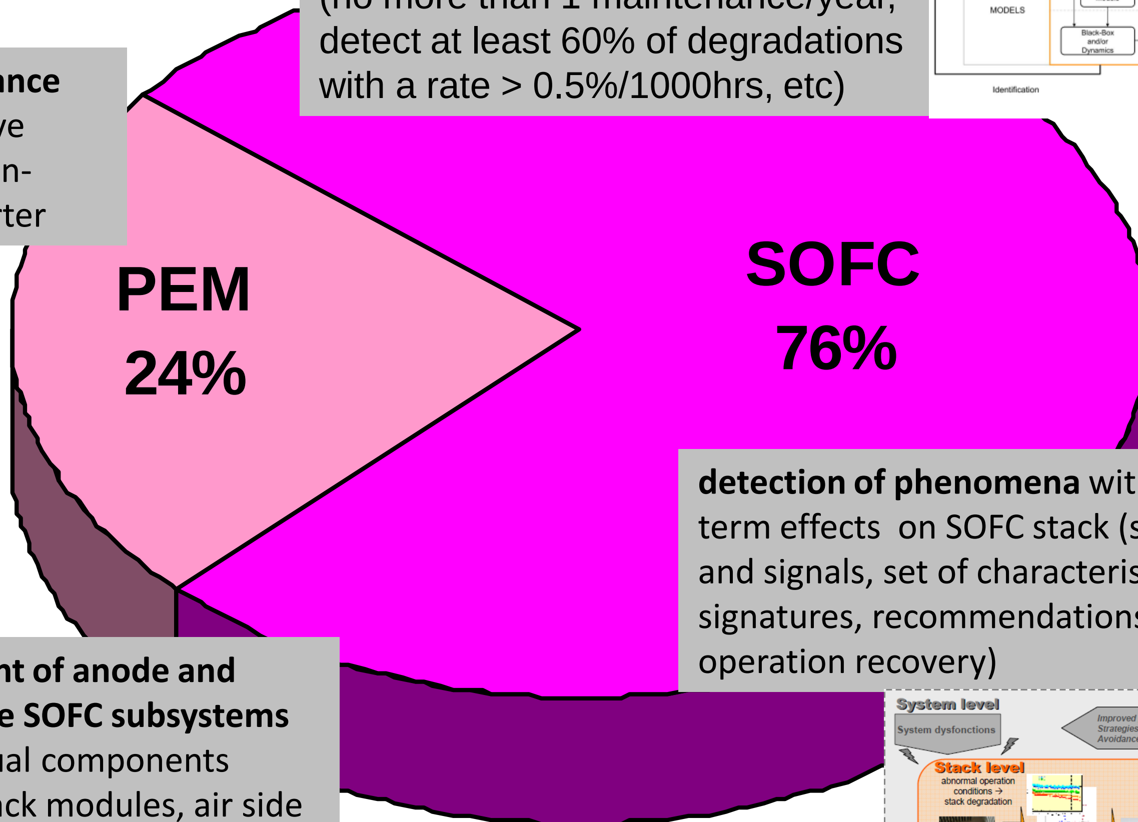
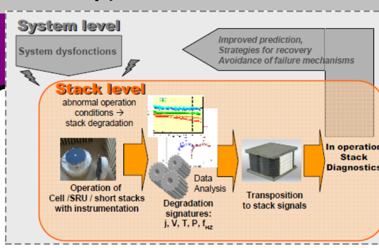
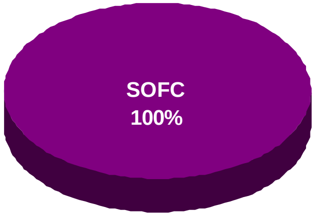


Figure 20 - Example of impedance spectrum for a 100W 3-cell stack.



detection of phenomena with long-term effects on SOFC stack (sensors and signals, set of characteristic signatures, recommendations for operation recovery)

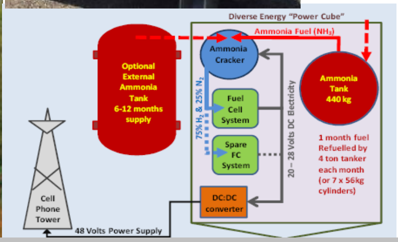


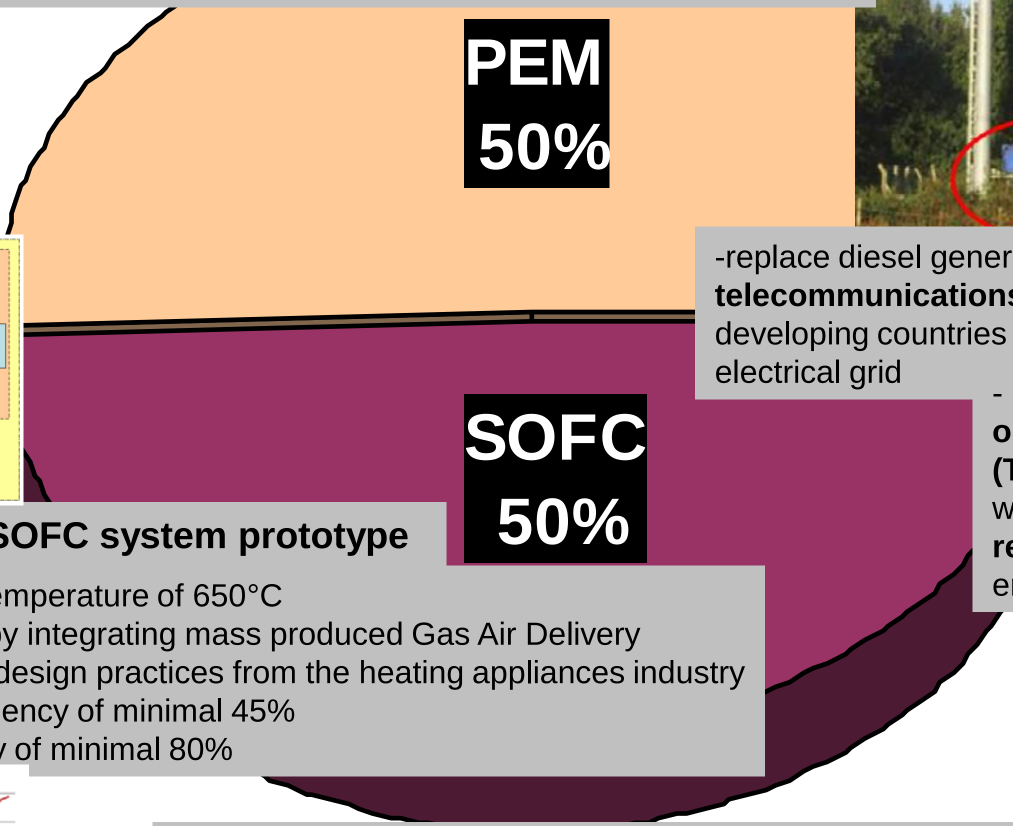


development of anode and cathode side SOFC subsystems and individual components (scalable stack modules, air side fluid, thermal management and mechanical solutions) - for future ~250 kWe atmospheric SOFC systems

Proof-of- concept & Field demonstration

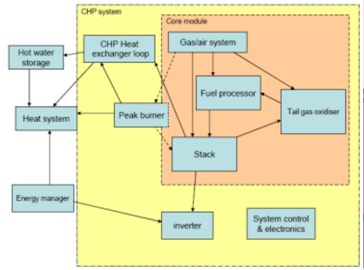
Deployment of 40 PowerCubes in differing climates - in Europe (laboratory validation units) and Africa, including refueling infrastructure based on Linde's current NH3 distribution network (trials for the 3 years of the project)





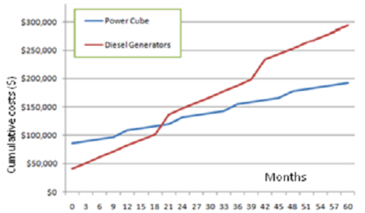
-replace diesel generators to power **mobile telecommunications towers** (cell-phone towers) in developing countries and regions without a reliable electrical grid

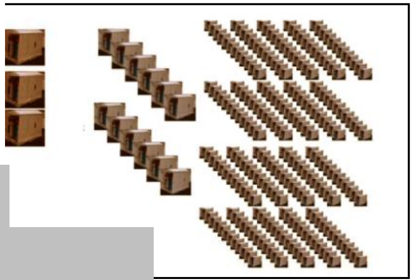
- PowerCube offers a **25% discount on the Total Cost of Ownership (TCO)** compared to diesel generators with a **2-year ROI**, as well as an **80% reduction in green-house gas** emissions



Low Temperature SOFC system prototype

- Operating low stack temperature of 650°C
- Reducing down time by integrating mass produced Gas Air Delivery
- Modular concept and design practices from the heating appliances industry
- Electrical system efficiency of minimal 45%
- Total system efficiency of minimal 80%





Fully automated and integrated SOFC CHP system

- Electric power output of 770W gross on the stack
- Electrical efficiency of more than 35% (net DC efficiency of ca. 30%)
- Total efficiency of the system up to 78% in facilities
- Performance degradation of the fuel cell unit around 10%/1000h operation

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Industry and Research Organisations involved in stationary applications

DLR

IRD Fuel Cell Technology

JRC European Commission

mtu

AnsaldoFuelCells A Finmeccanica Company

FORTH Foundation for Research & Technology - Hellas

NEXT ENERGY

JM Johnson Matthey

cea

TOPSOE FUEL CELL clean, efficient and reliable

ENEA

SAINT-GOBAIN CORPORATION

Linde

WÄRTSILÄ

AVL

RISØ DTU

KTH Vetenskap och Konst

Advent

NedStack

HYGEAR

HEXIS

bosal

EBZ

CNRS

pemembrain™

Dantherm Power

SOFCPOWER Solid Oxide Fuel Cells

Ceramic Fuel Cells Limited Clean power for your home

SINTEF

SOLVAY

EIFER

HTceramix From Powder to Power High Technology Electroceramics

VTT

fumatech Funktionelle Membranen und Anlagentechnologie

Università degli Studi di Salerno

ikerlan ik4 research alliance

50 Jahre Zukunft Forschungszentrum Jülich in der Helmholtz-Gemeinschaft

e.on

National Research Council Canada / Conseil national de recherches Canada

International cooperation in stationary field

Within Europe: difficult to formulate precise targets and requirements for stationary fuel cell applications due to the complicated interaction of FC system operation with grid specifics and the differing goals of FC implementation in the Member States

→ **benchmarking project** to look into the interdependencies of stationary fuel cell systems with electricity and heat supply grids (benchmark indicators and measures to assess and compare FC with conventional power generating technologies, but also amongst themselves + identify optimal conditions under which FC can offer a maximum of environmental and efficiency advantages

- **Additional cooperation will be sought with US and Japanese institutions: U.S. DoE (NREL) and NEDO** (discussion of results and validation of methodologies). It may be advisable to also involve the IEA, Cogen Europe and representatives from South Korea and other countries with major stationary fuel cell development programmes.

Other international collaborations:

- At the level of small tasks in the **running projects**, bilateral collaboration with NRC Canada and Institute of High Temperature Electrochemistry from Russia
- Unlikely possibility to fund international partners (decision of the Board)
- Continue discussions with all our possible worldwide partners for future collaboration
- Participation in IPHE workshops (decision level with the EC)

Future activities and perspectives

- Negotiations with beneficiaries of budget 2010 – starting March 2011
  - ✦ 1 MW PEM plant based on H2 produced from clori-alkali plant
  - ✦ 40 CHP units of 1-2 kW SOFC
  - ✦ Proof-of-concept for SOFC technology (MW scale)
  - ✦ Next generation cell/stacks (new architectures etc)
- Publication of call/budget 2011 – estimated April/May 2011
  - ✦ Approx 37 mill Euro for stationary applications
  - ✦ Additional 1.5 mill Euro for commercialisation plan for stationary applications
- Scoping study for stationary applications – to be launched end of March 2011
  - ✦ Almost 20 industry commitments (suppliers and end-users)

Conclusions

- **Over 1 billion Euro investment through the FCH JU into the Fuel Cells and Hydrogen activities (jointly public/private) during 2007-2013**
- **Over 200 million Euro public support in stationary applications (triggering at least the same private investments)**
- **Support for all types of technologies and activities (from degradation issues until demonstration and commercialisation strategies)**
- **Need for even more support (including public funds from 2014 onwards)**

Thank you for your attention !

for more info

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