

www.fuero.org

FUERO

**Fuel Cell Systems and Components
General Research for Vehicle Applications**

01.07.2000 - 31.12.2003

Budget: 4.5 M€

funded by the "European Commission"



Project partners / Objectives



FUERO Objectives:

The final objective of the “FUERO” project is to make available advanced system and component technologies for fuel cell application on different categories of vehicles according to relevant operational requirements. It will provide an overall study and definitions of the specifications of the components suitable for an optimised management of a Fuel Cell powered vehicle.

Project partners / Objectives



FUERO Objectives:

- studies of fuel alternatives
- overall study and definition of specifications of the FC powertrain's components
- life cycle analysis of the components
- test bench evaluation
- definition of demonstrators
- final assessment after demonstration phase

Work Programme

<u>WP leader</u>		
IKA	WP0	PROJECT MANAGEMENT
IFP	WP1	STUDY ON FUEL ALTERNATIVES - FUEL PRODUCTION AND DISTRIBUTION, ON-VEHICLE STORAGE, LIFE CYCLE ANALYSIS
PSA	WP2	OVERALL F.C. SYSTEMS SPECIFICATIONS AND OPERATIONAL PERFORMANCE REQUIREMENTS FOR DIFFERENT VEHICLE CATEGORIES AND APPLICATIONS
PSA	WP3	STUDIES ON SYSTEM INTEGRATION AND MANAGEMENT REQUIREMENTS
RENAULT	WP4	MODELLING OF COMPONENTS OF DIFFERENT F.C. TECHNOLOGIES
VW	WP5	SPECIFICATIONS OF SYSTEMS AND COMPONENTS INCLUDING AUXILIARIES OF THE F.C. POWERTRAIN ALTERNATIVES
VOLVO	WP6	DEFINITION OF COMPONENT BENCH AND ON-VEHICLE TEST PROCEDURES AND EVALUATION CRITERIA
VOLVO	WP7	STATE OF THE ART ASSESSMENT - BENCHMARKING - TESTING OF NEW COMPONENTS AND EVALUATION OF RESULTS
CRF	WP8	LIFE CYCLE AND IMPACT ANALYSIS
CRF	WP9	DEFINITION OF PROGRAMMES FOR DEMONSTRATORS OF GLOBAL F.C. PERFORMANCE
CRF	WP10	GENERAL ASSESSMENT ON PERFORMANCE AND LCA OF F.C. VEHICLES
IKA	WP11	CLUSTER COORDINATION

Work Programme

IKA	WP0	PROJECT MANAGEMENT
IFP	WP1	<p>STUDY ON FUEL ALTERNATIVES - FUEL PRODUCTION AND DISTRIBUTION, ON-VEHICLE STORAGE, LIFE CYCLE ANALYSIS</p> <p>Leader: IFP Partner: CRF, PSA, VOLVO</p> <p>Main Objective: Evaluation of the environmental interest of a large variety of fuels from "well to wheel" to feed a fuel cell vehicle</p> <p>Key Point: Fuel Storage on Board</p> <ul style="list-style-type: none"> - Production and distribution of different fuels - On vehicle storage - Life cycle analysis and cost analysis for different fuels
PSA	WP2	<p>OVERALL F.C. SYSTEMS SPECIFICATIONS AND OPERATIONAL PERFORMANCE REQUIREMENTS FOR DIFFERENT VEHICLE CATEGORIES AND APPLICATIONS</p> <p>Leader: PSA Partner: CRF, Renault, VOLVO</p> <p>Main Objective: Identification of requirements of different classes of vehicles</p> <p>Further Objective: Analysis of alternatives for system architectures</p> <ul style="list-style-type: none"> - Classification of vehicle categories and mission performance requirements - Studies on sytem architecture alternatives - Technical-economical trade off studies

Work Programme

PSA WP3 STUDIES ON SYSTEM INTEGRATION AND MANAGEMENT REQUIREMENTS

Leader: PSA Partner: CRF

Main Objective: Analysis for different types of vehicles for a rational integration of the F.C. system and relevant components

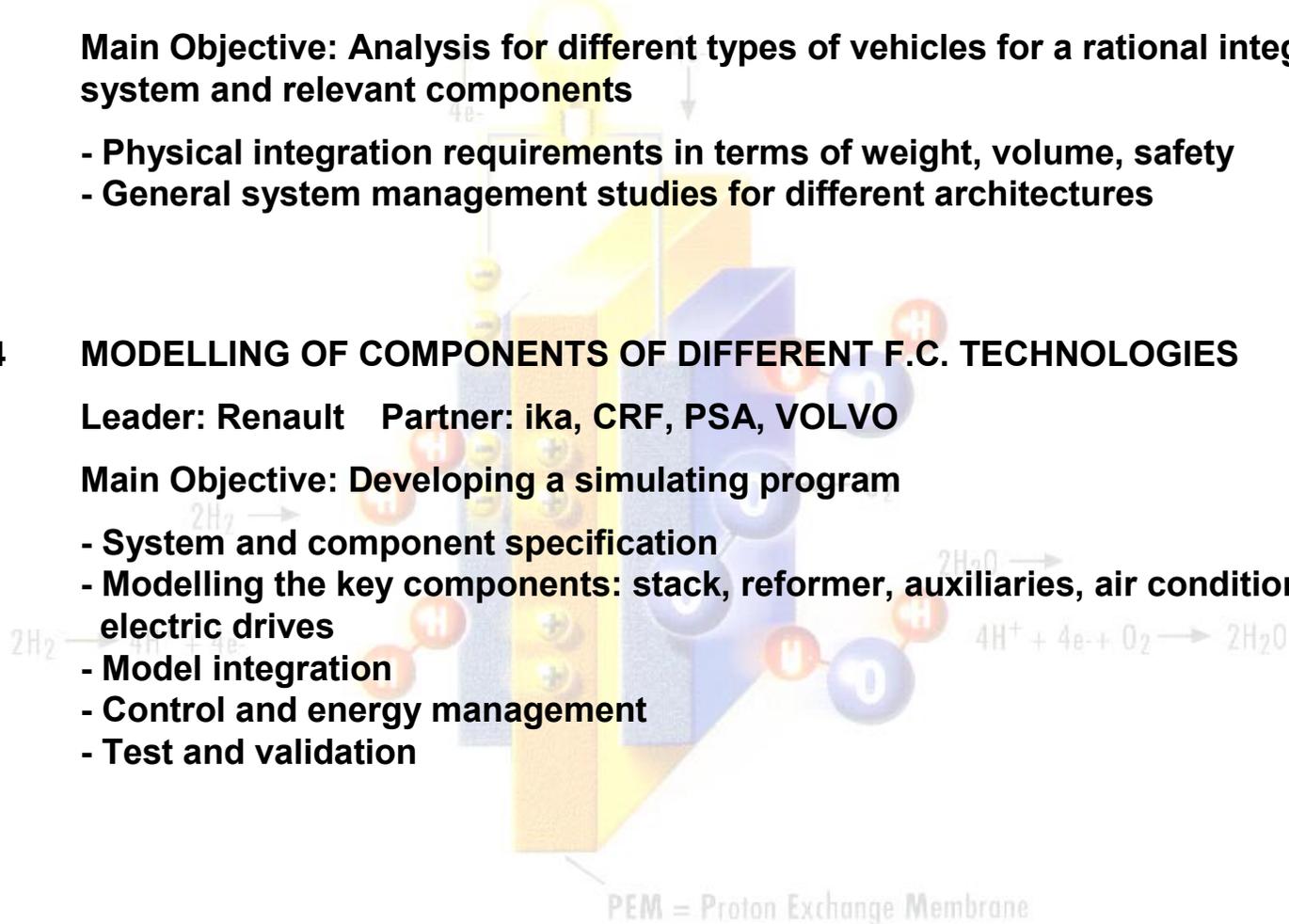
- Physical integration requirements in terms of weight, volume, safety
- General system management studies for different architectures

RENAULT WP4 MODELLING OF COMPONENTS OF DIFFERENT F.C. TECHNOLOGIES

Leader: Renault Partner: ika, CRF, PSA, VOLVO

Main Objective: Developing a simulating program

- System and component specification
- Modelling the key components: stack, reformer, auxiliaries, air conditioning, batteries, electric drives
- Model integration
- Control and energy management
- Test and validation



Work Programme

vw	WP5	<p>SPECIFICATIONS OF SYSTEMS AND COMPONENTS INCLUDING AUXILIARIES OF THE F.C. POWERTRAIN ALTERNATIVES</p> <p>Leader: VW Partner: CRF, PSA, Renault</p> <p>Main Objective: Knowledge and specification of performance data for each component in F.C. System, mathematical description of components, cost target indication for industrial production</p> <ul style="list-style-type: none"> - Specification for on board fuel processes - Specification for direct methanol F.C. stack - Specification for PEM F.C. stack - Specification for integrated compressor-expander units - Specification for optimised electric power trains for F.C. vehicles
VOLVO	WP6	<p>DEFINITION OF COMPONENT BENCH AND ON-VEHICLE TEST PROCEDURES AND EVALUATION CRITERIA</p> <p>Leader: VOLVO Partner: ika, CRF</p> <p>Main Objective: Definition of testing procedures</p> <ul style="list-style-type: none"> - Test procedures for on board fuel processors - Test procedures for direct methanol F.C. stack - Test procedures for PEM F.C. stack - Test procedures for compressor-expander units - Test procedures for electric power trains

Work Programme

VOLVO WP7 STATE OF THE ART ASSESSMENT - BENCHMARKING - TESTING OF NEW COMPONENTS AND EVALUATION OF RESULTS

Leader: VOLVO Partner: ika, CRF, PSA, Renault, VW

Main Objective: Testing of state-of-art components as reference

- State of the art component benchmark and assessment
- Testing of new on board fuel processes
- Testing of direct methanol F.C. stack
- Testing of PEM F.C. stack
- Testing of compressor-expanded units
- Testing of electric power trains specially developed for F.C. vehicles

CRF WP8 LIFE CYCLE AND IMPACT ANALYSIS

Leader: CRF Partner:

Main Objective: Defining the general life cycle figure of the F.C. in terms of energy and costs

- Boundary definition of LCA study
- Environmental burden due to vehicle usage
- LCA due to recovery and disposal

PEM = Proton Exchange Membrane

CRF WP9 DEFINITION OF PROGRAMMES FOR DEMONSTRATORS OF GLOBAL F.C. PERFORMANCE

Leader: CRF Partner: ika

Main Objective: Definition of demonstration programmes to complete the frame of data and information regarding fuel cell applications on vehicles

- Definition of vehicular solutions to be developed and tested in operation
- Definition of sites and missions for vehicle trials
- Identification of parameters to be analysed and relevant measurement
- User acceptance
- Co-ordinated scheduling for the different demonstrators

CRF WP10 GENERAL ASSESSMENT ON PERFORMANCE AND LCA OF F.C. VEHICLES

Leader: CRF Partner: ika

Main Objective: Making a general assessment of the fuel cell vehicle features in terms of operational capability, energy and environmental impact and life cycle costs

- Performance evaluation characterisation by performance index
- Energy consumption well to wheel evaluation - emissions environmental impact evaluation
- Reliability and maintenance aspects analysis
- Life cycle assessment / overall economics evaluation
- Industrial production issues
- End user acceptance evaluation – operational capability market estimation
- Components which need further improvement
- Comparative analysis with other engines

Work Programme

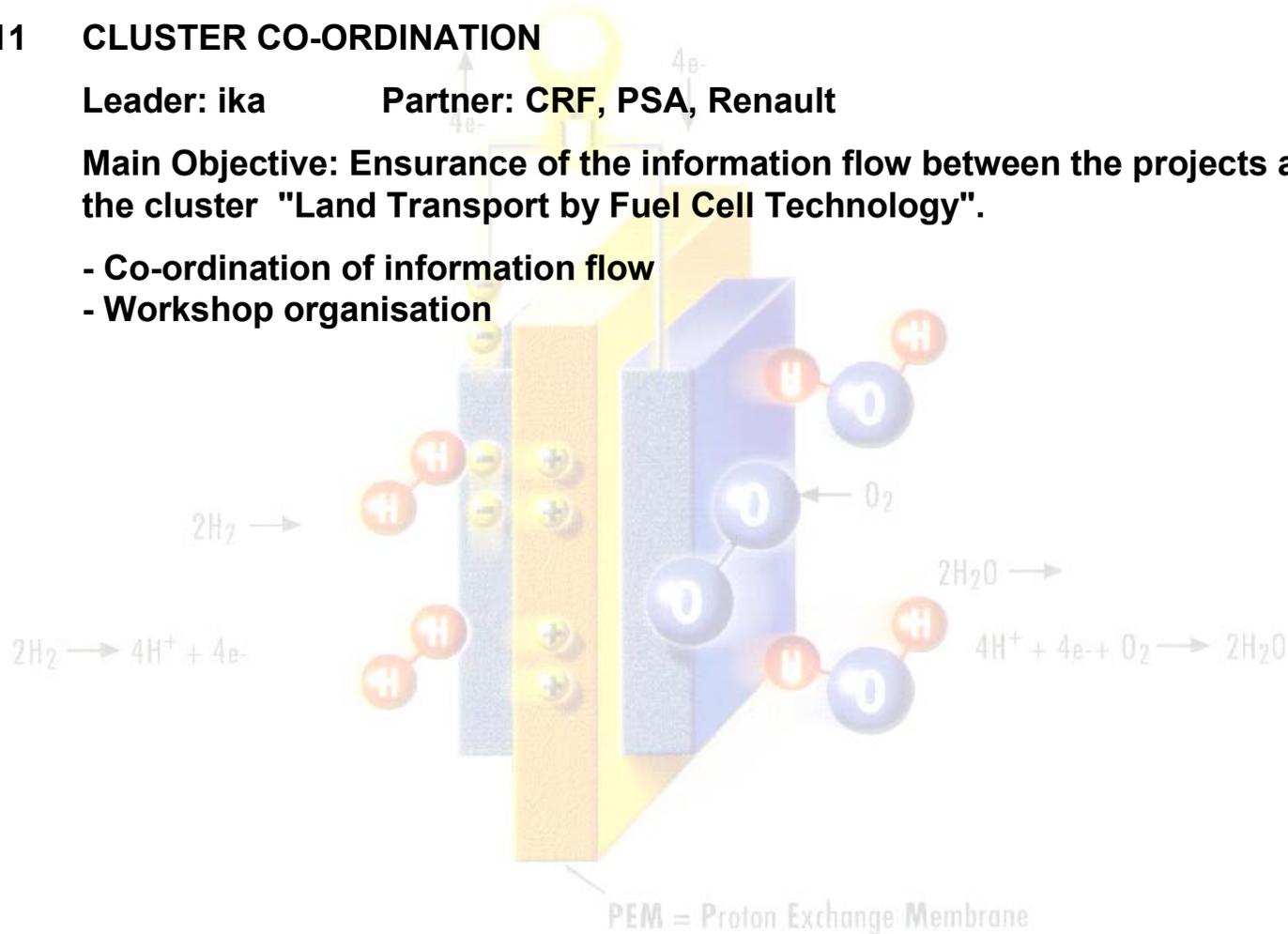
IKA

WP11 CLUSTER CO-ORDINATION

Leader: ika Partner: CRF, PSA, Renault

Main Objective: Ensurance of the information flow between the projects and partners within the cluster "Land Transport by Fuel Cell Technology".

- Co-ordination of information flow
- Workshop organisation



Idea: Cluster Land Transport by Fuel Cell Technology



Cluster Administrator: ika

FUERO
Fuel Cell Systems and Components General Research for Vehicle Applications

- Study on fuel alternatives - Life cycle analys.
- System specification
- System integration studies
- Modelling Interface for components
- Components specifications
- Test procedures definition
- State of the art assessment - Benchmarking new component testing and evaluation
- Life cycle assessment (Modelling)
- Demonstrators definition
- Fuel cell general assessment
- Cluster coordination

Partners: ika, CRF, PSA, RENAULT, VOLVO, VW, IFP
 Coordinator: ika
 Steering committee: Car manufacturers

Experimental Performance and Life Cycle Assessment of FC Vehicles

<p>Demo Partners: Car Makers, Comp.Manuf, Research Inst. Coordinator: Car Maker</p>	<p>Demo Partners: Car Makers, Comp.Manuf, Research Inst. Coordinator: Car Maker</p>	...	<p>Demo Partners: Car Makers, Comp.Manuf, Research Inst. Coordinator: Car Maker</p>
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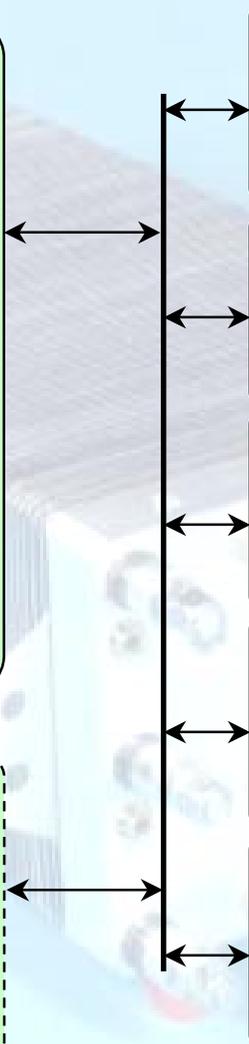
PROFUEL
On-Board Gasoline Processor for Fuel Cell Vehicle Application
 Partners: Johnson Matthey, CRF, ECN, FEV, ANSALDO, Politecnico de Torino, Volvo
 Coordinator: Johnson Matthey

CARDEMECEL
Direct Methanol F.C. Stack
 Partners: SRTI, Bertin, IRD, CRF, CNR-TAE, ECN, CNRS1, CNRS2, FUMATECH
 Coordinator: SRTI

HIPERSTACK
High performance PEM Stack for Automotive Applications
 Partners: IRD, CRF, VOLVO, ECN, SGL Carbon, Degussa-Hüls, ENEA, KTH, GKSS
 Coordinator: IRD

COMPEX
Integrated Compressor-Expander Unit for High Efficient Mobile F.C.System
 Partners: FEV, CRF, Univ. Sheffield, Holset
 Coordinator: FEV

ECO-POWER
Efficiency and Cost Optimised Power Trains for Fuel Cell Vehicles
 Partners: ANSALDO, CRF, ENEA, ECN, SEMELAB, Univ. Sheffield
 Coordinator: ANSALDO



Cluster Land Transport by Fuel Cell Technology

Cluster Administrator: ika

FUERO ERK6-CT1999-00024
Fuel Cell Systems and Components General Research for Vehicle Applications

- Study on Fuel alternatives - Life cycle analys.
- Systems specification
- System integration studies
- Modelling Interface for components
- Components specifications
- Test procedures definition
- State of the art assessment – Benchmarking new component testing and evaluation
- Life cycle assessment (Modelling)
- Demonstrators definition
- Fuel cell general assessment
- Cluster coordination

Partners: ika, CRF, PSA, RENAULT, VOLVO, VW, IFP
 Coordinator: ika
 Steering committee: Car manufacturers

Experimental Performance and Life Cycle Assessment of FC Vehicles

<p>Demo Partners: Car Makers Comp.Manuf Research Inst. Coordinator: Car Maker</p>	<p>Demo Partners: Car Makers Comp.Manuf. Research Inst. Coordinator: Car Maker</p>	...	<p>Demo Partners: Car Makers Comp.Manuf. Research Inst. Coordinator: Car Maker</p>
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PROFUEL ERK6-CT1999-00023
On-Board Gasoline Processor for Fuel Cell Vehicle Application
 Partners: Johnson Matthey, CRF, ECN, FEV, ANSALDO, Politecnico de Torino, Volvo
 Coordinator: Johnson Matthey

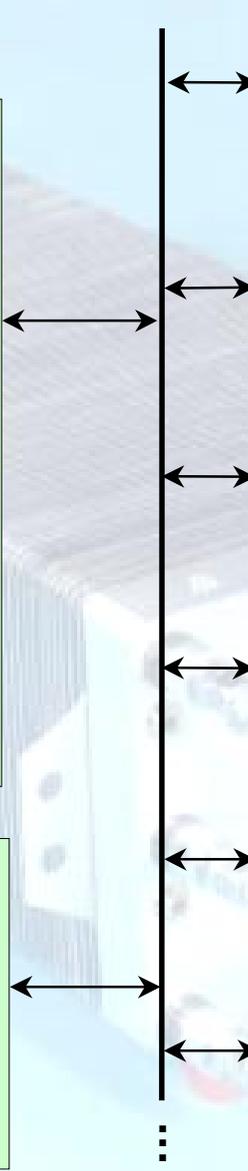
BIO-H2 ERK6-CT1999-00012
Production of clean Hydrogen for Fuel Cell by Reformation of Bioethanol
 Partners: CRF, ENEA, PCA, REN, IRC, URE, UPAT, ECN
 Coordinator: CRF

DREAMCAR ENK6-CT-2000-00315
Direct Methanol Fuel Cell Development for Hybrid Car
 Partners: SODETEG, CRF, CRN-ITAE, Solvay, Ramot
 Coordinator: SODETEG

AMFC
Advanced Methanol Fuel Cell
 Partners: AB Volvo, Tech. University of Denmark, University of Newcastle, Norwegian University of Science and Tech., Proton Motor FC, den norsk stats oljeselskap,
 Coordinator: AB Volvo

PEM-ED ERK6-CT1999-00025
Proton exchange membranes for application in medium temperature electrochemical devices
 Partners: FuMA-Tech, Nuvera ...
 Coordinator: FuMA-Tech

ASTOR NNE5-1999-20138
Assessment & Testing of Advanced Energy Storage System for Hybrid Electric Vehicle
 Partners: VW, BMW, CRF, DaimlerChrysler, OPEL, PSA, Renault, Volvo
 Coordinator: VW



Cluster Land Transport by Fuel Cell Technology



Cluster Administrator: ika

FUERO

ERK6-CT1999-00024

Fuel Cell Systems and Components General Research for Vehicle Applications

Partners: ika, CRF, PSA, RENAULT, VOLVO, VW, IFP

Coordinator: ika

Steering committee: Car manufacturers

Budget / EC: 4.517.260 EURO / 2.501.331 EURO

Duration: 01.07.2000 – 31.12.2003

PROFUEL

ERK6-CT1999-00023

On-Board Gasoline Processor for Fuel Cell Vehicle Application

Partners: Johnson Matthey, CRF, ECN, FEV, ANSALDO, Politecnico de Torino, Volvo

Coordinator: Johnson Matthey

Budget / EC: 6.844.684 EURO / 3.628.352 EURO

Duration: 01.07.2000 – 30.06.2003

BIO-H2

ERK6-CT1999-00012

Production of clean Hydrogen for Fuel Cell by Reformation of Bioethanol

Partners: CRF, ENEA, PCA, REN, IRC, URE, UPAT, ECN

Coordinator: CRF

Budget / EC: 3.807.123 EURO / 2.228.562 EURO

Duration: 01.07.2000 – 30.06.2003

DREAMCAR

NNE5-2000-00213 / ENK6-CT-2000-00315

Direct Methanol Fuel Cell Development for Hybrid car

Partners: THALES, CRF, CNR-ITAE, SOLVAY, RAMOT

Coordinator: THALES

Budget / EC: 4.989.710 EURO / 2.899.946 EURO

Duration: 01.02.2001- 31.07.2004

AMFC

Advanced Methanol Fuel Cell

Partners: AB Volvo, Tech. University of Denmark, den norsk stats oljeselskap, Univ. of Newcastle, Norwegian Univ. of Science and Tech., Proton Motor FC

Coordinator: AB Volvo

Budget / EC: 3.358.966 EURO / 2.489.441 EURO

Duration: 01.01.2001 – 31.12.2003

PEM-ED

ERK6-CT1999-00025

Proton exchange membranes for application in medium temperature electrochemical devices

Partners: FuMA-Tech, CNRS-LAMMI, CNR-ITAE, Univ. Strathclyde, Univ. Perugia, EDF, SEFAR, IFEU, De Nora

Coordinator: FuMA-Tech

Budget / EC: 3.137.571 EURO / 1.601.342 EURO

Duration: 01.03.2000 – 28.02.2004

ASTOR

NNE5-1999-20138

Assessment & Testing of Advanced Energy Storage System for Hybrid Electric Vehicle

Partners: VW, BMW, CRF, DaimlerChrysler, OPEL, PSA, Renault, Volvo

Coordinator: VW

Budget / EC: 3.000.000 EURO / 1.200.000 EURO

Duration: approx. 01.04.2001, 36 months

Information exchange between FC cluster projects

3 Levels of documentation

- 1 Project Level:* i.e. internal technical papers (of confidential nature)
- 2 Cluster Level:* limited to circulation within the cluster (not for general distribution)
i.e. selected number of technical documents covering key deliverables that would be of interest to the cluster
- 3 EC Level:* usual commission reports
(confidential, except the publishable final reports or abstracts)

Internet server autonomous information exchange between projects
restricted access only for cluster partners
Public area

Yearly workshop information exchange
report of progress in individual projects

Possible Cooperation With Other European Networks



FUERO
ERK6-CT1999-00024

**Coordinating:
Cluster Land Transport
by Fuel Cell Technology**

ENIGMATIC

1999-TN.10029

European Network on Integration of
Clean Vehicles Applying Technology
Innovations

ELEDRIIVE

ENK6-CT-2000-20057 / NNE5-1999-20036

Thematic Network on Fuel Cell, Electric &
Hybrid Vehicles

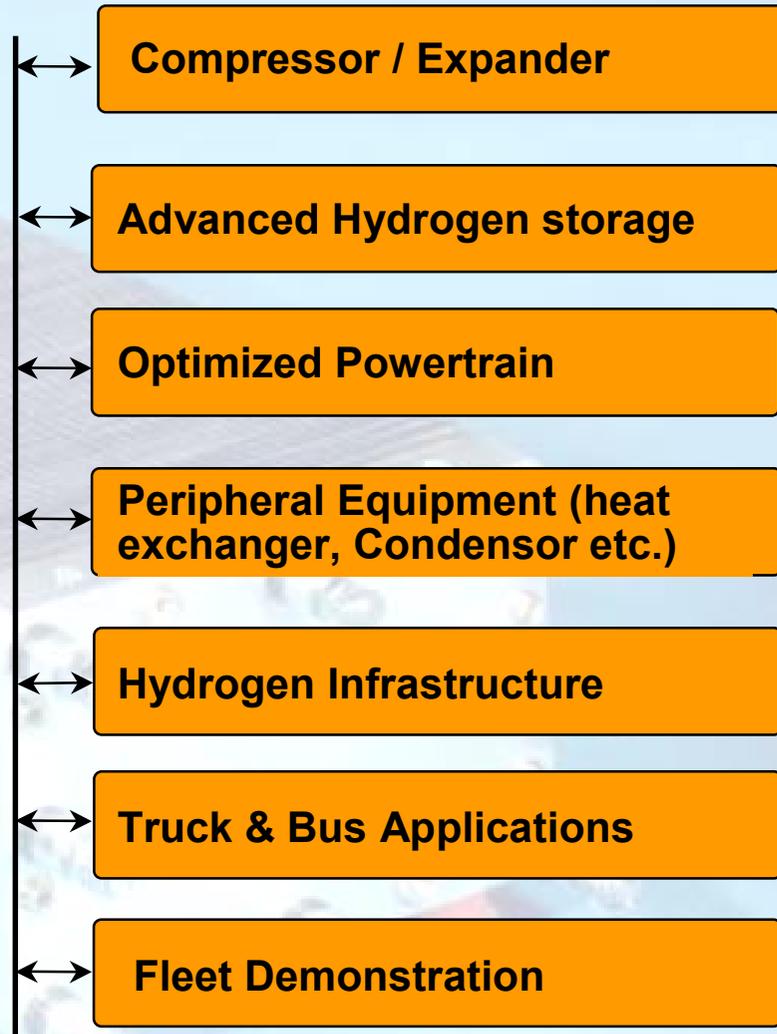
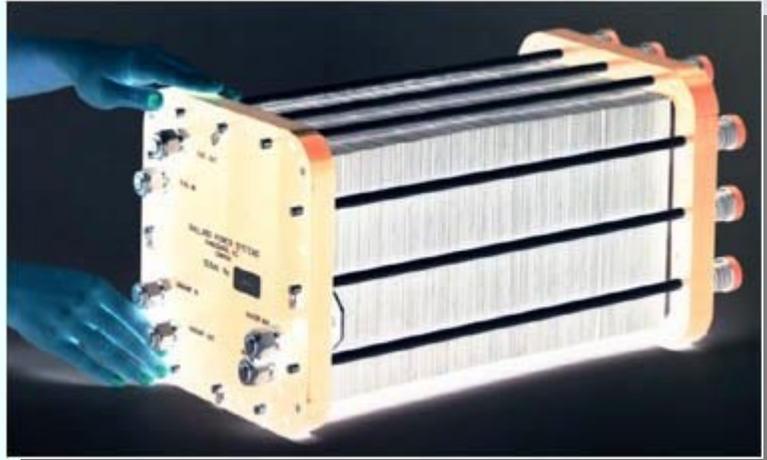
INVESTIRE NETWORK

NNE5-2000-00481

Investigation of Storage Technologies for
Intermittent Renewable Energies:
Evaluation and Recommended R&D Strategy

New Projects for Integration into Cluster Land Transport by Fuel Cell Technology

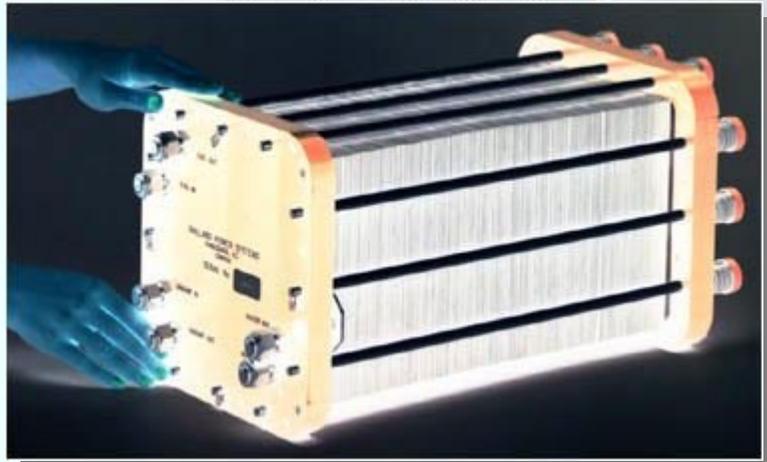
Cluster open to new projects on:



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New Projects for Integration into Cluster Land Transport by Fuel Cell Technology

Cluster open to new projects on:



Studies on Fuel Options and Fuel Chains

Auxiliary Power Unit

Advanced PEM FC

AMFC, PEM-ED

Fuel Reformer

AMFC, BIO-H₂, PROFUEL

Direct methanol FC

DREAMCAR

Electrical Storage

ASTOR



FUERO



**Fuel Cell Systems and Components
General Research for Vehicle Applications**