

# EIHP - European Integrated Hydrogen Project

## JOINT EUROPEAN UNION CONTRACTORS' MEETING FOR EU RT&D ON BATTERY, HYBRID, AND FUEL CELL ELECTRIC VEHICLES

Jean-Monnet-Haus, Berlin, 24<sup>th</sup> and 25<sup>th</sup> October 2001

Jointly organised by European Commission DG Research,  
Technical University Berlin, and German Electric Vehicle Association



# Presentation on the European Integrated Hydrogen Project

## European Integrated Hydrogen Project ( E I H P )

### PHASE I (EIHP)

Contract N° JOE3-CT97-0088

February 1998 - April 2000

Non-Nuclear Energy Programme -  
JOULE III  
of  
European Commission  
Directorate-General XII  
Science, Research and Development

### PHASE II (EIHP2)

Contract N° ENK6-CT2000-00442

February 2001- January 2004

Fifth Framework Programme  
Energy, Environment and Sustainable  
Development [EESD]  
of  
European Commission  
Research DG



# **EIHP1 - Project Partners**

**Air Liquide S.A., Sassenage, France,**

**Bayerische Motoren Werke AG, BMW, Munich, Germany,**

**EC-Joint Research Centre, Ispra, Italy,**

**Hamburgische Electricitäts-Werke AG, HEW, Hamburg, Germany,**

**Hydrogen Systems N.V., Turnhout, Belgium,**

**Instituto Nacional de Técnica Aeroespacial, INTA, Madrid, Spain,**

**Ludwig-Boelkow-Systemtechnik GmbH, LBST, Ottobrunn, Germany,**

**Messer Griesheim GmbH, Krefeld, Germany,**

**Renault - Direction de la Recherche, Guyancourt cedex, France,**

**AB Volvo, Göteborg, Sweden**



## EIHP1 - Overall Project Budget and Funding

The project has been conducted over two years  
(02/1998 to 04/2000)

The EIHP had cost-shared funding under the European Commission's 4th Framework Programme within the JOULE programme.

At least 50% of the total project budget amounting to approx. 2.5 MECU was brought up by the EIHP partners.

The co-sponsor European Commission contributed a maximum of 50% of the project budget in compliance with contract number JOE3-CT97-0088.



# EIHP1 - Overall Project Objectives

- ⇒ To create a Pan-European database of existing regulations and codes of practice
- ⇒ To contact other pertinent authorities outside Europe
- ⇒ To identify weak spots in today's technology
- ⇒ To define the areas requiring regulation
- ⇒ To integrate ECE guidelines and create a basis for ECE regulation of hydrogen vehicles (replacing national legislation/ regulations) and the necessary infrastructure



# EIHP1 - Project Organization in TASKs

The project was subdivided into eight work packages or tasks:

- Task 1: Survey/ analysis of rules, regulations and licensing procedures in all participating countries
- Task 2: Analysis of existing and planned H<sub>2</sub> safety concepts and technologies
- Task 3: Identification of rules and regulations ready for harmonization
- Task 4: Identification of deficiencies in rules and regulations
- Task 5: Identification of deficiencies in safety concepts and technologies
- Task 6: Proposal for investigations to create a basis for standardization
- Task 7: Proposal for safety concepts
- Task 8: Proposal of Draft for Submission to ECE



# EIHP1 - Activities Performed by Respective Partners

## **Air Liquide S.A.:**

**Survey on French regulations; Specification of LNG/ LH<sub>2</sub> tank; Analysis on eligibility of rules for harmonization; Deficiencies of existing rules; Deficiencies in tank system design; Inputs to definition of add. Investigations; Tank system modeling;**

## **BMW AG:**

**Survey on German and US regulations; Failure analysis; Deficiencies and alternative solutions for vehicles; Advanced LH<sub>2</sub> storage/ vehicle safety concepts;**

## **EC-JRC:**

**Simulation and modeling of hydrogen dispersion, ignition and combustion;**

## **HEW AG:**

**Experience in licensing and operation of CGH<sub>2</sub> refueling station and of fleet operated CGH<sub>2</sub> vans**

## **Hydrogen Systems N.V.:**

**Survey on Belgian regulations; Licensing of LH<sub>2</sub> city bus;**



## **EIHP1 - Activities Performed by Respective Partners (Cont.'d)**

<b>INTA:</b>	<b>Survey on Spanish regulations; Inputs on deficiencies of existing rules; Inputs to definition of add. Investigations; Definition of test infrastructure; Proposed gas vehicle regulations in Spain;</b>
<b>LBST:</b>	<b>Project Coordination and Liaison Office to EC</b>
<b>Messer:</b>	<b>LN<sub>2</sub>, LNG and LH<sub>2</sub> two phase flow test with safety valve</b>
<b>Renault:</b>	<b>Safety analysis of existing systems; Identification of harmonizable rules; Predictable failure modes; Acceptable of safety design;</b>
<b>AB Volvo:</b>	<b>Survey on Swedish and Japanese regulations; Deficiencies in safety concepts; Proposal of improved safety concept;</b>





## EIHP1 - Legislative Part of the Project - Top Down Approach

Adequate legislation scarcely exists today, particularly in the field of licensing procedures for hydrogen vehicles.

Correspondingly, a structured survey and analysis of existing relevant rules, regulations and licensing procedures in the participating countries (Belgium, France, Germany, Spain and Sweden) was conducted.

The aim was not only to identify deficiencies but also to define regulations which were already sufficiently comprehensive to facilitate harmonization throughout Europe.

The survey was structured such as to subsequently accommodate corresponding surveys of other countries.



# US Regulations applicable to hydrogen fueled road vehicles



## EIHP1 - Technical Part of the Project - Bottom Up Approach

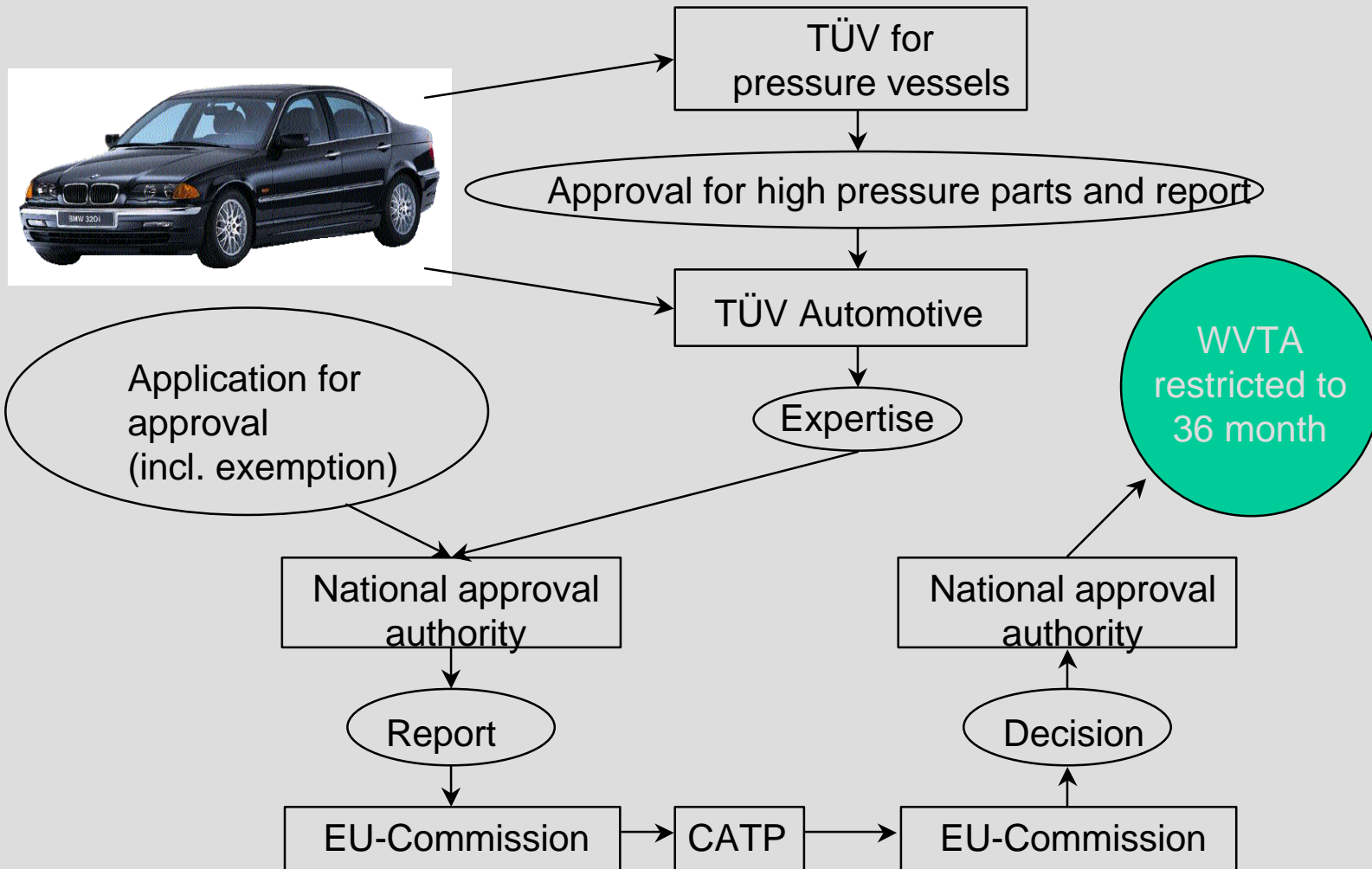
This part of the project focused on existing hydrogen vehicles in Europe including the fuel supply technology.

Systematic analyses such as Fault Tree Analysis (FTA), Failure Mode and Effect Analysis (FMEA), were conducted and complemented by detailed studies of worst-case scenarios.

This helped to document safety features while systematically improving the potential of hydrogen technology, thus creating a more solid basis for discussion with relevant licensing authorities.



# Application for a European Whole Vehicle Type Approval (WVTA)



# Reasons for Developing Harmonised Regulations

- Some 47 directives have to be applied in order to receive an approval for a road vehicle in Europe. If a vehicle is successfully tested according to these 47 directives it has to be approved. The result is a *Whole Vehicle Type Approval*.
- If approval is sought for a hydrogen fuel cell vehicle, *emissions*, *fuel consumption* and *engine power* cannot be tested according to the existing directives. The reason is mainly the absence of a standardised reference fuel or the absence of a procedure for testing the engine power.
- Some other directives can be fulfilled formally, but from the technical point of view they should be revised for hydrogen vehicles.
- Some requirements regarding the safety of the hydrogen on-board storage systems are missing in the existing directives.




# Why Develop a New Draft Regulation for Hydrogen Vehicles ?

The path of Council Directive No 98/14/EC, article 8(2)c,  
to approve hydrogen fuelled vehicles:



- ✓ Excessive amount of time required
- ✓ Uncertainty of the outcome of the process up until the very end

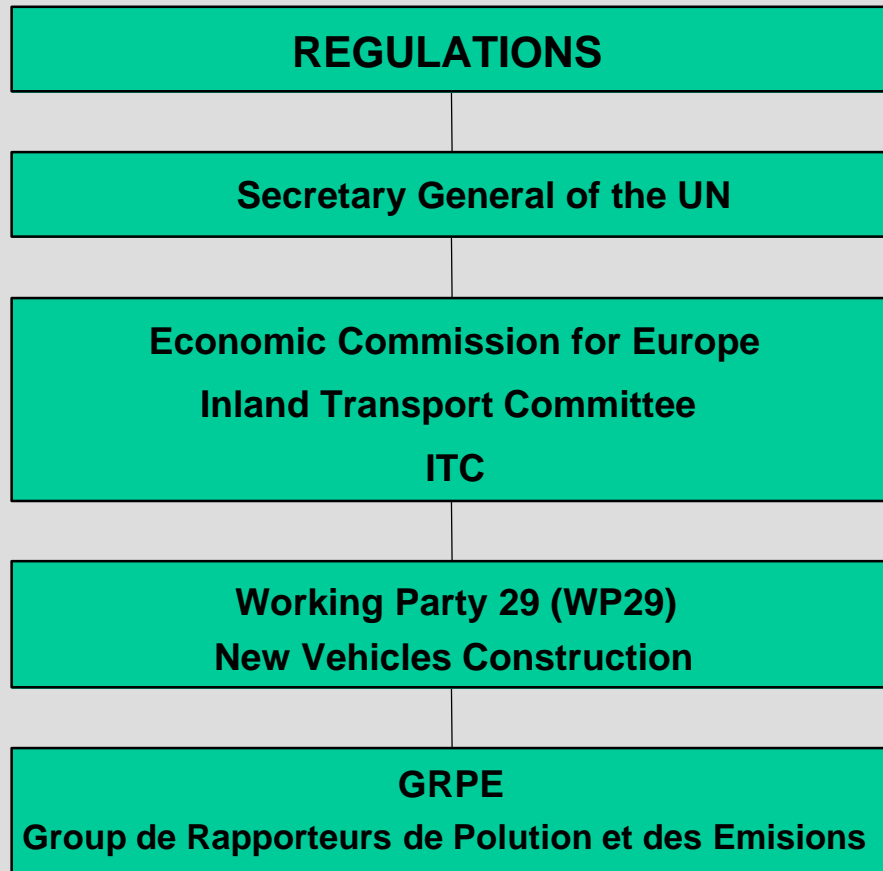


 **A draft regulation for hydrogen vehicles should be developed**

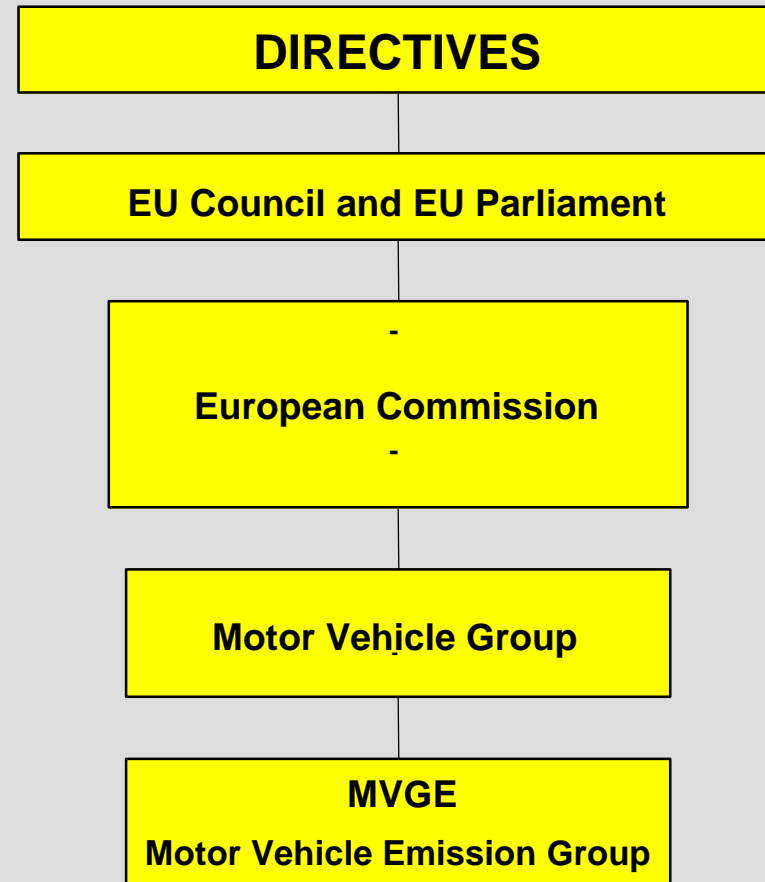


# Two Pathways to Present a Proposal for a Regulation

## UN-ECE

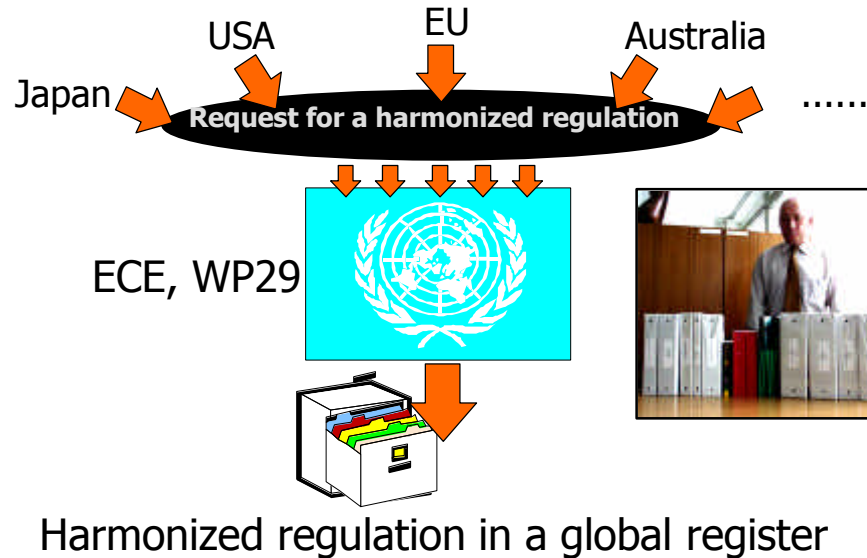


## EEC



# ECE Platform for Globally Harmonized Regulation for H<sub>2</sub> Vehicles

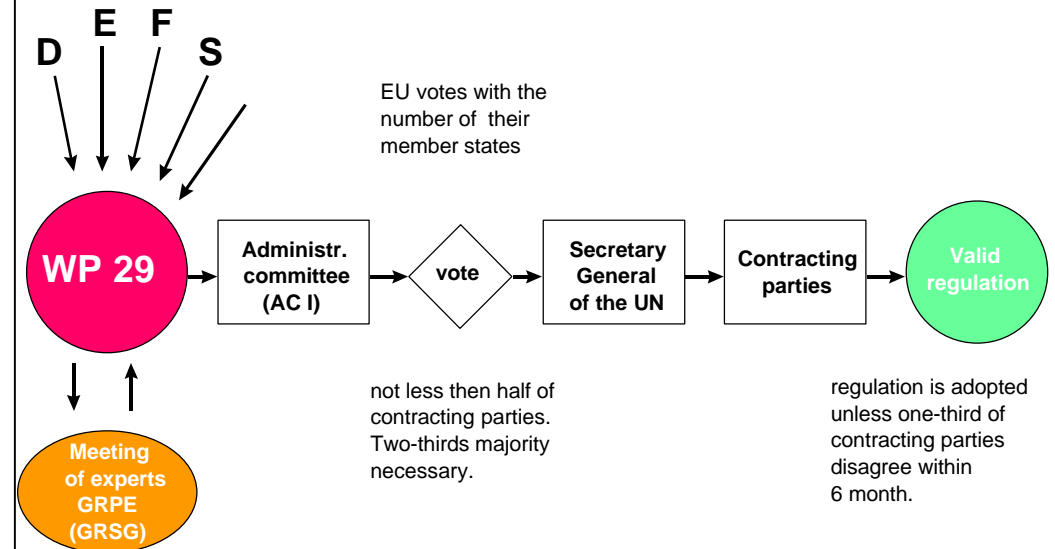
## Platform for Global Harmonisation Of Legal Requirements For Road Vehicles



- Step 1. ECE Regulation (1958 Agreement)
- Step 2. Global Technical Regulation (1998 Agreement)

ECE : Economic Commission for Europe, United Nations, Geneva

## Application for an ECE Regulation

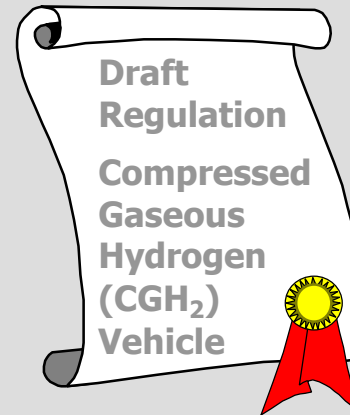




# EIHP1 - UN-ECE Draft Proposal Document



**PROPOSAL FOR A NEW DRAFT REGULATION**



**PROPOSAL FOR A NEW DRAFT REGULATION**

**UNIFORM PROVISIONS CONCERNING THE APPROVAL OF:**

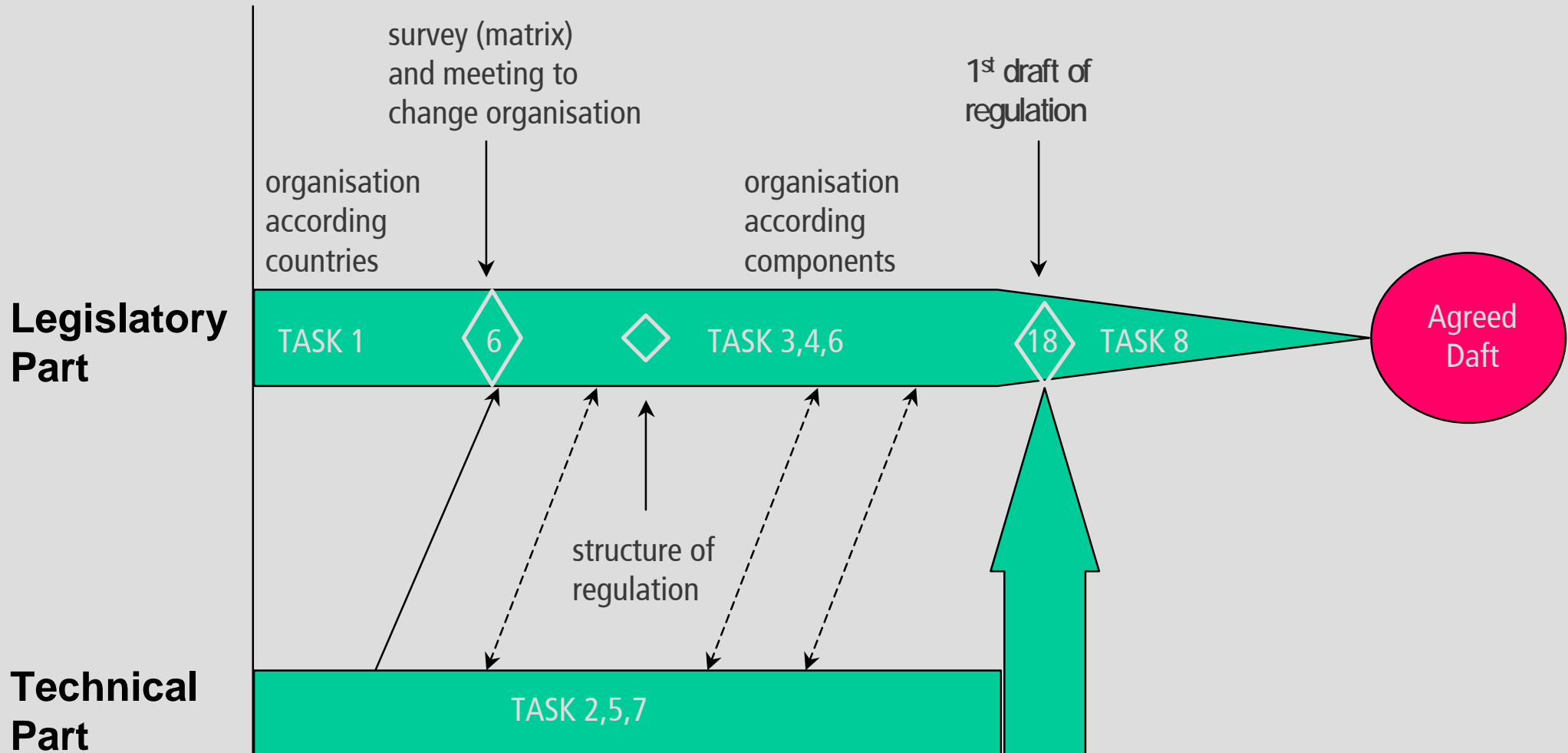
- I. SPECIFIC COMPONENTS OF MOTOR VEHICLES USING LIQUID HYDROGEN;**
- II. VEHICLES WITH REGARD TO THE INSTALLATION OF SPECIFIC COMPONENTS FOR THE USE OF LIQUID HYDROGEN**

**UNIFORM PROVISIONS CONCERNING THE APPROVAL OF:**

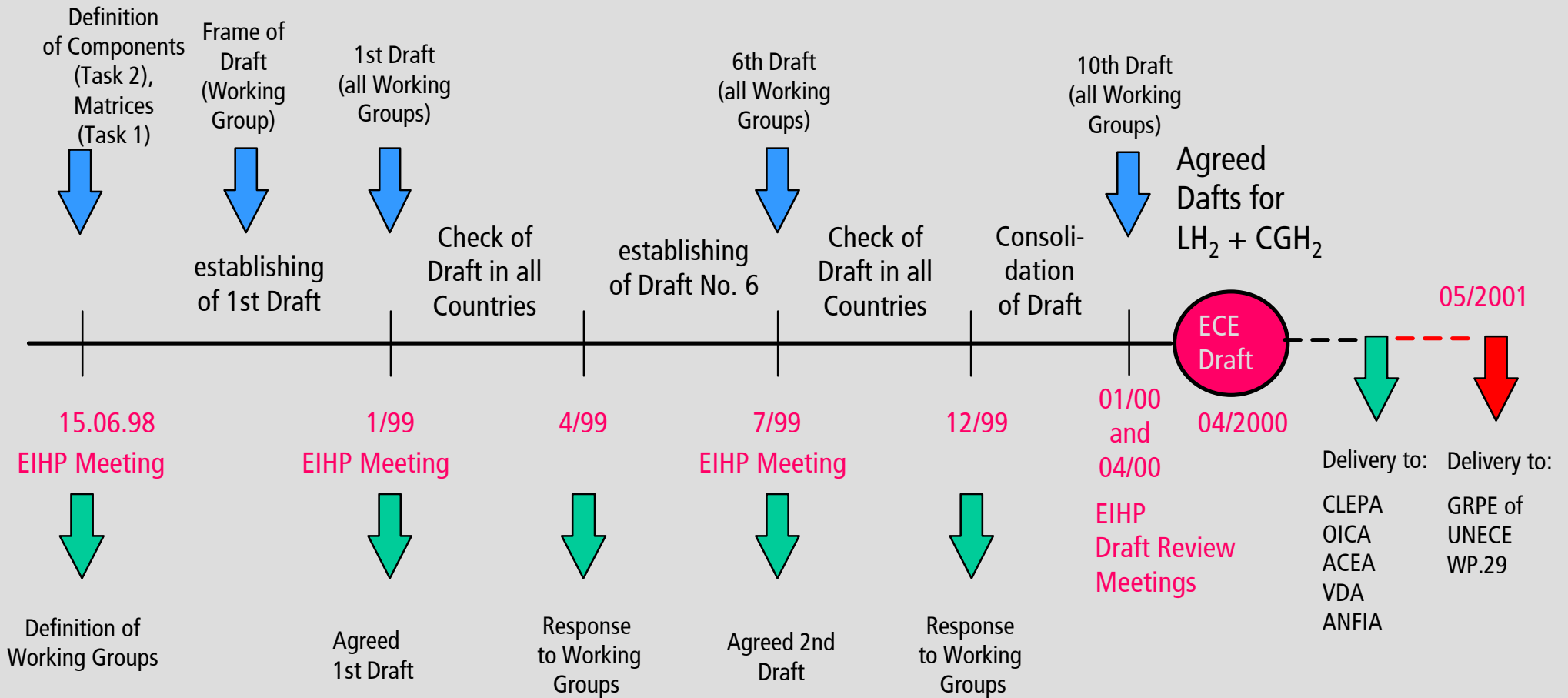
- I. SPECIFIC COMPONENTS OF MOTOR VEHICLES USING COMPRESSED GASEOUS HYDROGEN;**
- II. VEHICLES WITH REGARD TO THE INSTALLATION OF SPECIFIC COMPONENTS FOR THE USE OF COMPRESSED GASEOUS HYDROGEN**



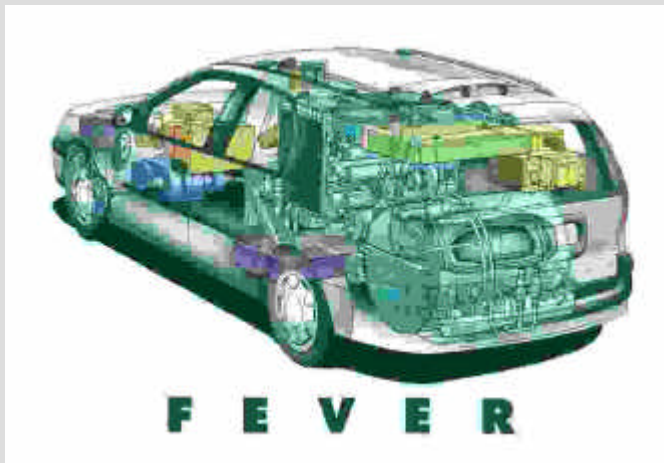
# EIHP1 - Overall Project Structure and Schedule



# EIHP1 - Overall Project Schedule [Contract N° JOE3-CT97-0088]



# EIHP1 - Partners' Projects with Hydrogen Involvement



Renault



BMW



HEW



Air Liquide



INTA



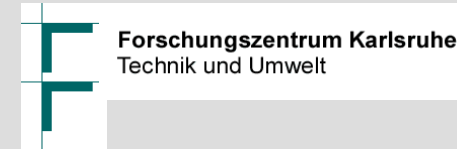
Hydrogen Systems



Messer



# EIHP2 - Project Partners [Contract N° ENK6-CT2000-00442]



DAIMLERCHRYSLER



Commissariat à l'Énergie Atomique



DET NORSKE VERITAS



E I H P European Integrated Hydrogen Project

LBST - OCT 2001



# EIHP2 - Key Project Parameters [Contract N° ENK6-CT2000-00442]

**Objective:** Initiate and provide inputs for regulations on an EU and global level for the approval of hydrogen fuelled road vehicles, hydrogen refuelling infrastructure and the relevant interfaces.

**Project Duration:** 36 Months [01FEB2001 - 31JAN2004]

**Project Budget:** 4.935 MEuro

**EU Funding:** 50%

**Partners:**

- B Vandenborre Technologies
- D BMW, DC, Ford, FZK, LBST, Messer, Opel
- E INTA
- F Air Liquide SA, Commissariat à l'Énergie Atomique
- GB Air Products, BP, Shell
- GR NCSRDemokritos
- NL EC-Joint Research Centre
- N Det Norske Veritas, Norsk Hydro ASA, Raufoss ASA
- S Volvo

## Work Packages:

<b>WP1</b> Overall Coordination	<b>WP2</b> Refuelling Station	<b>WP3</b> Refuelling Interface	<b>WP4</b> Vehicles	<b>WP5</b> Safety	<b>WP6</b> Links "EU- USA", Cluster Activities
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## **EIHP2 - Main goals to be achieved**

- Vehicles:** Regulations (uniform global requirements, i.e. equivalent requirements in all markets or preferably GTR)
- Refuelling Interface:** Standards (uniform global requirements - ISO) - one standardised interface and one identical refueling procedure
- Refuelling Infrastructure:** Standards and code of practice (uniform global requirements - ISO)
- ULTIMATE GOAL OF EIHP2** Introduction of safe and economic, mass-produced hydrogen road vehicles and their associated refuelling infrastructure



# EIHP2 - Work Packages Objectives

## **WP2: Refuelling Station**

Develop hydrogen specific industrial codes of practice for acceptance by European authorities  
Identify refuelling station components that need to be standardised

## **WP3: Refuelling Interface**

Identify optimum storage pressure for on-board compressed gaseous hydrogen storage  
Seek approval of liquid and compressed hydrogen connectors/refuelling interface  
Develop refuelling procedures  
Seek standardisation of hydrogen connectors/ refuelling interface

## **WP4: Vehicles**

Validate existing draft ECE regulations by following approval process for vehicles  
Monitor & assist continuing development of existing draft ECE regulations for hydrogen road vehicles  
Develop Global Technical Regulations for hydrogen road vehicles  
Develop procedures for periodic vehicle inspections

## **WP5: Safety**

Risk assessment of hydrogen vehicles and infrastructure  
Comparative study of hydrogen and other fuels  
Support safety aspects of WP2, WP3 and WP4





## EIHP2 - Networking Process Codes & Standards + Intl. Links

Cluster Activity	Standardisation Activity
<i>California Fuel Cell Partnership (CaFCP)</i>	<i>UN ECE WP.29 GRPE - Ad hoc group hydrogen</i>
<i>Clean Energy Partnership Berlin (CEP)</i>	<i>National Hydrogen Association (NHA), USA</i>
<i>Transport Energy Strategy</i>	<i>SAE Fuel Cell Standards Committee</i>
<i>Western Australian Department of Transport</i>	<i>CEN</i>
<i>International Hydrogen Infrastructure Steering Committee</i>	<i>ISO TC 197 - Hydrogen Technologies</i>
<i>Cluster 'Land Transport by Fuel Cell Technology'</i>	<i>ISO TC 22 - Road Vehicles</i>
<i>Canadian Fuel Cell Alliance</i>	<i>International Electrotechnical Commission (IEC ) TC 105</i>
<i>Clean Urban Transport for Europe (CUTE)</i>	<i>International Electrotechnical Commission (IEC ) TC 22</i>
<i>Icelandic New Energy Ltd.</i>	<i>International Code Council (ICC)</i>
<i>National Evaluation Service, Inc.</i>	<i>EIGA European Industrial Gas Association</i>
<i>Fuel Cell Commercialization Conference of Japan (FCCJ) {Kyogikai}</i>	<i>U.S. Fuel Cell Council</i>
<i>Blueprint for Hydrogen Fuel Infrastructure Development, DoE</i>	<i>World Fuel Cell Council</i>
<i>NEDO &amp; WE-NET</i>	<i>Japan Gas Association (JGA)</i>
<i>H<sub>2</sub> Joint Working Group of the Americas and the Pacific Rim (HJWG)</i>	<i>Japanese Electrical Vehicle Association (JEVA)</i>



## **EIHP2 - Recommendations for Future Progress**

- **Establish legal requirements for hydrogen on-board storage systems, i.e. an ECE regulation**
- **Establish a legal requirement that is valid worldwide, i.e. upgrade the ECE regulation to a Global Technical Regulation (SAE & EIHP2 have already agreed to focus on the ultimate goal of a GTR)**
- **In order to establish a worldwide legal requirement the involvement of authorities, technical services, vehicle manufacturers and component suppliers is essential**
- **The platform for the development of worldwide legal requirements for motor vehicles is United Nations ECE WP 29 (World Forum For Harmonisation Of Vehicle Regulations)**
- **A WP29 GRPE (Working Party On Pollution & Energy) Ad-hoc Working Group has been established**
- **ISO is a member of the GRPE Ad-hoc Working Group (see document ISO/TC 197 N179)**
- **It is strongly recommended that ISO standards and worldwide legal requirements are not published in parallel for the same subjects**

