Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

Role of Government Vision and Policy

The German National Innovation Program for Hydrogen and Fuel Cell Technologies

HTAC | Washington, USA

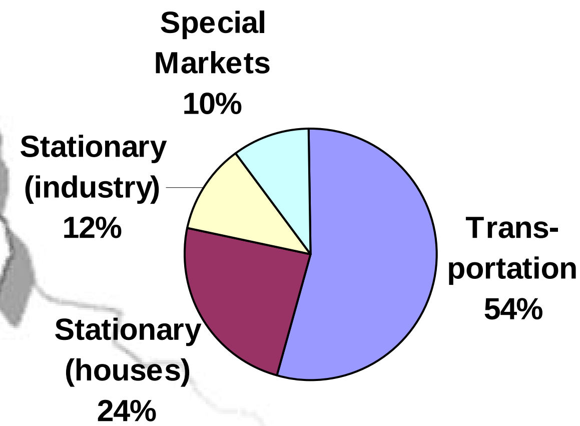
Dr. Klaus Bonhoff | July 22, 2008

Agenda

- NIP Overview – The National Innovation Program Hydrogen and Fuel Cell Technologies
- NOW – The National Organisation Hydrogen and Fuel Cell Technologies
- TES – The Transport Energy Strategy
- CEP – The Clean Energy Partnership
- GermanHy – Where does Hydrogen come from?
- Government Vision and Policy

German National Innovation Program (NIP)

- ten year program (2007 – 2016)
- strategic alliance (politics, academia, industry)
- 500 mio. € public funding for demonstration activities and market preparation for hydrogen and fuel cell technology (responsibility: Federal Ministry for Transport, Building and Urban Development)
- approx. 20-25 mio. € annually public funding for R&D programs (responsibility: Federal Ministry of Economics)
- Together with the industry investments in the NIP will add up to more than 1,4 billion €



German National Innovation Program (NIP)

NIP

National Innovation Program Hydrogen and Fuel Cell Technology

R&D

Markets / Applications:
Transportation
Stationary:Home Energy Supply
Stationary:Industrial Energy Supply
Special Markets

Demonstration and Market preparation

The NIP is supported by

Federal Ministry of Transport, Building and Urban Affairs

Federal Ministry of Economics and Technology

Federal Ministry of Education and Research

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

NOW – The National Organisation Hydrogen and Fuel Cell Technologies

NOW is

- the program management organisation responsible for the
- implementation of the National Innovation Program Hydrogen and Fuel cell Technologies (NIP)
- the central point of contact for hydrogen and fuel cell technologies in Germany

NOW's responsibilities include

- <u>Overall coordination</u> of the NIP
  - Link between demonstration and R&D activities
  - Setting of overall program direction and identification of synergies between areas
- the <u>implementation of demonstration activities</u>
  - Initiation, prioritization and approval of projects
  - Design of lighthouses
  - Project supervision
- <u>Communication</u> (general public, politics, etc.)
- International collaboration

Shareholder German Federal Government (100%)
Represented by the Federal Ministry of Transportation, Building and Urban Affairs (BMVBS)

Supervisory Board
BMVBS, BMWi, BMBF, BMU

Advisory Board
Government, Academia, Industry

Strategy Council
Plenum

Board of Management Dr. Klaus Bonhoff (chair), Kai Klinder

- **Hydrogen Infrastructure**
- **Transportation Applications**
- **Stationary Applications**
- **Special Markets**

Transport Energy Strategy - TES

develop consistent strategies to secure future mobility

Key Messages

- security of energy supply and climate protection are the central challenges in the 21st century

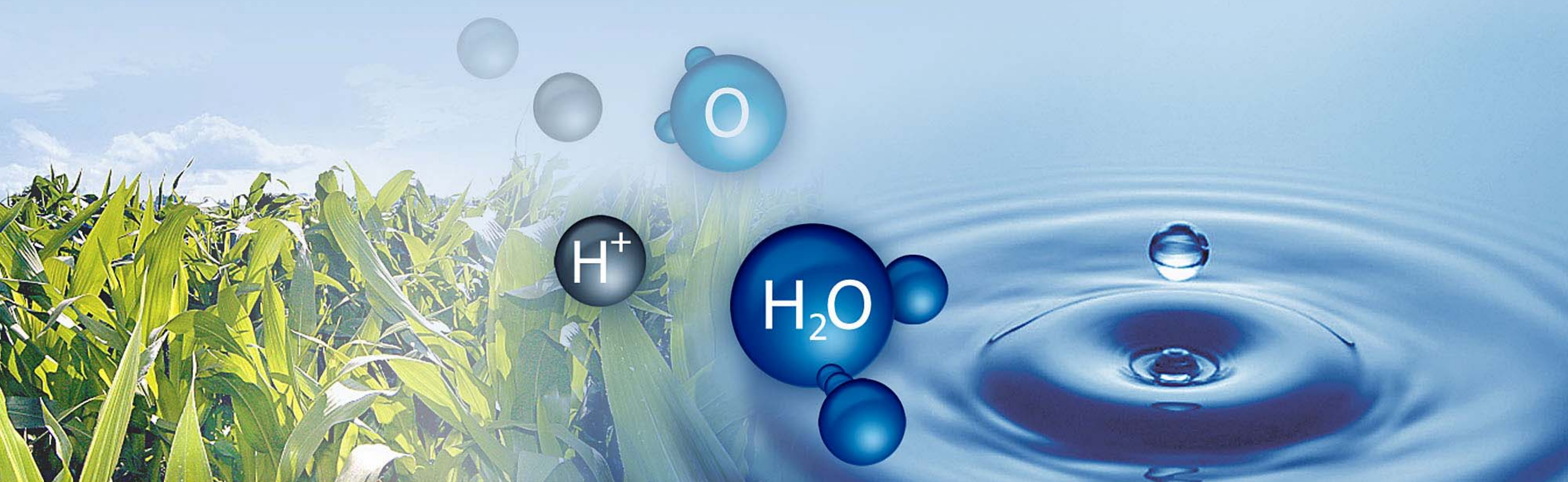
Key Messages

- energy effficiency and diversification of primary energy sources are key to secure the energy basis for transportation long term

- develop alternative fuels and innovative drivetrain technologies following common strategies built upon consensus of all stakeholders

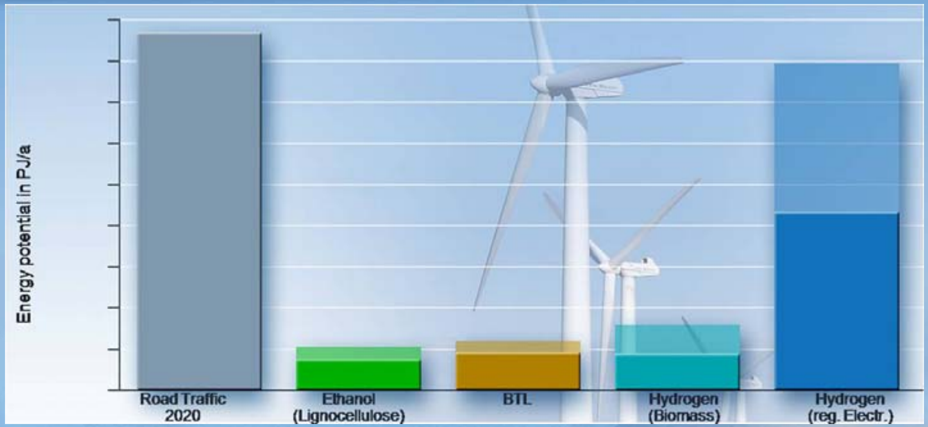
Key Messages

- concentrate on most promising technologies
  - hydrogen and fuel cells
  - 2nd generation biofuels
- define and implement a hydrogen- and biofuels roadmap



Key Messages

- increase usage of renewable energy sources in the transportation sector
- potentials exist to cover important share of the future fuels demand in Europe

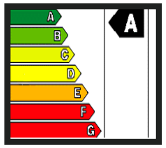


TES – 3rd Status Report, August 2007

- possible transition fuels towards hydrogen based on renewables (fuels matrix)
- **Potentials for renewable energies in Europe** and its possible use in the transportation sector
- **Legal framework** to introduce hydrogen as a fuel in Germany

Requirements of Future Energy Supply

Avoid/ reduce emissions



Increase efficiency

Secure fuel/ energy supply by diversification

Global Competition

Hydrogen and Fuel Cell Technologies offer huge potentials to support these goals!

Federal Government

CEP Part of the German national strategy for sustainability

Supported by

- Federal Ministry of Transport, Building and Urban Affairs
- Applies currently for funding through the German National Innovation Program (NIP) for Hydrogen and Fuel Cell Technologies

CEP 2003 – 2007

Largest hydrogen demonstration project in Europe

- Over 400.000 km with hydrogen fuel
- Over 3000 hydrogen refuellings
- Two new partners joined
- Continuous upgrade of existing stations and cars

GermanHy

1. Targets for Road Transport Sector in Germany

targets for tomorrow's mobility

- reduction of transport emissions
- decrease oil dependency
- increase energy efficiency
- enhance share of renewable energies
- strengthen competitiveness of German automotive industry

why hydrogen?

- hydrogen (H_2) is a carbon-free energy carrier
- hydrogen can be generated from different primary energy sources
- H_2 facilitates the use of the highly efficient fuel cell (FC)
- hydrogen may serve as storage media for renewable energies
- H_2 and FC are key technologies with a high potential for value creation

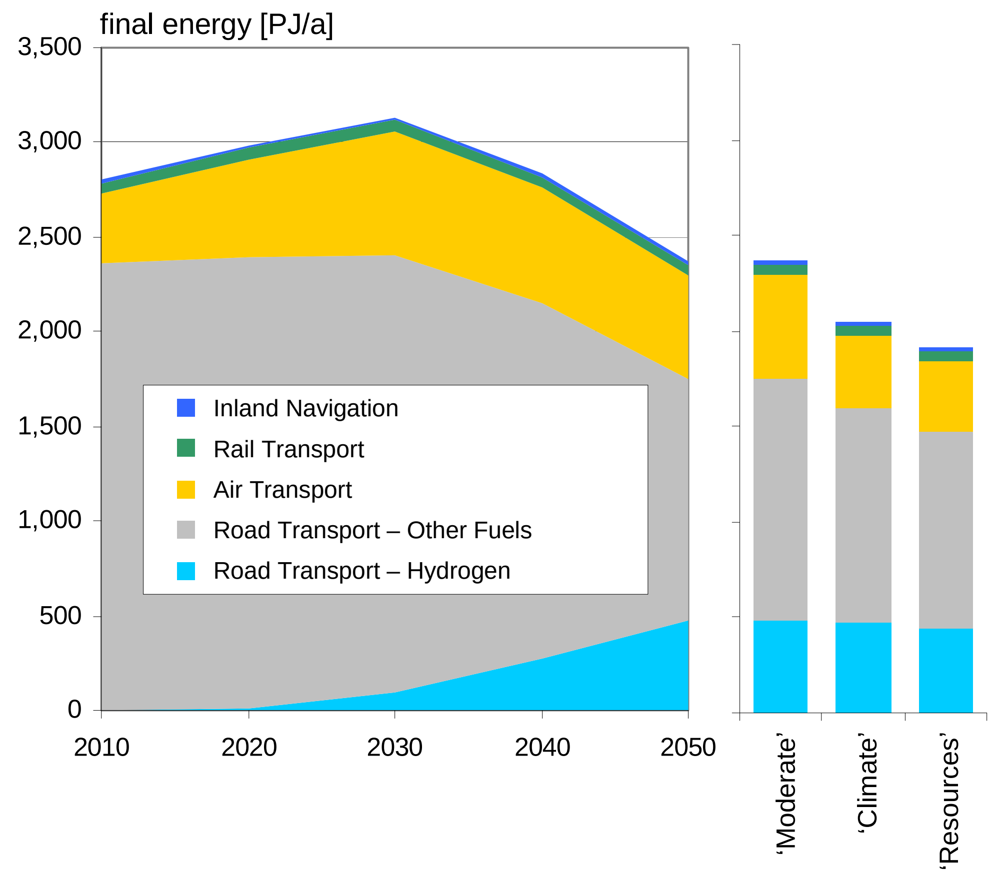
fuel strategy of federal government: **hydrogen can play an important role as a transport fuel in the future**

GermanHy

4. Relevance of Hydrogen in Road Transport

- Germany uses some 30% of its primary energy in the transport sector
- hydrogen and fuel cells can assume great importance in road transport by 2050, and evolve into central components of a more diversified market of fuels and propulsion concepts
- over 70% of all cars and LDVs may run on hydrogen and fuel-cell technology in 2050
- this equates to a hydrogen-share of 20 to 25% in the overall transport energy demand, depending on the scenario applied
- key limiting factor is the market penetration achieved by hydrogen vehicles

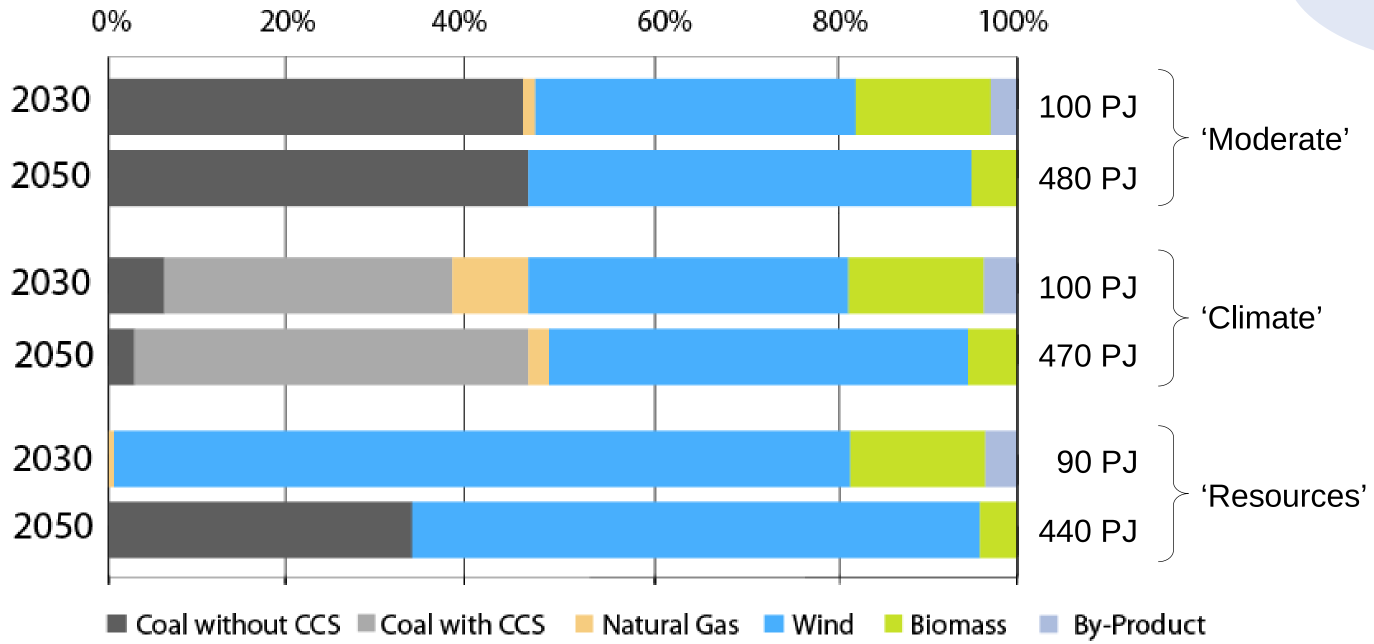
shares of transport modes in final energy consumption



5. Sources for Hydrogen in Germany (I/II)

political imperative: share of renewable energies at least 50%

shares of primary energy carriers in hydrogen production



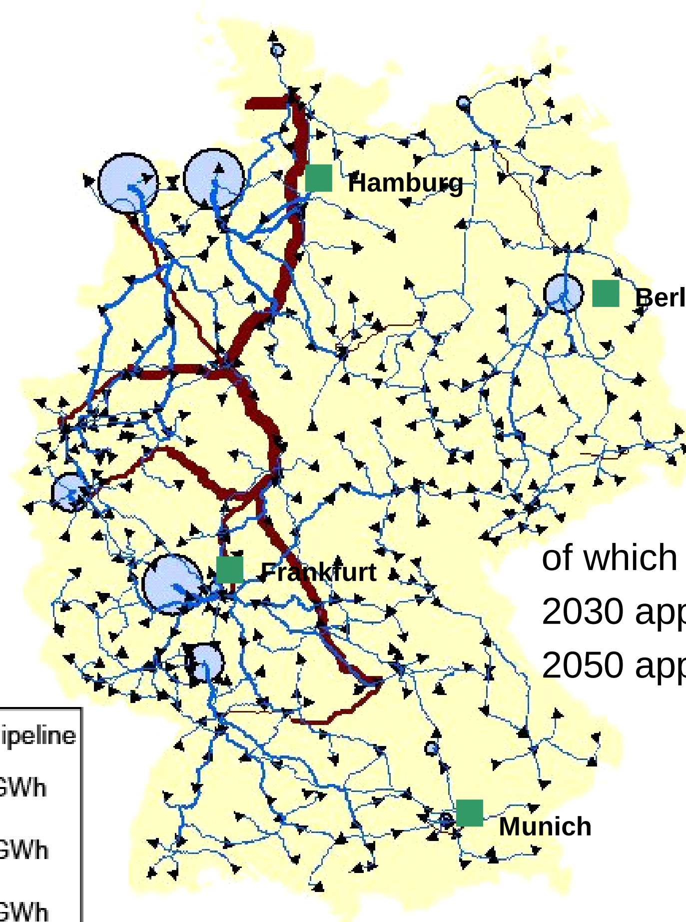
- hydrogen will be produced from different primary energy sources. depending on the scenario applied, the respective share of individual sources varies
- the future mix of energies used for hydrogen production will depend on political targets and framework conditions, as well as achievements on technological development

5. Sources for Hydrogen in Germany (II/II)

biomass	**biomass** gasification represents the most economical option for producing hydrogen from renewable energies, but the potential of biomass is limited
wind	**wind** is the most important renewable resource for hydrogen generation, and will further substantially gain in significance with growing shortage of fossil resources
	therefore, central **electrolysers** will play a key role in converting renewable energies to hydrogen
imports	with high rates of market penetration, **imports** - mainly electricity and hydrogen from renewable energies - may markedly grow in importance
by-product	most **by-product** hydrogen is already being used, though some potential remains
black coal lignite	as of 2020 gasification of black **coal** and lignite may represent an economical option, but CO_2 capture and storage (CCS) is mandatory to meet tough climate targets
natural gas	without CCS, more **natural gas r**eformation is needed to meet climate targets
on-site	**on-site** production may play a role in the introductory phase (though there remains some uncertainty about economic viability)

6. Development of a Hydrogen-Infrastructure

- the build-up of infrastructure happens step by step, starting from densely populated/urban areas
- during the introductory phase (until 2030) the transport by trailer of centrally produced liquid hydrogen to filling stations dominates (e.g. to integrate offshore wind and by-product hydrogen)
- with growing demand most hydrogen will be distributed by pipelines in compressed form
- on-site production of hydrogen from natural gas, biomass and electrolysis may play a role regionally

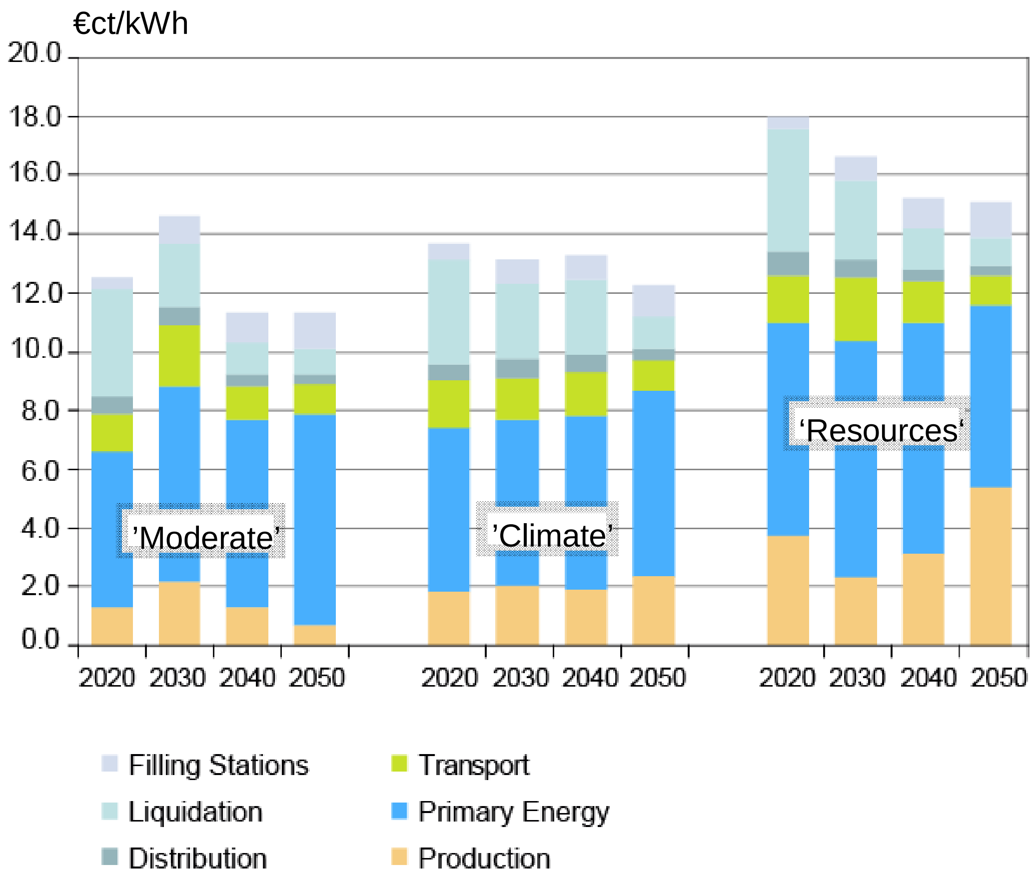


of which pipeline
2030 approx. 20%
2050 approx. 80%

LH_2 Production		H_2 Liquid Transport by Trailer		CH_2 Transport by Pipeline	
(large circle)	800 - 2400 GWh	(thick blue line)	800 - 2392 GWh	(thick red line)	6641 - 6911 GWh
(medium circle)	248 - 800 GWh	(medium blue line)	393 - 800 GWh	(medium red line)	5947 - 6640 GWh
(small circle)	24 - 248 GWh	(thin blue line)	<103 - 393 GWh	(thin red line)	5 - 2310 GWh

scenario 2030 “Moderate”

7a. Costs of Hydrogen



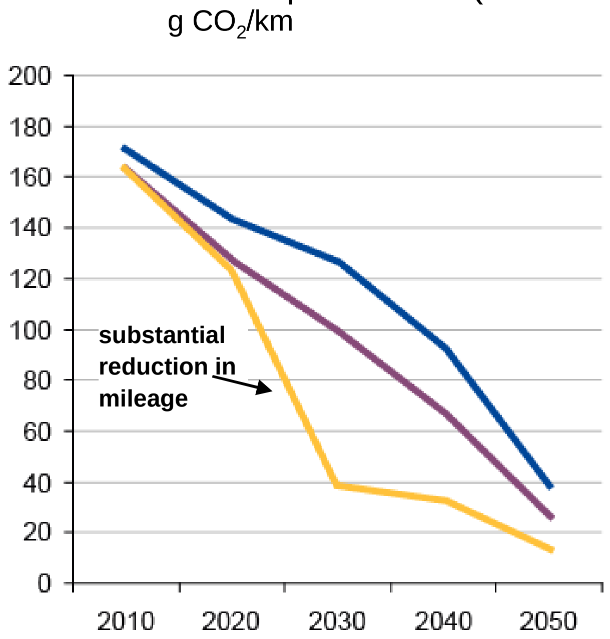
- fuel costs of hydrogen are comparable to today's costs of fossil fuels (both before tax)
- 50 to 80% of costs stem from primary energy and hydrogen production
- during the introductory phase higher costs arise from underutilization of infrastructure
- important factors of influence: political targets on climate protection and renewable energies, development of energy prices and viability of CO_2 capture and sequestration

GermanHy

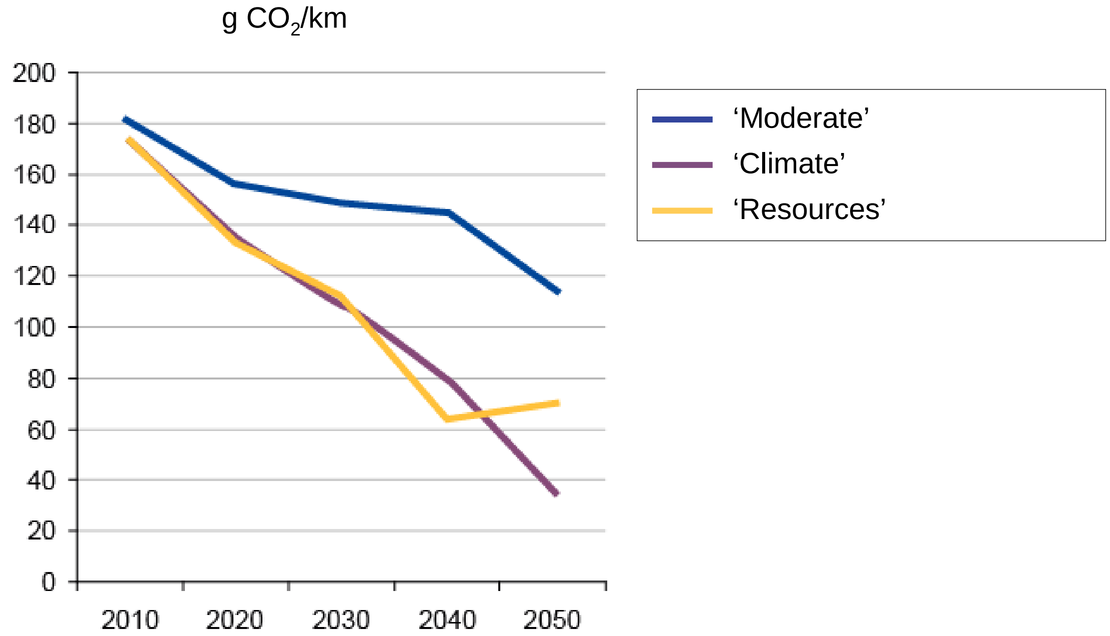
7b. Reduction of CO_2 and other Emissions

fleet emissions (passenger cars)

without fuel production (tank-to-wheel)



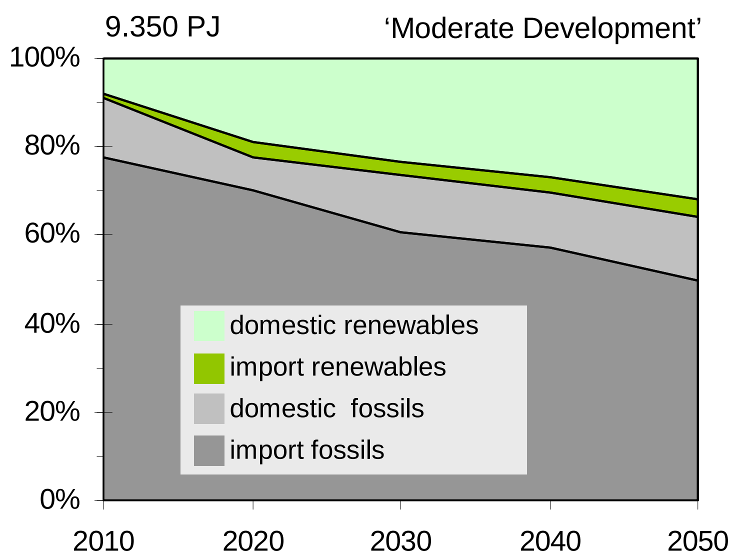
with fuel production (well-to-wheel)

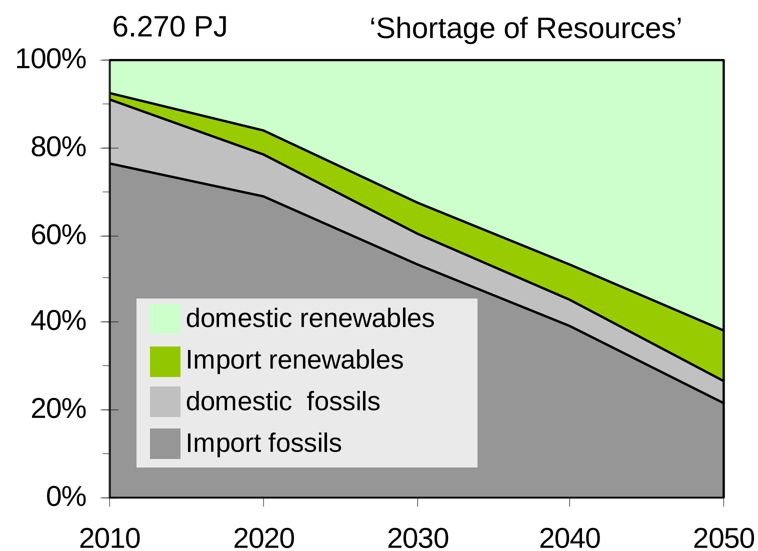


- carbon-dioxide emissions of passenger cars can be substantially reduced with hydrogen (fleet average may be as low as 20 g/km tank-to-wheel, and 36 g/km well-to-wheel emissions, if hydrogen is generated from renewable energies, or fossil energies using CCS)
- hydrogen-driven fuel cell vehicles cause no local air pollutants and only insignificant noise emissions

7c. Energy-Imports and Renewable Energies

primary energy supply in Germany





- dependency on energy imports drops from over 90% to 55% or even 35%, depending on scenario
- share of renewable energies rises from 10% to 30% or even 75%

- share of renewables in transport sector rises from below 10% to above 50%
- availability of domestic lignite is reduced drastically in scenario 'Shortage of Resources'

GermanHy

it can be concluded:

- in scenario **'Moderate Development'** the use of hydrogen is recommendable due to advantages in economics, CO_2 reduction and security of supply
- with scenario **'Climate Protection'** hydrogen is needed to ensure that CO_2 emissions are cut in the transport sector and that more renewable energies are used here
- in scenario **'Shortage of Resources'** reliance on hydrogen is imperative to maintain at least a part of today's private transport volume in the future

related measures and technologies:

- increases in energy efficiency are required in all scenarios and economic sectors
- batteries are a key technology for future mobility; battery-electric and plug-in-hybrid vehicles are complementary to fuel-cell and hydrogen propulsion technology
- biofuels will play an important role in the transport sector in spite of their limited availability, but mainly be used by heavy duty vehicles, aircraft and ships

Status of Hydrogen and Fuel Cell Technology

- Successful demonstration programs ongoing in Germany
- Some systems are already close to commercial applications
- Further **R&D** is necessary for most applications, especially to cut costs
- **Demonstration** is required in order to
  - validate the technology
  - prepare the market environment
- Industry, governments and research join forces to prepare the markets for hydrogen and fuel cell technologies

National Development Plan

Politics, industry and science together have defined the necessary steps for the implementation of the NIP in the National Development Plan.


IDEEN ZÜNDEN!

Nationaler Entwicklungsplan
Version 2.1

zum

„Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie“

vorgestellt vom

Strategierat Wasserstoff Brennstoffzellen

21.03.2007

<u>Content:</u>

- Development Plans for
  - Transportation
  - Stationary Home Energy Supply
  - Stationary Industry Energy Supply
  - Special Markets
- Criteria for project funding
- Guidelines for the evaluation of Lighthouse Projects
- Program Management (NOW)

Key Messages

- reliable legal framework for
  - planning and certification processes
  - production, distribution and storage of hydrogen
  - production and operation of hydrogen powered vehicles

is needed, to justify investments and to provide a competitive environment

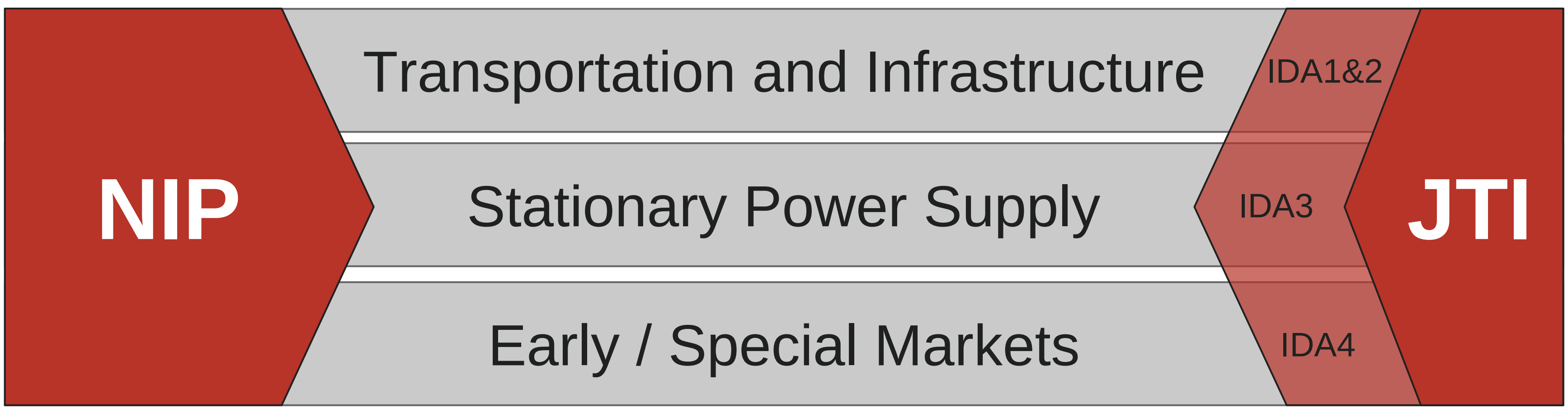
Key Messages

- strong national activities are the basis for a consistent, integrated European energy strategy for transportation
- a European harmonised strategy is needed in the fields of
  - technical innovation
  - technology funding
  - Regulation, Codes & Standards

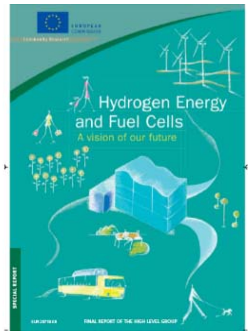
Nationale Organisation Wasserstoff- und Brennstoffzellentechnologie

Market Preparation Programmes

The German National Innovation Program (NIP) has a similar structure like the European counterpart, the Joint Technolgy Initiative (JTI).



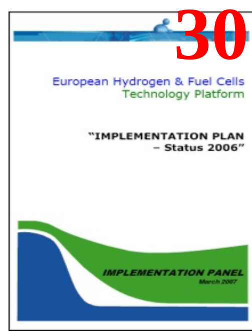
VISION
Hydrogen Energy And Fuel Cells
(2003)



STRATEGY
Strategic Research Agenda
Deployment Strategy
Strategic Overview
(2005)

Final approval by the Council for Competitiveness by May 30!

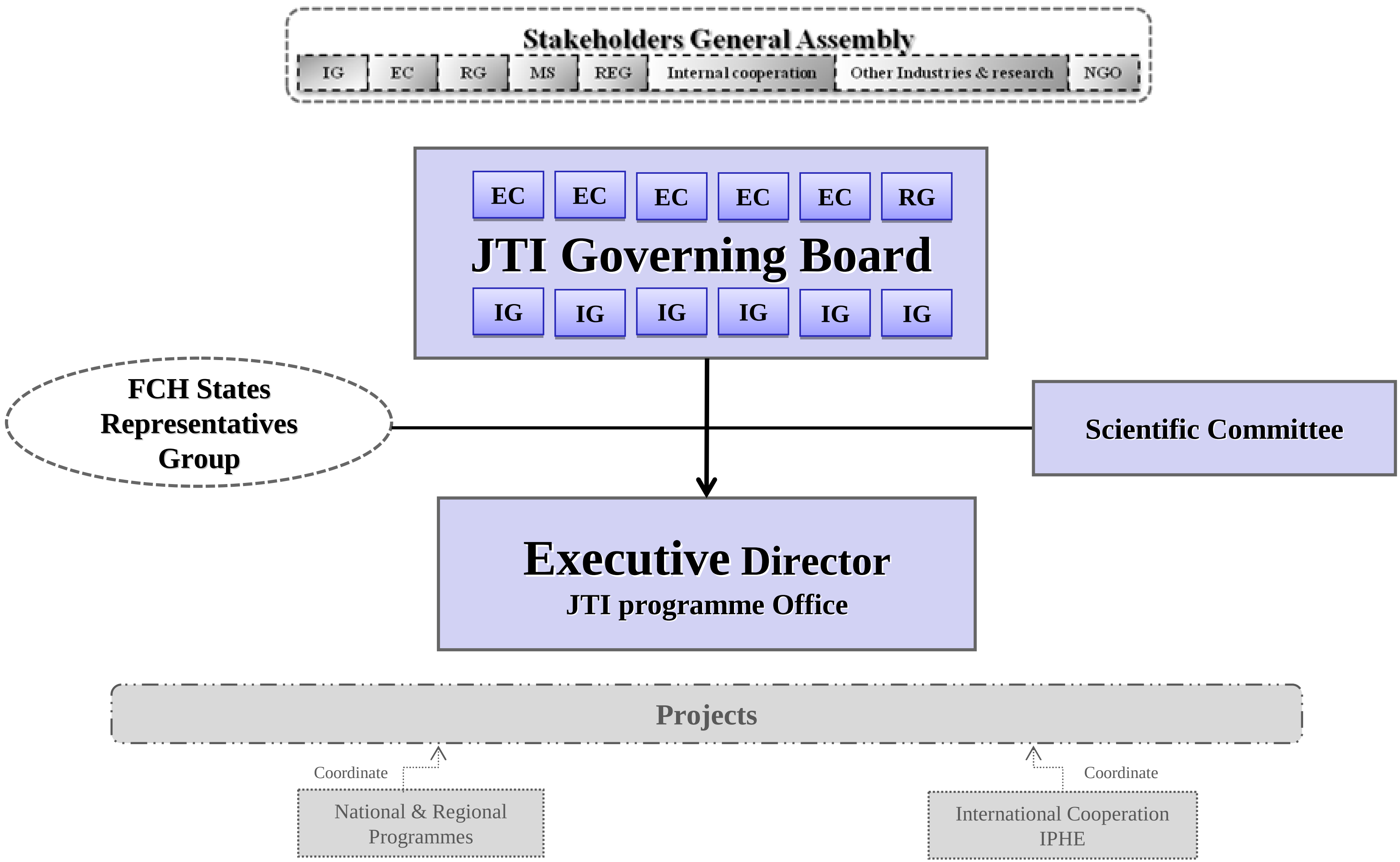
IMPLEMENTATION
Implementation Plan
(March 2007)



Documents available at:
www.hfpeurope.org/hfp/keydocs

Facilitating European collaboration

- Establish and execute long-term strategy
- Facilitate collaboration between industry and research
- Overcome fragmented research activities
- Co-ordinate upstream and market driven research
- Collaborate and coordinate with national and regional activities


Stakeholders General Assembly
IG
EC
RG
MS
REG
Internal cooperation
Other Industries & research
NGO
EC
EC
EC
EC
EC
RG
JTI Governing Board
IG
IG
IG
IG
IG
IG
FCH States Representatives Group
Scientific Committee
Executive Director
JTI programme Office
Projects
Coordinate
Coordinate
National & Regional Programmes
International Cooperation IPHE

The Industry Grouping

- 64 companies from 15 countries
- Major share of European FC industry
- Representing 90% of total industry investment
- Large corporations and SMEs
- Shares 50% of the JTI Program Office running cost

Industry Grouping Members

Linde Gas Linde

Enel
L'ENERGIA CHE TI ASCOLTA.

NUON

ludwig bölkow systemtechnik

Nedstack

The CCS Global Group Inc.
Serving the world since 1977

Icelandic New Energy
Promoting Hydrogen in Iceland

PLANSEE

ajusa

IRD
Fuel Cell Technology

mtu

HYGEAR

TOTAL

HYDRO

AIR PRODUCTS

CERAMIC FUEL CELLS LIMITED

Tropical
GREEN TECHNOLOGIES

HYNERGREEN

ANSALDO

TOPSOE FUEL CELL
clean, efficient and reliable

EADS

e·on

GRUPPO SAPIO

acciona

umicore

Gaz de France

BMW
Sheer Driving Pleasure

DAIMLER

VOLVO

A JOINT VENTURE OF DAIMLERCHRYSLER AND FORD MOTOR COMPANY
NUCELLSYS
THE FUEL CELL SYSTEM COMPANY

bp

alps
advanced low pollution power systems

OPEL

BASF
The Chemical Company

FIAT GROUP

Fuel Cell Control Ltd
alkaline fuel cells and control equipment

H2 Logic
Hydrogen Fuel Cell Motive Power Solutions

HEXIS

LABOR

EWE

ilT TECNOLOGIE

CLM
Hidrógeno

ENVIRONMENT PARK
Parco Scientifico Tecnologico per l'Ambiente

QUANTUM
ENERGY

AVL

HYDROGENICS
CORPORATION

AIR LIQUIDE

Rail Safety & Standards Board

SAINT-GOBAIN
HIGH-PERFORMANCE MATERIALS

INTELLIGENT ENERGY

NTDA
Energía

e·on

ILT TECHNOLOGY

WÄRTSILÄ

SIEMENS

Gamesa

Adelan

SOFCPOWER
SOLID OXIDE FUEL CELLS

Rolls-Royce

Shell Hydrogen

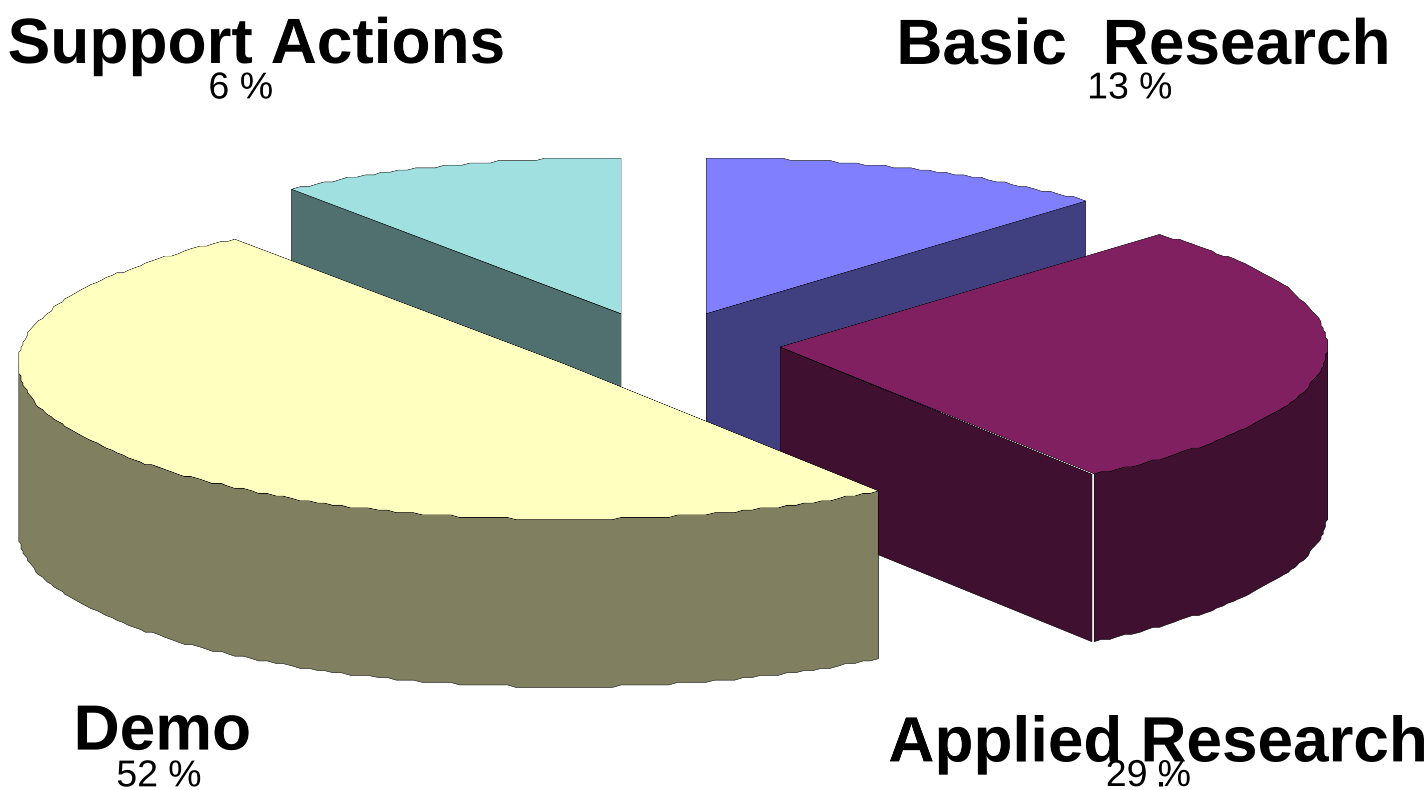
Snecma
Groupe SAFRAN

MAGNA STEYR

Research Grouping Members

Total: 47 out of 57
215.505 M€ (47 participants)
1838 persons (47 participants)

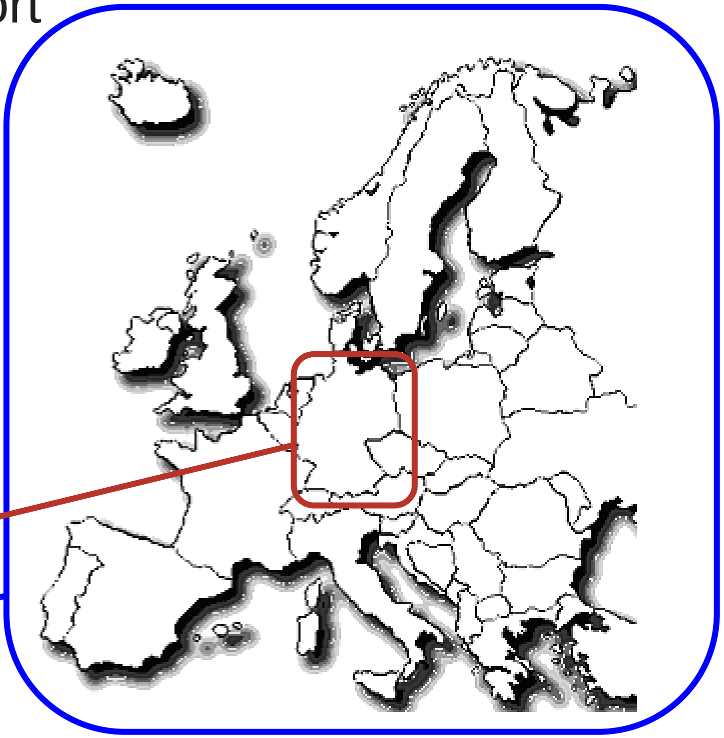
€ 1 billion public and private investment



Political Support

The driving factors for governments to support hydrogen and fuel cell technology are:

- Environmental benefits through reduced or no emissions
- Secure energy supply due to various sources of hydrogen
- Economic growth through innovative technologies



The German National Innovation Programme (NIP) and the European Joint Technology Initiative (JTI) provide the necessary public support

THANK YOU!

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