NOW
National Organisation Hydrogen and Fuel Cell Technology

ANNUAL REPORT

2012

MAGAZINE
ANNUAL REPORT 2012

FORE-WORD BY DR. PETER RAMSAUER

SECURING TOMORROW'S MOBILITY AND ENERGY TODAY

Mobility is the foundation for social participation and successful economies. However, transport growth, climate change and the finite nature of our energy resources are presenting us with an increasing number of significant challenges. If we want to make mobility affordable in the future too, transport must be organised in a sustainable and efficient way. In the federal government's energy concept we have also set ourselves a concrete energy savings target for the first time for the transport sector: the consumption of end-use energy will be reduced by 10 per cent by 2020 and by 40 per cent by 2050 compared to 2005. In order to achieve this we are focusing on vehicle innovations and technological developments among other areas. This certainly includes battery electromobility as well as hydrogen and fuel cell electromobility. Supporting these is the focus of my ministry's work.

If new mobility concepts are to be successful, then this can only be done both with and for people. That means applications must be developed which are efficient, low-emission, affordable and suitable for everyday use. We also want to organise mobility in a smarter way in order to take into account demographic change and the increasing urbanisation of our society.

That is why already since 2006 we have been supporting research, development and the demonstration of electromobility in a manner that is open to all types of technologies. We are working intensely on testing business models, resolving infrastructural issues as well as adapting the different drive technologies to respective user needs. At the same time we are working on solutions to storing renewable energy, as only when we are able to access this energy exactly when we need it can the transition be successful. Hydrogen offers interesting perspectives in this regard.

Following on from the funds from the second economic stimulus package, the federal government is providing up to one billion euros for the promotion of battery-electromobility from the Energy and Climate Fund. Government and industry are also together deploying 1.4 billion euros for the market preparation of hydrogen and fuel cell technology up to 2016. This technology is promising in both the transport and the stationary energy supply sectors. This is shown quite clearly by the results of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP), within which we support over 200 individual projects. For example, by 2015 we are building a nationwide network of hydrogen refuelling stations.

Fuel cells do not only have a future in the mobility sector. Fuel cell heating devices are suitable particularly for efficiently supplying electricity and heat in, for example, single and two-family houses. A substantial CO_2 savings potential is also to be found here. For 2013, I expect the first commercial fuel cell heating devices to come into operation in buildings. The practical test funded by my ministry in the framework of the NIP shows how new technologies can be successfully prepared for market introduction through the common commitment of government and private enterprise.

The 2012 Annual Report of the NIP shows that we are moving in the right direction. Germany has every chance of becoming the leading market and leading supplier for alternative mobility and energy concepts, so let's stay on track together.

Dr. Peter Ramsauer MdB
Federal Minister of Transport,
Building and Urban Development

» For new mobility concepts and technologies to succeed, these must be undertaken together with the people and for the people. «

FORE-WORD BY DR. KLAUS BONHOFF

THE ENERGY TURNAROUND WILL SUCCEED WITH HYDROGEN, FUEL CELLS AND BATTERIES

The safe, affordable and environmentally friendly provision of energy is a decisive issue for society when looking to the future. Government has committed itself to this key issue and created a framework in which all types of emission-free and highly efficient technologies can be tested in preparation for commercial market introduction.

NIP SINCE 2006 – PRODUCTS ARE TODAY SIGNIFICANTLY CLOSER TO MARKET

In 2006, the foundation to prepare the market for hydrogen and fuel cell technology was already being laid under the considerable influence of the Federal Ministry of Transport, Building and Urban Development (BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung) and the Federal Ministry of Economics and Technology (BMWi – Bundesministerium für Wirtschaft und Technologie): the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) was established. Since then and on the basis of this technology, vehicles for emission-free transport, electricity-producing heaters for highly efficient household power supply and numerous additional products for leisure and tourism as well as uninterruptible power supply units have been tested in comprehensive demonstration projects and under everyday conditions to attain commercial competitiveness. On the backdrop of the expansion of renewable energy, hydrogen technology holds the key for the long-term, high-capacity storage of volatile energy, especially that coming from wind power.

Hydrogen-run fuel cell vehicles and the associated refuelling infrastructure – being tested and further developed as part of the NIP-supported Clean Energy Partnership (CEP) – and fuel cell heating systems – being primed for everyday use within the NIP-»Callux« project group – have, in particular, meanwhile advanced to be very close to commercial marketability. As far as technical functionality and reliability is concerned, the products fulfil customer demands and in terms of emissions and efficiency, they tower over conventional solutions. The challenge in the final step is to become competitive in terms of price. A supporting role of the public authorities should therefore be considered at least during the market launch period.

ELECTROMOBILITY WITH BATTERIES – THE MOBILITY PORTFOLIO OF THE FUTURE EXPANDS

Efficient low or zero emission fuels will increasingly supplement the use of petroleum-based fuels. Hydrogen and electricity are hereby the most interesting alternatives in the long term as they can be produced using renewable energy. Complementing hydrogen, which is carried on board vehicles and converted to power in the fuel cell, battery-run electromobility represents a further mobility option. Within the context of the federal government's funding measures and supplementing the Electromobility Showcase, the BMVBS pursues the advancement of electromobility with batteries in the Electromobility Model Regions. From 2009 to 2011, structures were developed in the regions along with the establishment of vehicle fleets and a charging infrastructure for test purposes, with allocated funds from the second German economic stimulus package (KoPa II).

Building on the results of the KoPa II Electromobility Model Regions, the demonstrations were continued using BMVBS funds with the goal of further market preparation. An essential component of the funding activities are so-called cross-cutting themes, coordinated by NOW and the BMVBS, in which all project partners from all regions address key issues.

WHEN WILL THE TECHNOLOGY BE AVAILABLE IN THE MARKET?

The question of »When is the technology available?« is, as one can expect, frequently asked. Yet more important than providing a specific date to answer this question is the fundamental acceptance in society that the level of energy consumption – in the transport sector and in the home – can only be maintained or increased using renewable energy. To enable renewable energy to be used anytime and in real products, there is no alternative to hydrogen, fuel cells and batteries. Industry and government are therefore substantially investing in equal measure toward their market development and launch to ensure that Germany takes on a leading international position. This Annual Report provides an overview of the current status of products and developments in addition to detailed information on the projects completed or newly-approved in 2012, within the framework of the programmes coordinated and implemented by NOW.

Dr. Klaus Bonhoff,
Managing Director (Chair) NOW GmbH
National Organisation
Hydrogen and Fuel Cell Technology

NOW IS

NOW GmbH (National Organisation Hydrogen and Fuel Cell Technology) was founded in 2008 by the Federal Government, represented by the Federal Ministry of Transport, Building and Urban Development (BMVBS). The task of NOW involves the implementation of two federal development programmes – the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) as well as the Electromobility Model Regions of the BMVBS. Both programmes serve to advance the market preparation of alternative drive technologies along with efficiency and storage technologies for the energy system. Areas supported include research and development projects with a focus on testing under everyday conditions.

NOW is responsible for the initiation, evaluation and bundling of projects within the respective programmes and acts as the interface between government and the involved partners from research and industry. Central coordination of the projects enables individual partners to exchange experiences within the framework of an integrated process and to exploit existing synergies. The project administrator Jülich (PtJ) undertakes the concrete handling of the BMVBS' funding.

Besides targeted market preparation activities of hydrogen and fuel cell applications via various demonstration and research projects, NOW undertakes active public relations activities to raise awareness and acceptance of these technologies among users.

Representatives from politics, industry and science are a part of NOW committees. The advisory board counsels the organisation regarding the implementation of the NIP, especially with regard to current market demands. Because sustainable mobility represents a global challenge, NOW also promotes cooperation on an international level. As such, NOW chairs the secretariat of the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), which enables 17 nations and the European Commission to gather under one roof in order to advance the development of hydrogen and fuel cell technologies along with their associated applications.

THE NIP IS

National Innovation Programme Hydrogen and Fuel Cell Technology

The sustainable, low-emission supply of energy requires a shift from a reliance on fossil fuels in the long term. This means that hydrogen and fuel cell technology will take on an essential role when it comes to addressing mobility and energy supply needs of the future. With this realisation, government, industry and research initiated the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) in 2006. The programme is scheduled to run ten years and boasts a total funding volume of 1.4 billion euros. Half of funds are provided by the Federal Government – the Federal Ministry of Transport, Building and Urban Development (Bundesministerium für Verkehr, Bau und Stadtentwicklung – BMVBS) together with the Federal Ministry of Economics and Technology (Bundesministerium für Wirtschaft und Technologie – BMWi) – with the balance funded by participating industry. The NIP continues to be supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Ministry of Education and Research (BMBF). All four of the federal departments are represented in both the NOW Advisory and Supervisory Boards.

NIP encompasses four programme areas in order to advance in equal measure, numerous and diverse hydrogen and fuel cell technology application alternatives and to address market-specific challenges in a targeted manner. Research and development activities as well as demonstration projects are thereby implemented according to the areas of »Transport and Infrastructure«, »Hydrogen Provision«, »Stationary Energy Supply« or »Special Markets«. The respective technologies are tested under everyday conditions in so-called Lighthouse Projects together with several project partners, enabling potential challenges to be jointly and effectively countered. The strengthening of the supplier industry is also explicitly promoted in all programme areas to pave the way for future series production of the respective components.

Further information on the details of individual NIP projects can be found from page 002.

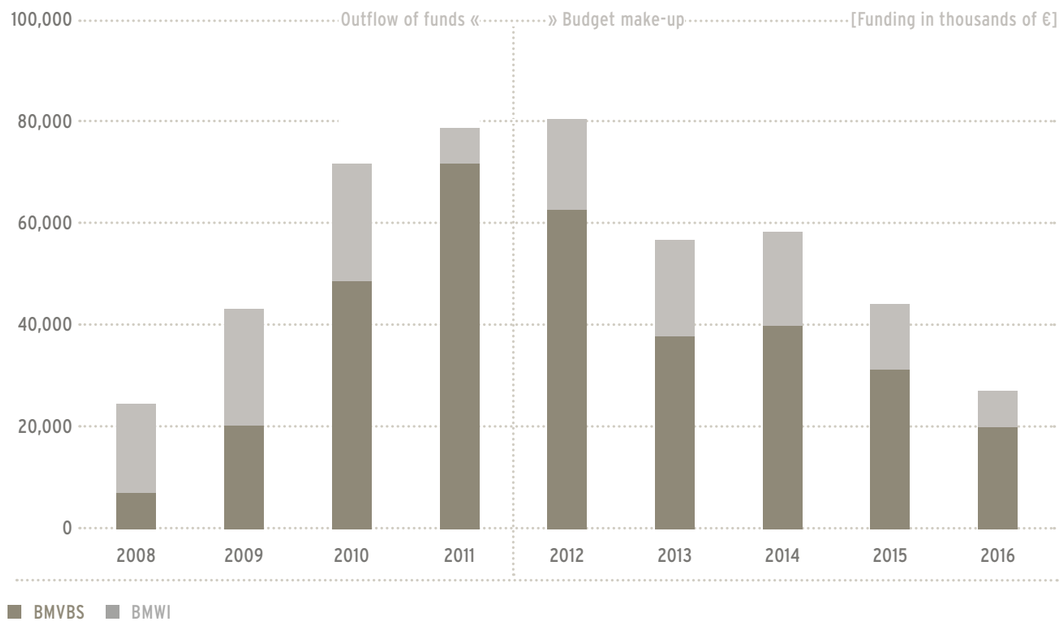
Federal Ministry of Transport, Building and Urban Development

Federal Ministry of Economics and Technology

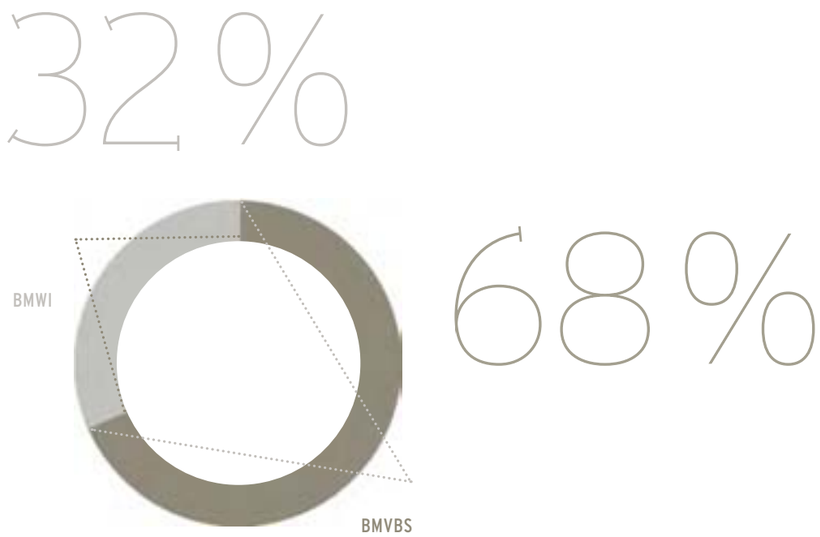
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Federal Ministry of Education and Research

NIP – SOURCE OF FUNDING
DEMONSTRATION (BMVBS) AND R & D (BMWI) *



* All data until 2012 refers to approved projects. Data from 2013 to 2016 include approved projects, LOI and projects being processed.



NIP – SECTORS OF APPLICATION
(AS AT DECEMBER 2012 *)

[** Letter of Intent]

PROGRAMME AREAS	BUDGET IN THOUSANDS OF €	FUNDING IN THOUSANDS OF €	IN DISCUSSION IN THOUSANDS OF €	APPROVED, LOI **, APPLICATION IN PROCESS AT PTJ IN THOUSANDS OF €
TRANSPORT AND INFRASTRUCTURE	574,802	276,341	72,769	203,571
HYDROGEN PROVISION	47,676	23,577	8,537	15,040
STATIONARY INDUSTRY	105,511	50,480	16,858	33,623
STATIONARY HOUSEHOLD	142,450	69,143	12,594	56,549
SPECIAL MARKETS	116,620	54,067	19,951	34,116
CROSS-CUTTING THEMES	15,439	7,411	7,920	18,976
INNOVATIVE DRIVES	55,938	26,896		7,411
TOTAL	1,058,436	507,915	138,629	369,286

* The information refers to BMVBS funds for projects since 2008.

THE MODEL REGIONS ELECTRO-MOBILITY ARE

Model Regions Electromobility

The main emphasis of the Electromobility Model Region programme is the testing of electromobility applications and transport concepts with a regional focus. The explicit goal is to embed electromobility more strongly in the public domain and to advance the development of the necessary associated infrastructure. Supplementing the federally funded Showcases, the regional context is a predominant issue due to the involvement of municipalities. The measures necessary in terms of transportation and research policy and regional and urban development as well as which application options exist for electro mobile applications in local public transport, will be interdisciplinarily examined and tested with the help of the various model regions, together with the associated partners from industry, research and the public sector. Furthermore, accompanying cross-regional platforms facilitate the well-founded exchange of experiences and accelerate the long-term networking of strategic-conceptual partners. The Electromobility Model Regions, complementing the Electromobility Showcases, will therefore also be continued by the BMVBS following on from the funding within the framework of the second economic stimulus package from 2009 to 2011.

Further information on the programme and the model regions can be found from page 068.

Federal Ministry of Transport, Building and Urban Development

THE NIP IS A JOINT PROGRAMME OF THE BMVBS, BMWI, BMU AND BMBF

Federal Ministry of Economics and Technology

THE FEDERAL MINISTRY OF ECONOMICS AND TECHNOLOGY (BMWI) FUNDS PROJECTS WITH A FOCUS ON RESEARCH AND DEVELOPMENT, WITHIN THE FRAMEWORK OF THE NIP

With the 6th energy research programme »Research for an environmentally friendly, reliable and affordable energy supply«, the federal government is setting the guidelines and points of focus of its support for the coming years. Funding initiatives for selected fields that are important for the future supply of energy in Germany are being developed together with other responsible departments. In the area of hydrogen and fuel cell technology, the BMWi is supporting application-based R & D projects aiming to improve components and systems. In addition, several fundamental investigations and studies are being financed. The scope of support thereby spans the entire application area of the technology: from transport and infrastructure, stationary fuel cells for household energy supply as well as for industrial applications, to special markets for fuel cell technology.

NEW FUNDING INITIATIVES IN ENERGY STORAGE

Due to the constantly growing share of energy from renewable sources, the storage of this energy will take on an increasingly important role in the medium to long term. Only with suitable energy storage methods can a high portion of the overall energy demand be secured from renewable sources. For this reason, the BMWi together with the Federal Ministry of Environment as well as the Federal Ministry of Education and Research have jointly started an initiative to support research and development in the area of energy storage technology. In a first phase the three departments are allocating up to 200 million euros in total until 2014 for the »energy storage funding initiative« and ensure targeted and efficient funding due to joint management of the programme. Research projects will be supported to develop a wide range of storage technologies for power, heat and other forms of energy. Consequently, comprehensive synergies realisable in regard to hydrogen and fuel cell technology emerge, which are coordinated together with NOW.

TRANSPORT

» Polymer Electrolyte Membrane Fuel Cells (PEMFC)
» Peripheral components
» Drive technology
» Solid Oxide Fuel Cells (SOFCs) for onboard power supply in vehicles

HYDROGEN GENERATION AND INFRASTRUCTURE

» Hydrogen storage

STATIONARY APPLICATIONS IN HOUSEHOLD ENERGY SUPPLY

» Reformation
» Low-temperature PEMFCs
» High-temperature PEMFCs, SOFCs

STATIONARY INDUSTRIAL APPLICATIONS

» Molten Carbonate Fuel Cells (MCFCs) and SOFCs
» Components
» Subsystems
» Series production manufacturing methods

SPECIAL MARKETS FOR FUEL CELLS

» Emergency power supply
» Warehouse vehicles
» Onboard power supply for the leisure market

Federal Ministry of Economics and Technology

THE FOLLOWING BMWI NIP PROJECTS WERE APPROVED IN 2012:

PROJECT	COMMENCEMENT	CONCLUSION	PARTNERS	FUNDING RATIO [%]	FUNDING BUDGET [€]
Small appliances programme II	01 August 2012	31 July 2013	Stöhr Armaturen GmbH & Co. KG	50	107,726
	01 August 2012	31 January 2014	Scheuermann + Heilig GmbH Federn Stanz- und Biegetechnik	50	93,737
	01 May 2012	30 April 2015	Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)	100	220,106
PumaS	01 February 2012	31 January 2013	EnyMotion GmbH	50	49,700
Catalysers for decentralised production of hydrogen and power for the fuel cell III	01 April 2012	01 October 2015	Clariant Produkte (Deutschland) GmbH	50	1,760,970
NEOKAR II	01 March 2012	28 February 2014	Umicore AG & Co. KG	50	1,121,188
EnerSta	01 April 2012	31 March 2014	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	100	824,384
	01 April 2012	31 March 2014	EADS Deutschland GmbH	50	188,292
miniBIP	01 June 2012	30 November 2015	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	80	960,000
	01 June 2012	30 November 2015	ThyssenKrupp Nirosta GmbH	50	605,693
	01 June 2012	30 November 2015	Daimler AG	50	1,349,746
ENSA III	01 April 2012	31 March 2015	J. Eberspächer GmbH & Co. KG	45	8,379,251
	01 April 2012	31 March 2015	ElringKlinger AG	45	5,964,984
	01 April 2012	31 March 2015	Behr GmbH & Co. KG	45	1,113,718
HT-Dicht	01 May 2012	31 March 2015	Eisenhuth GmbH & Co. KG	50	1,196,635
	01 May 2012	31 March 2015	Truma Gerätetechnik GmbH & Co. KG	50	256,558
	01 May 2012	31 March 2015	EnyMotion GmbH	50	262,778
MatFuel	01 November 2012	31 October 2015	Robert Bosch GmbH	47	1,186,111
	01 November 2012	31 October 2015	Universität Stuttgart	100	390,493
	01 November 2012	31 October 2015	Bayerische Motoren Werke AG	50	144,400
	01 November 2012	31 October 2015	Deutsche Edelstahlwerke GmbH	48	90,874
MÖWE III	01 April 2012	31 March 2015	OWI OEL-WAERME-INSTITUT GmbH	90	511,951
	01 April 2012	31 March 2015	ENASYS GmbH	45	283,050
	01 April 2012	31 March 2015	inhouse engineering GmbH	45	354,388
	01 April 2012	31 March 2015	Behr GmbH & Co. KG	40	388,698
100MPaH2	01 March 2012	28 February 2014	Universität Stuttgart	100	1,911,140
Stress	01 April 2012	31 March 2015	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	80	430,335
	01 April 2012	31 March 2015	FuelCon AG	60	363,893
AWAKOL	01 July 2012	31 December 2014	Institut für Mikrotechnik Mainz GmbH	50	587,494
	01 July 2012	31 December 2014	Truma Gerätetechnik GmbH & Co. KG	50	708,843
HyMotion 5	01 August 2012	31 July 2016	SolviCore GmbH & Co. KG	48	2,555,650
NG PEM-Stack	01 July 2012	30 June 2014	ElringKlinger AG	38	753,898
	01 July 2012	30 June 2014	AVL Deutschland GmbH	39	106,246

INTERVIEW WITH DR. SOPHIE HAEBEL

INTERVIEW WITH DR. SOPHIE HAEBEL, PROJEKTTRÄGER JÜLICH, ENERGY TECHNOLOGIES BUSINESS AREA

Together with NOW, Projektträger Jülich (PtJ) was commissioned as project administrator to implement the NIP and Electromobility Model Regions and administers the projects in cooperation with NOW. While NOW coordinates the funding programmes and concerns itself with the content of project applications, PtJ is responsible for the technical and administrative evaluation of the applications and associated projects extending from approval to the exploitation of results.

Dr. Sophie Haebel heads the »Fuel Cell (Market Introduction) and Electromobilty« area of PtJ since 2012.

For outsiders – what is a project administrator?

A project administrator is an organisation that deals with the implementation of public funding programmes. Strictly speaking, it is responsible for ensuring the lawful use of public funds that have been allocated to promote research and development projects. In many projects it also involved, however, in helping to shape the content of the programmes and provides advice to the responsible federal ministries on conceptual and strategic issues concerning R & D funding. Recipients of the funding may include research institutes or industrial enterprises, whereas the NIP places a focus on supporting companies.

Where exactly are tasks delineated between NOW and PtJ for the implementation of the NIP and the Electromobility Model Regions?

NOW is responsible for the strategic coordination of the NIP and decides which of the submitted project ideas is to be supported so that the government's research-political goals as set out in the National Development Plan are reached. Based on this decision, the project idea initiator is requested to make a formal funding application to the project administrator. PtJ takes over responsibility from the moment the application is submitted.

It evaluates the applications from a technical and administrative perspective, approves the funding (if applicable), accompanies the project throughout its duration, allocates the funding payments and upon project conclusion evaluates whether the funding support has served its intended purpose. In both phases, NOW and PtJ work together in a close, collaborative manner, with each party contributing its respective expertise.

Figures usually paint a clear picture. You see the amount that companies invest in the development of a technology. What is your assessment in this regard when looking at hydrogen and fuel cell technology and electromobility with batteries?

It never fails to impress me when I see with what resolve and determination companies pursue their developmental goals – which due to the difficulty of the task and the uncertainty of future framework conditions continues to be fraught with an extremely high level of financial risk. For the NIP, this applies to a particularly high level in the area of transport. Here, the hydrogen infrastructure and the fuel cell drives must be simultaneously technically developed and then brought to market maturity. Without the support of the NIP, this would certainly not succeed. In the case of purely battery-electric-run vehicles, despite a niche market beginning to develop such as in commercial transport, enormous challenges must still be overcome in order to reach the ambitious goals set out by the government.

»It never ceases to amaze with what resolve and determination companies pursue developmental goals...«

»NOW and PtJ work together in a close, collaborative manner«

COOPERATIONS

INTERNATIONAL COOPERATION

A general consensus exists today for the necessity to integrate renewable sources of energy into our energy supply system, to do away with the dependence on fossil fuels and thereby also ensure an across-the-board supply of energy in the future. Hydrogen and fuel cell technologies provide abundant opportunities to shape the move towards renewable forms of energy. They already fulfil numerous demands and offer promising solutions to meet the challenges of the future. But the efforts to transform our energy system do not end at our national borders. Besides the development of more efficient storage solutions and more flexible applications, we need to expand cooperation and exchange on an international level to be in a position to truly exploit the full potential of renewable energy and to simultaneously be capable of meeting its growing demand.

For this reason, NOW continued and extended its international cooperation efforts in 2012 in addition to those on the domestic front. International cooperation and a mutual strategic direction are essential to successfully commercialise hydrogen and fuel cell technologies and to establish these as an integral part of the global energy industry of the future.

BILATERAL ACTIVITIES

Europe: International cooperation projects are crucial for the development of a European hydrogen infrastructure for the transport sector. In contrast to the situation in the USA or Japan, where a virtually closed market can be developed, it is essential for Germany to establish transnational partnerships and expand national activities in order to promote the successful establishment of a comprehensive hydrogen infrastructure.

It was against this backdrop that cooperation between the Clean Energy Partnership (CEP) and the Scandinavian Hydrogen Highway Partnership (SHHP) was agreed on in 2012, to jointly advance development in the area of transport.

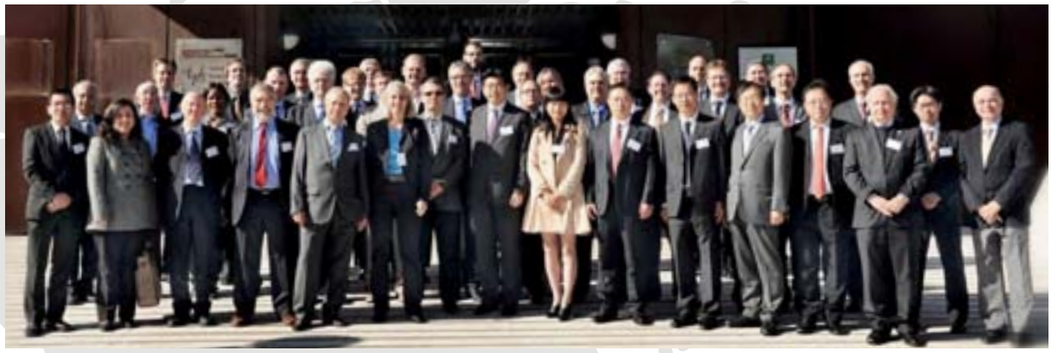
In addition, the collaboration with the Fuel Cell and Hydrogen Joint Undertaking (FCH JU) was successfully set forth this year.

In the area of stationary applications, the pan-European »ene.field« project commenced in September 2012. Modelled on the NOW »Callux« lighthouse project, 1,000 CHPs (Combined Heat and Power units) are to be installed and tested in 12 European countries within the framework of »ene.field«.

Japan: NOW and NEDO (New Energy and Industrial Technology Development Organization) already signed a Memorandum of Understanding in 2010 for the joint exchange of information. Since then, collaborations with Japan have continuously been intensified upon this basis. In 2012, NOW represented Germany not only at associated events and discussions in Japan, it also provided support for numerous visits to Germany from Japanese firms and government organisations.

As a result of the Fukushima catastrophe, the interest of Japanese firms for green hydrogen has risen sharply. Germany is considered as a centre of competence and is keenly sought as a partner.

USA: The USA is an important NOW cooperation partner. As in the previous year, NOW staff took part in the Annual Merit Review of the U.S. Department of Energy's Fuel Cell Technology Program, held in May 2012. In addition, the cooperation between the Clean Energy Partnership (CEP) and the California Fuel Cell Partnership is firmly established and was continued in 2012.



IPHE Steering Committee Meeting, November 2012, Seville, Spain

China: On the basis of the »Joint communiqué on comprehensively promoting strategic partnership between the Federal Republic of Germany and the People's Republic of China«, signed in July 2010 by Federal Chancellor Angela Merkel and Premier Wen Jiabao of the State Council of PRC, cooperation in the area of electromobility was further deepened in July 2011.

A joint declaration on cooperation between the Federal Ministry of Transport, Building and Urban Development of the Federal Republic of Germany (BMVBS) and the Ministry of Science and Technology of the People's Republic of China (MOST) in the areas of sustainable mobility, energy efficiency, emissions reduction and innovative transport technology was signed by Minister Dr. Peter Ramsauer and Minister Prof. Dr. Wan Gang. In the context of this declaration many activities between the Rhine-Ruhr, Bremen/Oldenburg and Hamburg Model Regions and the corresponding partner cities of Wuhan, Dalian and Shenzhen also took place in 2012, including delegation visits in Bremen as well as in Dalian. The Rhine-Ruhr Model Region was able to begin the follow-up project Wuhan2 in this year, which was accompanied by mutual visits. The Hanseatic City of Hamburg had already signed a Memorandum of Understanding with Shenzhen. In addition in 2012 in a workshop in Hamburg the »Shenzhen-Hamburg New Energy Vehicle Cooperation Plan« began to develop. The BMVBS and NOW are assuming the role of coordinators and organisers in this collaboration, with the said model regions undertaking the concrete project implementation.

MULTILATERAL ACTIVITIES 2012

IPHE: Following a two-year term as chair of the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), Germany assumed this position for another year. The IPHE is an association of 17 member states and the European Commission and has the objective of accompanying and promoting the commercialisation of hydrogen and fuel cell technologies. Under German leadership the organisational structures were streamlined and at the same time information exchange and international cooperation between IPHE member states was further strengthened. Aside from the regular steering committee meetings, two international workshops took place under the auspices of IPHE. Modelled on the 2011 IPHE Roundtable Meetings, IPHE delegates discussed the economic and ecological importance of hydrogen and fuel cell technologies in emerging economies, especially in South Africa, with representatives from South African politics and industry in May 2012. In November 2012 the European Commission and the Spanish company Abengoa Hydrógeno hosted an IPHE workshop on the theme of hydrogen as a storage medium for renewable energy. The focus was particularly on the appraisal of the current state of development of technologies as well as their future potential in terms of security of global energy supply. 120 representatives from politics, industry and research & development took part.

For more information, please visit
www.iphe.net

STRATEGIC PROGRAMME MANAGEMENT

The NOW flagship, National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) has meanwhile been active for more than half a decade. It is perhaps a fitting occasion to reflect on what has transpired over this time – and an important moment to develop new perspectives. What demands exist, which strategies and structures must be created or adjusted, and what could a scenario for the time after 2016 look like? The NOW Advisory Board addressed these questions under the working title »NIP 2016+«, along with other current issues concerning the programme and its projects.

The Advisory Board is comprised of representatives from the four participating federal ministries (BMVBS, BMWi, BMU and BMBF), a coordinator from the federal states, and representatives from all sectors of industry and research institutes involved. The interests of all players from government, business and research are collated and discussed within the highly esteemed Board. Goal of the regular Advisory Board meetings is to establish consensus on the strategic direction of the programme management.

As such, the Board is significantly involved in plotting the course of the entire long-term innovation programme, which has a budget exceeding 1.4 billion euros.

By the end of 2012, a diverse range of projects with a total budget of approximately 750 million euros had been initiated. A key area of focus of the NOW activities are so-called lighthouse projects that take a holistic approach for the development of new technologies. Besides hydrogen and fuel cell projects, NOW has coordinated development in battery-powered mobility as part of the »funding programme for model regions for electromobility« (part of the federal government's economic stimulus package, Konjunkturpaket II), which tests the performance of vehicles and infrastructure in representative model regions in Germany. The focus of research in the model regions is explicitly on everyday use: applications with battery-driven technology must be capable of being integrated and perceived as being user-friendly.

THE ADVISORY BOARD

Numerous events throughout the year demonstrated that extraordinary potential exists in both the battery-electric sector and with hydrogen and fuel cell technology.

»Conducting critical analyses and evaluations of previous activities as well as undertaking strategic discussions concerning the content of the NIP from 2016 are part of the tasks within the Board on the subject of ›NIP 2016+‹. To enable this, all market segments (stationary, special markets, transport and storage) were discussed at length with the responsible participants in 2012,« explains Prof. Werner Tillmetz, Chairman of the NOW Supervisory Board.

50 hydrogen filling stations should be operational by 2015, and in 2020 there should be one million vehicles running on alternative energy sources on Geman roads. It is therefore clear, especially when one regards the aims of the energy turnaround, that structures will be required beyond 2016.

THE ADVISORY BOARD IN DETAIL

The board is comprised of representatives from the following 18 interest groups:

GOVERNMENT

Federal Ministry of Transport, Building and Urban Affairs (BMVBS): Stefan Schmitt
Federal Ministry of Economics and Technology (BMWi): Dr. Georg Menzen (Advisory Board Chairman)
Federal Ministry for the Environment (BMU): Wolfgang Müller
Federal Ministry of Education and Research (BMBF): Karsten Hess
Representatives of the federal states: Dr. Heinz Baues, Heinrich Klingenberg (without voting rights)

SCIENCE

Helmholtz Association for Research & Development: Prof. Detlef Stolten
Research & Development Institutes/Universities: Prof. Ulrich Wagner
Education: Prof. Jürgen Garche

INDUSTRY / APPLICATION:

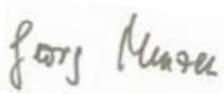
Mobility – Passenger cars: Dr. Sabine Spell
Mobility – Commercial vehicles: Peter Froeschle
Domestic energy supply: Joachim Berg
Industrial applications: Johannes Schiel
Specific applications: Prof. Werner Tillmetz (Advisory Board Chairman)
Fuel cell components manufacturing: Dr. Silke Wagener

INFRASTRUCTURE

Fuel industry: Patrick Schnell
H_2 production: Dr. Oliver Weinmann
H_2 delivery: Dr. Joachim Wolf
Network supply: Andreas Ballhausen

Advisory Board Chairman, Dr. Georg Menzen is also convinced that this will continue to be successful at the high levels currently enjoyed: »Open to multiple technologies, the government's approach provides us with considerable scope for activities. To make best use of this and create corresponding, efficient structures is a goal that is as challenging as it is realistic. With our partners from federal and state government as well as industry and research, we are well positioned to continue successfully accompanying the NIP and electromobility model region projects. We must strive to further extend our initiatives, particularly in light of international competition.«

»Develop the future together and demonstrate the present« – a motivational motto used during the establishment of NOW in 2008 is now more relevant than ever. And the many successful projects show that this is a promising approach.



Dr. Georg Menzen, BMWi
(Advisory Board Chairman)

Prof. Werner Tillmetz, NOW
(Advisory Board Chairman)

2 2012 4

ANNUAL REVIEW

17 FEBRUARY 2012 / OPENING OF HYDROGEN FILLING STATION AT HAFENCITY IN HAMBURG

Ecological refuelling: A new hydrogen filling station for fuel cell vehicles opens in Hamburg's HafenCity. Half of the hydrogen is produced directly on site via electrolysis using renewable energy and the other half is delivered. Besides private passenger vehicles, the Vattenfall Europe AG and Shell Deutschland Oil filling station also supplies the fuel cell hybrid buses from Hamburg Hochbahn (Hamburg public transport authority). As part of the Clean Energy Partnership (CEP), and within the framework of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP), the filling station is supported with funds totalling 6.3 million euros.

From right to left: Rainer Bomba (State Secretary, BMVBS), Pieter Wasmuth (Chief Representative, Vattenfall Europe AG), Dr. Oliver Weinmann (Managing Director, Vattenfall Europe Innovation GmbH), Frank Horch (Senator for Economy, Transportation and Innovation, Hamburg)

23 – 27 APRIL 2012 / HANOVER FAIR

Stimulus: Under this year's motto of »Green + Intelligence«, 5,000 exhibitors present products and applications relating to the key topics of energy and environmental technology, mobility and urbanisation at the world's largest industrial trade fair. Together with CEP, FCH Europe and Linde, NOW presents successful projects from the NIP area at a joint Hydrogen and Fuel Cell stand. In addition, NOW and the Electromobility Model Regions are also involved at a joint stand of the federal government where interesting vehicles from the various regions are presented within the framework of the MobiliTec.

From right to left: Rainer Bomba (State Secretary, BMVBS), Dr. Klaus Bonhoff (Managing Director, NOW)

5

22 MAY 2012 / LAUNCH OF THE ENVIRONMENTAL WEB PORTAL »MORGEN IN MEINER STADT« (»TOMORROW IN MY CITY«)

Ties Rabe (Senator for Schools, Hamburg) launches the portal with the support of numerous school students

Shaping change: Climate protection and the sustainable supply of energy are among the most important tasks within our society and will take on increasingly important roles in regional and urban development in the future. The NOW-supported »Morgen in meiner Stadt« (»Tomorrow in my city«) environmental web portal invites school students in Hamburg to present their visions of the future on subjects including nature, energy, existence, goods, mobility, ideas, living and working. Together with Hamburg's Senator for Schools, Ties Rabe, the online platform is presented at the Gut Karlshöhe (Karlshöhe Estate) in the north of Hamburg.

2012

6

03 – 07 JUNE 2012 / WHEC TORONTO

Global exchange: The 19th World Hydrogen Energy Conference (WHEC) provides representatives coming from more than 50 countries the opportunity to discuss the current status of research and development in hydrogen and fuel cell technology. NOW Managing Director, Dr. Klaus Bonhoff, shares latest news on the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) with the international visitors to the conference, taking place under the theme »Hydrogen systems – for new energy solutions«, and featuring an accompanying exhibition.

14 JUNE 2012 / EUROPEAN INVENTOR AWARD FOR NIP PROJECT

Congratulations: Entrepreneur Dr. Manfred Stefener receives the European Inventor Award from the European Patent Office at the Royal Danish Playhouse in Copenhagen. Together with Oliver Freitag and Jens Müller, he developed the world's first portable fuel cell, which besides for use in electric vehicles can also be deployed in mobile homes, off-grid security and surveillance systems as well as in the area of defence. Dr. Stefener is the founder of Smart Fuel Cell and today runs the company Elcomax. Both firms are successfully active with several projects in the Special Markets programme area within the framework of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP).

20 JUNE 2012 / 50 HYDROGEN FILLING STATIONS IN GERMANY

From left to right:
Dr. Peter Ramsauer (Federal Minister for Transport, Building and Urban Development), Prof. Thomas Weber (Director, Group Research Division, Daimler AG), Dr. Klaus Bonhoff (Managing Director, NOW)

Hydrogen station publically accessible: The Federal Ministry for Transport, Building and Urban Development and leading industrial companies sign a joint Memorandum of Understanding for the expansion of the hydrogen filling station network in Germany. Transport Minister Dr. Peter Ramsauer and other renowned partners will allow for 40 million euros of funding from the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) to expand the current network of 15 public filling stations to 50 by 2015. This ensures that the market-relevant testing of innovative filling station technologies continues and the 5,000 fuel cell vehicles anticipated to be on the roads at that time can be adequately supplied.

7

03 – 05 JULY 2012 / ELECTROCHEMICAL TALKS IN ULM

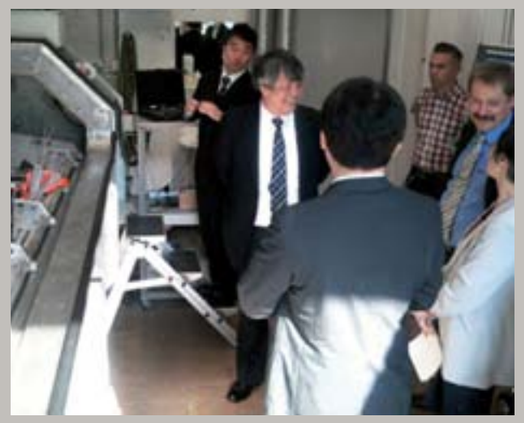
Talk, talk, talk: The Electrochemical Talks (UECT) take place in Neu-Ulm for the 13th time. Lithium-Ion batteries and fuel cells today receive a growing level of global attention. Due to the increased interest for electromobility and storage technologies for renewable energy, the conference organisers – ZSW, WBZU, the University of Ulm and the Helmholtz Institute – place a focus on this with the overall topic of »Advanced Technologies for E-Mobility and Energy Storage«. The specialist conference takes place every two years and is a key forum for representatives from the automobile and supplier industries, research and government. ZSW Director and Chairman of the NOW Advisory Board, Prof. Werner Tillmetz is delighted with the positive visitor response of some 300 participants from approximately 20 countries.

300 guests from 20 nations in the Edwin Scharff House in Neu-Ulm

8

29 AUGUST 2012 / JAPANESE DELEGATION IN BERLIN

Japan is guest: A delegation of the »High Pressure Gas Safety Institute of Japan« from Tokyo obtains information from NOW on the storage of hydrogen, its refuelling and the associated safety measures. A visit to the Berlin filling stations from Total on Heidestrasse and from Shell on Sachsendamm are on the agenda, as is an exchange with the Federal Institute for Materials Research (BAM – Bundesanstalt für Materialforschung) on the subject of testing methods.



The delegation from the »High Pressure Gas Safety Institute of Japan« visits Berlin's hydrogen filling stations

2012

9

04 SEPTEMBER 2012 / LAUNCH OF THE » ELMO « PROJECT

Kickoff: To launch the »ELMO« (Electromobile Urban Commercial Transportation) project in the Rhine-Ruhr model region, commercial vehicles with total loads of 7.5 to 12 tons are officially handed over in Dortmund. The vehicles, which have a focus on local delivery and commercial transportation, can even operate at night time and in the city's »green environmental zones« and therefore also contribute to saving time and improving the supply chain.

10 SEPTEMBER 2012 / SIEMENS BECOMES A PART OF THE CEP

CEP grows: Industrial company Siemens joins the network. The company brings in a self-developed electrolysis system based on PEM (Proton-Exchange Membrane) technology that is used by hydrogen filling stations. The system is to produce hydrogen made from energy sources that are at least 50 per cent renewable.

22 SEPTEMBER 2012 / CITIZEN EVENT: » HOW WILL WE DRIVE TOMORROW «

Discussed globally: On behalf of NOW, the Independent Institute for Environmenta« invites citizens to discuss new drives, innovative transport concepts and alternative mobility with a team of experts. Various speakers explain what the driving of vehicles has to do with climate change and why it is necessary to massively cut CO_2 emissions. Subjects such as required changes to behaviour, politicians acting as role models, the service life of batteries, the lack of the usual vehicle sound or the overall necessity of electric vehicles are debated and scrutinised in lively discussion sessions.

17 – 18 SEPTEMBER 2012 / CEP PHOTO SHOOT SESSION ON RÜGEN

Setting the scene: To effectively set the scene for fuel cell vehicles, the Clean Energy Partnership organises a photo shoot session on the island of Rügen. NOW is present with a Toyota FCHV-adv. The photo shoot is simultaneously the grand finale of a nationwide photo safari of the hydrogen-run vehicles. The idyllic island setting provides wonderful photo motifs – and the combination helps to again demonstrate that the technology helps to protect the environment.

Right: The Toyota FCHV-adv at the fishing port of Schaprode

10

08 OCTOBER 2012 / » INMOD « UP FRONT – E-BIKE AWARD 2012

Distinguished: The »inmod research project – Intermodal local public transport in rural regions based on electromobility components« (Intermodaler öffentlicher Nahverkehr im ländlichen Raum auf Basis von Elektromobilitätskomponenten) – receives first prize in the E-Bike Awards, which is conferred by RWE Deutschland AG and extraenergy.org. The award distinguishes projects that show, in a creative and innovative manner, how electromobility can be lastingly integrated in public mobility. The project, which is funded within the framework of the Electromobility Model Regions, tests how a dense network consisting of a high speed bus covering as short a distance as possible combined with feeder services from small towns and villages can be achieved.

08 – 10 OCTOBER 2012 / F-CELL AND AWARDING OF THE »JUGEND FORSCHT« PRIZE FOR SCHOOL STUDENTS

f-cell goes XL: For the first time, the f-cell takes place at the Stuttgart Airport trade fair centre. The expanded format shows: the subject is more topical than ever. NOW is involved with various keynotes, lectures and a stand at the associated accompanying exhibition. Once again, a highlight is the announcement of the national winner of the school student science competition »Jugend forscht« (youth researches). The congratulatory speech for winner Sebastian Klick is held by German football legend Guido Buchwald, who is an advocate of future-oriented technologies and is happy to support NOW projects.

22 OCTOBER 2012 / » MARKTPLATZ ZULIEFERER « (» MARKETPLACE SUPPLIERS «)

Market objectives: NOW organises the »Marktplatz Zulieferer« (marketplace suppliers) event for the second time. On its 10th anniversary, the event is held at Freudenberg FCCT SE & Co. KG, with a focus on the subject of fuel cell technology. The platform for exchange once again aroused great interest. Around 100 representatives from manufacturers and suppliers participate, discussing potential areas of applications along with synergies for the further development of fuel cell systems.

25 OCTOBER 2012 / IHK TECHNOLOGY FORUM

Energy storage: Over 130 experts and other esteemed visitors from business, research and government converge on the heating power plant in Berlin's Moabit district to discuss the subject of »Energy storage – Solutions for the sustainable integration of renewable energy in the energy system of tomorrow«, which is part of the IHK Technology Forum. The challenges of various energy storage systems are highlighted and discussed during lectures and discussions, and solutions from the Berlin-Brandenburg region presented. The personal exchange between representatives from diverse areas is a focus of the event. To close, a panel of experts, led by Dr. Klaus Bonhoff, discusses the subject on the podium. The cooperation between the Berlin and Brandenburg Chambers of Industry and Commerce together with NOW shows the increasing level of interest in this topic. The acceptance of renewable energy among the public, the positioning of the state of Brandenburg in the energy turnaround and the developed approaches for potential areas of application in business are common subjects that are energetically discussed by participants during breaks.

Left/from left to right: Guido Buchwald (1990 football world champion, Sport Director of Stuttgarter Kickers), Sebastian Klick (winner of »Jugend forscht«), Dr. Klaus Bonhoff (Managing Director, NOW)

Right: Dr. Veit Steinle (Head of Department, BMVBS) opens the f-cell

2012

11

02 NOVEMBER 2012 / COMPANY INITIATIVE ELECTROMOBILITY »UI ELMO« PROJECT KICKOFF

Hand-over of the funding agreement by Enak Ferlemann (Parliamentary State Secretary, BMVBS)

Green economy: To kick off the »UI EIMo – trans-company and cross-sector testing of electromobility in operational practice« project, Enak Ferlemann, Parliamentary State Secretary at the BMVBS, hands over the funding agreement to the lead company Bremer Nehlsen AG. As part of the project that is being conducted in the Bremen/Oldenburg model region, 80 companies will be equipped with around 160 electric vehicles and a total of 200 recharging points by 2015. The goal is to test the electromobile fleet in day-to-day operation.

15 – 16 NOVEMBER 2012 / IPHE WORKSHOP IN SEVILLE

The future in Spain: How can renewable energy be integrated in future global energy supplies? What role does hydrogen hereby play as a storage medium? These are the questions being tackled at the »Hydrogen – A competitive Energy Storage Medium for large scale integration of renewable electricity« workshop, organised by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). Participants from Spain, South Africa, Turkey, England and the USA as well as representatives from the European Commission discuss the potential of hydrogen as a storage technology. Numerous speakers provide insights as to the current status of the technology along with the technical and commercial hurdles that remain. Besides the exchange of know-how and experiences, the international forum also gives the opportunity to sound out the possibilities for cross-border cooperation.

26 NOVEMBER 2012 / DEPLOYMENT OF LOW MAINTENANCE FUEL CELLS IN THE NATIONAL DIGITAL RADIO NETWORK

Safety first: With the hand-over of a symbolic funding agreement, the NIP-supported »W-NEA BOS BB – Hydrogen emergency power systems for public safety authorities (BOS) in the state of Brandenburg« project is launched. Focus of the project is the deployment of a total of 116 fuel cells for the uninterruptible (emergency) power supply in BOS base stations for digital radio in the state of Brandenburg. Chief requirement and testing criteria is the reliability of the fuel cell to provide constant operational readiness. Without the support of the BMVBS and NOW, conventional high maintenance diesel generators would have been implemented for the emergency power supply.

12

05 DEZEMBER 2012 / »ECONOMY ON THE CURRENT« PROJECT LAUNCHED

From left to right: Dirk Inger (Transport Ministry), Achim Schaible (Chairman of the Board, Renault Deutschland AG), Klaus-Dieter Peters (Chairman of the Board, HHLA) and Frank Horch (Senator for Economy, Hamburg) at the hand-over of the HHLA electric fleet

Hello electromobility: The operators of the HHLA (Hamburger Hafen- und Logistik AG) now boast a fleet of 24 electric vehicles being deployed for transporting personnel at the Tollerort container terminal. The vehicles are handed over as part of the »Hamburg – Economy on the current« project, in which eleven project partners demonstrate the operational application of electric vehicles and their suitability for day-to-day deployment in a commercial context. The electric fleet replaces 60 per cent of conventional passenger vehicles and transporters at the Tollerort terminal and therefore contributes to a significant CO_2 reduction for container handling. The power to charge the vehicles is produced from renewable sources.

10 DEZEMBER 2012 / FEDERAL MINISTRY OF THE ENVIRONMENT RECEIVES FUEL CELL HEATER

From left to right: Rainer Bomba (State Secretary BMVBS), Volker Nerlich (Hexis), Katherina Reiche (State Secretary BMU), Dr. Klaus Bonhoff (Managing Director, NOW) at the hand-over of the fuel cell heater to the BMU

Warmth for Christmas: Rainer Bomba, State Secretary of the BMVBS, hands over a fuel cell heater to Katherina Reiche, State Secretary of the Federal Ministry for the Environment, Nature Conservation and Reactor Safety (BMU – Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit), to be integrated in the BMU energy supply. The hand over transpires as a part of the NOW lighthouse project »Callux« for the testing of fuell cell heating systems under everyday conditions.

NOW as social networker: down-to-earth and personal, NOW posts interesting articles, films and photos on facebook – and sometimes also provides a glimpse behind the scenes:

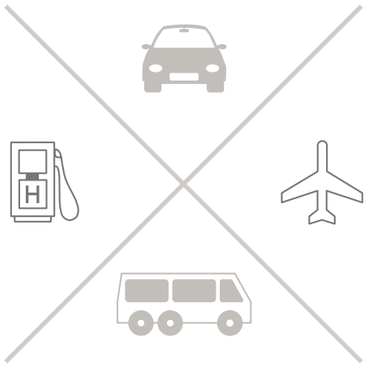
www.facebook.com/NOWGmbH

ZEIT ONLINE

by Christoph M. Schwarzer | 28 June 2012 – 10:54 am

ALTERNATIVE FUELS – »INVESTMENTS MADE IN HYDROGEN FILLING STATIONS WILL REAP DIVIDENDS«

Klaus Bonhoff, head of the hydrogen initiative NOW, explains in this interview how the development of infrastructure is financed, and that the allocated public funding should be repaid in the future.



»Hydrogen must be produced entirely from renewable energy in the long term.«

ZEIT ONLINE: Mr Bonhoff, at how many hydrogen fuel pumps will the fuel cell vehicles that have been announced for 2015 be able to be refilled?

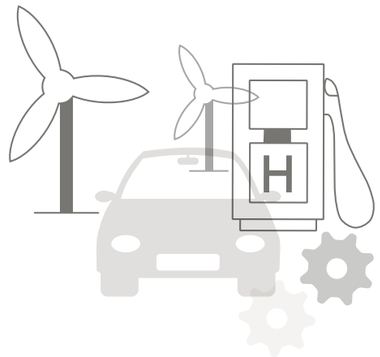
Dr. Klaus Bonhoff: Around 50 publically accessible filling stations should be operational by then. It is important that metropolitan regions are served and that a network of corridors exists. Everyone with a fuel cell vehicle should be able to traverse the country – emission free, from north to south, east to west.

ZEIT ONLINE: Aren't 50 pumps far too few? It sounds more like a prevention strategy in order to keep the demand for fuel cell vehicles low.

Dr. Klaus Bonhoff: Indeed, 50 pumps are too few. They will only let us meet the initial demand. That is why this number must be successively increased: the development of infrastructure must go in concert with the growing number of vehicles. The goal is 1,000 hydrogen filling stations. I expect we will reach this number from 2025.

ZEIT ONLINE: What does a hydrogen filling station cost?

Dr. Klaus Bonhoff: That depends on its size. A simple additional pump at a conventional filling station today costs € 700,000. For a large filling station with its own electrolyser for producing hydrogen on site, you are currently looking at least € 1.5 million. For the 50 pumps that are planned, we will be spending an additional € 40 million.



ZEIT ONLINE: What amount of public funding is available?

Dr. Klaus Bonhoff: The Federal Ministry for Transport via the National Innovation Programme Hydrogen and Fuel Cell Technology funds up to almost half of the total investment sum. The amount of allocated funding is calculated in accordance with the filling station's level of innovation.

ZEIT ONLINE: When will the companies benefitting from this approach pay back the funding they have received?

Dr. Klaus Bonhoff: As yet, this has not been clearly defined. But it is exactly what needs to be openly debated. What I consider to be a commercially successful idea is that government cushions the investment risks that are present in the preliminary phase. At the point where the infrastructure becomes profitable, the government funding should be repaid. Binding agreements between government and businesses need to be established for this.

ZEIT ONLINE: How likely is it that hydrogen will erode the dominance of the large oil companies?

Dr. Klaus Bonhoff: One must first differentiate between the production and distribution of hydrogen. In terms of production, companies from new industries such as wind parks or photovoltaic fields have good prospects of producing hydrogen from domestically sourced energy. Every litre of oil that is not imported is an economic gain. The other question concerns how the hydrogen gets to the customer and into their vehicle. Here, the oil companies can and should play a part. Naturally, it makes sense that drivers aren't forced to learn something new, but rather can simply refuel at places they are already familiar with.

ZEIT ONLINE: Are figures available that compare the potential savings from crude oil imports against the costs of hydrogen?

Dr. Klaus Bonhoff: Such analyses are currently being conducted. What can already be said is that a third of the primary energy in Germany is used by the transport sector – which is almost completely dependent on fossil fuels. That means crude oil imports. Each year, due to rising prices, € 200 billion more is spent in the EU than just 10 years ago. In view of such figures it is easy to imagine that the investments being made in hydrogen infrastructure will reap dividends.

ZEIT ONLINE: Where does the hydrogen actually come from?

Dr. Klaus Bonhoff: The very small amounts currently required predominantly stem as a by-product of industrial processes. For example, hydrogen is split from natural gas. In the long term, hydrogen must be completely produced using renewable sources of energy. Practical examples for this already exist today. Yet the amount of energy produced inherently fluctuates, which means that energy providers need to find a suitable storage solution. This is where hydrogen really comes into its own. And with it, the traditional separation of the transportation, power and heating markets can be overcome. That makes complete sense and there is simply no way around it.

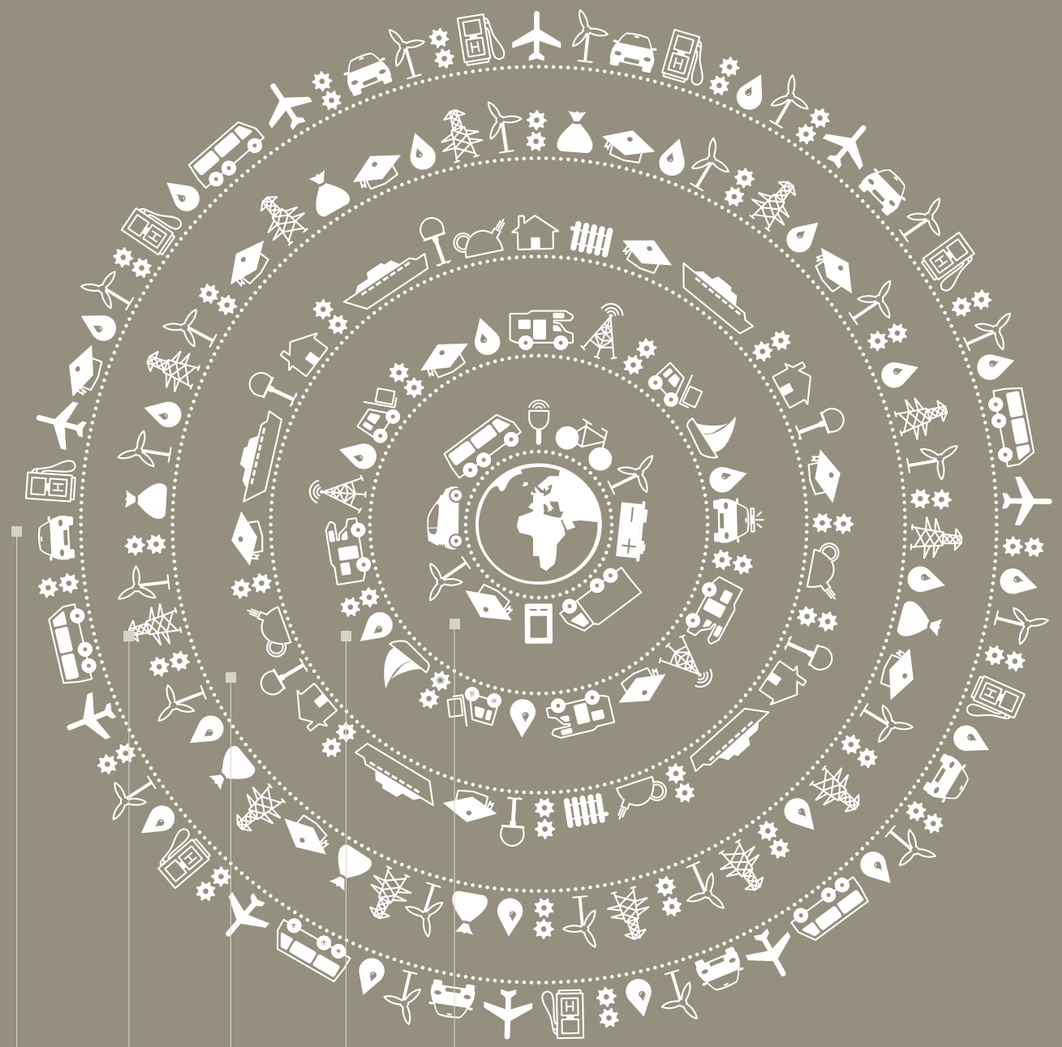
© ZEIT ONLINE

www.zeit.de/auto/2012-06/wasserstoff-tankstellen-finanzierung

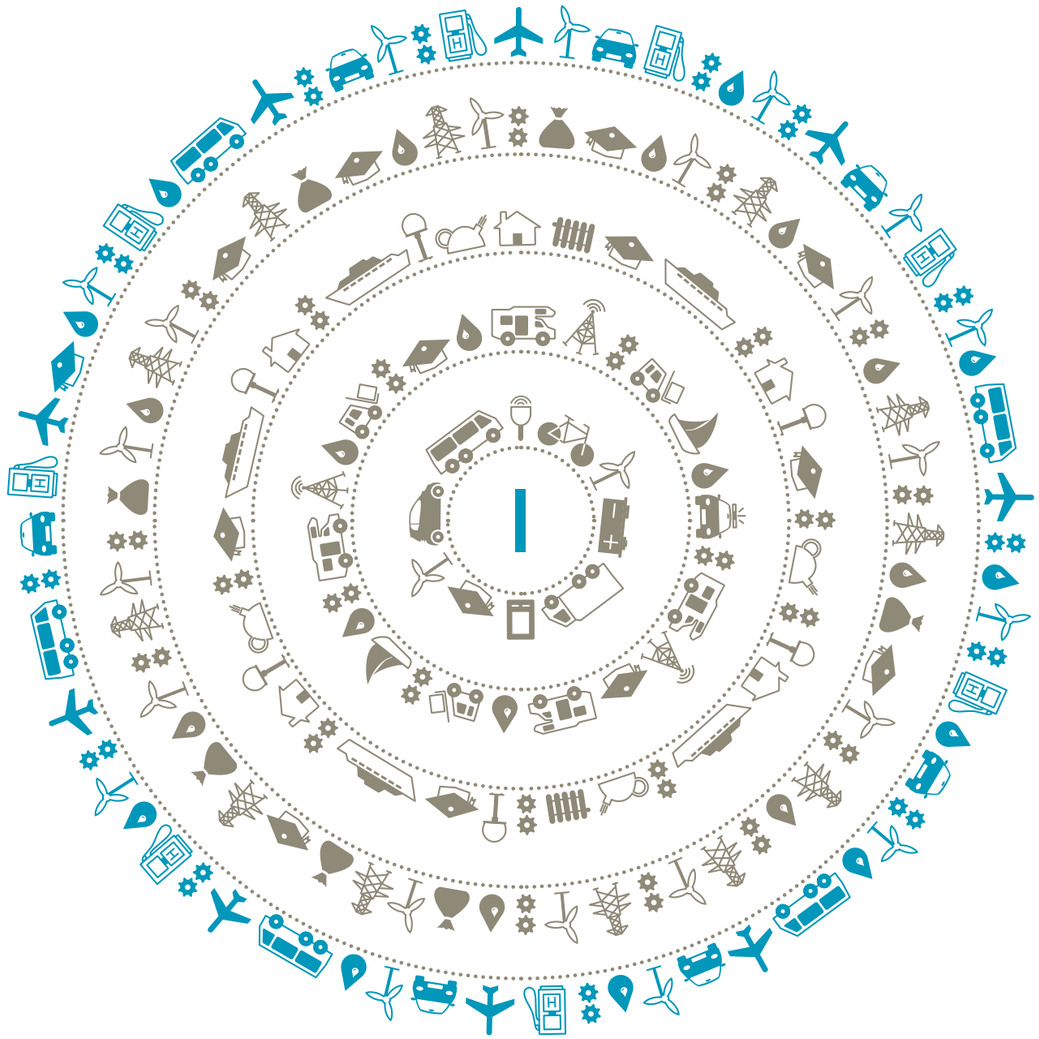

» I'm all charged for electromobility «
Federal Minister Dr. Peter Ramsauer
Der Tagesspiegel May 2012
The oil of the future
WirtschaftsWoche February 2012
Revolution at the pump – the hydrogen century begins
WirtschaftsWoche February 2012
Fully charged – expansion of the recharging infrastructure
Frankfurter Allgemeine Zeitung / publisher's supplement March 2012
» Mobility will undergo fundamental changes «
» Hydrogen: the key to achieving Germany's energy turnaround «
ATZ, October 2012
» The century of hydrogen begins now. We believe in vehicles running on this fuel. Hydrogen is the better oil. «
Dieter Zetsche, Head of Daimler AG
Spiegel Online June 2012
Storage done differently – electrolysis
Energiespektrum July 2012
» We are all aware that electric vehicles have a pioneering role for mobility in the future. I want that Germany, the country that invented the automobile, is at the forefront of this innovation. «
German Chancellor Angela Merkel
ADAC Motorwelt February 2011
Press review 2011/2012
» In the future we will see both electric vehicles with batteries and those with a fuel cell and hydrogen as the source of energy on the roads «
Dieter Zetsche, Head of Daimler AG
Spiegel Online June 2012

NOW coordinates the National Innovation Programme Hydrogen and Fuel Cell Technology of the federal government and the Electromobility Model Regions of the BMVBS.

The following provides detailed information of projects newly approved in 2012 as well as those concluding in 2012.



NIP – TRANSPORT AND INFRASTRUCTURE



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COMPLETED PROJECTS ARE MARKED WITH 🏁 .

NIP – TRANSPORT AND INFRASTRUCTURE

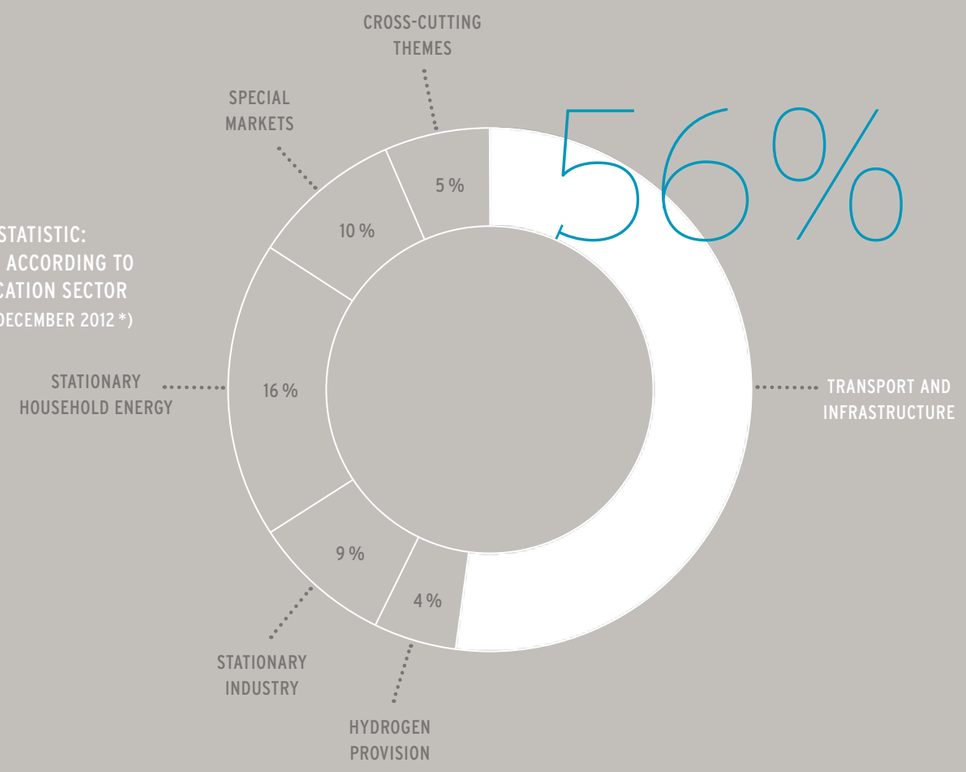
The Transport and Infrastructure programme area in the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP) incorporates research and development (R & D), demonstration activities for hydrogen-fuelled vehicles on public roads as well as the corresponding necessary infrastructure.

In terms of vehicles, its scope extends from R&D activities to fuel cell drives and the on-board power supply for various transport applications – including drives for passenger cars, buses and the on-board power supply of aircraft, for example. Complete drive systems and key components such as PEM fuel cells and the storage of hydrogen are dealt with as a part of the various projects being undertaken. The aims include: reducing costs and weight, increasing service life and efficiency as well as improving reliability in day-to-day operation. In regard to these goals, the focus in terms of infrastructure is aimed at the continued advancement of compression technologies and the development of technology standards for hydrogen filling stations.

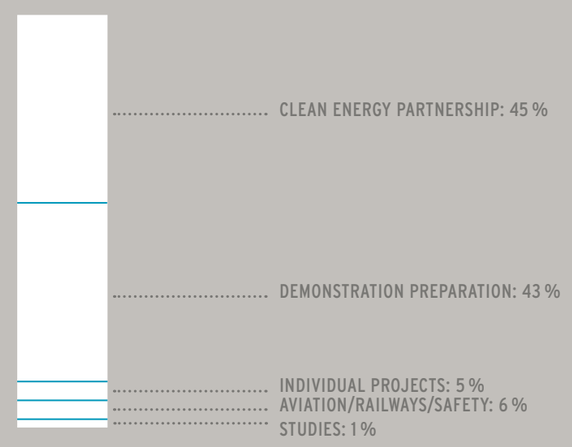
An important aspect in the NIP programme area of Transport and Infrastructure concerns demonstration projects that can validate the implemented technology under everyday conditions and prepare the market by increasing user acceptance. To enable this, hydrogen-run fuel cell vehicles are being tested in comprehensive collaborative projects spanning both personal transportation and local public transport applications across several key regions, which also encompass the filling station infrastructure.

Contact Head of Programme: Thorsten Herbert / thorsten.herbert@now-gmbh.de

NIP – STATISTIC: SHARE ACCORDING TO APPLICATION SECTOR (AS AT DECEMBER 2012 *)



NIP – TRANSPORT AND INFRASTRUCTURE: ALLOCATION BY APPLICATION AREA (AS AT DECEMBER 2012)



* The diagram incorporates projects at planning stage at NOW, being processed by PtJ, LOI (Letter of Intent) as well as those approved.

DEVELOPMENT OF INFRASTRUCTURE PICKS UP SPEED – CLEAN ENERGY PARTNERSHIP (CEP)

The CEP is Europe's largest demonstration initiative for hydrogen mobility and a lighthouse project in the NIP Transport and Infrastructure programme area.

In January 2011, the Clean Energy Partnership (CEP) entered into its third and final project phase, which will end in 2016 with the market introduction of series production vehicles. Phase III therefore places a strong focus on the wide-scale operation of vehicles by users in order to attain valuable insights regarding the interfaces of vehicle, user and infrastructure. The emphasis in 2012 was on infrastructure.

Witnesses to this endeavour were the openings of CEP filling stations in Berlin (Total), Hamburg (Shell, Total, Vattenfall), Dusseldorf (Air Liquide) and Karlsruhe (EnBW). In Hamburg, four of seven fuel cell hybrid buses are in scheduled service by the Hamburg transport authority (Hamburger Hochbahn). Two new partners joined the CEP: the Baden-Württemberg energy supplier EnBW – which due to filling stations in southern Germany now enables vehicles to be delivered there – and German technology company Siemens, which will support the CEP in the area of production with electrolysis technology.

On a working level, the CEP took on several new themes that must be resolved prior to the market introduction of hydrogen vehicles. Specifically, these include the certifiable measurement of hydrogen dispensed and its level of purity, the testing of refuelling coupling quality as well as the validation of the refuelling process. Regular exchanges with the California Fuel Cell Partnership and the Scandinavian Hydrogen Highway Partnership serve to additionally ensure that technical solutions and the development of infrastructure are promoted on an international level.

For more information, please visit:
www.cleanenergypartnership.de

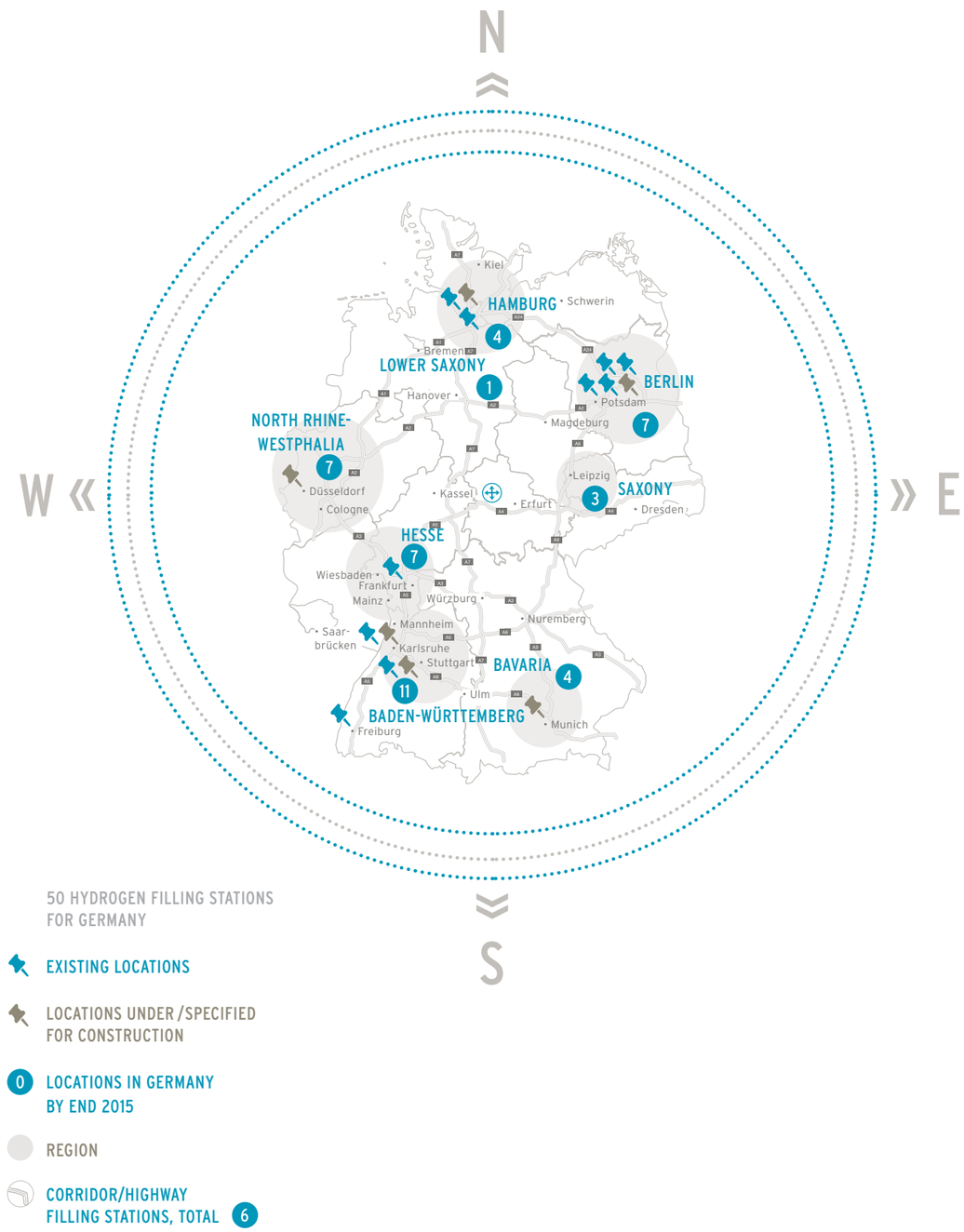
From left to right: Patrick Schnell, Dr. Klaus Bonhoff, Markus Sieverding, Jörg Hömberg, Prof. Thomas Weber, Dr. Peter Ramsauer, Dr. Andreas Opfermann, State Secretary Rainer Bomba, Burkhard Reuss

50 HYDROGEN FILLING STATIONS FOR GERMANY – FEDERAL MINISTRY OF TRANSPORT AND INDUSTRY PARTNERS DEVELOP CROSS-REGIONAL FILLING STATION NETWORK

The commercial introduction of electric vehicles with fuel cell drives is dependent on the establishment of a comprehensive network of hydrogen filling stations. On 20 June 2012, the Federal Ministry of Transport, Building and Urban Development (Bundesministerium für Verkehr, Bau und Stadtentwicklung – BMVBS) resolved to extend the hydrogen filling station network in Germany, signing a Letter of Intent together with leading industrial enterprises. A national supply network of at least 50 public filling stations throughout Germany is to be operational by 2015. As such, the expansion of the hydrogen filling station network is supporting the commercialisation of fuel cell vehicles.

With funds exceeding 40 million euros, government and industry will together increase the current number of hydrogen filling stations from 15 to 50 within the framework of the NIP. This ensures the demand will be met for the number of fuel cell vehicles anticipated to be on the roads at this time, while simultaneously also testing the innovative filling station technology. Metropolitan regions stand at the focus of this plan as well as the establishment of corridors connecting the metropolitan regions.

Federal Minister Dr. Peter Ramsauer as well as representatives from the companies Air Liquide, Air Products, Daimler, Linde and Total Deutschland signed the Letter of Intent. NOW will coordinate the expansion of the filling station network.



» Hydrogen mobility with fuel cell vehicles is in market preparation. «

I / 01

» FUEL CELL MODULE 5 KW-CLASS «

The »BZM 5« project aims to develop a fuel cell module for a power range with a nominal capacity of between 3 and 8 kW, for deployment in industrial applications, e.g. warehouse vehicles such as forklifts. It will be based on a metal bi-polar plate stack and is to boast manufacturability using mass production processes. In doing so, a German supply chain will be developed as far as this is possible.

The project is structured into three general lines of development. At the core are the cell and metal bi-polar plate stack as well as the sealing and associated cell and stack construction concepts. Furthermore, a synthetic end plate assembly unit suitable for injection moulding will be developed in which components of the fluid system are to be integrated. An enclosure will ensure mechanical, thermal and electrical shielding. Assembled, a fuel cell module that covers the essential system functionalities and significantly simplifies system integration will be created.

Upon successful completion of this reference project, ElringKlinger AG will establish itself as a capable mass producer of industrial stacks. Sustainable industrial solutions for stack components, stacks and fuel cell modules will be developed and demonstrated. Besides developing the fuel cell module for vehicles in industrial deployment, the potential for transfer to other applications will also be investigated. With the project's goal of commercialisation, the introduction of fuel cell applications to the market is coming into reach. ElringKlinger AG anticipates that the series development and market introduction phases can respectively be embarked upon following completion of the field tests.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
ElringKlinger AG	7,735,102	3,712,849

COMMENCEMENT: 01 September 2011
CONCLUSION: 31 August 2015

» Opening up the market segment of fuel cell modules for vehicles in commercial deployment «

» Knowledge on business, ecological and social aspects «

I / 02

» ETUDE – THE PATH TO THE FUEL CELL VEHICLE «

The »ETUDE« qualification project addresses the three key educational areas of vocational training (upper secondary), higher education and ongoing professional training:

» Development of a **modular technology system** for the demonstration of the electro-technical and mechanical relationships of battery, fuel cell and hybrid drives for use within the framework of vocational training.

» Development of a **powertrain model** for the demonstration and simulation of the technological, functional and systematic relationships of battery, fuel cell and hybrid drives for use within the framework of tertiary/apprenticeship education.
The model is suitable for researching system relationships and approaches for the optimisation of the energy management of drive concepts.

» **Information software** will be developed for the ongoing professional training of specialists already involved in associated industry, service and trade. The software will address technical issues in regard to the vehicles and infrastructure to provide relevant specialists with detailed background knowledge on business as well as ecological and social aspects for the introduction of electromobility. The software will also have the ability and purpose to serve as an aid for decision makers in government and business.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Heliocentris Energy Solutions AG	1,443,720	692,986
H-TEC Wasserstoff-Energiesysteme GmbH	239,085	114,761
Modern Learning GmbH	145,327	69,757
Spilett New Technologies GmbH	152,327	73,117

COMMENCEMENT: 01 January 2012
CONCLUSION: 31 October 2014

I / 03

» CONTINUATION OF FORD FUEL CELL TECHNOLOGY DEVELOPMENT TO ATTAIN THE COMPANY COST-TARGETS (TECHN. MODULE FORD FCEV) «

Ford is a founding member of the Clean Energy Partnership (CEP) Berlin and as such, involved in the project since 2002. Goal of the third CEP phase that runs from 2011 to 2016 is the elimination of obstacles that are still present for the market introduction of fuel cell technology. Cost-benefit aspects and service life are of particular focus, as well as the efficiency and power density of the system.

When the first publically accessible hydrogen filling station opened in Berlin in 2005, Ford introduced three Ford Focus fuel cell vehicles into the project. In the meantime, one of these has been replaced with a Ford Explorer, equipped with the next generation of fuel cell technology. From the beginning, the vehicles have been in the hands of customers, with the goal of testing the everyday suitability of hydrogen mobility. In the interim, all vehicles were also modified from using 350 bar hydrogen technology to 700 bar tank system technology in order to increase the range and subsequently customer acceptance. The Ford vehicles deployed in the CEP have exceeded their originally estimated service life by a large margin and are highly cherished by their users due to their robustness and reliability.

Ford has been working on the development of fuel cell vehicles since 1994, and together with the companies Daimler and Ballard, is stakeholder in the Automotive Fuel Cooperation, headquartered in Vancouver. The developments within the CEP are lead by Ford's European research centre in Aachen.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Ford Forschungszentrum Aachen GmbH	4,590,084	2,203,240

COMMENCEMENT: 01 APRIL 2012
CONCLUSION: 31 SEPTEMBER 2016

Ford Focus Fuel Cell

Hydrogen filling station in Berlin's Heidestrasse

I / 04

» CLEAN ENERGY PARTNERSHIP (CEP) – OPERATION OF A FULLY-INTEGRATED, PUBLIC HYDROGEN FILLING STATION IN HEIDESTRASSE IN BERLIN «

With its filling station in the Heidestrasse in Berlin's Mitte district in the immediate vicinity of the government quarter and main railway station, TOTAL is operating its third and simultaneously most powerful fully-integrated hydrogen filling station in Berlin. This means a total of four hydrogen filling stations are now in operation for public use in the German capital.

The filling station was established in 2011 with funding from the government's second economic stimulus package. It was the first time that the specifications outlined in the »Hydrogen Refuelling Station Standardisation« paper produced within the framework of the »H_2 Mobility Initiative« were implemented for the construction of a standardised hydrogen filling station in Germany. The filling station has been in operation since December 2011 within the framework of the NIP.

The plant technology, which was supplied by Linde AG, meets the specifications as set out in the H_2 Mobility Initiative for so-called small plants. It boasts a capacity of 212 kg/day and allows up to 6 refuelling procedures per hour or 38 per day with a maximum waiting time of 5 minutes. Hydrogen is provided at a pressure level of 700 bar. Its particular feature: only hydrogen produced using renewable energy is dispensed, which is made by Enertrag AG through wind power in Prenzlau, and is delivered by trailer.

The filling station is equipped with the customer information system from the CEP. Its availability can be checked in real time on the CEP website in the customer section. The CEP H_2 Card may be used for refuelling, which provides authorisation and allows cashless payments at all CEP locations across the country.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Total Deutschland GmbH	420,945	202,054
Linde AG	1,130,669	542,721

COMMENCEMENT: 01 December 2011
CONCLUSION: 01 April 2012

I / 05

» H_2 MOBILITY STUTTGART – ESTABLISHMENT OF A HYDROGEN FILLING STATION INFRASTRUCTURE IN STUTTGART «

EnBW filling station in Stuttgart's Talstrasse

Hydrogen filling stations at which hydrogen for fuel cell vehicles is produced emission free and on a needs basis are rare. With its pilot plant in Stuttgart, EnBW Energie Baden-Württemberg AG wishes to assess whether such hydrogen filling stations for customers can be operated in an economically viable manner. The company is also examining in Stuttgart whether hydrogen filling stations are generally suitable for use as dynamic consumers and/or for the storage of power from renewable sources. If so, hydrogen filling stations could then take on a second role as a storage facility and thereby help, for example, to relieve the electricity networks of excess supply during periods of high wind. The company has already been operating an hydrogen filling station in Karlsruhe, which is supplied with hydrogen from a large-scale plant via truck.

A connection to an energy source is a prerequisite for the production of hydrogen at the point of sale. The hydrogen filling station in Stuttgart was equipped with an electrolyser that, in future, can be controlled in proportion to the supply of renewable energy. The pilot plant will be publically accessible for 2.5 years after completion and can therefore be used by all fuel cell vehicle pioneers.

EnBW's involvement in the establishment of a hydrogen infrastructure also supports existing climate policy goals: the state of Baden Württemberg is supporting a reduction in CO_2 emission by 2020 of 27 %.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
EnBW Energie Baden-Württemberg AG	4,341,264	2,083,807

COMMENCEMENT: 01 February 2011
CONCLUSION: 31 December 2013

I / 06

» DEMONSTRATION MERCEDES-BENZ B-CLASS F-CELL FLEET IN STUTTGART AND FRANKFURT «

» Fleet demonstration project with a total of 30 fuel cell vehicles from Mercedes-Benz

» Deployment of the Mercedes-Benz B-Class F-CELL under everyday conditions in multi-city operation by customers

Since January 2011, a cross-regional fleet demonstration project with a total of 30 Mercedes-Benz fuel cell vehicles has taken place in the Stuttgart and Frankfurt regions. Customers use the Mercedes-Benz B-Class F-CELL under everyday conditions within the framework of the Clean Energy Partnership (CEP).

Aim of the project is to deploy the vehicles, especially over long distances. Previously, due to the lacking infrastructure, use was limited to the city area and immediate surroundings. With filling stations in Stuttgart and Frankfurt, customers can experience these vehicles on highways and interstate roads as they travel between cities. The tank of a Mercedes-Benz B-Class F-CELL is filled at modern hydrogen filling stations in just three minutes, which provides a range of 400 km. With additional filling stations in cities including Karlsruhe, Freiburg, Munich and Dusseldorf, other cities can now also be reached with fuel cell vehicles. A comprehensive hydrogen infrastructure is a decisive factor for a successful, widespread market introduction of fuel cell technology.

The experiences made throughout the project and the results from an associated customer acceptance survey are used to further develop fuel cell technology. The results are also put to the disposal of supplier project modules and thereby also help to support their research and development activities.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Daimler AG	13,179,140	5,864,611

COMMENCEMENT: 01 January 2011
CONCLUSION: 30 June 2015

Mercedes-Benz B-Class F-Cell in front of the OMV filling station at Stuttgart Airport

I / 07

» PROTOTYPE DEVELOPMENT OF A CRYOGENIC PRESSURE FILLING SYSTEM «

The fundamental challenge for the introduction of hydrogen as a fuel is to achieve a sufficiently high energy density, especially in the vehicles. While 700 bar refuelling and storage technology is chiefly used today by car manufacturers in their test vehicles, research is continuing in developing complementary storage technologies.

A promising development is in so-called cryogenic pressure tanks, which store cryogenic liquid hydrogen under pressure. These enable similarly high storage densities to be attained as with the atmospheric storage of liquid hydrogen, while simultaneously significantly suppressing and delaying the boil-off effect. The resulting increase in vehicle range is estimated to be comparable to that of using today's conventional technology.

As with the direct refuelling with hydrogen at 350 and 700 bar, the filling station system must be adjusted to meet specific conditions und critical components for refuelling. Key aspect of this undertaking is the interface between the vehicle and the filling station – the pump coupling. Aim of the development project is a functional prototype of a cryogenic pressure coupling with the associated controller and a safety analysis as well as the theoretical conception of the entire filling station system.

In the future, cryogenic pressure technology can supplement today's advanced 700 bar technology and provide the end consumer with alternative storage concepts according to their usage patterns.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Linde AG	439,424	210,924

COMMENCEMENT: 01 February 2011
CONCLUSION: 31 December 2012

Hydrogen at public filling stations in Berlin

I / 08

» FURTHER DEVELOPMENT OF CRYOGENIC PUMP TECHNOLOGY «

The value-added chain must be further optimised for the introduction of a new, sustainable fuel in the existing energy system. With hydrogen, for example, various distribution and storage concept alternatives exist: gas is stored at the filling station in either liquid or gas form, depending on the local circumstances.

In cases where hydrogen delivery is in liquid form, Linde has developed a special, highly efficient pump technology for the direct compression of liquid gas to gaseous hydrogen, within the framework of the National Innovation Programme.

This technology is being demonstrated in various filling stations and further possibilities for improvement on the system level could be identified during operation of the plants. The ongoing project deals with subjects that include space requirements, complexity, efficiency, supply chain and costs – and through increased standardisation is paving the way for commercialisation of the technology.

Besides filling stations with very high refuelling amounts, this technology can also, for instance, be used for cryogenic pressure storage, which is also currently being developed.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Linde AG	648,200	311,136

COMMENCEMENT: 01 April 2012
CONCLUSION: 31 March 2014

I / 09

» TEST OPERATION OF FIVE TOYOTA FCHV-ADV FUEL CELL VEHICLES IN FLEET OPERATIONS AND PROVISION OF SERVICE CAPACITIES IN BERLIN «

As partner of the Clean Energy Partnership (CEP), Toyota is convinced that there is currently not one single solution when developing sustainable drive technologies of the future. Toyota has taken on a broad developmental course in which fuel cell hybrid vehicles play a key role – especially for long ranges.

Since 1992, Toyota has been working on fuel cell vehicles. In 2002, it launched its first such production vehicles, based on an SUV. The second generation of this vehicle, the FCHV-adv, hit the road in Japan in 2008. The FCHV-adv possesses pressure tanks that are rated to 700 bar.

By implementing this tank technology, the vehicle range possible from a single tank has been increased to around 700 km.

Five FCHV-adv fuel cell vehicles were deployed to test the everyday use of this technology in the hands of users in field trials by Toyota, within the framework of this project. At the core is the optimisation of the interface between vehicle and filling station, which is a prerequisite for high customer acceptance and in turn successful market introduction.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Toyota Motor Europe NV./SA	1,067,802	512,545

COMMENCEMENT: 01 September 2011
CONCLUSION: 30 June 2015

I / 10

» S-PRESSO «

Gathering experience with new drive concepts and technologies is a guiding principle for the vehicle strategy in area of buses at Stuttgart public transport operator Stuttgarter Straβenbahnen AG (SSB). The company is continuously testing new technologies in cooperation with vehicle manufacturers and also invests in innovative vehicle technology itself.

Its goal to deploy fuel cell hybrid buses on the new bus route 70 between Plieningen and the airport by the end of 2013 has taken a decisive step forward. On 17 December 2012, Dr. Veit Steinle of the Federal Ministry for Transport handed over the funding agreement to Stuttgart's Lord Mayor and Chairman of the SSB Board, Dr. Wolfgang Schuster.

Total funding volume of the project entitled »S-Presso« (Stuttgarter Praxiserprobung von wasserstoffbetriebenen Omnibussen – Stuttgart practical testing of hydrogen-run buses) amounts to approx. 3.2 million euros. These funds cover around 50 % of total costs for the test project earmarked to run for three years (until mid-2016). The project costs include the procurement of three fuel cell hybrid buses, workshop expenditures, training measures, technical consultation and adaptation of the hydrogen filling station for bus operations.

To date, SSB has made positive experiences with both fuel cell and hybrid buses (SSB currently deploys five diesel hybrid buses). With the integration of fuel cell hybrid buses for scheduled services, SSB aims to test, for example, how refuelling of the vehicles using a combination of hybrid technology and energy from hydrogen is possible during scheduled services without needing to establish an additional filling station infrastructure at the depot. The public hydrogen filling station is currently located at Stuttgart airport.

The overall goal is to examine and enhance the practical suitability of fuel cell drive technology for local bus services. Only with such tests can empirical values concerning the real potential to protect resources be generated and thereby – through a holistic and sustainable approach – be in a position to make qualified statements regarding which drive is best for what type of deployment.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Stuttgarter Straβenbahnen AG	6,605,421	3,240,036

COMMENCEMENT: 01 June 2012
CONCLUSION: 31 May 2016

»Local buses with fuel cells«

I / 11

» HYDROGEN-REFERENCE MEASURING SYSTEM TO 70 MPA «

The refuelling of hydrogen vehicles at public filling stations must fulfil diverse requirements. A significant criterion is that the amount of hydrogen refuelled is precisely measured for payment. The hydrogen reference measuring system developed by Linde now enables a comparison between the amount shown at the fuel pump and a calibrated norm and thereby facilitates the calibration of existing measurement technology.

Experience gained by Linde AG in the area of hydrogen filling station technology and established calibration and measurement systems of natural gas filling stations provided the foundation for the development and construction of the reference measuring system for hydrogen refuelling at 700 bar. The project commenced in 2009 within the framework of phase II of the Clean Energy Partnership (CEP). Following a two-year development period, the first series of tests were conducted in 2011 and functionality of the development proven by the end of the project in 2012.

As the hydrogen reference measuring system is to be implemented throughout Germany, a trailer was used as a base. A regular 700 bar vehicle tanking system for up to four kilograms was affixed on a set of precision scales, and installed on the trailer. This construction enables an accurate measurement of the mass of hydrogen coming from the fuel pump into the tanking system. A particular challenge was to design the calibration and testing module in accordance with applicable safety and ADR regulations for the transportation of dangerous goods, which accounted for a large portion of the project duration. Approval of the reference measuring system by the German technical inspection agency TÜV means the system is now permitted to travel on public roads and can be used at public hydrogen filling stations.

Possible fields of operation for the Linde hydrogen reference measuring system are the calibration of hydrogen pumps at filling stations as well as the official calibration of these by state-run Offices of Weights and Measures (Eichämter). The system can also provide facts on real consumption data of fuel cell vehicles and can simulate refuelling procedures. During the first series of tests in the Linde hydrogen centre in Unterschleissheim and at the CEP filling station on Berlin's Sachsendamm, the system was successfully tested. Nevertheless, there is still potential for further development, such as in regard to an infrared interface and the prospect for the approval of hydrogen fuel pumps conforming to SAE.

The development of the hydrogen reference measuring system is an important step on the path to commercial hydrogen filling stations, without which the calibration of the measuring equipment is not possible.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Linde AG	204,300	98,064

COMMENCEMENT: 01 August 2009
CONCLUSION: 30 April 2012

I / 12

» OPTIGAA – OPTIMISATION OF THE GAS DIFFUSION LAYER FOR USAGE IN FUEL CELLS FOR VEHICLES «

The fuel cell is a promising alternative energy source of the future for vehicles. In contrast to competing technologies such as batteries, fuel cells are more competitive and environmentally friendly – increasingly so if successful in boosting efficiency and service life while simultaneously reducing the price. For developing solutions for the technical requirements and to reach the cost goals, the core components of the fuel cell – thereby the gas diffusion layer (GDL) in particular – play a significant role.

The following developmental themes were addressed within the »OptiGAA« project:

» Develop a comprehensive understanding of materials and the impact on the GDL in terms of performance, together with corresponding simulation and characterisation methods

» Development of GDL surfaces that do not damage even thin membranes and guarantee a long service life for the fuel cell

» Adjustment of the mass transfer properties to the prevailing operational conditions in the vehicle application according to the developed specification

» Optimisation of the mechanical characteristics to minimise

» › intrusion of the GDL into the gas channels of the flow field, as well as

» › contact resistance of the GDL to the catalyst layer for more effective use of the catalyser.

»OptiGAA« is a joint project of Freudenberg FCCT SE & Co. KG and Daimler AG.

Daimler provided the design requirements, operating conditions of the PEMFC, developed the requisite specification and characterisation know-how and clarified the necessary requirements for the GDL to improve operating characteristics and cost effectiveness. The developmental products from Freudenberg where evaluated by Daimler both in and ex situ. The results were subsequently compared with the calculations arising from simulations.

Freudenberg could reduce the GDL's potential to damage membranes by 80 % due to the improved GDL manufacturing process that was developed. The result is a significant increase in fuel cell service life.

Through the deployment of new raw materials to impregnate and coat the GDL, both the mass transfer properties and contact resistance could be improved and performance was enhanced by up to 30 %, while simultaneously achieving more robust operation.

The GDL mechanical characteristics were improved due to the use of new raw fibres and an adjusted production process, resulting in the reinforced GDLs delivering improved cell performance by up to 20 % – especially in wide gas channels.

The developments were both very cost-intensive and time-consuming as they were required to be conducted on continuous production plants. It was also shown that the new impregnation and coating materials make an adjustment of the current production process necessary. A finding made in the project was that the GDL microstructure has a great influence on the transfer properties for the reactant gases and water. Through an improved understanding of the relationships between the structure and function of the GDL materials, further GDL optimisation is achievable.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Freudenberg FCCT SE & Co. KG	1,977,221	949,066
Daimler AG	1,892,953	908,617

COMMENCEMENT: 01 September 2008
CONCLUSION: 31 December 2012

I / 13

» EXPANSION OF OPERATION OF HYDROGEN4 HYDROGEN-FUEL CELL VEHICLES TO NORTH RHINE-WESTPHALIA, WITHIN THE FRAMEWORK OF THE CEP «

Ten Opel HydroGen4 fuel cell vehicles were converted and certified in accordance with the European policy for road use. The expansion of operation to North Rhine-Westphalia augments the existing CEP locations in Berlin, Hamburg and Frankfurt (Main), and aims to demonstrate the suitability of the vehicles in everyday deployment in addition to removing existing obstacles for the market introduction of hydrogen-run passenger vehicles. Besides the key project goals, the aspects of driver and emergency services education at the new location and the certification of a new workshop to conduct maintenance on fuel cell vehicles were to be addressed.

While not a part of the described project, the establishment of a hydrogen filling station in Dusseldorf by Air Liquide was nevertheless a prerequisite for the deployment of the vehicles. Commencement of operations was originally scheduled for autumn 2010, yet due to administrative problems was delayed until summer 2012. As such, the first fuel cell vehicles could not be handed over until July 2012. This entailed that the scheduled 26 months of vehicle operation by customers within the scope of the regular project duration was reduced to just five months. For this reason, a six-month extension of the project was applied for.

An essential aim of the project is the effective presentation of fuel cell technology to the public. With 3M, Air Liquide, Energie Agentur NRW, e-Plus and Total, customers could be secured that used their Opel HydroGen4 vehicles both for everyday use as well as for official, promotionally effective events and thereby bring the message of environmentally friendly mobility to the public. Due to the delay in commencement of operation of the filling station, three of the vehicles were relocated to other CEP sites during the project term. The remaining seven HydroGen4 vehicles covered around 20,000 kilometres from the beginning of their deployment in North Rhine-Westphalia until the end of 2012. Operation was extremely reliable – only one single day of operation was lost due to reasons of the fuel cell system since summer 2012.

» Training of drivers and emergency services «

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Adam Opel AG	4,052,511	1,945,205

COMMENCEMENT: 01 June 2010
CONCLUSION: 31 December 2012

I / 14

» 700 BAR SAE J2601 LINDE HYDROGEN FILLING STATION IN UNTERSCHLEISSHEIM «

A pivotal aim within the framework of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) is to support and promote the expansion of the hydrogen infrastructure. With the establishment of the first 700 bar hydrogen filling station in Bavaria at the Linde production site in Unterschleissheim, the initial national infrastructure network is being advanced. For the first time, this means the Munich-Stuttgart corridor is now usable for fuel cell vehicles of the latest generation. Besides its overall objective, this project also facilitates the continued development of system-relevant components for filling station technology.

Linde AG has used the Unterschleissheim site since 2006 for intensive research into hydrogen technology. The developments on the vehicle side over the last few years – in particular introduction of 700 bar high-pressure storage – required the adjustment of technology to the latest refuelling standards. Comprehensive constructional measures to the storage system, compression unit and hydrogen pump were necessary to meet these new demands. It was advantageous that it was possible to build on existing subsystems, which meant it largely represented an upgrade.

Technologically, the upgrade of the existing filling station at the Linde site is based on so-called cryogenic pump technology. This highly efficient compression technology was similarly developed within the framework of the NIP and is especially known for its high throughput capacity and low need for maintenance. The hydrogen is stored on site in liquid form and is directly compressed by the pump to the required pressure for refuelling.

The upgrade of the existing testing and development centre to today's 700 bar refuelling technology enables testing and optimisation of refilling systems to be conducted. Furthermore, the centre can be used as a training facility for service technicians as well as a demonstration filling station for the general public.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Linde AG	648,200	311,136

COMMENCEMENT: 01 December 2010
CONCLUSION: 31 August 2012

» Continued development of system-relevant components for filling station technology «

REFUELLING WITH HYDROGEN – FILLING STATION TECHNOLOGY

Hydrogen is a very promising carrier of energy in many respects: for one, it boasts a very high energy content, and for the other it produces no emissions whatsoever when the hydrogen is reconverted to energy for the fuel cell.

Yet in order for it to be deployed as a commercial fuel, its distinguishing feature as lightest element in the universe with the lowest density must be taken into account for its storage and refuelling.

The hydrogen is delivered to the filling station in a cryogenic liquid form at -253° Celsius (LH_2) or pressurised in gaseous form at approx. 200 – 500 bar (CGH_2) and transferred into corresponding storage tanks on site. It can, however, also be produced on site using electrolysis, for example. As space is limited in vehicles for a tank, the maximum amount of energy possible must be stored within this space. For this reason, the hydrogen is compressed at the filling station. The fuel cell vehicle can then be refuelled with gaseous hydrogen. Substantial support for market preparation in terms of the construction and operation of hydrogen filling stations is being provided within the framework of the NIP.

The centrepiece of a hydrogen filling station is its compression technology. There are generally two methods available. The first involves compressing gaseous hydrogen to 900 bar. Various compressors such as dry-rotor systems, diaphragm compressors or ionic compressors are implemented for this purpose. The second method increases the compression of liquid hydrogen to 900 bar via cryogenic pump technology, then warms this up to -40° Celsius and can thereupon be used for refuelling in gaseous form.

Refuelling pressurised hydrogen

Gaseous hydrogen is stored in fuel cell passenger vehicles at either 700 or 350 bar, depending on the manufacturer. In fuel cell buses, 350 bar is usual. Refuelling at the pump occurs at around 900 bar which provides enough difference in pressure to completely fill the tank. Currently, a passenger vehicle tank can store up to seven kilograms of hydrogen. This corresponds with a range of up to 700 kilometres.

The technology along with the processes for storage, compression and refuelling have today been developed to such an extent that uniform global refuelling standards are now in place for commercial use (e.g. SAE 2601). Standardised solutions are already in place for the refuelling procedure and use of the pump nozzle. As in conventional vehicles, refuelling takes around three minutes – only the dispensed unit of mass is different, as hydrogen is refuelled in kilograms.

» HYDROGEN MOBILITY IS NO LONGER A VISION OF THE FUTURE. IT IS A REALITY. «

Above left: Prof. Johann-Dietrich Wörner (right), DLR Chairman of the Board and Project leader Dr. Josef Kallo (left) provide Transport Minister Dr. Peter Ramsauer (middle) with information on Antares DLR-H_2 and the potentials for implementing hydrogen technology in aviation

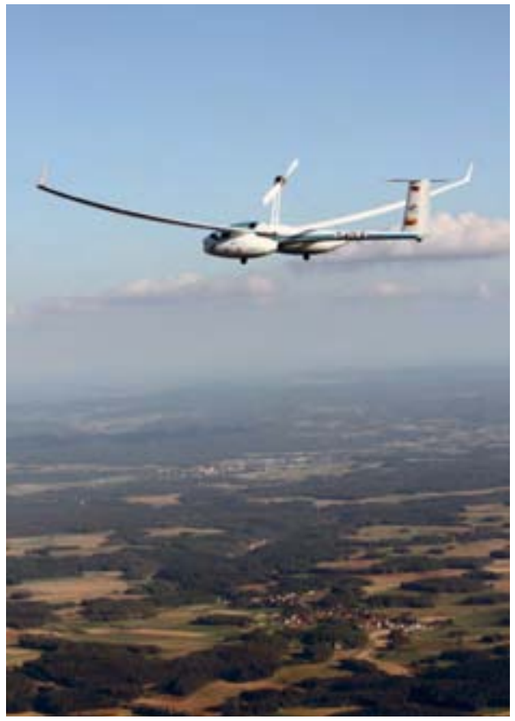
Bottom left: Antares DLR-H_2 on its way to the ILA air show in Berlin: low-temperature fuel cells demonstrate their reliability

HYDROGEN AND FUEL CELL TECHNOLOGY SPREADS ITS WINGS – THE ANTARES DLR-H_2 TOURS GERMANY

The fuel cell aircraft of the German Aerospace Centre (DLR – Deutsches Zentrum für Luft- und Raumfahrt) had already proven its flightworthiness in May 2009. Equipped with a new fuel cell system, Antares DLR-H_2 took to the air in September 2012 and covered almost 1,500 kilometres on its first tour of Germany.

Alternative drive technologies will also play a greater roll over the coming years in the aviation industry. For this reason, one of the funding priorities of the NIP Transport and Infrastructure programme area lies in the development of emission reducing innovations for air traffic. Fuel cells offer great potential for the more efficient and environmentally friendly production of energy, especially as power can also produced autonomously on the ground without the jet engines. As such, more than 17 million euros of funds have been allocated to projects in the area of aviation.

The Antares DLR-H_2 research aircraft is the world's first manned aircraft to be powered exclusively by fuel cells. On 07 September 2012, Antares DLR-H_2 took off on its first long haul flight across Germany. Enabling the flight was a new low-temperature fuel cell, developed in cooperation with Hydrogenics, which delivers up to 33 kW of electrical energy to significantly increase the aircraft range.



Integration of the fuel cell, however, harboured several challenges. In contrast to high-temperature systems, the air supply as well as the entire cooling system including coolant pump, cooler, impeller, expansion tank and piping needed to be housed, which meant alterations within the external pods were required. The stacks together with the air supply were arranged by the project engineers on a board in the top half of the pod, the cooling duct was placed beneath the equipment carrier. In addition to the spatial constraints, the special aviation requirements in terms of weight distribution, safety and a lightweight construction needed to be taken into account.

The Antares DLR-H_2 fuel cell aircraft is refuelled with gaseous hydrogen

In the external pod on the right wing, the developers replaced the previous two-litre-capacity tank with a new, larger pressure tank capable of carrying five kilograms of hydrogen at 350 bar. Sensors continuously monitor the hydrogen concentration to guarantee operational safety at all times in all areas of the fuel cell system. In addition, numerous other sensors were installed in the aircraft to ensure that data regarding the general conditions of operation are comprehensively recorded. Zweibrücken Airport in the state of Rhineland-Palatinate was the starting point of the German tour. Following a successful test flight by pilot Axel Lange, the aircraft set course for the ILA Berlin Air Show. A conventional engine-powered aircraft, from which specialist engineers continuously monitored the fuel cell aircraft's operation, accompanied the Antares DLR-H_2. The first leg of the flight led to Hof/Plauen Airport. Here the aircraft was refuelled and prepared for the next leg. The flight continued without any special incident to the ILA in Berlin. The Antares DLR-H_2 was one of the very few aircraft that demonstrated a very promising and completely new type of technology at the show.

Antares DLR-H_2 left the ILA in Berlin on 13 September and headed to Hof/Plauen again. On 19 September the journey continued to Stuttgart, where Baden-Württemberg State President Kretschmann and Airport Managing Director Prof Fundel opened the Innovation Day at the Stuttgart Airport. The innovative aircraft landed prominently before the eyes of the trade visitors. The aircraft was then shown at further exhibitions and fairs, beginning in the congress centre of the Stuttgart trade fair grounds for the fuel cell conference f-cell. Next was an exhibition in Paris on the occasion of the Fuel Cell and Hydrogen Joint Undertaking Stakeholder's General Assembly, which this time took place at Maison de La Chimie. Rounding off the tour was the exhibition during the Open Day at the DLR's Oberpfaffenhofen site.

Gigabytes of data were recorded during the flights throughout the eventful summer. These are now being evaluated at the DLR Institute for Thermal Dynamics. Various potentials for improvement have already been identified and are being successively implemented. For this reason Antares DLR-H_2 has returned to the workshop for now, so that it can take to the skies again in spring to continue flight testing with fuel cells.

NIP – HYDROGEN PROVISION

ALL PROJECTS ARE MARKED WITH II / 01 – II / 04 ON THE FOLLOWING PAGES,
COMPLETED PROJECTS ARE MARKED WITH .

NIP – HYDROGEN PROVISION

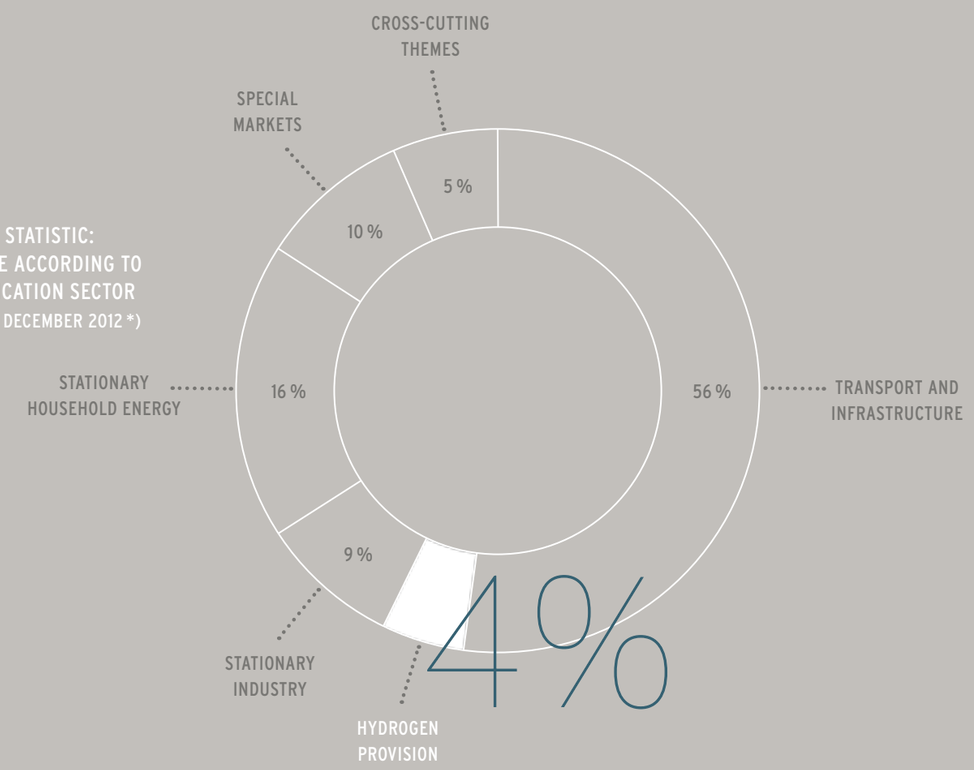
The NIP Hydrogen Provision programme area incorporates demonstration projects and studies on the production, storage and distribution of hydrogen as a fuel for fuel cell vehicles. As part of the so-called energy turnaround, hydrogen is significantly gaining importance. Besides its »classic« role as a fuel in its own right, hydrogen is now also becoming increasingly important as a medium for storing large amounts of fluctuating renewable energy – which opens up new opportunities for hydrogen as a cross-cutting technology that brings the transport and energy sectors closer together. The integration of hydrogen in both transportation and energy industries is an important task within the programme area.

Hydrogen production via the highly efficient water electrolysis method, chiefly from excess wind energy is at the core of the programme area. There are several electrolysis methods with different levels of suitability for particular applications, at diverse stages of development and boasting varying levels of potential. Water electrolysis is regarded as a key technology for the integration of renewable energy in the areas of transportation and energy. New and growing markets for hydrogen lay the foundation for exploiting the significant development potential that is inherent in all electrolysis technologies. Alkaline electrolysis is the most common method of producing hydrogen today, while the alternative PEM electrolysis method is significantly gaining in importance. A complete wind-hydrogen system, which besides the aspect of electrolysis also involves storage and the reconversion to power on a needs basis, is also being supported in the programme area.

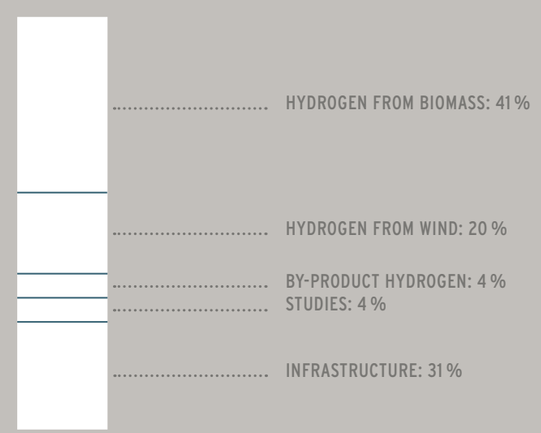
Hydrogen produced from biomass and as a by-product of industrial processes is also important for the supply of fuel. During the production of hydrogen from biomass, comprehensive evaluations are necessary that take all relevant technical, ecological and economic factors into account. In the case of by-product hydrogen, climate protection potentials should be examined in order to ensure the sustainability of this form of production. The aspects of evaluating sustainability and incorporating hydrogen in the transportation and energy industries are important overall themes in the programme area, which is reflected in the studies commissioned.

Contact Head of Programme: Dr. Oliver Ehret / oliver.ehret@now-gmbh.de

NIP – STATISTIC: SHARE ACCORDING TO APPLICATION SECTOR (AS AT DECEMBER 2012 *)



NIP – HYDROGEN PROVISION: ALLOCATION BY APPLICATION AREA (AS AT DECEMBER 2012)



* The diagram incorporates projects at planning stage at NOW, being processed by PtJ, LOI (Letter of Intent) as well as those approved.

HYDROGEN – ENERGY STORAGE OF THE FUTURE

The integration of growing amounts of renewable energy into the electricity supply is a key challenge in the so-called energy turnaround. Windpower in particular can often not completely be taken up by overloaded electricity networks and is lost due to cut-offs. Hydrogen has the potential to store this excess energy and make it available according to demand at a later time and or at another location. Questions regarding the use of wind-hydrogen as a storage medium are answered within the »Integration of wind-hydrogen systems in the energy system« study, which is support by NIP.

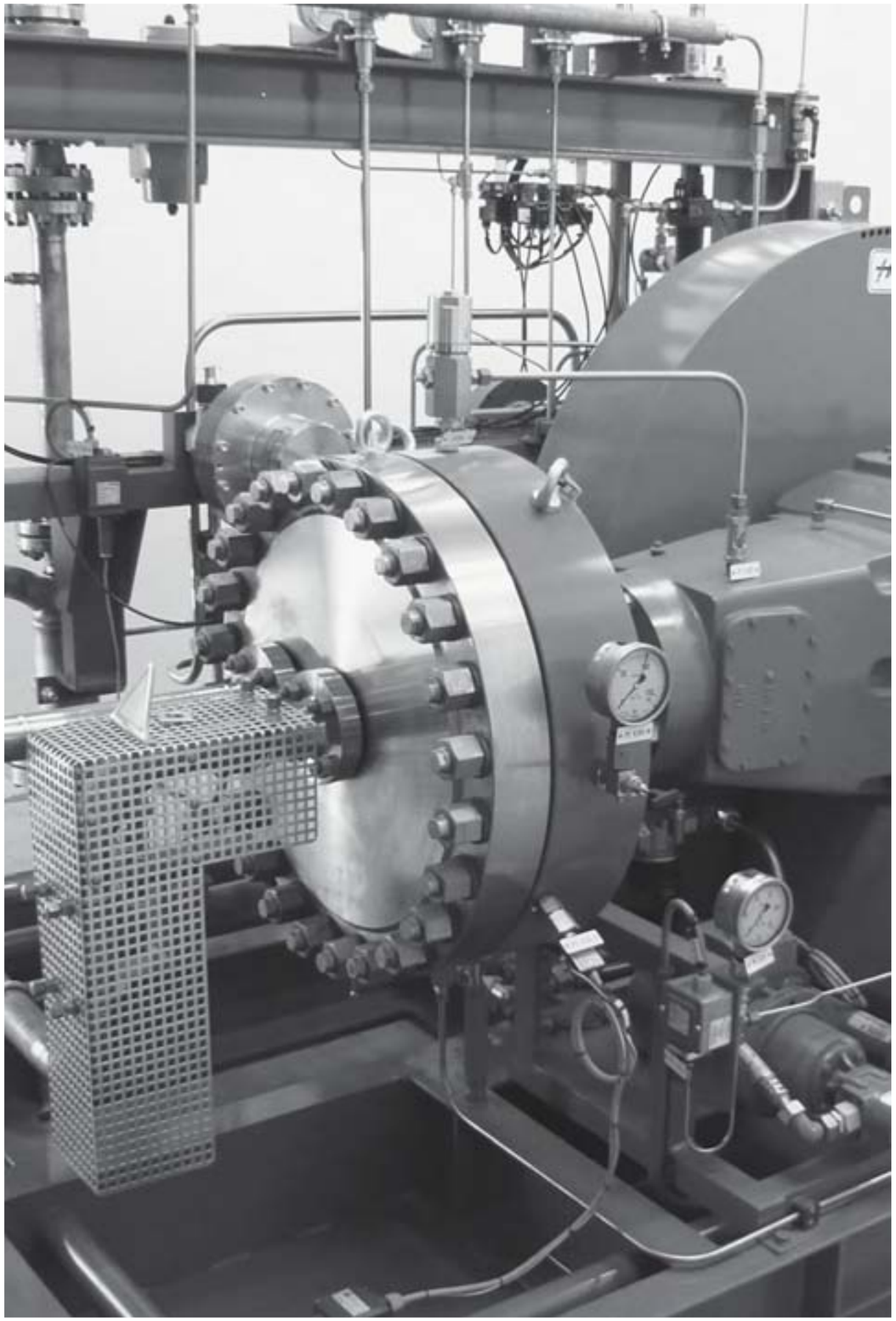
Hydrogen is the only carrier of energy that is capable of storing large amounts of renewable energy over long periods in the existing gas infrastructure. For this reason, hydrogen lends itself not only as a stationary energy storage medium with exceptional capacities but also as fuel for highly efficient fuel cell vehicles that will be ready for market from 2015 onwards. Wind electricity can be converted to hydrogen via electrolysis, stored and then used by vehicles or reconverted and fed back into the electricity grid as required. To harness this potential, the Hydrogen Provision programme area addresses issues concerning hydrogen production, distribution and delivery.

Until hydrogen as an energy carrier can contribute to promoting the energy turnaround, important questions must still be addressed: what surplus amounts of wind energy are really expected to be available in Germany until 2030? How can wind energy be converted to hydrogen in a wise technical and economical manner and then stored in large quantities? What amounts of hydrogen and electricity can be made available and at what cost for transport and stationary energy supply? What synergies are possible with a merging of the energy and transport energy sectors?

The »Integration of wind-hydrogen systems in the energy system« (Integration von Wind-Wasserstoff-Systemen in das Energiesystem) study, which was initiated by NOW and produced by a consortium led by PLANET (Planungsgruppe Energie und Technik GbR), contributes to answering these questions. With the expertise of the Lübeck and Stralsund Universities of Applied Sciences, the Fraunhofer-Institut für System- und Innovationsforschung (ISI), KBB Underground Technologies GmbH and an advisory board comprising eight renowned companies from the energy sector and automotive industry, a considerable volume of information on the potential of hydrogen as a carrier of energy could be collated and its effects quantified. It revealed that in 2030, up to 14,000 Gigawatts of surplus electricity from wind energy will be generated in the German states near to the coastline. Part of the excess energy can be converted to hydrogen in powerful electrolysis plants. With just one such plant, more than 30,000 tons of hydrogen could be produced each year. This corresponds with the energy content of 110,000 litres of petrol and is sufficient to operate around 200,000 fuel cell vehicles with an annual mileage of between 11,500 and 16,000 kilometres.

A PowerPoint presentation outlining the results as well as the final report of the study can be downloaded from **www.now-gmbh.de** (German language version only.)

For more information, please visit: **www.performing-energy.de**



Hydrogen compressor (300 bar)

II / 01

» HY-NOW – EVALUATION OF METHODS AND TECHNOLOGIES FOR SUPPLYING HYDROGEN FROM BIOMASS «

Increased global demand for energy and a growing awareness of mobility means, especially in the transport sector, that more stringent requirements for the sustainable provision of sources of energy must be met. In association with fuel cell-based mobility, the production of hydrogen from biomass represents a relevant course of action. Current methods and technological approaches for the production of »bio-hydrogen« differ considerably in terms of their technological maturity and their need for further research and development prior to becoming marketable.

Upon this backdrop, the goal of the study was to identify, analyse and evaluate the means in which bio-hydrogen can be produced. Methods and technologies that allowed realisation in the form of demonstration units in the short to middle term were of special interest.

To begin, a two-step pre-screening process was commenced in the study. All bio and thermo-chemical processes suitable for directly converting biomass to hydrogen were thoroughly examined for their appropriateness in terms of the study's goal. Key assessment criteria of the pre-screening were the technical maturity of the process and of the technological approaches. Three technological approaches were identified that were subsequently subjected to a detailed examination. These included steam reformation of biogas as well as two methods implementing an allothermal fluidised bed gasification of biomass approach.

Distribution and system concepts for these three technological approaches were defined, then examined and evaluated in terms of their technical (material and energy balance including flow chart simulation), ecological (ecological balance) and economical (cost calculation) capabilities. Key criteria included the net conversion rate of biomass to hydrogen, technological maturity, innovation requirements, costs of the hydrogen production as well as the associated greenhouse gas emissions. Furthermore, the availability of the raw materials of the individual concepts was examined and evaluated. It was shown that none of the three overall concepts was clearly superior in all assessment criteria. Rather, each has certain advantages and disadvantages that must be weighed up against each other.

The study was compiled by the Deutsche Biomasseforschungszentrum (German biomass research centre) with the involvement of Ludwig-Bölkow-Systemtechnik and the Fraunhofer-Institut für System- und Innovationsforschung (ISI) between May 2011 and May 2012.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
DBFZ Deutsches BiomasseForschungsZentrum gemeinnützige GmbH	204,323	204,323

COMMENCEMENT: 01 June 2009
CONCLUSION: 31 May 2012

II / 02

» CHEMERGY – PRODUCTION OF BY-PRODUCT HYDROGEN AND DEVELOPMENT OF LOCAL HYDROGEN INFRASTRUCTURE «

Over the 36 months from June 2009 until May 2012, the »Chemergy« project had the goal of providing public access to the chemical infrastructure in Hürth Knapsack, which until now had not been given. Aim was to make the hydrogen, which was produced as a by-product from on-site industry – for example during the chlorine production process – available for use as an environmentally friendly fuel for transport, as well as raising acceptance of hydrogen among the public and decision-makers in business and public authorities.

Through field tests and integration of the projects »Chemergy« and »Phileas« – fuel cell hybrid buses of the Cologne public transport authority (RVK) – it was possible for project leader Boris Jermer and Carsten Krause of HyCologne GmbH to successfully reach the project aims in field trials. Together with the various partners including public utilities company Stadtwerke Hürth (SWH), InfraServ GmbH & Co. Knapsack KG (ISK), Air Products GmbH (AP), HyCologne GmbH (HyCo) and Praxair Deutschland GmbH & Co. KG Hürth (PA), the first public hydrogen filling station in North Rhine-Westphalia could be opened in May 2010, which has been in operation ever since. Besides providing a meaningful use for by-product hydrogen, important insights into the further development of hydrogen infrastructure in regard to the technical and economical framework could be attained. A significant aspect was the development of a sustainable business model including defined conditions for sales of the hydrogen to its consumers.

The »Chemergy« joint project was supported the Federal Ministry for Transport, Building and Urban Development (BMVBS) within the government's National Innovation Programme Hydrogen and Fuel Cell Technology (NIP). Objective of the programme is to promote market preparation of future-oriented products and services associated with fuel cell and hydrogen technology. In addition to technical realisation, the »Chemergy« project is also pursuing the goal of increasing user acceptance of fuel cell and hydrogen technology among the general public. Through its use in the public transport system, citizens have the opportunity to experience fuel cells in daily life and are therefore introduced to hydrogen as an environmentally friendly fuel of the future. As such, the contribution by »Chemergy« fulfils the NIP funding policy objectives and is well regarded.

Use of the hydrogen filing station by RVK fuel cell hybrid buses is guaranteed for at least an additional four years. In the year of operation, 4.5 tons of hydrogen was dispensed at the hydrogen filling station, which received 78 deliveries. Expansion of the RVK fuel cell hybrid bus fleet is planned. Companies in the region have indicated that they wish to procure fuel cell vehicles. The establishment of several companies in Hürth with a direct association with fuel cell applications (including Ballard Power Systems, Proton Motor Fuel Cell GmbH), ensures that the »Chemergy« filling station will also be persistently used in the future. The HyCologne – Wasserstoff Region Rheinland e.V. (Rhineland Hydrogen Association) initiative could also strengthen the network due to securing new members (including Propan Rheingas GmbH & Co. KG, Flughafen Köln/Bonn GmbH, Linde Group, Air Products GmbH, EMCEL GmbH).

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Stadtwerke Hürth Technische Betriebe und Einrichtungen AöR	1,833,877	880,261

COMMENCEMENT: 01 June 2009
CONCLUSION: 31 May 2012

II / 03

» INTEGRATION OF WIND-HYDROGEN SYSTEMS IN THE ENERGY SYSTEM «

The aim of the project involved establishing the conditions under which wind-hydrogen systems can be operated in a technically and economically wise manner in the year 2030. The systems should serve to mainly or exclusively take up excess energy from the transmission network arising through fluctuating renewable energy – which in northern Germany primarily stems from wind energy – which otherwise would be wasted due to so-called feed-in management (cut-offs). It involves the long-term storage of large amounts of energy, which in the case of hydrogen offers particular advantages due to its comparably high energy density compared to other options.

To begin, the storage requirements of excess (wind) energy needed to be assessed. The northwest and northeast of Germany were considered individually, taking into account anticipated offshore windparks. A wind-hydrogen system was dimensioned on this basis and was consigned suitable technology in a further step. To be examined was what is available today and what is expected to be available in 2030. The technical and economical parameters of the components were determined as input data for model-based simulations.

The system involves producing hydrogen via electrolysis (the splitting of water) and storing it in underground salt caverns ready for use. Such caverns are today already used for the storage of natural gas. The consumption of hydrogen examined in this project included its use as a fuel (for fuel cell vehicles) and for its reconversion to electricity (in a gas or steam power plant). Among the tasks was to establish whether synergies could be exploited through delivery to these very different types of market segments.

An industrial-scale system was considered with electrolysis of 500 mW input and a power plant with 270 mW output. The cavern can take up large amounts of hydrogen, with an energy equivalent of around 15 million litres of petrol.

The system analysis showed, depending on region and assumptions, up to 3,000 hours of excess power is to be expected in 2030 (which corresponds with around 80 – 125 days). With 500 mW of electrolysis, around 30,000 tons of hydrogen can be produced – or even more if larger or more systems were available.

30,000 tons of hydrogen is equivalent to an energy content of 110 million litres of petrol. This amount of energy would allow around 200,000 fuel cell vehicles to be operated with an annual mileage of 11,500 to 16,000 kilometres each. Under favourable conditions, this hydrogen could be offered to consumers at the pump at costs per kilometre that are lower than conventional fuels.

Alternatively, the hydrogen could be reconverted to power in lulls of wind. 30,000 tons of hydrogen would cover the annual requirements of around 135,000 four-person households. However, the fuel path is the more economical alternative.

> » Hydrogen can store vast amounts of energy «

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
PLANET Planungsgruppe Energie und Technik GbR	278,199	278,199

COMMENCEMENT: 01 August 2011
CONCLUSION: 30 November 2012

II / 04

» TREMOD-GERMANHY «

Hydrogen as an energy carrier and the subjects of electromobility and bio-fuels are parts of a whole bundle of options that the federal government is focusing on during the transition to climate-neutral and sustainable mobility. In order to counteract that various energy options and fields of action simply run undifferentiated and parallel to one another, the Federal Ministry for Transport has recently initiated the Mobility and Fuel Strategy (Mobilitäts- und Kraftstoffstrategie – MKS) dialogue. Its goal is to comprehensively bring together specialist knowledge, bundle a variety of activities and to introduce partners in a targeted manner in order to ultimately develop a consistent and sustainable strategy for mobility of the future. The key area of focus lies in the technical developments that will make a significant contribution towards supply reliability, increased efficiency and CO_2 reduction upon successful market introduction.

From where will the hydrogen for the transport infrastructure come from? How will it be produced and distributed? Is it possible to calculate the expected reduction in CO_2 emissions today? Is Germany's ambitious climate goal of reducing greenhouse gasses by 80 % by 2050 compared to the level in 1990 realistic?

The »TREMOD-GermanHy« [1] study attempts to answer these and other questions independently and from a technical-scientific basis. It is coordinated by the Federal Highway Research Institute (BASt–Bundesanstalt für Straßenwesen) and conducted jointly with the Heidelberg Institute for Energy and Environmental Research (IFEU – Institut für Energie und Umwelt), the Fraunhofer Institut für System- und Innovationsforschung (ISI), Ludwig-Bölkow-Systemtechnik GmbH (LBST) and the Wuppertal Institute for Climate, Environment and Energy (WI – Institut für Klima, Umwelt und Energie).

The previous study on hydrogen as a source of energy »GermanHy – where does hydrogen come from in Germany« (GermanHy – woher kommt der Wasserstoff in Deutschland) [2] comprised the starting point of the task. The fundamental aspects such as industrial production and transport routes, as well as the associated energy consumption and emissions were here brought together, quantified and evaluated. An outlook to the year 2050 is provided on how market developments for hydrogen as a source of energy for the transport sector could look like and the effect various political-economic factors could have on the dynamics of this development. However, »GermanHy« could only present a general basis for the introductory scenario into the hydrogen age in the form of overall energy requirements for transport, which primarily stems from the driving development prognoses of the pilot study conducted in 2010 [3]. But which concrete introductory scenarios need to be supported over the coming years, with what level of momentum would the number of vehicles increase, and how would the composition of the vehicle fleet in the field look like in order to fulfil the prognoses provided by the »GermanHy« study until the year 2050?

The »TREMOD« (TRansport EMission MODel) [4] transport emission model provides the necessary simulation system to develop a hydrogen scenario based on a differentiated quantity structure of fuel cell vehicles of various segments. While perhaps not representing the last word on the questions raised here, »TREMOD« provides a significantly more vivid and realistic illustration of the future development of vehicle numbers than was previously possible.

»TREMOD« was originally commissioned by the Federal Environment Agency (UBA – Umweltbundesamt) from the Heidelberg-based IFEU. In its most current version, it represents the foundation for the official emission reporting of the government (the UBA national emission inventory) and bases its data on databases from the Federal Motor Transport Authority (KBA – Kraftfahrtbundesamt), the Energy Balances Working Group (AG Energiebilanzen) and examinations such as »Mobility in Germany« (Mobilität in Deutschland) [5], »Transport in Numbers« (Verkehr in Zahlen) [6] and the regularly conducted traffic counts and mileage assessments of the BASt [7]. As a database expert system, »TREMOD« has been providing the benchmark in terms of transport emission modelling assessments in Germany for more than 15 years and its data regularly updated together by the BASt and UBA.

Not only is the entire inventory of German vehicles recorded each year in »TREMOD« according to vehicle segment and class, but also the specific mileages and emissions of the vehicles including those accrued in the upstream chain and during the production of the consumed fuel. In addition, empirical information such as that new vehicles are driven more kilometres than older models, luxury cars more than their compact counterparts, diesel models more than petrol-driven ones, etc., is taken into account. The model determines

II / 04

» TREMOD-GERMANHY «

emissions and consumption in such a way, that according to the vehicle segment, the aspects of mileage, traffic situation, road categories and pitch are differentiated and linked back with the corresponding emission and consumption factors and finally aggregated.

The trend scenario allows for a projection of the inventory of vehicles and mileage covered for each year into the future. As such, scenarios are possible that, for example, incorporate a new vehicle stock that is introduced to the fleet, which replaces a part of the old stock.

Key task of the »TREMOD-GermanHy« project was to transpose the hydrogen transport scenario from the previous »GermanHy« study into a new vehicle inventory, which while still fictional was relatively concrete due to the specific data available in terms of mileage and consumption. The future fuel cell vehicles were to be available in three segments (small, medium and large). In terms of their technical characteristics (consumption, service life) and introduction into the overall vehicle inventory, a range of assumptions needed to be determined, always so, however, that the consistency of the scenario concerning interaction with alternative drives, the primary energy availability and economical fundamentals, was ensured.

The following illustrations provide an overview of the main study conclusions. Consequence of the transition in passenger vehicles to largely fuel cell, plug-in hybrid or battery-electric drives by 2050, a reduction in CO_2 emissions of more than 100 million tons compared with today's levels could be modelled, which represents a decrease of more than 80 % of greenhouse gas emissions produced by passenger vehicles.

The study does not, however, provide answers to the question concerning under what conditions such a strategy can be implemented, and in particular, how realistic the assumed introduction strategy really is given the existing restrictions (costs, regulatory framework, acceptance, technology and safety). This requires further information and insights. With the current »TREMOD«, an instrument exists with which such details can be modelled in greater depth and allows the effect on greenhouse gas emissions to be calculated.

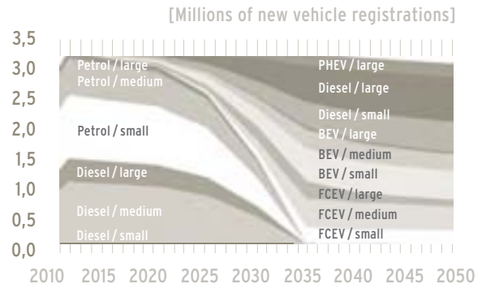
References and further reading

[1] More information on »TREMOD-GermanHy« at: www.tremod-germanhy.de
[2] »GermanHy – Woher kommt der Wasserstoff in Deutschland bis 2050?«, Deutsche Energie-Agentur, 2008. More information at: www.germanhy.de
[3] Pilot study 2010/../2012: »Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global« – pilot study 2010/../2012, Commissioned by the BMU
[4] More information on »TREMOD«: www.tremod.de
[5] Mobilität in Deutschland (MiD), Infas Institut, DLR. Study commissioned by the BMVBS
[6] Verkehr in Zahlen (ViZ), DIW, Berlin. Study commissioned bythe des BMVBS
[7] Fahrleistungserhebung 2002 – Inlandsfahrleistung und Unfallrisiko, BASt-Schriftenreihe »Verkehrstechnik« BASt V 121

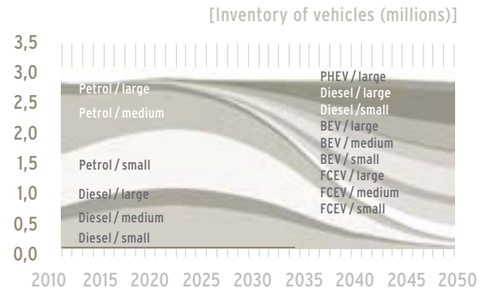
PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
IFEU-Institut für Energie und Umweltforschung Heidelberg GmbH	219,779	219,779

COMMENCEMENT: 01 October 2010
CONCLUSION: 31 December 2012

NEW REGISTRATION BY SEGMENT

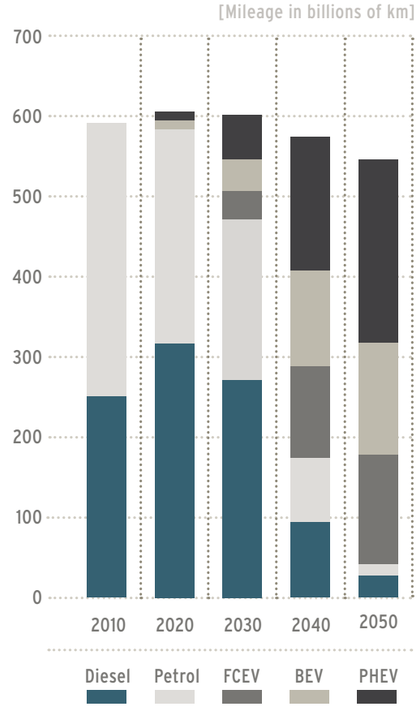


STOCK BY SEGMENT



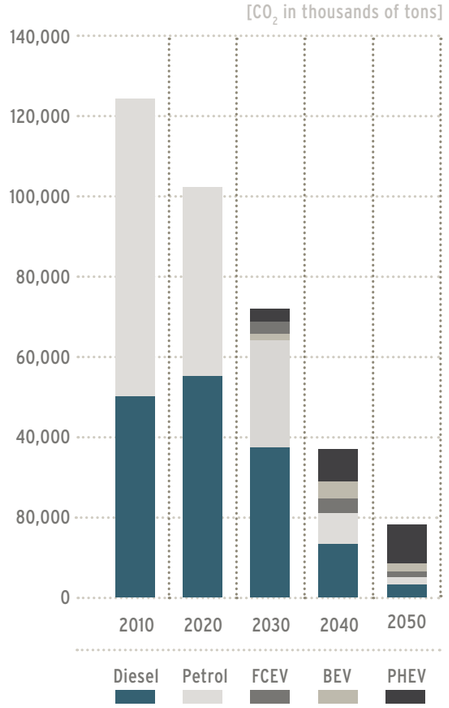
New passenger vehicle registrations according to results of the TREMOD-GermanHy study (left) and the change in overall vehicle inventory (right), differentiated according to various vehicle concepts (petrol, diesel, fuel cell, battery and hybrid vehicles) and segments (small, medium and large vehicle classes).

MILEAGE BY DRIVE TYPE



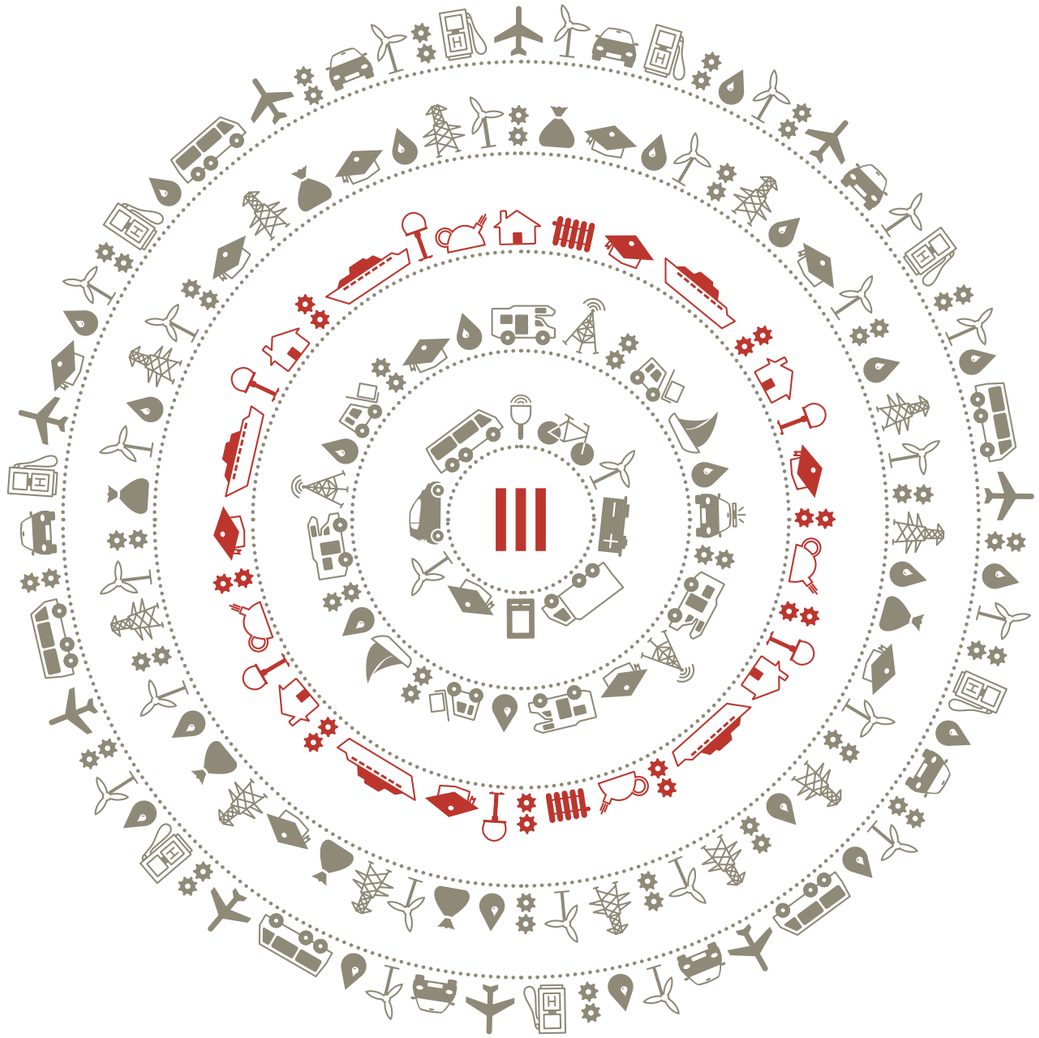
»TREMOD-GermanHy« scenario of mileage, according to drive concept.

CO_2 EMISSIONS BY DRIVE TYPE



»TREMOD-GermanHy« scenario for the reduction potential of CO_2 from cars on the roads until 2050, based on the scenarios shown in illustrations 1 and 2.

NIP – STATIONARY ENERGY SUPPLY



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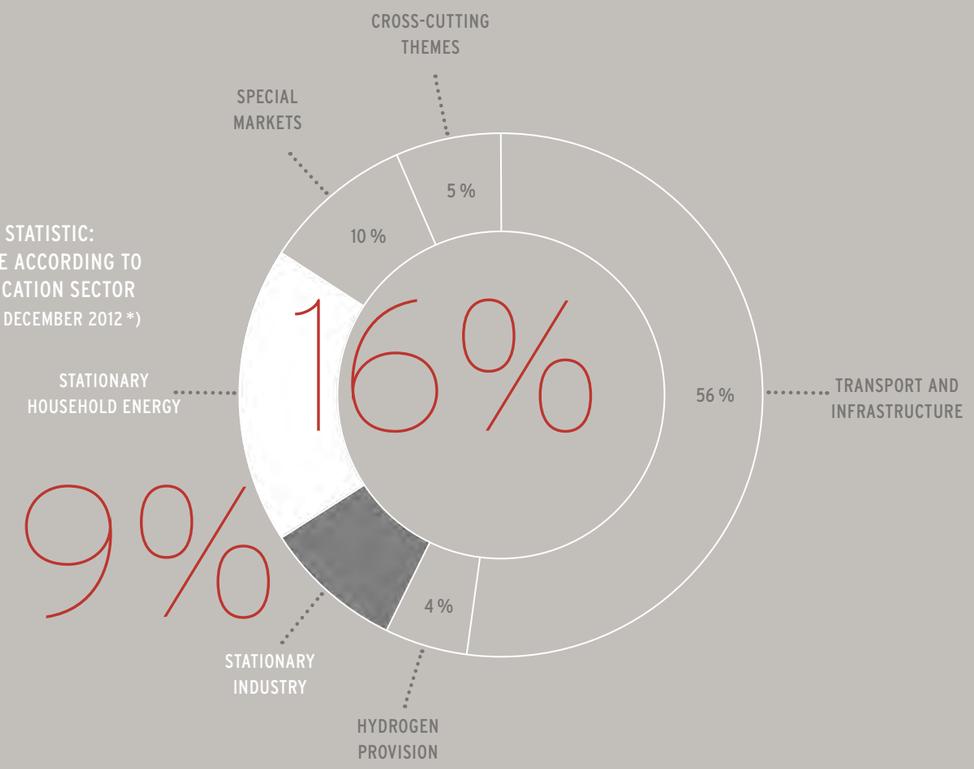
NIP – STATIONARY ENERGY SUPPLY

The Stationary Energy Supply programme area for household energy and industrial facilities in the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP) comprises systems from a lower capacity range of one kW to five kW of household energy, right up to plants with some ten kW to a few MW in industrial use. The simultaneous generation of heat and power via fuel cells facilitates high overall efficiency rates (>85 per cent). This enables CO_2 savings of between 25 and 35 per cent compared with modern conventional supply systems. The systems in household energy supply work on the principle of combined heat and power and burn natural gas from existing pipelines. In the medium term, biogas and fluid renewable energies that are fed into the natural gas network will also be used. Fuel cell devices for household energy thus have the advantage of being directly usable without requiring investment in the surrounding infrastructure. Low- and high-temperature PEMFCs and SOFCs will be used in this area.

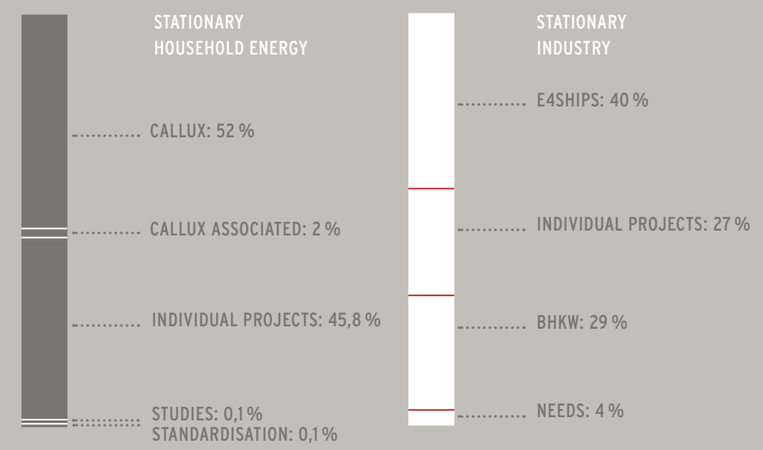
For fuel cell facilities in the industrial area, mainly SOFC technology will be used. However high-temperature PEMFC technology is also becoming an important issue. In total there are several hundred fuel cell combined heat and power facilities with a power capacity of 100 kW and above in use worldwide.

Contact Acting Head of Programme: Wolfgang Axthammer / wolfgang.axthammer@now-gmbh.de

NIP – STATISTIC: SHARE ACCORDING TO APPLICATION SECTOR (AS AT DECEMBER 2012 *)



NIP – STATIONARY APPLICATIONS: ALLOCATION BY APPLICATION AREA (AS AT DECEMBER 2012)



* The diagram incorporates projects at planning stage at NOW, being processed by PtJ, LOI (Letter of Intent) as well as those approved.

callux nip
Fuel cell field tests for the home

INNOVATIVE SUPPLY OF HEAT AND POWER FOR THE HOME – » CALLUX «: FUEL CELL HEATING SYSTEMS IN DEPLOYMENT

»Callux« is an NIP lighthouse project in the Stationary Energy Supply programme area for the testing of fuel cell heating system technology in day-to-day use, to promote energy saving and climate protection.

Ever greater numbers of fuel cell heating systems are providing environmentally friendly heat and power to individual and semi-detached homes. More than 300 plants have already been installed within the framework of the »Callux practical tests« and a further 250 are yet to follow. Besides the installation, operation and evaluation of field test results, »Callux« also focuses on activities that pave the way towards market introduction by 2016 at the latest.

REDUCING COSTS, SERIES PRODUCTION, VIRTUAL POWER PLANTS

In terms of the hardware, the involved system manufacturers (Baxi Innotech, Hexis and Vaillant) are currently concentrating on preparing for series production, the associated cost reduction aspects, along with further optimisation of individual components. They are also testing virtual power plants, which has been made possible thanks to the communications interface »Callux-Box«.

FOCUS ON MARKET PARTNERS AND TRAINING

Furthermore, all project participants, including energy suppliers EWE, MVV Energie, E.ON Ruhrgas and VNG Verbundnetz Gas, and the manufacturers mentioned above, have intensified their activities in terms of market partners and training. With the »Information program fuel cell heaters«, an interactive online platform was launched at www.callux.net that simplifies entry into the world of power generating heaters. Besides this training program, specialised tradespersons and installers are primed on this new technology through specialist information and training sessions from the system manufacturers. A dedicated information service »praxistest« puts a focus on questions arising from the aspects of installation, operation as well as marketing the innovative devices. In one edition of »Callux-Praxistest«, tradespersons involved in the project were asked to reveal the specific demands accompanying the installation of fuel cell heating systems. The subsequent report showed that as far as the trade was concerned, the barriers to market entry are relatively small. Reasons for this include experience with other CHP technologies and the support provided by »Callux«. In this regard, »Callux« will intensify its communication efforts in parallel to those conducted by the system manufacturers in order ensure knowledge on fuel cell heating systems becomes anchored in the trade and continues to advance.

CONSUMERS SEE THE ADVANTAGES OF FUEL CELL HEATING SYSTEMS

Market research results from GfK indicate that potential future purchasers regard the technology very favourably. The attributes being associated with fuel cell heating systems such as highly efficient, environmentally friendly and sustainable are all advantageous for the future marketing of the technology. The market research activities will be continued with the goal of producing a good information basis for further marketing activities by 2016.

For more information, please visit:
www.callux.net

Experts trained for maintenance procedures attend the plants during the practical tests

III / 01

» PA-X-ELL – MODULAR ENERGY SUPPLY SYSTEM WITH FUEL CELLS ON PASSENGER SHIPS «

Approximately 3 % of global CO_2 emissions are attributable to shipping. In addition to this are other pollutants such as sulphur dioxide, nitrogen oxide and soot particles coming from the use of heavy oil for fuel. To protect human health and the environment, shipyards, shipping operators, fuel cell manufacturers and classification organisations joined forces in 2009 with the NIP »e4ships« lighthouse project. The joint project aims to test new technologies that are earmarked to replace conventional ship-based aggregates in the future. It consists of three sub-modules.

Goal of the ongoing NIP lighthouse project is to prove the functionality of fuel cells in the on board energy supply of ships under everyday conditions. In contrast to conventional ship's aggregates, the use of fuel cells can significantly contribute to the reduction of emissions.

Based on existing high-temperature membrane technology with an operating temperature of 150 – 200° C, a new module with 15 kW of electrical power is to be developed. System operation with LNG will be developed in a second step.

Following successful testing of the module, plug-in modules and an associated rack are to be developed next, in which up to four modules can be simultaneously operated. A rack will the provide performance up to 60 kW electrical and thermal performance in equivalent sizes. The individual modules are to be pluggable, allowing a quick and easy exchange during maintenance.

After successfully passing evaluations on land taking long-term stability into account under various operating conditions, a 120 kW system is to be installed in a cruise ship to demonstrate its suitability under specific conditions at sea. In the next step, several modules will be connected for a 1 mW system in order to supply a fire zone on a ship with thermal and electrical energy.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Serenergy A/S	7,733,309	3,711,988
Meyer Werft GmbH	7,005,671	3,362,722
Fr. Lürssen Werft GmbH & Co. KG	1,049,145	503,590
Flensburger Schiffbau-Gesellschaft m.b.H.& Co. Kommanditgesellschaft	1,832,696	879,694
Germanischer Lloyd SE	243,046	116,662
INVEN Absorption GmbH	914,228	438,829
MTU Friedrichshafen GmbH	273,059	131,069
DNV Germany GmbH	870,539	417,859

COMMENCEMENT: 01 February 2011
CONCLUSION: 31 December 2015

e4ships nip
Brennstoffzellen im maritimen Einsatz
Ein Projekt im Nationalen Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie

For more information, please visit:
www.e4ships.de

Fuel cells being deployed on the AIDA cruise ship

III / 02

» ELCORE 1 «

Elcore develops highly efficient energy systems with advanced fuel cell technology. The company focuses on natural gas-run combined heat and power systems. Elcore is part of an independent private group of companies based in Munich, which was founded in 2007 by Dr Manfred Stefener. Today, a highly skilled team of 80 employees is working on the development and production of the products.

The developments and results achieved to date from within the company group have led to the establishment of an innovative manufacturing process that enables Elcore GmbH to produce catalysers and MEAs cost-effectively.

Within this project, Elcore GmbH will develop, produce, test, qualify, optimise and demonstrate combinable HT-PEM fuel cell modules in the 10 kW performance range. Cost-effective stack technology, a highly-efficient reformer concept, straightforward heat integration and management, as well as a clear philosophy in terms of control and regulation technology are innovations that will be in particular focus during developmental process.

The overall goal is to achieve a dramatic reduction in costs and a significantly simplified design in comparison to current solutions.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Elcore GmbH	3,750,000	1,800,000

COMMENCEMENT: 01 January 2012
CONCLUSION: 30 Juni 2013

» The goal is to drastically cut costs and significantly simplify the system design «

III / 03

» GLASSEAL – COST REDUCTION AND OPTIMISATION OF GLASS SEALING TAPE FOR SOFC TECHNOLOGY «

The use of glass tapes for the joining and sealing of stacks is a common procedure used throughout the world in the area of high temperature fuel cells (SOFC). The »GLASSeal« project is contributing to an environmentally friendly energy supply with high temperature fuel cells (SOFC) in stationary applications, such as for the supply of household energy. Through the reduction in costs of the stack component glass sealing tapes and the development of production capacities on an industrial scale, its commercial application has been decisively promoted. The continuous requirement to reduce production costs and simultaneously preserve long-term durability and reliability demands ongoing research and development.

Aim of the project was the development of procedures for cost-effective series production through the implementation of tape cast sealing elements. In contrast to the method used until now, where the tape material was applied as a paste via a syringe and needed to go through several time-consuming drying stages, using tape cast sealing elements that are pressed to the exact design requirements for stack assembly can save a significant amount of time.

To realise systems with a high level of impermeability and robustness, glass sealing tapes that are optimised, reliable, feature long-term durability and thermocyclability should also be developed for stack assemblers and system builders. It was a goal to develop cost-effective stack component glass sealing tapes for commercial application by the end of the project period.

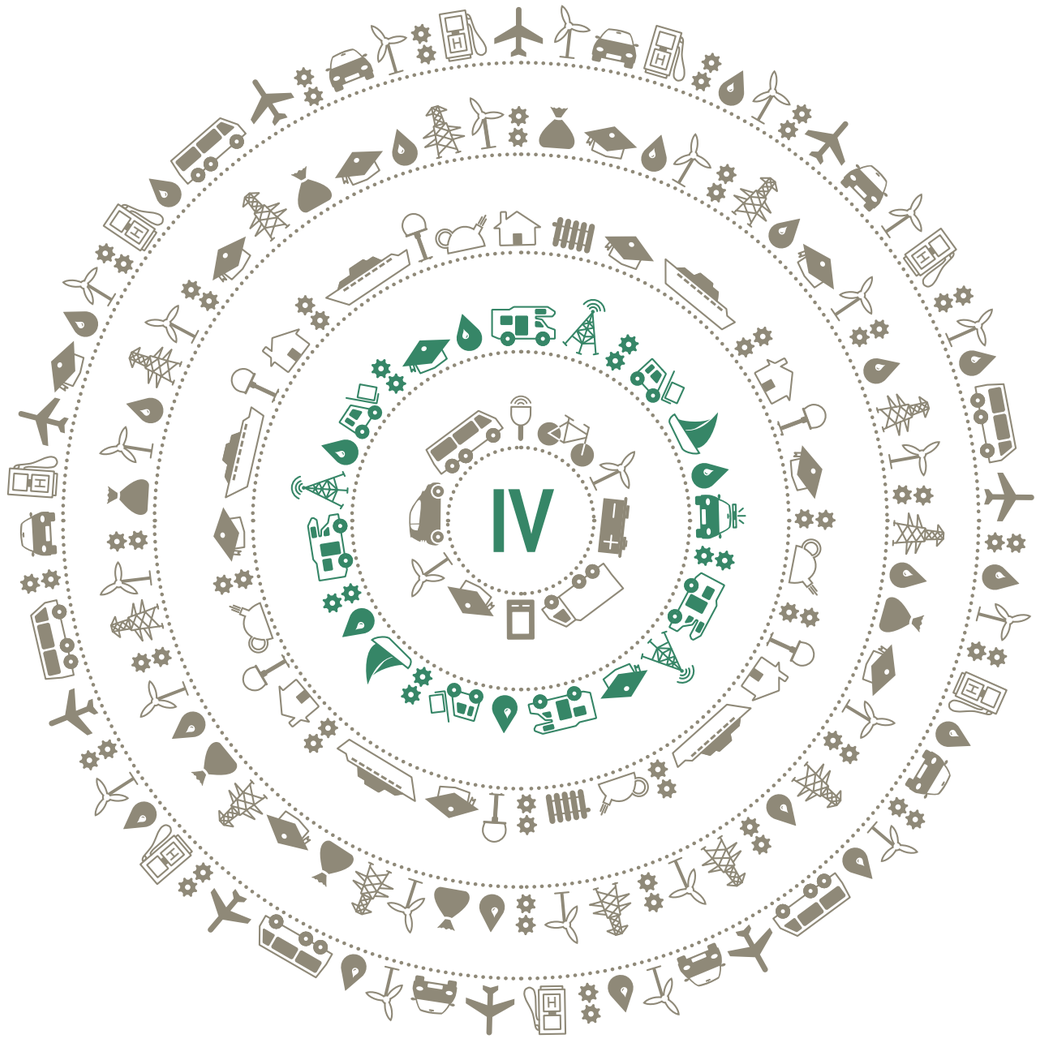
To reduce the costs, an optimisation in the melting of the glass, its preparation and the manufacturing of the tape was to be achieved within the framework of this project. It was thereby established that the melting and grinding conditions as well as grain size distribution have a substantial effect on the developed microstructures and functioning of the tape. Essential relationships could become understood and the processes leading to the manufacture of functional tapes could be established. The glass sealing tape quality can now also be assured for mass production thanks to the established and cost-optimised QM system. The functionality of the glass sealing tapes molten in large batches and in standardised production processes was proven by several tape casting scars. Customers can now obtain high-quality glass sealing tapes in larger numbers – and at a significantly reduced price to that which was customary at the commencement of the project.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
KERAFOL Keramische Folien GmbH	761,551	365,544
Forschungszentrum Jülich GmbH	262,366	125,936

COMMENCEMENT: 01 March 2010
CONCLUSION: 31 December 2012

» Environmentally friendly energy supply «

NIP – SPECIAL MARKETS



ALL PROJECTS ARE MARKED WITH IV / 01 – IV / 11 ON THE FOLLOWING PAGES,
COMPLETED PROJECTS ARE MARKED WITH 🏁.

NIP – SPECIAL MARKETS

The Special Markets programme area of the National Innovation Programme Hydrogen and Fuel Cell Technology (NIP) incorporates a broad spectrum of applications. Likewise, the scope of power ranges is large, as are the diverse types of implemented fuels and fuel cell technologies. The special markets also utilise many of the key technologies that are required in the mass automobile and stationary fuel cell markets.

The power range of applications in the special markets extends from very low with just a few watts for micro fuel cells, through several 100 W for on-board power supplies, up to several ten kW for uninterruptible power supplies or range extenders for battery-electric special vehicle applications. Hydrogen, methanol, ethanol, bioethanol and LPG in combination with a reformer are employed as fuels.

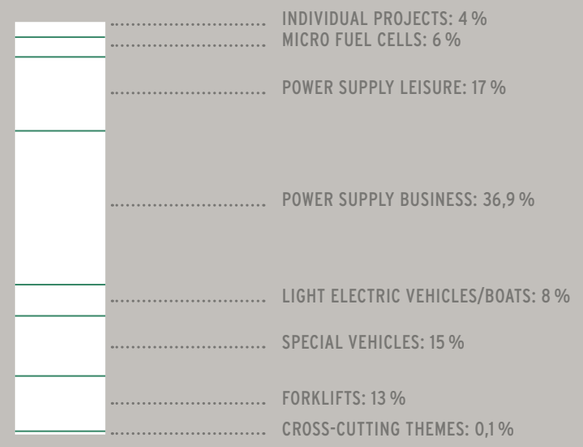
Various systems are in use for the supply of hydrogen; from gas cylinders and cartridges within metal hydrides or hydrogen generators based on chemical hydrides, to methanol with a relevant infrastructure and logistics for distribution, but also the construction of hydrogen service stations is foreseen. In terms of fuel cell technologies, the spectrum covers the ranges from PEM, HT-PEM, DMFC to SOFC.

The special markets incorporate fields of application including: business power supply (emergency power supply, UPS, off-grid power supply, autonomous/hybrid power supply, emergency power systems), leisure power supply (on-board power supply and drives), warehouse vehicles (forklifts, haulers), special vehicles, electric light vehicles and micro fuel cells (industrial sensors, small device supply).

Contact Head of Programme: Wolfgang Axthammer / wolfgang.axthammer@now-gmbh.de

NIP – STATISTIC: SHARE ACCORDING TO APPLICATION SECTOR (AS AT DECEMBER 2012 *)

NIP – SPECIAL MARKETS: ALLOCATION BY APPLICATION AREA (AS AT DECEMBER 2012)



* The diagram incorporates projects at planning stage at NOW, being processed by PtJ, LOI (Letter of Intent) as well as those approved.

clean power net
Brennstoffzellen in Industrie und Business

FROM CO_2 TO H_2O – THE TELECOMMUNICATIONS SECTOR GOES GREEN

In cases when the regular power supply fails, autonomous technologies are the only solution. This is case for general mobile phone networks but is all the more crucial for public safety authorities (BOS – Behörden und Organisationen mit Sicherheitsaufgaben). At best, something may still function in the so-called direct mode in such circumstances. Fuel cell technology is considered the incarnation of a clean energy supply. Its areas of application seem to be without limit: from the supply of heat and power for homes and businesses, for factories as well as for cars, trains computers and mobile phones, and not least for the base stations of mobile phones – in short, for green telecommunications. The NIP programme area Special Markets deals with the diverse range of areas in which fuel cell technology is finding application that are off the beaten track.

The supply of power to a base station must always be assured. The Federal Agency for Digital Radio of Security Authorities and Organisations in Germany (Bundesanstalt für den Digitalfunk der BOS – BDBOS) prescribes a network availability of 98.5 per cent, with these requirements being less strict for the public mobile phone network. Nevertheless, today's widespread combination of diesel aggregates and accumulators is widely considered as antiquated as besides generating noise, smell and heat, also produces carbon dioxide. Furthermore, tight restrictions exist for their construction and operation – not a single drop of diesel may enter the soil, especially so in nature reserves and water protection areas. Lead batteries are mostly used as lithium ion types are often simply too expensive.

Fuel cell technology offers an alternative. 2,000 fuel cell systems are to be funded within the framework of the NIP programme area Special Markets, for BOS networks, the armed services and THW technical assistance organisation. In the state of Brandenburg, the use of fuel cells for the supply of power at BOS base stations is being trialled. A total of 116 base stations are being equipped with fuel cells in Brandenburg to ensure uninterruptible (emergency) power supply (UPS). Yet the demands prescribed in largest of the new German states are high: the fuel cells must simultaneously act as a UPS and emergency power supply – capable of bridging downtimes of up to 72 hours.

Fields of application for fuel cell technology also exist in public telecommunications. For example, mobile phone operator E-Plus brought Europe's first power-independent base station online at Versmold in April 2012. The required power is produced from a combination of photovoltaic, windpower, batteries and fuel cells. The fuel cell system alone can bridge 250 hours. A total of 24 hydrogen canisters each containing 50 litres at 300 bar are available on top of a massive battery capacity. 7.88 tons of carbon dioxide can be save annually in this way. »In future, E-Plus will operate 13 such CO_2-free locations. 2.3 million euros of NIP funding from the Ministry of Transport (BMVBS) will be allocated for the fuel cell component plus the energy management system and interface«, explains Wolfgang Axthammer, head of the Special Markets programme area at NOW.

For more information, please visit:
www.cleanpowernet.de

Uninterruptible power supply for telecommunications using fuel cells

IV / 01

» PROAIR – PROTOTYPE DEVELOPMENT OF HUMIDIFIERS AND FILTERS FOR THE OPTIMAL SUPPLY OF AIR FOR PEM FUEL CELLS «

Supplying polymer electrolyte membrane fuel cells (PEM FC) with optimally humidified air without contaminants has a significant influence on their effectiveness, reliability and service life.

Goal of the project is the development of filters and humidifiers for the supply of air to PEM FCs that bear the following attributes:

Various filters and humidifier components are being developed with new production processes that:

» allow for reduced costs and design flexibility in terms of tooling, enabling the cost-effective adaptation of components for defined installation spaces and connections, and

» deliver optimal performance due to minimal pressure loss resulting from flow optimisation.

Moreover, the filters will be developed in such a manner that they will also provide protection against damaging salt spray and be built to fit in an enclosure enabling leak-proofing and easy servicing without the need to open the system housing.

FCCT is developing the concepts and is providing the necessary guidelines for the development of tools. mm-plastic is developing the tools and processes for the production of the housing and produces test samples and prototypes.

The prototypes are produced in cooperation with associated end users and are examined and evaluated for their suitability in laboratory and field tests. This ensures the conditions are met for accelerated implementation of the developed components in marketable products.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Freudenberg FCCT SE & Co. KG	1,578,226	757,548
mm plastic gmbh	593,269	284,769

COMMENCEMENT: 01 August 2012
CONCLUSION: 31 January 2015

» Goal of the project is the development of filters and humidifiers for the supply of air «

IV / 02

» BICYCLE – FUEL CELL BICYCLES FOR THE EMISSION-FREE TRANSPORTATION OF GOODS IN CITY CENTRES «

Aim of this project is to develop fuel cell technology and hydrogen infrastructure for micro drives. The advantages of fuel cells are especially apparent in the case of transporting small loads. Using secondary batteries, the required energy to move loads can only be provided with great difficulty. Meanwhile, the large range paired with refilling that takes just a minute are further competitive advantages over a purely battery-electric drive.

The project involves setting up fleets of fuel cell bicycles for various operators in Freiburg, for the commercial transportation of goods. Fraunhofer ISE will conduct a scientific evaluation of the fuel cell technology, including refilling at solar hydrogen filling stations. Insights gained from the evaluations will be made available to the bicycle supplier HyPower to promote further technological development.

The operators of the fuel cell bicycles in this project are:

» Breisgauer Medienvertrieb providing mail delivery services for Arriva GmbH

» Abfallwirtschaft und Stadtreinigung (waste management and city cleaning) Freiburg for the removal of unauthorised billposting and broken glass on pavements and cycle paths

» mobile-freiburg as the mobility service provider for the rental of load-carrying bicycles to companies

» Fraunhofer ISE for internal mail and goods transportation between its organisational units within the city

Additional potential operators are to be approached during the course of the project.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Abfallwirtschaft und Stadtreinigung Freiburg GmbH	156,615	75,175
Breisgauer Medienvertrieb	398,915	191,479
Fahrradstation und Mobilitätszentrale Freiburg mobile gGmbH	342,649	164,472
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	850,499	408,240

COMMENCEMENT: 01 October 2011
CONCLUSION: 31 March 2015

Fuel cell-powered cargo bicycle

IV / 03

» W-NEA BOS BB – HYDROGEN EMERGENCY POWER SYSTEMS FOR PUBLIC SAFETY AUTHORITIES (BOS) IN THE STATE OF BRANDENBURG «

The BOS digital radio base stations in the state of Brandenburg are to be equipped with fuel cells. Focus of the project lies in the testing of fuel cells for the uninterruptible (emergency) power supply (UPS) under real conditions. The demands placed on reliability are especially high, as the public safety authorities (BOS – Behörden und Organisationen mit Sicherheitsaufgaben) must guarantee uninterrupted operational readiness. The provided service and logistics concepts are also to be verified. It is planned to equip 116 locations. Locations are to be divided into three groups and allocated to three different providers. Allocation will take place via a tendering process in accordance with VOB guidelines. The resulting documentation will be made available to other public authorities in the form of a template, to enable the establishment of fuel cell technology in other areas of public procurement. In addition, interested states and authorities will have the opportunity to take part in workshops that will explain the wide spectrum of applications possible with fuel cell technology. Project partner the Technical University of Applied Sciences Wildau will support operation as well as assist in the evaluation of results in the form of scientific support. Results will ultimately be collated and published. Without this funding project and technical support from NOW, the state of Brandenburg would have implemented conventional diesel generators for its emergency power supply.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Zentraldienst der Polizei des Landes Brandenburg – Projektorganisation Digitalfunk BOS Brandenburg	6,605,421	3,170,602

COMMENCEMENT: 01 April 2012
CONCLUSION: 31 March 2016

» Testing of fuel cells for uninterruptible power supply «

Fuel cells can be implemented for power supply back-ups in the digital radio networks of public authorities

Sailing yacht with an SOFC on-board energy supply system

IV / 04

» SOFC ON-BOARD ENERGY SUPPLY «

Aim of the project is the development, application and field testing of a compact SOFC on-board energy supply system with 500 W of electrical power using SOFC (Single Oxide Fuel Cell) technology for operation initially with liquid gas. It is primarily intended for mobile applications where a reliable and environmentally friendly supply of power is required, e.g. yachts, motor homes or in remote areas without mains power supply. The chosen power range of the systems of at least 500 W distinctly stands out from competitor technologies with fuel cells and closes a gap for energy demands of up to 12 kWh/day, which is currently primarily covered by diesel generators from 4 kW.

An SOFC system with a power range of at least 500 W is to be conceived and configured for the abovementioned uses, along with the development of applications to integrate the systems for their intended uses. A particular focus of the application area lies in a hybrid solution deploying lithium batteries in the vehicle electrical system. In total, 16 field test systems are to be developed and manufactured by new enerday in three generations, as well as undergoing comprehensive tests on test benches, climatic chambers and environmental testing facilities. Fischer Panda develops the specific applications to integrate the systems into the test beds and plays the leading role in the field tests and their evaluation.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
new enerday GmbH	1,553,523	745,691
Fischer Panda GmbH	665,346	319,366

COMMENCEMENT: 01 June 2012
CONCLUSION: 31 May 2015

IV / 05

» µMEGA «

Goal of the »µMEGA« project running until the end of 2012 was the development of an inexpensive micro fuel cell system. Coinciding with the annual f-cell, the field test of the direct methanol fuel cell system developed at the Umwelt-Campus Birkenfeld (Birkenfeld Environmental Campus) commenced on 9 October 2012 and is now being tested in practice by various partners.

The system, which was developed in close cooperation with the companies Wellgo Gerätetechnik and Ille Papierservice, is a genuine marathon master that can continuously handle small power requirements of up to 10 W without maintenance for up to six months before needing to be refuelled with methanol. One litre provides approximately one kilowatt hour: translated, this means one would need to store 1,000 litres of liquid hydrogen in pressure tanks. Hybridisation with accumulators provides for dynamic load behaviour and thereby enables application for a wide spectrum of uses, without needing to change the fuel cell module.

Areas of application can be found in the replacement of batteries in timetable displays and container tracking (EPSa), safety technology for use in tunnels (Siemens), or electronic dispensing systems such as those used in sanitary facilities (Ille).

Besides the applications mentioned above, the partners Bartels, Freudenberg and Solvicore are providing components suitable for series production in this innovative system. Furthermore, Fraunhofer ISE analyses the system through long-term characterisation under extreme climatic conditions, and together with the VDE-Prüfinstitut (Association for Electrical, Electronic & Information Technologies in Germany) attends to the aspects of quality control and certification.

Thanks to the close and effective cooperation between partners, the project consortia has successfully proven that the entire value-added chain can be covered by German firms: from component producers (Solvicore, FCCT, Bartels), through systems manufacture (Wellgo) to applications (Ille, EPSa, Siemens). Partner EPSa manufactured the system electronics.

October 9 was finally the day: The fuel cell – which thanks to an injection moulding method can now be manufactured inexpensively – entered in the field test phase. It was accompanied by a ceremonial start on the occasion of f-cell, together with Wolfgang Axthammer (NOW), Thomas Jungmann (Fraunhofer ISE), Prof. Gregor Hoogers (Umwelt-Campus Birkenfeld) and Dr. Holger Dziallas (Solvicore).

The first field test devices are successfully being deployed in the sanitary area and will achieve a service life significantly exceeding 10,000 hours. The other mentioned applications could not as yet be realised due to the demanding nature of their outdoor applications. The results and insights coming from the field tests will assist in continued developments for a system suitable for outdoor use.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Bartels Mikrotechnik GmbH	188,361	90,413
EPSa Elektronik & Präzisionsbau Saalfeld GmbH	306,626	147,180
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	691,620	331,978
Freudenberg FCCT & Co. KG	801,660	384,796
Siemens Aktiengesellschaft	1,119,971	537,586
Umwelt Campus Birkenfeld – Fachhochschule Trier	255,842	122,804
SolviCore GmbH & Co. KG	1,553,965	745,903
VDE Prüf- und Zertifizierungsinstitut GmbH	271,342	130,244

COMMENCEMENT: 01 July 2009
CONCLUSION: 31 December 2012

ASSOCIATED PARTNERS: Ille Papierservice GmbH, Wellgo Gerätetechnik GmbH

IV / 06

» MODULAR ENERGY SUPPLY SOLUTION FOR SPECIAL VEHICLES AND FOR MOBILE USE AT OPERATING SITES «

SFC Energy AG, market leader for mobile and portable fuel cell technology and Sortimo International GmbH, market leader for in-vehicle organisation systems, have jointly developed an energy supply solution on the basis of the EFOY Pro fuel cell. The modular components, spanning from the fuel cells and lithium-ion batteries through to voltage converters, are fully compatible with the Sortimo Globelyst vehicle equipment and the L-BOXX storage system. This lets the individual modules be quickly connected with each other in the vehicle or at the operating site to enable plug & play energy supply.

The system provides energy for electrical devices or measurement and data system technology in the vehicle or for using tools or mobile equipment on site. Using a fuel cell to supply energy, sufficient power is available at any location for many days or even weeks. The DMFC (Direct Methanol Fuel Cell) as core component and the flexible lightweight modules from Sortimo ensure energy supply can be deployed flexibly and easily. The power is produced in an environmentally friendly manner and without emissions.

As part of this project, prototypes could be tested, for example, in a mobile ticket sales vehicle of the German Railways (DB) as well as in portable deployment for an energy supplier. In the application at DB, the fuel cell provides for a workplace with wireless data communications, a PC, printer and lighting. In the remote deployment by an energy supplier, measurement and surveillance technology for sensitive sensors is being reliably supplied with environmentally friendly energy – far from a conventional power source.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
SFC Energy AG	2,862,000	1,373,760
Sortimo International GmbH	350,722	163,347

COMMENCEMENT: 01 May 2010
CONCLUSION: 31 October 2012

Ticket sales vehicle

IV / 07

» FUEL CELL 4 LEISURE – SUPPLY OF POWER FOR BOATS AND CARAVANS IN THE LEISURE AREA WITH 250 W FUEL CELL SYSTEMS IN THE LAKE CONSTANCE REGION «

The »Fuel Cell 4 Leisure« R&D project was conducted within the framework of the NIP Special Markets programme area according to the development plan for the deployment of fuel cell systems for the on-board supply of power in the leisure market.

The project aimed to develop a close-to-series-production fuel cell system for the on-board supply of power for recreational vehicles. Widely used and easily available liquid petroleum gas (LPG) was to be used as the fuel. The system should distinguish itself through its quiet operation, independence of location or climatic conditions as well as boasting low maintenance and emission characteristics in operation.

Building on an initial operating model, work commenced in June 2009 and continued to June 2012 at which time many system generations had been developed. The systems and their components where tested under realistic conditions during field tests and in the ZBT climate chamber, with results being fed back into the development cycle.

At the core of the system is a high-temperature PEM fuel cell, which in contrast to low-temperature PEM fuel cells, is distinguished by high CO tolerance. This allowed for a reduction in system complexity and significantly increased robustness. The design of the fuel cell underwent numerous adjustment cycles throughout the development work and was optimised to such an extent that the fuel cell stack is now distinguished by stable parameters for reliable operation. The hydrogen required to produce power with the fuel cell was produced from LPG via a reforming process. LPG is desulphurised and subsequently catalytically converted into a hydrogen-rich reformat gas. The development and qualification of the desulphurisation cartridge was also a component of this project, as was optimisation of the gas processor. The water required for the reforming is collected via an innovative recycling process, where it is gathered in a gaseous form from the exhaust of the fuel cell. On the one hand, this means that there is no need for another source of water, and on the other hand start and operation of the system below freezing is also without problem.

Many components and monitoring elements in the system must be precisely aligned with one another to ensure safe and reliable operation. As such, complex demands were placed on the control system. This was developed to such an extent that the system is now completely automatically operational. Users have the possibility to adjust the operational and battery settings via an interface and can also obtain information concerning the state of the battery and overall system.

To ensure safe operation, particular attention was given throughout development to the integration of safety-related facilities in the system. Due to correspondingly designed components and processes, the accumulation of flammable or poisonous substances can be ruled out. The system and its safe operation were successfully certified for testing by field trial customers.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
enymotion GmbH	1,047,104	502,610
Zentrum für Brennstoffzellen-Technik GmbH	366,605	175,970

COMMENCEMENT: 01 June 2009
CONCLUSION: 30 June 2012

IV / 08

»EU-SKAB – CREATION AND EVALUATION OF A MODULAR, SCALABLE FUEL CELL SYSTEM WITH A 1-10 KW POWER RANGE«

The area of »power supply for business«, in particular uninterruptable power supply (UPS) is considered as an early market for fuel cell systems. While several hundred units are in operation in the USA, there were no series production products available on the market in Germany upon commencement of the project. Existing solutions in the 1–10 kW power range for industrial deployment were not yet sufficiently mature.

The project aimed to demonstrate to industrial customers the technology's readiness for start of series production through improved integration, an industrial-grade design and by proving its suitability in practice.

A key requirement was that all components needing revision throughout the lifecycle (fuel cell modules, buffer batteries, filters) needed to be easily accessible or exchangeable. The system was produced as an air-cooled fuel cell stack, which reduces the number of secondary aggregates by 70 % in comparison to a water-cooled system. This resulted in increased system availability as well as reduced scope of maintenance.

An air-cooled system requires a defined volumetric flow to dissipate produced heat. For outdoor deployment, a compromise could be found between a large opening for high air flow in summer and an opening that was as small as possible for winter operation (fuel cells are sensitive to frost), and to avoid damage from vandalism. These requirements could be resolved during the project so that the outdoor system can be deployed in temperatures ranging from -30 to +45°C.

As quantities are yet still very low due to the high costs, a rigorous focus was put on standardisation to reduce packaging expenses. As such, the core components of the module mounting and the internal airflow are identically designed for both indoor and outdoor cabinets and independent of the power/number of fuel cell modules.

For performance in the range between 1 and 5 kW, where only one or two fuel cell modules are deployed, at first glance this system appears to be expensive and uses more space as the capacity of the rack is only exploited to 50 %. The remaining 50 % can, however, easily be filled with customer or project-specific power electronics (DC/DC, DC/AC) and thereby be housed in the same cabinet. This is further simplified due to using standardised designs such as the Rittal system and the 19" convention. This also significantly promotes system integration and wiring expenses – and ultimately reduces the need for space.

> »Proving the maturity of the technology through evidence of its suitability for use in practice«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Rittal GmbH Co. KG	412,698	198,095

COMMENCEMENT: 01 June 2009
CONCLUSION: 31 December 2012

IV / 09

»BBH-MH II – DEVELOPMENT OF FUEL CELLS / BATTERY HYBRID POWER SUPPLY SYSTEMS FOR WAREHOUSE VEHICLES ON THE BASIS OF NICKEL METAL HYDRIDE (NIMH) AND LITHIUM ION TECHNOLOGY«

Global market demands in the logistics area are constantly increasing. In order to meet these challenges, forklifts and other warehouse vehicles must continue to be developed through new product innovations. Growing cost awareness (lifecycle costs), an increase in full-service and rental agreements with these customers continually require new solutions that can only be realised through a constant further development of »intelligent« systems for the supply of energy.

Goal of the project, within the framework of the hydrogen and fuel cell technology funding programme, was the continued development of emission-free drivetrain concepts for the material handling area implementing hybrid fuel cell and battery technology.

Building on the previous »BBH-MH« project, in which three prototypes were developed and the feasibility of such solutions was demonstrated, the focus of the »BBH-MH« II project was on the further development of the battery technology and the complete system solution. Three development phases were defined to enable this.

The first development phase was concerned with the continued development of the existing systems in terms of the mechanical design, control aspects and the user interface. With a completely new and innovative control concept for hybrid operation, a significantly more gentle and life-extending operation of the fuel cell could be achieved. Furthermore, overall system efficiency and the energy efficiency from the hydrogen to the vehicles could be increased. Goals set in terms of installation space could also be reached due to comprehensive evaluations and studies on packaging along with the modular design of the system. However, the development of new battery technologies with higher energy and power densities were a prerequisite for this.

The second development phase involved the development of a high-performance nickel metal hydride (NiMh) cell with increased power density. From the insights gained from the previous project, it was possible to stipulate the optimal size and capacity. Due to the more compact dimensions and higher power density, a particular focus on the system level was placed on battery cooling.

To entirely fulfil the project goals of a compact system and higher hydrogen capacity, the development of a hybrid-compatible lithium battery was necessary. This could be realised in the third development phase with a benchmark of large capacity cells on the market and the construction of prototypes. Here too did the thermo management of the batteries comprise a special challenge.

The project showed that a direct replacement of standardised lead batteries in fork lifts and other vehicles for material handling is possible, through the hybrid implementation of the latest battery technology with fuel cells. In order to further reduce system costs and complexity, fuel cell systems in particular should be significantly simplified, for example, through the implementation of stacks with open cathodes.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
HOPPECKE Advanced Battery Technology GmbH	1,837,000	881,760

COMMENCEMENT: 01 September 2009
CONCLUSION: 30 August 2012

IV / 10

» USV PROGAS – NEW UNINTERRUPTIBLE POWER SUPPLY THROUGH PROPANE GAS FUEL CELL SYSTEMS. SUB-PROJECT: DEMONSTRATOR DEVELOPMENT «

Aim of the »USV ProGas« project is market preparation for fuel cell technology, demonstration of its practical suitability and the transition to series production in the niche area of uninterruptible power supply. The project contributes to promoting market development, the establishment of a value-added chain in Germany to secure jobs as well as shoring up Germany's technological leadership. Comprehensive developmental and cost optimisation steps are necessary to ensure this occurs.

The deployment of propane fuel cell technology in computer data centres is to be tested in practice and promoted within this project. A reduction in necessary infrastructural technology is to be achieved along with greater flexibility. Electrical and thermal losses are to be reduced and the overall efficiency of the energy supply is to be boosted. The associated reduction in energy requirements is to be recorded and compared with various other supply approaches.

During the project's three-year duration, simulation, packaging and manufacture of the first 1 kW systems along with the system design comprised the first phase. The second phase saw a further development cycle conducted and the development of 5 kW systems.

Within the course of the project, the implementation of this technology using propane gas as fuel in an HT-PEM fuel cell could be shown. In particular, the start-up time could be reduced to around 15 minutes, which means this is no longer an exclusion criteria for deployment in UPS applications. Problems were experienced in the quality of the employed stacks, which meant changing to a different manufacturer.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
FCPower Fuel Cell Power Systems GmbH	1,322,009	634,564
regio iT gesellschaft für informationstechnologie mbh	693,226	332,748

COMMENCEMENT: 01 September 2009
CONCLUSION: 31 December 2012

Deployment of fuel cells in data processing centres

IV / 11

» ENSURING AVAILABILITY OF TELECOMMUNICATIONS NETWORKS, FUEL CELL SYSTEMS IN LANDLINE TELEPHONY «

Aim of the project was to test fuel cell systems to ensure availability of telecommunication networks.

The new fuel cell system technology that was deployed within the framework of this demonstration project is to replace conventional rectifier systems and also become a virtual power plant for the provision of supplemental power reserves and to reduce peak loads. An additional goal is the integration of the individual components and the optimisation of the overall system with a focus on raising efficiency, lowering costs and decreasing CO_2 emissions.

Five sub-projects were realised with various PEM-FC systems, which were technically suitable to deal with the four expected operational situations (stand-by, back-up, supplemental power reserves, peak loads).

Besides planning and integration, particular challenges were experienced in putting the fuel cell systems into operation as well as when documenting operating states. Instrumental in this regard was the scientific and evaluative support provided by the Centre for solar energy and hydrogen research (Zentrum für Sonnenenergie- und Wasserstoff-Forschung – ZSW).

Throughout the duration of the project, forced and real situations, such as an automatic supply changeover following the failure of the main power network, could be dealt with as planned. The systems are easy to administer by the service personnel. WBZU GmbH developed suitable training concepts.

The results from operation with the virtual power plant for supplemental power reserves and peak load reduction can be used in the design of future virtual power plants and decentralised power generation systems. Due to the low capacity of individual systems, however, is participation in the electricity balancing market only feasible in a pooling system.

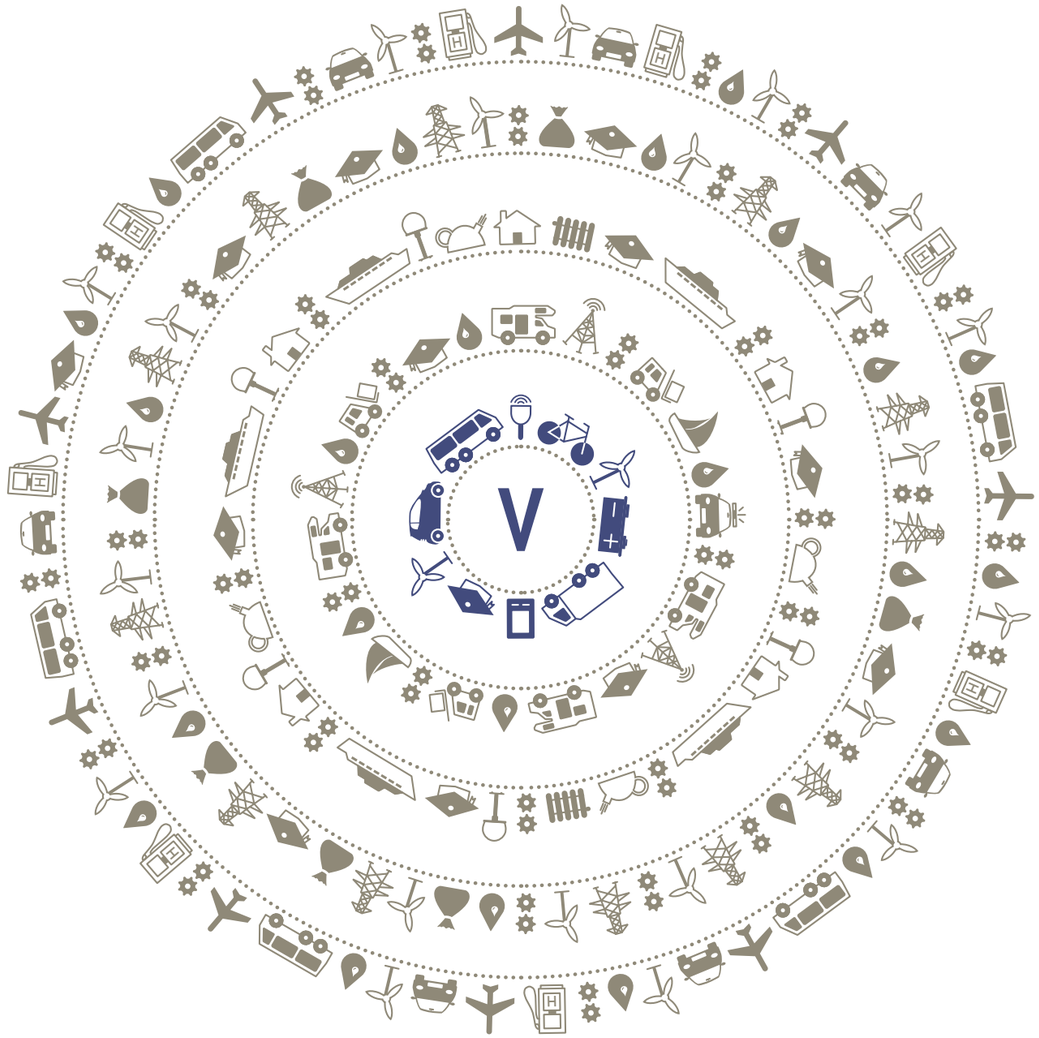
The technology and quality of the fuel cell systems were consistently convincing. Their cost effectiveness, however, remains a challenge. Potential for optimisation exists in both manufacturing and operational costs.

The economic viability of fuel cell plant implementation appears in back-up applications and partly only in niche applications. Here, specific requirement constellations may have a positive effect on the profitability analysis, for example, when there is only a small power demand and high need for reserve time, fuel cells stand in closer competition to diesel-based emergency power systems than to battery systems.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
PASM Power and Air Condition Solution Management GmbH & Co.KG	2,000,000	960,000

COMMENCEMENT: 01 March 2009
CONCLUSION: 31 December 2012

BMVBS – ELECTROMOBILITY MODEL REGIONS



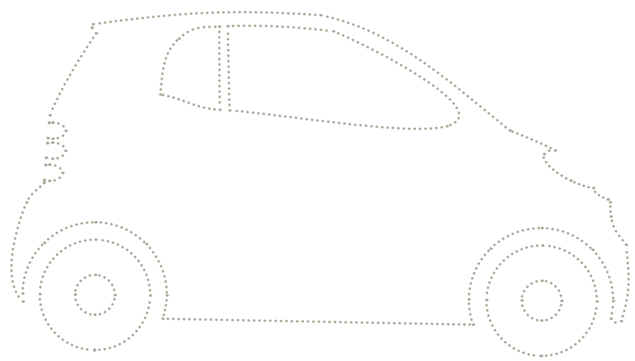
ALL PROJECTS ARE MARKED WITH V / 01 / 01 – V / 10 / 07 ON THE FOLLOWING PAGES.

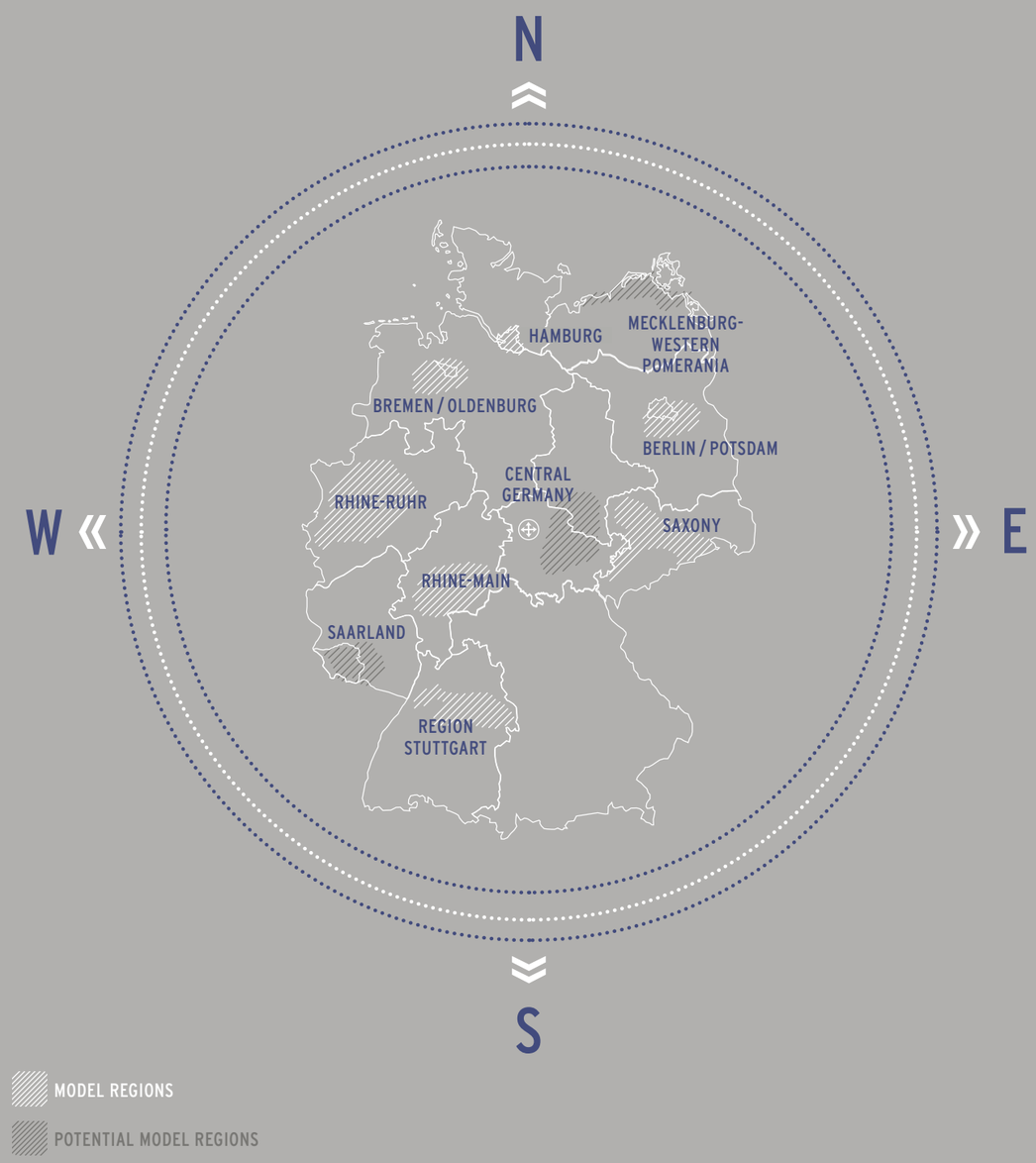
ELECTROMOBILITY: A DRIVE FOR BUSINESS AND THE ENVIRONMENT

Business success and innovative strength in Germany are closely linked with accessibility to reliable mobility and in particular, individual mobility. The automobile industry, as well as associated manufacturers and suppliers, hereby play a central role. They are considered a driving force for the creation of jobs in Germany. The finite nature of fossil fuels, rising energy prices and the pressing challenge of climate change have led to a shift in thinking and acting in all business sectors. This especially applies to the automobile industry. Alternative, sustainable drive technologies are the future. And electromobility plays a key role in this regard.

The momentum in the area of electromobility in Germany over the past years has been nothing short of impressive. Hardly a week goes by without the media presenting some new model, idea or concept. All major automobile manufacturers now include electric vehicles in their ranges. The strong involvement and commitment of industry towards electromobility and high media attention have created an adequate level of public awareness within a very short space of time.

Electromobility means: battery and fuel cell. In both, an electric motor ultimately drives the vehicle. In the case of a battery vehicle, power is carried on board in the battery. The fuel cell vehicle, meanwhile, carries hydrogen, which a fuel cell converts to power on board.





V. BMVBS – ELECTROMOBILITY MODEL REGIONS

FUNDING PRIORITY ELECTROMOBILITY – AN INVESTMENT INTO THE FUTURE

One million electric vehicles on the roads by 2020 is the goal of the federal government. Germany is to become the world's leading market and supplier for electromobility. It was against this backdrop that the Federal Ministry of Transport, Building and Urban Development (BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung) developed the »Electromobility in Model Regions« funding programme. The initiative supplements and rounds off the »National Innovation Programme Hydrogen and Fuel Cell Technology« (NIP), which was established in 2006 to run 10 years with a total funding budget of 1.4 billion euros.

As such, the BMVBS supports the whole array of electromobility technologies and is showing, together with the NIP and the electromobility model regions, that the technology is suitable for use on the roads, by railways, in aviation as well as in the maritime domain. The focus of electromobility with batteries is on applications in an urban context.

Mobility infrastructure and user habits are affected by numerous factors. Population density, demographics and the respective financial resources of cities or municipalities are significant aspects that influence the growth of and differences in mobility systems regionally. It was on this basis that the Model Regions concept was developed. The goal is the preparation of the market and technology for electromobility in various regions, specifically:

» funding support for technology-open R & D on battery-electric mobility

» user-oriented demonstration under everyday conditions

» integration into mobility, regional and urban planning

» networking of relevant local players in industry, research and government

» results-oriented exchange in overarching subject areas.

To promote battery-electric mobility, from 2009 to 2011 the federal government provided 500 million euros of support from funds stemming from the second economic stimulus package (Konjunkturpaket II), of which 130 millions euros was allocated to the Electromobility Model Regions programme of the BMVBS. Hereby, the value of the federal funding was to correspond with a private sector share of at least the same amount. Using the funds from the second economic stimulus package, a total of 220 individual electromobility projects undertaken between 2009 and 2011 by large-scale industry as well as small and medium-sized firms, were supported. With this funding it was possible to expand the competencies and systems of suppliers, strengthen regional networks and cooperation, boost the marketability of new technologies, develop and test new business models and not least promote awareness and acceptance of electromobility in Germany.

Support of the model regions will continue until 2016 with further funds from the BMVBS. A total of approximately 200 individual projects in more than 50 groups will be implemented. The continuation of support reflects the success of the electromobility model regions.

The Model Region programme supplements the »Schaufenster Elektromobilität« (Showcase Electromobility). With funding totalling 180 million euros, the Showcases bundle the most innovative elements of electromobility with a focus on roads and passenger vehicles in large regional demonstration and pilot projects, and make it more visible on an international level. Four federal ministries are involved in the Showcases: the Ministry of Economics and the Ministry of Transport each participates with 67 million euros; the Ministry of the Environment provides 25 million and the Ministry for Research 20 million euros. The funding is supplemented at the Showcase level by state funding and from private sector participation.

RETHINKING MOBILITY

How can the demands of an increasingly complex world of mobility be best met? How can the future individual mobility requirements in cities and rural regions be identified and fulfilled? How can innovation and creativity be stimulated? And not least, how can new drive technologies be swiftly developed to market maturity?

The Electromobility Model Regions programme takes the approach of a fundamentally new and diverse mobility system. Sustainable electric drive technologies provide a foundation in this regard. Electric vehicles as a form of decentralised energy storage can assume completely new functions in the urban energy infrastructure. Whether hybrid, battery or fuel cell vehicle, various drive technologies will exist side-by-side in the foreseeable future and satisfy various mobility demands. With car sharing and leasing models as well as intelligently coupling various means of transport, new usage and business models are today already being trialled and will grow in importance in the future. Various forms of mobility can be increasingly used via mobility cards. It is anticipated that a cultural transformation will accompany the widespread introduction of electric drive systems. Networking, cooperation and communication will play a more prominent role in the mobility systems of the future.

INNOVATION STIMULI FROM THE MODEL REGIONS

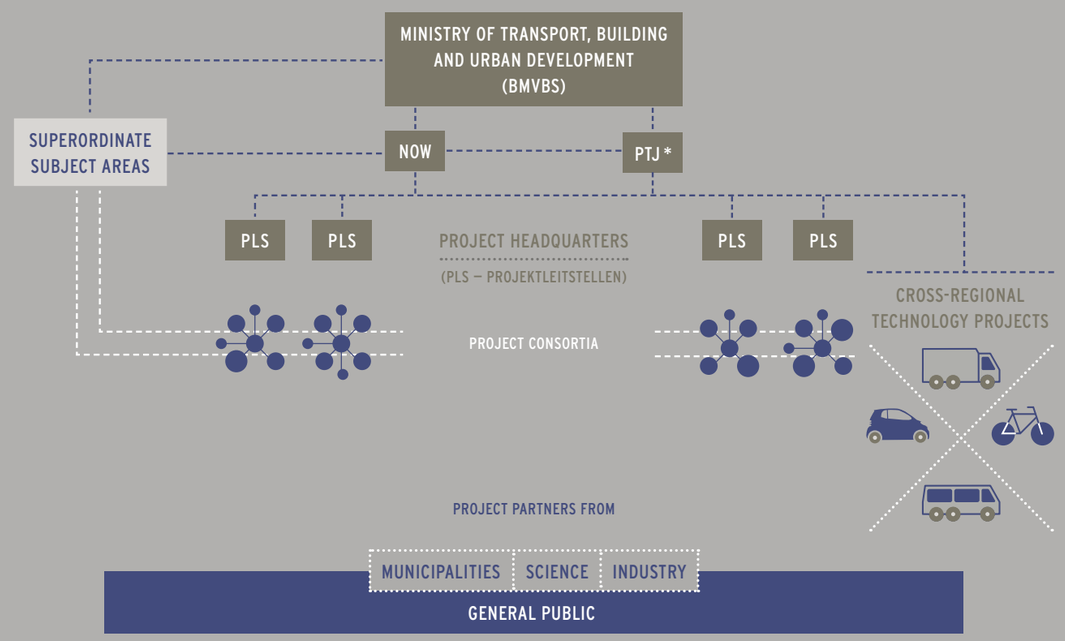
The electromobility model regions place an emphasis on the coordinated promotion and development of regional innovation clusters that can act as a stimulus for innovation for the whole of Germany and for the entire electromobility value added chain. It not only applies to the research and testing of concepts in concrete practical projects, but also for their actual introduction to the market. This is made possible due to the established structures of the programme, a detailed scientific analysis and evaluation of the projects, and the continuous exchange of information and project results in defined subject areas, across Germany.

THE PROJECTS: COOPERATION FOSTERS INNOVATION

The significant advances that electromobility has made over the last two years in Germany would hardly be imaginable without the numerous insights provided by the projects from the model regions. They are the source of the results and innovations that are necessary for the continued development to advance electromobility technologies to maturity. Until June 2011, more than 220 project partners worked in around 70 project consortia across the model regions. The partners come from business, science and research as well as from government. Specifically, these include participants such as universities, research institutes and consulting firms, local public transport authorities and other transport companies, vehicle manufacturers and providers as well as suppliers, component manufacturers, public utility companies and providers of infrastructure in addition to municipalities and cities. It is precisely this diversity that bestows the model regions with their innovative strength. New perspectives, ideas and projects have developed from what at first seemed to be unusual cooperations and partnerships.

The model region projects let know-how be developed and implemented on site to promote electromobility in everyday life. The exchange and networking with other projects and regions takes place continuously. A central element for this comprises accompanying supplementary research.

ORGANISATIONAL STRUCTURE



* PROJECT ADMINISTRATOR JÜLICH

SUPPLEMENTARY RESEARCH

The subjects and objectives of the model region projects span the entire spectrum of electromobility. In order to bring together the results of the individual projects of the regions on a programme level and to ensure the exchange of experiences between participants, seven overarching subject areas were identified and established within the framework of the supplementary research, building on the structures already created within the second economic stimulus package. These subject areas are: user perspectives; fleet management; innovative drives and vehicles; safety; infrastructure; regional, urban and transport planning; and regulatory framework.

The supplementary research is coordinated by the BMVBS and NOW. Almost all model region projects are collected there and categorised and evaluated according to the thematic platform. As such, the practical insights gained support an exchange of experiences that extends beyond the region. Building on these examinations, regional specifics can be detected, especially successful models identified and synergies exploited. The results of the supplementary research are available for all partners to benefit from.

IMPLEMENTING ORGANISATIONAL STRUCTURE

In consultation with the BMVBS, NOW develops the overall funding focus and conducts the coordination and bundling of the projects according to thematic and geographic aspects. The BMVBS ensures the contents are coordinated with other activities of the federal government and aligned in a political context. The federal ministry together with the federal government is thereby responsible for determining the focus of content in the area of electromobility and comprises the interface to the National Platform Electromobility (NPE).

Programme management, project development in the line with the federal government and the BMVBS, and the overarching overall coordination of the model region is conducted by NOW. This encompasses the preparation of content for project selection, more detailed specifications of the project outlines from industry, research and municipalities, as well as developing project suggestions with regional project headquarters. In addition, NOW coordinates the seven overarching subject areas of the supplementary research and accompanies the individual and group projects during their implementation.

Projektträger Jülich (PtJ) is responsible for project administration and supports the programme with legal advice on public funding.

The project headquarters (PLS – Projektleitstellen), conduct coordination tasks on a regional level. The project headquarters are comprised of regionally-based actors from the areas of business development, public utilities, energy agencies and from other public-private partnerships. Furthermore, they also ensure exchange takes place between project partners.

Local and regional participation is thereby quickly enabled in this manner and the responsibility for programme implementation is promoted. The regional headquarters also take on an important function during the selection and development of initial project ideas, bringing together regional players and uniting project consortiums.

THE ELECTROMOBILITY MODEL REGIONS: IMPORTANCE FOR THE INTERNATIONAL COMPETITIVENESS OF GERMANY'S AUTOMOBILE INDUSTRY

The development of alternative drive technologies in Germany is transpiring against the backdrop of challenging international competition. Numerous countries from Asia, North America and Europe are working at full steam to develop new drive and mobility concepts.

The development of electromobility will play a crucial role, not only for the future of the automobile industry, but for all of Germany as a leading economic and technological centre. If Germany wishes to retain its leading position in global markets, investments must be made in new drive technologies. The course towards marketability and competitiveness is being set today. The model regions are thereby playing a crucial pioneering role.

Contact Head of Programme:

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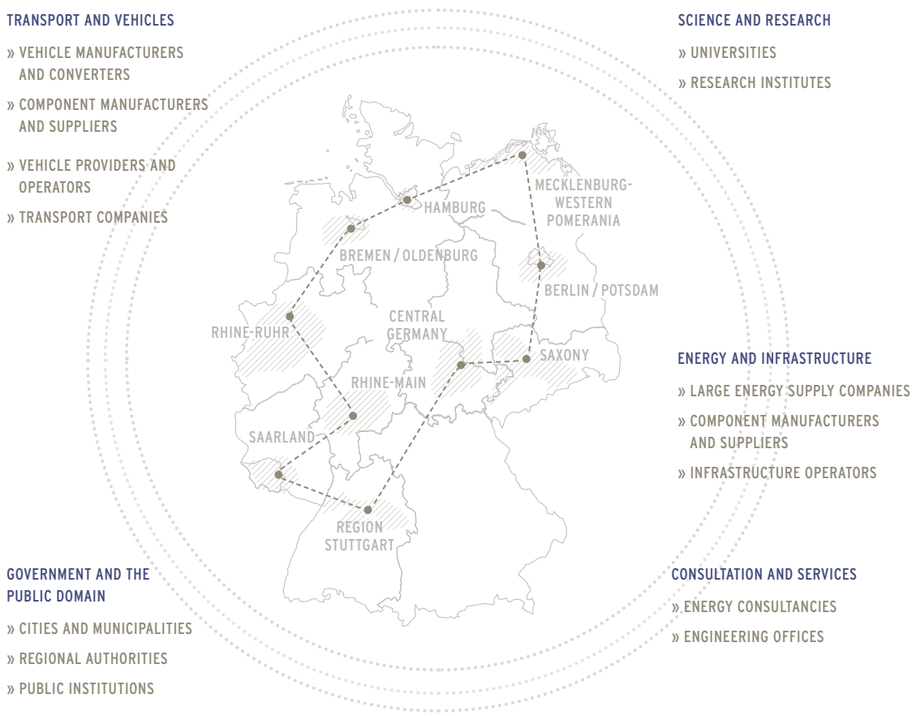
christina.tenkhoff@now-gmbh.de

SUBJECT AREAS OF THE SUPPLEMENTARY SCIENTIFIC RESEARCH

Project work undertaken in the individual model regions is complemented by supplementary scientific research in the key subject areas of electromobility and is conducted on an inter-regional basis. Working on the quintessential issues surrounding the development of electromobility are the project partners and representatives from the regional headquarters, supported by scientific institutions together with the BMVBS and NOW. A special characteristic of the programme is the long-term nationwide networking and collaboration between industry, government and research.



ACTORS WITHIN THE SUBJECT AREAS

SAFETY SUBJECT AREA

Vehicle safety is a prerequisite for user acceptance of electric vehicles. This subject area therefore deals with all aspects related to the safety of such vehicles. Through the targeted monitoring of malfunctions of vehicles deployed in the model regions as well as comprehensive safety documentation, initial results highlighting deficiencies within the existing statutory regulations could be identified along with information on how malfunctions could be avoided, within the framework of the Electromobility Model Regions demonstration activities funded by the federal government's second economic stimulus package. Building on these insights, the reasons for malfunctions and failures are now being investigated to determine how these may be countered. The present monitoring will continue and be extended to include commercial vehicles and those deployed in local public transport. A particular focus will be on the general effect electric vehicles have on road safety: What effect does the reduced noise level have for everyday traffic? Which guidelines for developing legal provisions can be identified in this regard on the national, European and international levels?

Besides operational safety, the areas of battery and infrastructure safety are also dealt with. Here, issues regarding the safety requirements are raised in terms of the charging procedure as well as the entire battery lifecycle – from the availability of raw materials, the design and concept phase, production, storage and transport, to actual use and recycling. The various issues are worked on in the battery safety, vehicle and road safety, and infrastructure safety working groups.

INFRASTRUCTURE SUBJECT AREA

The basis for the market introduction of electromobility is a comprehensive recharging infrastructure that spans the country. The expansion of this infrastructure was promoted between 2009 and 2011 as part of the Electromobility Model Regions programme, during which time 2,000 charging points could be made available to the 2,500 vehicles. Experience gained as a result was fed back into the ongoing supplementary research. Important insights resulting from this were compiled and made accessible to a broad public in the publications "Practical compendium for the development of a public recharging infrastructure" and »Scenarios for the establishment of infrastructure for electromobility«.

Now, the infrastructure subject area continues these endeavours in the »Interoperability«, »Technology«, »Demand & locations« and »Business models« working groups. With the support of the Fraunhofer IFAM, the results are compiled are made available, in particular, to municipalities, public utility companies and energy supply corporations.

FLEET MANAGEMENT SUBJECT AREA

Great potential has been attributed to electromobility especially in regard to fleet applications. The focus of this subject area is the deployment of electric vehicles in commercial or public fleets, such as for business mobility, vehicles for mobile services or for delivery services. The objective is to network users with similar issues and to show potential users of this target group the possibilities of integrating electric fleets. For this purpose, the information and insights gained by project partners already possessing experience in regards to the integration of electric vehicles are made publically available to enable solutions to be developed for joint challenges.

USER PERSPECTIVES SUBJECT AREA *

The prerequisite for long-term integration of electric vehicles in our mobility system is user acceptance. Therefore, the wishes and demands of (potential) users and operators of electric vehicles are at the core of this subject area. Diverse scenarios for the use of electric vehicles, e.g. private, commercial and as a part of integrated mobility solutions, are examined within the scientific supplementary research to obtain comparable data across projects. The compiled results are discussed in the relevant working group and used to optimise mobility offers as well as make policy recommendations.

REGULATORY FRAMEWORK SUBJECT AREA **

The market introduction of electromobility cannot be removed from a regulatory framework as this comprises the basis for the effective integration of electric vehicles on the roads. Objective of this subject area is, together with representatives of local municipalities, universities, public utility companies, energy providers and recharging infrastructure operators, to identify necessary regulatory issues and to develop specific approaches to solve these in the next step. Possible parallels may be found, for example, in road traffic law, transport legislation or building law as far as the issue of vehicle identification is concerned or in respect to electric vehicle standardisation. Regulatory measures already implemented are evaluated and continually examined with the assistance of a dynamic monitoring system. Successful measures are compiled as best practice examples and published in compendiums.

*

UNIFORM CROSS-PROJECT SURVEY OF ALL USERS (AFTER TWO WEEKS TO SEVERAL MONTHS)

EVERYDAY EXPERIENCES (T1)

TIME-LINE (TX)

TARGETED ADDITIONAL SURVEYS AND DATA ANALYSES IN CONJUNCTION WITH SELECTED PROJECTS/PERSONS FOR SPOTLIGHT TOPICS

FOCUS OF CONTENT FOR USER RESEARCH

- INFRASTRUCTURE (T1, TX)
- COMBINATION OF TRANSPORT MODES (T1, TX): SHARING AND INTEGRATED MOBILITY
- PARAMETERS PURCHASE/USAGE INTENT FOR PRIVATE USERS (T1)
- PRIVATE USERS: MEANING OF VEHICLE MOBILITY (T1)
- COMMERCIAL USE (T1, TX)

**

AREAS FOR ACTION REGULATORY FRAMEWORK

PUBLIC SPACE	INFRA-STRUCTURE			VEHICLE					OTHER		SUBJECT AREA
PARKING	PERMIT GUIDELINE	IDENTI-FICATION INFRA-STRUCTURE	NON-DISCRI-MINATORY ACCESS	E-CAR-SHARING	LOCAL PUBLIC TRANSPORT	PEDELECS	PUBLIC PROCURE-MENT	IDENTI-FICATION	INCENTIVE MEASURES	ELECTRO-MOBILITY AND CITY	IDENTIFIED AREAS FOR ACTION

» The prerequisite for the long-term integration of electric vehicles in our mobility system is user acceptance. «

REGIONAL, URBAN AND TRANSPORT PLANNING SUBJECT AREA

Municipalities can assume a special role for the introduction of electromobility by, for example, supporting the availability of electric vehicles suitable for everyday use as well as mobility concepts, during approvals processes. While the practical experiences, field tests and vehicle developments have all progressed to date, traffic planning and integrated location-based mobility concepts are still lacking in order to integrate electromobility on a widespread level for everyday use, whether this be in the form of an intermodal transportation module or deployment in city logistics concepts.

Objective of the supplementary research is therefore to address the interests and concerns of municipalities in regard to the local implementation of electromobility. The subject area especially aims to develop and expand competence on a municipal level. Municipalities must be in the position to:

» adjust unsuitable framework conditions in close, discursive cooperation with the relevant players as well as be able to conceive new framework conditions and test these for their feasibility,

» identify the various factors that promote and also restrict implementation, and in the best case, eliminate the negative factors and recognise the scope for manoeuvring,

» network with various (regional) players in order to promote and intensify the exchange of experiences and knowledge among these in order to develop suitable approaches for action and solutions, and

» overcome problems during development and implementation faster.

Hereby, the inventiveness of the municipalities is to be inspired through the supplementary research and specific scope for action highlighted. A focus is placed, on the one hand, on the »municipal mobility strategies« thematic cluster, and on the other, on aspects highlighting multimodality and intermodality, sharing and city logistics concepts. The »urban development/planning« thematic cluster, meanwhile, deals with the linking of mobility concepts with housing, business, trade and with urban design and compatibility of infrastructure along with town planning issues. The goal is to provide the municipalities with the results in the form of guidelines.

Around 30 – 40 participants from all model regions take part in subject area conferences occurring twice a year. Participants work through selected focal points in two to three working groups and develop these further. Expert interviews, focus group discussions and workshops also take place as well as the constant intensive exchange with the infrastructure and regulatory framework subject areas.

The regional, urban and transport planning subject area is coordinated and organised by NOW representing the BMVBS. The German Institute for Urban Studies (Difu – Deutsche Institut für Urbanistik) conducts the accompanying scientific research. The University of Stuttgart also supports a series of workshops.

INNOVATIVE DRIVES AND VEHICLES SUBJECT AREA

Besides the infrastructural hurdles, considerable challenges also exist in the area of vehicles and powertrains for the widespread market introduction of electric vehicles. These include the still high purchase price, limits to vehicle volume, the number of available models as well as the limited mileage range. The optimisation and continued technological development of the vehicles, associated components and the batteries, therefore represents a substantial step towards boosting efficiency and user acceptance.

Preliminary findings on energy consumption, reliability, commercial maturity and usage patterns of deployed vehicles could be gathered within the framework of the BMVBS Electromobility Model Regions funded by the second economic stimulus package. On the basis of the data obtained from the deployment of around 350 vehicles in test operation across the model regions and in cross-regional projects, corresponding environmental potentials could be calculated and recommendations could be furnished to policymakers and business.

These examinations will continue and be developed further within the framework of additional BMVBS research activities. The objective is to enhance the existing database with more quantitative and qualitative data. The data and individual results obtained from the projects will build on the existing cooperational structures and be compiled and evaluated within the supplementary research activities. Statements can therefore be made on the technological further development of the deployed vehicles (also in direct comparison to the second economic stimulus package) within the market development phase, along with corresponding recommendations for action to policymakers and decision makers in business. To ensure that the distinctive features and characteristics of the various modes of transport are satisfactorily considered, separate working groups are each working on the areas of bus applications, passenger and commercial vehicles as well as rail transport.

» The › urban development/ planning ‹ thematic cluster deals with the linking of mobility concepts with housing, business and trade. «

V. BAVBS – ELECTROMOBILITY MODEL REGIONS

V / 01
MODEL REGION BERLIN / POTSDAM

V / 01 / 01

» BERLIN ELEKTROMOBIL 2.0 (BEMOBILITY 2.0) «

»Berlin elektromobil 2.0« (BeMobility 2.0) is a research project in the framework of the Electromobility Model Region Berlin/Potsdam under the consortium leadership of Deutsche Bahn. It consists of the integration of electric rental vehicles in urban transport and energy networks. Through the integrative examination of mobility, energy systems and city charging infrastructure, sustainable business models (including flexible e-carsharing) will be developed. The capital city region is suitable as an innovative cluster for sustainable integrated transport, urban development and energy supply concepts. The findings of the previous project (»BeMobility«) from 2009 to 2011, as well as other research projects are being taken into account. They show that because of limited ranges and higher costs, electromobility will only prove successful when introduced in new usage concepts. Intermodal choices (mobility cards) and information systems (Smartphone Apps) are being optimised and expanded. Added to this is integration in an intelligent energy grid (Micro Smart Grid) on the EUREF Campus. The focus is on the triple networking of e-carsharing with regard to transport, information and energy. »BeMobility 2.0« is funded through the Federal Ministry of Transport, Building and Urban Development (BMVBS). It is coordinated on a regional level by the TSB Innovationsagentur Berlin GmbH and overseen by the National Organisation Hydrogen and Fuel Cell Technology (NOW) GmbH.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Choice GmbH	262,807	131,403
Contipark Parkgaragen GmbH	220,223	110,112
Daimler AG	221,850	110,925
DB FuhrparkService GmbH	2,971,622	1,485,811
HaCon Ingenieurgesellschaft mbH	690,015	345,008
Happold Ingenieurbüro GmbH	815,700	407,850
Innovationszentrum für Mobilität und gesellschaftlichen Wandel (InnoZ) GmbH (Centre for Innovation in Mobility and Social Change)	1,461,657	730,829
Robert Bosch Car Multimedia GmbH	450,762	225,381
Schneider Electric GmbH	664,053	332,027
Technische Universität Berlin	1,560,291	1,560,921

VEHICLES: > 75 electric vehicles, (of which 50 are new)
INFRASTRUCTURE: 18 car-sharing stations with charging infrastructure (e-Flinkster), Electromobility Platform and Micro Smart Grid on the EUREF Campus in Schöneberg, Berlin (including 20 charging points of varying designs, large-scale battery, wind and solar power systems)

COMMENCEMENT: 01 January 2012
CONCLUSION: 31 December 2013

EUREF Campus at the gasometer in Berlin-Schöneberg

Above: Smartphone application »BeMobility Suite«

Bottom left: Citroën C-Zero from »e-Flinkster« at the recharging station at Potsdamer Platz in Berlin

Bottom right: Vehicles from »e-Flinkster« in Berlin

V/02
MODEL REGION BREMEN/OLDENBURG

V / 02 / 01

» DYNAMIC INDUCTIVE ENERGY TRANSMISSION «

The concept is quite simple: electric vehicles don't get their energy to drive from the heavy on-board batteries, but can be virtually »refuelled« during the journey, in a contactless way. The contactless TRANS-RAPID power transmission system has impressively demonstrated for the first time worldwide that larger electrical loads can be inductively transmitted at high speeds with minimal losses. It is precisely this idea of dynamic inductive energy transmission that is pursued by the project: the future »Inductive Power Road – IPR«.

The subject of current project work is the definition of the cheapest system component architecture (primary cable, converter, positioning system), segment lengths and cable geometry. On the basis of these results a 25 metre-long part-section is being built on the grounds of the former TRANSRAPID testing facility in Emsland. For the individual system components, marketable, built-for-purpose and parts requiring optimisation are used.

The conclusion of the first project phase consists finally of tests with real vehicles. For the purpose of use here adapted vehicles are used from the Fraunhofer Institutes IFAM and IVI, where two different deployment scenarios are pursued: charging busses in local public transport as well as charging cars on a constant straight journey (e.g. motorway). The aim of the first project phase is the prototype development of the overall system (vehicle and roadside) as well as the evidence of technical feasibility.

The IABG is in charge of the project, and the partners are Alcatel-Lucent (communications and positioning technology) Max Bögl (road-building), the Prysmian Group (high-frequency cable), Tridelta (ferrite), ABB (inverters) as well as the Fraunhofer Institutes IFAM and IVI (vehicles). In a second project phase inductive charging during the journey is to be tested in a test environment simulated for use. This second phase is open to additional participants.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Industrieanlagen-Betriebsgesellschaft mbH	1,955,727	977,863
Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V.	1,033,400	930,060
Alcatel-Lucent Deutschland AG	364,597	182,298
TRIDELTA Weichferrite GmbH	50,130	25,065
Max Bögl Bauunternehmung GmbH & Co. KG	140,925	70,463

VEHICLES: Autotram (Test vehicle of the IVI), Artega

COMMENCEMENT: 01 September 2011
CONCLUSION: 30 September 2013

V / 02 / 02

» UI ELMO – CROSS-COMPANY AND -SECTORAL TESTING OF ELECTROMOBILITY IN BUSINESS PRACTICE «

The deployment of electromobility was up to now scientifically supported in individual fleet trials. A cross-company test for everyday operation by companies of different sectors and sizes has on the other hand, not been yet carried out. For the first time therefore, at least 90 electric vehicles from the members of »UI ElMo« are being procured for business use and/or as company vehicles for private use in business practice in order to test their suitability for normal everyday operation. A special feature of the scheme is the cross-company approach, in which participants commit themselves to opening their charging infrastructure to all member companies of the initiative in order to provide a comprehensive infrastructure.

Furthermore the companies declare themselves ready to make their respective company-owned electro-vehicle fleet also available to those within »UI ElMo« as needed and to build a common fleet management for this purpose. To this end there will also be a common registration of all vehicles in a databank for management of the fleet.

Included in the »UI EIMO« proposal is that at least three companies which together have over 40 locations within the Bremen/Oldenburg Model Region offer service and maintenance facilities for the electric vehicles. In addition comprehensive training and driving safety programmes are to be developed.

The company initiative is scientifically supported by the DFKI. The DFKI is evaluating the vehicle use and assessing the cross-company use of electric vehicles in business operation. In this process the service life of the vehicles as well as their operational safety and actual availability are being highlighted. At the same time the interface to Personal Mobility Center as coordinating body for electromobility in the Bremen/Oldenburg Model Region is being covered through the DFKI.

Only vehicles are deployed which meet the latest standard of technical development. Commercially available (series) vehicles are being procured. The charging infrastructure equally reflects the newest technical status. Only high-value equipment is used which also measures up to the demanding fire protection requirements of the participating firms. Moreover uniform standards will be implemented at the charging stations, which can individually identify the vehicle being charged and thereby facilitate cost allocation.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Nehlsen AG	7,149,236	3,574,618
HWT Hansen Wärme- und Tanktechnik GmbH	221,640	110,820
Emigholz GmbH	172,550	86,275
Move About GmbH	844,163	506,498
Deutsches Forschungszentrum für Künstliche Intelligenz GmbH	578,041	520,237

VEHICLES: 160 electric vehicles (Renault, Smart, Peugeot, Mercedes, among others)
INFRASTRUCTURE: up to 200 charging stations (Manufacturer VENIOX GmbH & Co. KG)

COMMENCEMENT: 01 Oktober 2012
CONCLUSION: 30 September 2015

V / 02 / 03

» NEMOLAND – NEW MOBILITY IN RURAL AREAS «

Flexible and individual mobility is a given in a modern society and currently a very important topic in rural areas. The environs of the Bremen/Oldenburg model region are characterised by the rural-urban mix. Particular mobility needs arise from transport between the three cities Bremerhaven, Bremen and Oldenburg as well as the surrounding towns and boroughs. In order to investigate and optimise electromobility in rural areas fleet trials with different vehicles and vehicle types are being tested. The target group is private as well as commercial users of electric vehicles. Fleet trials and their assessments are among the key building blocks of research and optimisation of electromobility. In the process not only the technology currently available on the market, but also the integration of new technology in everyday life and the actual economic benefits are assessed.

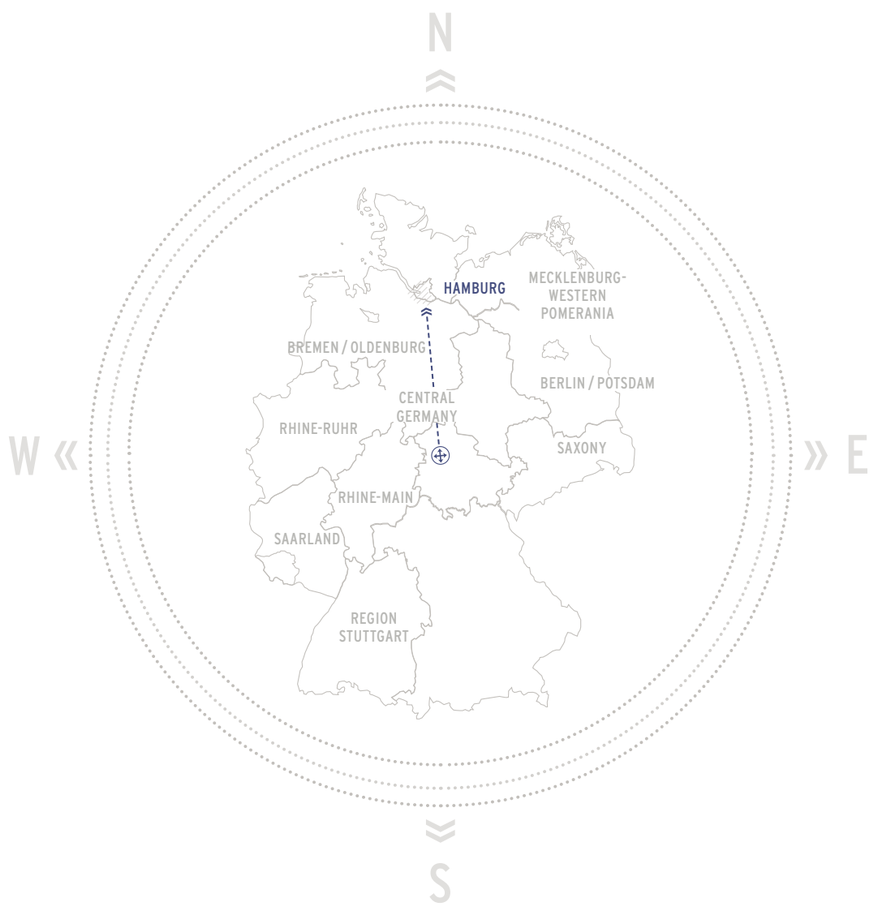
The experiences and reactions gained from the trials are leading to the redefinition and further development of technological approaches. This includes on the one hand, ICT topics as well as conceptual vehicle developments and charging technologies. On the other hand, the effects that electromobility brings about and facilitates are evaluated in terms of ecological, economic, sociological and transport policy perspectives.

» Flexible and individual mobility «

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	1,263,555	1,137,200
OFFIS e. V.	290,184	261,166
Verein zur Förderung der wissenschaftlichen Forschung in der Freien Hansestadt Bremen e.V. (VFwF)	285,344	256,810
H2O e-mobile GmbH	716,331	429,799
Jacobs University Bremen gGmbH	327,910	295,119
Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (German Research Center for Artificial Intelligence)	2,294,508	2,065,056
Universität Bremen	588,137	588,137
T-Systems International GmbH	206,212	103,106
AGT Group (R&D) GmbH	1,060,626	530,313
B2M Software AG	922,718	645,903

COMMENCEMENT: 01 Oktober 2011
CONCLUSION: 31 März 2014

V/03 MODEL REGION HAMBURG



V / 03 / 01

» TESTING AS WELL AS OPERATIONAL AND TECHNICAL OPTIMISATION OF HOCHBAHN DIESEL HYBRID BUSSES «

In their corporate strategy, Hamburger Hochbahn AG aspires to convert their busses in the medium term to efficient and climate-friendly drive systems as well as end pure fossil fuels in the long term. They therefore support the automotive industry already in the initial phase of the market in the technical and operational optimisation of innovative electric hybrid busses through tests on their routes.

In this project the technical innovations already achieved in diesel hybrid busses are being examined directly for their effectiveness in terms of fuel reduction and availability and the further development of new components continually advanced. In this way the technical expertise developed so far can be optimally exploited and promising cooperation with industry continued.

Aside from the technical optimisation, the significance of the operational parameters such as, for example, the distance between stops or average speed is the focus of the research in the project. The aim is to evaluate the influence of route characteristics on fuel consumption and thus determine proposals that can help to best link the technology of the hybrid drive with the respective routes.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Hamburger Hochbahn AG	1,947,476	1,947,476

VEHICLES: technical further development and operational testing of 5 serial diesel hybrid busses
INFRASTRUCTURE: Modifications/additions to an existing garage for functional complete maintenance and repair of diesel hybrid busses

COMMENCEMENT: 01 October 2011
CONCLUSION: 30 September 2013

V / 03 / 02

»HAMBURG – ECONOMY ON THE CURRENT«

The project »Hamburg – Economy on the current« focuses on the testing of up to 740 vehicles in companies and municipalities and builds on the experiences of the first model region phase. Aside from location-specific sectors such as the port industry, logistics or air travel, the emphasis is on the participation of small and medium-sized businesses like the car fleets of Hamburg's administration. The goal is to identify operational options for using electric vehicles and to demonstrate their everyday suitability in the commercial area.

To identify the potential vehicle demand in the commercial sector, questionnaires have been sent to all Hamburg companies in the companies' register. The scientific accompanying research on the factors for success and constraints of using electric vehicles in companies and the establishment of a database for those interested in actual vehicle use constitutes a fundamental element of the project. Alongside this the development as well as the implementation of innovative charging technology and storage options is being advanced. By the end of the project the practicality and economic concepts for the use of electric vehicles in company fleets will be developed.

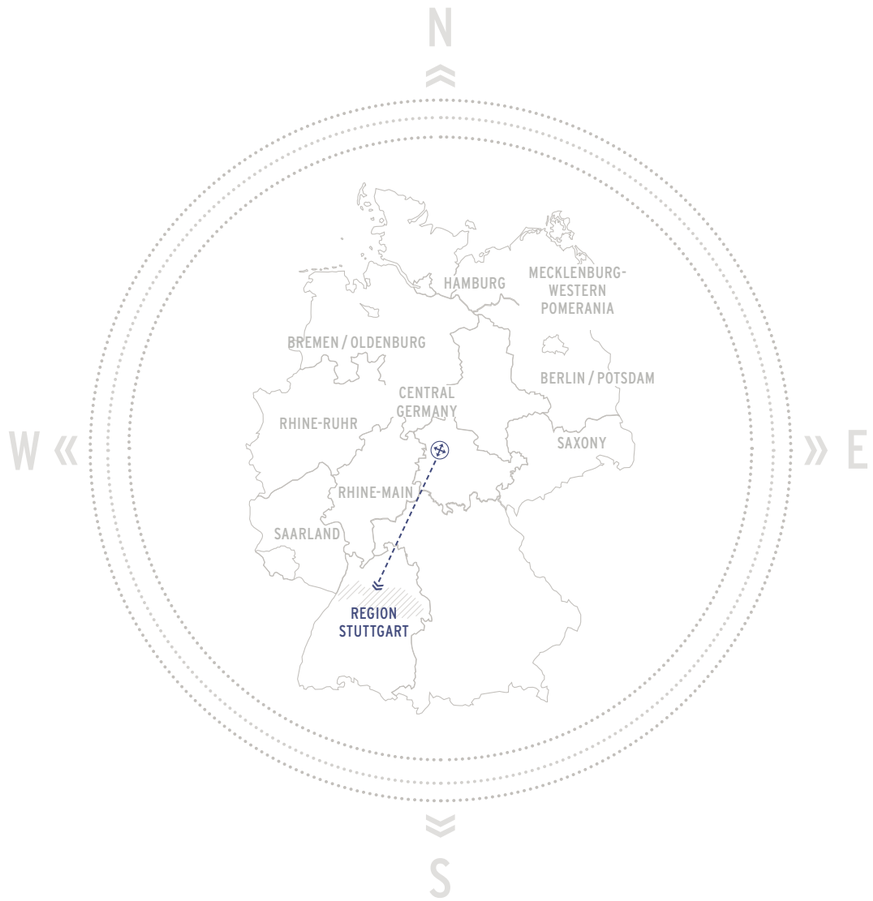
PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Daimler AG	264,586	132,293
DB FuhrparkService GmbH	6,511,461	2,364,730
Freie und Hansestadt Hamburg	2,532,129	1,385,399
Hamburg School of Business Administration gGmbH	152,952	137,656
HKS Handelskammer Hamburg Service GmbH	178,207	124,745
HySOLUTIONS GmbH	310,218	155,109
Mercedes-Benz Leasing GmbH	2,096,868	732,880
Technische Universität Hamburg-Harburg	1,194,676	1,194,676
Vattenfall Europe Innovation GmbH	3,324,211	1,662,105

VEHICLES: up to electric vehicles
INFRASTRUCTURE: up to 250 charging points

COMMENCEMENT: 01 September 2012
CONCLUSION: 31 December 2015

Sculpture at the Oberbaum Bridge in Hamburger's HafenCity

V/04
MODEL REGION REGION STUTTGART



V / 04 / 01

» EMIS – ELECTROMOBILITY IN STAUFERLAND – INTEGRATED IN URBAN DEVELOPMENT AND CLIMATE PROTECTION «

Both medium-sized cities Göppingen and Schwäbisch Gmünd are »Staufer cities« in the catchment area of the Stuttgart region. Together with another six partners as well as the Urban Development Institute of the University of Stuttgart (Städtebau Institut der Universität Stuttgart), they have initiated the »EMiS project – Electromobility in Stauferland – integrated in urban development and climate protection«. The aim of the project is to test the contribution of electromobility to urban development and climate protection goals. The evaluation is based on an integrated analysis of urban, mobility and energy systems. The results will be compiled in the form of action guidelines for local authorities, in which it will be practically illustrated how a municipality can develop into an electromobile city.

The advantages and potential of electromobility have to date hardly been examined and tested in relation to medium-sized centres in metropolitan regions. It is exactly on the regional scale that electromobility can best showcase its advantages against conventional drives, as for example, the public transport system there is less well-developed and many households currently dependent on cars with combustion engines. In order to bring 1 million electric cars onto German roads by 2020, appropriate electromobility models and concepts must on the one hand, be developed for medium-sized centres, and on the other, local authorities must already prepare themselves now for this new technology.

Private, commercial and also public e-transport will be examined in the »EMiS« project, in order to be able to determine the full potential of electromobility. User surveys will be supplemented by scientific models, such as the »electromobile neighbourhood typology«, and with workshops involving public administrations. The study of electricity supply from decentralised, regenerative energy sources completes the project. The results will be rooted in the urban development and climate protection concepts and made transferable in the form of »local authority toolboxes« for other medium-sized centres.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Stadt Göppingen	163,987	118,727
Stadt Schwäbisch Gmünd	96,548	69,128
Stadtwerke Schwäbisch Gmünd GmbH	385,591	192,795
Wohnbau Göppingen GmbH	40,363	20,181
Energieversorgung Filstal GmbH & Co. KG	55,024	27,512
Heldele GmbH	1,345,880	672,940
ETG Entsorgung + Transport GmbH	300,615	150,307
GOA – Gesellschaft im Ostalbkreis für Abfallbewirtschaftung mbH	399,834	199,917
Universität Stuttgart	452,213	452,213

VEHICLES: 20 electric cars, 2 hybrid rubbish collectors, further potential of 60 electric vehicles from private users
INFRASTRUCTURE: 30 charging stations

COMMENCEMENT: 01 September 2012
CONCLUSION: 31 August 2014

V / 04 / 02

» ELENA II – ELECTRIC DRIVE RETROFITS FOR DIESEL DELIVERY VANS «

In the »EleNa« project a consortium of medium-sized companies and research facilities is developing electric drive retrofit kits for delivery vans with conventional combustion engines, as often used by small- to medium-sized businesses (SMEs). Independent of medium- to long-term OEM strategies and plans, these retrofits facilitate a speedy, step-by-step switch to the new drive technology with only few barriers to investment.

In Phase 1 of the »EleNa« project, a Mercedes Sprinter aggregate carrier for the testing and optimisation of the installed components and systems was built. Using this vehicle, the overall functioning of the hybridisation developed could be proven and the first drive and consumption analysis carried out.

In Phase 2 of the »EleNa« project the further industrialisation of the electric drive retrofits developed in »EleNa I« is therefore being advanced with the following aims for the retrofit-equipped vehicles:

» To achieve small-scale series approval.
» To develop a level of maturity that enables an initial test with a total of 8 vehicles (of which 2 are development vehicles, 3 for customers and 3 for the suppliers) within Phase 2 of the »EleNa« project.
» To bring the costs of the retrofits to a level that facilitates entry into commercialisation from 2013.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
ARADEX Aktiengesellschaft	647,562	323,781
Forschungsinstitut für Kraftfahrwesen und Fahrzeugmotoren Stuttgart (FKFS) (Research Institute of Automotive Engineering and Vehicle Engines Stuttgart)	214,382	192,944
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	302,659	272,393
Hochschule Esslingen	666,988	509,402
Huber Automotive AG	1,525,925	726,035
Lauer & Weiss GmbH	422,991	211,495
Horst Mosolf GmbH & Co. KG	707,717	353,856
WS Engineering GmbH & Co. KG	68,900	34,450

VEHICLES: Mercedes Sprinter vans

COMMENCEMENT: 01 March 2012
CONCLUSION: 31 August 2013

» Switch to new drive technology «

V / 04 / 03

» BODENSEEMOBIL – › NETWORKED MOBILITY ‹ – THE TRIPLE-NETWORKED CAR IN THE T-CITY FRIEDRICHSHAFEN «

Electromobility in the Lake Constance region

The »BodenseEmobil« project aims to research the acceptance of electric cars as part of local public transport in the rural area and develop an integrated service for residents of the Lake Constance region. The central concept is the triple networking of electric cars: in the public transport system, in the energy grid and with each other by means of modern information and communication technology (ICT). This means that the electrically-operated vehicles should be integrated in public transport in such a way as to allow the user to change without difficulty from car to bus or train, and vice versa. By linking to the energy grid the conditions are created to enable the electric vehicle to be recharged at any time solely with renewably-generated power. Finally a networking ensures smooth communication among all system participants and components.

This concept should ensure that traffic conditions are considerably improved, e.g. spontaneous and individual mobility needs are fulfilled and also the so-called »last mile« is taken care of, which in the Lake Constance region is often not covered by local public transport at all times. It is important to check whether the user accepts electromobility in an integrated local public transport system. The experiences from this will then be incorporated in the transport company for the benefit of the citizens of the city and region.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
DB FuhrparkService GmbH	1,377,924	688,962
T-Systems International GmbH	1,761,949	740,018
Technische Universität Berlin	192,758	173,490
Innovationszentrum für Mobilität und gesellschaftlichen Wandel (Innoz) GmbH (Centre for Innovation in Mobility and Social Change)	261,600	130,800
Duale Hochschule Baden-Württemberg Ravensburg	325,113	292,602
Landratsamt Bodenseekreis (Rural District Office of the Lake Constance Region)	689,956	484,280
Stadt Friedrichshafen (City of Friedrichshafen)	629,998	503,998
Stadtwerk am See GmbH & Co. KG	578,009	289,005
HaCon Ingenieursgesellschaft mbH	588,174	294,087

VEHICLES: up to 30 electric vehicles
INFRASTRUCTURE: 40 charging posts constructed in the Lake Constance region

COMMENCEMENT: 01 November 2012
CONCLUSION: 30 April 2015

V / 04 / 04

»ELEKTROMOBILISIERT.DE – DEVELOPMENT OF A SERVICE FOR THE ELECTRIFICATION OF VEHICLE FLEETS«

The goal of the »Elektromobilisiert.de« project is to support car fleet operators in integrating electric vehicles in their fleets. To this end a software-supported car fleet analysis on the basis of logbooks is being carried out on a total of seven application partners, taking into account their individual economic and ecological framework conditions. Electrification scenarios are being developed for the fleets and evaluated with a view to their costs and environmental impacts. In addition, a scientifically-supported practical fleet trial is being carried out in each case over several months with different electric vehicles. For this purpose the Langmatz company is making mobile charging stations available. Training for employees and support in the procurement of own vehicles and charging infrastructures complete the programme.

All methods and technical aids are developed in the framework of the project and advanced on the basis of existing preliminary work. Among these are the procurement of electric vehicles along with preparation of accompanying material, vehicle fleet analysis software, mobile charging infrastructure as well as the concept for scientific accompaniment of the fleet trial. The experiences from the sub-projects will be summarised in a study at the end of the project term.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraunhofer-Institut für Arbeitswirtschaft und Organisation (IAO)	225,709	203,318
Universität Stuttgart Institut für Arbeitswissenschaft und Technologiemanagement (IAT) (Stuttgart University Institute for Labour and Technology Management)	521,944	521,944
Langmatz GmbH	355,881	142,352

VEHICLES: 12 electric vehicles (3x Opel Ampera, 5x Renault Twizy, 2x Nissan Leaf, 2x Renault Kangoo ZE)
INFRASTRUCTURE: Langmatz company mobile charging infrastructure for temporary project use in local authority and company vehicle fleets

COMMENCEMENT: 01 October 2011
CONCLUSION: 31 March 2014

Electric vehicle fleet

V/05
MODEL REGION RHINE-MAIN

V / 05 / 01

» SOCIO-SCIENTIFIC AND ECOLOGICAL ACCOMPANYING RESEARCH › ELECTROMOBILITY ALLIANCE ‹ «

Because of the diversity of the individual projects in the model regions there is large research potential. All projects in the »Electromobility alliance« are scientifically supported with the aid of quantitative surveys, in-depth interviews, workshops and mobility analyses.

Prior knowledge gained from »e-mobility« activities in the framework of the second economic stimulus package will be used and expanded upon in a targeted way for new research questions.

The research will provide new knowledge on individual and collective opportunities from and barriers to the mobility changeover towards electromobility.

The knowledge gained and associated recommendations will be made available to the project partners and the cross-regional subject areas. This way following the end of the project term, on the one hand existing projects can be continued, and on the other hand the knowledge gathered facilitates the successful implementation of new projects. The accompanying research thus contributes to establishing electromobility in the long term.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fachhochschule Frankfurt am Main	431,697	431,697
Goethe-Universität Frankfurt am Main	450,434	450,434
e-hoch-3 GbR	213,010	170,408

COMMENCEMENT: 01 May 2012
CONCLUSION: 30 April 2015

V / 05 /02

» TEBALE – TECHNICAL ACCOMPANYING RESEARCH › ELECTROMOBILITY ALLIANCE ‹ «

The Fraunhofer Institute will carry out the project for Wind Energy and Energy System Technology. The goals of the project are:

» The cross-project development of general, technical questions, in particular on the project themes relevant to the »Electromobility alliance«
» The consistent collection of data necessary for the technical assessment of the »charging infrastructure and electric vehicle« system, evaluation of data and dissemination of the results
» The formulation of transferable knowledge about electric vehicles, components and operational behaviour
» The timely support of projects and overarching platforms with existing and still to be developed technical knowledge
» Cooperation with the socio-scientific and ecological accompanying research

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	929,362	836,426

COMMENCEMENT: 01 November 2012
CONCLUSION: 31 August 2015

V / 05 / 03

» E-FLEET OPERATED BY FRAPORT «

Fraport AG is internationally one of the leading companies in the airport business and together with Frankfurt airport, operates one of the most important aviation hubs in the world. The content of the »E-fleet operated by Fraport« project is:

» Examination of the suitability of electric vehicles in different service areas and in aircraft ground handling with respect to airport-specific requirements
» Examination of possibilities for optimisation in the electricity supply through demand-oriented, controlled charging
» Examination of possibilities for optimisation in the electricity supply through demand-oriented, controlled charging
» Comparison of different charging systems
» Analysis and improvement of user acceptance
» Incorporation of knowledge gained into the »Electromobility alliance«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraport AG	2,580,601	1,290,300

VEHICLES: 42 electric vehicles
INFRASTRUCTURE: 15 charging points

COMMENCEMENT: 01 August 2012
CONCLUSION: 31 December 2015

V / 05 / 04

» LIVING IN THE WEST – IMPLEMENTATION OF SUSTAINABLE ELECTROMOBILITY IN PERIPHERAL RESIDENTIAL AREAS «

The project has the following aims:

» Development of transferable planning instruments for sustainable integration of electromobility into urban planning.
» Building of infrastructure, particularly manned rental stations, which are at the same time linked to a new business model: mobility consultancy and vehicle rental in existing commercial enterprises and for business start-ups.
» Organisation of a broad mixed fleet of electric vehicles.
» Setting up of a suitable operator model for the vehicle fleet: cooperative foundation, rental in a sharing system.
» Goal: close-to-home mobility chains as a product, integration in a regional booking system of »Electromobility alliance«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
KEG Konversions-Grundstücksentwicklungsgesellschaft mbH	973,728	468,864

VEHICLES: 18 cars, 4 transporters, 30 pedelecs
INFRASTRUCTURE: 5 charging points

COMMENCEMENT: 01 February 2013
CONCLUSION: 31 January 2016

V / 05 / 05

» EMIO – ELECTROMOBILITY IN OFFENBACH «

Up to 40 electric vehicles (cars and transporters) are to be brought onto the streets of Offenbach.

» Supply in a »use and share« system: working day use by Offenbach companies, electric vehicles could be optionally used at the weekend and on holidays by employees
» Development of a business model for multiple usage.
» Achievement of a higher efficiency through multiple usage
» Provision of the necessary infrastructure and services as required
» Integration of the project in the »Electromobility alliance«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Stadtwerke Offenbach Holding GmbH (SOH)	2,910,753	1,273,163

VEHICLES: 40 electric vehicles
INFRASTRUCTURE: charging points as required

COMMENCEMENT: 01 October 2012
CONCLUSION: 31 August 2015

V / 05 / 06

» EMOMA – ELECTROMOBILITY MANAGEMENT «

» Development of a sustainable, cost-oriented and multimodal mobility management concept for the changeover of pool vehicles and personal company cars with private use to electromobility
» Development of a mobility management system for optimal and demand-oriented dispatching of electric vehicles in a mixed vehicle pool
» Installation of a test environment at the juwi Wörrstadt location with up to 50 electric vehicles (company & pool vehicles)
» Increase in user acceptance using electric vehicles in the area of business and private mobility through creation of optimal framework conditions
» Implementation of a first pilot project in the Rhine-Main model region
» Generation of interfaces to other projects in »Electromobility alliance«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
juwi R & D Research & Development GmbH & Co. KG	3,350,209	1,675,105
Ecolibro GmbH	731,755	585,404
CSB-System AG	375,379	187,689

VEHICLES: 50 electric vehicles
INFRASTRUCTURE: 40 wall boxes

COMMENCEMENT: 01 September 2012
CONCLUSION: 31 August 2015

» Increase in user acceptance using electric vehicles in the area of business and private mobility through creation of optimal framework conditions. «

» Reducing inner-city emission levels and increasing capacities «

V / 05 /07

» FREE – LEISURE AND EVENT TRANSPORT WITH INTERMODAL BOOKABLE ELECTRIC VEHICLES «

» Development of an intermodal electromobility range for visitors of leisure destinations and large-scale events in North Hesse. Visitors will already be able to book in advance before their stay through an innovative booking system as well as through hotels on location and thereby be encouraged to travel there without a car
» Electric vehicles support local public transport in order to reduce inner city emissions and to raise capacities
» Harmonisation of the charging infrastructure of different suppliers
» The networking of all available local mobility services will be pursued with the help of an integrated tariff system with standardised access medium
» Continuation of already implemented projects in the framework of the Rhine-Main Electromobility Model Region
» Incorporation of findings into the »Electromobility alliance«

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Regionalmanagement Nordhessen GmbH	867,746	564,035
Universität Kassel	612,338	612,338
Kasseler Verkehrs-Gesellschaft Aktiengesellschaft	2,036,841	1,018,420
E.ON Mitte AG	479,291	239,645
Heinrich Müller	157,440	125,952

ASSOCIATED PARTNERS: Stadtwerke Kassel AG, City of Kassel, Nordhessischer VerkehrsVerbund (NVV)

VEHICLES: 21 electric vehicles
INFRASTRUCTURE: 120 charging points

COMMENCEMENT: 01 September 2012
CONCLUSION: 31 August 2015

V / 05 / 08

» E-LIFT (CATERING LIFT TRUCKS OF THE FUTURE) «

LSG Sky Chefs, the world's largest service provider of on-board service, has particular interest in the development of new, environmentally-friendly drive concepts in the framework of its sustainability strategy, in order to thus contribute to the reduction of harmful emissions, noise pollution and energy consumption. In Frankfurt alone, the company provides flight meals and other equipment for more than 400 flights per day. Approximately 170 so-called lift trucks undertake the transport of goods from the catering firm to the aircraft.

The »eLift« project has the aim of developing electric-based catering lift trucks of the future. »eLift«, under the leadership of LSG Sky Chefs, is a collaboration between Doll Fahrzeugbau, Euro Engineering and the Technical University of Kaiserslautern.

Different concepts for the electrification of individual components of the trucks, e.g. the lifting mechanism and the drive, will be considered in the project. The basis for the new vehicle is an e-truck. The box-type truck body should fulfil the same functions with the corresponding electric drives as a conventional truck.

In addition all types of emissions, noise and CO_2 emissions should be considerably and sustainably reduced through the use of electrical drive energy.

The catering lift truck of the future should facilitate a mechanical and energetic separation of truck chassis and box body, in order to thus ensure an independent supply of the hub system and the independence of future vehicle developments.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
LSG Sky Chefs Frankfurt ZD GmbH	1,004,349	502,174
Euro Engineering AG	1,286,205	643,102
DOLL Fahrzeugbau AG	274,377	137,188
Technische Universität Kaiserslautern	275,303	275,303

VEHICLES: Development of a new electric-based catering lift truck

COMMENCEMENT: 31 December 2012
CONCLUSION: 31 December 2015

» Reduction of pollutants, noise and energy consumption «

» Delivery of valuable information on the deployment of electric vehicles «

V / 05 / 09

» AMPERE – GENERAL PRACTICAL TEST FOR ELECTRIC VEHICLES WITH LONGER E-REV RANGES «

Electromobility is on the advance in urban mobility concepts. In a common project between Adam Opel AG, Vattenfall Europe Innovation GmbH and the Department of Motor Vehicles at Berlin Technical University, 300 electric vehicles with longer ranges are being studied in everyday operation. The Opel Ampera has an electric range of 40-80 km and can use the on-board combustion engine as a generator for longer distances. This largest planned European fleet trial of electric vehicles thus provides valuable information on the use of electrified vehicles and the use of supply infrastructure under real conditions.

The project focuses on few geographical aspects and puts the analysis of user behaviour in the context of economic and ecological framework conditions. For the Berlin/Potsdam, Rhine-Main, Rhine-Ruhr, Hamburg and Stuttgart model regions, direct development possibilities will be derived from the specifications for vehicle use (routes, energy conversion).

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Technische Universität Berlin	405,559	405,559
Vattenfall Europe Innovation GmbH	66,956	33,478
Adam Opel AG	527,257	263,628

VEHICLES: Examination of 300 customer vehicles – largest European fleet trial

COMMENCEMENT: 31 December 2012
CONCLUSION: 31 December 2015

Environmentally friendly taxiing and towing via electromobile applications

V / 05 / 10

» AIRPORT EMOVE – ELECTROMOBILE TAXIING AND TOWING OF AIRCRAFT TO REDUCE GROUND NOISE AND KEROSENE CONSUMPTION «

The entire project is aimed at devising the quietest, most environmentally- and resource-friendly taxiing and towing of aircraft possible. Instead of using the engines that are optimised to a large extent for the flight, alternative concepts are taking centre stage. Aircraft normally taxi into position using their own power after landing and to the runway before take-off. The engines used for this generate a significant portion of ground noise and emit pollutants through kerosene consumption. The auxiliary power unit of an airplane cannot provide the power necessary for taxiing and, like diesel-operated aircraft tugs, also consumes fuel and causes noise. Aircraft tugs with combustion engines are also used in bringing aircraft to other positions or to the hangar. At best this slightly lessens the problem. Electromobile taxiing and towing on the other hand, reduce fuel consumption, noise and pollutant emissions and thus offer a forward-looking alternative. The Institute of Flight Systems and Automatic Control (FSR) from the Technical University Darmstadt is scientifically accompanying the project.

In addition a homogenous charging infrastructure is to be developed in cooperation with the airport in order to facilitate broadest possible use through different vehicles and equipment and to promote the use of the technology.

The Lufthansa Group is aware of its responsibility in the development of environmentally-friendly technologies and actively advocates them.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Deutsche Lufthansa AG	2,145,056	1,072,528
Lufthansa Technik AG	2,757,910	1,378,955
Lufthansa Engineering and Operational Services GmbH	5,075,281	2,537,640
Technische Universität Darmstadt	252,572	252,572

VEHICLES: Aircraft (eTaxi), aircraft tugs (eSchlepper, TaxiBot)

COMMENCEMENT: 31 December 2012
CONCLUSION: 31 May 2016

» Responsibility in the development of environmentally friendly technologies «

V/06
MODEL REGION RHINE-RUHR

V / 06 / 01

» LONG-HAUL ELECTROMOBILITY «

Based on a three-pillar strategy, different technical concepts are being looked at in the project in order to overcome the range problem of a field trial in which citizens participate.

» The energy efficiency of the vehicle is being analysed and improvement options explored. The main starting points are the recuperation and the intelligent management of auxiliaries.
» A comprehensive testing and examination of vehicles with range extender drives is being carried out with a view to everyday suitability for service providers and medium-haul commuters.
» This is contrasted with the testing and examination of fast-charging vehicles. To accompany this, a comprehensive infrastructure of fast-charging stations is being constructed and their grid reactions analysed.

The examination of the different technologies takes place with a view to technical and socio-economic aspects. 350 users from a representative population sample with different socio-economic backgrounds and driver profiles integrate electric cars into their daily use. By means of recorded vehicle operating data, important results will be gained about the use of vehicles.

For the field investigations a vehicle fleet with a total of 30 vehicles is being used, six of which come from the previous project: »Technology roadmap«.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Ruhr-Universität Bochum	541,794	541,794
Adam Opel AG	248,046	124,023
Delphi Deutschland GmbH	233,926	116,963
Franz Rüschkamp GmbH & Co. KG	138,172	69,086
GLS Gemeinschaftsbank eG	358,363	179,181
Stadtwerke Bochum Holding GmbH	53,972	26,986
USB Umweltservice Bochum GmbH	61,846	30,923

VEHICLES: 24 e-passenger vehicles
(battery-electric vehicles and range extender vehicles)
INFRASTRUCTURE: 7 charging posts

COMMENCEMENT: 01 March 2012
CONCLUSION: 31 May 2014

V / 06 / 02

» RUHRAUTO^{E} E-MOBILITY METROPOLIS – ELECTRIC VEHICLES AS THE FOUNDATION FOR INTERMODAL MOBILITY «

A car-sharing network is being established in Essen and Bottrop with 30 vehicles, offering citizens a first point of contact with the theme of electromobility and networking of transport modes.

For the formation of this demonstration platform, five strong partners are pooling their interdisciplinary competences and in this way lending a very special innovative character to the project.

Special and unique to the project are the strong linking of living and mobility as well as the intensive networking of rental mobility with local public transport. Through consortium members Vivawest Wohnen GmbH and VRR it is possible to bring electromobility closer to fixed target groups (the tenants of Vivawest Wohnen GmbH and those with travel passes) in a direct way (as opposed to opportunity-oriented and centralistic approaches). In addition car-sharing stations have been built beside Essen's inner city as well as in three different residential areas.

Drive CarSharing GmbH brings along its many years of experience in the car-sharing area to the project and is charged with developing the business model. At the same time it is integrating the project in its existing network of 250 partners, so that a variety of existing clients can be acquired as potential users for the project.

The University of Duisburg-Essen is coordinating and leading the project and is carrying out a comprehensive scientific (as well as economic and technical) accompanying research during the project's term.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Universität Duisburg-Essen	531,278	531,278
Drive-CarSharing GmbH	711,208	355,604
Viwawest Wohnen GmbH	98,750	49,375
Verkehrsverbund Rhein-Ruhr AöR	309,650	154,825
D+S Car Analysen UG	85,565	42,782

VEHICLES: 30 passenger cars (20x OPEL Ampera (from 09/2012), 10x Smart EV (from 03/2013)
INFRASTRUCTURE: 14 charging points (11 in Essen/ 3 in Bottrop, 11 already in operation/3 from 03/2013)

COMMENCEMENT: 01 September 2012
CONCLUSION: 28 Februar 2014

Test-drives in Essen Rüttenscheid

V / 06 / 03

» E-CARFLEX BUSINESS «

The project partners of the state capital Düsseldorf, Drive CarSharing and Stadtwerke Düsseldorf are introducing 31 newly procured electric passenger vehicles in a virtual common vehicle pool. The vehicles are being used in an initial phase for company purposes to ensure basic utilisation. Additionally in a second phase, the vehicles will be rented out to employees for private use outside of business hours and at weekends. In the remaining time periods during the second phase the vehicles will be booked by external users, for example by car-sharing customers. The project partner Drive CarSharing is undertaking the provider function. A business model for the use of electric vehicles in companies is being developed. Incentive schemes distinguished by the different users are to be developed and investigated. Cooperation with the local public transport companies should lead to a link-up of the vehicle pool to the Düsseldorf mobility card. The Wuppertal Institute is carrying out the scientific accompanying research.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Landeshauptstadt Düsseldorf	694,770	474,462
Drive CarSharing GmbH	784,696	549,287
Stadtwerke Düsseldorf AG	1,727,684	863,842
Wuppertal Institut Klima, Umwelt, Energie GmbH	390,991	351,892

VEHICLES: 31 electric vehicles
INFRASTRUCTURE: 40 charging posts

COMMENCEMENT: 01 Oktober 2012
CONCLUSION: 30 September 2015

V / 06 / 04

» INTERNATIONALISATION RHINE-RUHR – NETHERLANDS «

The goal of the project is to build up a long-term partnership between North Rhine-Westphalia and the Netherlands in the area of electromobility.

As a first step towards common measures, a dialogue forum is being established for the exchange of experiences of vehicles in test operation, concepts for charging infrastructure, vehicle and battery safety and transport and mobility concepts. Furthermore a series of workshops are to be designed and organised based on the results of preliminary discussions between the partners, in order to work up targeted questions and thematic areas of mutual interest, present results in the form of status reports and recommendations for action, thereby laying the groundwork for further cooperation projects. Another building block will be the implementation of cross-border transport with electric vehicles. A point of departure for this could be the already initiated projects in Phase I of the Rhine-Ruhr Model Region. Because of their proximity to the border, the cities of Aachen (on the Dutch side Heerlen and Maastricht) as well as Emmerich (Arnheim, Nijmengen) are options.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
ee energy engineers GmbH	276,232	248,609

COMMENCEMENT: 01 November 2011
CONCLUSION: 31 August 2014

V / 06 / 05

» INTERNATIONALISATION RHINE-RUHR – CHINA «

The continuation of the dialogue forum begun in 2010 with stakeholders from business, research and politics for the exchange of results achieved in the electromobility model regions Rhine-Ruhr and Wuhan. Goal: Comparative analyses between the states, partly with cost-benefit analysis, with the following emphases:

» Establishment of projects between companies from NRW and Wuhan; Build-up of economic links
» Comparison and improvement of business models and transport concepts for electromobility with respect to urban planning and development in particular
» Discussion of optimisation of subsidising measures and programmes, in particular the effectiveness of incentives
» Working out common solutions to safety risks of electric vehicles in general and especially of vehicle drive batteries
» Comparison of different infrastructure concepts
» Evaluation of the impact of electromobility on the environment (CO_2 balance, local emissions)
» Exchange of experience from the customer's perspective to increase user-friendliness

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
ee energy engineers GmbH	479,144	431,230

COMMENCEMENT: 01 January 2012
CONCLUSION: 31 August 2014

V / 06 / 06

» ELECTROMOBILE URBAN COMMERCIAL TRANSPORT (ELMO) «

Despite the advantages that an electric vehicle offers, many of those in charge are too hesitant and reluctant to include such vehicles into their fleets. The Fraunhofer IML has therefore launched the »Elmo« project – Electromobile urban commercial transport. The project will help to remove anxieties and support companies in the acquisition of vehicles, planning and vehicle operation. Electric vehicles will increasingly demonstrate a competitive advantage in inner cities. Driving is often either not allowed using conventional vehicles or is highly restricted, with access restrictions due to increase in the coming years.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraunhofer-Institut für Materialfluss und Logistik (Fraunhofer Institute for Material Flow and Logistics)	396,261	356,635
T€Di Logistik GmbH & Co. KG	758,359	379,180
United Parcel Service Deutschland Inc. & Co. OHG	519,917	259,959
Busch Jäger Elektro GmbH	105,497	52,749
CWS-boco International	765,953	382,977
Wirtschaftsförderung Dortmund (Dortmund Economic Development Agency)	92,588	46,294

VEHICLES: 11 commercial vehicles (> 7.5 t)
INFRASTRUCTURE: 13 charging posts

COMMENCEMENT: 01 September 2012
CONCLUSION: 31 December 2015

V / 06 / 07

» EFBEL VRR – EXTENDED ACCOMPANYING RESEARCH FOR THE USE OF ENERGY EFFICIENT ROUTE BUSSES IN THE RHINE-RUHR TRANSPORT ASSOCIATION «

In this project analyses of city busses with hybrid and alternative drive concepts will be carried out. Based on the experiences from the previous project the following themes will be reinforced:

» Precise ascertainment of fuel consumption, exhaust and noise emissions
» Energetic balancing of the main ancillary units
» Simulation and use profile analysis to identify primary influencing factors on fuel consumption
» Analysis of the impact of operational concepts and driver behaviour
» Analysis of route profiles and topological features and their impact on mode of operation
» Examination of consumption development in terms of operating life
» Observation of weather-related differences in consumption and availability (winter vs. summer months)

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Institut für Kraftfahrzeuge RWTH Aachen	1,932,714	1,932,714
Verkehrsverbund Rhein-Ruhr (VRR)	105,155	52,577

VEHICLES: Different busses with hybrid and alternative drive systems

COMMENCEMENT: 31 December 2012
CONCLUSION: 30 June 2015

V / 06 / 08

» METROPOL-E «

The overarching aim of the »metropol-E« project is the sustainable integration of innovative electromobility applications in future mobility concepts within the Ruhr metropolitan region. For this two development threads are pursued in two topics: both lines of development should, in so far as is reasonable, be combined with one another and practically tested in a fleet use concept of the city of Dortmund. In addition the practical test is supplemented by the deployment of additional vehicles in the area of commercial traffic for the testing of charging infrastructure and charging concepts.

The two »metropol-E« lines of development are:

» On the one hand a municipal fleet use solution for electric vehicles is being developed and tested in practice for their everyday suitability, in which electric vehicles are integrated into existing car pools The fleet use solution to be developed will be supported by an intelligent fleet management system on the ICT side.

» On the other hand innovative charging concepts are being (further) developed, which incorporate new applications such as fast-charging technologies and differentiated booking and paying methods. These are to be tested at different locations with high public visibility incorporating fleet vehicles.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
RWE Effizienz GmbH	4,468,206	2,234,103
PTV Planung Transport Verkehr AG	520,560	260,280
Technische Universität Berlin	174,627	174,627
Technische Universität Dortmund	590,560	590,560
Stadt Dortmund	567,059	453,647
ewald consulting GmbH & Co. KG	547,400	328,440

VEHICLES: 12 passenger cars, 10 pedelecs and e-Scooters
INFRASTRUCTURE: 62 charging points planned

COMMENCEMENT: 01 January 2012
CONCLUSION: 31 December 2013

University of Dortmund

Commercial vehicles in the Ruhr city

V / 06 / 09

» COLOGNE-MOBIL II – ELECTROMOBILITY SOLUTIONS FOR NRW «

Based on the experiences of Phase I of »cologne-mobil«, the entire electromobility system is to be further developed and implemented both conceptually (e.g. through the incorporation of the taxi operation and car-sharing themes) as well as in terms of content. Aside from a numerical increase in the electric vehicle fleet by an additional 49 vehicles, a technical advance with respect to plug-in hybrids is also being made. A total of 66 electric vehicles are being used in this fleet trial (including 17 from Phase 1) in order to on the one hand, further explore the uniform approach taken up to now as well as on the other hand, offer the electromobility experience in a metropolitan area in all its forms.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Ford-Werke GmbH	4,455,781	2,227,890
RheinEnergie AG	4,824,069	2,412,034
Universität Duisburg-Essen	1,563,848	1,563,848
Regionalverkehr Köln GmbH	114,300	57,150
Flughafen Köln/Bonn GmbH	635,621	317,810
TÜV Rheinland Kraftfahrt GmbH	433,635	216,817
DB Rent GmbH	885,506	442,753
Energiebau Solarstromsysteme GmbH	302,384	151,192
TRC Transportation Research & Consulting GmbH	278,275	166,965

VEHICLES: 55 passenger vehicles, 9 commercial vehicles, 2 busses
INFRASTRUCTURE: 120 charging posts, 240 charging points

COMMENCEMENT: 01 July 2012
CONCLUSION: 30 June 2015

V / 06 / 10

» EMERGE – PATHS TO INTEGRATION OF ENERGY, VEHICLE AND TRANSPORT DEMANDS – FLEET TRIAL IN THE RHINE/ RUHR AND BERLIN MODEL REGIONS «

The focus of electromobility projects so far in the model region programmes was heavily on the technical application and everyday suitability of charging infrastructure and vehicles. From the results obtained it is now worth analysing and developing the electromobility system in its entirety. This can only happen through an integrated examination of all participating sectors from vehicle, energy and transport to users.

This approach is the foundation for the »eMERGE« project. In the framework of a fleet trial with electric vehicles, 175 smart electric drives are on the road in the Rhine/Ruhr and Berlin model regions. Apart from private customers, company fleet vehicles are also being used, so that knowledge can be gained about both user groups.

The goal is to investigate the technical aspects of electric cars as well as intelligent charging systems to improve grid capacity. In addition different price systems are used with a view to customer acceptance, which allow conclusions to be drawn about user behaviour. Taking into account environmental aspects, new business models will then be developed from these findings for the optimisation of electromobility.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Daimler AG	4,050,063	2,025,031
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	652,000	586,800
PTV Planung Transport Verkehr AG	464,520	232,260
RWE Effizienz GmbH	2,023,994	1,011,997
Technische Universität Berlin	270,955	270,955
Universität Siegen	224,898	224,898
Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen	198,586	198,586

VEHICLES: 175 passenger vehicles

COMMENCEMENT: 01 July 2012
CONCLUSION: 31 December 2014

» An integrated view from the vehicle to energy, from road traffic to the user «

V / 06 / 11

» EMOVE «

Electromobility is a central building block of an environmentally sustainable reshaping of mobility in Germany. Aside from the proliferation of private electric vehicles this calls for the development of »e-mobility« services as well as the integration of these different modes of transport into existing mobility options and strategies. Until now the exploration of technical framework conditions for electromobility (vehicle technology, battery technology, etc.) was the focus. Concrete implementation of measures to promote »e-mobility« and their integration in existing, regional and local authority plans and planning processes was hardly examined. In addition, the development of different modes of transport options is in its infancy in Germany. The »eMoVe« project monitors the introduction of electromobility from an integrated perspective with concrete implementation options in cities and regions. The aim of the project is the preparation of a comprehensive spread of electromobility through instrumental, conceptual, strategic and functional integration of electromobility into municipal mobility.

- » Instrumentally, the integration of electromobility is gaining importance in existing planning processes and procedures. This applies to regional concepts (e.g. networking with rail local public transport or clean air planning) as well as local authority ones (e.g. transport development plan, local transport plan).
- » Conceptually, the lines of development of individual mobility services so far are to be combined to form a single source electromobile mobility association. The aim here is to develop structures, business models and processes for an electromobile mobility association.
- » Strategically, the integration of electric vehicles in important mobility operator vehicle fleets is to be promoted. The goal of the project is the conception of fleet strategies for the introduction of electric vehicles for reference users.
- » Functionally, connecting e-mobility and public transport through common access points will be pursued. The goal is the development of »e-mobility« stations linking to rail and bus stop points.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
RWTH Aachen University – Institut für Stadtbauwesen und Stadtverkehr (ISB) (Institute of Urban Engineering and Urban Transport)	141,764	141,764
Stadt Aachen	882,492	661,869
Aachener Verkehrsverbund GmbH (AVV)	80,622	40,311
Aachener Straßenbahn und Energieversorgungs-AG (ASEAG)	65,340	32,670
Stadtwerke Aachen AG (STAWAG)	154,060	77,030
Cambio Aachen Stadtteilauto CarSharing GmbH	253,296	162,768
EcoLibro GmbH	135,772	95,041
Fachhochschule Aachen	150,295	150,295
Probst & Consorten Marketing-Beratung	111,017	55,508

VEHICLES: 20 passenger vehicles
INFRASTRUCTURE: Construction of 4 mobility stations

COMMENCEMENT: 01 December 2012
CONCLUSION: 30 June 2015

V / 07
MODEL REGION SAXONY

V / 07 / 01

» PRIMO – STUDIES OF PRISMATIC LITHIUM CELLS FOR LOCAL PUBLIC TRANSPORT DRIVE TRAIN & PRIMO II – DEVELOPMENT OF MODULAR, DISTRIBUTED ENERGY STORAGE SYSTEMS AND COST-OPTIMISED MANUFACTURING TECHNIQUES FOR USE IN THE LOCAL PUBLIC TRANSPORT SECTOR «

In the long term emission-free battery-electric or hydrogen-operated fuel cells will be the most effective system in short-haul mobility. At the same time delays could take place for the benefit of the pure battery-operated drive through advances in the area of battery technology in the future. In accordance with the electromobility government programme, electromobility is an important element of climate-conscious energy and transport policy. The energy storage system thus illustrates a key technology for electromobility. The aim of both »PRIMO« projects is to develop competitive and innovative energy storage concepts for local public transport and special vehicle use.

With its examinations into prismatic lithium cells for the local public transport drive train, the »PRIMO« development project constitutes the starting point for the »PRIMO« II project »Development of modular, distributed energy storage systems and cost-optimised manufacturing techniques for use in the local public transport sector«. Through this, an international comparison of technological status by benchmarking prismatic lithium cells for the electrification of e-bus drive trains was carried out. The choice of prismatic cell technology for the construction of the distributed, modular energy storage systems was made on the basis of the preliminary standard DIN SPEC 9152 for lithium. The cells conforming to the preliminary standard will be used in future by the automotive industry for electrification in passenger vehicles and, cost-optimised, will be available in high volumes.

The benchmarking results serve to identify lithium cells suitable for application, which form the basis for the rough construction of »sub-modules« in lightweight design. The »sub-module concept« developed is the departure point for the construction of distributed high-voltage energy storage systems in local public transport.

The detailed development of the overall system is currently taking place in the ongoing »PRIMO« II development project. The estimated development should lead to innovative distributed energy storage solutions, which can be used for a flexible, application-specific design in the local public transport area. The focus of development is the overall system including the necessary charging technology. Thus an entire system development will be run for electrification in the local public transport area, whose efficiency in relation to energy supply and consumption can be significantly raised by individual coordinated components at system level and offered to the operator as an independent overall concept. Energy storage systems > 400 V necessary for the electrification of the drive train in local public transport thereby provide a good starting point. Current requirements for the electrification of the drive train for electric busses are approx. 650 V. For the system construction lightweight components are being evaluated, where the design of this kind of multi-functionally designed sub-module allows for integration of different prismatic cells.

Apart from the development of these distributed, modular energy storage systems, new, innovative production and process technologies to prove economic viability are also being developed.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
PRIMO: HOPPECKE Advanced Battery Technology GmbH	262,034	131,017
PRIMO II: HOPPECKE Advanced Battery Technology GmbH	7,251,200	3,625,600

COMMENCEMENT PRIMO: 01 November 2011
CONCLUSION PRIMO: 29 February 2012

COMMENCEMENT PRIMO II: 01 January 2012
CONCLUSION PRIMO II: 31 December 2014

V / 07 / 02

» SAXMOBILITY II – MOBILE TERMINALS AS ACCESS AND SETTLEMENT SYSTEMS FOR CHARGING INFRASTRUCTURE AND LINKING WITH LOCAL PUBLIC TRANSPORT «

In the »SaxMobility II« project the necessary conditions are created to test the principle of standardised access to charging infrastructure and billing via mobile terminals as well as to levy payment through local public transport payment platforms. The scheme also specifically contributes to eventually establishing common mobility services with transport operators in order to promote multimodal transport use through a combination of electric vehicles and local public transport.

Aside from the project partners' further continuation of fleet operation with electric vehicles, the expansion of applications on the subject of »Making vehicles available – charging pole location – charging – billing« is planned. To continue on with previous activities the charging infrastructure is being expanded as required in (semi-) public transport areas, existing charging stations technically adapted and the stock of electric vehicles increased for customer and fleet use. The tests and data collection is being continued and scientifically evaluated. For the implementation of the access and settlement system, appropriate hardware components must be employed and software systems adapted which meet the technical demands of the grid at an acceptable price.

The project thus helps to raise public perception as well as the acceptance of electromobility, in that its use is made easier and can be experienced.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
KEMA – IEV Ingenieurunternehmen für Energieversorgung GmbH	145,527	72,764
Stadtwerke Leipzig GmbH		
Forschungs- und Transferzentrum Leipzig e.V. an der Hochschule	2,972,785	1,486,392
für Technik, Wirtschaft und Kultur Leipzig (FH)	74,177	66,759
ENSO NETZ GmbH	493,319	246,660
Hochschule für Technik und Wirtschaft Dresden (FH)	956,520	956,520
DREWAG – Stadtwerke Dresden GmbH	1,248,651	624,325
Leipziger Verkehrsbetriebe (LVB) Gesellschaft mit beschränkter Haftung	656,697	328,348

VEHICLES: 58 electric vehicles
INFRASTRUCTURE: 250 charging points
(demand-driven expansion)

COMMENCEMENT: 01 October 2011
CONCLUSION: 30 September 2014

Federal Minister Dr. Peter Ramsauer launches »SaxMobility II« to link buses, railways and electric vehicles in Saxony

V/08
FURTHER REGIONS

V / 08 / 01

»EMOTIF – ELECTROMOBILE THURINGIA IN THE REGION«

The purpose of the project »EMOTIF – Electromobile Thuringia in the region« is to test and study the performance of electric vehicles in an integrated network of publicly-accessible vehicle fleets and public transport in a predominantly rural area. The focus of the research is the question of whether the appeal of the Free State of Thuringia with its rural touristic regions can be further increased through the use of electric vehicles linked with local and long-distance public transport and whether users of private transport, also in smaller and medium-sized towns, can be reached through electric vehicle services.

The point of departure is the expansion of a fleet of 8 electric vehicles in the towns of Eisenach, Erfurt, Weimar and Jena and their integration in the car-sharing service of DB AG. The vehicles are to be stationed at the central junctions of public (long-distance) transport in order to offer users the option of taking a fully electromobile journey. Attractive (touristic) locations in Thuringia, which are either poorly or not at all connected to public transport, can be reached in this way. This option should not only cater for rail travellers, tourists and already active car-sharing users, but also the residents of the towns and the region. Particularly for this last group, the new car-sharing option should create an incentive to test electric vehicles and leave their own car at home.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fachhochschule Erfurt	290,177	290,177
DB Rent GmbH	474,197	237,098
Eisenacher Versorgungs-Betriebe GmbH	76,292	38,146
Erfurt Tourismus und Marketing GmbH	122,640	61,320
Stadtwerke Energie Jena-Pößneck GmbH	98,117	49,058
Stadtwerke Weimar Stadtversorgungs-GmbH	90,000	45,000

VEHICLES: 8 electric vehicles
INFRASTRUCTURE: 8 charging posts

COMMENCEMENT: 01 October 2012
CONCLUSION: 30 September 2014

V / 08 / 02

» E-MOBIL SAAR «

The aim of the »e-Mobil Saar« project is to make Saarland and in the long-term, the wider Saar-Lor-Lux region a model region for sustainable mobility and additionally to establish Saarland as a test region for the use of modern drive technologies. Therefore Saarland's Economic Ministry together with partners in the region (DB Fuhrpark GmbH, Verkehrsmanagement-Gesellschaft Saar mbH and the Institute for Future Energy Systems), with support of the Federal Government, have developed the »e-Mobil Saar« model project. The scheme will link electromobility and local public transport and provide new service qualities. Across the state up to 35 new charging stations will be placed at local public transport points, for example in front of train stations and bus stops and will be linked to an intelligent information and booking system, that will make linking public transport and individual transport as easy as possible for citizens. Across Saarland there will up to 50 new electric vehicles available, which will be provided by the Saarland transport association and Deutsche Bahn's »Flinkster« car-sharing network directly at train stations. The »e-Mobil Saar« research project is financed by federal funds in the amount of 3.4 million € and partly flanked with state funds.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Ministerium für Wirtschaft, Arbeit, Energie und Verkehr des Saarlandes	791,022	791,022
IZES gGmbH (Institut für ZukunftsEnergieSysteme)	892,082	802,874
VGS Verkehrsmanagement-Gesellschaft Saar mbH	497,752	248,876
DB Fuhrpark Service	2,494,896	1,247,448

VEHICLES: 20 electric vehicles in conjunction with the Saarland transport association (saarVV – Saarländischer Verkehrsverbund), additional vehicles in conjunction with leasing companies
INFRASTRUCTURE: max. 35 charging stations

COMMENCEMENT: 01 June 2011
CONCLUSION: 31. May 2013

> » Connecting electromobility and local public transport as well as a new level of service «

Bus stop with inmod boxes in Klützer Winkel

V / 08 / 03

» INMOD – INTERMODAL LOCAL PUBLIC TRANSPORT IN RURAL AREAS ON THE BASIS OF ELECTROMOBILITY COMPONENTS «

In November 2011 the Hochschule Wismar (Wismar University) began »Inmod«, one of the research projects funded by the Federal Ministry of Transport, Building and Urban Development as well as by the Ministry for Energy, Infrastructure and Regional Development Mecklenburg-West Pomerania, which is making local public transport in rural areas more appealing.

»Inmod« goes to the four regions of Klützer Winkel, Salzhaff, Usedom and the Mecklenburg Lakeland as a supplementary service on that route. Since August 2012 a climate-friendly electric and hybrid bus travels on the main route, without turning left or right into the small villages. This way the travel time is considerably reduced and frequency can increase so that during the day, in regions where up to now there was partly no bus transport, there is a bus on almost an hourly basis.

What is so special about »inmod« is that how to get along the feeder road from the villages and districts off the main route to the bus stop is not left to the passengers, but is systematically integrated into the local public transport system (first and last mile). »Inmod« is an integrated intermodal local transport system for rural areas. With »Inmod«, e-bikes are used for the first and last miles. This way anyone, whether local resident, commuter active in the region or tourist, can reach the next bus stop and get on a bus there or vice versa.

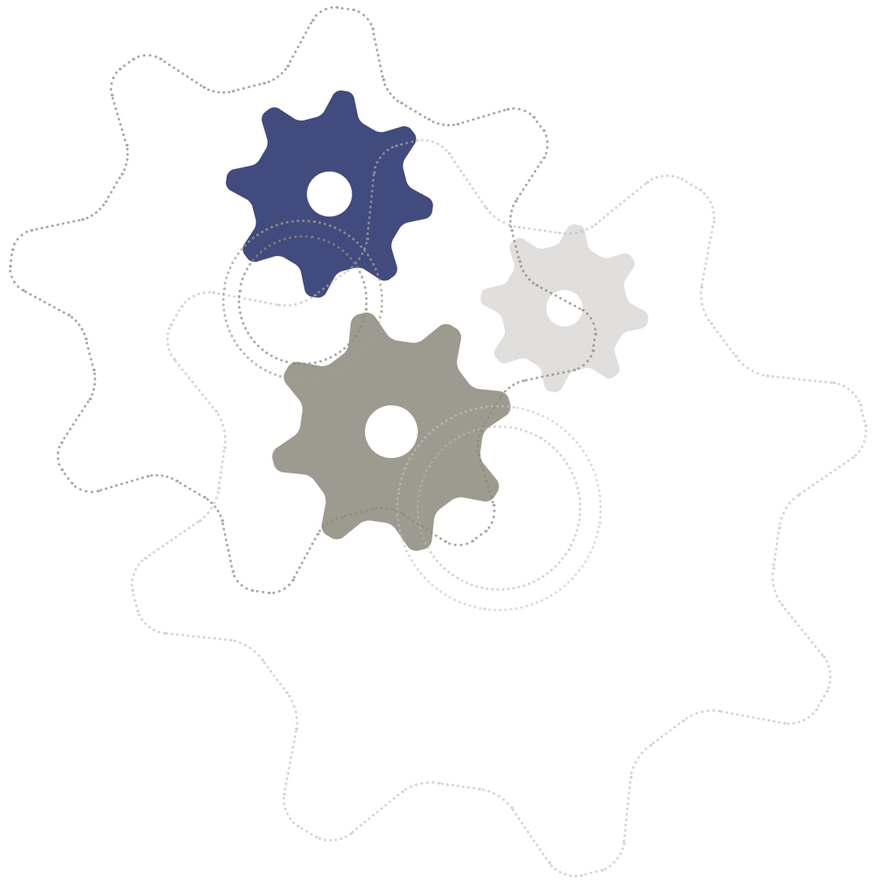
The pedelecs are parked in the »Inmod« boxes as well as in the villages and the bus stops. In order to be able to use the e-bike, the user must register beforehand and then receives the »Inmod« smartcard. With this card the service can be used at any time and as often as desired.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Hochschule Wismar, Kompetenzzentrum ländliche Mobilität	4,823,591	3,402,091

VEHICLES: 1 electrobus, 2 hybrid busses, 320 pedelecs
INFRASTRUCTURE: 200 boxes with integrated charging system, spread over 44 locations. One technical box per location with box electrics and user terminal as well as 2 – 12 bike boxes.

COMMENCEMENT: 01 November 2011
CONCLUSION: 31 October 2014

V/09 OVERARCHING PROJECTS / TECHNOLOGY PROJECTS



V / 09 / 01

» VOITH ELVODRIVE – SERIAL DIESEL HYBRID BUSSES «

In cooperation with HESS, Voith Turbo is developing a diesel hybrid bus with diesel and electric engine serial gearshift (ElvoDrive) as a prototype that is being tested in an actual route service of Munich's public transport system (Münchner Verkehrsgesellschaft AG). Voith's areas of expertise are drive motors, generators, converters, energy storage and software. HESS is developing the package and operational strategic system modifications in the vehicle. Measures are being taken in the project to meet the new European functional and electric safety standards and both hardware and software components of the drive train developed and tested to secure an optimal fuel consumption and driving comfort. In order to check the sustainability of the technology, PE INTERNATIONAL is examining the environmental performance of the ElvoDrive drive with the help of an environmental life cycle assessment.

Using new bus technologies and the test operation at a German transport operator, Voith is actively pursuing the strategy of introducing electromobility in Germany. The project findings on the level of maturity of the drive technology, the reduction of fuel consumption and the impact on emissions provide the basis for which series diesel hybrid busses with ElvoDrive are to come into operation in the context of the planned market launch. The experiences from practical use make an important contribution to the successful series development of the ElvoDrive System.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Voith Turbo GmbH & Co. KG	7,807,885	3,903,942

VEHICLES: Diesel hybrid busses

COMMENCEMENT: 01 November 2011
CONCLUSION: 30 Juni 2013

V / 09 / 02

» PRIMOVE MANNHEIM «

Mannheim is reinterpreting electromobility in local public transport: in the course of the »PRIMOVE« research project electric busses will be recharged in future during the boarding and alighting of passengers at regular bus stops and thus can be used for everyday transport operation, also over long distances. In close cooperation between the municipal transport company Rhein-Neckar-Verkehr (RNV), the city of Mannheim, Bombardier Transportation GmbH, and the Karlsruhe Institute for Technology (KIT), the deployment of two inductively-charged electric busses over a 12-month period on the regular RNV 63 bus route as well as the use of an electric vehicle service in the transport area of RNV GmbH is planned. The aim of the project is to prove the practicability of a technology transfer in the interest of further optimising low-emission, public transport. In the process, investigating cost-reducing potential dependent on the established framework conditions for reliable everyday operation is the focus. The experiences gained in the framework of the »PRIMOVE-Mannheim« project regarding technology, public resonance and economic feasibility will serve to prepare the deployment of »PRIMOVE« technology and apply it in the future for the entire transport region of the RNV.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Rhein-Neckar-Verkehr GmbH	4,601,089	2,254,533
Karlsruher Institut für Technologie (KIT)	374,680	374,680
Bombardier Transportation GmbH	1,554,120	699,354
Stadt Mannheim	101,025	50,512

VEHICLES: 2 fully-electric 12-metre busses; 1 electric delivery vehicle
INFRASTRUCTURE: Induction charging by means of Primove technology

COMMENCEMENT: 01 October 2012
CONCLUSION: 30 March 2015

Left: First tests with the Bombardier Viseon e-bus on the Bombardier's tram testing track in Augsburg, for multimodal inductive recharging

Right: Bombardier Viseon bus at the IAA international exhibition for commercial vehicles in Hanover

V / 09 / 03

» PRIMOVE ROAD – DEVELOPMENT AND DEMONSTRATION OF ELECTRIC CITY BUSSES WITH INDUCTIVE CHARGING ON MULTIMODAL USABLE CHARGING INFRASTRUCTURE «

Together with the bus manufacturer Viseon, Bombardier developed and built a purely electrically-operated 12-metre bus, whose inductive batteries are charged via the automatic, cable free Bombardier »PRIMOVE« system. In addition »PRIMOVE« on-board components – primarily consisting of an electricity pick-up system and a transmitter – were installed in the e-bus. Viseon developed a fully-automatic lifting device for the receptacle coil with an automatic air gap check and adjustment. The Bombardier-Viseon e-bus is additionally equipped with the newly-developed electric drive system for Bombardier busses. Bombardier's century of experience in electric drive systems for rail vehicles is a great advantage in developing the electric system. The bus was already publically presented at the IAA Commercial Vehicles trade show in Hanover and proved its efficiency in over 150 test drives.

The bus completed the first successful tests on static charging on »PRIMOVE« test track-equipped car with high inductive power was charged on the same track. In this way it was practically proven for the first time worldwide that in principle a multimodal inductive energy transmission for electric road and rail vehicles is possible.

Further tests on the e-bus are planned on a test track in Mannheim. There the bus will be dynamically (during the journey) as well as statically (at a standstill), contactlessly charged.

PARTNERS:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Bombardier Transportation GmbH	3,119,974	1,559,987
Viseon Bus GmbH	1,337,506	668,753

VEHICLES: A fully-electric Viseon bus with PRIMOVE on-board components
INFRASTRUCTURE: Combined rail-road routes for dynamic inductive charging

COMMENCEMENT: 01 Juni 2011
CONCLUSION: 30 June 2013

» The future of local public transport lies in the integration of electromobility within the overall mobility concept. «

V /10 EUROPEAN COOPERATION

Climate change and the spread of sustainable mobility concepts are a global challenge. In order to create the relevant long-term and sustainable conditions for electromobility development in Europe, the transnational funding initiative Electromobility+ was launched, with the participation of public funding programmes from eleven countries: France, Germany, the Netherlands, Austria, Finland, Norway, Sweden, Denmark, Poland, Belgium and Italy.

Through the opening up of these regional and national programmes for transnational cooperation, their research activities were networked in order to thus generate a European added value.

In addition to the total of 15 million euro from national funding, the EU is providing up to 7.3 million euro for the subsidised programmes in the framework of the ERA-NET Plus programme.

Funding areas include research projects on political and regulatory aspects of electromobility as well as technology-based and experimental research.

The project funding within Germany is undertaken by the Federal Ministry of Transport, Building and Urban Development (BMVBS) and the Federal Ministry of Economics and Technology (BMWi). TÜV Rheinland is responsible for the overall coordination of the transnational Electromobility+ initiative.

V /10 / 01

» CACTUS – MODELS AND METHODS FOR THE EVALUATION AND OPTIMAL USE OF BATTERY-CHARGING AND BATTERY-EXCHANGE TECHNOLOGIES FOR ELECTRIC BUSSES «

In the »CACTUS« project, models and methods for the evaluation and optimal use of battery-charging and battery-exchange technology for electric busses in a given timetable as well as other secondary parameters will be developed.

If fully-electric busses are to be operated in future in local public transport, practical solutions must be found for the charging management. If the total medium-range daily routes of a bus of up to 300 km are to be completed without recharging, batteries of today's technology would weigh several tonnes and thus they would not be economically feasible. The high costs of conversion to fully-electric drives are mainly caused by the investment required in vehicle technology and/or charging infrastructure. In order to better assess these costs and be able for example, to minimize them through optimal infrastructure placement and appropriate driving strategies, different models and methods of optimising driving strategies and recharging procedures are being explored, developed and evaluated.

PARTNERS

Fraunhofer Institute for Material Flow and Logistics (Germany), HVB Harzer Verkehrsbetriebe GmbH (Germany), Institut für Automation und Kommunikation e.V. (Germany), MVB – Magdeburger Verkehrsbetriebe GmbH (Germany), PVGS – Personenverkehrsgesellschaft Altmarkkreis Salzwedel mbH (Germany), PKM – The Urban Transit Authority Ltd. In Sosnowiec (Poland), Silesian University of Technology (Poland)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Fraunhofer-Institut für Materialfluss und Logistik (Fraunhofer Institute for Material Flow and Logistics)	312,453	281,208
Institut für Automation und Kommunikation e.V.	335,451	301,906

COMMENCEMENT: 01 June 2012
CONCLUSION: 31 May 2015

V / 10 / 02

» DEFINE – DEVELOPMENT OF AN EVALUATION FRAMEWORK FOR THE INTRODUCTION OF ELECTROMOBILITY «

The »DEFINE« research project has the goal of assessing the state support of greater market penetration of electromobility by means of political instruments. In this process costs and benefits of tax and incentive measures in the macro-economic context will be examined as well as particular impacts on the energy market, including effects on electricity prices and the grid integration of renewable energies through energy storage mechanisms by means of electric vehicle fleets. From a cost-benefit comparison of certain political instruments, indications of the best policies as well as optimal times for the introduction of these political measures are obtained. Through public dissemination of the research results in the appropriate print media and at conferences, a political advisory as well as a scientific demand will be fulfilled. The consortium consists of UHS Wien, TU Wien, Umweltbundesamt, Öko-Institut, CASE Poland and DIW Berlin. The international research project is funded by the economic and transport ministries in the respective countries of the consortium members. DIW's contribution to the overall project can be divided roughly into two work areas: an overall economic analysis and an energy market-specific analysis. In the DIW-led energy market analysis area, it will be investigated to what extent funding of electromobility can be involved with grid integration of renewable energies and what price and electricity demand is likely. Furthermore other changes on the energy market will be discussed which could result from a high number of electric vehicles, such as the increasing possibility of storing energy through electric vehicles.

» Option for the storage of power «

PARTNERS

German Institute for Economic Research Berlin (DIW) (Germany), Institute for Applied Ecology (Germany), Institute for Advanced Studies Vienna (Austria), Vienna Technical University (Austria), Environment Agency Austria (Austria), CASE – Center for Social and Economic Research (Poland)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Deutsches Institut für Wirtschaftsforschung Berlin (German Institute for Economic Research Berlin)	204,635	204,635
Öko-Institut für angewandte Ökologie e.V. (Institute for Applied Ecology)	139,344	125,410

COMMENCEMENT: 01 June 2012
CONCLUSION: 30 November 2014

V / 10 / 03

» EMAP – ELECTROMOBILITY-SCENARIO BASED MARKET POTENTIAL, ASSESSMENT AND POLICY OPTIONS «

The focus of the research project »eMAP« is the examination and evaluation of market penetration of electric vehicles and their economic implications. For the 2025 – 2030 timeframe, market penetration of electric vehicles in the three partner countries Germany, Poland and Finland as well as on the European level will be estimated with the aid of a scenario-based market model. In addition results from the supply and demand sides through consumer surveys as well as expert workshops will be used. Based on the findings of the model calculations, the socio-economic impacts in terms of emissions reductions, transport costs, technological changeover and security of energy supply for the respective scenarios will be assessed. Alongside this political incentive measures and strategies for market introduction and their effects will be examined and determined. Lastly recommendations for political support for market penetration of electric vehicles will be made. The leading ERA-NET Electromobility+ project, headed by the BASt, is financed from EU funding and the BMVBS and has a project duration of 33 months. The consortium comprises 6 project partners from Poland, Finland and Germany.

PARTNERS

Bundesanstalt für Straßenwesen (BASt) (Germany), KE-Consult (Germany), Institute for Applied Social Sciences (infas) (Germany), German Aerospace Centre (DLR) (Germany), Technical Research Centre of Finland VTT (Finland), Motor Transport Institute Warszawa ITS (Poland)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Bundesanstalt für Straßenwesen (BASt)	312,453	281,208
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (German Aerospace Centre)	335,451	301,906

COMMENCEMENT: 01 June 2012
CONCLUSION: 28 February 2015

» Political funding measures and strategies «

V / 10 / 04

» SCELECTRA – SCENARIOS FOR THE ELECTRIFICATION OF TRANSPORTS «

On 01 July 2012 the project »Scenarios for the electrification of transports« (SCelecTRA) began. The project's goal is the formulation of real political measures to promote the electric vehicle market in Europe until 2030. To this end different policy scenarios will be analysed in terms of their economic efficiency (cost-benefit analysis on the basis of a Europe-wide country-specific optimisation model of the energy and transport sectors) and their environmental impact (environmental performance evaluation and costs for society, i.e. so-called external costs). The following electromobility-relevant influencing factors will be especially considered:

- » Differences in the energy mix of European countries,
- » Impact of political actions on the transport sector and on technical developments in the automotive industry as well as
- » Charging intervals, types of storage and infrastructure for the operation of electric vehicles.

On the basis of the results very effective political measures on the promotion of alternative drive concepts are expected to be identified.

PARTNERS

European Institute for Energy Research (Germany), IFP Energies nouvelles (France), PE CEE Nachhaltigkeitsberatung & Softwarevertriebs GmbH (Austria), Institut Français des Sciences et Technologies des Transports de l'Aménagement et des Réseaux (France), KANLO Consultants SARL (France)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Europäisches Institut für Energieforschung (European Institute for Energy Research)	48,821	43,810

COMMENCEMENT: 01 July 2012
CONCLUSION: 30 June 2015

» Support of the electric vehicle market in Europe until 2030 «

V / 10 / 05

» SELECT – SUITABLE ELECTROMOBILITY FOR COMMERCIAL TRANSPORT «

Commercial traffic constitutes a significant share of overall traffic in cities. It is responsible to a great extent for air and noise pollution. Commercial traffic is by no means just freight transport, but rather also the journeys of service providers, like for example craftspeople or social services. Urban commercial traffic journeys are normally quite short and the daily mileage of the vehicle rarely exceeds 100 km. These journeys are also normally scheduled beforehand. Short distances and early planning make urban commercial traffic therefore an excellent candidate for the use battery electric drives. The »SELECT – Suitable electromobility for commercial transport« project examines to what extent the use of electric vehicles can be an alternative for environmentally-friendly commercial traffic in the city. The project, supported by European Union as well as national initiatives in Austria, Denmark and Germany, is coordinated by the Berlin Institute for Transport Research of the German Aerospace Center (DLR). The central objective of the project is the identification of the technical and practical user demands for the use of electric vehicles in commercial traffic. In addition it focuses on the economic, infrastructural, as well as political requirements necessary to be able to implement the smoothest possible transition from conventional to electric vehicles. »SELECT's« point of departure is the research results from projects, how they have been compiled for example in the framework of the Electromobility Model Region in Berlin.

On this basis surveys are being designed which will be conducted within the »SELECT« project, in order to determine the range of possible applications as well as their sector- and operation-specific requirements. In a further step »SELECT« is developing methods for the establishment of planning tools, which will accommodate the particular needs of commercial traffic and will support fleet operators in the efficient use of electric vehicles. What is important here in the overall project is the ongoing accompanying discussion with (potential) users of electric vehicles as well as with decision-makers from politics and planning.

» Environmentally friendly commercial transport in the city «

PARTNERS

German Aerospace Centre (DLR) (Germany), Technical University of Denmark (Denmark), AIT Mobility – Austrian Institute of Technology (Austria), CLEVER A/S Denmark Copenhagen (Denmark), Consilio Information Management GmbH (Austria), Reffcon GmbH (Austria)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (German Aerospace Centre)	577,339	519,605

COMMENCEMENT: 01 July 2012
CONCLUSION: 30 June 2015

V / 10 / 06

» EV-STEP – SUSTAINABLE TECHNICAL AND ECONOMIC PATHWAYS FOR ELECTRIFIED MOBILITY SYSTEMS IN EU27 BY 2030 «

In the »EV-STEP« project long-term perspectives for different electromobile drive concepts and their impact on the national as well as on the European energy system are to be analysed. The evaluation of sustainable development options for the transport sector is a complex issue. Electric vehicles can play a significant role in this: they can reduce oil dependency, increase flexibility in energy supply, raise energy efficiency in the end-use sectors and considerably reduce greenhouse gas emissions and other air pollutants in the transport sector.

Because of electromobility's multi-faceted interconnections within the energy system it must be ensured that an evaluation of the development options of electric vehicles is carried out within a consistent model framework.

Within the project an integrated approach will be created for assessing electromobility by further developing existing model approaches. The European energy system model TIMES PanEU will interface with the statistical, calculable general equilibrium model IMACLIM-S in order to derive a technology roadmap for the introduction of electric vehicles with comprehensive political recommendations.

> » The evaluation of sustainable development options for the transport sector «

PARTNERS

Institute for Energy Economy and the Rational Use of Energy at the University of Stuttgart (Germany), ARMINES – Centre for Applied Mathematics (France), RISOE-DTU (Denmark), Société de Mathématiques Appliquées et de Sciences Humaines (SMASH) (France)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Institut für Energiewirtschaft und Rationelle Energieanwendung Universität Stuttgart (Institute for Energy Economy and the Rational Use of Energy at the University of Stuttgart)	134,745	134,745

COMMENCEMENT: 01 July 2012
CONCLUSION: 30 June 2014

V / 10 / 07

» EVERSAFE – EVERYDAY SAFETY OF ELECTRIC VEHICLES «

The successful integration of electrically-operated vehicles in the European transport system of the future will be dependent on the clear and transparent communication of safety standards for vehicles and their control systems. These standards are decisive for the whole transport system, i.e. for transport users, planners and also the automotive industry.

While the first generation of electric vehicles follows the design principles of conventional vehicles, future electric vehicles will occasionally be developed with their own design. Thus one can assume, for example, that in future highly efficient, light and comparatively robust wheel hub motors will be used in electric vehicles.

The overarching goal of the current project is to determine the safety requirements for electrically-operated vehicles taking new electro-specific designs into account. The research themes of the »EVERSAFE« project are dynamic stability, crash impact and battery safety in electric vehicles. These will be addressed via two sub-projects:

» Vehicle stability and its significance for driver experience and behaviour
» Crash impact and battery safety

PARTNERS

BASt (Bundesanstalt für Straßenwesen) (Germany), Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V. (Germany), Chemnitz Technical University (Germany), VTI (Swedish National Road and Transport Research Institute) (Sweden), KTH (Royal Institute of Technology) (Sweden), VCC (Volvo Car Corporation) (Sweden)

FEDERALLY FUNDED, IN CONJUNCTION WITH ERA_NET PLUS ELECTROMOBILITY+:	PROJECT BUDGET/€:	PROJECT FUNDING/€:
Bundesanstalt für Straßenwesen	329,282	329,282
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	356,500	320,850
Technische Universität Chemnitz	237,682	237,682

COMMENCEMENT: 01 May 2012
CONCLUSION: 30 April 2014

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