

Fuel cells and hydrogen in Finland

Finnish Fuel Cell Programme 2007–2013

Tekes



Fuel cells and hydrogen future market potential for Finnish industry

At present the competitiveness of the Finnish industry is in peril. New innovative products are urgently needed to improve the industrial competitiveness. It would therefore be worthwhile for the Finnish industry to invest in fuel cell and hydrogen applications, where the international industry base is still modest but advancing. The potential in this area is huge because the variety of possible applications is enormous and there is much space for technical advances, areas where the Finnish industry is traditionally strong.

Stationary

In Finland Wärtsilä has had a considerable program on the development of stationary 20–50 kW SOFC power plants. This work is now continued by a new company, Convion. Another application is the soon to come 50 kW PEM power plant to the Kemira plant in Äetsä to use its surplus hydrogen for electricity production.

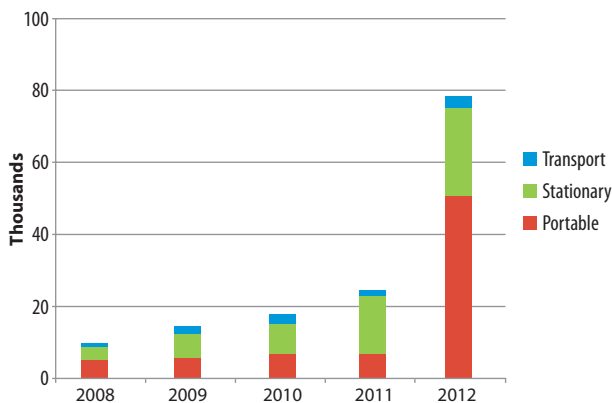
The international stationary market especially in Japan, Korea, USA and Europe is growing strongly. The most popular applications are residential 200 W – 2 kW units. These are partly PEM and partly SOFC units. Hundreds are installed in Europa and thousands in Japan. In Finland the residential market is very small because we have very few households with individual natural gas distribution. The second reason is the magnitude of the district heating.

The other popular area is the 100 kW to several MW market in USA and South Korea. This is served by 100–200 kW SOFC, 400 kW PAFC and 200 kW – 4 MW MCFC systems. The applications are biogas and anaerobic digester gas like water purification plants and as back-up for large data centers. In Finland a possible application could be back-up for nuclear power plants. Smaller plants could use biogas from industry and large farms.

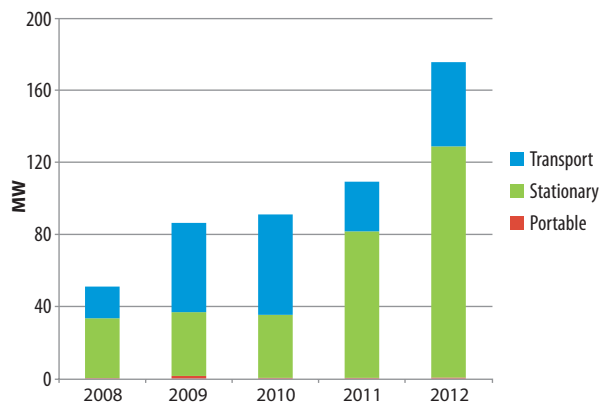
Transport

Internationally all large automobile companies are investing in fuel cell electric vehicles (FCEV), both in busses and small

Shipments by applications 2008–2012



Megawatts by applications 2008–2012



Source: Fuel Cell Today

automobiles. In Finland, we have important international companies producing industrial transport vehicles, like Car-gotec, Sandvik Mining and Construction, Konecranes and Patria Vehicles. All these companies have shown interest in fuel cell applications electric drive and APU, although they are not producing at this moment. Internationally the only popular application is in small material handling vehicles which are sold in thousands, mostly in the USA.

However, there are strong benefits through decrease in emissions and savings in fuel cost by electrifying larger transporters. Development work in a rather small scale is on its way, but there is room for much more. There are several companies in Finland with high potential in fuel cell applications. Arctic Power company is developing an electric snowmobile with fuel cell range extender. This and related applications could be the future of Finnish industry.

Backup and chargers

In Finland there are a few companies interested in this area, Fitelnet, Powerfinn, T Control Oy. Uninterrupted power supply is of increasing interest in such applications as telecommunication and electric control systems. Fuel cell systems are cheaper to run and provide much longer operation periods than the conventional battery systems used now. The market growth has been relatively modest but there seems to be growing interest at present. Battery chargers for leisure and military applications have been quite successful.

Printed bio fuel cells for niche applications

Small disposable low cost, usually printable power sources are expected to have a number of applications in the future. Those applications include RF-tags, medical sensors and appliances, cosmetic patches, intelligent packaging, sensors for identifying products for logistics and so on. At present this very promising market is only emerging. An area to be developed in the near future.

Hydrogen

The major automobile companies are all planning to start large scale FCEV and bus production 2015 or after. All of the vehicles are based on hydrogen fuel. The fuel is stored in the

vehicles in 700 bar pressurized form. The hydrogen can be produced from natural gas by reforming, from water by electrolysis and biomaterials by gasification. A number of fuelling stations are needed. Norway, Denmark, Germany, Japan and the USA are forerunners in taking FCEV:s into use. Therefore a number of fuelling stations will be built in these countries. In Finland Woikoski Oy has decided to go into this business. They have developed their own system with own technology and expect to export the systems to those countries.

Trigeneration – hydrogen, fuel cells and renewables to balance the grid

All over the world distributed power generation is growing very fast. Especially wind and solar electricity is produced in relatively small units and the production varies strongly with wind and light. Therefore the connection of those to the grid requires special circumstances in order to ensure a stable grid. Electricity need to be stored or transported away and then back again when needed. Hydrogen is very well suited for the storage of electricity. Hydrogen can be used as fuel for FCEV or it can be used to produce electricity to the grid. Fuel cells can be used to produce hydrogen, electricity and heat. They are therefore suitable for grid control together. Several countries are investigating this and there could be a considerable market for such systems in the future.

Research results support the industrial development

The results of publicly funded research are mainly intended for supporting the industrial development in the country in question. However, the results can also be used for creating direct income to the research institutes. There are several examples of this in which patents and licenses have been sold to the industry in the own country but also abroad. Main markets seem to be materials and designs for fuel cell stacks and cells. Another successful object is different computer programs. Those could be related to modeling of systems and stacks for instance. Also VTT in Finland has been successful in selling both computer programs, materials and stack designs.

Rolf Rosenberg
RJR Consulting

Stationary fuel cell applications, system integration and component development

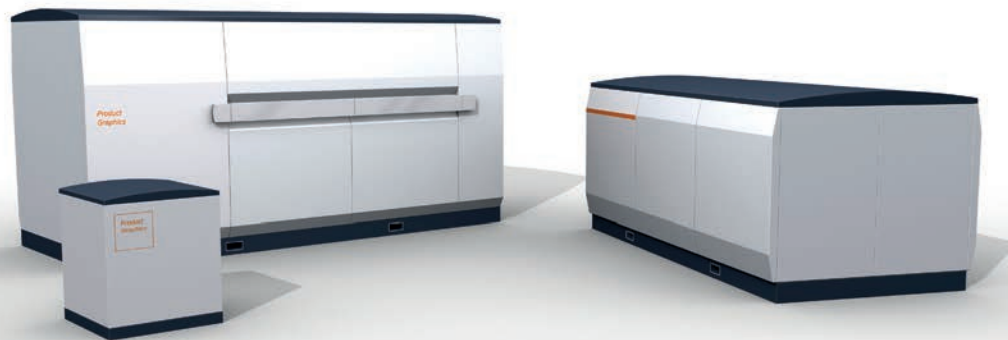
Stationary solid oxide fuel cell systems and applications offer clean, efficient and reliable heat and power generation. High electrical efficiency, flexible fuel selection and low emissions will provide customers operational flexibility, power security and environmental benefits. SOFC technology is well suited for distributed generation markets as well as back-up power applications. Various hydrocarbon fuels such as natural gas, LNG, agricultural biogases or landfill gases can be used. Markets for systems utilizing biogases and natural gas with high efficiency are worldwide and growing rapidly.

Power to People

Erkko Fontell, CEO, Convion Oy
www.convion.fi



The Convion Team is among the leading SOFC system developers. Convion people have extensive know-how in SOFC system development and operation. Four 20 kW and three 50 kW units have been developed and validated with over 15000 h cumulative operating hours on NG, BG and methanol. Convion will become a leading provider of sustainable and secure fuel cell solutions for customers in distributed power generation markets, including back-up power applications, by commercializing 50–300 kW products based on SOFC technology. Convion products can increase customer's energy efficiency by providing excellent electrical and total efficiency. High product reliability combined with grid flexibility increases customers power security. Convion products are suitable for various applications fuelled by natural gas and/or biogas.

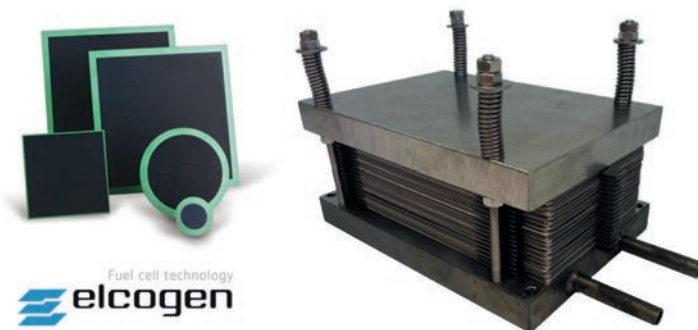


State of the art solid oxide fuel cell stacks

Matti Noponen, Development manager, Elcogen Oy
www.elcogen.com



Elcogen Oy is a solid oxide fuel cell stack manufacturer. Our first product is 500W stack optimized for combined heat and power applications (μ -CHP). The stack has an equal power density at 650 °C as our competitors have at least 100 °C higher temperatures. Reduced operating temperature enables the use of low cost material solutions both in the stack as well as in SOFC system components enabling better to meet customers' cost requirements. Development work has been done in close cooperation with VTT. The next target of Elcogen is to introduce 1 kW solid oxide fuel cell stack that will meet both the cost and durability targets of our customers. The vision of Elcogen is to become one of the leading solid oxide fuel cell stack providers worldwide. The target customers of Elcogen are solid oxide fuel cell and solid oxide electrolysis system integrators that concentrate on stationary applications.



SOFC systems research

Matias Halinen, Senior Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi



VTT has cutting-edge technological know-how, research tools and experimental infrastructure for SOFC related research work. A comprehensive set of simulation tools for SOFC system design, control and diagnosis as well as the actual hardware for SOFC systems has been developed. These tools and hardware have been utilized in practice by building a 10 kW SOFC system that uses natural gas as a fuel and produces electricity and heat to grid. Performance and technical feasibility of this system has been validated with long term experiments spanning several thousands of hours. In the future, the research focus is on improving the SOFC system reliability and controllability with advanced diagnosis tools, and to further simplify and optimize the system layout and hardware.



Transport, specialty vehicles and fuel cell hybrid solutions

Fuel cells are the most promising clean technology that can be used to power various vehicles. Commercialization of fuel cell vehicles by many leading car manufacturers is expected to boost the application of fuel cells in other transportation sectors as well. High efficiency electric drive trains combined with fuel cells in mobile machines and heavy vehicles reduce the fuel consumption and emissions. The need for zero emission, high efficiency electric powertrains in worldwide working machine industry is growing.

eSled – zero emission snowmobile

Tuomas Alakunnas,
Project Manager, Arctic Power
www.arcticpower.fi
www.esled.fi



Arctic Power has developed the world's first prototype of a fuel cell equipped electric snowmobile. The concept has been developed according to the needs of the tourism industry in Lapland and the benefits of electric snowmobile are zero emissions and silent operation. The main purpose is to operate emission-free snowmobile safaris. In the future, the goal is to get an extended driving range with fuel cell and help expanding the user segment.

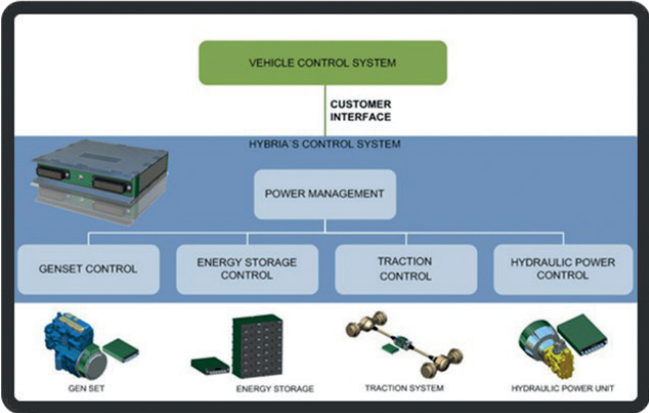


Excellence in electric drivelines

Teemu Lehmuspelto, CEO, Hybria Oy
www.hybria.fi



Hybria HE-mach and HE-bus power management is control software for hybrid electric machines and busses. It controls parallel and series hybrid systems as well as fully electric driven powertrains. Because of active power management, Hybria's HE-mach and HE-bus control software offers the best system efficiency with minimum system power reducing purchase cost of machine manufacturers, as well as operating cost of end users. The system is also independent from component suppliers, which enable Hybria's customers the freedom to choose any system component suitable their needs. In the future, Hybria will introduce preconfigured control systems to enable easy and cost efficient way to hybridize selected types of mobile work machines. With HE-mach and HE-bus power management Hybria's customers can integrate high quality hybrid applications from any components from different component suppliers, on any system voltage level and utilizing any type of electrical load and power source combinations. Hybria's target market is mobile machinery, buses, other heavy vehicles.



Electricity in Motion

Tommi Ristimäki, Manager, Marketing and Sales, Visedo Oy
www.visedo.com



Visedo PowerSERIES™ product family for high efficiency electric drive trains in mobile machinery and heavy vehicles is ready. The products are already available in the market in vehicles and machines built by Visedo customers as well as in use with major manufacturers developing next generation solutions. Visedo offers the highest efficiency electric drive trains on the market to heavy mobile machines and vehicles which has been designed to match the harsh conditions requirements in these applications. The products also have in-built intelligence and are very compact in size making them easy to integrate into existing vehicle designs. In the future, Visedo electric drive trains will be used in diesel-electric hybrid and zero emission mobile machines and heavy vehicles to reduce the fuel consumption and reduce the emissions. By the year 2016 Visedo is the preferred electrical drivetrain supplier for heavy mobile work machine applications with turnover exceeding 50 M€. Visedo target market is the mobile work machines, marine vessels and buses.

Optimal solution for fuel cell hybrid systems

Jari Ihonen, Principal Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi



In TopDrive -project, methods and solutions have been developed to optimize fuel cell hybrid drive trains in working machines. In the project the use of inexpensive low quality hydrogen was studied. The use of this enables more cost-efficient solutions. In the future, the target is to apply the knowledge when designing hybrid drive trains in new products of Finnish industry. When the cost of automotive PEFC systems is in acceptable level is at acceptable level, hybrid drive train knowledge can be applied in products. The target market is working machine industry.

Total Visedo® hybrid package

Full electric system including control software

- Energy storages
- Control inverters
- Electric motors
- Generators

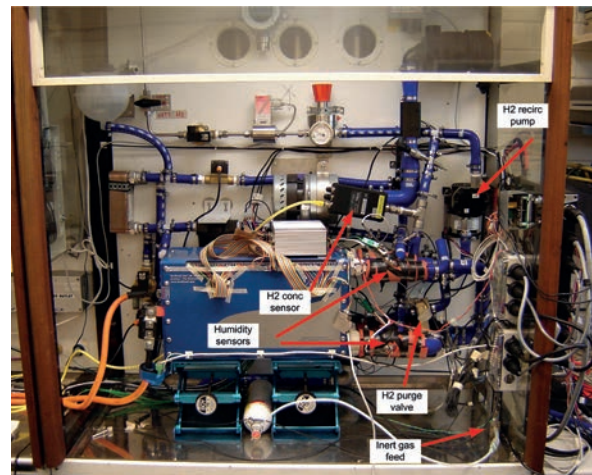
- Extremely high efficiency for total operating cycle
- Compact size
- Meeting the high power and torque demands in heavy vehicles and machines
- Long lifetime - designed for 20 years of operation
- Especially designed for harsh environment heavy duty mobile applications
- Full system approach - all necessary parts for conversion from traditional solutions including control software
- State-of-the-art technology based on our own patents and co-operation with high end technology partners

Grid connection converter product family development

Pekka Seppälä, CEO,
MSc Electronics Oy
<http://www.mscelectronics.fi/>



Small 1-500kW distributed and renewable energy sources such as solarcells, windturbines, wave power generators needs to be connected to the electricity distribution grid. These electrical energy sources produce either variable voltage (DC) or variable voltage and frequency (AC). MSc Electronics Oy develops converters to connect the variable voltage and/or frequency from the energy source to the fixed voltage and fixed frequency 1 or 3 phase standard grid.



Niche products: bio fuel cells and printed solutions

There is a growing need globally for small, cheap and green disposable power sources. Increasing consumer awareness favor ecological and functional solutions that are adaptable and that provide enough power output for demanding low power applications. Competitive edge comes from the environmentally friendly materials which makes the products disposable. Target market is initially in the field of cosmetics, medicine and logistics.



Battery assisted integrated solutions

Jouni Heinonen, Member of the Board, Enfucell Oy
www.enfucell.com



Enfucell has developed thin and flexible power source for disposable electronics solutions. The flexible power source is thin and highly adaptable to several integrated applications, and will be the main platform to build flexible and disposable integrated systems. Enfucell's main target is fast and profitable growth and the main market, the home market, is Europe.



The Sugar Battery

Mikael Bergelin, Senior Research Scientist,
Åbo Akademi University
(Project together with VTT,
Tampere University of Technology and
Aalto University)
www.abo.fi/pcc



In the project, the world's first fully printed Bio Fuel Cell has been created. The product is metal free and does not contain any components which would limit disposability. Additionally, it only becomes a battery when activated by the customer, which means that producing or selling it is not limited by the EU battery directive according to Finnish authorities. The battery construct is currently being

incorporated into a consumer product within the project COSPAD. In the future, the target is to find suitable low power demanding applications into which the battery can be incorporated, where the competitive edge through the benefit of disposability is clear. Initial target market is in the field of cosmetic patches, and secondary market within the field of medical patches.



Low power applications: backup power and portable solutions

Backup power requirements in many market segments such as telecom, data centers and authorities, are becoming more stringent. Current battery-based solutions can't meet many of the new requirements and diesel generators are too noisy and polluting. Fuel cells are becoming the economical solution in these markets with their reliable and efficient operation. The fuel cell backup power solutions have long service intervals, can operate on different types of fuels such as methanol-water mix or hydrogen, and are well suited for critical power backup applications. They can be used as backup power in case of grid failure or configured to operate completely independent of the electricity grid. Target market for fuel cell backup power applications are telecom, authorities and private operators who appreciate power security combined with low operating costs and environmental benefits.

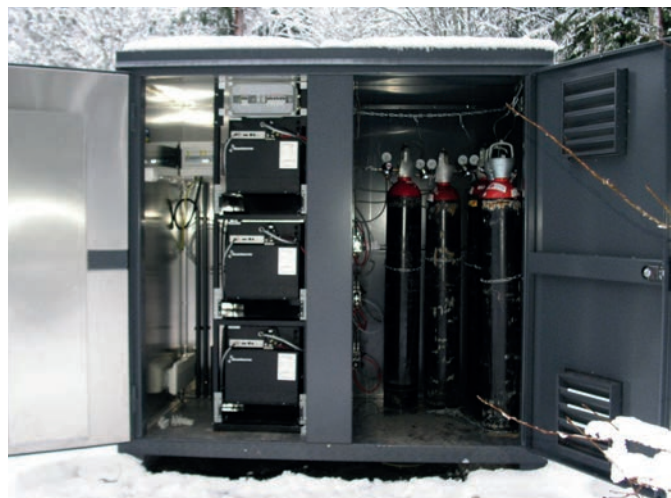
Flexible back-up

Teppo Korhonen, Managing Director, T Control Oy

www.tcontrol.fi



T Control's back-up power products have long period experience of reliability at cold and various climate. T Control Oy, in collaboration with Dantherm Power AS, has become known in Finland as reliable producer of back-up power solutions. The solution will be utilized in areas where long lasting back-up power is needed. The standard back-up power module or a tailored cabin is ready to be installed into customer sites. Service is needed only once in five years. The reliable and proven system is easy to monitor and provides power security to the customer. The large and growing target market is telecommunication, TETRA, Bluelight and customers who need back-up power in range of 1,7–10 kW. The design of the system can be tailored to local customer needs.



Protected movable energy system for telecommunication

Markku Valkealahti, CEO, Fitelnet Oy
www.fitelnet.fi



Fitelnet Oy has completed the tests of Methanol Fuel Cell's features and use in small, 350-watt units. The product uses methanol-water mixture (60/40) as a fuel that can tolerate very critical environmental conditions. The shelf life, transport and storage properties are the basis for logistics operative, a perennial of the total solution. The fuel cell unit size and power class is flexibly adaptive, simple to use and need minimal amount of maintaining measures. In the future, the target is to produce dimensioned units for energy applications for fixed and portable use in power range from 350 W to 10 kW. The target market is authorities and private operators, whose interest is to make use of green energy for their operations and maintenance, and who appreciate the availability and total logistics solution provided by the new energy unit.



Fuels: Hydrogen, biogas and hydrogen infrastructure

Global expectations for hydrogen and biogas are currently high. Transport applications stand at the threshold of commercialisation, while ahead lies an investment boom in the hydrogen distribution network. If hydrogen could be produced from domestic renewable raw material, our car and bus traffic would eventually be self-sufficient and leave a significantly reduced carbon footprint. Biogas is a renewable source of energy that can be used in transport applications or in heat and power production in solid oxide fuel cells (SOFC). Biogas can also be reformed to hydrogen in a steam reformer.



Domestic bio hydrogen fuel for emission free mobility in Finland

Jussi Solin, Principal Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi



In the project, a roadmap to emission free hydrogen society for Finland has been drafted. Bioenergy is dominating the Finnish renewable energy market and biomass offers also a potential source for renewable hydrogen. Hydrogen refueling stations and forest biomass based hydrogen production have been identified as technologies with export potential. The project recommendations will be used as input for long term national energy and climate policies. Technologies with global market potential are to be developed.

Hydrogen refueling

Kalevi Korjala, CEO, Oy Woikoski Ab
www.woikoski.fi



Woikoski has developed and manufactured a high pressure hydrogen refueling station for fuel cell vehicles. The refueling station is an environmentally friendly solution that includes innovative own technology. Being the oldest gas company in Finland, Oy Woikoski Ab has been producing hydrogen for over 100 years and is now mostly focused on hydrogen. In the future, Woikoski will continue the development and deployment of hydrogen refueling stations in Finland and worldwide. The target market is fuel cell vehicles that will be introduced to large consumer markets by 2015. Woikoski is utilizing the by-product hydrogen from the various chemical plants in Finland. Woikoski is also investing 2014 to a new innovative hydrogen plant which produces 100...150kg/h of fuel cell purity hydrogen.

Towards a cleaner tomorrow with natural gas

Sari Siitonen, Technology Manager, Gasum Oy
www.gasum.fi



Gasum supplies natural gas and upgraded biogas to its customers. Gas is transported and distributed via the underground gas network to the gas consumers. Natural gas and biogas can be used as fuels in the solid oxide fuel cells (SOFC). Natural gas can also be reformed to hydrogen in the steam reformer. A small quantity of hydrogen could be mixed and distributed with natural gas in the existing network.



Sustainable use of Earth's natural resources

Ilkka Kojo, Vice President – Environment & Sustainability,
Outotec Oyj
www.outotec.com



During the project, a five-cell laboratory scale electrolyzer facility was built, and the depolarization effect of sulfur dioxide in hydrogen electrolysis was tested. The required characteristics of the electrode materials were confirmed, and a catalyst for the anodic cell reaction, the oxidation of sulfur dioxide to sulfuric acid, was identified. The process aims for a solution that produces hydrogen more economically than the competing solutions. The process idea is based on an open cycle between hydrogen electrolysis and a sulfuric acid plant. The process operates at much lower temperatures than the high-temperature stage of sulfuric acid decomposition which is needed in thermochemical cycles. In the near future, a techno-economic feasibility study of the process will be made within the company. This means the evaluation of the whole process chain including the SO₂ depolarized electrolyzer as a part of the process. The know-how obtained in the development project may be applied also to other processes which can utilize the SO₂ depolarization effect. The potential target market of the future includes metallurgical plants producing sulfur dioxide.

Breakthroughs in basic research, material development and demonstrations

Demonstrations of fuel cells in action will increase public awareness of the benefits of fuel cell technologies and convince decision makers and end users of their safety, reliability and effectiveness. Long-term demonstrations give companies a chance to test and market their products in a real working environment. Sharing the information efficiently to the public will answer to customer needs and help in commercialization of the products. Feedback and experience from demonstrations are important for end-users in assessing the energy efficiency and environmental benefits of fuel cells.

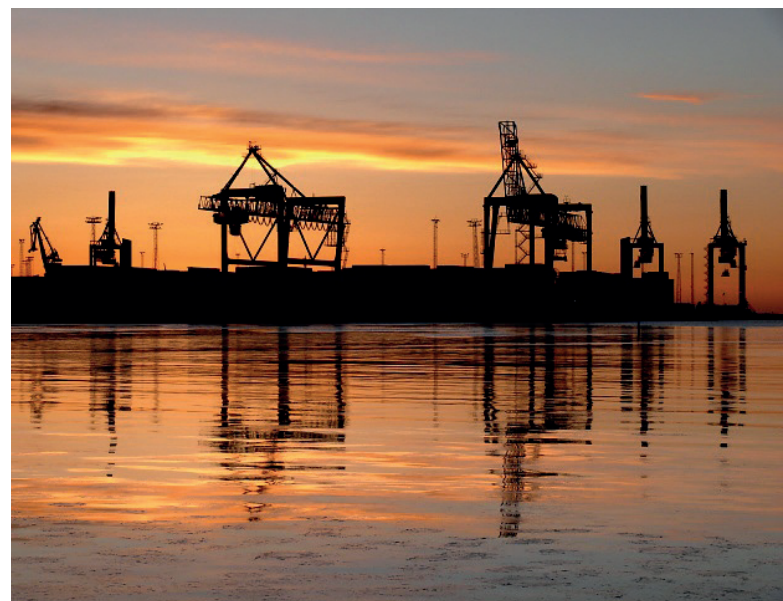
There is a need to develop cheaper, more durable and more efficient materials for fuel cells for international markets. This development includes adding new features as well as integrating the functionalities of existing ones. These improvements will enable fuel cells to get closer to commercial markets.

Demo2013 – from know-how to show-how

Anneli Ojapalo, Project Manager, Demo2013

<http://www.teknologiateollisuus.fi/fi/ryhmat-ja-yhdistykset/demo2013.html>

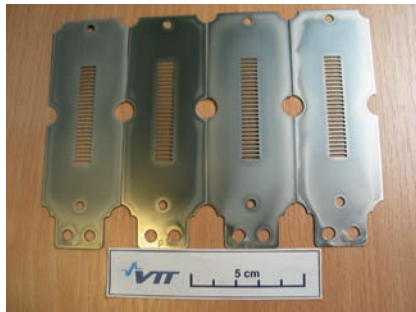
This large-scale demonstration of fuel cells in action will also increase public awareness of the benefits of fuel cell technologies. Demo2013 will spotlight the reliability, safety and energy efficiency of fuel cells, as well as their clear environmental benefits. This demonstration facility for fuel cell solutions and applications will be located in and around the new port facilities at Vuosaari, on the outskirts of Helsinki. Port facilities can play a pioneering role in promoting green technologies. Demonstrating fuel cell applications in a real harbour environment is an excellent way to publicise their benefits and make decision-makers more aware of their potential.



Improved materials and components for the PEM fuel cell industry

Pertti Kauranen, Chief Research Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi

In Marapoke-project, stainless steel coatings and graphite compounds as well as in-situ test methods for the coatings have been developed for PEMFC bipolar plates. The graphite compound is injection moldable and stable at temperatures up to 200 °C. Cost effective electroplating is used for the steel coatings. In the future, the test method is offered as a service to the industry and the target is to seek industrial partners to bring the technologies into the market. The target market for steel coatings are low temperature PEMFC applications and for the graphite compounds high temperature PEMFC applications.



Safety of fuel cell applications

Minna Nissilä, Senior Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi

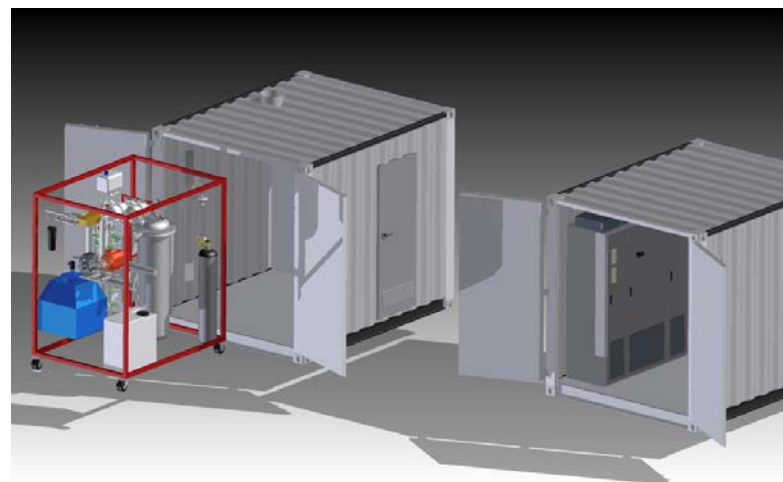
In addition to technical and economic competitiveness, also public acceptability affects the introduction of fuel cell applications into the market. To achieve public acceptance safety and reliability of fuel cell applications and use of hydrogen must be ensured as well as possible. Increasing number of manu-

facturers and those placing fuel cell applications on the market will need information and guidance on the regulations and requirements concerning safety and conformity of the applications. The project gives an overview of safety requirements in EU-regulations and in Finland's national regulations. Also the standards concerning safety of fuel cells and hydrogen fuelling stations are studied. Results are published as VTT report.

DuraDemo

Timo Keränen, Research Scientist,
VTT Technical Research Centre of Finland
www.vtt.fi

One of the main results of DuraDemo-project is the 50kW stationary PEMFC pilot plant utilizing by-product hydrogen from process industry. The system concept has been designed and its performance will be confirmed by a 5000 hour field experiment at Kemira Chemicals site in Äetsä during the project. The pilot plant offers a platform for experimental studying the PEMFC technology, produces valuable data about system performance and allows testing different system level solutions from component and layout design to diagnosis and control. In the future, the commercial product can be utilized by a wide range of end-users running processes where hydrogen is produced as a by-product. Market potential in Finland is considerable and also international markets need to be considered. The emerging power-to-gas market for storing energy from renewables to hydrogen is also an option worth considering for stationary PEMFC systems.



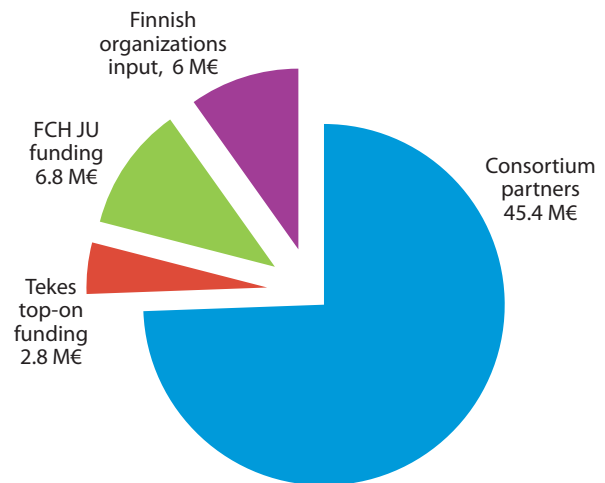
International cooperation

- 17 FCH JU projects with total budget of 61 million euros
- Two ERA-NET HYCO projects with total budget of 1,5 million euros
- Five FP6 and one LIFE projects with total budget of 53 million euros
- Total budget of 17 FCH JU, two ERA-NET HYCO, five FP6 and one LIFE project is 116 million euros

Impacts of international funding

- Leveraging the Finnish funding investments to gain access to the top results of large consortiums
- Access to European research & industry networks and value chains
- Competence building in Finnish fuel cell and hydrogen industry
- Building world class testing facilities and know-how
- Strengthen the Finnish footprint in European fuel cells and hydrogen platform
- Creating future international business for Finnish organizations

17 FCH JU projects – access to results worth of 61 M€



Finnish research projects in FCH JU

Stationary fuel cell applications, system integration and component development

- Anode Subsystem Development & Optimization for SOFC
- Generic diagnosis instrument for SOFC systems
- Cathode Subsystem Development and Optimisation
- Degradation Signatures identification for stack operation diagnostics
- Solid Oxide Fuel Cells – Integrating Degradation Effects into Lifetime Prediction Models
- SOFC CCHP with poly-fuel
- Innovative cell and stack design for stationary industrial applications using novel laser processing techniques
- Integrated low temperature methanol steam reforming and high temperature PEM fuel cell
- Steel coatings for reducing degradation in SOFC

Low power applications, bio fuel cells and printed solutions

- In-situ H₂ supply technology for micro fuel cells powering mobile electronics appliances

Wild cards, breakthroughs in basic research and material development

- Primolyzer
- Evaluating the Performance of Fuel Cells in European Energy Supply Grids
- Material testing and design recommendations for components exposed to hydrogen enhanced fatigue
- Alhaisen platinapitoisuuden kehittyneet katalyyttirakenteet autoteollisuuden polttokennoihin

Hydrogen and hydrogen infrastructure

- Pressurized PEM electrolyzer stack
- Hydrogen fuel Quality requirements for transportation and other energy applications
- Sun-hydrogen hybrid cyclesz

Project portfolio and funding

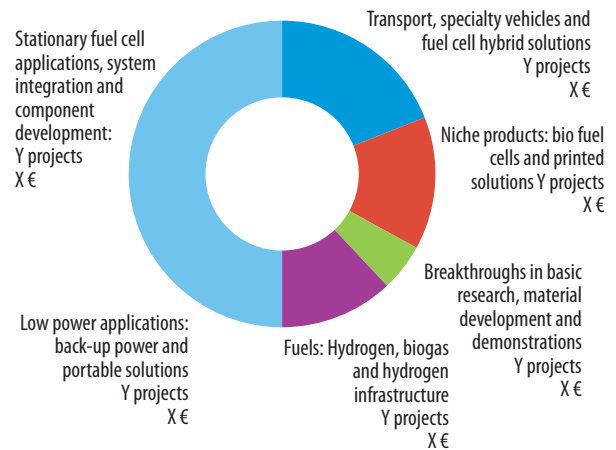
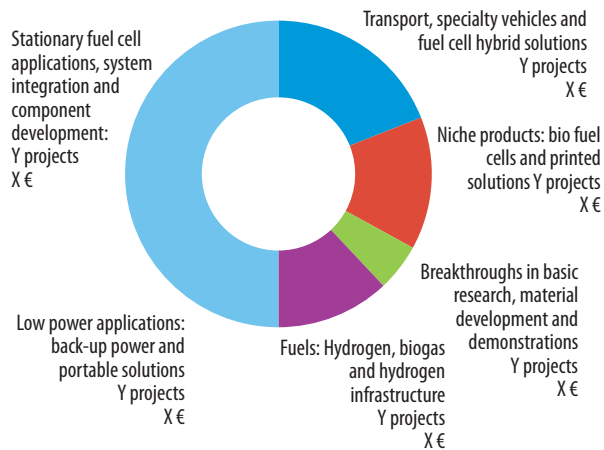
Programme duration	Funding of different core areas
2007–2013, total volume 100 million euros	
Calls	

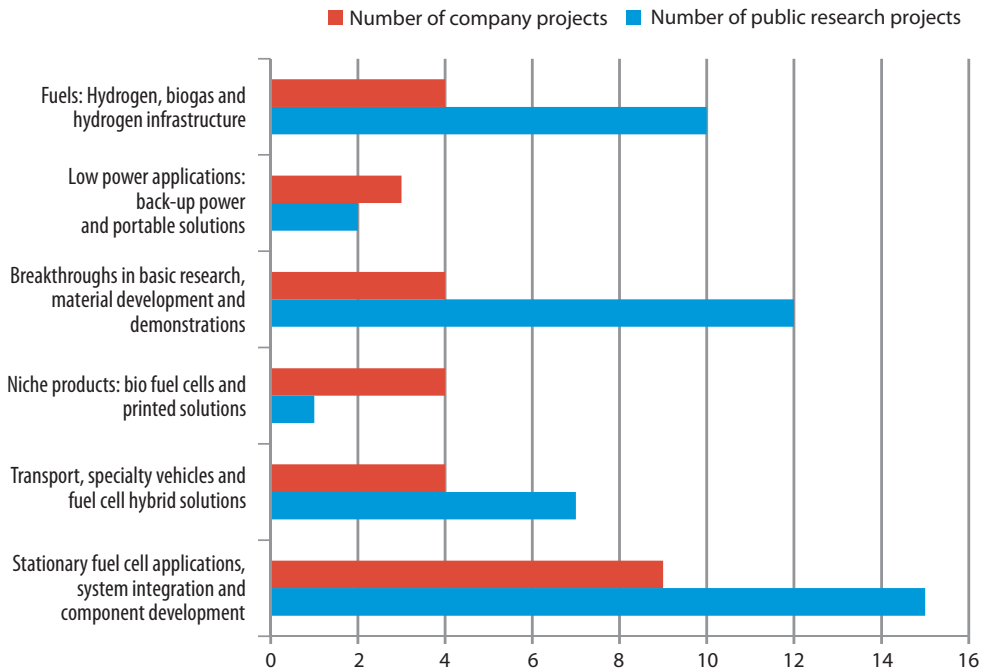
Tekes funding to research organisations:

X projects
 Tekes X M€
 Volume X M€

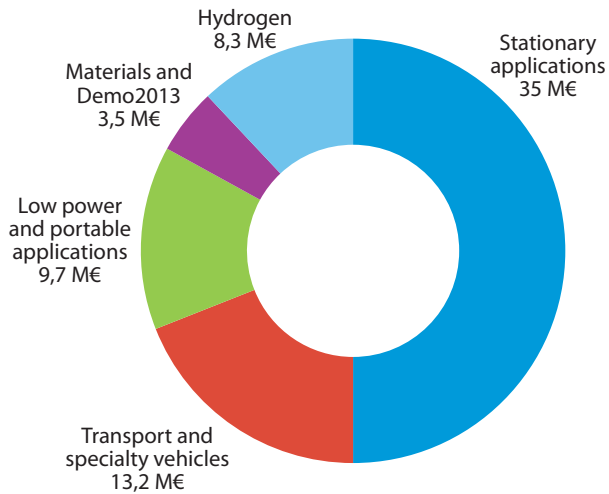
Tekes funding to companies:

X projects
 Tekes X M€
 Volume X M€

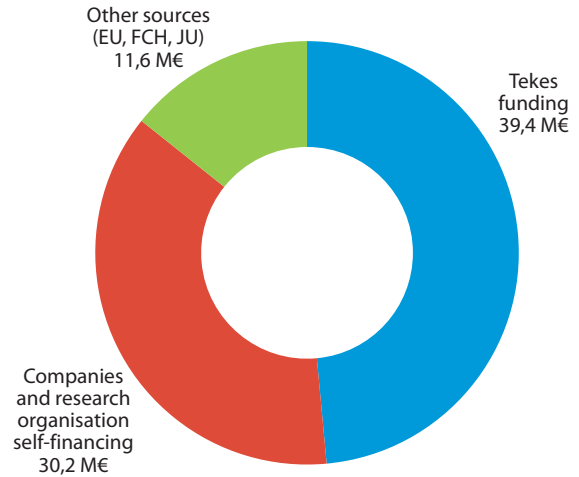




Tekes funding in core areas, M€



Shares in the total funding of the Fuel Cell Programme, M€



The Tekes Fuel Cell programme facilitated the development of successful fuel cell and hydrogen technologies and services for the programme period 2007–2013. The programme helped to create viable new businesses and business models, by bringing together key players along the fuel cell value chain. The programme speeded the development and application of innovative fuel cell technologies. More than 70 projects were successfully completed and more than 60 companies were involved in the programme.

Some of the organisations that participated Tekes Fuel Cell Programme 2007–2013 are introduced in this brochure

Arctic Power
Convion Oy
Elcogen Oy
Fitelnet Oy
Gasum Oy
Hybria Oy
MSc Electronics Oy
Outotec Oyj
T Control Oy
The Federation of Finnish Technology Industries
Visedo Oy
VTT Technical Research Centre of Finland
Woikoski Oy Ab

Tekes, the Finnish Agency for Technology and Innovation is the main public funding organisation for research and development and innovation in Finland. www.tekes.fi

Tekes

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