

## Fuel Cell Specialty Vehicles











Mfr.	Vehicle	Partners	Year Shown	Fuel Cell Size/Type	Range	Max. Speed	Fuel/Storage Type	Commercialization Plans	Picture
Aerovironment	Helios – unmanned aerial vehicle	NASA Dryden Flight Research Center	2003	10-25kW PEM	250 miles	17-27 m	2 compressed hydrogen tanks	Destroyed in crash in 2003, fuel cell not responsible	
	Global Observer		May 2005	N/A			Liquid hydrogen	Mission applications include communications relay & remote sensing payloads for military or commercial customers.	
	Puma	Protonex, U.S. Air Force Research Laboratory, the Naval Research Laboratory	2007	1000 W	9+ hours		Metal hydride on-board hydrogen storage	First shown in 2007, in 2008 beat its own record twice – first flying 7 hours and then 9 hours	
Anuvu, Inc.	Fuel cell boat	Millennium Cell, Duffy Electric Boats, Seaworthy Systems	2003	4 1.5 kW PEM	N/a	N/a	Hydrogen from sodium borohydride	18 passenger boat was tested in San Francisco Bay.	
Asia Pacific Fuel Cell Technologies (APFCT)	ZES V.b		2008	PEM fuel cell/Lithium-Ion Battery hybrid	80 km	60 km/h	Metal hydride on-board hydrogen storage	Takes less than 1 minute to refuel	
	ZES IV		September 2003	APFCT 2 kW/PEM	60 km	35 km/h	Metal hydride on-board hydrogen storage	APFCT, DuPont Fuel Cells and DuPont Taiwan	
	ZES III		July 2002	5 kW PEM	120 km	58 km/h	Metal hydride on-board hydrogen storage	Plans to introduce in the European market, ZES II introduced in 2000.	
Astris Energi	Freedom golf cart		2001	1 kW Alkaline	8-10 hours	19 mph/31 km/h	Compressed hydrogen gas		
Besel S.A.	Wheelchair	MEYRA, ONCE	2003	PEM	N/a	N/a	Metal hydride on-board hydrogen storage		
	Scooter	Derbi	Project went from January 2003 – October 2004	PEM	N/a	N/a	Metal hydride on-board hydrogen storage		
Cellex Power Products	Forklift	BOC, Wal-Mart	2004	Cellex PEM	N/a	N/a	Compressed hydrogen	Wal-Mart is participating in field trials	
Coval H2 Partners	Utility truck	Shell hydrogen, UK government, City of Westminster	1999	Zevco alkaline fuel cell		100 km/h	Compressed hydrogen	28 Nm <sup>3</sup> CGH stored in tank outside and on top of the cab. Range of 200 km. City of Westminster parks maintenance van.	

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Deere & Company	Commercial Work Vehicle (CWV)	Hydrogenics	2005	Hydrogenics HyPM 20 kW Power Module	6 hours	40+ km/h	Direct hydrogen		
	Pro-Gator™	Hydrogenics, Dynatek	2003	Hydrogenics 20 kW	4 hours	50 km/h	Compressed hydrogen	Entered into 5-year agreement with Hydrogenics. No immediate plans to commercialize.	
Deutsches Zentrum für Luft-und Raumfahrt e.V.	HyFish	Team SmartFish, DruKon, Luxfer, BaltiCo, Horizon Fuel Cell Technologies, Technikzentrum Ainet, LTB-Borowski	March, 2007	Horizon Fuel Cell	N/a	200 km/h	Compressed hydrogen	A successful first flight was carried out in March 2007.	
ECN	FRESCO scooter	Piaggio & C SpA, Selin Sistemi SpA and Commissariat a l'Energie Atomique	2004	12 kW PEM	100 km goal	75 km/h goal	Hydrogen	Project ended November 2004	
EIVD/MW-Line	Hydroxy 3000	Paul Scherrer Institute (PSI)	2003	3 kW/PEM	160 km	10- 15 mph	Compressed hydrogen@200bar	Switzerland's first family leisure fuel cell boat, had several versions before	
FAAM	Camaleo Hydrogen bicycle	Beijing Fuyuan	2003	400 W PEM	90 km	N/a	Metal hydride on-board hydrogen storage		
FASTec/ATP	Fuel cell-powered electric plane	UQM Technologies, NASA, American Ghiles Aircraft, Giner Electrochemical Systems, Satcon Technology Corp., Diamond Aircraft, Analytic Energy Systems, Lockwood Aviation, Lynntech	July 2001	Phase 2 – 25kW Phase 3 – 75 kW	Phase 2 – 250 mi Phase 3 – 500 mi	230mph at sea level	On-board hydrogen	First fuel cell flight in 2005	
From Concept to Car	H-ergo Piemonte Personal Mobility Vehicle	From Concept to Car is a consortium of Italian auto part makers, government agencies & universities	2009	Politecnico di Torino and HySyLab developed the fuel cell	2 hours	12/4 mph (20 km/h)	Hydrogen	No info available on commercialization plans for this fuel cell-powered wheelchair	
Fuyuan Fuel Cell Company	Golf cart concept vehicle		2002	2.5 kW PEM	500 km	80 km/h	Ammonia		
Georgia Institute of Technology	Unmanned Aerial Vehicle	Georgia Institute of Technology, NASA, FC/BT	September 2006	500 W PEM	N/a	N/a	Hydrogen	Flew for 22 minutes	
H2 Logic ApS	H2 Truck	A. Flensburg - Herning A/S	2005	PEM hybrid fuel cell system	N/a	15 km/hr (9.3 mph)	Low pressure hydride storage	Includes an H2 Filling Station where the replaceable H2 Canisters inside the H2 Truck can be refilled with hydrogen. Operating time of 4 hours continuously.	
HaveBlue LLC	X/V-1 Sailboat	Texaco Ovonic Hydrogen Systems, Hydrogenics, Catalina Yachts	2004	Hydrogenics 10 kW PEM	N/a	N/a	Metal hydride on-board hydrogen storage	Public demonstrations in 2004.	

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Honda	Fuel cell scooter		2004	Honda fuel cell stack	N/a	N/a	Hydrogen	Based on a 125cc scooter	
Horizon Fuel Cell Technologies	HMX – Hydrogen Mobility X-tender bike	N/a	2008	PEM fuel cell	300 km 190 mi	25 km/h	Metal hydride on-board hydrogen storage	300 km pedal assisted range	
Howaldtswerke-Deutsche Werft AG (HDW)	U 33 Class 212 A submarine	Germany Navy – now other Navies are placing orders	2002	Siemens 300kW fuel cell	N/a	N/a	N/a	January 2006	
Hydrogenics	GEM hybrid mini-car	GEM	TBD	Hydrogenics 5 kW HyPM	N/a	N/a	Hydrogen	Demonstrator vehicle	
	Airport tow tractor	U.S. DoD, FCTec	TBD	65kW	N/a	N/a	N/a	Will be used in fuel cell demonstrations at select Air Force Bases and civil airports in the USA	
	Forklift	Deere & Company, FedEx Canada, General Motors of Canada, HERA Hydrogen Storage Systems, NACCO Materials Handling Group and City of Toronto	2004	10 KW	N/a	N/a	Direct Hydrogen, On-board hydrogen storage	Numerous demonstrations at GM, FedEx and other locations.	
Intelligent Energy	ENV - fuel cell motorbike	Seymourpowell	2005	1 kW Intelligent Energy CORE PEM	100 miles	50 mph	High pressure composite cylinder		
Iwatani Corp.	Fuel Cell Electric-Assisted Bicycle		2008	300W	N/a	N/a	N/a		
Kurimoto, Ltd	Fuel cell cart II		2007	250W/PEM & Li-on battery	250W/PEM	3.7mph 6km/h	H2 storage 190g/4 canisters	Can run continuously for 5 hours/30km	
	Fuel cell wheelchair	APFCT	Four versions released between 2003 - 2006	APFCT 250W/PEM & Li-on battery	APFCT 250W/PEM	3.7mph 6km/h	Pure Hydrogen @150psi / H2 storage 180g/4 canisters	Can run continuously for 10 hours/60 km	
Los Alamos National Laboratory (LANL)	Personal mobility vehicle	Ergenics	2003	140W/PEM	50 miles	5 mph	Metal hydride on-board hydrogen storage		
Manhattan Scientifics	Fuel cell Segway	U.S. Army ERDC/CERL, FCTec, Concurrent Technologies Corporation	November 2003	700 W/PEM	Range should double	12- 17 mph	Compressed hydrogen (2-liter)		
	Mojito FC scooter	Aprilia s.P.a.	2002	NovArs 3 kW PEM	100 km	55 km/h	Hydrogen		

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	Enjoy FC Bicycle	Aprilia s.P.a.	2001	600 W/PEM	43 miles	20 mph	Compressed hydrogen (2-liter tanks)		
	Hydrocycle™	Aprilia s.P.a.	December 2000	NovArs 670 W PEM	100 km	30 km/h	Compressed hydrogen (2-liter tanks)		
Masterflex AG	Cargobike		2007	Masterflex 250W/PEM	250 km	6km/h (3.7mph)	90 grams of hydrogen storage	Already being sold to industrial customers and at least 40 Cargobikes will be deployed in four regions in Europe as part of the HyChain-MINITRANS project over the next two years.	
	Fuel cell bike	Veloform	2004	Masterflex 250W/PEM	120 km		Metal hydride stored hydrogen (45 grams)	2005 Masterflex also signed agreement with Swizzbee AG for fuel cell bikes.	
MES-DEA	Aprilia Atlantic Zero Emission fuel cell scooter	Aprilia	2004	Two 3kW fuel cells	140 km (87 miles)	85km/h (53 mph)	Hydrogen		
MTU Friedrichshafen	"No. 1" Yacht	Ballard Power Systems	2003	CoolCell™ 4.8 kW/PEM	225 km	6 km/h	Hydrogen	Demonstrated on Lake Constance	
New Holland	NH2 fuel cell tractor	Iveco	2009	N/a	N/a	N/a	Hydrogen @ 350 bar	Carries enough fuel to operate 1.5-2 hrs. Shown at Turin, Italy in Jan. 2009. Production planned in 2013.	
Palcan Fuel Cells Ltd.	Scooter	MOU with Celco Profil S.R.L.	June 2003	2 kW PEM	N/a	45km/h	Metal hydride on-board hydrogen storage	Commissioned by University of Victoria to prepare and supply two scooters for comparative research purposes – one will be a fuel cell scooter.	
	E-bike	Yamaha	May 2002	500 W PEM	N/a	20mph	Metal hydride on-board hydrogen storage		
PEM Technologies, Inc.	PemPower-04 3-wheel motorcycle		June 2003	1 kW PEM	50 km	30 km/h	N/a		
	PemPower-03 2-wheel motorcycle		January 2003	1 KW PEM	50 km	30 km/h	N/a		
Peugeot	Quark concept vehicle	MES-DEA	2004	1.5 kW MES-DEA PEM	100km (60mi)	110 km/h	Compress. hydrogen		
Powerzinc Electric	Motorcycle		2003	Zinc-Air fuel cell (ZAFC)	250 km	70 km/h	Zinc oxide		

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	Scooter		2003	ZAFC	150 km	30 km/h	Zinc oxide		
	Fuel cell/electric bicycle	Shanghai Green Light Electric Bicycle	2002	ZAFC	200 km	20 km/h	Zinc oxide		
Proton Motor Fuel Cell	ZemShip (Zero Emission Ship)		2008	Two 48kW PEM fuel cells	N/a	14 km/h	50 kg gaseous hydrogen	Operates in Hamburg, Germany and can hold 100 passengers	
	Fuel cell lift truck	Linde and STILL	2004	PEM	8 hours	N/a	Hydrogen	Undergoing field trials at Munich Airport	
Quantum Fuel Systems Technologies	Quantum AMV "Aggressor"	U.S. Army TARDEC	2004	10 kW PEM		80 mph	Compressed hydrogen/ impact resistant carbon fiber storage tanks	Will be tested at different military bases for a period of six months.	
Research Centre Jülich	JuMOVE fuel cell electric vehicle	Ministry for Science and Research of the Federal State of North Rhine-Westphalia	2004	DMFC 1.3 kW	120 km	N/a	Methanol	Successfully completed road trials. Still being tested.	
Shanghai Pearl Hydrogen Power Source Technology Ltd.	Fuel cell moped		2008	PEM	70-80 km	15 mph	Metal hydride on-board hydrogen storage		
Shen Li High Tech	Fuel cell tourist cart			10 kW PEM			Low pressure hydrogen	Seats 11 passengers	
	Fuel cell tourist cart		2004	PEM					
Siemens/KWU	Forklift		1999	10 kW/PEM	8 hours	N/a	Hydrogen		
Suzuki	Crosscage Motorbike concept	Intelligent Energy	2007	PEM	N/a	N/a	Hydrogen	Introduced at Tokyo Motor Show	
	MIO Wheelchair		2006	DMFC	25 miles	N/a	Methanol solution		
Taigene	Scooter	APFCT, Japan Steel Works (JSW)	2007	PEM	100km @ 30km/h	60km/h	Hydrogen	A full demonstration project of 20 scooters will begin in April 2007 in a science park.	
Toyota Industries Corp.	Forklift	Toyota Motor Corp.	Oct. 2005	30 kW/PEM	N/a	18 km/h	Hydrogen	Toyota developed fuel cell stack	

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Tropical S.A.	Fuel cell scooter		August 2008	500W/PEM	150km		Metal hydride on-board hydrogen storage	Delivered to Center for Renewable Energy Sources in Athens, Greece	
University of Tasmania	Fuel cell scooter	Technical University of Nuremburg, Germany	2004	PEM fuel cell	N/a	N/a	Metal hydride on-board hydrogen storage		
U.S. Naval Research Laboratory	Unmanned Aerial Vehicle, "Spider-Lion"	Protonex Technology Corporation	November 2005	100 W Protonex fuel cell			Compressed Hydrogen	Long-term goal is development of an efficient fuel-cell propulsion system for long-endurance (8-24 h) mini-UAV applications.	
Vectrix		Parker Hannifin, Protonex and NGen	November 2004	500 W DMFC	240 km	100 km/hr	Methanol		
	Fuel cell/electric hybrid scooter	Parker Hannifin, Giner Electrochemical Systems, GP Batteries, Methanex, Robradly Design	November 2003	800 W DMFC	250 km @ 40 km/h	100 km/h	Methanol		
Vehicle Projects, LLC	Mine locomotive	Nuvera	2002	Two Nuvera 17kW PEM	8.5 hours	N/a	Metal hydride	Also working on Army locomotive	
	Mine loader	Nuvera, Modine Manufacturing Company, HERA Hydrogen Storage Systems, Caterpillar, U.S. DOE, UQM Technologies, Natural Resources Canada	2004	Nuvera 160kW/ battery	N/a	N/a	Metal hydride	Expected to be placed in demonstration at a mine in Nevada in early 2005	
Veloform	3-wheel electric bicycle	SFC Smart Fuel Cell AG	October 2006	EFOY DMFC	N/a	N/a	Methanol		
Yamaha Motor Company	FC-Dii		November 2007	1kW DMFC	N/a	N/a	Methanol		
	FC-AQEL		2006	PEM	N/a	N/a	Compressed hydrogen gas		
Yamaha Motor Company	Fuel cell motorcycle	Yuasa Corporation	September 2003	500W DMFC	200 km	40 km/h	Methanol stored in 4-liter tank	Road-testing	