Fuel Cell Workshop

Wasserstoff und Brennstoffzellen

E.V.A. / bmvit Workshop

Wien,31.3.-1.4.2004

„Stand Alone

Photovoltaic Fuel Cell Hybrid Systems“

Ewald Wahlmüller, Fronius International GmbH

Heinrich Wilk, Energie AG Oberösterreich

Photovoltaic/Fuel Cell Hybrid Remote Power System

WILK, EU, 24.7.2003 Foto: www.dfrc.nasa.gov/gallery/photo/helios

HELIOS, NASA

62.120 solar cells
35 kWp, eta=18,4 %
PEM FC, H2 storage
14 engines, 2 hp each
v_{max}=23 mph
wing span 247 ft, 63 m
mass: 1600 pounds

$Alt._{max}$ = 96.863 ft
August 2001

Photovoltaic/Fuel Cell Hybrid Remote Power System

Polar Observer

a technological igloo drifting on the ice

Jean Louis Etienne

10 PV modules 75 Wp each

Axane PEM FC operated with H2

WILK, 12.3.2004 Foto: www.jeanlouisetienne.com

ENERGIE AG

Photovoltaic/Fuel Cell Hybrid Remote Power System

Redwood National Park, CA

Radio-telephone repeater

PV:780Wp, 24V Battery 1200Ah

FC: 100 W PEM/H2 (32 cells)

WILK 12.3.2004 Foto: Schatz Energy Research Centre, California

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Photovoltaic/Fuel Cell Hybrid Remote Power System

PV Hybrid system
with fuel cell back up,
hydrogen powered PEM fuel cell

Applications:
- telecommunications
- power supply for autonomous GSM repeater station
- Data logger

WILK 12.3.2004 Foto: T-Mobile, PV Hybrid (Gasgenererator) für GSM Repeater

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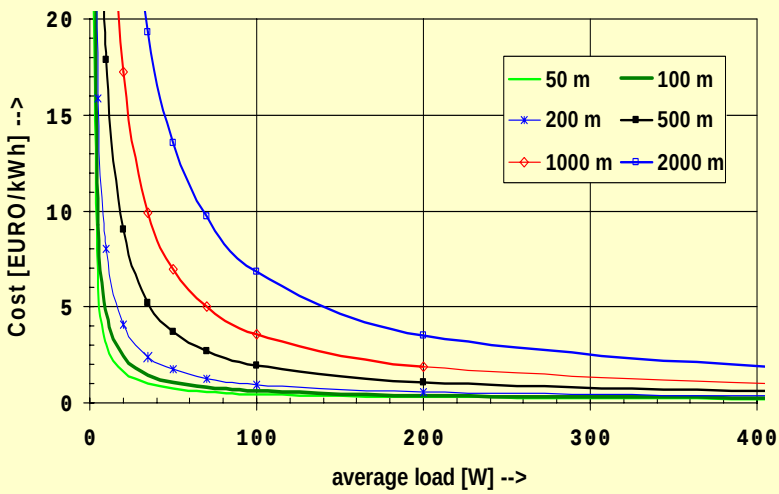
Electricity Cost Grid extension with 0,4 kV - cable



WILK 12.3.2004

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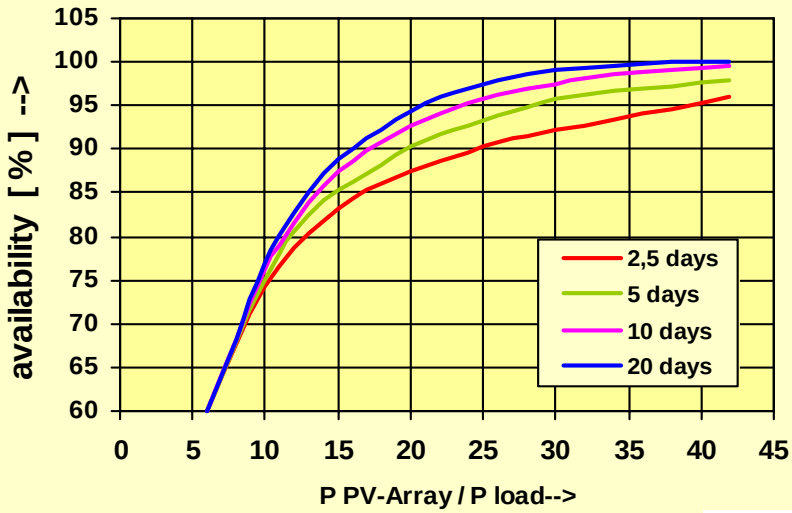
Stand alone Photovoltaic Systems



WILK, 12.3.2004 Data: TRY 9, Munich, simulation for a complete year

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Auxilliary Generators for Hybrid Applications

Options for back up:

Fuel Cell, $h_{el.}$ = 45 %

Motor Generator operated with
- Gasoline
- Diesel
- Propane

$h_{el.}$ = 10 to 20 %

WILK 12.3.2004

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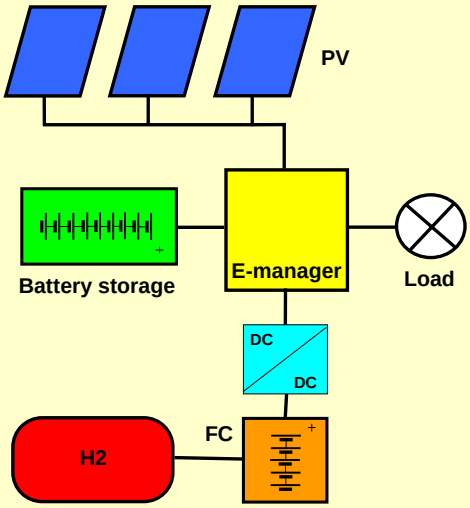
Photovoltaic/Fuel Cell Hybrid Remote Power System



Energy management system

PV-charge controller

FC-controller

FC Temperature management

Alarm, Datalogger

Load control

DC/DC-Converter

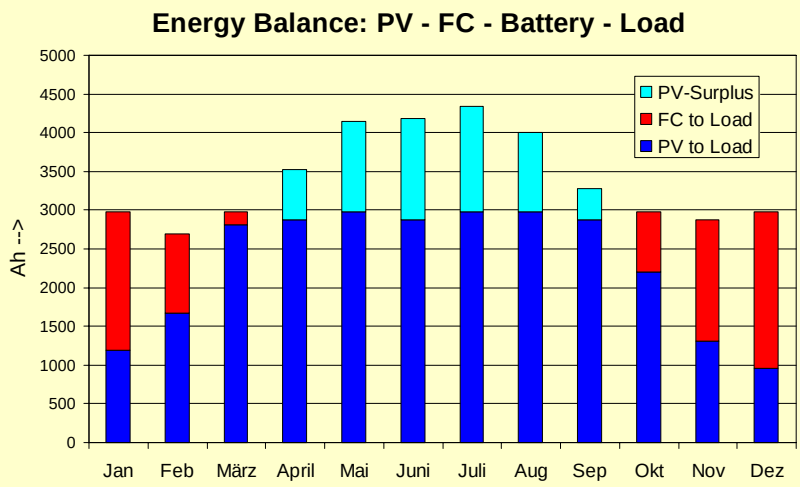
Step down converter

FC->Battery

WILK 12.3.2004

ENERGIE AG

Photovoltaic/Fuel Cell Hybrid Remote Power System



WILK 12.3.2004 P Load=100 W, P PV=1300 Wp, Battery 24 V, Weatherdata Linz

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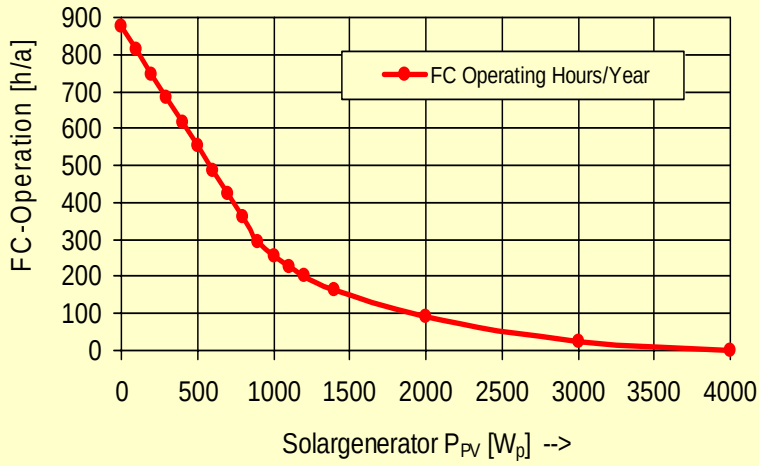
Photovoltaic/Fuel Cell Hybrid Remote Power System

FC-Operation hours as f(P_{PV}) Load=100 W



WILK 12.3.2004 FC: Nexa 1,2 kW, 26 V, 46 A, Weatherdata: Linz

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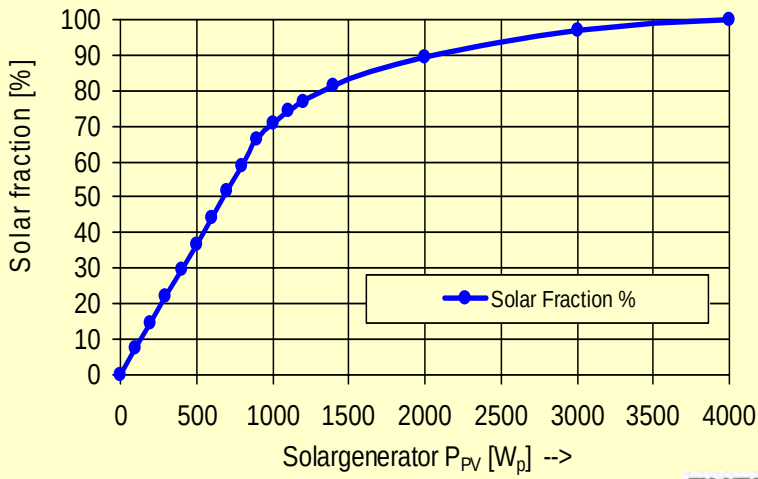
Photovoltaic/Fuel Cell Hybrid Remote Power System

Solar fraction of load current , Load=100 W



WILK 12.3.2004 FC: Nexa 1,2 kW, 26 V, 46 A, Weatherdata: Linz

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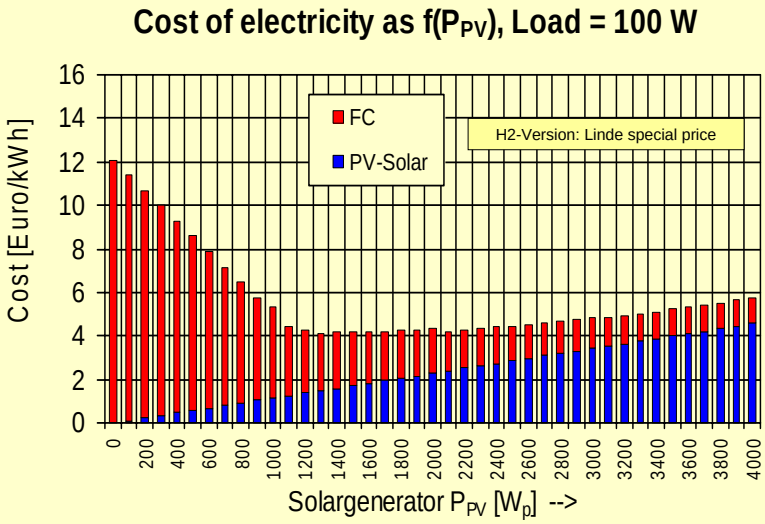
Photovoltaic/Fuel Cell Hybrid Remote Power System



WILK 12.3. 2004 FC: Nexa 1,2 kW, 26 V, 46 A, Weatherdata: Linz

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The Fronius Group

Employees Worldwide	**1365**	**Active Patents**	**180**
Turnover 2002	**116 Mio €**	**Representation**	**75 Countries**
R&D Expenditure	**8.1%**	**Production sites**	**6**
Export share	**80.1%**		

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Fronius: Focussing on Energy

Welding Technology

Solarelectronics

Battery Charging Systems

Synergy: PV-Fuel Cell Hybrid

	Photovoltaics	Fuel Cell
Application Potential	+	+
Environmentally Friendly	+	+
Scalability	+	+
integrability	+	+
Energy Density	-	+
Generation on demand	-	+
Service/Safety	+	- (+)
Operating Environment	+	- (+)
Cost	- (+)	- (+)

Ballard NEXA
Fuel Cell Power Module

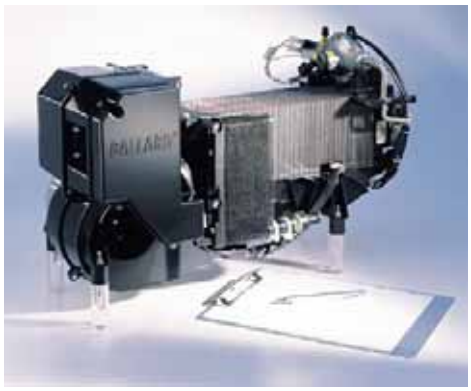

Foto: Ballard

Ballard PEM Fuel Cell:

Fuel type: Hydrogen 5.0
H_2 Consumption: <0,018 Nm^3/min
Fuel Composition: 99,99 % H_2
P_{el} = 1,2 kW net max.
at V=26 V, I=46 A
V_{min} = 22 V
P_{therm} = 1,65 kW max.
Operating life: 1500 h
MTBF: 1000 h
Cycle life: 500 max.
Operating-temp. Stack: 65 °C
Ambient temp: +3 bis 30 °C
Freeze/thaw cycles: 50 max.
Weight: 13 kg

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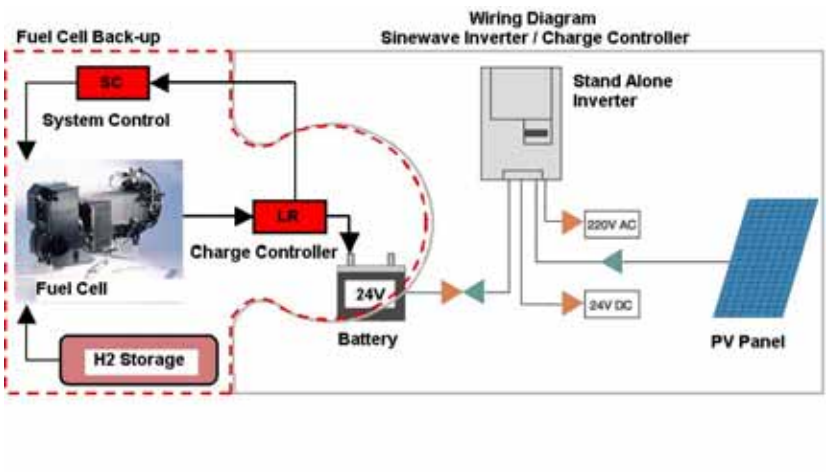
Stand-Alone
PV-Fuel Cell Hybrid System



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Integration Aspects

Fuel Cell

- Maximise fuel cell efficiency
- Minimise number of fuel cell start-ups
- Fuel cell operation under freezing ambient
- Completion of safety features (monitoring of cooling air current and redundant hydrogen sensor)

Battery

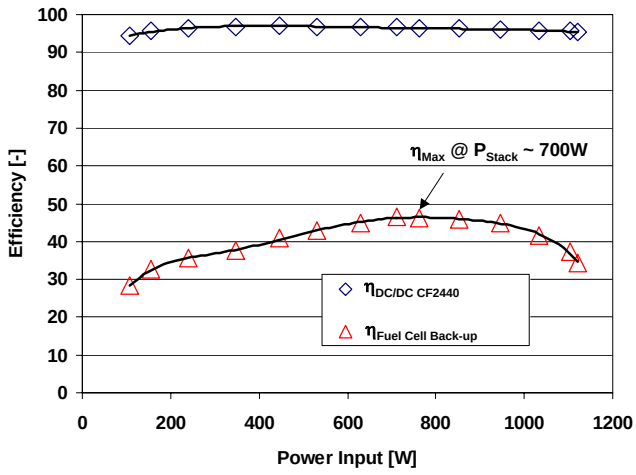
- Continuous monitoring of battery state of charge and prevention of total discharge of battery
- Automated battery charging along definded characteristic

General

- Data logging and communication
- Minimisation of parasitic loads !!!

Hard- & Software Development

Optimum Fuel Cell Load



Implementation Site

HTL Steyr, Implementation Site of PV-Fuel Cell Hybrid System

R&D Project:
5 kW Direct-Hydrogen APU „fCDT“

Project Duration: 11/02 – 08/04

Project Partners: Bitter GmbH (Co), Fronius International GmbH, OÖ. TMG/CDT, ECHEM, JKU Linz, KTM Kühler GmbH, Kirstein GmbH

Financing: private, governmental subsidy (A3 program, bmvit)

Objectives:
- cascadable unit for mobile and stationary applications in the 5 – 20 kW Range
- Integration of (automotive) components appropriate for large quantity manufacturing
- Integration lightweigt 350 bar cartouche System
- Improvement of system lifetime

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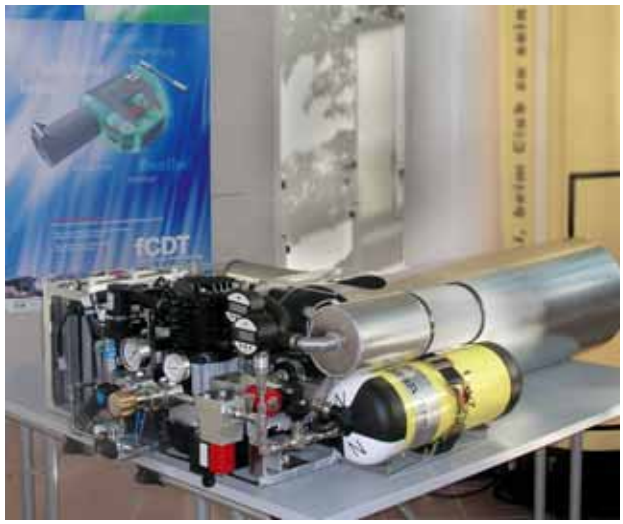
Prototype 5 kW APU „fCDT “



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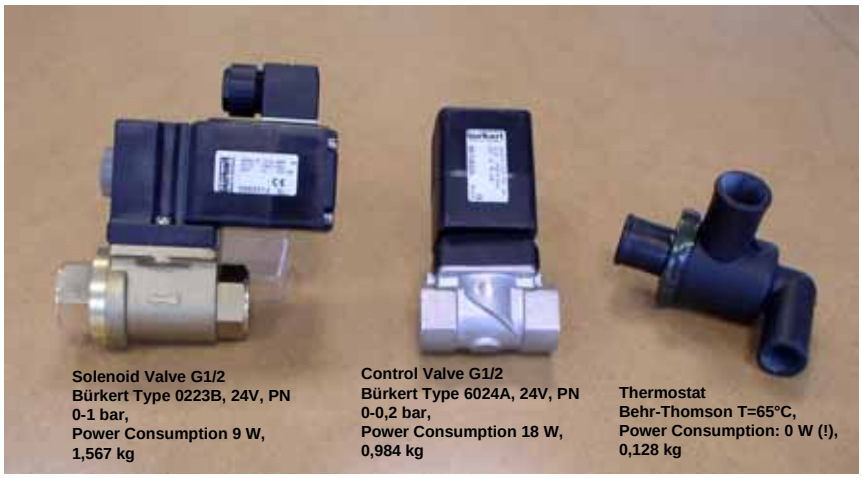
Potential of Automotive Components



Solenoid Valve G1/2
Bürkert Type 0223B, 24V, PN 0-1 bar,
Power Consumption 9 W,
1,567 kg

Control Valve G1/2
Bürkert Type 6024A, 24V, PN 0-0,2 bar,
Power Consumption 18 W,
0,984 kg

Thermostat
Behr-Thomson T=65°C,
Power Consumption: 0 W (!),
0,128 kg

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Early Markets

Stand-Alone Applications:

- **Camping, Yachting & Leisure**
- **Telecom, Telematics**
- **National Parks**
- **Rural Electrification**
- **UPS**

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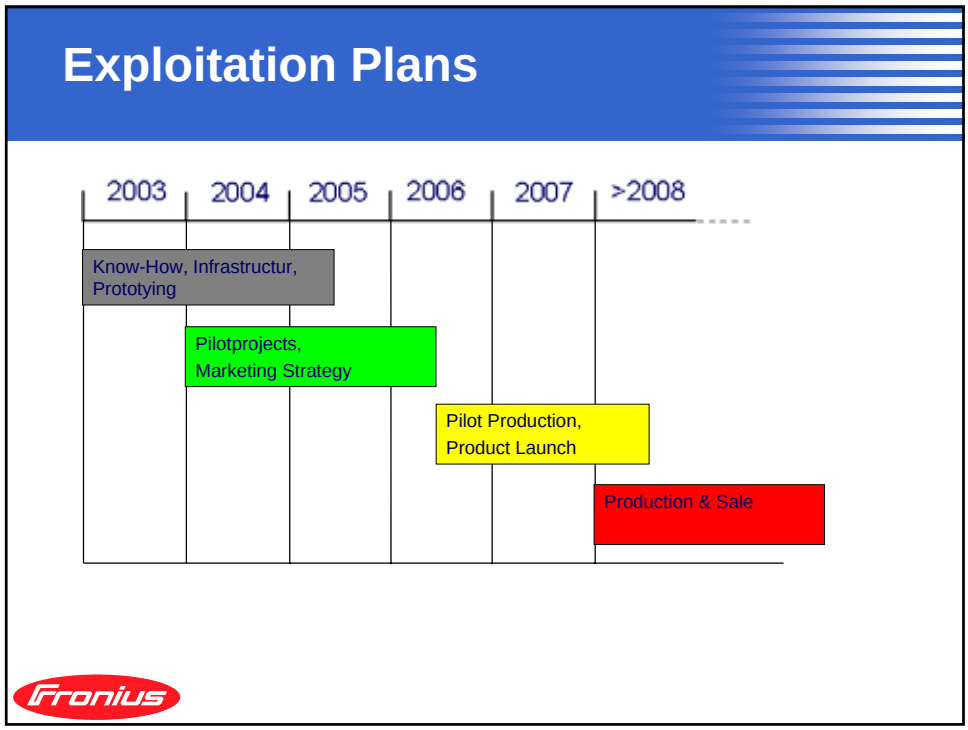
Exploitation Plans
2003
2004
2005
2006
2007
>2008
Know-How, Infrastructur, Prototying
Pilotprojects, Marketing Strategy
Pilot Production, Product Launch
Production & Sale
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