



MTU CFC Solutions GmbH

- Subsidiary of DaimlerChrysler AG
- Established January 2003
- Located near Munich / Germany
- Total Area: 5000 m²
- Research & Development
- Power Plant Assembly and Test
- Pilot Cell Manufacturing

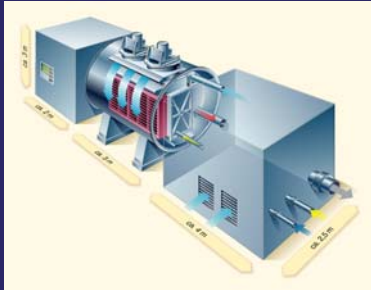


The HotModule – Fuel Cell Programme

Peter M. Berger

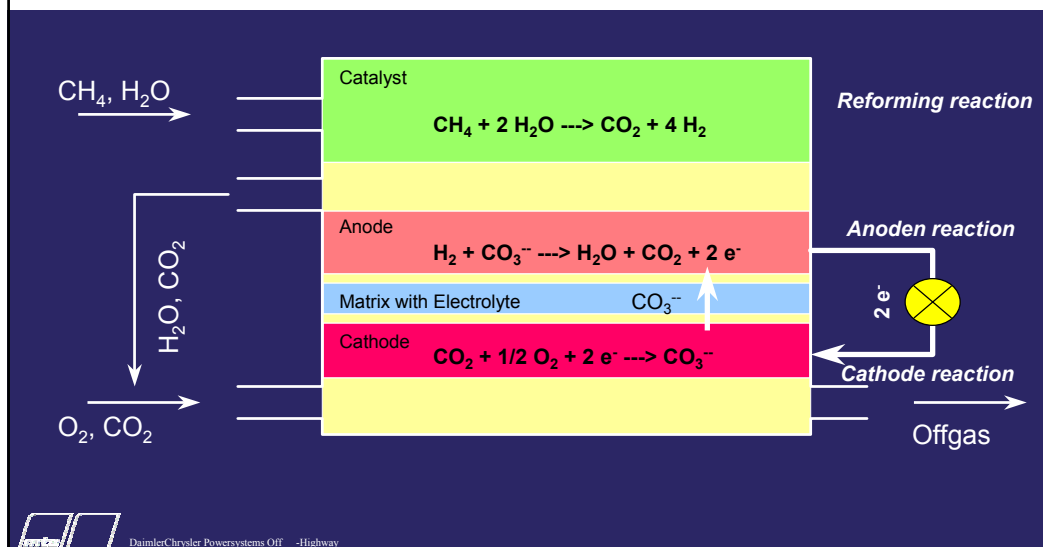
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D – 81663 München

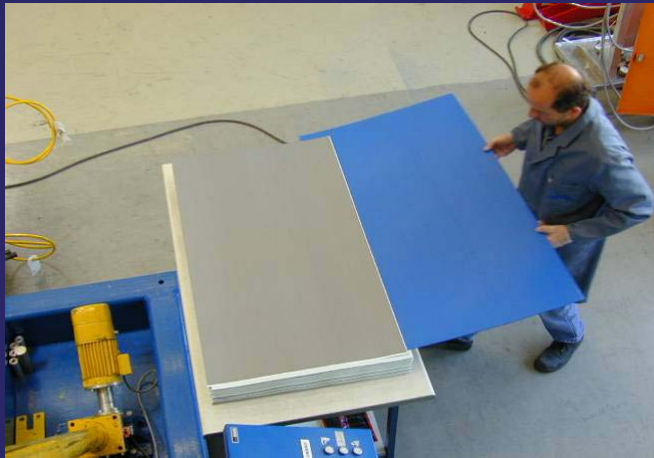


- Technology und Plant-Design
- Advantages compared to conventional power plants
- Biogas and the carbonate fuel cell
- Next steps, Commercialisation

Principle of the Carbonate Fuel Cell



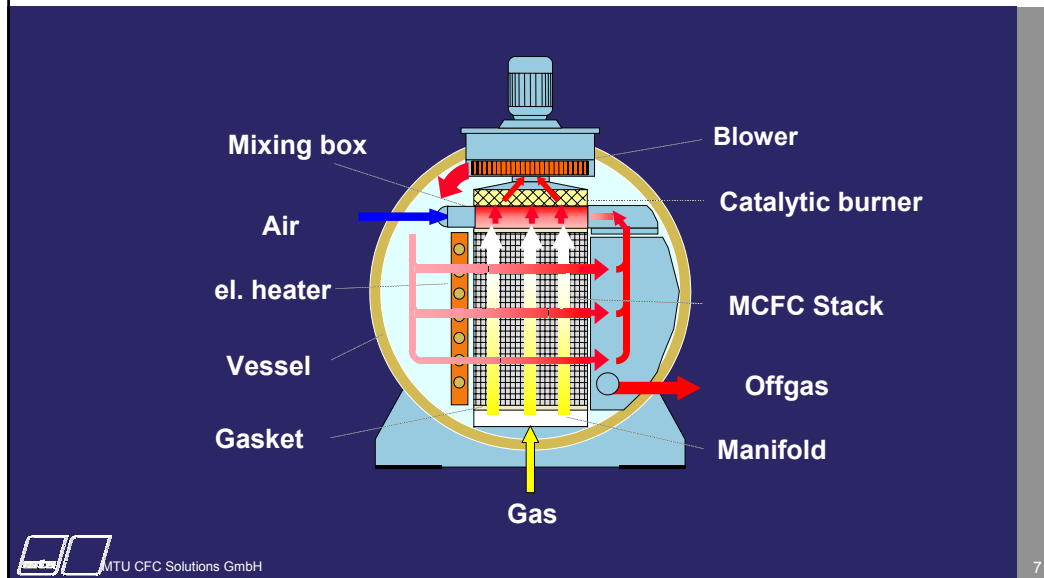
Single Carbonate Fuel Cell



Integration - Fuel Cell Stack

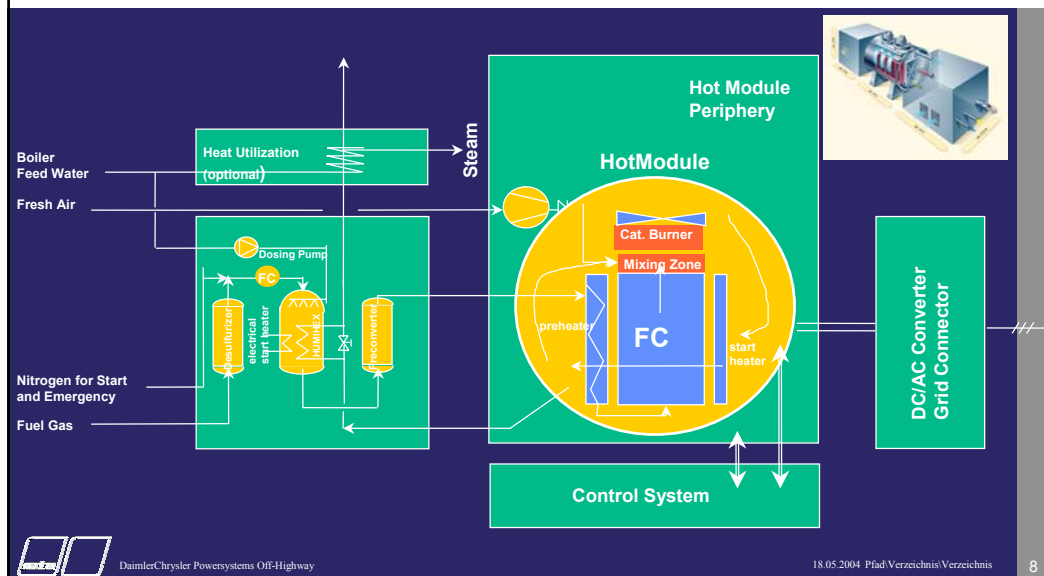


Hot Module packaging prinzipile



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Process Flow Diagram



18.05.2004 Pfad/Verzeichnis/Verzeichnis

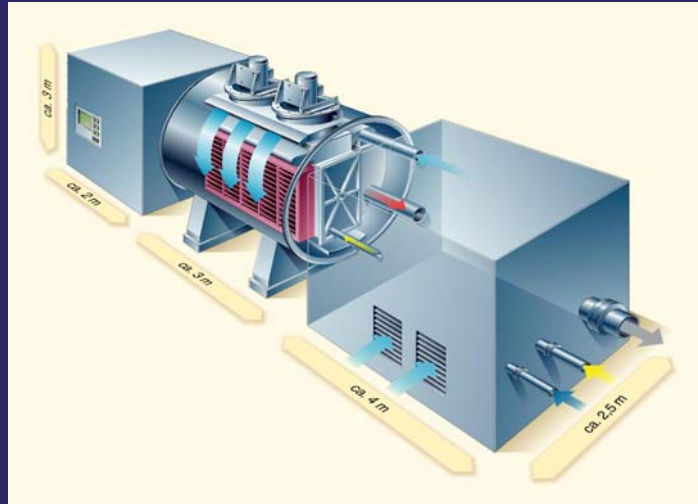
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Prototyp

Prototyp,
Dezember, 2001

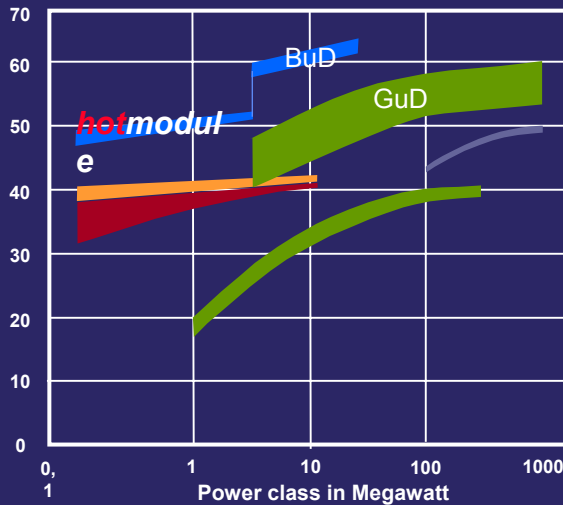


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Electrical efficiencies of power plants

El. Efficiency in %



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- MCFC, High temperature fuel cell
- PAFC, Low temperature fuel cell
- Gas engine
- Gas turbine
- Steam power plant
- ▬ Future technology
- ▬ Today's technology

Options for the use of high temperature heat (400°C)

Process steam and/or heating heat

Coldness in combination with absorption chiller engines

- Better **utilization** of the power plant
- Higher **coldness to heat ratio**
- **Compact shelving**
- The market for cooling is growing worldwide



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Applications & Customers



Hospitals



Beverages



Pharmaceutical



Commercial Facilities



Utilities



Food Industry



IT-Sector

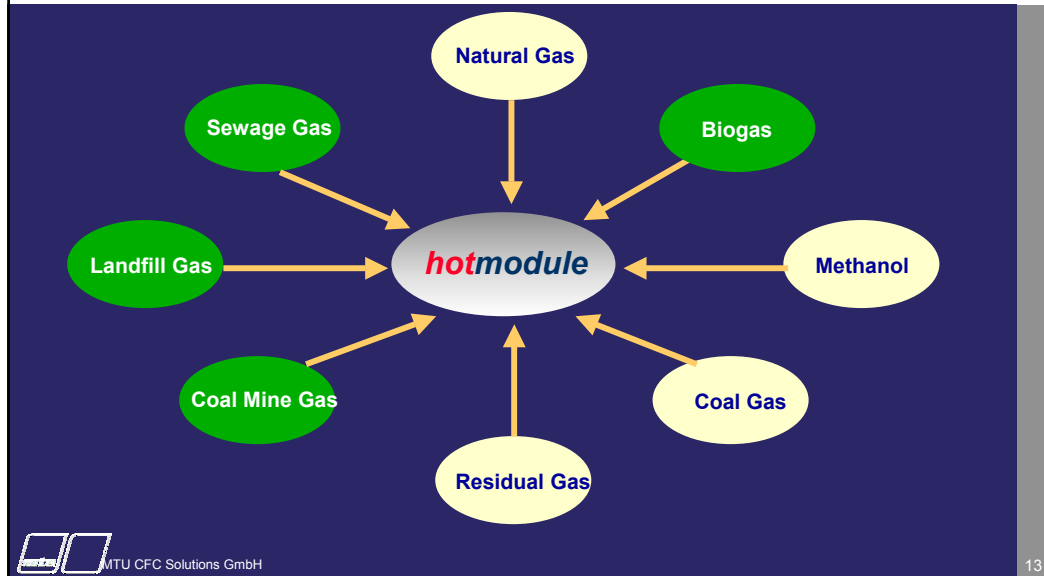


Telecommunication



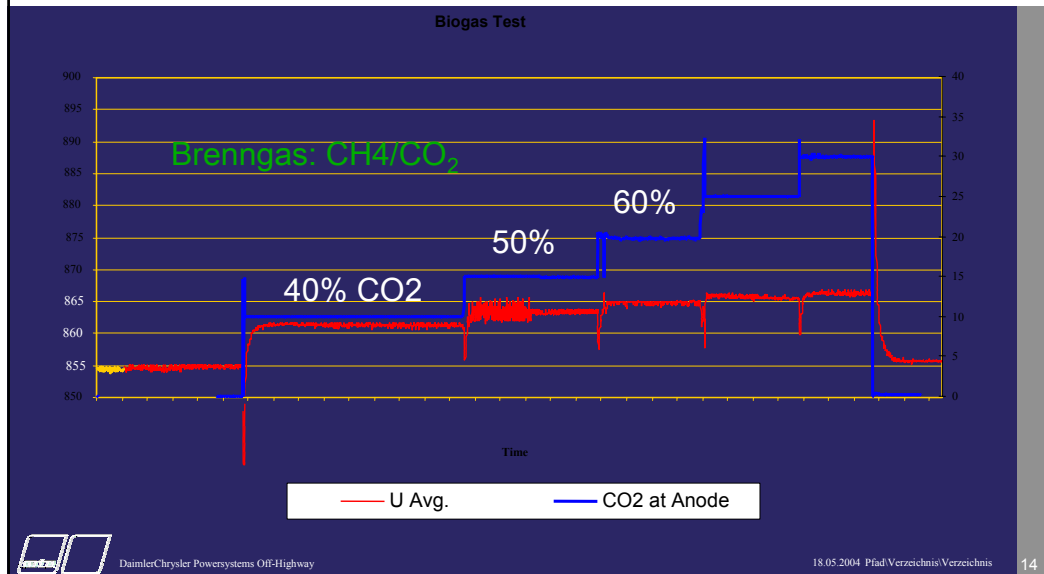
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Fuel Flexibility



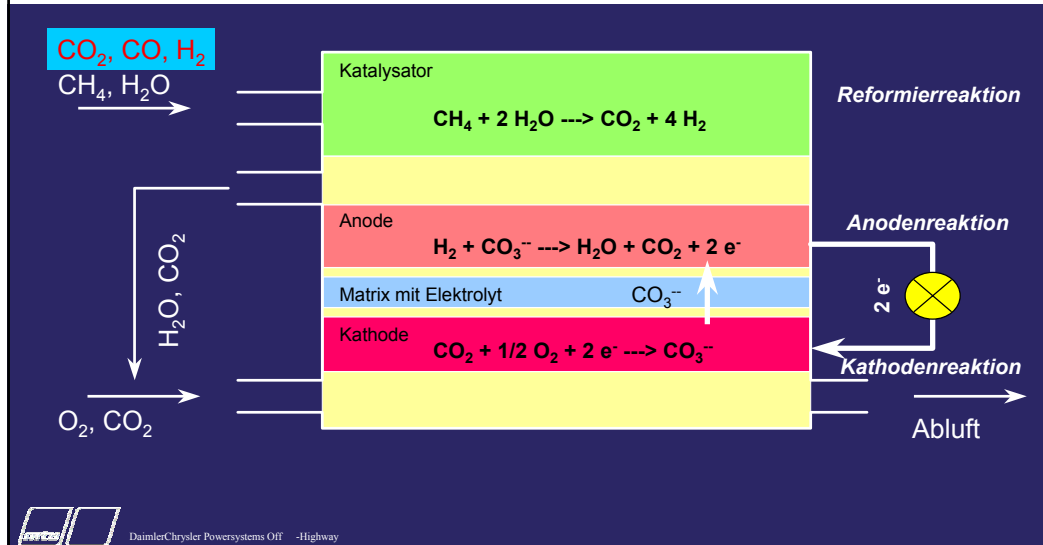
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Die Zellspannung profitiert vom CO₂-Gehalt des Gases



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Variation der Gaszusammensetzung



Renewable Energies



Agriculture waste



Biogas Plants



Sewage Plants



Residual Gas



Coal-Mine Gas



Landfill Gas



Field trial in Germany



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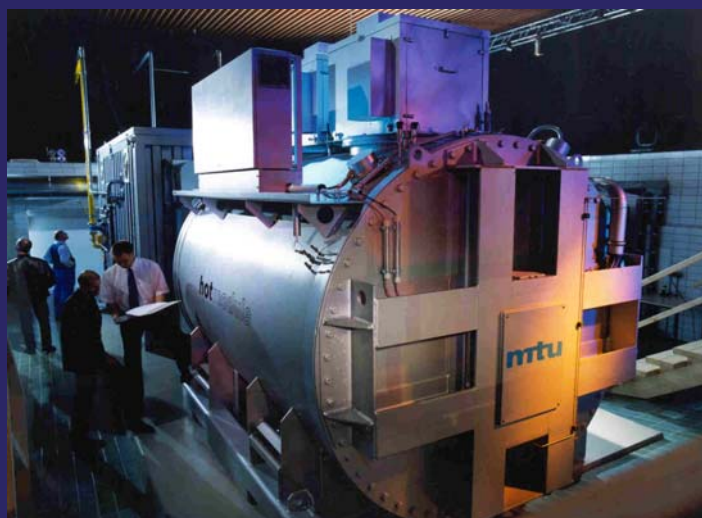
Gesamtanlage HM300-3 AG

Rhön-Klinikum

Krankenhaus
Energieversorgung

In Bad
Neustadt/Saale

betrieben von der
Rhön-Klinikum AG



DaimlerChrysler Powersystems Off-Highway

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Emission Measured



HotModule	Piston Engine
Pilot Plant	Cogeneration Unit

CO	mg/m ³	14	30 – 480
NOx	mg/m ³	< 2	10 – 750
Total Carbon (incl. CO) 450	mg/m ³	5	310 –
Organic Carbon	mg/m ³	< 1	



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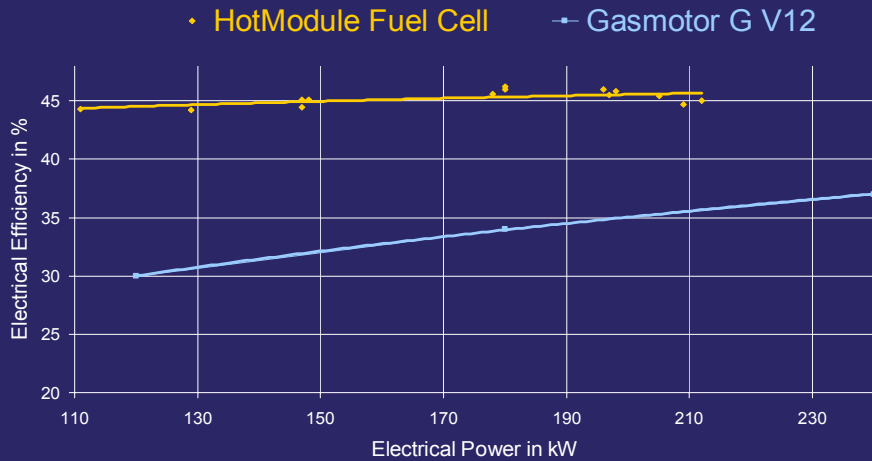
Clinic Magdeburg - Germany



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System Part Load Efficiency Electrical Efficiency over Electrical Load

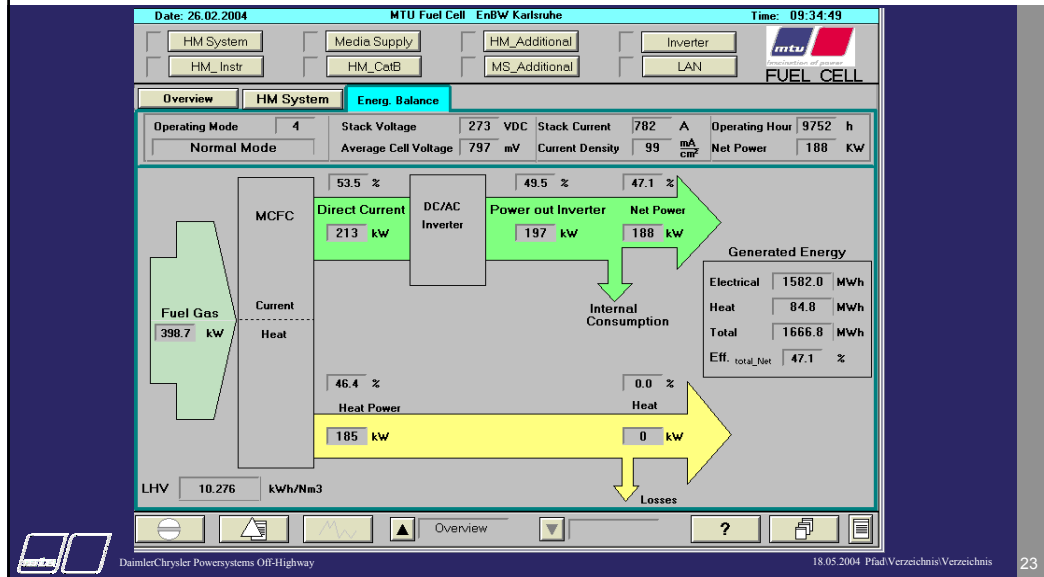


The HotModule System confirms an excellent part load efficiency

EnBW - Michelin - Karlsruhe



Efficiency of the power plant

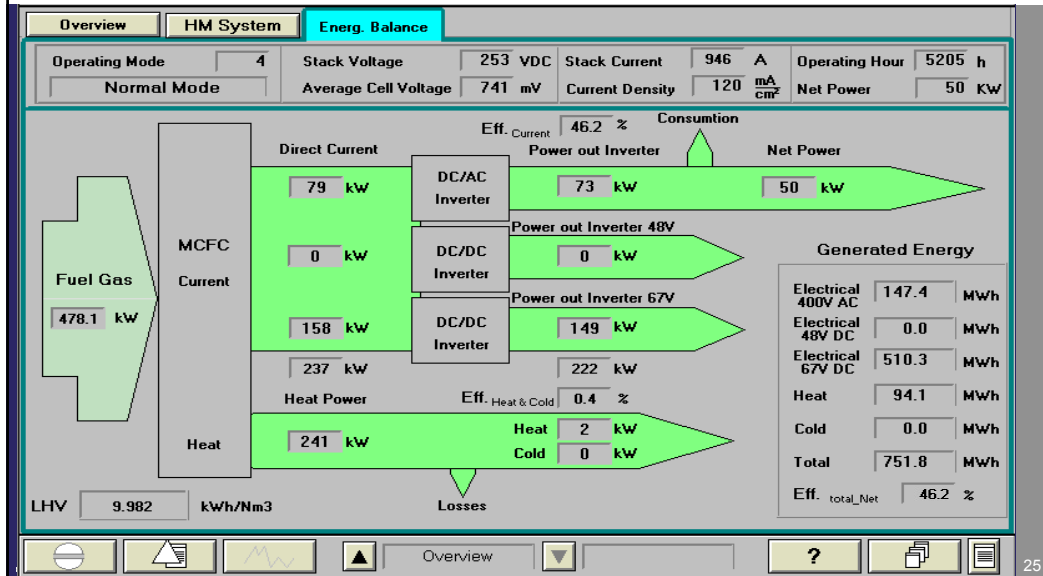


Telekom - München



Operation and Monitoring

Entirely remote controlled test operation



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Pfalzwerke - Kreiskrankenhaus Grünstadt



Foto: Pfalzwerke



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Ongoing Field Test Installations



Grünstadt Hospital



RWE / Germany



Otto-von-Guericke
Clinic / Germany



Telekom / Germany



IZAR / Spain



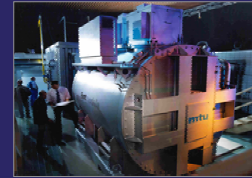
Mercedes Benz / USA



LADWP / USA



Michelin / Germany



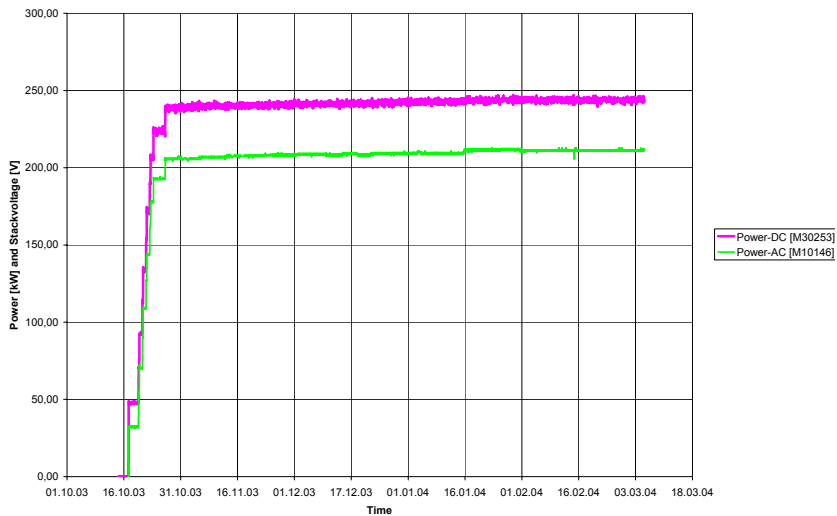
Rhön Klinikum
/ Germany



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Load Profile of the Bad Berka-unit

Load Profile Diagram from 10/01/03 to 03/05/04



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MTU Field Test Units



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Field Test Experience

- ✓ Electrical Plant Efficiency: 47 % Demonstrated
- ✓ Operating Time of one Field Test Unit > 19.000 hrs.
- ✓ Total Accumulated Operating Time > 80.000 hrs.
- ✓ Variable Power to Heat Ratio
- ✓ Over 90 % Total Efficiency
- ✓ Multistage Heat Utilization
- ✓ Trigeneration Demonstrated: Power, Heat, Cooling
- ✓ DC Application Demonstrated



Foto: RWE Essen

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