Austrian Energy Agency

Fuel cells for stationary and portable applications

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Contents

Aims, scope & participation

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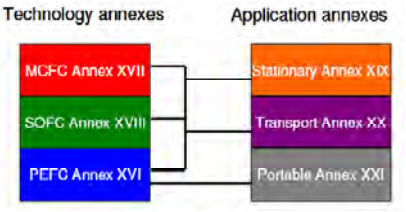
- Aims to advance knowledge in the field of (advanced) fuel cells
- Task shared R&D + info exchange
- Covers technologies and applications for:
  - Polymer Fuel Cells (PEFC)
  - Solid Oxide Fuel Cells (SOFC)
  - Molten Carbonate Fuel Cells (MCFC)
- 19 participating countries (US, JP, KR, CA, DE etc.)
- Present period: 2010 – 2014
- Website: http://www.ieafuelcell.com/



- Austrian participation:
- XIX, 25: Stationary Applications: AEA (Energie AG OÖ)
- XXI, 27: Portable Applications: Labor für Brennstoffzellen, TU Graz
- XVI, 22: PEFC: Labor für Brennstoffzellen, TU Graz

Annex 25: Stationary applications - Focus and motivation

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- **Focus**
  - Analysis of the techno-economic framework for the deployment of fuel cells/micro CHPs in Austria
  - Identification of niche markets and of market segments for the deployment of fuel cells/micro CHPs in Austria (residential sector, applications in the industrial and commercial sectors)
  - SWOT-Analysis for the market introduction of fuel cells/micro CHPs (incl. market transformation efforts)
- **Motivation**
  - Heat market is characterised by an old boiler stock in Austria
  - EBPD - Energy Performance of Buildings Directive
    - Article 6: MS shall ensure that – before construction starts – the technical, environmental and economic feasibility of high-efficiency alternative systems is considered and taken into account (incl. CHP solutions) (RECAST: Article 3 – Annex 1)
    - Article 8: ... advice for operators of inefficient boilers for adequate replacements and/or alternative solutions (RECAST: Article 14)
  - Market introduction of boilers and micro CHPs received major attention by Austrian Bund/Länder authorities (Article 15a)
  - First subsidy schemes for micro CHPs are already in place

Fuel cells/micro CHPs: State of the art in Europe

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	Baxi Innotech: Gamma 1.0	Hexis AG: Galileo N	CFCL: Blue Gen
Fuel cell type	LT-PEM	SOFC	SOFC
Electrical output	1 kW (mod. 30 %)	1 kW	2 kW
Thermal output	1,7 kW	2,5 kW	0,3 – 1 kW
Aux. Burner	3,5 -15 or 3,5 -20 kW	4 – 20 kW	Not specified
Electrical efficiency	32 % (Hi)	25 - 30 % (Hi) (goal: > 30 %)	60 % @ 1,5 kWel (Hi)
Total efficiency	96 % (Hi)	> 90 (Hi)	Ca. 85 % (Hi)
Fuel	Gas	Gas	Gas
Market implementation	34 systems in Callux project, commercial by 2013 ?	30 systems in Callux project, commercial by 2013 ?	Demo projects with German utilities announced, commercial by ?

Courtesy: Baxi, Sulzer & CFCL

Commercialization of residential fuel cells in Japan

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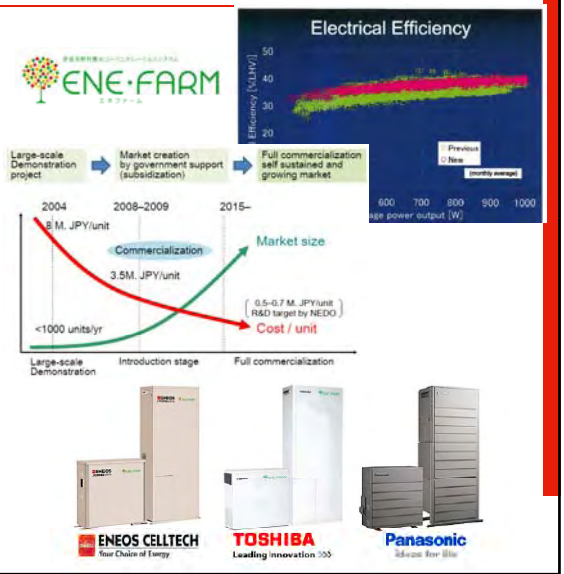
- Residential fuel cell systems
  - 0.7–1.0 kW PEFC + heat recovery (CHP)
  - Three manufactures
  - Subsidization program initiated
- 1/2 of users' costs (system + installation) up to 1.4M JPY
- 1,500 units installed (as of Sep. 2009)
- + 3,307 in 2004 to 2008
- SOFC demonstration project incl. 5 projects (0,7 kWel) shows electr. eff. > 40 % (Hi)
- 1 € = 114 Yen
  1 Mio Yen = 8.650 €



Analysis of the specific Austrian framework

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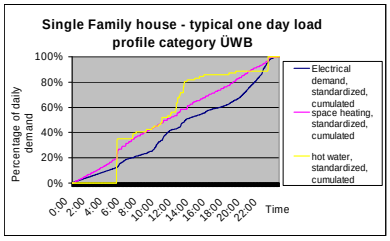
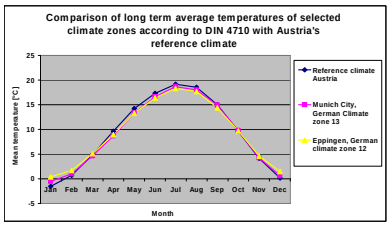
- Parallel to the EU and international developments the framework of the implementation of fuel cell/micro CHPs was analysed for Austria
- Five model cases (building categories) reflecting typical Austrian buildings were selected:
  - single family houses: new & existing
  - multi family houses: new & existing
  - small office building: refurbished
- The specifications of Austrian model cases are based on Statistic Austria data sets
- Specific Austrian reference climate conditions were defined
- Typical load profiles following VDI 4655 were used
- Due to missing fuel cell demonstrators in Austria specifications were used from the German Callux project, the cost levels are based on state-of-the-art micro CHP systems.





Five model cases (building typologies)

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	Residential buildings				Office building
	Existing single family home	New single family home	Existing multi – family home	New multi – family home	Refurbished office building
Building phase	1961-1981	2010	1961-1981	2010	1971, renovated
Gross-external area	150 m²	150m²	560m²	560m²	3.600m²
Number of inhabitants / flats	3	3	6	6	-
Specific heat demand	219,0 kWh/m²a	46,6 kWh/m²a	130,2 kWh/m²a	35,7 kWh/m²a	40,8 kWh/m²a
Specific domestic hot water demand	12,5 kWh/m²a	12,5 kWh/m²a	12,5 kWh/m²a	12,5 kWh/m²a	4,7 kWh/m²a
Total heat demand	34.760 kWh/a	8.900 kWh/a	80.060 kWh/a	27.140 kWh/a	164.700 kWh/a
Demand of electrical energy	3.069 kWh/a	3.069 kWh/a	1.974 kWh/a /flat	1.974 kWh/a /flat	129.450 kWh/a
Standard heat load	14,0 kW	4,3 kW	37,3 kW	14,6 kW	103,0 kW

Pay back period of additional investment - taking account of annual discounted payments, feed-in tariff and investment incentive

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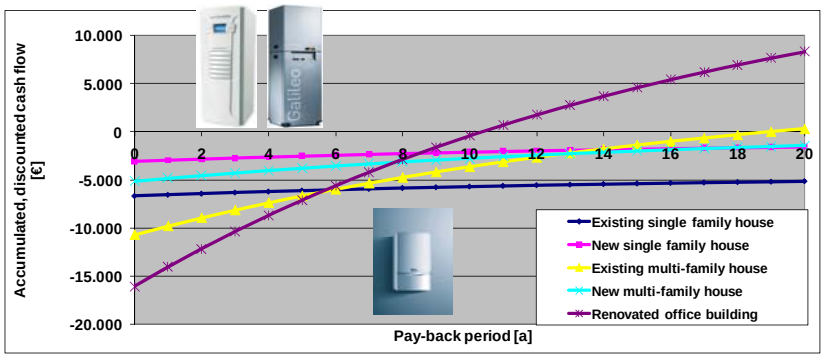

Investment incentive:	Feed-in tariff similiar to German tariffs („KWK – Gesetz“):
25% of the Investment for the CHP system (incl. installation)	Self used: 5,11 [ct/kWh] Feed into grid: 10,30 [ct/kWh]

Analysis of CO2eq. emissions and CED

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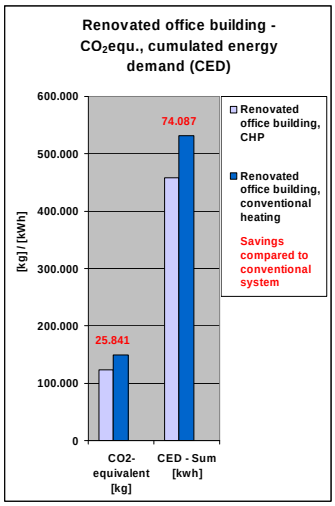

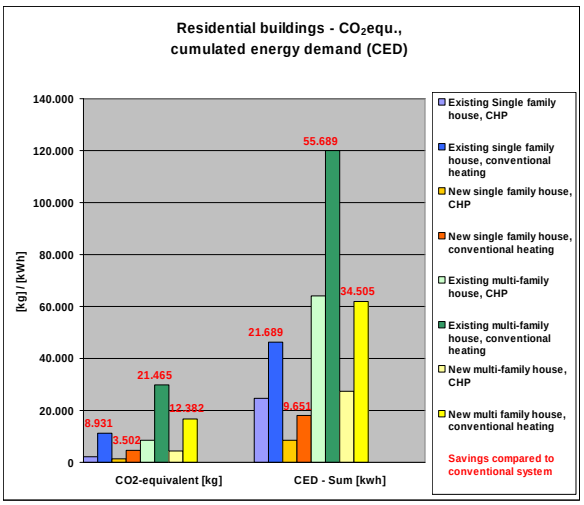

Annex 27: Portable applications

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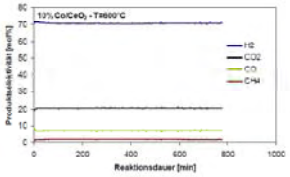
- Goal: R&D activities focussing on micro power (cellular phones, note-books), portable power (emergency and backup power) and light traction. Most promising technology are PEFCs fuelled with with methanol, ethanol or hydrogen.
- Subtask 1: FC Stack / MEA
  - Improvement the power density
  - Improvement of MEA performances and durability, and better quality control to minimize performance variation among cells
  - Reduction of the platinum-loading and improvement of bipolar plate manufacturing.
- Subtask 2: Power generation system including BoP, secondary batteries and controls
  - Maximization of the system efficiency
  - Maintaining of the water balance in the system
  - Assurance of reliability
- Subtask 3 Product development
  - Better product concepts and quality assurance to exceed customers expectations / requirement
  - Assurance of fuel quality and establishment of fuel-supply network
  - Cost reduction

Courtesy of Motorola



Activities of TU-Graz focussed on ethanol reforming and catalyst development/optimisation of CO/CeO2.

Highlights in Annex 27: Portable Applications

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- Development of DMFC scooter (Yamaha; JP)
- Development of PEFC powered truck (Kanto, Tokyo Gas, JFEC; JP)
- Development of a DMFC system as battery replacement in warehouse trucks (FZ Jülich, DE)
- Development of DMFC 800 W stack for scooters (Kier; KR)
- Development of DMFC system for wheel chair (Kier, KR)
- Development of fuel cell technology to realize cordless personal devices (NEC JP)
- Five Watt class DMFC Stack for cellular phone KIER; KOREA)
- Development of fuel cells system for recharging personal handhelds (MYFC, SE)

Conclusions

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- Austrian IEA participation shows a positive picture concerning International co-operations and know-how transfer from and to Austria
- Results of International demonstration projects may be accessed and lessons were learned by the market introduction programmes of the leading industrialised countries
- Japanese stationary demonstrators in the residential sector outreach already existing micro-CHP systems based on ICE, stirling and micro turbine concerning electrical efficiency und justify public involvements in fuel cell technology. However, progress in cost reduction is still necessary to achieve commercial viability.
- The Austrian framework has to be significantly improved both by investment subsidies and(!) by feed-in tariffs (similar to the German „KWK Gesetz 2009“) in order to initiate investments for micro CHP systems (missing level playing field)
- Emission reductions in all model cases have to be described as significant if fuel cells would be implemented in the residential sector (this also applies for primary energy savings!)
- Portable & micro applications are expected to be the first markets for fuel cells; issues like miniaturisation, system integration, fluid management and cost reduction remain the primary R&D challenges for a successful commercialization.

Vielen Dank für Ihre Aufmerksamkeit!

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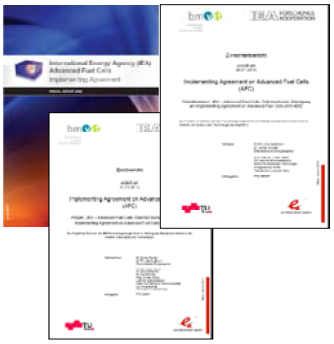
AEA: http://www.energyagency.at/energietechnologien/aktuelle-projekte/afc.html



bmvit Bundesministerium für Verkehr, Innovation und Technologie

IEA FORSCHUNGS KOOPERATION

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