Austrian Energy Agency

Fuel cells for stationary and portable applications

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Contents

- Introduction to the AFC programme
- Activities of Annex 25: Stationary applications
- Activities of Annex 27: Portable applications
- Summary
**Aims, scope & participation**

- 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/](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**

**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
  - 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

<table>
<thead>
<tr>
<th></th>
<th>Baxi Innotech: Gamma 1.0</th>
<th>Hexis AG: Galileo N</th>
<th>CFCL: Blue Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel cell type</td>
<td>LT-PEM</td>
<td>SOFC</td>
<td>SOFC</td>
</tr>
<tr>
<td>Electrical output</td>
<td>1 kW (mod. 30 %)</td>
<td>1 kW</td>
<td>2 kW</td>
</tr>
<tr>
<td>Thermal output</td>
<td>1.7 kW</td>
<td>2.5 kW</td>
<td>0.3 – 1 kW</td>
</tr>
<tr>
<td>Aux. Burner</td>
<td>3.5 -15 or 3.5 -20 kW</td>
<td>4 – 20 kW</td>
<td>Not specified</td>
</tr>
<tr>
<td>Electrical efficiency</td>
<td>32 % (Hi)</td>
<td>25 - 30 % (Hi)</td>
<td>60 % @ 1.5 kWe (Hi)</td>
</tr>
<tr>
<td>Total efficiency</td>
<td>96 % (Hi)</td>
<td>&gt; 90 (Hi)</td>
<td>Ca. 85 % (Hi)</td>
</tr>
<tr>
<td>Fuel</td>
<td>Gas</td>
<td>Gas</td>
<td>Gas</td>
</tr>
<tr>
<td>Market implementation</td>
<td>34 systems in Callux project, commercial by 2013</td>
<td>30 systems in Callux project, commercial by 2013</td>
<td>Demo projects with German utilities announced, commercial by ?</td>
</tr>
</tbody>
</table>

 Courtesy: Baxi, Sulzer & CFCL

## Commercialization of residential fuel cells in Japan

- Residential fuel cell systems
  - 0.7–1.0 kW PEFC + heat recovery (CHP)
  - Three manufacturers
  - 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 kWe) shows electr. eff. > 40 % (Hi)
- 1 € = 114 Yen
  - 1 Mio Yen = 8.650 €
Analysis of the specific Austrian framework

- 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)

<table>
<thead>
<tr>
<th>Residential buildings</th>
<th>Office building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building phase</td>
<td></td>
</tr>
<tr>
<td>Gross-external area</td>
<td>150 m²</td>
</tr>
<tr>
<td>Number of inhabitants / flats</td>
<td>3</td>
</tr>
<tr>
<td>Specific heat demand</td>
<td>219.0 kWh/m²/a</td>
</tr>
<tr>
<td>Specific domestic hot water demand</td>
<td>12.5 kWh/m²/a</td>
</tr>
<tr>
<td>Total heat demand</td>
<td>34.760 kWh/a</td>
</tr>
<tr>
<td>Demand of electrical energy</td>
<td>3.069 kWh/a</td>
</tr>
<tr>
<td>Standard heat load</td>
<td>14.0 kW</td>
</tr>
</tbody>
</table>

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

Pay-back period [a]

Accumulated, discounted cash flow [€]

Existing single family house
New single family house
Existing multi-family house
New multi-family house
Rovened office building

Investment incentive: Feed-in tariff similar 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

Renovated office building - CO2eq., cumulated energy demand (CED)

Residential buildings - CO2eq., cumulated energy demand (CED)
Annex 27: Portable applications

- 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 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

Highlights in Annex 27: Portable Applications

- 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 wheelchair (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

- 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 and 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

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