

# ENATEC micro-cogen BV



## Development of a DCHP unit based on a Free Piston Stirling Engine

*Generating electricity with a  
Condensing Boiler*

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# Introducing ENATEC

- ENATEC mirco-cogen BV was founded in 1997 by



Eneco

(Major utility in the Netherlands)



ATAG Heating

(Leading Dutch boiler manufacturer)



ECN

(Energy research Center of the Netherlands)

The objective of the consortium ENATEC is:

- to develop a marketable dchp technology
  - to license this technology to boiler manufacturers
- The development phase of ENATEC is supported financially by the Dutch Ministry of Economic Affairs, through the **Novem** agency

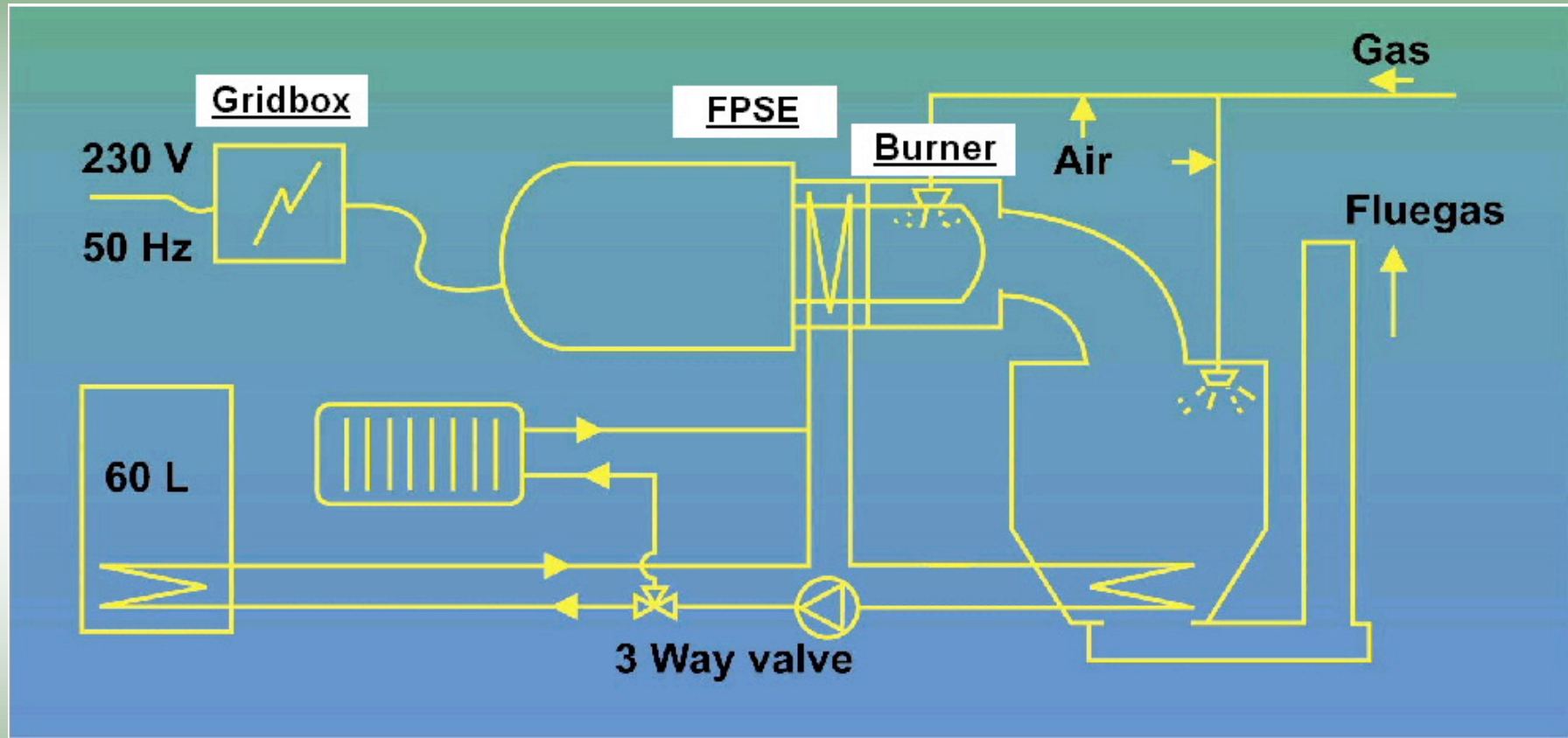
# Domestic CHP

- **State of the art: Condensing Boiler,**
  - Caloric efficiency: 107 % (LHV)
  - Gas consumption: 2100 m<sup>3</sup> (Dutch reference house)
  - CO<sub>2</sub> emission: 3.7 ton/y
  - NO<sub>x</sub> emission: < 40 ppm
  
- **Next step: Domestic Combined Heat and Power,**  
**Combination of a CB and a Prime Mover (i.e. Stirling engine)**
  - Higher energy efficiency
  - Reduced environmental impact
  - No extra maintenance

# Enatec solution: Stirling driven DCHP

- Thermal system: 6 - 24+ kW Condensing Boiler
  - Caloric efficiency: 97% (LHV)
- Electrical system: 1 kW Free Piston Stirling Engine
  - Operating mode: grid connected
  - Frequency: 50 Hz
  - Voltage: 230 V
  - Electrical efficiency: 10% (LHV)
- Combined DCHP system:
  - Life, constant: 60,000 hours (15 years)
  - Life, intermittent: 200,000 cycles (15 years)
  - System efficiency: 107 % (LHV)

# Operating principle of the dchp units



# Enatec building blocks

- **Free Piston Stirling Engine**
  - Basic development by Stirling Technology Company (Kennewick, WA/USA)
  - Maintenance free
- **Radiant Burner (patented)**
  - Ceramic foam type
  - Basic design by ECN
- **“Gridbox”, interface between grid and FPSE (patented)**
  - Establishment of grid connection
  - Overview of operation when grid connected
- **System integration know-how (patented)**
  - Guidelines for DCHP control
  - Assembly guidelines

# Field trial of Enatec prototype system

- Field trial with 10 units (2002-2003)
  - 7 units in private residences
  - 3 units in laboratory environment
- Preliminary results
  - proof of concept
  - reliability of main components demonstrated
  - ongoing optimization of system and components, including the Enatec building blocks





# Present status and future development

- Continued testing with an optimized version of last season's field trial units
- Estimated CO<sub>2</sub> reduction: 14% (Dutch reference case)
- Redesign of the FPSE aimed at further decreasing manufacturing cost

# Commercial activities

- Sell license to Stirling manufacturer
- Negotiations with potential manufacturers
  
- Sell licenses to third party boiler manufacturers
- Negotiations with boiler manufacturers
  
- Facilitate introduction of new technology
- Discussions with utilities
- Discussions with governmental bodies

# Thank you for your interest!

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