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# The Industrial Gas Turbine, the European Perspective

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Gas Turbine Technologies

10 – 11 July, 2003 Brussels



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# EuMIGT

## EuMIGT MEMBERS

Alstom Power	Sweden
Demag Delaval Industrial Turbomachinery	UK
MAN Turbomaschinen AG	Germany
Nuovo Pignone	Italy
Rolls-Royce plc	UK
Turbomeca Land and Marine Turbines	France
Volvo Aero Corporation	Sweden

## Associate members

Industries, universities and institutes with connection to Industrial Gas Turbines

**Industrial gas turbines are gas turbines for land and marine applications in the power range below 50 MW**

**Sales € 1,5 billion**

**5,500 DIRECT EMPLOYEES**

- Steel, Exotic Alloys
- Aluminium, Light Materials
- Electrical & Electronic Equipment
- Cables, Machines & Tools
- Driven Equipment, Acoustic Treatment
- Component Suppliers
- Power Providers, Gas & Liquid-Fuel Suppliers
- Repair & Maintenance, Overhaul
- Combined Heat & Power, District Heating
- Process Plants
- Power Station Building & Maintenance
- Industrial Safety
- Press & Publishing, Finance & Insurance

**110,000+**



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## Competitiveness through collaboration

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### **Strengthen European Industrial Gas Turbine Industry through**

- **Precompetitive research and development**
- **Improving Europe's knowledge base**
- **Views on EU actions and legislation**
- **Collaboration with other groups**

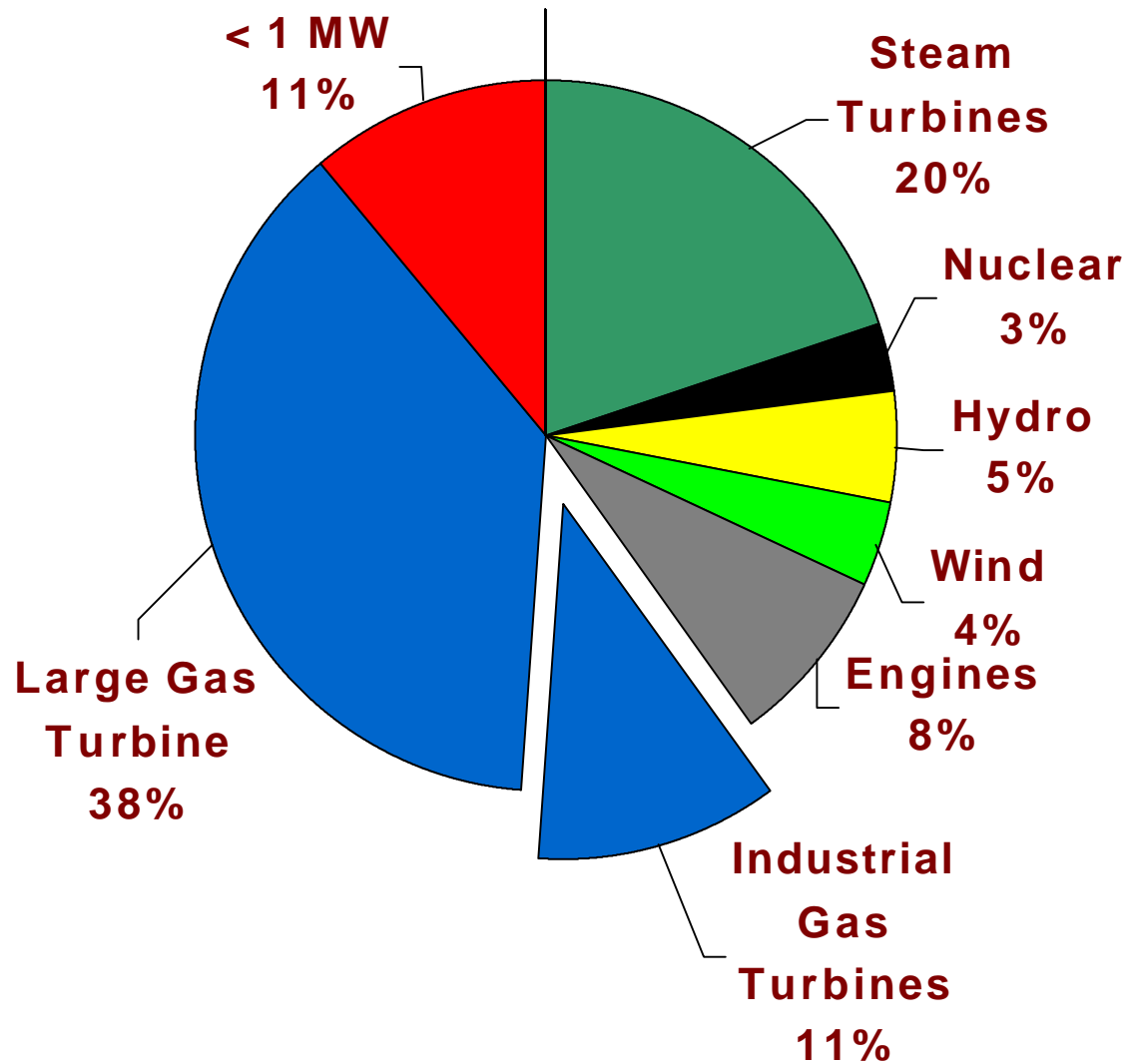


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# Worldwide Power Generation Market

~~Typically 100 000 MW per year~~





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## The Industrial Gas Turbine ( IGT )

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- **Power levels from 5kW up to approx 50 MW**
- **Used on land and in marine applications**
- **Small size and easy to install and transport**
- **Based on aero gas turbines or specifically designed as IGTs**
- **Micro/Miniturbines in the very small end of power spectrum ( < 1-2 MW )**
- **Many different applications - power generation, mechanical drive, marine, transportation**



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## Major markets (GT's <50 MWe)

- Generation 60%
  - Combined Heat and Power
  - Distributed Generation
  - Peak lopping
- Oil & Gas 35%
  - Local Generation
  - pumping
  - compression
  - distribution
- Marine propulsion 5%
  - Civil
  - Naval
-



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**Alstom, Sweden 22 MW system in district heating system**

**Turbomeca 1,2 MW CHP plant**



**100 kW Turbec microturbine in green house**

**Volvo Aero VT 600**



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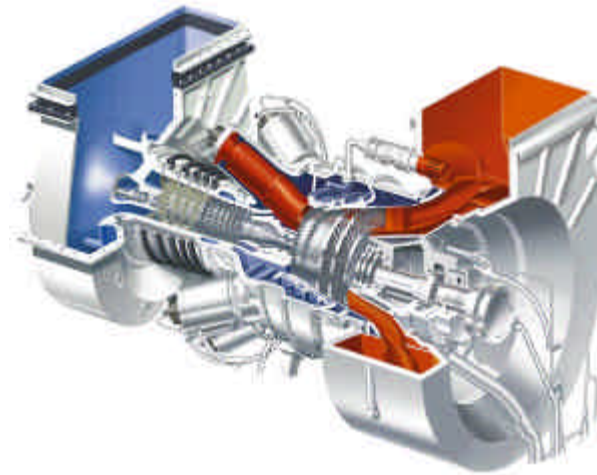
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# Oil and Gas



Cyclone

SIEMENS



Demag Delaval 13  
MW Cyclone

Cyclone Power Generation Demag Delaval Industrial Turbomachinery Ltd 2

Four MAN THM 1304  
in gas treatment  
plant



Gas treatment plant in Bulgaria fitted with four THM 1304 gas turbines and centrifugal compressors RV080/01





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High speed ferries  
of different sizes

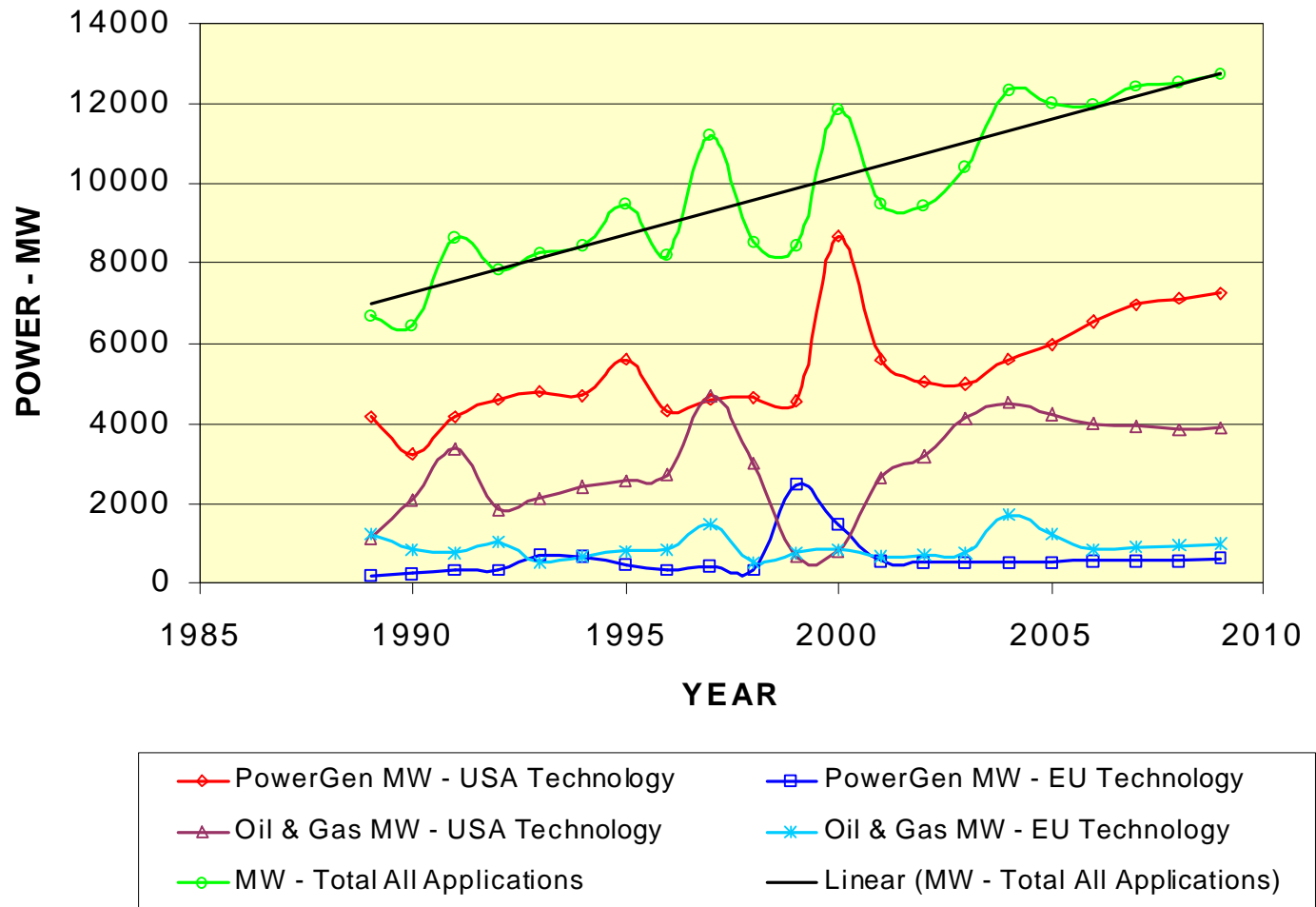
**Rolls Royce MT 30**



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Historical & Expected Future Global Sales of Sub 50 MW  
Gas Turbines by Market and Technology Origin



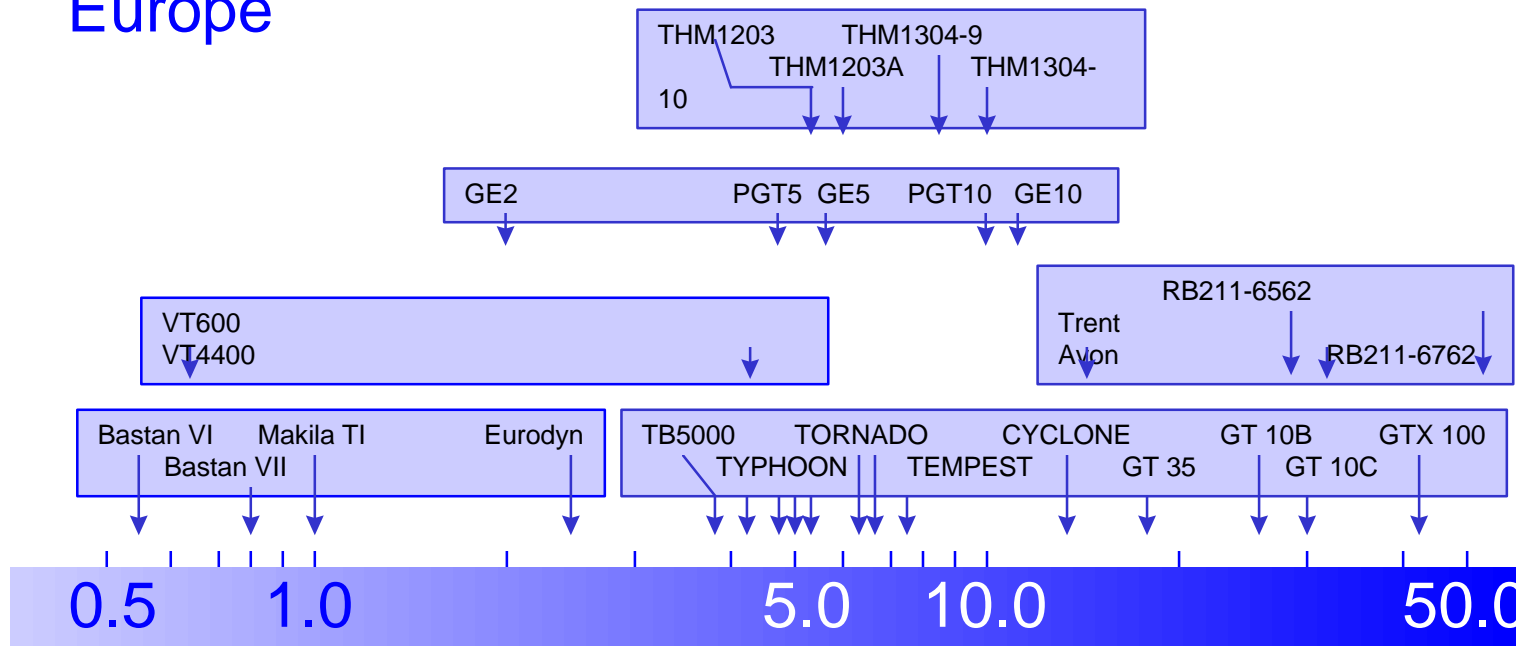


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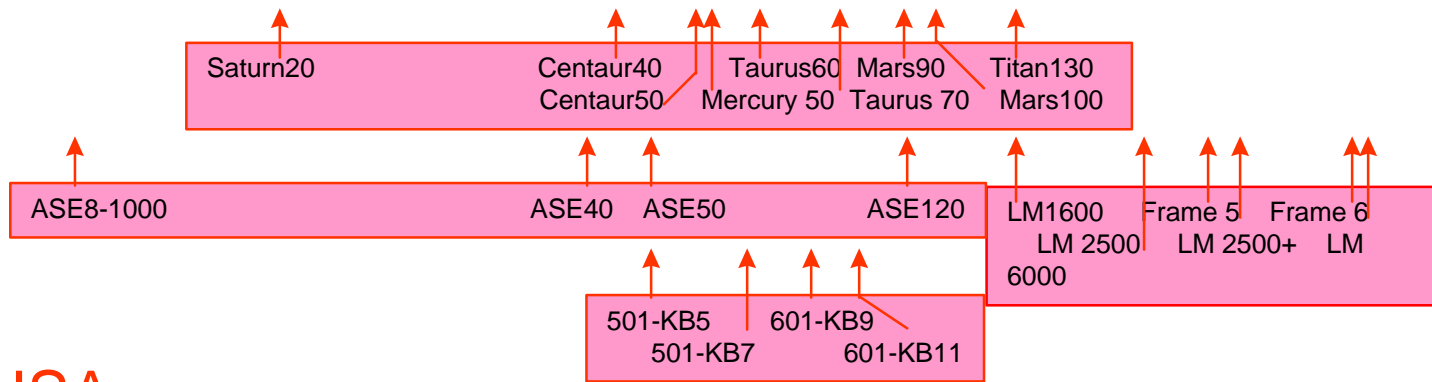
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# Products Europe v USA

## Europe



## USA



# Mini/microturbines

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## Europe

**Turbec ( Volvo /ABB)**

**Bowman ( US gas turbine technology)**

**Microturbo ( Development )**

## USA

**Capstone**

**Elliott**

**Ingersoll-Rand**

**DTE**

**GE**

**Well organized DOE project**



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## Future requirements

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	<b>Today</b>	<b>3-5 years</b>	<b>10 years</b>
<b>Efficiency</b>	<b>30-40%</b>	<b>40-50%</b>	<b>40-50%+</b>
<b>Emission</b>	<b>&lt;35ppm NOx</b>	<b>&lt;10ppm &lt;3ppm</b>	
<b>Fuels</b>	<b>nat gas diesel landfill sewage</b>	<b>+</b>	<b>+</b> <b>low quality gas, hydrogen</b>

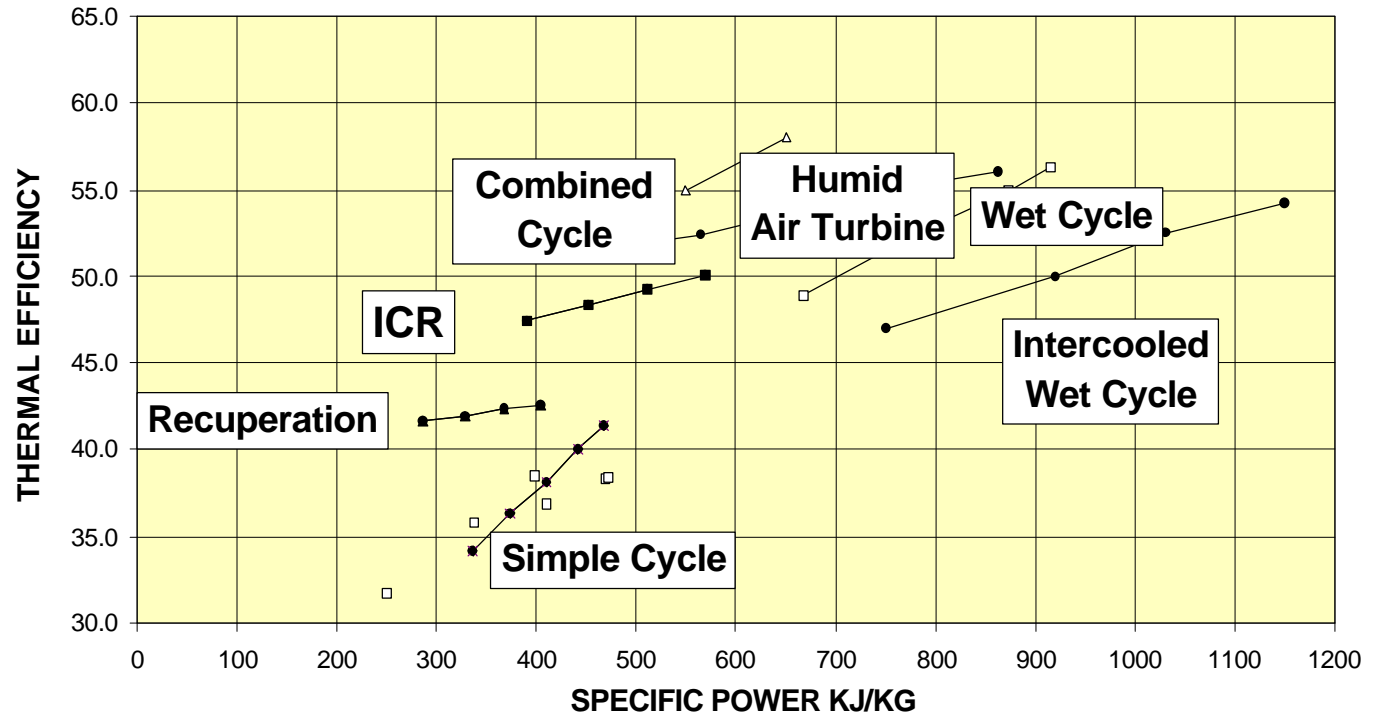
**The requirements varies depending on size and applications**  
**Also hybrid systems**



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# Gas Turbine Cycle Performance





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## Clusters

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- **Recuperators – design, materials, manufacturing**
- **Advanced cycles - intercooling and recuperation, wet cycles, variable geometry, topping and bottoming cycles**
- **Turbomachinery – aero/thermo analyses, improved cooling concepts, part load performance, ceramics**
- **Fuel flexibility – bio fuels, process gases, hydrogen, alcohols**
- **Low emission – variable geometry, catalytic combustion, aero/thermo/ stress analyses**
- **Control and monitoring – control strategies including adaptive control and fuzzy logic, simulation modeling**
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## Important activities in 2002

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- **IGT in FWP 6**
- **CE-IGT**
- **ATEX directive**
- **Establish stronger presence in Brussels**
- **Informing and act as catalyst for networking**

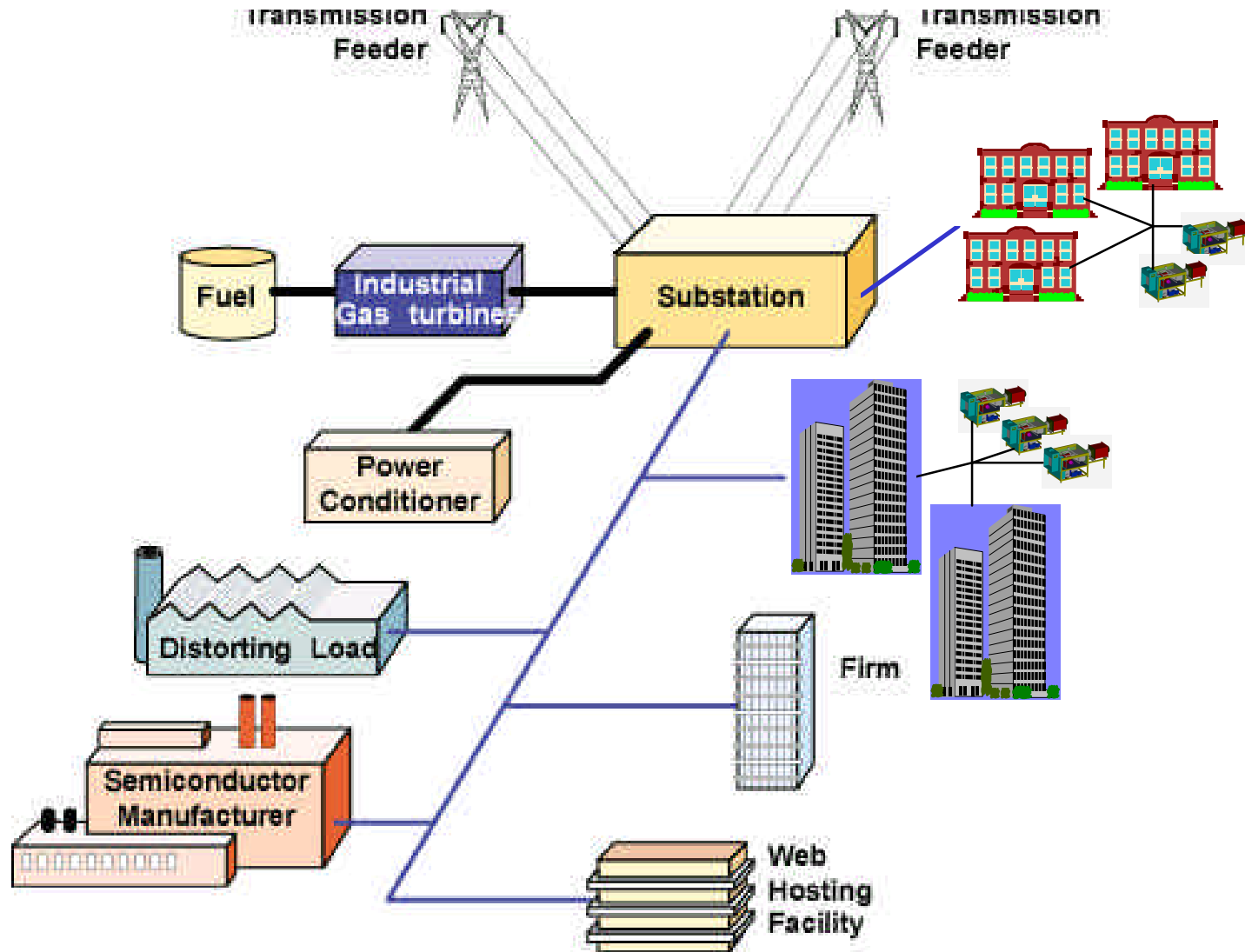




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# Decentralised Power Plant System





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## IGT Best Distributed Generation Solution

- **Decentralised Power will be an important part of the future global energy system**
- **Growth 10-20 % per year**
- **Industrial Gas Turbines (50 kW to 50 MW) is the best DG solution near as well as long term**
  - **efficiency**
  - **fuel flexibility**
  - **easy to install and operate**
  - **large development potential**
- **Solution both for the developed world and developing countries**



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# Goals for LIPIGT

## Meeting Sustainable Development

### Industrial Gas Turbines

Efficient Decentralised Power  
for a Sustainable Energy System

#### Operation

- Availability/Reliability
- Easy maintenance
- Flexibility-cycling

**Bring the benefit of  
easy, efficient power  
to small and  
heterogeneous users**

#### Environment

- Fuel efficiency
- Combined Heat and Power
- Low Nox
- Renewables and CO<sub>2</sub>-capture

**Easy and community  
- friendly energy for  
current and  
foreseeable  
environmental  
requirements**

#### Economics

- Fuel efficiency
- Fuel flexibility
- Low CoE

**Favourable  
economics to replace  
polluting sources  
and sustain energy  
supply in the long  
term**



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## LIP DER-GT

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- **Technologies for Decentralised Energy and Renewables for use in Gas Turbines**
- **New technologies for IGTs in 0,1 – 20 MW range**
- **Efficiency, emissions, fuel flexibility and system integration**
- **Advanced cycles ( ICR, wet, fuel cell etc ), ceramics, catalytic combustion and polygeneration**
- **Numerous projects administrated by management team**



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## Project Goals

**Develop technologies that long term will lead to the following general key IGT characteristics**

**Bio fuels, hydrogen, < 3ppm NOx**

and with efficiencies

**< 500 kW      40%**

**5 MW      50 %**

**20 MW      55-60 % (comb cycle)**



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## Working Procedure

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**A DER-GT Team is created**

**Project teams suggest specific projects**

**Suggestions are evaluated by DER-GT against its goals and decision is taken by board**

**DER-GT management continuously monitors performance of projects and gives management support**

**DER-GT will be active in finding projects and in creation of project teams**

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## The overall goal

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*“Make IGTs the power producer of choice over the next decades”*

- **Secure a future sustainable energy system**
- **Grow a strong industrial base in Europe by growing existing IGT industries and by creating new ones**

# CE-IGT Targets

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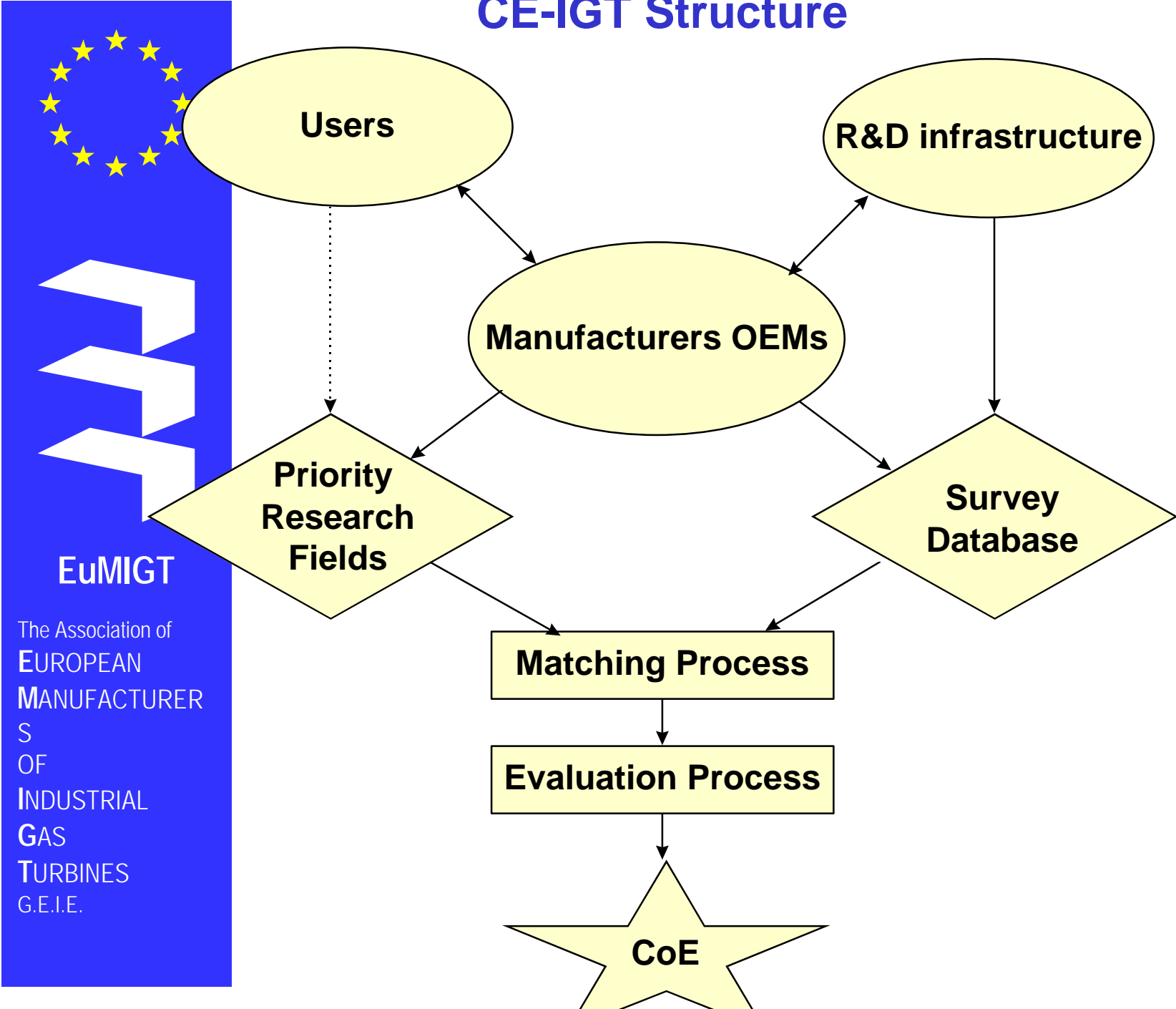
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Create more co-ordinated and integrated  
European research activities in the IGT field

- Identification and definition of future technology needs and requirements in the European IGT industry
- Identification and mapping of expertise in the field of IGT research
- 
- Evaluation and identification of Centres of Excellence (CoE)
- 
- Creation of clusters in the priority research field where the CoE will play an essential role.



# CE-IGT Structure





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User's workshops:  
Long term goals (2015-2020)

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- **Unattended, uninterrupted operation for 48.000 hours**
- **Simple cycle efficiency > 50% - 55%**
- **Investment costs down with 20%**
- **Maintenance costs down with 40% (short term), 50%-60% (long term)**
- **Oil free engine (magnetic bearings)**
  
- **Hybrid cycles - fuel cells**
- **Exhaust treatment**



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## **Conclusion and next steps**

- **EuMIGT is established in Brussels with office and General Manager**
- **A forum and procedure for cooperation has been created**
- **We have established good links with EU on funding, directives etc**
- **but not been able to create a Large Integrated Gas Turbine program**
- **We now will consolidate the position and**
  - **Invite large GT manufacturers**
  - **More associate members**
  - **Increase activity in Brussels and in member states**
  - **Plan for next FWP**
    -