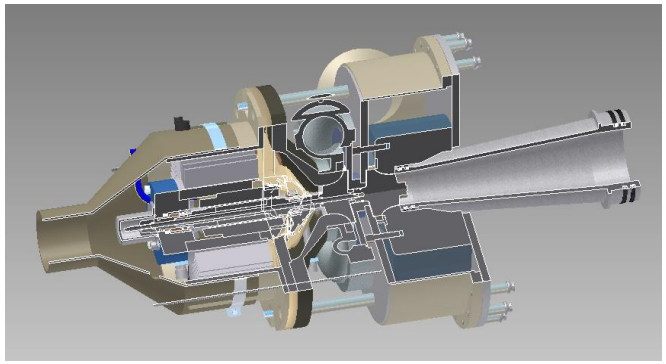

Small scale microturbines

London May 12, 2015

Compower AB
Solna, Sweden

Lars Malmrup
+46 733550081

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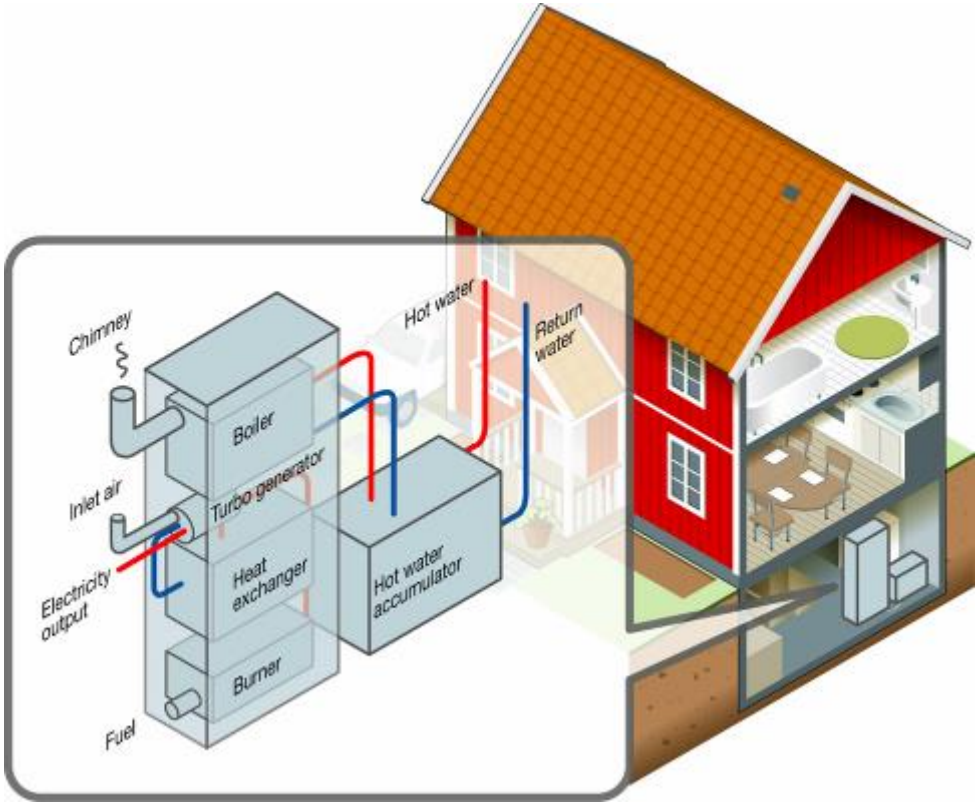
COMPOWER'S MISSION

Develop, manufacture and market small-scale environmentally compatible power generation systems that offer the customers reliable and economical electricity.

Power range below 30 kW with systems based on a unique microturbine solution.



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COMPOWER'S STORY

1987 | **1992-1996** | **1998** | **2004** | **2007** | **2010**

Kungl Tekniska Högskolan

World's 1st micro turbine with high speed permanent magnet alternator

VOLVO & ABB microturbine hybrids and components

Turbec T100 microCHP

Compower Company formed (Residential microCHP)

First prototype assembled

KTH polygeneration Stockholm

VATTENFALL

HSG 40 microCHP
40 kWe/100 kWth

Kristianstads kommun

ET10 field trial unit

Compower

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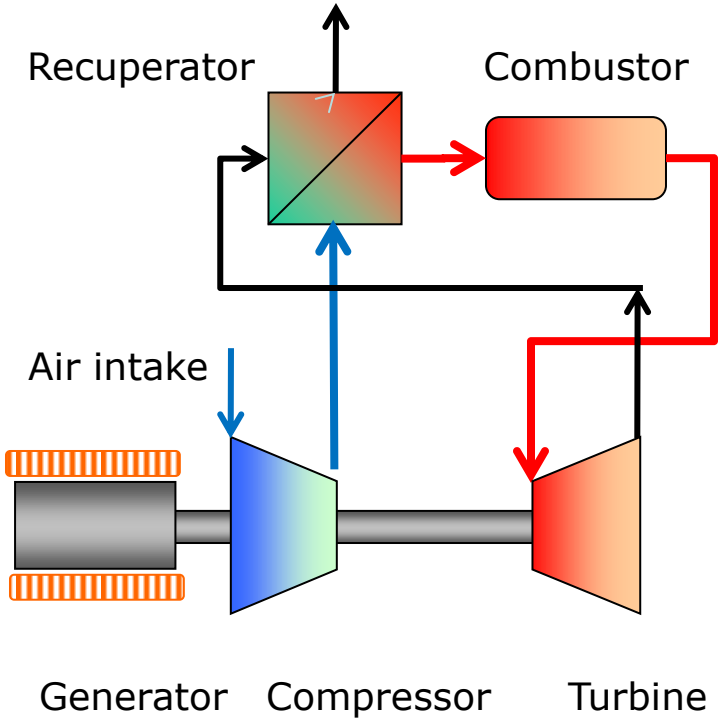
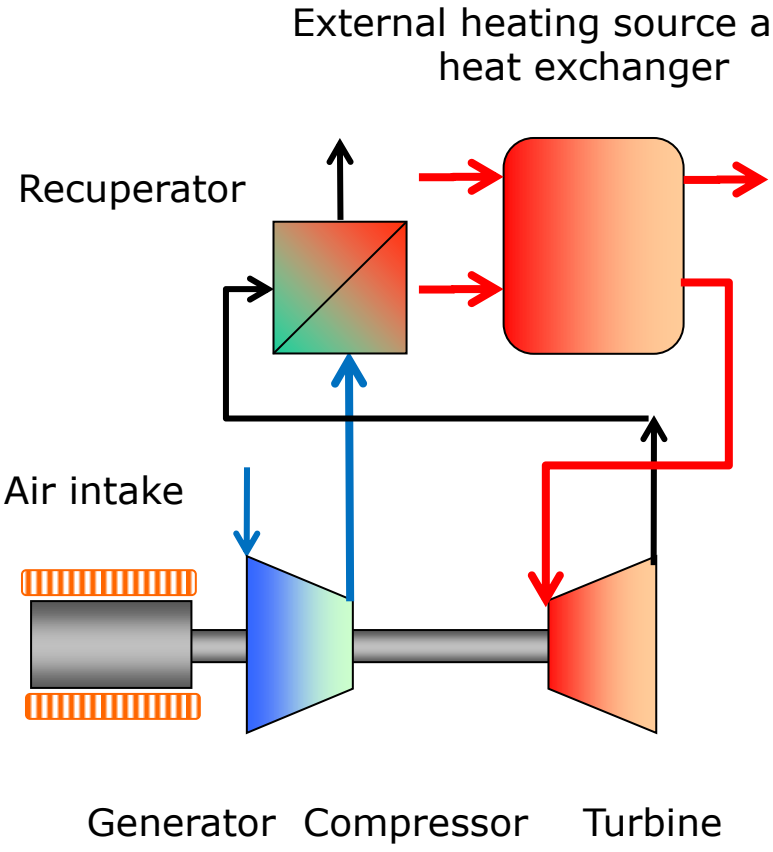
DIRECT AND INDIRECT HEATING

Directly fired



Externally heated



Same core microturbine

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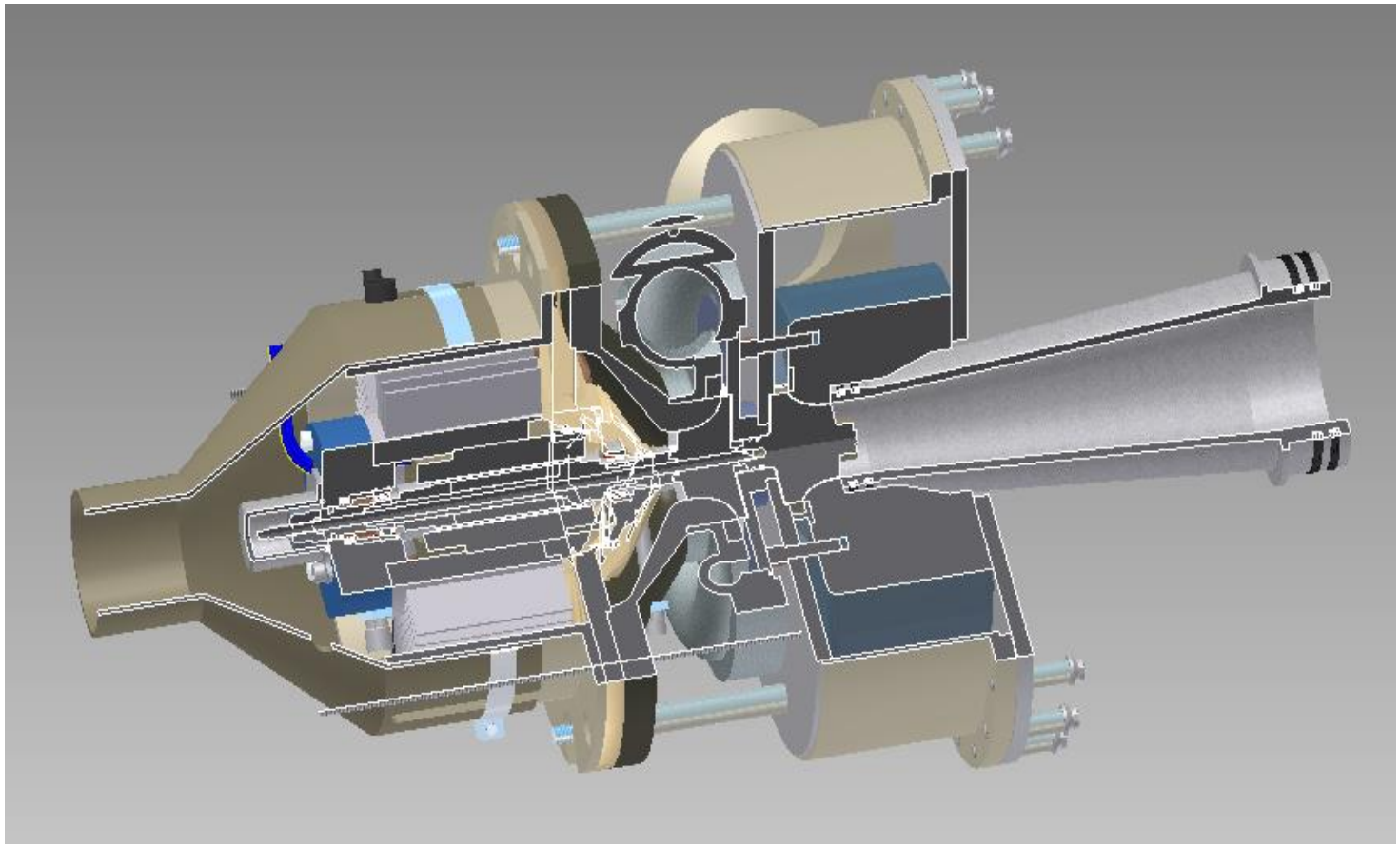
CORE MICROTURBINE



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ROTATING ASSEMBLY

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PROTOTYPES

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ET10 FIELD TEST PROTOTYPE

In cooperation with

Kristianstads kommun

Energimyndigheten

SGC Svenskt Gastekniskt Center AB

Bentone

REGION SKÅNES MILJÖVÅRDSFOND

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Most critical task – reduce cost

- Improve robustness
- Production engineering

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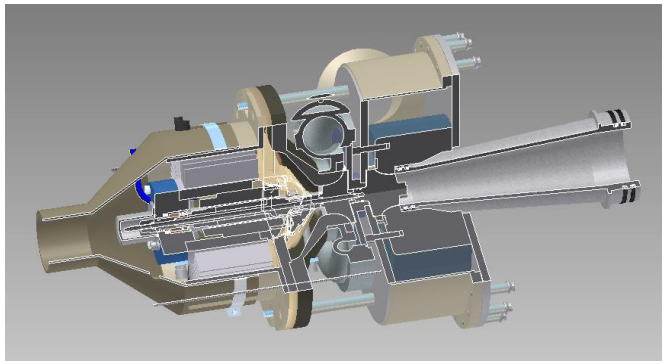

Microturbine technology

London May 12, 2015

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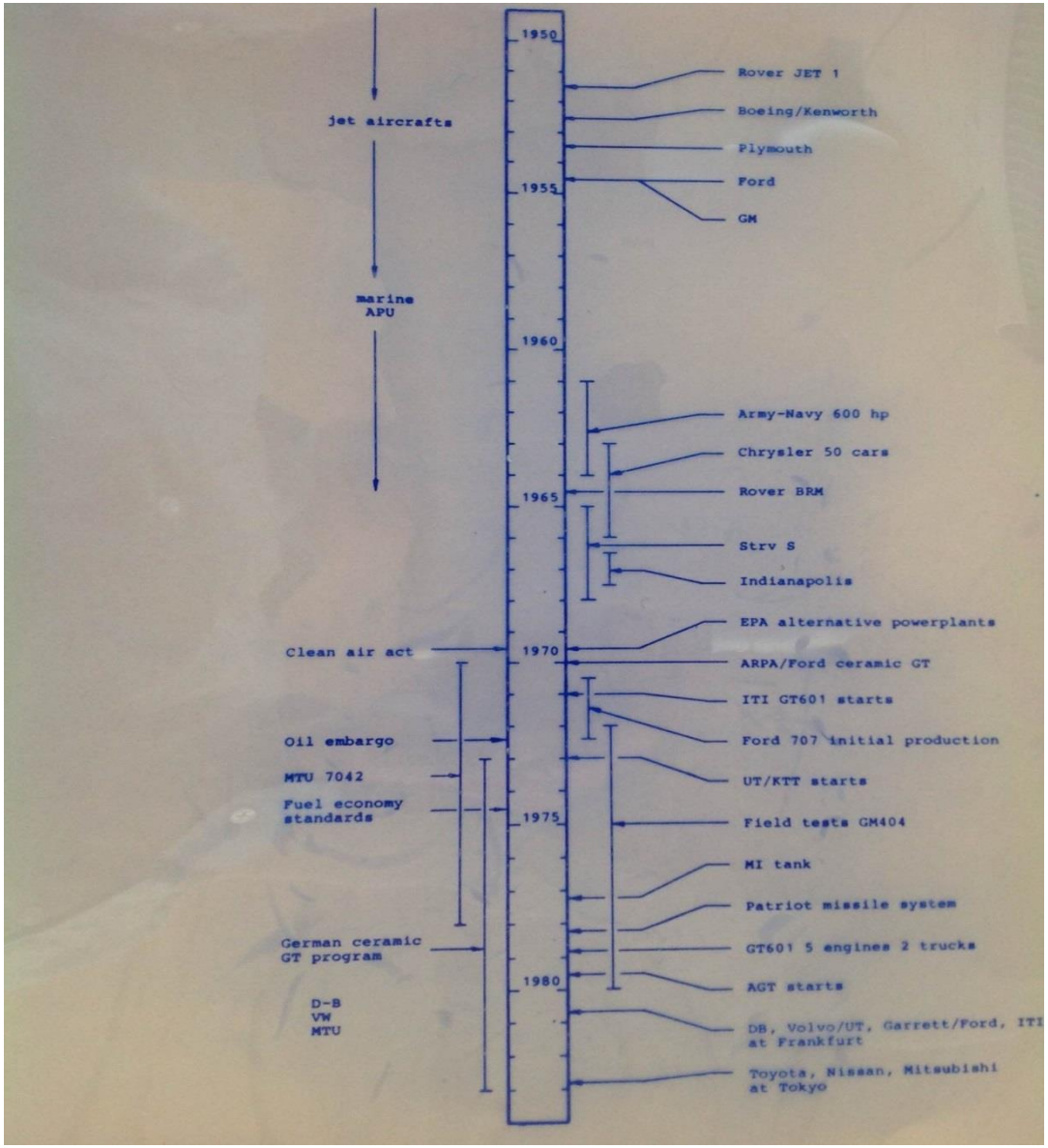
IT STARTED WITH AUTOMOTIVE GAS TURBINES



Power

Emissions

Fuel Economy

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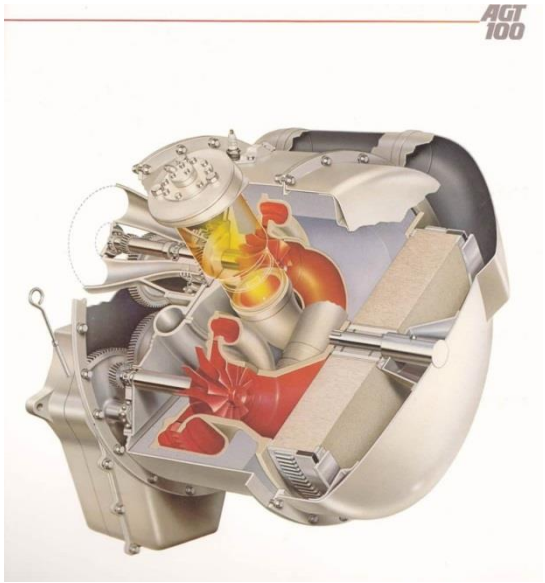
DOE AGT PROJECT

October 1979 through June 1987. …. provide the US automotive industry the high risk, long range technology necessary to produce gas turbine engines for automobiles that will reduce fuel consumption and reduce environmental impact.

Similar Projects in Germany and Japan

Ceramic Components incl heat exchanger



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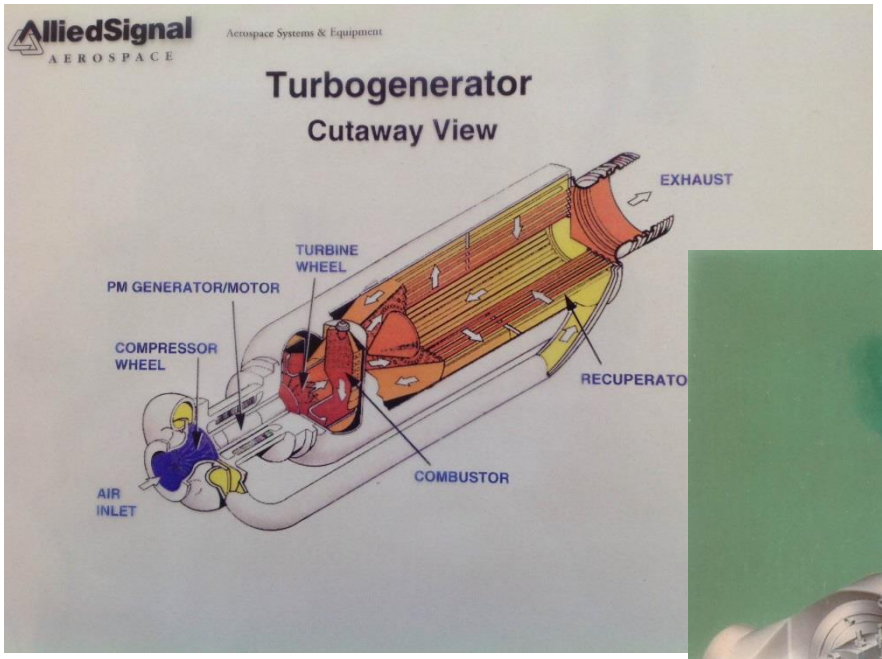
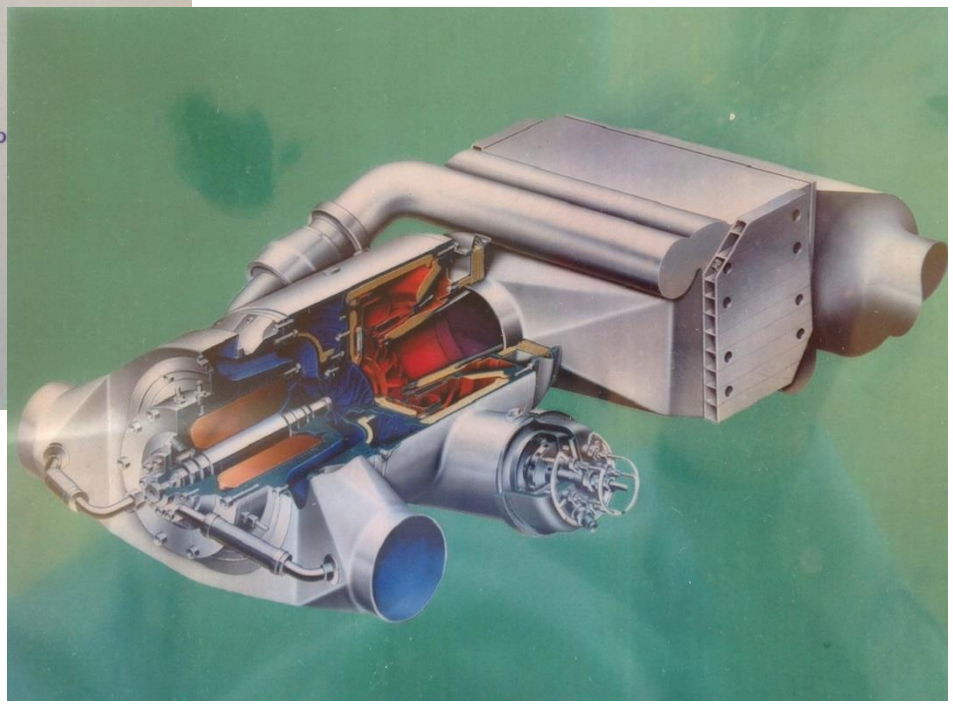
PM GENERATORS LEAD TO MICROTURBINES



Allied Signal Military



Volvo Automotive

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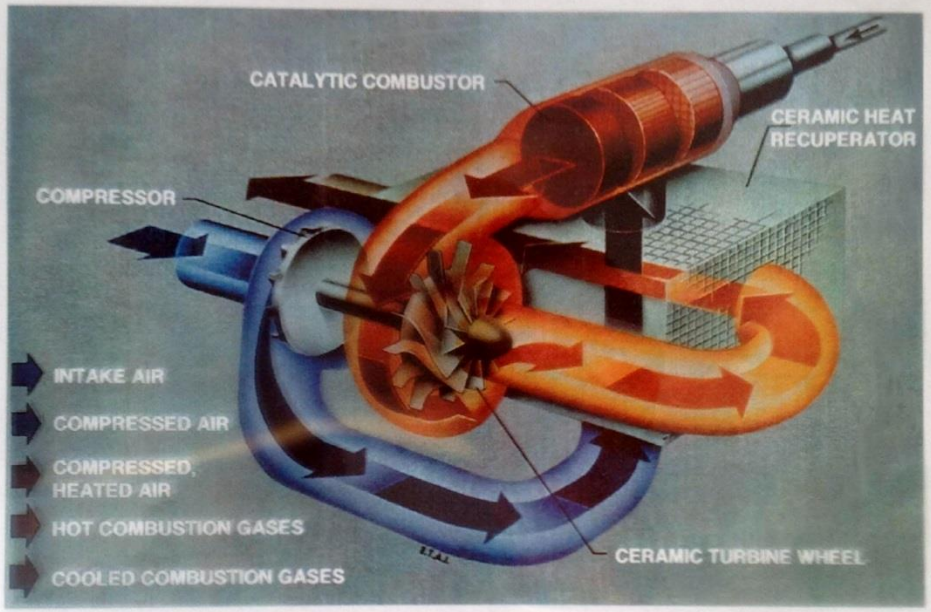
EUROPEAN PROJECT 1993-1996

AGATA



- Three components
  - Catalytic combustor
  - Ceramic turbine wheel
  - Ceramic static heat exchanger

Combustor Division

VOLVO

Volvo Aero Corporation

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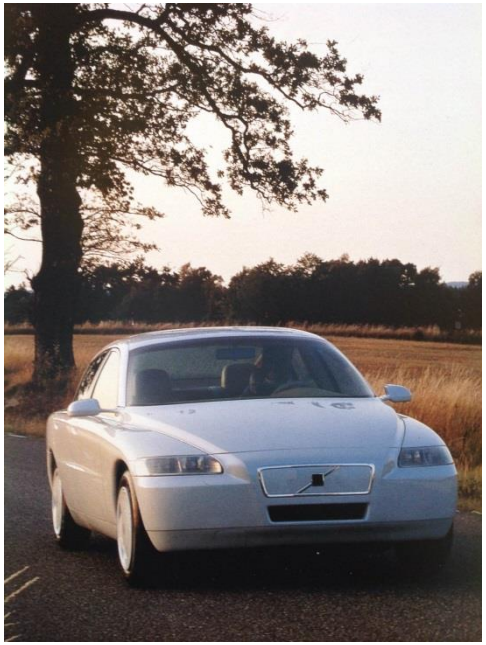
FOCUS FROM AUTOMOTIVE TO DG



LIFE
Cost
Fuel flex

COST
WEIGHT
SIZE

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ADVANCED MICROTURBINE PROJECT

- DOE project 2000-2006
- Systems, components, ceramics
- Capstone, Honeywell, I-R, Elliot, GE,UTC

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WHAT DO WE NEED?

PRIORITY 1

- Short term
  - Lower cost recuperators –cost vs effectiveness
  - Lower cost power electronics

- Longer term
  - Higher operating temperature for higher efficiency and lower specific cost
    Ceramics - also recuperator

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OTHER IMPORTANT TECHNOLOGY AREAS

- Bearing systems incl air bearings
- Combustion unconventional fuels
- Other cycles and components for those
  - External heating – heat exchangers
  - Sub atmospheric
  - Two stage intercooled
  - Other

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