



Trigeneration

“Future of clean & green energy generation”

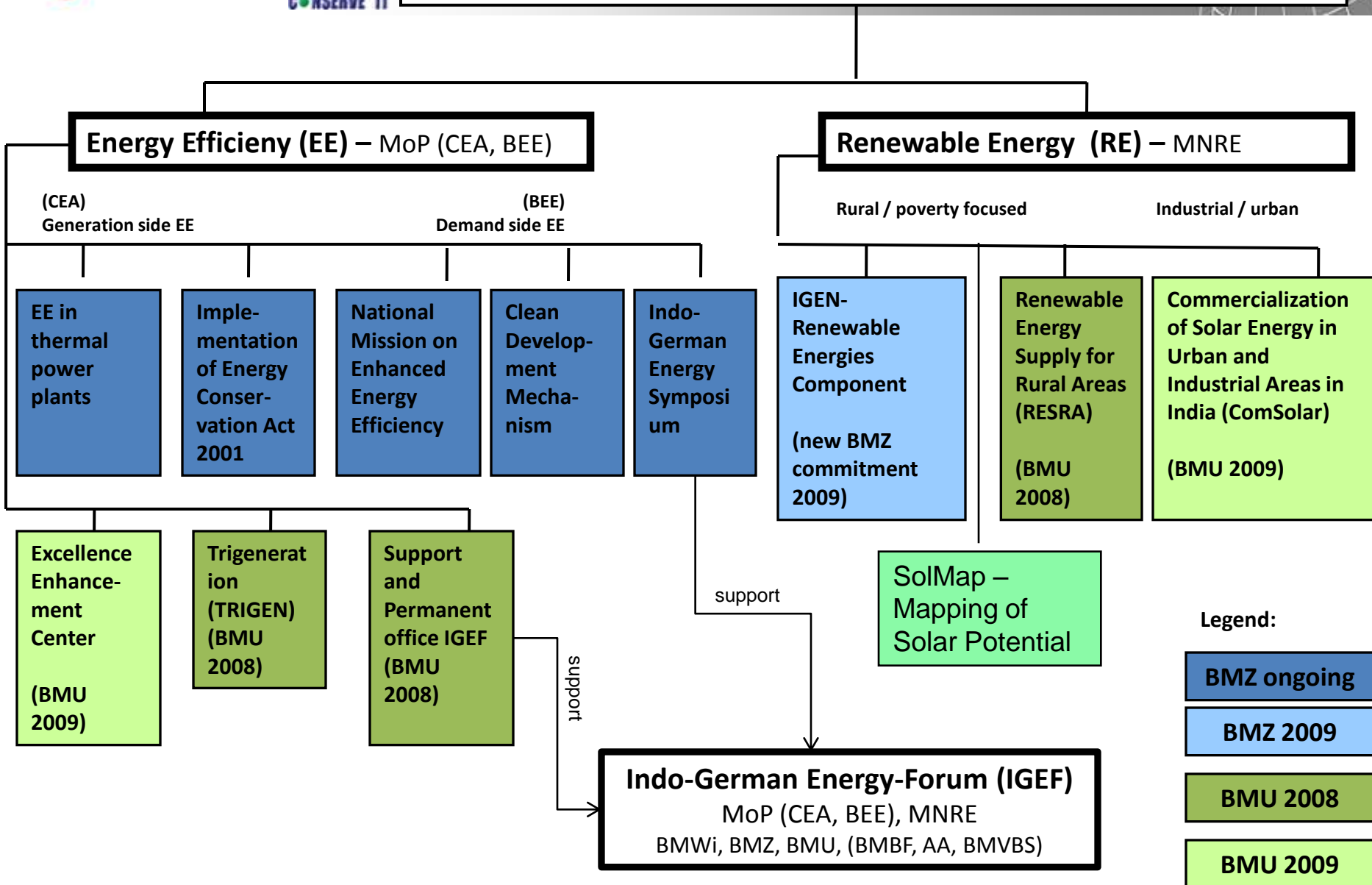


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Indo-German Energy Programme (IGEN)





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4. Economics of Trigeneration

5. Pay Back – Pilot Project





1. Energy Issues

Requirements:

- ⌘ Energy security
- ⌘ Cheap and reliable power

Problems:

- ⌘ Peak shortage
- ⌘ Power deficit
- ⌘ No power security
- ⌘ Open access allowed but not used

Issues:

- ⌘ Subsidies
- ⌘ Free electricity
- ⌘ T&D losses





1. Indian commercial building sector - profile

- ⌘ Demand for office space is rising due to increasing share of service sector
- ⌘ Office space with higher standards are in demand
- ⌘ Indian office space share
 - 70 % IT companies
 - 15 % financial service provider & pharma companies
 - 15 % other sectors
- ⌘ Average energy consumption in buildings
 - HVAC – 55 %
 - Lighting + Electronics (27 % + 14 %) = 41 %
 - Others – 4 %

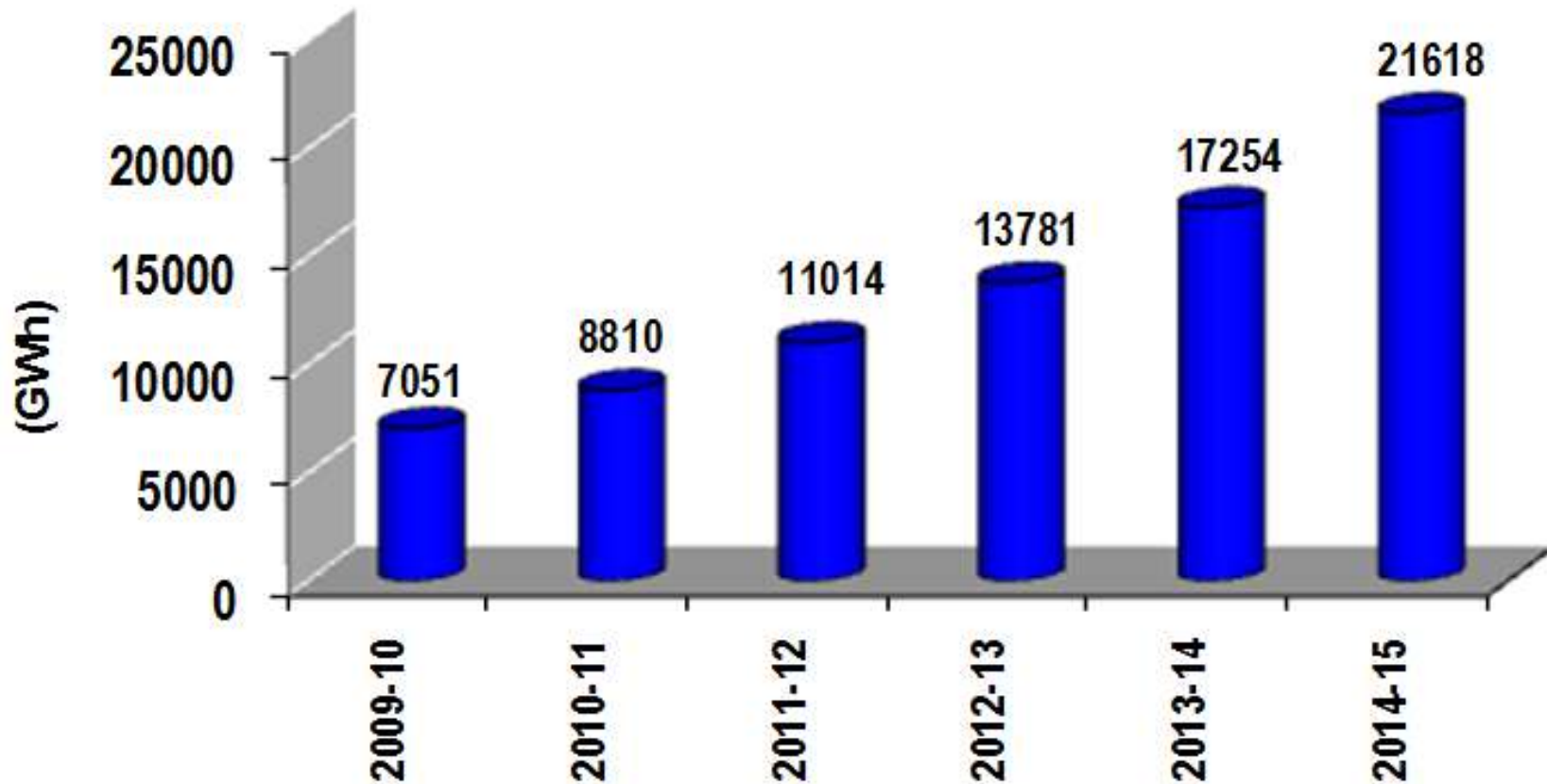


1. Factors that decide energy use inside a building

- α Climate zones: Hot and Dry, Warm and Humid, Composite, Temperate, Cold and Cloudy and Cold and Sunny.
- α Space use (function of): Occupancy
- α Schedule: Working hours
- α Building envelope: Glazing area
- α Lighting: Natural and artificial
- α HVAC systems: Conditioned/Non-conditioned
- α Miscellaneous loads: Motors, exhaust fans, lifts escalators, refrigeration equipments, etc

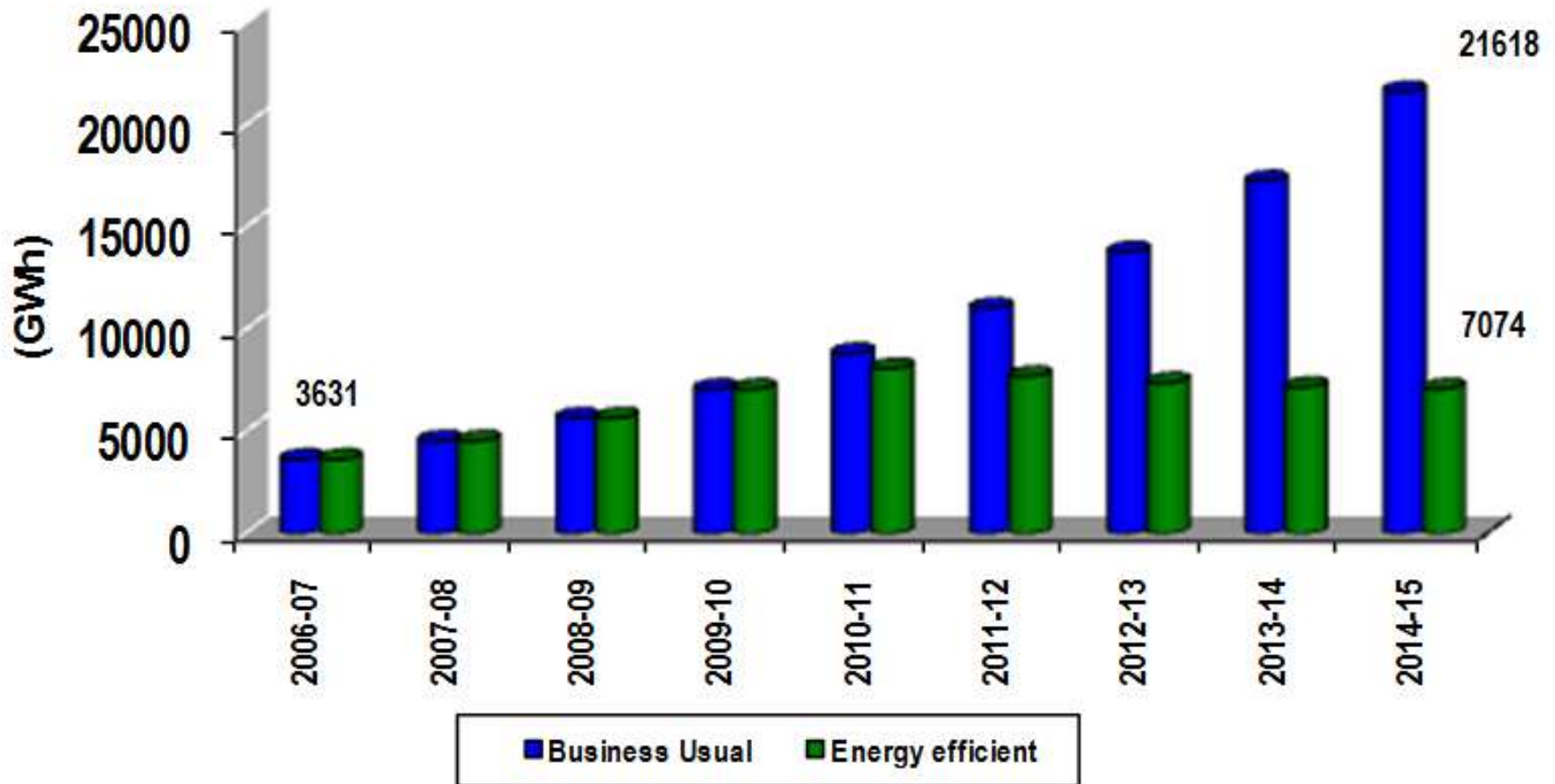


2. Projected energy consumption in Hotels





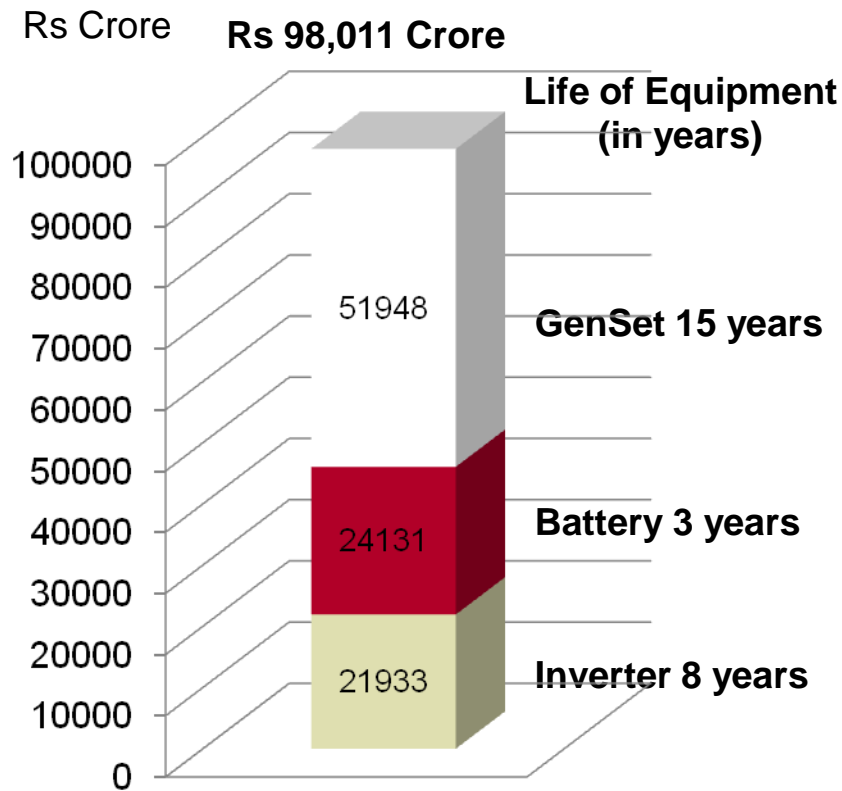
2. Energy Saving potential in Hotels



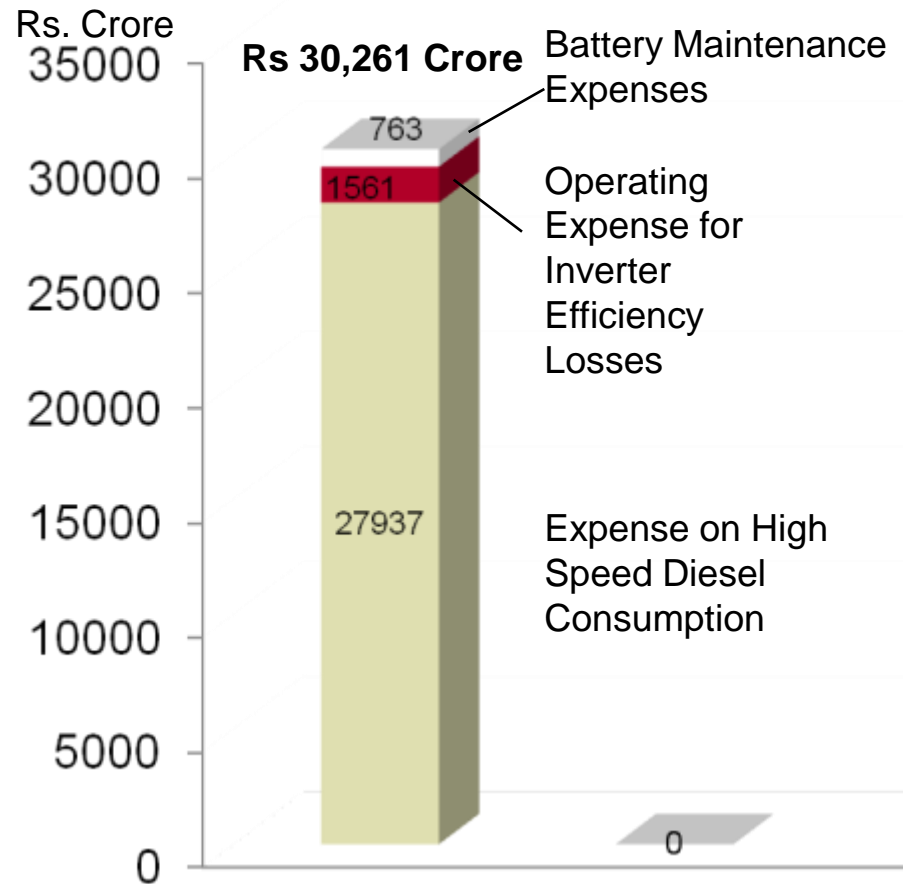


2. Investment in power backup

Investments in Backup Power Equipment



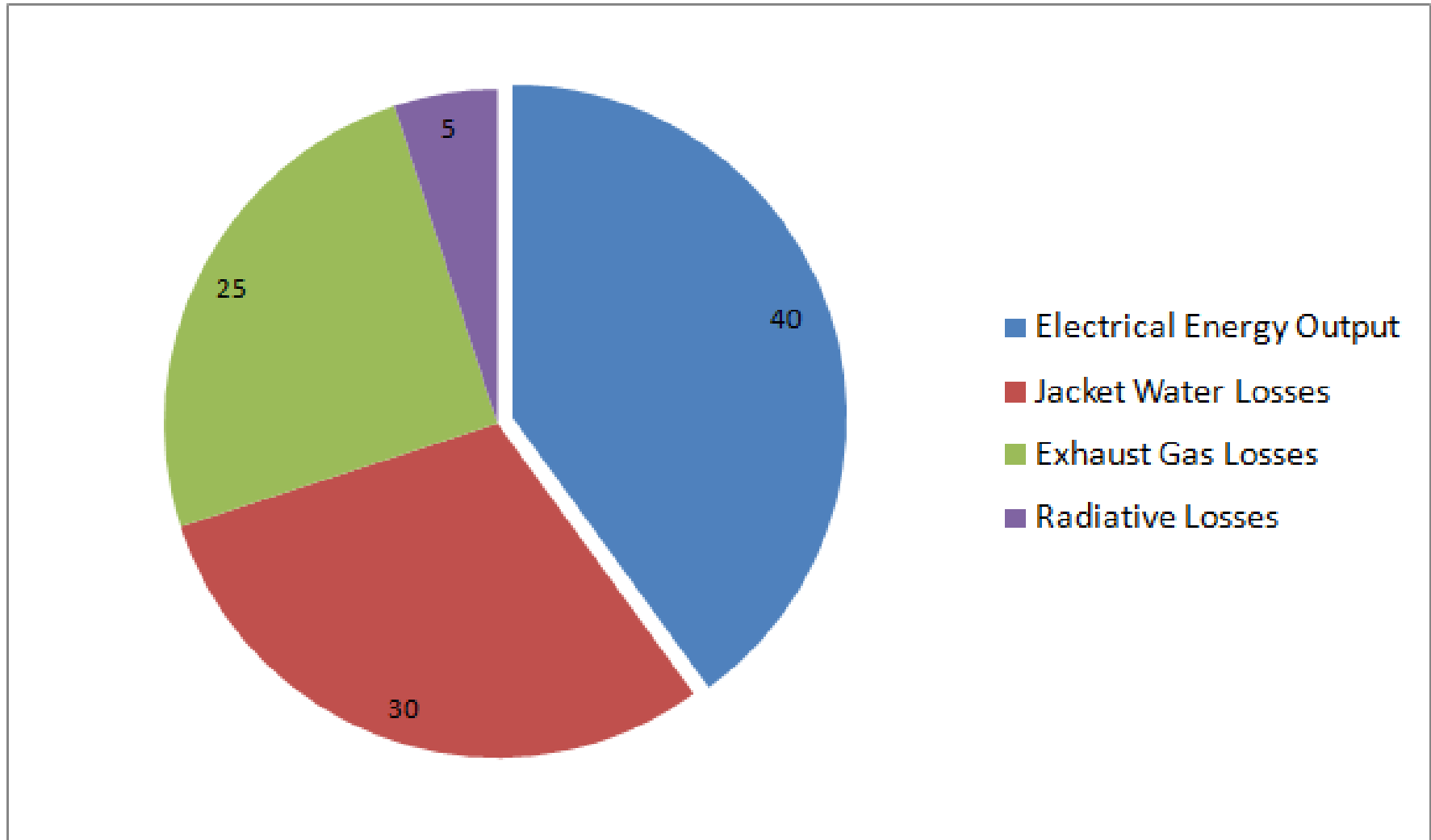
Annual operational expenses for Backup Power Generation



Source: The real cost of power, Wartsila

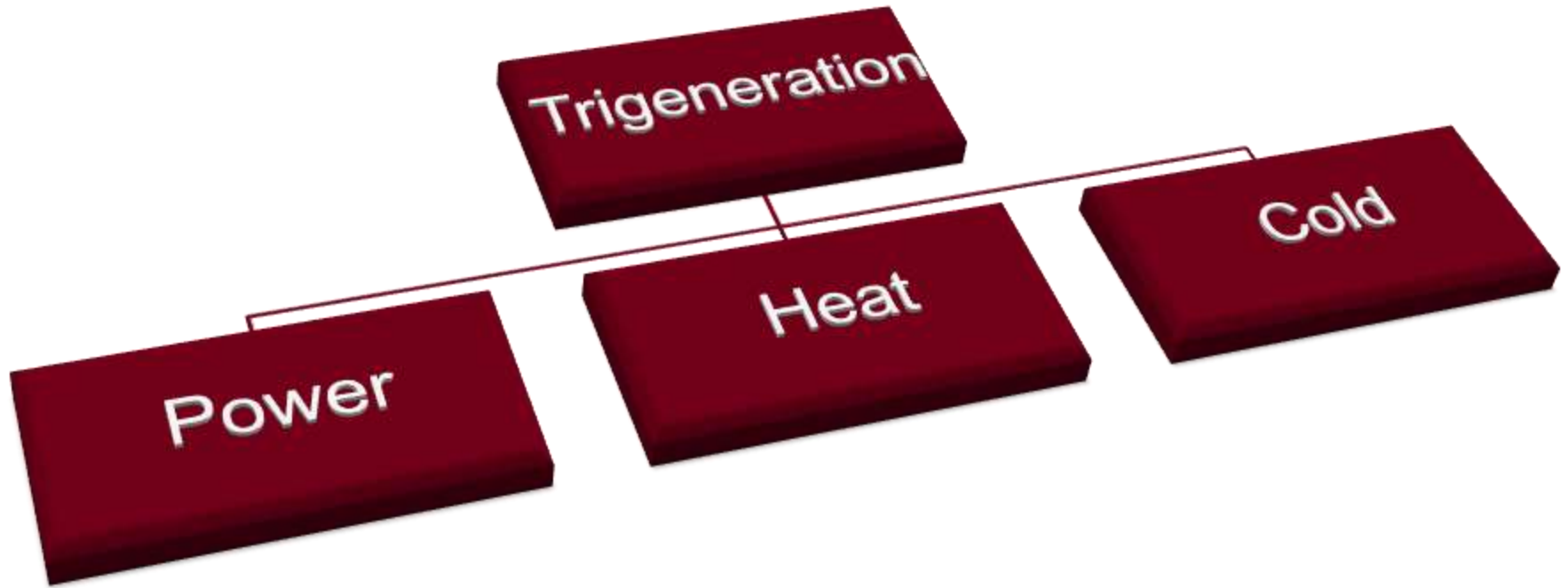


2. Energy from Diesel Generator (DG set)





3. What is Trigeneration?



Simultaneous production of Electricity, Heat and Cold

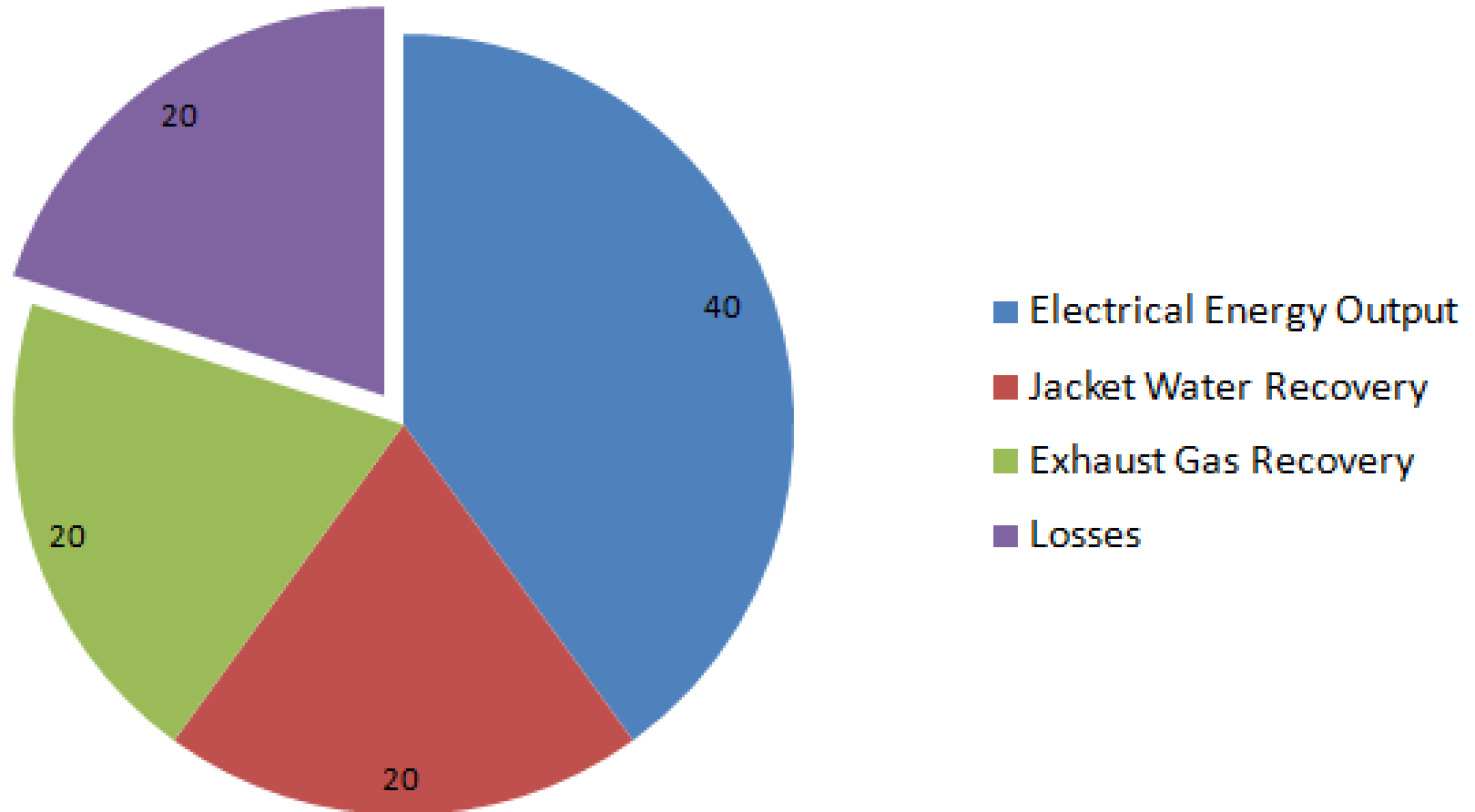


3. Trigeneration Technology - Overview

- ⌘ Electricity is the main product, heat as by-product is used for air conditioning and heating
- ⌘ Trigeneration uses primary energy more efficiently i.e. up to 80 % efficiency
- ⌘ Avoid high energy waste in the form of heat by utilizing waste heat
- ⌘ Single system to provide electricity, heat & cooling



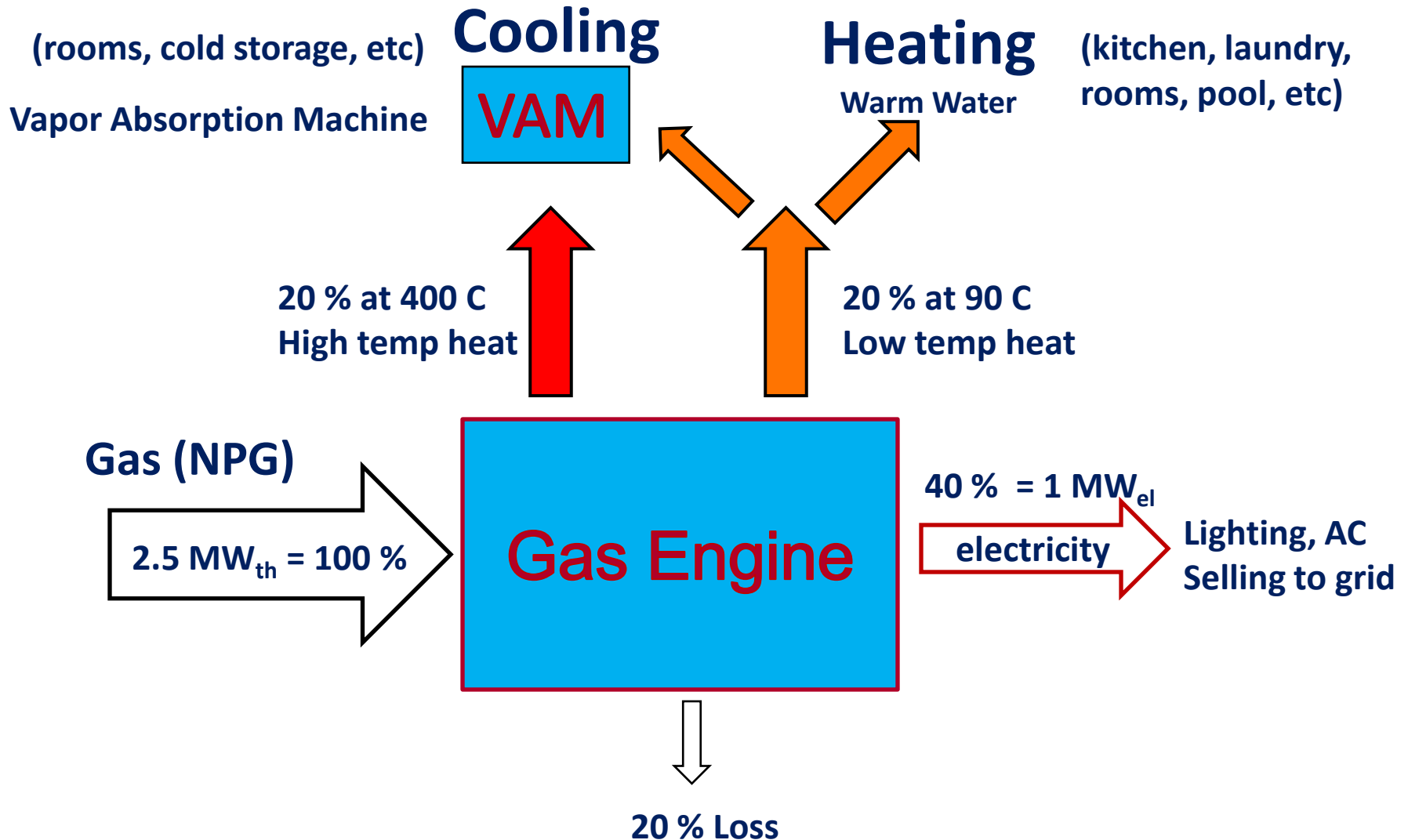
3. Energy generation from Trigeneration ~ 80 %



**Trigeneration efficiency ranges around 80 %
conventional electricity generation operates at 40 %**



3. Main Components of Trigeneration:



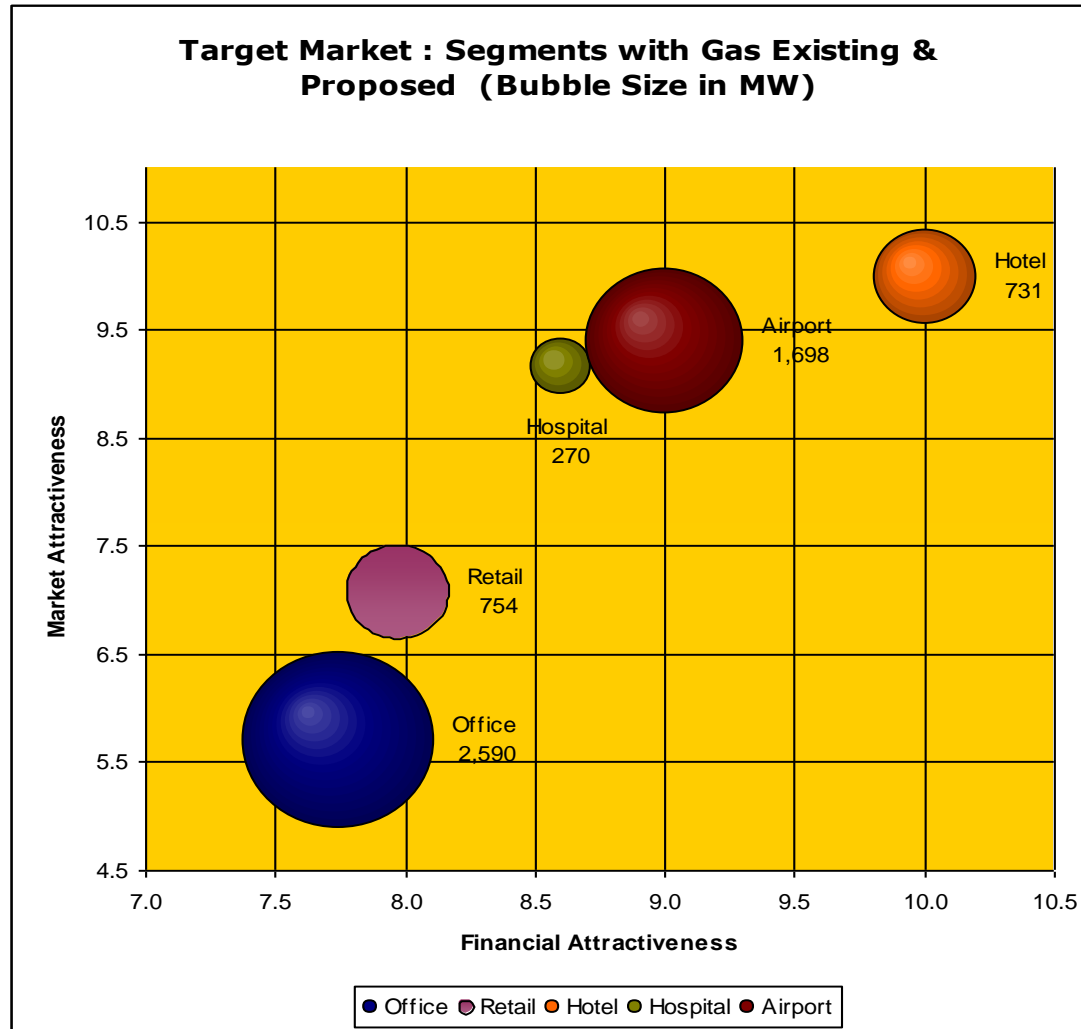


2. Target Market: Segments with Gas Availability (in MW)





2. Target Market: Segments with Gas Availability and Proposed Gas (in MW)







3. Main Components of Trigen – Gas Engine



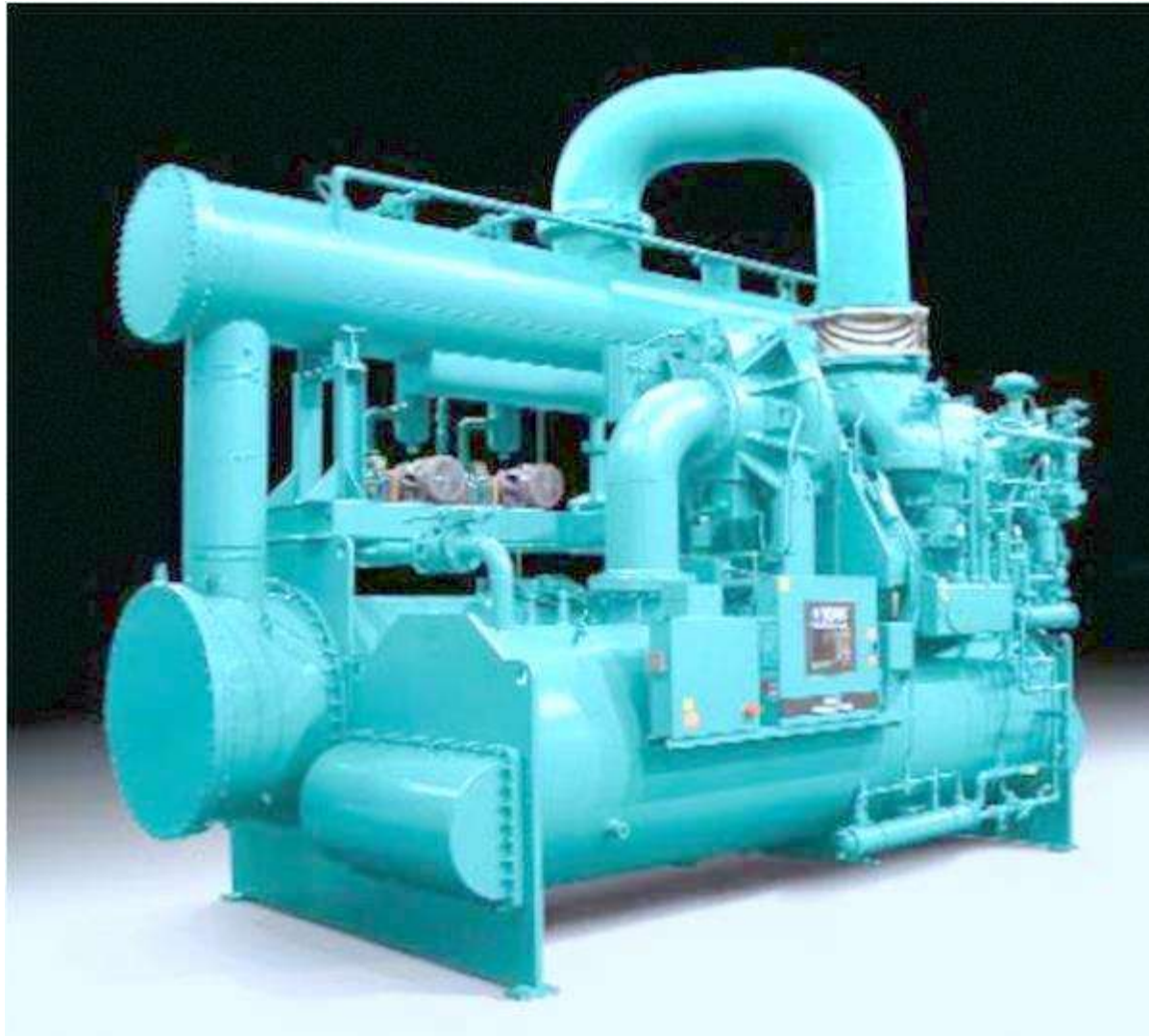


3. Main Components of Trigen - VAM





3. Main Components of Trigen - Chiller





3. Technology suitable to user requirement

Small scale to Large Scale

Gas engine to gas turbine

• Typical range: 250 kW_{el} to several MW_{el}

Single user to Multi user

User to cooperation



Requirement to setting up Trigen

- Simultaneous electricity, heating and cooling demand
- 24x7 operation
- **Space** for equipments
- Sufficient **height** to install/maintain the Trigen system
- Availability of Natural Gas/Fuel



3. Application areas of decentralized power generation

All buildings and industries which use simultaneous electricity, heating and cooling

Hotels, Hospitals

Airports, Industries

Data Centers

Shopping Malls,
Residential Societies



4. Why Alternate Energy Sources?



Efficiency

- Improve energy efficiency

Fuel

- Reduces fossil fuel consumption

Environment

- CO₂ emissions reduced

Cost

- Reduced energy cost

Supply

- Energy supply security



4. Investment cost and benefits

Cost incurred

Benefits

Capital cost

Operation & Maintenance

Fuel cost

Power/Electricity

Air-conditioning

Heating

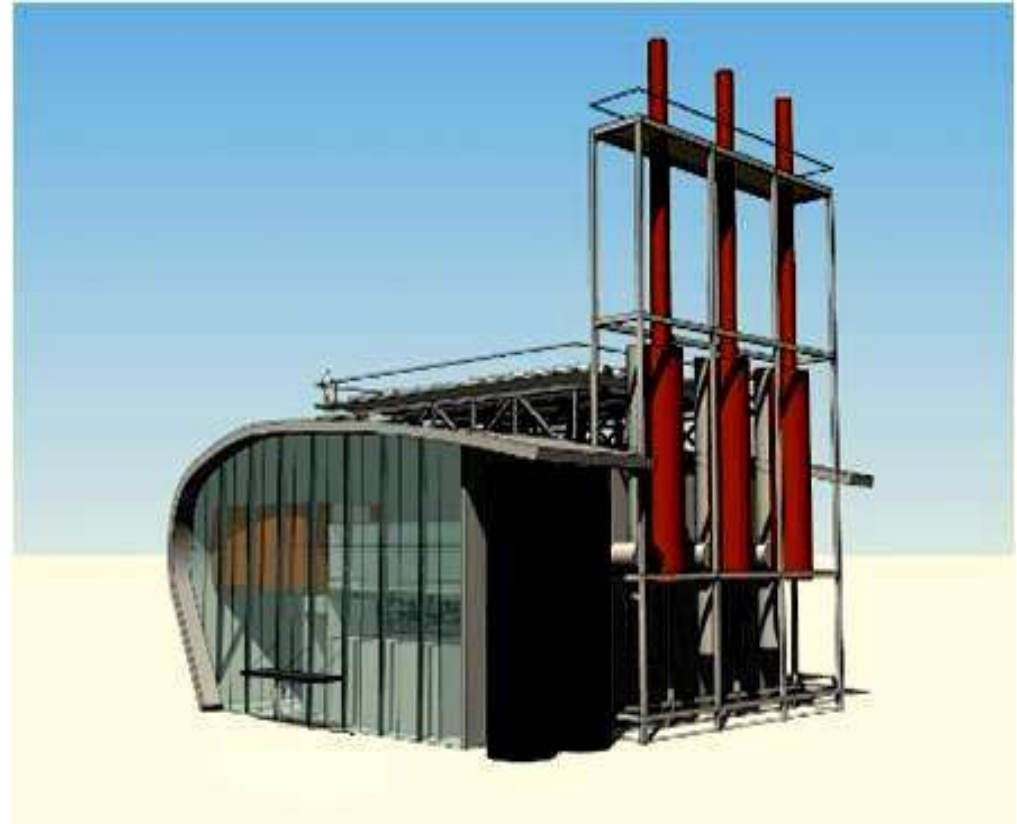
Selling to grid





4. Addressing the issues:

- α Low transmission and distribution losses
- α Easy availability of power
- α Optimized according to user requirement
- α Low investment risk
- α High profit, if surplus power fed into the grid
- α **Efficient use of primary fuel through Trigeneneration**





5. Pilot Project at New Delhi

Supply to the facility:

Electricity: 347 kW_{el}

Cooling: 265 TR (105 TR from waste heat recovery through VAM; balance from Centrifugal Chiller of 250 TR capacity)

Heating: 50 kW (LT heat recovery)

During power failures:

Three DGs of 1000 kW capacity installed



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3. Experiences
4. Ideas/suggestions for further improvement
5. Problems/issues related to technology/utility
6. Bridge between user, Supplier, O&M, policy makers



Indo-German Trigen Project

Experience quality reliability....

Industry Experts

1. Architects and consultants

Introduction

India's annual per capita energy consumption of 0.65 Tons of Oil Equivalent (TOE) and electricity consumption of 660 kWh is relatively low compared to 5 TOE and 7,000 kWh respectively in highly industrialised and urbanised countries. There is a strong relation between the Human Development Index (HDI) and per capita electricity consumption. Assuming a stabilised population of 1.65 billion in the future, India may reach the plateau of about 4,000 kWh in a best-case scenario in 2050.

The enactment of the Energy Conservation Act 2001 is seen as a major step towards regulating the...

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- ✘ Dissemination of case study



Thank you

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