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# Trigeneration

## *Future of clean and green energy generation*

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COOPERATION
REPUBLIC OF INDIA
FEDERAL REPUBLIC OF GERMANY

# Contents

# 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

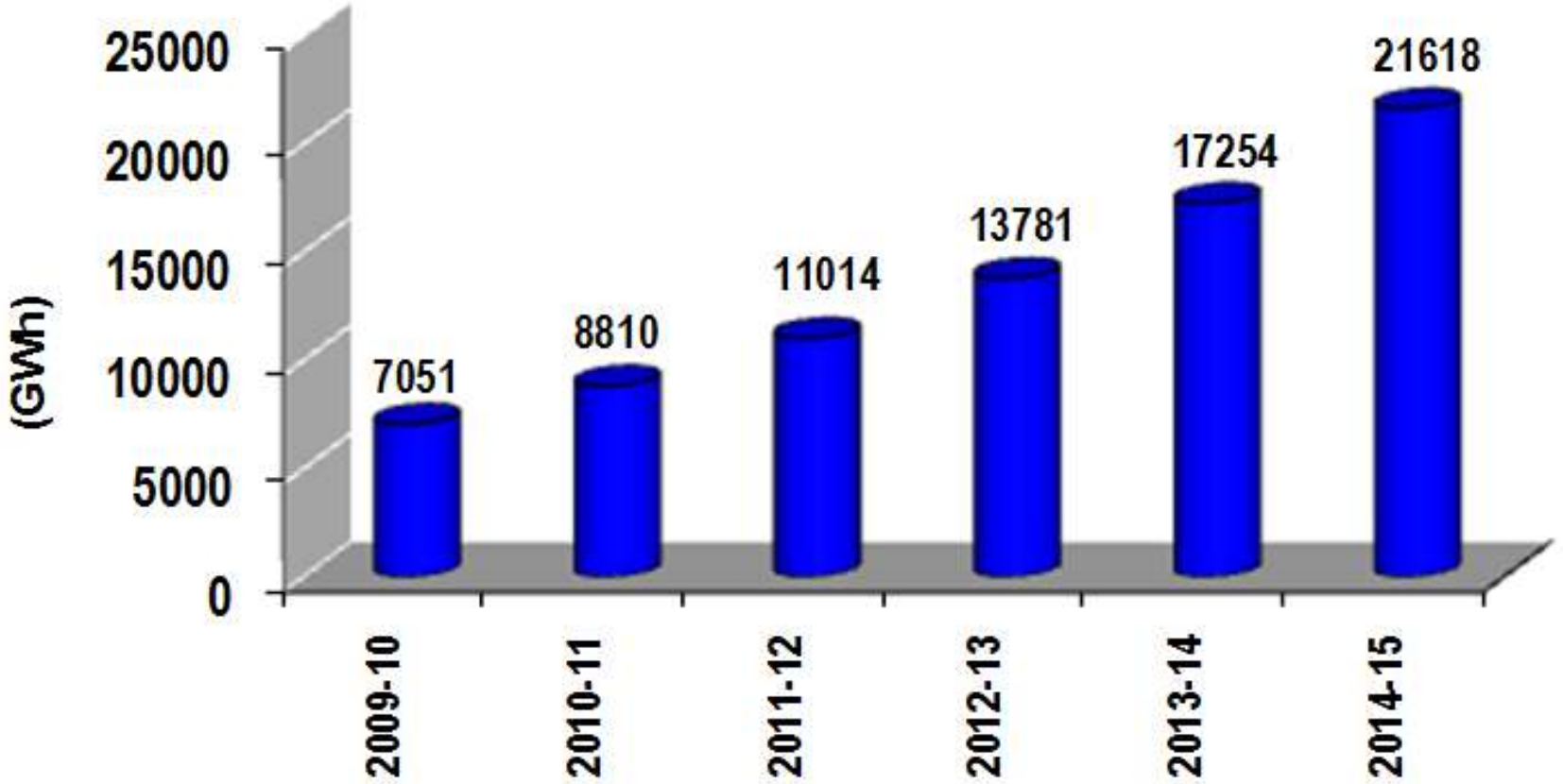
# 1. Indian commercial building sector - profile

- 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 %

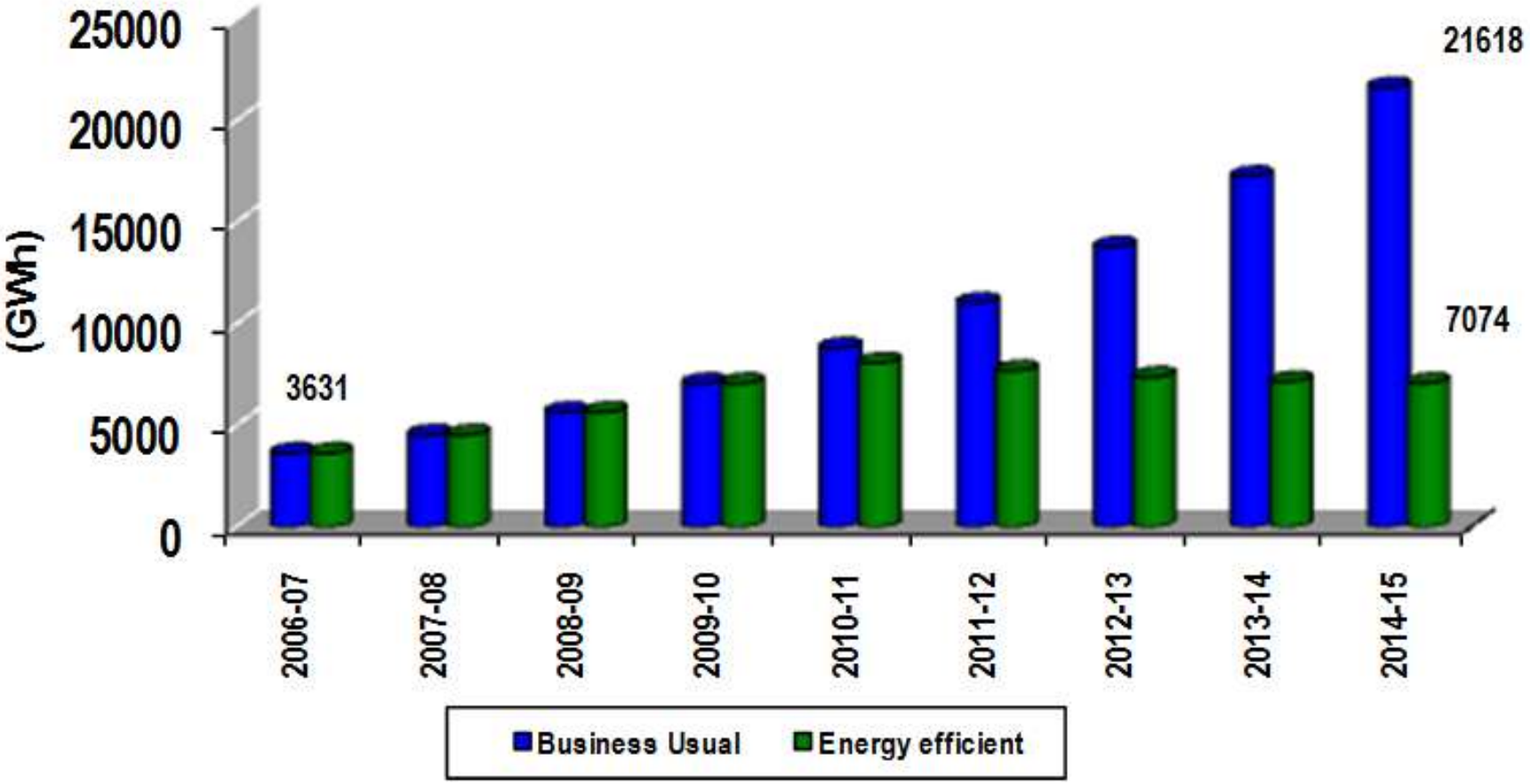
# 1. Factors that govern energy use inside a building

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

# 2. Projected energy consumption in Hotels

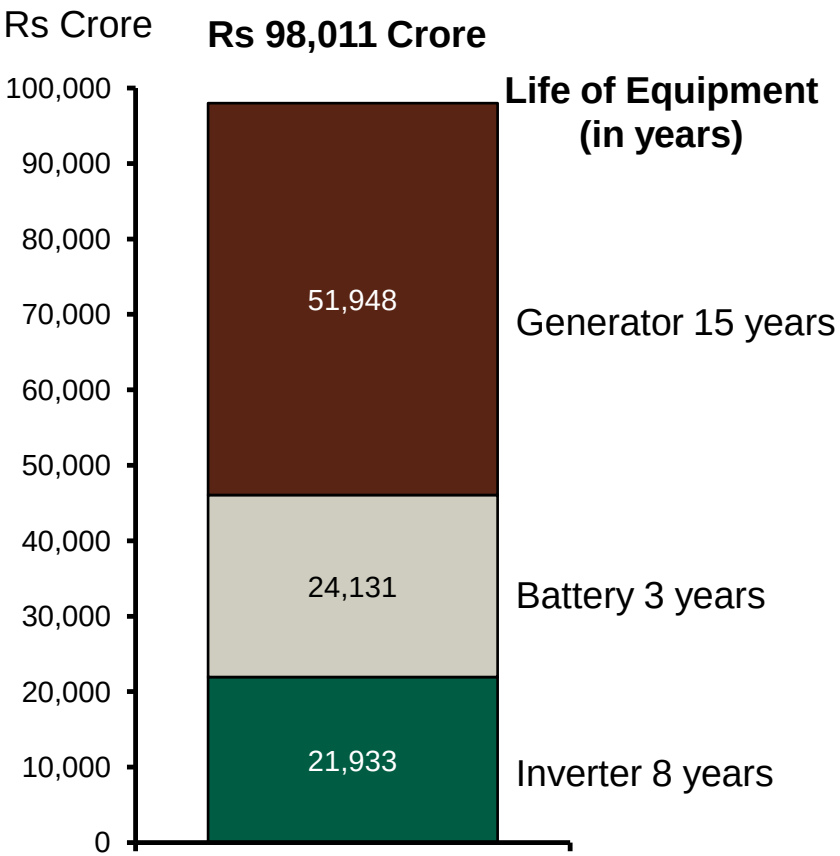


# 2. Energy Saving potential in Hotels

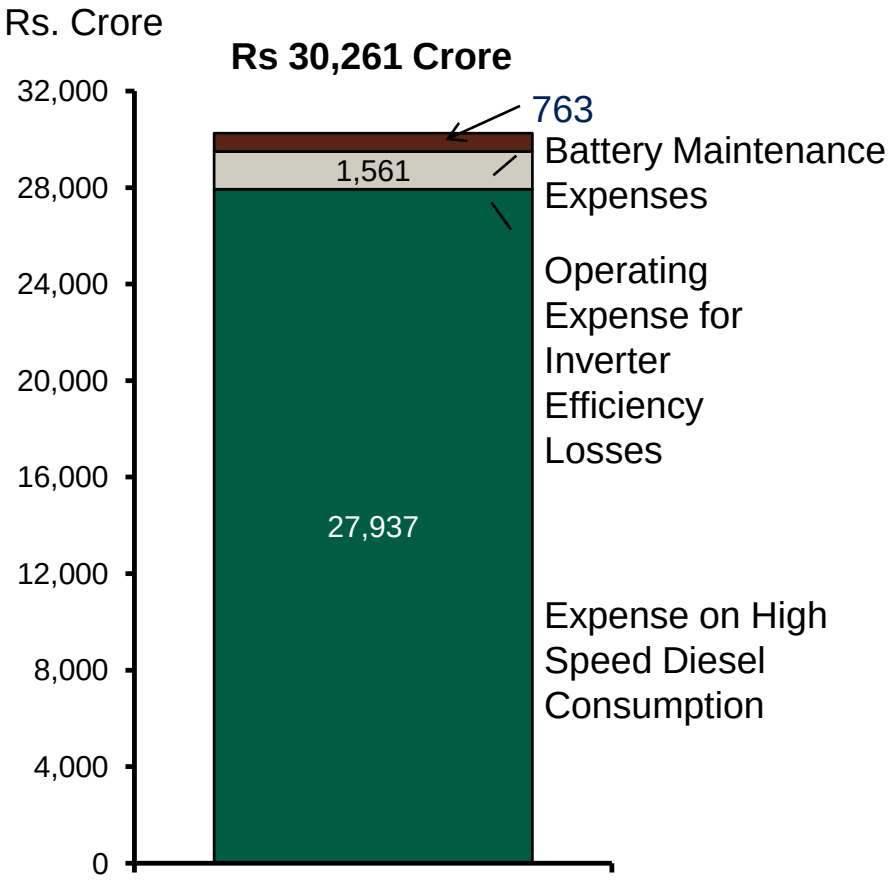


# 2. Investment in power backup

## Investments in Backup Power Equipment

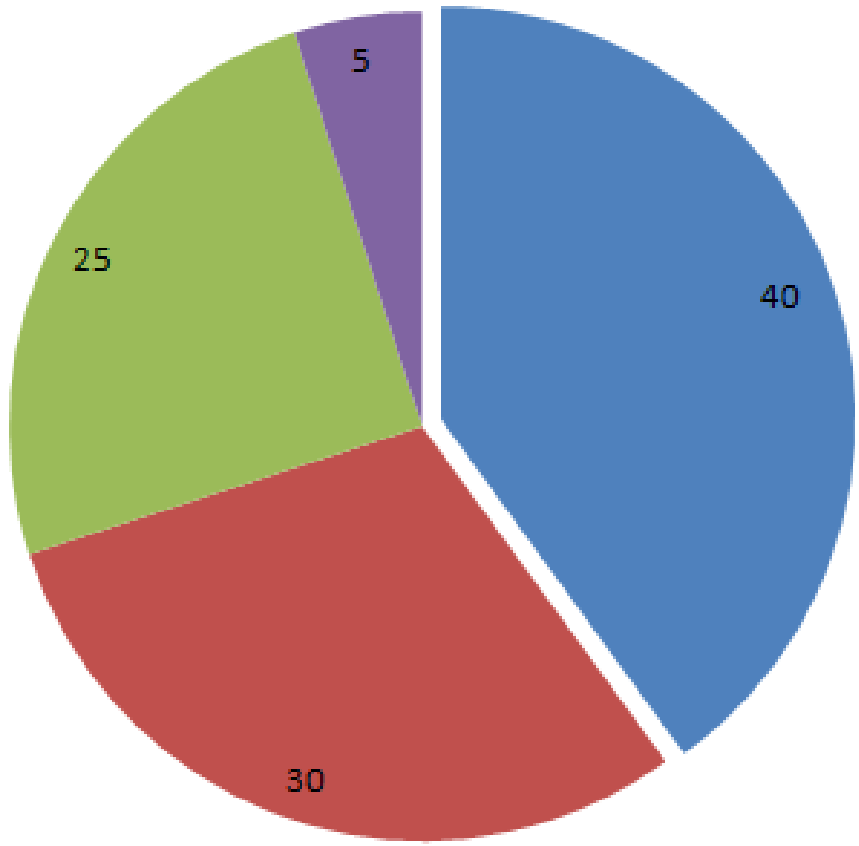



## Annual operational expenses for Backup Power Generation



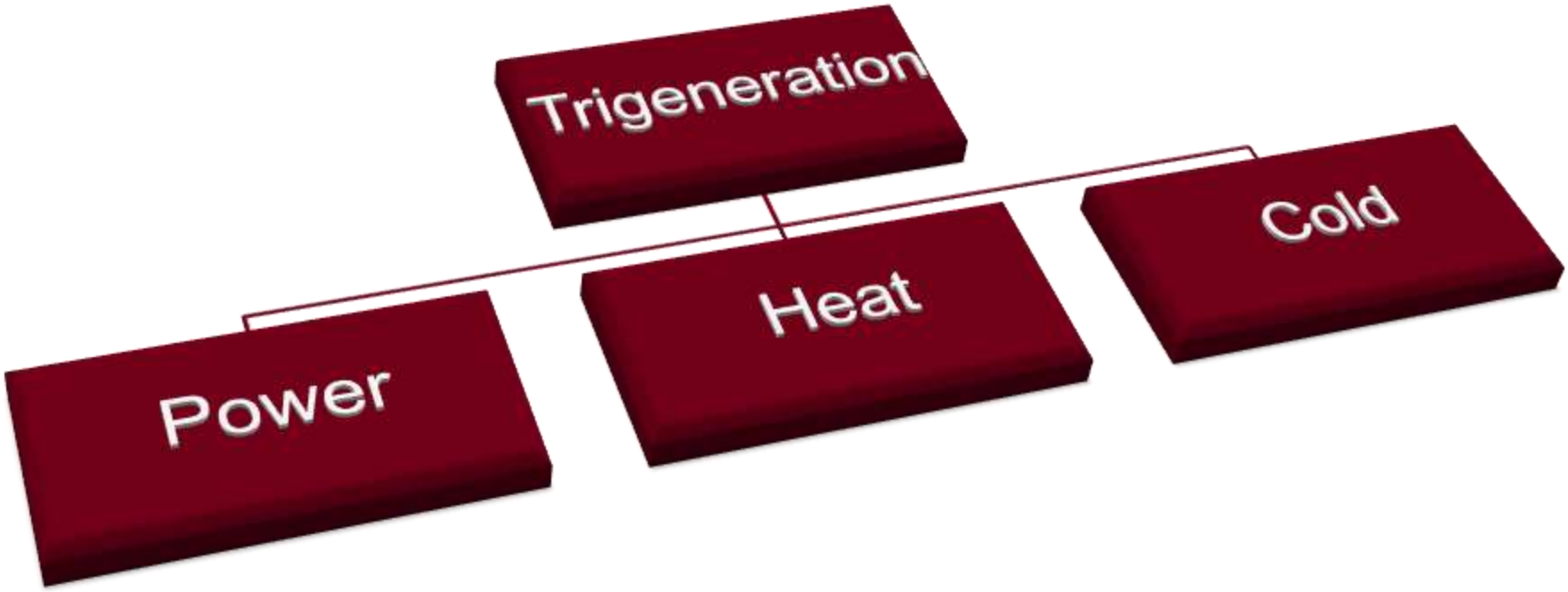

Source: The real cost of power, Wartsila

# 2. Energy from Diesel Generator (DG set)




Electrical Energy Output
Jacket Water Losses
Exhaust Gas Losses
Radiative Losses

# 3. What is Trigeneration?

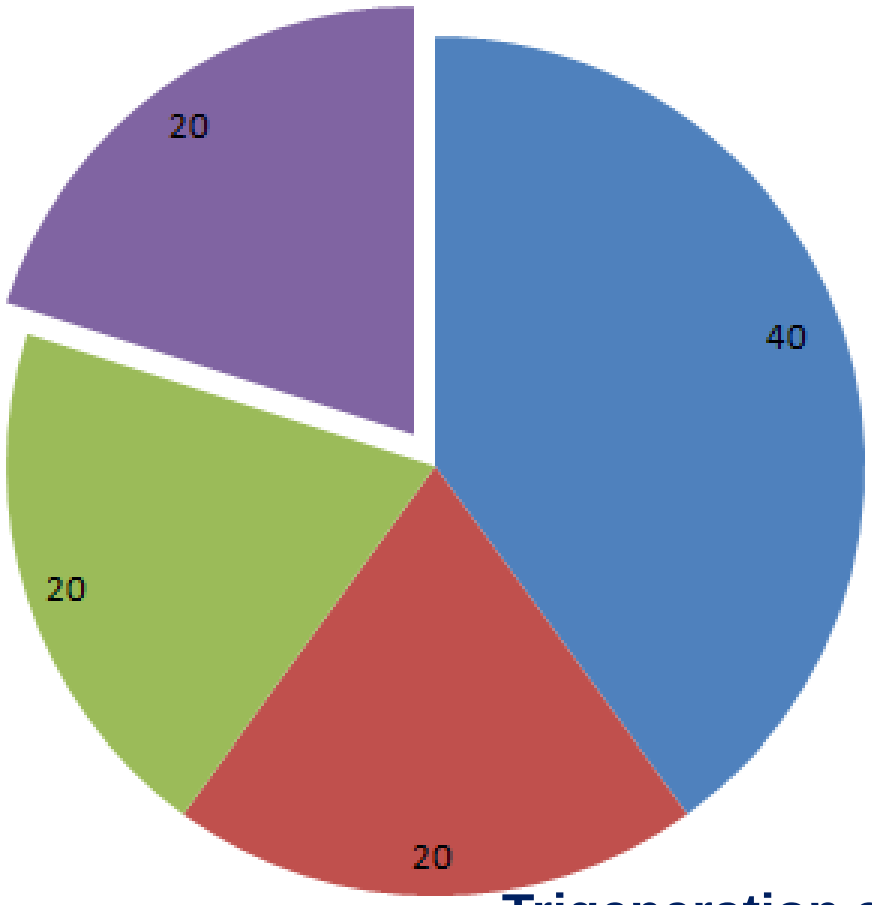



Simultaneous production of Electricity, Heat and Cold

# 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

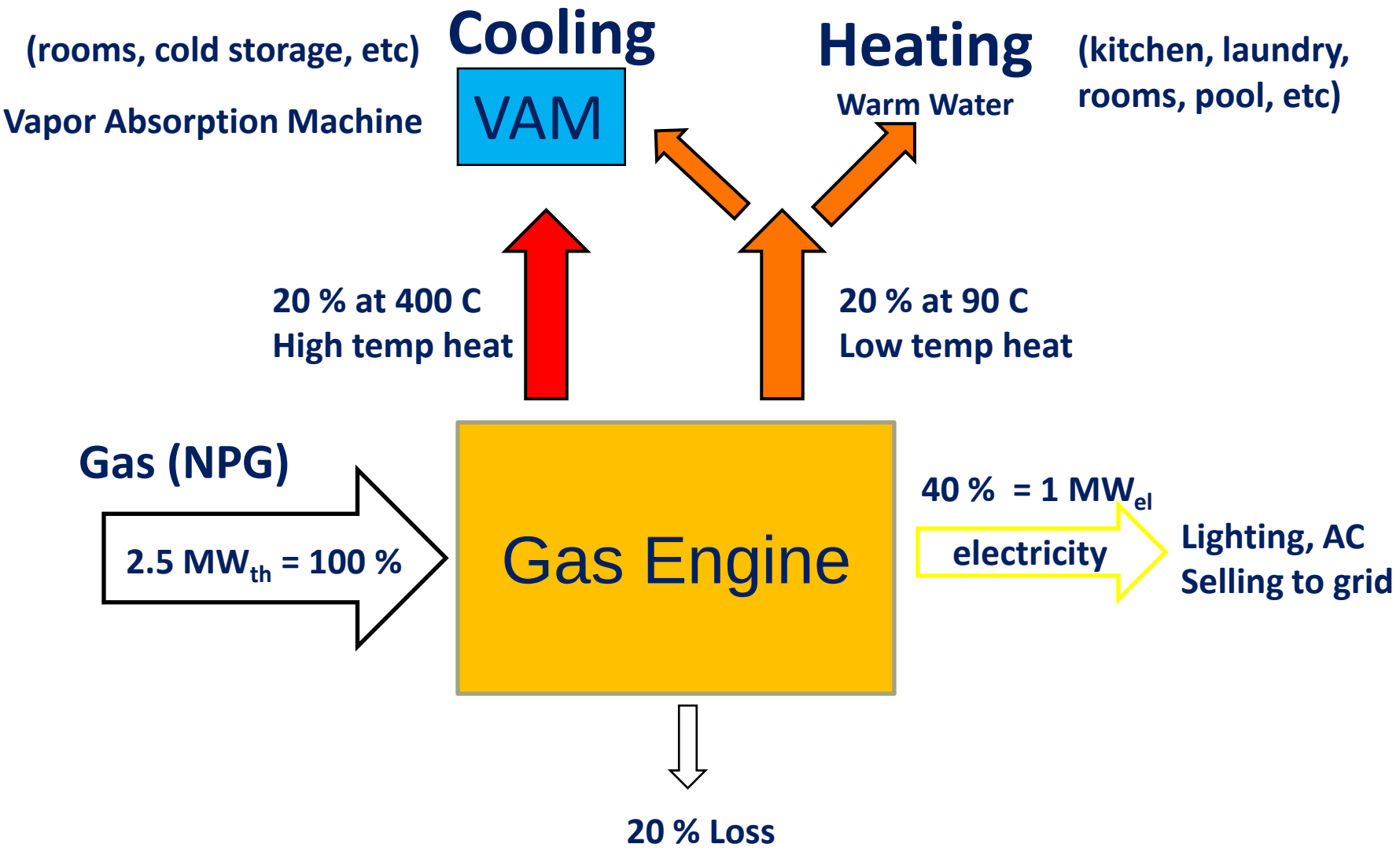
# 3. Energy generation from Trigeneration ~ 80 %




Electrical Energy Output
Jacket Water Recovery
Exhaust Gas Recovery
Losses

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

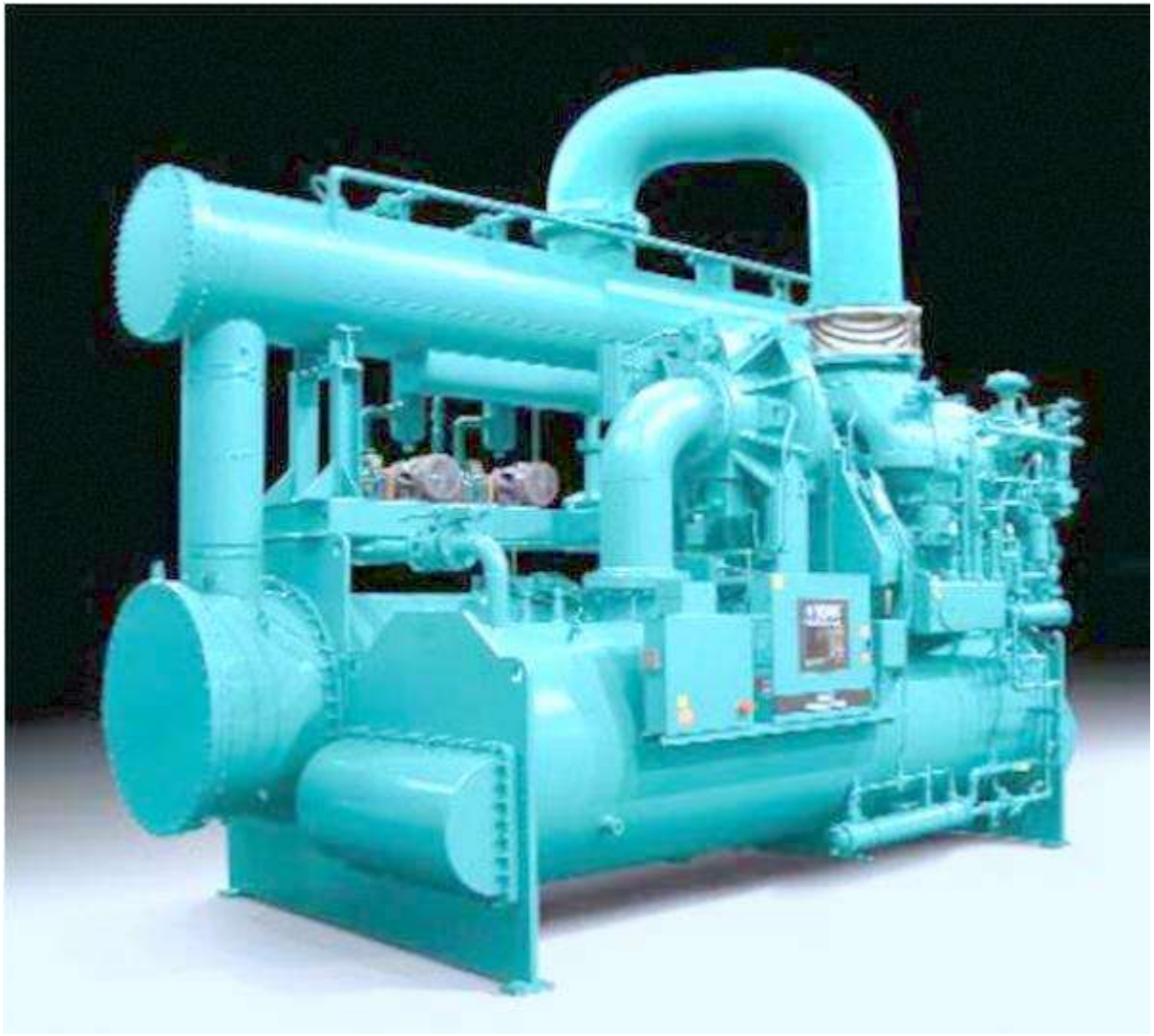
# 3. Main Components of Trigeneration:



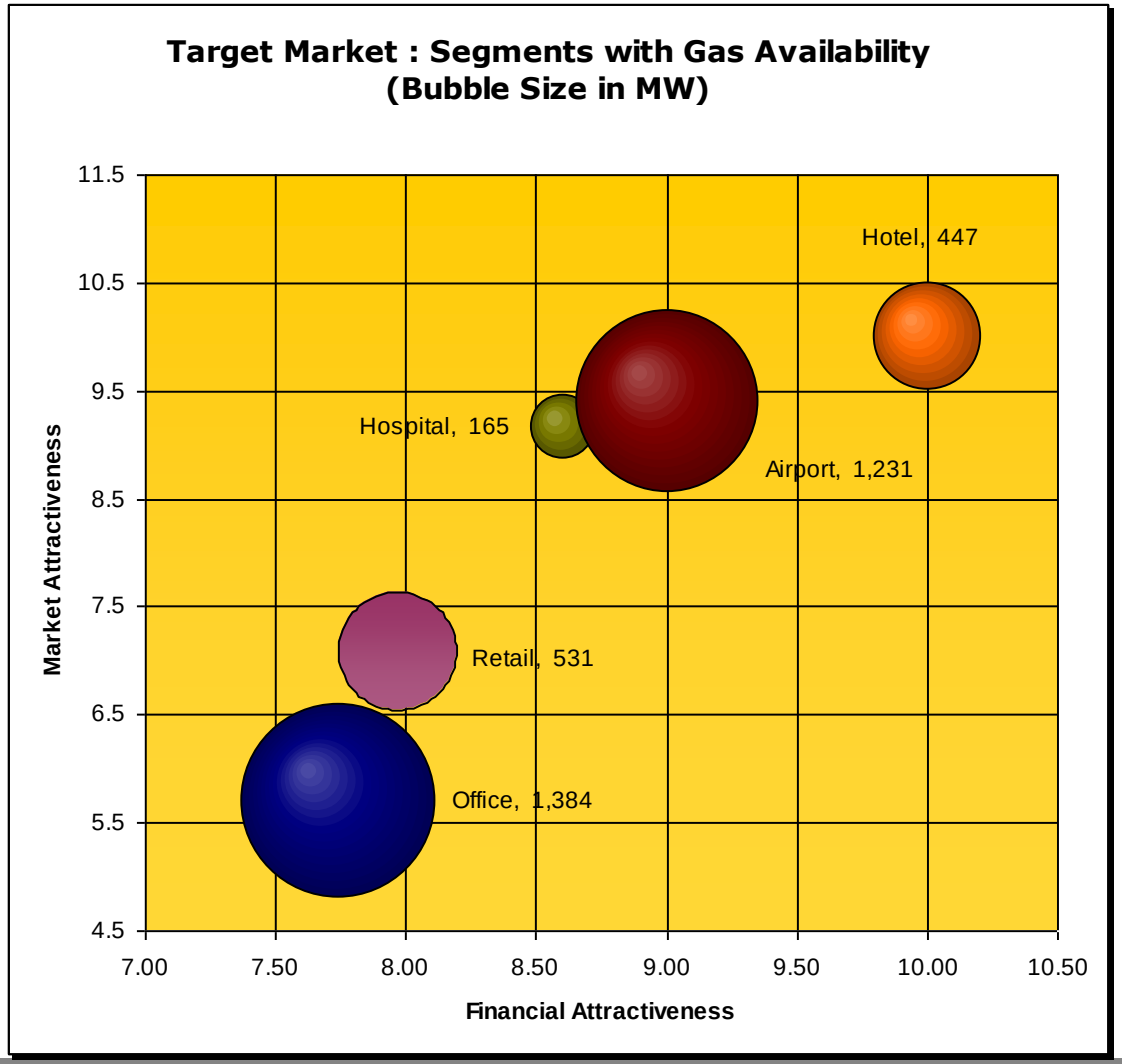
# 3. Main Components of Trigen – Gas Engine

# 3. Main Components of Trigen - VAM

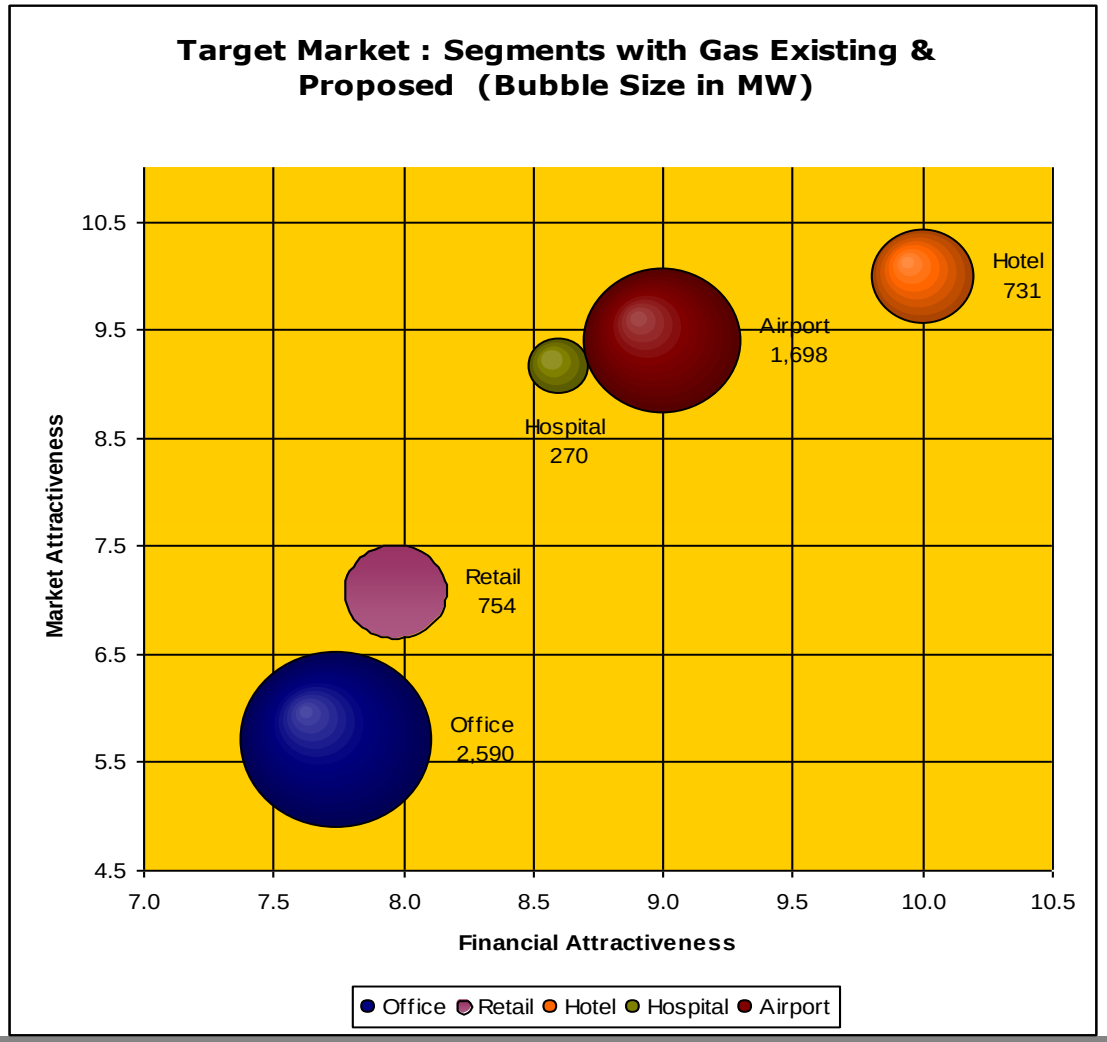
# 3. Main Components of Trigen - Chiller



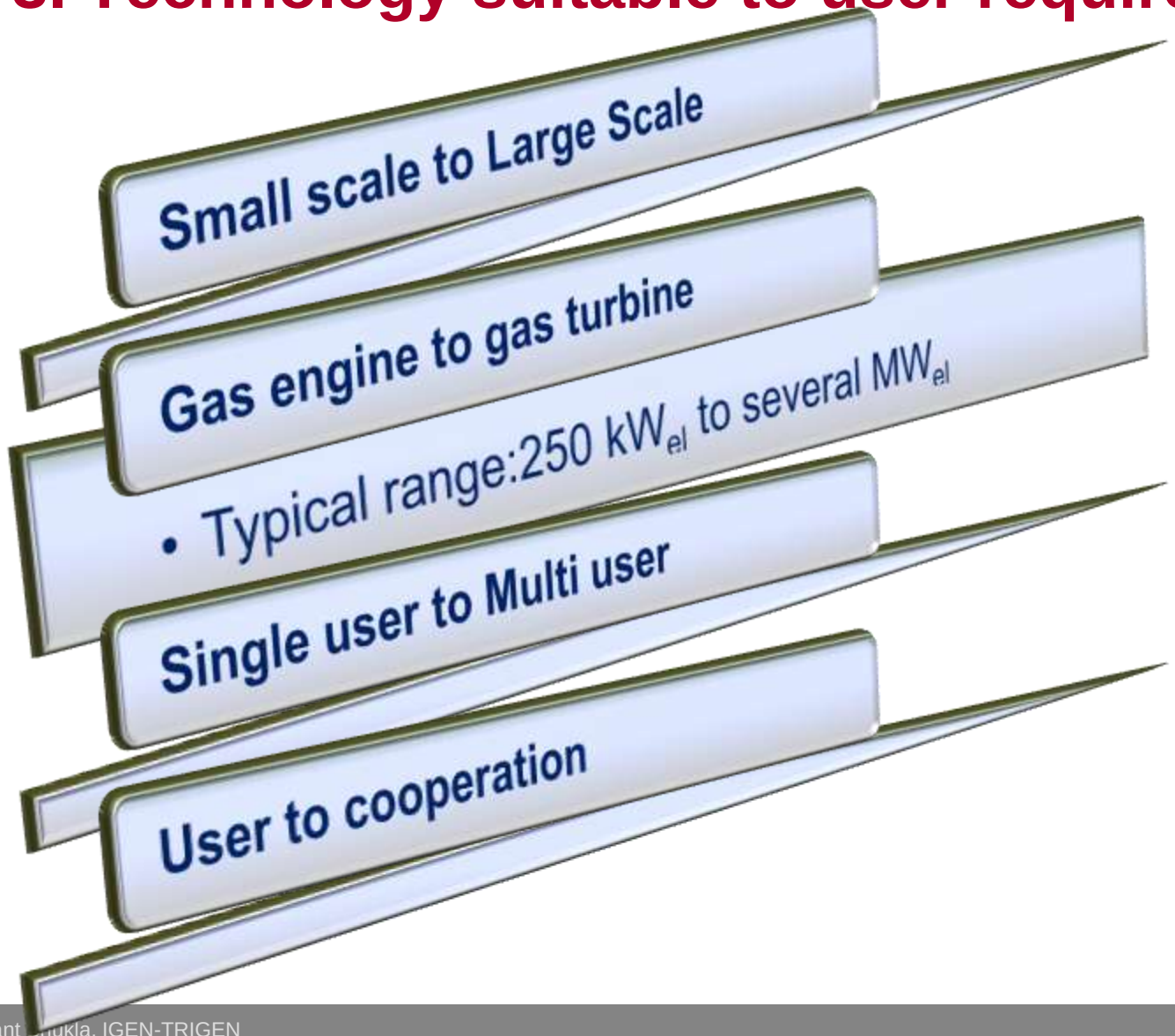
# 4. Target Market: Segments with Gas Availability (in MW)



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



# 3. Technology suitable to user requirement



# 4. Application areas of decentralized power generation

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

- Hotels, Hospitals
- Industries
- Data Centers
- Shopping Malls, Residential Societies

# 4. Technology benefits

**Efficiency**

- Improve energy efficiency

**Fuel**

- Reduces fossil fuels

**Environment**

- CO2 emissions reduced

**Cost**

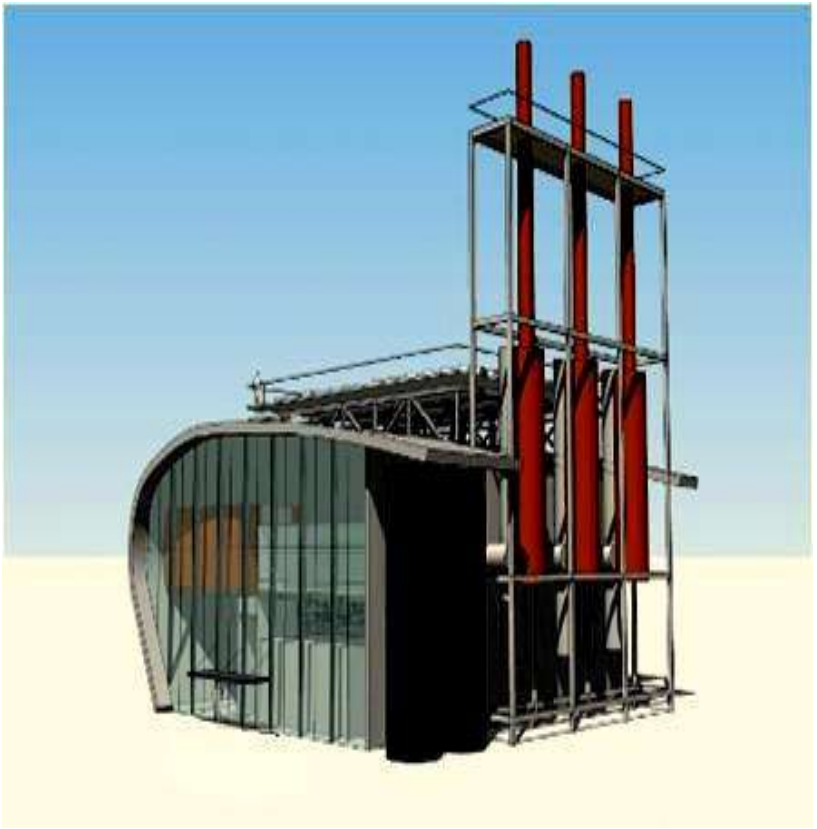
- Reduced energy cost

**Supply**

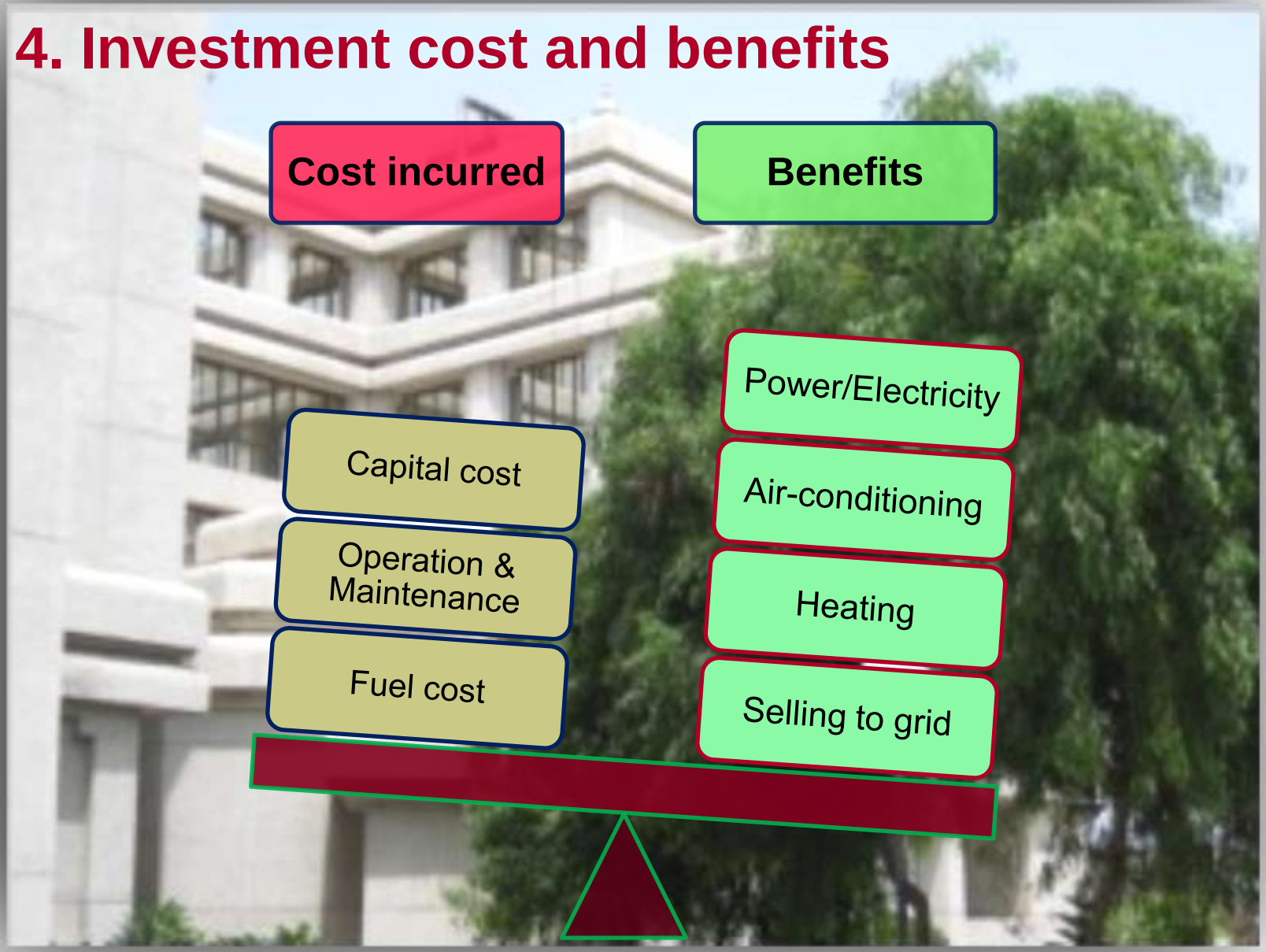
- Energy supply security

# 4. Benefits of Trigen:

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



# 4. Investment cost and benefits



# 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

# 5. Payback at demo site - Hospital

**Electricity**

- Medical equipment
- Lighting, fans, etc

**Air-conditioning**

- Electrical Chillers – 800TR

**Heating**

- Laundry – Electricity/Oil
- Kitchen – LPG

# 5. Savings per annum - Rupees

**Major benefits:**

- **Payback period – 2 years**
- **Annual savings: 2 Crores**

**Other benefits:**

- Save 40 % carbon emissions
- Energy Efficiency improvement upto 77 % or more

# Thank you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