

**WORKSHOP ON GRID CONNECTED RENEWABLE ENERGY &
COGENERATION / INDEPENDENT POWER**

**PANEL ON COGENERATION / INDEPENDENT
POWER TECHNOLOGIES AND PROJECTS
GAS TURBINES AND CHP**

**BY
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OVERVIEW *COMBINED HEAT AND POWER (CHP)* *OR COGENERATION*

- **Definition**
- **Characteristics**
- **Typical CHP Systems**
- **CHP Applications**
- **CHP v/s Grid - Benefits**



CHP or COGENERATION
Definition

CHP or Cogeneration Is:

**Simultaneous Production
of Useful Power and Heat
from Single Fuel Source**

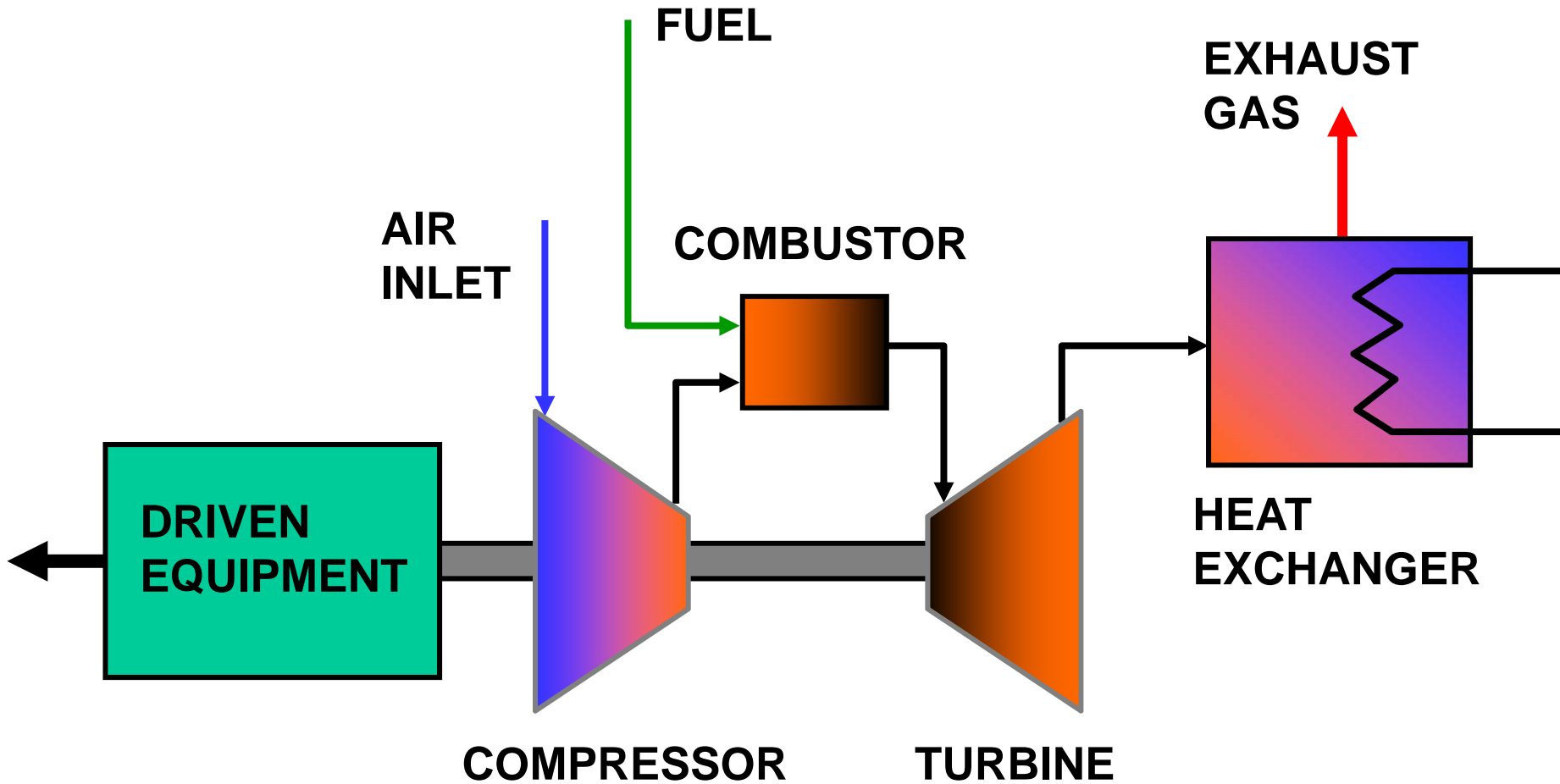


CHP or COGENERATION
Definition

**Is this only for
Baggase and Sugar plants?
Actually all forms of CHP is
Co-Generation**

CHP or COGENERATION

Typical CHP / System



Total Efficiency 75 – 90%

CHP or COGENERATION

Characteristics

- Provides both Electrical and Thermal Energy
- Uses Steam Turbine and/or Process Steam
- Uses Heat for Air-conditioning
- Extremely High Efficiency
- System Availability Very Important
- Continuous Operation



CHP or COGENERATION *Applications*

- **Power and Steam**
- **Direct Heat**
- **Power and Cooling**
- **Combined Cycle using Steam Turbines**

CHP or COGENERATION

Applications – Power & Steam

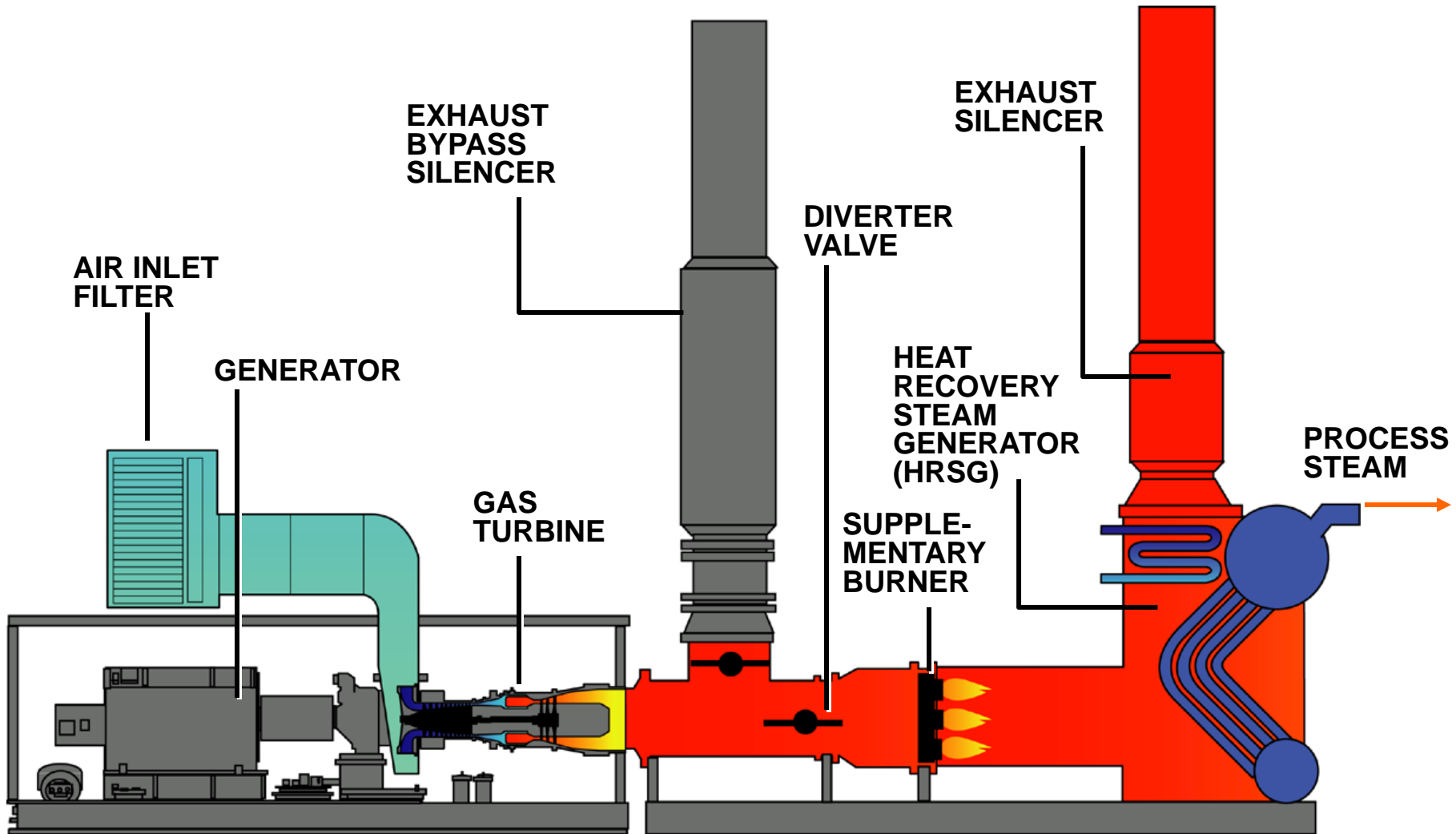
- **Power and Steam**
- **Direct Heat**
- **Power and Cooling**
- **Combined Cycle Gas Turbine**

Textiles, Chemicals,
Fertilizers, Food,
Pharmaceuticals,
Petrochemicals,
District Heating,
Etc.



CHP or COGENERATION

Applications – Power & Steam



CHP or COGENERATION

Industries using Power & Steam



Food Processing



Pharmaceutical



Pulp and Paper



Manufacturing

CHP or COGENERATION

Industries using Power & Steam



Refinery / Oil



Hospitals



Universities



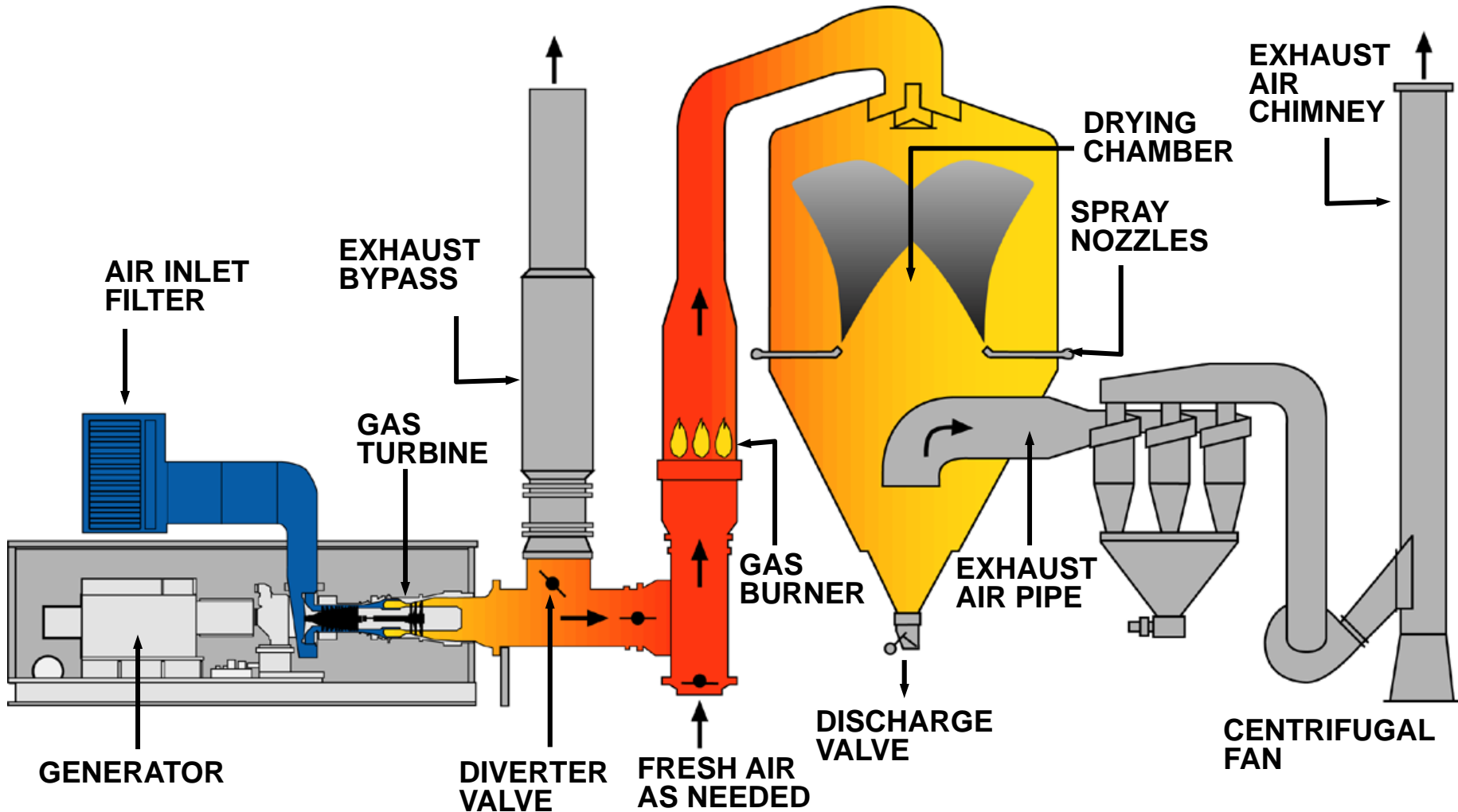
Utilities

CHP or COGENERATION *Applications - Direct Heat*

- Power and Steam
- **Direct Heat**
- Power and Cooling
- Combined Cycle using Steam Turbine

**Ceramic, Steel,
Etc.**

CHP or COGENERATION Applications - Direct Heat



CHP or COGENERATION

Industries using Direct Heat

4 MW CHP. Heat is used in the drying of slurry for manufacturing of ceramic tile. Karawang, Indonesia



5 MW CHP. Heat is used to dry gypsum for wall board production.

Chonburi, Thailand

CHP or COGENERATION

Applications – Power & Cooling

- Power and Steam
- Direct Heat
- **Power and Cooling**
- Combined Cycle using Steam Turbine

**Buildings,
Airports, Multi-
complexes, etc.**

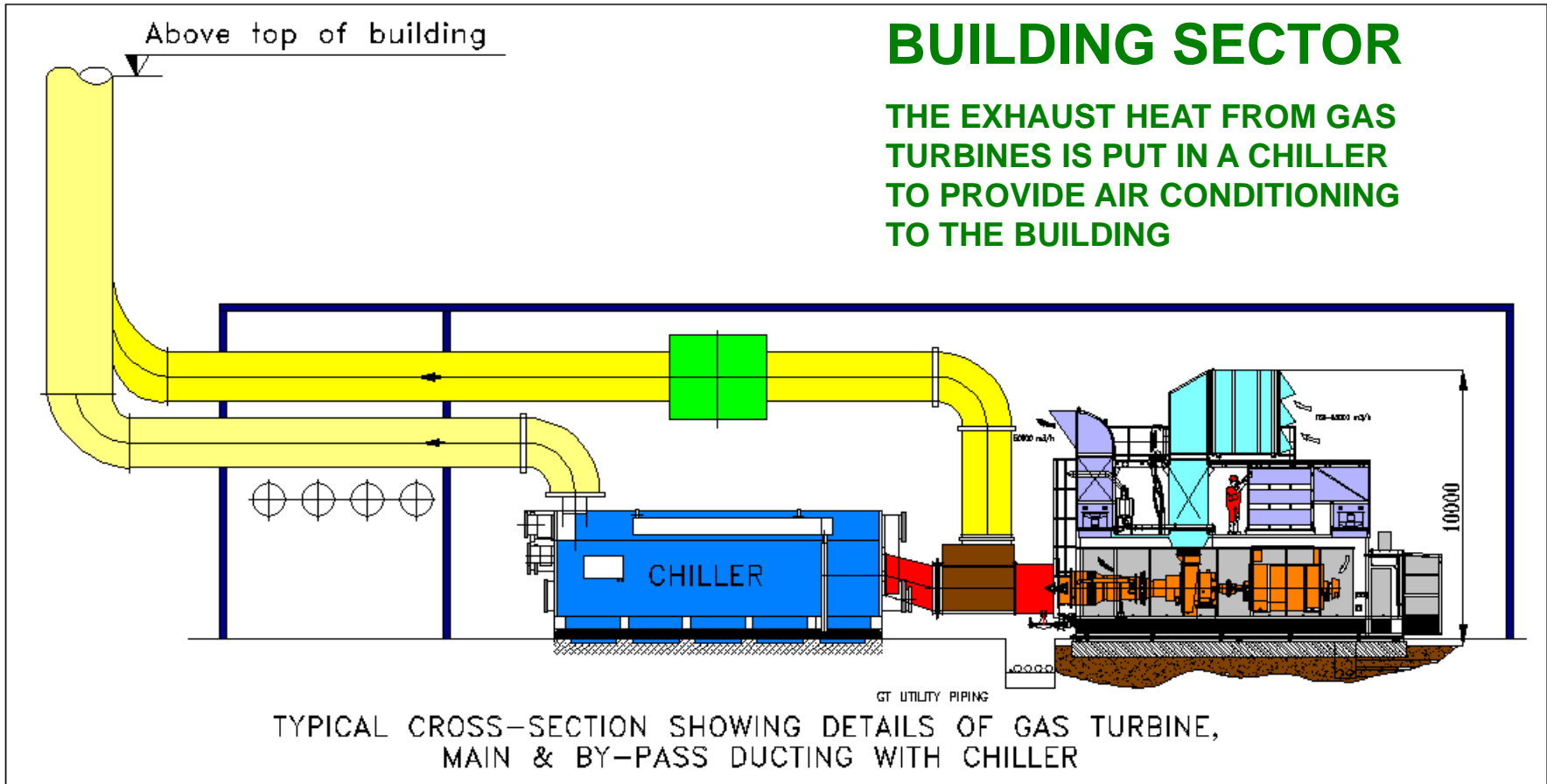


DLF Building No. 10 Cyber City, Gurgaon

CHP or COGENERATION Applications – Power & Cooling

BUILDING SECTOR

THE EXHAUST HEAT FROM GAS TURBINES IS PUT IN A CHILLER TO PROVIDE AIR CONDITIONING TO THE BUILDING



CHP or COGENERATION

Applications – Power & Cooling

Above top of building

CUSTOMER : DLF UTILITIES PVT. LTD.

CHP Data

GT mode / ISO Rating	Taurus 60 / 5.6 MW
Power at site conditions	5200 kwh
Exhaust Heat	7600 kwh
Exhaust Heat Chiller	3200 TR

Gas Turbine CHP configuration

The exhaust heat coming out of 5.6 MW Taurus 60 Gas Turbine is put in a 3200TR chiller to provide air-conditioning for Buildings. 4 such Gas Turbines will be installed in one cluster giving total of 20 MW Electrification and 12800 TR Chilling Capacity.

CHP or COGENERATION

Applications – Combined Cycle using Steam Turbines

- Power and Steam
- Direct Heat
- Power and Cooling
- **Combined Cycle using Steam Turbines**

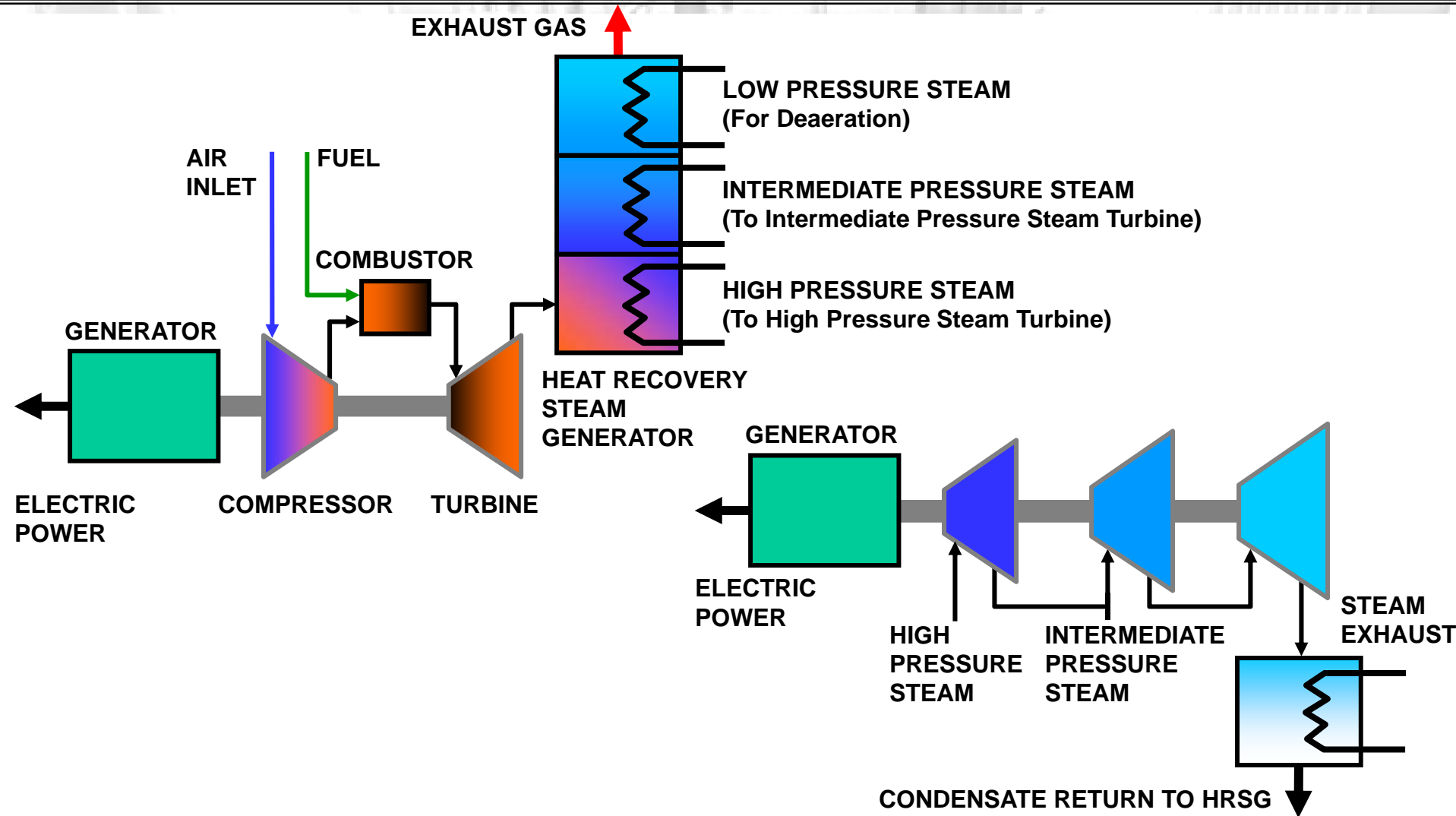
IPP, Automobile,
Paper, etc.

Maruti Suzuki Automobiles, Gurgaon, India



CHP or COGENERATION

Applications – Combined Cycle using Steam Turbines



CHP or COGENERATION *Industries using - Combined Cycle*

A Sanitation Digester Plant Carson, CA.



University of Cincinnati, Ohio

CHP or COGENERATION v/s Grid *Benefits*

SAVINGS IN FUEL CONSUMPTION

- Upto 30% as compared to Grid and fuel burnt for heat generation

CHP or COGENERATION v/s Grid *Benefits*

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POWER GENERATION AT SOURCE

- No T&D losses

CHP or COGENERATION v/s Grid *Benefits*

SAVINGS IN FUEL CONSUMPTION

- Upto 30% as compared to Grid and fuel burnt for heat generation

POWER GENERATION AT SOURCE

- No

**CHP can be encouraged
for every potential application
by favorable policies
&
incentives programmes**

Fuel Versatility Gas Turbine - CHP

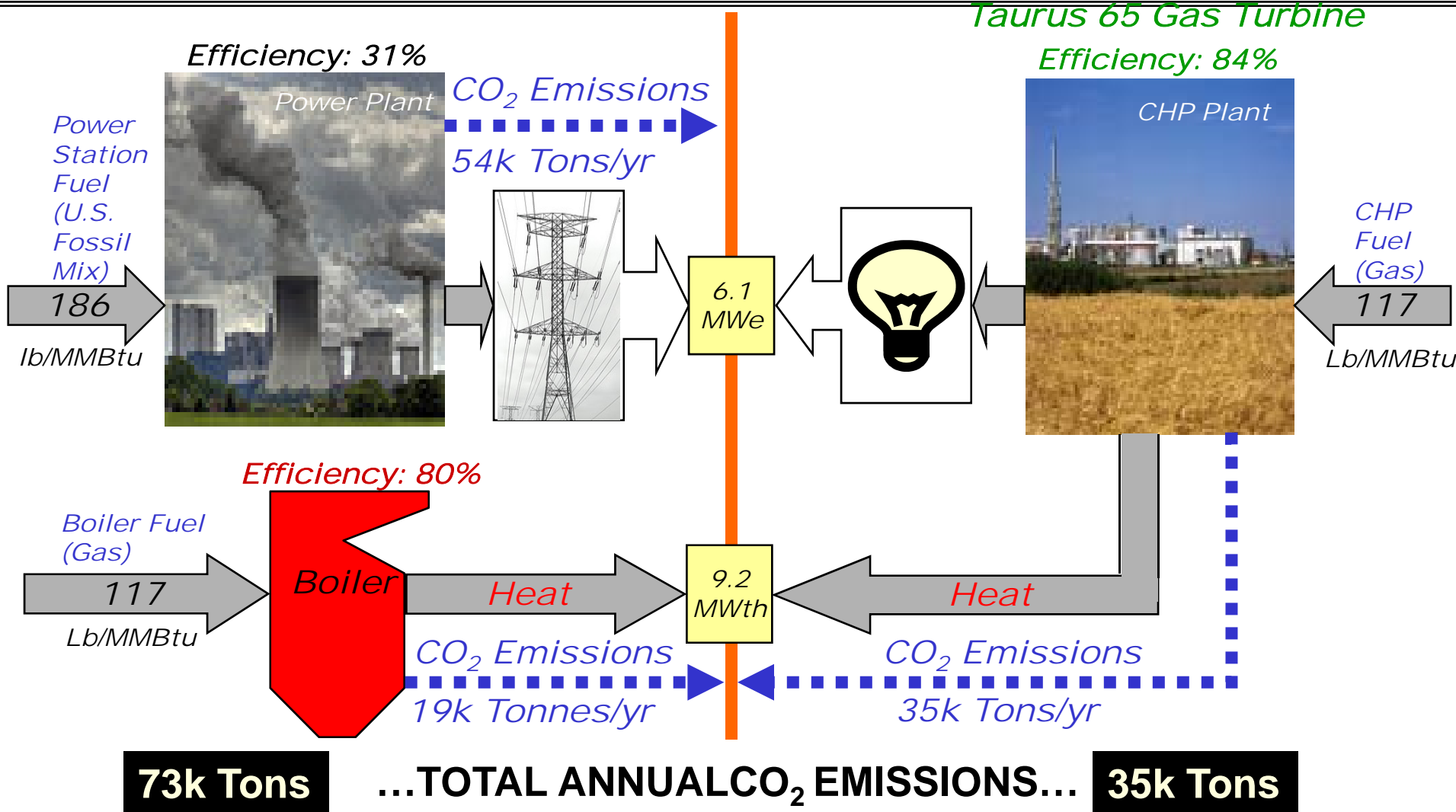
- **Natural Gas**
- **Light Distillates – Diesel, Kerosene, etc.**
- **LPG**
- **Naphtha**
- **Low BTU & Renewable Fuel Opportunities**

CHP or COGENERATION v/s Grid

CO₂ Emissions Reductions from CHP

Conventional Generation

Combined Heat & Power:



RENEWABLE & ALTERNATIVE FUEL OPPORTUNITIES

- **Coke Oven Gas**
- **Refinery Gas**
- **Landfill and Digester Gas**
- **Coal Bed and Coal Mine Methane**
- **Synthetic Gas**
- **Gasified Biomass**



RENEWABLES HYBRID - FOR RELIABILITY AND SCALE?

**Gas Turbines are multi fuel capability high
Co-gen efficiency**

- **Back up with Gas / Diesel for Reliability?**
- **Mix with Gas for Scale up?**
- **Put the Bio gas in Pipeline (Instead of
electricity in the Grid)?**

Wobbe Index

$$WI = \frac{LHV}{\sqrt{SG}}$$

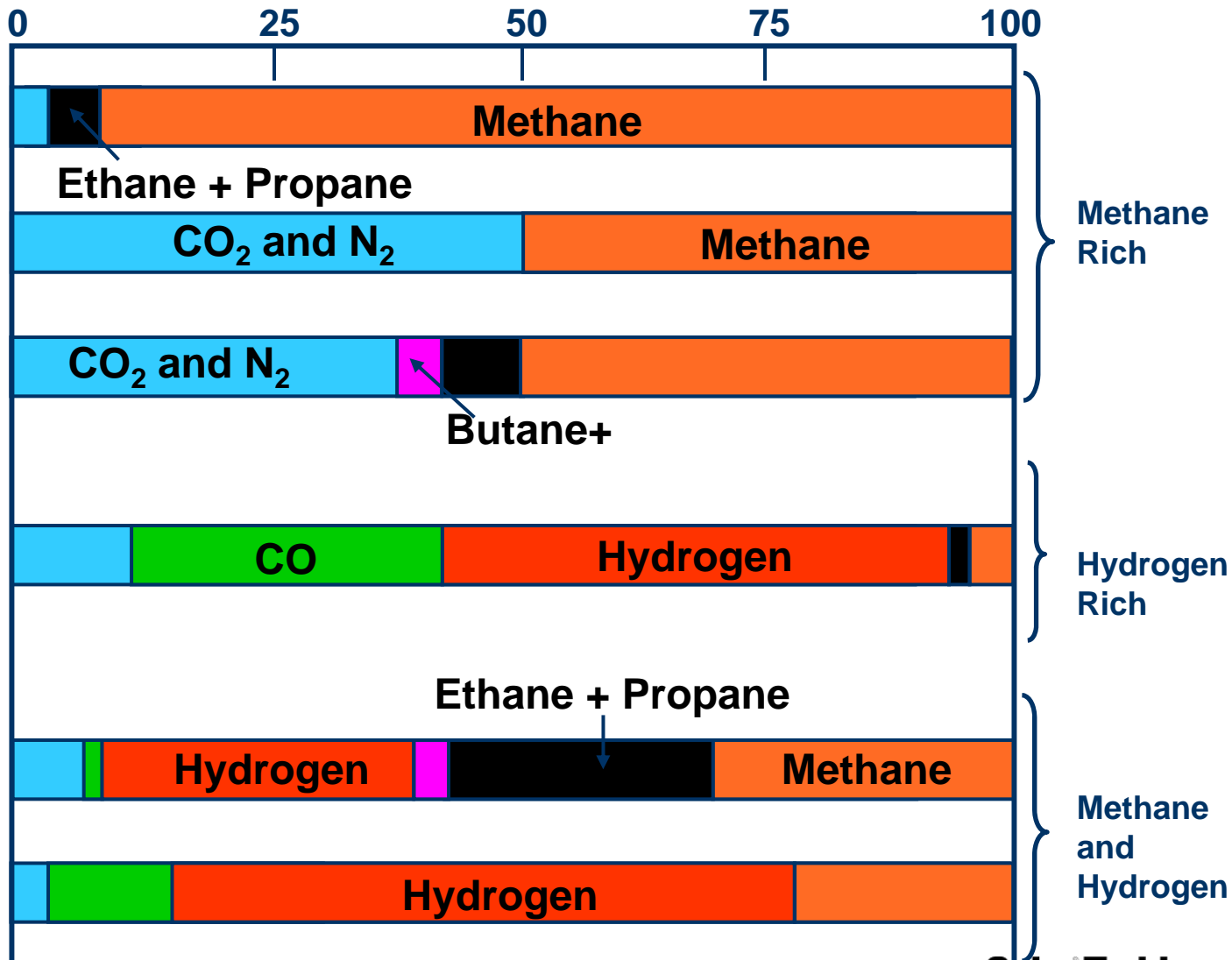
LHV = Lower Heating Value

SG = Specific Gravity

US Pipeline Natural Gas Ranges
Gas Processors Association (1998)

	Btu/scf		MJ/Nm ³	
	Minimum	Maximum	Minimum	Maximum
Higher Heating Value	950	1150	35.4	42.9
Lower Heating Value	856	1040	31.9	38.8
Wobbe Index, LHV	1085	1296	40.5	48.3

Percent Species (%)





OVERVIEW

DISTRIBUTED GENERATION

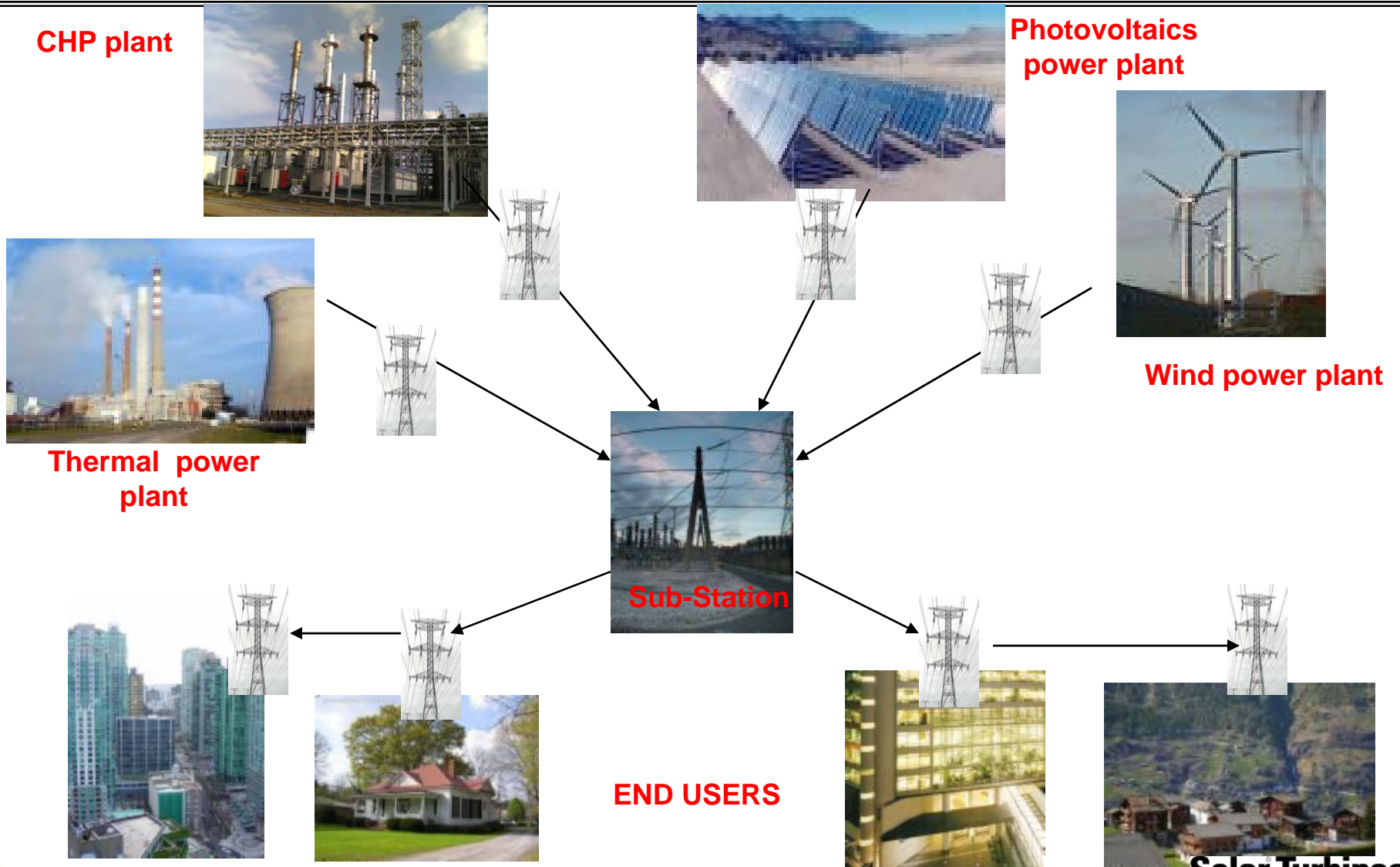
- **Definition**
- **Typical Schematic**
- **DG Benefits**

DISTRIBUTED GENERATION DEFINITION

Distributed Generation is:

Small electricity generation facilities, up to 50MW, located on the distribution system close to the point of consumption.

DISTRIBUTED GENERATION SCHEMATIC



CHP plant



Photovoltaics power plant



Wind power plant



Thermal power plant



Sub-Station



END USERS



DISTRIBUTED GENERATION *BENEFITS*

- ✎ Lower perceived risks by investors / institutions due to lower capital investments and hence better chances of financial closures.
- ✎ Adequate power generation capacity to meet existing as well as projected demand without the risk of surplus capacity and redundancy.
- ✎ Low gestation fast track implementation, which results in faster capacity addition.
- ✎ Projects can be off-grid in remote areas which avoids massive investments in transmission and distribution networks.
- ✎ Due to small size projects, capacity addition can be phased out to match the demand and avoid surplus power or vice versa.
- ✎ Since generation is close to point of use, it will result in lesser T&D losses, higher overall efficiency and reduced emissions as DE can be more responsive to various types of customer loads such as residential, commercial or industrial.
- ✎ Due to small plant size, shutdowns/trips of any plant will have an insignificant effect.
- ✎ Increased quality of power and reliability can be maintained in a distributed and localized set up.
- ✎ The efficiency of cogeneration gives it environmental benefits even when fossil fuels are used.



OVERVIEW

GRID CONNECTIVITY AND CHP

- **Key facts**
- **Case Study – Textile Industry**
- **Constraints**

GRID CONNECTIVITY AND CHP

KEY FACTS

- ⚡ **Could impact the economics greatly** – Power at source reduces T&D losses and CHP improves efficiency
- ⚡ **Could impact the addition of Generation Capacity** – DG is the fastest way to add capacity
- ⚡ **Optimum utilisation of installed CHP Plants** – since CHP can run on full load all the time
- ⚡ **Strengthen Grid** – Voltage and frequency due to power input at various points

GRID CONNECTIVITY AND CHP CASE STUDY - TEXTILE

TYPICAL POWER 10 MW

TYPICAL STEAM 50 TPH

WITHOUT GRID CONNECTIVITY

GAS TURBINE RATING 10 MW

SUPPLEMENTARY FIRED WHRB 50 TPH (Unfired 25 TPH)

FUEL CONSUMPTION 5300 Sm³/hr

FUEL CONSUMPTION

ADDITIONAL

TOTAL

**POWER
STEAM
FUEL**

**10 MW
50 TPH
5300 SM³/HR**

An Example – Surplus Power Textile Industry

WITH GRID CONNECTIVITY

GAS TURBINE RATING 20 MW

UNFIRED WATER POWER 20 MW

FUEL CONSUMPTION 50 TPH

FUEL CONSUMPTION 1300 SM³/HR

ADDITIONAL

**10 MW EXTRA POWER AT ADDITIONAL
FUEL CONSUMPTION OF
1300 SM³/HR
80% EFFICIENCY**

An Example - ON EDGE CASES Building / Commercial Complexes

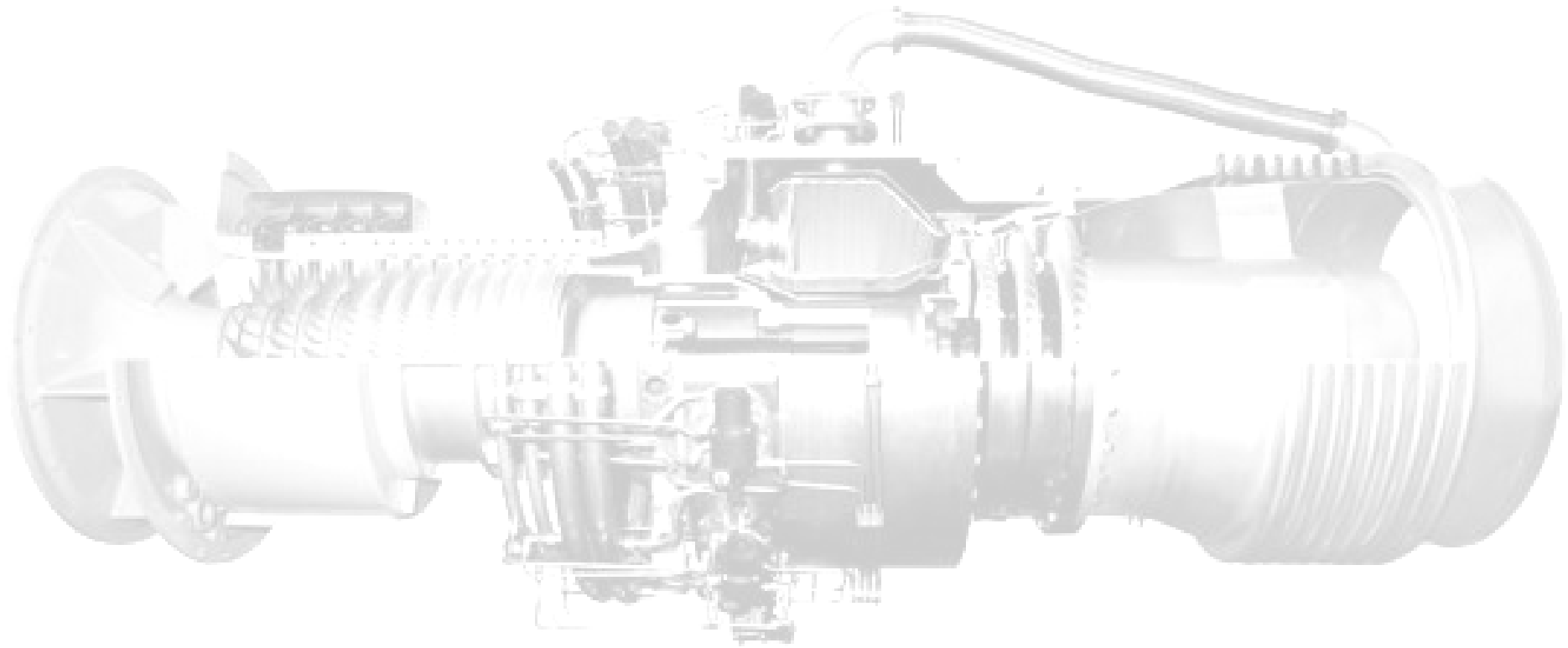
- **TYPICAL VARYING POWER & AIR CONDITIONING LOADS**
- **END USERS ARE NOT DEVELOPERS – INVESTORS**
- **IT GRID CONNECTED – POWER GUARANTEE CAN BE CONSTANT WITH SURPLUS POWER TO GRID**
- **ATTRACTIVE FOR SPV/BOO - INVESTORS**

GRID CONNECTIVITY AND CHP CONSTRAINTS

- **Clear Policy guidelines for Grid connectivity across all states**
- **Government priority low for Co-generation / DG – see gas utilization draft policy**
- **Identify MSW projects – Good potential in India – needs initiative**
- **CBM finds – Commercialize and priority for power / Industry**
- **Policy on customs duties, tax holidays, etc – level playing field for DG and Mega power**
- **Incentives for DG Co-generation (if surplus power fed to the grid)**

GRID CONNECTIVITY AND CHP *BOTTOM LINE*

- **DG with CHP helps improve economics & addition of Generation Capacity**
- **Grid Connectivity will pool in new applications / on edge cases**
- **Partnership between policy makers, end users & technology suppliers**



Thanks for your attention!