



Energy Efficiency at Paper Mills: Combined Heat and Power in Italy

*MSc. Anshuman Pandey
Lead Application Engineer, OPRA Turbines*



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Objective

Introduce highly energy efficient, reliable, low emission energy generation plant in the tissue paper industry

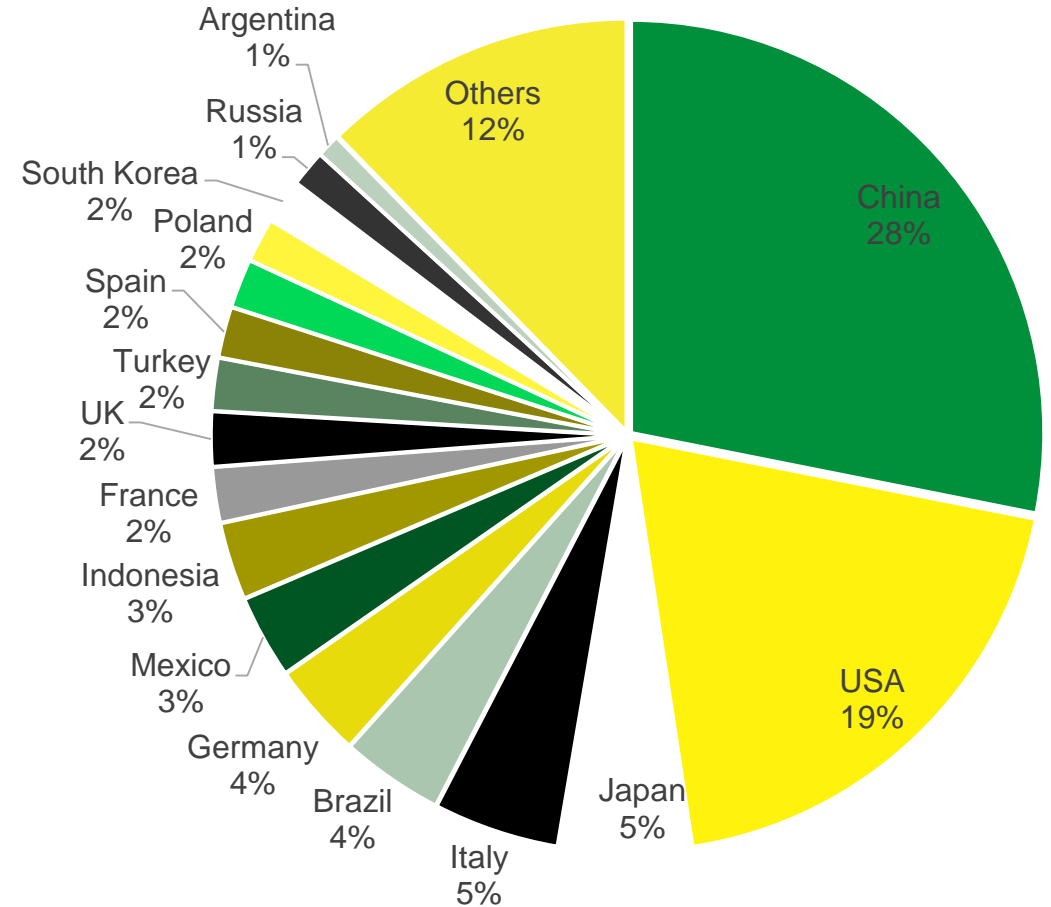
History of paper mills in Italy



- ❑ Lucca is the paper district of Italy
- ❑ First paper mill in the 16th century for paper production
- ❑ In the 70's more than 200 paper mills for tissue production
- ❑ Today tissue paper production in Lucca:
 - 900,000 t/y
 - 80% total Italian production
 - 17% total European production

Tissue Paper: Market Distribution

- ❑ Worldwide tissue production 46 million tons per year
- ❑ China and USA account for 50% of worldwide production
- ❑ Europe 20% global production
 - Italy and Germany leading the market
 - Italy has a long tradition in the tissue sector
- ❑ Top exporting countries are Italy, Indonesia, USA and China



Introduction to tissue production

- ❑ Tissue Paper: produced from pulp obtained from tree fibers
- ❑ Energy accounts for 12% of production costs.
- ❑ High thermal energy consumption:
 - Steam
 - Hot Air
- ❑ High electrical energy consumption:
 - Conveyor belts
 - Presses
 - Winders
- ❑ Emphasis on implementation of cogeneration

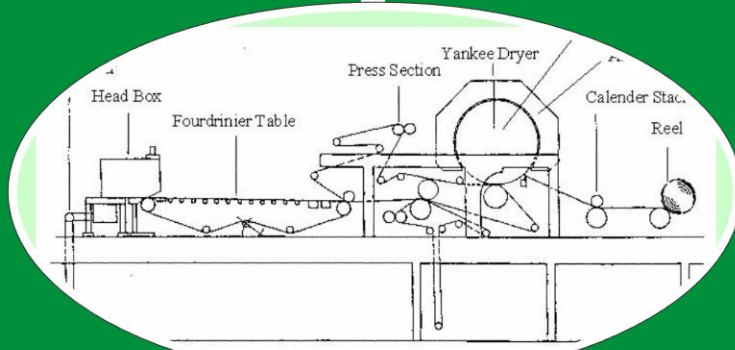


Tissue Paper: Manufacturing Process



Raw material processing

- Tree fibers
- Mixing with water
- Pulper



Forming and pressing section

- Pulp spread on a "wire"
- Water drained
- De-watering press

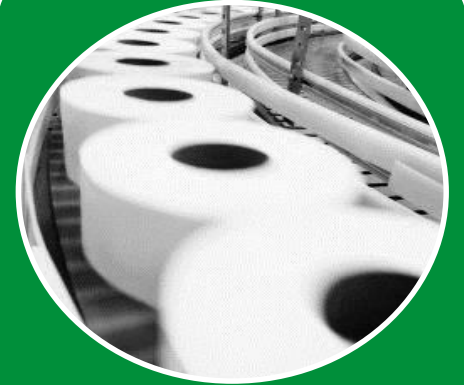
Yankee Hood Drier

- Tissue dried
- Steam in the Yankee
- Hot air in the hood



Calender Section

- Paper compressed
- Uniform thickness
- Jumbo rolls in reel



Packaging and Converting

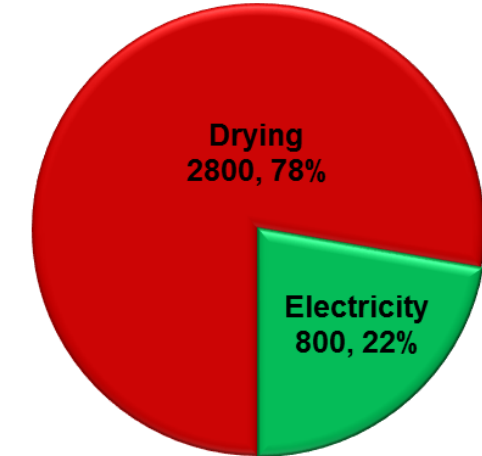
- Jumbo roll processed for end-user

Tissue Paper: Energy Distribution

- ❑ Specific Energy Consumption:
 - Amount of energy required to produce 1 ton of tissue paper
- ❑ Heat to Power ratio favorable for Combined Heat & Power

Utilities	Energy level
Hot Air	932 -1112°F (depending on the paper quality)
Steam	Low pressure saturated steam at 116 psi & 347°F

Specific Energy Consumption

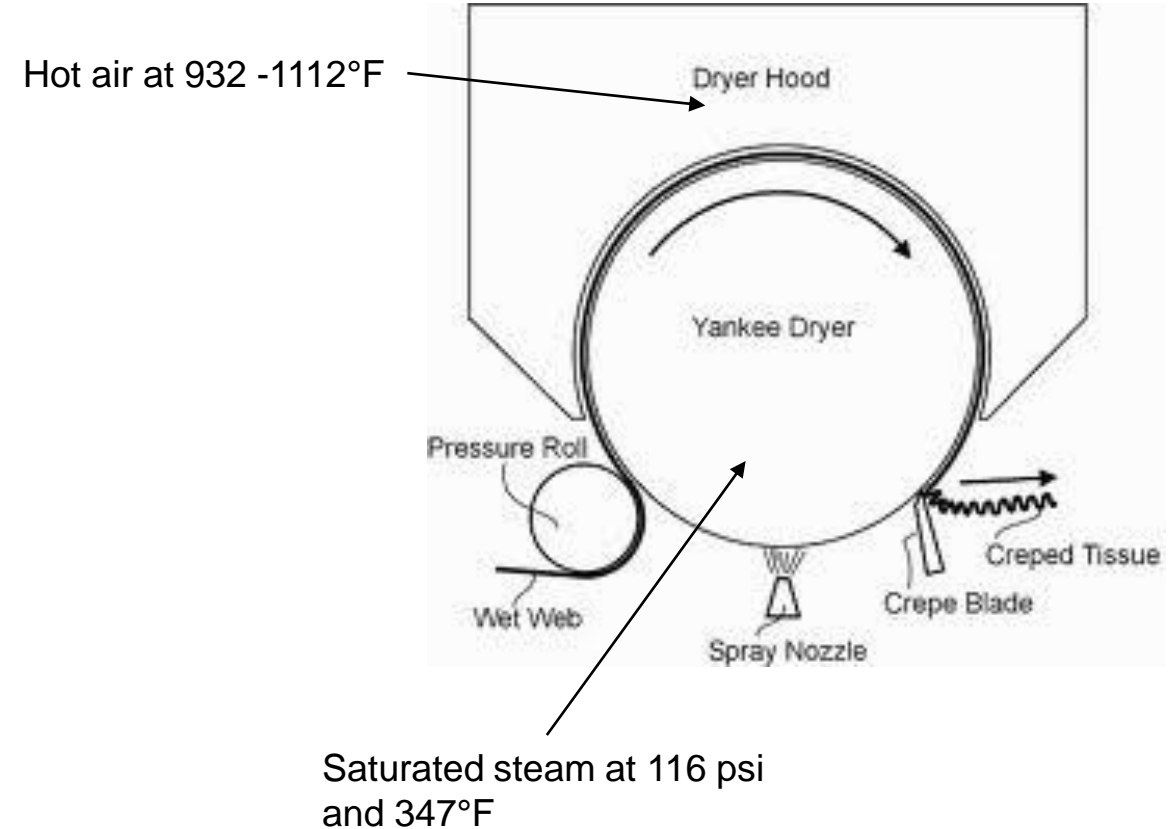


- Specific Thermal Energy Consumption (kWh/ton)
- Specific Electrical Energy Consumption (kWh/ton)

Heat to Power Ratio=3.5:1

Tissue Paper: Energy in the Yankee Hood Drier

- ❑ Double drying of the paper:
 - Convection in the Hood (hot air)
 - Conduction in the Yankee (steam)
- ❑ The tissue passes through small clearance between Yankee and Hood



Tissue Paper: Energy Consumers

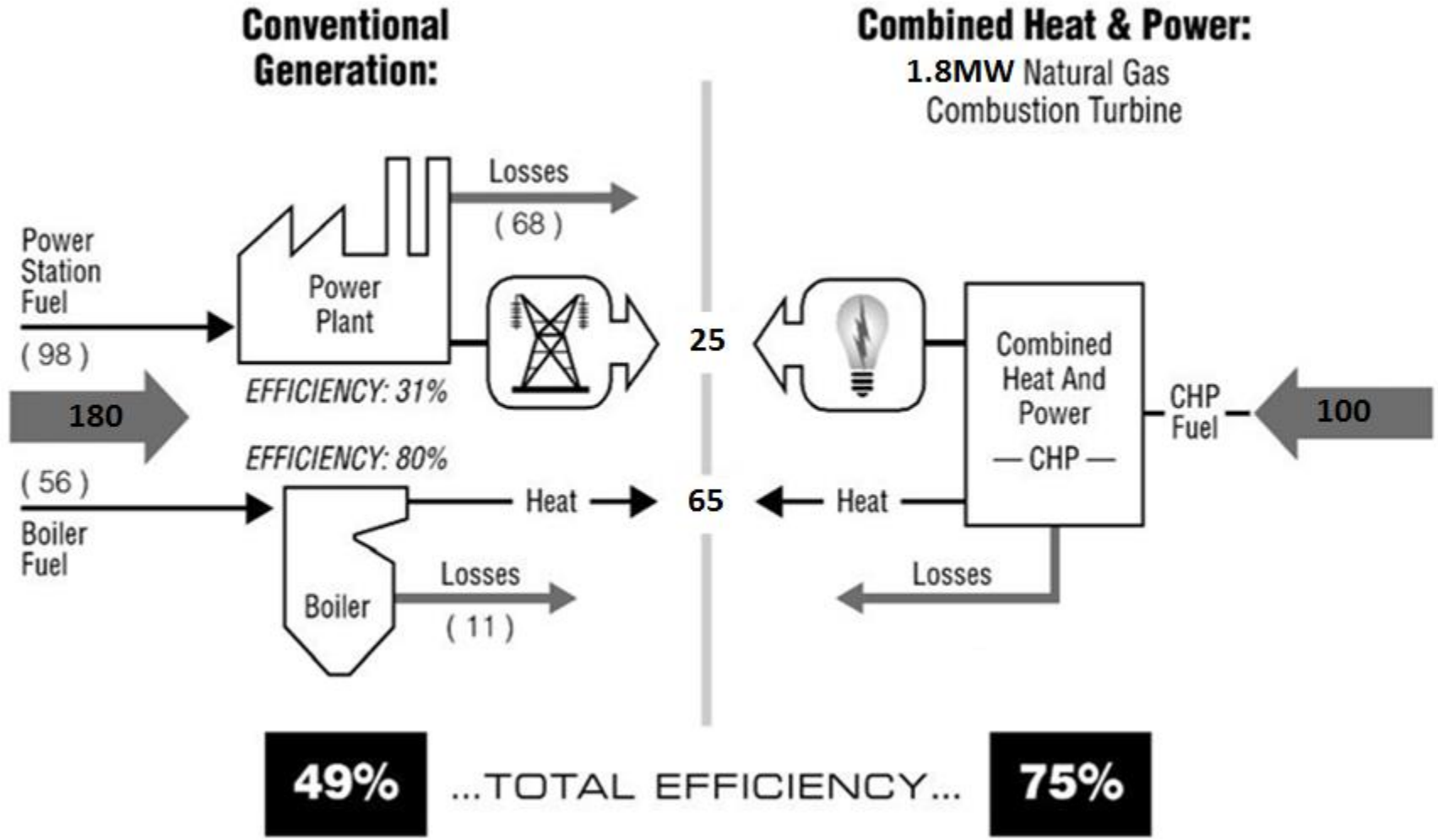
Energy use on-site

- ❑ Thermal energy → Natural Gas
 - Driers
 - Boiler

- ❑ Electricity → Bought from grid
 - Rollers
 - Auxiliary drives
 - Presses



Combined Heat and Power (CHP) increases efficiency



Source: U.S. EPA: Combined Heat and Power Partnership

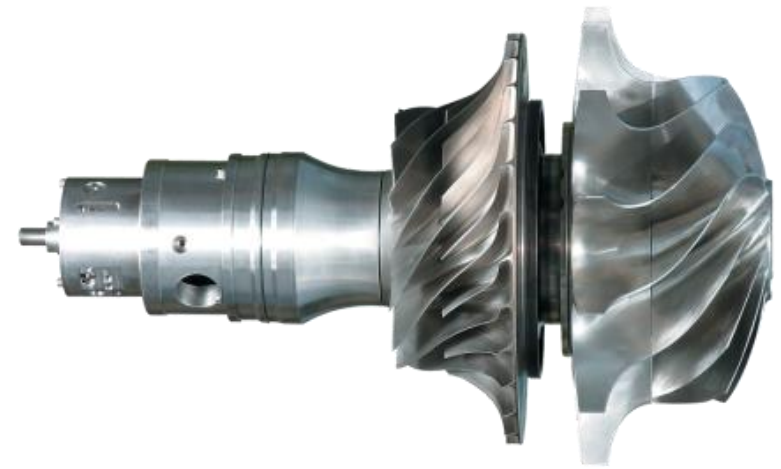


Combined Heat and Power: Key Benefits

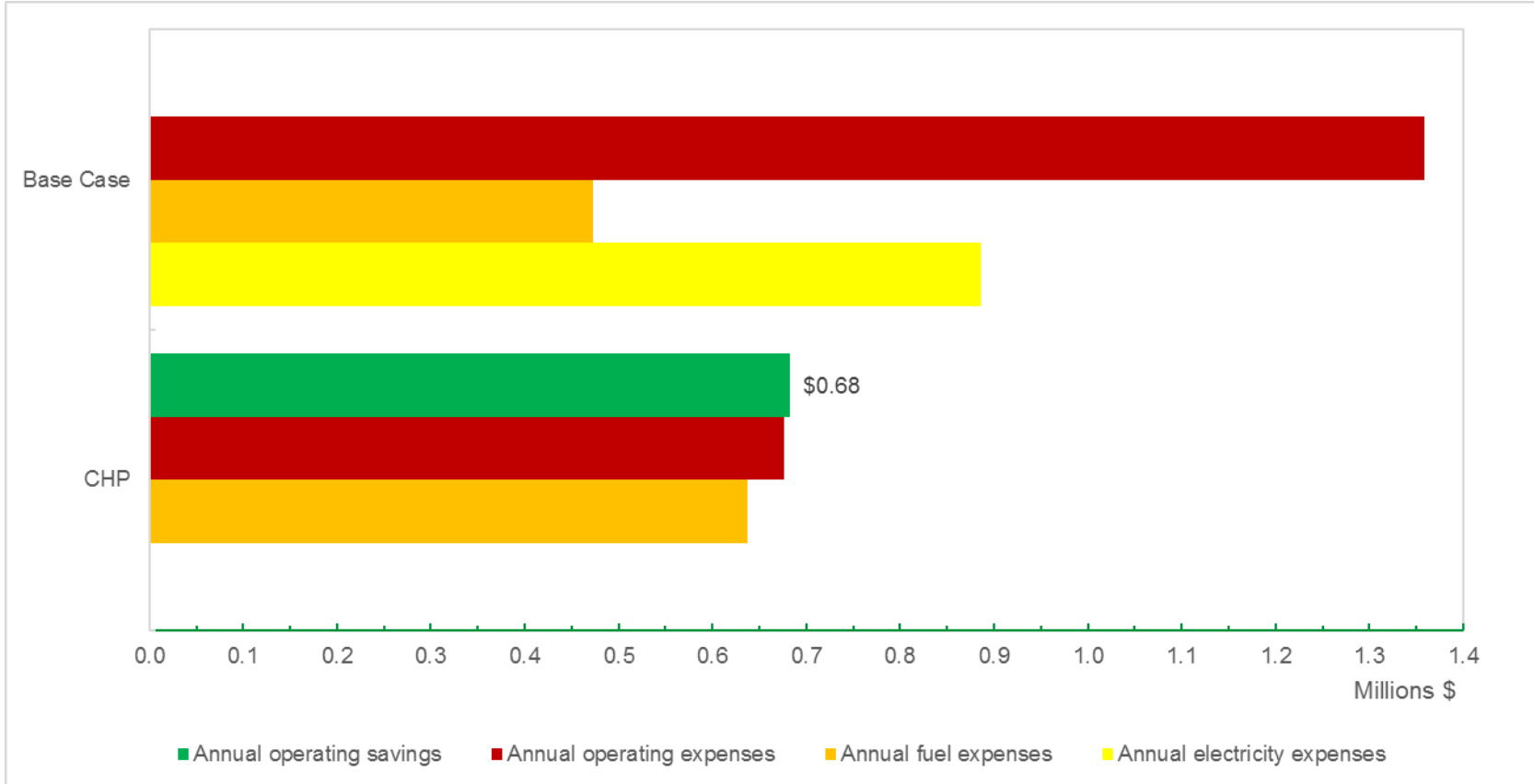
- ❑ Independency: Independent power generation
- ❑ Reliability: Gas turbines offer reliable power generation with lower downtime
- ❑ Availability: High availability of power and heat
- ❑ Profitability: Increased production with lower expenses on energy bills

CHP with gas turbine improves availability

- Independency
 - Security of supply
 - Power, steam, hot air, cooling on site
- Reliability
 - Robust design
 - Packaged solution
- Availability
 - Low maintenance



Feasibility Study: American market



Tissue mill Size	19,000 tons tissue paper annually
Electricity Demand	1,870 kWe
Heat Demand	4,400 kWth
OP16 Exhaust Heat	4,400 kWth
Direct Drying	8.5 Kg/s [70,636 lb/hr] @570°C [1058°F]
Steam Demand	8800 lbs/hr @ 217 PSI
Natural Gas Price	0.062 \$/kWh
Electricity Price	0.011 \$/kWh

- ✓ **High Operational Savings: 50% (0.68 million dollars)**
- ✓ **Payback time 3.3 years**

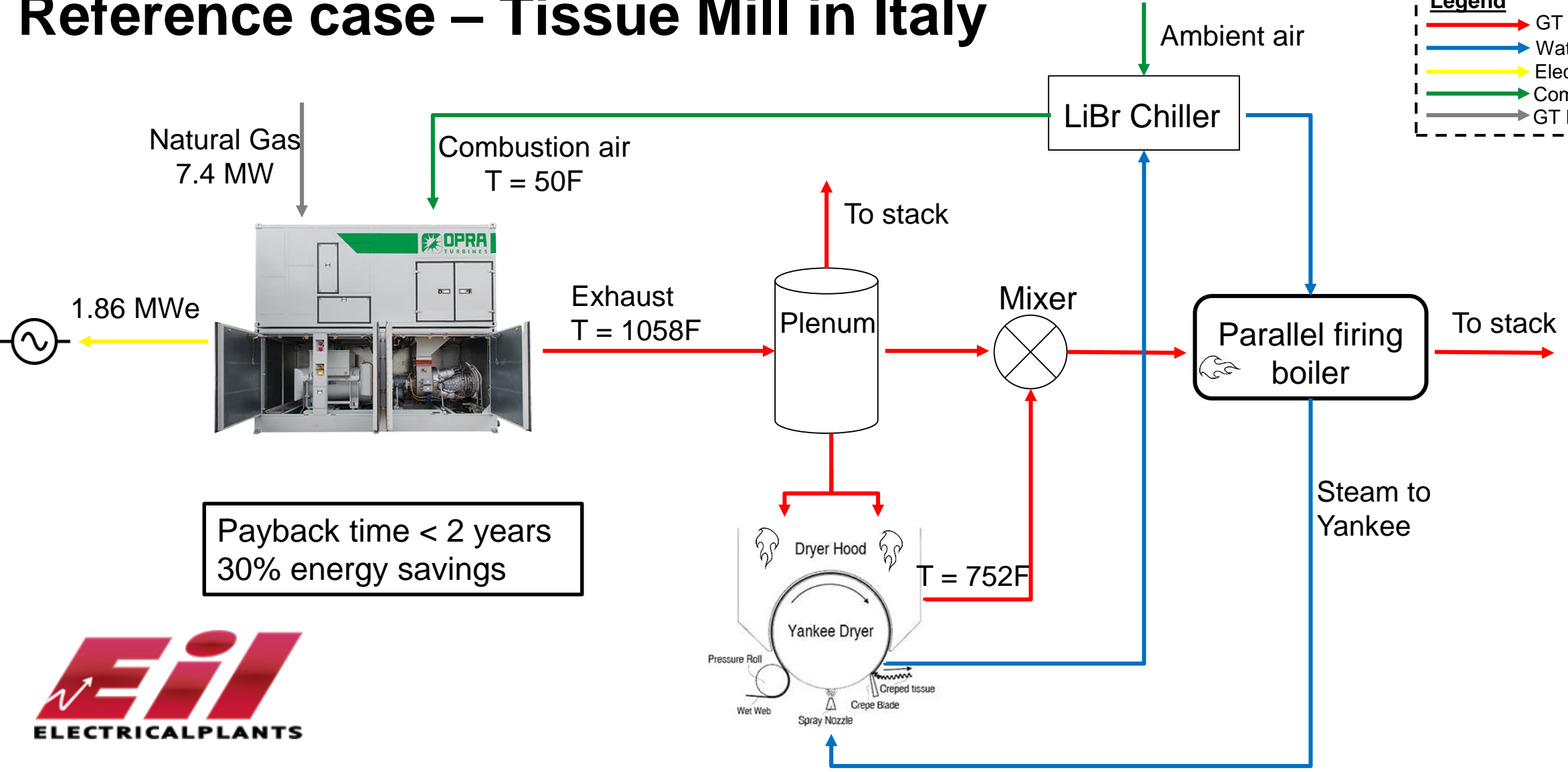
- Mills ≤ 20,000 tons of annual tissue paper production is good fit for 1 OP16
- Mills > 20,000 tons of annual tissue paper production is good fit for 1 or 2 OP16

** All calculations for CHP is including investment and LTSA cost for OP16.

Reference case – Tissue Mill in Italy

Legend

- GT Exhaust
- Water/Steam
- Electricity
- Combustion air
- GT Fuel



Payback time < 2 years
30% energy savings



Conclusions

- ❑ Highly energy efficient tissue paper plant
- ❑ Reduction in production costs
- ❑ Reduction in emissions
- ❑ Highly reliable source of Power and Heat



Thank You

