

Egypt: Small Scale Cogeneration

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Notes before to go

Energy Efficiency Technologies include:-

- WHR, COG, HEI, HEL, HEM, EMS, SSI, HER, CCS, ... etc

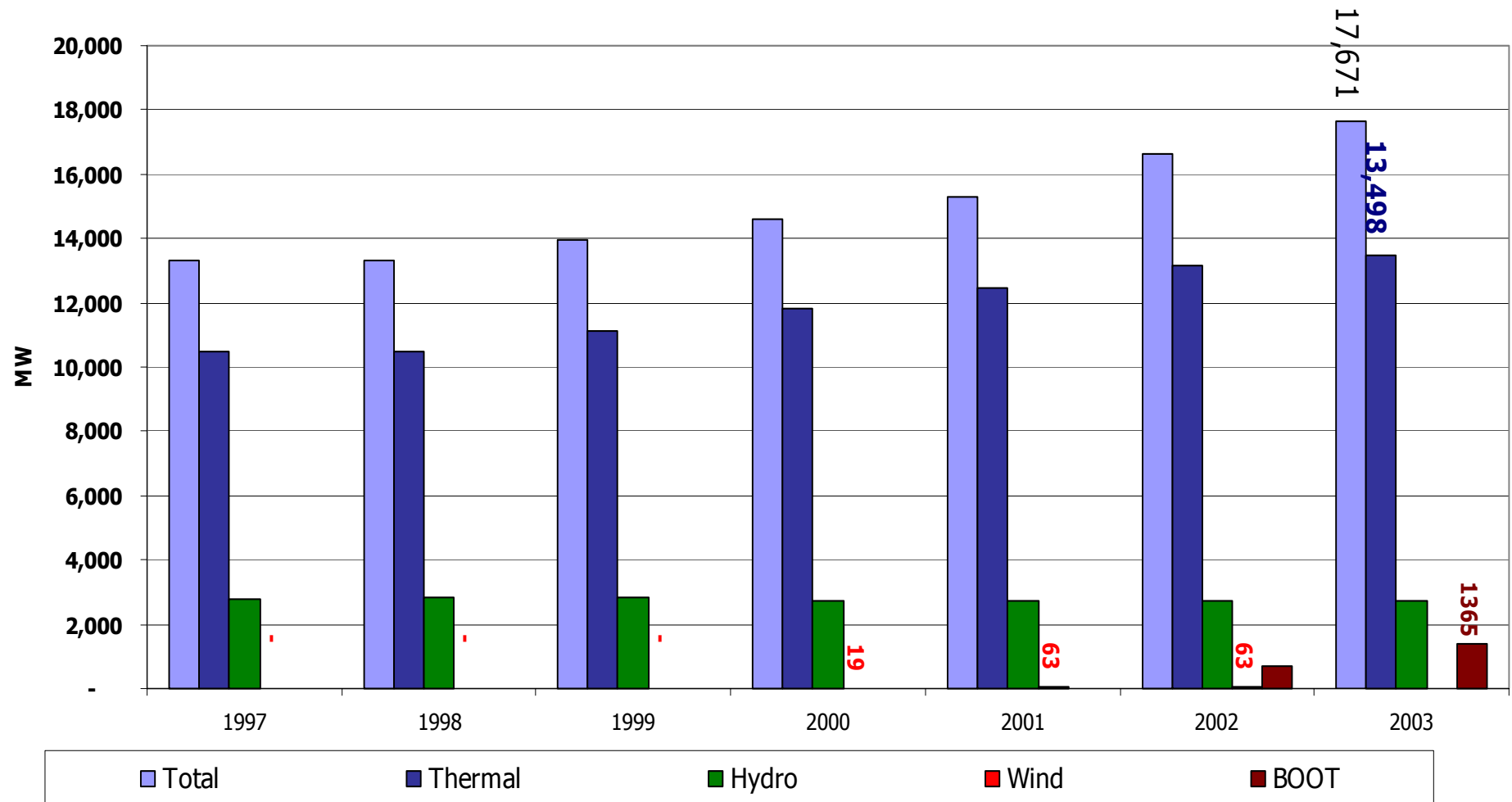
Cogeneration

- You do not have to sell back electricity
- Which is to be covered and/or partially covered thermal or electrical energy

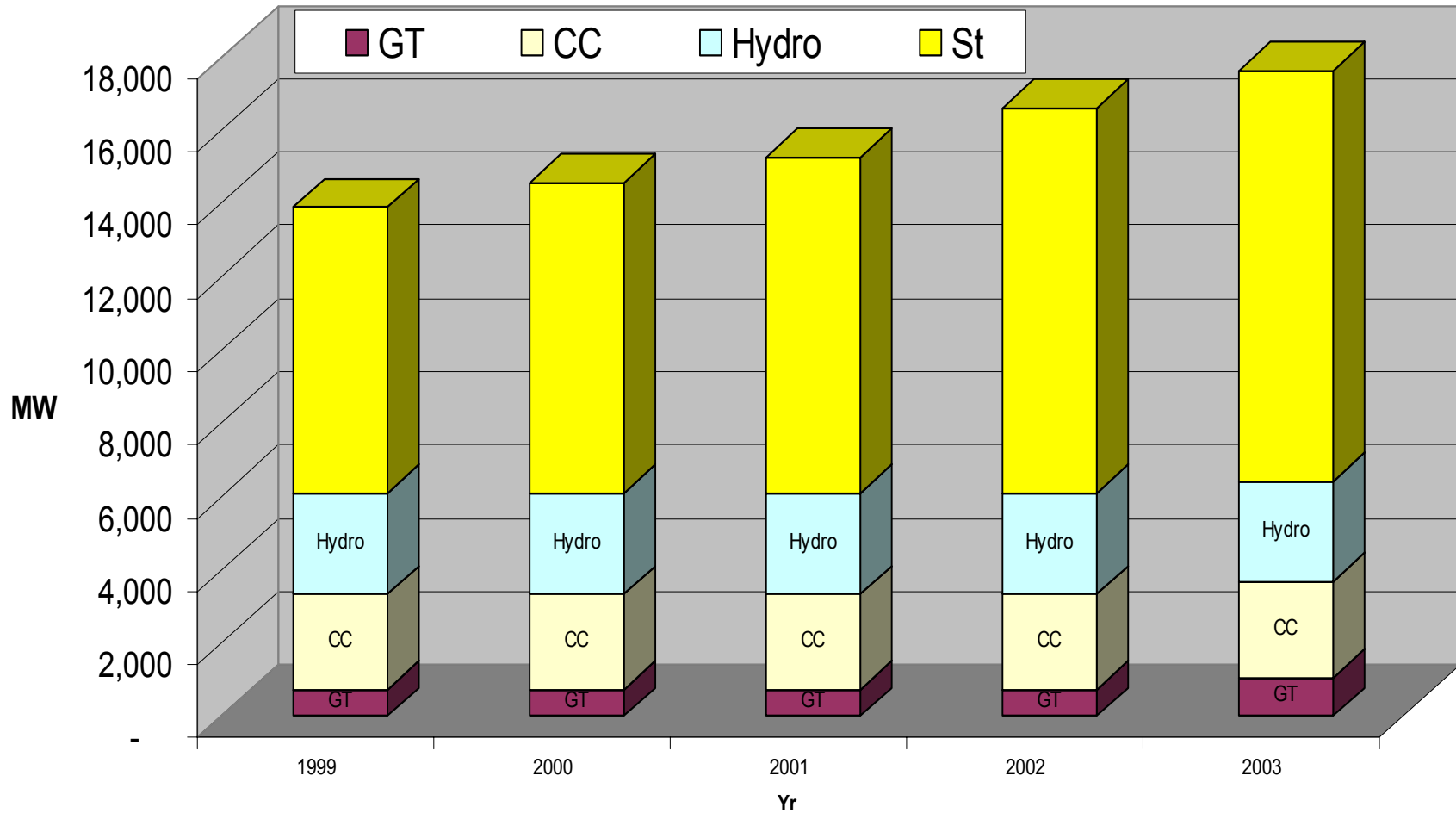
Egypt: Energy Situation (brief)

Egypt - Installed Power

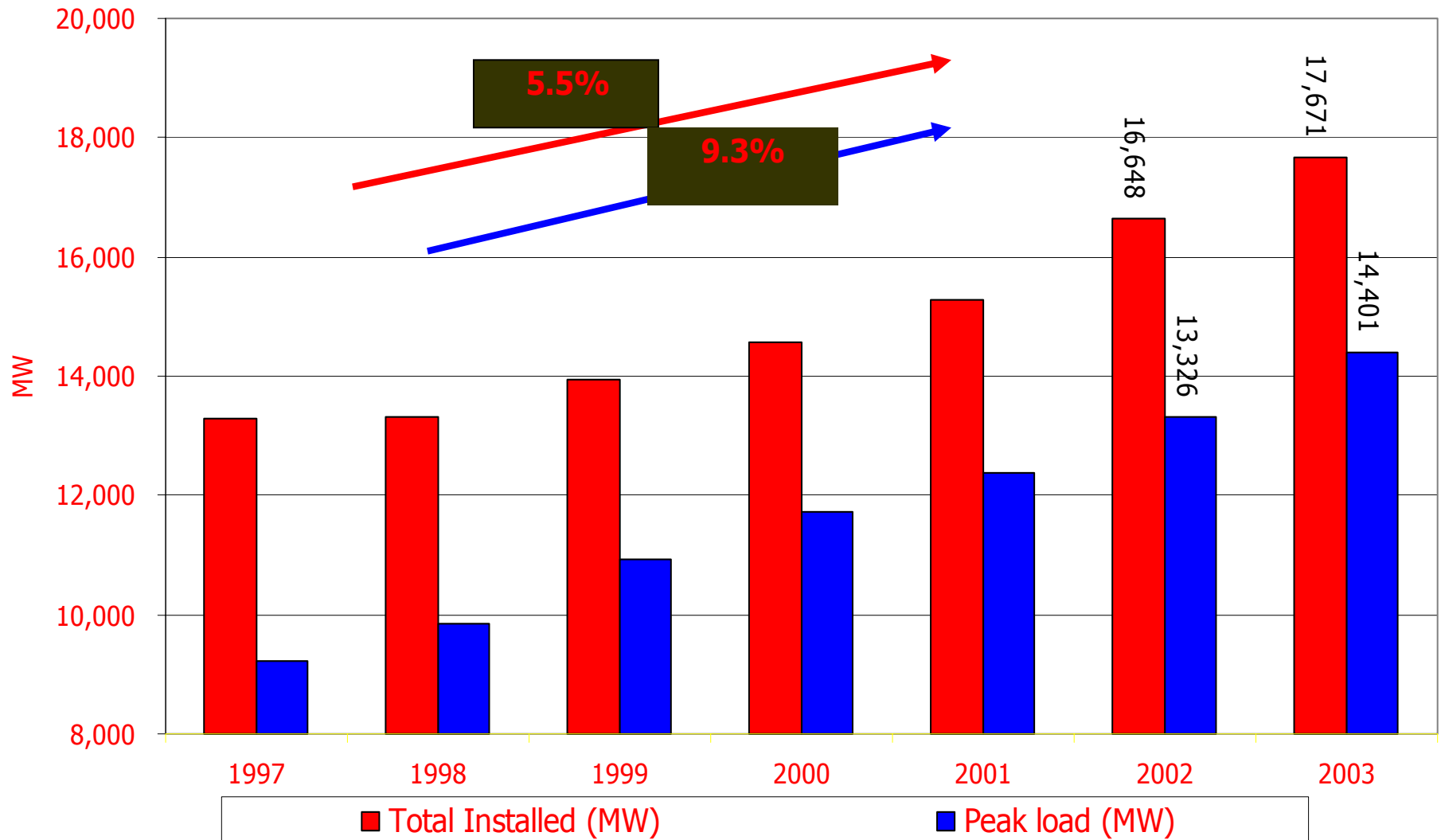
Egypt - Installed Power



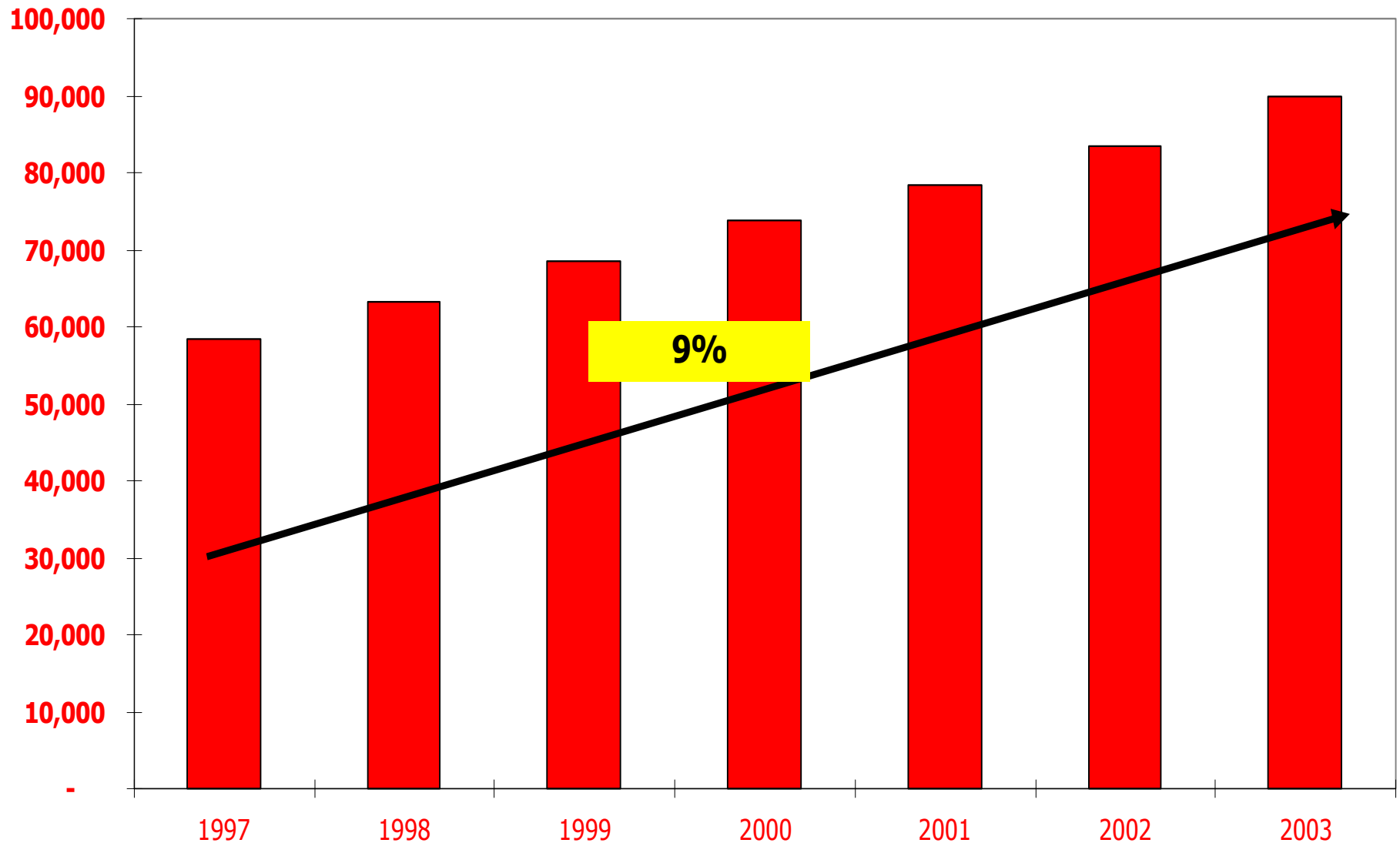
Egypt: PS Mix



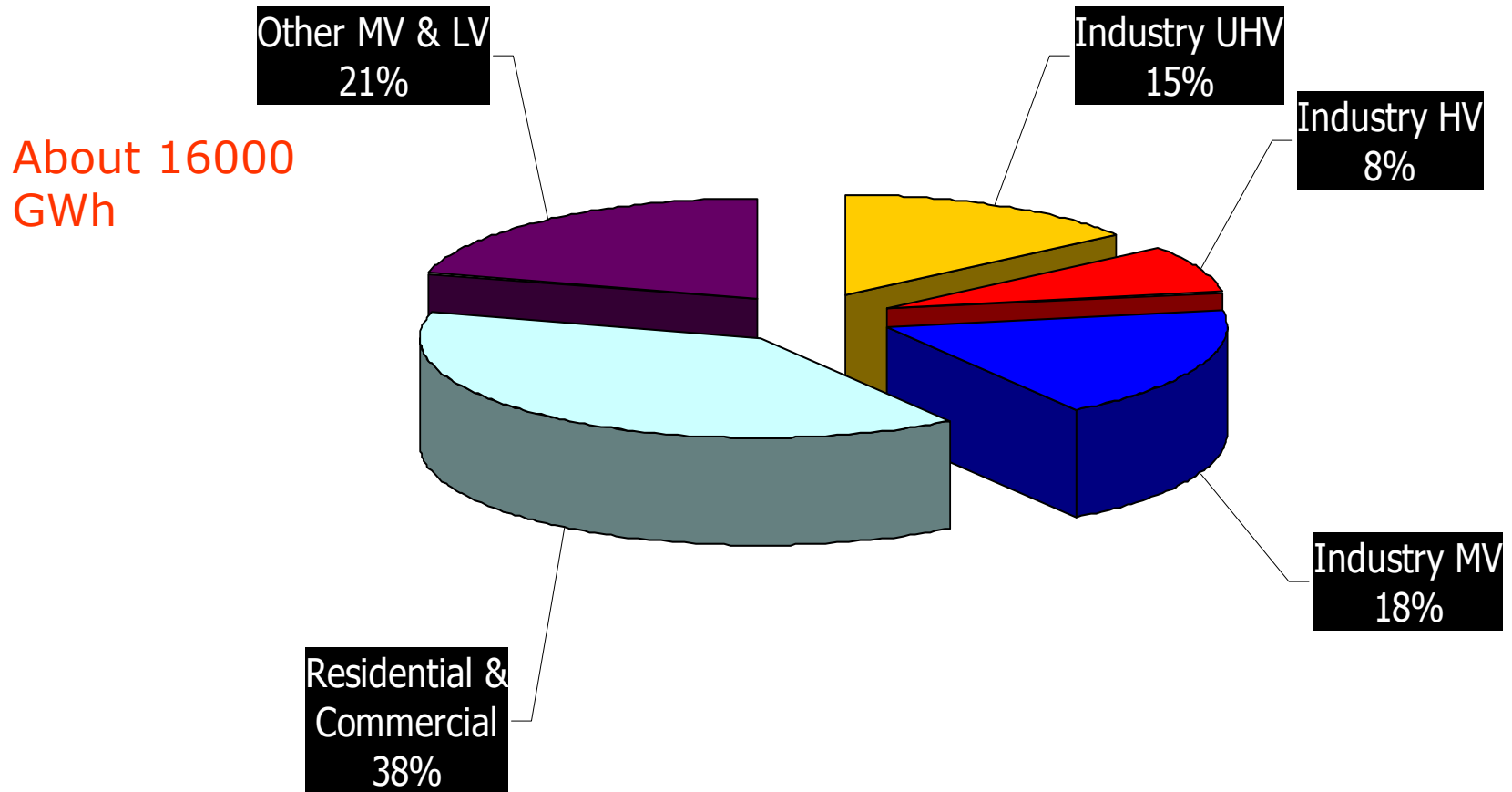
Egypt Annual Installed & Peak Power



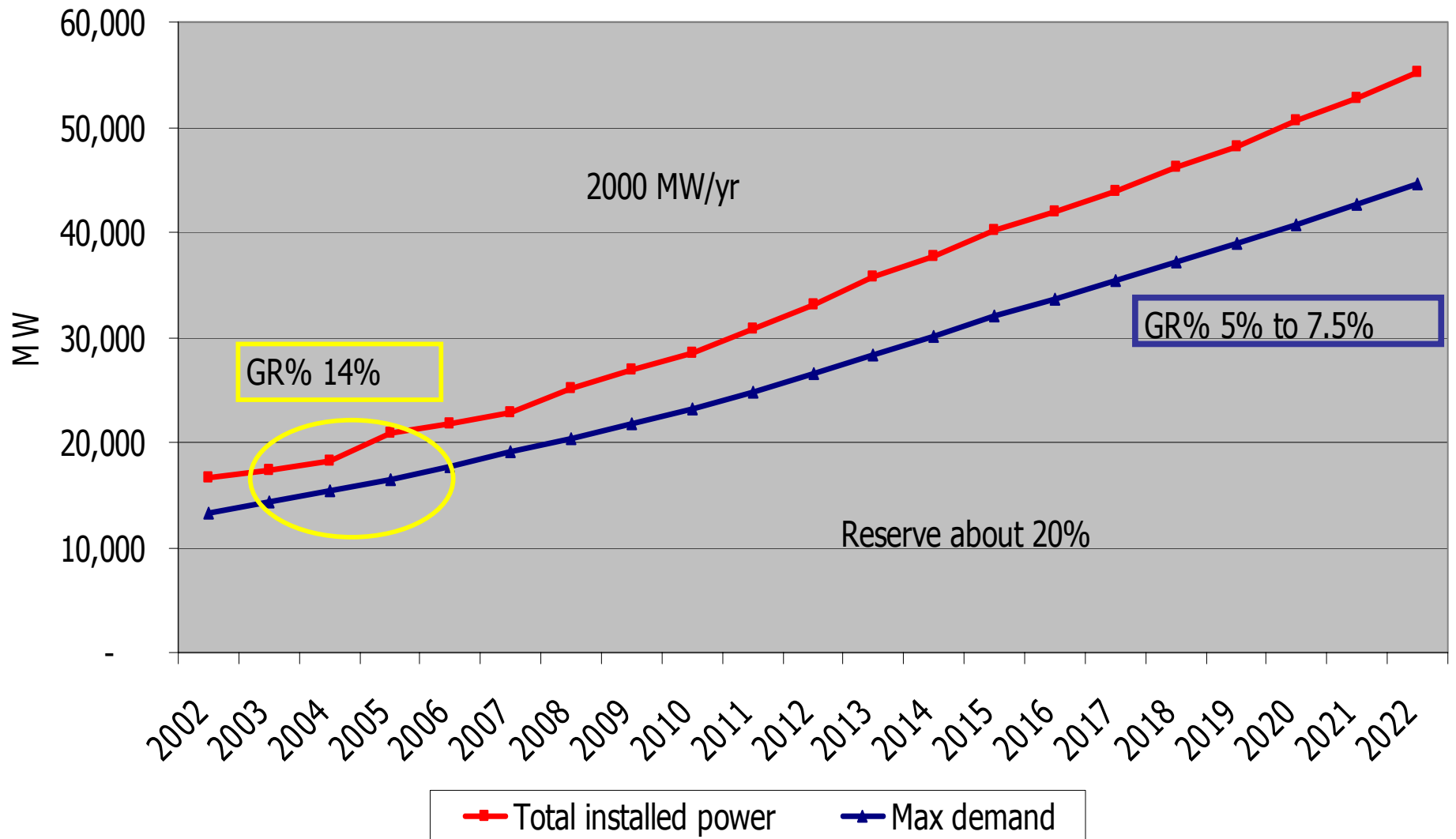
Egypt Annual Energy Consumption (GWh)

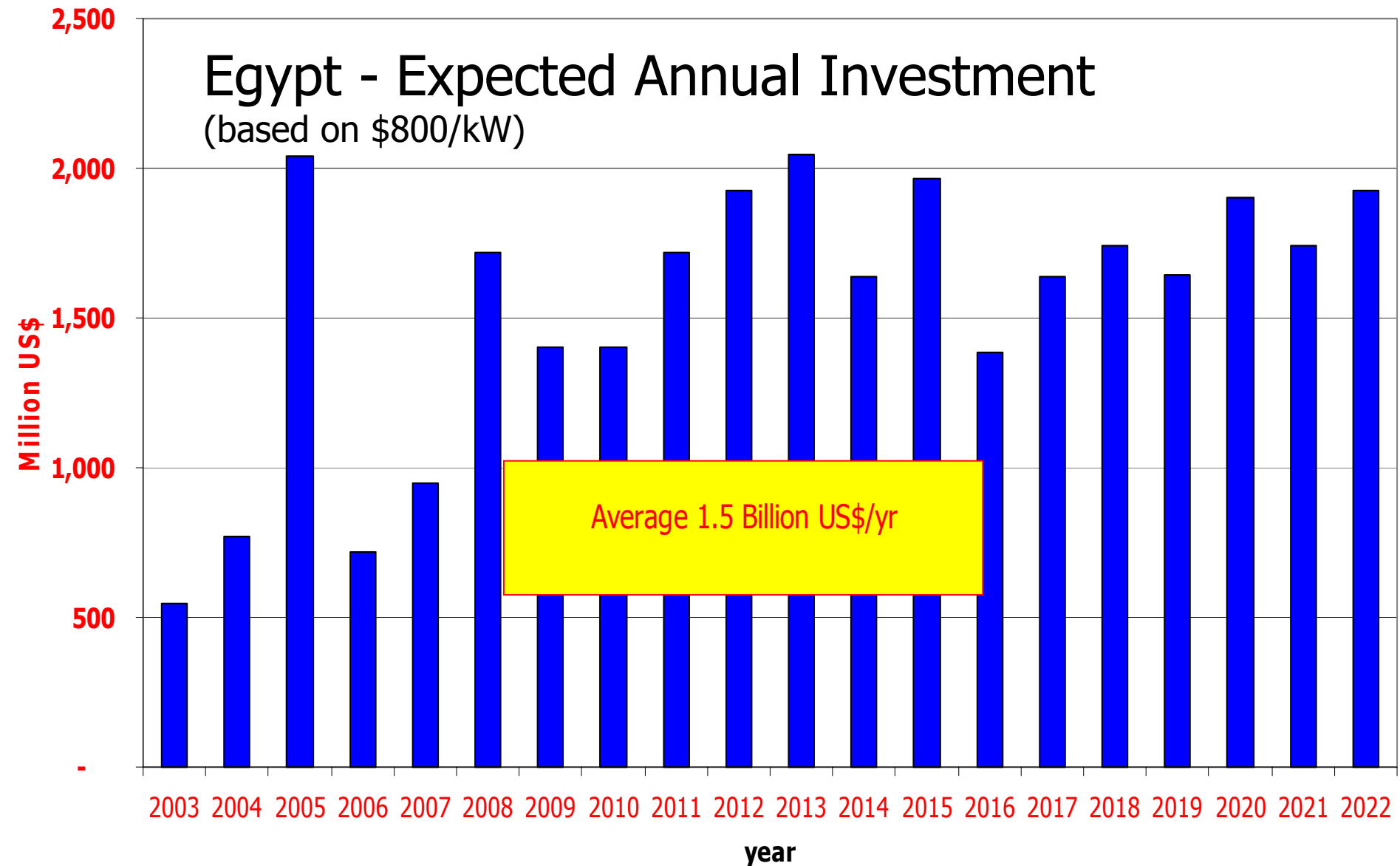


Egypt - Sectorial Energy Consumption (Typical)

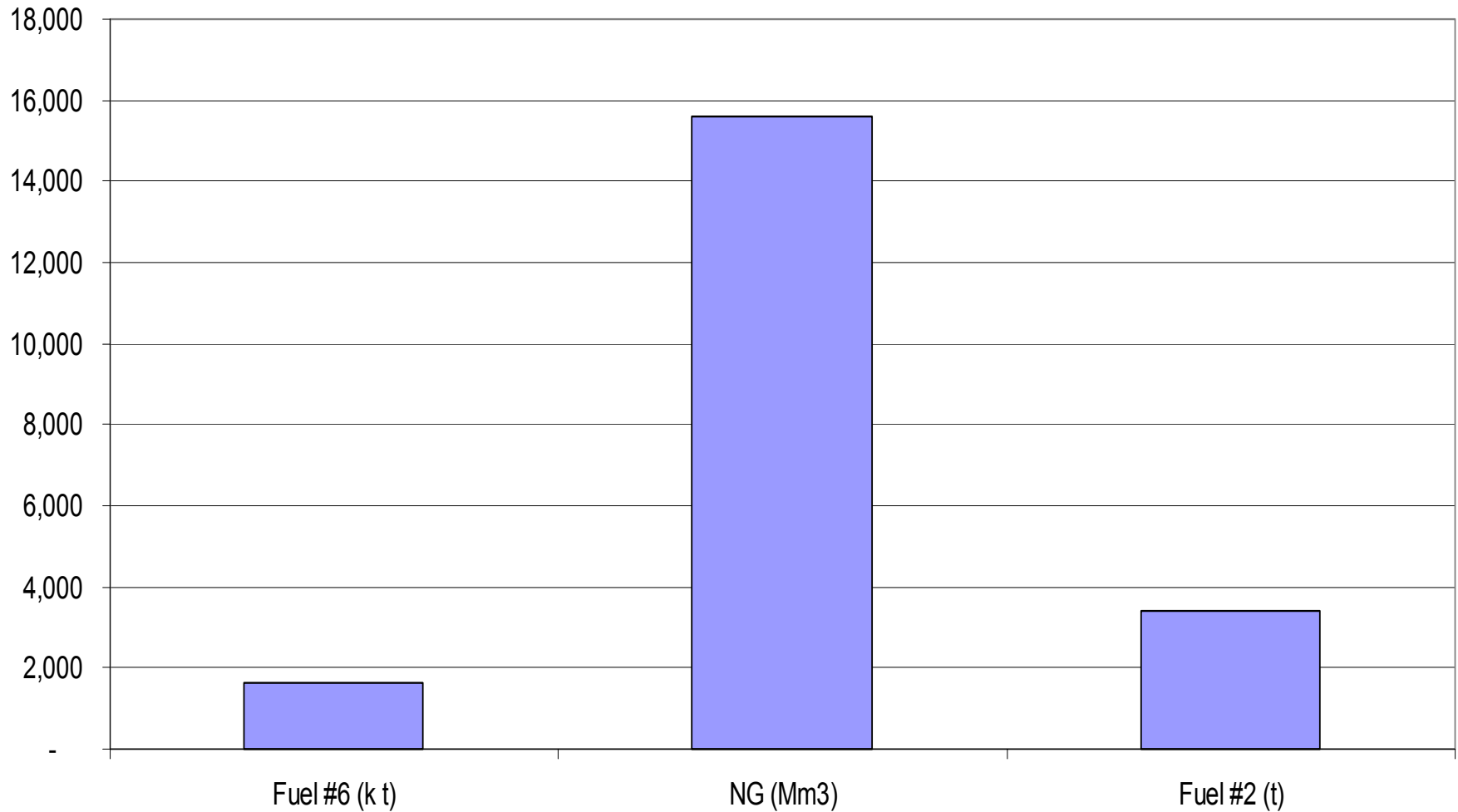


Egypt - Planned Installed Power & Maximum Demand



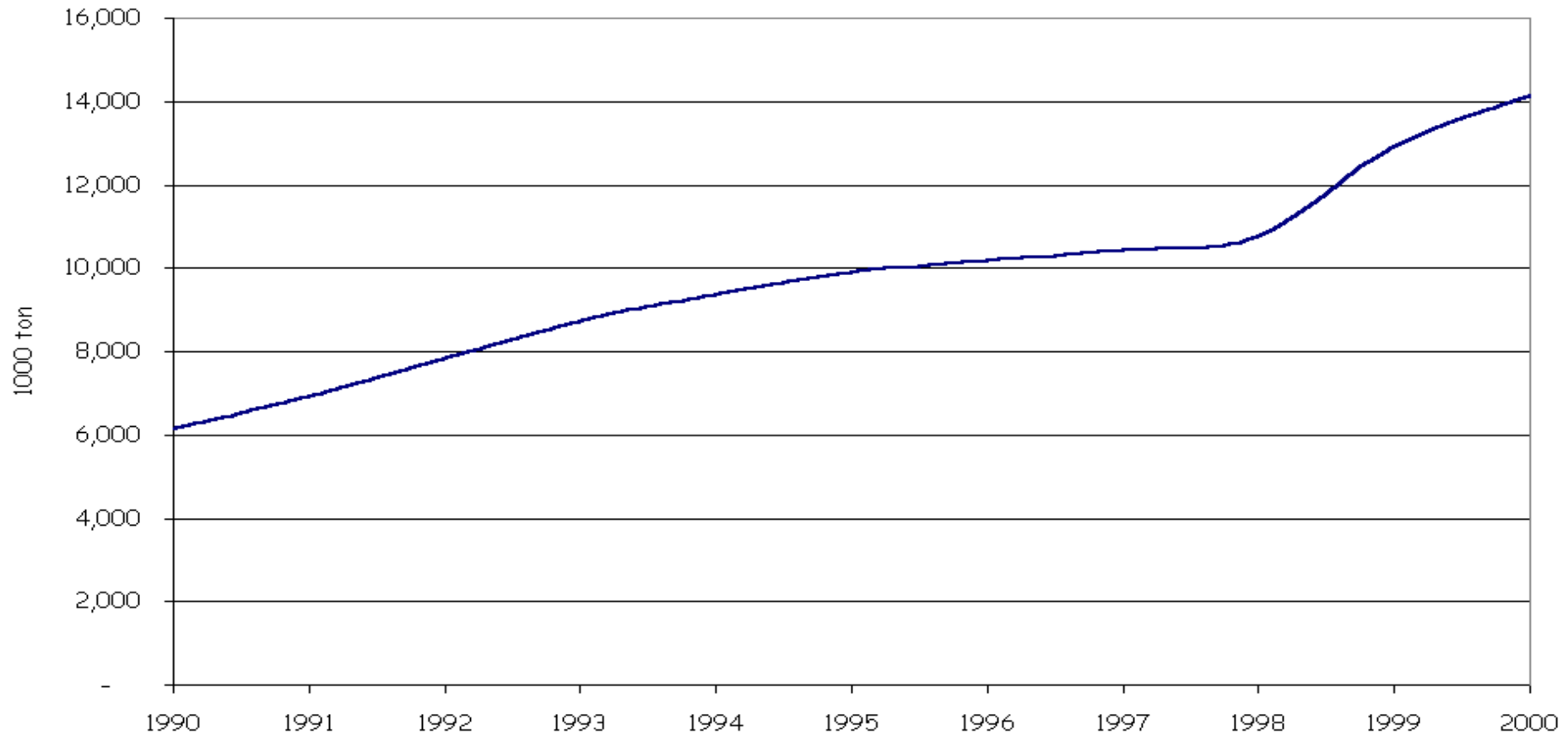


Fuel Mix in 2003

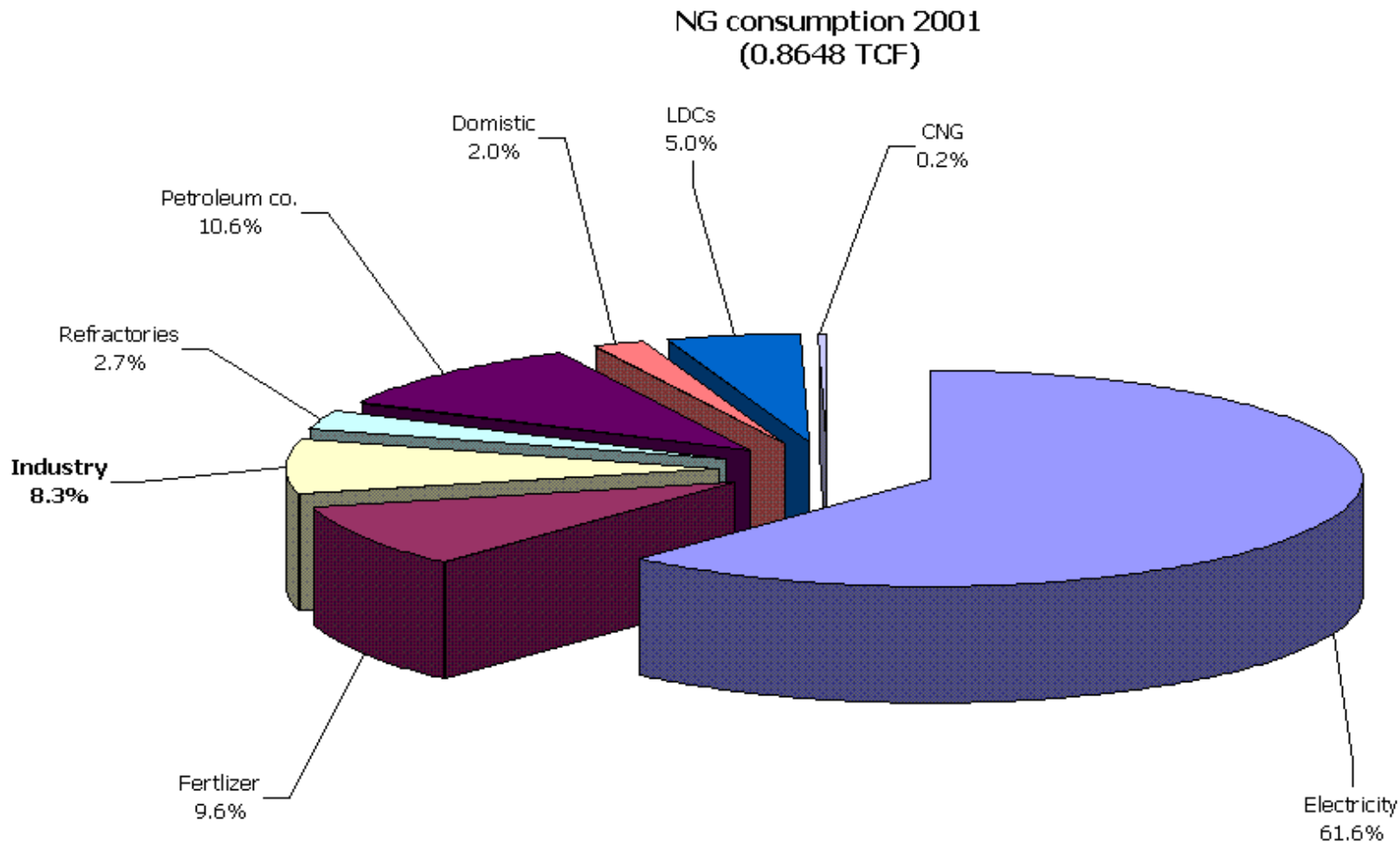


NG Consumption

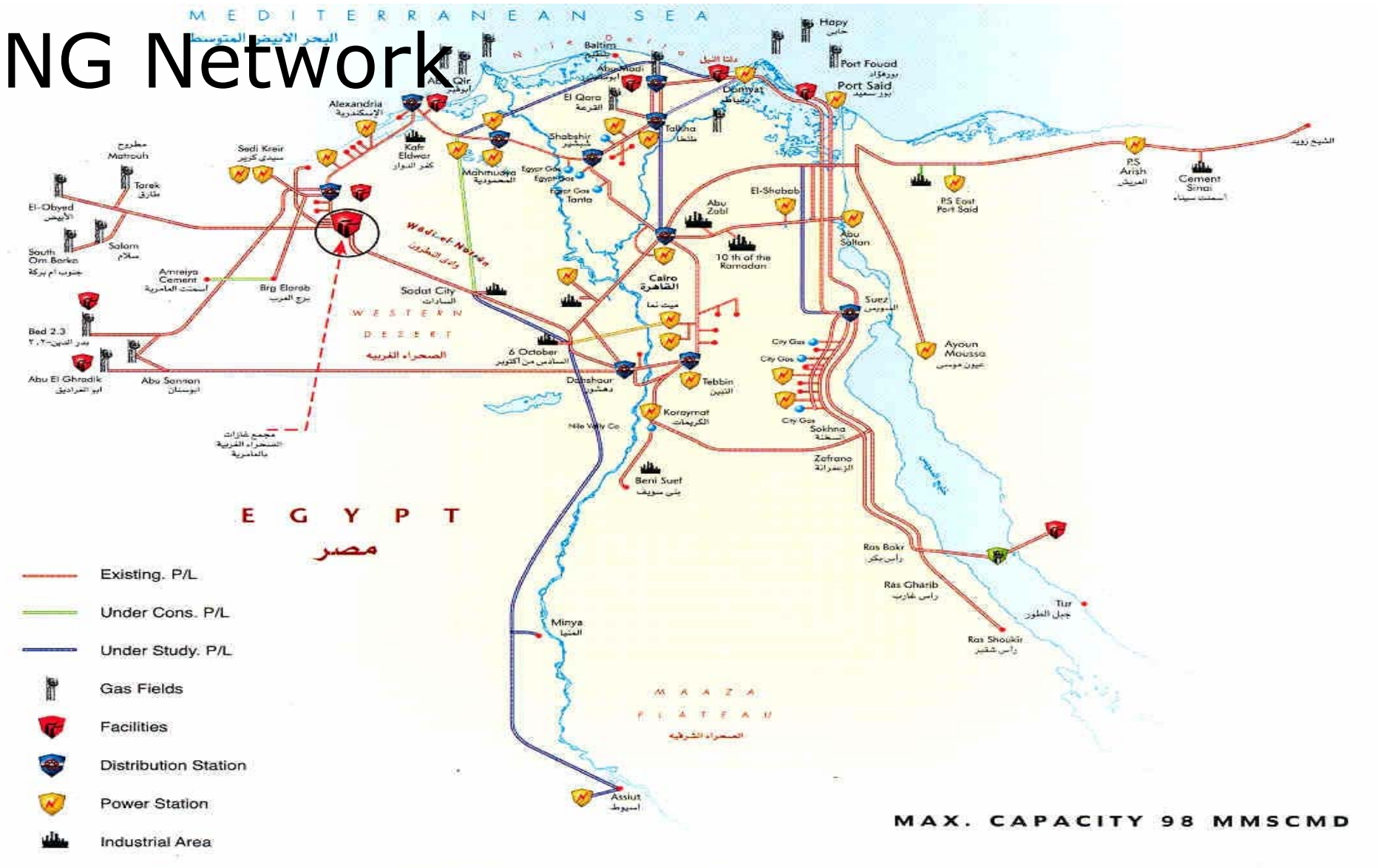
Evolution of NG Consumption In Egypt



Sectorial NG Consumption



NG Network



Industrial End-user Fuel Prices

Fuel	Local Price	Price in (LE/GJ)	Price in (LE/MBTU)	% Difference to Natural Gas Price
Natural Gas	0.141 LE/m ³	4.0	4.2	Base
Mazout (fuel oil #6)	185 LE/ton	4.7	4.9	+17%
LPG	320 LE/ton	6.8	7.1	+70%
Solar (fuel oil #2)	463 LE/ton	10.4	10.9	+160%

CHP or Co-generation

Cogeneration *is the simultaneous generation of usable heat and power, usually electricity, in a single process from the same fuel.*

CHP is not a new technology

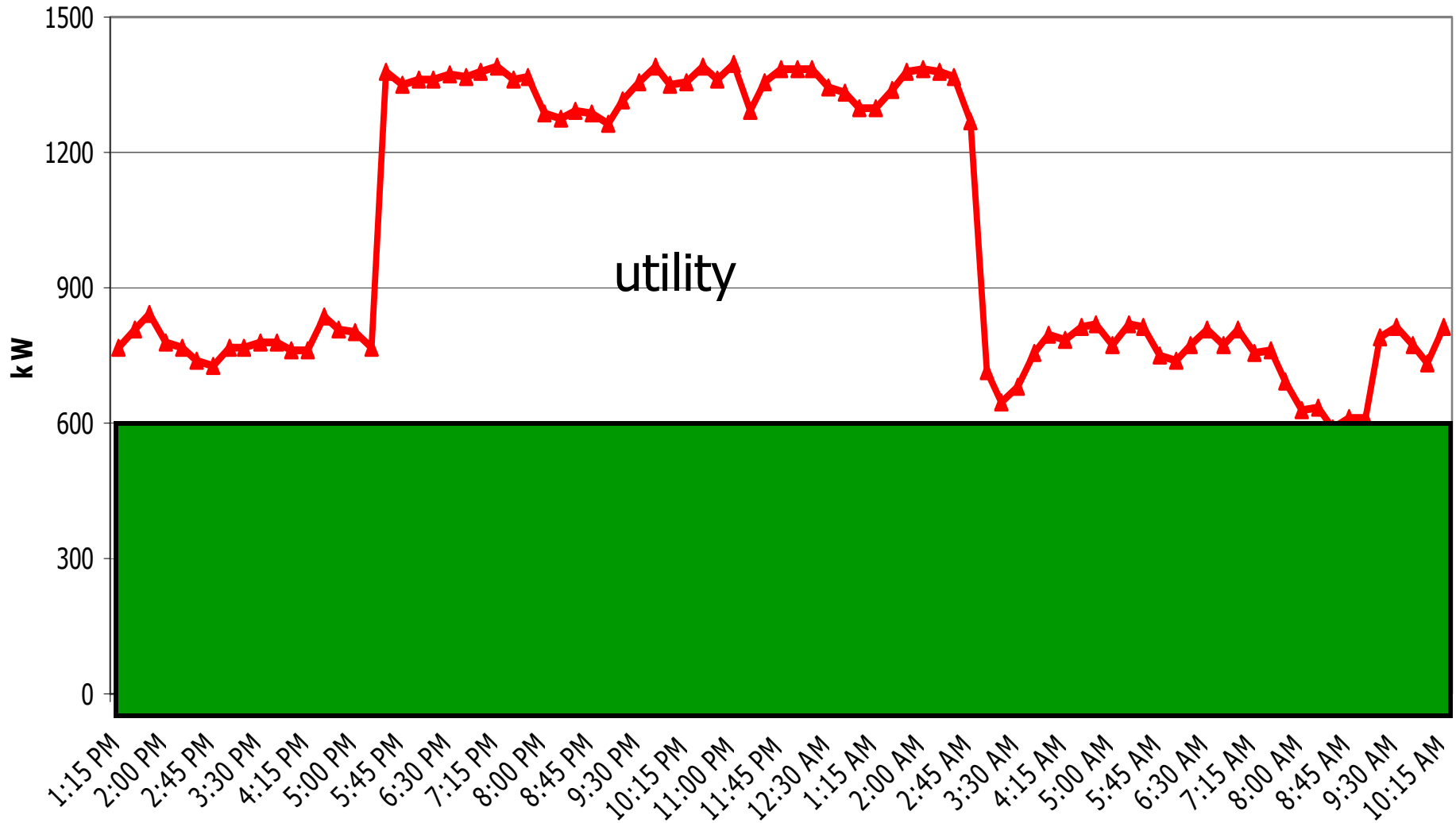
Used in Thomas Edison's first electric generating plant in 1891

Cogeneration: Principle

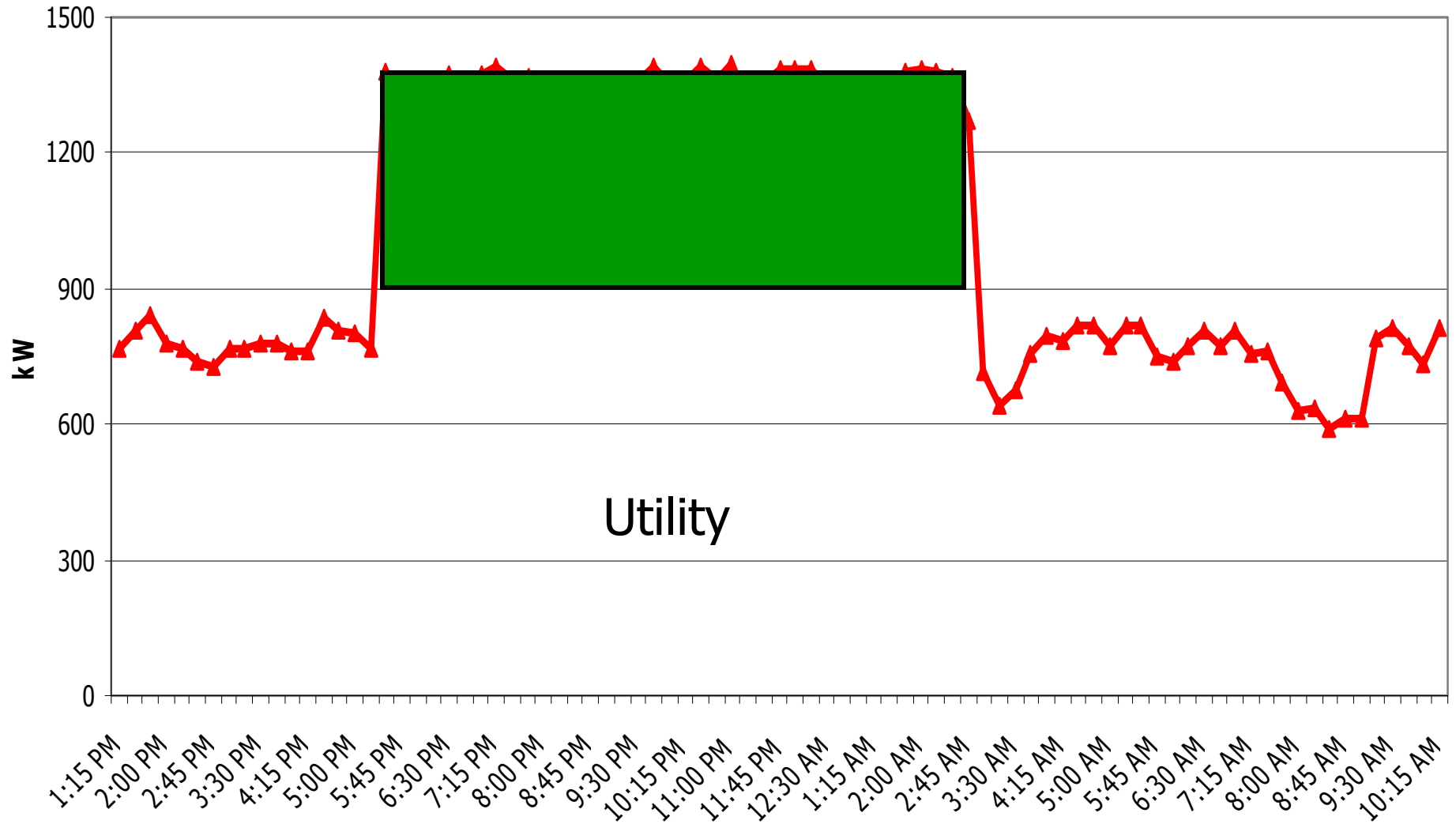
The principle behind cogeneration is simple. Conventional power generation, on average, is only 35-40% efficient – up to 65% of the energy potential is released as waste heat.

More recent combined cycle generation can improve this to 55%, excluding losses for the transmission and distribution of electricity. Cogeneration reduces this loss by using the heat for industrial & commercial plants.

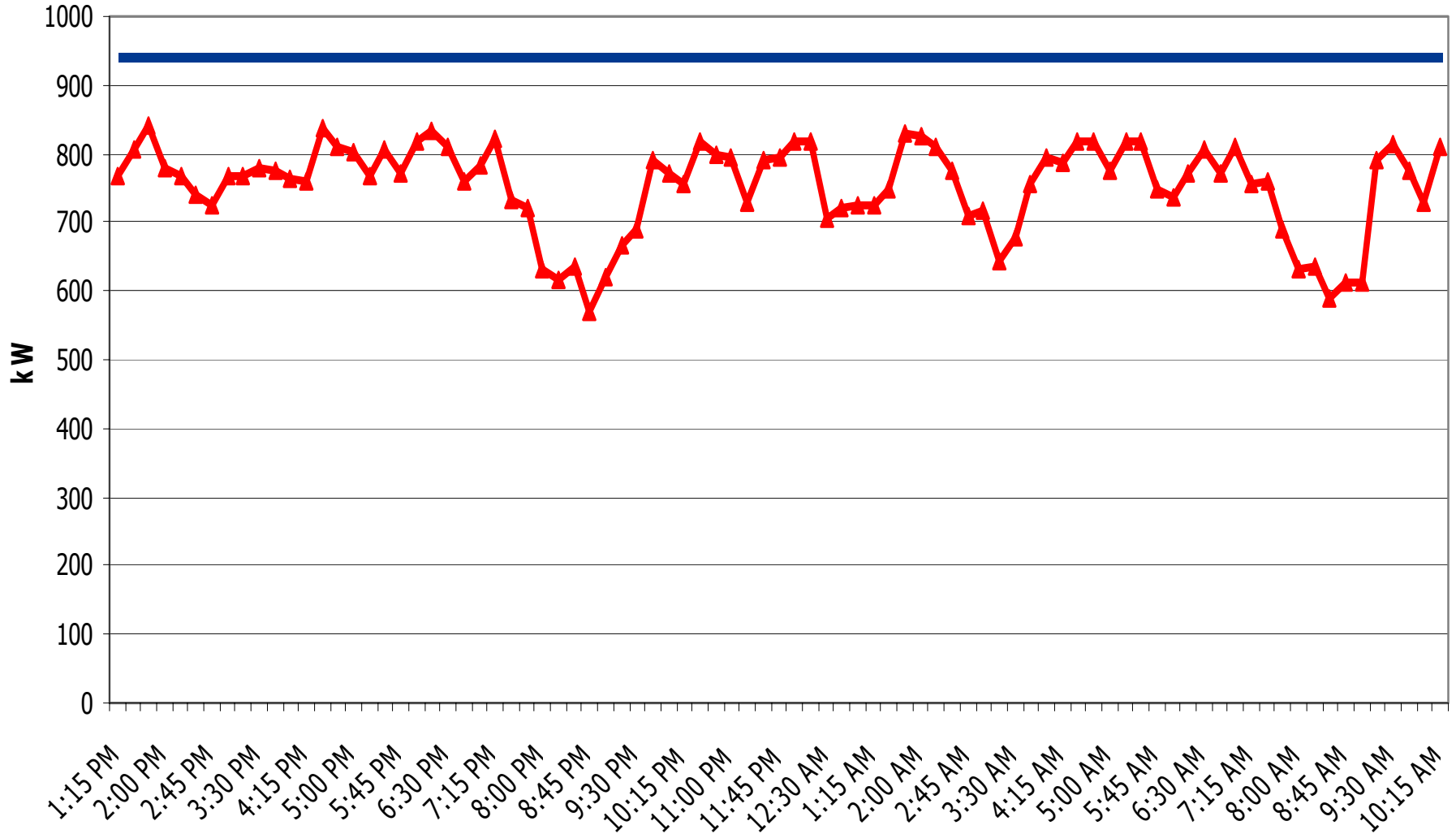
Power Generation -Base load



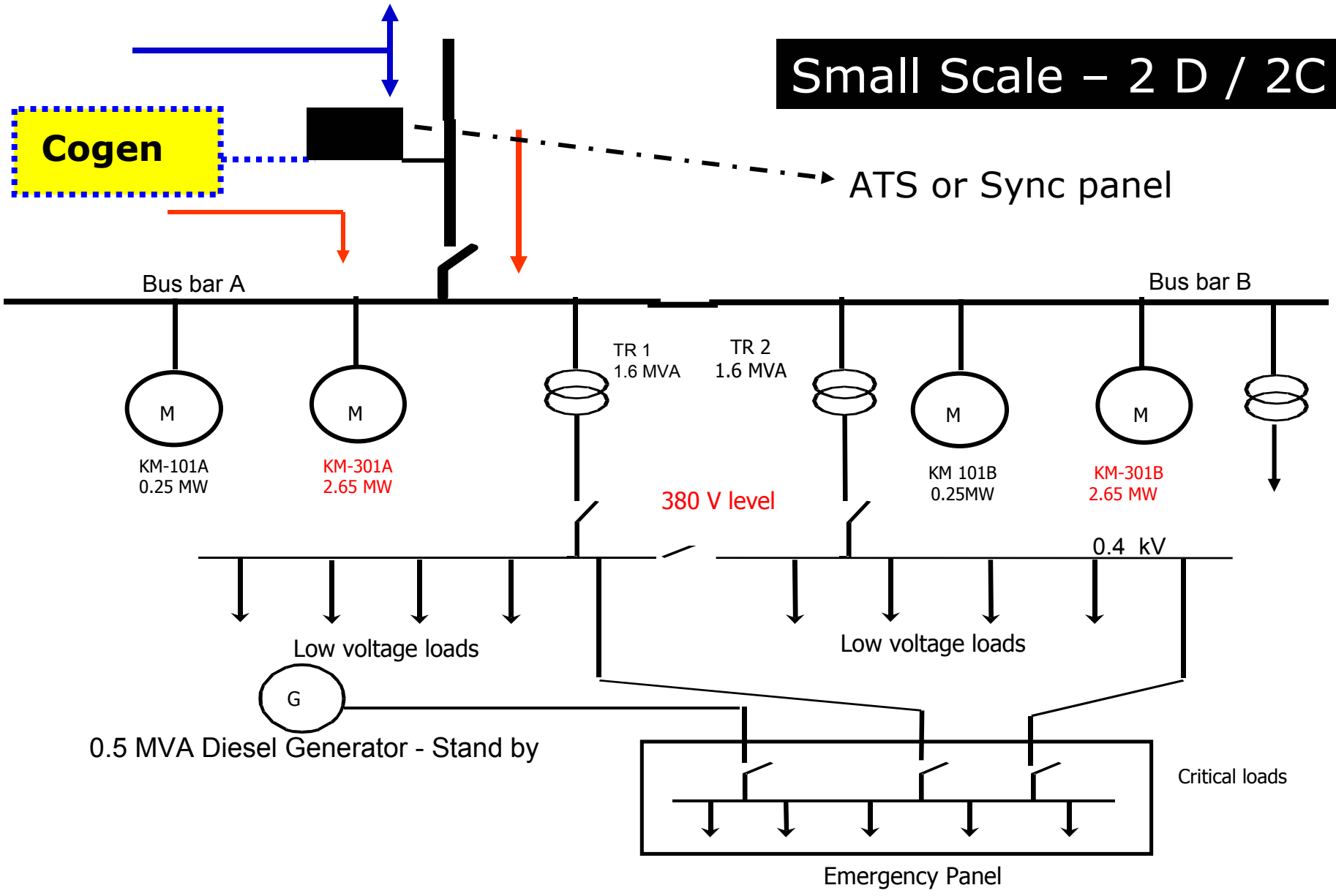
Power Generation- Peak shaving



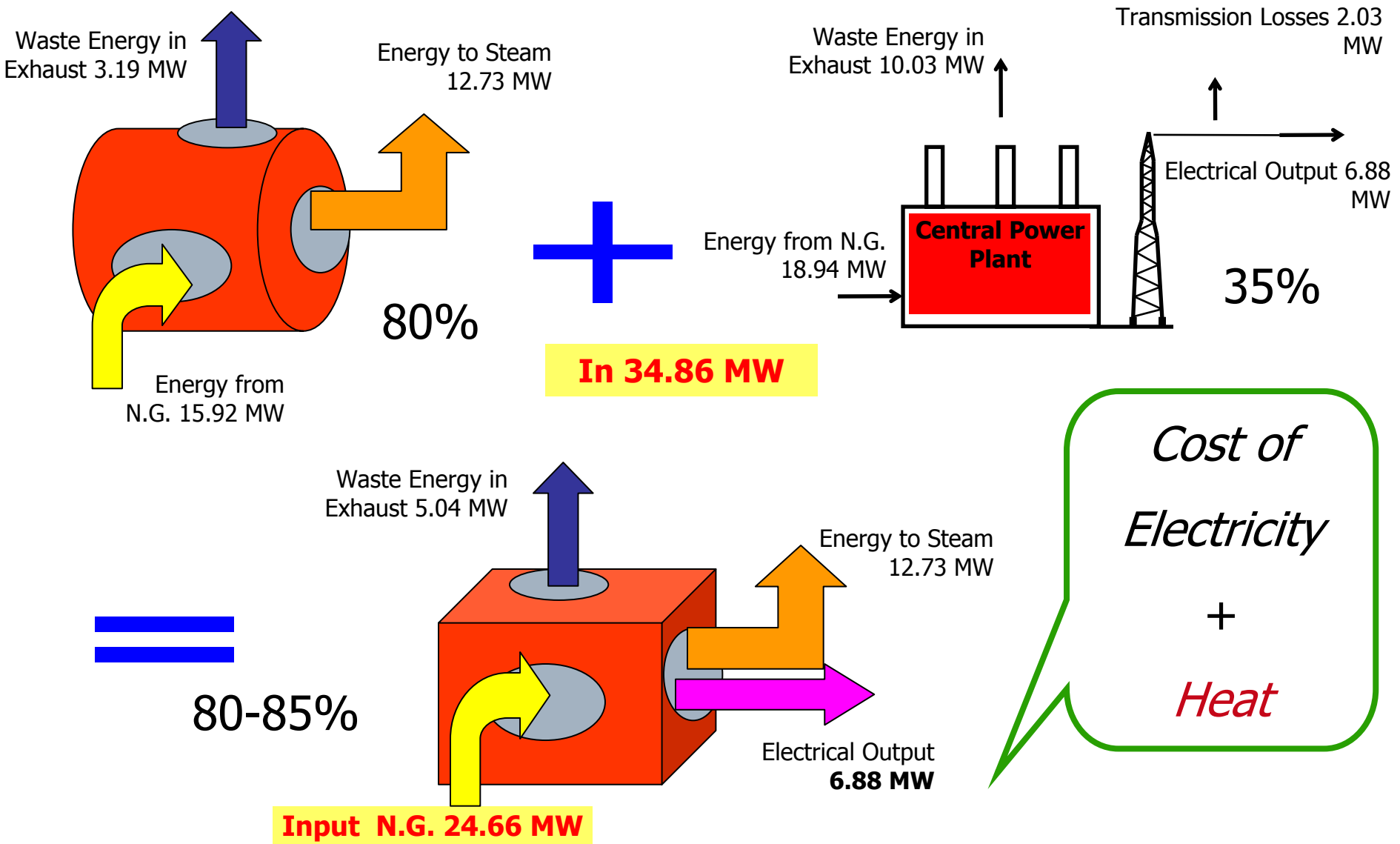
Power Generation- Self Generation



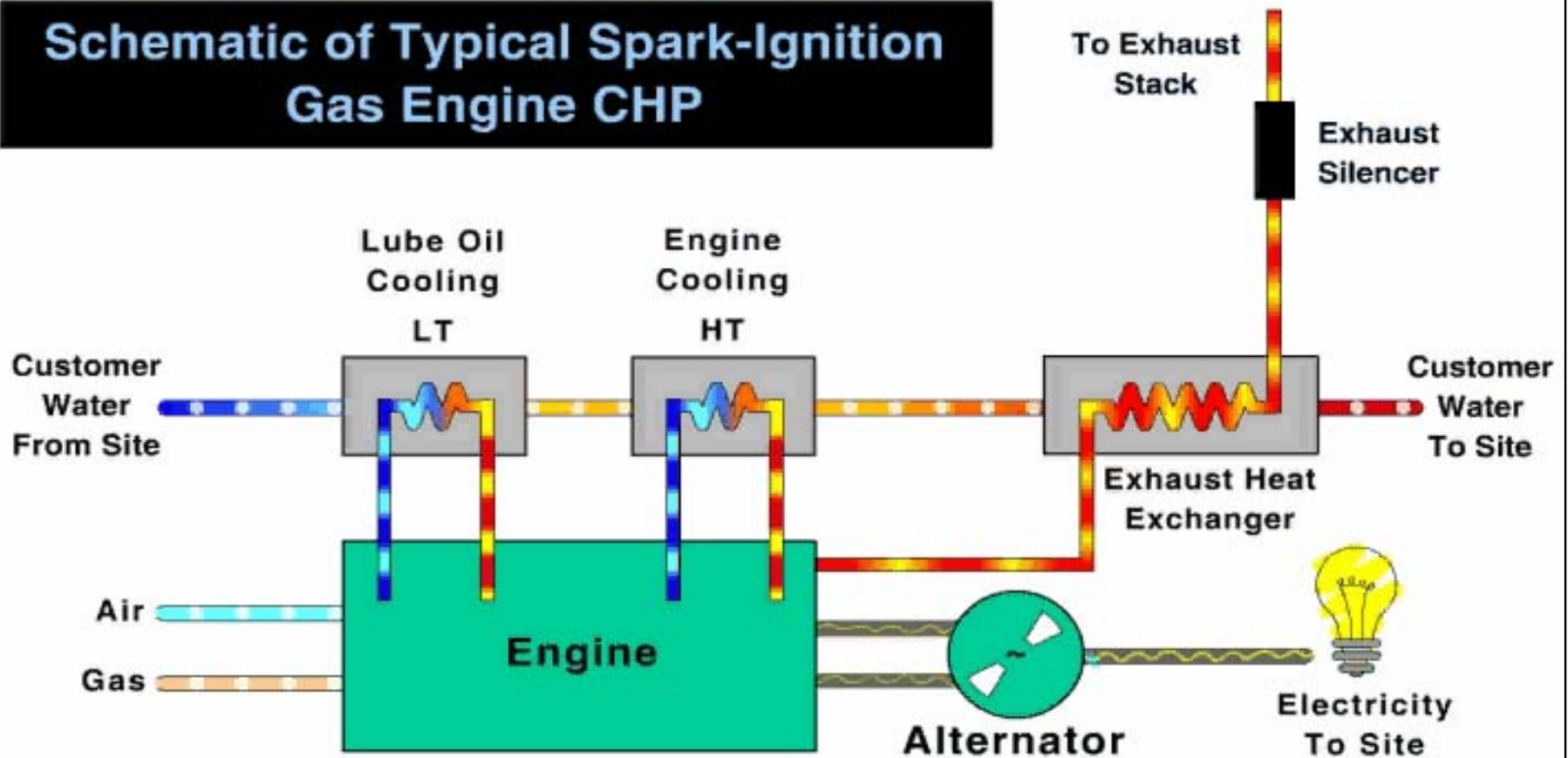
Small Scale – 2 D / 2C



Cogeneration Vs Conventional System



Schematic of Typical Spark-Ignition Gas Engine CHP





Applications

- Power Generation
 - Base load
 - Peak shaving
 - Self generation
- Turbo-expansion
- Co-generation
 - Hot Water
 - Steam
 - Hot Water and Steam
 - Heat
 - CO₂
 - (HVAC) Absorption Chilling

Advantages of Cogeneration

Plant perspective:

- Fuel/energy savings and its associated cost savings
- Improve the environment through the reduction of harmful emissions

Advantages of Cogeneration (contd.)

□ From National Perspective:

- Avoid distribution losses, which represents 10-12% of the total power transmitted.
- More cost effective than a central power station
- Reduce the grid peak demand
- Reduce air pollution due to the improvement in fuel utilization
- Creates **diversity**, resulting in a more robust and reliable electricity system
- Reduce emissions

Small Scale Cogeneration Systems Alternatives

- Gas turbine-based cogeneration system
 - Gas turbine with direct use of exhaust gases
 - Gas turbine with waste heat boiler/Absorption chiller

- Reciprocating engine-based cogeneration system (gas or Diesel)
 - Engine with waste heat recovery system/Absorption chiller

Parameters Affecting the Selection of Cogeneration System Type

- Plant thermal to electric ratio
- Plant electrical and heat demands
- Heat quality
- Type of fuel available

Selection Criteria of Cogeneration Prime-mover

Type	Available Process Heat	Thermal to Electric Ratio	Fuels
Steam Turbine	120-400 C	2:1 up to 30:1	Any
Gas Turbine	120-500 C	1.2:1 up to 4:1	Oil-based Gaseous
Reciprocating Engine	80-120 C	0.8:1 to 2:1	Oil-based Gaseous

Techno-economical Aspects of Cogeneration Systems

- Cogeneration system is sized according to the plant electrical and thermal demands.
- Selecting and sizing a cogeneration system is done as follows:
 - Develop the plant annual and daily electrical load profiles as well as the corresponding load duration curves.
 - Identify plant max, average electric load
 - Identify the thermal load types (i.e. hot gases, hot air, steam, hot water) as well as their corresponding conditions (pressure, temperature, quality)
 - Develop the thermal load profiles of the identified thermal load as well as the corresponding load duration curve
 - Identify the type of fuel supply available to the plant.

Techno-economical Aspects of Cogeneration Systems (contd.)

- According to the plant thermal to electric ratio, type of the thermal load and its required conditions, maximum electric demand, plant average demand and type of fuel available, both type and size of the cogeneration system can be identified.
- The savings is calculated as the difference in the cost between purchasing electricity and generated electricity as well as the avoided fuel cost which is used to the satisfy the thermal load. **Selling back**
- The cost of the equipment are defined. This cost can be varied according to the type and size of the unit.
- The running cost are defined including both the fixed and the variable one.

Techno-economical Aspects of Cogeneration Systems (contd.)

- To evaluate the project economically all the economical indicators such as; simple payback period (SPP), the internal rate of return (IRR), the net present value (NPV) and the life cycle cost (LCC) should be calculated.
- Since the cogeneration project is capital intensive project, a financial plan should be developed based on the available funds and scheme of implementation.
- Future plant expansion is considered

Regulatory Framework in Egypt

- Till now there is no clear regulatory framework for cogeneration activities in Egypt.
- Some efforts have been done to encourage cogeneration as an energy efficiency measure in industrial and commercial plants.

Current & Potential Cogen

- There is a very good opportunities for cogeneration projects as there are a huge number of textile, food, chemical, commercial plants.

Barriers in brief

- Awareness
- High investment
- Financing mechanism
- Financial indicators

Overview of the Project Portfolio

Project Code	Project	Investment (M\$)	ASC (ton)	CSC (\$/tC)	SPBP (yrs)
IV. Energy Efficiency					
IV.3 Cogeneration					
IV.3.1	Beni Soeif Cement Cogen	8.3	6,336	-125	8.5
IV.3.2	Industrial Investments Co. (Chemical Industry)	0.3	185	-174	7.8
IV.3.3	Misr Elmonifia Cogen (Textile)	1.6	911	-237	6.3
IV.3.4	Mohm cogen (metal works)	0.3	369	-133	5.5
IV.3.5	Egypt Air Hospital (Building)	0.3	59	-488	8.5