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TRIGENERATION FOR BUILDINGS
European Seminar by COGEN Europe

Market opportunities in South Europe

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Milan, Italy 22-2-2008

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TRIGENERATION

- *TRIGENERATION* is power generation with simultaneous heating and cooling generation, from the same energy source.
- *TRIGENERATION* (CHCP, Combined Heat Cool & Power), is practically an extension of CHP, (Combined Heat & Power), with adaptation of an **absorption cooling cycle.**
- *In TRIGENERATION,* part or all of heat generated is used for cooling generation, within an absorption cooling cycle and depending on building particular needs.

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ENERGY DEMANDS THAT DEFINE TRIGENERATION POTENTIAL

- Heating (hot water or steam)
- Cooling (at various temperature levels)
- Electricity (at low or medium voltage)

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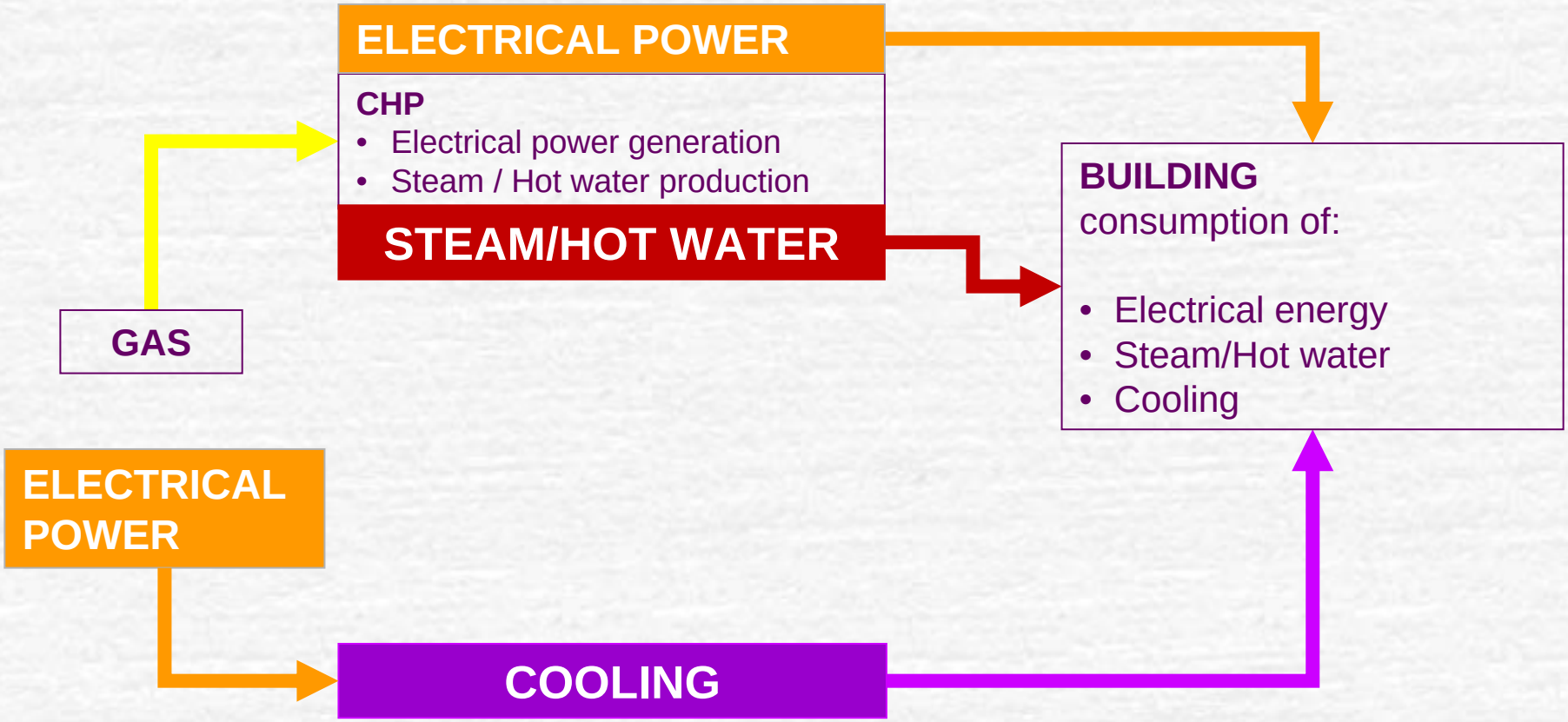
CHP



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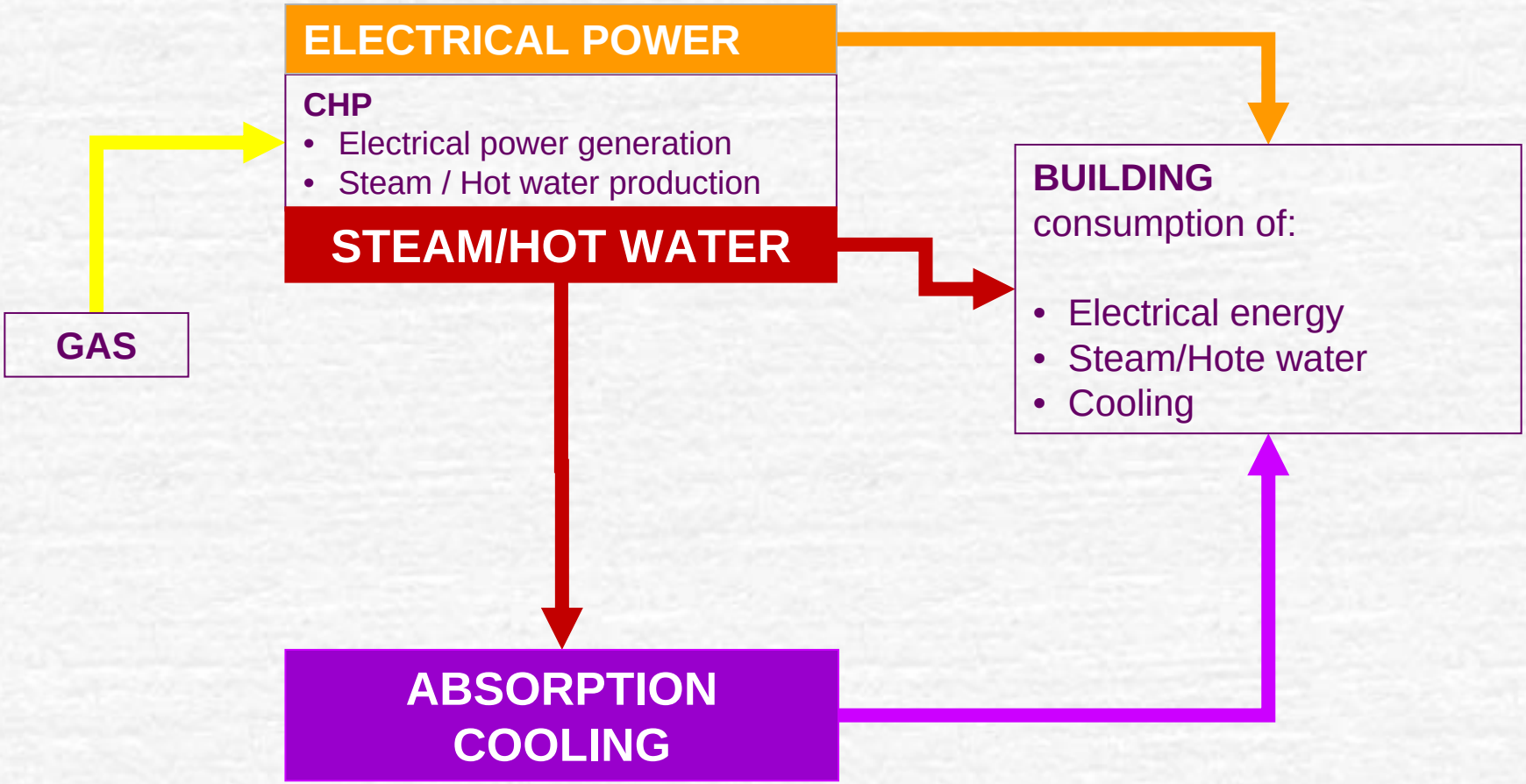
CHCP



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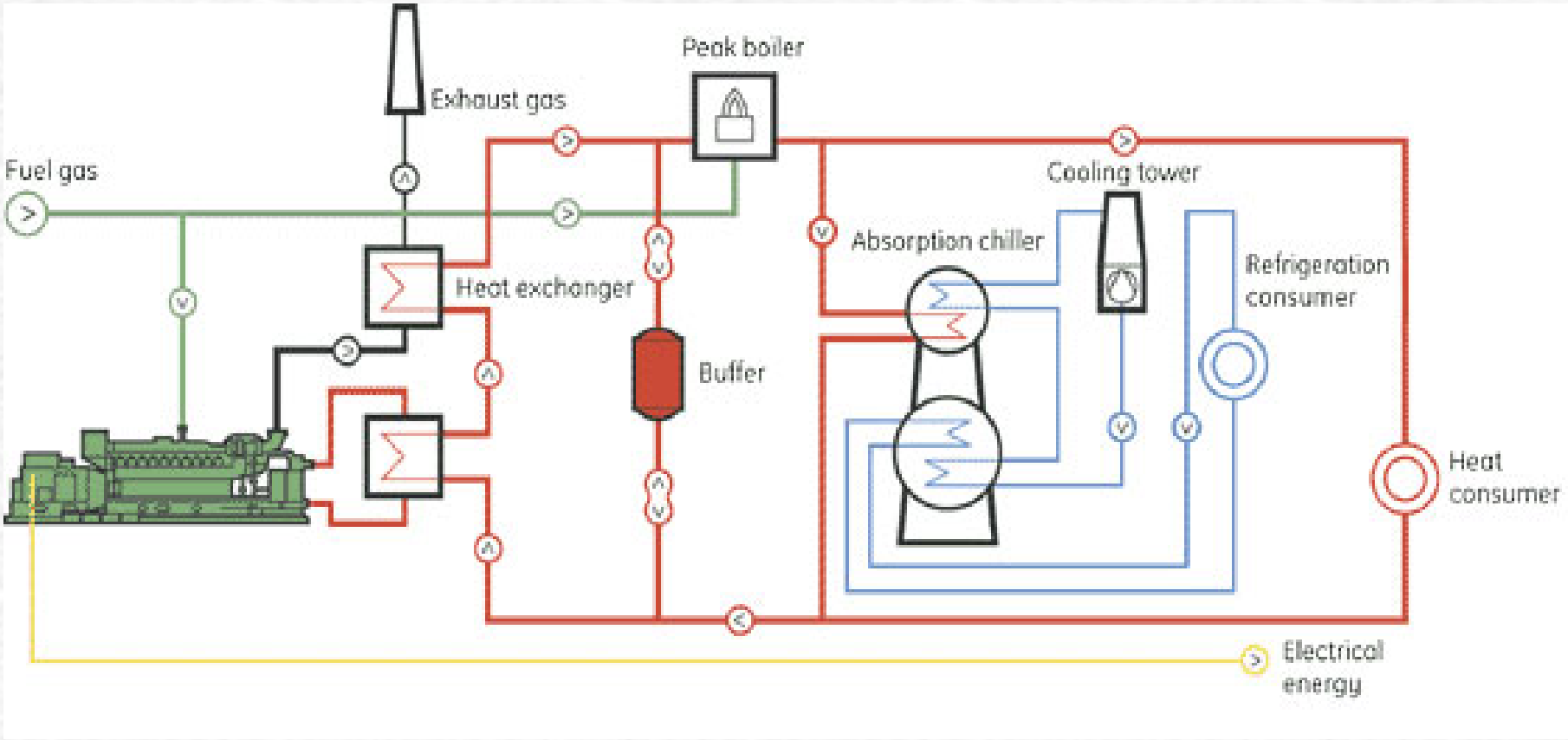
TRIGENERATION IN PRACTICE (1)



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TRIGENERATION IN PRACTICE (2)

- Main advantage of CHCP comparable to CHP, is the extension of useful operating period of CHP over the year. This is the reason that CHCP, under particular circumstances, minimizes initial capital's pay back period.
- In building sector, where central AC systems are used, CHCP application is of major importance because of high summer cooling loads and low or no heating loads.
- Main disadvantage of CHCP is the high cost of absorption chillers and their low COP, (Coefficient Of Performance), in comparison with conventional air-cooled chillers.This is because of the cooling tower needed with absorption chillers, which requires also more place for the same cooling load.

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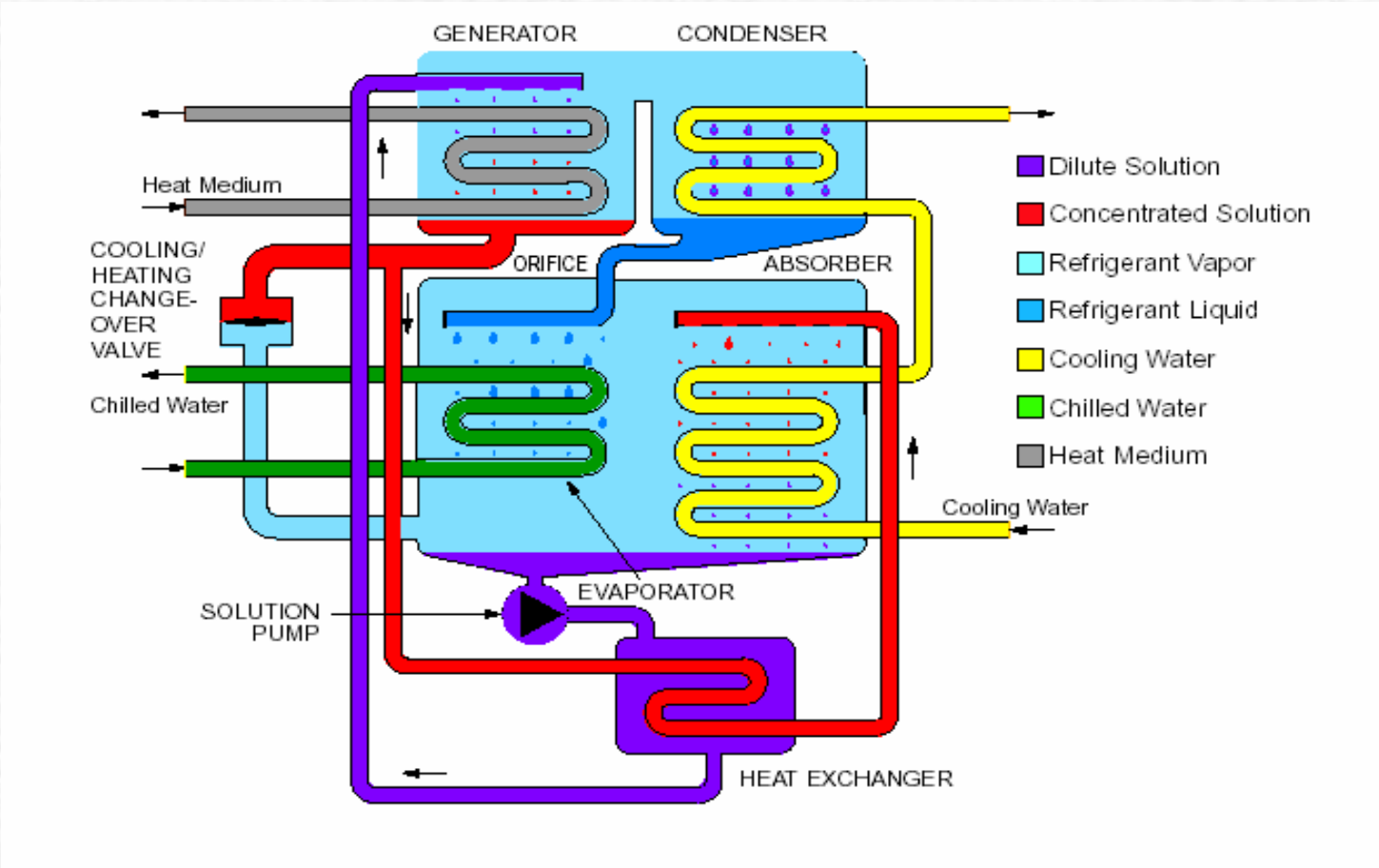
ABSORPTION COOLING LiBr (1)



(source: YAZAKI ENERGY SYSTEMS Inc)

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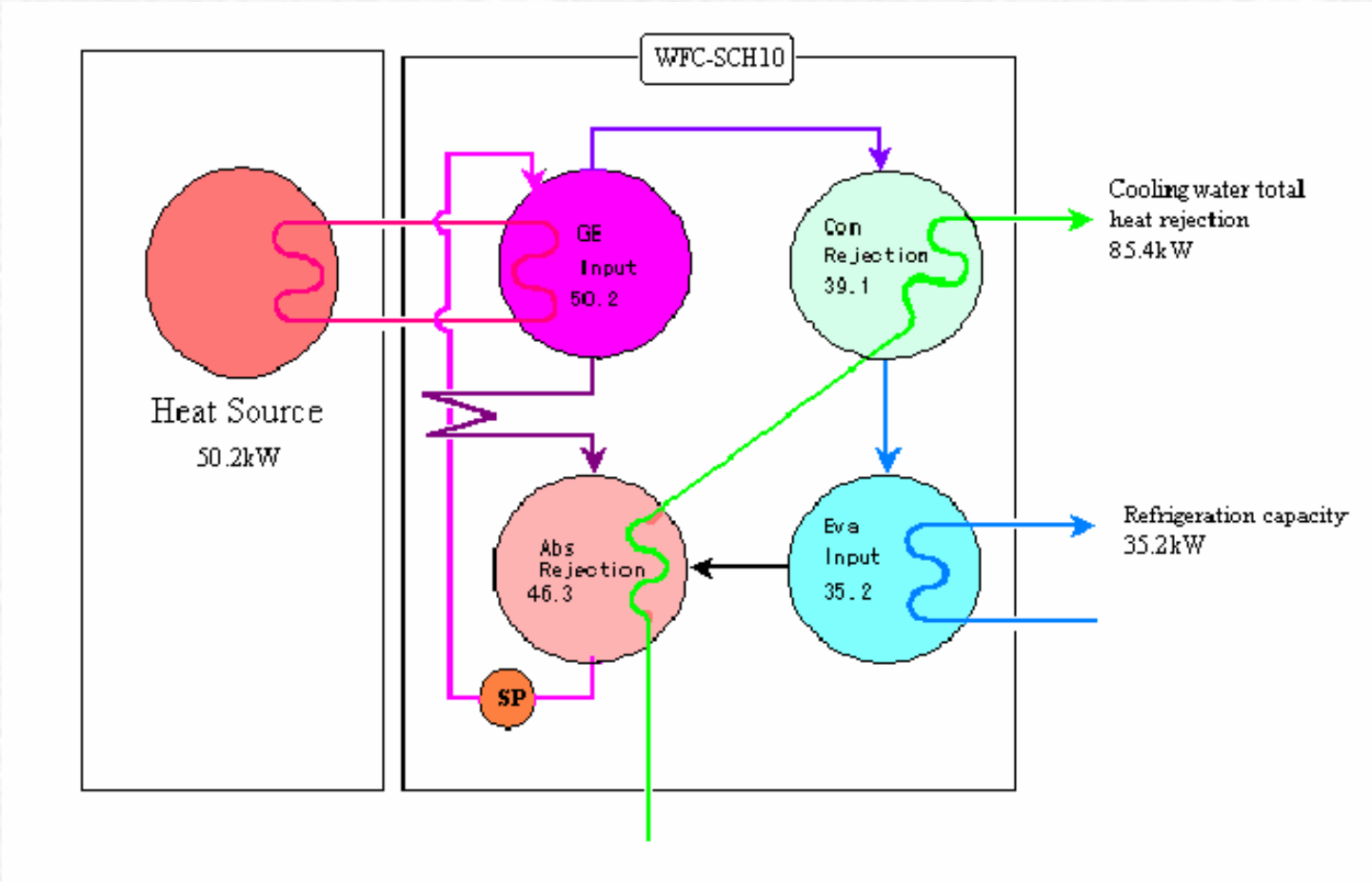
ABSORPTION COOLING LiBr (2)



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TRIGENERATION IN SOUTHERN EUROPE

- Cooling loads in Southern Europe are higher, because of geographical position but also of climate change during last years. So CHCP advantage becomes greater.
- Absorption cooling with LiBr-water solutions and direct fired with nat. gas, are more often used in building sector, due to special tarifs offered by gas companies.
- Not all gas companies offer attractive gas tarif for CHP, neither for CHCP, so CHCP has also low applicability.

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TRIGENERATION IN GREECE

- In Greek market there are a number of CHP units and absorption chillers distributors, but very few trigeneration applications .
- Main reasons are :
  - small gap between electricity and gas prices
  - Complicated and time-consuming licensing procedure for CHP and CHCP units over 20 kWel
  - Low financing of new installations through national and European programs
  - No grand for “green” electricity produced by CHP and CHCP

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CASE STUDY FROM ESTIA's EXPERIENCE (1)

- Typical 80 beds hotel "AEGEAN" in Thessaloniki (Northern Greece).
- Hotel el. power installed 86 kWel, thermal 232 + 30 kWth and cooling 132 kWc.
- CHP application was applied in September 2006, with one microCHP unit of 20 kWel/34 kWth, (POWERTHERM, by Spilling Energie Systeme Gmbh).

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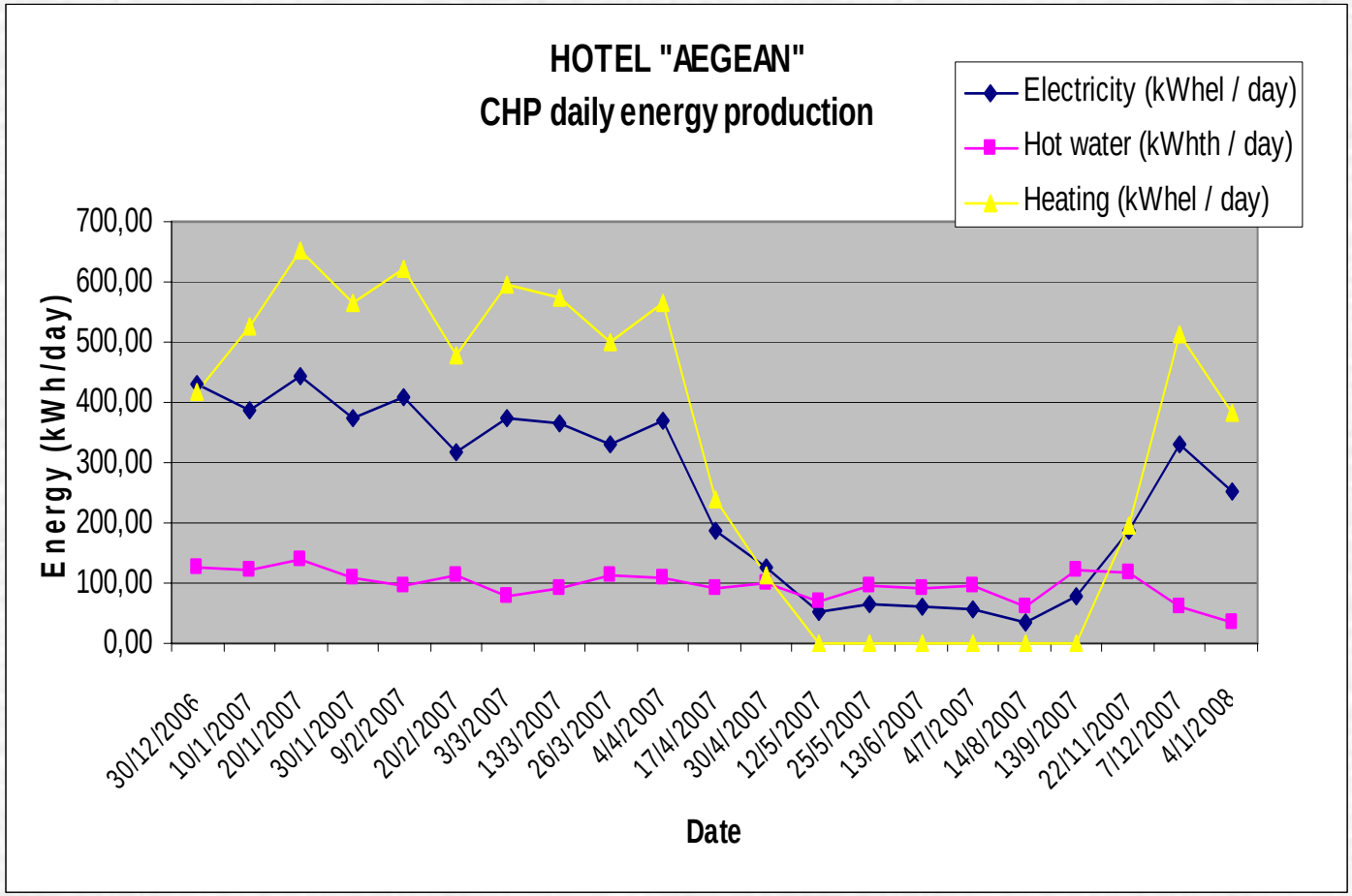
CASE STUDY FROM ESTIA's EXPERIENCE (2)



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CASE STUDY FROM ESTIA's EXPERIENCE (3)

- Case study period 30/12/06-30/12/07
- Total reduction in specific electricity consumption 33% .
- Total increase in specific thermal consumption 10% .

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TRIGENERATION APPLICATION (1)

- Installation of an absorption chiller 105 kWc operating with hot water 95-85 oC, to modify CHP to CHCP and cover hotel's cooling needs.
- Thermal power of 150 kWth required by absorption chiller during summer, will be supplied mainly by CHP (34 kWth) and secondary by boiler (232 kWth).
- Electrical power reduction, due to conventional chiller replacement, 58 kWel.
- Extra summer electricity production from CHCP application 38980 kWhel/ year.
- Summer electricity saving due to conventional chiller replacement 58680 kWhel/ year.

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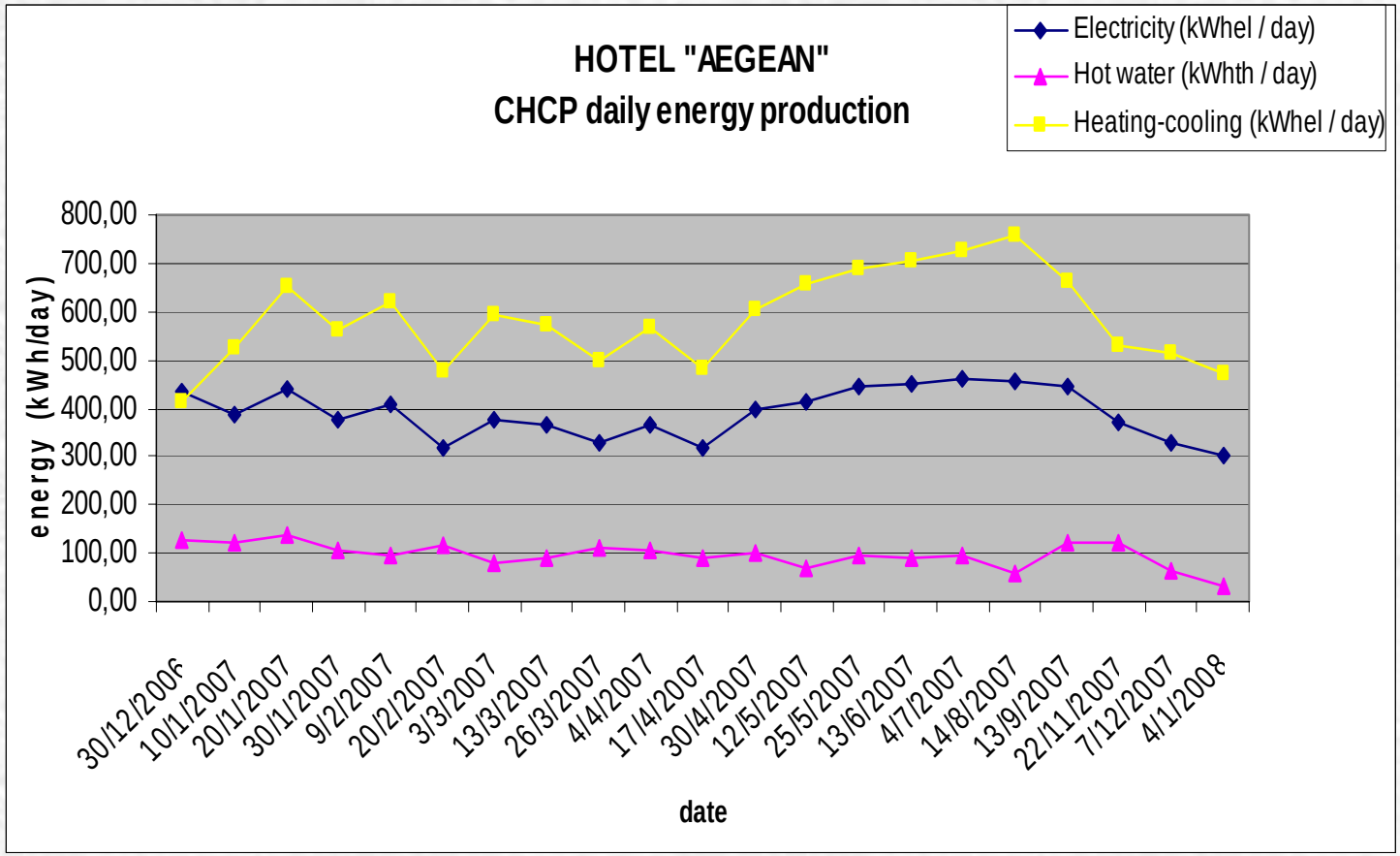
TRIGENERATION APPLICATION (2)



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CASE STUDY CONCLUSIONS

- Trigeneration application will save 38980 + 58680 = 97660 kWhel from main el. network during summer period.
- Trigeneration application will increase nat. gas consumption, which balances low summer nat. gas consumptions.
- Total cost for trigeneration application (on top of CHP), is approx. 60.000 €.
- Poor financial profit for hotel, due to low discount in nat. gas prices for CHP (5% on conv. use tarif), and no grand policy in electricity prices from CHP and CHCP (75 €/MWhel selling to grid, 104 €/MWhel buying from grid).
- Hotel management will not proceed, unless a good grand can be found for, at least, initial capital cost .

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GENERAL CONCLUSIONS

- Trigeneration is an important balancing factor for main electricity and nat. gas networks during summer, saving double of the installed power.
- Both nat. gas and elecricity companies must apply grand for trigeneration in commercial and industrial sector, in order to expand market.
- In Greece for example, CHCP electricity could be sold at same price as PV plants e.g. 450 €/MWhel.