

Overview of Combined Heat and Power

Objectives

- **To understand why CHP is used**
- **To be able to identify the components of a CHP system**
- **To understand the energy balance of a CHP unit**
- **To understand the basic operation of the system**
- **To identify suitable applications**

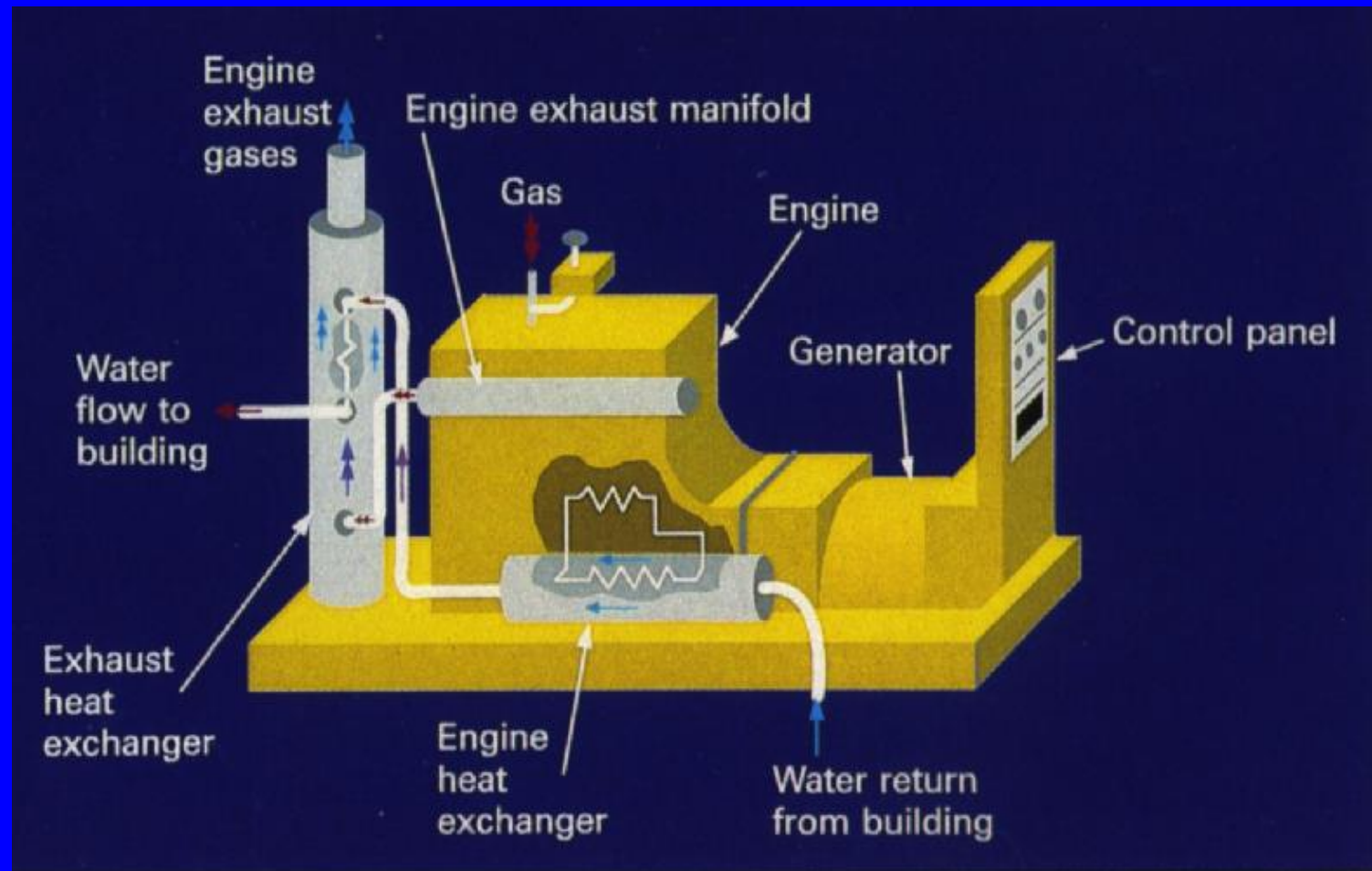
Why CHP?

- **Greatly reduced energy costs**
- **Reduced emissions?**
- **Improve security of supply**

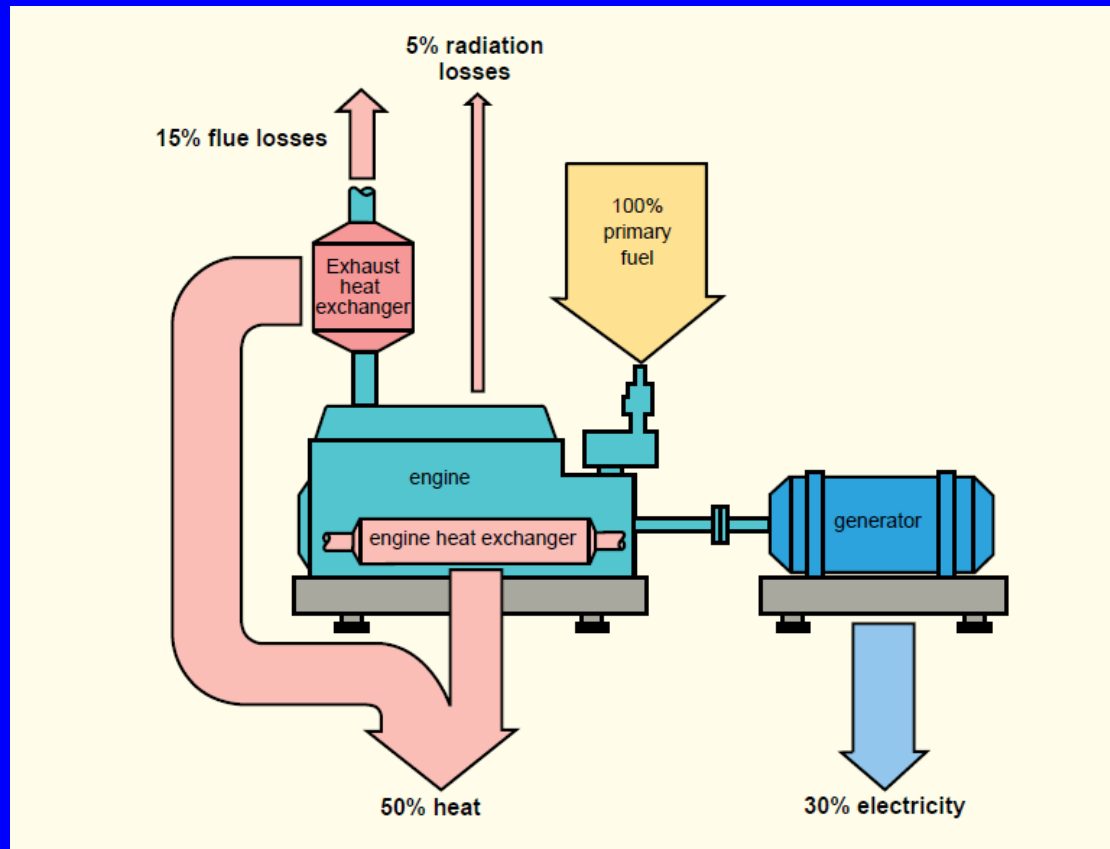
CHP Variations

- **Fuel – Nat. gas, bio-gas or diesel**
- **Engine – reciprocating or turbine**
- **Generator – Asynchronous or synchronous**
- **Size – micro(<5kWe), small scale (<500kWe) & large scale (>500kWe)**

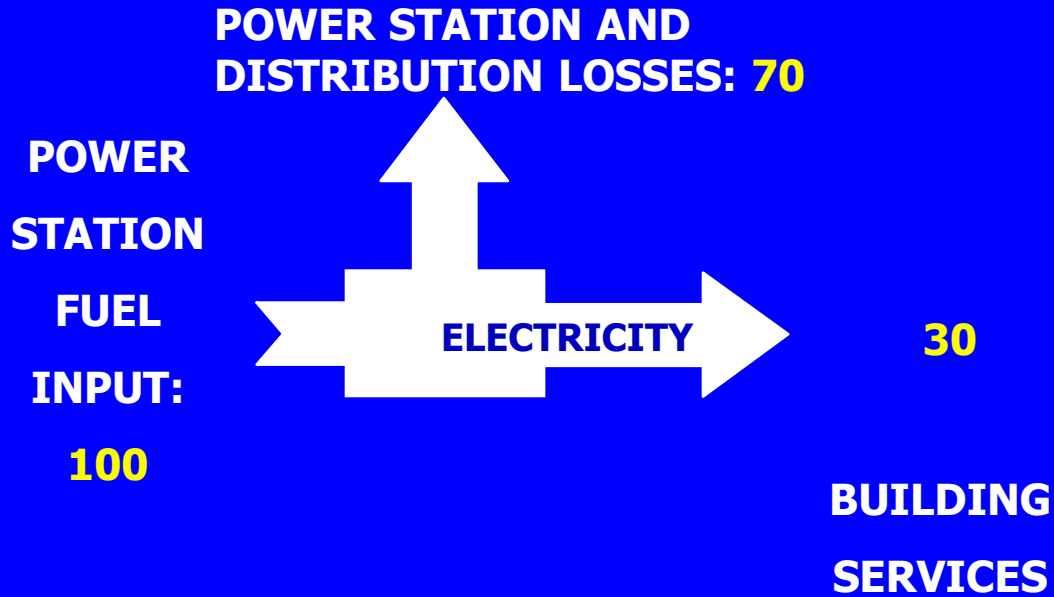
CHP Components



Typical Energy Balance

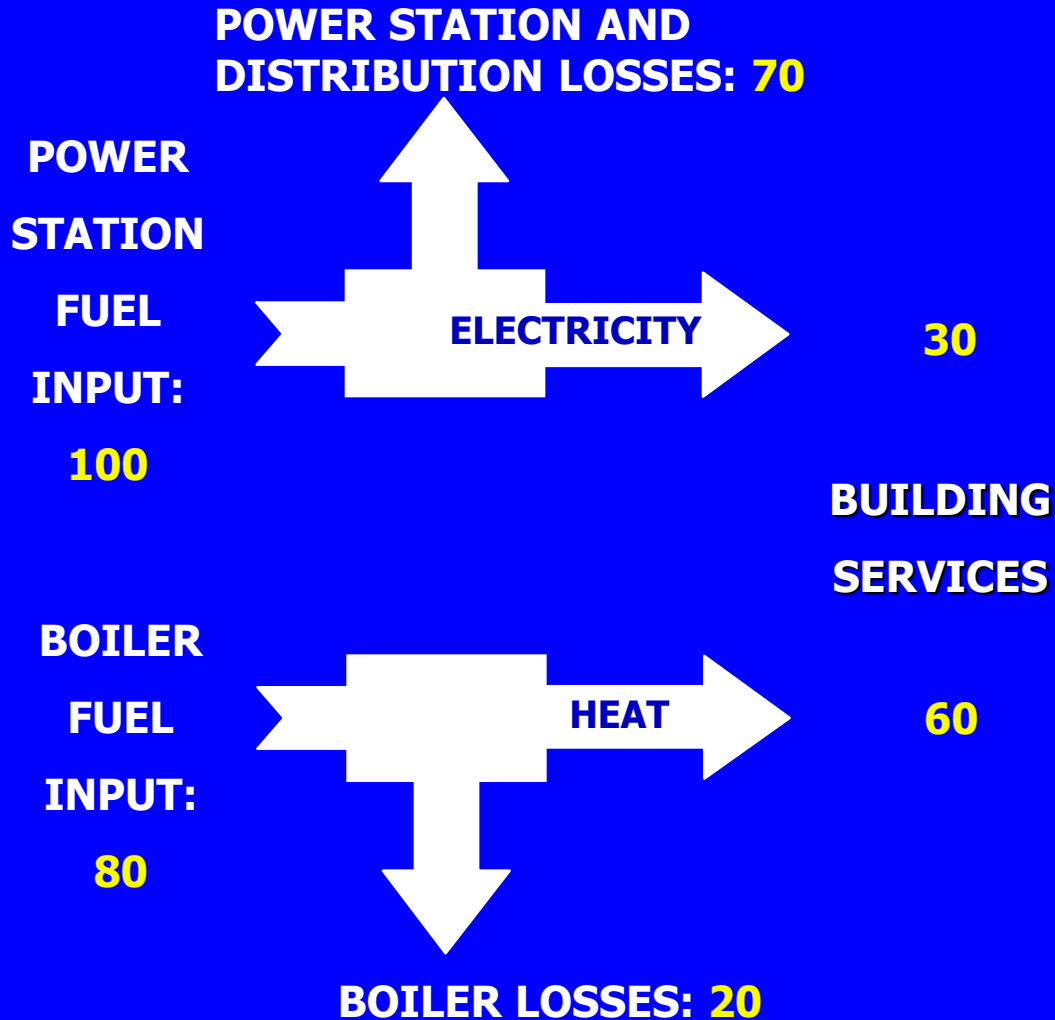


CHP Energy Balance



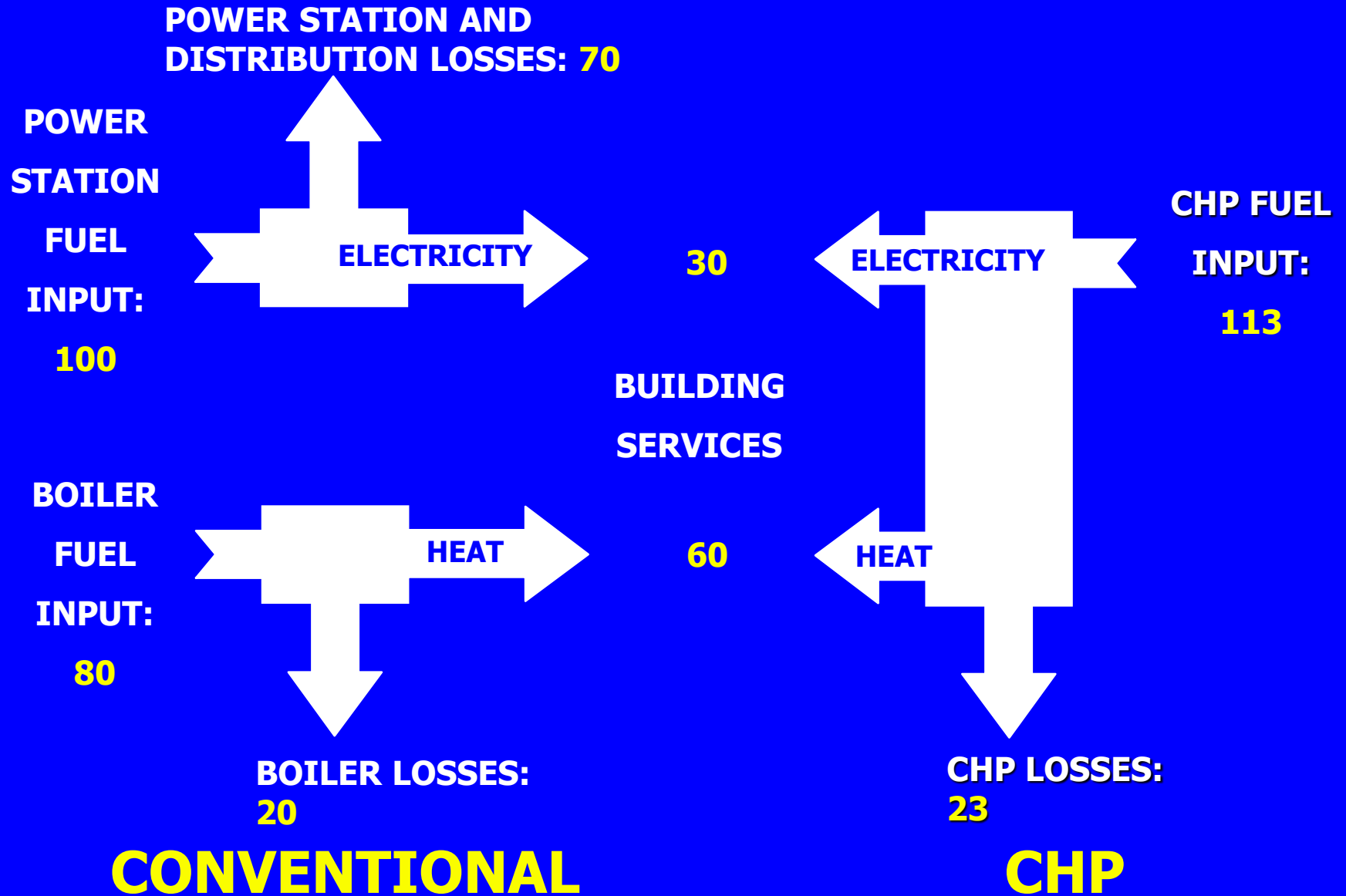
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CHP Energy Balance



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CHP Energy Balance



Sizing Strategies

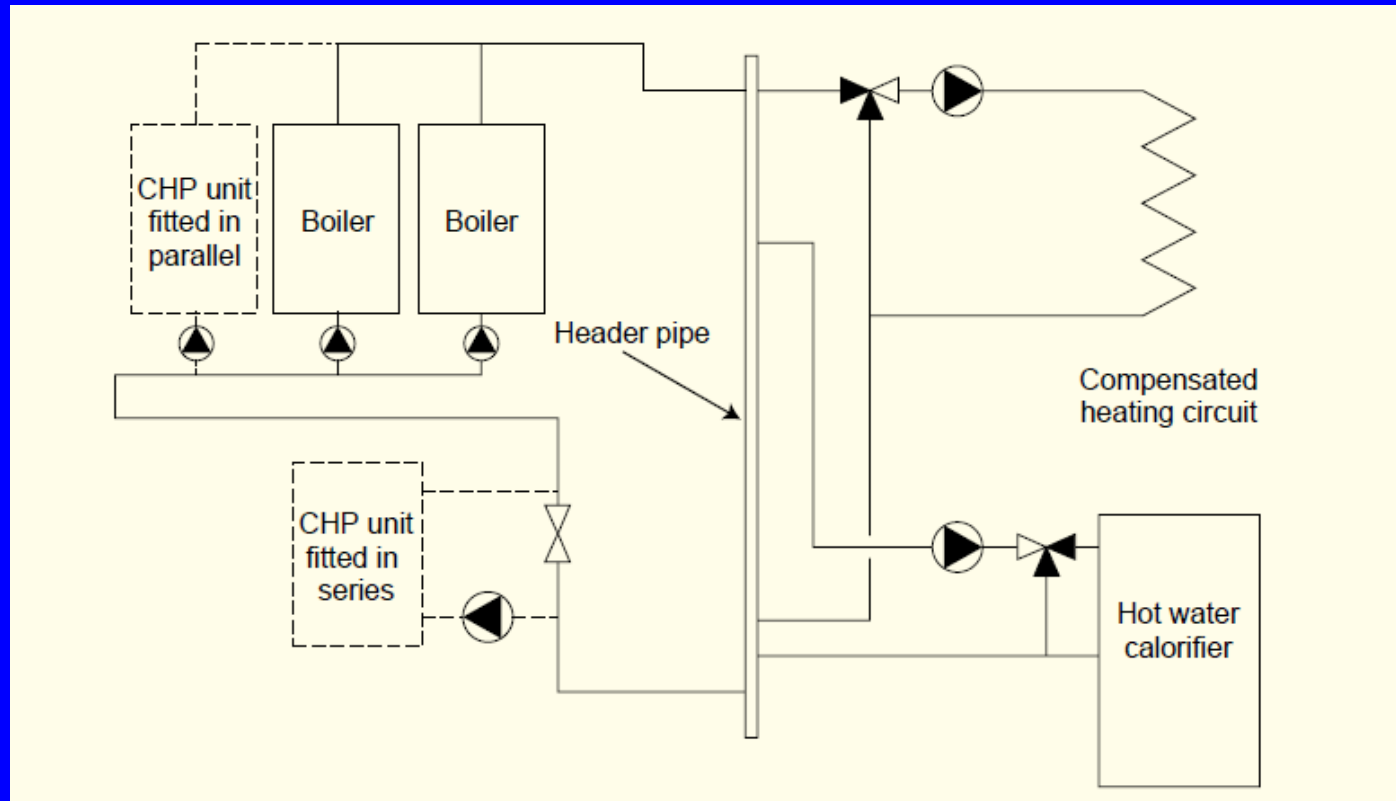
- **Heat led – CHP unit sized to utilise all heat generated**
- **Electrically led – necessitates dumping some heat to atmosphere**

Both likely to utilise thermal storage

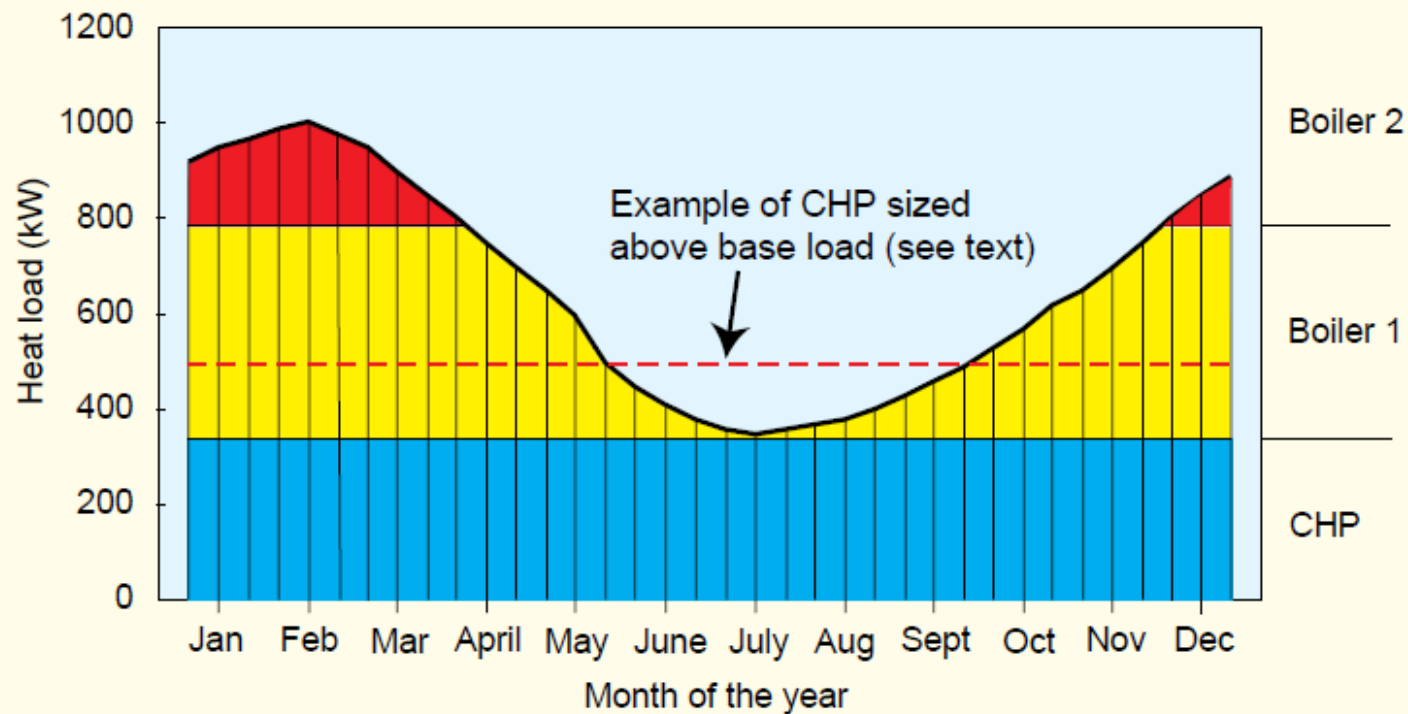
Heating System Integration

- **LTHW Systems typically 70 - 80°C**
- **CHP used as lead boiler to meet baseload for maximum operating hours**

Integration with Boilers



Sizing CHP



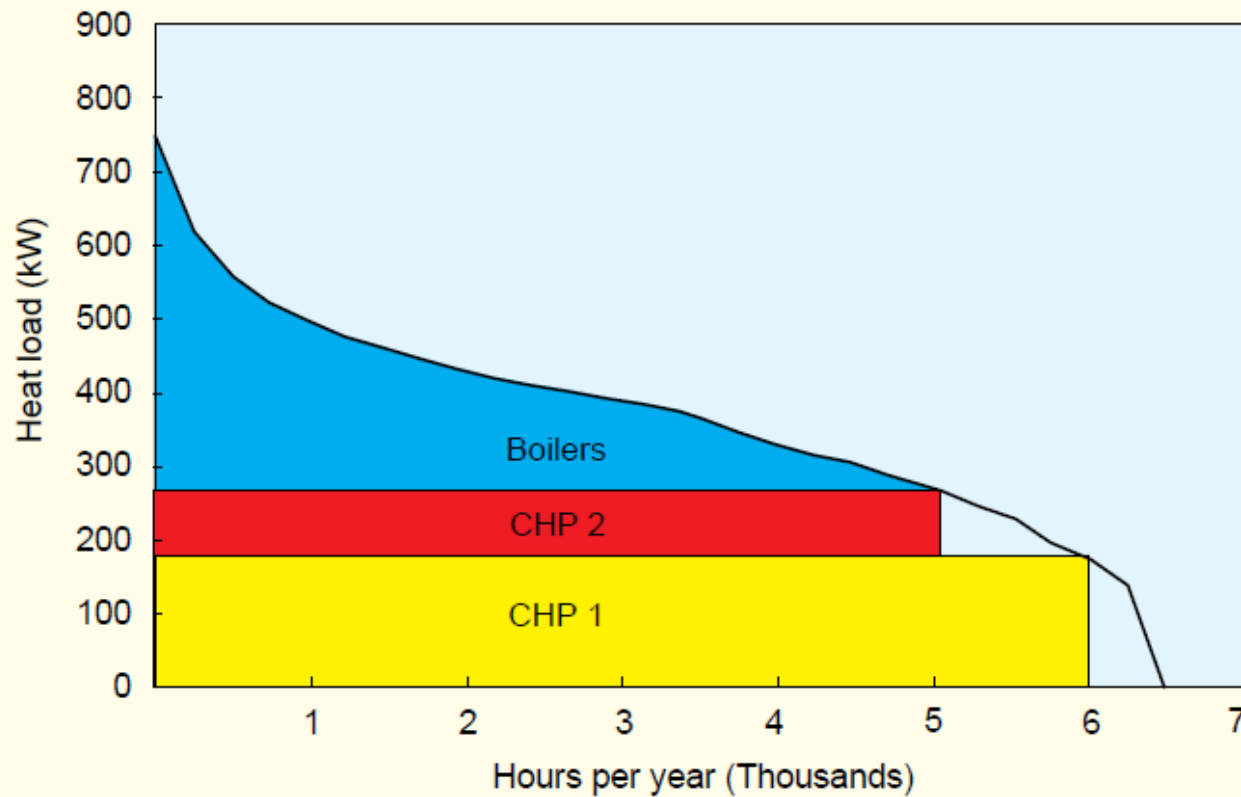
Large Single Unit

- **Lower maintenance costs per unit of electricity**
- **Lower installation costs per kW**
- **Potentially higher electrical efficiency if fully loaded**

Multiple Small Units

- **With variable heat load, better load matching**
- **Better efficiency on part loading**
- **Better guarantee of emergency supply**
- **Less service loss due to maintenance**

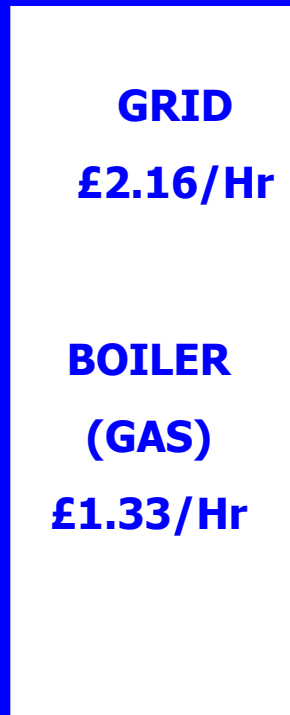
Sizing CHP



Source: Good Practice Guide 176
reproduced in CIBSE Guide F

Economic Summary

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TOTAL:
£3.49/Hr

45 kW
ELECTRICITY

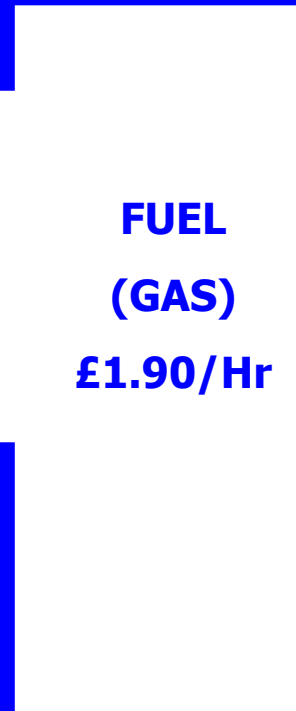
87 kW
HEAT

LOSSES

LOSSES

SAVING:
£1.27/Hr

CHP



TOTAL:
£2.22/Hr

Maintenance Costs

Table 5.7 Typical CHP maintenance costs

Maintenance option	Cost for stated CHP output /(p/kW.h)	
	50-150 kWe	200-800 kWe
Service only (with remote monitoring including consumables)	0.6-0.7	0.3-0.5
Comprehensive service (with remote monitoring; for a minimum period of five years)	1.1-1.3	0.6-0.9
Comprehensive service (with remote monitoring and performance guarantees normally for a minimum period of five years)	1.3-1.5	0.9-1.3

Source: CIBSE Guide F

CHP as Standby Generation

- **Capital saved can be offset**
- **Potential incentives (STOR)**
- **More reliable**
- **Special control requirement**
- **Dump radiators may be required**

Application Requirements

Heat Demand

- **Minimum of 4500 - 6000 hours per year**
- **Continuous rather than intermittent operation**

Electrical Demand

- **Ideally all year round electricity demand**

Likely Applications

- **Hospitals**
- **Leisure Centres with pools**
- **Hotels**
- **District Heat Networks**
- **?**

Financing Options

- **Capital Purchase**
- **Equipment Supplier Finance (ESF)**
- **Energy Services Company (ESCo)**

CHP & CCL

- **Climate Change Levy came into effect 1 April 2001**
- **Exemption for fuel used by good quality CHP**
- **From 1 April 2003 also exemption for good quality CHP electricity from licensed suppliers**

CHP & ECA

- **Enhanced capital allowances to encourage good quality CHP & other energy efficient technologies**
- **Businesses can write off the whole cost of their investment against taxable profits during the period in which they make the investment**

WHAT IS GOOD QUALITY CHP?

The CHP Quality Assurance programme defines the threshold criteria for good quality CHP. These are set in the CHPQA Standard. There are two threshold criteria for good quality CHP, namely:

- A threshold power efficiency criterion, eg, 20%
- A threshold quality index criterion, eg, 105

The Quality Index (QI) is calculated as $(X \times \text{power efficiency}) + (Y \times \text{heat efficiency})$ where X and Y vary depending on the size, type and fuel of the scheme. The power and heat efficiencies are defined as follows:

- $\text{Power efficiency} = \text{Total power output} / \text{Total fuel input}$
- $\text{Heat efficiency} = \text{Useful heat output} / \text{Total fuel input}$

Useful References

Combined Heat and Power for Buildings
Good Practice Guide 176 (Action Energy)
(2004)