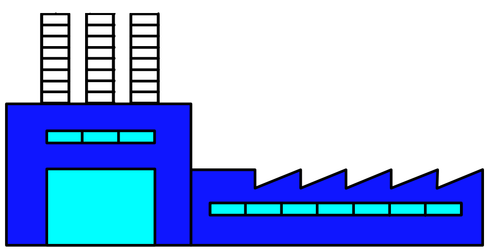
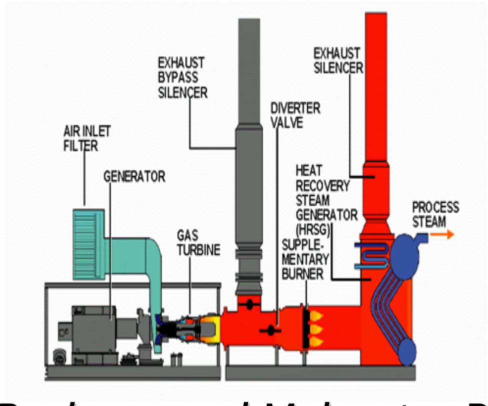
Pre-accession Assistance Programme

Improvement of Energy Efficiency in Turkey, Twinning Project: TR03-EY-01

Examples of successful CHP and District Energy Applications Around the World

Twinning project:
Improvement of energy efficiency in Turkey





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Ankara
21-22 March 2007

History of district heating

- **Historical development**
  - *Roman settlements*
  - *France – 17^{th} century*
  - *US cities – 19^{th} century*
  - *Soviet Union & Eastern Europe*
  - *South Korea and China*

Case study of Lerwick DH scheme

- Challenge
  - *Implementation of an effective and dynamic waste to distribution system*
- Solution
  - *Develop a peak load boiler station to operate with waste and distribute electricity and heat to 7,600 inhabitants*
- System configuration
  - *2 MW and 6.5 MW boilers*
  - *10 km of pre-insulated pipework to transfer the hot water from the boiling station to businesses, public and local authority buildings and housing areas that were due for refurbishment*
  - *State-of-the-art ultrasonic heat meters to measure consumption among both domestic and commercial users*

Case study of Lerwick DH scheme

- The benefits
  - *Reduced maintenance costs*
  - *Reduced CO_2 emissions*
  - *Increased reliability and life expectancy*
- Some details
  - *Client: Shetland Heat Energy & Power*
  - *Contract value: 9.7 million €*
  - *Finance: Shetland Islands Charitable Trust*

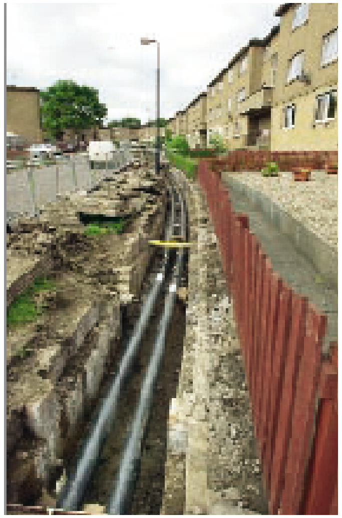
Case study of Edinburgh

- Challenge
  - *Replace a 50-year old heating scheme which had become inefficient, unreliable and expensive to maintain*
- Solution
  - *Delivery of a complete CHP scheme – from initial feasibility study through to solution implementation*
- System configuration
  - *330 kWe gas fired CHP engine in the boiler house to replace coal fired boilers*
  - *Connection to 220 houses and 30 flats over 3.5 km of network using pre-insulated 125 mm flexible pipes*

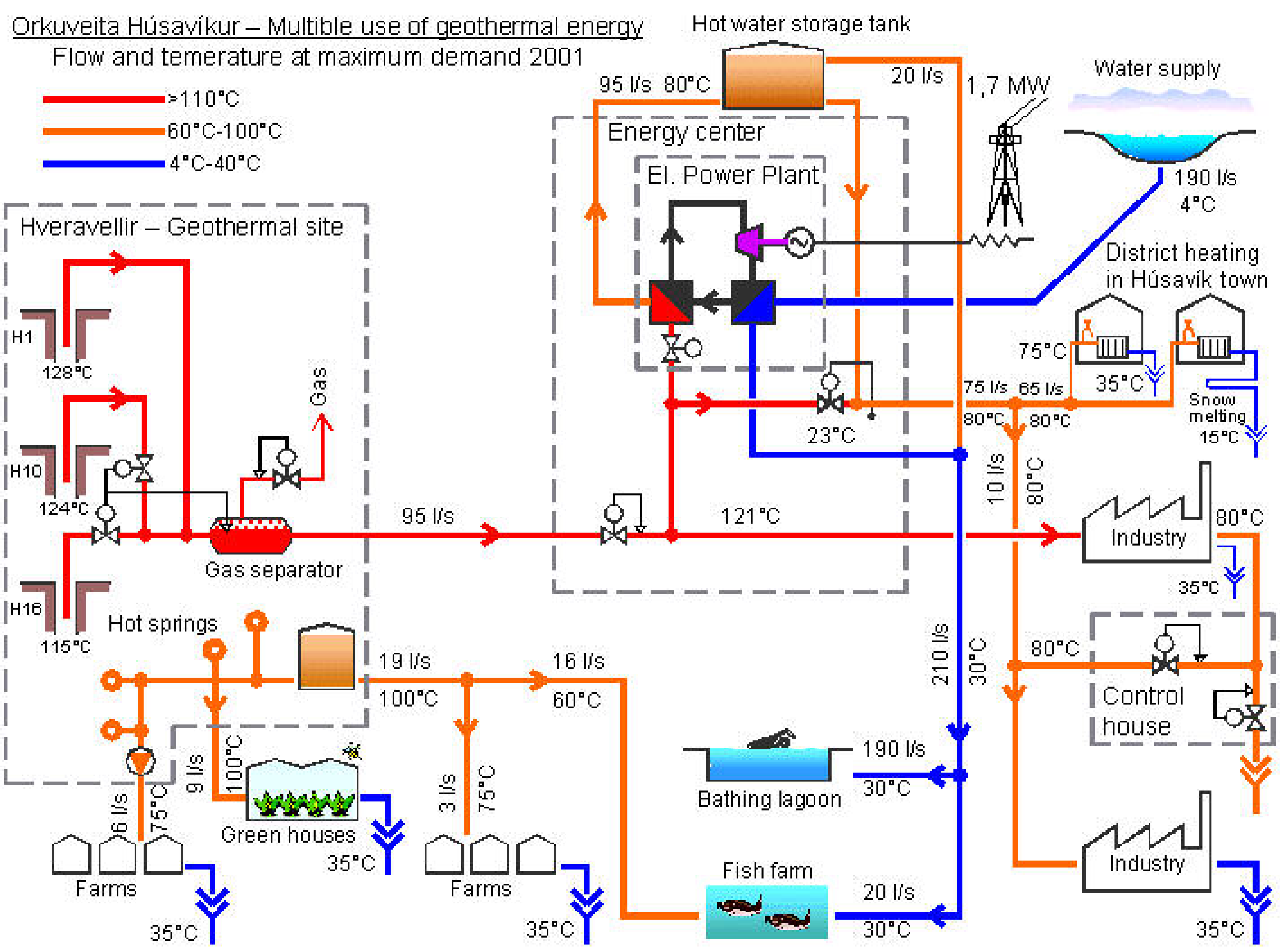
Case study of Edinburgh

- The benefits
  - *Safe, reliable and readily available heating*
  - *Continuity of service*
  - *Reduced maintenance costs*
  - *Reduced CO_2 emissions*
  - *Increased reliability and life expectancy*

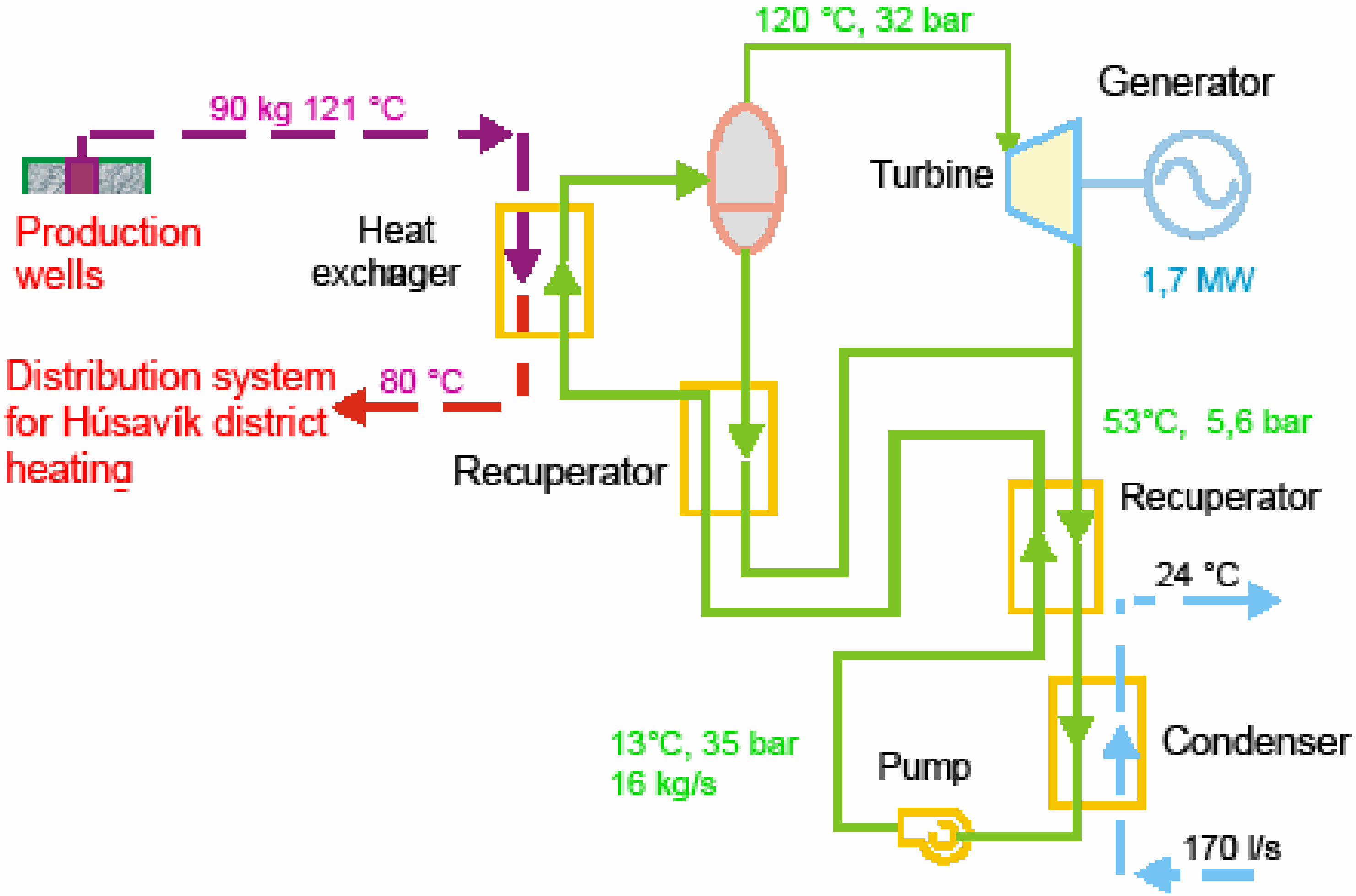
- Some details
  - *Client: Midlothian council*
  - *Contract value: 2.5 million €*
  - *Area covered: 10 km^2 (220 dwellings)*
  - *Finance: Midlothian Council & Community Energy Program*
  - *Key partners: Alsthom Power Flowsystems*



DH with geothermal energy in Iceland



DH with geothermal energy in Iceland

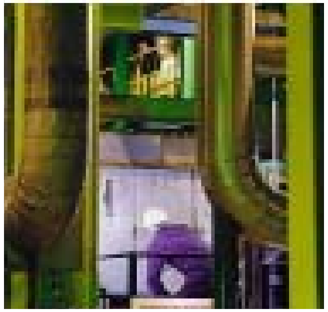


Case study of utilities management

- Property
  - *United Leeds Teaching Hospitals NHS Trust and Leeds University*
- System retained
  - *5 dual-fuel reciprocating engines, 5 conventionally fired package boilers, 5 waste heat boilers, 2 vapour compression chillers*
- New system configuration
  - *4.5 MW gas turbine*
  - *Unfired waste heat boiler*
  - *2 package steam boilers*
  - *Steam turbo-generator*
  - *2 absorption chillers and 2 compression chillers*
  - *2 conventional steam package boilers and 3 new water chillers*
  - *Provision of steam, hot water, electricity, compressed air and chilled water*
  - *40% electricity exported to the grid*

Case study of utilities management

- Benefits
  - *Cost-effective configuration, yielding substantial savings, taking into account the cost of capital and operation and efficiencies*
  - *Compliance with existing and future environmental legislation*
  - *Reliable and uninterrupted energy supply for the hospital*
  - *Capital investment of 9.5 million € made by the utility manager (DALKIA) and recovered from the energy bill and electricity sales*



CHP at the airport of Bordeaux (France)

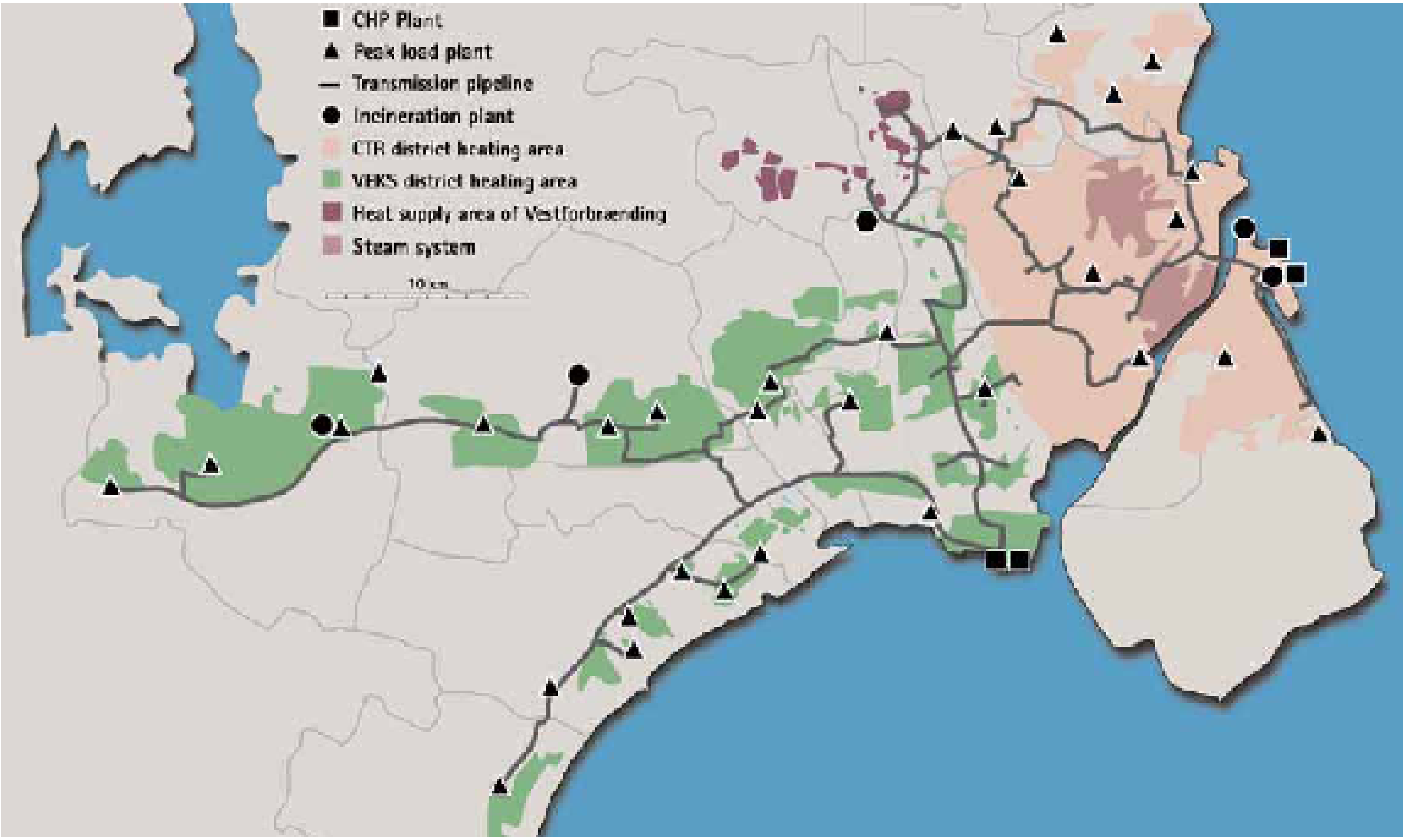
Prime Mover:	**- 2 Gas Engines (1250 kVA Each)**
Heat Exchanger:	**- 2 for Heat Recovery (550 kW Each)** **- 2 for Jacket Heat Recovery (815 kW Each)**
Compression Cooling:	**- Screw Chillers (1200 and 1000 kW)** **- Water -Cooled Screw Chiller (560 kW)**
Absorption Cooling:	**- 1 Driven by Recovered Heat (500 kW)** **- 1 Driven by Natural Gas (815 kW)**
Operation started:	**- November, 1995**
Total System Cost:	**- 3.5 Million €**
Pay -Back Period	**- 5.7 Years**

CHP & district energy at Trenton (USA)

Cogeneration System:	**12 MW Dual Fuel (Oil/Gas) Engines**
Heat Supply:	**Exhaust + Oil/Gas Fired Boilers** **112,000 MWh/year to 31 commercial buildings**
Supply Temperatures:	**High (At 200 °C by a 4.8 km Network)** **Medium (At 175 °C by a 9.7 km Network)** **Low (At 95 °C by a 3.2 km Network)**
Chilled Water Supply:	**Centrifugal Units (2 x 1,000 RT; 2 x 650 RT)** **Screw Chiller (2,000 RT Capacity)** **Absorption Chiller (2 x 850 RT)** **9,600 Million RT.h/year to Clients** **4.8 km of Chilled Water Network**

Case study of Copenhagen

- City-wide CHP and DH



Case study of Copenhagen

- CHP and large-scale DH
  - *Several production units*
  - *Variety of fuels*
    - Coal
    - Natural gas
    - Waste
    - Biomass
    - Others
  - *Back-up boilers*
  - *Booster pumps*

Case study of Copenhagen

- Piping infrastructure
  - *Systems are built to last*
  - *Transmission and distribution systems*
  - *Mainly preinsulated pipes*
  - *Transmission network designed for 60% of maximum heat demand*

Case study of Copenhagen

- Energy from waste
  - *Mass-burn waste incineration considered as proven technology with no technical risks*
  - *Waste supplies base load heat*

Case study of Copenhagen

- Energy from biomass
  - *CO_2 neutral*
  - *Fuel available locally or through suppliers*
  - *Alternative to other energy sources – stabilizing prices, increasing supply security*

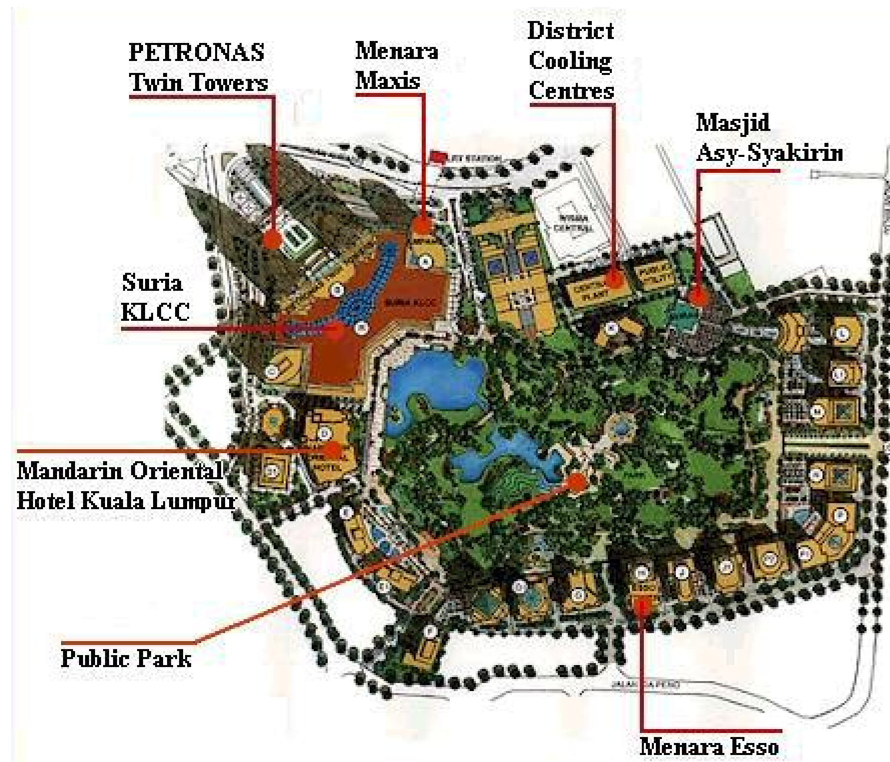
Case study of Copenhagen

- Conventional fuels
  - *Oil*
    - Heavy fuel oil used earlier – now almost entirely for back-up
  - *Coal*
    - Environment issue of great importance
  - *Natural gas*
    - Availability and price have both moved up on the agenda recently

Case study of Copenhagen

- Fuel flexibility
  - *Natural gas*
    - In power stations, gas engines, back-up boilers
  - *Oil*
    - Heavy fuel oil, light fuel oil for back-up boilers
  - *Coal*
    - In central power plants
  - *Waste*
    - In traditional waste treatment plants or novel technologies
  - *Biomass*
    - Straw, wood chips, pellets
  - *Other renewables*
    - geothermal

KLCC district energy supply (Malaysia)



District cooling for over 600 000 m² of floor space in the KLCC North West Development area.

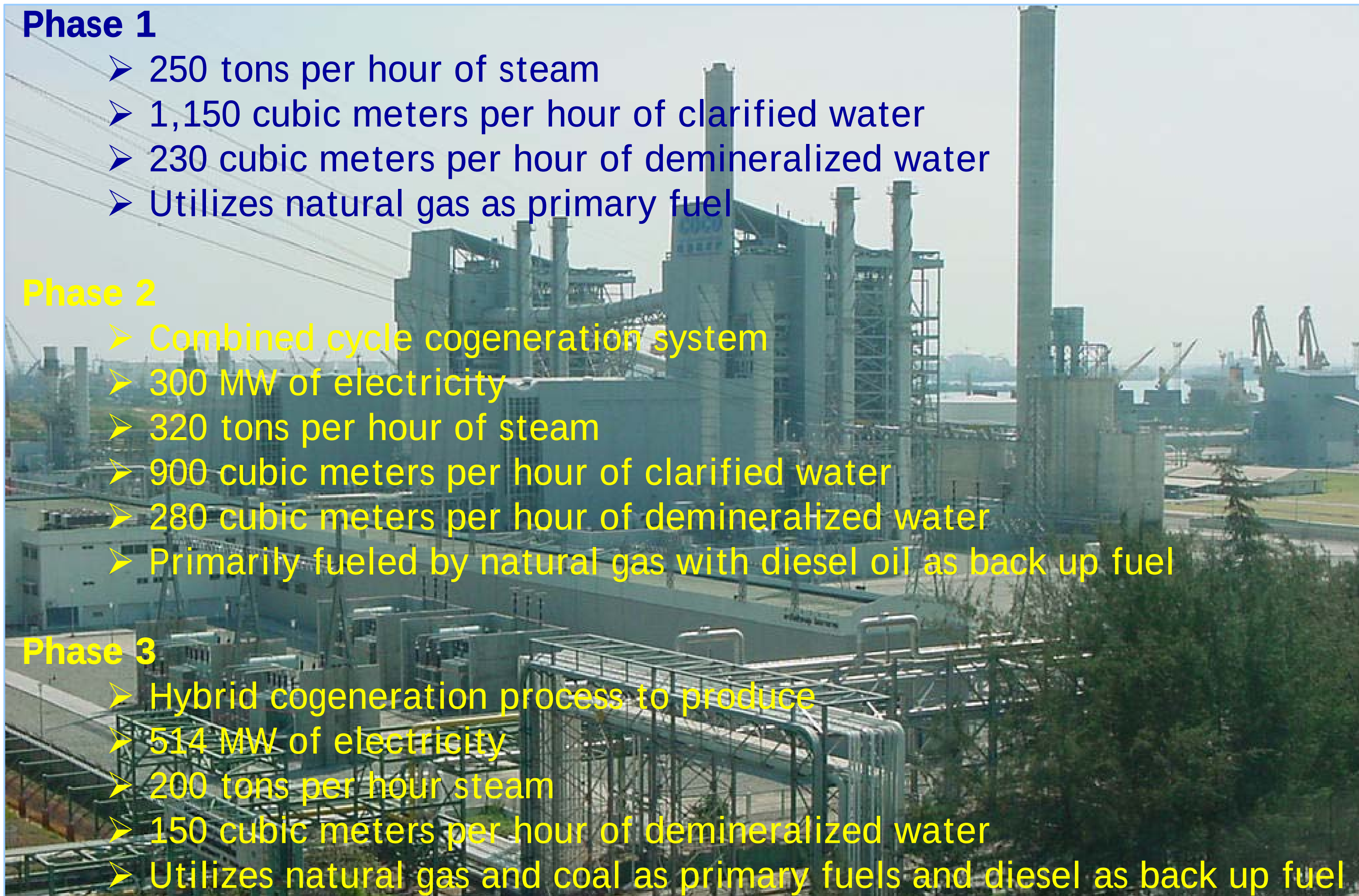
KLCC CHP and district energy facility

- 2 gas turbine generators (each 50 MW)
- 2 gas turbine generators (each 4 MW)
- 2 heat recovery and gas fired steam generators (each ton/hr each)
- 3 electrical centrifugal chillers (each 5000 RT)
- 3 steam turbine driven centrifugal chillers (each 5000 RT)

Industrial CHP & district heat (Thailand)

- Cogeneration company created in October 1993
- 300 MW gas-fired combined cycle power plant
  - In 2 phases: 3 x 35 MW gas turbines with heat recovery steam generator + 1 x 50 MW steam turbine
  - Production in each phase: 150 MW electricity and 145 T/h steam (6 T/h at 52 Bar & 425°C; 85 T/h at 19 Bar & 250°C)
  - Sale of steam, electricity and demineralised water to industrial customers; sale of surplus power to utility grid
- Power generation efficiency
  - Combined cycle: 45.14%
  - Overall efficiency: 69.5%

Map Tha Phut distributed cogeneration



Phase 1

- 250 tons per hour of steam
- 1,150 cubic meters per hour of clarified water
- 230 cubic meters per hour of demineralized water
- Utilizes natural gas as primary fuel

Phase 2

- Combined cycle cogeneration system
- 300 MW of electricity
- 320 tons per hour of steam
- 900 cubic meters per hour of clarified water
- 280 cubic meters per hour of demineralized water
- Primarily fueled by natural gas with diesel oil as back up fuel

Phase 3

- Hybrid cogeneration process to produce
- 514 MW of electricity
- 200 tons per hour steam
- 150 cubic meters per hour of demineralized water
- Utilizes natural gas and coal as primary fuels and diesel as back up fuel