Cleaner Production and Energy Efficiency in Industry

With Focus on the Electricity Supply

Cleaner Production (CPEE) Purpose

Prevent or reduce pollution and waste by implementing measures that are:

- ✓ Environmentally sound
- ✓ Economically profitable

by reducing per unit produced:

- ✓ Raw materials
- ✓ Water consumption
- ✓ Energy consumption

which leads to:

- ✓ Less pollution
- ✓ Less waste
- ✓ Better working conditions
- ✓ Better product quality
- ✓ Higher profit

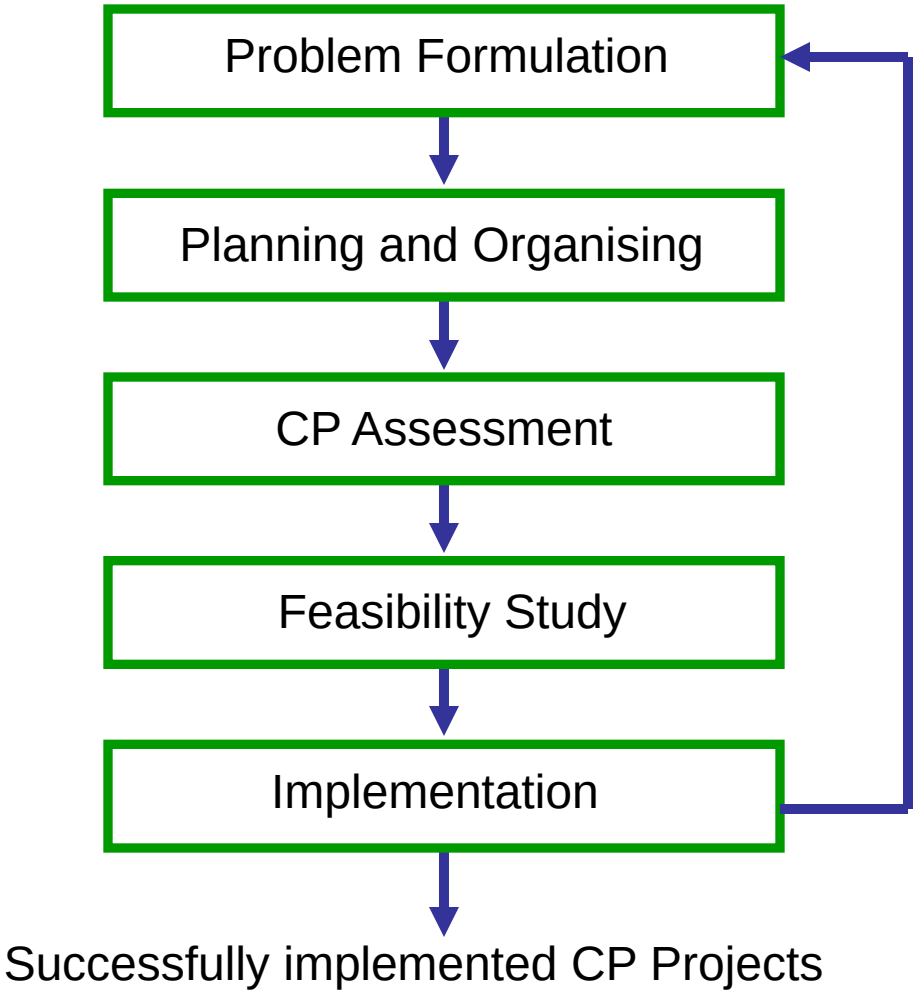
Who can benefit from CPEE?

- Companies that have an on-going production.
- Not new establishment plans, companies with big capacity problems

What can CPEE do for you?

- Improvement of existing environmental and economic situation.
- Initial phase to implementation of Environmental Management Systems (EMAS, ISO 14000)

The Cleaner Production procedure



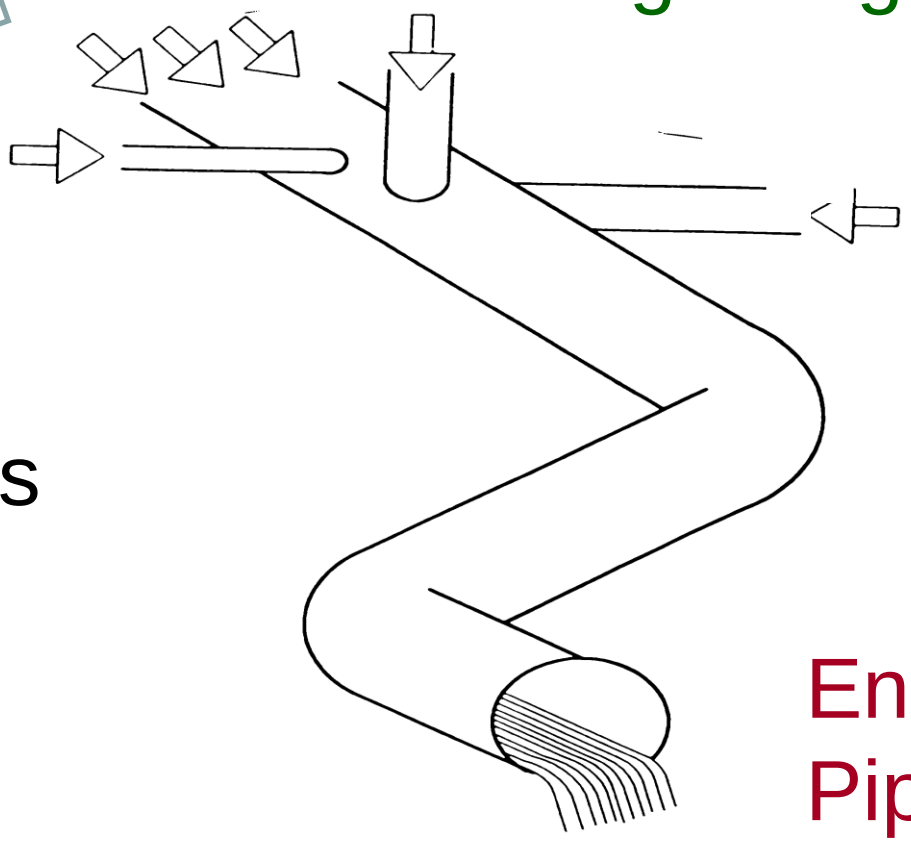
CPEE Methodology

- Consider your company with “new” eyes.
- Make mass – energy balances to see where the materials and energy are going.
- Identify problem areas.
- Generate project ideas, check their viability.
- Realise the projects.
- Go for the solution of new problems.

Problem formulation

Start here

Beginning of Pipe



Waste Streams

End of Pipe

The Norwegian Model

- Classroom studies
- Group Work
- In-company work
- In-company advice
- Project development
- Project implementation

Results of the programme

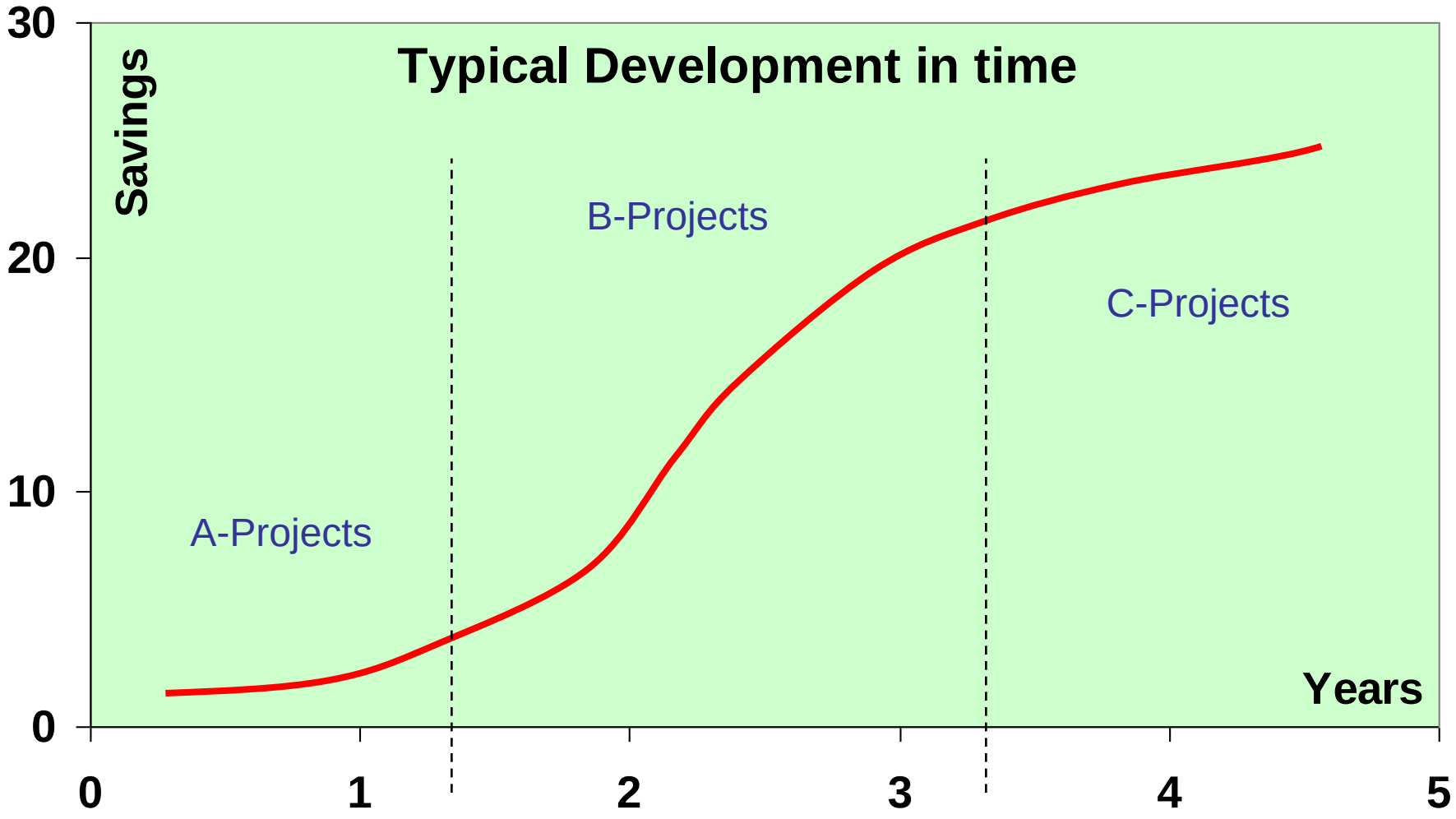
Three categories of Cleaner Production and Energy Efficiency measures (A, B and C) identified for your own projects:

Category A: No (negligible) Investments
Should be implemented ASAP

Category B: Small Investments, Payback < 1 year
Own financing or Revolving fund?

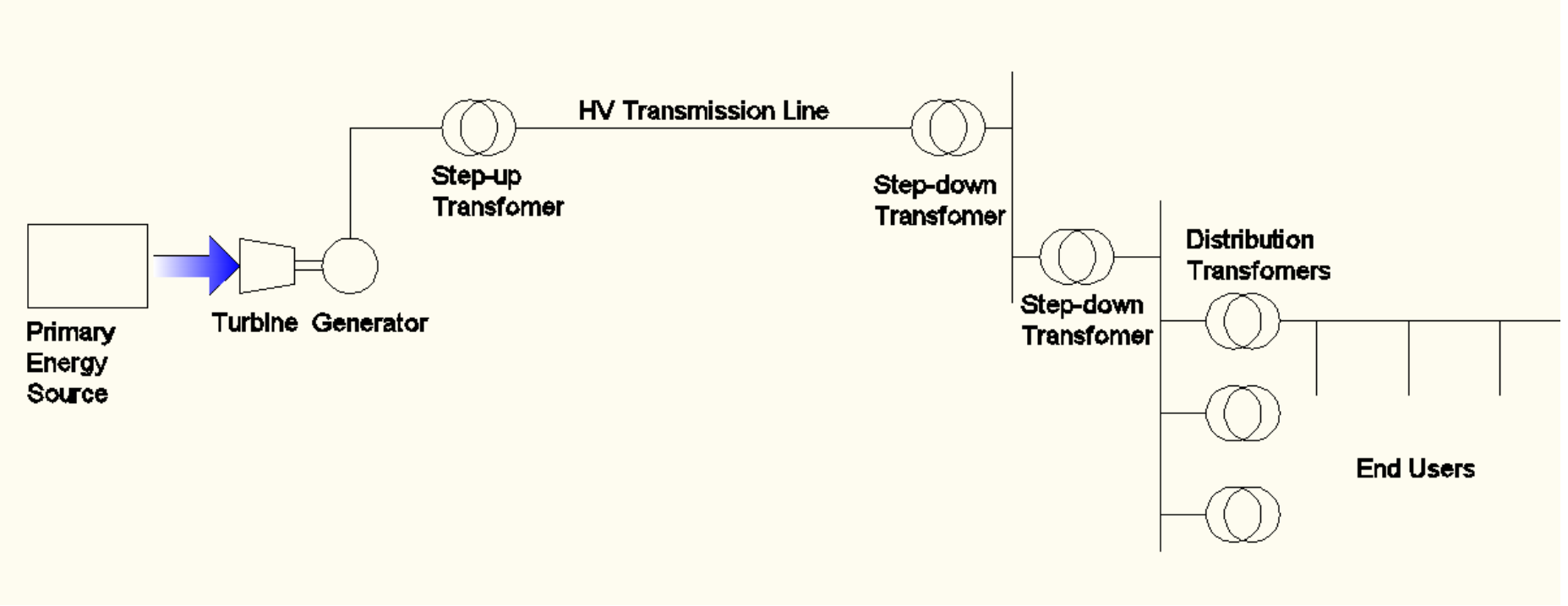
Category C: Larger Investment, Payback > 1 year
Require Business Plan (Financial Engineering)

Pick the low-hanging fruit first


Typical Development in time
Savings
30
20
10
0
A-Projects
B-Projects
C-Projects
Years
0
1
2
3
4
5

CPEE in the Electrical Supply

Components in an Electrical Supply System



The Grid

- The grid consists of some generators and some load.
- The load can be a collection of households (cities), industry, transportation systems etc.
- All these components are spread around the system and are interconnected.

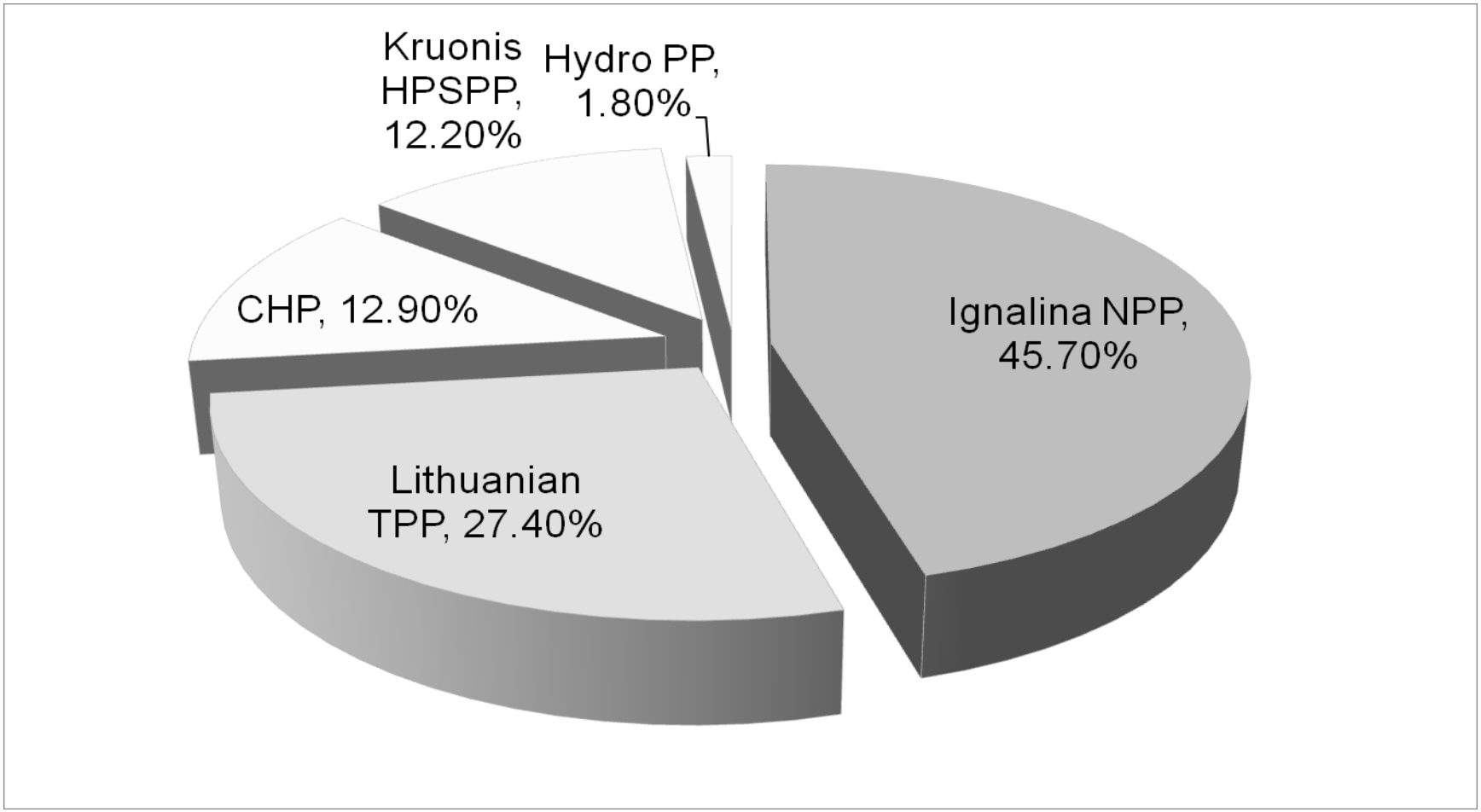
The Baltic Grid

- Data for Lithuania from CIA World Fact Book (2007) in TWh:
  - Total Generation: 12.09
  - Total Import: 5.649
  - Total Export: 6.606
  - Total Consumption: 9.612
  - Balance (Losses) : 1.521

Electricity Generation

Components and their efficiency

Existing Power Generation Capacity in Lithuania



Gas Powered Generators

35-40% electrical efficiency

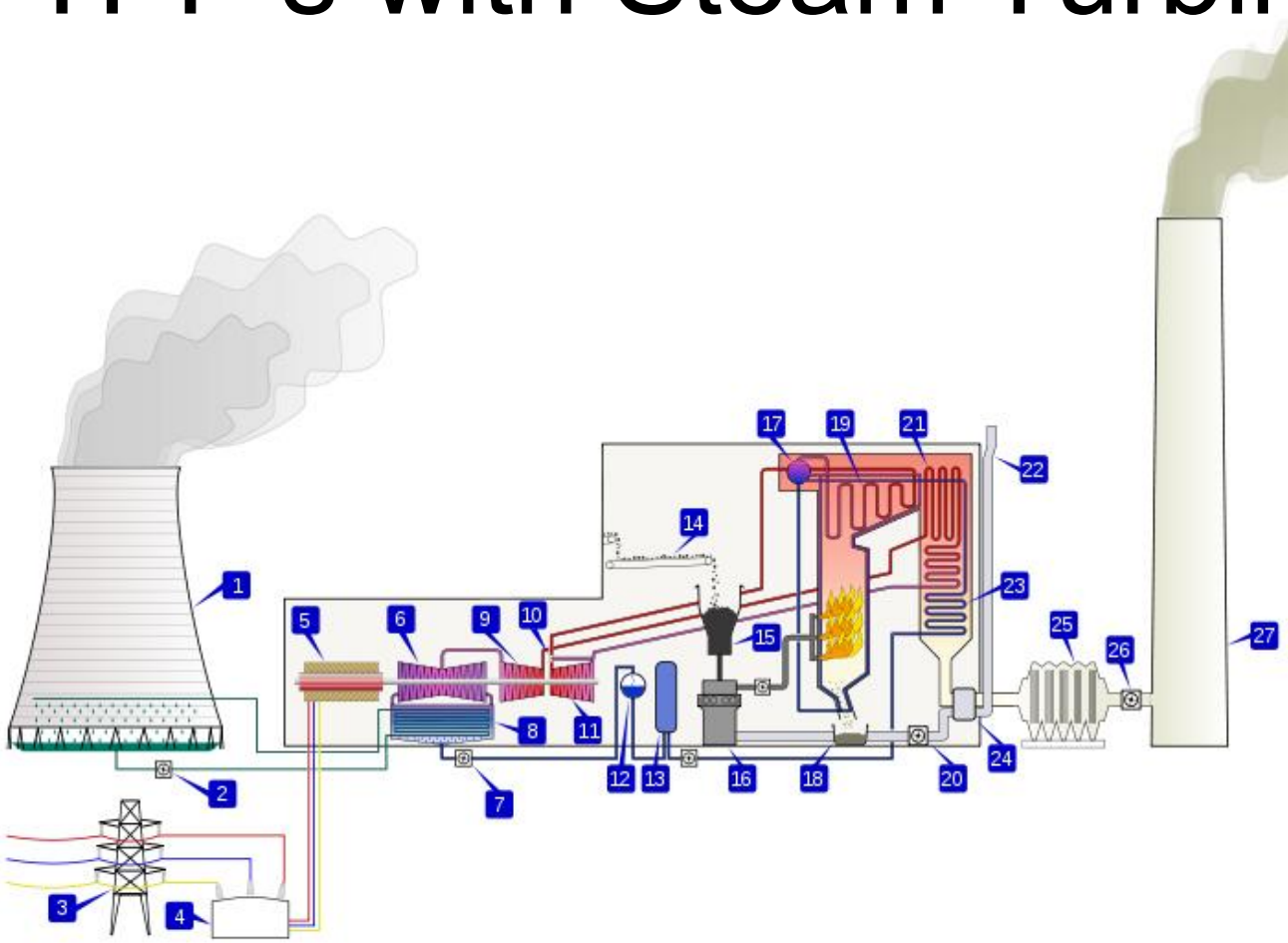
Improvement of Efficiency of a Gas Turbine

- Utilise the heat in the exhaust gasses
  - High pressure steam turbine
  - Low pressure steam turbine
  - District heating
- The efficiency of the complete system can be improved to “80%”
  - Condition: There must be nearby customers who are willing to purchase the heat energy.

Improvement of the Efficiency of an existing Gas Turbine

- Turbine blades will be deformed by time and cause extra losses.
- Down-time increases for older turbines.
- Regular maintenance is important.

TPP’s with Steam Turbines



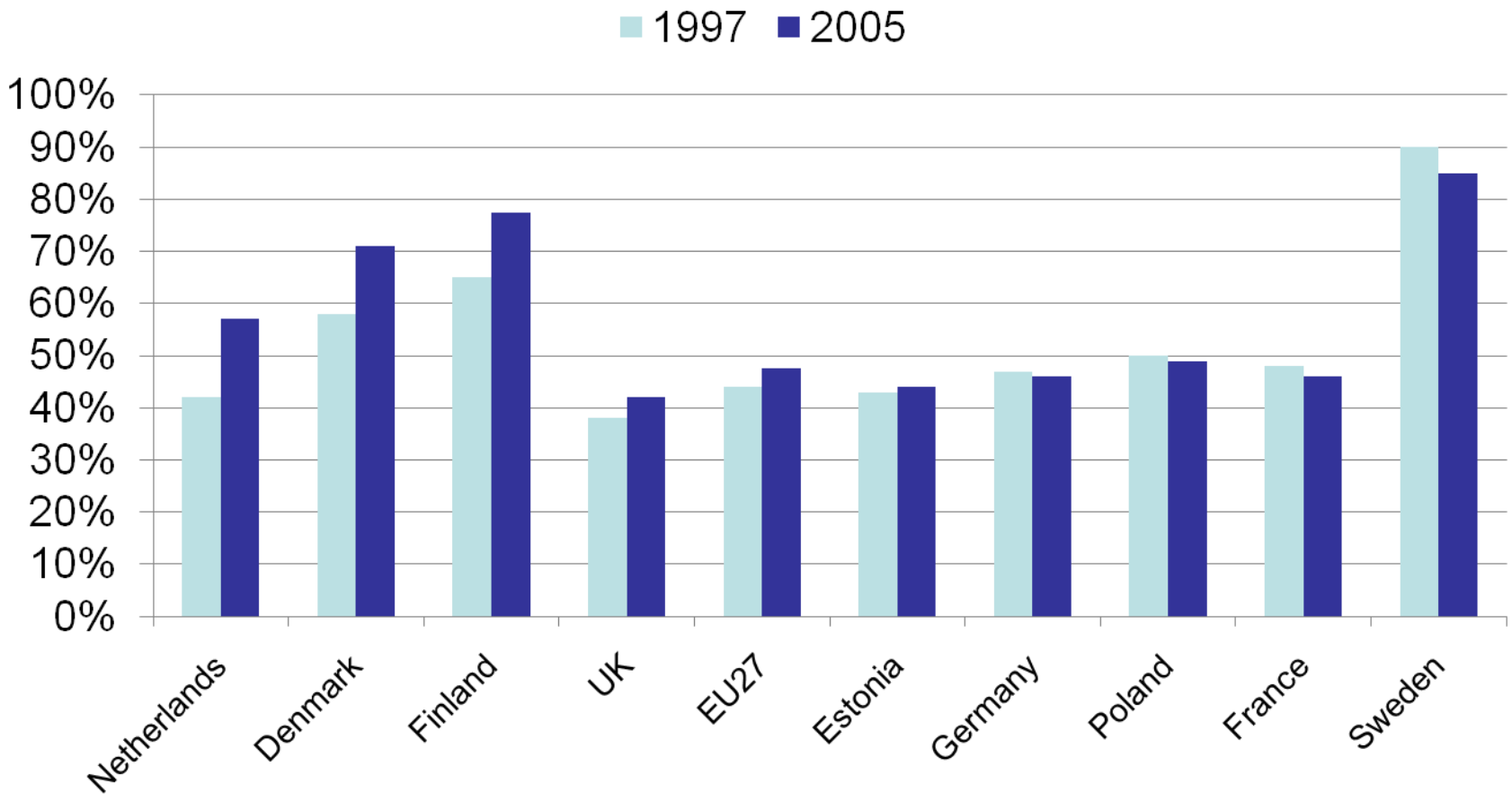
Typical diagram of a coal-fired thermal power station

1. Cooling tower
2. Cooling water pump
3. transmission line (3-phase)
4. Step-up transformer (3-phase)
5. Electrical generator (3-phase)
6. Low pressure steam turbine
7. Condensate pump
8. Surface condenser
9. Intermediate pressure steam turbine
10. Steam Control valve
11. High pressure steam turbine
12. Deaerator
13. Feedwater heater
14. Coal conveyor
15. Coal hopper
16. Coal pulverizer
17. Boiler steam drum
18. Bottom ash hopper
19. Superheater
20. Forced draught (draft) fan
21. Reheater
22. Combustion air intake
23. Economiser
24. Air preheater
25. Precipitator
26. Induced draught (draft) fan
27. Flue gas stack

Improvement possibilities

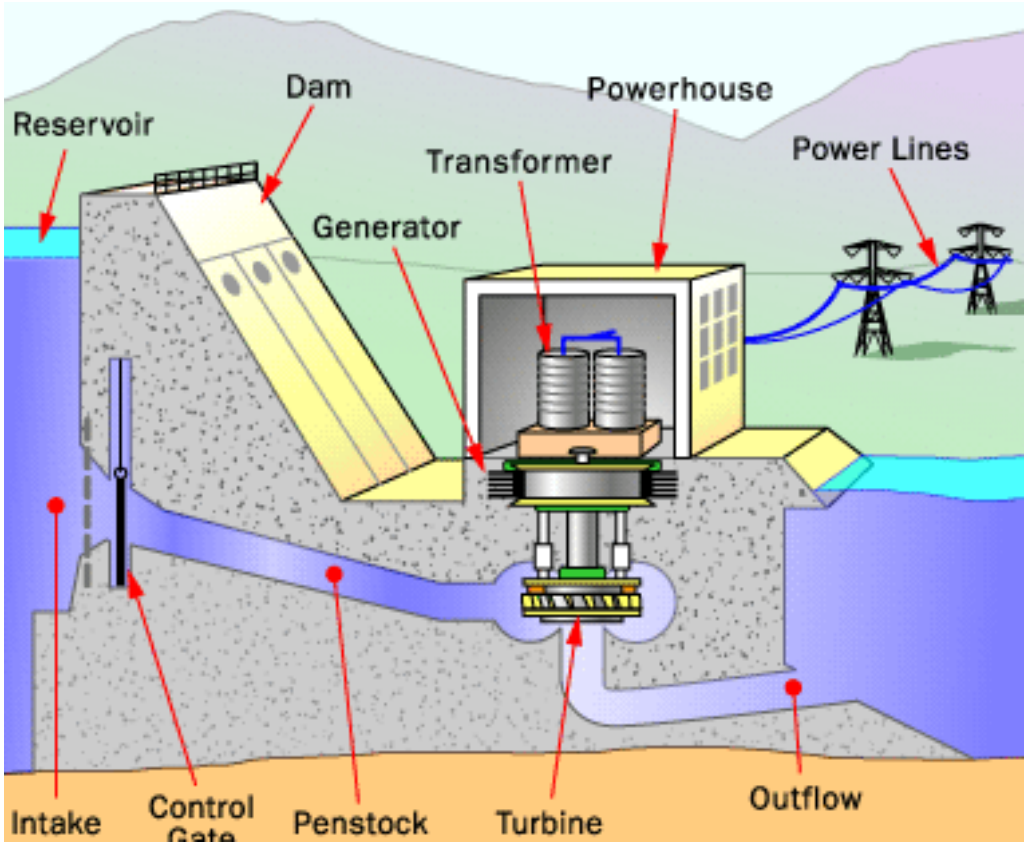
Fuel	Technology and Environment		
	Conventional	**Short-term improvements**	**Medium-term improvements**
Coal and petroleum residues	Pulverised coal boiler	CFB atmospheric boiler Staged combustion Supercritical thermodynamic cycle	IGCC (integrated gasification combined cycle) High temperature ultra supercritical thermodynamic cycle
Heavy fuel oils and petroleumbased products	Standard boiler	CFB atmospheric boiler Supercritical thermodynamic cycle	Gasification of petroleumbased products and combined cycle
Natural gas	Standard boiler Turbine	Critical thermodynamic cycle (boiler) Combined cycle (turbine)	

Efficiency improvement for some countries for TPP's



Hydropower Stations

- Electrical efficiency 90-95%



Losses in the grid

- “Technical Losses”: 6-10% for a modern transmission & distribution system.
- “Non-technical Losses”: Can amount up to 10-15% in some countries. Especially in the low voltage system.

Measures to Reduce Losses in the Grid

- **To reduce technical losses**
  - Reactive power control
  - Production/Load optimising
  - Utilise modern components with high efficiency
- **To reduce non-technical losses**
  - Better control of consumption in the households
    - Automatic meters
    - Meters non-accessible by the consumers
    - Insulated distribution lines

Reactive Power Control

- Reactive power is not possible to use as real power but it flows in the network and causes losses. Additionally it “fills up” the capacity of the network.
- It is analogous to the foam in a beer glass

Reactive Power Control

- Industrial processes that utilise a lot of motors and fluorescent light require reactive power.
- The user of the reactive power can and should compensate by installing static power compensators.
- Revise tariffs? Penalties for reactive power usage?

Thank You