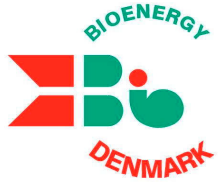


Danish Follow-up Programme for Solid Biomass CHP Plants

Small scale biomass co-generation
Danish experience and perspective

IDA workshop October 7. 2010

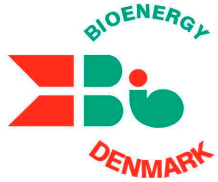
Henrik Flyver Christiansen
Danish Energy Agency



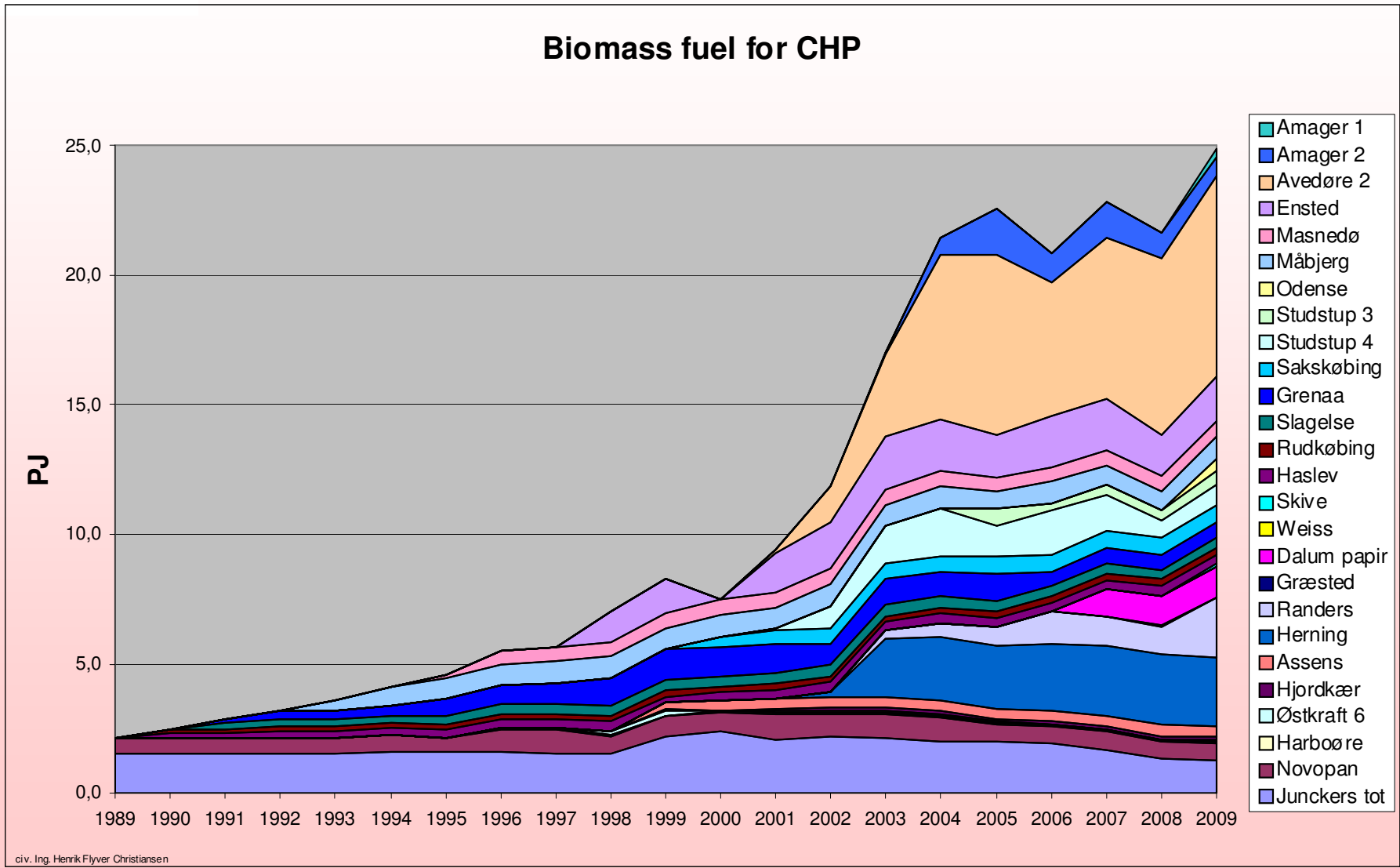
Danish Follow-up Programme for Solid Biomass CHP Plants

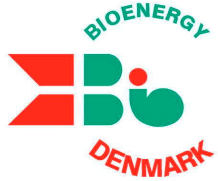
DK Follow-up programme

- Started 1993 continued to 2005 on full load.
- Process-, fuel-, energy-, environment-, waste water-, ash-, chemical- and economy analysis
- Monthly data collection
- Continues reporting.
- Task group



Danish Follow-up Programme for Solid Biomass CHP Plants

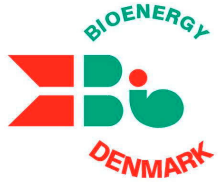




Danish Follow-up Programme for Solid Biomass CHP Plants

Fundamental consideration

- Saving – reduced consumption
- Efficiency – reduced consumption
- Renewable energy – reorganize production
- Long term - Biomass become only carbon resources.

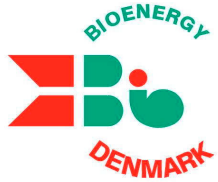


Danish Follow-up Programme for Solid Biomass CHP Plants

Unique Danish position

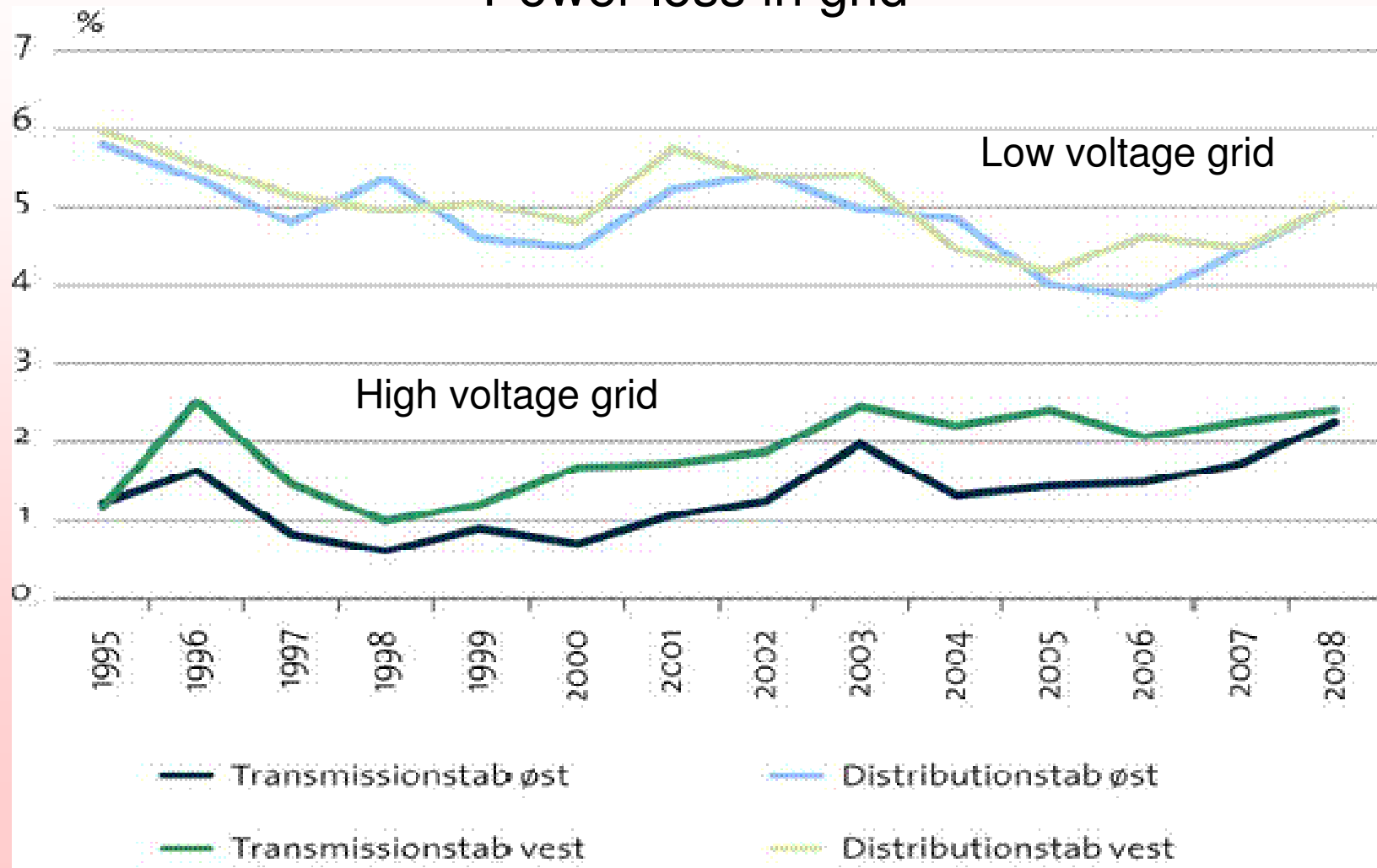
Consumption \Leftrightarrow Production

- National power grid – **partly storable**
- National natural gas grid – **partly storable**
 - Local district heating – **storable**
- Transport of fuel / product - **storable**
 - Information transport – **storable**

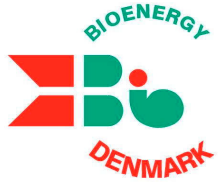


Danish Follow-up Programme for Solid Biomass CHP Plants

Power loss in grid

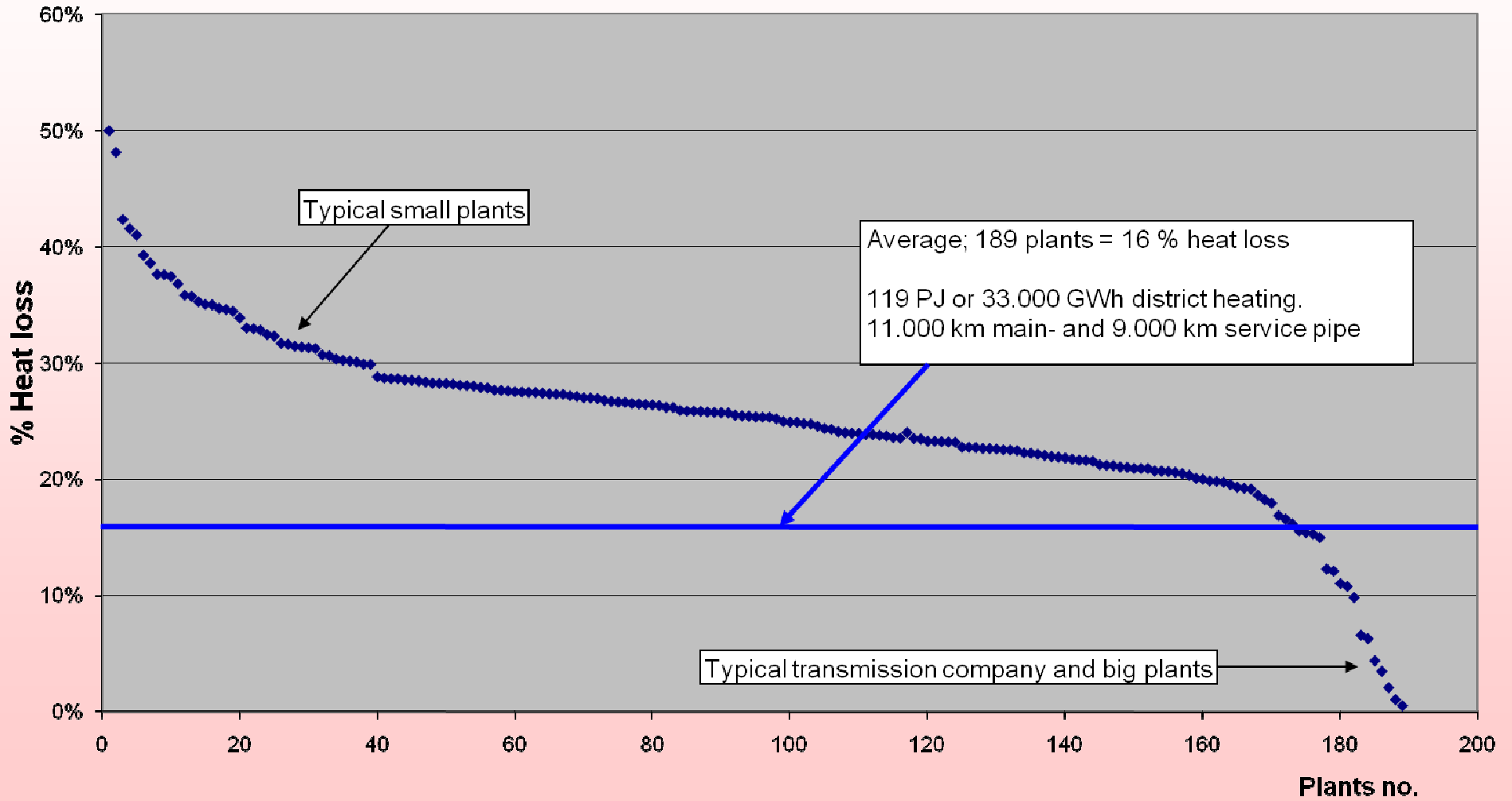


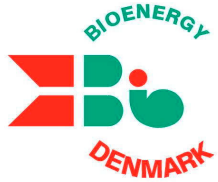
Source Miljørapport 2009, Baggrundsrapport, Energinet.dk



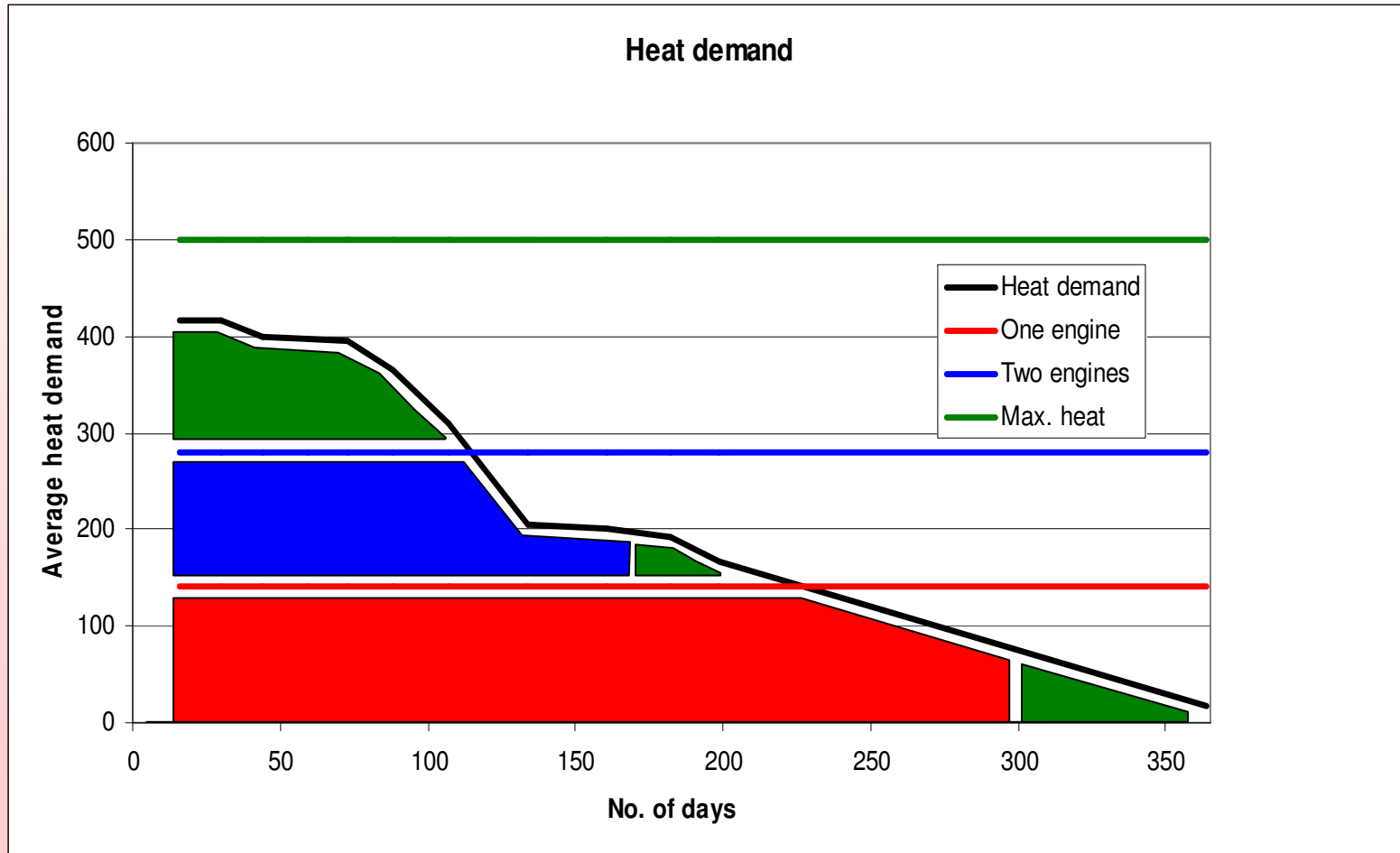
Danish Follow-up Programme for Solid Biomass CHP Plants

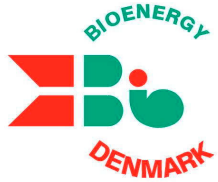
Heat loss in district heating



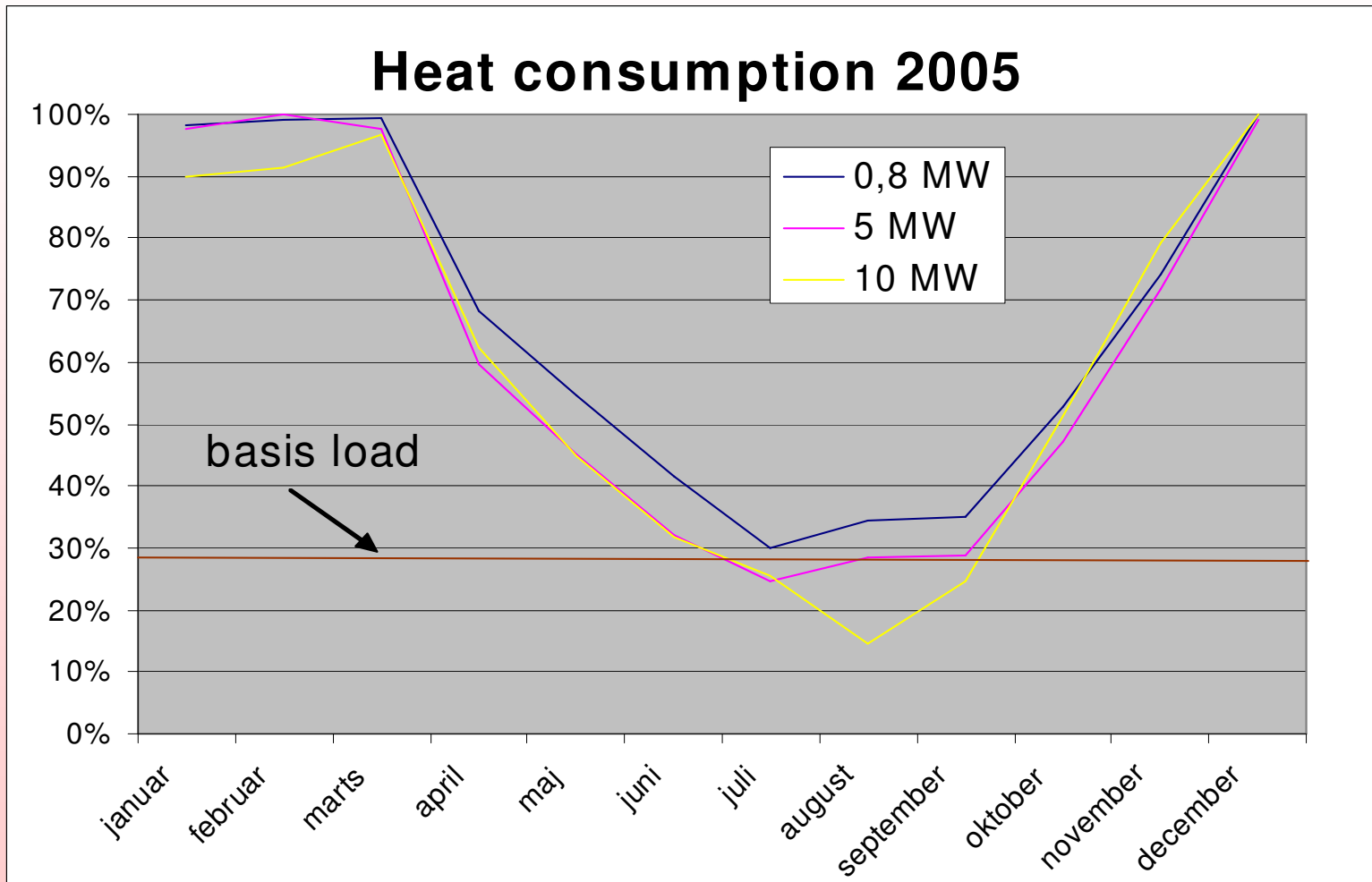


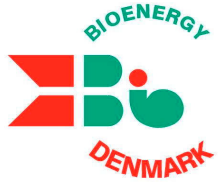
Danish Follow-up Programme for Solid Biomass CHP Plants



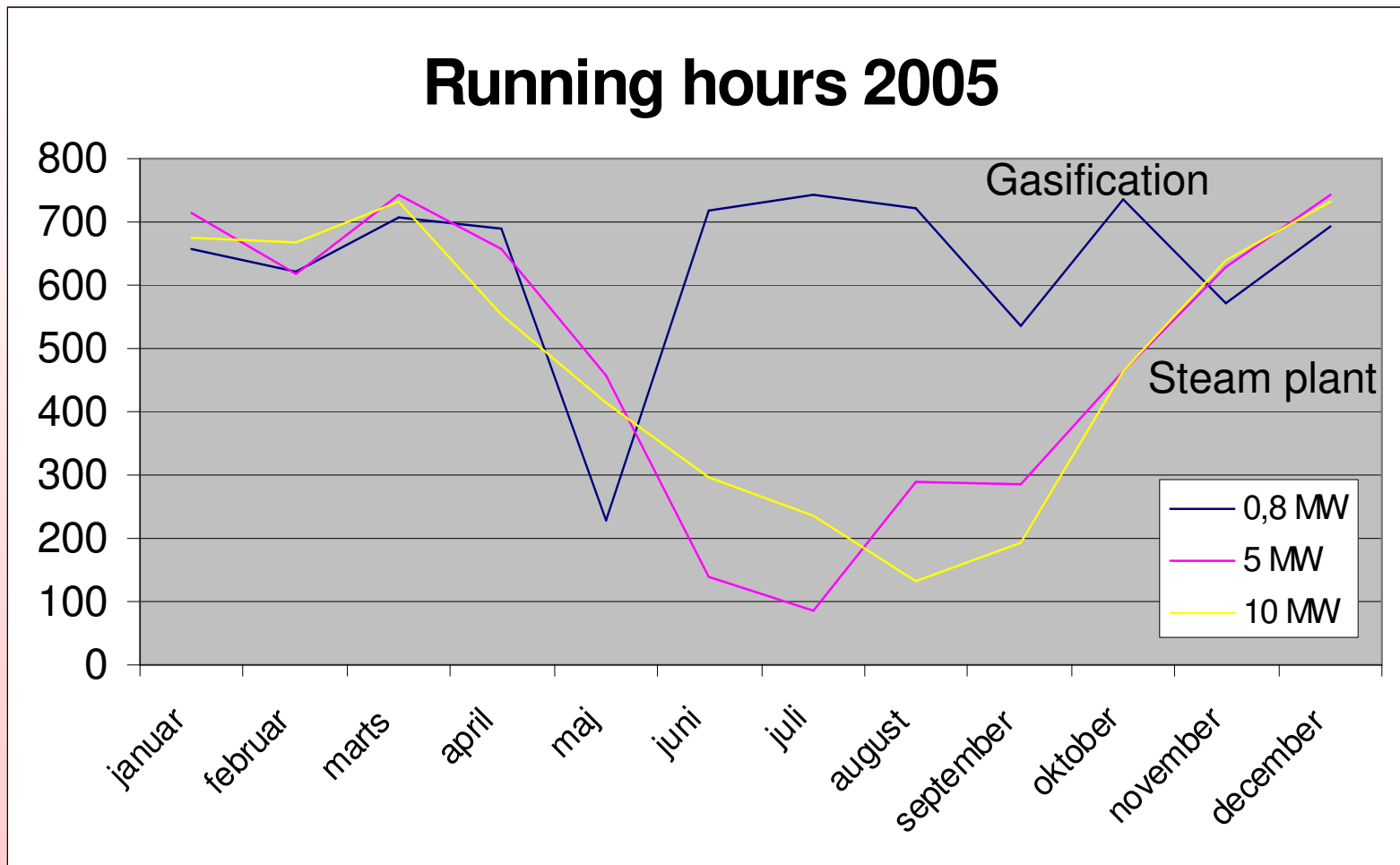


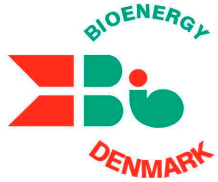
Danish Follow-up Programme for Solid Biomass CHP Plants





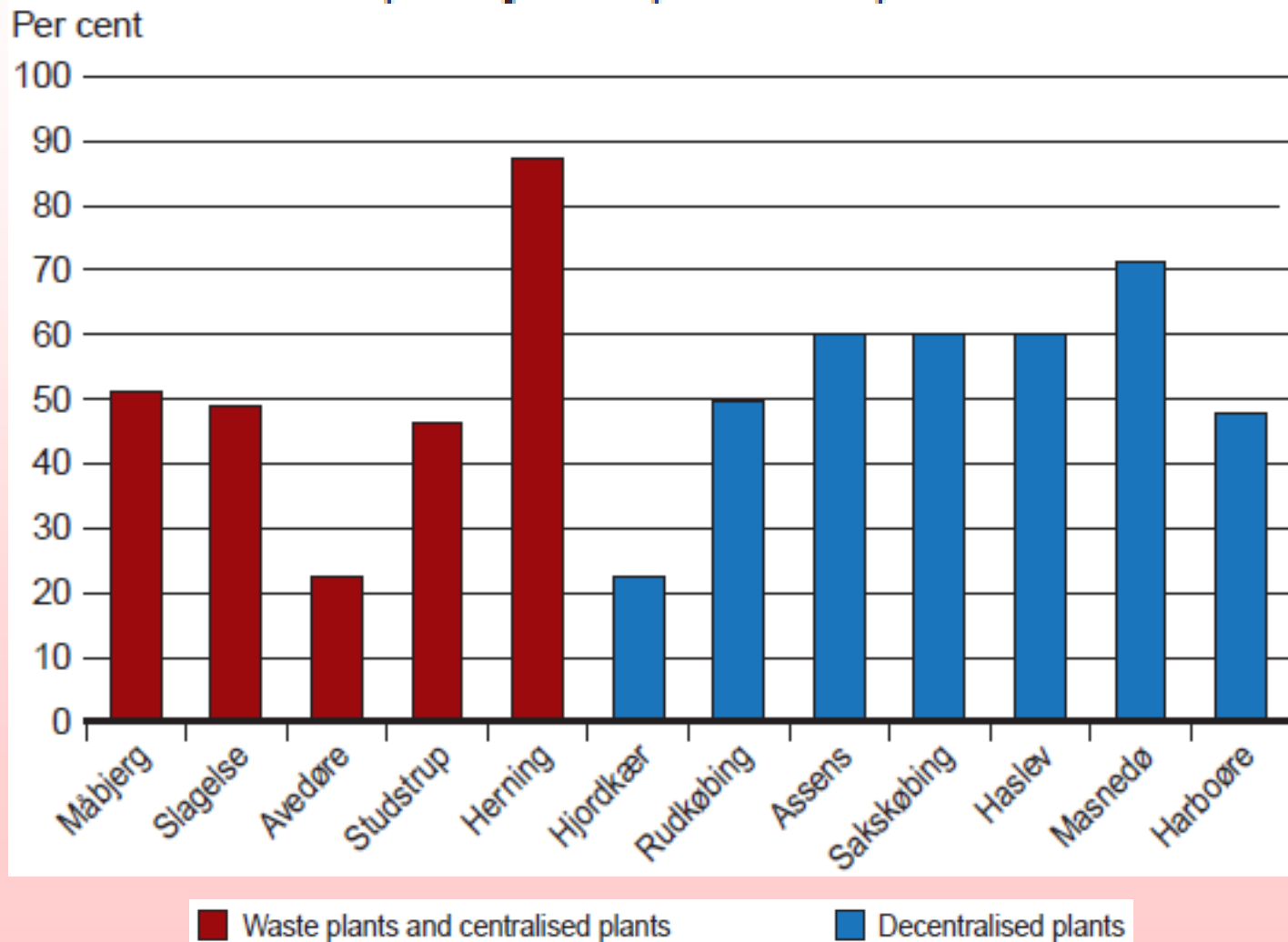
Danish Follow-up Programme for Solid Biomass CHP Plants

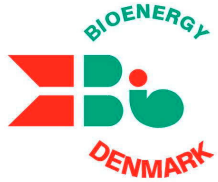




Danish Follow-up Programme for Solid Biomass CHP Plants

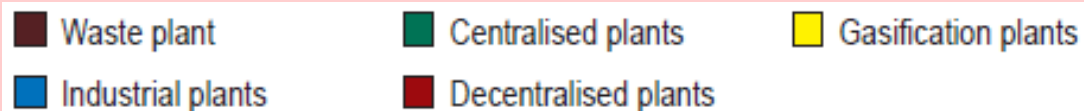
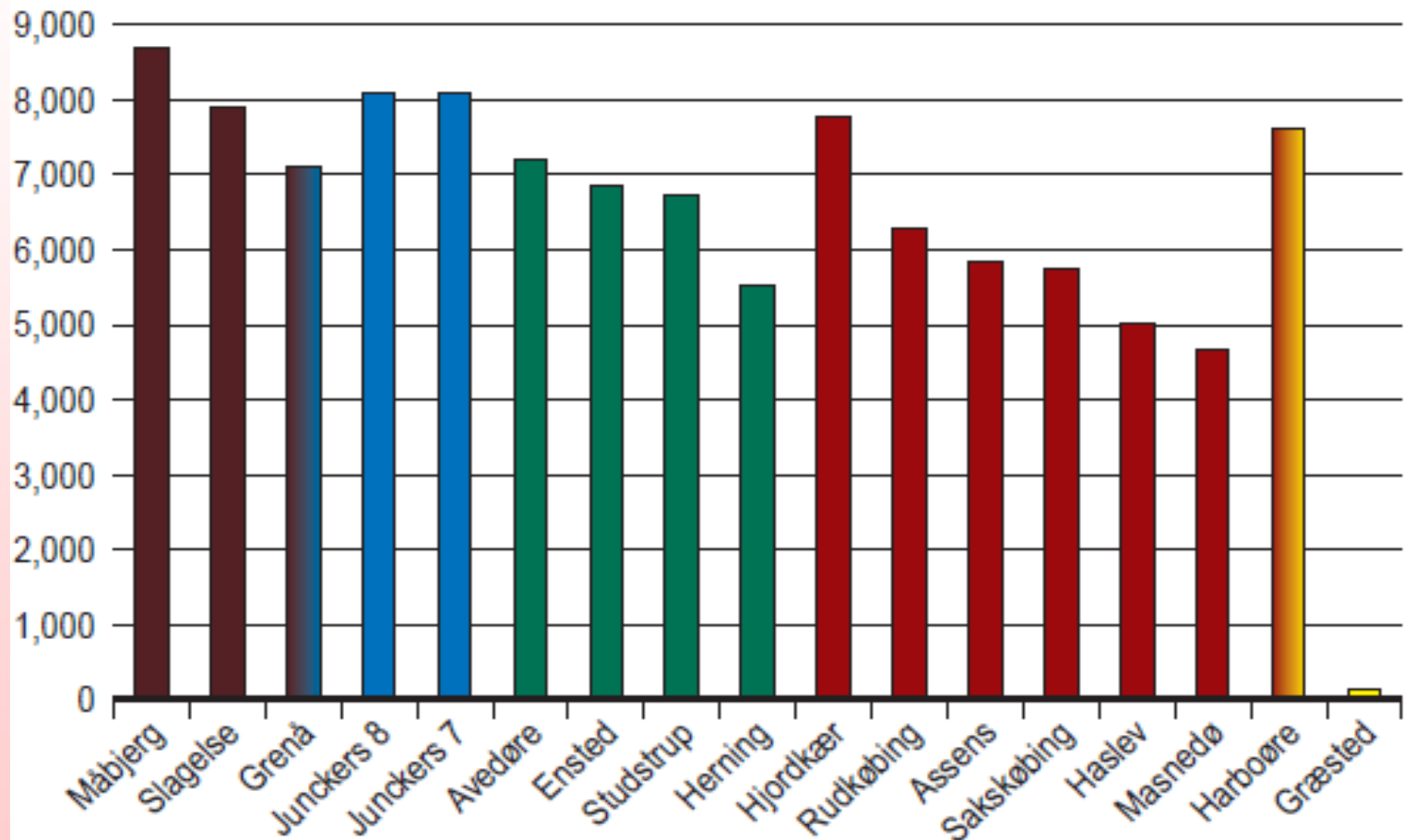
Heat capacity compared to peak load

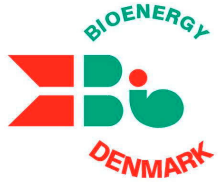




Danish Follow-up Programme for Solid Biomass CHP Plants

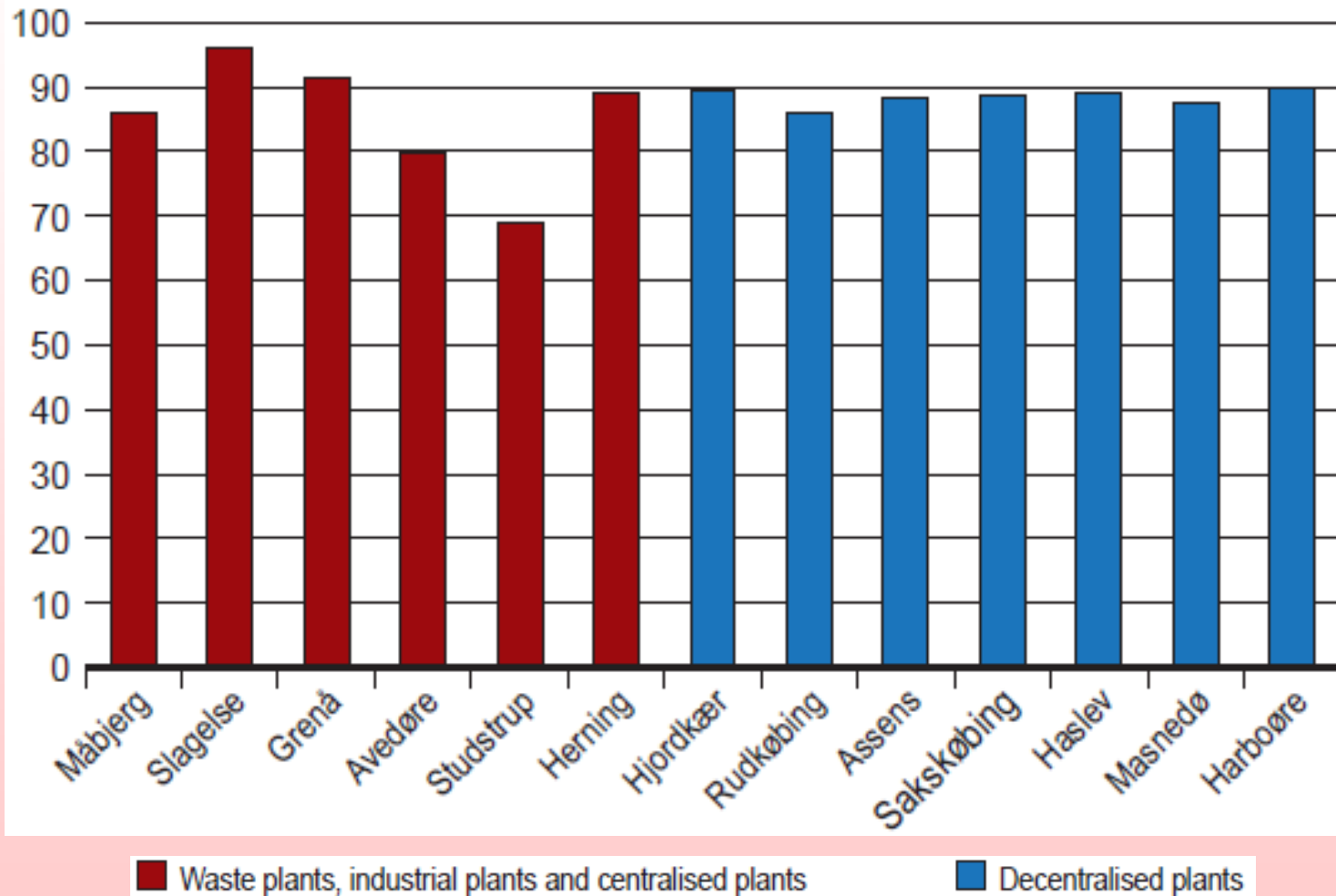
Operation hours in 2005

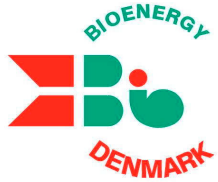




Danish Follow-up Programme for Solid Biomass CHP Plants

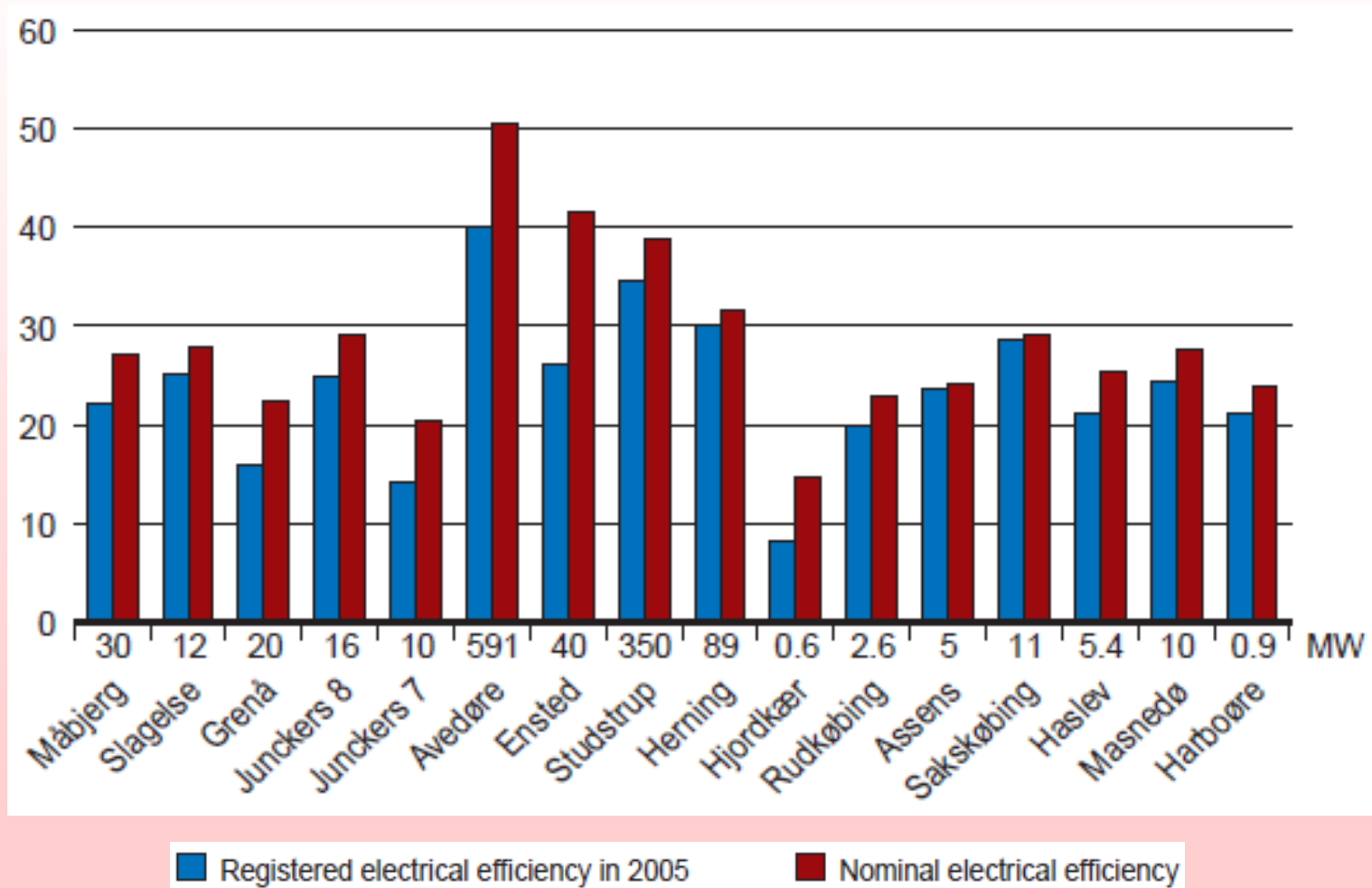
The average total efficiency for the plants in 2005.

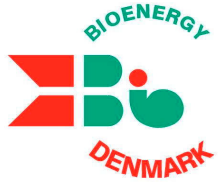




Danish Follow-up Programme for Solid Biomass CHP Plants

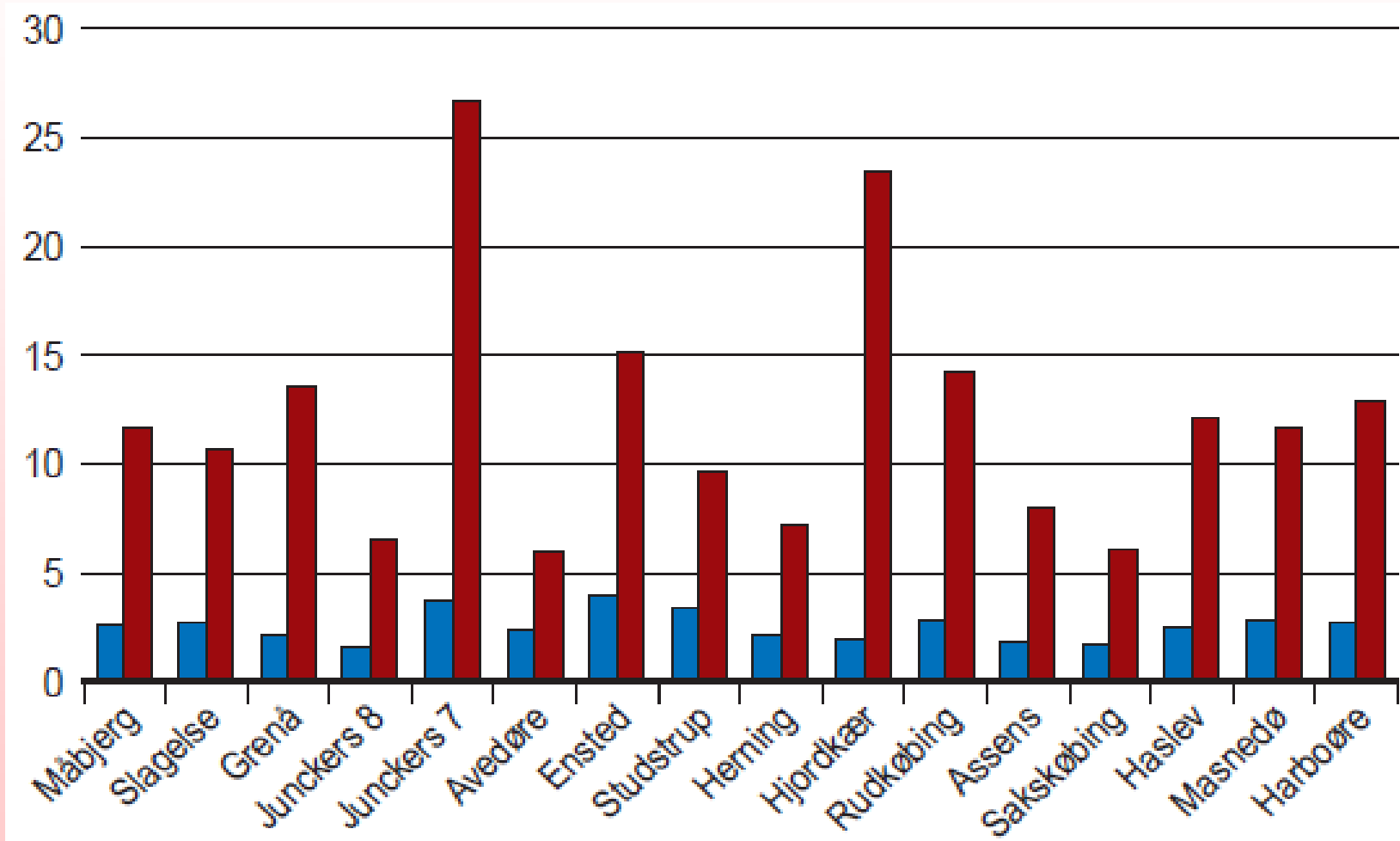
Power efficiency in 2005





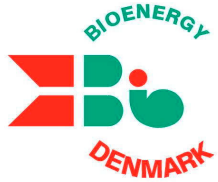
Danish Follow-up Programme for Solid Biomass CHP Plants

Power consumption in 2005



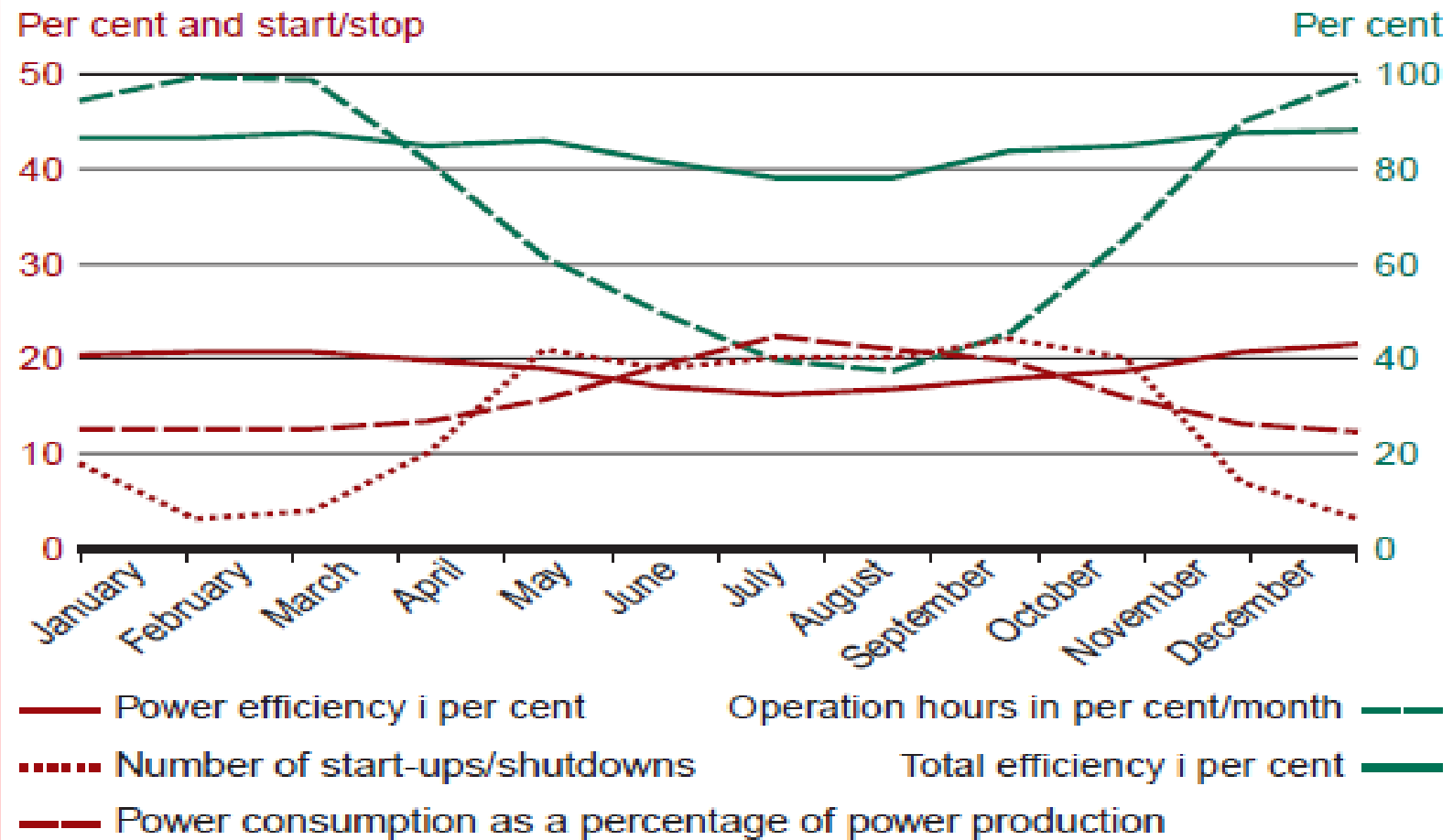
■ Power consumption/power production

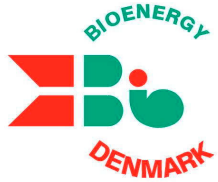
■ Power consumption/fuel consumption



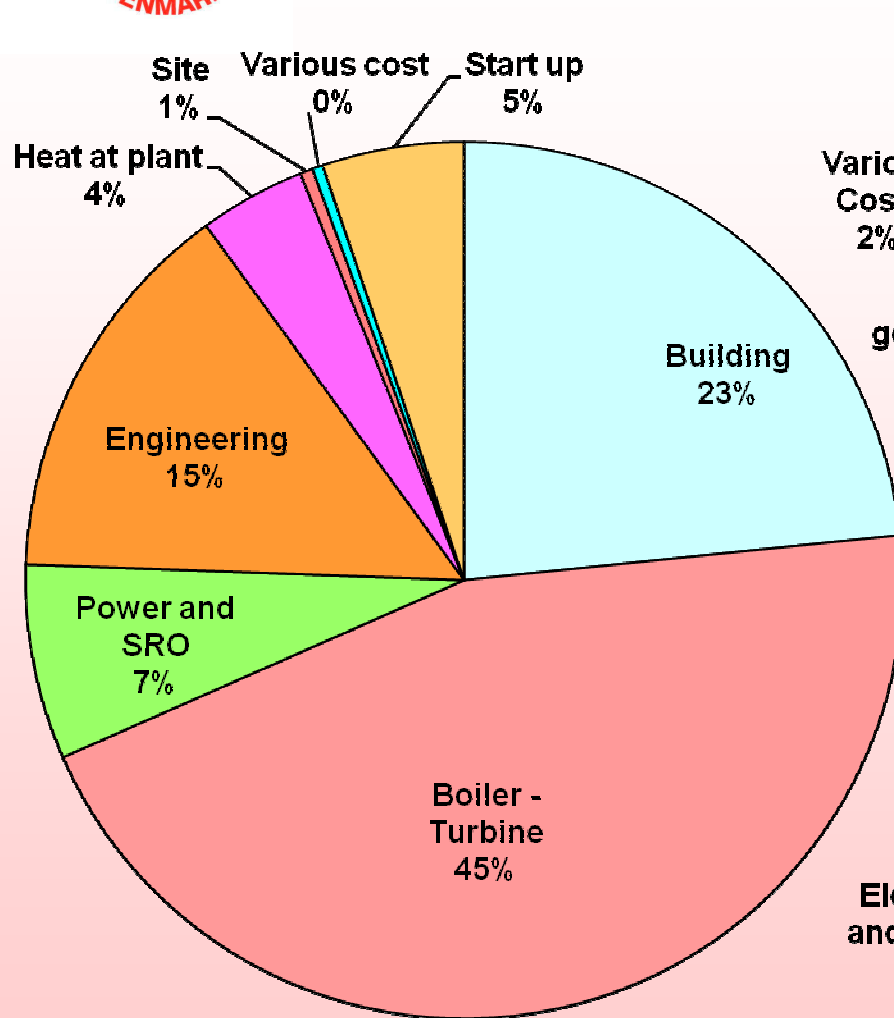
Danish Follow-up Programme for Solid Biomass CHP Plants

Rudkøbing 2,3 MW steam in 2005

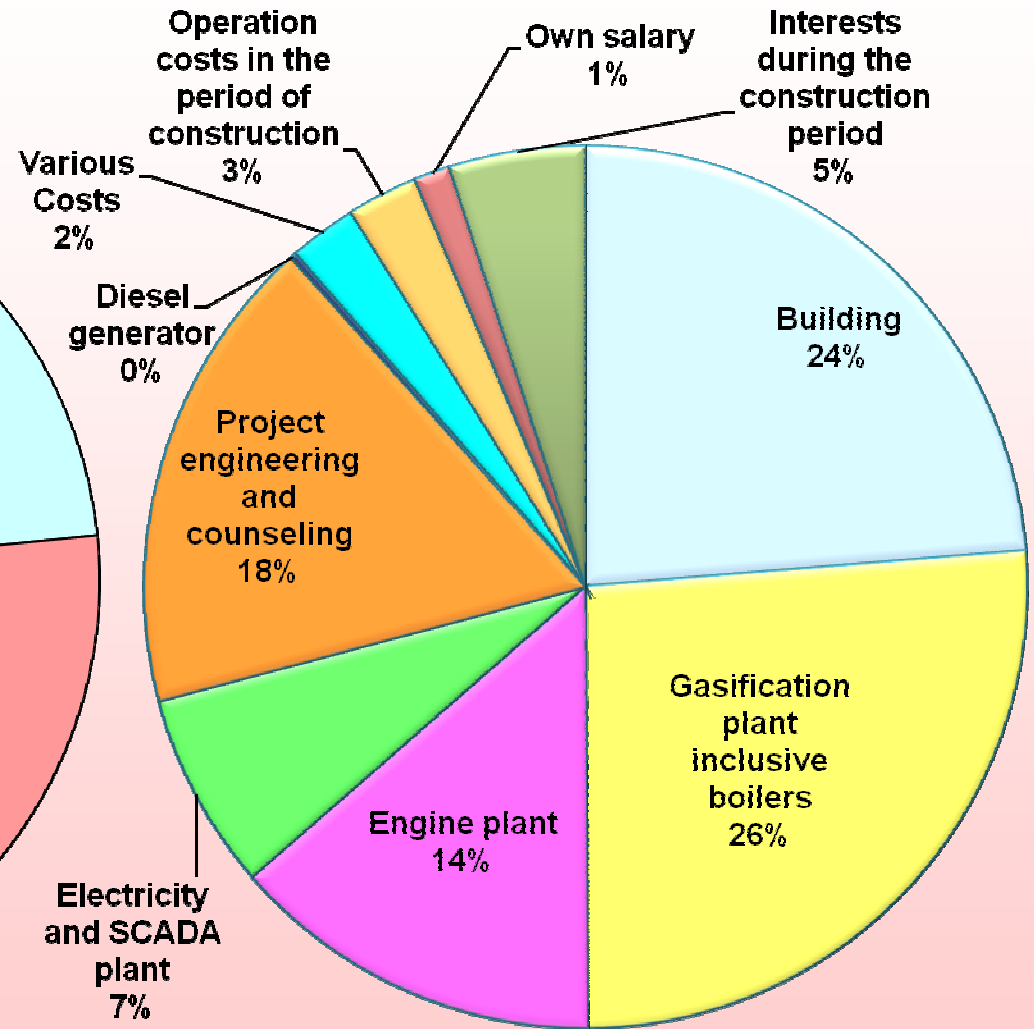




Danish Follow-up Programme for Solid Biomass CHP Plants

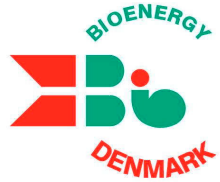


Steam Plant. Straw



Gasification Plant. Wood

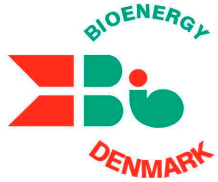
Plant Investment



Danish Follow-up Programme for Solid Biomass CHP Plants

Key no. and Plant Investment

	Fuel MW	Electricity MW	Heat MW	Liquid MW	Costs Mio. DKK	Rate Mio. DKK/MW
Skive project	18	6	10	0	250	42
Skive optimised	28	9	16	0	288	32
Skive 2 + fuel	28	10	15		262	26
Skive 2 + liquid	28	10	15	18	302	30
Skive 2 pressurized + oxygen	98	43	43		608	14
Straw combustion, 2002 costs; Sakskøbing	39	11	23		252	22

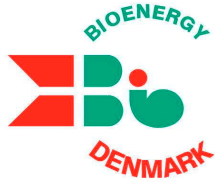


Danish Follow-up Programme for Solid Biomass CHP Plants

DK Follow-up programme

Some results:

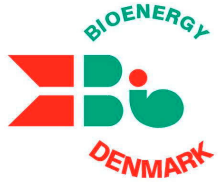
- **Combustion:** fuel- and ash handling. Plant guarantee. Plant consumption – cut down.
- **Gasification:** Tar- and dust measurement. Guarantee for engine. Basis research.
- **Common:** Standard for fuel. Standard for preformant test.



Danish Follow-up Programme for Solid Biomass CHP Plants

How to make success

- Secure delivery of homogeneous fuel
- Step by step – don't do every thing at same time
- Development takes time – often more than 10 years for new technology
- National network of developer and supplier
- New plant don't work
- The staff at the plant
- Long term program and a lot of money



Danish Follow-up Programme for Solid Biomass CHP Plants

Development of Straw Fired CHP Plants

