The exergetic efficiency (see also Section 2.7.5) associated with the operation of a CHP plant under BAT conditions is considered to be 45 - 55 %, which is equal to a heat rate in the range of 1.3 - 1.1, and an energy (fuel) efficiency of 75 - 90 %, depending on the specific plant application. Comparing this to the heat rate and the efficiency of new coal- and lignite-fired electricity only condensing plants with efficiencies of 42 – 47 % and heat rates of 2.3, the fuel savings, and thus the reduced amount of CO_2 generated, become apparent.

It should be kept in mind that these BAT levels are not achieved under all operating conditions. The energy efficiency is at its best at the design point of the plant. The actual energy efficiencies throughout the operational period of the plants may be lower due to changes in the load during the operation, quality of the fuel, etc. The energy efficiency also depends on the cooling system of the power plant, its geographical location (see Table 2.3), and on the energy consumption of the flue-gas cleaning system.

For existing coal- and lignite-fired plants, a number of retrofit and repowering techniques can be applied to improve the thermal efficiency. The technical measures described in Section 3.2.6.1 should be taken into account as part of the BAT options to improve the efficiency of existing plants. Significant results have been achieved by repowering old boilers, especially in transition phase countries.

In general, the following measures need to taken into consideration to increase efficiency:

- combustion: minimising the heat loss due to unburned gases and elements in solid wastes and residues from combustion
- the highest possible pressure and temperature of medium pressure steam. Repeated superheating of the steam to increase net electric efficiency
- the highest possible pressure drop in the low pressure end of the steam turbine through the lowest possible temperature of the cooling water (fresh water cooling)
- minimising the heat loss through the flue-gas (utilisation of residual heat or district heating)
- minimising the heat loss through the slag
- minimising the heat loss through conduction and radiation with isolation
- minimising the internal energy consumption by taking appropriate measures, e.g. scorification of the evaporator, greater efficiency of the feed-water pump, etc.
- preheating the boiler feed-water with steam
- improving blade geometry of the turbines.

The levels of the thermal efficiency associated with the application of the BAT measures that have been considered in Chapter 4.3 to improve efficiency are summarised in Table 4.66.

<table>
<tr><th rowspan="2">Fuel</th><th rowspan="2">Comb. Tech.</th><th colspan="2">Unit thermal efficiency (net) (%)</th></tr>
<tr><th>New plants</th><th>Existing plants</th></tr>
<tr><td>Coal and lignite</td><td>Cogeneration (CHP)</td><td>75 – 90</td><td>75 – 90</td></tr>
<tr><td rowspan="3">Coal</td><td>PC (DBB and WBB)</td><td>43 – 47</td><td rowspan="6">The achievable improvement of thermal efficiency depends on the specific plant, but as an indication a level of 36[1] – 40 % or an incremental improvement of more than 3 % points can be seen as associated with the use of BAT for existing plants</td></tr>
<tr><td>FBC</td><td>>41</td></tr>
<tr><td>PFBC</td><td>>42</td></tr>
<tr><td rowspan="3">Lignite</td><td>PC (DBB)</td><td>42 – 45</td></tr>
<tr><td>FBC</td><td>>40</td></tr>
<tr><td>PFBC</td><td>>42</td></tr>
<tr><td>1</td><td colspan="3">Industry and one Member State claimed that for existing plants, the achieved net unit efficiencies following major upgrading projects are only in the range of 30 – 40 %. They claimed that this depends on the specific plant and the fuel characteristics as well as the climatic conditons, taking into account the efficiency drop due to the significant energy consumption of the (usually retrofitted) emissions control equipment.</td></tr>
</table>

Table 4.66: Levels of thermal efficiency associated with the application of the BAT measures