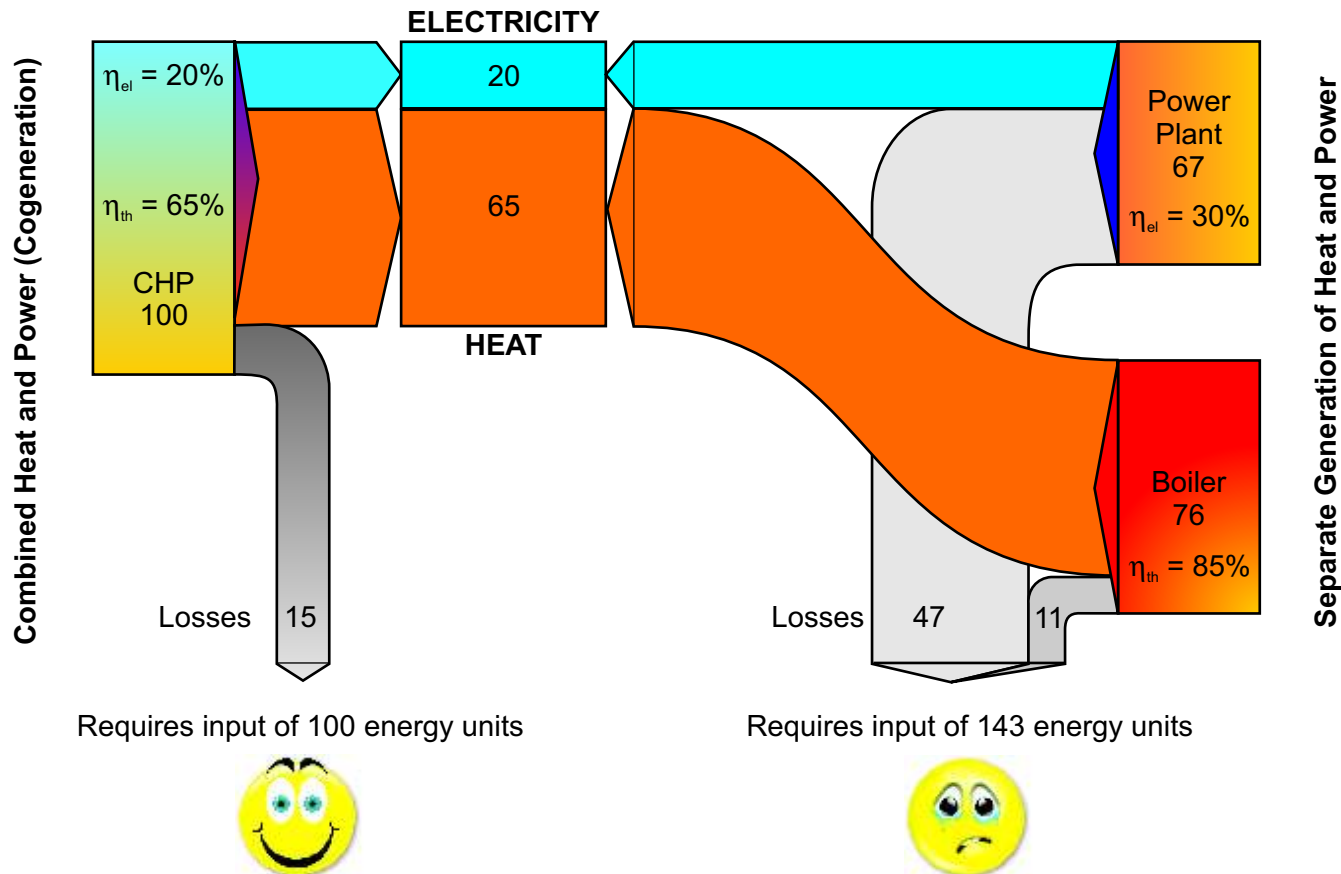


# COMBINED HEAT AND POWER

under the Energy Conservation Act, 2001



## CHP at a glance

Due to law of nature (read thermodynamics) in conventional thermal power generation much of the energy input has to be wasted. Combined Heat and Power (CHP) – also often named co-generation – where usable heat and power are generated simultaneously in a single process, can lead to reduce primary energy consumption up to 30% (and even above) as compared to generation of power and heat in separate systems. CHP in general can be applied where process heat is needed and demand can be synchronised with demand for power.





## Who are we?

The Bureau of Energy Efficiency (BEE) was established under the Energy Conservation Act (2001) of the Government of India. The mission of BEE is to 'institutionalize' energy efficiency services, enable delivery mechanisms in the country and provide leadership to energy efficiency in all sectors of the country. Within this mandate, the BEE is promoting CHP under the aegis of its 3L-Programme (Life-Long-Learning).

As partner of the BEE, the Indo-German Energy Programme assists BEE's in its various activities and approach to promote energy efficiency. The agency behind the Indo-German Energy Programme is the German Technical Cooperation (GTZ).

Promoting CHP in India is also supported by the Indian Renewable Energy Development Agency (IREDA) by providing financing for CHP plants operated either on renewable or fossil fuel.

## What do we want?

The objective of this initiative is to facilitate and accelerate investments into 200 new Combined Heat and Power plants or optimisation of existing ones. If heat and power is demanded at the same site, energy can be converted, with cogeneration, far more efficiently than with separate production. Consequently, not only emissions will be reduced, you also will be able to cut your energy costs - depending on the case - often dramatically!

## How do we proceed?

The BEE has recently launched a CHP working group. Professionals interested in CHP in India are invited to join.

This working group will undertake its tasks in close coordination with BEE aiming to promote networking and knowledge distribution within the group as well as to foster interlinks and synergy effects between members. Additionally, through the website, [www.energymanagertraining.com/CHP](http://www.energymanagertraining.com/CHP), we will also disseminate information such as:

- announcements of important CHP related events within India
- distribute information on CHP in general from India and abroad
- publish studies, brochures and presentations conducted by the initiative

The dialogue on the website offers a two-way communication where the members of the working group are encouraged to take the opportunity to interact through the website for questions, requests, recommendations etc. On the other side, we also may ask members to distribute information to us, in order to gather information to formulate a larger scenario for CHP in India.

## What do we offer?

Within this promotional scheme, we offer the following to the CHP working group members:

- Preparing and publishing technical documents of general interest such as brochures, information leaflets, market overviews etc.
- Preparation of studies according to actual demand
- Organisation of events (Conferences and seminars) - The first CHP India conference is planned to take place in January 2008 in New Delhi
- Certified appraisal of your existing or future CHP plant design. This will assist you in identifying the options for improvement and potential impacts.
- Technical assistance for CHP plant investors for best practice layout on a case to case basis
- Technical assistance for CHP plant operators for improvement of plant design and its operation on a case to case basis
- Financing services investment in CHP plants may be offered by our partner IREDA according to the provisions of its current schemes
- Benchmarking of CHP plants using the European method of primary energy savings
- CHP awards in the categories "India's most efficient CHP plant" and "India's most innovative CHP plant".

Our initiative is backed by a host of national and international expertise.

## The next steps are

For us:

- identifying the potential of CHP in selected industrial sectors in India.
- identifying potential investors in CHP technology
- conducting studies, producing technical brochures, etc.
- incorporating your feedback

For you:

- to register as a member of the CHP working group at: [www.energymanagertraining.com/CHP](http://www.energymanagertraining.com/CHP)
- to contact us if you think about investing into CHP plants
- to contact us if you have a relatively constant process heat requirement, which is not presently generated via a CHP cycle.
- to contact us in case you have any questions, recommendations etc.
- to give us feedback so that we can improve our service



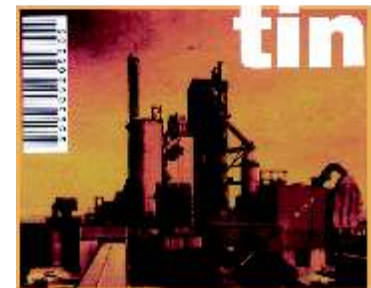


## Benchmarking

Benchmarking CHP systems is a challenging task, as Primary Energy Savings (PES, will be explained next page) do also depend on applied technology and fuel type. Additionally, the heat demand pattern and the way of operation of the CHP plant may have an influence on the PES value. However, good layout, best practice operation and well chosen technologies may counteract these issues. CHP plants shall also be classified in four categories, gold, silver, bronze and tin, as it is known already from other BEE initiatives.

After receiving sufficient feedback from CHP plant operators, we will publish aggregated performance data on quality status of CHP plants in India based on the method of PES.

As mentioned, we are planning to award two prizes within the categories: “India’s most efficient CHP plant” and “India’s most innovative CHP plant”.



## Evaluation of CHP plants

The approach of “Primary Energy Savings” (PES) is an internationally accepted method to assess and compare the “quality” of CHP plants. According to EU Directive 2004/8/EC, PES is calculated on bases of the following formula:

$$PES = \left[ 1 - \frac{1}{\frac{CHP H\_eta}{Ref H\_eta} + \frac{CHP E\_eta}{Ref E\_eta}} \right] \times 100 \%$$

$CHP E\_eta = \frac{P}{F}$  (electrical efficiency of cogeneration plant)

$Ref H\_eta$  = reference efficiency of separate heat production

$CHP H\_eta = \frac{Q}{F}$  (thermal efficiency of cogeneration plant)

$Ref E\_eta$  = reference efficiency of separate electricity production

$P$  = net electrical output

$Q$  = net thermal output

$F$  = fuel energy consumption of total CHP plant (GCV!)

$P, Q, F$  – annual mean values!!!

Where a cogeneration plant delivers mechanical energy instead of electricity, this energy should be considered.

All stated efficiencies are based on the following definition:

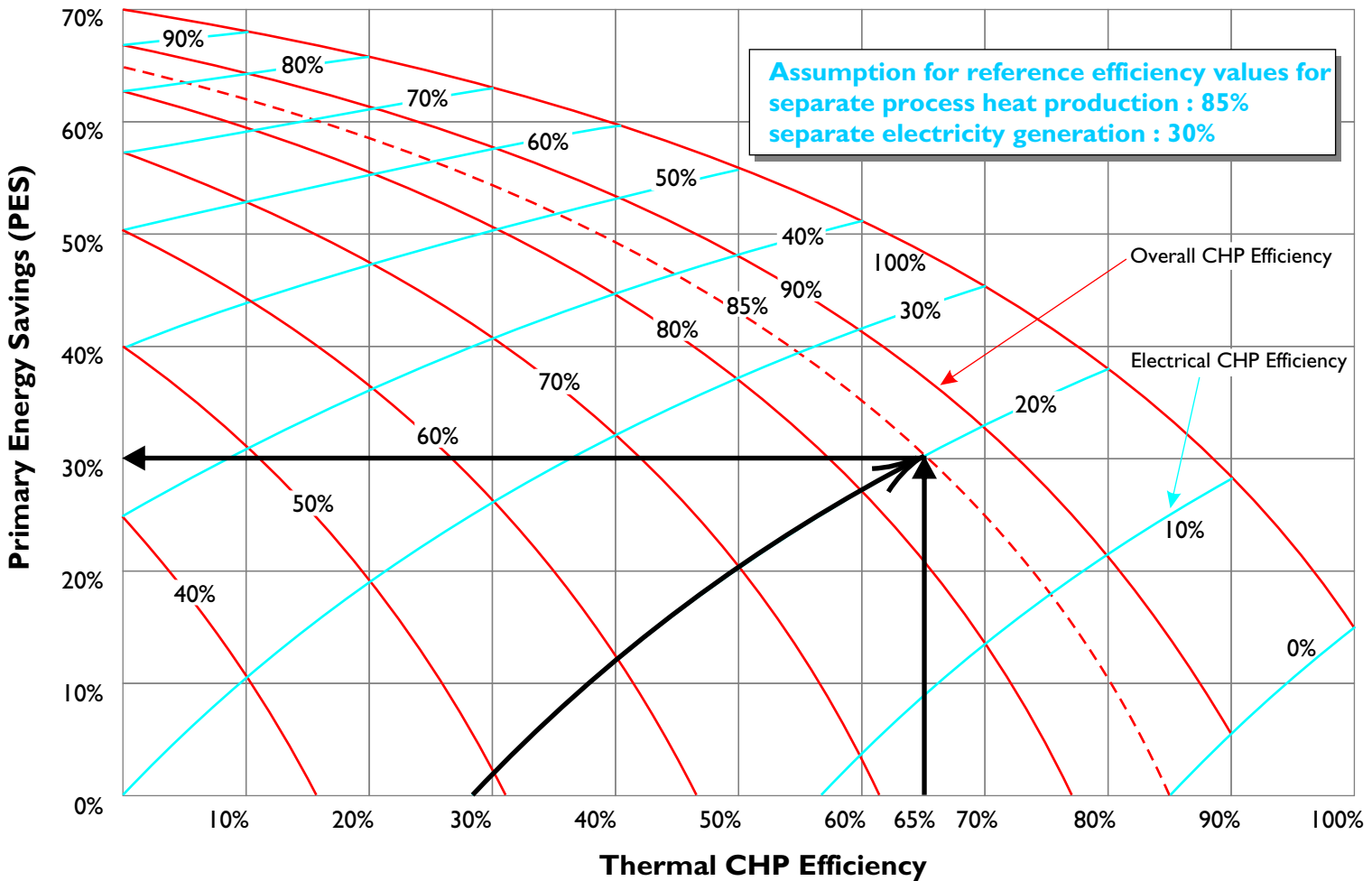
$$\eta = \frac{\text{net energy output (heat and power)}}{\text{fuel input (gross calorific value)}}$$

### Efficiency reference values for separate production of heat and electricity:

The principles for defining these efficiency reference values referred to the separate heat and electricity production that cogeneration is intended to substitute having the following constraints:

- ✓ Comparison with separate electricity production shall be based on the principle that the same fuel types are compared
- ✓ Each cogeneration unit shall be compared with the best available and economically justifiable technology for separate production of heat and electricity on the market in the year of construction of the cogeneration unit incorporating ambient conditions of site
- ✓ The efficiency reference values for cogeneration units older than 10 years of age shall be fixed on the reference values of units of 10 years of age





**Example:**

Reference efficiency of a steam boiler may be 85%. For reference electrical efficiency, 30% is assumed. With these reference values, the above graph results. The x-axis displays the thermal CHP-efficiency, the blue lines the electrical CHP-efficiencies and the red lines the overall CHP efficiency.

Instead of separate production of process heat and electricity, with a CHP plant consisting of a backpressure turbine with an electrical efficiency of 20% and a thermal efficiency of 65% can be considered as realistic (overall CHP efficiency 85%). With this arrangement, up to 30% of primary energy can be saved compared to separate generation of electricity and process heat, as shown in the graph above. The cover page of this brochure shows the same example.



For further information please visit the website :  
[www.energymanagertraining.com/CHP](http://www.energymanagertraining.com/CHP)

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