

**FINATER OFFERS
INNOVATIVE AND SUSTAINABLE SOLUTIONS
TO COMPANIES AND COMMUNITIES
TO HELP THEM TO :**

- **BETTER USE ENERGY**
- **OPTIMIZE ENERGY EFFICIENCY**
- **REDUCE THEIR ENVIRONMENTAL IMPACT**

FINATER

ENERGY EFFICIENCY

**TRIGENERATION
TECHNOLOGY**

TRIGENERATION technology

The resource for companies seeking further informations
on trigeneration technology

This presentation is designed for use by companies who are interested in investigating the benefits of trigeneration technology.

This technology is growing in popularity due to its economic and production efficiency, and its positive impact on carbon emissions.

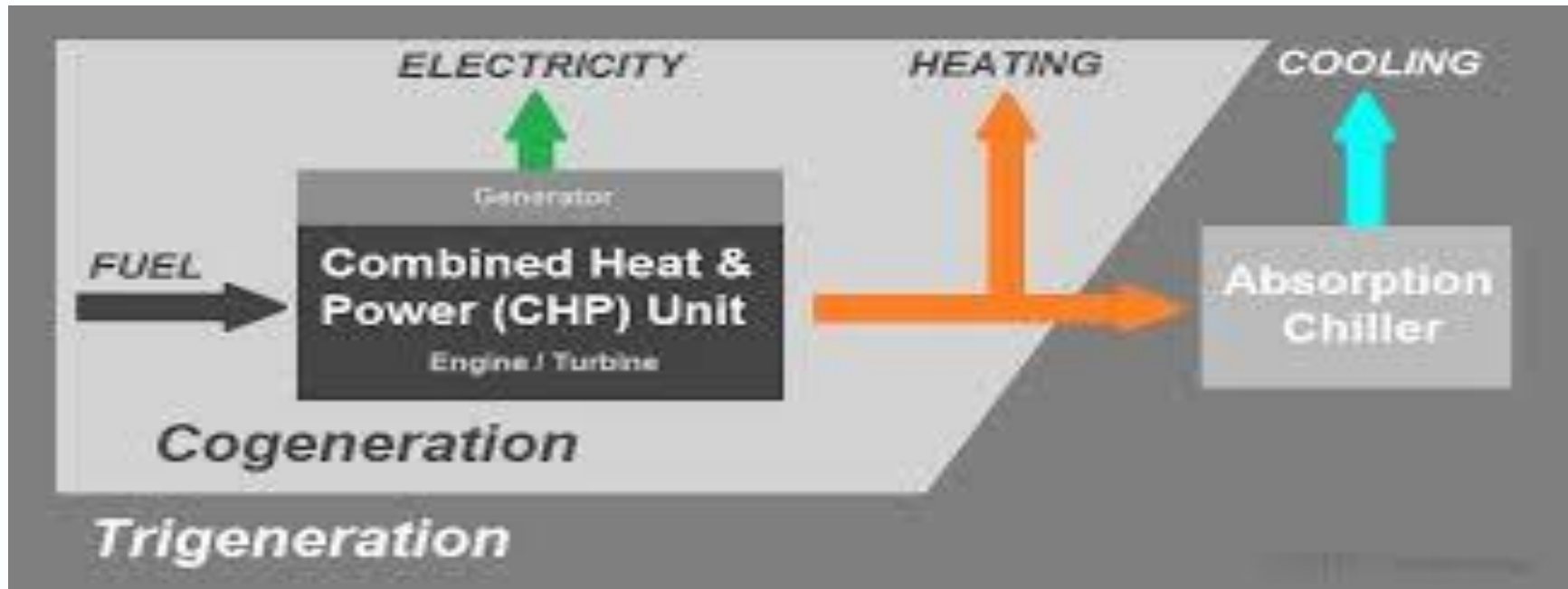
This Finater's resource includes information on the technology, the many benefits associated with its use, technology available, key considerations when deciding which solutions to buy, important questions to ask when considering the best application.

What is “Trigeneration”?

- ✓ **Trigeneration** or combined heat, power and cooling (CHPC), is the simultaneous production of three forms of energy - typically, **Heating, Power and Cooling (chilled water for air conditioning or refrigeration)** - from only one fuel input. Put another way, **trigeneration** power plants produce three different types of energy for the price of one.
- ✓ **Trigeneration** further improves the efficiency of a cogeneration (CHP) plant to maximize the use of waste heat. CHPC systems achieve these greater energy efficiencies through the conversion of exhaust or reject heat from power generation into needed energy services like cooling and heating of buildings as well as campuses. This is called “*Waste Heat Recovery*” or “*Recycled Energy*”
- ✓ **Trigeneration** energy systems can reach overall system efficiencies of 86% to 93%. Typical "central" power plants, that do not need the heat generated from the combustion and power generation process, are only about 33% efficient.
- ✓ **Trigeneration** can help you save money through efficiency.....

How “Trigeneration” works?

Trigeneration is the process by which some of the heat produced by a cogeneration plant is used to generate chilled water for air conditioning or refrigeration. An absorption chiller is linked to the combined heat and power (CHP) to provide this functionality. *NB : Quadgeneration takes this process one step further with the addition of systems to purify carbon dioxide from the engine exhaust.*

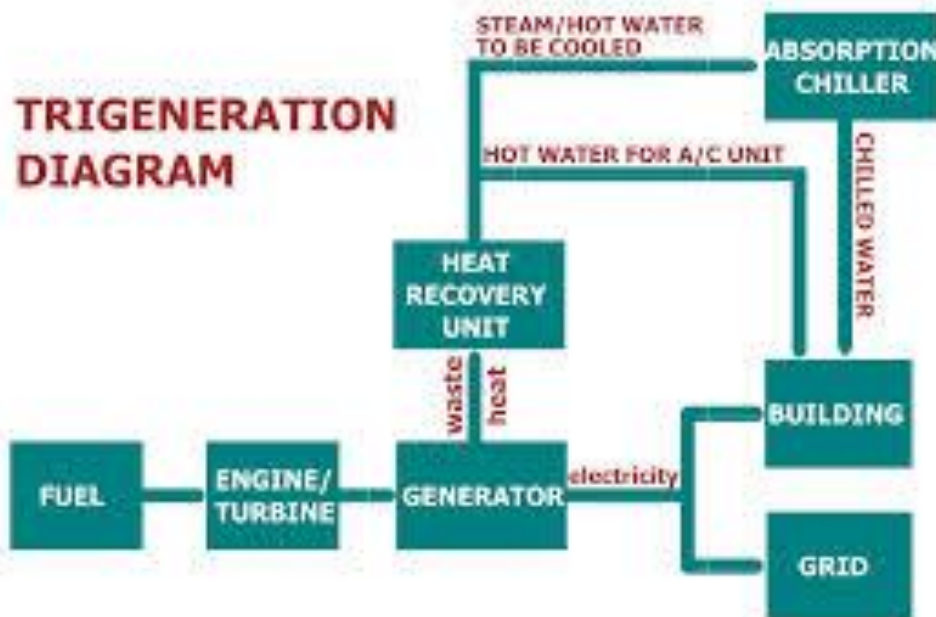


How “Trigeneration” works?

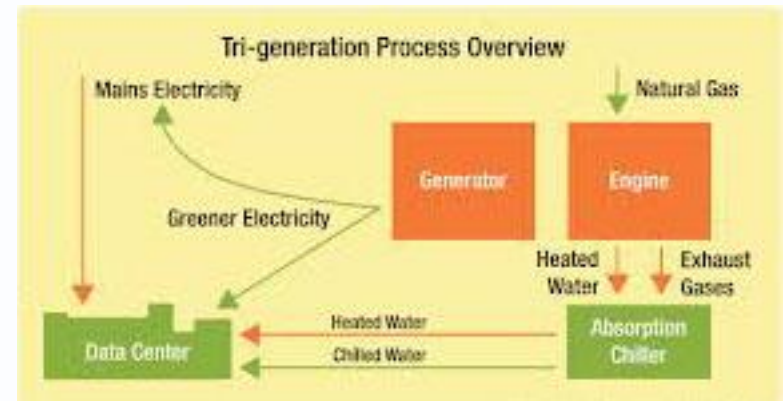
A **trigeneration** engine runs on natural or renewable gases and produces low-carbon electricity, heating and air-conditioning for connected buildings.

The engine generates heat that is captured to make hot water. The hot water can be distributed to nearby buildings by a network of underground pipes.

A secondary piece of equipment, an **absorption chiller**, can be positioned in each connected building to convert the hot water into chilled water for use in air-conditioning.



Trigeneration process overview



Trigeneration example for datacenters

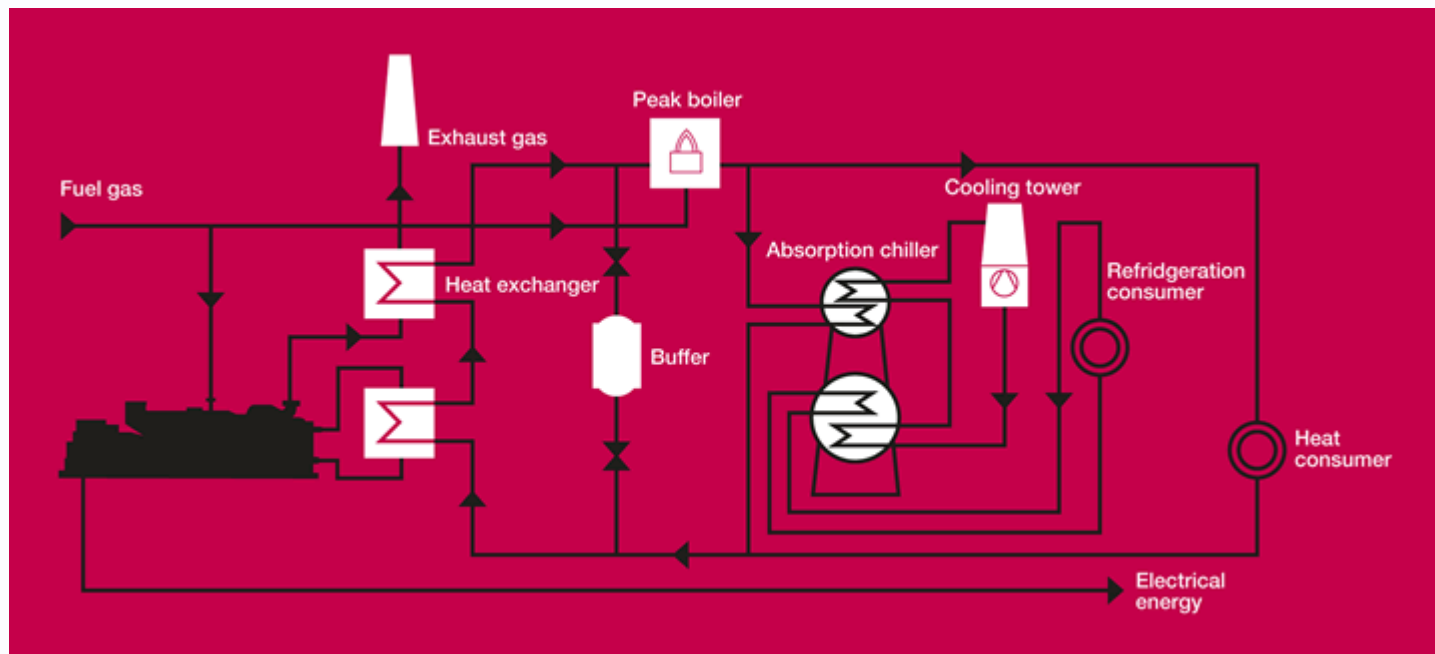
How “**Trigeneration**” works?

Absorption chillers provide an economical and environmental alternative to conventional refrigeration. Combining efficiency, low emission power generation equipment with absorption chillers allows for maximum total fuel efficiency, elimination of harmful refrigerants and reduced overall air emissions. There are a number of different configurations of CHP units where refrigeration can be derived. These include:

- **Absorption Chillers**
 - Operation using hot water
 - Operation using steam
 - Direct heat via combustion
- **Compression-type refrigeration machines**
 - Direct drive power
 - Electrical drive power

How “Trigeneration” works?

Combining a CHP or cogeneration plant with an **absorption refrigeration system** allows utilization of seasonal excess heat for cooling. The hot water from the cooling circuit of the plant serves as drive energy for the absorption chiller. The hot exhaust gas from the gas engine can also be used as an energy source for **steam generation**, which can then be utilized as an energy source for a highly efficient, double-effect steam chiller. Up to 80% of the thermal output of the cogeneration plant is thereby converted to chilled water. In this way, the year round capacity utilization and the overall efficiency of the cogeneration plant can be increased significantly.



“**Trigeneration**” potential users

Trigeneration are suited to sites with a small – medium and large heating and/or cooling load. Therefore, there are numerous applications for **Trigeneration** plants.

CHPC Systems are an ideal solution for :

- Hospitals complex and health facilities,
 - Educational facilities, universities
 - Data centers,
 - Government facilities,
 - district energy systems electric utilities,
 - district energy systems that distribute thermal energy to buildings in a college campus,
 - electric co-ops,
 - electrical sub-stations,
 - energy service companies,
 - Industrial and manufacturing facilities,
 - food processing operations including breweries and dairies,
 - refrigerated warehouses,
 - military bases,
 - Hotels, cinemas and hospitality venues,
 - Residential areas,
 - Airports and public utilities,
 - commercial or institutional buildings,
 - and also very attractive for cities.
- among many others,,,,,

“**Trigeneration**” benefits

With the increase in use of energy in short and medium term power generation future, trigeneration technology will play a vital role in energy efficiency and emission reductions. This technology are also important for its versatility – it can increase the efficiencies of renewable as well as fossil fuel energy sources. **Trigeneration** can use various fuels, including coal, petroleum products, natural gas, biomass and biogas. **Trigeneration** technology are suited for small, medium and large scale applications.

Trigeneration plants, as well as electricity, can produce:

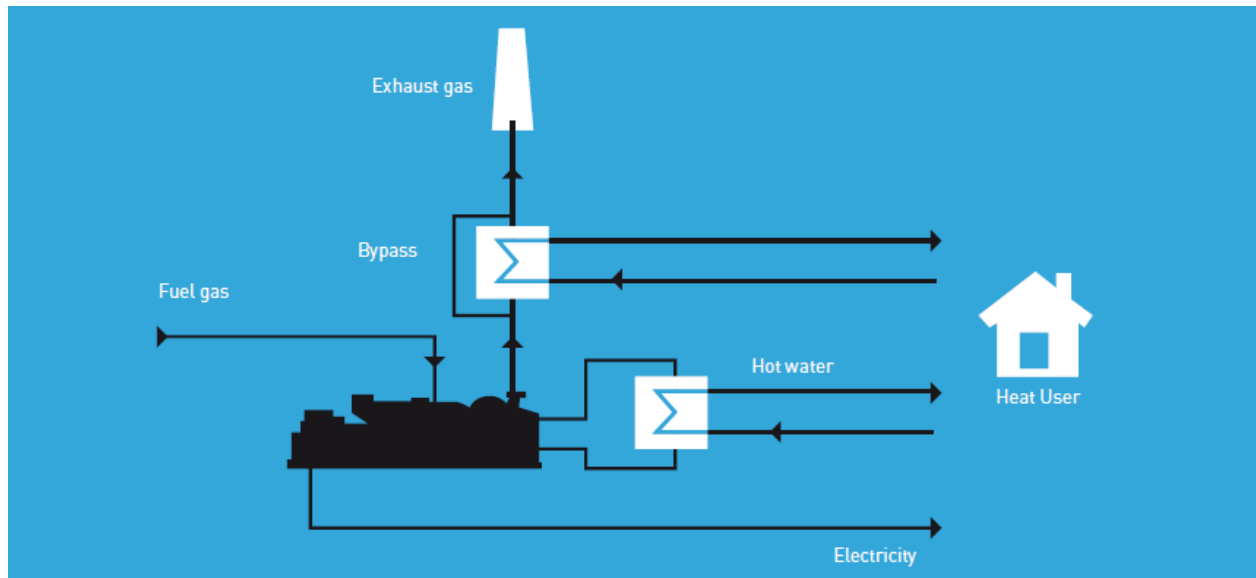
- Hot water
- Space heating
- Space cooling (with the use of an absorption chiller)
- Dry air (with the use of a desiccant)
- Hot air and steam for industrial head processes.

“Trigeneration” benefits

Distribution efficiency

Electricity travels through power lines. Nearly half of electricity bill is the cost of transporting the power from one place to another. Known as *network charges*, these fees are set to increase in next years.

Trigeneration provides distributed power generation at or near the point of consumption which lessens the need for costly expansion of the grid. This reduces transmission losses, stabilises the electricity grid and lessens the impact of rising electricity prices.



Distributed generation

Trigeneration provides distributed power generation at or near the point of consumption, so generation of electricity close to the end user helps to reduce losses associated with transmission. Heat from the combustion process can be captured as hot water and used for heating close to the source of generation. This therefore stabilizes the grid by reducing the need for expensive extensions to the grid, and also minimizes the impact of rising electricity prices and reduces transmission losses.

“Trigeneration” benefits

Energy efficiency

Maximizing the output of an energy source is essential to improving energy efficiencies, and this is the key principal of trigeneration technologies.

Trigeneration's simultaneous generation of electrical power and thermal energy achieves greater energy efficiency (70-90%) than conventional systems producing power and heat separately (35%). Less fuel is required to produce a given amount of energy because the conversion and transmission losses associated with the separate production of power and heat are avoided. This reduces the demand and costs associated with providing power and heat to a facility.

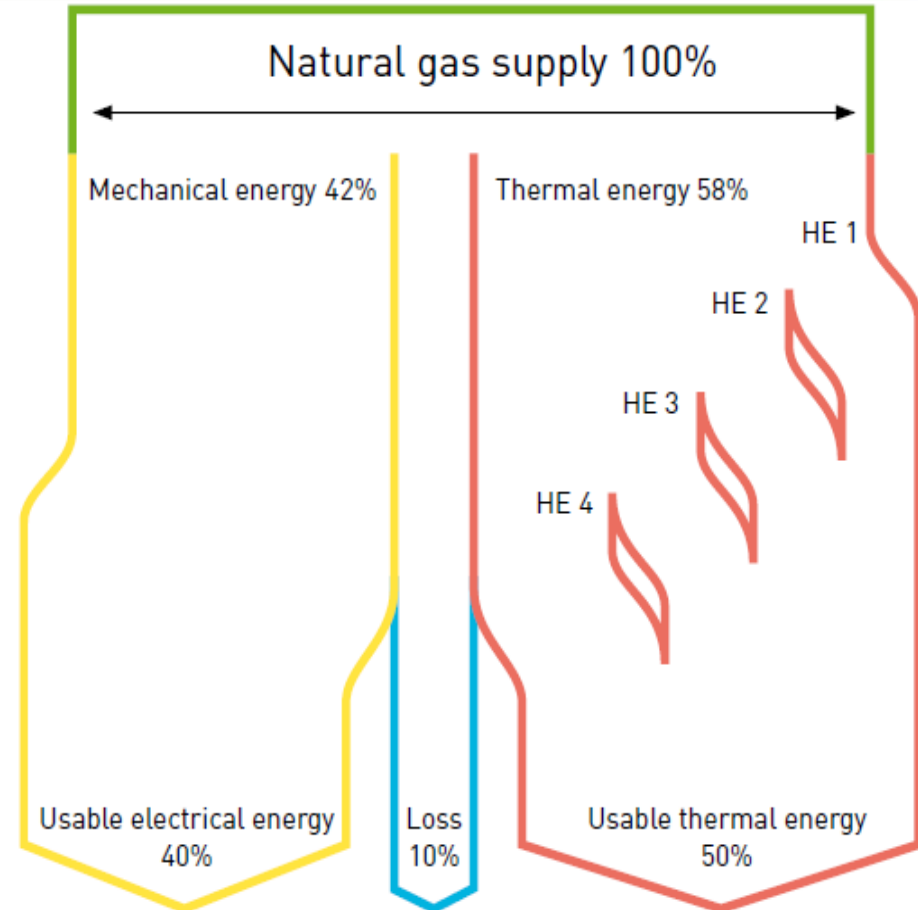


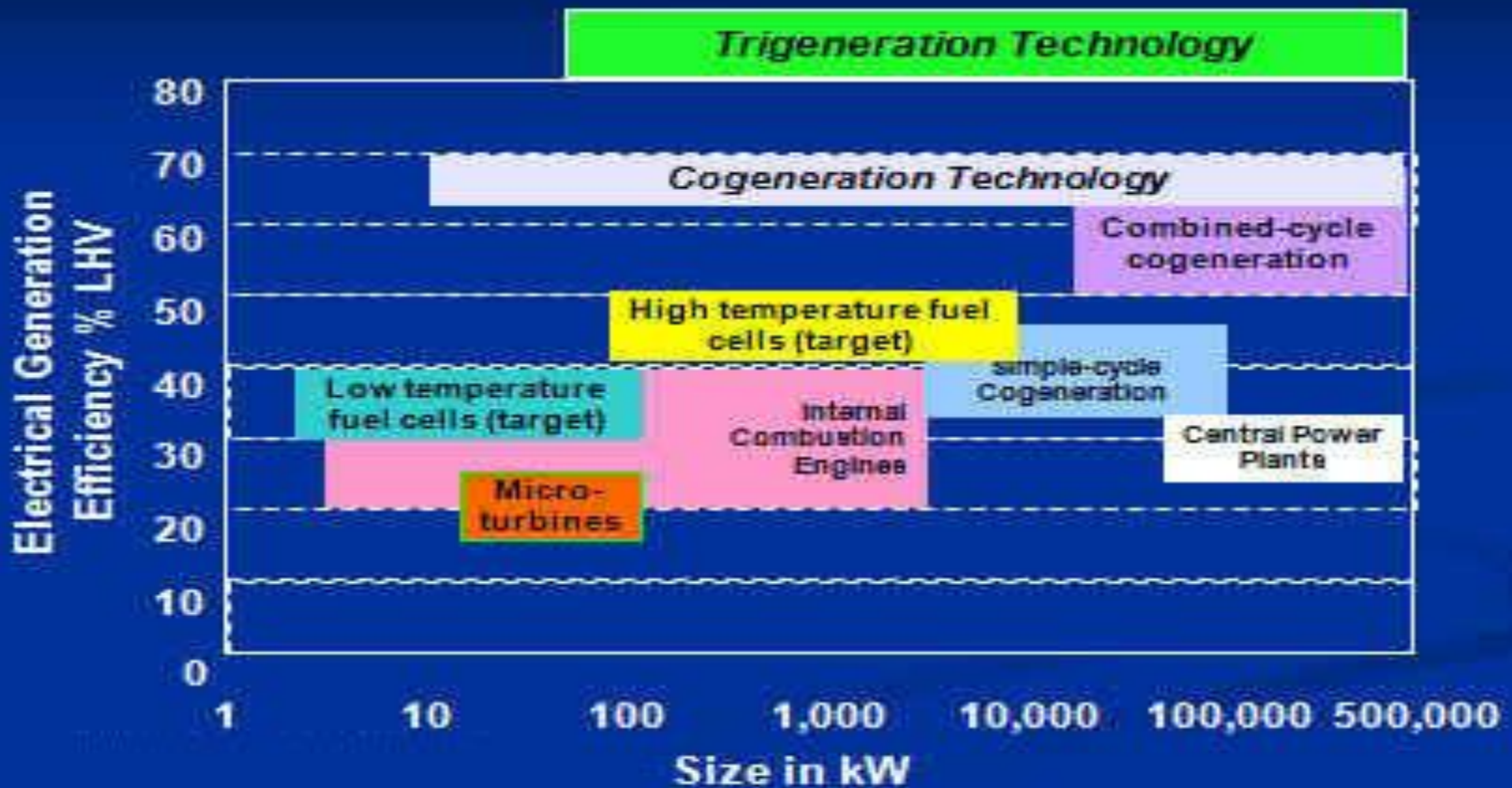
Diagram key

- HE 1 – Mixture intercooler
- HE 2 – Oil exchange heater
- HE 3 – Engine jacket water heat exchanger
- HE 4 – Exhaust gas heat exchanger

“Trigeneration” benefits – Advantages comparison

Trigeneration’s « Super-Efficiency » exceeds

All others available Power & Energy Technologies, for commercial, Utility and Industrial Customers.



“Trigeneration” benefits – Advantages comparison

Advantages Versus Conventional Refrigeration

Absorption based refrigeration technology offers the **most established** and **economic** solution for reduced emission, air conditioning systems.

- Operated with heat, utilizing relatively inexpensive ‘excess energy’
- Production of electricity that can be fed into the power grid or used to cover the plant’s electricity requirements
- During cold seasons, the heat can be utilized to cover heat requirements
- Absorption chillers have no moving parts, therefore there is no wear and maintenance costs are low.
- Absorption system has noiseless operation
- Low operating costs and lifecycle costs
- Using water as a refrigerant replaces the use of ozone damaging substances.

“Trigeneration” benefits

Greenhouse Gas savings

Not only is the technology an efficient use of energy and lowers electricity costs, and an efficient solution to eliminate blackouts and electric grid supply problems.

But also, High-efficiency **Trigeneration** Systems significantly reduce* **greenhouse gas emissions** and **hazardous air pollutants** associated with electric power generation at central power plants. This is a significant benefit to companies following the introduction of the carbon pricing scheme, as well as an increased international focus on the environment and carbon footprint.

Trigeneration, or *CHPC*, has an absorption chiller that is linked to the CHP to generate chilled water for air conditioning or refrigeration. This means that no harmful chemical pollutants exist, since water is used as the refrigerant, and during the peak summer period there is lower electrical usage. Absorption chillers can produce refrigeration using hot water, steam, or direct heat via combustion. Then, The benefits of absorption based refrigeration are clear – it is inexpensive, during the colder months the generated heat can be used for heating, and there are low operating costs.

**Trigeneration power plants have a third of the emissions associated with producing electricity from coal power plants*

“Trigeneration” benefits - Summary

- ✓ **Saving on energy transport and power line transmission**
- ✓ **Onsite, high efficiency production of electricity and heat**
- ✓ **Reduced fuel and energy costs**
- ✓ **Lower losses for all energies used**
 - Electrical efficiency -----> **80%** versus **30 to 55%**
 - Performance heat -----> **80%** versus **50 to 90%**
 - Cold COP (coefficient of performance) -----> **3** versus **2 to 2.5**

Therefore improvement of the carbon footprint and saving on quotas
- ✓ **Lower electrical usage during peak summer demand**
- ✓ **Adaptability and flexibility of the process to the needs**
 - all day (addional heating and cooling storage)
 - All the year (Flow sheet adaptation to the needs)

which allows the operator an economic optimization
- ✓ **Engine heat can be used to produce steam of hot water for on site use**
- ✓ **Significant reductions in greenhouse gas emissions**
- ✓ **No harmful chemical pollutants since water is used as the refrigerant**
- ✓ **Beneficial for improving building’s energy efficiency ratings**

“Trigeneration” video

To see a video demo of a Trigeneration system

[CLICK HERE](#)





How to choose the right “Trigeneration” technology?

Across the world, there is a new emphasis on projects that combine climate protection and economical primary power generation.

Trigeneration technology represents an optimal solution for a year-round efficient source of cooling and heat.

To define most accurate specifications for a **Trigeneration** project following criteria have to be considered

IMPORTANT CHOICE CRITERIA

- **Analysis of demand analysis in three energies**
- **Sizing based on electricity, heating, cooling needs**
- **Ratio between the different needs**
 - Low Cooling demand  absorption
 - High Cooling demand  mix (absorption + compression)
 - Low Heating demand  cooling generated from electricity
 - High Heating demand  cooling generated from absorption
- **Experienced engineering**

How to choose the right “**Trigeneration**” technology?

Finater also helps you to answer to others important questions regarding **Trigeneration** technology such as :

- Do I understand the benefits of trigeneration?
- Is there proven technology and performance available for my site location?
- which engine to choose?
- Will this equipment have the best operational efficiency for my purposes?
- How is the equipment sized to meet optimum efficiency?
- Will delivery of the equipment fit in with my program and schedule?
- Am I maximizing financial savings by investing in trigeneration technology?
- What are the risks to my facility if I install a trigeneration system?
- Assess the level of availability and reliability guarantees – and at what cost?
- What are the best qualities to look for in choosing a company to implement the technology?
- Who is recommended to undertake the installation – an OEM or a building services contractor...?
- What is the financial strength of the OEM?
- Will the OEM signs-off on the installation compliance?

Benefits of working with Finater for my “Trigeneration” Project?

With more than 30 years of experience in Energy sector,

Finater provides flexible solutions for trigeneration projects. Our services range from the study of your trigeneration project in order to optimize the efficiency and pay back, through to the complete turnkey installation of trigeneration facility.

Finater provides a dedicated, top-quality team of sales, engineering, project management, and commissioning and maintenance staff to meet any project's requirements.

More information about Trigeneration

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