

Deploying Recycled Energy





‘Waste Heat’

– wāst | hēt Term for the heat produced by machines, electrical equipment and industrial processes for which no useful application has been found.

Companies across the globe are recognizing that their waste heat can be put to productive use. It makes business sense, it makes operational sense, and it makes environmental sense.

Waste Heat Recovery - Defined

Nearly all types of engines, furnaces, boilers, and other combustion devices release a substantial portion of the energy they consume as heat. Whether vented through a stack or a cooling circuit, this “wasted” energy can be harnessed and put to productive use. This is commonly referred to as “Waste Heat Recovery.”

A Time-Tested Technical Solution

At the heart of our solution lies a power generation device based on the organic Rankine cycle. Systems using the organic Rankine cycle have been in operation for decades in geothermal and waste heat recovery facilities. In fact, the organic Rankine cycle is extremely similar to the conventional steam cycle and the entire process is analogous to traditional cogeneration. The chief difference between the two is that in an ORC, an environmentally friendly refrigerant (instead of water) with a low vapor point is used as the working fluid.

A Contemporary Business Solution

KGRA **designs, builds, owns** and **operates** the heat recovery facilities for its customers. In this way, customers can enjoy all the benefits of recycling their wasted heat without any capital outlay.

For customers that have a sufficient electric load, KGRA will supply them with low-cost power from the system. For customers with smaller electric loads, KGRA will sell the produced power into the grid and provide the heat host a royalty.

In either instance, KGRA’s customers remain entirely and exclusively focused on their core business operations. KGRA is extraordinarily focused on engineering its solutions in ways that maximize its clients’ ability to carry on “business as usual” while at the same time harvesting valuable energy that was otherwise being wasted into the atmosphere.



“We had been keenly aware that our process consistently dumped vast quantities of heat into the environment. Once we began working with the KGRA team, we put this wasted heat to sound economic use – and of course helping with our green PR.”

- US natural gas company

Valuable Benefits

Financial – KGRA’s solutions provide its customers with **immediate** and **tangible** financial benefits. Whether it’s through cost savings on power bills or through new royalty streams from selling their wasted heat, KGRA allows its customers to realize the value inherent in this previously overlooked asset.

Environmental – KGRA’s solutions are emission-free and can qualify for various environmental benefit programs administered by local and national governments.

Corporate Social Responsibility – KGRA’s solutions produce clean, renewable electricity from an asset stream that had previously been wasted. By helping companies and their shareholders realize that “doing the right thing” is also financially beneficial, KGRA delivers value.

Public Relations – Public interest in global warming is growing and companies are increasingly seeking solutions that improve their carbon footprints. KGRA delivers a competitive solution to “going green.”

The movement has begun

As a result of new legislation enacted to incent this valuable “hidden energy” resource, companies are rapidly tapping their waste heat for productive use. KGRA provides companies with the solutions to recognize this value.

“Once we realized this was similar to standard cogeneration just on a smaller and safer scale, we were interested. Then when we learned how similar this was to the standard off-gas business models we engage in every day, it became a no-brainer.”

- Global refiner and chemical company

KGRA's systems are rated to last for 25 years and come with performance warranties exceeding 90%.

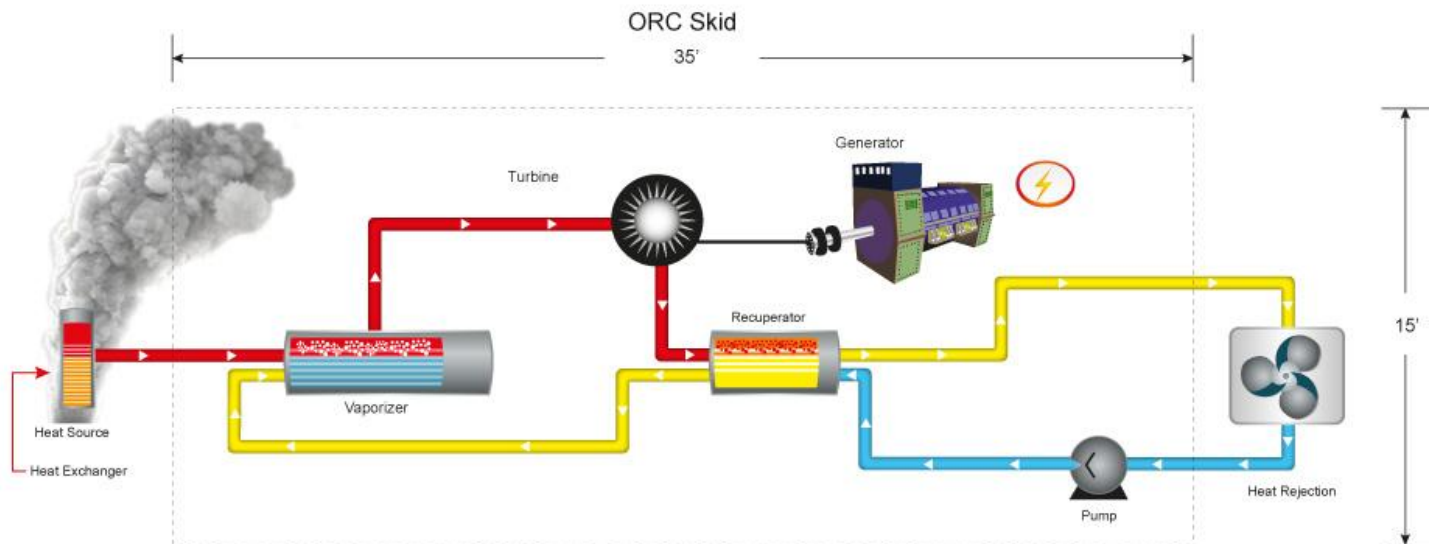
This means customers can rest assured that they will continue to enjoy the benefits of clean energy produced from their waste heat on a near-continuous basis.

KGRA's systems can be custom-tailored to adhere to standards and codes required by a variety of industry-specific conditions.



Safety and Controls

KGRA's systems are designed with safety and environmental stewardship in mind. The power generation systems use a non-hazardous working fluid and have numerous safety and remote-monitoring systems integrated into the design to ensure hassle-free, unattended operation.



Modular, standardized components

KGRA's systems use modular, standardized, factory-assembled components to generate power from customers' waste heat. The confluence of these factors leads to shortened production cycle times and precise configurations in controlled environments.

How it Works

Step 1. Hot gas or fluid from the customer's heat source passes across a heat exchanger, which transfers the heat energy into a thermal transport fluid. The heat exchanger is custom-designed to minimize backpressure along with other site-specific requirements.

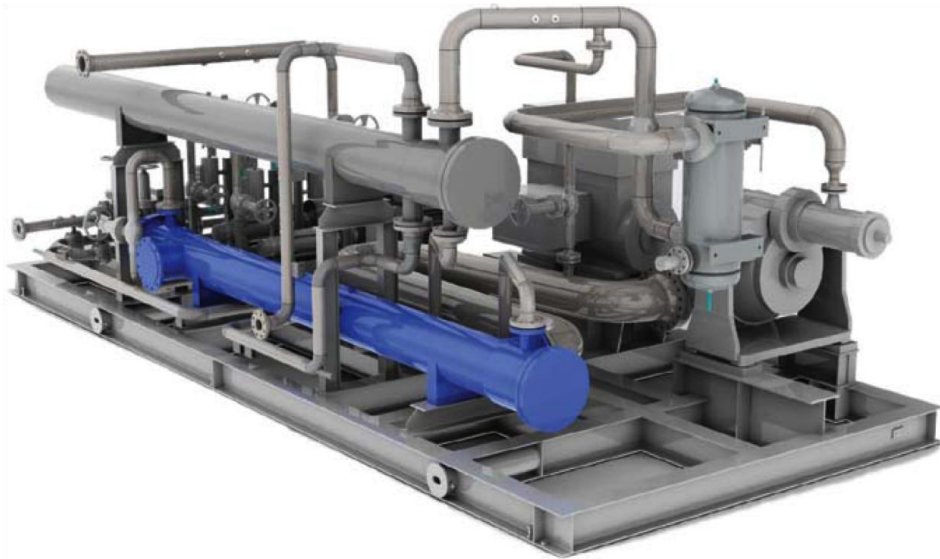
Step 2. The thermal transport fluid vaporizes the high-pressure refrigerant (R245fa) in the vaporizer.

Step 3. High-pressure vapor expands in a two-stage turbo expander coupled to a generator, which produces electricity.

Step 4. Low-pressure vapor is de-superheated through a shell and tube heat exchanger in the recuperator, which also serves to pre-heat the incoming working fluid. For customers that have a need for process heat, KGRA can eliminate the recuperator and provide heat for industrial use, offsetting the need to burn additional fossil fuel for heating.

Step 5. Low-pressure, low-temperature vapor is sent to the cooling apparatus to be condensed and then sent through a pump to restart the cycle.





Custom designed, factory built

Because they are built under tight environmental and process control, KGRA's systems are customized to specifically address each customer's unique needs. Systems start at 750kW and can cost-effectively scale to match the size of a heat source - in a compact footprint.

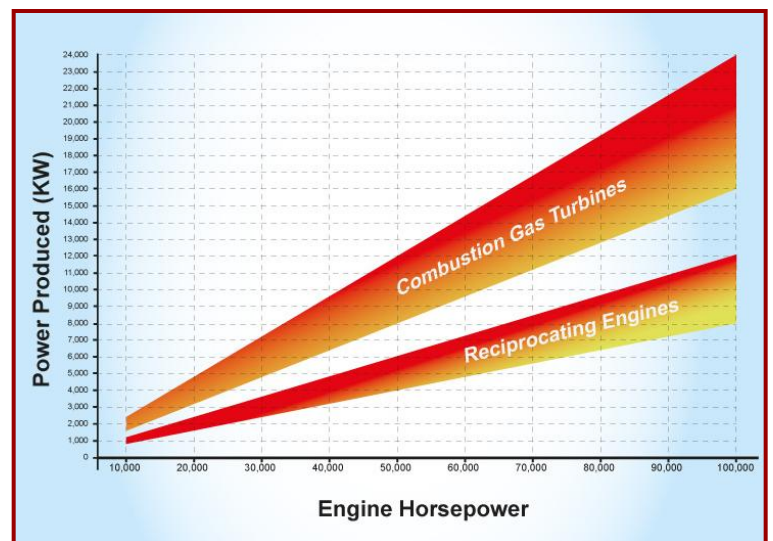
“Our facilities are very standardized. What we can deploy at one facility can be easily replicated across our entire global footprint”

- Global castings company

Power Production

Generalizations can be made about the amount of power KGRA's systems can make from certain heat sources. Given the prevalence of standard cogeneration and combined heat and power (CHP) systems, most engine suppliers now provide data sheets with the metrics of the energy stream being vented through the cooling system or exhaust stack.

KGRA's business development professionals help customers assess the physical and economic viability of their various heat sources. Careful consideration is paid to properly understand all elements of a customer's existing systems, their anticipated duty cycles, and the amount and nature of the customer's electrical consumption. The combination of these factors helps determine the most effective solution for each customer.



Intersections of engine horsepower and power produced. Note that this is only an indicative curve illustration and that site-specific conditions can vary the amount of power produced by a KGRA system. Boilers and furnaces are also excellent sources of waste heat and are evaluated on a case-by-case basis given their more customized nature.

“As our obligation to environmental responsibility has increased, we have begun to look for service providers that can help lower our carbon footprint in an economical and efficient way. This was an important consideration in choosing KGRA.”

- International oil and gas producer

Serving Our Clients in a Flexible Way

KGRA recognizes that not all client engagements are the same. The unique challenges faced by clients in varied industries means that we must be flexible in how we work with our customers.

To that end, KGRA offers its heat recovery solutions that span the continuum from build/own/operate to build/transfer and across the industry spectrum from petrochemicals to steel. KGRA works with its clients in the manner in which the clients want to work.

We use field-proven designs with time-honored deployment strategies to minimize risk and optimize the solutions we deliver to our clients. They are after all, our most prized assets.

Leaders in Heat Recovery Development

KGRA has the breadth of experience, the global deployment capabilities, and the deep industry knowledge to help companies holistically realize the value of their waste heat while driving operating costs down and reducing their carbon footprints.

KGRA also manages a focused portfolio of strategic alliances – companies that range from established leaders to emerging innovators in the field of heat recovery technologies and services. These alliances enable us to enhance our offering while remaining responsive to market changes and individual customer demands.



*Above top left: modular assembly produced on the shop floor;
Left: ORC skid being loaded onto a truck for transportation to a project site;
Above: a 4MW waste heat installation on an existing dual-turbine gas compression site (the ORC system and its heat rejection is circled in red)*

KGRA Energy offers its customers high-value solutions for harvesting waste heat for conversion into electricity. This saves money, greenhouse gas emissions, and improves facility operations.

Served Markets

Natural Gas Gathering and Distribution Systems

Gas gathering and distribution requires compression at regular intervals. In areas where this gas is compressed by a combustion turbine or reciprocating engine, there are inevitably vast quantities of waste heat emitted. KGRA can make use of engine exhaust, cooling jacket waters, and even the process heat from compression. KGRA can also provide heat to fire amine plants and dehydrators by sending low-pressure high-temperature gas to the facility instead of to its own recuperator, saving operators even more money and emissions.

Refineries and Petrochemical Plants

Refining of oil and petrochemicals is typified by large quantities of heat and pressure. Furnaces, crackers, and boilers are excellent sources of waste heat, as are on-site combustion turbines used for power generation. KGRA systems can help refinery and petrochemical customers by acting as a cooling medium. Wherever customers are spending money to cool their fluid or gas streams, KGRA can instead provide this service, harvesting the heat to produce power and eliminating costs for cooling the various streams. This “double dipping” allows for power production and increased savings on cooling costs.

Steel and Metal Furnaces

Furnaces are excellent sources of waste heat due to their relatively high temperatures. Whether for steel, cast parts, or other metal processes, KGRA’s solutions offer mills and processing facilities a way to harvest the heat from these furnaces to lower their power bills and reduce their carbon footprint.

Lumber, Wood products, Woodpulp and Paper Mills

Paper and forest products facilities have been targets for biomass-based cogeneration for decades. Although the momentum continues for this technology (generating an average of two-thirds of the industry energy needs onsite), purchased energy remains the 3rd largest manufacturing cost. KGRA can provide an ORC-based “bottoming cycle” – effectively harvesting the heat that remains unused due to traditional cogeneration’s high temperature requirements. Viable heat sources start at north of 300°F and include hog fuel fired furnaces, lumber kilns, bark boilers, black liquor evaporators and recovery boilers.





K I L O W A T T H O U R S

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Take the next step in improving your facility's financial operations while reducing its carbon footprint.

