gTET

Hot Wire

The Heat Transformers

ISSUE 8 Q4 2021

News & Updates from green Thermal Energy Technologies

gTET is open for business as usual after COVID lockdowns

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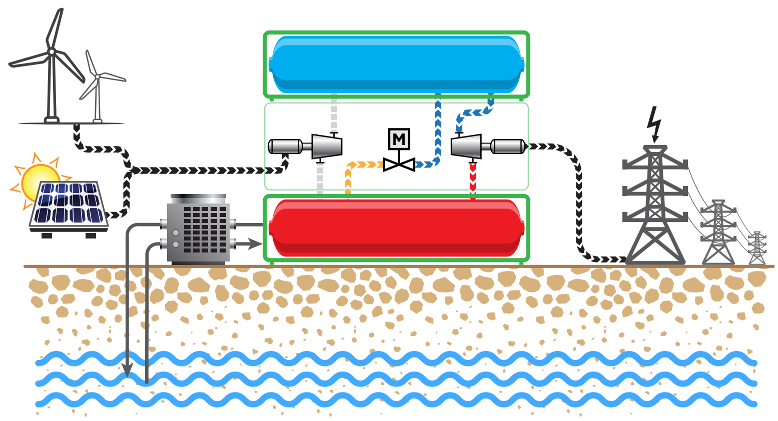

Turn-key solutions to transform waste into useful energy, delivering economic and climate change benefits

gTET

gTET specialises in innovative solutions at industrial scale for thermal energy management, in particular redeploying waste or renewable streams to reduce opex and carbon footprint.

gTET's revolutionary ORC generators enable thermal energy to be effectively converted into electrical power where this is the most efficient and effective use of the energy.

As we like to say here "*WASTE* is the new *OIL*"

www.g-tet.com

Refer to www.g-tet.com/news for previous editions of Hotwire

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1. Projects:

Geothermal Study Latrobe Valley Authority (LVA)

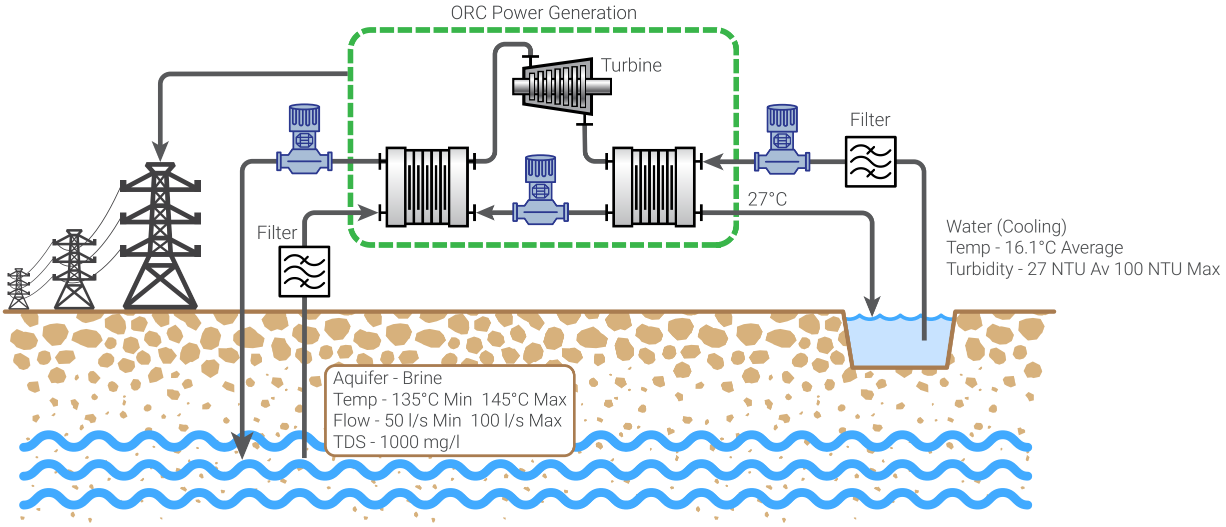
gTET has been engaged by Melbourne University to assist in conducting an initial scoping study of geothermal power generation for the Latrobe Valley Authority (LVA). The study looks at options in several locations in Gippsland Victoria including Traralgon and Loch Sport.

The Latrobe Valley Authority (LVA) is seeking opportunities to draw on the regions current strengths with the aim of utilising these to create new industries such as renewable power generation. The region has a long history of power generation combined with significant existing power transmission infrastructure and a skilled local workforce.

The scoping study is investigating the technical and commercial viability of several scenarios using moderate temperature geothermal sources for small-scale electricity production. Geothermal power generation technology scenarios being investigated include:

1. Binary Cycle Generation

Binary cycle power generation is effective for moderate temperature water sources typically between 85°C and 182°C. The Binary cycle passes the geothermal brine (hot water) through a heat exchanger to boil off a working fluid used to drive a turbine. A common form of binary system used for geothermal power generation is the Organic Rankine Cycle.



gTET has significant experience in binary cycle electricity generation gained from a variety of projects it has undertaken using its unique Organic Rankine Cycle (ORC) generators designed and manufactured at its headquarters in Victoria. The generation of power using gTET ORC generators is not limited to geothermal, many forms of waste heat can be used to generate electricity.

2. Hybrid System (Wind/Solar/Geothermal)

In this scenario wind/solar and geothermal are used to generate energy which is converted to thermal energy using heat pumps and chillers. The energy is stored in a thermal battery which uses either water or a phase change material (PCM) to store the energy. Thermal energy is then converted on demand to electricity using Binary Cycle generation. The below image depicts the TORC energy storage system which uses a phase change material to store thermal energy. The TORC system is rapidly deployable, scalable, and requires a small footprint.

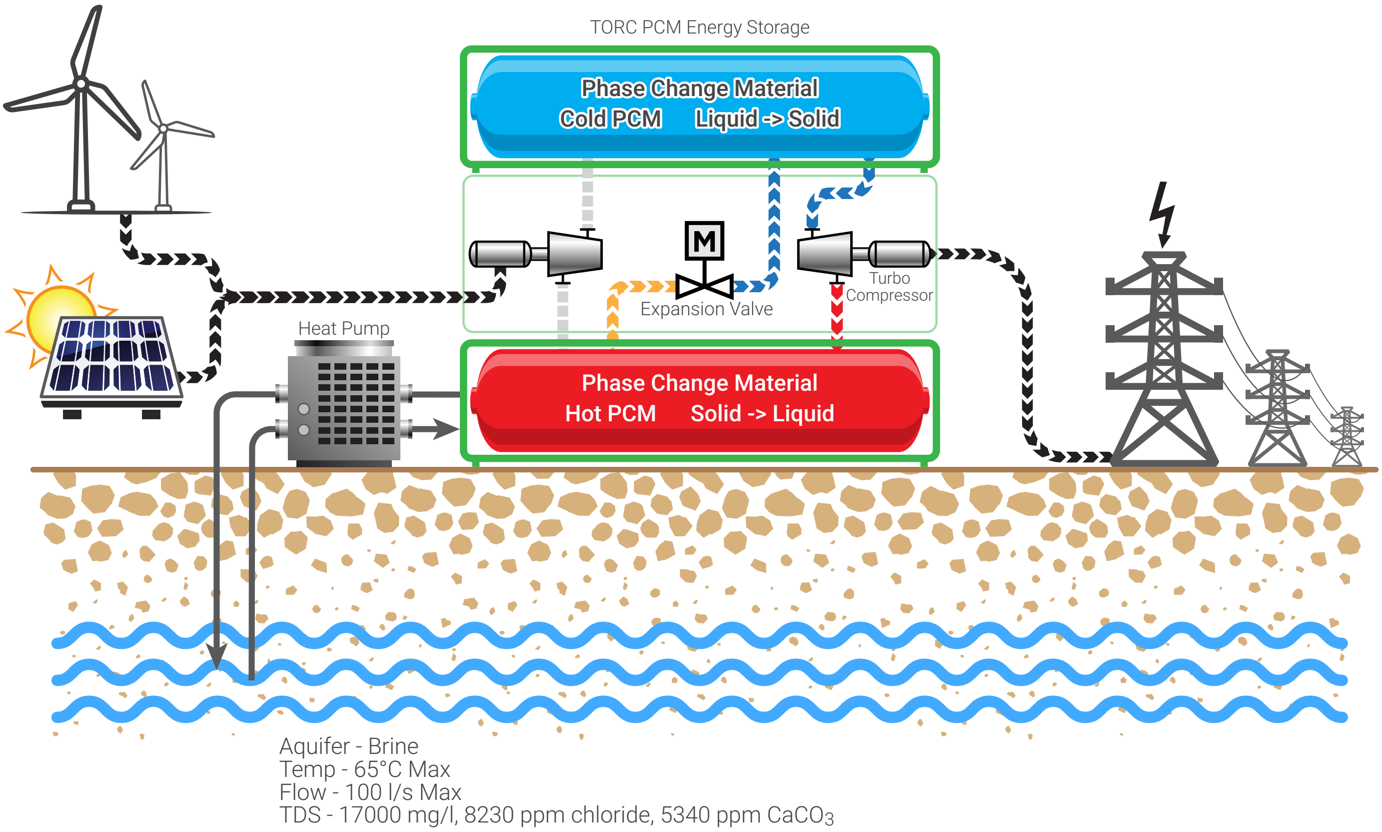
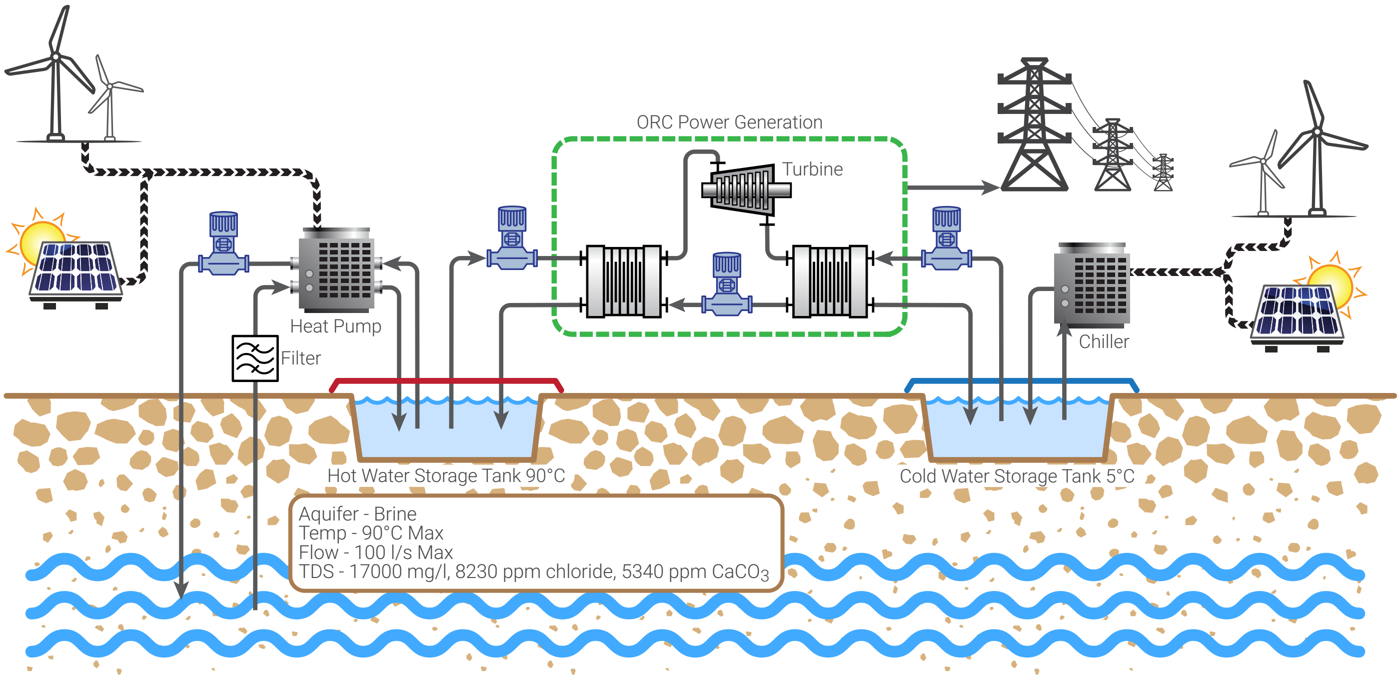
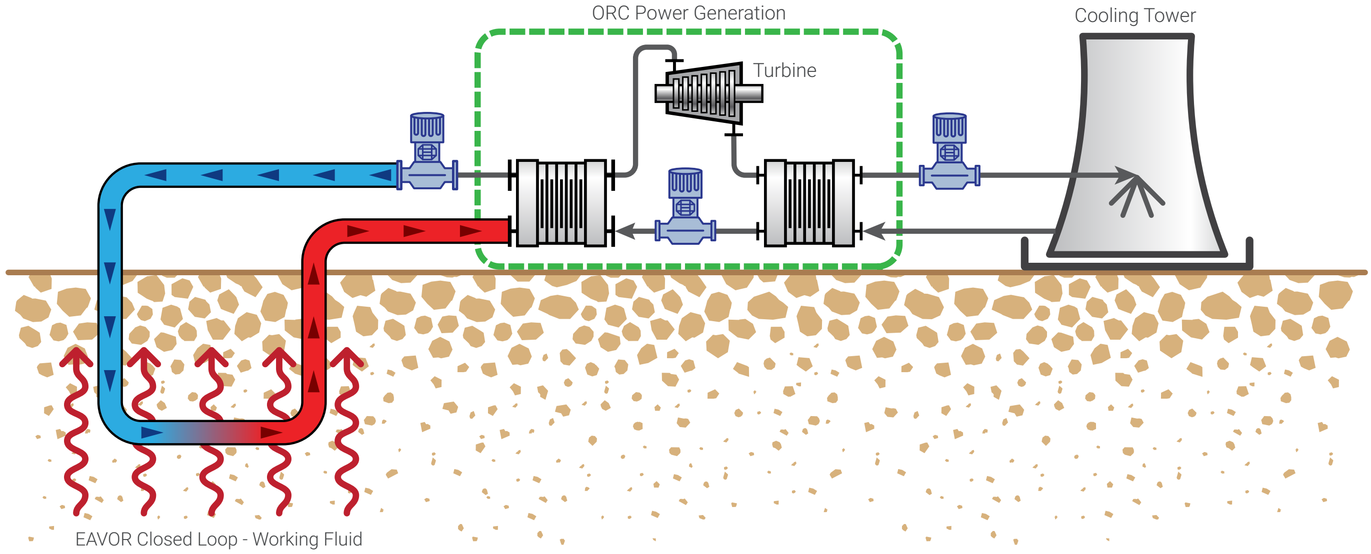


Image of a system using water as a thermal battery shown in underground storage tanks.



3. Eavor Loop Geothermal

An Eavor loop is the connection of two vertical wells with many multilateral wellbores creating a closed buried pipe system. The Eavor system uses a benign working fluid which is circulated through the loop collecting heat from the natural geothermal gradient of the earth via conduction. The working fluid passes through a Binary Cycle system (ORC) to generate power from the heat of its working fluid.



The study also investigates water quality and its impact and heater exchanger performance. Geothermal brine often contains high amounts of suspended solids, calcium carbonate and chlorides which can lead to fouling and corrosion of the heat exchanger reducing system performance. Cooling water drawn from lakes, rivers, creeks & ponds can also cause heat exchanger fouling, and water quality from these sources can vary seasonally. gTET has drawn on its extensive experience to provide recommendations for heat exchanger material selection and water quality management systems to maximise system performance.

The scenarios assessed are micro grid capable systems that can be used to power remote communities some of which are currently powered by diesel generators or have frequent interruptions to supply.

The gTET ORC can load follow and is capable of downturn between 15 – 20%. The inverter used on the gTET ORC system can be programmed to support FCAS (Frequency Control Ancillary services) which is used to maintain the frequency of the system within the normal band of 50Hz.
Based on the data provided to date, gTET has assessed the power generation capability of each option with a maximum net power output of up to 1.7kWe, and capital costs ranging from $4 - $7m (excludes production well drilling, solar farms and wind turbines).

The initial scoping study is due to be completed mid-December with results being handed to the Latrobe Valley authority for assessment and next steps.

3. Technical Brief:

High Temperature Heat Pump Technology

Visit https://youtu.be/w2orCsQPtcM to see an animation of above heat pump functioning. gTET is using its years of experience in ORC generator design and manufacture to bring high temperature heat pumps to the market. A significant market opportunity was identified several years ago in high temperature heat pumps as a much more cost and energy effective solution to produce industrial heating requirements as opposed to traditional gas fired boilers and dryers. The operating temperatures associated with our ORC generators was the ideal temperature for the vast majority of applications identified in industries such as dairies, distilleries, abattoirs, pulp and paper, food etc that relied on gas boilers and dryers. Many of the applications delivering even greater efficiency when they had chilling requirements alongside the heating requirements so that the chiller condensing heat could be used for the heat pump to push against.

The high-speed turbo-alternator design and manufacture, used in the ORC, was also ideally suited to become a high temperature turbo-compressor.

This high temperature turbo-compressor is the key enabler to producing high temperature heat pumps up to 200°C. Unlike other heat pump producers using refrigeration-based compressors, such as screw or reciprocating, there are a number of factors in our turbo-compressor design, learned from years of experience in the ORC turbo-alternator, that make it successful.

The high-speed permanent magnet design results in a smaller package for equivalent power to most other refrigeration compressors. The smaller package is less impacted by thermal growth associated with the higher temperatures, gTET's 200 kW compressor has a shaft length under half a meter.

The highly efficient permanent magnet motor and sophisticated power module motor control result in electrical efficiencies in excess of 90%.

gTET designs the turbo-machinery so that as the temperature increases the impellor to shroud tip clearances (a major factor in turbine efficiency) becomes smaller as the rotor 'grows' to the operating design temperature. This means highest efficiencies occur once the machine has 'warmed up'.

gTET is the only ORC manufacturer globally with turbines using unique 'foil' bearings (aerospace derived technology) that are capable of operating at temperatures well in excess of 250°C, and without the need for additional lubrication which may break down at elevated temperatures. The only fluid used within the compressor is the primary refrigerant which is also used to cool the stator and rotor. The liquid working fluid is injected behind the stator then flowing via the rotor at a rate controlled by the stator temperature. These are all critical factors in producing a reliable compressor at the elevated temperatures required in a high temperature heat pump.

R245fa is the working fluid or refrigerant of choice for high temperature heat pumps because of its critical temperature at around 154°C, making it suitable for sub critical heat pumps up to 145°C and possibly higher, and the fact it's not flammable or toxic. gTET has years of experience with R245fa in its ORC generators, although we will likely transition to other lower GWP fluids in the future.

gTET's turbo-compressors are semi-hermetically sealed with twin impellors on a single common shaft with the permanent magnet rotor which equalises thrust loads resulting in minimal bearing loads. This also results in no external shaft seals or leak points.

A key advantage of turbo compressors is that they have a higher-pressure ratio compared to screw or reciprocating compressors which is required to limited the number of stages required in the heat pump. Even single stage machines can achieve triple the pressure ratio available to traditional technologies.

gTET's years of experience in ORC generators is invaluable in optimising the high temperature heat pump heat exchanger designs to manage the wide range of temperatures that are experienced from the highly superheated gases to significantly subcooled liquids. This also involves managing the infamous "pinch point" and three stage heating process. (gas, multiphase, liquid).

Large scale high temperature machines also can suffer from issues associated with accumulation in an off state for which gTET has developed many strategies to manage this issue. At its least, poor management in this respect increases the charge level required, at worst it can cause failure.

gTET has developed strategies in permanent magnet motor control of the turbo-compressor to manage smooth pressure transitions and protect the bearing system; it's relevant to note that our turboalternator used in the ORC generator is actually operated as a motor during the start-up process. Turbocompressors, like turbo-alternators, are subject to surge and motor control is extremely important in managing this issue.

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