gTET Hot Wire

The Heat Transformers

ISSUE 7 Q3 2021

News & Updates from green Thermal Energy Technologies

gTET remains open for business during COVID19

IN THIS ISSUE...

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*"

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1. News:

g-TET moves offices to Carribean Industrial Park

gTET is excited to have moved into its new offices in Caribbean Industrial Park in Melbourne's East. We'll retain the factory for fabrication, FAT and engineering development within walking distance from our new office.

New office building in Carribean Industrial Park

2. Projects:

Australian Tartaric Products

ATP Australian Tartaric Products

ATP manufactures and supplies the finest quality Natural Tartaric Acid, Natural Cream of Tartar and Food Grade Spirit to the Australian wine industry.

From humble beginnings ATP has grown to be a major contributor to the Australian wine industry and has a unique symbiotic relationship with many of the largest wine companies in the country.

The end-to-end process starts when ATP collects the grape marc, grape lees and centrifuge sludge from the partner wineries. This is then processed to produce Natural Tartaric Acid and Food Grade Spirit.

After the grape marc has been processed it is then used to provide energy for the ATP plant via a biomass boiler, which burns the spent marc to produce saturated steam. The steam produced then drives an Organic Rankine Cycle system which is able to generate electricity for internal consumption.

ATP is proud of its relationship with the wineries of Australia and our product is used in all Australian wine growing states.

Biomass boiler

Biomass power station, ORC generator building foreground with the biomass boiler in the far ground and grape marc fuel mound on the right

In 2013 gTET was contracted to design and install ATP's 600kWe ORC generator that consumed 10bar steam from the 8Tph biomass boiler designed to combust the processed grape marc. The ORC generator needed to continually modulate its energy consumption to match the fluctuating steam pressure created by the ATP's fluctuating steam production consumers.

At ATP's location in North West Victoria Australia water is a scarcity and so the ORC generator needed to be designed for dry air condensers.

The ORC power station was connected to grid under a none-export connection agreement with the associated authority since all the power could be consumed on site. A grid protection module located at the incomer communicates with the ORC generator to enable it to regulate its output if the site demands falls and approaches export.

The result has been a biomass power station that provides all of ATP's steam requirements (replacing bottled LPG previously trucked in), a significant portion of the site electrical demand and avoidance of landfill costs and impacts of the spent grape marc.

gTET's 600kWe ORC generator comprising 4 high speed turbo-alternators and integrated turbine drive and grid inverter (far ground)

3. Technical Brief:

Industrial Heat Recovery and Efficiency Technologies

In researching for this Hotwire topic of industrial heat recovery and efficiency technologies I've found that much of the work has already been completed in ARENA's (Australian Renewable Energy Agency) November 2019 paper Renewable Energy Options for Industrial Process Heat for which gTET has been involved in a number of the case studies cited.
The paper and its associated appendices are available at:
https://arena.gov.au/assets/2019/11/renewable-energy-options-for-industrial-process-heat.pdf
https://arena.gov.au/assets/2019/11/appendices-renewable-energy-options-for-industrial-process-heat.pdf

To summarise some of the key technologies that gTET can deliver to improve a site energy consumption and emissions:

1. Heat to electrical using gTET's revolutionary ORC generators produced in Melbourne

gTET has demonstrable capabilities in recovering and generating power from heat sources as low as 85°C up to several hundred degrees C.

A significant differentiator in gTET's ORC generators is the permanent magnet turbo-alternator and power module technology that are cascaded in parallel to increase the overall generator capacity. The power module's each output into a common DC bus which is connected to a grid certified inverter. This configuration means that the turbines are asynchronous with the grid allowing for very high turn-down ratio typically required in a fluctuating waste to energy application. The grid inverter also delivers the very valuable PFC (power factor correction) and FCAS (Frequency Control Ancillary Services) to the sites grid connection providing greater value than just the power generated.

The high speed turbo-alternator uses a revolutionary twin radial turbine on a common shaft with a PM rotor and gas 'foil' bearings delivering electrical efficiencies of over 95%. The turbines are hermetically sealed, using the working fluid for stator and rotor cooling, and require no ancillary equipment like lubrication or magnetic drives.

gTET has delivered ORC generators across a wide range of industries and applications and can provide complete turn-key solutions for most waste or renewable heat source. The ORC generator can be skid based for a plant room or containerised for locating outdoors. gTET's ORC generators will result in less than 5yr payback compared to typical grid power prices.

2. Phase Change Materials for thermal storage

Phase Change Materials for thermal storage in applications that have variable sources or loads can deliver significant capex and opex savings. Examples include:

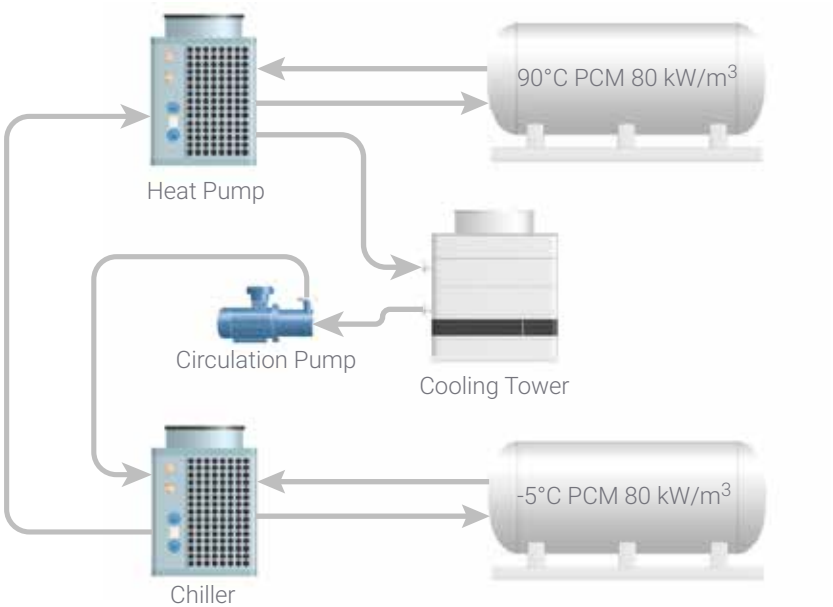
a. A high temperature heat pump delivering 90°C hot water can be powered from PV solar on the site and hot water supplied via a storage vessel. Using 90°C PCM containers in the storage vessel will provide energy storage in the order of 80kWh/m^3. This means the energy from a 1MWth boiler can be stored for 1hour or 100kWh of hot water could be delivered for 10hrs with 12.5m^3 of PCM.

b. Similarly 5°C cold water from a chiller powered from PV can be stored and used during periods of low solar load with similar volumes of PCM.

c. Sources of clean or renewable thermal energy including biomass boilers, thermal solar (including low temperature evacuated tube or roof top thermal hot water systems) and geothermal can be scaled and levelised to demand using PCM thermal storage.

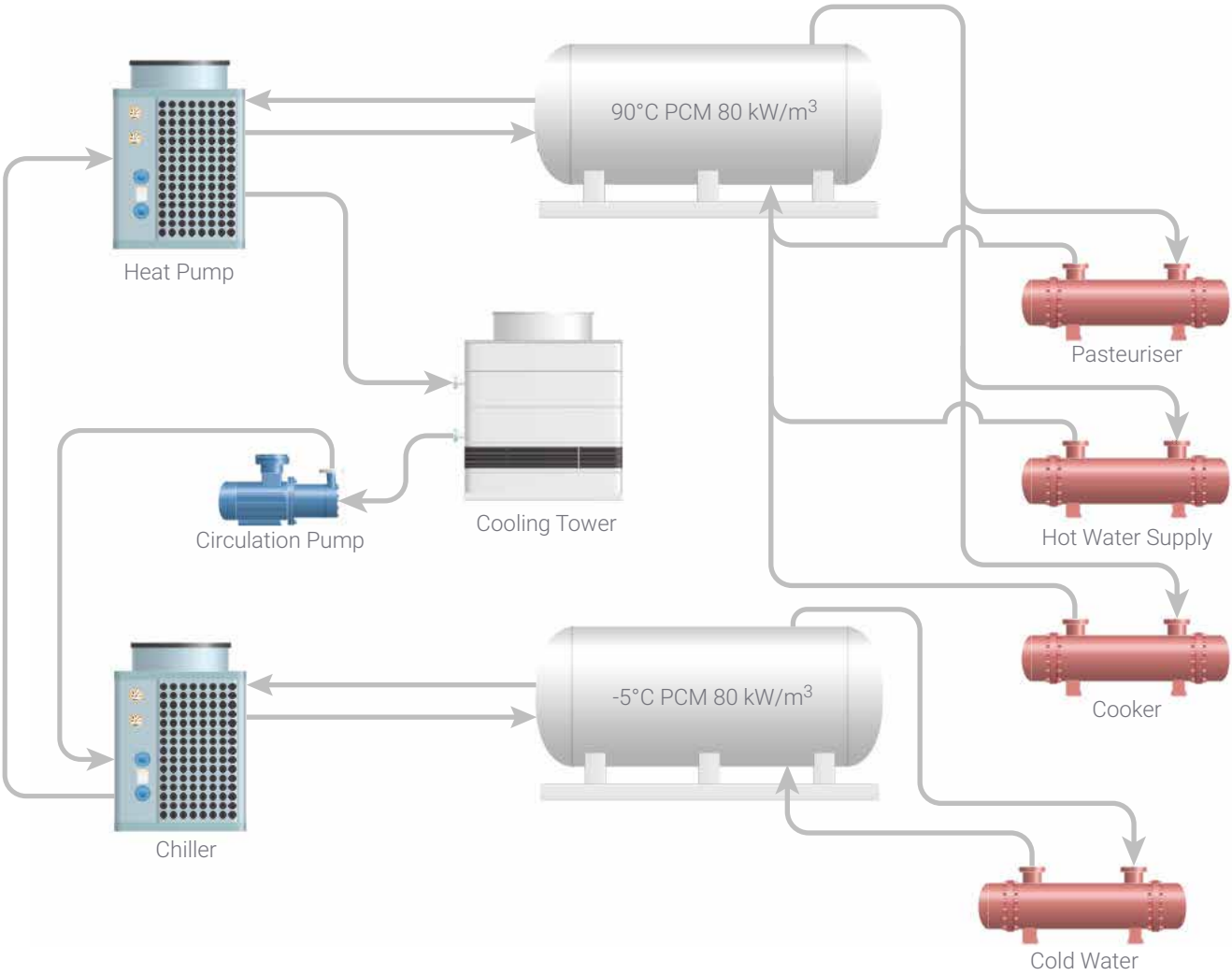
d. PCM thermal storage can also benefit NG boilers by levelising varying demand and allowing the boiler to operate more efficiently.

e. PCM can be incorporated into steam accumulator vessels to substantially increase the steam storage capacity. As example, a 60m^3 steam accumulator providing 500kWh of steam storage can be increased to 1MWh of storage with just 7m^3 of PCM added



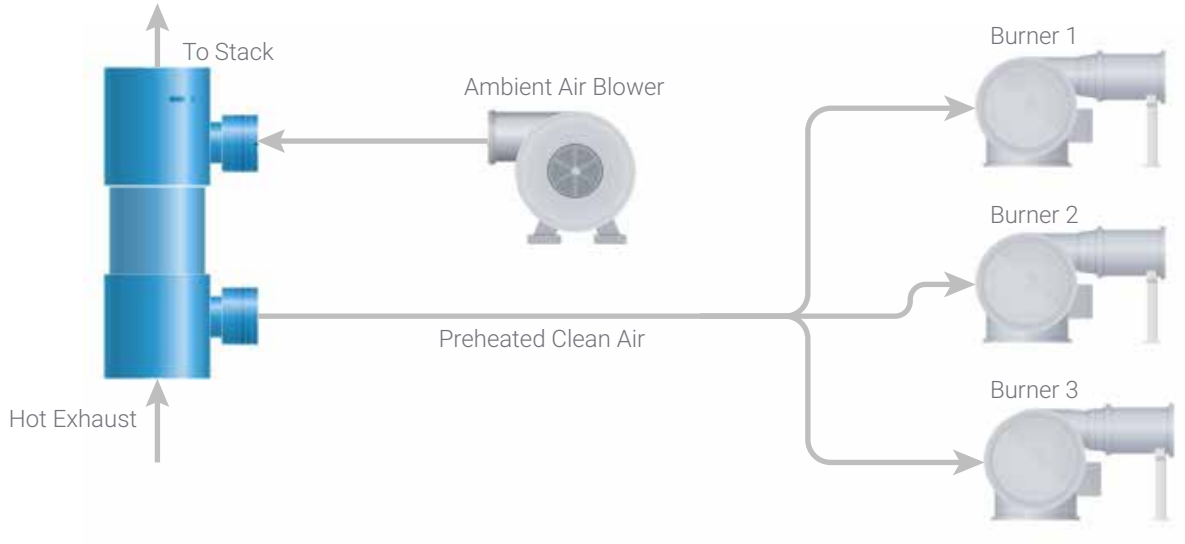
3. Wide temperature ranging heat pumps up to 150°C

Wide temperature ranging heat pumps up to 150°C benefit from leveraging a COP (coefficient of performance) associated with the Carnot cycle, meaning that thermal energy output is greater than the electrical power input. Typically COP's of 2 to 4 can be achieved depending upon the cold side temperature of the heat pump. When used in combination with a chiller so that the condensing temperature of the chiller is used to provide heat for the cold side of the heat pump significant energy efficiency gains are achieved compared to more conventional boilers and chillers. This is particularly of benefit, for example, to dairies that have demand for hot and chilled water but often replacing a gas boiler with high temperature heat pump alone will deliver energy efficiency gains.



4. Gas burner pre-heating systems

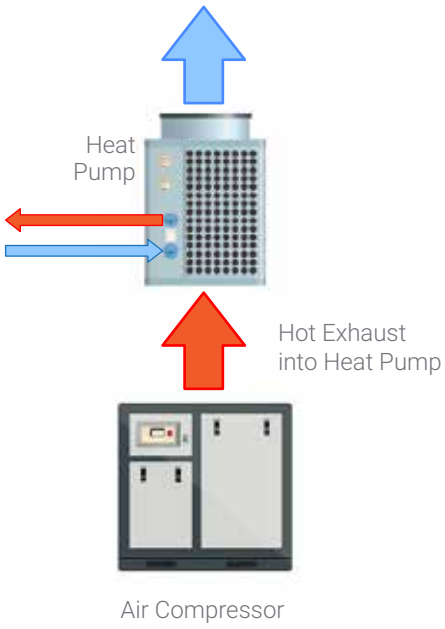
Gas burner pre-heating systems use waste process heat to increase the air feed temperature to the burners. This reduces the gas consumption for an equivalent burner temperature. Burner control systems must be capable of managing the varying combustion air density with temperature. Often the project will require installation of air to air heat exchange to ensure combustion feed air has correct O_2 levels. Pre-heating the combustion air can often deliver as much as 10% gas reduction.



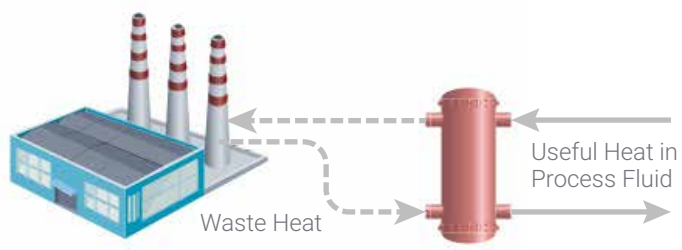
5. Heat transfer from waste streams

Heat transfer from waste streams to other useful applications. Plant configuration and process design will dictate what is possible but examples of technologies are:

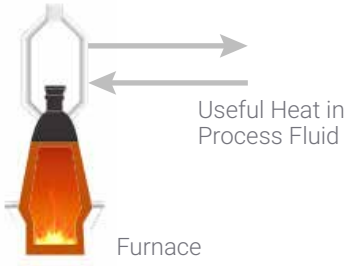
a. Air compressor exhaust heat recovery for drying or preheating other thermal processes including heat pumps. Air compressors will typically transfer 90% of the input electrical energy as exhaust heat at useful temperatures.



b. Transferring waste heat into useful process fluids, for example steam to air, high pressure water or steam to food grade glycol, exhaust air to clean air, exhaust to high pressure water.



c. Recovering exhaust heat from furnaces, ovens etc up to 800C to produce hot water, steam, hot air or thermal oil for use in another process.



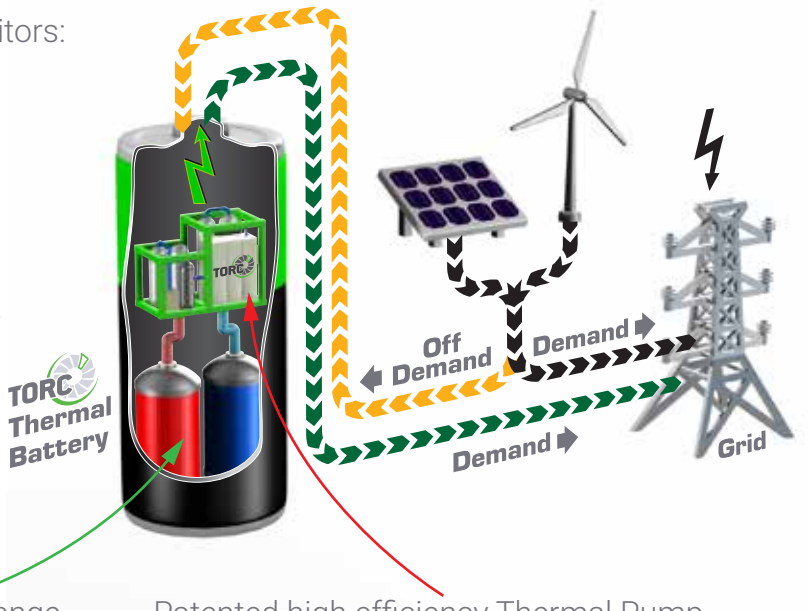
6. Long duration electrical energy storage

Long duration electrical energy storage using patented thermal pump and PCM. An explanation of this technology was included in Hotwire #5 earlier this year.

Storage performance to rival competitors:

- Energy storage solution targeted for delivery >1hr (as opposed to peaking)
- Round trip efficiency target >60%
- Deployable at the generating source
- 100% depth of discharge
- Commercial targets <$10/kWh, easily leading Li Ion at $200/kWh
- Design life >20yrs

Patent Pending AU2021901038



Patented low temperature Phase Change Materials (PCM)

- Technology developed at Monash Univeristy
- PCM's selected on both hot side and cold side of the Thermal Pump for optimal efficiency
- PCM's selected for world leading energy density at the reqiuired operating temp's
- PCM's selected for earth abundant ingredients while achieving required performance metrics

Patented high efficiency Thermal Pump

- Transfers electric energy source into thermal energy to store in the PCM's with COP>4
- Transfers thermal energy from the PCM's to electrical energy with efficiencies ~15%
- All energy remains in the Thermal Battery according to charge/discharge cycle with very low losses
- Thermal pump comprises novel integrated high temp heat pump ond ORC generator using world leading turbine and power converter technology

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to stay up-to-date on news, updates, past and present project info