

Dollars in Dirty Water

Wastewater energy mapping in Dunedin



Dunedin City Council is working with Smart Alliances and other collaboration partners to calculate and map the thermal energy available within one of Dunedin's three wastewater networks. Smart Alliances' **Nick Meeten** says the potential energy savings are huge.

Wastewater is an enormous untapped source of thermal energy available in every town and city. It can be used to provide a highly-efficient source for heating and / or cooling for buildings and industries, and independent research shows it can lower heating or cooling electrical energy use by approximately 40 percent. The infrastructure is already there and using this resource could help cities become more energy efficient and potentially earn new revenue. Yet this potential is currently almost totally ignored.

Dunedin City Council recognised this untapped opportunity after hearing my presentation at the August 2016 IPWEA conference in Melbourne. In late 2016, the council commissioned Smart Alliances to help it get started taking advantage of the resource by calculating and mapping the thermal energy available within one of the city's three wastewater networks.

The project was recently completed

and showed up to 10,000 kilowatts of thermal energy available within the network studied. This is estimated to be approximately 60 percent of the overall total, if all three systems were taken into account.

Nevertheless, the system studied could provide enough thermal energy to heat about 1000 typical New Zealand houses (or equivalent commercial buildings and industries) and Dunedin City Council now has information and energy maps allowing it to develop a strategy to start utilising this wasted energy.

Why is using wastewater as a thermal source so efficient? Wastewater is stable and neutral in temperature all year round. This makes it relatively warm in winter and relatively cool in summer compared to ambient temperatures.

This temperature stability, together with the excellent energy capacity of water, means buildings' heating and cooling systems do not have to work so much against nature to provide heat or take heat away from buildings.

This translates to significant increases in efficiency of the heating and cooling systems, and savings in electricity needed to power these systems.

But no one need be worried that sewage will be pumped around their building. Wastewater comes out of a street trunk sewer, goes through a special heat exchanger, and then goes back into the sewer. Everything else within the building is conventional equipment.

There are also other benefits, such as allowing heavy heat exchanger equipment, which is normally mounted on the roof of a building, to be located down at ground level. In a seismically active country like New Zealand, removing this weight from high up on a building lightens the load on the building structure, which is welcome.

Around the world, there are an estimated 500 to 700 established systems that recycle the energy from wastewater for heating and / or air conditioning, and this number is starting to rise rapidly. Though the idea may seem to be new in



District energy project in Vancouver, Canada. The development area shown by the red border will have heating energy provided from wastewater.

A BREATH OF FRESH AIR

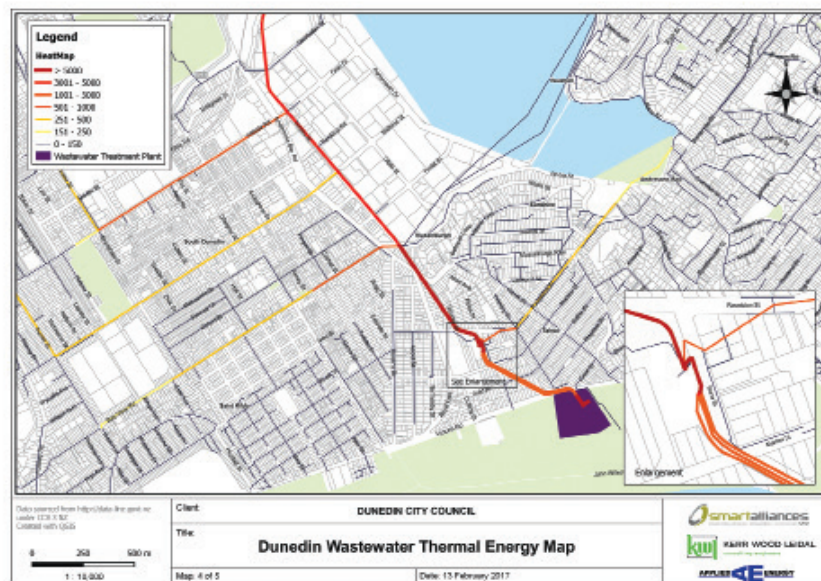
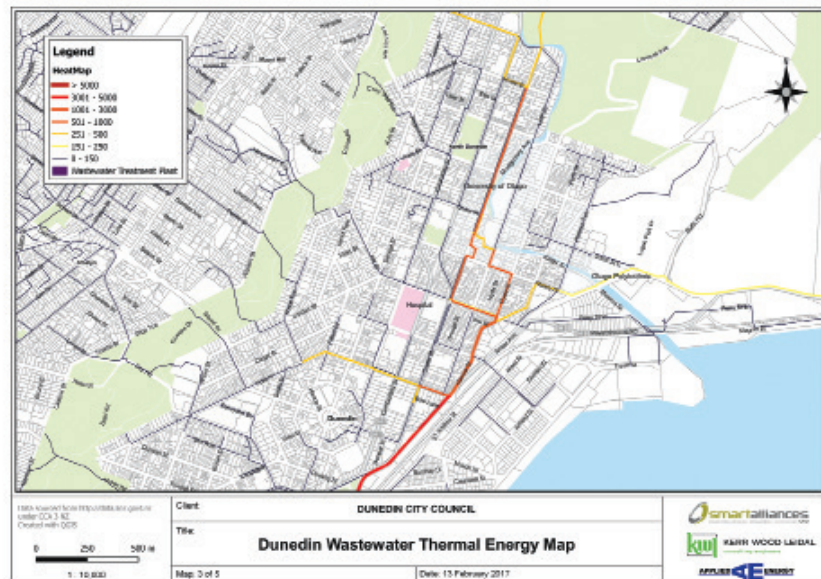
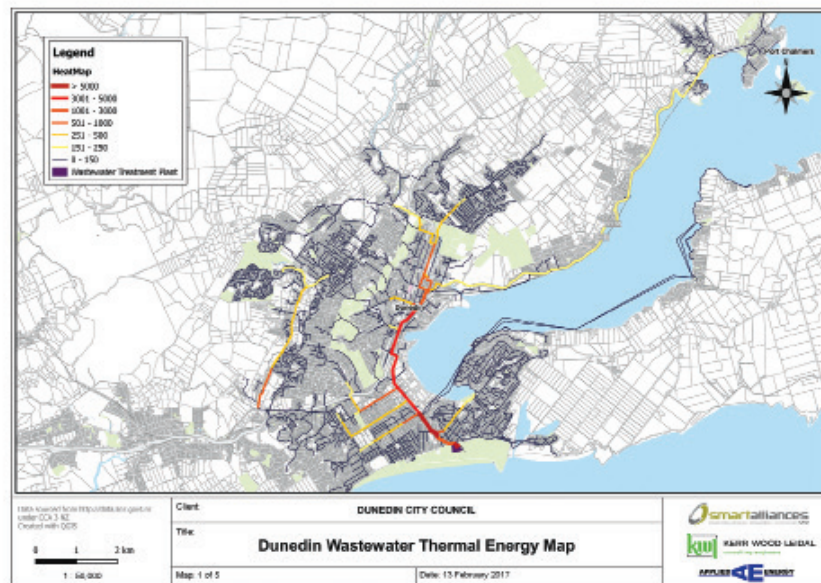
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Dunedin energy maps.

New Zealand, and by association seem quite risky, technically it's very simple.

The first systems were installed in Switzerland more than 30 years ago and there are at least five operating in Australia, including the Hobart Aquatic Centre, which has been running successfully for over 20 years.

The project team consisted of Dunedin City Council wastewater manager Laura McElhone as the client, and Smart Alliances in Blenheim as project leader. Smart Alliances teamed up with collaboration partners Applied Energy also in Blenheim and Kerr Wood Leidal (KWL) engineers in Vancouver, Canada.

Despite the project team being widely distributed geographically, the entire project was delivered smoothly and without requiring any travel, which kept costs down.

As the project leader, Smart Alliances was the single point of contact with Dunedin City. KWL provided the specialist calculations and Applied Energy the mapping skills. KWL had previously developed a specialised calculation model for this purpose for wastewater energy projects it had previously undertaken for Metro Vancouver (a federation of 21 municipalities that collaboratively plans for and delivers regional-scale services for the Vancouver region).

However, before the collaboration started with Smart Alliances, the calculation modelling service had never been provided for other cities outside of Canada.

The Smart Alliances / KWL / Applied Energy team started working together in early 2016 by trialling the calculation and mapping process on Blenheim as a test project, and this had ironed out initial teething problems.

For the Dunedin project, a variety of council data was used such as wastewater infrastructure data, temperature data and hydraulic modelling data. Other criteria required by the KWL calculation model were discussed and agreed.

Once the necessary data and inputs were in place, this was delivered to KWL which ran its calculation model and delivered the results back to Smart Alliances. This calculation data was sent on to Applied Energy which displayed the data as thermal energy maps for Dunedin City.



Revenue Generation

The energy source from wastewater could become a new source of revenue for cities which want to utilise it. There are different ways it can be monetised, and at least two different commercial models are being used in other parts of the world.

Quebec City charges an annual connection fee for tapping into the energy from its wastewater network.

Scottish Water adopts a different approach by metering the amount of energy withdrawn by a college campus and charging per kilowatt hour of energy.

Other commercial models will evolve. However, every city should view their wastewater flows not just as dirty water but also a flow of energy with a value attached.

A variety of maps were generated, at differing scales to provide high-level overviews down to detailed maps for parts of the city.

Once the maps were generated, a number of locations within the city presented themselves as good candidates for potential energy from wastewater projects. These locations ranged from the existing university campus, and hospital to areas identified as possible future development sites for the council itself.

A comprehensive report was also provided to Dunedin City. This covered the topic of using wastewater as an energy source, the agreed inputs used in the calculation model, and discussion of the findings.

A comparison of the wastewater temperatures from Dunedin with a number of other cities was provided, to illustrate that Dunedin is well within the normal expected range.

The report also covered variations in thermal energy due to daily flow profiles and where the threshold limits are to manage possible impacts in the wastewater treatment plant's biological processing. A number of example projects from overseas were shown within the report, to give Dunedin City some ideas for what could be suitable candidates within Dunedin.

Dunedin City Council is now looking to establish an in-house champion to take the concept forward. This champion will need to be a bridge between the council and the private sector, as well as a bridge between the wastewater and building sectors. At least they have maps to guide them on their way. **LG**

• Nick Meeten is buildings, water and sustainability consultant at engineering consultancy Smart Alliances. nick@smartalliances.co.nz

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