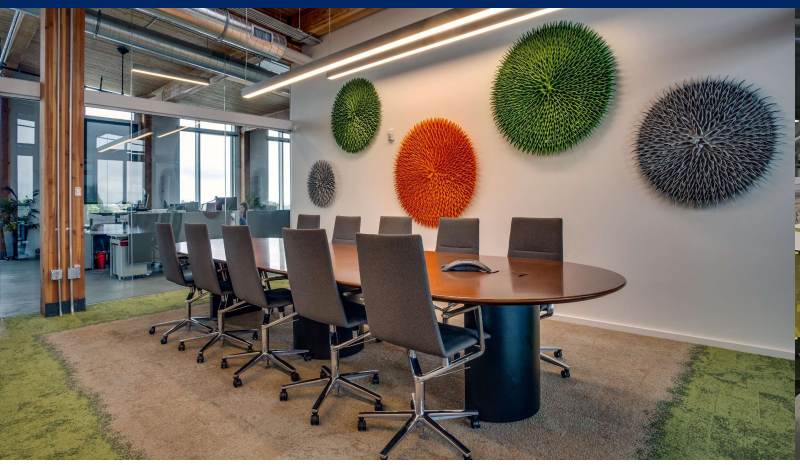
Case study: Renewable heat helping to manufacture a sustainable future

Clean Energy Knowledge Sharing Initiative



Summary

Interface is a carpet design and manufacturing company that uses large amounts of natural gas for its manufacturing processes. To improve its environmental performance, Interface is looking for renewable options to provide process heat for its manufacturing. In partnership with NSW Government and ITP Renewables, Interface conducted a feasibility study into the use of solar thermal technology at its Minto factory. This technology collects energy from the sun, which can then be used in the manufacturing process. This approach has great potential but has never been used before in large manufacturing facilities in Australia.

By using a solar thermal system, the factory could reduce its gas use by 70-80 per cent, which is a promising result. However, there are challenges with this approach, including the cost of the system and aligning the heat output with the manufacturing process. Interface is now doing more research on whether solar thermal will support its transition to 100 per cent renewable manufacturing.

Fast facts

Feasibility project cost	$50,000 ($30,000 from NSW Government)
Potential decrease in the factory's gas use	70 – 80 per cent
Potential energy use from renewable sources	85 – 90 per cent (from 40 per cent)

Background

Interface, a carpet tile manufacturer, is dedicated to corporate sustainability. In 1994, the company committed to sourcing 100 per cent of its energy from renewable sources by 2020. However, an internal progress analysis indicated Interface needed to undertake more effective action to meet its 2020 target. Although electricity from renewable sources powers 40 per cent of heat dependent operations at the factory, it still relies on natural gas to fuel the remaining 60 per cent.

Interface partnered with Australian consultancy ITP Renewables after receiving an introduction through the NSW Government's Clean Energy Strategies for Business program. Together, they conducted a feasibility study into a sustainable replacement for natural gas.

Journey

Interface operates two manufacturing steps, requiring a heat source of 220°C and 180°C respectively.

An earlier study looked at different renewable heat technologies and identified solar thermal technology as the most promising option for Interface. This technology can reach the temperatures required by Interface, and its footprint is small if installed as a roof mounted system.

Four solar thermal technologies were investigated, looking at temperature output, cost and other performance parameters.

These fall into two main categories:

- Parabolic and Linear Fresnel systems – these are concentrating systems which use moving mirrors to reflect the sun's heat onto a receiver, typically a pipe carrying the heat transfer liquid.
- Evacuated tube and Flat plate systems – these are non-concentrating systems with receivers, either tubes or plates, absorbing solar energy directly into its heat transfer liquid.

The heat transfer liquid is run through a heat exchanger to heat air used in the manufacturing process.

Parabolic trough: curved mirrors that reflect heat

Linear Fresnel: rows of parallel mirrors are angled to reflect heat

Evacuated tube: closed tubes containing heat transfer liquid

Flat plate: a plate of passaged tubing containing heat transfer liquid

During the feasibility study, additional economic, process and engineering challenges emerged. These will require further investigation before the project can progress. Key challenges and potential solutions are summarised in the table below.

Challenge	Solution
High upfront capital cost of $1.8 million to $3.5 million	• Collaborate with neighbouring sites to build a larger, more cost-effective precinct-wide renewable heating system • Apply for a government grant to help fund installation
Heat generated during the weekend is lost because heat storage is costly	The factory's operating hours could be changed from five to seven days per week to make better use of the system
This project would be the first of its kind in Australia, so reliability and performance risks are not well understood	Suppliers may provide an energy performance guarantee, or reduce the system price to pilot the technology in Australia
Process lines and factory roof need modification to accommodate technology	Detailed engineering and roofing studies need to be carried out in the next phase

Outcomes

To guarantee a reliable heat supply, all solar thermal technologies can increase their heat output and temperature by using a gas booster.

Of the four solar thermal technologies considered, evacuated tube was found to have the lowest upfront cost. However, the evacuated tube temperature limit of 200°C means the gas booster would need to run most of the time. As a result, approximately 20 per cent of the heating requirements would still come from burning natural gas.

The technology with the next lowest payback period is parabolic trough. A parabolic trough system could deliver temperatures up to 250°C, and would likely use the gas booster less frequently. A tracking system moves the mirrors with the sun throughout the day, which means the system creates a relatively consistent heat output. It also generates heat more efficiently than a flat plate system because it has lower heat losses.

Overall, a parabolic trough solution is likely to be the most economic option meeting Interface's heat requirements from almost entirely renewable sources. The overall estimated payback period is 14 years. An overview of the investigated technologies is shown below.

Technology	Concentrating systems		Non-concentrating systems	
	Parabolic Trough	Linear Fresnel	Flat plate	Evacuated tube
Temperature limit	250°C	250°C	180°C	200°C
Solar Share	89%	92%	60%	80%
Payback period	14 years	18 years	17 years	11 years

"This feasibility study was a major step towards reaching our renewable energy target. It allowed us to collaborate with industry experts and explore innovative technology."

Aidan Mullan, Engineering and Sustainability Manager, Interface

Takeaway points

- Solar thermal technologies are a feasible option to generate renewable process heat. However, potentially longer payback periods need to be considered.
- Non-concentrating systems can be an attractive option for manufacturing processes with temperature requirements of 180°C or less.
- Concentrating systems can reach higher temperatures more efficiently compared to non-concentrating systems.
- Grants, supplier sponsored pilot studies and industry precinct collaboration could reduce costs and risks for early adopters.
- On-site renewable heat sources can require a lot of space. The first step to using free roof space instead is to find out whether the roof can carry the weight of the system.

Next steps

While the feasibility study showed integrating parabolic trough solar thermal has excellent potential for Interface, more research is necessary before a final decision can be made. Interface will need to commission a detailed cost-benefit analysis, an in-depth engineering assessment and an engineering study into the strength of the factory's roof.

Interface also plans to start discussions with parabolic trough suppliers to determine the exact costs of purchase, installation and operation. Engaging current users of this technology in other countries will also provide valuable information for the next steps.

Interface is confident it will achieve its goal of 100 per cent renewable energy by 2020. In fact, it is looking ahead to a new target of becoming carbon negative by 2040.

About the Initiative

The NSW Clean Energy Knowledge Sharing Initiative supports the NSW Government's objective to achieve net zero emissions in the state by 2050. The Initiative gives innovators and early adopters an opportunity to test and trial new clean energy solutions. To find out more or learn about similar projects, visit www.energy.nsw.gov.au/clean-energy-initiative.

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