

Floating solar array

A CASE STUDY



An innovative demonstration project presenting an additional use of a waste water settlement pond: **generating electricity from floating photovoltaic cells.**

Summary of project

In 2015, Infratech Industries in conjunction with the Local Government Association (LGA) Solar Innovation Fund and Northern Areas Council, planned, installed and began operating Australia's first floating bank of solar panels on a wastewater treatment plant in Jamestown, South Australia. This innovative project demonstrates that councils, waste water agencies, community development boards and industries with large ponds of non-corrosive water can benefit from high value opportunities.



The array of photovoltaic cells floating on a Northern Areas Council settlement pond.

Brochure objectives

This brochure summarises the lessons learned from establishing Australia's first floating solar array in order to inform others who are considering a similar project. There are important lessons here for:

- planning
- working with solar companies
- stakeholder engagement
- approvals processes
- impact on operations
- technology capability and assessment
- financial management
- long-term contract management and power purchasing agreements
- ongoing monitoring and evaluation of performance.

Jamestown is located in South Australia, approximately 200 kilometres north of Adelaide. Part of the Northern Areas Council local government area, Jamestown has a population of 1400.



Background

Prior to 2012, the Northern Areas Council upgraded their Jamestown plant to include wastewater pre-treatment and a water reuse scheme. While this was beneficial, it led to a significant increase in power consumption. The Council sought ways of reducing their power bills.

In 2012, the council received a grant from the LGA Solar Innovation Fund to install solar panels at the plant. Before installation, Infratech (then known as Geits) approached the council, proposing Jamestown as a trial site for a floating solar project. The company proposed that floating solar arrays totalling up to 4 megawatts (MW) could be installed on the wastewater plants at Jamestown and nearby Gladstone. The council could use part of the power generated to offset its own

consumption. The rest would be sold to third parties. Thus, the Northern Areas Council would reduce its electricity usage and receive a royalty for power sold to other customers.

Infratech presented Council with a range of proposals that were modified as they worked through the issues and technologies. In May 2013, Council signed a memorandum of understanding giving Infratech the authority to investigate options and identify the best solution.

Infratech, with significant assistance from Council, sought approval for the project from regulatory agencies, who were chiefly concerned about the impact of the solar installation on the operation of the treatment plant and the water reuse scheme. This would be Australia's first floating solar array,

and it took considerable time for the authorising agencies to assess the issues involved. In April 2014, approval was granted for up 157 kilowatts (kW) of installed capacity to demonstrate the approach, and investigate the impact on the treatment plant.

Council leased the site to Infratech, who constructed and operated the solar facility. Council entered into an agreement requiring purchase of a minimum amount of power at a discount to the standard electricity tariff.

The currently installed capacity at Jamestown is 30 kilowatt hours (kWh). The solar array covers 20 per cent of the surface of pond 2. All electricity generated is either being used at the site or sold to the energy retailer at standard feed-in tariff prices.

Why floating solar cells?

Floating solar panels offer the following benefits over ground installations:

COOLING | Solar panels become less efficient as they get hot. Water from the ponds cools the panels, maintaining optimal operating temperature, which can improve performance.

TRACKING | The entire system can easily and cheaply rotate, following the sun.

ALGAL BLOOMS | Reduced sunlight penetration lowers the potential for blue-green algae growth.

EVAPORATION | The increased shading reduces evaporation and saves water. Solar panels could potentially reduce evaporation by 75 per cent.

The wastewater treatment plant

Effluent from Jamestown is pre-treated in tanks to aerate and remove the bulk of the solids. Pre treatment water is pumped into ponds 2 and 3 where it receives further ultraviolet treatment. The ponds are lined with rubber to eliminate seepage.

When needed for irrigation, water is pumped back into a tank at the site for chlorination before being piped 2.2 km to a holding tank at the oval in Jamestown. Pond 1 (former facultative lagoon) is being reconstructed and lined to provide future extra capacity. Currently, it serves as emergency winter storage. The system is designed to cater for a population of 5000.



The Jamestown treatment plant is located just west of the town and comprises four ponds. The solar plant (visible as a circular structure) floats on pond 2. (Image: Google Earth 2016)

The floating solar system

The array at Jamestown consists of pontoons tethered away from the edges of the pond. Thus, if the pond is emptied the pontoons will settle on the bottom without damaging the pond lining. The pontoons rotate, tracking the sun.

The solar panels lie flat, with angled reflectors directing more light onto the panels. On hot days, a cooling mist improves the panels' efficiency.



The plant is tethered to the edges of the pond.



The solar panels lie flat, next to angled reflectors.



The floating solar plant in Jamestown.

The role of council

The Northern Areas Council owns and operates the wastewater treatment plant. They have leased the site to Infratech to install and operate the solar panels. Council has entered into a power purchasing agreement with Infratech.

“The project has created much interest from around Australia. We have received a lot of calls from other councils and other organisations interested in this concept.”

Mr Colin Byles, CEO, Northern Areas Council

Lessons learned

PROJECT INCEPTION

It took approximately three years from project inception to commissioning of the power plant. Future developments are likely to be faster as there is now a clearer understanding of the regulatory requirements.

APPROVALS

The approvals process took considerable time. The approved installation in Jamestown of up to 157 kW is well below the original proposal of up to 4 MW. This is because approving bodies wanted to assess the impact of the facility on the operations of the treatment plant.

Environment Protection

Authority (EPA) | Issued the licence for the operation of the waste water facility. As the main approving body, EPA sought information about the effects of the installation and maintenance of the solar array on the operation of the treatment plant. This included the impacts of the array on light penetration into the pond, water levels and pH.

EPA raised concerns about the impact of installing floating solar panels on the fundamental processes that occur as part of wastewater treatment, storage and disposal, including the overall water balance of the system (based on engineered design), the reuse path and the integrity of the

lining system. Proposals needed to include a contingency plan to repair pond lining systems.

The approval is site specific. Jamestown has too much water and the EPA was concerned about a risk of overflow due to the reduced evaporation. Approvals may be easier at other sites with a lower risk of overflow. However, sites with strong customer demand for water could run the risk of draining, causing potential for liner damage.

Department of Health | Required that the facility would not affect the quality and safety of the water, particularly in relation to the waste water reuse scheme.

Department of Planning, Transport and Infrastructure | Required that the installation, operation and maintenance would not significantly change traffic patterns in the area.

Local Government Association of South Australia | Approved the use of the Solar Innovation Grant to support the project. They were interested in having other councils benefit from the lessons learned from the project.

Northern Areas Council | Provided a site licence that allowed Infratech access for construction and maintenance of the solar facility.

SA Power Networks | Refer below for grid connection issues.

INSTALLATION

Installation happened in less than two months without any major issues. Care needed to be taken to ensure that heavy vehicles accessing the site did not damage the ponds or equipment.

There is a safety requirement, specified in the contracts, that at least two people must be present at the treatment plant when any work is undertaken.

OPERATION AND MAINTENANCE

The Jamestown treatment plant had recently been upgraded with the installation of wastewater pre-treatment and lining in the ponds. This significantly reduced the likelihood that the ponds would need to be drained over the life of the solar plant. The floating solar platform would increase maintenance costs if the treatment pond is to be cleaned or the liner replaced. Therefore, there is advantage in minimising the need to drain and clean the ponds during the life of the facility.

The water-mist cooling system may cause the panels to accumulate dust. This will need to be addressed as dust will reduce electrical output if it is not regularly removed.

Birds resting on and soiling the panels do not seem to be a problem, although birds perch on the surrounding pontoon.

There is a need for close cooperation with council works staff. There is potential for site damage and conflicting activities when there is another project happening at the plant involving various contractors. Agreements were needed to ensure that it was clear how contractors would work together.

“Council’s largest electricity consumer is the wastewater treatment facility at Jamestown, so any reduction in that cost is a very positive step.”

Mr Colin Byles, CEO, Northern Areas Council

GRID CONNECTION

Operators of solar installations must seek permission from SA Power Networks if they wish to access the electricity grid. Regulations and requirements differ from region to region, dependent on the local power distribution network operator (network company).

Connection and network protection costs can be significant.

Connection standards differ depending on the size of the installation. For example, there are substantial differences in connection standards in South Australia between plants that have capacities of less than 30 kW, less than 200 kW, less than 5 MW and greater than 5 MW. The larger the plant, the more onerous the connection requirements.

Network companies may require a full engineering study and a connection agreement for any plant greater than 30 kW.

For information about the process in South Australia, see: http://www.sapowernetworks.com.au/centric/customers/embedded_generation.jsp

At the Jamestown treatment plant, the grid connection capacity is fairly small and, without a significant upgrade, has limited the opportunity to sell power to third parties. The alternative that will be used in Jamestown, if it is expanded, is to construct a stand-alone microgrid that feeds power directly to local power customers.

POWER PURCHASE AGREEMENT

The agreement between Infratech and the Northern Areas Council provides the revenue stream to Infratech to fund the solar installation. The agreement is based on staged construction of solar facilities. The first phase of the construction has been a 30 kW system.

Council has agreed to purchase power from the solar installation for a set period at a discount to the standard tariff. This represents the minimum amount of electricity used by both the Jamestown and Gladstone treatment plants.

Power that is not sold to council will either be sold to the grid at the standard feed-in rate, or sold directly to third parties. Council will receive a royalty for any power that is sold to third parties.

POWER COSTS

The council agreed to participate in the floating solar array project to lower the cost of power consumption. Currently, only modest savings are being achieved through the purchase of generated power.

The power meters were changed to measure exported power for the feed-in tariff from the solar facility. Council used this change as an opportunity to move to off-peak tariffs, which brought substantial savings to the operation of the treatment plant, well beyond those provided by the solar installation.

Should the system expand, the Council will derive additional benefit through royalty payments from selling power to third parties.

“This is an Australian first for floating solar power, and it’s a great way to put the Northern Areas Council on the map.”

Cr Dennis Clark, Mayor, Northern Areas Council

CHECKLIST: are you ready for floating solar?

- ☐ Is the facility accessible by heavy vehicles?
- ☐ Are the treatment ponds lined and cleaned?
- ☐ Are the treatment ponds likely to be full and not require cleaning for the life of the solar installation?
- ☐ Is the water pH and chemistry suitable for cooling the panels and not causing corrosion of the solar installation? The more neutral the pH, the better.
- ☐ Is there sufficient regional electricity demand to justify the installation?
- ☐ Will the electricity grid support feed-in, or will you need to consider a microgrid for distribution of excess power?
- ☐ Have you already considered the benefits of off-peak electricity?
- ☐ Do you have customers who will benefit from the additional water available from the reduced evaporation?
- ☐ Are you able to manage water balance as a result of reduced evaporation?
- ☐ Will the reduced ultraviolet penetration affect the operations of your facility?
- ☐ Will there be benefit from reduced blue-green algae growth?
- ☐ Are you willing to enter into a long term power purchase agreement?
- ☐ Are you aware of the approvals required by regulatory bodies?
- ☐ Will your community support the project?

KEY STAKEHOLDERS

The project has involved a diverse range of stakeholders:

- Council staff and elected members who were interested in the financial, governance and operation of the facility
- Approving bodies – in particular, EPA and Departments of Health and Transport
- LGA SA, who were interested in the lessons for other councils
- Water reuse customers – who needed to be reassured that the plant would not affect water quality
- Potential power purchasers – who would benefit from the additional generated capacity
- Electricity utility – who regulate the impact on the grid
- Community members – who expressed an interest in the project
- State Government – who are keen to foster innovation and renewable energy
- Other local governments – who are considering similar projects.

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