Synauta
A GRADIANT COMPANY

CASE STUDY

ML for Reverse Osmosis shows up to 18% energy savings

4,000m^3/day
Seawater Reverse Osmosis Plant
Australia

Summary

Energy costs for desalination are expensive. However, plant optimization to reduce energy use is a manual burden for operators.

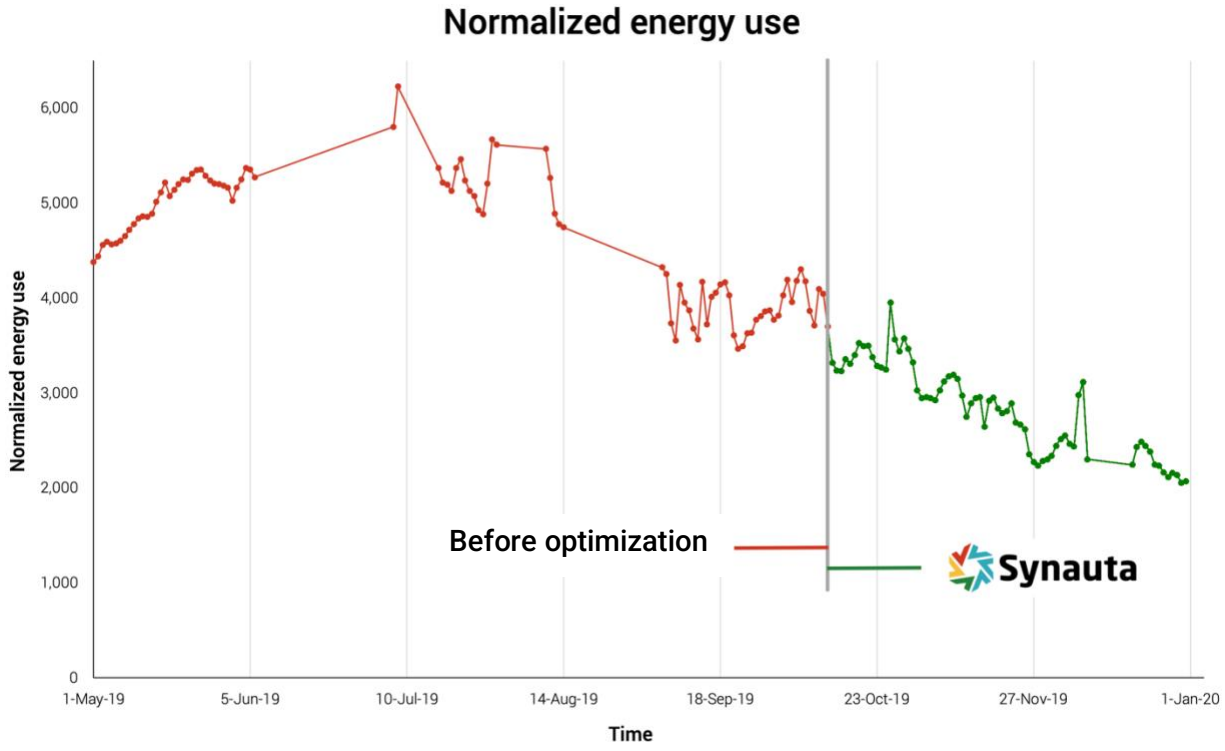
Phase 1: Audit shows if the customer had applied Synauta's supervised machine learning to a 4,000m^3/day plant, they would have saved up to 18% energy, with an average saving of 9.7% over six months.

Phase 2: The customer's operators apply recommended daily set points. Energy savings were apparent immediately, with a sharp drop on the first day.

Phase 3: Testing has also started to automate the recommended set points via SCADA integration, to save additional energy costs.

By manipulating plant recovery based on three set points, up to 18% instantaneous energy savings could be made with an average saving of 9.7% over six months.

The 4,000m^3/day plant saves AU$65,000 every year.



Intro to the desalination plant featured in this case study

The customer operates more than 100 desalination plants around the world. The desalination plant in regional Australia has a typical seawater RO arrangement, with an isobaric energy recovery device. The plant has 4 trains, each capable of producing 1,000m³/day. The trains have 14 vessels and 6 membrane elements in each. Elements are 6,000 GPD flux and 99.7% rejection sourced from a major RO membrane manufacturer.

Challenge

Seawater Reverse Osmosis (RO) requires a lot of energy to produce water and costs plant owners millions of dollars every year.

Optimizing a plant manually, to match the design conditions, takes time that operators and control room operators do not always have. Additionally, optimization is made more difficult when a plant has multiple trains to track performance and optimize manually.

Solution

Synauta's patent pending technology helps plant operators produce the right quantity and quality of water, without the distraction or headaches of lengthy calculations. Where math has limitations, machine learning is accurate. Machine learning can also be codified and deployed to SCADA to predict variations/trends in water temperature and salinity and undertake multiple set point changes per day, ultimately minimizing energy use and adapting to consistently fluctuating feedwater conditions.

To achieve energy savings, Synauta alters the RO plant recovery. While this parameter is fixed at most RO plants, by frequently analyzing plant operating conditions the recovery can be varied to achieve optimal energy use while still conforming to the main plant design constraints, such as lead element recovery, lead element flux constraints, etc. In this case Synauta regularly recommended values for three set points to the customer's plant operators:

- High pressure pump flow
- PX booster pump flow
- PX valve to drain

To validate Synauta's energy savings for the customer, Synauta created a new metric called *normalized energy use*, which accounts for temperature and salinity variation and is adjusted to standard seawater test conditions (25°C, 32,000ppm NaCl).

Business benefits

By applying Synauta's software, the customer could have saved instantaneously up to 18% energy and on average 9.7% over six months. For this plant size (4,000m^3/day), the OPEX saving would amount to $65,000 every year.

Applying Synauta's energy saving product to even larger plants, the customer's energy savings would increase, slashing OPEX costs. For instance, for a plant producing 300,000m^3/day, more than $3 million could be saved every year with Synauta's solution.

The customer and Synauta worked to understand the key energy-related problems associated with plant operations at this Australia location. Synauta adjusted algorithms to suit the constraints at the plant, such as minimum daily flows and maximum permeate quality.

Synauta regularly demonstrates iterations of the technology to ensure full alignment and security with the customer operations.

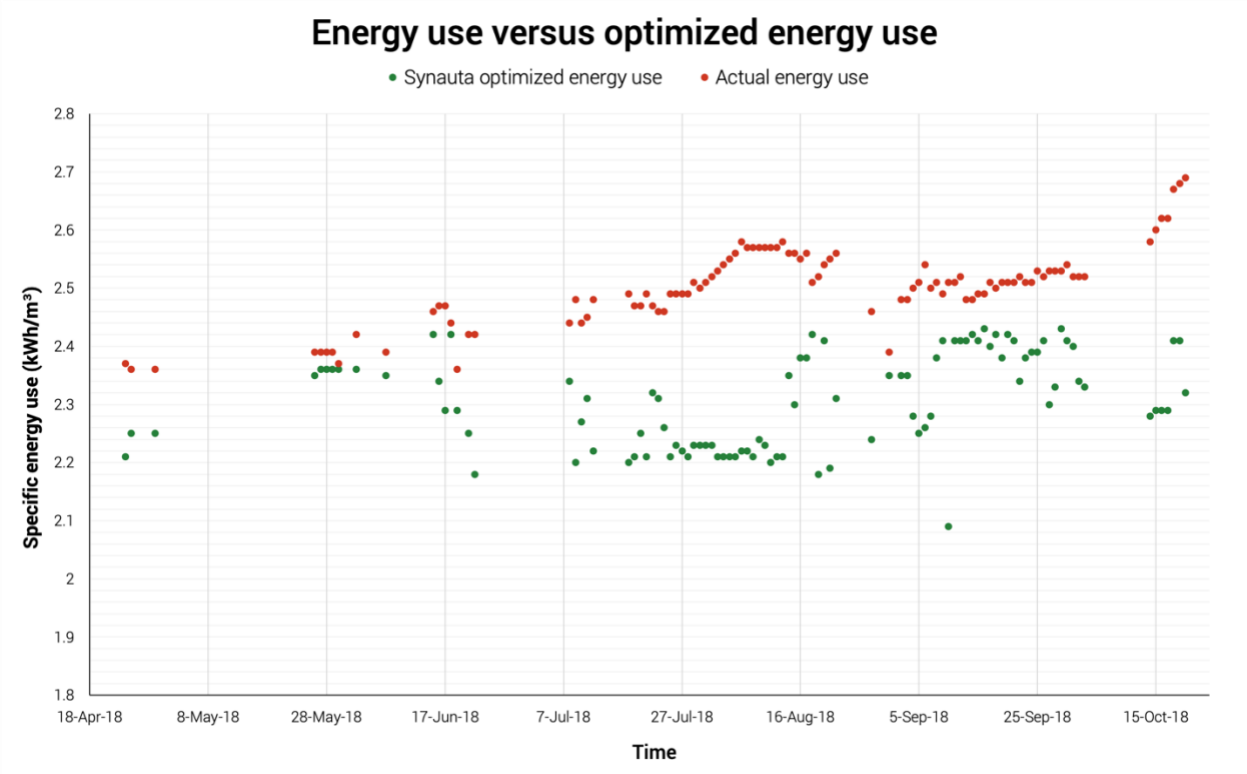
Phase 1: Report shows significant energy savings

Phase 1 is a Machine Learning Readiness Report. During this phase with the customer, Synauta analyzed multiple plant constraints such as fluxes, recoveries, minimum permeate flow and maximum permeate conductivity to ensure a plant maintains deliverables, without causing issues on plant.

The report was performed on a data set provided by the customer and cleaned and validated for machine learning by Synauta.

In Phase 1, with Synauta's recommended set points applied, the customer would have benefited from a maximum energy saving of 18% and an average saving of 9.7%.

The graph below shows the results of a comparison using a representative set of the historic data.



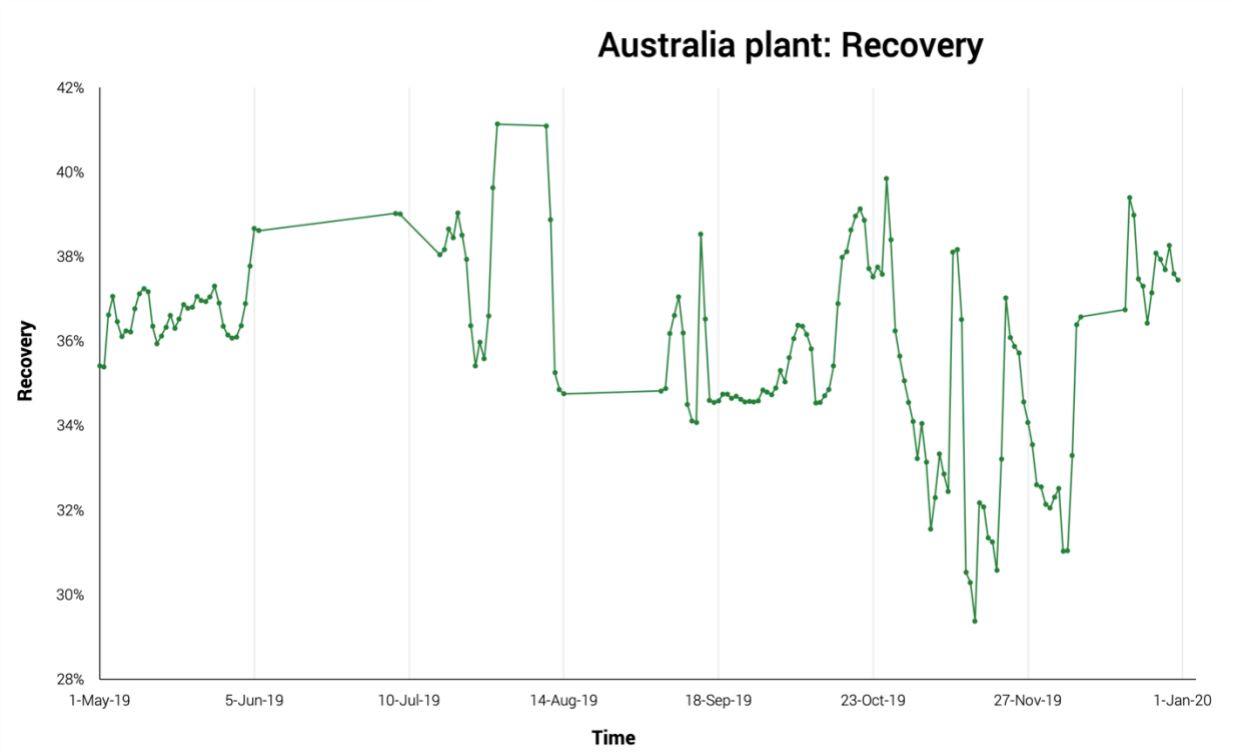
Phase 2: Saving energy right now

Starting on October 11, 2019, using Synauta's recommendations, the customer's operators began making changes to three set points: high pressure pump flow, PX booster pump flow and PX valve to drain. This phase is currently active. The operators receive an email each day and make one change to each set point per day on site.

The Western Australian plant's energy use trend is declining, which also demonstrates the machine learning in Synauta's solution is gaining more efficiency for our customer over time. This is contrasted against the impact of fouling in a period from May 2019 to June 2019, before Synauta made recommendations (see graph on page 2 of this case study).

To compare energy savings, baseline energy use data had been collected between May and September 2019 (also visible on page 2).

To achieve energy savings, Synauta alters the plant recovery. While most RO plant's recovery stays fixed, by analyzing plant conditions regularly, we can change recovery without breaking lead element recovery and lead element flux constraints.



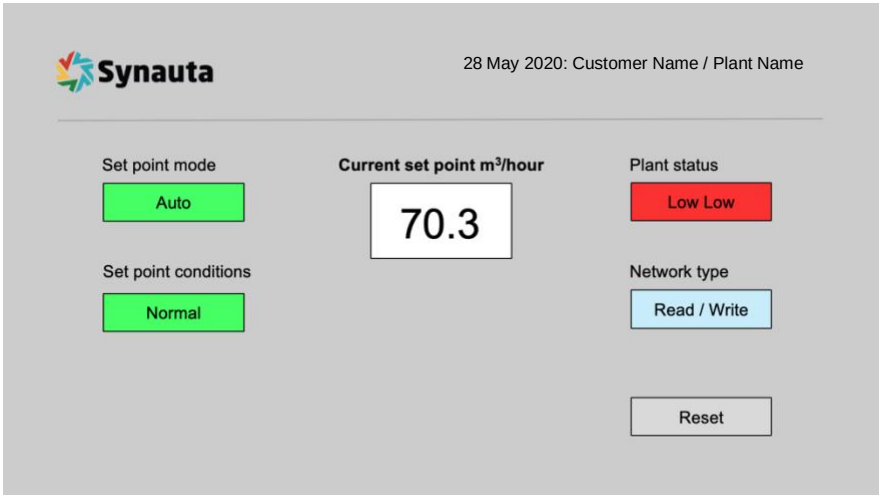
Phase 3: Connecting to SCADA for additional energy savings and saving operators' time

In this phase Synauta securely integrated our software with the customer SCADA system.

This removed the risk of human error by manually sending data from the plant and ensured the format and frequency of data was in place for optimization.

The secure connection also enabled set point changes up to once every hour, to maximize possible energy savings at the plant. The connection uses Ignition and OPC.

While data is automated, the operators maintain full control over the plant and must accept the set points generated.



About Synauta, a Gradiant company

Synauta is a cleantech startup collaborating with desalination innovators around the world. Founded in 2018, our vision is that we all live in a world where energy and water is not wasted.

We currently work with desalination and water reuse leaders in Europe, Australia, the Middle East, Southeast Asia, and North America. Together these companies share our goal of reducing energy and chemical use in reverse osmosis.

For energy saving, Synauta applies a phased process to software integration:

- Phase 1 Machine Learning Readiness Report: Answers how much energy we can save you
- Phase 2 Semi-Auto Mode: Your operators receive recommended daily set points
- Phase 3 Full-Auto Mode: Realize additional energy savings with secure SCADA integration

Through our solution we estimate the global industry can save more than 12 million tonnes of CO2e every year (*Synauta Environmental Benefits Quantification Report*, GHD, 2020).

The Synauta team brings a blend of global experience and industry knowledge across water markets, commercialization, and software.

Contact us for a Machine Learning Readiness Report to see how much your plant can save.

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