LUMEN

Aged care and retirement living

Fuel switching case study

EECA

DECARBONISATION PATHWAY

AGED CARE AND RETIREMENT LIVING

Example fuel switching financials (a hypothetical scenario, based on real-world experience)

Existing System Description

A South Island retirement village has two LPG fired boilers that provide domestic hot water for its residents. The domestic hot water boilers are 100kW each equipped with two 800 L holding tanks. The boilers operate 24/7 on an "as demanded" basis. The annual LPG consumption of the system is 369,000 kWh per year. A recent boiler tuning exercise identified that boiler efficiencies are 80%. The boilers rarely operate together, indicating that there is almost a 100% system redundancy. The actual LPG demand/domestic hot water demand is not measured onsite as there is no measuring equipment.

The village pays $45/GJ for LPG. On a per annum basis, the village currently pays $59,800 per year for LPG.

Proposed System Description

An initial evaluation of options was carried out and the assessment results indicated that hot water heat pumps would be the best fuel switching option for this site. As a next step, the retirement village operator decided to install a new hot water meter to understand the demand of the domestic hot water system. It was identified that the optimal size of the domestic hot water system is 100 kW.

The financials of the proposed system are calculated based on the following key parameters:

- LPG price of $45/GJ (16.2¢/kWh) over the lifetime of the project
- Forward average electricity price of 14¢/kWh over the lifetime of the project
- Electricity Network (lines company) charges of $70/kVA per year
- ETS price of $75/tCO2-e
- Existing boiler system efficiency of 80%
- Domestic hot water heat pump system efficiency of 350% (COP of 3.5)
- The village has available outdoor space near the boiler room to install the heat pumps
- The existing hot water holding tanks will be used with the heat pumps
- There is spare electrical capacity available to accommodate the additional electrical load from the heat pumps.
- Maintenance related costs are excluded, assuming these are the same for the existing and proposed systems
- Project lifetime is 15 years
- Annual discount rate of 7.5%

Initial discussions and pre-design quotations indicated that the capital cost required to install 3x40kW heat pumps, including electrical work, would be $350,000. In addition to the quoted price, 10% was allowed for design and project management and another 10% was assumed as a contingency. As such the total estimated project cost is $423,500. The following are the financial results of the proposed heat pump system.

Parameter	Value	Remark
Existing system (LPG)		
Existing system consumption	369,000 kWh	Boiler efficiency of 80%
Annual CO2-e emissions	80 tCO_2-e	Based on 0.218kg/kWh emissions factor
Annual opex of the existing system	$59,800	Based on contracted price (includes ETS charges)
ETS component of existing cost	$6,000	Based on ETS price of $75/$tCO_2$-e
Proposed system (heat pump)		
Capital cost estimate	$430,000	Based on the quoted price and allowances
Proposed system electricity consumption	94,900 kWh	Accounting for boiler efficiency and COP
Proposed system electrical demand	29 kW	Required for additional network charges
Annual CO2-e emissions of proposed system	11 tCO_2-e	Based on 0.12kg/kWh emissions factor
Annual opex of the proposed system	$15,300	Based on the forward electricity cost (14c/kWh)
ETS cost component of proposed system	$800	Based on ETS price of $75/$tCO_2$-e

Item	Existing system	Available fuel switching options and their advantages
Financial analysis		
Estimated annual opex savings	$44,500	Estimated savings from total opex (ETS component included)
Simple payback period	9.52 years	Capital cost/annual savings
Annual CO2-e savings	71 tCO_2-e	
Annual ETS related cost savings	$5,200	Based on ETS price of $75/$tCO_2$-e
Project lifetime	15.00 years	Typical lifespan of heat pumps is 15 years
Lifetime CO2-e savings	1,065 tCO_2-e	Based on 15 years of project lifetime
Net present value (NPV) – cash basis	-$31,000	Based on 15 years of project lifetime
Net present value (NPV) – ETS component removed	-$77,000	Based on 15 years of project lifetime
Marginal abatement cost (MAC)	$72/$tCO_2$-e	-NPV (excluding ETS) / Lifetime Carbon savings