PUBLIC COMMISSIONING KNOWLEDGE SHARING REPORT

HYDROGEN BLENDING PROJECT

ATCO GAS AUSTRALIA

Jandakot Depot, 81 Prinsep Rd, Jandakot WA 6164

05/07/2023

Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

In 2019, the Western Australia (WA) Government released its Renewable Hydrogen Strategy, delivering a roadmap to a low-carbon future through renewable hydrogen for the state, with WA aiming to become a significant producer, exporter and user of renewable hydrogen. Within this strategy, the WA Government lists blending hydrogen into the existing gas network as one of its key milestones, with 2022 the target date for distributing renewable hydrogen in the gas network. By 2040, the aim is for WA's gas pipelines and network to contain at least a 10% renewable hydrogen blend.

The Hydrogen Blending Project described in this report enables the delivery of up to 2% (v/v) blended natural gas to approximately 2700 residential and commercial gas consumers located in the estates of Glen Iris, Calleya and Treeby.

Based on the forecast of injecting 3,456kg of H_2 into the gas distribution network during the trial period, the estimated reduction in CO_2 will be 21.4 tonnes.

The upfront CAPEX at project completion was $2,188,560 with ongoing costs for the first year of operation estimated at $295,805. The estimated fixed and variable operations cost for are $211,651 and $84,154 respectively. The variable costs comprise primarily of electricity, usage of the electrolyser and consumables associated with Hydrogen production. The saving in avoided cost of natural gas based on $5.46/GJ is estimated to be $2,213.

For the purposes of the trial, the cost of H_2 production will be absorbed by ATCO due to the low quantities injected into the gas distribution network. Consequently, there will be no cost impact to gas consumers. This decision will be reconsidered in future trials involving higher blending percentages.

ATCO engaged with the community and stakeholders through in-person information sessions and discussions with the City of Cockburn, gas retailers and community groups; letter drops to all affected customers; and established a dedicated phone line to take enquiries and website with detailed information. The website received over 3000 individual hits, which indicated a high level of engagement from consumers. Only three phone calls were received indicating that the website was an effective means of disseminating useful information regarding the trial.

ATCO's experience in implementing the Hydrogen Blending Project demonstrated that early and ongoing engagement with key stakeholders including gas customers, the Regulator, the Gas Plant Safety Case nominated auditor, community groups and the like was crucial in ensuring that the project was completed in a timely manner. Moreover, the use of proven design and equipment for the blending skid with support from an experienced technical consultant were also key factors in the success of the project.

Government of **Western Australia**
Department of **Jobs, Tourism, Science and Innovation**

ACKNOWLEDGEMENT OF FUNDING

The project (Project) received grant funding from the Western Australian Government's Renewable Hydrogen Fund, which is administered by the Department of Jobs, Tourism, Science and Innovation (the Department).

DISCLAIMER

The Project represents and expresses the research, information, findings, outcomes and recommendations solely of the Recipient and does not in any way represent the views, decision, recommendations or policy of the Department. The Department does not accept any responsibility for the Project in any matter whatsoever and does not endorse expressly or impliedly any views, information, product, process or outcome arising out of or in relation to the Project.

OVERVIEW

ATCO, with support from the Government of Western Australia, is installing a Hydrogen Blending Gas Plant at the Jandakot Operations Centre. The Jandakot Hydrogen Blending Gas Plant (Gas Plant) is designed to blend up to 10 volume% (% v/v) hydrogen into natural gas stream and distribute within a discrete Jandakot (Glen Iris estate) and Treeby (Treeby and Calleya estates) GDS local area sub-network (the Hydrogen Blending Project Sub-network) to down-stream connected consumer gas installation. Only Type A appliances are installed in the area.

The total duration of this project is 2 years including design, construction and the blending trail period.

The Gas Plant is designed to accommodate the maximum modelled gas flow rate of 730 Sm3/hr and blend 0 to 10% (v/v) hydrogen into the natural gas stream. At the completion of this project, the Gas Plant will be capable of delivering up to 2% (v/v) blended natural gas to consumers.

Commissioning of the Gas Plant was completed by the end of November 2022, achieving a short term WA Hydrogen Renewable Strategy goal to have renewable hydrogen distributed in a WA gas network by 2022.

The Hydrogen Blending Gas Plant project was delivered by ATCO on-time and under-budget.

1. MILESTONE NUMBER 2

1.1 Public FEED Knowledge Sharing Report

1.1.1 Project Summary & Overview

ATCO, with support from the Government of Western Australia, is installing a Hydrogen Blending Gas Plant at the Jandakot Operations Centre. The Jandakot Hydrogen Blending Gas Plant (Gas Plant) is designed to blend up to 10 volume% (% v/v) hydrogen into natural gas and distribute within a discrete Jandakot (Glen Iris estate) and Treeby (Treeby and Calleya estates) GDS local area sub-network (the Hydrogen Blending Project Sub-network) to down-stream connected consumer gas installation as shown in Figure 1 below. ATCO intends to commence operation of the Gas Plant and distribute within the GDS by the end of December 2022 commencing in August 2022, i.e. a 3-month construction period.

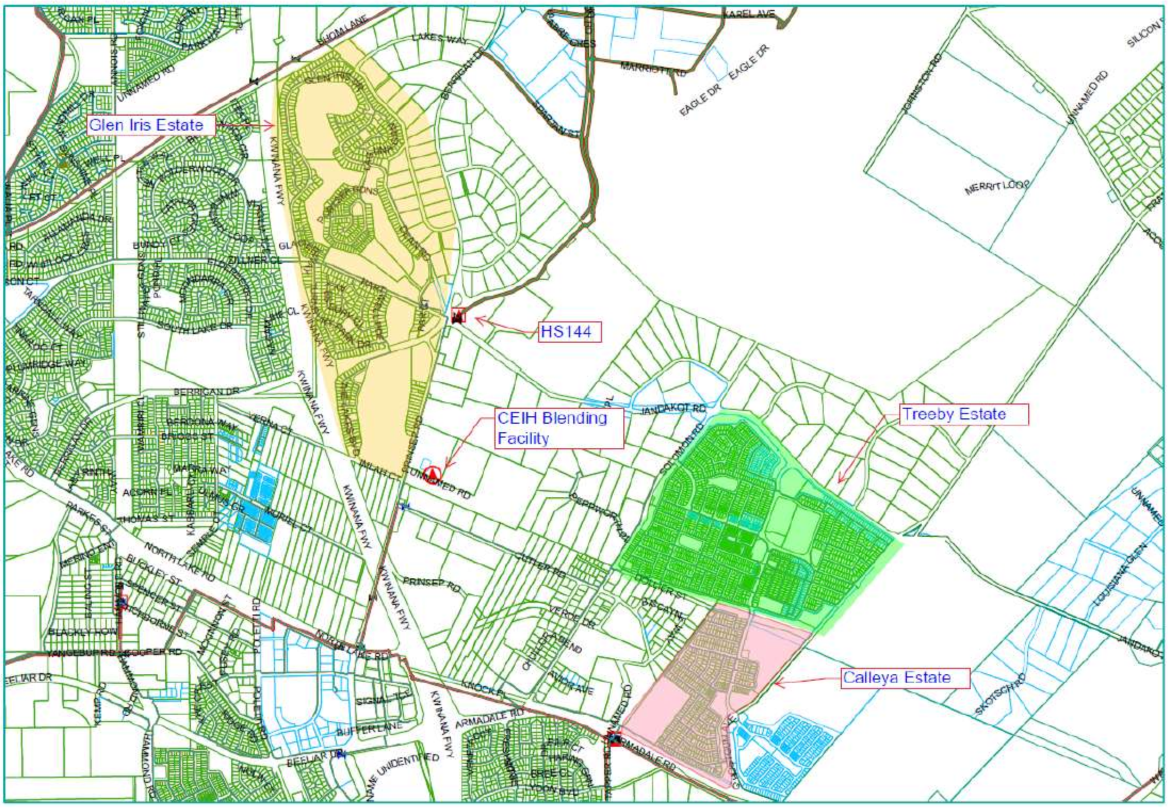

Figure 1. Project Blending Areas.

The Gas Plant is designed to accommodate the maximum modelled gas flow rate of 730 Sm^3/hr and blend 0 to 10% (v/v) hydrogen into the natural gas stream. The Hydrogen Blending Project is to be implemented in stages of increasing hydrogen concentrations. Further review, acceptance of the revised risk assessments will be required prior to progressing to the next stage of the project as defined in this Gas Plant Safety Case. The stages of the Hydrogen Blending Project are as follows:

- Stage 2, with a nominal operating concentration of 2% (v/v) hydrogen and a maximum emergency shut-down (ESD) level of ≤2.8% (v/v);
- Stage 3, with a nominal operating concentration of 5% (v/v) hydrogen and a maximum ESD level of ≤7.5% (v/v);

- Stage 4, with a maximum operating concentration of 10% (v/v) hydrogen and a maximum ESD level of 13% (v/v); and
- Where there is insufficient hydrogen available, 100% natural gas will pass through the Gas Plant unimpeded for security of supply.

1.1.2 Approach and Methodology

GPA Engineering was engaged by ATCO to support the execution of the project. GPA Engineering were selected due to their recent experience with implementation of the HyP SA project.

Table 1.1: Division of Responsibilities

Activity	ATCO	GPA Engineering	Contractor
Request for Proposal with gas network operating parameters	●		
Safety Case			
Gas Distribution System (GDS) Safety Case Amendments	●		
Gas Plant (Blending Skid) Safety Case	●	●	
Stakeholder Engagement	●		
Project Management	●		
Design			
Develop basis of design		●	
Undertake detailed design of the blending skid and H_2 control panel		●	
Undertake detailed design of the controller		●	
Develop datasheets for procurement of equipment		●	
HAZOP, HAZID, LOPA		●	
Procurement			
Obtaining quotes and recommendation for purchase		●	
Procurement of equipment	●		
CRAW	●		
Gas Distribution System upgrades			

Activity	ATCO	GPA Engineering	Contractor
Develop Scope of Work, Design & Work Packs	●		
Installation, Testing and commissioning			●
Site Installation of Blending Skid			
Fabrication of blending skid			●
Fabrication of H_2 Control Panel			●
Civil works			●
Mechanical installation works	●		
Electrical installation works	●		
Control system installation works			●
Testing and Commissioning	●	●	●
Operations and maintenance	●		

The project milestones were achieved through the application of a mix of internal and external resources.

The use of ATCO resources to complete the mechanical and electrical installation works for the blending skid was highly advantageous in being able to,

- Achieve a high level of quality of work;
- Minimise the cost of site installation works due to the flexibility of ATCO's personnel to manage variations in scope;
- Manage resources more flexibly to achieve the project milestones; and
- Engage ATCO operations personnel in the construction, testing and commissioning of the H_2 Blending Skid which facilitates familiarity with the plant going forward into the operations phase.

1.1.3 Technical Design Considerations

The Gas Plant design includes a safety instrumented system (SIS) controller with associated inputs and outputs; flame detection; remote monitoring; alarming; control of hydrogen blending systems; manual and automated unit or emergency shut-down systems.

The Gas Plant is designed with controls to assure adequacy of billing and control of hydrogen concentrations are achieved to assure safety of ATCO personnel operating the Gas Plant; the GDS

Hydrogen Blending Project Sub-network; and downstream-connected consumer gas installations; as follows:

- Metering and monitoring of metering is installed on the natural gas and hydrogen streams for both operational and Hydrogen Blending Project Sub-network billing purposes.
- A restriction orifice has been installed within the hydrogen stream to restrict the maximum flow of hydrogen to 20 Sm^3/hr, which is equal to 10% (v/v) of the design minimum gas demand of 200 Sm^3/hr.
- Operation of Gas Plant blending is to be curtailed when Hydrogen Blending Project Sub-network flowrates fall below 250 Sm^3/hr to assure stability of control of the blend concentration.
    - Initially this will be achieved by monitoring flowrates and manually isolating hydrogen injection.
    - After installation and commissioning of a second natural gas flow meter that is still to be obtained; this flow meter is to be hard wired to the second emergency shut-off pneumatically-actuated control, fail closed ball valve on the hydrogen stream. This will automate the low natural gas flow hydrogen blending stream shut-off and enable the shut-off level to be set as low as 200 Sm^3/hr.
- The hydrogen gas analyser package and associated controls are designed to automatically activate the hydrogen injection unit, or emergency shut-down when the maximum project stage hydrogen concentration is detected.
- Flame detection system is controlled by the SIS controller and detection of flame (fire) will result in emergency shut-down of the entire Hydrogen Hub which includes the Gas Plant, electrolyser, H_2 refuelling station, solar PV and battery storage system.
- Pressure control and prevention of over-pressurising the downstream GDS Hydrogen Blending Project Sub-network is achieved through pressure regulation, pressure indicating transmitters and pressure safety relief valves.

1.1.4 High Level Project Budget

Table 1.2. Forecast CAPEX and OPEX

Breakdown	Estimated Cost, $
Estimated Project Capital Costs	
Network reinforcements and modification	513,624
Blending facility design and construction	405,531
Risk and Safety (Safety Case)	251,943
Community and Stakeholder engagement	275,000
ATCO Internal Labour	265,468
ATCO Project Management and Procurement	232,158
Contingency (20%)	388,236
Estimated Total CAPEX	**2,331,419**
Estimated Operating Costs (project life)	
CEIH Hydrogen Production Allocation to Blending	32,115
CEIH Electrolyser Utilisation Allocation to Blending	52,039

Breakdown	Estimated Cost, $
Inspection Scheme (5% allocation)	36,607
Network Operations	175,044
Estimated Total OPEX	**295,805**
Estimated Total Project Cost	***2,627,765***
JTSI Contribution (Funding Application Approved)	1,970,824
ATCO Estimated Contribution (after JTSI funding)	**656,941**

Levelised cost of H_2 production: $24.56 /kg

1.1.5 Key Components and Equipment

Table 3. Technical Specifications of Key Components and Equipment

Key Component	Parameter	Comments
Renewable Power Plant	Solar PV: 300kW (3 x ABB PVS-100-TL 100kW Solar Inverters) Battery Storage: 270kVA, 479kWh (ABB PowerStore™)	ATCO purchases renewable energy from Synergy (Synergy NaturalPower - Commercial Green Energy) enabling production of green H_2 at any time
Electrolysis Plant	Production capacity: 65kg/day (NEL C30 PEM)	Water consumption: 26.9L/hr Power consumption: 64.5kWh/kg
Cooler	Capacity: 100kW Type: Evaporative (BAC VXI-S 18-0X)	
Water Treatment	Production capacity: 120L/hr (CENTRA R120)	Purification using reverse osmosis, UV photo-oxidisation, deionisation and 0.2µm filtration
Monitoring	Emerson DeltaV Distributed Control System	

1.1.6 Hydrogen Storage Facilities (Existing)

Table 4. Technical Specifications of Hydrogen Storage Tank

Parameter	Value
Volume	4000L
Design Pressure	3450kPA
Hydro Pressure	4934kPA
Design Temp.	29^0C to 70^0C

Figure 2. Hydrogen Storage Tank

1.1.7 Annual Forecasts of Production and Consumption

Figures in the table below are calculated based on a 12-month trial period.

Parameter	Value
Production of H_2	3,456kg
Production of O_2	27,624kg (Vented to atmosphere)
Electricity Consumption – Electrolysis Unit	223MWh
Water Consumption – Electrolysis Unit	34,326L
Electricity Consumption – Balance of Plant	17MWh
Water Consumption – Balance of Plant	191,409L

1.1.8 Other Information

Information Request	Comments
Other information of interest to the Australian hydrogen industry, Government agencies and researchers	None
Schedule or plan for testing/certification of high-pressure hydrogen storage vessels	Hydrogen storage vessel is existing therefore testing/certification is not part of the H_2 Blending project
Periodic fuel quality reporting method	Not applicable
Market and economic characteristics for renewable hydrogen, hydrogen or any derivative and/or by-product (e.g. ammonia/oxygen)	Hydrogen is produced at ATCO's Jandakot depot for self-use only in the following applications. 1. Blending into the natural gas network 2. Re-fuelling of hydrogen fuel cell vehicles 3. Hydrogen fuel cell for power generation Oxygen is vented to atmosphere and no other derivative and/or by-products are produced.
Commissioning plan to include targeted energy balances, production costs and plant availability	The hydrogen production plant is existing and was not commissioned as part of this project.
Hydrogen offtake and supply chain options and analysis	Hydrogen is produced at ATCO's Jandakot depot for self-use only. There are no off-takers for the hydrogen produced.
Environmental impact, constraints and mitigation	Gas Plant will be established within an existing area within ATCO's Jandakot depot known as the Clean Energy Innovation Hub (CEIH) where the existing electrolyser with balance of plant is installed. As a consequence, there will be no additional impact on the environment.
Carbon dioxide footprint analysis (to most comparable alternative products)	Hydrogen will be produced using electricity from, 1. 300kW Solar PV and battery storage system; and 2. "Green" energy purchased from the grid. The carbon dioxide footprint of hydrogen production will be relatively minimal. Refer to Section 1.1.9 below.

Information Request	Comments
Regulatory impacts, constraints and mitigations	Refer to Section 1.1.10 below.
Workplace health and safety impacts, constraints and mitigations	There were no new impacts with the introduction of the Gas Plant in to the CEIH given that H_2 production and storage plant was already in existence on the site. ATCO personnel were familiar with the operation of H_2 plant and the associated processes and procedures for safe operation of the plant.
Modelling and analysis of cost of hydrogen production under various electricity input price assumptions	Modelling of the cost of production was undertaken based on purchasing green energy from the grid. Refer to Section 1.1.11 below.

1.1.9 Carbon Dioxide Footprint Analysis

ATCO forecasts that 3,456kg of H2 will be injected into the GDS over the trial period hence displacing 0.415TJ of energy that would have been supplied by Natural Gas.

Given the CO2 intensity of NG at 51.539 tonnes of CO2/TJ, the CO2 emission reduction with H2 blending at 2% v/v is estimated to be 21.374 tonnes of CO2 over the trial period.

1.1.10 Regulatory Impacts, Constraints and Mitigations

As part of the regulatory approvals necessary to enable blending of H_2 in to the GDS, ATCO submitted to Department of Mines, Industry Regulation and Safety (DMIRS), the Regulator, for approval the documents described below.

- ATCO Inspection Policy Statement and Plan Revision - Addendum to Revision 7 (AGA-R&R-PL11-FM01), approval 21 October 2022. This addendum defines ATCO's requirements regarding the undertaking of 5% inspection of new and additional Gasfitting Work within the hydrogen blended natural gas sub-network for the phased hydrogen blending up to a maximum of 2.8% by volume.
- Gas Distribution System Safety Case (AGA-R&R-PL12), accepted 18 November 2022. This GDS Safety Case demonstrated the safety of reticulating up to a maximum of 2.8% by volume hydrogen within the hydrogen blended natural gas sub-network.
- Jandakot Hydrogen Blending Gas Plant Safety Case (AGA-R&R-PL15), accepted 28 November 2022. This Gas Plant Safety Case demonstrated the safety of Gas Plant and design of the Gas Plant to control the levels of hydrogen within the hydrogen blended natural gas sub-network and to consumer gas installations to predefined maximum levels up to 10% by volume, with phase one being limited to 2.8%.

Key issues that had to be resolved with the Regulator to enable approvals to be obtained within the extremely tight project timeframe are described below.

1. "Light under" condition where with increasing percentage blend of H_2, there is a possibility that the flame burns under the cap of the kitchen stove-top burner and is not visible through the burner nozzles. This can result in excess carbon monoxide production leading to potential poisoning of household occupants.

   This was mitigated by installing an orifice plate to limit the amount of H_2 that can be physically injected into the natural gas stream. Refer to Section 1.1.3 above for details of the implementation.

2. Approval of the ATCO Inspection Policy Statement and Plan Revision - Addendum to Revision 7 (AGA-R&R-PL11-FM01) to allow ATCO to undertake 5% inspection of new and additional Gasfitting Work within the hydrogen blended natural gas sub-network for the phased hydrogen blending up to a maximum of 2.8% by volume.

   In early discussions with the Regulator, there was an expectation for 100% inspection.

   This was mitigated through early and close engagement with DMIRS representatives to agree on the most appropriate approach to ensure public safety when blending H_2 into the GDS.

3. Safety Integrity Level 1 (SIL1) Safety Instrumented Function (SIF) on low natural gas flow to mitigate the risk of over-blending of H_2 by volume. An outcome of the Layer of Protection Analysis (LOPA) workshop was to incorporate a flow meter capable of mass (or standard volumetric) flow, either natively, or with internal compensation from actual volume flow and compatibility with minimum target of SIL 1.

   Due to timing constraints for commissioning with respect to design and procurement lead times, a low flow SIF-2 was not included in the project initially. Over-blending risk reduction is achieved by 100% operator attendance with manual stop on low flows, i.e. $< 250\ Sm^3/hr$. The Gas Plant is currently commissioned and operational.

   A low flow SIF-2 is currently in procurement phase and will be added to remove the operator attendance constraint. Injection of H_2 into the natural gas stream will be automatically shut-off on detection of low flow.

Moreover, the Gas Plant Safety for the Blending project was the first to be developed and submitted to the Regulator for approval under Schedule 3 of the Gas Standards (Gas Supply and System Safety) Regulations 2000. ATCO engaged GPA Engineering to develop the Gas Plant Safety Case based on their recent experience with the HyP SA blending project.

In all of the above cases, the critical factor that facilitated timely regulatory approvals was early, regular and close engagement with the Regulator in a highly collaborative approach.

This was also the case in ATCO's engagement with the Independent Auditor for the Gas Plant Safety Case.

1.1.11 Modelling and Analysis of Cost of Hydrogen Production

Total H2 Produced (kg)	3,456.00				
Electrolyser Utilisation cost ($)	$32,391.04	**Electricity Price Variation**			
Electricity Consumed (kWh)	222,967.74	-20%	-10%	10%	20%
Electricity Cost (cents/kWh)	0.23	0.18	0.21	0.25	0.28
Total Electricity Cost	$52,484.66	$41,026.06	$46,154.32	$56,410.84	$61,539.10
LCOH	$24.56	$21.24	$22.73	$25.69	$27.18

2. MILESTONE 4

2.1 Public Commissioning Knowledge Sharing Report

2.1.1 Regulatory Approvals and Licensing Requirements

Refer to Section 1.1.10 above.

2.1.2 Procurement, Sub-Contracting and Equipment Supply Arrangements

Description of Procurement Item	Procurement Method
H_2 Blending Skid – Natural Gas Piping	Contracted to Trushape Engineering Pty Ltd for fabrication based on GPA Engineering technical specifications.
H_2 Control Panel – Hydrogen tubing, valving and instrumentation	Contracted to Swagelok Western Australia for fabrication and fit-out based on GPA Engineering technical specifications. Valves and instruments were procured by ATCO and free issued to Swagelok for installation and factory acceptance testing.
Fabrication of support steel structures	Contracted to MPI Engineering for fabrication based on GPA Engineering shop drawings.
Concrete footings and slab	Contracted to Fueltech Consulting Pty Ltd for installation based on GPA Engineering detailed design drawings.
Valves and instruments	Procured directly by ATCO and free issued to H_2 Blending Skid and H_2 Control Panel fabricators for installation. Where items were not procured in time for installation by the fabricators, valves and instruments were installed on-site by ATCO personnel.
Site installation of H_2 Blending Skid, H_2 Control Panel and supports including cranage	Contracted to SteelDiamond based on Scope of Work prepared by GPA Engineering.
GDS upgrades	Contracted to Downer Group based on ATCO developed Scope of Work and Work Packs.
Mechanical, electrical and control wiring site installation	Undertaken by ATCO personnel based on GPA Engineering developed detailed design drawings.

Description of Procurement Item	Procurement Method
Control system installation, testing and commissioning	Contracted to Emerson Automation Solutions based on GPA Engineering functional specification of control loop.

2.1.3 Environmental Impact, Incidents, Constraints and Mitigation

As noted in Section 1.1.8, Gas Plant will be established within an existing area within ATCO's Jandakot depot.

2.1.4 Safety Impacts, Incidents, Constraints and Mitigations

The highest safety risk for the project was identified as the cranage and heavy lifting required to install the H_2 Blending Skid, H_2 Control Panel and steel support structures. The key control measures to mitigate this risk included,

1. Undertaking detailed lift studies;
2. Ensuring suitable weather conditions during lifting operations; and
3. Use of spotters, barricading and traffic management to minimise potential interaction with the general public and non-project personnel.

No safety incidents were recorded for the project.

2.1.5 Project Budget (Actual CAPEX)

Actual CAPEX at project completion was $2,188,560 against a budget of $2,331,960. Therefore, the project was implemented on schedule and under-budget by $143,400.

The most significant cost deviation was related to the additional engineering support required to complete the project caused by the factors identified in Section 2.1.8 below. Total cost-to-complete for engineering support increased by $318,280 from $390,932 to $709,212.

This increase was absorbed through cost savings in other areas of the project.

2.1.6 Analysis of Commissioning Actual to Forecast

Description	Comments
Timing	Pre-commissioning tests and inspections were completed as planned over the last two weeks of October 2022. Final commissioning was delayed by approximately 4 weeks to the end of November 2022 while waiting for DMIRS approval of the Gas Plant Safety Case, which was obtained on 28th November 2022.
Costs	GPA Engineering's original proposal included the following estimates.

Description	Comments
	• Prepare commissioning procedure: $9,096 • Site commissioning support: $12,540 • Total: $21,636 GPA Engineering submitted a Scope Change Request for the additional costs outlined below to complete the site commissioning works. • Prepare commissioning procedure: $13,671 • Pre-commissioning site attendance: $18,833 • Project management: $504 • Total: $33,008
Approvals	As noted under Timing, final commissioning of the Gas Plant could only be completed after DMIRS accepted the Gas Plant Safety Case. Hydrogen was not permitted to be introduced into the system until the Gas Plant Safety Case was accepted.

2.1.7 Electrolyser Efficiency

Based on a higher heating value (HHV) of Hydrogen of 39.5kWh/kg and the energy consumed as stated in the Proton C30 Electrolyser datasheet of 64.5kWh/kg, the calculated efficiency of the electrolyser at nameplate production rate of 65.0kg/24hr is 61%.

2.1.8 Project Specific Lessons Learnt

Outlined below are the key lessons learnt from implementation of the project within a very short timeframe.

- ATCO was able to minimise negative reactions from impacted members of the local community (i.e. suburbs of Glen Iris, Calleya and Treeby) by engaging early, widely and comprehensively with affected stakeholders through multiple channels including but not limited to,
    - Community information, education and Question and Answer (Q&A) sessions;
    - Engaging with Local Councils;
    - Letter drops;
    - ATCO website and social media channels;
    - Gas retailers;
    - Industry associations; and
    - Call centre.

- Obtaining timely approvals for the Gas Plant Safety Case and amended Gas Distribution System Safety Case were critical elements to enable commissioning and operation of the Gas Plant and associated gas distribution system upgrades before the end of 2022. This was achieved by,
    - Meeting with and working closely with representatives of DMIRS and JTSI on a fortnightly basis to provide updates on project progress and key issues that required input and/or to resolve.
    - Providing key personnel in DMIRS with advance information related to the safety cases to enable timely review.
    - Maintaining open and collaborative communication channels between DMIRS, the appointed Gas Plant Safety Case auditor and ATCO personnel to enable open discussion and resolution of major issues/obstacles.
    - Engaging a suitably qualified and experienced consultant to support ATCO in the development of the Gas Plant Safety case.
- Engaging ATCO internal resources to undertake the majority of the site installation works allowed flexibility in managing resources and attain a high level of quality of work due to the commitment of ATCO staff to complete the project in a timely manner.
- Engaging a suitably qualified and experienced engineering consultant to support ATCO in the following areas enabled the project to be expedited.
    - Detailed engineering technical specifications and design;
    - Procurement support;
    - Site-installation support; and
    - Site commissioning support.
- GPA Engineering was engaged to assist ATCO in this project because of their experience with implementing the HyP SA hydrogen blending project. It was originally intended to duplicate the HyP SA design with minimal changes, where possible. However, the following changes and constraints resulted in significantly increased engineering resources required to procure the appropriate equipment.
    - GPA Engineering's original design for the HyP SA project based on Parker equipment was changed to Swagelok to be consistent with ATCO's preferred equipment supplier for valves.

      This resulted in significantly increased procurement support necessary to define and finalise the technical parameters of flow control valves and other equipment.
    - Revision of the operating basis after the commencement of detailed design which required rework of the design documentation.
    - Procurement lead-time was a major issue due to the tight project delivery timeframe. Consequently, it was necessary to liaise directly with multiple vendors in parallel for equipment such as the Coriolis flow meter (e.g. Emerson and Endress & Hauser); and temperature and pressure transmitters (e.g. Yokogawa, Engdress & Hauser, Emerson, Siemens and Instrowest).

- Use of an existing Emerson Rosemount Gas analyser required re-confirmation that the performance capabilities were adequate, e.g. gas sampling rate and SIL rating.

  Also, given that the unit had been in storage for some time, it was necessary to engage Emerson to carry out a major service of the Gas Analyser which also required support from GPA Engineering.
- GPA Engineering had originally allowed for desktop HAZOP and LOPA workshops only based on the HyP SA project, however due to changes in design it was necessary carry out full-day workshops involving in-person and online attendance by key GPA Engineering personnel.
- Requirement to install a second flow meter as detailed in Item 3 of Section 1.1.10 above.