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## AIR PRODUCTS (BR) LTD

PROJECT NUMBER: A3145

### INSTALLATION: LLANWERN HYDROGEN INSTALLATION (BL 2459)

**TITLE: Energy Efficiency Report**  
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**T C Ryan, UK Operations - Llanwern (APBR Ltd)**  
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## **Llanwern Hydrogen Installation Energy Efficiency Report**

### **Objective**

This report documents all the available techniques and the estimated CO2 reductions associated with these, in accordance with improvement item 9.2.

This energy efficiency report reviews the plant performance against the design, and proposes any energy efficiency improvements that might be required against the Environment Agencies PPC application template, published in December 2002. This report is kept on site and reviewed at a minimum every year, and updated if necessary.

### **General**

The plant was commissioned in April 2002. The electrical equipment (detailed in the PPC application V3145 section 2.7) was all purchased from new for the project and to state of the art energy efficiency standards. The reformer itself and the burners were also manufactured specifically for this project and represent BAT.

BAT for energy use on the plant was described in the PPC application V3145 section 2.7). The site is covered by a CCL agreement and thus only housekeeping energy efficiency measures are subject to PPC regulation. In addition the site energy use is below the threshold for low impact installations) of 1 MW.

A Natural Gas Booster Compressor has been installed, within the Air products facility compound. This was a late request from Tata Steel, and was not included in the original energy calculations

The Booster compressor is designed to prevent loss of feed gas pressure from the Tata Steel distribution main, as more equipment is brought on line within the Tata Steel facility. (including gas fired boilers and pipeline gas supply to other sites within the Tata Steel works)

### **Plant Performance vs Design**

Further efficiencies made, by increasing the use of purge gas for burner operation. This also reduced the natural gas required for burner operation

The plant reformer tube temperatures have been maintained.

Plant operation still to design, Customers on reduced demand since September 2008, plant load following capability increased, now 43% reduction in rates possible. The customer demands increased in 2018.

Due to the loss of one of our customers we have lowered our production again to 43% of rates, as of December 2019.

Table 1 show the basis theoretical annual energy performance

Energy source	Base units	Energy consumption Base theoretical			Emissions Tonnes CO2
		Delivered, Mwhr	Primary, Mwhr	% of total	
Electricity - National Grid	170.5	1494	4267	67%	708
Gas - burners only not feedstock	42	2120	2120	33%	403
Total		3613	6387	100%	1111
Production	kg/yr	727000			
Efficiency	MWHr/Tonne	8.79			

Table 2 shows the actual energy performance for the plant for the period January 2020 to December 2020

Energy source	Base units	Energy consumption Period Jan 2015 to Dec 2015			Emissions Tonnes CO2
		Delivered, Mwhr	Primary, Mwhr	% of total	
Electricity - National Grid	80.98	660	1886	67%	313
Gas - burners only not feedstock	19.64	923	923	33%	175
Total		1583	2809	100%	488
Production	kg/yr	49386			
Efficiency	MWHr/Tonne	56.88			

### Comments

With load following implemented, average natural gas usage to burners has been maintained at an average of 19.64 Kg/Hr.

Minimum plant rate achievable 43% of plant production.

Customer demand for H2 below contract levels during all of 2020 as we have lost one of our customers Or Electrical Steels. Air Products as a company are actively seeking other markets for the excess Hydrogen at the Llanwern Facility.

## **Energy Efficiency Plan**

Continued operation of the (VAX) system. (Installed November 2007).

The VAX system collects data from the plant processor, enabling close monitoring of plant efficiency and load following.

Further routines added during 2009

The assumptions made in the original PPC application were also reviewed and remain valid. All the relevant techniques identified in the guidance note H2 have been implemented in the plant design

Relocation of Fire eye monitors, to provide better monitoring of burner flame.

This has resulted in reduced Purge gas venting, allowing more purge gas to be used for burner operation and reducing natural gas usage.

Main furnace burners replaced in summer shutdown 2013.

New plant cooling tower December 2013.

Plant gas coolers cleaned summer 2015.

Plant process heat exchangers cleaned using a CO2 surface blasting technique summer 2018.

Power meter installed to measure total power to the plant.

Regarding the trending and analysis of the Smart plant efficiency, this data has been added to the KPI visualization tool via the VAX data system. This allows the plant and process support staff to monitor the Smart plant efficiency in real time

Appendix 1 Based on Environment Agencies IPPC template.

***Basic energy efficient operating and maintenance measures are described in the Table below.***

**Table 2.7.2.1**

Are documented <u>operating maintenance and housekeeping measures</u> in place for the following (where relevant):	Yes/no	Not relevant	Further Information (reference documentation, date measures will be in place or reason why not relevant)
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<p>air conditioning, process refrigeration and cooling systems (leaks, seals, temperature control, evaporator/condenser maintenance);</p>	<p>Yes</p>		<p>Cooling system is maintained as part of the planned maintenance system</p> <p>Reformer catalyst changed July 2005</p> <p>Processor controlled Load following installed July 2005</p> <p>Full cooling tower clean completed October 2007.</p> <p>VAX system installed November 2007</p> <p>Syngas cooler clean July 2008</p> <p>Full cooling tower clean completed December 2008.</p> <p>Reformer catalyst changed March 2010.</p> <p>Syngas cooler cleaned March 2010.</p> <p>Syngas cooler cleaned July 2011.</p> <p>Syngas cooler cleaned July 2012.</p> <p>Syngas cooler cleaned July 2013.</p> <p>Reformer catalyst changed July 2013.</p> <p>New plant cooling tower December 2013.</p> <p>Syngas cooler cleaned July 2014.</p> <p>Plant gas coolers cleaned July 2014.</p> <p>Syngas cooler cleaned June 2015.</p> <p>Plant gas coolers cleaned June 2015.</p> <p>Burners check for correct operation June 2015.</p> <p>Syngas cooler cleaned July 2016.</p> <p>Reformer catalyst changed July 2016.</p> <p>Syngas cooler cleaned July 2017.</p> <p>C201 Natural Gas compressor coolers cleaned July 2017.</p> <p>Syngas cooler cleaned July 2018.</p> <p>Reformer inner/outer tubes plus catalyst changed July 2018.</p> <p>Process gas heat exchangers cleaned July 2018.</p> <p>Burners check for correct operation June 2018.</p> <p>Burners check for correct operation July 2019.</p> <p>Syngas cooler cleaned July 2019.</p> <p>Full cooling tower clean completed November 2019.</p> <p>Burners check for correct operation July 2020.</p> <p>Syngas cooler cleaned July 2020.</p>
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Operation of motors and drives	Yes		Maintained as part of the planned maintenance system
Compressed gas systems (leaks, procedures for use);	Yes		Small Compressed (instrument) air system part of planned maintenance
Steam distribution systems (leaks, traps, insulation);	Yes		Maintained as part of the planned maintenance system
Space heating and hot water systems;		✓	No buildings in the installation
Lubrication to avoid high friction losses;	Yes		Compressor operations and maintenance
Boiler maintenance e.g. optimising excess air;		✓	Automatic control system
Other maintenance relevant to the activities within the installation.			Reformer burners constantly monitored Fire eye monitors relocated to provide better monitoring of burner operation, and increased use of Purge gas within the burners (Also reducing natural gas usage) July 2008 Reformer furnace burners replaced July 2013.

Table 2.7.2.2

Confirm that the following physical measures are in place to avoid excessive heating or cooling losses for the following (where relevant):	Yes/no	Not relevant	Further Information (date measures will be in place or reason why not relevant)
Sufficient insulation of steam systems, heated vessels and pipework	Yes		September 2004. Screens installed to minimise the effects of high winds during winter conditions. Some vessel insulation replaced July 2013.
Provision of sealing and containment methods to maintain temperature	Yes		
Simple sensors and timers are fitted to prevent unnecessary discharge of heated liquids and gases.		✓	Discharges are only what is necessary for the blow down of the steam system
Other appropriate measures			

Table 2.7.2.3

Confirm that the following building service measures are in place for the following (where relevant):	Yes/no	Not relevant	Further Information (reference documentation, date measures will be in place or reason why not relevant)
Energy efficient lighting is in place	Yes		External flood lights with LED lighting. Internally with high efficiency fluorescent tubes (appropriate to relevant hazardous area classification) Lighting replaced with units requiring less maintenance September 2008

Energy efficient climate control systems are in place for: Space Heating Hot water Temperature control Ventilation Draught proofing		✓	No buildings in the installation
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*An energy efficiency plan is provided below to identify and appraise applicable energy efficiency techniques.*

**Table 2.7.2.4**

ALL APPLICANTS			APPLICANTS WITHOUT CCA OR TRADING ONLY		
Energy efficiency measure e.g. CHP	CO <sub>2</sub> savings (tonnes)		Equivalent Annual Cost (EAC) £k	EAC/CO <sub>2</sub> saved £/tonne	Date for implementation
	Annual	lifetime			
CHP	NA	NA	N/a		
Process efficiency measures	NE	NE			
<b>Further information</b>					
See below on CHP					
As a new plant operating well within original design, no process changes planned and none evaluated (NE) at this early stage. However energy efficiency work is on going and any process changes identified will be added to the efficiency plan.					

**Notes**

1. Refer to Energy Efficiency Guidance Note for cost appraisal methodology and CO<sub>2</sub> emission factors.
2. Where other appraisal methodologies have been used, state the method, and provide evidence that appropriate discount rates, asset life and expenditure (£/t) criteria have been employed

**Efficient Energy supply techniques**

**Table 2.7.3.2**

Energy supply techniques	Is this technique currently used at the installation? (Y / N)	If NO explain why technique is not appropriate or provide implementation date
Use of CHP;	No	Not economic, v low energy user There is no on or off site use for other low grade heat such as the process steam. Thus the plant is designed to operate as close as possible to steam balance, with the excess vented
Recovery of energy from waste;	No	No high calorific value streams
Use of less polluting fuels.	Yes	Natural gas is the feedstock
Others applicable to your activities		None
<b>Further information</b>		