The Transition to Low Carbon in Alumina Refining

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Abstract

The Rusal Aughinish Alumina (AAL) refinery is located on Aughinish Island on the shore of the Shannon Estuary, 33 kilometres west of Limerick city in the South West of Ireland. The plant, commenced operation in 1983 and has a current production capability of 1.99 million tonnes per annum. The source of bauxite is predominantly from Guinea and Brazil, which is used to produce alumina via the Bayer process. AAL started its decarbonisation investment journey nearly two decades ago with the installation of a high efficiency Combined Heat and Power (CHP) plant which was best available technology at the time in Ireland, and today is still second only to renewables such as wind or solar for low carbon intensity. In the intervening years AAL has progressively converted the entire refinery from fuel oil to natural gas. In December 2019, the introduction of the European (EU) Green Deal to reduce carbon emissions by 55 % by 2030 gave a clear signal to the world that a transition to renewable energy technologies is required in society and in industry sectors, including the aluminium value chain where alumina refining belongs. Beyond 2030, the EU Green Deal also provides a framework to carbon neutrality by 2050 with many other countries recently providing similar pledge. With this goal in mind, each industrial sector and individual facility must identify the optimum decarbonisation path based on geographical location and available renewable energy technologies, now and in the future. Many of the decarbonisation technologies are currently not commercially viable at the scale required for alumina refining. Private and public stakeholders have to work together to provide solutions that are practical, can be made viable and implemented at an historically fast pace to meet this goal. This paper provides details of the decarbonisation plan for an alumina refinery based in Ireland.

Keywords: Alumina refinery, decarbonisation, renewable energy.

1. Introduction

Alumina production started in 1983 with a production name plate capacity of 800,000 tonnes per annum using a single production chain. Over the years, production capability was increased to 1,990,000 tons per annum while remaining a single chain operation. Protecting the surrounding environment has been an integral part of the management of the refinery for decades. For nearly two decades, the focus to reduce emissions to air and more specifically Greenhouse gas (GHG) emissions has been paramount for AAL.

AAL's approach to reduce emissions used in the early 2000s was three-fold:

- Improve energy efficiency in the refinery to reduce primary energy consumption.
- Implement new technology to significantly reduce carbon emissions
- Transition to new fuel type to reduce emissions

This resulted in a complete transition to natural gas for all process heat requirements and the installation of a high efficiency CHP plant to generate electricity for internal use and also to export to the National electricity network.

Nearly 20 years later, a much more ambitious transition is being developed in Europe under a program called the European Green Deal (EU Green Deal) which was released in Dec 2019. The European Green Deal is a set of policy initiatives introduced by the European Commission (EU COM) with the overarching aim of making Europe climate neutral in 2050 [1]. On July 14th 2021, the EU COM released a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55 % by 2030, compared to 1990 levels. Achieving these emission reductions in the next decade is crucial to Europe becoming carbon neutral by 2050 and making the European Green Deal a reality.

AAL has been actively involved in understanding how to implement the EU Green Deal which will be both a major challenge to our industry sector to remain competitive globally and an opportunity to participate in the development and integration of new technologies which will be necessary to protect the environment and climate of the planet.

The following sections of the paper provide details on the carbon journey so far and an insight into transition options open to AAL.

2. Carbon Journey so Far

The migration from fuel oil to natural gas was delivered with a major multi-year investment programme.

In 2006, a new 160MW natural gas High Efficiency Combined Heat and Power plant (or CHP) was installed which supplies 300 tph of steam to the refinery and 45 MW of electricity to supply the plant equipment. The excess power is exported to the National electricity grid. The electricity produced by AAL CHP (240 g CO_2 per kWh) has had much lower carbon content compared to the National electricity grid carbon content which was at 635 g CO_2 per kWh when CHP was commissioned and at 324 g CO_2 per kWh in 2019 [7] (see figure 1). In 2021, AAL CHP still produces the lowest carbon power on the grid after renewables such as wind and solar in Ireland. CHP will remain the best technology until a renewable fuel is commercially available and economically viable to industry in Ireland which is many years away.

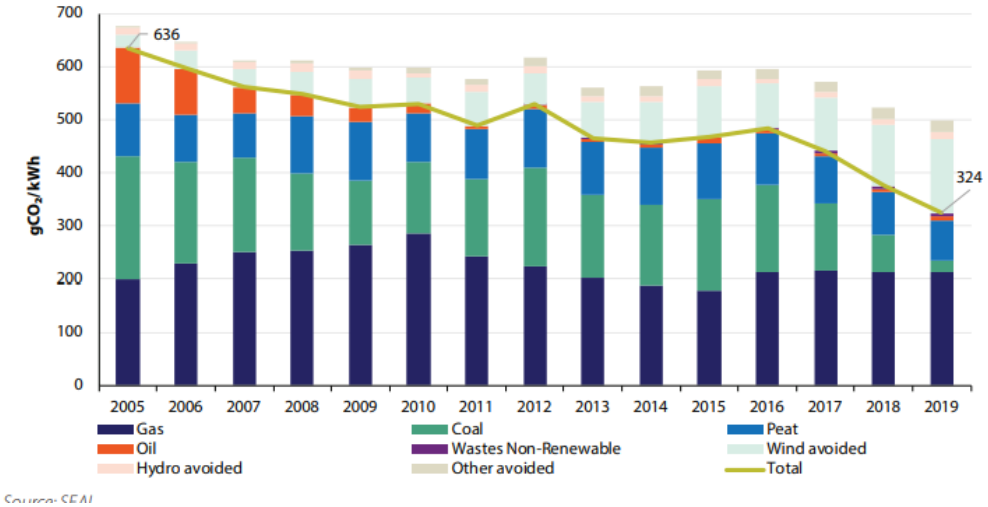

Figure 1. CO_2 Intensity of electricity in Ireland [7].

The AAL transition to natural gas continued with the conversion of the three alumina calciners completed by 2012. In 2014, two new gas boilers were installed to replace the fuel oil boilers fully completing the transition to natural gas (see Figure 2).

8. Conclusion

The European Union, including Ireland, have signed up to the EU Climate Law under the Green Deal Initiative to reduce carbon emissions by 55 % by 2030 towards carbon neutrality by 2050. Many other countries have made similar pledges to carbon neutrality around the globe by 2050 - 2060. This represents the greatest of technological, commercial and policy challenges, but also presents a major opportunity to make real difference for climate and environment for this and next generations.

AAL is facing this challenge with a clear commitment by Rusal to deliver a comprehensive carbon reduction road map. The road map for the coming decade will be achieved using two routes; efficiency improvement across the plant and substitution of natural gas by process electrification while following closely development in future energy sources such as bio-fuels, carbon capture and storage and green hydrogen.

AAL will prioritise carbon reduction via efficiency improvement and follow with renewable energy source to complete the decarbonisation when technologies are available in required quantity and economically viable.

9. References

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