



## Introduction to Fossil Free Steelmaking

Steel is the most versatile and important material in the world. The steel industry is imperative to civilisation. However, the steel industry is a major contributor to greenhouse gas emissions and associated global warming. Sources of greenhouse gas emissions from traditional integrated ironmaking & steelmaking will be detailed and the latest advancements to realise a carbon-neutral steel industry will be introduced.

### Who Should Attend

This course is designed for individuals interested in or involved in the steel industry and seeking to understand and adopt sustainable practices in steel production. This course would benefit engineers, managers, researchers, and professionals in the steel manufacturing sector, including those involved in production operations, sustainability, environmental management, and innovation. Additionally, individuals from related industries, such as energy, environmental consulting, and policy-making, interested in the transition to fossil-free steelmaking can also benefit from attending this training course.

### Learning Outcomes

After completing this module, the student should be able to demonstrate an understanding of:

- the pressure on the steel industry to reduce greenhouse gas emissions
- the distribution of greenhouse gas emissions across traditional integrated ironmaking & steelmaking
- traditional integrated ironmaking & steelmaking processes with emphasis on the Blast Furnace and Basic Oxygen Furnace
- established ironmaking processes besides the Blast Furnace with emphasis on Direct Reduced Iron by natural gas
- Direct Reduced Iron by hydrogen with water the only by-product
- hydrogen production processes with emphasis on water electrolysis
- how to store & transport hydrogen
- established steelmaking processes besides basic oxygen steelmaking with emphasis on the increasing proportion of steel produced by the electric arc furnace process
- effective scrap steel recycling to capitalise on the Electric Arc Furnace
- the socioeconomic factors that need to be addressed alongside the technical challenges

## Course Programme

- Introduction: greenhouse gases, global warming, the need for fossil-free steelmaking
- Legislation: emissions trading, carbon pricing, the UK post-Brexit
- Greenhouse Gas Emissions from Traditional Integrated Steelmaking: charge preparation, Blast Furnace, Basic Oxygen Furnace
- Routes to Cleaner Steelmaking: Blast Furnace efficiency, carbon capture, Direct Reduced Iron
- Direct Reduced Iron: chemistry, coal-based, gas-based, hybrid processes
- Direct Reduced Iron by Hydrogen: chemistry, kinetics, emissions
- Hydrogen: water electrolysis, renewable electricity, fuel cells, storage & transport
- Electric Arc Steelmaking: how it works, emissions, electricity demand and use of other heat sources
- Scrap & Recycling: classification, quantity, quality, measures to increase recycling
- The Business Case: the cost of fossil-free steel, cooperation across sectors & nations

## Course Delivery

The course is conveniently delivered through Swansea University's Learning Management System, Canvas, providing a seamless online learning experience. Students are granted a generous three-month period to complete the course, allowing for personalised learning at their own preferred pace.

Throughout the course, participants will engage in three progressive assessment quizzes, complemented by a comprehensive final written assessment that culminates their learning journey. All assessments are conveniently submitted through the secure and user-friendly platform, Canvas.

To ensure a supportive and enriching learning environment, expert guidance and assistance are readily available from our project lecturers and dedicated learning technologists. These experienced professionals can be easily reached through Canvas or via email.

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