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Fundamentals of Green Steel

Future proofing the way the world makes steel with minimal carbon emissions

Delivered in **Live Online Training** Format

Apr 2022	Part 1: **12th April**	Part 2: **13th April**
	Course Parts will commence at **15:00** and end at **18:00** **(AEST)**. There will be short breaks during each course Part.	
Nov 2022	Part 1: **24th November**	Part 2: **25th November**
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2 Part Series

KEY LEARNING OBJECTIVES

- Understand commercial considerations involving green steel, hydrogen and lessons-learned
- Gain awareness of the Green Standards
- Learn the techniques for the production and use of green steel as part of net zero construction
- Understand practical risks and opportunities associated with the production and use of green Steel, especially via the use of hydrogen
- Appreciate the challenges around a net zero aligned steel industry support and bailouts
- Explore alternatives to green steel
- Learn about real-world projects aimed at reducing CO2 emissions in steel making
- Understand the differing perspectives of the investor, the operator, the customer and government
- Recognise political and diplomatic implications of international trade in green steel including recent trends
- Review design, storage, and hydrogen transportation considerations
- Discover the characteristics that broaden yet constrain the commercial and technical links in the 'supply chain'
- Consider various options for green steel-market developments

Our Expert Course Instructors

Charley Rattan

Charley Rattan, Hydrogen and Offshore Wind Business Advisor and Trainer. The course is led by Charley Rattan, international hydrogen expert and respected energy insider and facilitator bringing over 25 years' real-world renewable experience and a track record of successful major project delivery.

Joachim von Schéele
Global Director Commercialization, Linde plc

Joachim von Schéele received his MSc in Process Metallurgy and PhD in Production Engineering from Royal Institute of Technology (KTH), Stockholm, Sweden in 1987 and 1992, respectively. With a mix of steel research and consultancy background, he joined the industrial gases industry in 1996.

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ABOUT THE COURSE

The green steel sector is expected to grow significantly across the globe in the coming years. The UK, for example, recently set a target to produce forty gigawatts of offshore wind and so will require vast quantities of green steel for turbine foundations and cabling infrastructure. Five gigawatts of hydrogen is also projected by 2030, representing a 40-fold increase within nine years for that sector.

The journey to a renewable, circular and low-carbon economy (facilitated with electrons, hydrogen and other technologies), will be challenging and the very top priority will be that it is implemented and delivered safely. This course details how global leaders can assist. Developers and stakeholders require their people and supply chain to possess the necessary skills and competencies to deliver green steel projects safely, on time and with the highest quality standards.

The course aims to enable companies and stakeholders to be aware of the fundamentals of green steel. What it is and what it means for the future? What decisions and plans are likely to be made based on the real opportunities that are emerging? Participants will be guided as to where early opportunities are most likely to lie, who is involved and how to engage.

WHO WILL BENEFIT

Existing companies particularly those who are already part of the steel supply chain and those looking to future-proof their capabilities. Project developers seeking to decarbonise and source green infrastructure, financiers and the construction industry. Construction, OEM's and balance of plant organisations. Particularly relevant to engineering companies, those involved in storage compression equipment and shipping as well as those seeking to enter the energy arena with its myriad opportunities in a market set for exponential growth. The course will also benefit stakeholders from government, finance and consenting and those wishing to understand the realities of green steel production.

EXPERT COURSE INSTRUCTORS

Charley Rattan
Hydrogen and Offshore Wind Business Advisor and Trainer

The course is led by Charley Rattan, international hydrogen expert and respected energy insider and facilitator bringing over 25 years' real-world renewable experience and a track record of successful major project delivery. Charley is a trusted strategic advisor to global energy companies and an advocate and facilitator for the emerging innovation energy market.

Charley is respected as a leading authority in hydrogen and renewables providing consultancy and training at high level across the globe including for key stakeholders, governments, consenting authorities and world organisations such a the United Nations.

Joachim von Schéele
Global Director Commercialization, Linde plc

Joachim von Schéele received his MSc in Process Metallurgy and PhD in Production Engineering from Royal Institute of Technology (KTH), Stockholm, Sweden in 1987 and 1992, respectively.

With a mix of steel research and consultancy background, he joined the industrial gases industry in 1996. Since then, he has served in many different technical and commercial management roles at AGA, BOC and Linde, and been actively doing business in more than 40 countries around the world. After a decade in Asia, first in India as VP for South Asia and then in China heading Application Sales for Asia-Pacific, he is since 2020 based in Munich, Germany. With a focus on hard-to-abate-industries, Joachim von Schéele is very much engaged in driving the sustainability agenda – with focus on decarbonization – and involving and co-operating with Linde's customers on this topic to achieve joint progress and success. He is a world-leading expert on green steel production.

Joachim von Schéele is a well-known speaker and has published more than 200 papers on energy and emission conservation, recycling, and production. He has served as a member of more than 30 boards of companies, associations, and research and education organizations, and as session chairman at many conferences. He is included in Who's Who in the World, Who's Who in Engineering, and Who's Who in Asia, and he holds seven patents related to combustion and recycling.

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Course Outline

Introduction

- Netzero target setting, high level ramifications for the steel sector.
- CO2 emissions classification (scope 1, 2 and 3)
- CO2 emissions by sector (contribution of steel making, 7-10%)

How and where steel is made, main players/corporates

- Describe the two processes to make steel, and their applications:
  - Integrated steelmaking (72% of global steel production): iron making in a blast furnace, steel in a blast oxygen furnace.
  - Electric steelmaking: direct reduction of ore into iron, and steel from iron / scrap metal in an Electric Arc Furnace
- Discuss global steelmaking capacity (80/20 rule), by country, by end-application, and outlook for future demand (including uncertainties, e.g. from competing, more sustainable solutions)
- Identify/introduce the global and niche specialist steel companies (e.g. Arcelor, Nippon, Tata, Dillinger etc.)
- Illustrate the global supply chain (from iron ore and metallurgical coal to steel and end-products) and the different competitive strategies (low cost/high volume – construction, high price – performance steels)
- Circular principles in the steel sector (current practices, new developments, in particular related to a steel intensive renewable sector like wind e.g. Ørsted)

Options to decarbonise steel

- Emission intensity by steel making process, sources and types of emissions (direct emissions – scope 1 e.g. fuel combustion for heat, reduction of iron ore, indirect emissions - scope 2, for example emissions from mining iron ore, purchased electricity for power)
- Technology options for the primary (iron and steel making) process:
  - CCS and keeping iron ore reduction as is
  - Eliminate emissions through iron ore reduction with green hydrogen.
  - Steel making discuss technology options for oxygen steel plants and EAF
- Hydrogen: green or blue? For green hydrogen: sources of supply – offshore wind, offshore floating wind, mega scale solar, electrolysers, other equipment and services required, location challenges.
- Promising emerging technologies for low carbon intensive steel (at lower TRL's)
- Addressing secondary sources of emissions, as well as emissions elsewhere in the chain
- Fundamental constraints (e.g. DRI – EFA, shortage recycled steel, legacy assets - longevity of BF's/retrofitting versus new plant, CCS <100% effective and geographical limitations, security of supply & defence)
- Other challenges to overcome (e.g. cyclical overcapacity, green steel certification – transparency in end-to-end supply chain emissions reductions, global competitive dynamics)

Green steel – economics, and supply chain considerations

- Cost drivers of green steel, cost of emissions reduction, importance of renewable electricity prices
- Cost comparison of GHG intensive steel versus green steel, now and future projections (and the associated assumptions)
- Global competition and commercial perspectives of green steel. For example: netzero users of steel – i.e. their indirect emissions from purchased steel i.e. scope 2. Cost increase of steel translated into increase in total cost of end-product, e.g. a car.
- First mover advantages, late adopters' strategy
- Competition from alternative green materials, e.g. aluminium, engineered wood.
- The outlook for the extractive industries, global metallurgical coal and iron ore consumption
- Extractive sector netzero initiatives and challenges
- Supply chain considerations of green steel (e.g. hydrogen supply agreements, security of supply, co-investment & joint venture partnering, defence sourcing strategy)
- Possible transition plans (staged reduction in emissions, e.g. [1] reduced energy usage, recycling heat, renewable energy [2] retrofitting low carbon technologies, [3] Wide scale adoption of transformative low or zero carbon technology that is cost competitive) - examples

Green steel projects – overview and discussion, deep dives into case studies

- Description/discussion of pilot plants currently in operation, including projections on cost of green steel.
- Plants under development/planning process (consenting, implementation, construction) - locate live applications on global portals, nuances an stakeholder feedback seek and share videos for major projects
- Project pipeline/outlook
- Linkages to regeneration of existing, obsolete steel making facilities (e.g. Scunthorpe, Teesside)
- State sponsored initiatives (ULCOS program (Ultra low CO2 Steelmaking - EU), National COURSE50 (Japan, e.g. DRI electrolysis), USA, India, China
- Topics/issues/choke points in need of more attention (e.g. policy support, investment, R&D)

Policy and regulatory perspectives – global initiatives and national nuances

- IPCC perspective
- United Nations perspective
- IEA outlook
- EU Green steel directive (including import restrictions on CO2 intensive products)
- National nuances: Canada, UK, USA, Australia, Saudi Arabia, UAE, China, Japan, South Korea, Finland Nordics, Germany

Key stakeholder perspectives

- Iron ore and metallurgical coal producers
- National steel making companies.
- Large consumers of steel (car manufacturing, shipping, offshore wind, 'new' O&G, construction)
- NGO's
- Investors
- Irena

10 points to consider when investing in a green steel project

- List of things to address (e.g. permitting, operational requirements, HSE)

Summary, wrap up, final questions

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