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Energiewende Switch to the Future

Welcome to the

Australian-German Energy Symposium

18-19 September 2019

adelphi

ENERGY TRANSITION HUB an Australian-German innovation partnership

AHK Deutsch-Australische Industrie- und Handelskammer German-Australian Chamber of Industry and Commerce

Transition implications for energy-intensive industries for the transition

Moderator: **Prof. Ken Baldwin**
Director, Energy Change Institute, Australian National University

Marc Barrington
CEO, SIMEC Energy Australia

Dr. Volker Hille
Head of Corporate Technology, Salzgitter AG

Karen Durand
Corporate Sustainability Manager, Incitec Pivot

Dr. Silvia Maddedu *(no slides)*
Senior Industry Expert, Potsdam Institute for Climate Impact Research (PIK)

Michael Lord
Zero Carbon Researcher, Energy Transition Hub

Transition implications for energy-intensive industries for the transition

Professor Ken Baldwin

1. Changing forces

- Shifting comparative advantage

  = labor + energy + minerals + capital + ecosystems

- Decarbonisation = cheap renewable energy (or energy vectors like hydrogen)

- Geopolitics = Belt and Road, Russian gas, Middle-East decline, US unconventional gas, climate uncertainty

2. Repositioning in the context of Australia

- Vast, cheap renewable energy
- Massive mineral resources
- Highly skilled (low intensity) labour
- Stability and good governance
- Topic of the ANU Energy Change Institute Grand Challenge:

  Zero-Carbon Energy for the Asia-Pacific

3. New opportunities vs incumbency

- Sunk investments – maximising the asset value
- Repositioning to take advantage of mature economic drivers: venture capital, financial institutions, skilled corporate capabilities, big project experience
- Sector coupling – renewable energy, hydrogen production, transport, downstream industries

Australian National University

ANU Energy Change Institute

Thank you !

SIMEC

SIMEC ENERGY AUSTRALIA

Australian-German Energy Symposium

CEO, Marc Barrington

MEMBER OF GFG ALLIANCE

September 2019

About us

SIMEC

MEMBER OF GFG ALLIANCE

SIMEC Energy Australia (SEA) is a member of the GFG Alliance.

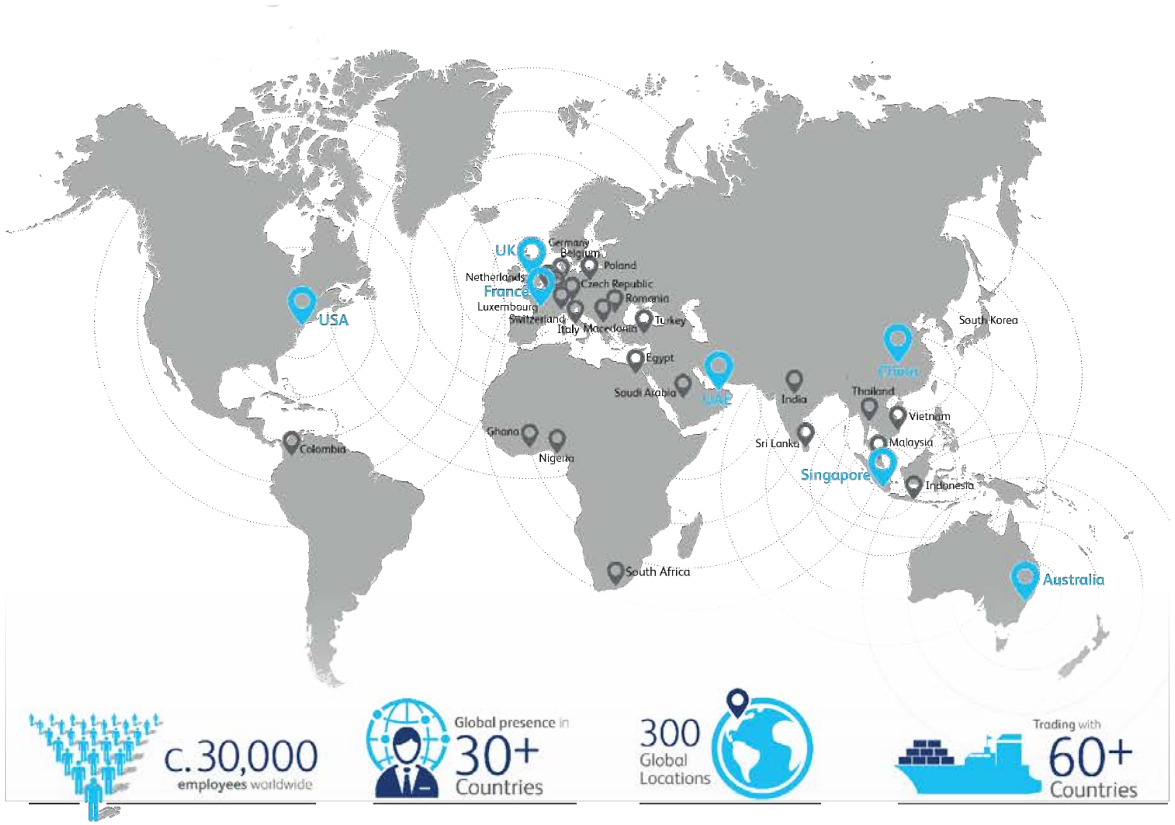
The GFG Alliance is an international grouping of businesses with interests in mining, energy generation, metals engineering, financing and property.

SEA is a relatively new energy company embracing the challenges of a low emissions economy through retailing, procurement and development of renewable generation. We are the only vertically integrated Australian electricity retailer whose major shareholder is a large consumer of energy.

SOUTH AUSTRALIA

SEA is also the electricity retailer to the South Australian (SA) Government, the SACOME Buyers Group, Infrabuild and a growing list of customers. We are backing our SA customer base with a pipeline of renewable energy projects exceeding 1 GW.

GFG's global footprint



Source: https://www.gfgalliance.com/about-us/our-global-footprint/

Our goal

In a market focused on cost and sustainability, we partner with customers to deliver innovative, flexible and transparent energy solutions.

- Delivering globally competitive energy solutions
- Providing real value and 'win-win' outcomes - understanding the needs of our customers through the current sectoral transformation and beyond
- Identifying technologies that deliver the best value for our customers including, matching load with generation and demand response (DR)

Increasingly we are engaging with 'SMART' customers with evolving energy needs.

- **S** Sophisticated technology uptake
- **M** Matching own renewable generation with battery storage
- **A** Automating Demand Response
- **R** Rewards for providing Market Ancillary Services
- **T** Trial participation that could further lower energy costs

Our targeted generation portfolio

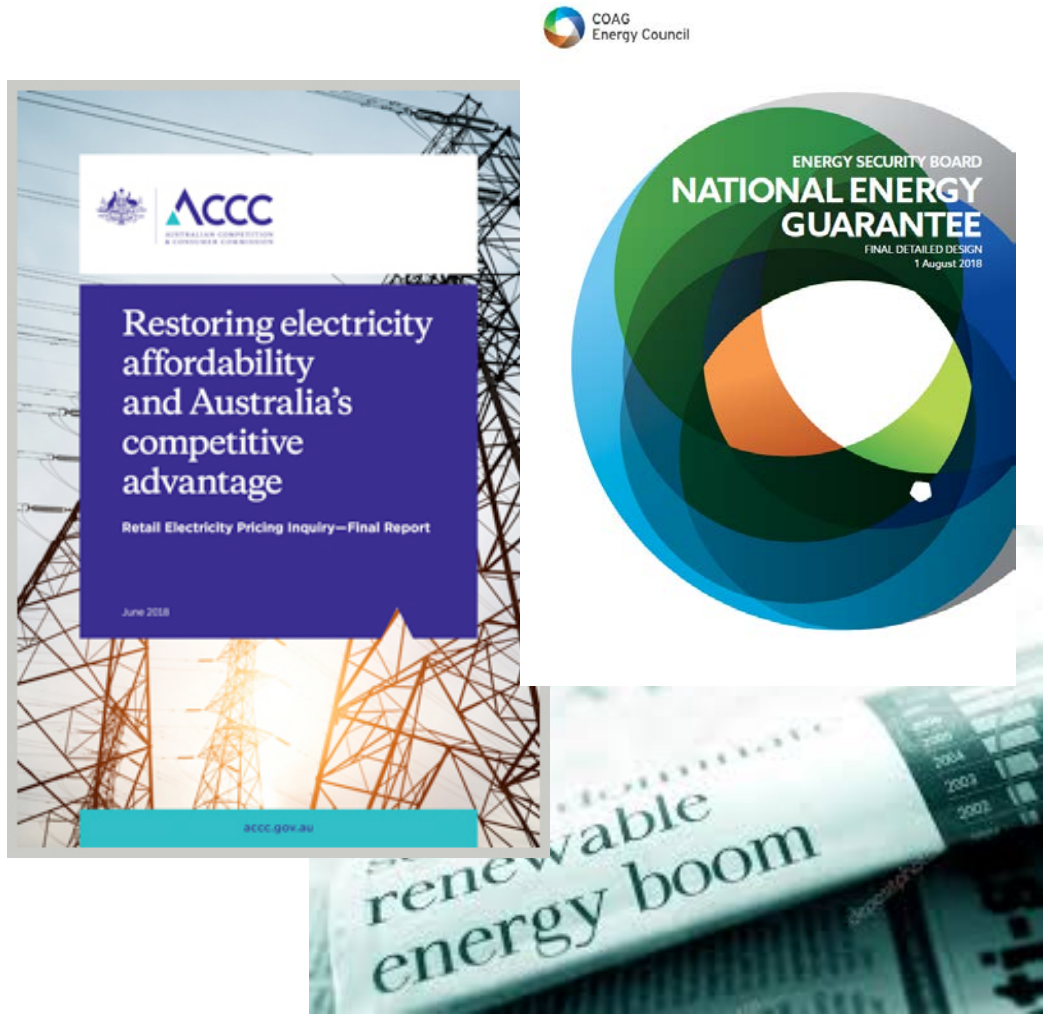
Regulatory & policy environment

Policy predictability

- Almost daily press commentary on the state of east-coast energy markets i.e. asset withdrawals/reliability concerns, 'big stick' legislation, price shocks and diminishing industry competitiveness
- The simultaneous pursuit of the 3 policy objectives being; reliability; emissions reductions; and price; may be tantalisingly out of reach?

Impacts of a lack of predictability on market outcomes

- Without predictable policy settings investors typically delay implementing new capital (physical and financial) OR increasingly seek a higher rate of return to account for market conditions
- The lack of predictability can then generate more confusion (and costs) as policy makers attempt to resolve pressing market issues via policies and measures including; resorting to RERT; changes to market settings i.e. WDRM OR potentially going it alone on a jurisdictional basis



What our customers want

Changing customer needs

- Forward thinking organisations, such as REX Minerals, are considering energy market integration, and the associated value streams that can be unlocked, in business decision making
- This integration improves the ROI for advanced technology deployment including automated Demand Response (DR)
- DR involves changing how customers use energy for short periods of time to respond to energy market signals.
  - Use of automation technology to maximise energy flexibility can enable a customer to unlock additional value streams including DR incentives from retailers, cost avoidance from tariff arbitrage and peak load management along with participation in other markets such as FCAS
  - Capital improvement works (expansion or new build) on sites presents the opportunity to embed this technology, along with flexible plant design and energy assets (VSD, batteries etc)

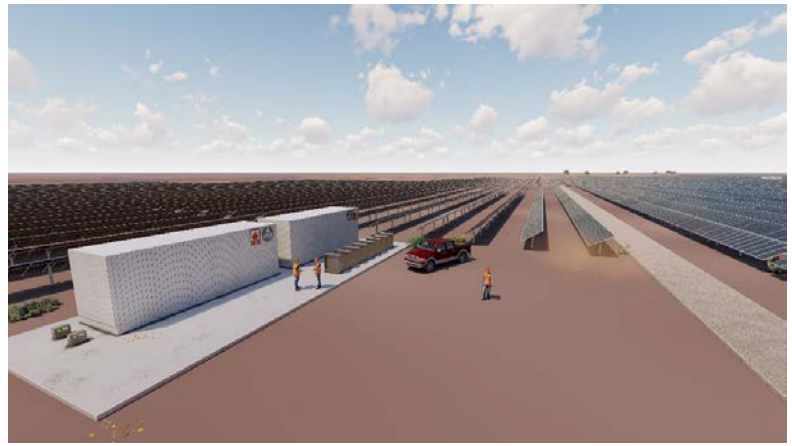
Drawing to a close

Sectoral need

- There exists a real need to reduce the price of electricity, achieve the sectoral transformation to a lower emissions future and also maintain reliability – solving the 'trilemma' is now critical
- Delivering policy predictability will secure the sectoral outcomes required and ensure that customers have access to competitively priced energy – this is simply markets working efficiently

SIMEC actions

- SIMEC is not waiting for policy predictability
- We are proactively working with our customers to create 'win-win' solutions that deliver globally competitive energy; lower emissions; and also contribute to market strength
- Technology costs are continually declining, providing us the capability to deliver on this objective



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SALCOS

CDA Deep Decarbonization of Primary Steelmaking – Features and Prerequisites

Australian-German Energy Symposium

Melbourne, 19.09.2019

Dr. Volker Hille, SZAG

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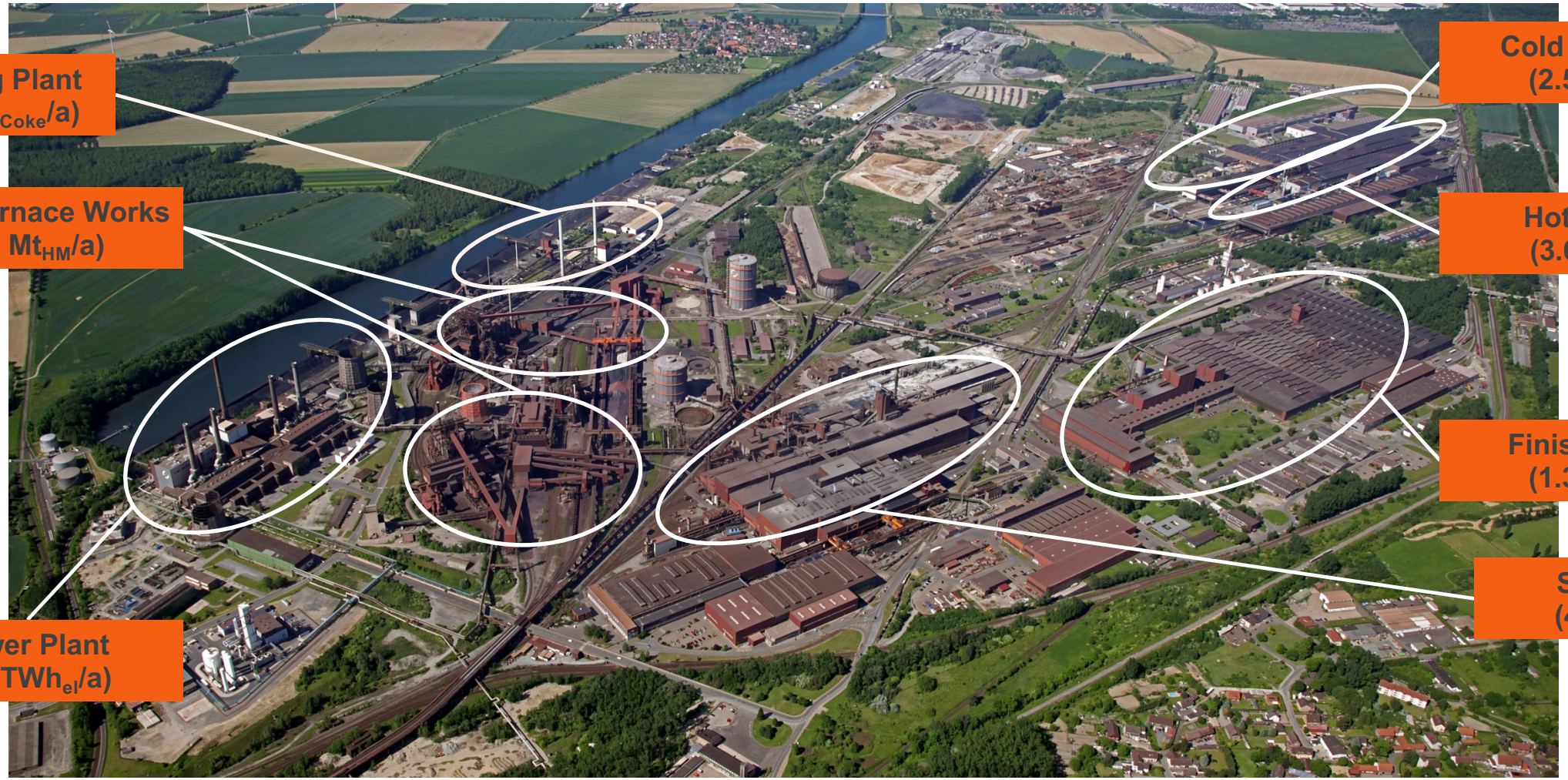
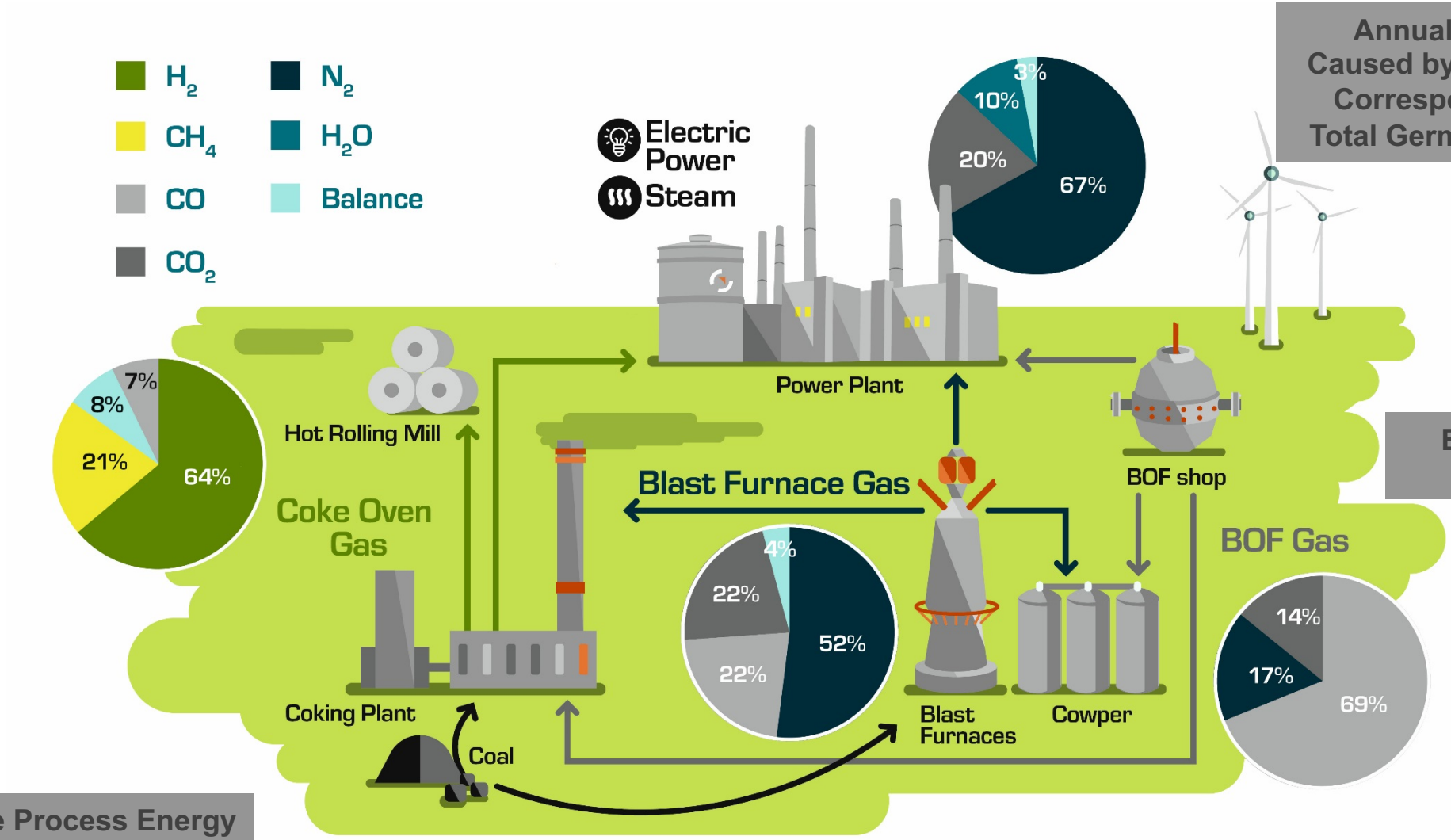
Integrated Steelworks of SZFG at Salzgitter (2018)



Status Quo: Highly Efficient, Energetically Optimized, Fully Carbon Based Integrated Steelmaking

SALZGITTERAG Stahl und Technologie

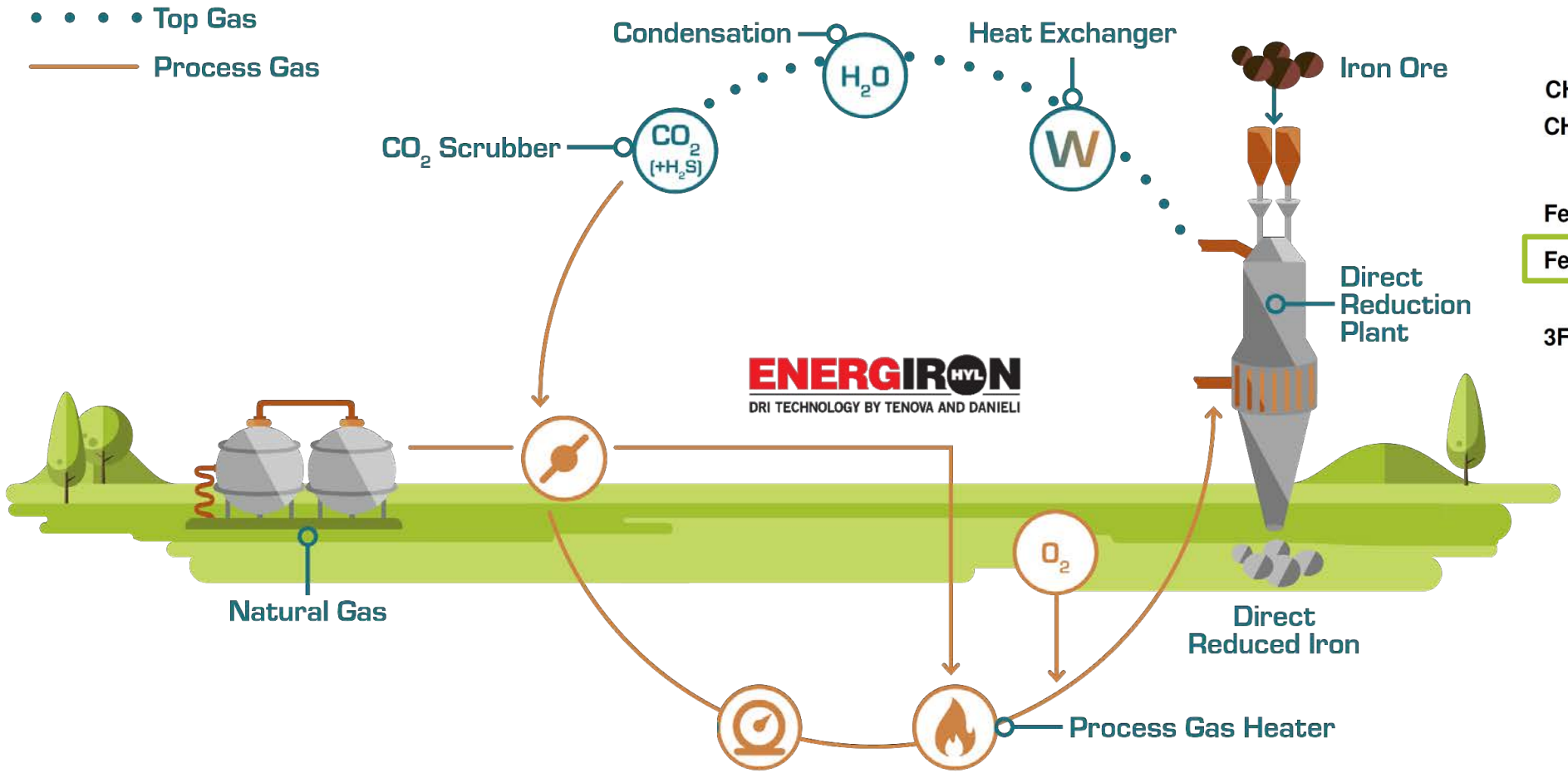
Annual CO_2 Emissions Caused by SZFG: ~ 8 Mt_{CO2}/a, Corresponding to ~ 1% of Total German CO_2 Emissions



Energy Losses via Flares ~ 0.1 %

Complete Process Energy Supplied via Carbon!

Starting Point: Natural Gas Based ENERGIRON „Direct Reduction Process" (DRP)



In-situ Reforming

$CH_4 + H_2O \longrightarrow CO + 3H_2$

$CH_4 + CO_2 \longrightarrow 2CO + 2H_2$

Reduction

$Fe_2O_3 + 3CO \longrightarrow 2Fe° + 3CO_2$

$Fe_2O_3 + 3H_2 \longrightarrow 2Fe° + 3H_2O$

Carburization

$3Fe° + CH_4 \longrightarrow Fe_3C + 2H_2$

„DRP 2.0“ - Further Lowering the CO_2 Footprint via Additional, Flexible Electrolytical Hydrogen Input

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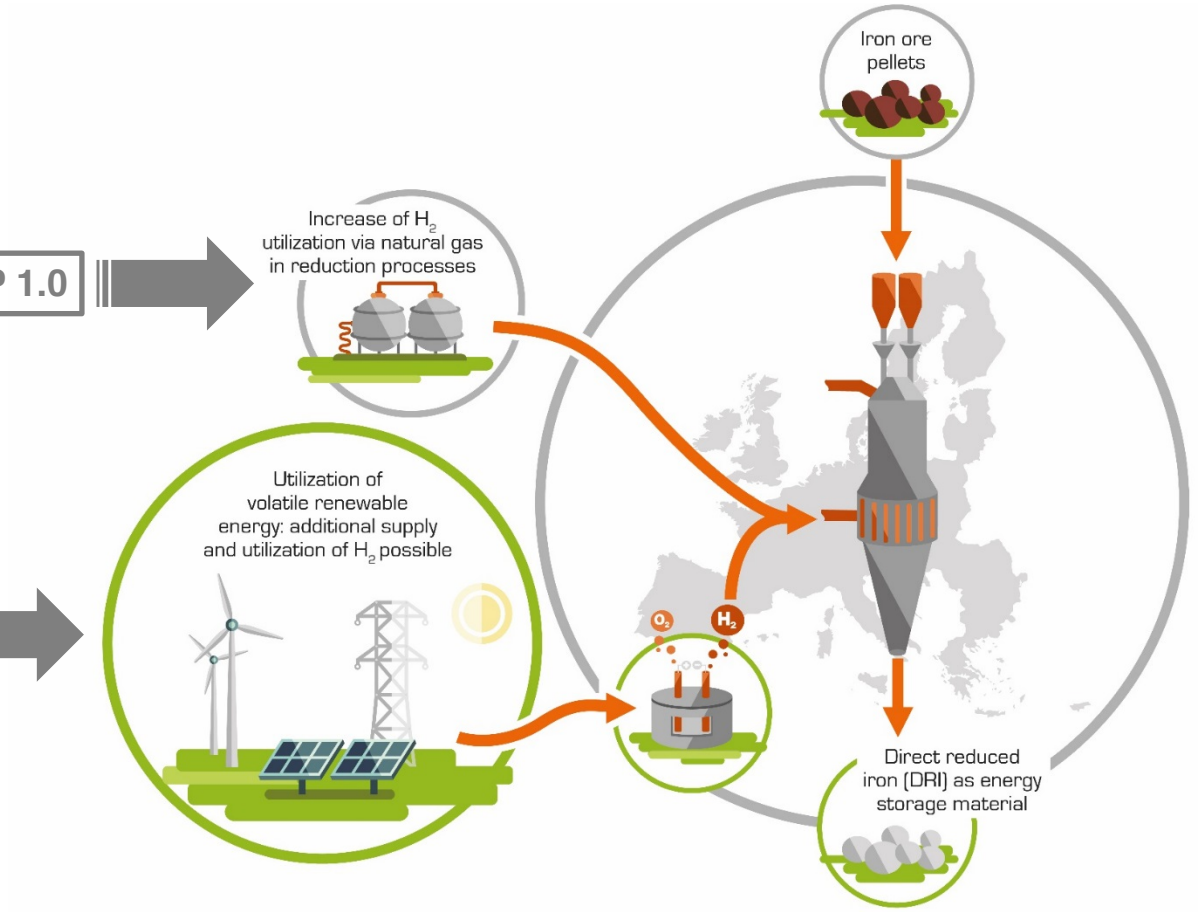
DRP 1.0

SALCOS
Low Carbon Steelmaking



- Combination of Established (Direct Reduction with Natural Gas) and Innovative (Hydrogen Production and Use) Technologies
- Integration into Existing Integrated Steel Works
- Incremental Reduction of CO_2 Emissions up to 95%
- Sustainable "Carbon Direct Avoidance" Approach

Transformation of Integrated Steelmaking to H_2-Enhanced DRP/EAF Based Steelmaking in Three Stages

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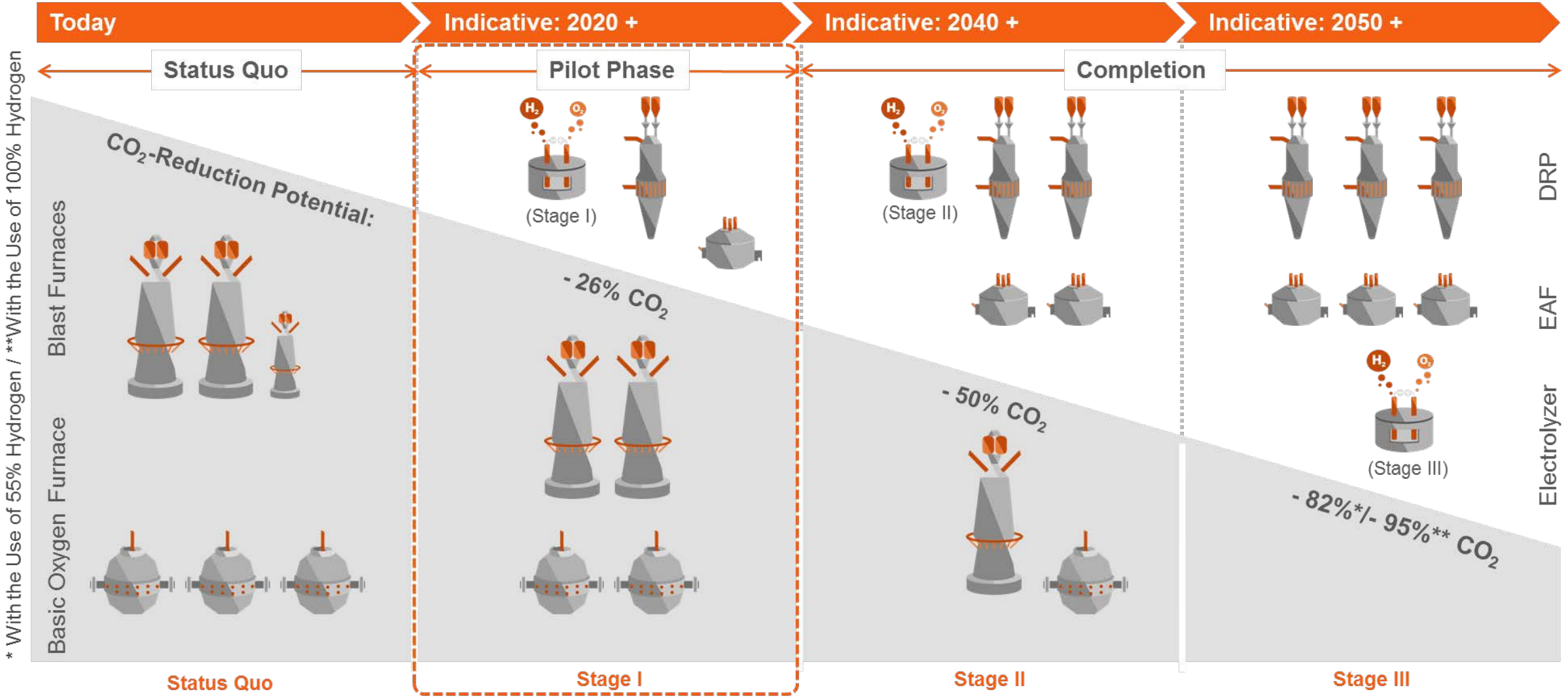

Individual Stages may Technically also be Realized in Combination – Earlier or Later than Indicated, Depending on the Actual Economic and Political Framework

Summary: Electrical Power Demand for the Transformation of SZFG Primary Steel Production

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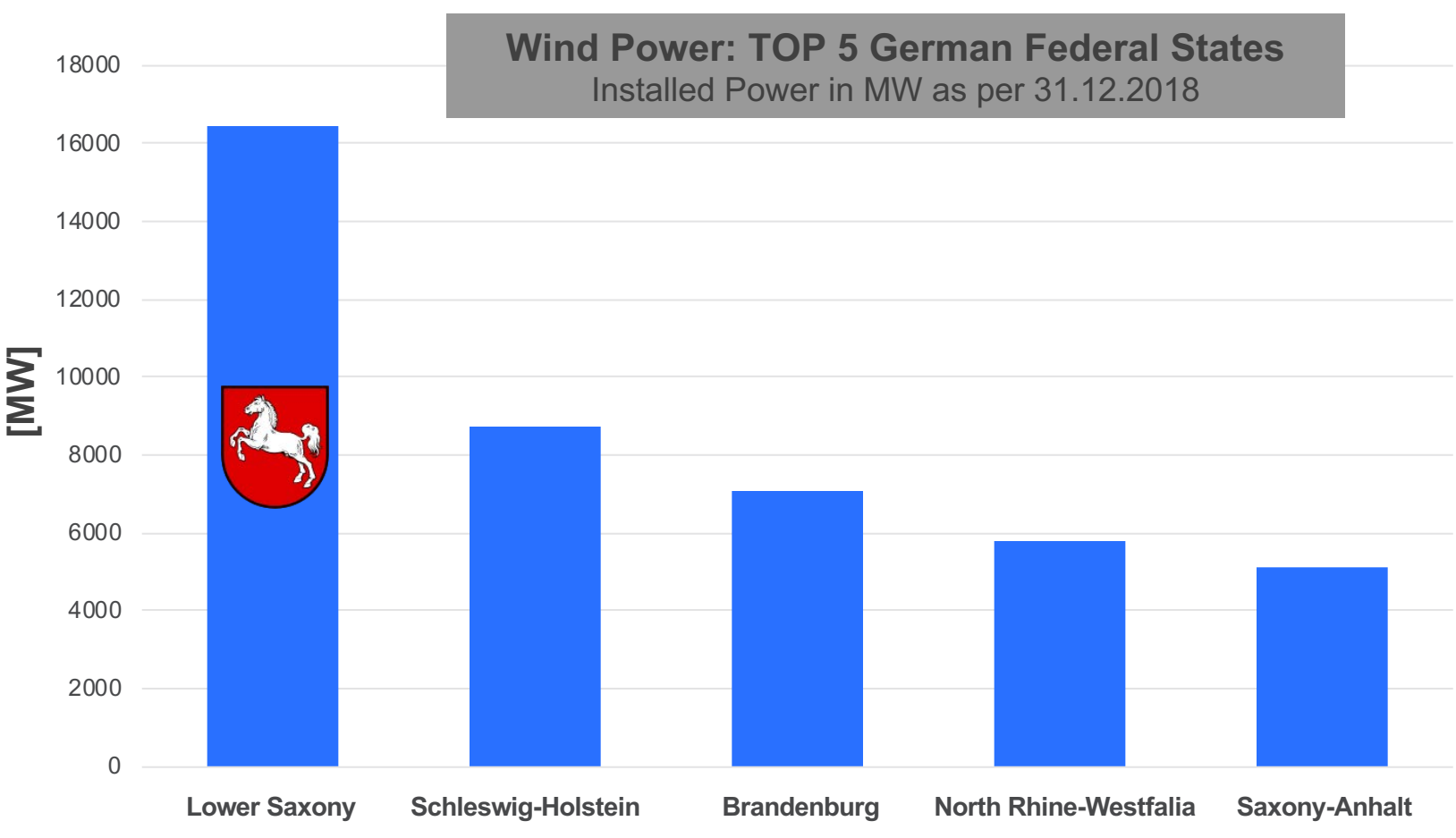
Total Power Generation in Germany (2018):
647 TWh_{el}/a
(Share of Renewables: 35%)

- 26% CO_2
„**Stage I**“ @ 35% H_2
4.3 TWh/a
(**incl.** Energy for the Production of **58,500 t_{H2}/a**)

- 82% CO_2
„**Stage III**“ @ 55% H_2
12.4 TWh/a
(**incl.** Energy for the Production of **185,000 t_{H2}/a**)

- 95% CO_2
„**Stage III**“ @ 100% H_2
19.2 TWh/a
(**incl.** Energy for the Production of **294,000 t_{H2}/a**)

The Location of the Salzgitter Site in Lower Saxony is Favourable for the Implementation of SALCOS



Source: Bundesverband Windenergie

Summary: Electrical Power Demand for the Transformation of German Primary Steel Production

SALZGITTER AG
Stahl und Technologie

Total Power Generation in Germany (2018):
647 TWh_{el}/a
(Share of Renewables: 35%)

- 26% CO_2 → „**Stage I**“ @ 35% H_2
27 TWh/a
(**incl.** Energy for the Production of **0.4 Mt_{H2}/a**)

- 82% CO_2 → „**Stage III**“ @ 55% H_2
78 TWh/a
(**incl.** Energy for the Production of **1.2 Mt_{H2}/a**)

- 95% CO_2 → „**Stage III**“ @ 100% H_2
120 TWh/a
(**incl.** Energy for the Production of **1.9 Mt_{H2}/a**)

The Idea of German Self Sufficiency with Respect to Renewable Electricity Production is an Illusion in the Light of the Future Electricity Demand for the Decarbonization of Energy Intensive Industries!

Electricity/ Hydrogen Supply Options for Future Large Scale Deep Decarbonization – Example: Potential of PV

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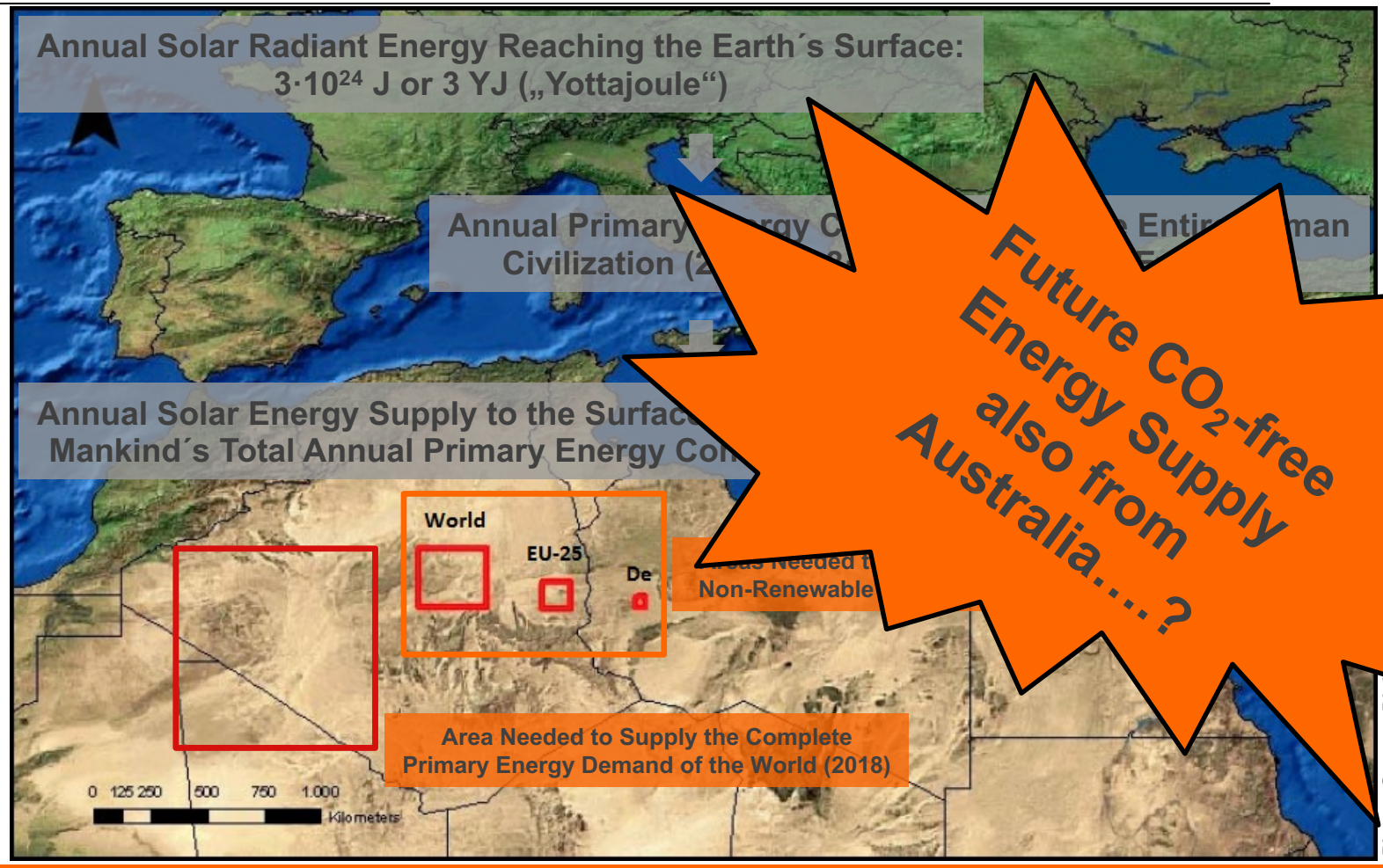

With a System Conversion Efficiency of 10%, a North African Desert Area (Average Insolation 251 W/m²) of ~733,000 km² in Needed to Supply the Complete Annual Primary Energy Demand of the World (2018). This Equals a Square of 856 x 856 km. If Only the World Non-Renewable Electricity Production of ~ 20,000 TWh has to be Covered, the Respective Area is ~91,000 km², Corresponding to a Square of 301 x 301 km. In Reality, The Needed Areas have to be Geographically Distributed Worldwide For Obvious Reasons.

CO_2-Mitigation per Unit of Applied Electrical Energy for Relevant PtX-Processes in Different Applications

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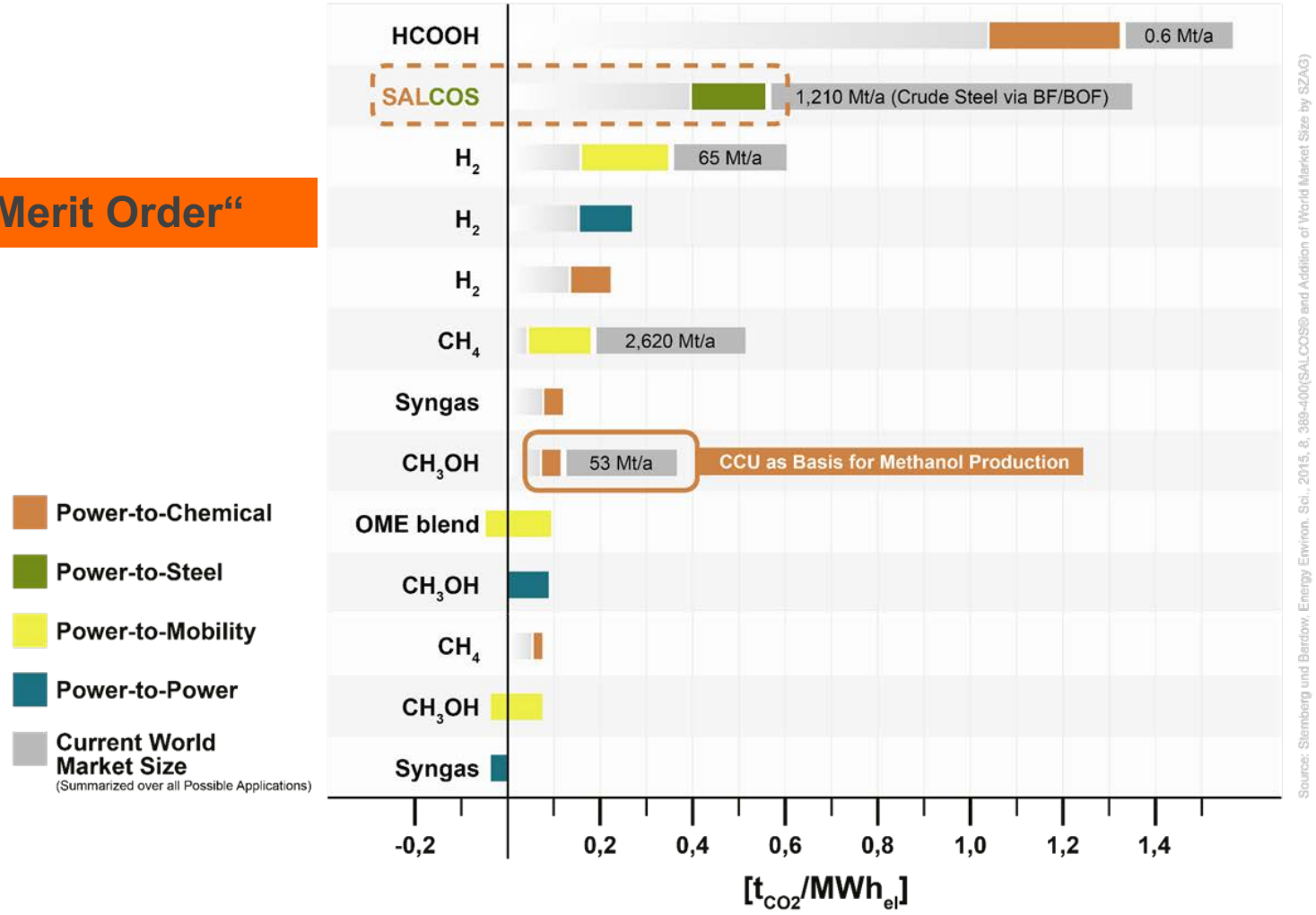
„Merit Order“



Renewable electricity as necessary energy source will continue to be the bottleneck for decarbonisation in the future.
The key figure "t_{CO2} per MWh_{el}" (together with the applicable global market size) therefore represents the decisive criterion for the respective technology assessment.

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Necessary Framework – Right from the start

- Reliable, continuous and economical supply of electrical energy from renewable sources (e.g. wind energy in northern Germany) to the required, considerable extent, e.g. for hydrogen production, for the operation of electric arc furnaces and for the replacement of process gases.
- Government fees on electrical energy (e.g. EEG fee) should be eliminated or significantly reduced.
- Continued reliable, cost-efficient supply of natural gas.
- Preferential link-up to new energetic infrastructure (power grid as well as hydrogen and natural gas pipelines).
- A “level playing field" has to be created: Fair conditions for all market participants in Europe, both for imports into the EU and for exports from the EU - because most countries in the world are not pursuing any comparable, costly climate protection efforts.
- Incentives and/or regulatory systems to facilitate the use of green steel in final products.

Decarbonisation is a task for the whole of European society: Public funding of investments and solutions for economic operation are indispensable!


SALCOS
Green steel ready.

Implications for energy-intensive and HYDROGEN BASED industries to transition

AUSTRALIAN-GERMAN ENERGY SYMPOSIUM 2019

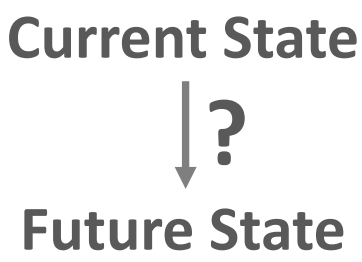
Date: 18 September 2019

Incitec Pivot Limited

INNOVATION ON THE GROUND

Pathway to an export renewable hydrogen industry

1. Demonstration scale - 1-10 MW electrolysis
2. Industrial scale - 100-200 MW electrolysis
3. Export Scale – 1000 MW electrolysis

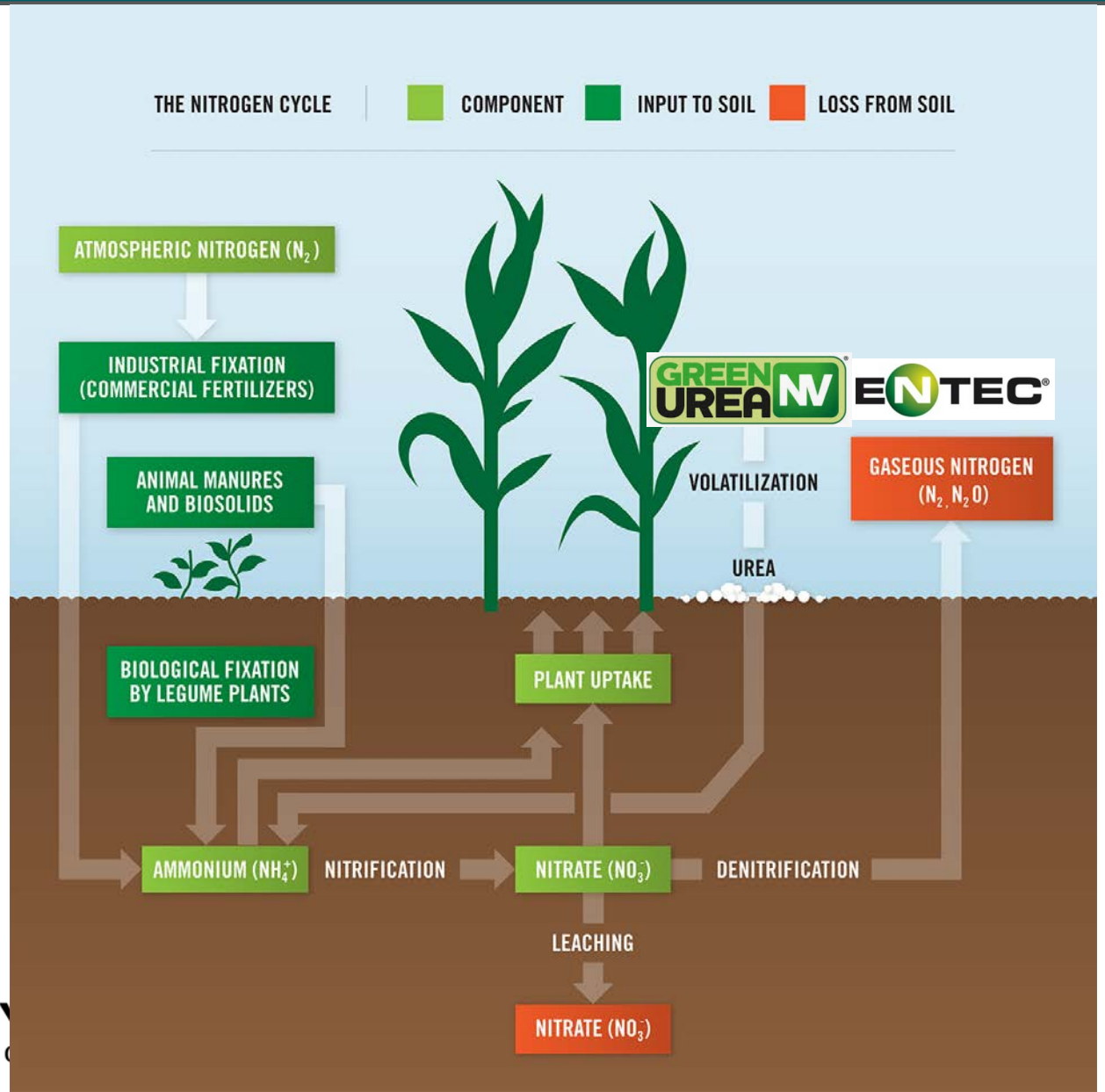


- **Does anyone here think that this industry will skip stage 2?**
- To get there, Stage 2 requires:
  - investment
  - a market that provides acceptable returns
  - logistics for storage and transport
- Is there a market that will provide acceptable returns at industrial scale now?

Incitec Pivot Limited - hydrogen is not just about energy

- IPL uses the Haber-Bosch process to make hydrogen (Yes – we use German technology)
- Hydrogen as a feedstock to make ammonia
- Hydrogen (as ammonia) is the only carrier molecule for delivering N to plants
- Ammonia Production from natural gas is an Emissions Intensive Trade Exposed (EITE) industry under NGER due to the release of the carbon associated with the methane (natural gas) molecule
- So, in the Australian economy, hydrogen is not just about energy

In the Australian economy, hydrogen is also about food security and the agriculture industry



- The resulting increased yields are currently feeding more than 1/3 of the world's population (both yields and protein)[1]
- For food security in a world impacted by climate change, even more intensive ag is required
- High efficiency ferts reduce GHG emissions:

Incitec Piv
INNOVATION

In the Australian economy, hydrogen is also about resource extraction and the mining industry

Differential Energy™
TITAN® BULK EXPLOSIVES

- Hydrogen is currently used to make ammonium nitrate for resource extraction
- Extraction of new world minerals required for new technologies
- Quarry & Construction to rebuild infrastructure as the physical impacts of climate change increase
- High efficiency explosives technologies that reduce both energy use and GHG emissions by matching explosives density to borehole geology

In the Australian economy, hydrogen is therefore also about manufacturing

- Australian manufacturers currently use 500,000 t of hydrogen annually as feedstock
- This existing domestic market is larger than the target 2030 Japanese ‘hydrogen-for-energy’ market
- At present, 100% is made from steam methane reforming (natural gas)
- Feedstock replacement is the highest existing $ return for solar hydrogen at an industrial scale
- Feedstock replacement presents an effective pathway for scale up
- Why not convert now?

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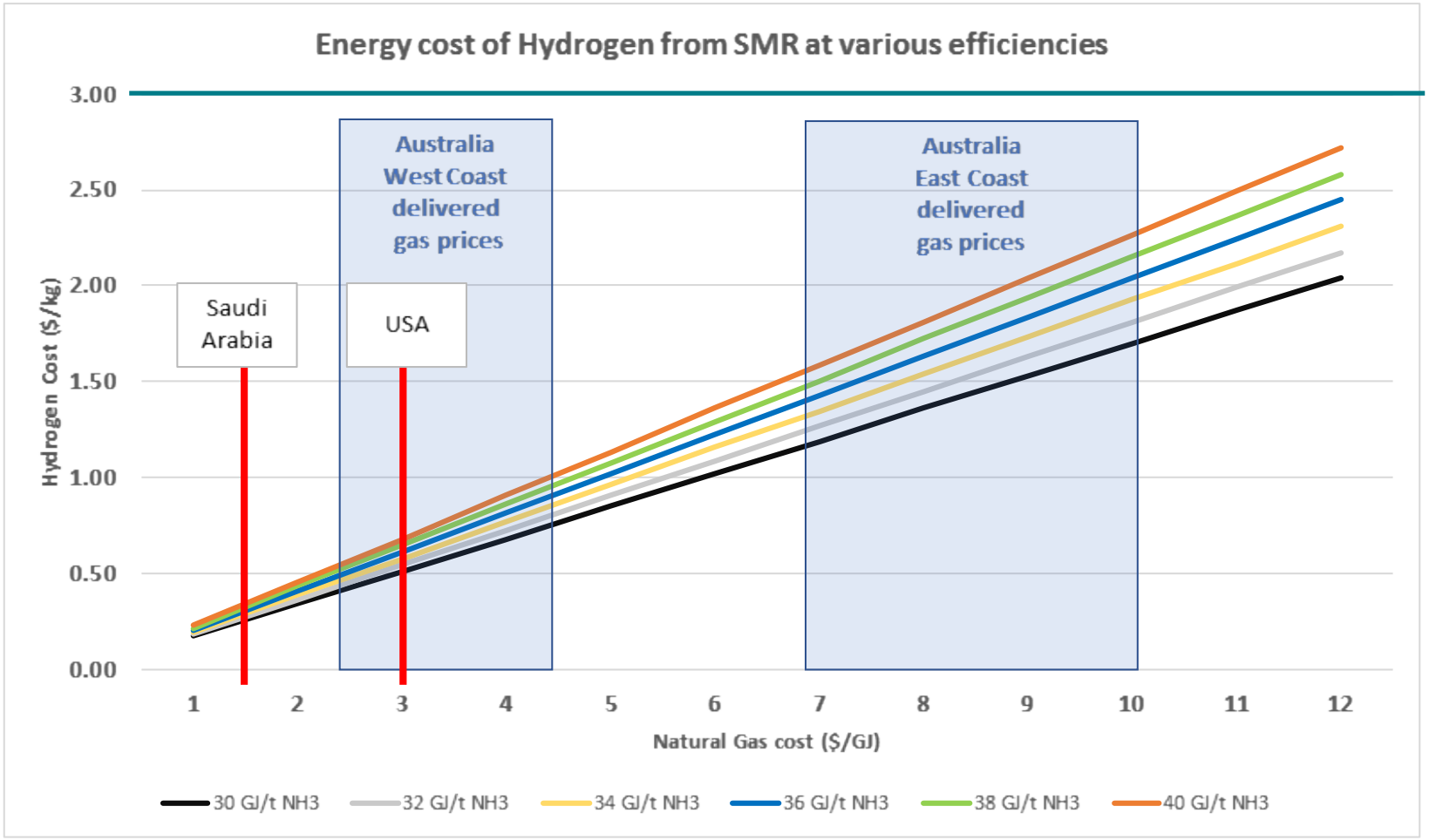
INNOVATION ON

Pathways to scaling up the technology for an Australian hydrogen industry

Costs need to come down to compete with natural gas (& for export!)



Grid purchased solar

Costs are required to be similar for export

- Japanese Basic Hydrogen Strategy (METI 2017) states 300,000t demand by 2030
  - initially at @ $4.50 kg
  - then later @ $3.00 kg
- It will therefore need to be made in Australia @ ~ $2 per kg to compress, ship and sell in Asia
- Presently, 50 kWh = 1 kg hydrogen = $3 per in raw materials only
- **In summary:**
  - An export industry will take industrial size scale up
  - Ammonia is the highest economic value return in current markets AND there are existing plants in remote locations with land/space
  - Behind the meter is essential
  - Will still require government subsidy for a full scale export industry

Incitec Pivot Limited

DYNO®
Dyno Nobel

Incitec Pivot Fertilisers

INNOVATION ON THE GROUND

1. Erisman, J.W., M.A. Sutton, J. Galloway, Z. Klimont and W. Winiwarter (2008) How a century of ammonia synthesis changed the world. *Nature Geoscience*, Vol. 1 (Oct.): 636-639.

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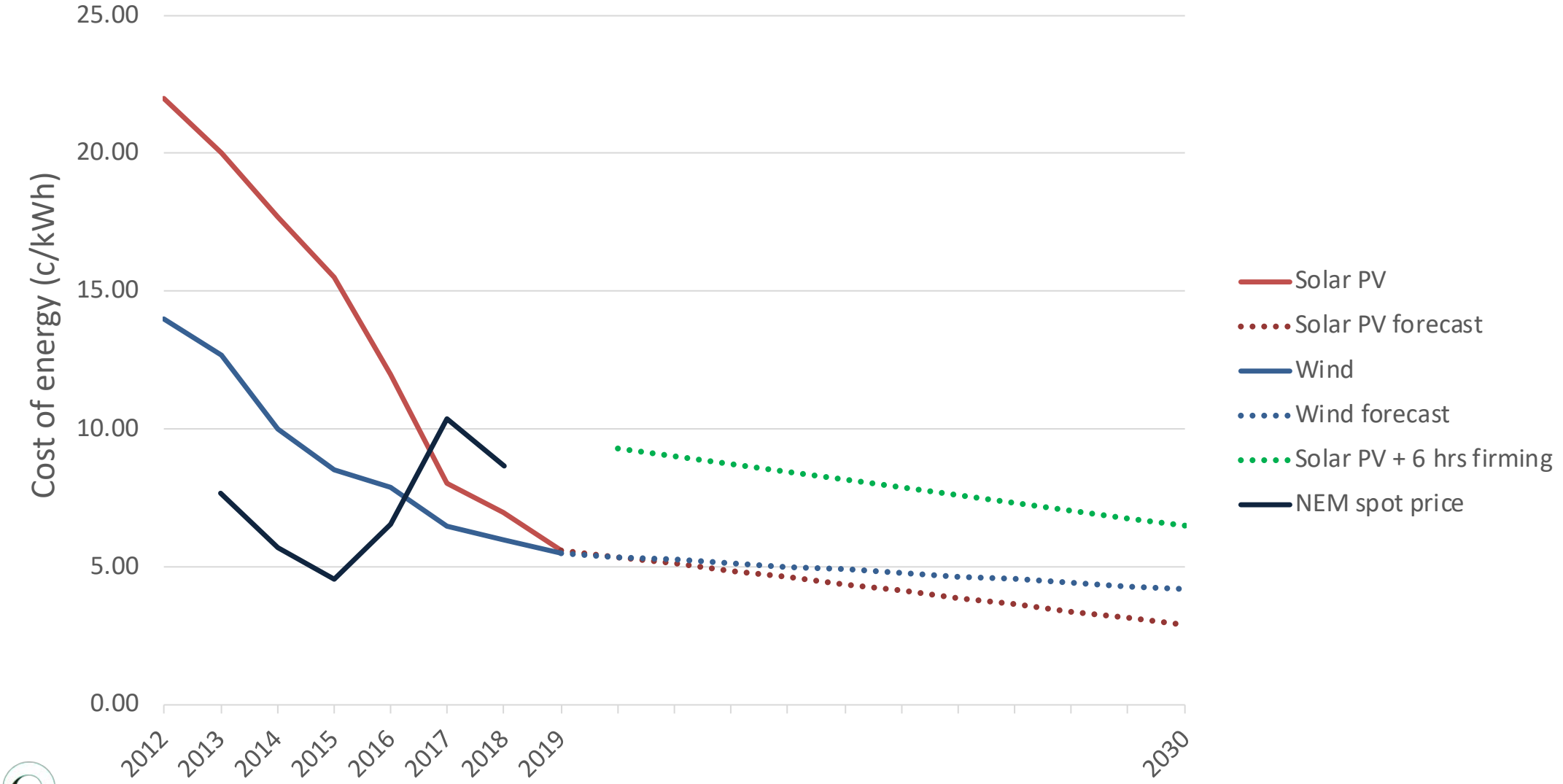
Zero carbon industry – Australia's opportunity

Michael Lord

Renewable energy costs in Australia



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Companies are targeting supply-chain emissions

Zero-emissions metals

- **Sun Metals** – zinc
- **Infrabuild** – steel
- **Element 25** – manganese metal

- **Alumina** – concentrated solar
- **Aluminium** – powered by renewables
- **Steel** – hydrogen reduction
- **Copper, manganese, silicon, lithium…**

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