



LUND
UNIVERSITY

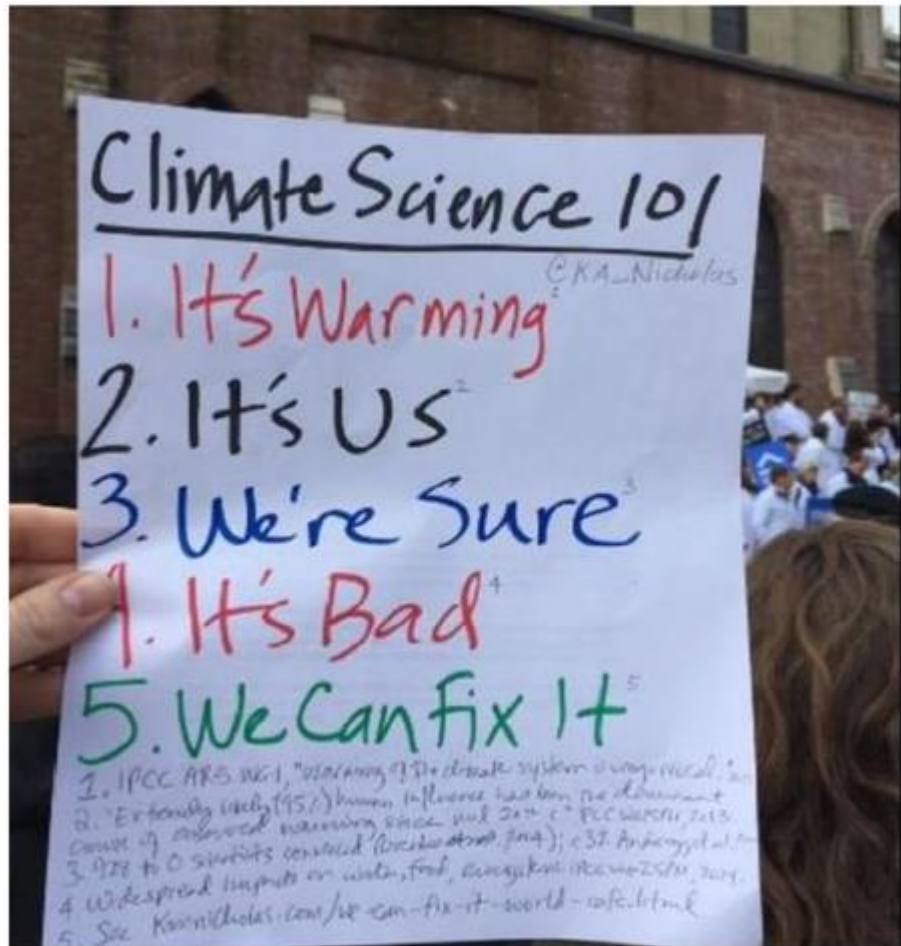
ENABLING THE DIFFUSION OF SUSTAINABLE STEELMAKING

VALENTIN VOGL



CONTENTS

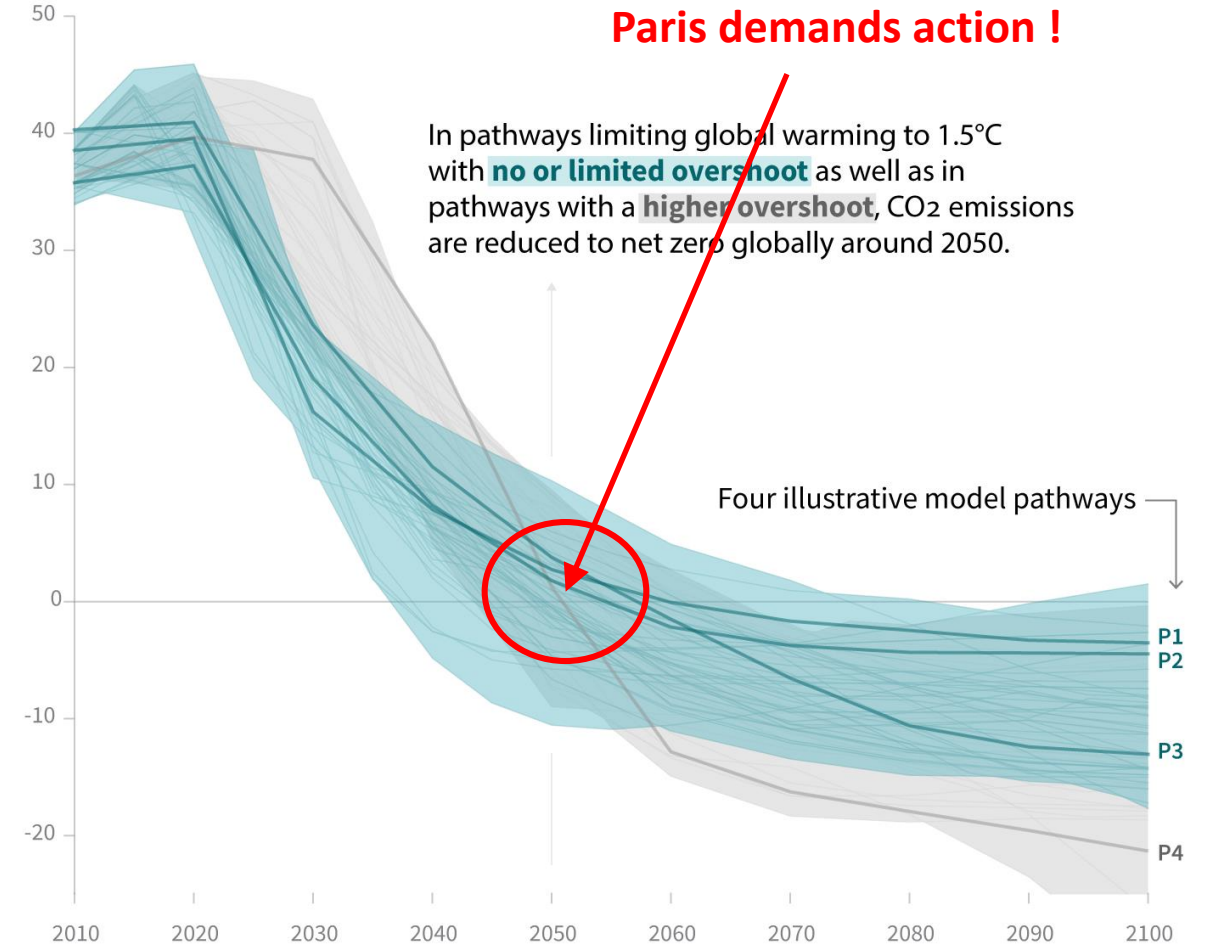
1. steel & 1.5 °C
2. international co-operation
3. enabling factors for low-emission steelmaking
4. demand pull for sustainable basic materials



sources:
 IPCC SR15 (ch.2),
<http://www.kimnicholas.com/climate-science-101.html>

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



Timing of net zero CO₂

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



A GLOBAL TRANSFORMATION

- Growing steel demand: India, Africa, Latin America
- transforming existing + leapfrogging future demand
- RD&D in Europe, but emissions outside EU
- 'common but differentiated responsibilities'

electrification



CCUS



Environmental Science & Technology

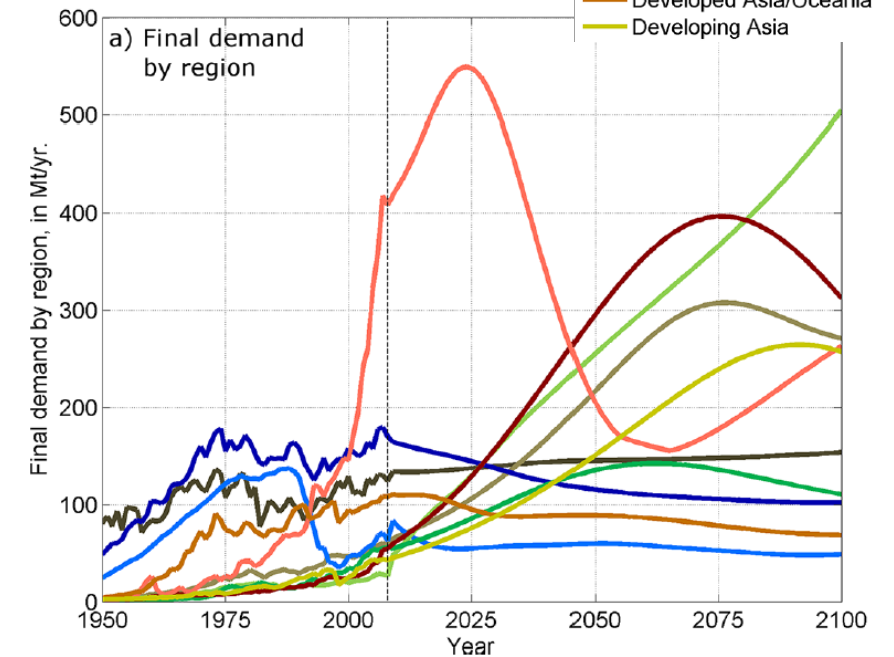


Figure 3. Final steel demand and old scrap supply by region.

source: Pauliuk, S, Milford, RL, Muller, DB & Allwood, JM 2013, 'The steel scrap age', *Environ Sci Technol*, vol. 47, no. 7, pp. 3448-54.

INTL. CO-OPERATION FOR THE STEEL TRANSITION

1. national visions & capacity building
 - local enabling conditions

2. intl. finance:

creative
(push, pull & systemic) + **destruction**
(phase-out emitters)

- sharing risks, sharing benefits

3. demand pull
 - markets for climate-neutral basic materials



ENABLERS FOR TECHNOLOGY ADOPTION

geographical

- iron ore reserves
- CO₂ storage sites
- renewables potential
- oil/gas/coal/coke

innovation system

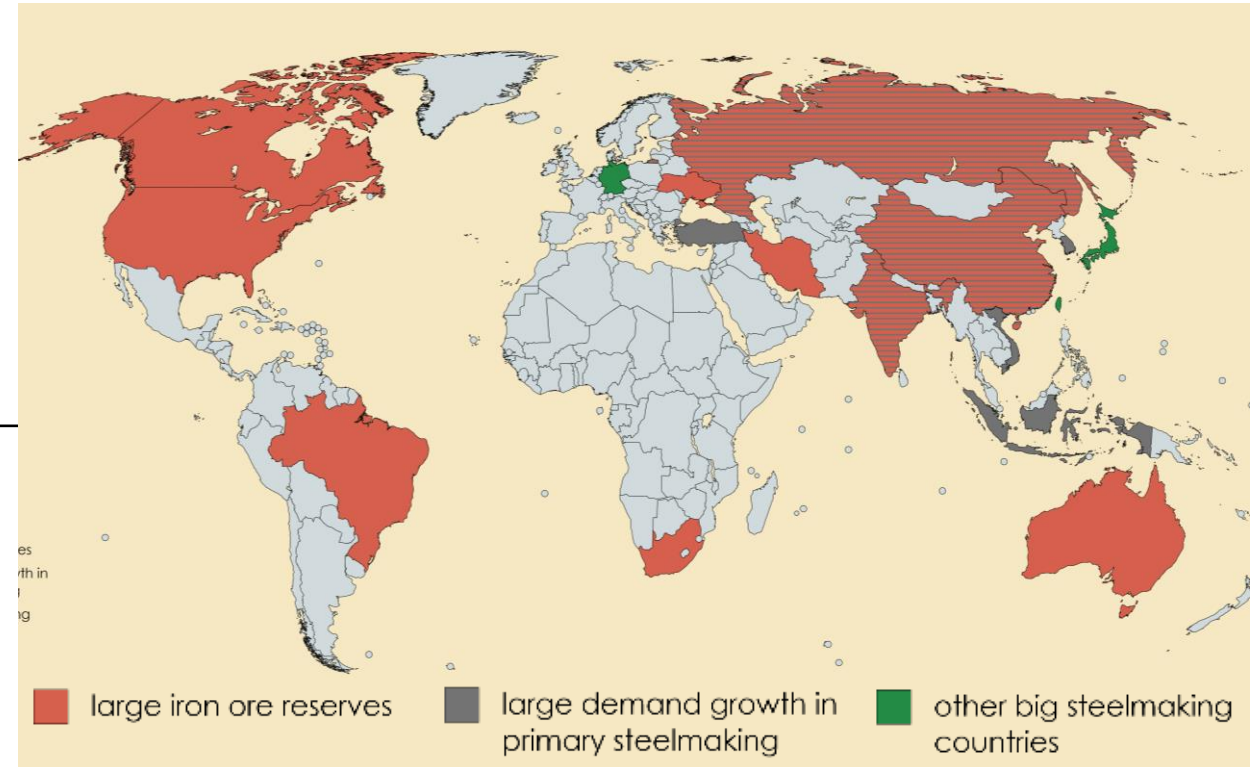
- innovative industry
- access to finance
- global firms
- strength of networks

policy context

- climate targets
- environmental regulation
- carbon price

economic outlook

- steel demand outlook
- investment conditions



source: mapchart.net

ENABLERS (2)

Electrification

- costs of renewables
- iron ore reserves (export HBI instead of ore)
- experience with direct reduction & EAF

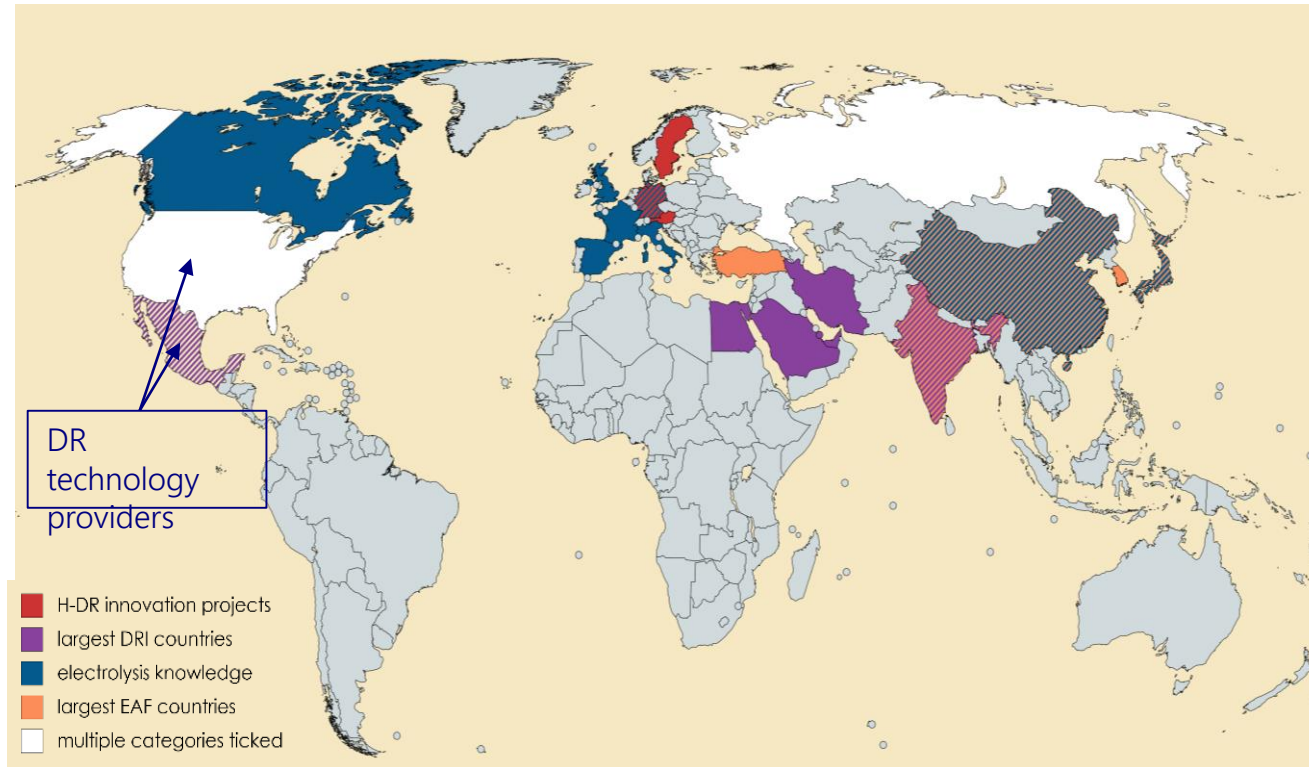
CCS

- carbon price
- public acceptance
- storage sites
- coking coal access



source: mapchart.net

H-DR: EMERGING GLOBAL INNOVATION SYSTEM?



marked countries represent 88% of global steel production

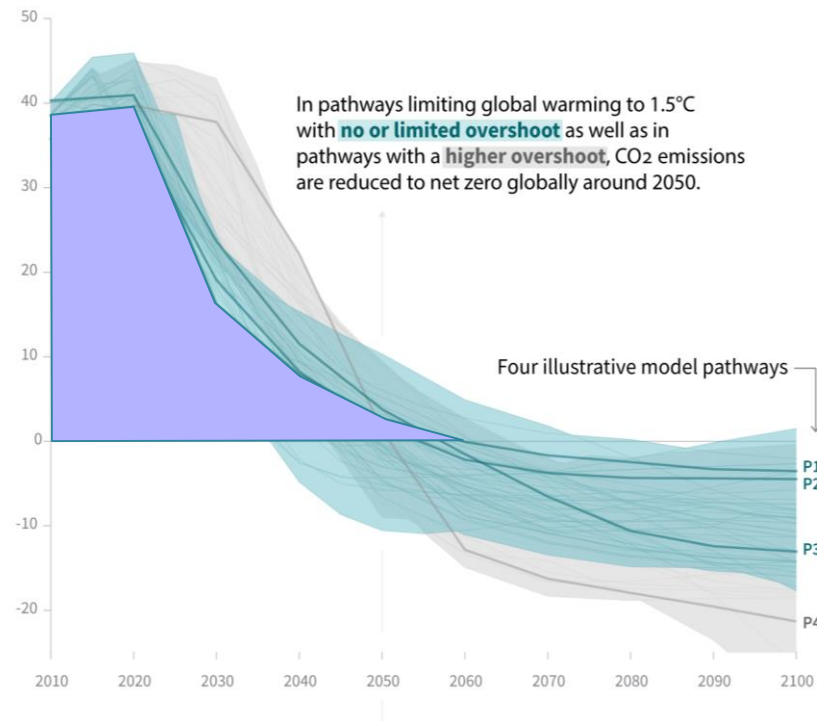
- H-DR... hydrogen direct reduction
- systemic innovation challenge
- knowledge dispersed globally
- innovation system needs to be nurtured

source: mapchart.net

DEMAND PULL FOR 'GREEN' STEEL

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



based on:

- Vogl V. & Åhman M. (2019). *What is green steel? - Towards a strategic decision tool for decarbonising EU steel production*. paper presented to METEC-ESTAD 2019, Düsseldorf, GER.
- Lösch O., Vogl V., Arens A. (2019). *How to get green steel into the market?*. paper presented to ECEEE Summer Study 2019, Belambra Presqu'île de Giens, France.

- price increase for car/building with climate neutral steel: <1%
- coalition of the willing (Paris Agreement art. 6)
- designed inclusive and expanding over time



LUND
UNIVERSITY

SUMMARY

- 1.5 °C means zero emissions globally by 2050
- early action: roadmaps and explicit technology needs
- demand pull for climate-neutral steel → unleash creative forces

Valentin Vogl

valentin.vogl@miljo.lth.se

Lund University – Environmental and Energy Systems Studies

<http://miljo.lth.se/>

@valenvogl

Recent publications:

Vogl, V, Åhman, M & Nilsson, LJ 2018, 'Assessment of hydrogen direct reduction for fossil-free steelmaking', *Journal of Cleaner Production*, vol. 203, pp. 736-45.

Åhman, M, Olsson, O, Vogl, V, Nyqvist, B, Maltais, A, Nilsson, LJ, Hallding, K, Skånberg, K & Nilsson, M 2018, *Hydrogen steelmaking for a low-carbon economy*, Lund.

--- funded under the Swedish Energy Agency under the project HYBRIT-RP1 ---



LUND
UNIVERSITY