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*Decarbonizing Value Chains: Hard-to-Abate Industries*  
*Executive Roundtable Summary (Ingelheim/Germany –April 20-21, 2023)*

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## Background

Certain materials in a company's value chain are especially difficult to decarbonize because of the high levels of energy required for their production. These hard-to-abate industries include steel, aluminum, cement, chemicals, glass, and fertilizers, which together account for 22 percent of global emissions. WEC's Roundtable delved into the opportunities to decarbonize these industries as new technological solutions such as green hydrogen and carbon capture are evolving. However, besides technological progress, the transition depends on business models that are embedded into a strategic roadmap for heavy industry over the entire value chain and that result in investments.

A diverse group of business executives and academic experts discussed those aspects during this roundtable. The event, in collaboration with Boehringer Ingelheim and ERM, brought together 20 senior sustainability experts from Germany, the Netherlands, Switzerland, the UK and the U.S. – with 75% from large companies of various industries and 25% from academia/NGOs.

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## Participants

Host & co-sponsor:  **Boehringer Ingelheim**



- **Lars Murawski, Boehringer Ingelheim**
- **Graham Lane, ERM**

### Moderators

- **bp:** Andrea Galieti
- **ERM:** Alexandra Fraser
- **Mission Possible Partnership:** Maximilian Held
- **World Environment Center:** Glenn Prickett

### Speakers

- **Boehringer Ingelheim:** Lars Murawski
- **CRH Group:** Richard Leese
- **Ecologic Institute:** Nils Meyer-Ohlendorf
- **ERM:** Tom Reichert
- **Holcim:** Magali Anderson
- **Rhein-Waal University of Applied Sciences:** Prof. Mona Wappler
- **Shell:** Audny van Helden

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## Key Points

1. **The level of commitments made by the largest companies in the Hard-to-Abate industries to decarbonize towards Net-Zero by 2050 is extraordinary.** Given the fact that we discussed these industries' technological ability to reach Net-Zero emissions at all in a [WEC event in 2020](#) (drawing from the [Energy Transition Commission's legendary report of 2018](#)), these fast developments give some reason for optimism. However, during the course of this current roundtable discussion, participants found themselves rather concerned that moving from technological feasibility and goal-setting towards action on the ground is very challenging, especially in the Hard-to-Abate sectors where the investments needed are enormous and the timing urgent.

It was recognized that recent regulatory frameworks in major world regions (e.g. the [Inflation Reduction Act \(IRA\)](#) in the U.S. and the [EU Green Deal](#)) and also a growing demand of investors to de-risk their climate-sensitive portfolios are helping the transition. It is assumed that the IRA, being especially successful, will provoke reactions in the EU and Japan, and that a large investment boom may be on the horizon, if accompanied by an articulated demand from companies. Cutting down global emissions will depend mostly on the largest markets, so China and India must also make that transition, and their business executives must find it valuable. A need of global investments of approximately \$2 trillion/year has been articulated.

**Stimulating more demand for green investments in the Hard-to-Abate Industries needs a clear vision of the change management within companies.** Thus, the conversation must involve e.g. the heads of operations and

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procurement and respect their language and priorities, so that they find value in integrating decarbonization opportunities comprehensively into their business strategies. Elements of a Net-Zero ambition are foremost a reduction of emissions in a company's own operations and value chain, removal of the remaining emissions in high-quality capture and storage schemes, and finally high-quality offsets. Companies are advised to work on all options immediately and in parallel as it is predicted that by 2027 – already close to 2030 when mid-term targets must be delivered – a large move towards these opportunities might take place.

2. **At less than 0.1% of global hydrogen production, the supply of green hydrogen\* is currently very limited** while the higher cost involved creates uncertainty about companies' willingness to pay for their expressed demand. Given the fact that commitments in purchasing green hydrogen or making investments in Carbon Capture and Storage (CCS) may result in very large investments, companies reported that they face the challenge that stock markets take their good intentions as financial risk, which has resulted in significant drops of share prices. That is why companies currently tend to not invest heavily in a technology under development although they plan to do so when prices fall in the future. The path forward seems to be investments in pilot projects and small shares of production, primarily in markets that reward clean investments, such as the EU and the U.S. Obviously this creates a problem on the supply side.
3. **Decarbonizing Hard-to-Abate industries can't rely on a "Tesla-moment"**, when a superior product at a higher price has enjoyed sufficient demand to justify large investments because so many consumers are willing to bear the cost. In that case, and similarly with organic food, consumers benefit from enjoying the better product itself, however, also draw from reputation and health gains. The benefits are emotional and highly visible, resulting in a large enough share of consumers willing to invest and stimulate supply. Hard-to-Abate industries are dependent on professional investors and B-2-B customers, both groups bare of emotions and very risk-averse. Can impact investors be a source of change? And will new competitors be able to challenge established cement and steel production when the geographic location of their sites is optimal given the other resources needed for production?
4. **The Green Hydrogen ramp-up still has to prove feasibility.** Although technological solutions are available costs are high (thus limiting demand) and purchasing commitments are modest (limiting supply). The "chicken and egg"-question was discussed, i.e. which must come first, demand or supply? In addition, an infrastructure must be built: from renewable energy production sites and electrolyzers to pipelines, ships, and trucks suitable for hydrogen/ammonia transportation as well as adequate facilities at the customers sites. Investments must also consider the best geographic locations for green hydrogen production as not only sun/wind is needed but also clean water. Water desalination might not be a good solution in geographies where the salt waste could pollute marine or terrestrial ecosystems.

In this challenging environment the group of participants came up with two possible options to move ahead:

- (a) *Industry might be able to connect supply and demand* like it has been done successfully when investments in new pipeline projects were initiated: supplier and customer should collaboratively create infrastructure chains for a long-term engagement while they also create "take-or pay"-contracts\*\*.
- (b) *Governments should stimulate demand for green (or clean) hydrogen*, e.g. by subsidizing its use in the initial years and/or by establishing an adequate regulatory framework. Green public procurement is estimated to also play a considerable role. In addition, governments should support a massive increase of renewable energy supply as the additional volume of electricity needed to produce green hydrogen is estimated to equal the total electricity consumed today. When governments suggest priority access for green hydrogen to the production of e.g. fertilizers, hydrocracking, hydrogenation, methanol, steel, desulfurization, chemical

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feedstock, long-term storage, and shipping (the latter through ammonia), governments can refer to the limited availability of green hydrogen and their own subsidies to increase its production.

Knowing that the energy transition is all about speed, the Hard-to-Abate sectors are currently not moving fast enough. Some optimism can be drawn from the fact that the number of electrolyzer manufacturers to supply the industry with green hydrogen has doubled between 2021 and 2022 to almost 80 companies (with 50% of these companies from the U.S., Germany, and China). Furthermore, global installed electrolyzer capacities have almost tripled in the same year to 1.4 GW in 2022. Coming from a low base, future supply is expected to pick up steeply.

**5. Carbon Capture and Storage (CCS) is an important element in the decarbonization process, for two reasons:**

- (a) Even if the Hard-to-Abate Industries succeed with their energy transformation in line with Science Based Targets, the Earth’s atmosphere will suffer from unacceptable CO<sub>2</sub>-concentrations. Thus, removals must take place far beyond 2050 to avoid catastrophic climate scenarios.
- (b) Even though access to green hydrogen is limited, companies in the Hard-to-Abate Industries have developed strategies to start the decarbonization process as soon as possible. Some are moving forward by replacing coal with natural gas in their production processes and as a second step capture and store the remaining CO<sub>2</sub>. The use of natural gas prepares an infrastructure for the future use of green hydrogen, with some adjustments to be made.

Other elements of the decarbonization strategy in Hard-to-Abate industries focus especially on replacing the materials used with other materials of equal quality that can be processed at lower temperatures. With 75% of emissions in scope 1 the cement industry has a strong lever as it can replace its most important source of emissions (the commonly used clinker) with alternative materials such as ground limestone, calcined clay and other materials. The steel industry can replace iron ore by melting scrap (to the extent they find enough scrap) - based on the [electric arc furnace \(EAF\) process](#). Even still cement- and steel manufacture will continue to create large amounts of CO<sub>2</sub>-emissions as a result of the current production process that cannot be avoided. That is why carbon capture and storage (CCS) must be part of the solution. Concerns are justified, but technological progress may help.

**6. Removing carbon emissions is technically possible but expensive, and jurisdictions are only developing:** It is important to understand that different types of removals are being discussed. According to the IPPC and the EU, permanent storage is the key. The EU’s legislative proposal defines “permanent carbon storage” as a carbon removal activity that stores carbon for several centuries (e.g. in geologic storage). Removals through biogenic storage is also part of the EU’s proposed regulation. As this option is not permanent but temporary storage - some refer to it as “carbon parking” or “delayed emissions” - it is subject to discussion.

Companies that plan to offset emissions by using biogenic storage should be aware that EU authorities have not yet developed a mechanism for replacing expired certificates. The EU regulation’s purpose is to support market development for carbon removals by improving and streamlining their certification to create trust and transparency. At least for permanent removals in geologic storage systems the EU proposal seems to be robust. Not so for biogenic storage (e.g. soils, forests). On the other hand, Nature Based Solutions that aim at protecting biodiversity and ecosystems have an undisputed value. Their primary purpose should just not be to store carbon permanently.

**The energy needed to permanently store the global demand for CCS** has been estimated to equal 5% of the current global energy use (which equals the current energy demand of Japan), and it must be done with renewable energy. A key question is whether the limited green electricity produced should be used for CCS projects or rather to replace other uses such as combustion engines and fossil fuel power production?

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Generally, carbon storage can get very expensive, complex, and sometimes perceived as too slowly administered or not fair, according to some participants. Here are two examples:

(a) Instead of point source capture of CO<sub>2</sub> a company would favour [direct-air capture](#) at a preferred location to reduce costs. However, EU legislation leaves many questions unanswered, so the investment cannot be made.

(b) Supported by funds from the UK and the EU Innovation Fund a company is planning to capture carbon from its production process to turn it with green hydrogen into carbon-neutral fuel for the aviation industry (thus, it helps to avoid one unit of CO<sub>2</sub> with each unit produced). The airline buying those fuels receives emission credits while the company turning CO<sub>2</sub> into sustainable aviation fuel\*\*\* is left alone with the extra cost. It is understood that emission credits can only be claimed once, however the incentive for the supplier of the fuel seems to be too low.

7. **Value chain collaborations to decarbonize are essential but face major coordination challenges.** Amongst those are ① a relatively young technology for the hard-to-abate sectors with high initial costs, meaning that everybody is waiting for the costs to come down; ② a lack of regulative clarity (e.g. definitions, the possibility that governments may provide financial incentives in the future); ③ a lack of investment due to a lack of perceived demand (see above: the chicken-and egg challenge); ④ long investment periods (e.g. large scale electrolyzer plants require 6-10 years from planning to production); ⑤ diverse investor interests as some insist on high financial returns known from the past; ⑥ slow administrative processes due to complexity and little expertise within local authorities; and ⑦ various parties in the value chain that have to be willing to make a change at the same time and be first-movers to invest in appropriate technology.

**As part of innovating their business model some of the hard-to-abate industries are already trying to build coalitions of the willing.** The major challenge is to line up all parties at a time when not everybody in the chain is ready yet. It has been mentioned that first-movers are coming together step by step – with demonstration projects, faster permits for those projects to prove their commercial viability, larger replication projects, co-funding, growing expertise in administrations, etc.). It is expected that by 2027 or 2028 some important collaboration projects will result in major investments.

First movers clearly understand that somebody else might have it easier when they can draw from experience. However, impact investors, authorities, the general public, and talents value those companies who take the risk and innovate faster than their competitors – some roundtable participant suggested we call them HEROES.

A significant side-effect of those value chain collaborations between industries is that companies must involve key operational staff on a journey that teaches them to understand how the world is changing. Companies that learn this lesson are making themselves fit for the future. Several examples from the Hard-to-Abate industries have been mentioned during the roundtable: they successfully innovated their business model.

*\* GREEN HYDROGEN is produced with renewable electricity (e.g. wind, solar) while CLEAN HYDROGEN also includes hydrogen being produced with zero atmospheric releases due to Carbon Capture & Storage and Utilization. Other forms of hydrogen are also available (BLUE: from natural gas & CCUS; GREY: from natural gas and by-products; BLACK/BROWN from black coal or lignite; PINK: from nuclear power)*

*\*\* "Take-or-pay" contracts enable large investments by assuring the supplier, who bears the risk of an investment, to get paid for his expenses even if the customer doesn't make use of the supply.*

*\*\*\* According to a RT-participant CO<sub>2</sub> accounts for approximately 1/3 of aviation's climate impact. 2/3 are caused by condensation trails, nitrogen oxides.*

*Further Reading: While this event focused on heavy industry's energy demand and carbon removal options, the development of a Green Electricity Grid is of similar importance to decarbonize business. Those topics have been discussed in a WEC Executive Roundtable in 2022 and can be reviewed [here](#).*

*Note: WEC Executive Roundtables are conducted under the Chatham House Rule.*