A Clean Industry Package for Europe:
Making sure the Green Deal kickstarts the transition to climate-neutral industry

Oliver Sartor
Senior Advisor for Industry
Two new studies by Agora Energiewende on decarbonising energy-intensive industry in Europe

Available at: https://www.agora-energiewende.de/en/projects/a-clean-industry-package-for-europe/
Industry has a vital role in the EU achieving higher climate ambition in 2030 and 2050

<table>
<thead>
<tr>
<th>Year</th>
<th>EU27 Industry CO₂ Emissions (Million t CO₂e)</th>
<th>EU Long-term Strategy 2018 (-93%)</th>
<th>Required reductions to achieve EU -55% goal in 2030 (impact assessment)</th>
<th>Zero industrial emissions scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1,019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>862</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>703</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>643</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>667</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>670</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>502</td>
<td>-168 to -188 Mt CO₂</td>
<td>-22% to 25%</td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>482</td>
<td></td>
<td>-93%*</td>
<td>-100%*</td>
</tr>
</tbody>
</table>

Agora Energiewende 2020, based on data from Eurostat, EEA and European Commission.
The situation is urgent: investments in key low-carbon technologies must start during the coming decade.
EU ETS industry would need to reduce emissions by ~27% under a -55% EU 2030 climate target, since much of the effort is done by the power sector and past abatement.

Expected emissions reductions from EU ETS industry under a -55% 2030 EU climate target and decarbonization options available

Agora Energiewende, based on data from European Commission, EEA, and Eurostat.
This 142MtCO₂ can and should be abated by deploying key *climate-neutral* technologies, not just setting tighter conventional technology benchmarks…

<table>
<thead>
<tr>
<th>CO₂ abatement potential of selected key low-carbon technologies in the steel, chemical and cement sectors by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MtCO₂</strong></td>
</tr>
<tr>
<td>Required Emission Reduction Industry under EU ETS</td>
</tr>
<tr>
<td>Potential Emission Reduction</td>
</tr>
<tr>
<td>Further emission reduction potential (e.g. efficiency, biomass use)</td>
</tr>
<tr>
<td>Direct reduced iron (Steel)</td>
</tr>
<tr>
<td>Electric arc furnace (Steel)</td>
</tr>
<tr>
<td>Power-to-Heat (Chemicals)</td>
</tr>
<tr>
<td>Green hydrogen (chemicals)</td>
</tr>
<tr>
<td>Chemical recycling (Chemicals)</td>
</tr>
<tr>
<td>Oxyfuel-CCS (Cement)</td>
</tr>
</tbody>
</table>

Agora Energiewende and Wuppertal Institute, 2020
EU steel companies are ready to build commercial DRI plants before 2030. They are hydrogen-ready, but could partially run on natural gas until enough clean H2 is available.

<table>
<thead>
<tr>
<th>Project, Site</th>
<th>Country</th>
<th>Company</th>
<th>Status Quo</th>
<th>Fuel</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYBRIT, Lulea</td>
<td>Sweden</td>
<td>SSAB</td>
<td>Started pilot operation with clean hydrogen in 2020 (TRL 4-5)</td>
<td>Green H2</td>
<td>2020: pilot plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2026: commercial</td>
</tr>
<tr>
<td>DRI, Galati</td>
<td>Romania</td>
<td>Liberty Steel</td>
<td>MoU signed with Romanian government to build large-scale DRI plant within 3-5 years Capacity: 2.5 Mt/DRI/year</td>
<td>Natural gas then clean H2</td>
<td>2023-2025: commercial</td>
</tr>
<tr>
<td>tkH2Steel, Duisburg</td>
<td>Germany</td>
<td>Thyssenkrupp</td>
<td>Plan to produce 0.4 Mt green steel with green hydrogen by 2025, 3 Mt of green steel by 2030</td>
<td>Clean H2</td>
<td>2025: commercial</td>
</tr>
<tr>
<td>SALCOS, Wilhelmshaven</td>
<td>Germany</td>
<td>Salzgitter</td>
<td>Feasibility study to build DRI plant in Wilhelmshaven</td>
<td>Likely Clean H2</td>
<td>n.a.</td>
</tr>
<tr>
<td>H-DRI-Project</td>
<td>Germany</td>
<td>ArcelorMittal</td>
<td>Planned construction of an H2-DRI demo plant to produce 0.1 Mt DRI/year (TRL 6-7)</td>
<td>Grey H2 initially, Then green H2</td>
<td>2023: demo plant</td>
</tr>
<tr>
<td>DRI, Taranto</td>
<td>Italy</td>
<td>ArcelorMittal</td>
<td>Plans to build DRI plant, ongoing negotiations with Italian government</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>IGAR DRI/BF, Dunkerque</td>
<td>Italy</td>
<td>ArcelorMittal</td>
<td>Plans to start hybrid DRI/BF plant and scale up as H2 becomes available</td>
<td>Natural gas then Clean H2</td>
<td>2020s</td>
</tr>
</tbody>
</table>
In the cement sector, at least 11 well-located sites could be connected to offshore CO2 storage sites via shipping by 2030.

- CO2 infrastructure in coastal regions can be developed for cement and blue hydrogen.
- CCS in cement paves the way for negative emissions through Bio-energy and CCS (BECCS).
- The combination of biomass and Oxyfuel CCS allows for negative emissions once cement plants use more than 25% of biomass in the fuel mix.
- Additional lower CO2 cement solutions also available.
Carbon pricing + CBAM + « hydrogen alliance » are not sufficient to drive these investments before 2030

Estimated CO₂ abatement costs of selected key technologies versus today’s conventional reference process for 2030

- Direct reduction with natural gas (Steel)
- Direct reduction with hydrogen (Steel)
- CCU of waste gases of the blast furnace route (Steel)
- Green hydrogen from electrolysis (Chemicals)
- Methanol-to-olefin/aromatics route (Chemicals)
- Carbon capture with the oxyfuel process (Cement)

Current CO₂ price: 27 €/t of CO₂; Expected CO₂ price range in the EU ETS until 2030

Agora Energiewende/Wuppertal Institute, 2019
The industrial transition is complex: a coherent “Clean Industry Package” covering the full value chain is required

<table>
<thead>
<tr>
<th>Clean energy and raw materials infrastructure (Upstream)</th>
<th>Climate-friendly production processes (Midstream)</th>
<th>Climate-friendly end products (Downstream)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen investment incentives and support framework</td>
<td>Carbon Contracts-for-Difference (CCfD)</td>
<td>Climate surcharge on CO₂-intensive final products</td>
</tr>
<tr>
<td>Robust clean hydrogen sustainability criteria</td>
<td>De-risking instruments for unproven technologies</td>
<td>Requirements and labels for embedded CO₂</td>
</tr>
<tr>
<td>Planning and financing of clean-energy &amp; CO₂ infrastructure for industry</td>
<td>Climate neutral production standards</td>
<td>Recycling quality targets &amp; end-of-life obligations</td>
</tr>
<tr>
<td></td>
<td>Reformed anti-carbon leakage system</td>
<td>Public procurement requirements</td>
</tr>
</tbody>
</table>
Clean Industry Package: Policy needs (Upstream)

1. Clean energy and raw materials infrastructure (Upstream)
   - Hydrogen investment incentives and support framework
   - Robust clean hydrogen sustainability criteria
   - Planning and financing of clean-energy & CO₂ infrastructure for industry

2. 

3. 
Clean Industry Package: Policy needs (Midstream)

1. 
2. Climate-friendly production processes (Midstream)
   - Carbon Contracts-for-Difference (CCfD)
   - De-risking instruments for unproven technologies
   - Climate neutral production standards
   - Reformed anti-carbon leakage system
3. 
Clean Industry Package: Policy needs (Downstream)

1. Climate-friendly end products (Downstream)
   - Climate surcharge on CO₂-intensive final products
   - Requirements and labels for embedded CO₂
   - Recycling quality targets & end-of-life obligations
   - Public procurement requirements
A Clean Industry Package could be implemented by adapting *existing* legislation, planning and funding instruments.

<table>
<thead>
<tr>
<th>11 POLICY PROPOSALS</th>
<th>RELEVANT LEGISLATIVE INSTRUMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upstream</strong></td>
<td></td>
</tr>
<tr>
<td>→ Hydrogen investment support policy-framework</td>
<td>→ Renewable Energy Directive Clean H₂ enabling framework</td>
</tr>
<tr>
<td>→ Robust clean hydrogen sustainability criteria</td>
<td>→ Hydrogen Sustainability Criteria Regulation (under REDII)</td>
</tr>
<tr>
<td>→ Industrial energy &amp; CO₂ infrastructure planning &amp; financing</td>
<td>→ Energy Union Governance Regulation &amp; TEN-E Regulation</td>
</tr>
<tr>
<td><strong>Midstream</strong></td>
<td></td>
</tr>
<tr>
<td>→ Carbon Contracts for Difference (CCfD)</td>
<td>→ New CCfD Enabling Policies (state aid; criteria; EU funding)</td>
</tr>
<tr>
<td>→ Capital de-risking instruments for unproven technologies</td>
<td>→ Innovation Fund Regulation (ETS Directive)</td>
</tr>
<tr>
<td>→ Climate neutral production standards</td>
<td>→ Industrial Emissions Directive &amp; Eco-labelling</td>
</tr>
<tr>
<td>→ Reformed anti-carbon leakage system</td>
<td>→ EU ETS Directive; State Aid Guidelines (2021); new BCA framework</td>
</tr>
<tr>
<td><strong>Downstream</strong></td>
<td></td>
</tr>
<tr>
<td>→ Climate surcharge on CO₂-intensive final products</td>
<td>→ Climate surcharge on basic materials-intensive products</td>
</tr>
<tr>
<td>→ Requirements &amp; labels for embedded CO₂ in intermediate &amp; final products</td>
<td>→ Energy Performance in Buildings Directive &amp; Eco-design</td>
</tr>
<tr>
<td>→ Recycling quality targets &amp; end-of-life obligations</td>
<td>→ Waste Framework Directive (End of Life Vehicles regulation, CDW*)</td>
</tr>
<tr>
<td>→ Public procurement requirements</td>
<td>→ Public Procurement Directive</td>
</tr>
</tbody>
</table>
Summary

➔ The situation is urgent, industry will need to make major reinvestments by 2030.

➔ CO2 prices, a CBAM and “industry alliances” will not be enough on their own.

➔ A Clean Industry Package is needed to unlock the needed incentives along the full value chain.

➔ A Clean Industry Package could be implemented by adapting existing legislation.
Thank you for your attention

oliver.sartor@agora-energiewende.de

Oliver Sartor
PARIS, 18-11-2020
4. Annex I on Carbon Leakage
Higher EU 2030 climate ambition will mean significantly higher carbon prices

A -55% ambition target for the EU in 2030 would lead to significant increases in carbon prices in the EU ETS.

Carbon leakage risk is increased unless adequate carbon leakage protection is provided.

CO2 Price Ranges Expected under Increased EU ETS 2030 Ambition

Sources: Agora Energiewende
Carbon leakage protection is not just about protecting incumbents, it is also about creating a viable business case for green production in the future...

Carbon costs as a % of gross operating margins at 50€/tCO2

Additional cost of low carbon technologies (in €/tCO2)

- Forecast 2020-30 ETS price range under a 50 to 55%
- 2030 breakeven CO2 price ranges of key technologies
The current anti-carbon leakage system which is in place consists of two elements: free allocation & state aid

<table>
<thead>
<tr>
<th>Pillar 1. Free allocation under the EU ETS</th>
<th>Pillar 2. State aid for electro-intensive industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>➔ Installations in sectors considered at risk of carbon leakage receive free allocation of ETS allowances</td>
<td>➔ For traded electro-intensive industries (e.g. non-ferrous metals, certain chemicals),</td>
</tr>
<tr>
<td>➔ Free allocation based on historical production x best performance benchmarks (BM = average of best 10% in EU market)</td>
<td>➔ Higher CO2 prices increase their power costs.</td>
</tr>
<tr>
<td>➔ Given « ex ante » (i.e. at beginning of year: not adjusted for true production except in case of large changes)</td>
<td>➔ EU State Aid Guidelines allow for Member States to offer maximum 75% compensation of assumed CO2 price pass-through in power prices</td>
</tr>
<tr>
<td>➔ Adjusted downwards for all installations over time to reflect declining EU ETS cap (« cross sectoral correction factor »)</td>
<td>➔ Guidelines currently being revised.</td>
</tr>
</tbody>
</table>
Unfortunately, the existing system is not sustainable - increased climate ambition hastens the need for reform…

Problem 1. At constant ETS scope, faster decline in total number of allowances means Cross Sectoral Correction Factor kicks in well before 2030

Problem 2. At high CO2 prices, ex-ante free allocation does not avoid « operational leakage » (i.e importing products and selling excess allowances at profit)

Problem 3. At higher CO2 prices, incomplete state aid protection for electro-intensives is more problematic (max of 75% of benchmark)
Even if the ETS is enlarged to include other sectors, thus increasing the pool of free allowances, three kinds of reforms would be needed...

In short run,

→ Free allocation should be given to energy-intensives based on **ex-post verified production levels**, to avoid « operational leakage ».

→ State aid to electro-intensives should be given at 100% of the BAT benchmark, when CO2 prices are > 30€/tCO2 not max. 75%

In medium term,

→ A transition to a robust long-term alternative to free allocation needs to be made, to secure the investment framework for clean industry assets.
A package of transitional and protective anti-carbon leakage solutions

Short, medium and long-term policy tools for carbon leakage protection

- State aid for indirect CO₂ costs @ 100% of benchmark
- Output-based free allocation for direct emissions
- Support to transition to key low-carbon technologies (CCIFs)
- Carbon Border Adjustments
- Green material product requirement

Source: Agora Energiewende (2020)
4. Annex II on CCfDs
Carbon Contracts-for-Difference to support commercial deployment of key-low carbon technologies

The CCfD mechanism with two anti-leakage policies (free allocation vs BCAs)

Agora Energiewende, 2020
Cost of CCfDs would be manageable even for large member states, especially if combined with ETS reform to raise CO2 prices

<table>
<thead>
<tr>
<th>Breakthrough Technology</th>
<th>Breakeven CO₂ price range &amp; central estimate for 2030*</th>
<th>CCfD payment per tCO₂ avoided @ETS=45€/tCO₂</th>
<th>Support per tonne primary Steel/Cement</th>
<th>10% of EU27 primary production</th>
<th>Annual Costs for CCfD (for greening 10% of EU market)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEEL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRI (NatGas) (~66% t CO₂/t steel)</td>
<td>71</td>
<td>60€/tCO₂</td>
<td>15€/t CO₂</td>
<td>17€/t CO₂</td>
<td>10Mt/yr = 0.17 bn €/yr</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRI (Green H₂) (~80% t CO₂/t steel)</td>
<td>165</td>
<td>132€/tCO₂</td>
<td>87€/t CO₂</td>
<td>132€/t CO₂</td>
<td>10Mt/yr = 1.32 bn €/yr</td>
</tr>
<tr>
<td></td>
<td>99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CEMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxyfuel-CCS (~90% CO₂/t cement)</td>
<td>131</td>
<td>101€/tCO₂</td>
<td>55€/t CO₂</td>
<td>31€/t CO₂</td>
<td>16Mt/yr = 0.50 bn €/yr</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CO₂ reductions refer to conventional process (steelmaking, cement)

Green Power price = 60€/MWh – 70€/MWh

Assumes 45€/t CO₂ average price in EU ETS

2017 EU primary steel (cement) production = 95 Mt (159 Mt)

Number will vary for bigger or smaller Member states & depending on capacity supported.

Agora Energiewende
How might CCfDs be funded?

1. Re-direction of certain innovation funds

2. Use of new ETS auction revenues (from either ETS expansion / BCA)

3. Climate surcharges on final products with high levels of energy-intensive basic materials, e.g. buildings, vehicles, packaging…

Agora Energiewende, 2020
CCfDs are best suited to de-risk and support opex costs of breakthrough tech, while other «market creation» policies have different strengths

<table>
<thead>
<tr>
<th></th>
<th>De-risk &amp; pay opex of breakthrough technologies</th>
<th>Time to implement at scale</th>
<th>Creates scalable markets?</th>
<th>Leverages broad portfolio of decarbonisation solutions</th>
<th>Incidence of cost burden</th>
<th>Speeds up phase out of residual “high carbon” products/practices?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon contracts for Difference</td>
<td>+++</td>
<td>Fast</td>
<td>++</td>
<td>+</td>
<td>Depends on revenue source</td>
<td>+</td>
</tr>
<tr>
<td>Climate-neutral material labels/requirements</td>
<td>+</td>
<td>Slow</td>
<td>+++</td>
<td>+</td>
<td>Final consumers</td>
<td>+++</td>
</tr>
<tr>
<td>Embedded carbon requirements</td>
<td>-</td>
<td>Medium/Slow</td>
<td>++</td>
<td>+++</td>
<td>Final consumers</td>
<td>+++</td>
</tr>
<tr>
<td>Green Public Procurement</td>
<td>-</td>
<td>Slow</td>
<td>++</td>
<td>+++</td>
<td>Public funds</td>
<td>+++</td>
</tr>
</tbody>
</table>