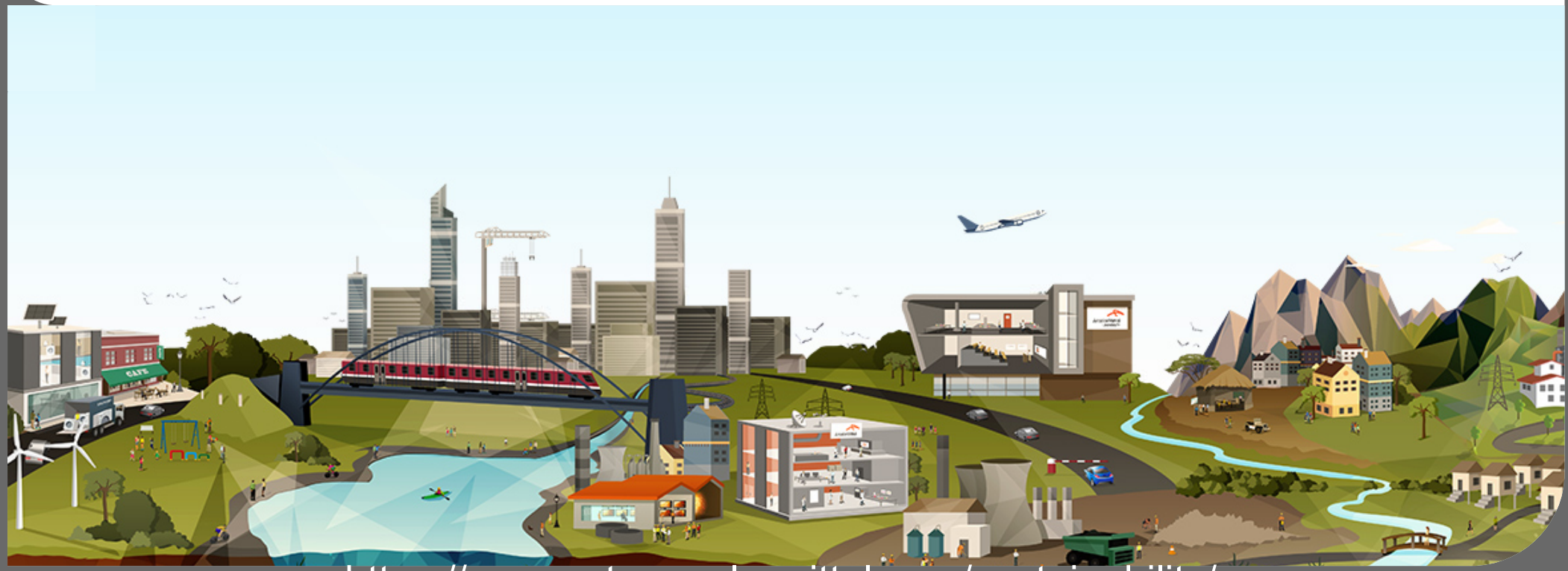
Matériaux et développement durable : démarches industrielles et impact sociétal

Steel sustainability



https://corporate.arcelormittal.com/sustainability/

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Box 1: materials production and recyclability

Global materials production has grown significantly over the past three decades; steel is the only manufactured material that can be fully recycled.

Figure 1: global production (1990=100)

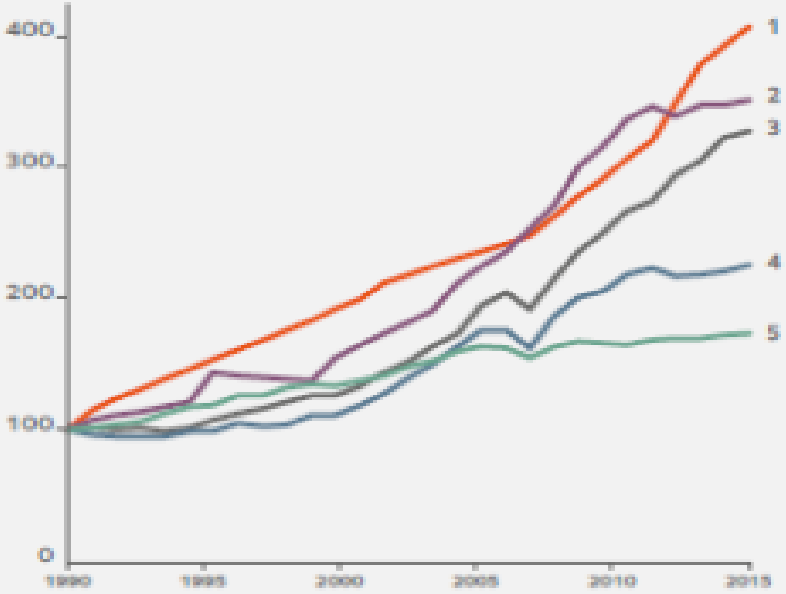

Table 1

Material group	Recyclability*	Made from end-of-life material
1 Plastics and synthetic fabrics	◒	5–10%
2 Cement[5]	○	0%
3 Aluminium	◔	21%
4 Steel	●	22%
5 Paper and cardboard	◔	50–60%

*Ability to make same material again at end of life

● Fully recyclable, low risk of downcycling
◔ Highly recyclable, risk of downcycling
◒ Partially recyclable, risk of downcycling
○ Little or no recyclability

Source: ArcelorMittal corporate strategy

Steel production accounts for 7% of global emissions

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Figure 2: Indicative CO_2 emissions outlook for steel

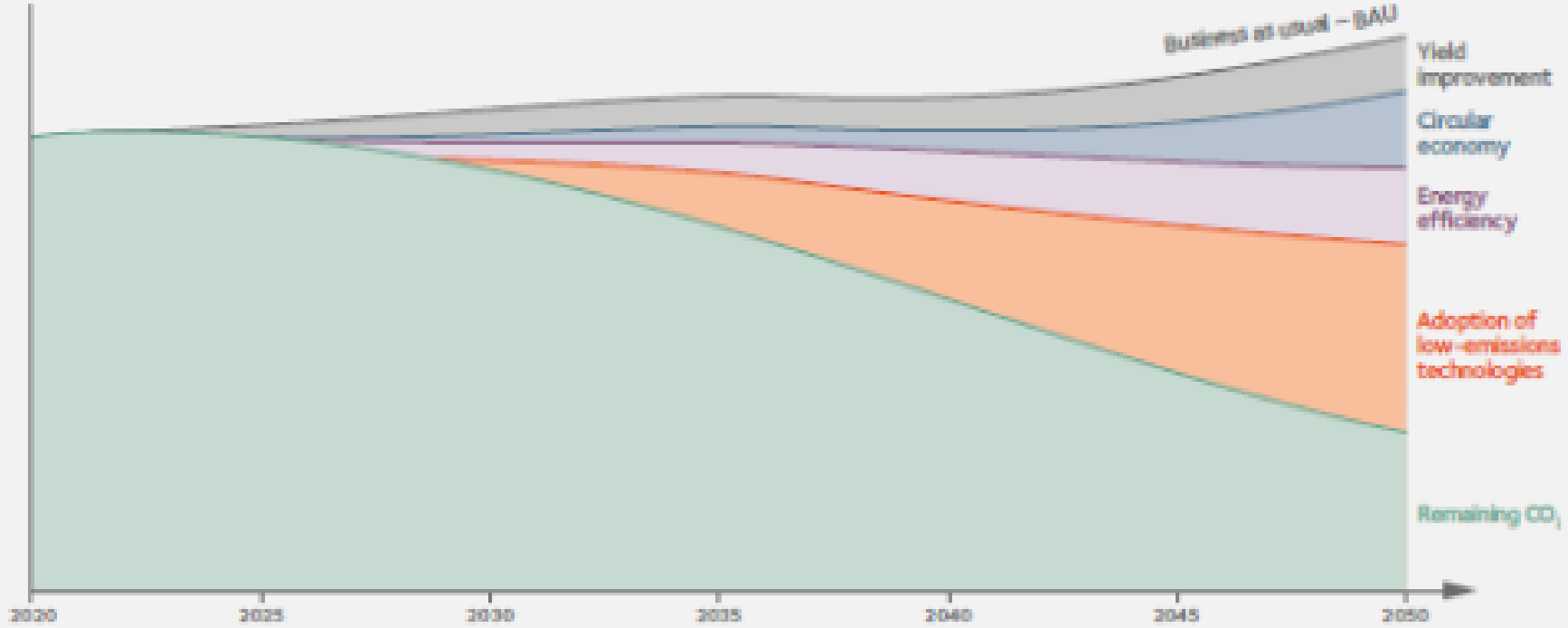

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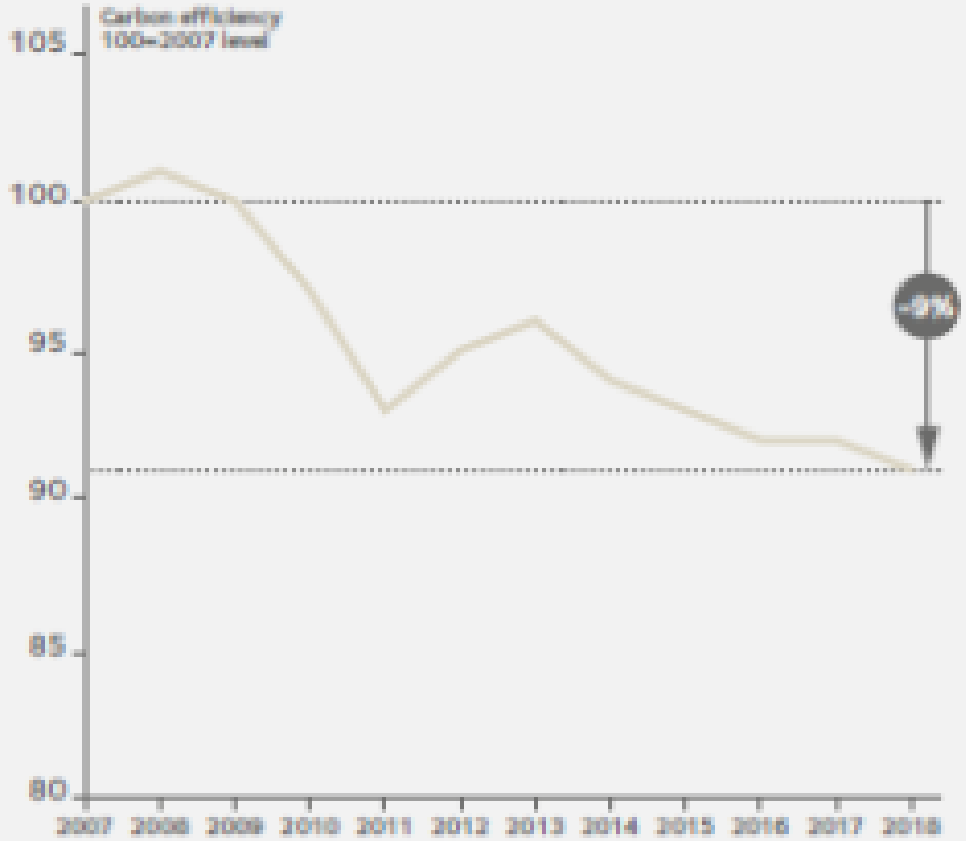
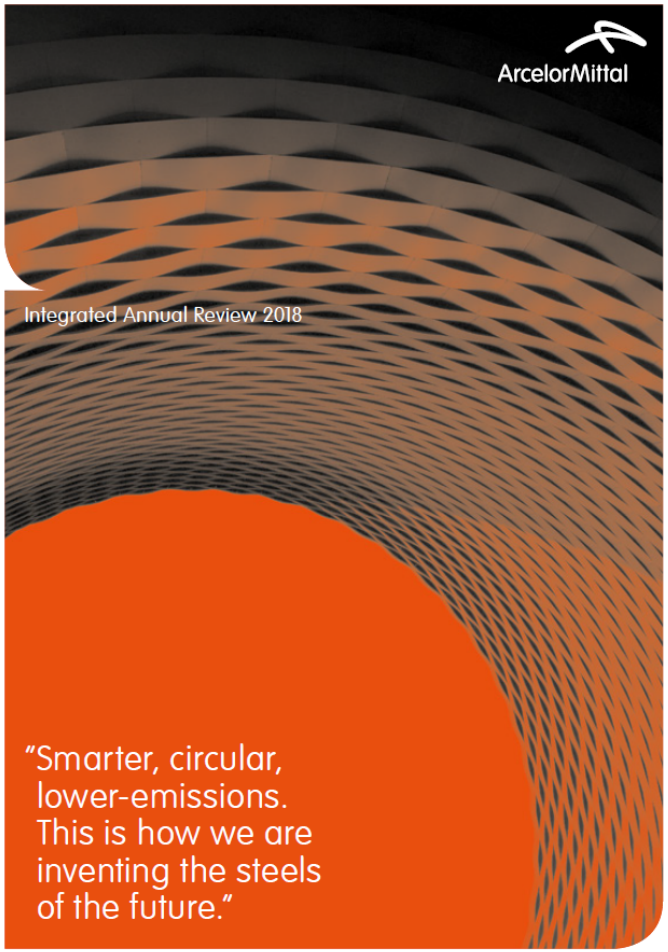
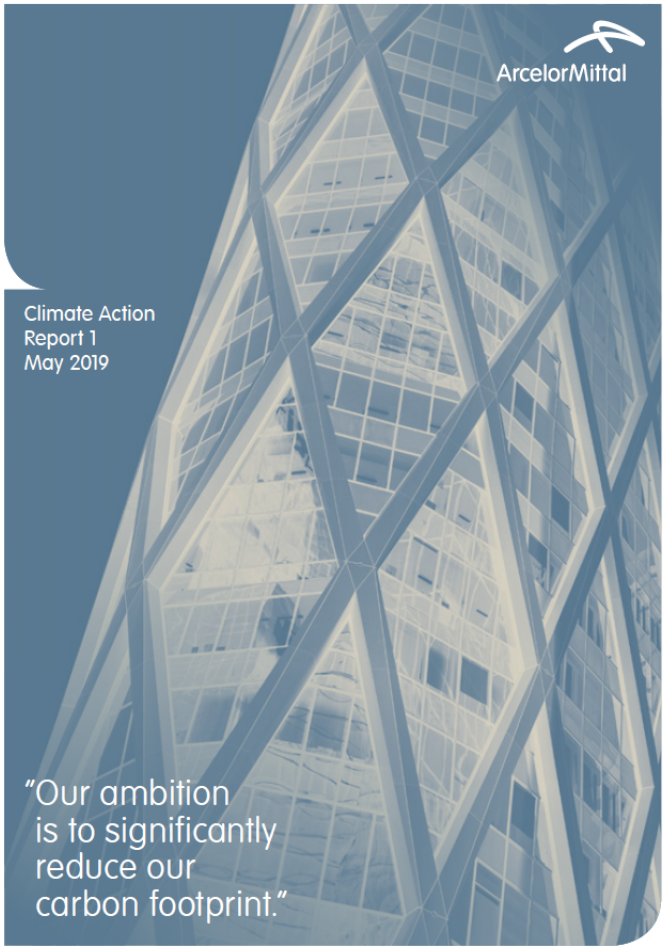
Figure 15: carbon efficiency improvement per tonne hot rolled coil (2007=100)



Our commitment to sustainability





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Our commitment to sustainability

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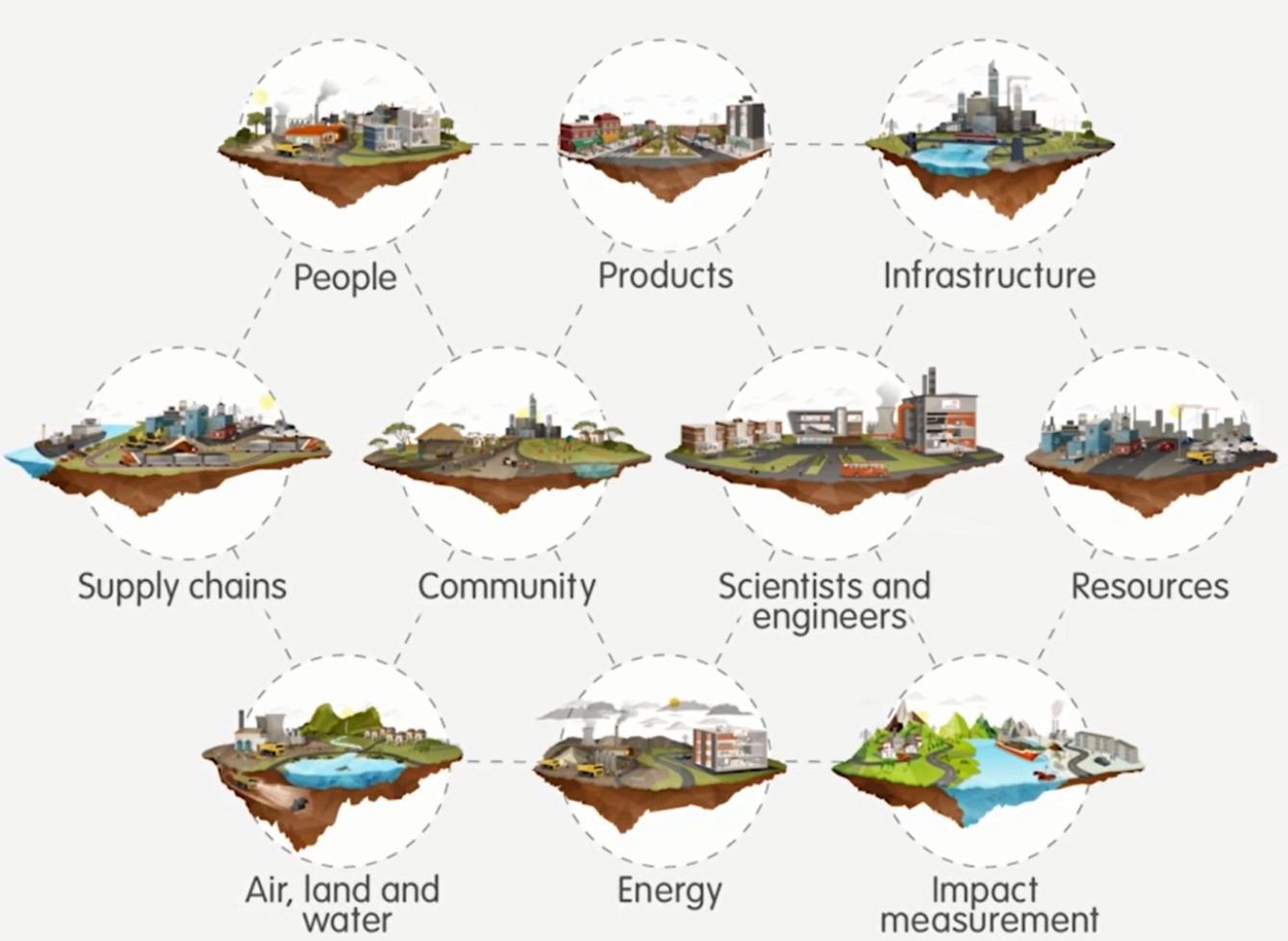
10 sustainability outcomes



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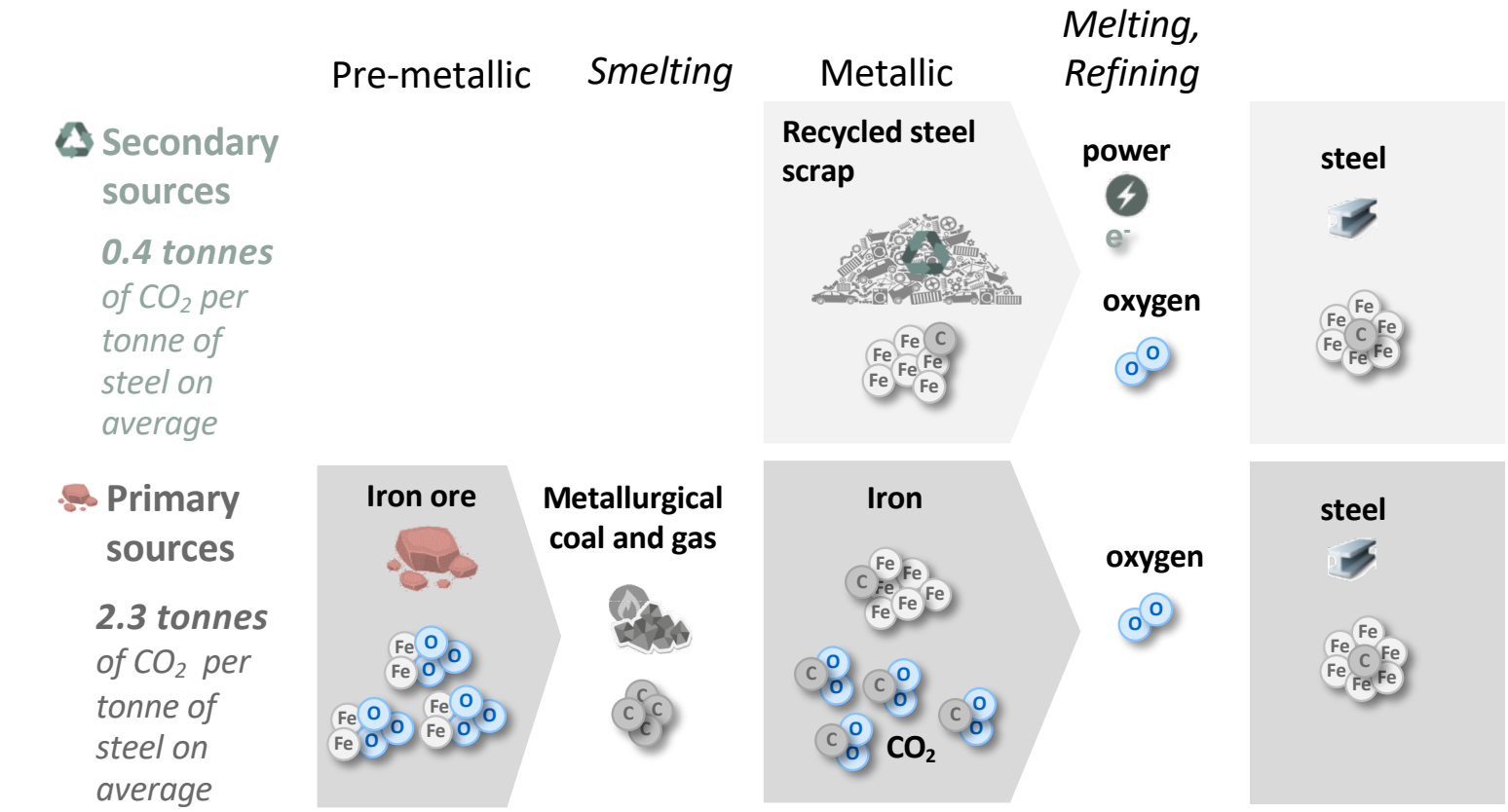
Steel carbon footprint today



Source: Energy Transitions Commission

Steel production accounts for 7% of global emissions

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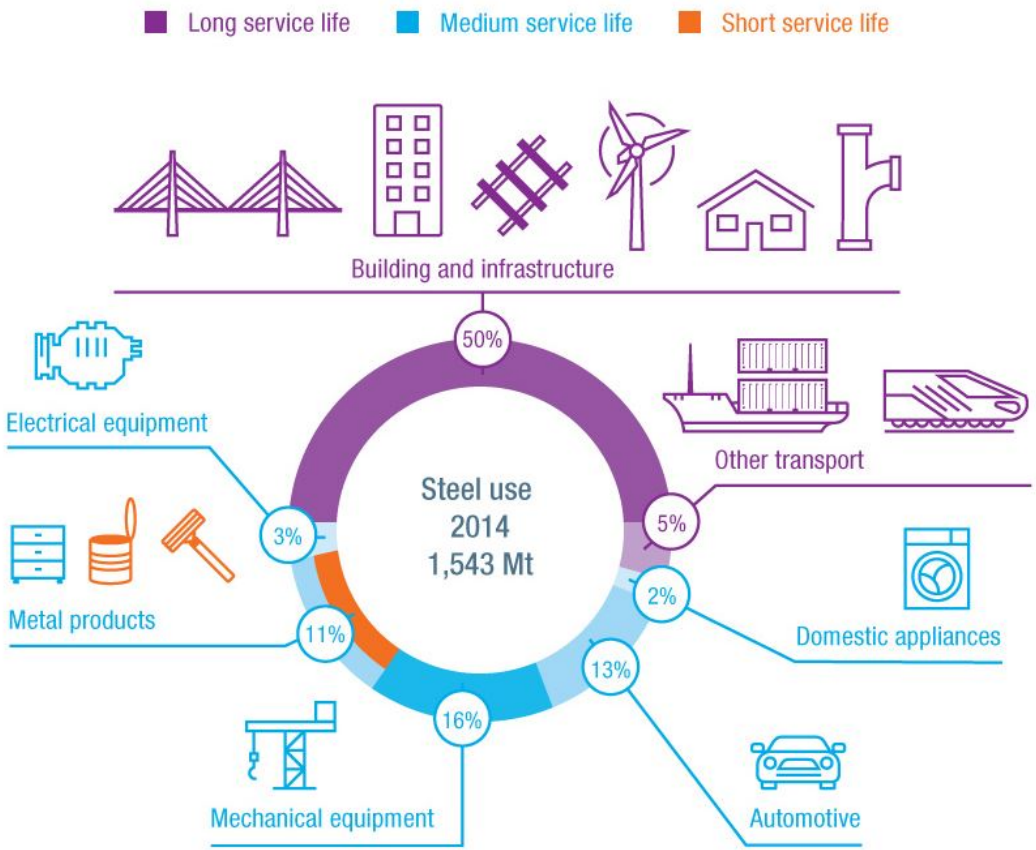
Why don’t we produce only from secondary?
1/ context: distribution and lifespan of steel products



Source: http://circulareconomy-worldsteel.org/

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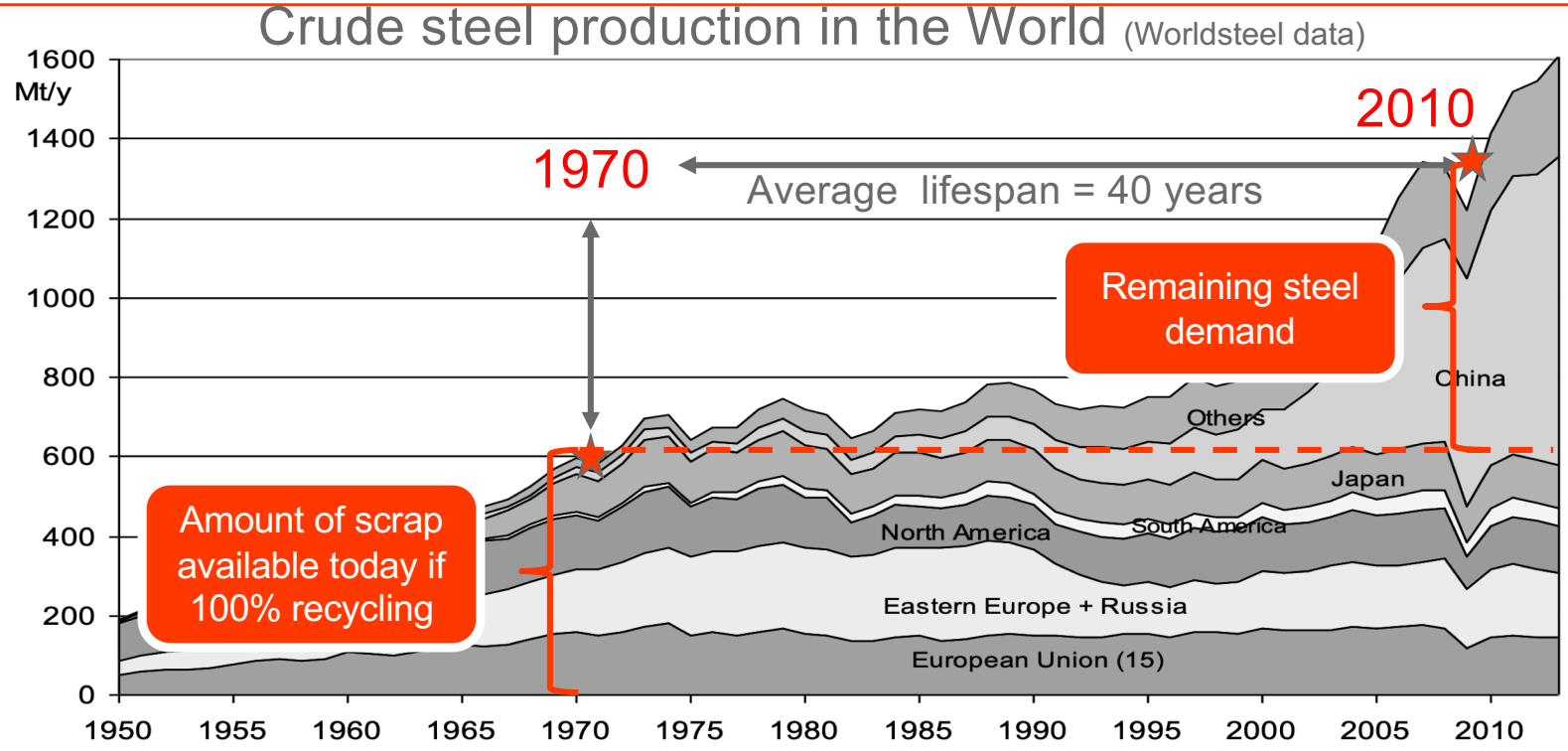
Why don't we produce only from secondary?
2/ scrap availability



As long as steel demand increases, scrap = resource
→ support recycling, not use of recycled material (recycled content)

Scrap available (600 Mt) << steel demand (1,400 Mt)

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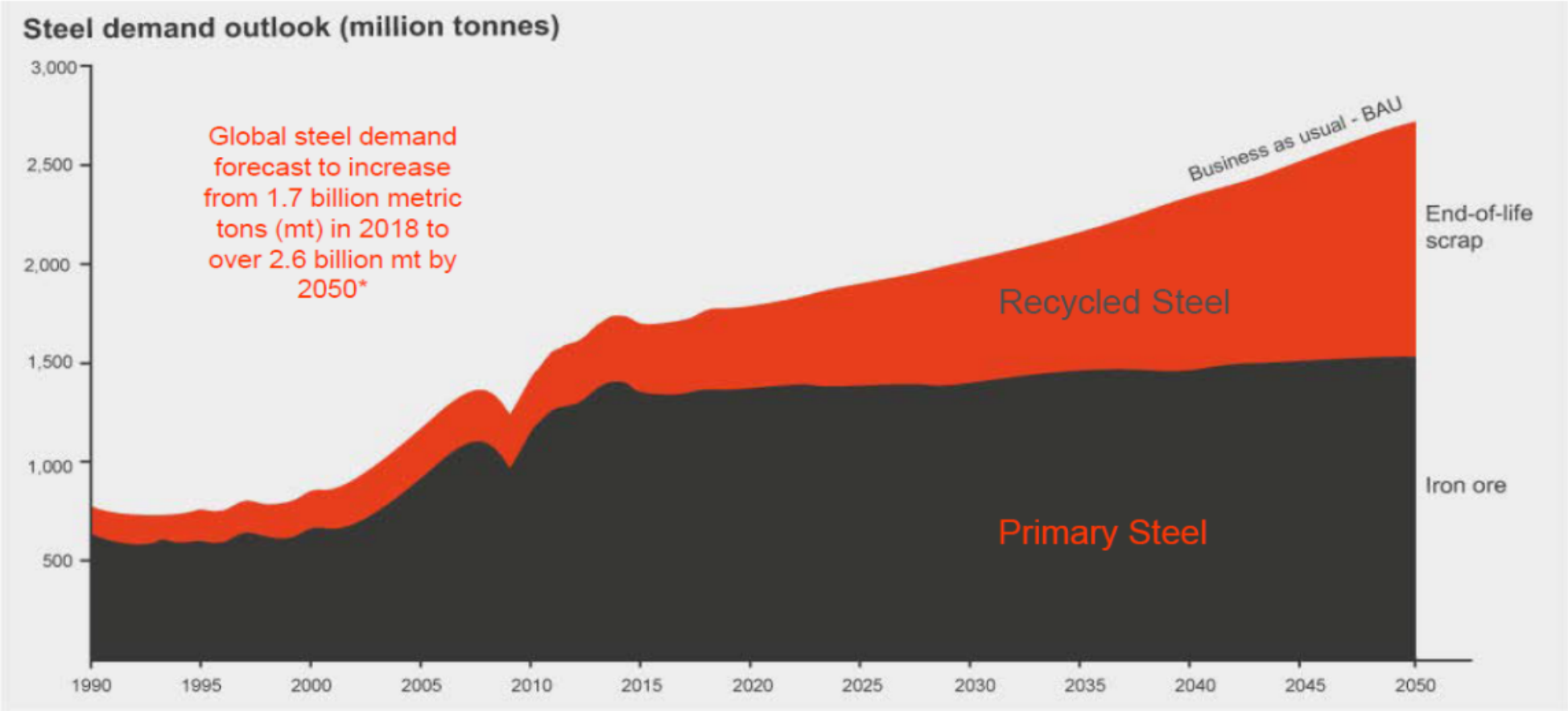
Primary steel will continue to be needed to meet global demand until 2100



* ArcelorMittal's central forecast

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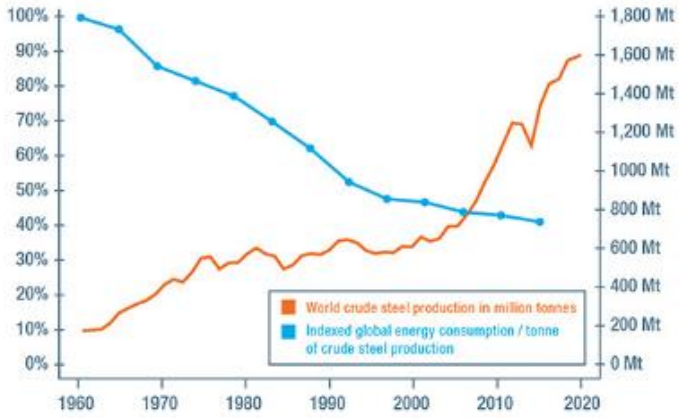
Steel environmental profile
1/ reducing manufacturing impacts

Committed to environmental impact mitigation…

…today …



- Global steel production has increased almost fivefold since 1960
- Energy consumption has been reduced by 60% per tonne of steel in the same period

For every tonne of steel produced today, we save almost 24 GJ per tonne compared to 1960. That's enough energy to drive an average passenger vehicle 17,380 km, which is equivalent to driving across the USA and back more than twice.

Sustainability CHAMPIONS worldsteel ASSOCIATION

…and in the future

Responsible Steel™ standards & certification

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No single silver bullet for low-emission primary steelmaking

- Fossil fuels, but with carbon capture, utilisation, and storage (CCUS) – add on to existing iron and steelmaking processes
- Less coal – more circular carbon including bio-based/plastic wastes from municipal and industrial sources and agricultural and forestry residues
- No coal and clean power – hydrogen-based ironmaking, direct electrolysis ironmaking (and needed for other solutions)

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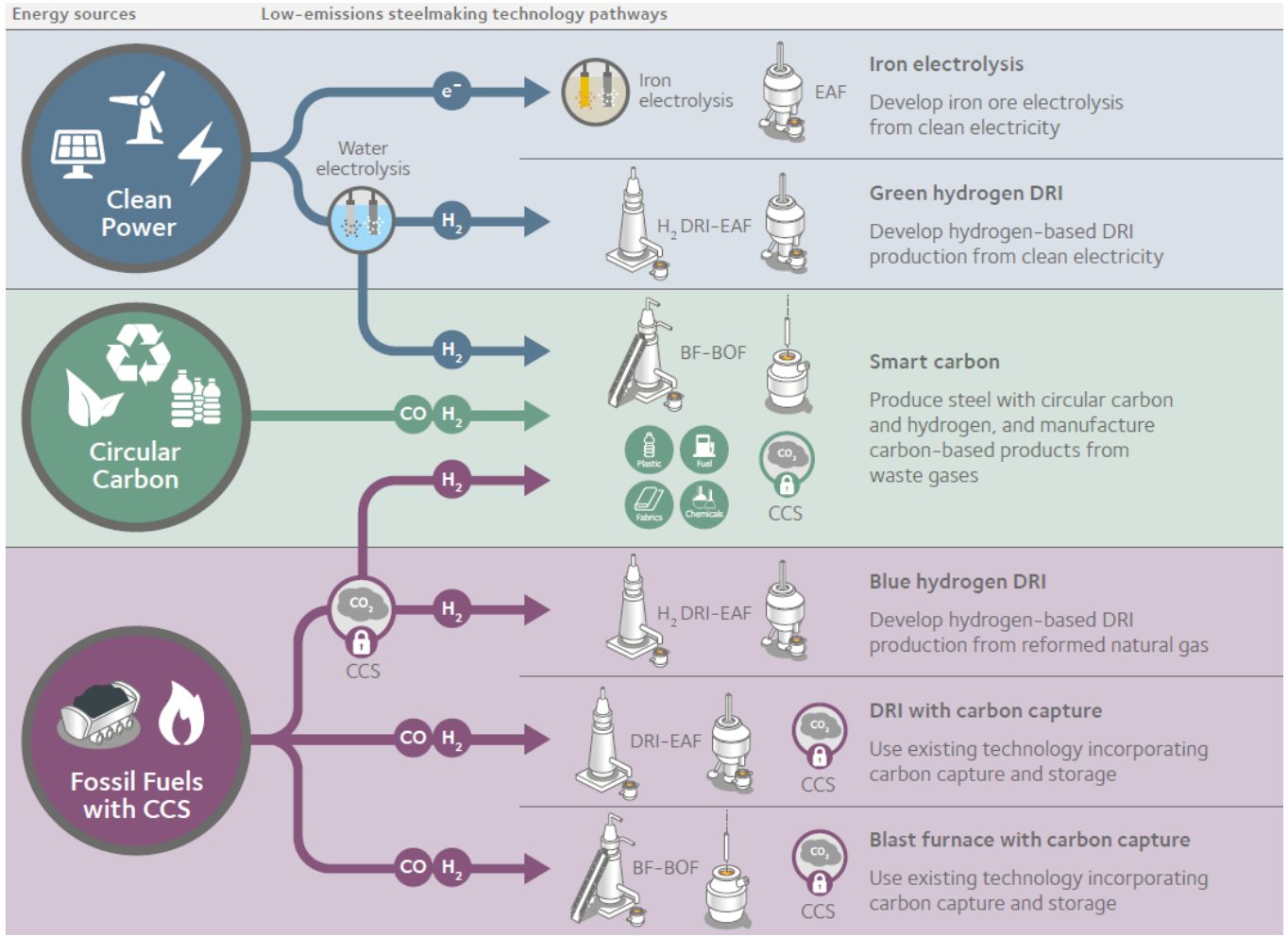
Steel environmental profile
1/ reducing manufacturing impacts



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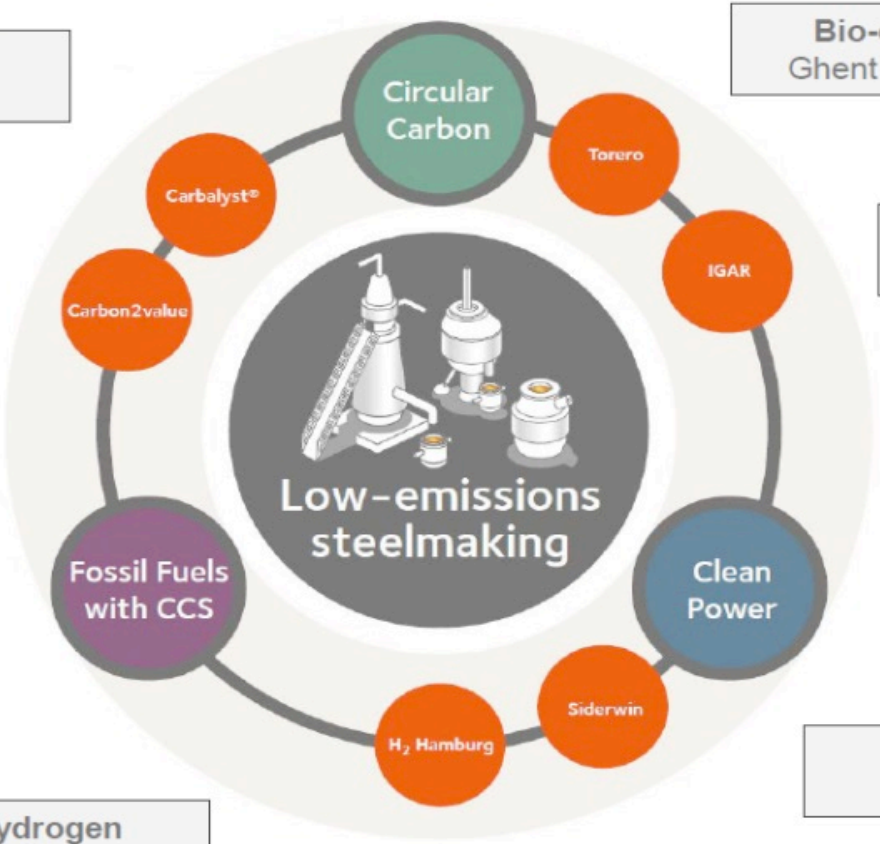
ArcelorMittal's low-emissions innovation program – Investments +$250 million

Bio-fuels from off gases
Ghent - €120M

Capture and use of CO_2 from off gases
Ghent - €70M
Dunkirk - €20M

Steel from Hydrogen
Hamburg - €65M



Bio-coals
Ghent - €40M

Injecting rich gases in BF
Dunkirk - €20M

Electrolysis of iron ore
Maizières R&D - €7M

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Steel environmental profile
2/ reducing needs for use phase

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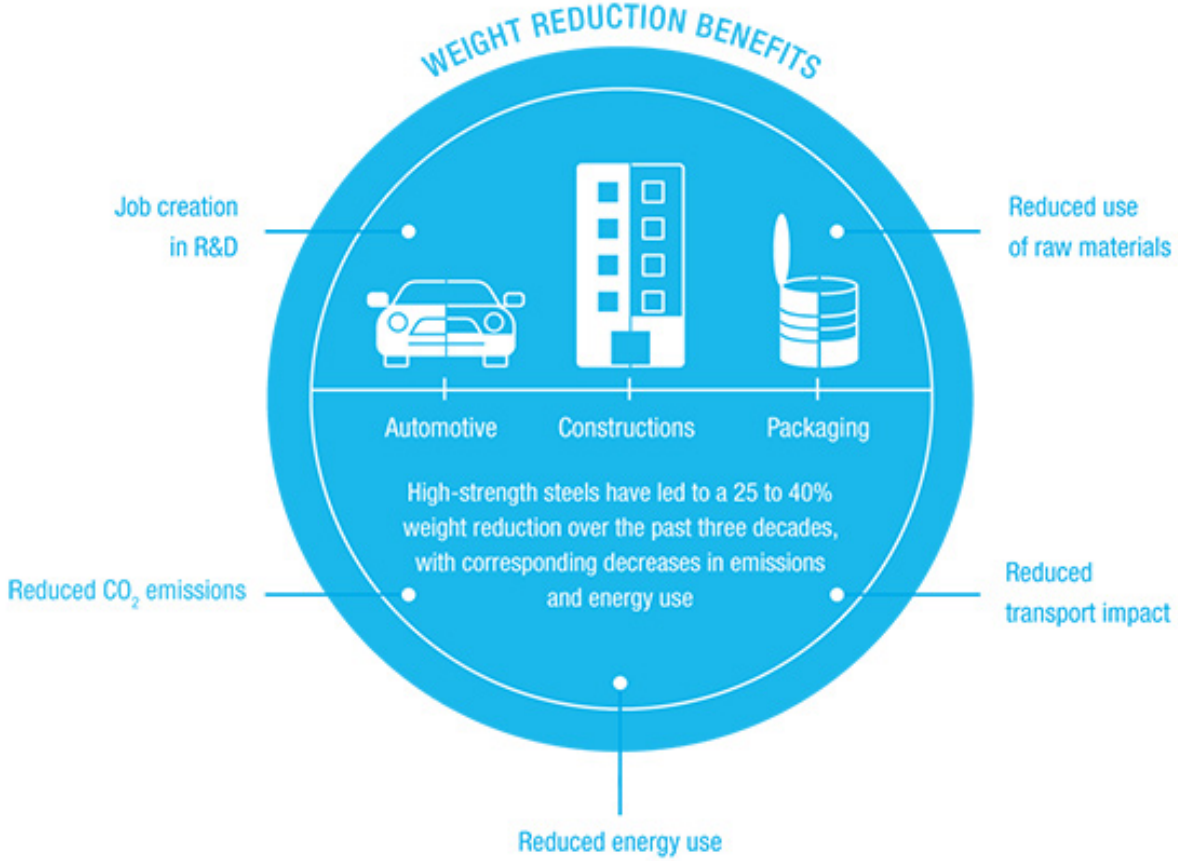

www.worldsteel.com

Steel environmental profile
3/ maximising end-of-life benefits

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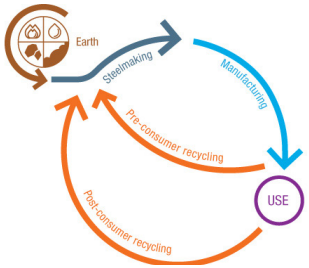

Steel attributes — Benefits of steel recycling

Infinite recycling without loss of properties

Permanent material

Easy magnetic separation and recovery

Raw materials conservation
One tonne of steel recycled saves on average :
1,400 kg iron ore
740 kg coal
120 kg limestone

70% Energy saving
Recycling a single steel can saves :
1 laundry load, or
1 hour TV, or
24 hours of a 10 watt LED bulb

Job creation
Jobs required for scrap collection, separation and recycling

Life cycle thinking is key to assess environmental footprint

- Important to evaluate whole lifespan of a product
- Allows Informed and sustainable choices
- Avoids burden shift between life cycle stages

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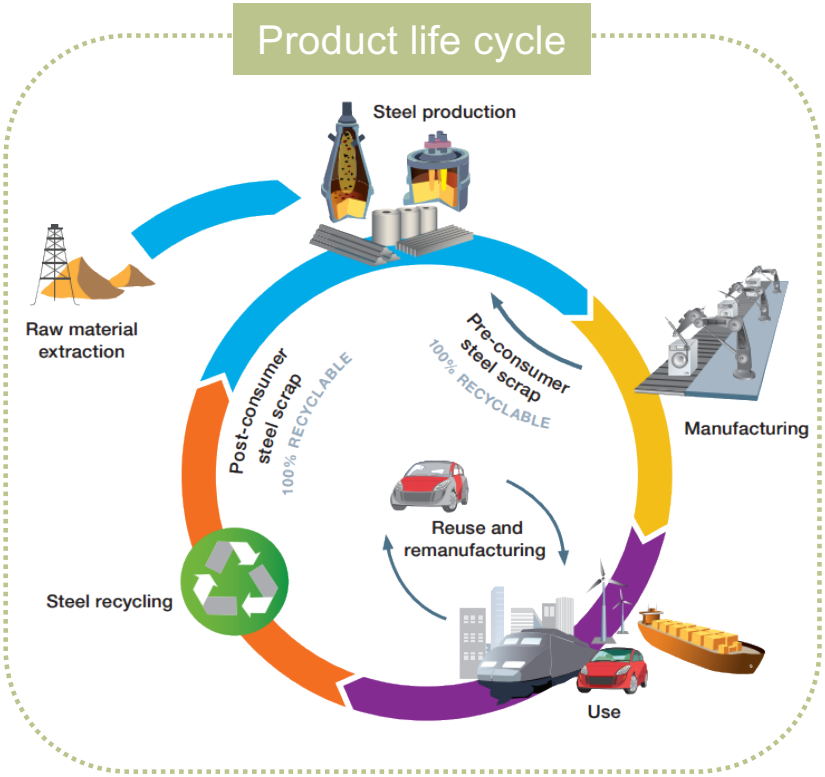
Consumption of resources

Product life cycle



Emissions and wastes to the environment

For comparison with competitors, the keyword is Functional unit

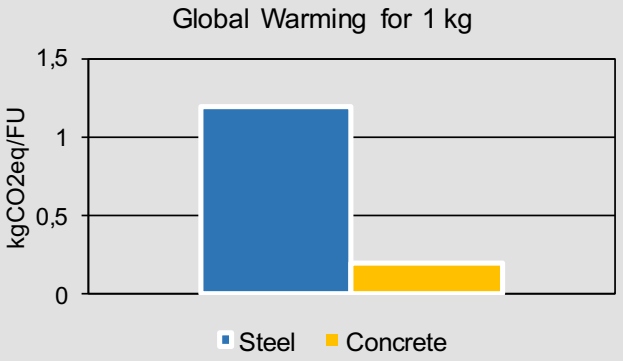
→ *Comparisons between products only for equivalent functions*

Examples: 1m² of cladding or 1 beam for a specific span and load

vs.

1kg steel

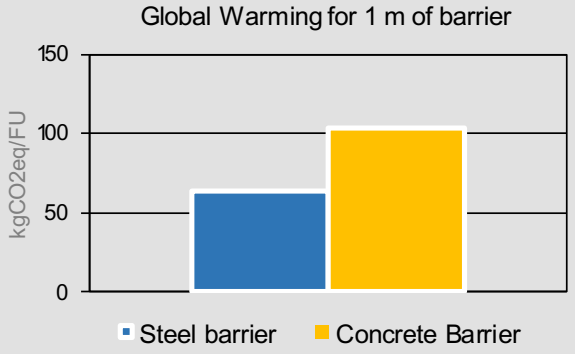
1kg concrete



vs.

1m steel barrier

1m concrete barrier



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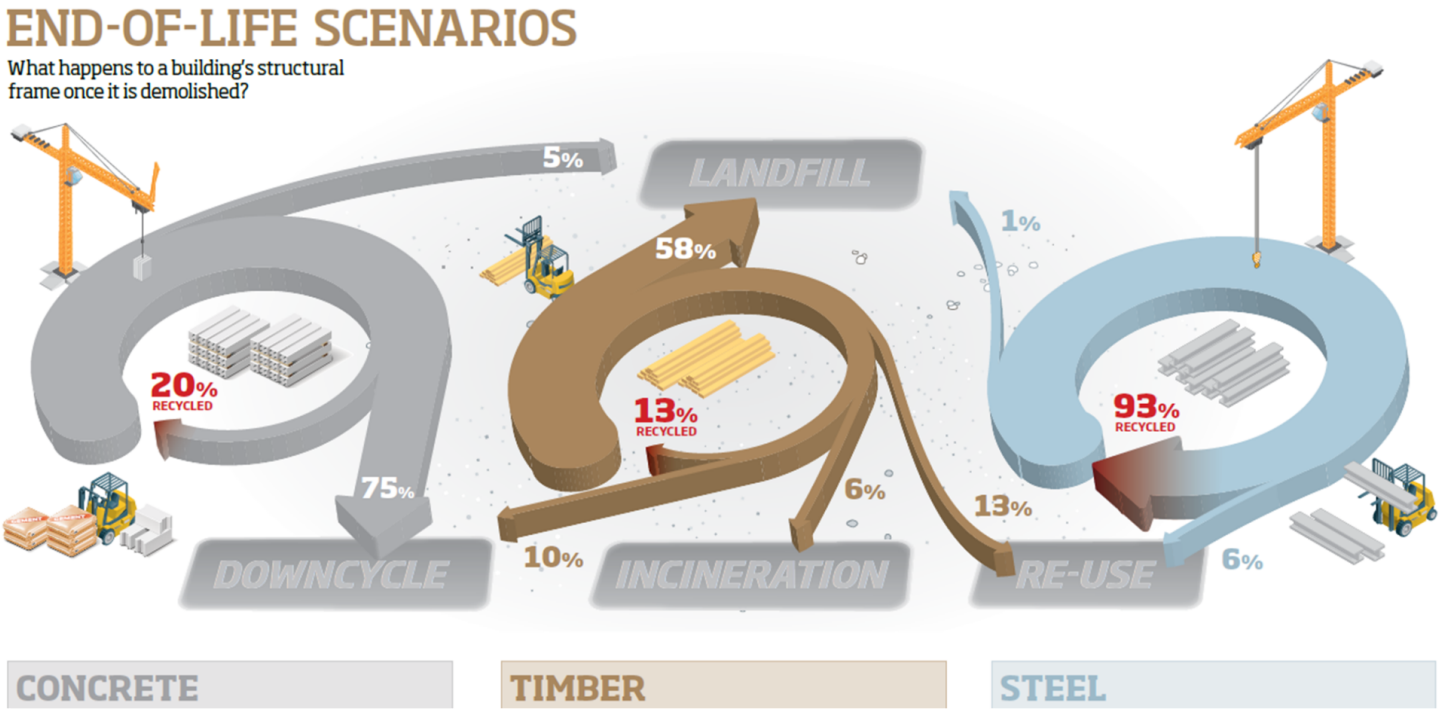
End-of-life benefits: comparison with other materials & the concept of “downcycling”

www.steelconstruction.info



Similar issue in Steel vs Aluminum for automotive

- Steel has a limited number of tramp elements; steel can be easily recycled while keeping original quality.
- Most often Aluminum is downgraded due to tramp element accumulation

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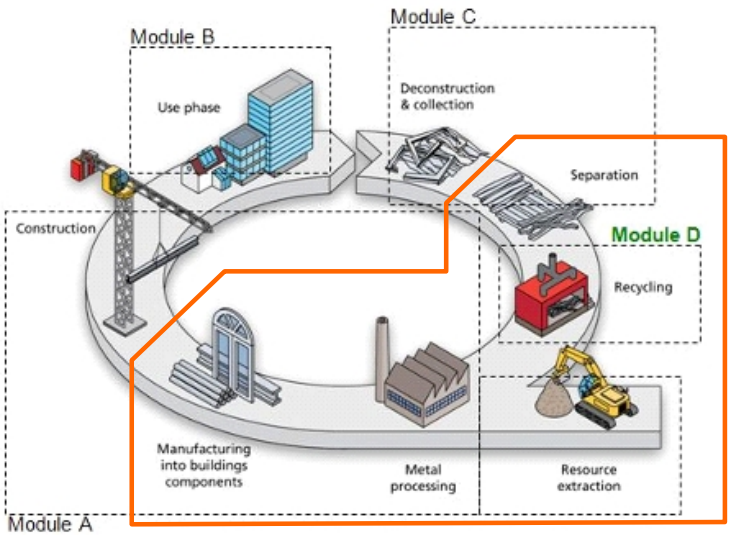
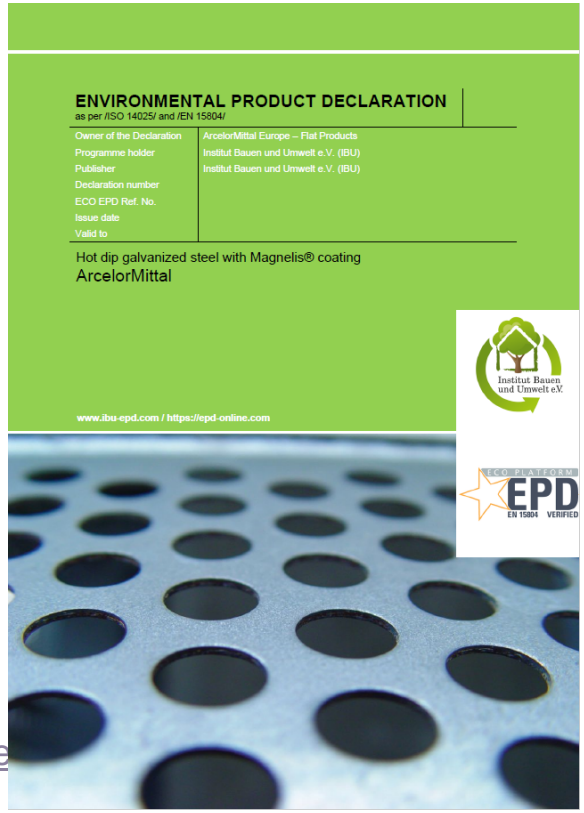
Transparency in communication: Ecolabelling Environmental Product Declaration (EPD)

An EPD is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products (EN15804).





More info: Youtube

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Our published EPDs

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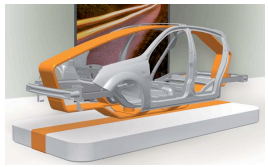
Hot-rolled steel sheet piling	Single-sided Safety Barrier - containment level H1W4A	Structural steel sections and merchant bars
HISTAR	Single-sided Safety Barrier - containment level H2W5B	Hot dip galvanized steel with pure Zinc coating
Rebar	EcoSheetPiles™	Hot dip galvanized steel with Magnelis® coating
Single-sided Safety Barrier - containment level H1W3A	Cold formed steel sheet piles	Rails for transport, tramways, rail track devices and cranes

https://epd-online.com/PublishedEpd/Index

S-in Motion

The “body in white” weight reduction needed to achieve emission targets can be achieved at attractive cost and without impacting vehicle performance
with **existing steel grades and solutions,** with further potential from new grades

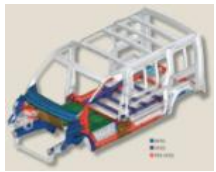


S-in motion®
C-Segment Vehicle

Achieved 20% BIW weight reduction from 2009 baseline

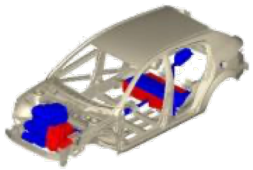
S-in motion®
Battery Electric Vehicle

Achieved 11% BIW weight reduction from 2011 baseline

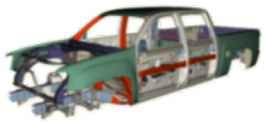


S-in motion®
Light Commercial Vehicles

Achieved 20% underbody weight reduction



S-in motion®
Electric & Plug-in Hybrid C-Segment Vehicles



S-in motion®
Pickup Truck

Achieved 23% BIW weight reduction from 2013 baseline

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Example of LCA results: S-in Motion

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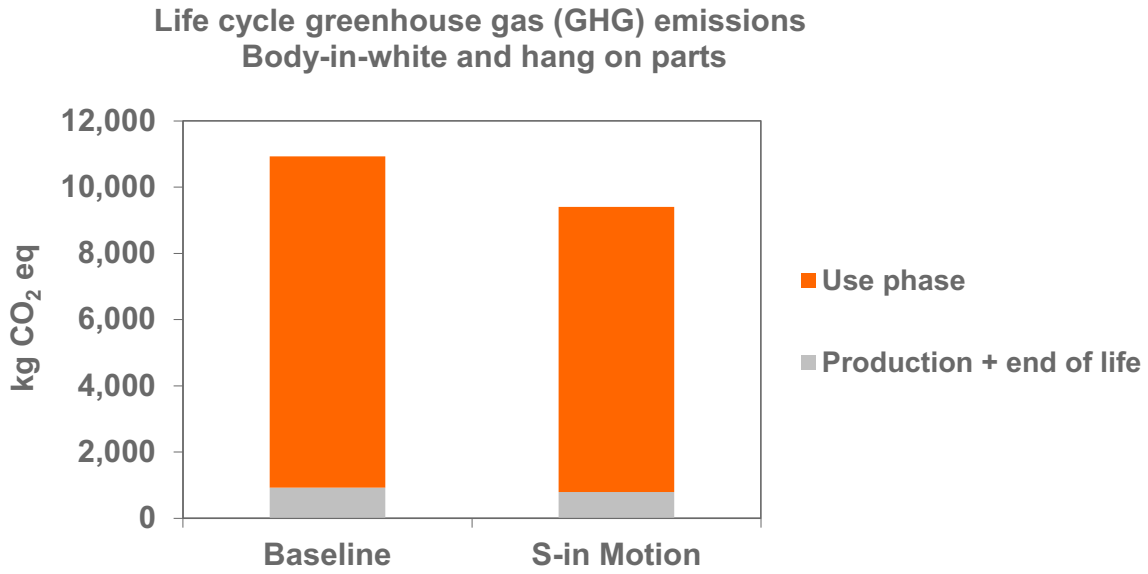


S-in Motion benefits:

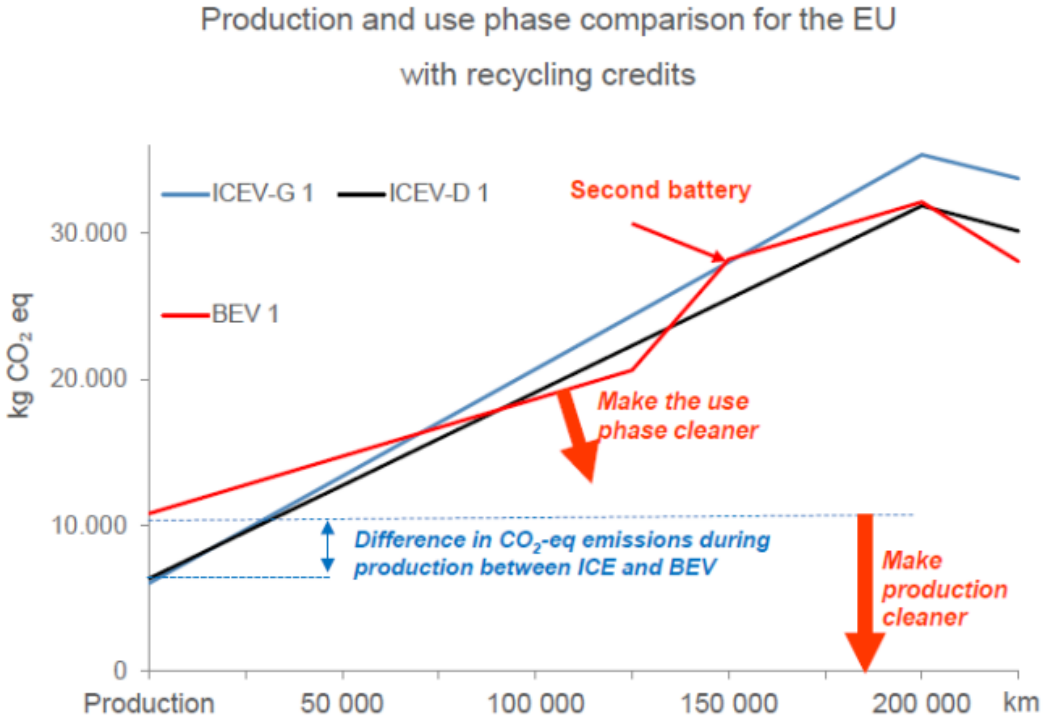
- 73 kg of weight reduction
- 15% reduction of GHG during the production phase thanks to the use of Usibor
- 14% reduction of greenhouse gas emissions (GHG) over the entire vehicle life-cycle
- 6.2 gCO_2/km reduction during the use phase

Battery electric vehicles (BEVs): Potential to improve sustainability considerably

Based on a Life Cycle Assessment (LCA) approach
→ A BEV is not always greener than a conventional ICE car

To make BEVs more sustainable, we can:

- Reduce the CO_2-eq emissions during the production phase
- Reduce CO_2-eq emissions during the use phase



LCA analysis shows a fair comparison between ICE and BEV cars. In the case of a BEV, the CO_2-eq released during the production phase has more weight in its overall LCA performance

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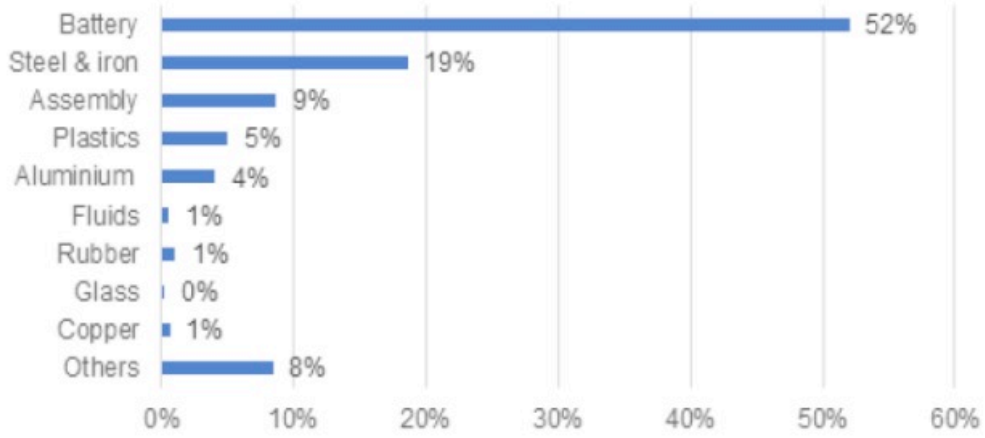
A BEV's body-in-white is the second carbon hotspot after battery production

- After the batteries, steel for the body-in-white is the second largest source of CO_2-eq emissions
  - The high contribution of steel can be explained by its intensive use (approx. 68% of the car's weight)
  - Aluminium seems to have less impact, but only because the volume of steel used is far higher (steel intensive body-in-white)
- The three main drivers which can improve the LCA performance of a body-in-white are:
  - Material choice
  - Weight savings
  - Material utilization rate

Innovation in BIW design and materials can play a major role and help OEMs to produce more sustainable cars

Cradle-to-gate carbon footprint generic C-class BEV



UCSB model v5

Approximately 20% of the CO_2-eq emissions during the production phase are directly linked to the material used for the BIW and closures.

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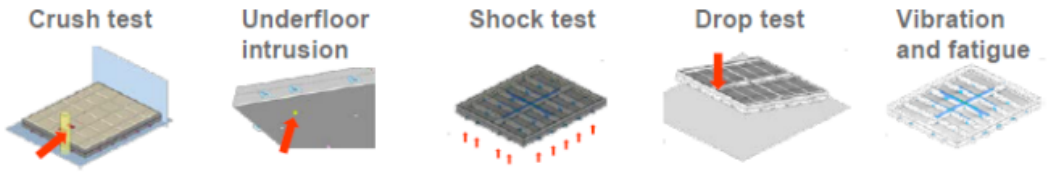
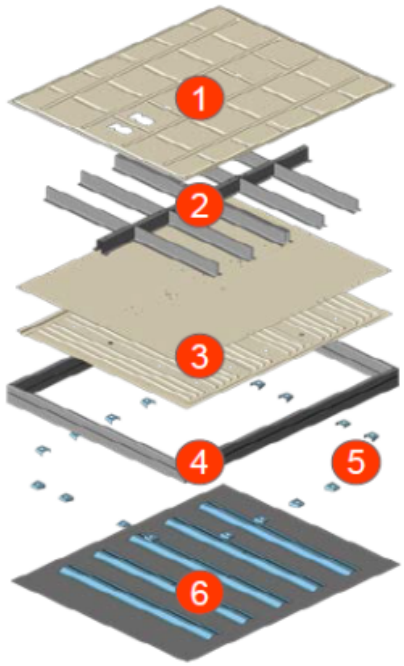
Making BEVs more sustainable: Battery pack applications

- The benefit of steel for the LCA performance of a solution has been highlighted in the S-in motion® Battery Pack study
- The S-in motion® battery has been efficiently designed using the latest AHSS technologies and fulfils the most severe crash requirements worldwide

- *More information on the ArcelorMittal Automotive web page https://automotive.arcelormittal.com/battery_pack*
- *See previous webinar about battery pack study https://automotive.arcelormittal.com/2019WebinarVideoBEV*

The S-in motion® Battery Pack is an optimized and high-performance steel solution fulfilling all technical requirements at an attractive cost





1. Top cover
HSLA300 – 0.5 mm. High performance coating allows OEMs to remove e-coating step on this part.

2. Upper cross-members
MartINsite® 1500 – 1.2 and 2.0 mm

3. Integrated cladded cooling system
Steel panels

4. Frame
MartINsite® 1500 – 2.0 mm

5. Brackets to BIW
HR CP800 – 2.5 mm

6. Lower shield and lower cross-members
MartINsite® 1500 – 1.35 mm
DP780 Y450 – 0.7 mm

Note: assembly parts 2-6 are e-coated

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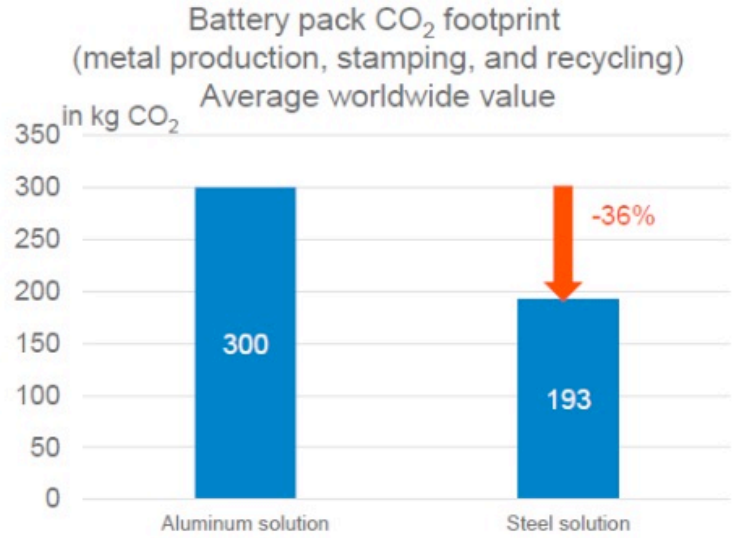
Making BEV more sustainable: Battery pack application
Steel releases 36% less CO_2 eq than an equivalent aluminum solution

- In order to have a fair comparison of LCA performance, an equivalent aluminum solution was studied:
  - New material innovations from aluminum suppliers were considered (6xxx and 7xxx)
  - Both steel and aluminum solutions are compliant with the same crash loads
- Analyses revealed that the steel solution releases 36% less CO_2-eq during the production phase compared to the aluminum solution



The steel battery pack is 36% less CO_2 intensive compared to the aluminum solution (C-Segment)

The Battery Pack application proves that steel offers clear advantages over aluminum, enabling designers to create more sustainable cars

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Making BEVs more sustainable: Design innovations
Benefits of advanced nesting for a typical A-pillar

Standard A-pillar nesting configuration

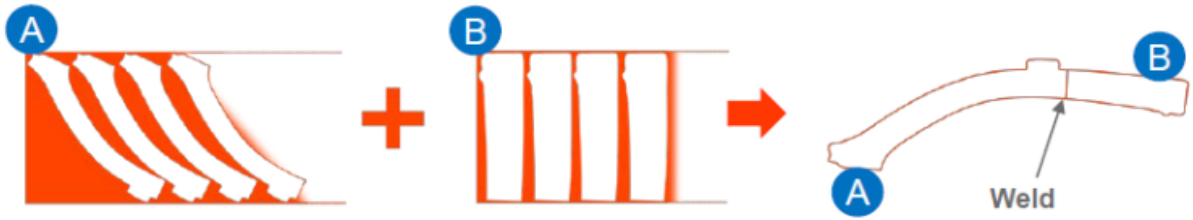
- Uses common nesting configuration deployed by OEMs who produce A-pillar blanks
- Monolithic blanks face each other

- Steel required to produce each part: 10.6 kg
- Net part weight: 5.6 kg
- Effective scrap rate: 48%

Leads to higher scrap rates

Advanced A-pillar nesting solution

- Two blanks are created instead of one monolithic blank
- Position of both blanks optimized to reduce steel required
- Solution already applied by OEMs



- Steel required to produce each part: 7.3 kg (-3.3 kg)
- Net part weight: 5.6 kg (no change)
- Effective scrap rate: 23% (-52% vs standard)
- **CO_2 eq savings: 26%**
- Cost benefit: ~€1 per car

Reducing scrap reduces material required and CO_2 emitted during production

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Low-carbon steelmaking and sustainable development – summary

- Steel is central to a future low-carbon, circular economy
- The steel industry needs to transition to low-emission primary steelmaking
- ArcelorMittal committed to the objectives of the Paris Agreement
- Stated our ambition to be carbon neutral in Europe by 2050 and reduce emissions in Europe by 30% by 2030
- Central to a successful transition will be supportive public policy
- New levels of customer reassurance on environmental and social issues
- Not just steelmaking but mining too…
- Hence our commitment to create and achieve ResponsibleSteel™
- But the contribution of our steel products and solutions will be significant…

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