Material Efficiency in Clean Energy Transitions

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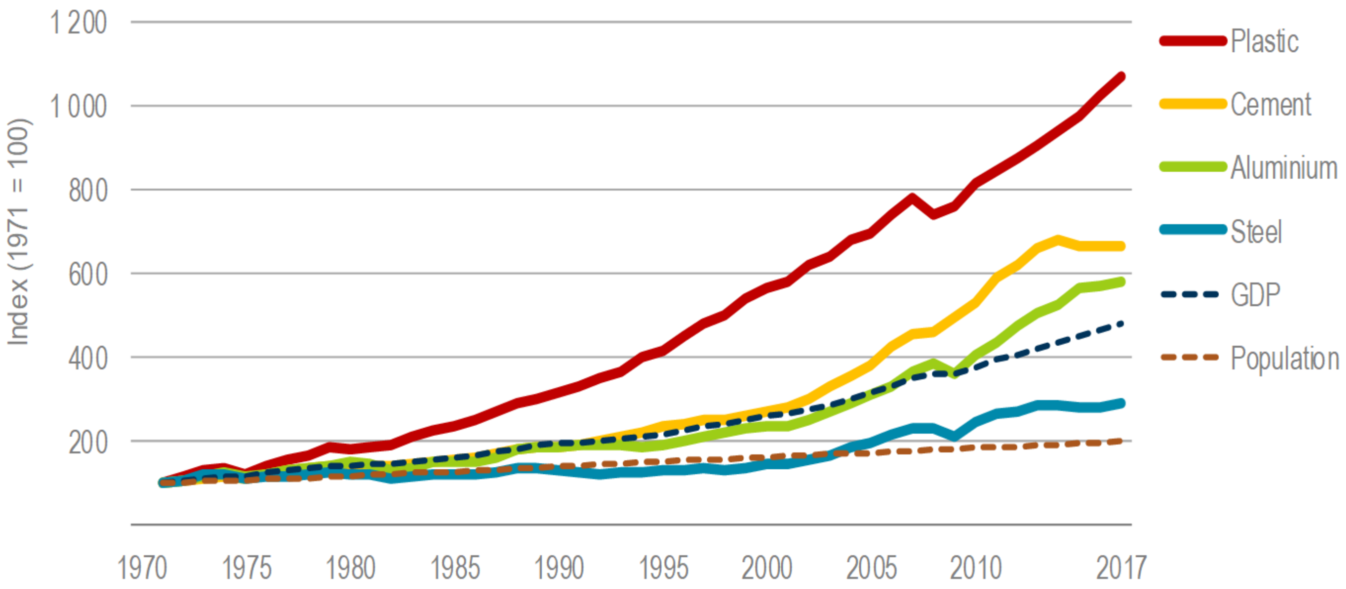
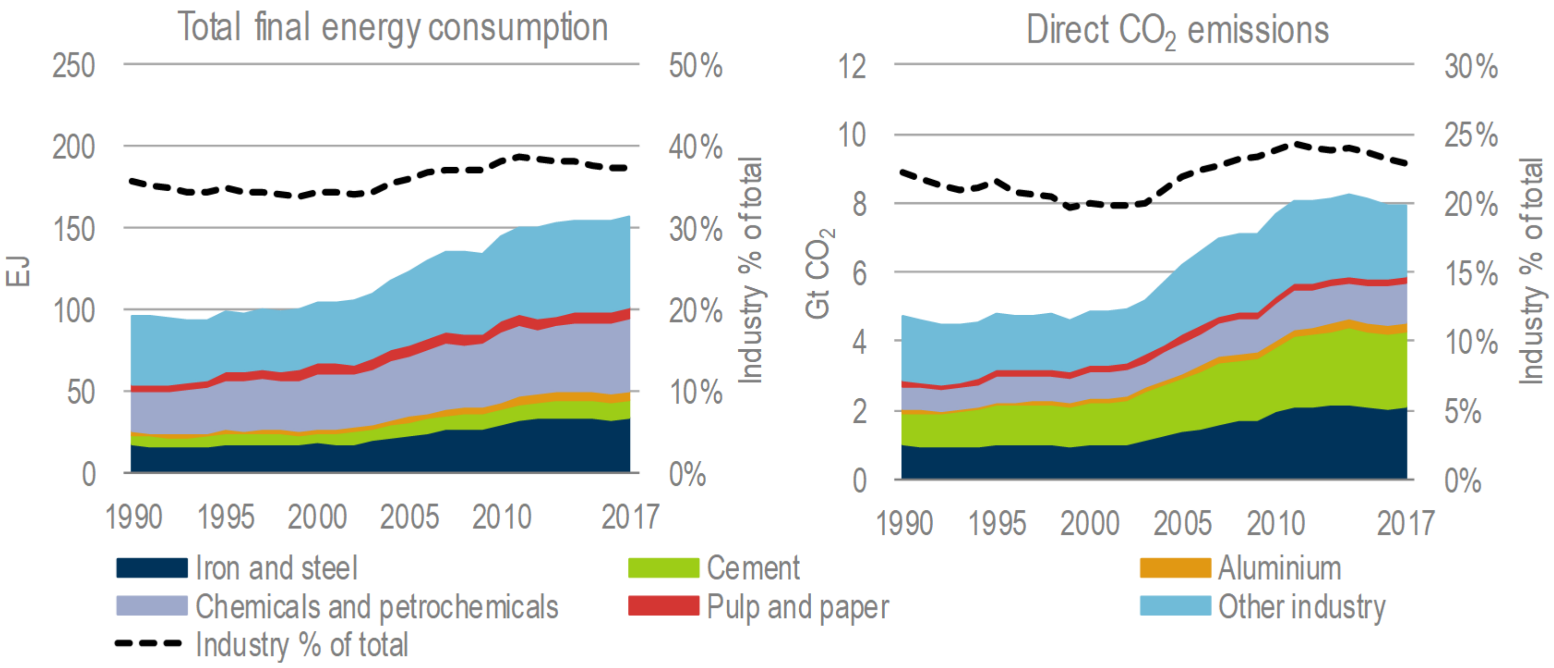
Growing demand for materials drives growth in industry emissions

Demand growth for key materials, GDP and population



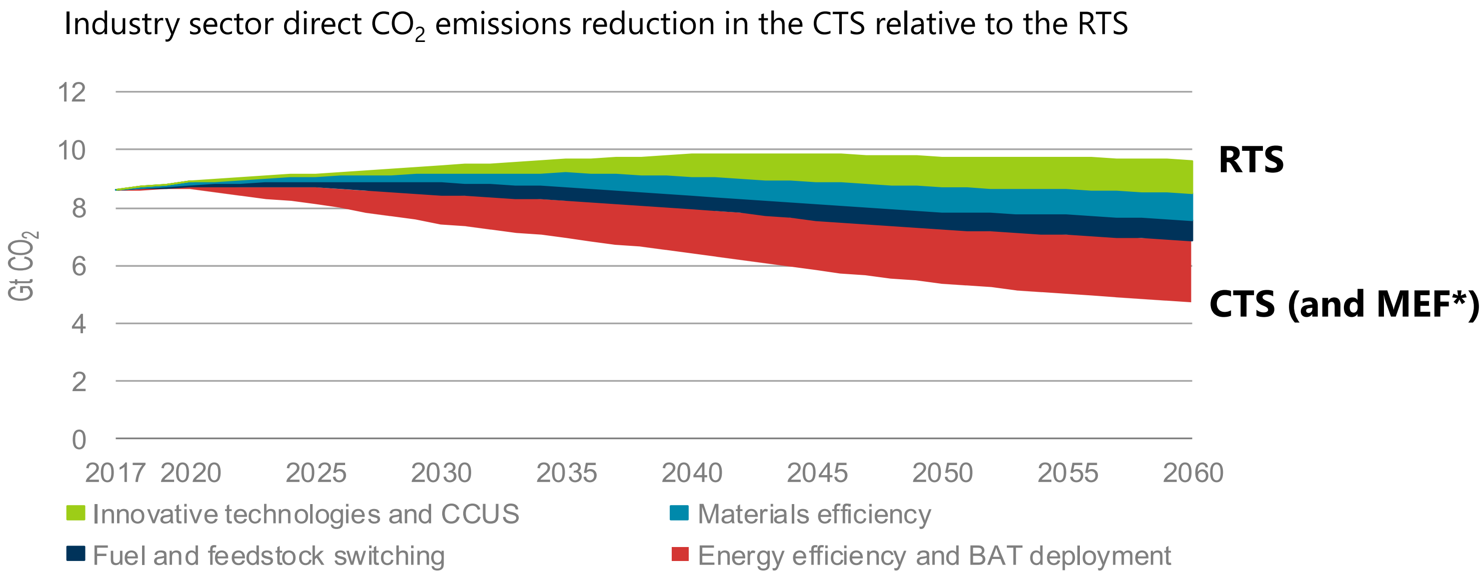
Demand for materials – a key driver of industrial emissions – has grown considerably over past decades. Much of the growth since 2000 has been due to rapid development in China.

Industry contributes a large share of global energy use and CO_2 emissions



Industrial total final energy consumption and direct CO_2 emissions have grown more than one and a half times over the last 25 years.

Multiple strategies are needed to reduce industry emissions

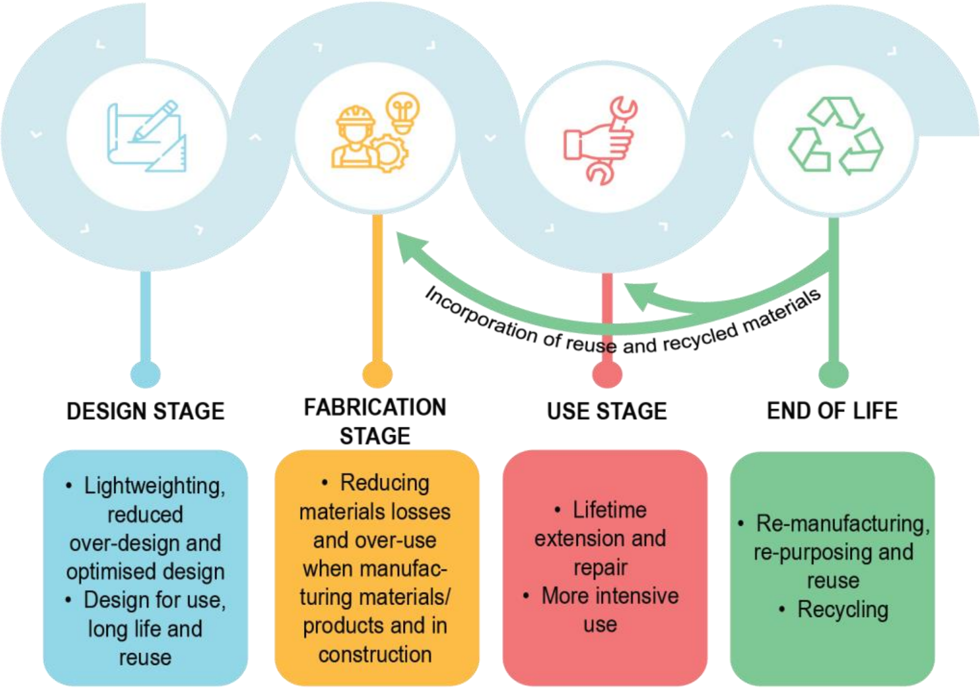


RTS = Reference Technology Scenario. CTS = Clean Technology Scenario. MEF = Materials Efficiency variant.

*MEF contribution by strategy differs from CTS

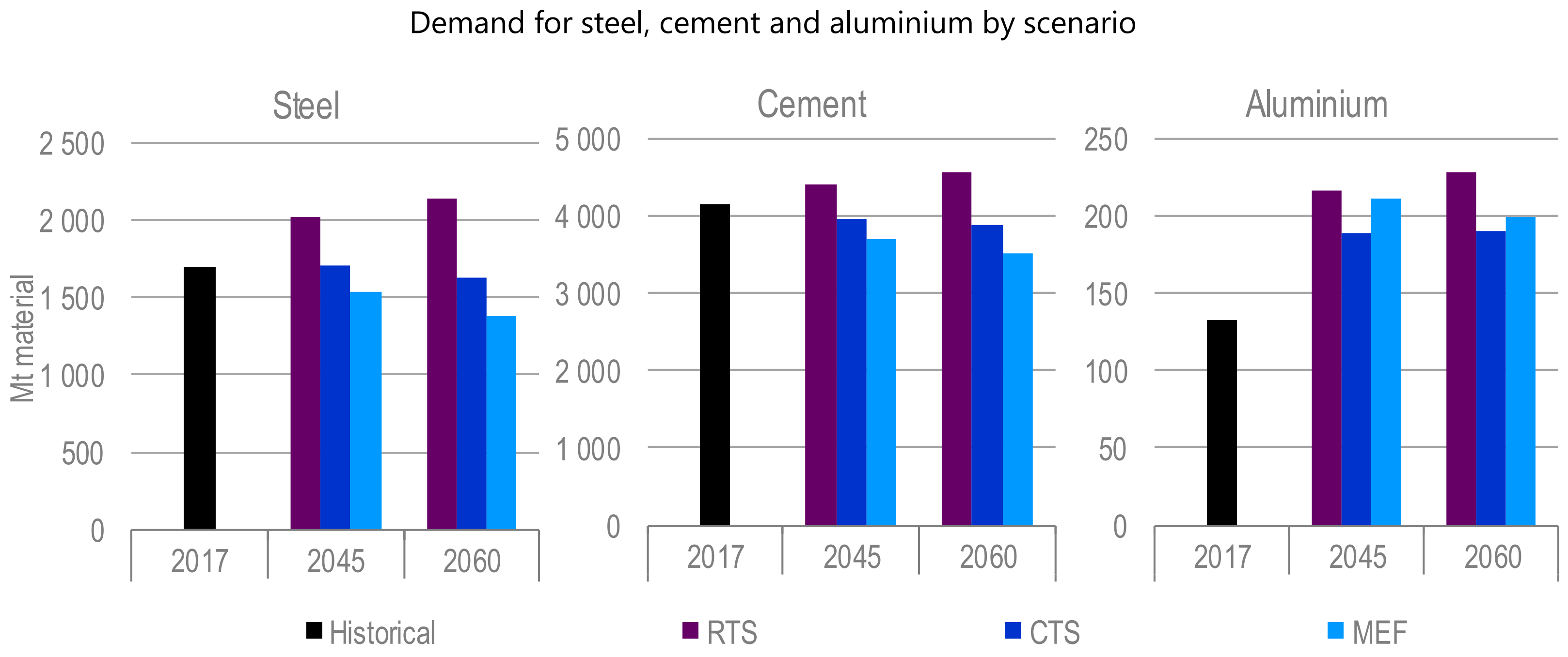
The Clean Technology Scenario lays out an ambitious climate mitigation pathway. Material efficiency contributes to industry emissions reductions; it is pushed further in the Materials Efficiency variant.

Opportunities for material efficiency are found across value chains



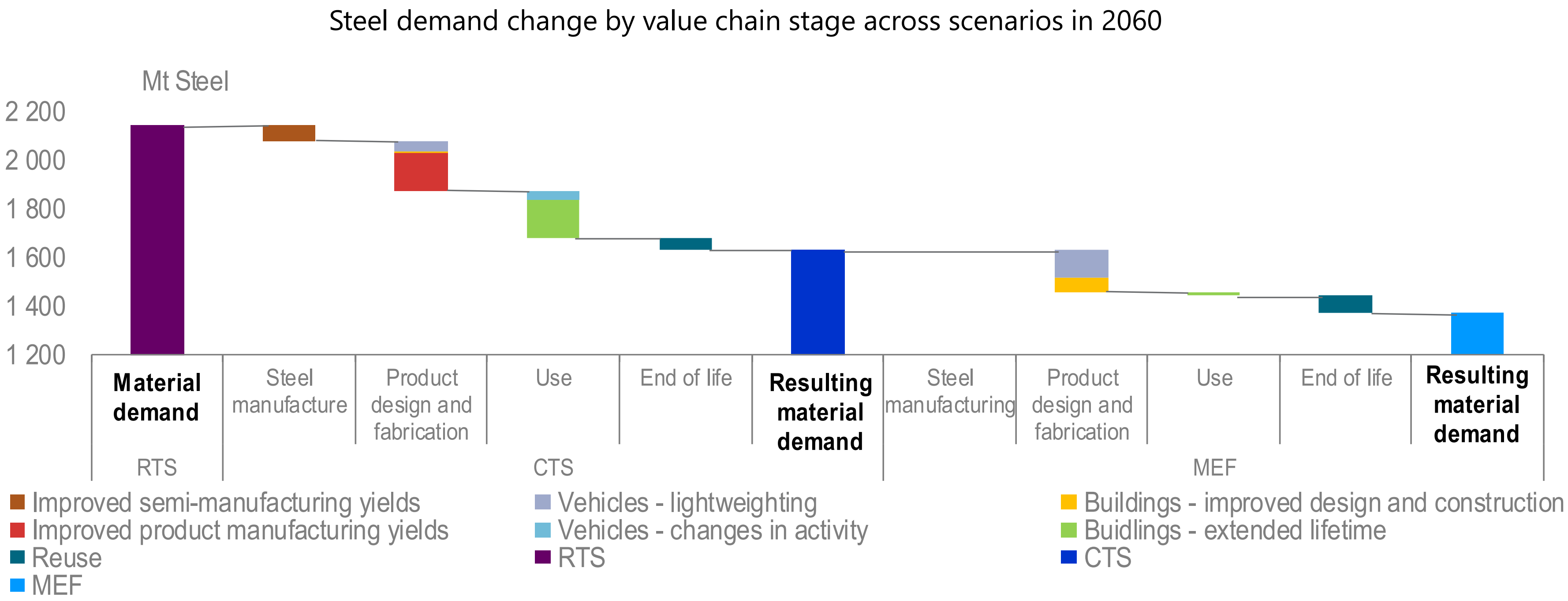
Numerous material efficiency strategies can be applied in the design, fabrication, use and end-of-life stages.

Material efficiency can drive changes in material demand



While material demand grows over time in the RTS, it is considerably reduced in the CTS and MEF.

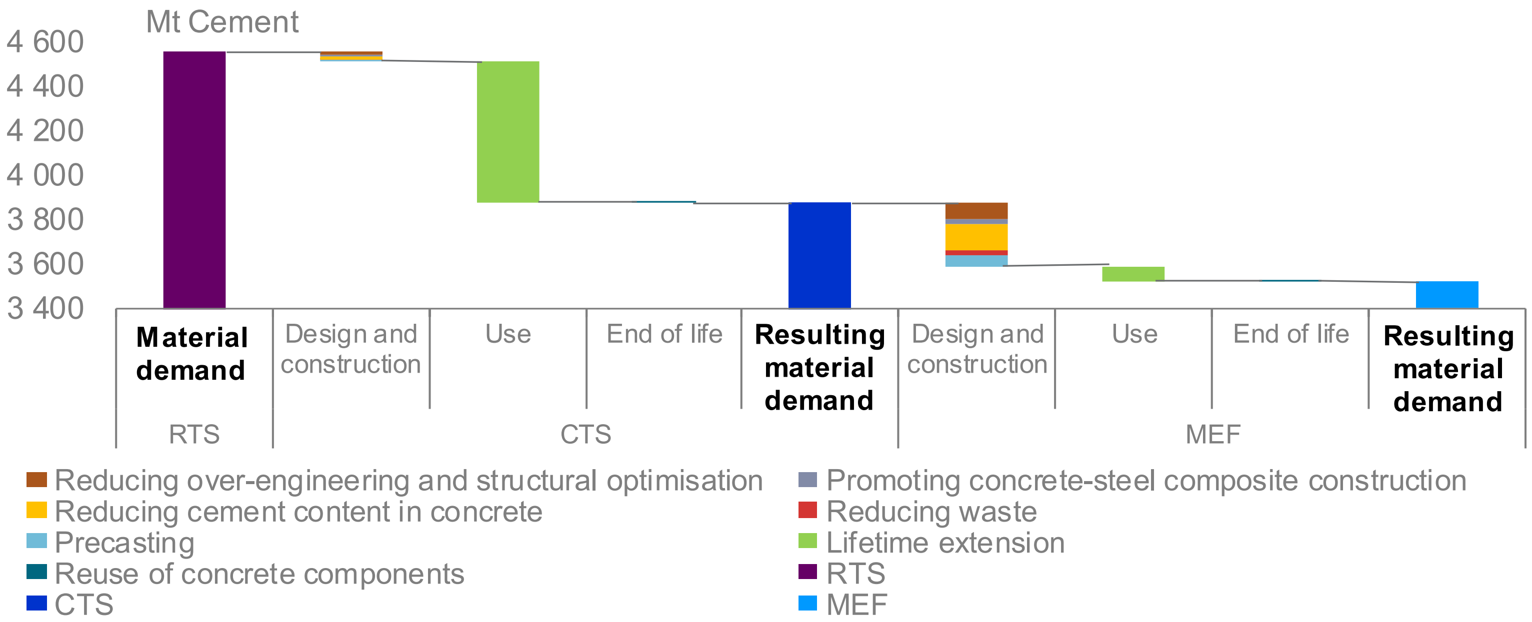
Steel demand reductions are driven by multiple strategies



Considerable potential to reduce steel demand exists at all stages of product and buildings life cycles. Key contributors are yield improvements, buildings lifetime extension and vehicle lightweighting.

Cement demand is reduced through buildings sector efforts

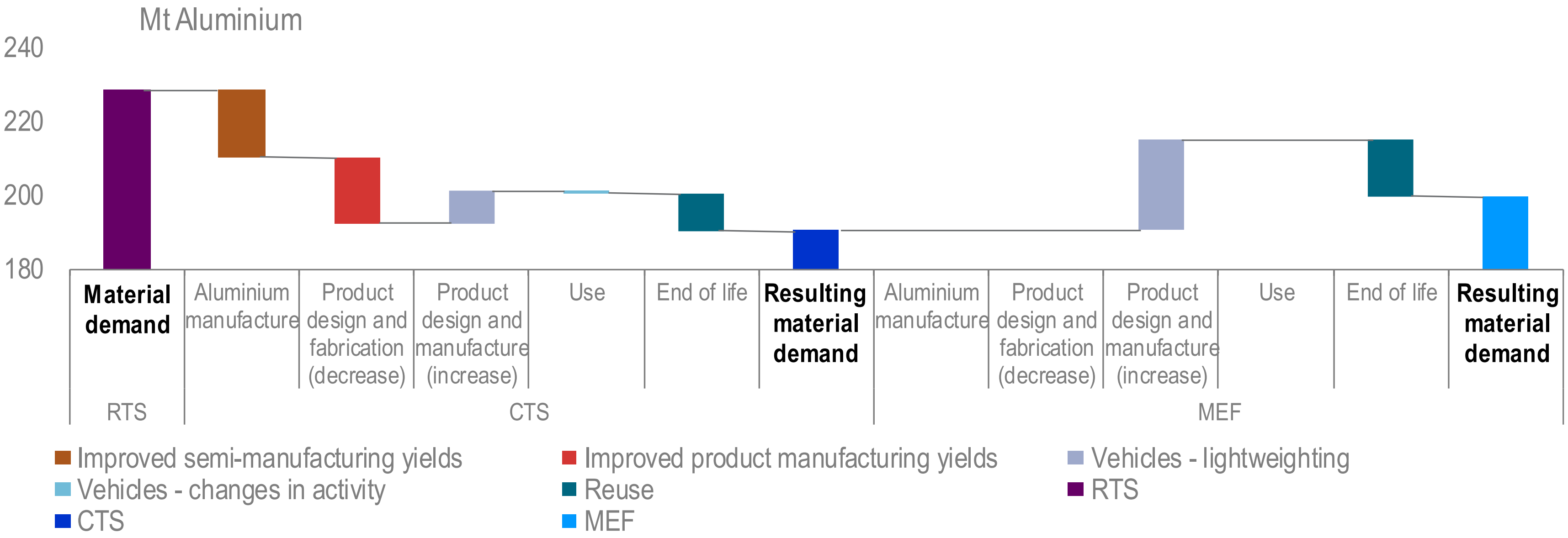
Cement demand change by value chain stage across scenarios in 2060



The buildings use phase offers the largest potential to reduce cement demand, followed by the design and construction stage.

Aluminium demand sees both downward and upward pressures

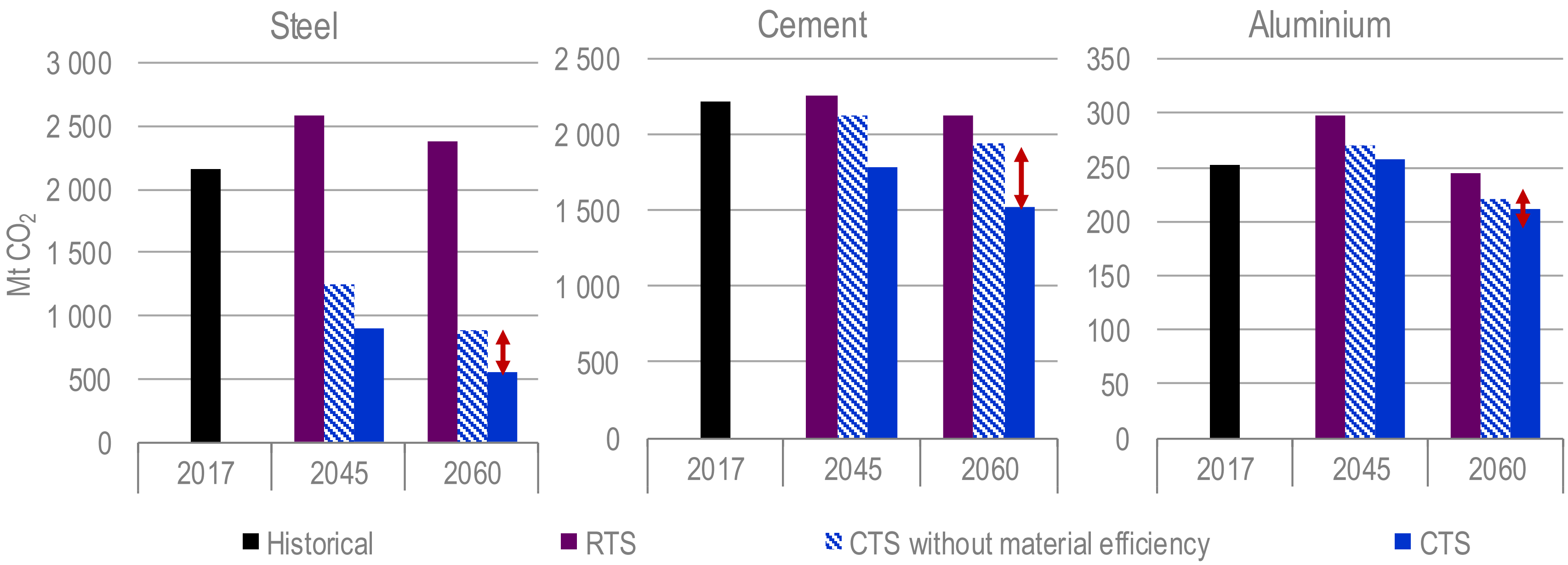
Aluminium demand change by value chain stage across scenarios in 2060



While reductions in aluminium demand can be achieved at various stages in value chains, a large portion of these reductions is offset by increases in demand from lighter vehicles.

Material efficiency is important to reducing industry emissions

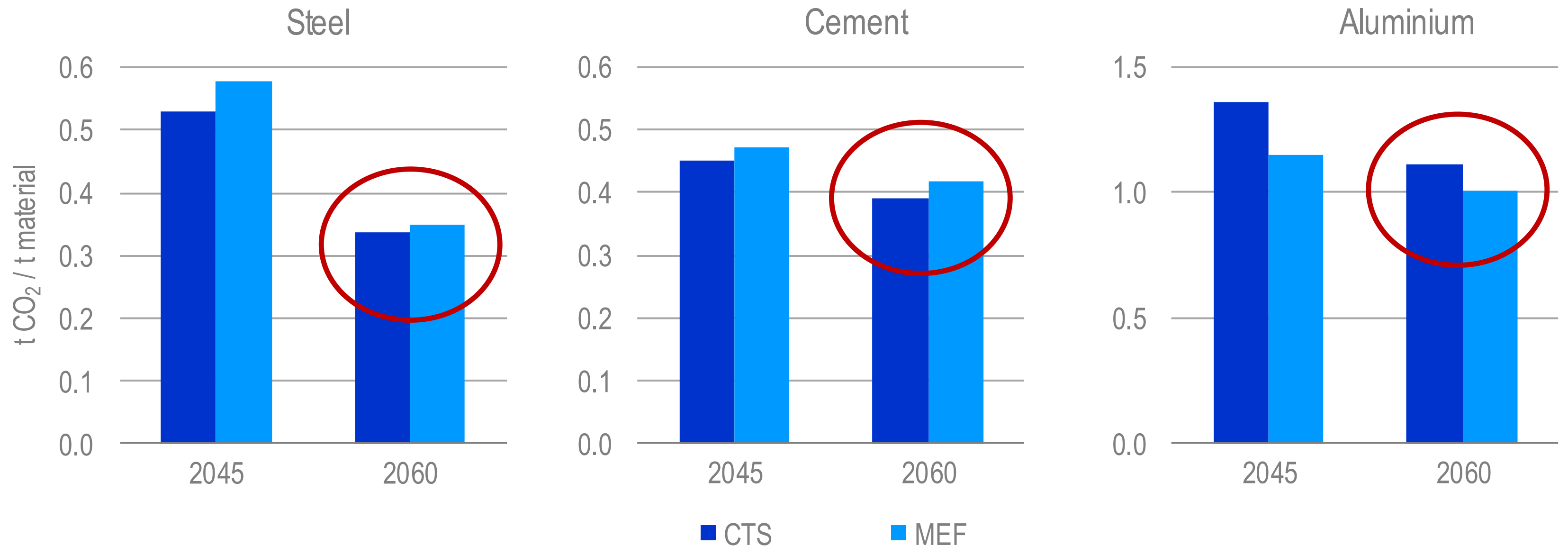
Direct CO_2 emissions from steel, cement and aluminium production in the RTS and CTS



Material efficiency accounts for approximately 30% of the combined emissions reduction for steel, cement and aluminium in 2060 in the CTS.

Demand changes can reduce deployment needs for other strategies

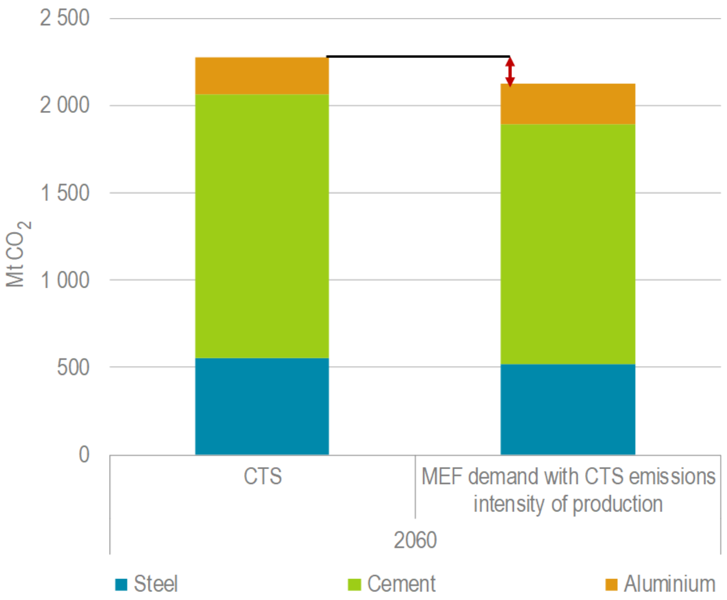
Direct CO_2 intensity of production for steel, cement and aluminium in the CTS and MEF



Lower material demand levels result in higher direct CO_2 intensity of steel and cement production in the MEF while remaining within the CTS industrial emissions level.

A stronger push on material efficiency could reduce additional emissions

Direct CO_2 emissions for steel, cement and aluminium in different contexts



If CTS levels of process technology deployment were maintained, additional material efficiency would result in an additional 7% net decrease in steel, cement and aluminium emissions in the MEF.

Policy and stakeholder action is needed to advance material efficiency

- Increase **data collection**, life-cycle assessment and benchmarking
- Improve consideration of the life-cycle impact at the **design stage** and in **climate regulations**
- Increase **end-of-life** repurposing, reuse and recycling
- Develop **regulatory frameworks** and incentives to support material efficiency
- Adopt **business models** and practices that advance circular economy objectives
- Train, **build capacity** and share best practices
- Shift **behaviour** towards material efficiency

Efforts from government, industry, researchers and consumers can together help improve material efficiency in support of climate change mitigation.

Full report available online at:
www.iea.org/publications/reports/MaterialEfficiencyinCleanEnergyTransitions/