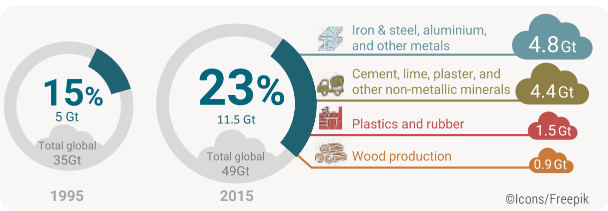
RESOURCE EFFICIENCY AND CLIMATE CHANGE:
Material Efficiency Strategies for a Low-Carbon Future

The way in which the global economy manages natural resources deeply influences the Earth's climate. How we extract these resources and how we produce and use them determines GHG emissions. Global climate change mitigation efforts have traditionally focused on improving energy efficiency and accelerating the transition to renewables. While this is key, we need to pay greater attention to material efficiency, otherwise, it will be nearly impossible and substantially more expensive to keep global warming below 1.5° C.

> Increasing material efficiency is a key opportunity to move towards the 1.5° C goal set by the Paris agreement.

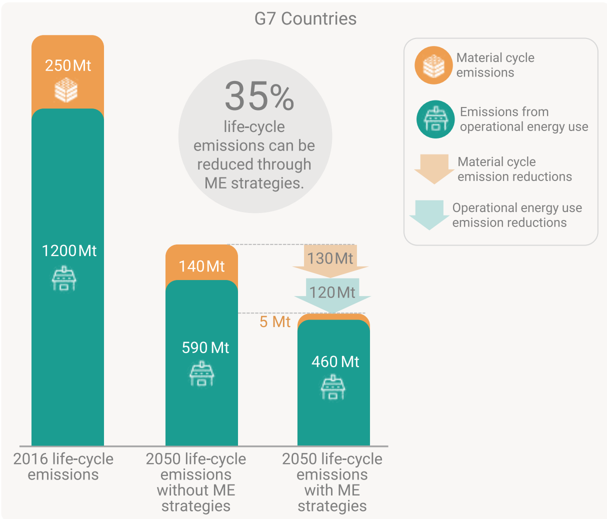
Policymakers must make more ambitious commitments to emission reductions if they are serious about achieving the aspirations of the Paris Agreement. Emissions from the production of materials as a share of global GHGs increased from 15% in 1995 to 23% in 2015. These correspond to the share of GHG emissions from agriculture, forestry, and land use change combined, yet they have received much less attention. An estimated 80% of emissions from material production were associated with material use in construction and manufactured goods. Reducing the GHG emissions for materials required for homes and cars, the most important products of the construction and manufacturing sectors, can cut cumulative life cycle CO2e emissions in the period of 2016-2060 by up to 25 Gt in G7 countries. The technologies to increase material efficiency are available today.



> There are significant opportunities to reduce GHG emissions associated with residential buildings.

In G7 countries, material efficiency strategies, including the use of recycled materials, could reduce GHG emissions in the material cycle of residential buildings by 80–100% in 2050. Potential reductions in China could amount to 80-100%; and to 50-70% in India in 2050.

Life-cycle emissions from homes with and without Material Efficiency strategies in 2050 in G7 countries

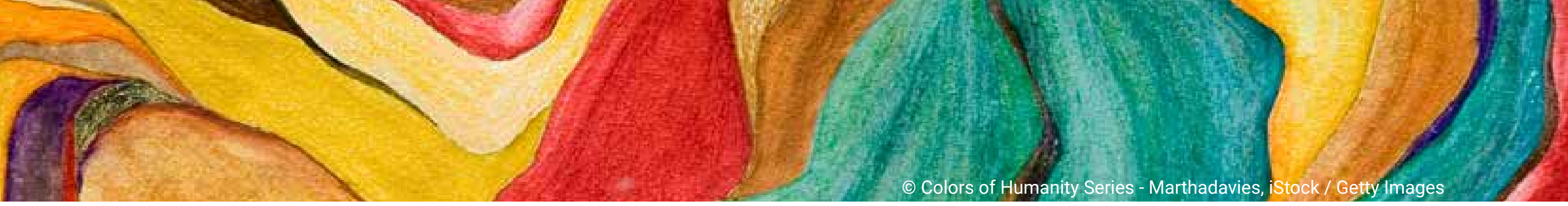


Strategies which show significant potential to reduce emissions include: more intensive use of homes (up to 70% reduction in 2050 in the G7), designing buildings which use less material (8–10% in 2050 in the G7), and sustainably harvested timber (1–8% in 2050 in the G7). Improved recycling of construction material could reduce GHGs by 14-18% in 2050 in the G7. Overall, using these strategies in the G7 could result in cumulative savings in the period 2016-2050 amounting to 5–7 Gt CO2e.

Material efficiency strategies can also affect other stages of the life-cycle of residential buildings, leading to synergistic reductions of energy use. Looking at the whole building life-cycle, material efficiency strategies could reduce emissions in 2050 from the construction, operations, and deconstruction (dismantling) of homes by 35-40% in the G7. The savings from these stages could be up to 50-70% in China and India.

> There are significant opportunities to reduce GHG emissions associated with passenger cars.

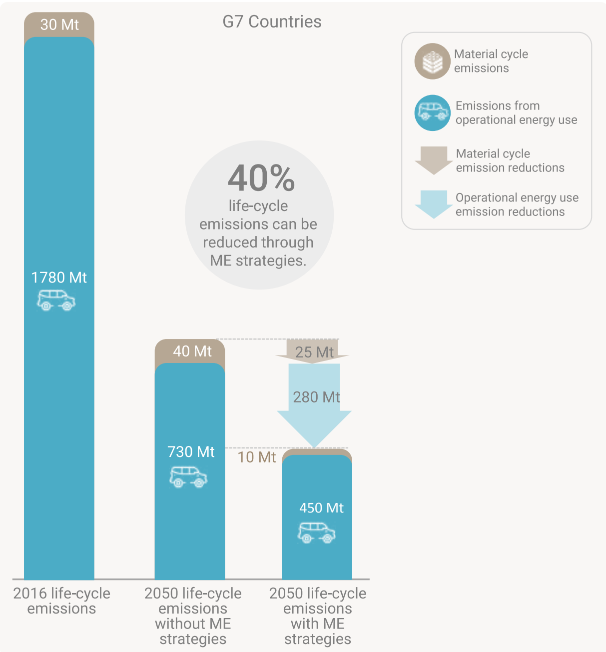
In addition to the GHG emissions savings achieved by shifting to clean energy and electric- or hydrogen-fuelled vehicles, material efficiency could deliver further and greater savings. Material



efficiency strategies could reduce GHG emissions from the material cycle of passenger cars in 2050 by 57%–70% in G7 countries; and 40-60% in China and India.

Material efficiency strategies can also reduce GHG emissions from operational energy use. Material efficiency strategies could reduce total GHG emissions for the manufacturing, operations, and end-of-life management of cars in the G7 by 30–40% in 2050.

Life-cycle emissions from cars with and without Material Efficiency strategies in 2050 in G7 countries



The largest reductions of life-cycle emissions could be achieved by changing patterns of vehicle use (ride-sharing, car-sharing) and shifting towards trip-appropriate smaller vehicles. This is mainly because they reduce not only the demand for materials but also the energy use during the operation of the vehicles.

Similar savings can be obtained from implementing material efficiency strategies in China and India.

> Policy intervention is required if material efficiency benefits are to be achieved.

The design of houses and vehicles determines how much material they use, the energy used in their manufacturing and operations, their durability, and their ease of reuse and recycling. Building codes and standards connect building design to policy. They can encourage or constrain material efficiency.

Cross-cutting policies including revision of building standards and codes, use of building certification systems by governments, vehicle registration and congestion fees, green public procurement and virgin material taxation, among others, are likely to have significant impacts on material efficiency, but quantitative estimates are largely unavailable.

> Policy paths to changes in material efficiency are multiple and can be indirect.

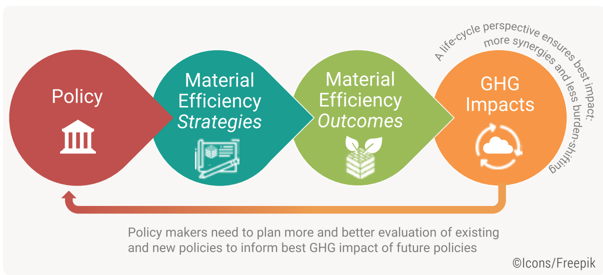
Increasing user intensity shifts the policy focus from choice and use of materials to how people live. Policy instruments such as taxation, zoning and land use regulation play a role, but so do consumer preferences and behavior.

Material efficiency is vulnerable to rebound effects because monetary savings can lead to an increase in consumption. These effects could be reduced by using policy instruments which directly or indirectly raise the cost of production or consumption, e.g., taxes or cap-and-trade systems.

Another potential policy path could be the integration of material efficiency considerations into existing Nationally Determined Contributions of individual countries towards the Paris Agreement. Currently, only Japan, India, China, and Turkey even mention resource efficiency, resources management, material efficiency, circular economy or consumption side instruments in their NDCs.

> Policies should be evaluated on a life cycle basis to reveal burden shifting and synergies across life cycle stages and industrial sectors.

Measuring the material efficiency gains from policy requires the use of life cycle assessments to reveal synergies and trade-offs between different stages of the product life cycle, for example between material savings and operational energy use. Policies for end-of-life management would benefit from focusing more directly on the reduction of GHG emissions, rather than just on landfill diversion. More rigorous, comprehensive analysis of policies could drive successful policy development.



For more information please contact the Secretariat of the International Resource Panel at: **resourcepanel@unep.org**
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