

The background of the entire page is a photograph of several large, light-colored, circular pipes or tubes stacked on top of each other. The lighting is dramatic, with strong highlights on the edges of the pipes and deep shadows in the centers of the openings. Overlaid on this image are several semi-transparent geometric shapes: a large circle in the center, a smaller circle below it, and various triangles and polygons in shades of grey and black, creating a modern, architectural feel.

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Using recycled plastics to build a more sustainable future

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Anish Khandewal and Karl Salameh also contributed to this report.

EXECUTIVE SUMMARY

Building activity is surging in Gulf Cooperation Council (GCC)¹ countries. This building boom presents an opportunity for the region to pioneer more sustainable construction practices and, in the process, move closer to meeting its net-zero commitments. The key to reaching these goals: ramped-up use in construction of recycled materials, and especially recycled plastics.

Conventional building materials such as steel, cement, and even clay bricks have a large environmental footprint. Manufacturing, transporting, and installing them in construction projects are all carbon intensive. Worldwide, the building materials sector contributed about 10 percent of global greenhouse gas (GHG) emissions in 2019.² Reducing that footprint is a priority for the industry—and it is an area in which GCC countries could take the lead.

We examined nine potential applications of recycled plastics in building materials to gauge their environmental and economic impact in the GCC. We estimate that GCC countries alone could cut CO₂ emissions by about 2 to 2.5 percent of the expected emissions from the buildings materials sector by 2040. Along with making this positive environmental impact, substituting recycled plastics would encourage innovation, create up to 13,000 jobs, and boost GDP by some US\$2 billion to \$3 billion by 2040.

All key stakeholders need to take action to increase the use of recycled plastics in construction if they are to have a large environmental impact. They should set up dedicated innovation hubs across GCC countries to drive technological advancements for recycled plastics use in building materials, put in place regulatory standards and targets, and allocate public- and private-sector capital to support investments in the use of recycled plastic—investments and efforts that will help the region meet its sustainability goals, foster innovation, and achieve recognition as a technology pioneer.

RECYCLED PLASTICS ARE A VIABLE ALTERNATIVE TO TRADITIONAL, HIGH-EMISSIONS BUILDING MATERIALS

Recycled plastics can help reduce emissions in two ways. First, they can support enhanced recycling and reuse of existing materials—for example, plastic waste can be used as an ingredient to make “green” concrete. Second, recycled plastics can substitute for high-emissions materials such as brick or steel. Use of plastics as a building material has nonetheless taken time to gain acceptance, in part because of a lack of awareness of its suitability for construction, and in part because of misconceptions about its potential hazards and toxicity in the event of fire. The growing track record of plastics usage and improved technology have shown such concerns to be unfounded. In Western Europe, for example, fire fatalities have substantially declined in the past two decades, even as the use of plastics in building and construction has doubled.³

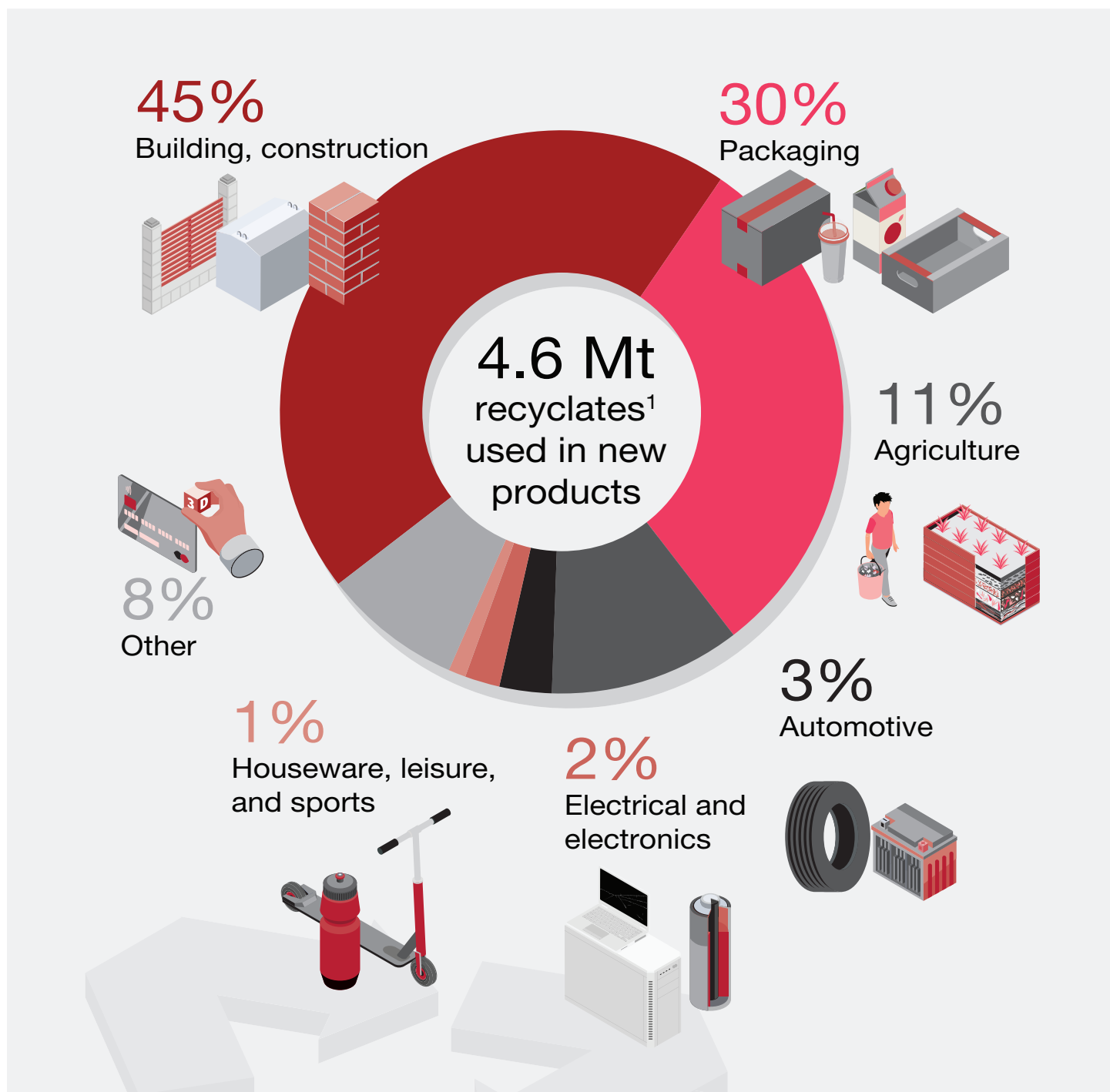
The European experience with recycled plastics in the building and construction sector also underscores the advantages. Plastics are easier to transport, handle, and install than other materials because of their light weight. They preserve their required mechanical properties for use in construction applications. Building materials made of recycled plastics also have a long shelf life and are easier to recycle than mixed plastics and many other materials. Just under half of post-consumer recycled plastic in Europe is now used in building and construction, including for bricks, curbstones, and fences, whereas about one-fourth is reused in packaging (see *Exhibit 1*).



EXHIBIT 1

Europe uses just under half of all post-consumer recycled plastics in building materials

Use of recycled plastics in the E.U., Norway, Switzerland, and the United Kingdom (2020)



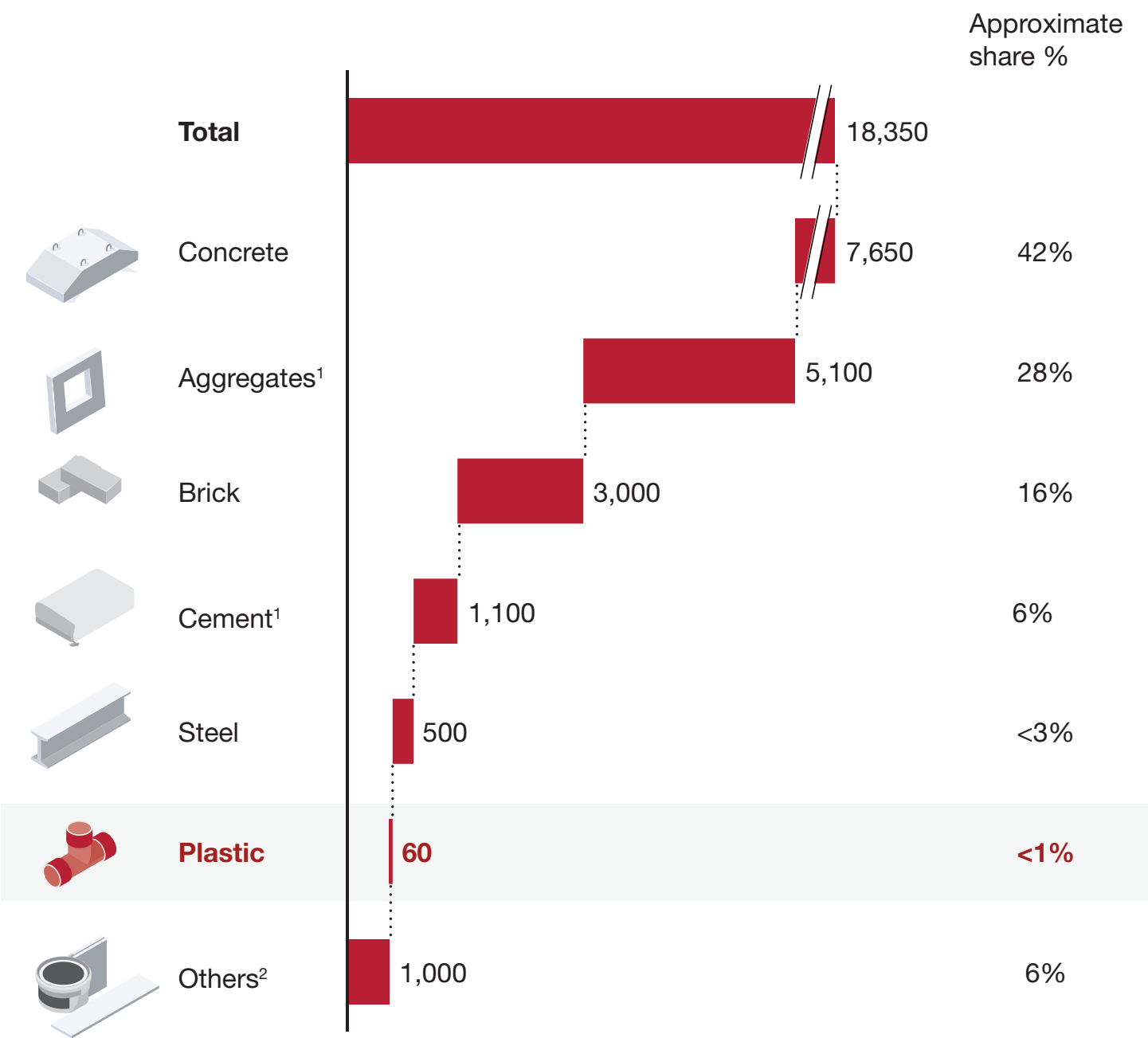
¹ Post-consumer recycled plastics. Note: Mt = million tons.

Source: Plastics Europe, *The Circular Economy for Plastics—A European Overview*, Second Edition, 2022 (<https://plasticseurope.org/knowledge-hub/the-circular-economy-for-plastics-a-european-overview-2/>), Strategy& analysis


Even so, plastic remains a marginal building material, with only about 60 million tons—less than 1 percent of the total material used in buildings—employed globally in 2019. It is mostly used for pipes and ducts, doors and windows, siding, insulation, and floors (see *Exhibit 2*).

EXHIBIT 2
Plastic is used very little in buildings

Building materials by weight (million tons, 2019)



¹ Non-concrete use. ² Mainly includes wood, ceramics, glass, asphalt, aluminum, copper, plaster and gypsum, and lime.
Source: Fior Markets, Strategy& analysis



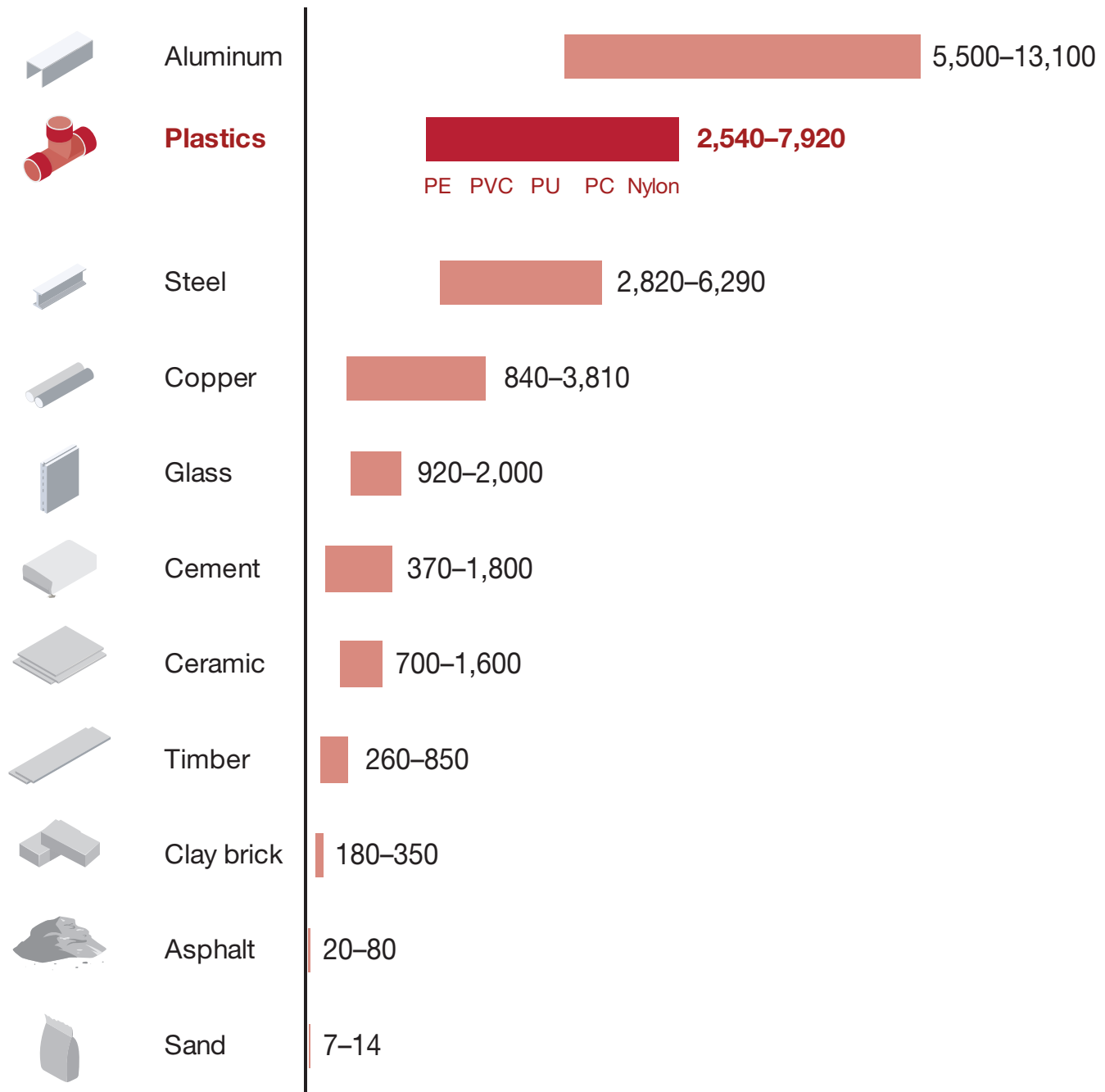
More commonly used items, which include concrete, brick, cement, and steel, are also the materials that are responsible for more than 90 percent of the total carbon emissions generated by the building materials sector. Steel and cement each account for about 25 percent of the sector's carbon emissions on a consolidated basis, brick accounts for 22 percent, and concrete accounts for a further 20 percent.⁴ Of these

materials, steel is the most significant carbon emitter given its large role in the sector: Manufacturing, transporting, and installing steel, for example, generate GHG emissions of between 2,820 and 6,290 kilograms per ton of CO₂ equivalent for every ton of steel. That compares with 370 to 1,800 kilograms per ton of CO₂ equivalent emitted in the manufacture of cement (see *Exhibit 3*).⁵

EXHIBIT 3

Some of the most important building materials contain considerable embodied carbon

Embodied carbon (cradle to gate)¹ of building materials (kg CO₂ equivalent per ton)



Note: PE = polyethylene, PVC = polyvinyl chloride, PU = polyurethane.

¹ Refers to carbon footprint from the manufacturing, transport, and installation of building materials.

Source: International Energy Agency; Circular Ecology, "Inventory of Carbon and Energy Database v3.0." (<https://circularecology.com/>); United Nations Environment Programme (2020). 2020 Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector. Nairobi (https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR_FULL%20REPORT.pdf), Strategy& analysis



THREE BENEFITS FOR THE GCC IN USING MORE RECYCLED PLASTICS

GCC countries should give serious consideration to using recycled plastics on a large scale. Three important aspects of such an approach argue for it.

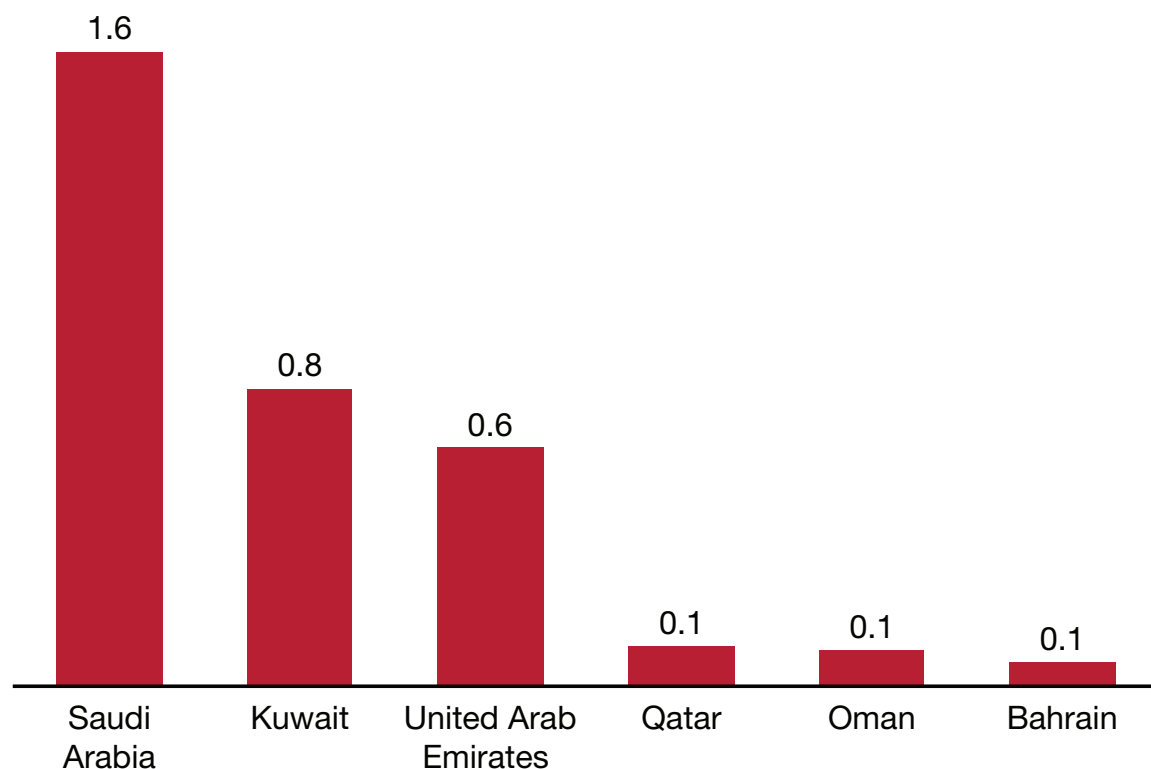
First, most countries in the region have now made firm—and often ambitious—commitments to reduce net GHG emissions to zero in the next 30 to 40 years, as part of the worldwide effort to limit global warming to 1.5 degrees Celsius above preindustrial levels. At Expo 2020 in Dubai in October 2021, the United Arab Emirates (UAE) announced that it aimed to reach the net-zero target by 2050, on the same timetable as the U.S. and the European Union. Saudi Arabia, for its part, launched its Green Initiative Forum in the fall of 2021, aiming to achieve net-zero emissions by 2060. Bahrain has also set 2060 as its target date. All three countries are engaged in substantial investment in renewable energy sources as the main way to achieve these goals. However, their plans to continue oil and gas operations mean that the GCC countries will need to find additional ways to bring their net emissions down to zero.

Second, accelerated use of recycled plastics in building materials can be effective at increasing sustainability in the GCC because of the massive construction activity now underway across the region. Indeed, the potential impact could be significant regionally and globally. The GCC market for building materials is expected to almost double in size by 2030, from \$55 billion in 2019 to \$101 billion in 2030, a compound annual growth rate of approximately 6.5 percent.⁶ Numerous megaprojects are fueling this growth. One is NEOM, a planned city of 26,500 square kilometers that is to be a tourist destination. Another is a project to transform a 200-kilometer stretch of the Red Sea coastline into luxury hotels and resorts, and an accelerated push by the Saudi Ministry of Housing to deliver 500,000 housing units by 2028. Multiple such projects are underway elsewhere in the GCC. For example, the UAE is transforming the town of Hatta into a major tourist destination, with an inland beach, lake, and cable-driven mountain railway, and continuing to build Yas Island, a tourism resort.

Third, prioritizing efforts to use recycled plastics in building materials would create a focus for the area's growing research and development (R&D) initiatives and an investment opportunity for technology funds. Some existing recycling initiatives would get an additional boost. Saudi Arabia, for example, is already accelerating momentum on waste management, through the establishment of the National Waste Management Center, and has access to significant quantities of plastic waste (see *Exhibit 4*).

EXHIBIT 4
Abundant plastic waste is generated in the GCC region

Plastic Waste Generated in the GCC (2020, millions of tons)



Source: Organization of Arab Petroleum Exporting Countries, Nexant, Strategy& analysis

Although recycled plastics are already being used in the building materials sector, there is considerable room for new solutions to emerge. From an R&D perspective, many of the key applications are still in the research phase or under development. Wall coverings, windows and doors, and roofing are all being deployed commercially, but using plastics to replace cement in concrete is taking place only in the lab, and using plastics as a substitute for steel rebar and sheet steel is still in development.

MEASURING THE ENVIRONMENTAL AND ECONOMIC IMPACT OF RECYCLED PLASTICS USE IN THE GCC

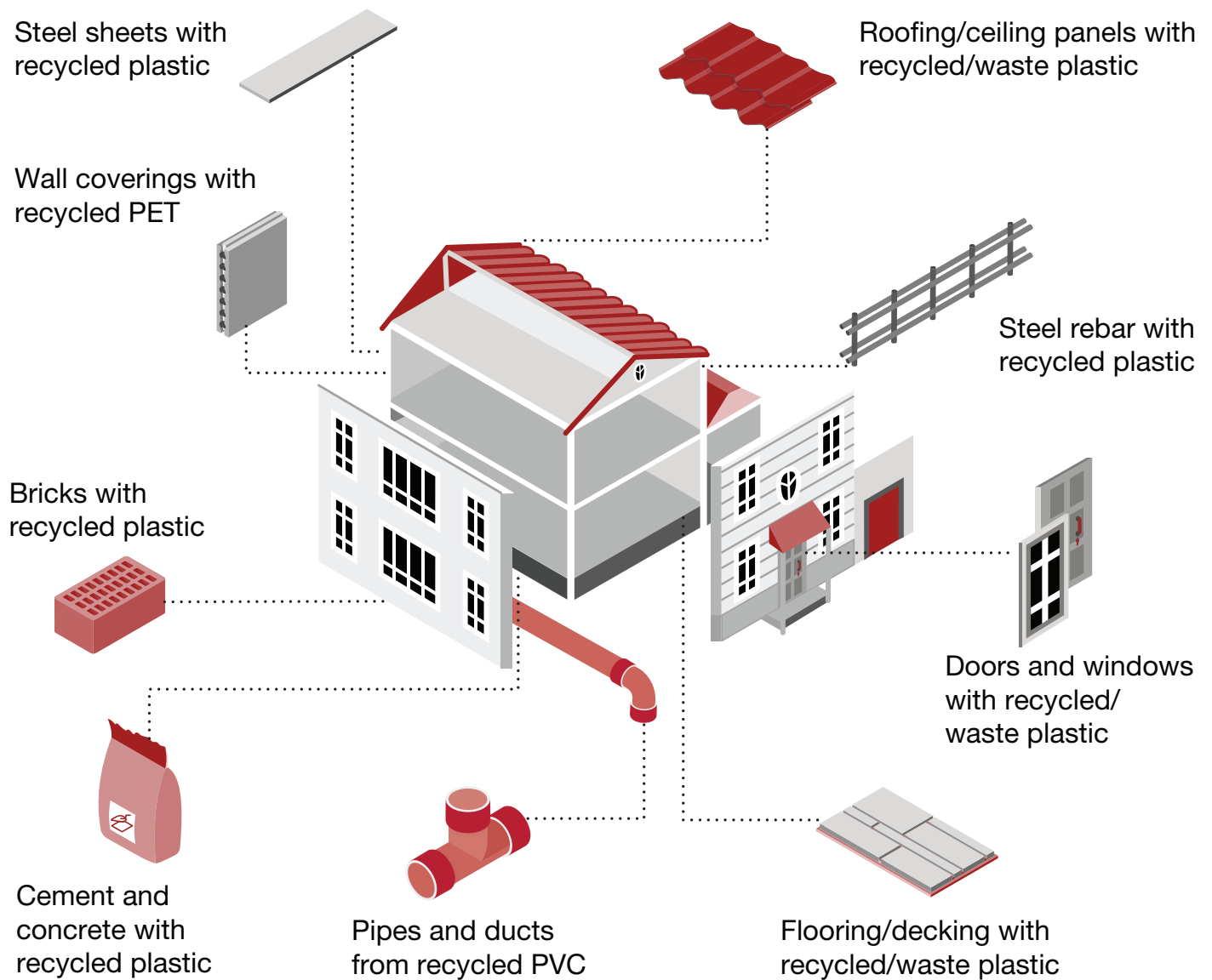
For this research, we sought to estimate the potential benefits to GCC countries of enhanced use of recycled plastics in building materials in terms of the environmental impact, through emissions reduction. We also looked at other economic benefits, specifically in the areas of employment and costs.

In all, we used five parameters. Three parameters measure potential volumes of: GHG emissions reduction, decreased use of virgin materials, and the use of recycled plastics. The fourth parameter was the potential for net job creation, measured in full-time equivalent employees. The fifth parameter examined the economic impact, and specifically the potential cost savings—the abatement cost per million metric tons of CO₂ that could be saved (abatement cost refers to the reduction of negative environmental externalities such as the amount of CO₂ produced when oil and coal are burned).

We considered also nine potential applications (or use cases). These include instances in which recycled plastics replace traditional building materials such as clay bricks, cement in concrete, steel sheet products, and steel rebar. The cases also include using recycled plastics such as polyvinyl chloride (PVC) and polyethylene terephthalate (PET) to replace new, or “virgin,” plastic products in pipes and ducts, windows and doors, flooring and decking, roofing and ceiling panels, wall coverings, insulation material, and bathroom units (see *Exhibit 5*).

EXHIBIT 5

Applications where recycled plastics can be used in building materials



Note: PET = polyethylene terephthalate, PVC = polyvinyl chloride.
Source: Strategy&

Modeling the impact of these high-potential applications in the GCC, we calculate that between 2 million and 2.5 million metric tons of recycled plastics could be used by 2040. That would potentially reduce CO₂ emissions in the same period by between 4 million and 4.5 million metric tons. About 13,000 jobs could be created, and the overall GDP increase would be between \$2 billion and \$3 billion by 2040.

As things stand today, the abatement cost for some of the use cases shows limited value. However, with technological advancements and economies of scale as the use cases mature, higher value can be achieved (see *Exhibit 6*).

These figures are based on our conservative assumptions about the rate of recycling, the penetration rate of recycled plastics in the building materials sector, the calculation parameters for job growth based on economic multipliers, and the degree of technological readiness in the region to deploy recycled plastics at the required scale. Although uncertainties about these factors are inevitable, which also makes the overall estimates uncertain, the message that emerges clearly from our analysis is that a concerted effort to use recycled plastics in building materials in the GCC could have significant impact across all the parameters we examined.

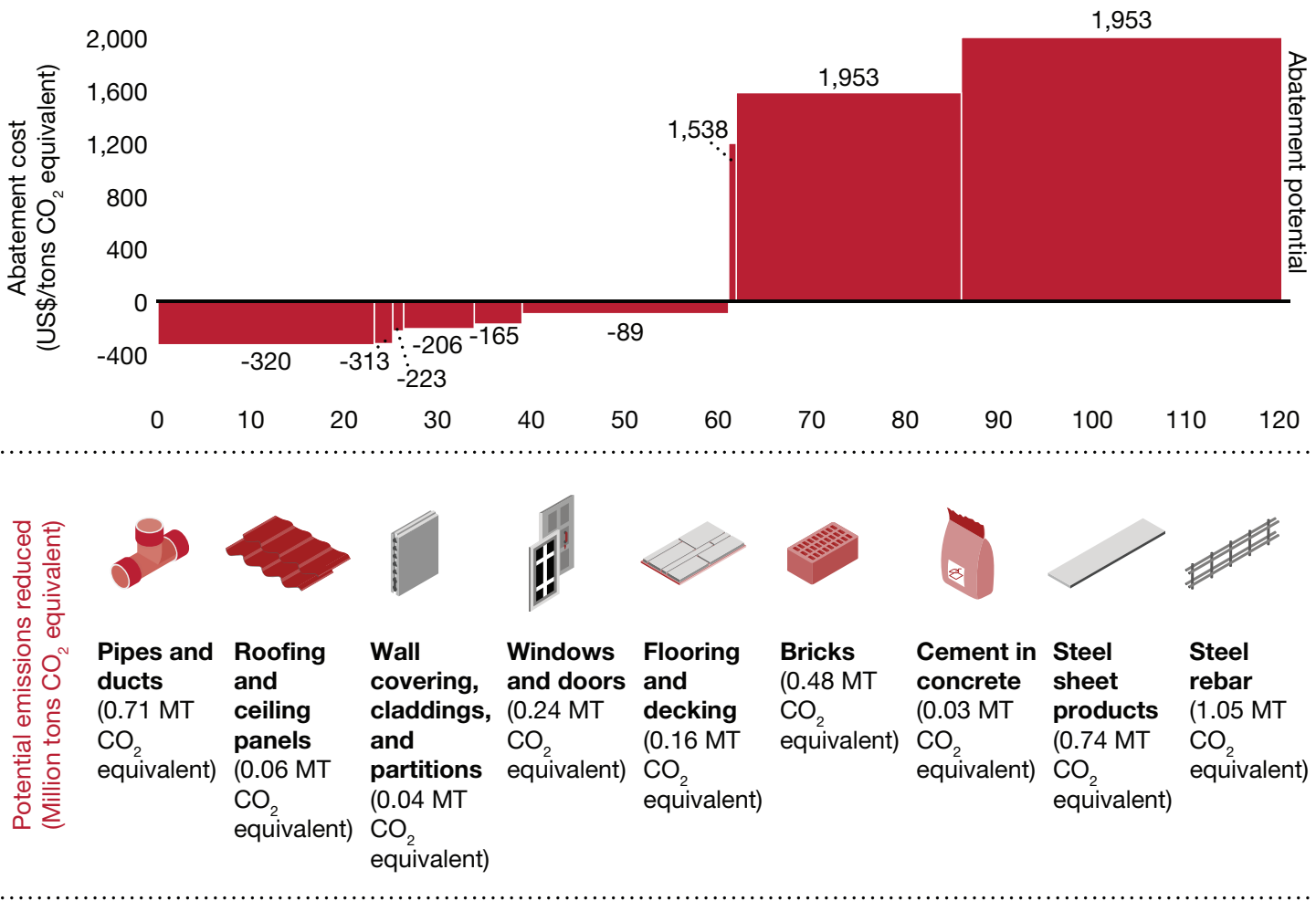
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A concerted effort to use recycled plastics in building materials in the GCC could have significant impact.

EXHIBIT 6

Abatement potential curve can improve with technological advances and economies of scale

Marginal abatement cost analysis for key use cases



Note: Mt CO₂ equivalent = millions of tons of carbon dioxide equivalent.
Source: Strategy&

POLICYMAKERS, REGULATORS, INDUSTRY, AND OTHER STAKEHOLDERS HAVE KEY ROLES TO PLAY

Several hurdles stand in the way of GCC countries being able to realize such potential gains. The starting point is a successful ramp-up in the use of recycled plastics. However, use of these materials is often not governed by clear standards and regulations that would accelerate their use. Moreover, the GCC recycling ecosystem is relatively underdeveloped, and there is insufficient understanding of the benefits of using recycled plastics in building materials. Removing these hurdles and accelerating adoption will require major stakeholder commitment and action, along three lines.

First, there is no current comprehensive legislative framework in GCC countries that applies specifically to the use of recycled materials in building and construction. Indeed, guidelines and standards are lacking for the use of recycled plastics more generally. Manufacturers also lack incentives to use recyclables in building materials.

Policymakers and regulators have a major role to play in overcoming such challenges. Governments will need to increase state funding and incentives to promote the use of recycled plastics in building materials and implement guidelines to lift and sustain demand. Regulators can help by setting appropriate targets and standards for the sector.

Second, the recycling ecosystem in the GCC is underdeveloped. Greater investment is needed to develop and commercialize recycling technologies; for now, private-sector participation across the plastics recycling value chain is limited.

Government funding and the setting of priorities can overcome such hurdles. Regulators can provide operations licensing to secure quality and technology standards in recycling. R&D champions in both the public and private sectors can establish financial vehicles to support investment in recycled plastics. Dedicated innovation hubs can enable development and commercialization of technologies to promote recycled plastics use in building materials. National champions in the GCC countries should play a lead role in developing the ecosystem through partnerships and strategic alliances with global players. In 2021, for example, Saudi Aramco, as part of its Namaan industrial investment program, signed a memorandum of understanding with Armorock, a leading U.S.-based technology company, to validate the feasibility of developing and using nonmetallic polymer concrete applications in the building and construction sector.⁷

Third, there is the lack of awareness surrounding the use of recycled plastics. Consumers, companies, and governments are unlikely to seek change where they do not perceive a problem. The large carbon footprint of traditional building materials is not widely understood. Even professionals in the construction industry can lack familiarity with the potential role of recycled plastics as a substitute for high-emissions materials. In response, companies that champion the circular economy can use awareness campaigns to influence the buying behavior of consumers. The same circular economy champions can offer training programs for industry practitioners on the use of recycled plastic as a building material.

CONCLUSION

GCC countries have a significant opportunity to establish themselves as trailblazers at a global level by substantially increasing the use of recycled plastics in building materials. Their substantial spending on construction projects over the next decade and beyond, already earmarked, creates the preconditions for such a move.

Surmounting the challenge of using more sustainable building materials can boost the region's innovative capabilities and profile—and could enable GCC countries to largely define and set global standards on the use of recycled plastics. At a time when all countries are looking for ways to reduce GHG emissions, the large-scale deployment of recycled plastics can help GCC countries move faster to net-zero emissions, and build a better future for their economies and the planet.

ENDNOTES

1. The GCC countries are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
2. United Nations Environment Programme (2020). 2020 Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector. Nairobi (https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR_FULL%20REPORT.pdf).
3. Plastics Europe, Plastics and fire safety in building & construction, 2016 (<https://plasticseurope.org/knowledge-hub/plastics-and-fire-safety-in-building-construction/>).
4. International Energy Agency, “*Energy Technology Perspectives 2020*” (<https://www.iea.org/reports/energy-technology-perspectives-2020>).
5. Circular Ecology, “Inventory of Carbon and Energy Database v3.0” (<https://circularecology.com/>).
6. Mordor Intelligence, “Construction Market in GCC Countries—Growth, Trends, COVID-19 Impact, and Forecasts (2022–2027)” (<https://www.mordorintelligence.com/industry-reports/analysis-of-the-construction-industry-in-gcc-countries-industry>).
7. “Aramco Announces Major Expansion of Its Industrial Investment Program,” Aramco News, September 7, 2021 (<https://www.aramco.com/en/news-media/news/2021/aramco-announces-major-expansion-of-its-industrial-investment-program>).

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