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SUSTAINABLE INFRASTRUCTURE PARTNERSHIP

DEVELOPMENT CORRIDORS PARTNERSHIP

POLICY BRIEF I OCTOBER 2019

Making Infrastructure Resource Efficient

BACKGROUND

Natural resources are the foundations for our socio-economic systems. Over the past five decades, the global population has doubled, and the global output has grown fourfold,[1] accompanied by the unprecedented extraction of natural resources.[2] While population growth rates appear to be abating, the socio-economic demands of a growing middle class suggest that our desire to extract finite resources shows no signs of slowing down.[3]

This economic growth has been characterized by rapid industrialization and urbanization and underpinned by large-scale infrastructure development. The development itself has been driven by linear economic models that follow a 'take, make, dispose' pathway. Under this predominant model, natural resources and material goods end their lifecycle as waste or emissions, with severe implications for the environment and human health.

There is now a critical need to decouple economic growth from the extraction and use of natural resources. Infrastructure development is particularly resource intensive, and in 2015 the construction sector alone accounted for half of the global material footprint.[4] Increasing the resource efficiency of infrastructure can be a major driver of the transition to sustainable development.

Meeting the objectives of the 2030 Agenda for Sustainable Development will require the international community to rethink how it plans, designs, builds, and operates infrastructure across all sectors. It is now vital that policymakers and planners recognize the interlinkages between natural resources, material resource use, and the diverse and complex systems of infrastructure that are required to support economic and human development.

1. International Resource Panel (IRP). (2019). Global Resources Outlook 2019: Natural Resources for the Future We Want.
2. One Planet Network. (2019). Economic Growth and Natural Resource Use: Breaking-up with 'Business as Usual.'
3. Ellen MacArthur Foundation. (2013). Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (Check original source).
4. UNEP. (2019). SCP Hotspot Analysis Tool (SCP-HAT).

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1. An unprecedented level of infrastructure development has been projected over the next few decades. This development is in response to the increasing global demand for infrastructure in both developed and developing countries. The OECD, for example, has estimated that an annual average of US$6.9 trillion in infrastructure investment is required until 2030 to achieve the Sustainable Development Goals (SDGs).[5] The bulk of this investment is needed in developing countries, including fragile low-income and emerging economies, where infrastructure supply is failing to meet the changing demands generated by strong population growth, increased income levels, and rapid urbanization. Given the long lifespan of infrastructure assets, it is critical that this investment does not lock-in the adverse environmental impacts of resource – inefficient infrastructure and technology.

2. Meeting this future global infrastructure demand in a resource efficient manner will require new approaches to the assessment of infrastructure needs. Traditionally, infrastructure systems have been developed on a 'project-by-project' basis, and through 'siloed' planning. Such approaches often fail to consider the infrastructure services that these systems are intended to deliver, resulting in a piecemeal and inefficient approach to development. Needs-based assessments can instead ensure that infrastructure development responds to identified end-user service needs.[6] Such assessments should inform the development of national, long-term strategic visions that respond to infrastructure needs and direct short, medium, and long-term decision making. These processes should also facilitate meaningful stakeholder consultations and public participation to identify and address local needs, including the specific requirements of poor and vulnerable groups.

3. Needs-based assessments for the development of new infrastructure should first consider whether end-user service needs can be met by the retrofitting and maintenance of existing infrastructure. Such considerations have been a key oversight of traditional 'siloed' approaches to infrastructure planning, and this has meant that the default response for policymakers and planners has often been to construct new infrastructure. However, with the construction sector accounting for almost half of the global material footprint, significant resource efficiency gains can be made by simply reducing the amount of infrastructure that is built.[7] Better management of existing infrastructure assets can generate savings of up to 15% on infrastructure investments.[8] The benefits of retrofitting and maintaining existing assets are, therefore, increasingly being recognized, and infrastructure planners can now tap into emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and big data analytics to examine the possibilities for retrofitting and maintaining existing infrastructure.[9]

4. By considering the interconnections between different infrastructure systems, sectors, and spatial scales, integrated systems-level approaches can be key drivers of more resource efficient infrastructure development. The complex, networked properties of infrastructure systems necessarily demand more integrated, systems-level approaches to infrastructure planning and development. Such approaches aim to maximize the natural synergies and trade-offs between different infrastructure systems and sectors and recognize that developments in one sector can have positive, crossover impacts in another. For example, technological advancements in the transport sector, such as improved fuel efficiency in vehicles and trends towards the electrification of public transport, can simultaneously reduce energy demand and thereby the need for new energy infrastructure.[10]

5. OECD. (2018). Investing in Climate, Investing in Growth: A Synthesis. https://www.oecd.org/environment/cc/g20-climate/synthesis-investing-in-climate-investing-in-growth.pdf.
6. ITF-OECD-UK National Infrastructure Commission. (2017). Strategic Infrastructure Planning: International Best Practice.
7. McKinsey Global Institute. (2016). Bridging Global Infrastructure Gaps.
8. McKinsey Global Institute. (2016). Bridging Global Infrastructure Gaps.
9. The Economist-Intelligence Unit. (2017). Cities of the Future: Retrofitting and Fitting Infrastructure.
10. UNOPS-ITRC Mistral. (2018). Infrastructure Underpinning Sustainable Infrastructure.

Furthermore, efficient spatial planning can foster alternative solutions for resource use by facilitating the transportation of materials between source and user, enabling industrial symbiosis whereby the waste streams from some industrial processes are used as inputs in others.[11]

5. Enhancing the resource efficiency of infrastructure reduces the demand for natural resources, as well as the generation of negative externalities such as pollution and waste. Sand, for instance, is now the second most consumed natural resource after water, with an estimated 30 billion tons being extracted each year to make concrete and gravel, predominantly for the construction of buildings, roads, and dams.[12] The degree of resource use, particularly within the construction phase, also directly correlates to the levels of negative environmental and social impacts that are generated by infrastructure systems. Buildings currently account for up to 40% of all solid waste produced in developing countries.[13] Developing more resource efficient infrastructure is, therefore, a key vehicle by which to minimize the harmful impacts on both human health and the environment. This can include circular processes that promote the recycling and reuse of materials, thereby closing material loops and extending resource lifecycles.[14]

6. More resource efficient infrastructure also carries significant economic benefits, by reducing construction costs and minimizing the risk of wasted resources. With the construction phase representing the most resource-intensive stage of infrastructure development, the costs of raw materials can reach up to 40-60% of the total construction and manufacturing costs for a given infrastructure asset. More efficient practices could save up to US$630 billion each year in the European Union (EU) manufacturing sector alone.[15] At the same time, by better aligning the supply of infrastructure with demand, needs-based assessments and integrated, systems-level approaches to infrastructure planning can minimize the risk of wasted resources caused by infrastructure oversupply (i.e. infrastructure that is built but does not get used). They also help avoid fragmented service delivery and ensure that infrastructure development provides value for money.

7. Nature-based Solutions (NbS) can provide vital infrastructure services and serve as sustainable, cost-effective, and resource efficient complements or alternatives to traditional, 'grey' infrastructure. The benefits of complementing 'grey' infrastructure with NbS are now being increasingly recognized.[16] Natural and artificial ponds, reed beds, and wetlands can be used to treat raw sewage and wastewater.[17] Afforestation or protection of existing forests can enhance traditional flood protection measures and reduce soil erosion,[18] while urban green infrastructure, such as walls and roofs planted with native species, can sequester carbon, remove air pollutants, and reduce the incidence of water pollution caused by urban run-off.[19] These natural solutions to infrastructure end-user service needs can reduce the need to construct new infrastructure and are also often less costly than traditional, 'grey' infrastructure alternatives.[20] Nature-based infrastructure

11. UNEP. (2019). Integrated Approaches to Sustainable Infrastructure.
12. Peduzzi, P. (2014). 'Sand, Rarer than One Thinks.' 11 Environmental Development 208. (Check original source).
13. International Resource Panel (IRP). (2017). Assessing Global Resource Use: A Systems Approach to Resource Efficiency and Pollution Reduction.
14. International Resource Panel (IRP). (2017). Assessing Global Resource Use: A Systems Approach to Resource Efficiency and Pollution Reduction.
15. Ellen MacArthur Foundation. (2013). Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (Check original source).
16. Thacker, S., Adshead, D., Fay, M., Hallegatte, S. et al. (2019). Infrastructure for Sustainable Development.
17. UN-Water. (2018). The United Nations World Water Development Report 2018: Nature-based Solutions for Water.
18. https://www.eea.europa.eu/highlights/forests-can-help-prevent-floods (Consider alternative source).
19. UN-Water. (2018). The United Nations World Water Development Report 2018: Nature-based Solutions for Water.
20. Thacker, S., Adshead, D., Fay, M., Hallegatte, S. et al. (2019). Infrastructure for Sustainable Development.

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solutions[21] and the investment in ecosystem protection and maintenance,[22] can, therefore, be key drivers of more resource efficient infrastructure development.

8. Policymakers and planners can tap into a number of existing tools, standards, and guidelines to support their development of more resource efficient infrastructure. Strategic Environmental Assessments (SEAs), for example, aim to integrate environmental considerations into strategic, program-level planning, and to consider their interlinkages with social and economic impacts.[23] While often only applied to specific infrastructure sectors, resulting in missed cross-sectoral synergies, a more holistic, systems-level application of SEAs could ensure that inefficient development practices are identified and addressed early in the planning process. The Evidence-Based Infrastructure approach, developed by UNOPS and ITRC at the University of Oxford, is also designed to account for the interconnections among infrastructure systems, and utilizes a 'systems-of-systems' approach to identify cross-sectoral interdependencies and maximize synergies. At the same time, existing guidelines and sustainability rating schemes, such as Envision and SuRe (The Standard for Sustainable and Resilient Infrastructure), can be used to support an integrated, systems-level approach to infrastructure planning, ensuring that end-user service needs are delivered in the most effective, resource efficient, and sustainable manner possible. Similarly, standards from financial institutions that regulate financing of infrastructure projects should follow international best practice in environmental and social risk management such as, for example, the IFC's Performance Standard 6 that aims to achieve no net loss or even net gain of biodiversity in critical habitats

9. Infrastructure development should embrace new, innovative, and disruptive technologies that foster more resource efficient practices and modes of social behavior in response to changing infrastructure demands. For example, approaches such as the One Planet Network's BAMB (Building as Material Banks) and SHERPA (a Personal Guide to Sustainable Housing) make it possible to save up to 50 % of building materials by reusing previous structures in the construction of new buildings. A construction sector shift towards reusing as many materials as possible would, therefore, significantly reduce the demand for further resource extraction. At the same time, disruptive innovations across a range of sectors are driving new business models that promote more efficient modes of social behavior. For instance, sharing economy applications, such as car, home, or food-sharing platforms, are redefining the way in which people interact with infrastructure.

10. Innovative financing solutions can incorporate the external costs of resource consumption, incentivizing the development of more resource efficient infrastructure. Innovative fiscal measures will need to be combined with policies that tackle fundamental price distortions and ensure that the external costs of infrastructure development are properly allocated. Resource consumption taxes, for instance, can facilitate a levelling of the playing field between sustainable and unsustainable policy options. Incorporating sustainability considerations within investment decision-making processes can also ensure that investment decisions are driven towards more resource efficient solutions, while at the same time engaging the private sector and mobilizing private investment. To this end, integrated, systems-level approaches enable environmental

21. See the construction of an artificial wetland in Washington D.C. as an example in: UNEP. (2014). Green Infrastructure Guide for Water Management: Ecosystem-based Management Approaches for Water-related Infrastructure Projects.
22. See the protection of natural ecosystems in Mozambique as an example in: World Bank (2019). Mozambique GEF Conservation Areas for Biodiversity and Development Project. http://documents.worldbank.org/curated/en/828921568998735228/pdf/Disclosable-Version-of-the-ISR-Mozambique-GEF-Conservation-Areas-for-Biodiversity-and-Development-Project-P131965-Sequence-No-12.pdf
23. OECD. (2006). Applying Strategic Environmental Assessment.

and social risks to be identified and addressed at the planning stage. By doing so, such approaches can increase the bank-ability of infrastructure projects, making them more attractive to investors and leveraging access to project financing.

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INFRASTRUCTURE for the SUSTAINABLE DEVELOPMENT GOALS