Multi-utility infra, the way to go

SEVERAL BENEFITS. It not only drives resource efficiency but also improves the economics of infrastructure projects

NITIN ZAMRE
MUKESH KHANDELWAL

Back-of-the-envelope estimates suggest that capturing 25 per cent of Delhi's intracity freight traffic, Delhi Metro could earn an additional ₹750 crore per annum. and generate a margin of ₹270 crore while displacing nearly 17,000 small goods vehicles from the city's roads and reducing carbon emissions by nearly 3.2 million tonnes. That's the power of multi-utility infrastructure.

The infrastructure and construction sectors account for a significant share of the world's consumption of material resources. One way to address our ever-increasing resource challenge is to ensure that infrastructure is conceived, developed and operated from a resource-efficiency mindset. Multi-utility infrastructure can drive significant resource optimisation.

Resource extraction has already reached unsustainable levels globally. The *Global Resource Outlook* 2019 of UNEP highlights that the extraction of material resources from the earth has grown 340 per cent since 1970. The bulk of this resource extraction was non-renewable.

It is estimated that $1 billion in infrastructure investment consumes around: 50,000 tonnes of steel; 300,000 tonnes of cement; 1,000,000 tonnes of sand; and 1,750,000 tonnes of gravel and crushed stone. With the estimated annual investments at about $3.9 trillion on global infrastructure and $5-6 trillion on building construction through 2040, we are staring at the demand for 500 million tonnes of steel, 3 billion tonnes of cement, and 28 billion tonnes of sand and aggregates annually. This is staggering at the least.

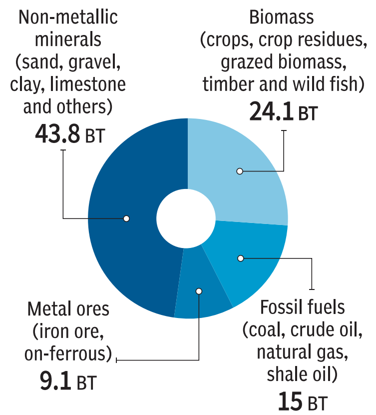
This issue of resource efficiency has been acknowledged. The current efforts focus on better maintenance, demand-responsive planning, and the utilisation of recycled materials. For example, UNEP proposes the following pathways towards resource-efficient infrastructure:

Retrofitting and maintenance of existing infrastructure to potentially reduce investments by up to 15 per cent

Integrated systems-level approaches — example, improved transportation infrastructure to reduce fuel needs

Use of nature-based solutions — the use of natural ponds to treat raw sewage and wastewater

Global resource extraction, 2017



BT - billion tonnes

Source: Global Resource Outlook, 2019 (UNEP)

Use of innovative, and disruptive technologies — example, reuse of previous structures in new buildings

However, the ability of an asset to be multi-utility and drive resource efficiency is overlooked. Most infrastructure is currently designed for a single primary purpose. A highway asset is typically built to carry passenger and goods vehicles. Several components of the asset remain under-utilised — example, the land under the highway, or the air space above it. As an exception, infrastructure assets such as urban roads often double up as carriers of various utility lines to support the distribution of water, electricity, sewage, telephone and data lines.

MULTI-UTILITY DEFINED

We propose that current and future infrastructure be developed as multi-utility. We define multi-utility when:

The project assets are used for purposes beyond the primary purpose (secondary purposes), with no or small incremental investments

Any such incremental investments for the secondary purpose are lower than if the infrastructure was created as a greenfield

This asset usage for secondary purposes doesn't adversely impact the primary purpose and may provide additional benefits

> **The infrastructure and construction sectors account for a significant** share of the world's consumption of material resources.

Multiple uses — some examples

Project	Canal solarisation	MRTS for intracity goods transport	Electric Vehicle (EV) batteries as distributed grid storage
Primary purpose	Conveyance of fresh water for irrigation and other purposes	Passenger transportation	An energy source for electric vehicles
Unused project asset	Air space over the canal	Track and related infrastructure, especially during off-peak hours	EV battery remains unused to the extent of 95% (non-running time for vehicles)
Secondary purpose	Deployment of solar panels over canal air space	Intra-city transportation of goods	Usage of battery storage capacity as distributed grid storage
Incremental investment for a secondary purpose	Steel structures for mounting; solar panels, inverters and electrical systems; electricity evacuation infrastructure	Goods terminals at key origin and destination nodes; EMU freight train sets	Bi-directional EV charging stations using Vehicle to Grid (V2G) technology; grid integration and management systems
Resource advantages	~2 MW of solar generation per km of canal (for a certain width), saving ~10 acres of ground space	Each trainload of goods can carry ~400 tonnes of goods. This displaces road capacity demand from 400-500 road transport vehicles	1 EV with 100 kWh capacity can provide ~200 kW peak power output, creating valuable capacity for solar rooftop integration into the urban electricity distribution system
Economic assessment – project payback period	25 years	Less than 2 years	Less than 3 years
Additionalities	Reduction in water evaporative losses by ~85,000 cu m p.a. per km	Possibility to eliminate ~25,000 small goods road vehicles — associated reduction in traffic congestion, pollution, fuel	Grid stabilisation, possible peak power supply

Designing infrastructure for multiple uses can thus deliver several benefits — resource efficiency and sustainability; improved economics and additionalities.

Let's look at some examples of multi-utility infrastructure:

We applied this principle to the Delhi Metro to see the impact. In 2023, Delhi has an estimated intra-city goods movement at around 83,000 tonnes, utilising about 68,000 vehicles for movement. These vehicles not only drive congestion on the city's already over-burdened roads but being predominantly CNG-fueled, also add to global warming via higher emissions of greenhouse gases.

Delhi Metro is the country's most extensive system, with 12 lines covering a total of 390 km track length and serving 286 passenger terminals across the National Capital Region. The network served 2.52 million passenger rides daily in FY22. Traffic operations earned revenues of ₹1,976 crore, and incurred an operating loss of ₹1,251 crore.

As a multi-utility infrastructure, shifting the intracity freight traffic to Delhi Metro's network can enhance the network's revenues significantly and reduce losses while contributing to a massive reduction in the small goods vehicles on the city's roads.

This initiative can leverage existing track infrastructure and will require relatively small incremental investments for dedicated goods terminals with associated warehousing facilities at major traffic origin and destination points; and dedicated freight rolling stock.

The benefits of such usage are huge as indicated above.

Designing and operating multi-utility infrastructure not only drives resource efficiency and sustainability but also significantly improves the economics of infrastructure projects. It's time to take this seriously before we run out of resources.

Zamre is the Chief Operating Officer at The Infravision Foundation, and Khandelwal is the founder, PSmith Advisors LLP