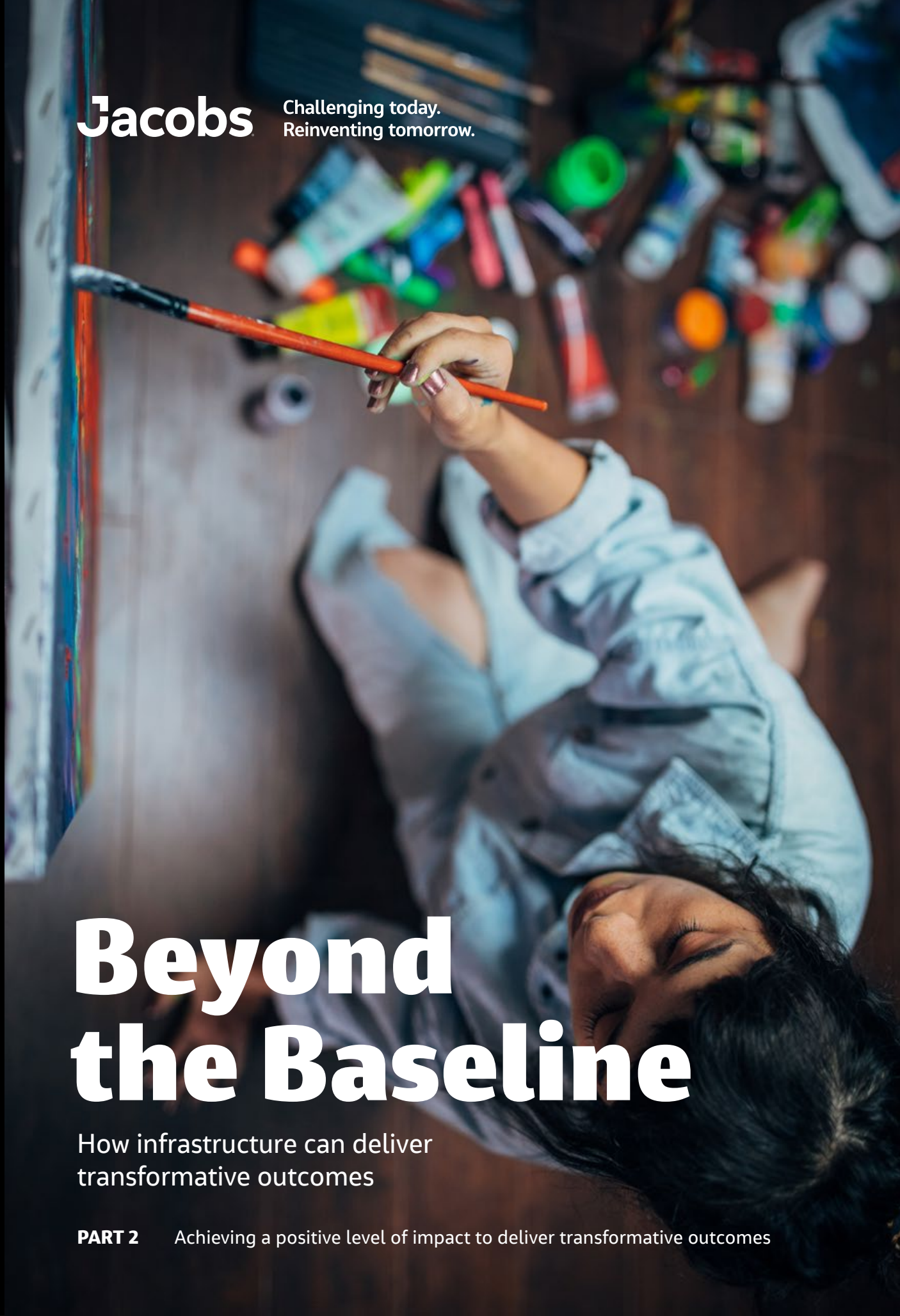


Jacobs

Challenging today.
Reinventing tomorrow.

Beyond the Baseline

How infrastructure can deliver transformative outcomes

PART 2 Achieving a positive level of impact to deliver transformative outcomes







A message from Jacobs

Every infrastructure program or project begins with the opportunity to make a positive difference.

What that positive difference is and whether it is realized depends in large part on leadership's abilities and aspirations.

In the first Beyond the Baseline paper we explored six categories of transformative outcomes — identified by the Global Infrastructure Hub in their Transformative Outcomes Through Infrastructure initiative — that programs and projects should be targeting, and the role of infrastructure leaders in delivering those outcomes.

In this second paper, we focus on articulating the aspiration for the level of impact programs and projects should seek for the six transformative outcome categories. The challenge for infrastructure leaders is to achieve a meaningful level of impact against all six transformative outcome categories – to go beyond what has previously been done and achieve something greater - a positive level of impact.

But what is a positive level of impact? Well, a positive level of impact exceeds what has typically been achieved from infrastructure. This is perhaps best illustrated through an example. For environmental regeneration, a typical level of impact would be maintaining the current health of the natural systems on which we and other species depend. A positive level of impact on the other hand would be restoring, regenerating and enhancing the health of those natural systems.

It is not our intention to set impossible targets for the six transformative outcome categories. It is our intention to challenge leaders to do more.

We have produced this paper to help infrastructure program and project teams understand how a typical and positive level of impact differs. In doing so, we hope to create shared leadership thinking from which teams can be empowered to investigate in detail how to go beyond what they have done before.





Mariane Kurban

Jacobs' Global Vice President, Market Solutions

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Disclaimer

In preparing this report, Jacobs has relied upon, and presumed accurate, information from publicly available sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

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Note on Investment Figures and Currencies: To help readers easily compare the scale of investment across countries, all figures are stated in US dollars. The original foreign currency figure IS included in parentheses. Figures were converted to USD on 7 November 2022.

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The Beyond the Baseline thought leadership series

AVAILABLE AT JACOBS.COM

Paper one

Are our current and emerging infrastructure leaders ready and able to lead the charge on achieving transformative outcomes?

Leading infrastructure teams

Achieving transformative outcomes through infrastructure investment hinges largely on whether infrastructure leaders can justify solutions capable of delivering such outcomes and inspire infrastructure teams to deliver beyond what they have typically done prior.

This paper:

- Identifies 13 leadership attributes needed to lead teams to deliver transformative outcomes through infrastructure.
- Outlines methods for developing these leadership attributes at a jurisdictional/ organizational and program/ project level.

YOU ARE HERE!

Paper two

What transformative outcomes and positive impacts should infrastructure deliver and how do they differ from what infrastructure has typically delivered?

Inspiring infrastructure teams

To inspire infrastructure teams we need to clearly articulate the level of positive impact programs and projects are seeking to achieve for each transformative outcome. This clarity is fundamental to inspiring teams to provide infrastructure that delivers more and lasts longer.

This paper:

- Outlines the difference between typical and transformative outcomes from infrastructure.
- Recognizes the key barriers that must be overcome to achieve transformative outcomes.

COMING SOON

Paper three

How can we equip program and project teams to quickly and effectively reach a shared appreciation of these transformative outcomes?

Mobilizing and equipping infrastructure teams

Infrastructure programs and projects involve people and entities working together, often for the first time. It can take weeks, months and sometimes years for teams to form a shared understanding of the people, groups, actions and initiatives that drive transformative outcomes. We need to mobilize and equip infrastructure teams to have an immediate focus on transformative outcomes.

This paper:

- Describes a clear set of activities to undertake from day one of an infrastructure program or project to mobilize and equip the team to realize transformative outcomes.
- Activities include engaging the market for private finance, producing a digital capability plan, understanding local project context, involving citizens, setting positive transformative outcome targets and appraising scope/ options.



Clarifying the terminology in this paper

An ***outcome*** relates to the change in state or condition of the theme because of the infrastructure's activities/ features/ functions.[1]

An ***impact*** is the level of contribution to achieving the change in state or condition.[2]

All infrastructure programs and projects start with a current or "baseline" state for each outcome. A ***typical level of impact*** may be no net impact or incremental improvement against this baseline.

A ***positive level of impact*** goes beyond a minimum standard or regulated level of impact. Instead, it seeks to restore, enhance or replenish.[3]

The impact felt from these outcomes needs to be targeted across generations, not simply impact a single generation. Programs and projects seeking a "positive" level of impact aim to deliver a significant improvement on the baseline state for many, if not all, outcomes.

As per Paper 1, the term ***infrastructure leader*** is used to refer to an individual, while ***infrastructure leadership*** refers to the collective leadership group responsible for delivering the infrastructure program or project. Both terms encompass leadership roles ranging from executive level to the program manager/ director level of organizations.



INTRODUCTION

Setting the scene

A quick recap of paper one

In September 2021, the Global Infrastructure Hub (GI Hub) released its *Transformative Outcomes through Infrastructure initiative*, which examined the $3.2 trillion in infrastructure stimulus announced by G20 countries between February 2020 and August 2021.[4] The initiative identified 13 transformative outcomes, across six outcome categories, being targeted by the stimulus (Figure 1).

The opportunity for infrastructure to deliver more extends well beyond pandemic related short-term infrastructure stimulus. Over the coming decades there is significant scope for infrastructure to deliver transformative outcomes. Moving forward, GI Hub estimates global infrastructure investments needs to reach $94 trillion by 2040 to keep pace with service needs and gaps.[5] This represents the need for a sustained increase in infrastructure investment over the next 20 years.

Embedding the commitment and capacity to realizing transformative outcomes through infrastructure now delivers an array of benefits for both current and future generations.

However, while the urgency and the need for infrastructure to do more is clear, the "how" is less clear.

To answer this question, Jacobs collaborated with GI Hub to articulate the urgent need and opportunity to deliver transformative outcomes through infrastructure. Jacobs then drew on its global infrastructure program management experience to operationalize these concepts to better support clients to deliver transformative outcomes through infrastructure, launching the Beyond the Baseline series.

Part 1: Leading infrastructure teams to deliver transformative outcomes, examined the question:

Are our current and emerging infrastructure leaders

ready and able

to lead the charge on achieving transformative outcomes?

FIGURE 1

The six transformative outcome categories.

01. Environmental sustainability



Enhancing the environment by regenerating ecosystems and biodiversity, maximizing resource recovery, eliminating use of finite resources and becoming carbon positive.

TRANSFORMATIVE OUTCOMES

Circularity
Environmental regeneration
Low carbon transition
Pollution reduction

02. Resilience



Building the capacity of individuals, communities, institutions, businesses and systems (natural and built) to survive, adapt, grow and thrive no matter what kinds of chronic stresses and acute shocks they experience.

TRANSFORMATIVE OUTCOMES

Disaster and climate adaptation
Social cohesion

03. Inclusivity



Improving the quality of life and wellbeing of individuals, specifically by reducing inequalities and inequity in all its forms.

TRANSFORMATIVE OUTCOMES

Inclusive mobility
Digital connectivity
Affordability and access to services

04. Research and development

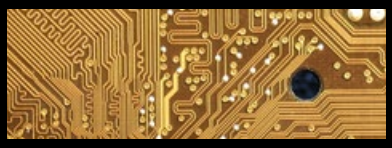


Creating for citizens and businesses new products and services that are more useful and valued, thereby developing an enduring innovation culture.

TRANSFORMATIVE OUTCOMES

Disruptive innovation

05. Digital/InfraTech



Achieving rapid technology advancements as a result of infrastructure either scaling-up or advancing a new or existing secure (physical, information, operational) infrastructure technology.

TRANSFORMATIVE OUTCOMES

Digitalization
Cyber security
Digital connectivity

06. Economic development



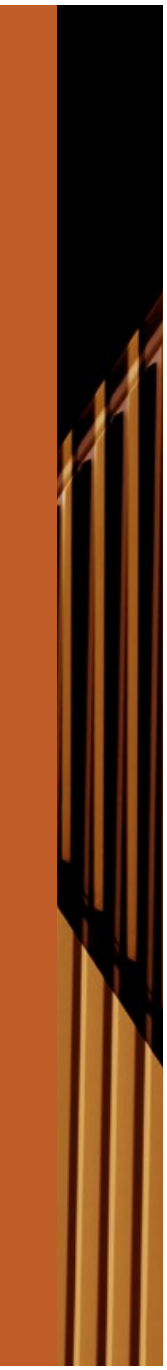
Supporting sustained and diverse growth that drives job creation and a rise in living standards.

TRANSFORMATIVE OUTCOMES

Job creation and economic growth

To deliver transformative outcomes we must evolve our thinking about the role of infrastructure in delivering greater positive outcomes for people and the planet. Previously programs and projects may have aimed to have a positive economic impact and incremental improvement or no net impact on other transformative outcomes. Today we need infrastructure programs and projects to prioritize and deliver multiple, if not all, transformative outcomes at every investment opportunity (Figure 2).

Achieving this largely hinges on the ability of infrastructure leaders to justify solutions capable of delivering transformative outcomes and to challenge and inspire teams and stakeholders to deliver beyond what they have typically done prior. We concluded that this required particular leadership skills.



Leadership must:

- ☑ Fully appreciate the complicated and dynamic nature of the strategic operating environment
- ☑ Have clear values and communicate these values
- ☑ Be able to mobilize private capital and partner with an array of potential investors
- ☑ Be exceptional at building and leading diverse teams
- ☑ Have the experience needed to deliver complex projects
- ☑ Have an entrepreneurial spirit
- ☑ Be politically astute and able to collaborate across government(s)
- ☑ Be excellent communicators
- ☑ Implement agile organizational structures with clear plans for resourcing both now and in the future
- ☑ Be data and analytics driven
- ☑ Be comfortable with disruption and change
- ☑ Commit to a learning-based approach
- ☑ Create an environment that values and facilitates cooperative relationships with partners.



FIGURE 2

The changing role of infrastructure - shifting from incremental & variable impact to multiple positive impacts

THE PRESENT - Incremental & variable impact from infrastructure

1 Indirect GHG emissions from embodied carbon in construction materials and operational carbon emissions.

2 Secure but not connected infrastructure providing a less compelling user experience.

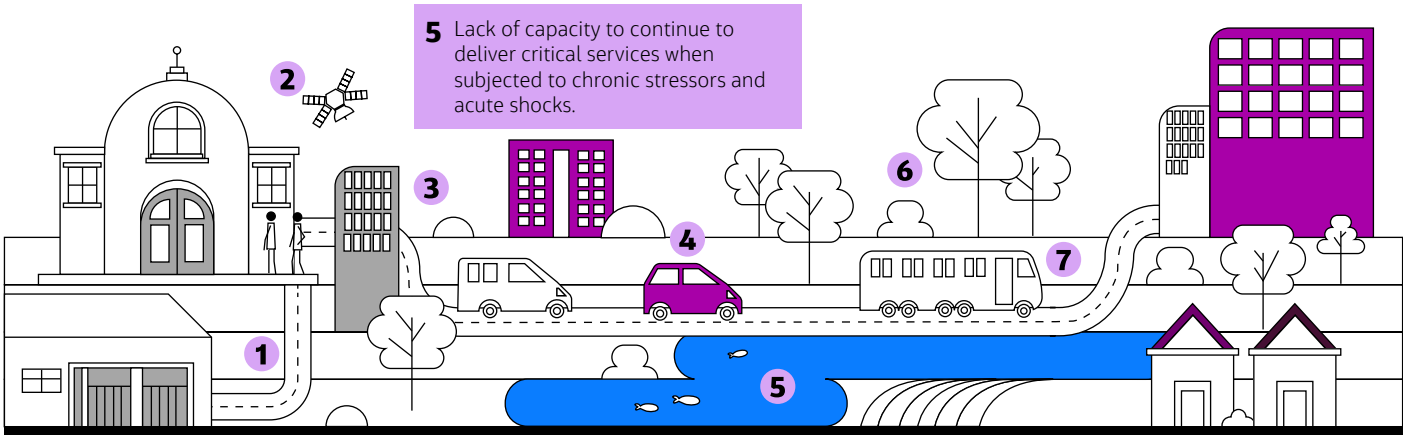
3 Job creation targets that focus on short-term direct employment opportunities, largely short-term construction opportunities.

4 Journey times and amenity are improved for people who are well off and already experience a high level of public transport service.

5 Lack of capacity to continue to deliver critical services when subjected to chronic stressors and acute shocks.

6 Habitat and biodiversity loss through land clearing, degradation and fragmentation.

7 Incremental improvement in consumer choice about how they use service.



From a focus on impacts of a singular asset

THE FUTURE - Infrastructure delivers multiple long term positive impacts

1 Job creation that focuses on increasing the productivity of both human and technological capital, and promotes employment opportunities for disadvantaged communities.

2 Eliminate the use of finite resources, use materials with low life cycle impacts and build in resource recovery and circularity in materials consumption and design for decommissioning.

3 Assist in reversing biodiversity loss, avoid pollution and realize restoration and creation of ecosystems and habitat native to the local reference habitat.

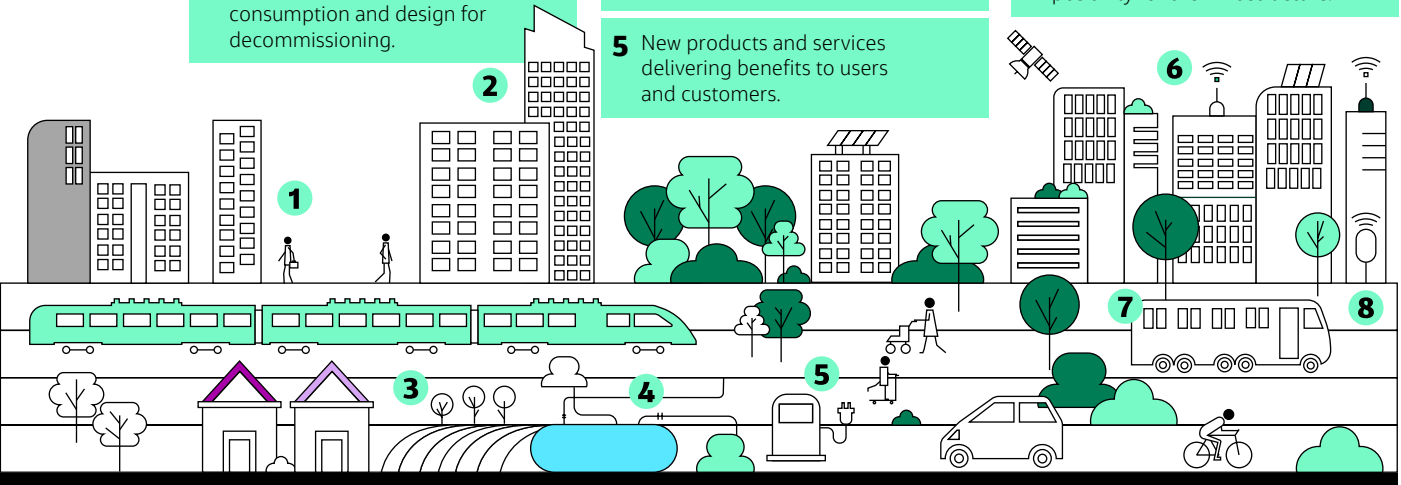
4 Build for long term resilience with system redundancy for critical infrastructure to ensure service provision if infrastructure is compromised.

5 New products and services delivering benefits to users and customers.

6 Connected and smart infrastructure that has a reduced risk of cyber attack.

7 Enable modal shift to realize improved mobility and emissions outcomes.

8 Aid in the transition to a low carbon economy and realize carbon positivity for the infrastructure.



To a focus on blended infrastructure

Introducing paper two

According to the UK Government, "The starting point for all of our interventions... should be defining and incorporating strategic outcomes (that address a range of societal challenges – from changing patterns of use to the need for adaptation and resilience, particularly within the context of climate change) into longer term collaborative delivery models in which industry partners are incentivized to deliver them."[6]



In this second paper in the Beyond the Baseline thought leadership series we focus on how infrastructure leaders can, for the six transformative outcome categories:

1. **Articulate why it is important to realize a positive level of impact.**

2. **Describe the difference between a typical and positive level of impact and how the difference can be measured.**

   The indicators identified in this paper broadly align with those outlined in similar research, including the Inter-Development American Bank's A Common Set of Aligned Sustainable Infrastructure Indicators[7] and the Climate Policy Initiative's FAST-Infra Sustainable Infrastructure Label initiative.* They also align with principles outlined in the G20/GI Hub Framework on How to Best Leverage Private Sector Participation to Scale Up Sustainable Infrastructure Investment[8] and the FDI Qualities Indicators: Measuring the sustainable development impacts of investment[9].

3. **Determine whether they are ready and able to pursue a positive level of impact.**

   A positive level of impact doesn't occur simply because it is stated. Infrastructure leaders must recognize the key impediments that may exist, and enablers needed to achieve a positive impact. The paper provides a critical set of questions leaders should ask their teams at the outset of the program or project to determine their level of readiness to deliver transformative outcomes.

4. **Provide a practical example of an infrastructure program or project that is targeting and/or achieving a positive level of impact.**

*FAST-Infra Sustainable Infrastructure (SI) Label initiative covers 14 criteria across four dimensions — environmental, adaptation and resilience, social and governances. For each criteria it lays out an expected baseline and a positive contribution that is over and above the baseline. Each project must achieve the baseline in all criteria and reach positive impact in at least one criteria to achieve the SI label. Projects that obtain the SI label are assessed as delivering "significant positive sustainability performance".[10]



TRANSFORMATIVE OUTCOME CATEGORY 1

Environmental sustainability

TYPES OF TRANSFORMATIVE OUTCOMES

1. *Circularity*
2. *Environmental regeneration*
3. *Low carbon transition*
4. *Pollution reduction*

This category broadly encompasses the following UN SDGs:













Why it's important

The latest Intergovernmental Panel on Climate Change's Sixth Assessment report concluded that human influence is the principal driver of a global average temperature rise of almost 1.1 degrees Celsius (2 degrees Fahrenheit) since the start of the industrial era.[11]

We are already feeling the impacts of climate change and if this warming continues unabated, the projected effects on people and the planet will be catastrophic.

According to scientists, we must restrict warming to a maximum of 1.5 degrees Celsius (2.7 degrees Fahrenheit) above pre-industrial levels to mitigate the worst impacts of climate change.



Meeting this target requires the rapid decarbonization of economy and society to reduce greenhouse gas (GHG) emissions by 7.6% every year between now and 2030.[12]

The infrastructure sector is responsible for 79% of total global GHG emissions.[13] Reduction targets challenge infrastructure leadership to take steps to rapidly decarbonize assets and operations, and programs and projects to prioritize low-carbon solutions.

A 2019 report published by the United Nations Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) found that nature is declining more rapidly now, than at any other point in human history.[14] This decline is occurring as a direct result of five key factors, including changes in land use, climate change and pollution.[15]

Aside from the obvious implications for the future survival of many species and habitats currently at risk, natures decline has significant implications for the lives and livelihoods of all of us. The World Economic Forum approximates around half of the world's GDP — $44 trillion of economic value generation — is moderately or highly dependent on nature.[16]

Infrastructure should seek to improve the health of natural systems which are vital to our economic wellbeing, food security, health and overall quality of life.

How leaders can articulate the difference between a typical versus positive level of impact for environmental sustainability outcomes

The next page contrasts a typical level of impact infrastructure can have on environmental sustainability outcomes with a potential positive level of impact, how the difference between the two can be measured and the key readiness questions leaders should ask their teams.



Circularity

Typical level of impact

- Uses virgin extracted materials and unsustainably harvested natural resources in construction.
- Is not designed for reuse post decommissioning.
- Excess and decommissioned infrastructure is disposed of to landfill with no beneficial reuse. In some countries, it may not make landfill.

Positive level of impact

- Uses no or minimal virgin extracted materials or unsustainably harvested natural resources in construction.
- Uses largely locally sourced recycled materials and stimulates market opportunities for recycled materials beyond the infrastructure footprint boundary.
- Designs for and integrates circularity principles to promote closed material loops and reuse/ repurposing at the end of the design life.

Indicators of impact

- Percentage of renewable materials/ non-virgin materials used in construction.
- Percentage of construction or operational material inputs that are designed for circularity.
- Rate of water consumption and recycling.
- Whole of life impact assessment scoring using a globally recognised LCA tool.

Key readiness questions

Do we understand what the key resources and materials we are likely to use are and what the current market availability is for recycled materials?

Do we recognize the true cost of resource use and value of waste reduction?

Does the performance management framework for the infrastructure prioritize circularity and avoid virgin extracted or unsustainably harvested natural resources?

Environmental regeneration

Typical level of impact

- Results in habitat and biodiversity loss or degradation through land clearing and fragmentation.
- Maintains current health of natural systems on which we, and other species depend.

Positive level of impact

- Restores and creates sustainable terrestrial, riparian and marine ecosystems and reverses biodiversity loss, e.g. retention and natural treatment of storm water, habitat creation aligned to local reference habitat.
- Sustainable use of local natural resources.

Indicators of impact

- Area of natural habitat regenerated to local reference habitat.
- Percentage of native vegetation, species and coverage.
- Species diversity measured or predicted through models appropriate to the scale and location of the site.
- Surface, ground and marine water quality parameters, e.g. acidity or basicity (pH), temperature, electrical conductivity, dissolved oxygen, turbidity, hydrocarbons, nutrients. (As applicable to the geography's guidelines or, in the absence of guidelines, recognized international standards.)

Key readiness questions

Do we have a strong understanding of the baseline natural environment and ecosystem function and, if not, how can we acquire a strong understanding?

Do we prioritize long term value as well as short term use?

Do current laws (legislation/regulations), policy and standards support or prevent positive impact?

Does the performance management framework for the infrastructure prioritize the protection, restoration and creation of ecosystems, habitat and biodiversity?

Low carbon transition

Typical level of impact

- Draws from grid connection/ power sources derived from carbon intensive energy sources.
- Generates direct GHG emissions due to land clearing and operation of construction plant and the infrastructure.
- Contributes indirect GHG emissions from embodied carbon in construction materials and those generated by the infrastructure and users over the infrastructure's operational life.

Positive level of impact

- Reduces net GHG emissions for the project over the entire infrastructure lifecycle, e.g. direct and indirect including enabled emissions resulting from the use of the infrastructure – electric vehicle charging, bike lanes, bus access.
- Uses materials with a low embodied carbon and made from recycled sources, e.g. geopolymer concrete, high percentage recycled steel or cross laminate timber.
- Sources low cost, low carbon energy to operate the infrastructure which can also be provided to local communities.

Indicators of impact

- Carbon sinks and storage created using recognized methods.
- Gross GHG emissions over the entire infrastructure lifecycle, measured using the methods in the Greenhouse Gas Protocol.
- Percentage of power derived from low carbon energy sources.

Key readiness questions

Do we have access to low carbon embodied materials both for construction and the operating life of the infrastructure?

Do we factor whole of life carbon costs into the business case for the infrastructure?

Does the performance management framework for the infrastructure prioritize the abatement, avoidance and sequestering of GHGs?

Pollution reduction

Typical level of impact

- Assesses but doesn't necessarily mitigate the impact on human and natural environment with respect to ecosystem/ human health, productivity or recreation.

Positive level of impact

- Improves upon current ambient baseline conditions.

Indicators of impact

Pollution reduction is context specific rather than driven by standards. Some example indicators are:

- Net reduction in air pollutants, as defined by recognized national/ international air quality guidance.
- Net reduction in noise (decibels).
- Net reduction in light pollution (lumens).
- Improvement to water quality, as defined by recognized national/ international water quality guidance.
- Improvement to nutrient levels in soils or decontamination of soil.

Key readiness questions

Do we know the baseline conditions for receiving environments?

Do we understand which surrounding pollutants we can assist in mitigating through the infrastructure?

Do we understand the current and future adjacent land uses and therefore what an appropriate level of pollution is?

CASE STUDY - ENVIRONMENTAL SUSTAINABILITY

Tyndall Air Force Base, USA

Challenge:

In October 2018, Tyndall Air Force Base (Tyndall AFB) in the panhandle of Florida was hit by Category 5 Hurricane Michael. The storm caused damage to close to 100% of buildings and infrastructure assets. The extensive damage caused by the hurricane and the planned addition of a new mission on base presented an opportunity to frame a new vision for Tyndall AFB to be more resilient, sustainable and smart. This ultimately triggered a $5 billion[17] rebuild project to deliver an "Installation of the Future" capable of recovering from an event in "days and weeks, not months and years".[18]

Transformative outcomes targeted:

The rebuild strategy targeted a number of environmental sustainability and regeneration outcomes[19], including:

- Restoring the coastline as part of the "first line of defense" and the "caboose of the stormwater treatment train"
- Balancing the natural and built environment to maximize ecosystem services for ground water recharge, carbon management, air quality, heat regulation, erosion protection, recreation and open space provisions.
- Restoring previously lost habitats in significant land areas using only native plant species and minimizing the disruption of existing healthy habitats during the rebuild
- Restoring the natural landscape to better manage stormwater
- Developing a shade tree and revegetation program to reduce heat island effects, provide a more comfortable walking environment, improve energy efficiency in buildings, extend the life of the transportation pavement, increase air quality, reduce wildfire risk and reduce stormwater runoff through improved water capture.

Progress towards achieving transformative outcomes:

To achieve these outcomes, the TAFB project team is using an Engineering with Nature (EWN) and Nature Based Infrastructure (NBI) approach to ensure new development conserves, manages, restores and generates high-functioning ecosystems while improving resilience and climate action.

The project team developed a comprehensive set of performance standards, design guidelines, and updated the landscape master plan and Installation Facilities Standards (IFS).[20]

Architects, engineers and constructors are using these components to rebuild TAFB in a transformative or transformational way.

The rebuild project is in its fifth year and is delivering a range of positive outcomes, including:

- Restoring natural landscapes, such as forests, floodplains and wetlands
- Reducing risk of wildfires
- Restoring natural stormwater management onsite, using biofiltration planters, bioswales, constructed wetlands, shallow and vegetated stormwater ponds and native forests and eliminating concrete, pipes and metal
- Largely redeveloping previously disturbed lands resulting in reduced greenfield development, ecology disruption and habitat loss.





TRANSFORMATIVE OUTCOME CATEGORY 2

Resilience

TYPES OF TRANSFORMATIVE OUTCOMES

5. *Disaster and climate adaptation*
6. *Social cohesion*

This category broadly encompasses the following UN SDGs:





Why it's important

Resilience directly relates to our capacity to withstand and respond to major shocks.

Natural disasters, including pandemics, and more extreme weather events as a result of climate change pose significant environmental, economic and social risks.

These events also come at a huge financial cost. For example, the United States experienced 20 separate billion-dollar plus weather and climate events in 2021, with a total cost of over $145 billion of damage to homes, businesses and public infrastructure.[21] Thirty percent of the world's population is exposed to deadly heatwaves for more than 20 days a year.[22]

Rapid decarbonization now will help mitigate future impacts but, despite even our best efforts to reduce greenhouse gas emissions to net zero, many climate change impacts are here to stay. Infrastructure must withstand and respond to an array of increasingly frequent major shocks such as storms, flooding, sea level rise, heatwaves, drought and water scarcity.

Infrastructure will need to be appropriately located, designed and maintained to avoid failure because of major shocks.

How leaders can articulate the difference between a typical versus positive level of impact for resilience outcomes

The next page contrasts a typical level of impact infrastructure can have on resilience outcomes with a positive level of impact, how the difference between the two can be measured and the key readiness questions infrastructure program and project leaders and teams should ask themselves at the outset.



Disaster and climate adaptation

Typical level of impact

- Infrastructure is located in places highly susceptible to natural hazard risks, e.g. fires, floods.
- Lacks the capacity to continue to deliver critical services when subjected to chronic stresses and acute shocks.
- Speed of recovery depends on supply chain and subject to availability based on market demand.
- Potential for service to be permanently impacted if environmental conditions change beyond design thresholds.
- Infrastructure is recovered to pre-event state, not improved.

Positive level of impact

- Provision of the infrastructure provides additional capacity to absorb shocks and stressors for surrounding natural and human receptors.
- Has system redundancy to ensure service provision if critical infrastructure is compromised.
- Continues to operate at a required level of service during a natural or non-natural disaster.[23]
- Quickly restores and resumes providing a required level of service after a natural and non-natural disaster.
- Recovery activities follow resilience standards, providing improved system/infrastructure post-recovery.

Indicators of impact

- Percentage of population exposed to natural hazard risks, e.g. cyclone, flood, earthquake.
- Existence of a resilience strategy and resilience design standards, accounting for future conditions.
- Extent of adaptive capacity to adjust in future to potentially changed environmental or social conditions.
- Existence of an approved 'Continuity of Operations Plan' (CoOP). CoOP includes established contractual and operational arrangements with supply chain for service provision during an event.
- Extent of system redundancy.

Social cohesion

Typical level of impact

- Infrastructure is delivered and operated with limited community input and engagement failing to build community capacity to respond to natural and non-natural disaster.

Positive level of impact

- Completed infrastructure guided by community involvement regarding how the community can respond to natural and non-natural disasters.

Indicators of impact

- Level/extent of community/stakeholder engagement/participation.



Key readiness questions

Do we focus on both near-term cost of providing resilience and longer-term value?

Do we have design standards and regulatory processes relevant to future shocks to inform planning/design and address the uncertainty of potential changes in future conditions (especially climate change)?

Do we have an integrated planning approach to infrastructure provision and management which balances focus on primary function and consideration of wider/ ancillary benefits, including community and social benefits, that could be delivered?

Do we have infrastructure funding with strict requirements that limit embedding resilience outcomes?



CASE STUDY - RESILIENCE

Changi Water Reclamation Project, Singapore

Challenge:

Singapore is a water stressed country with limited space to store water. There is significant need to use water reclamation/ reuse technology to make the country resilient to increasing variability in rainfall as a result of climate change. In response to this challenge, Singapore's national water agency, PUB, has undertaken the Changi Water Reclamation Plant (Changi WRP). Changi WRP is one of the largest and most advanced used water treatment plants in the world. Aside from treating used water to a suitable quality for discharge to the sea, Changi WRP manufactures NEWater, one of the four national taps used by PUB to ensure water security for the island nation.

Transformative outcomes targeted:

Recover as much clean water as possible from used water and ultimately not waste a drop.

Transformative outcomes achieved/ progress towards achieving transformative outcomes:

The plant increases the level of water reclamation using biological separation, physical separation, membrane bioreactors and reverse osmosis, applying the technology at a scale not previously seen. It currently produces 120 million gallons (US) of treated water daily and design is underway to increase the capacity to produce up to 180 million gallons (US) of treated water daily.

The next phase of development will be a facility to recover energy in the form of biogas from food waste and grease trap waste to increase the energy self sufficiency of Changi WRP.









TRANSFORMATIVE OUTCOME CATEGORY 3

Inclusivity

TYPES OF TRANSFORMATIVE OUTCOMES

7. *Inclusive mobility*
8. *Digital connectivity*
9. *Affordability and access to services*

This category broadly encompasses the following UN SDGs:





Why it's important

Inclusivity outcomes are directly related to the standard of wellbeing and quality of life experienced by the people and communities reliant upon and in proximity to infrastructure.

Wellbeing outcomes can be positively impacted by infrastructure interventions such as urban redevelopment programs that improve community cohesion and a sense of place.

As well as providing safe and healthy places for us to live, infrastructure must be designed and operated to make it easier for communities to access critical and affordable services, including access to education, employment, housing and other factors that determine wellbeing.*

How leaders can articulate the difference between a typical versus positive level of impact for inclusivity outcomes

The next page contrasts a typical level of impact infrastructure can have on inclusivity outcomes with a positive level of impact, how the difference between the two can be measured and the key readiness questions leaders should ask their teams.

**The Marmot Review (2010) concluded that an individual's health and wellbeing is determined not just by environmental and biological factors, but also by the social determinants of health. These include education, social status, occupation, income, gender, and ethnicity, which are in turn affected by the social, political and cultural context around them.*[24]

Inclusive mobility

Typical level of impact

- Targets improving trips for commuters rather than benefiting all sections of society.
- Improves journey times for those that already experience a high level of transportation service.
- Reduces number of transport-related accidents and fatalities.

Positive level of impact

- Benefits marginalized and under served communities through improved access to and affordability of public transportation services.
- Achieves modal shift towards sustainable and affordable modes of travel including active travel.
- Improves services for transport modes traditionally used by marginalized groups, e.g. buses .
- Improves accessibility for people with disabilities.

Indicators of impact

- Community level of satisfaction with variety and efficiency of transportation options.
- Journey time from disadvantaged neighborhoods to places of employment, community and healthcare facilities.
- Number of people from low-income households accessing each mode of transportation.
- Proportion of people with disabilities reporting year-on-year improvement in accessibility of public transport.
- Number of people switching from private car to other modes of travel, including active travel (walking, cycling or scootering).

Digital connectivity

Typical level of impact

- Maintains access to internet services.
- Improves digital connectivity for people who already experience a high level of service and/or find the technology easily accessible.

Positive level of impact

- Facilitates affordable, secure and high-speed internet services that can be used universally across society.
- Focuses particularly on traditionally isolated groups, including older people and people living in rural areas.
- Educates groups that may feel excluded from the digital world on the benefits of technology and how to use it to access employment and skills opportunities.

Indicators of impact

- Proportion of people reporting year-on-year improvement in access to high-speed internet.
- Proportion of people using the internet for education, skills, employment and socializing opportunities.
- Proportion of people feeling less lonely or isolated.

Affordability and access to services

Typical level of impact

- Maintains access to community and healthcare facilities and essential services.
- New services are designed for those who are already well-off, exacerbating existing social and economic inequality.

Positive level of impact

Provides universal access to good quality affordable facilities and services.

Indicators of impact

Proportion of people reporting year-on-year improvement in access to and quality of community facilities and essential services including*:

- Affordable housing
- Utilities (power and water)
- Cultural events or places of culture
- Green and blue recreational space
- Education facilities
- Emergency services
- Level of life satisfaction reported by residents.

Level of wellbeing reported by residents, including key determinants such as:

- Educational attainment and income
- Perceptions of neighborhood and local crime rates.

**For example based on Community Wellbeing Index: Being Well Together, The Young foundation, 2020[25]*

Key readiness questions

Have we identified marginalized groups and how best to engage them?

Do we understand the community's wellbeing and life satisfaction needs and interests?

Is data available to support robust measurement, monitoring and evaluation of individual life satisfaction and community wellbeing?

Are we up to date with changes in government policy, priorities and levels of investment related to wellbeing determinants and how these can be leveraged?





CASE STUDY - INCLUSIVITY

Klyde Warren Park, USA

Challenge:

Deliver a new park, spanning an eight-lane freeway, to bridge Dallas' Uptown and Arts District neighborhoods.

Transformative outcomes targeted:

Deliver a public park that is a space for all and connects two Dallas neighborhoods.

Transformative outcomes achieved:

The park includes a wide pedestrian promenade, Great Lawn, pavilions, a children's playground, interactive water features, a dog park, botanical garden, and numerous plaza and garden spaces. Programming includes free daily events such as yoga classes, family activities, outdoor theatre and concerts.[26]

The park promotes healthy living according to 86.3% of park users surveyed. Sixty nine percent of the users agree that the creation of a functional, programmed open space increases their participation in outdoor activity.[27]



Klyde Warren Park Deck
© Thomas McConnell



TRANSFORMATIVE OUTCOME CATEGORY 5

Research and development

This category broadly encompasses the following UN SDGs:



TYPE OF TRANSFORMATIVE OUTCOMES

10. Disruptive innovation

Why it's important

Research and development outcomes are directly related to disrupting the "status quo" for using infrastructure to meet societal needs. By promoting a mindset of "disruptive innovation" infrastructure leaders can deliver more valuable and relevant products and services to society. Disruptive innovation is about putting the "customer" at the center of the infrastructure solution and offering greater choice regarding why, when and how the "customer" chooses to interact with the infrastructure.

For example:

- **Smart-meters**

  Using smart meters to monitor and inform customers of their usage and the corresponding costs of water and electricity can enable customers to better determine the optimal time (day or night) to consume.

- **Telehealth**

  Providing both the capacity to visit a Health/Medical Practitioner in person or undertaking a consultation online/phone provides the consumer with greater choice about how they access critical services and lessens barriers to accessing the service (e.g. needing to travel distances, finding the time in already busy daily schedules).

- **Shared mobility**

  Car ownership is a significant household cost. Providing an array of mobility options offer customers greater choice about whether they need to own or not. Mobility options ranging from public transport, micro-mobility (e.g. e-Scooters), ride sharing and short-term car sharing continue to disrupt the transport sector.



A stronger infrastructure innovation ecosystem can increase the likelihood of achieving other transformative outcomes. For example, environmental sustainability and regeneration outcomes can be achieved through using construction processes with a smaller carbon footprint or using materials that are more durable, increasing the life of infrastructure and minimizing the need to replace as frequently.

Infrastructure should target to build our research and development/disruptive innovation capacity by unlocking new thinking, new ways of working, and new products, services and solutions.

How leaders can articulate the difference between a positive versus typical level of impact for research and development outcomes

This page contrasts a typical level of impact infrastructure can have on research and development outcomes with a positive level of impact, how the difference between the two can be measured and the key readiness questions leaders should ask their teams.

Disruptive innovation

Typical level of impact

- Single or limited use case innovations.
- Incremental improvements in an existing design, construction or operational process, product or service.
- Siloed innovation e.g. within individual teams, disciplines, infrastructure phases or businesses.
- Limited collaboration and innovation engagement across the supply chain.
- Innovation slow to scale.
- Innovations deliver benefits for direct end-users/customers.

Positive level of impact

- Solution and/or innovation capability provides value beyond a single project or phase of the infrastructure lifecycle.
- Develops new business/ commercialization models.
- Eliminates or optimizes process(es) in the design, construction and operation of the infrastructure.
- Strengthens innovation engagement across the end-to-end value chain.
- Improves ability to scale outcomes due to streamlined and timely access to critical resources (money, people, systems, software/hardware etc.)
- Stronger and more mature cooperation among global public, private and academic stakeholders spanning multiple disciplines and/or industries thereby building capacity for future research and development.



Indicator of impact

- Number and type of new products or services launched.
- Number of existing processes eliminated or optimized.
- Increase in infrastructure-related patents sought.
- New commercial and procurement models adopted.
- Degree of knowledge transfer across the end-to-end value chain.
- Greater diversity in innovation participants e.g. global public, private and academic stakeholders, and the sharing or co-sponsoring of innovation exercises/activities.
- Greater capability to use design thinking, lean startup and agile approaches
- Creation of new, or expansion of existing, innovation and knowledge networks, e.g. open innovation - a more collaborative approach where the flow of knowledge from internal and external networks accelerates innovation.[28]

Key readiness questions

Have we identified our critical challenges and have we sufficiently defined and understood our problems?

Do we have the processes to constantly evaluate alternative options, e.g. do we need to build new infrastructure or are there other options to achieve the same outcome?

Do we know how innovation will be funded?

Do we know what level of risk we are willing to accept, e.g. technology readiness levels, and why?

Can we leverage external innovation ecosystems, e.g. industry accelerators?

Do we understand the governance risks, e.g. funding, approvals, ownership, which could stifle innovation?

Do we have the right people, technology, processes, systems etc. to rapidly test new products and services?

Are project partners aligned on the importance of innovation and how the risks/rewards of innovation, e.g. IP ownership, are to be managed, e.g. appropriate contracting mechanisms?

Do we know how we will share data and learning to promote further innovation?



CASE STUDY - RESEARCH AND DEVELOPMENT

Sellafield and Copeland Borough Council's Industrial Solutions Hub, (UK)

Challenge:

Sellafield is a nuclear site going through decommissioning. The reactor stopped producing energy in 2003 and since then it has been owned by the UK's Nuclear Decommissioning Authority. A significant challenge for the whole region is transitioning from an economy where the majority of the jobs were focused on energy production to one where there is more diversity and looking to a future without decommissioning work.

Sellafield and Copeland Borough Council developed a new Industrial Solutions Hub (ISH) model to re-purpose and regenerate the site. Research and development is at the core of the outcomes targeted by the ISH. ISH is a new enterprise support organization and campus aiming to develop jobs, allow companies to strengthen their innovation capability and use an innovative business model to drive regeneration in the region by producing skills that can benefit the wider region, the UK and international markets.

Transformative outcomes targeted:

Develop a regional cluster of companies, bringing together the world leading skills within the supply chain to create an innovation capability which can provide value beyond a single project and/or a single phase of the infrastructure lifecycle.

Progress towards achieving transformative outcomes:

Currently, the ISH team is working on developing the first businesses to come from the cluster creator. Expansion to include international programs will allow for further collaboration.





TRANSFORMATIVE OUTCOME CATEGORY 4

Digital/InfraTech

TYPES OF TRANSFORMATIVE OUTCOMES

11. Digitalization

12. Cyber security

This category broadly encompasses the following UN SDGs:





Why it's important

Digital/InfraTech outcomes are directly related to widespread technology commercialization and its resulting impact on infrastructure users, operators, owners and surrounding natural and built environments.

During the past 40 years digital infrastructure has become central to the economy. Advancing technology and wide scale commercialization has resulted in more infrastructure delivering benefits such as:

- More sustainable construction (e.g. 3D-printed materials replacing traditional construction materials)
- Lower operating costs (e.g. using new technology is expected to deliver between 5-10% cost savings on infrastructure project delivery and maintenance costs through greater efficiencies)[29]
- More connected communities (e.g. 5G telecommunications enables families and friends to instantly share the important and sometimes less important moments of their lives)
- More resilient places (e.g. Geospatial data is facilitating real-time monitoring and predictive modeling to forecast and prepare for disasters in advance and assess real-time damage)
- Reduce carbon emissions (e.g. digitization has the potential to reduce global carbon emissions by up to 15% through artificial intelligence optimization of energy consumption).[30]

How leaders can articulate the difference between a positive versus typical level of impact for digital/InfraTech outcomes

This page contrasts a typical level of impact infrastructure can have on digital/InfraTech outcomes with a positive level of impact, how the difference between the two can be measured and the key readiness questions leaders should ask their teams.

NOTE

In GI Hub's findings, the outcome Digital Connectivity is included in both the Inclusivity category and Digital/InfraTech category. For the purpose of this paper, Digital Connectivity is covered earlier in this document in the Inclusivity category on page 28.

Cyber security

Typical level of impact

- Secure but not connected infrastructure that provides a less compelling user experience.
- Operational Technology with cybersecurity is added retrospectively, increasing costs.
- At risk from adverse data privacy and data loss events.

Positive level of impact

- Connected and smart infrastructure that reduces risk of cyber attack.
- Higher user confidence in smart environment and systems.
- A continuous and evolving understanding of cyber risks, to ensure connected, digital infrastructure remains secure through its lifecycle.

Indicator of impact

Level of cybersecurity maturity and risk. Measured using frameworks such as National Institute of Standards and Technology Cyber Security Framework (NIST CSF).

Key readiness questions

Do we understand our cybersecurity risk?

Do we know our cybersecurity legal and regulatory requirements?

Do we have recognized, comprehensive and robust methodologies in place to assess cybersecurity risk?

Do we have a cybersecurity governance statement?

Do we practice secure by design, e.g. is cybersecurity an integral part of the initial design?

Do we have a procedure in place to respond to a cybersecurity event or incident?

Digitization

Typical level of impact

- Slows decision cycles due to disparate data and a disconnected data environment.
- Facilitates the replication of physical to online services.
- Identifies incremental cost savings related to different aspects of infrastructure solution.
- Slow to adapt to changing demand and user preferences.

Positive level of impact

- Facilitates near real time decision cycles due to InfraTech solution enabling trusted data sharing. Demonstrated advanced decision-making capabilities.
- InfraTech solution identifies and aggregates infrastructure cost savings. Aggregated cost savings enables alternative supply chain solutions.
- Alternate solutions attract greater private capital to accelerate InfraTech commercialization.
- Infrastructure quickly and efficiently adapts its inputs, service performance and availability to meet changes in demand and user preferences.
- Links consumer behavior and expenditure of resources with infrastructure efficiency. Users should have the option to not use the infrastructure, rather than having no choice.

Indicators of impact

- Speed of decision-making.
- Cost savings throughout the asset life-cycle stages.
- Reduced InfraTech deployment time frame.
- Increase in private capital infrastructure investment.
- Increase in innovative financial solutions (e.g. dynamic pricing mechanisms).
- Number and type of new infrastructure services which did not previously exist.
- Percentage of the population with access to digital connectivity infrastructure, that can afford to pay for the access and can afford to pay for sufficient data.

Key readiness questions

Do we understand the current level of infraTech and country readiness?#*

Do we have access to the requisite InfraTech capabilities, e.g. 5G network?

Are we willing and capable of using advanced analytical tools to design, construct and operate the infrastructure?

Do we understand what government policies we can leverage to promote collaboration with industry on foundational technologies such as high-speed connectivity, cloud computing, smart sensors and fintech?

Are there common data standards and terms which increase data being shared across stakeholders?

Do government regulations match the targeted pace of technological change and adoption? E.g. regulations are overly prescriptive rather than outcome focused.

Does the capacity and capability in technology innovation sector, e.g. technology innovation hubs and small-to-medium enterprises and start-ups, exist to advance Infratech?

**Technology readiness can be determined using the following factors: capital and whole-of-life costs for the solution; maturity of technologies underlying the use case; and implementation difficulty.*

#A country's readiness to adopt and benefit from different InfraTech will depend on the following factors: existing foundational technologies to support the InfraTech; legislation and regulation; procurement and contract management; funding and financing; institutional capacity; and future enabled workforce[31]





CASE STUDY - DIGITAL/INFRATECH

Aurangabad Industrial Smart City (AURIC), India

Challenge:

India is connecting its political and financial capitals, Delhi and Mumbai, with 24 smart industrial cities along the 921-mile (1,482 km) Delhi-Mumbai Industrial Corridor (DMIC). DMIC is India's most ambitious infrastructure program. Its objective is to expand India's manufacturing and services base and develop DMIC as a global manufacturing and trading hub. AURIC is the first of seven new industrial cities to be developed during Phase One of the program.

Transformative outcomes targeted:

AURIC will:

- Deliver a fully connected smart city, including an Internet of Everything (IoE), to streamline the city functions, for example sensors that detect water leaks, smart street lighting and smart waste collection that monitors bin use and plans waste pickups.
- Deliver a centralized command and control facility to maintain and monitor citywide utilities to help achieve operational efficiencies across resources and workforces. Businesses, residents and visitors alike will benefit from an integrated information and communication technology platform for smart traffic management, smart grid and smart housing.
- Create a smart, green, industrial city of the future, focusing on clean, reusable and recycling methodologies.

Progress towards achieving transformative outcomes:

As the region becomes a major manufacturing area, AURIC will generate an estimated 151,000 jobs and create a vibrant, livable place for an estimated 325,000 people to live, work and play.

By integrating physical and digital infrastructure with city Wi-Fi solutions, this model smart city will exceed international benchmarks.





TRANSFORMATIVE OUTCOME CATEGORY 6

Economic Development

TYPE OF TRANSFORMATIVE OUTCOMES

13. Job creation and economic growth

This category broadly encompasses the following UN SDGs:



Why it's important

Economic development outcomes are directly related to jobs creation and economic growth.

During the pandemic, economic growth slowed and supply chains were heavily disrupted, putting pressure on economic development and social wellbeing, exposing the precariousness of systems. Many economies rebounded once the most restrictive health measures were discontinued, and some are enjoying near-record level employment, but the rebound was patchy and low-income countries in particular have yet to recover.

Today, the war in Ukraine is having catastrophic consequences for the people of Ukraine and causing significant headwinds for global growth. Inflation in many parts of the world has reached levels not seen since 1980s and consequently central banks are rising interest rates to combat inflation.

The lasting impact of the pandemic, Ukraine conflict, higher inflation and cost of borrowing could be a prolonged reduction in investment, slowing of asset value, reduction in real wages and eventual increase in unemployment. All these factors impact quality of life, and the global movement of people, ideas and goods.

Infrastructure has always been used to drive economic development and it must underpin economic growth, productivity and prosperity now more than ever. The GI Hub found public sector investment in infrastructure "*is more effective than other types of public spending in increasing economic output.*"[32]

Embracing the previously described transformative outcomes, infrastructure can create employment and business opportunities beyond traditional construction and operation. For example, infrastructure enabling a low carbon economy is projected to grow during the next ten years creating significant opportunities for new investment and jobs in the fields of decarbonization, energy management and broader Environmental, Social and Governance management etc.

How leaders can articulate the difference between a typical versus positive level of impact for economic development outcomes

This page contrasts a typical level of impact infrastructure can have on research and development outcomes with a positive level of impact, how the difference between the two can be measured and the key readiness questions leaders should ask their teams.

Job creation and economic growth

Typical level of impact

- Sets job creation targets that focus on short-term direct employment, largely lower-skilled construction opportunities.
- Equity, inclusion and diversity initiatives target infrastructure construction workforce, e.g. number of trainees, apprentices, indigenous communities, women, people with disability and/or the unemployed, which delivers short-term employment opportunities, training and skills development.

Positive level of impact

- Creates "decent work" opportunities directly and indirectly for all, e.g. women, young people, people with a disability. Decent work refers to work that provides a fair income, opportunities for development, as well as security and protection.[33]
- Job creation focuses on increasing the productivity of both human and technological capital.

Indicator of impact

- Number of jobs created for target demographics (focusing on groups typically excluded or marginalized in the job market).
- Number of upskilling opportunities created.

Key readiness questions

Do we have the willingness and mechanisms to collaborate and integrate across relevant government departments and agencies to join relevant programs, and policies?

Do we want to and do we know how we can balance the pressure on infrastructure projects to be "shovel ready" within a short timeframe with the opportunity for more complex workforce readiness/ labor market initiatives?

Are we ready from the outset to seek input from a wider and more diverse group of stakeholders and "harder to reach" communities about their economic development needs and how infrastructure can address these?



CASE STUDY - ECONOMIC DEVELOPMENT

Longbridge Regeneration, UK

Challenge:

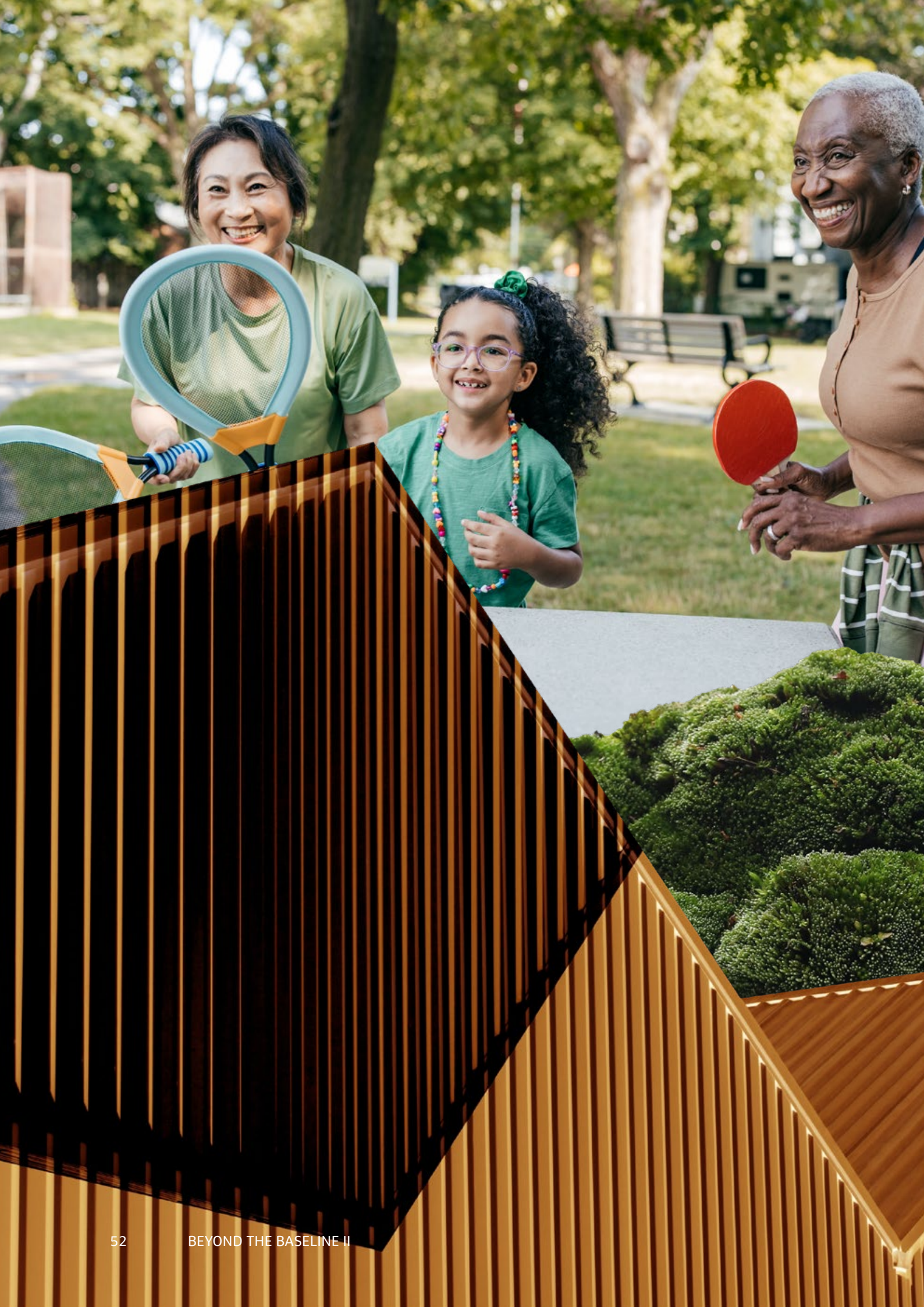
To regenerate an area which lost 6,500 car manufacturing jobs when the MG Rover factory closed in 2005. The closure caused an economic shock that battered the Longbridge economy and the wider economies of Birmingham and England.

Transformative outcomes targeted:

To create new, sustainable jobs and redevelop the town center.

Transformative outcomes achieved:

The Longbridge Innovation Center and Devon Way were completed in 2007, helping to reinvigorate employment in the local area. This was followed by completion of The Cofton Center in 2008. In 2011, a new $103 million (£89.4 million) purpose-built facility for Bournville College was completed. A new $109 million (£94.6 million) town center, incorporating shops, restaurants and offices, was completed in August 2013. The development culminated in the opening of the new town center and the $3.1 million (£2.7 million) urban environment known as Austin Park. More than 3,000 jobs have been created since work started onsite in 2007.



CONCLUSION

Delivering transformational projects



By clearly differentiating positive impact from what infrastructure has typically delivered, we can inspire infrastructure program and project teams to produce plans such as the Edinburgh City Centre Transformation Plan (CCTP).

Through the CCTP, Edinburgh City Council shows that, by planning infrastructure alongside health, education, economic development and social inclusion policies, a city that has been a vibrant and thriving place for hundreds of years can remain so well into the future. It also shows that, by aligning infrastructure investment to transformative outcomes, we can better co-ordinate across spheres of government.*

**The OECD highlights the importance of coordinating infrastructure investment with other complementary areas of government in "Getting Infrastructure Right – The Ten Key Governance Challenges and Policy Options".*[34]



CASE STUDY

Edinburgh City Centre Transformation Program

Challenge:

To create an exceptional city center for everyone to live, work, visit and play, designed for the future, enriched by the past.

Transformative outcomes targeted:

Environmental regeneration and sustainability

Aim to lower carbon and particulate emissions, to reduce air pollution within the city center, increase green spaces and mitigate the city's flooding risk.

Resilience

Reduce risk of flooding.

Research and development

Provide electric vehicle charging points to deliver last-mile freight solutions to the city center.

Inclusivity

Increase the health and wellbeing of residents and visitors by redesigning the city center to prioritize active journeys (walking or by bike) and use of public transport. The project aims to support more active lifestyles and make it easy to move around the city for all, regardless of age, mobility issues and sensory impairments.

Digital/InfraTech

Use data management to ensure the city is as efficient as it can be in its operation.

Economic development

Encourage tourism, increase footfall in the city center, decrease wasted time in traffic congestion.

Progress towards achieving transformative outcomes:

Environmental regeneration and sustainability

A low emission zone was approved with enforcement starting June 2024. The low emission zone will lower the carbon and particulate emissions by reducing the number of car journeys made within the city center. It is anticipated there will be a carbon saving of 381 metric tons of carbon (based on 1,676 more trips per day using active modes).

Inclusivity

Several streets are planned to be pedestrianized in a connected network of car-free streets. This will improve health and wellbeing and increase quality of life. The city center will become accessible to people of all ages and abilities with addition of lifts, shop mobility and wayfinding. A reallocation of space in the city center through a significant reduction of on-street parking with greater priority given to residents and blue badge parking.

Resilience

The increase in green spaces increased water absorbency and decreased overall risk of flooding.

Research and development

Micro consolidation centers are being developed on the edge of the city center, and then electric vehicles will be used to deliver goods into the city center.

Digital/InfraTech

Open-source data to allow more efficiency and resilience in the operation of the transport network and use data in real time to manage traffic.

Economic development

Estimated to be $124.5 million (£110 million) worth of additional economic benefit, with $73.5 million (£65 million) from increased spending in the city center.



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Published August 2023
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