Global Infrastructure Hub

AIIB ASIAN INFRASTRUCTURE INVESTMENT BANK

Stocktake of Approaches for Scaling Up InfraTech

Delivered for the G20 Infrastructure Working Group

7 July 2022

Contents

1 Background and rationale

The *Stocktake of Approaches for Scaling Up InfraTech* (Stocktake) is a deliverable under Priority 3 of the Infrastructure Working Group's (IWG) 2022 Work Plan. The Stocktake is the joint work of the Global Infrastructure Hub (GI Hub) and the Asian Infrastructure Investment Bank (AIIB). It supports the *G20 Blueprint for scaling up InfraTech financing and development* (Blueprint) by providing evidence (through case studies) of effective approaches that attracted financing for InfraTech development and implementation and that could be scaled and replicated across sectors and jurisdictions.

This Stocktake, as a supporting document for the Blueprint, advances the *G20 InfraTech Agenda* which was delivered under the Saudi Arabian Presidency and endorsed by the G20 Finance Ministers and Central Bank Governors in July 2020. InfraTech is defined in this agenda as the integration of digital and non-digital technologies with physical infrastructure to deliver efficient, connected, and resilient assets. The Stocktake also continues the GI Hub's work on the *Stocktake of InfraTech Use Cases* (a Reference Note to the InfraTech Agenda) and the GI Hub's *InfraChallenge* – an innovation competition was delivered under the Italian G20 Presidency in 2021.

2 Scaling up InfraTech investment

InfraTech has clear potential to achieve long-term infrastructure priorities by: 1) improving efficiency and reducing costs, enhancing economic, social & environmental value, and reshaping infrastructure demand and creating new markets[1], 2) supporting the *Roadmap to Infrastructure as an Asset Class* by providing enhanced data, tools as well as facilitating investors' ability to make informed decisions[Error! Bookmark not defined.], and 3) enabling infrastructure transition pathways[2].

This indicates the need for increased momentum across the industry in adopting InfraTech, however infrastructure remains one of the least digitally transformed sectors of the economy[3] and almost half of the technologies required to achieve transition goals are still at the demonstration or prototype stage.[4] Concerted effort is needed to scale up financing and development of InfraTech, and these need to be addressed at an industry, system and culture level.

[1] World Bank, 2020. *InfraTech Value Drivers.* Available at: https://cdn.gihub.org/umbraco/media/3062/world-bank-group-s-reference-note-on-infratech-value-case.pdf

[2] InfraTech was the second highest infrastructure transition pathway, as observed in G20 governments' long-term infrastructure strategies and plans. Source: GI Hub, 2022. *Report on Infrastructure Transition Pathways* submitted to the IWG in June 2022.

[3] WEF, 2019. *Transforming Infrastructure: Frameworks for Bringing the Fourth Industrial Revolution to Infrastructure.* Available at: https://www3.weforum.org/docs/WEF_Technology_in_Infrastructure.pdf

[4] International Energy Agency (IEA), 2021, *Net Zero by 2050 A Roadmap for the Global Energy Sector (4th Revision).* Available at: https://www.iea.org/events/net-zero-by-2050-a-roadmap

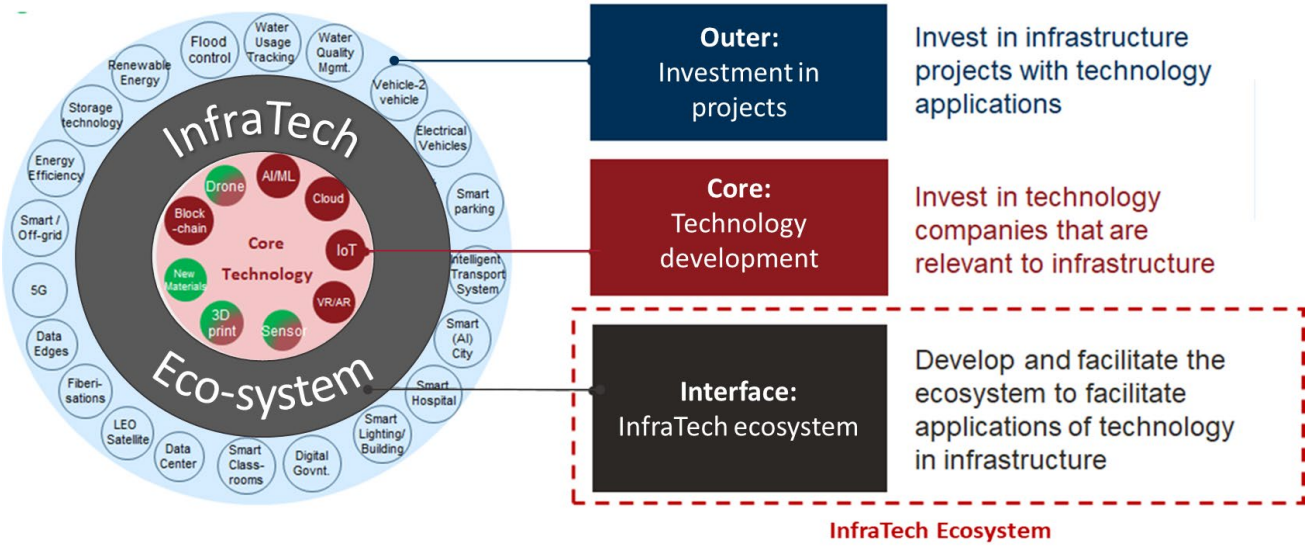

Figure 1: Three layers of the InfraTech landscape (Source: AIIB)

The role of the G20 through this Blueprint is one of enablement, providing key components to facilitate public and private sector collaboration through continuous, voluntary and non-binding action within the IWG work programs. In this context, the InfraTech landscape can be categorised into three layers,[5] as shown in Figure 1.

At the core of this landscape is **investment in InfraTech development**, which includes the activities of start-ups, small and medium enterprises (SMEs), and venture capital investors in developing the technological solutions for infrastructure. In the outer layer is the **investment in the infrastructure project,** which includes the procurement and implementation of technologies within infrastructure projects. This interface between the two is what we call the **InfraTech ecosystem.**

The activities within the technology development and the infrastructure investment layers are well established and underway; however, the InfraTech ecosystem – which involves the two-way collaboration and communication between technology developers and the financiers of infrastructure projects – is not well-established nor is it operating in an effective way. The InfraTech ecosystem is where the G20 could create impact in scaling up InfraTech investment. The G20 can act as a facilitator of the ecosystem by creating the bridge between the infrastructure investors and the technology developers, addressing key knowledge gaps in scaling up InfraTech investment and enhancing collaboration between the public and the private sector.

3 Methodology

The methodology undertaken to deliver the Stocktake aligns with the methodology for the Blueprint in that it uses four pillars to group the effective approaches to scaling up InfraTech investment. The four pillars are: **policy, commercial, technology, and finance.** The pillars, when considered in tandem, can drive success through a series of effective approaches that deliver value across the infrastructure lifecycle.

To ensure that the Blueprint was capturing a diverse range of approaches across different sectors and jurisdictions, all IWG members were invited, on a voluntary basis, to submit case studies of scalable InfraTech development and financing. To supplement this, the GI Hub also launched a global call for case studies in March 2022 to gather case studies from the broader industry.

[5] Based on analysis by the AIIB

38 case studies spanning a wide range of sectors, countries, approach types and long-term infrastructure priorities[6] (see Section 4) were gathered through the call for case studies. These case studies were then analysed to derive effective approaches to scaling up InfraTech. These effective approaches were used to inform the Blueprint opportunity areas and voluntary, non-binding actions as shown in Figure 2 below.

Figure 2: Methodology for developing the Blueprint opportunity areas and actions

4 Analysis

4.1 Benefits of InfraTech

The *GI Hub / AIIB Informal Paper: Challenges and Opportunities for Increasing InfraTech Investment* submitted to the IWG in January 2022 identified four specific ways in which InfraTech can help achieve long-term infrastructure priorities. These include:

1. To help bridge the infrastructure investment gap
2. To help enhance pandemic preparedness and response
3. To enable climate mitigation and adaptation
4. To enhance social inclusion[7]

These were further broken down into specific benefits as shown Figure 3. There is a good coverage of case studies across the long-term priorities listed above, with the largest emphasis on benefits like climate mitigation (66%) and improved infrastructure delivery and performance (63%).

[6] The *GI Hub / AIIB Informal Paper: Challenges and Opportunities for Increasing InfraTech Investment* submitted to the IWG in January 2022 mentioned that InfraTech has clear potential to help achieve long-term infrastructure priorities, including 1) bridging the infrastructure investment gap, 2) enhancing pandemic preparedness and response, and 3) enabling climate mitigation and adaptation. Following the comments received at IWG 1 and 2, a fourth priority was added: 4) enhancing social inclusion.

[7] The *GI Hub / AIIB Informal Paper: Challenges and Opportunities for Increasing InfraTech Investment* submitted to the IWG in January 2022 mentioned three ways that InfraTech can help achieve long-term infrastructure priorities (points 1 to 3). Following comments received at IWG 1 and 2, a fourth priority was added: 4) enhancing social inclusion.

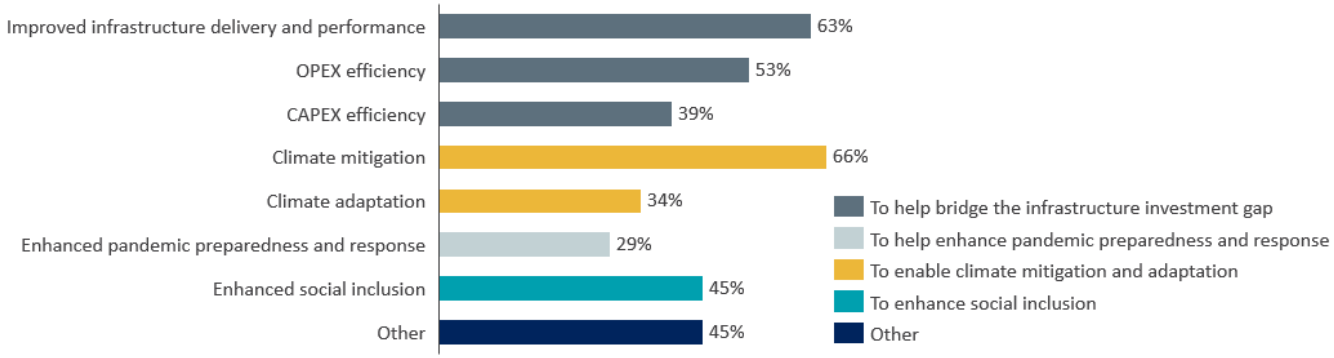

Figure 3: Benefits featured in the 38 case studies, as a percentage of the total number of case studies[8]

(Post-submission note: Some case studies included in the above breakdown are currently being updated and are not included in this version of the Stocktake, so they will not be found in Appendices A and B.)

4.2 Geographic and sector coverage

The case studies in this Stocktake covered a broad range of geographies, with InfraTech projects located in 27 countries, as shown in Figure 4 below. As would be expected from case studies looking to demonstrate scalability and replicability, all case studies had a national or international focus for the InfraTech solution, with just under half (45%) having an international focus.

There was also a broad coverage across infrastructure sectors as can be seen in Figure 5. The largest proportion of case studies (24%) are cross-sectoral (as indicated by the 'infrastructure (all)' category) with digital/enterprise solutions (16%) and roads sub-sectors (16%) also notably well-represented in the Stocktake.

Figure 4: Geographic coverage of InfraTech case studies

(Post-submission note: Some case studies included in the above map are currently being updated and are not included in this version of the Stocktake, so they will not be found in Appendices A and B.)

[8] One case study can be mapped to several benefits, therefore the percentages will not add up to 100%

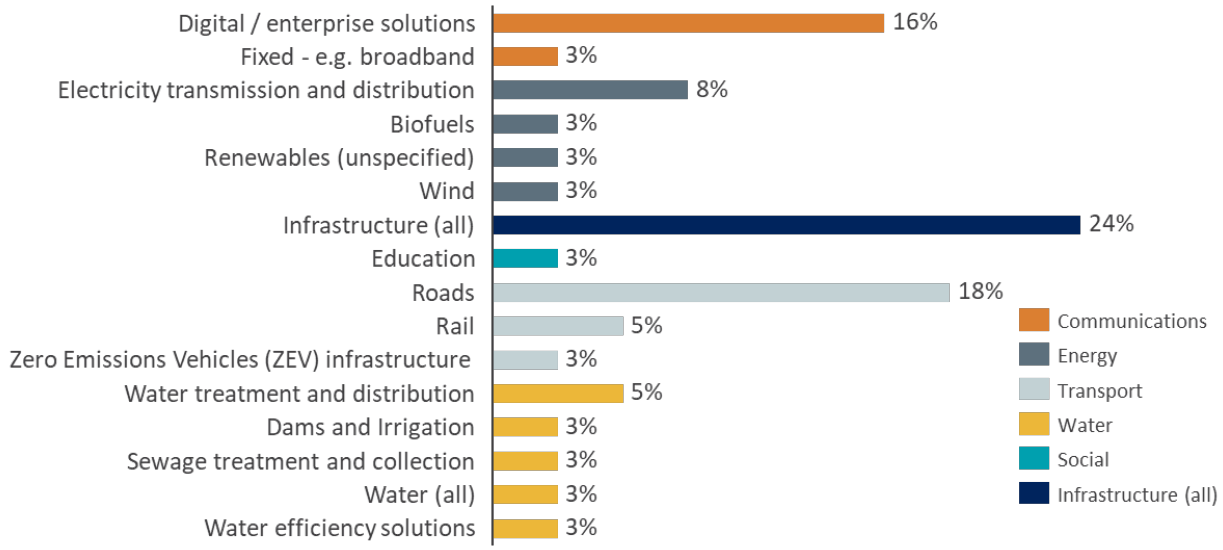

Figure 5: Sectoral coverage of the InfraTech case studies, as a percentage of the number of case studies

(Post-submission note: Some case studies included in the above breakdown are currently being updated and are not included in this version of the Stocktake, so they will not be found in Appendices A and B.)

4.3 Types of approaches

Each of the case studies were mapped to the four pillars of policy, commercial, technology and finance and analysed in terms of the challenges and approaches to scaling up InfraTech investment. Some of the challenges highlighted included:

- Limited access and availability of financing mechanisms that can enable the scaling up of Infratech
- Presence of systematic challenges such as restrictive procurement strategies and evaluation criteria
- Limited Infratech-related national strategies
- Limited capability and capacity to adopt InfraTech due to the lack of standards and frameworks to identify and communicate InfraTech value
- Limited effectiveness of the InfraTech ecosystem and the inability of the stakeholders to facilitate data and knowledge sharing and to foster collaboration between the public and private sector

The approaches taken by each of the projects in response to these challenges are shown in Figure 6 below. All 38 case studies were considered as having successful approaches to attracting InfraTech investment at scale, therefore all approaches derived in the analysis can be considered 'effective approaches' in scaling up InfraTech investment. 15 approaches[9] (across all four pillars) were derived from the 38 case studies.

[9] Not counting 'other' approaches

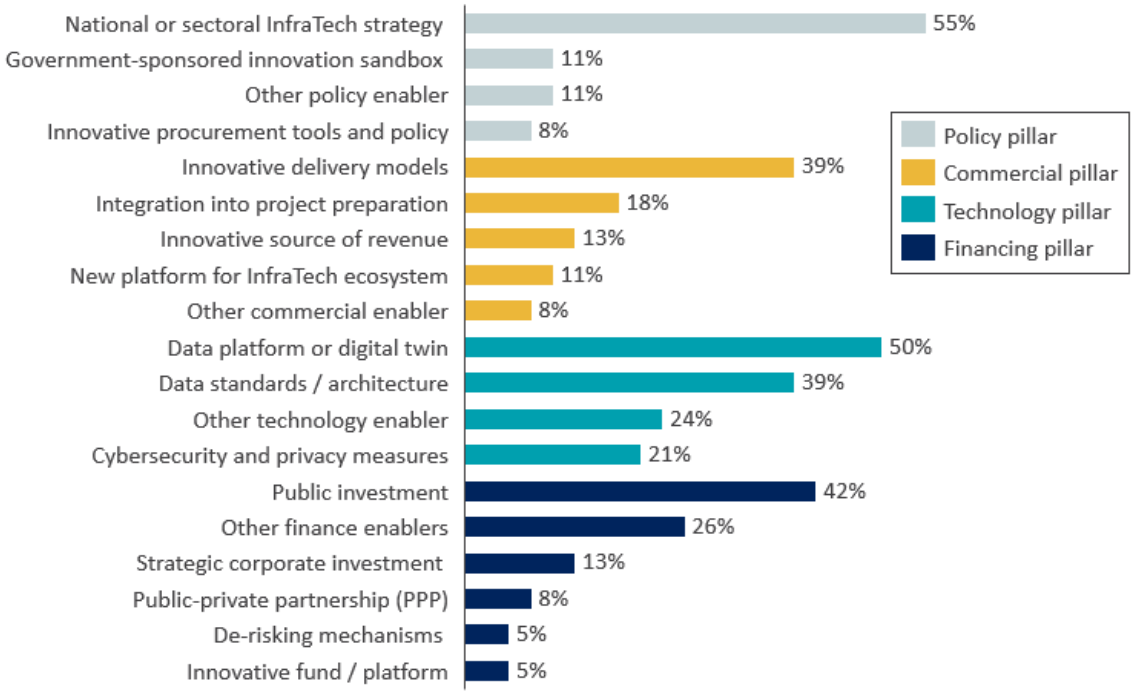

Figure 6: Effective approaches to scaling up InfraTech investment, as a percentage of the number of case studies[10]

(Post-submission note: Some case studies included in the above breakdown are currently being updated and are not included in this version of the Stocktake, so they will not be found in Appendices A and B.)

Eight of these effective approaches were highlighted as opportunity areas for the G20 moving forward. These were selected by taking the most common approach (i.e. the approach that featured most in the case studies) and the most emerging approach (i.e. the approach that featured least in the case studies) under each of the four pillars. The eight opportunity areas are listed in Table 1 below, together with a case study that shows the approach.

Table 1: Eight opportunity areas (and example case studies) to scaling up InfraTech investment

FOUR PILLARS	EIGHT OPPORTUNITY AREAS	
	BASED ON MOST COMMON APPROACHES	BASED ON MOST EMERGING APPROACHES
Policy pillar	**1. National or sectoral InfraTech strategy (55%)** **#8: Madrid 360 Environmental Strategy (Spain) –** The Madrid 360 Environmental Strategy provides an overarching strategy to drive the development and deployment of InfraTech to support Madrid's path to climate neutrality by 2050.	**2. Innovative procurement tools and policy (8%)** **#21: Analytics for renewable energy auctions (AreA) (Argentina) -** AreA is an online platform that can change the way renewable energy is procured in developing countries. It introduces a novel solution to design and conduct the entire Renewable Energy Procurement Program (REPP) online.

[10] One case study can be mapped to several approaches, therefore the percentages will not add up to 100%

FOUR PILLARS	EIGHT OPPORTUNITY AREAS	
	BASED ON MOST COMMON APPROACHES	BASED ON MOST EMERGING APPROACHES
Commercial pillar	**3. Innovative delivery models (39%)** **#14: CityTaps (Kenya) -** This is a prepaid smart water meter solution, integrated with existing mobile money systems, which is leased to water utility providers in developing countries. This enables a water 'pay-as-you-go' delivery model which improves cash flow that can be leveraged for future water network expansion.	**4. New platform for InfraTech ecosystem (11%)** **#38: AIIB Infratech Platform (International)** – AIIB is developing a holistic platform to scale up InfraTech investments in Asia. Activities are designed to drive Infratech investments tailored to sponsors, investors and financiers: from identifying technology to matchmaking stakeholders, and from capacity building to providing debt/equity financing for InfraTech projects.[11]
Technology pillar	**5. Data platform or digital twin (50%)** **#11: Allego EV Platform (EU) –** Allego is an electric vehicle (EV) infrastructure company with 400 million kilometres of network across Europe. Their automated digital platform ensures high availability of their charging infrastructure and allows for scalability of user onboarding, billing, and sourcing of green energy.	**6. Cybersecurity and privacy measures (21%)** **#20: e-Nabiz (Turkey):** e-Nabız system was developed by the Ministry of Health to create an integrated system for the electronic collection of citizens' health data produced by health institutions. Citizens can access all their health information digitally using e-Nabız.
Finance pillar	**7. Public investment (42%)** **#30-#33: Energy Strategy 2050 and Sustainability Strategy (UAE) –** The United Arab Emirates (UAE) Ministry of Energy and Infrastructure (MOEI) invested in several technology projects through their Energy Strategy 2050 and Sustainability Strategy. These include technologies for sustainable roadway designs and cool pavements.	**8. Innovative funds, platforms and de-risking mechanisms (5%)** **#26: Trial Reservoir (International) –** The Trial Reservoir accelerates technology adoption in the water sector through loans for trials, which minimises risk of piloting new water technology solutions. Isle Utilities operated the program and provides technical support. The loans are only repaid if the trial is a success.

[11] This case study is also relevant to the 'finance pillar'

5 Conclusions and next steps

The trends in this Stocktake demonstrate increasing levels of activity and momentum across the industry in adopting InfraTech. There was significant interest expressed by IWG members and the broader industry during the call for case studies, and 36 submissions (spanning 16 sectors, 27 countries, and a range of long-term infrastructure priorities[12]) were gathered and included in the Stocktake. 15 effective approaches were derived through the analysis, and these ultimately informed the eight opportunity areas and 13 voluntary and non-binding actions that are in the Blueprint.

The results from this Stocktake demonstrate that there is plenty of knowledge and experience that can be leveraged to help build capacity for scaling up InfraTech investment. As mentioned by the Blueprint, this is something that can be achieved through a global InfraTech ecosystem, which is where the G20 could create impact in scaling up InfraTech investment. The G20 can act as a facilitator of the ecosystem by creating the bridge between the infrastructure investors and the technology developers, addressing key knowledge gaps in scaling up InfraTech investment and enhancing collaboration between the public and the private sector.

The GI Hub and the AIIB will continue their collaboration to disseminate the outcomes from the Stocktake in the coming months, including through knowledge sharing webinars and workshops.

Due to the significant interest received through the call for case studies this Stocktake will become a 'living resource' on the GI Hub website. We are open to receiving case study submissions from IWG members (and the broader industry) on an ongoing basis. Please send all case study submissions to infratech@gihub.org.

[12] The *GI Hub / AIIB Informal Paper: Challenges and Opportunities for Increasing InfraTech Investment* submitted to the IWG in January 2022 mentioned that InfraTech has clear potential to help achieve long-term infrastructure priorities, including 1) bridging the infrastructure investment gap, 2) enhancing pandemic preparedness and response, and 3) enabling climate mitigation and adaptation. Following the comments received at IWG 1 and 2, a fourth priority was added: 4) enhancing social inclusion.

APPENDIX A: Summary of case studies

Table 2 Summary of case studies, including sectors, pillars, and approach types

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
1	**VIRNECT, South Korea**	Digital / enterprise solutions	*Technology to support digital transformation within industrial sites*			Novel core technology	Strategic investment by a corporate partner
2	**Low greenhouse gas emission wastewater treatment, Hong Kong SAR, China**	Sewage treatment and collection	*Deploying InfraTech to reduce greenhouse gas emissions from wastewater treatment*	Development of a national, regional, or sectoral InfraTech strategy	A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner
3	**Infraclear, USA**	Infrastructure (all)	*A FinTech start up using national language processing to unlock insights from infrastructure data*		Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture Innovative use of machine learning to analyse infrastructure data	Strategic investment by a corporate partner
4	**Oris, France and UK**	Roads	*A digital materials platform for sustainable roads supported by artificial intelligence*	Development of a national, regional, or sectoral InfraTech strategy	A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance Implementation of cybersecurity or	Strategic investment by a corporate partner

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
						improved privacy measures	
5	**Decentralised Microgrids and Peer-to-Peer Energy Transactions, Thailand**	Electricity transmission and distribution	*Deploying InfraTech to enable peer-to-peer trading of rooftop solar energy in Bangkok.*	Development of a national, regional, or sectoral InfraTech strategy	A new/ innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner
6	**EONEMP: Remote monitoring for algae risk in water bodies, South Africa**	Dams and Irrigation	*Deploying a cost-effective InfraTech solution to dramatically increase South Africa's ability to both monitor and assess changes in water quality on a national scale.*	Availability of a government-sponsored innovation sandbox	Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	Public investment
7	**Etherna B-Supply, Italy** *Submitted by Italy MoF*	Digital / enterprise solutions	*Deployment of blockchain technologies by Infratel Italia*	Automatization, certification, and notarization of process through Blockchain	Innovative delivery models	Implementation of Blockchain technologies	Public investment
8	**Madrid 360 Environmental Strategy, Spain**	Infrastructure (all)	*An ambitious strategy to reduce the Madrid's pollutant emissions with the aim of complying with the EU limit values, making progress towards sustainability and neutrality in the city.*	Development of a national, regional, or sectoral InfraTech strategy Availability of a government-sponsored innovation sandbox		Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	Public investment
9	**Electricity Distribution Network Modernisation and Expansion Project, Turkey**	Electricity transmission and distribution	*Adopting technology to support the upgrade, modernisation, and expansion of the electricity distribution network of the*		Tariff incentives associated with performance, efficiency, and quality of service	Improved overall technology maturity (e.g., maturing IoT and 5G applications)	Local currency lending to ensure long-term financing in local currency is available to support capex development.

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
			Osmangazi region, in western Turkey.			Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	
10	**High-efficiency water-saving irrigation, China** *Submitted by China MoF*	Water efficiency solutions	*A project that is using a high-efficiency water-saving information system to effectively improve the efficiency of water resource utilisation*		Innovative delivery models A new / innovative source of revenue Integration into project preparation process New platform for InfraTech ecosystem		Public-private partnership (PPP)
11	**Allego EVCloud Platform**	Zero Emissions Vehicles (ZEV) infrastructure	*An EV charging operator enabling EV mobility across all European countries.*	Development of a national, regional, or sectoral InfraTech strategy	Innovative delivery models A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner
12	**CityTap and Mathira Water and Sanitation Company (MAWASCO), Kenya**	Water treatment and distribution	*A pilot project deploying InfraTech to bring clean water to rural Kenya*	A change in regulation	Innovative delivery models New platform for InfraTech ecosystem	A change in data standards / architecture	Innovative financing instrument
13	**Smart AI-based waste management in stations, Hong Kong SAR, China**	Rail	*An AI-based solution for better waste management, deploying during the Covid-19 pandemic*	Development of a national, regional, or sectoral InfraTech strategy	Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance	

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
14	**Automated pre-fabrication of stainless-steel pipelines, Argentina**	Water treatment and distribution	*A new approach to welding pipelines that boosts productivity and the quality of industry practices*	Development of a national, regional, or sectoral InfraTech strategy	Innovative delivery models	A change in data standards / architecture	Loan
15	**Smart city as a service - Sejong city, South Korea**	Digital / enterprise solutions	*A flagship pilot for Smart Cities in South Korea*	Development of a national, regional, or sectoral InfraTech strategy Regulatory sandbox	Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance	Public-private partnership (PPP)
16	**EMIPAV, Spain**	Roads	*EMIPAV is tool to understand the relationship between the conditions of roads, fuel consumption, and vehicle emissions.*	Development of a national, regional, or sectoral InfraTech strategy	New platform for InfraTech ecosystem	A change in data standards / architecture	Public investment
17	**ÖZEDES and RUHSAD mental health support system, Turkey** *Submitted by Turkey Ministry of Health*	Digital / enterprise solutions	*A digital health project in Turkey to connect people with mental health services throughout the Covid-19 pandemic.*	Development of a national, regional, or sectoral InfraTech strategy		Change in the supply of healthcare services	Public investment
18	**e-Nabiz, Turkey** *Submitted by Turkey Ministry of Health*	Digital / enterprise solutions	*A project in Turkey to create an integrated system for the electronic collection of citizens' health data produced by health institution so that it is accessible to citizens and authorised health professionals.*	Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance. A change in data standards / architecture. Implementation of cybersecurity or improved privacy measures	Public investment

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
19	**AreA Platform (Analytics for Renewable Energy Auctions), Argentina**	Renewables (unspecified)	*A start up addressing traditional challenges in infrastructure procurement through the novel deployment natural language processing, neural networks, agent-based models, and the blockchain.*	A change in procurement policy	Integration into project preparation process	Implementation of a data platform or digital twin for greater transparency over performance	Public investment De-risking mechanisms or blended finance
20	**Biomass CHP Project, China** *Submitted by China MoF*	Biofuels	*An investment in a Biomass Power Generation to promote green and low-carbon development*	Development of a national, regional, or sectoral InfraTech strategy	Integration into project preparation process	A change in data standards / architecture	Public investment
21	**Future Grid, Australia**	Electricity transmission and distribution	*A technology company adapting electricity distribution networks for cleaner, greener, energy across Australia and New Zealand*	Market driven business need to adapt to changing customer needs	Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance	Public investment
22	**5G + Smart Industrial Park Security Application, Zhengzhou, China** *Submitted by China MoF*	Digital / enterprise solutions	*Using 5G and a private mobile edge computing (MEC) network to improve the reliability and security of end-to-end data transmission*	A change in procurement policy	Innovative delivery models Integration into project preparation process	Implementation of cybersecurity or improved privacy measures	Public investment
23	**Colouring Cities Research Programme, United Kingdom, and Multiple Locations**	Infrastructure (all)	*The Colouring Cities Research Programme (CCRP) has been set up, at the Alan Turing Institute (UK), to facilitate knowledge exchange and open data sharing about buildings across countries.*	Development of a national, regional, or sectoral InfraTech strategy Availability of a government-sponsored innovation sandbox		Implementation of a data platform or digital twin for greater transparency over performance Reuse of existing technology to produce low-cost open data, visual platforms	De-risking mechanisms or blended finance

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
						integrating crowdsourcing, building performance tracking and emergency support tools.	
24	**The Trial reservoir, Global**	Water (all)	*Accelerating the water industry's technology adoption to achieve net zero through a novel approach to funding technology trials.*		Innovative delivery models Integration into project preparation process	Working with end-user and vendor we design a robust, credible trial.	A new fund / investment platform Innovative financing instrument
25	**Guangxi Chongzuo Border Connectivity Improvement Project, China**	Roads	*A comprehensive infrastructure project deploying InfraTech and engineering management experience to improve the project management-control capability.*		Innovative delivery models	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture Implementation of cybersecurity or improved privacy measures	Partnership with AIIB
26	**Beijing Energy's Wind Power Project in Kangbao County, China** *Submitted by China MoF*	Wind	*A power plant that helped the 2022 Beijing Winter Olympics and Winter Paralympics achieve 100% green operation across all venues for the first time in the history of the Olympic games*	Availability of a government-sponsored innovation sandbox	Innovative delivery models	A change in data standards / architecture	Special loan
27	**EBRD Sustainable Infrastructure Group, Strategy for Digitalisation of Infrastructure**	Infrastructure (all)	*A project to optimise digitalisation in all future EBRD infrastructure investments.*	A change in procurement policy	Integration into project preparation process	Implementation of cybersecurity or improved privacy measures	

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
	Investments, All EBRD regions and countries of operation			Development of a national, regional, or sectoral InfraTech strategy		Utilisation of the new EBRD SIG sector specific digitalisation Roadmaps and Compendia	
28	**Digitalisation Impact Tool, United Arab Emirates** *Submitted by UAE MoF*	Infrastructure (all)	*A tool development by the UAE Government to measure the positive impact of digitalisation on a project or organisation.*	Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment
29	**Driver Behaviour Toward Road Signboards, Signals, Intersections, and Exits, United Arab Emirates** *Submitted by UAE MoF*	Roads	*A government-backed research project in the United Arab Emirates to understand driver behaviour to design better roads, and tackle C02 emissions.*	Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment
30	**The Sustainability Tools, United Arab Emirates** *Submitted by UAE MoF*	Infrastructure (all)	*Tools developed by the Ministry of Energy and Infrastructure in the United Arab Emirates to track air quality, energy performance, carbon emissions, water consumption and waster diverted from the landfill on its projects.*	Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment
31	**Cool Pavement, United Arab Emirates** *Submitted by UAE MoF*	Education	*A pilot to understand the performance evaluation of coated pavement surfaces to address the heat islands effects in the United Arab Emirates.*	Development of a national, regional, or sectoral InfraTech strategy			Public investment
32	**Pavimenta2, Latin America and the Caribbean**	Roads	*A novel platform for identifying, measuring, and quantifying pavement failures in addition to validating*		Adoption of an innovative digital tool	Novel technical solution	Technical cooperation funds and loans to governments in Latin America and the

ID	CASE STUDY NAME AND LOCATION	SECTOR / SUB-SECTOR	OVERVIEW	PILLARS AND APPROACH TYPES			
				POLICY	COMMERCIAL	TECHNOLOGY	FINANCE
			transportation signage using Artificial Intelligence (AI) and Deep Learning.				Caribbean to deploy technological infrastructure
33	**NEXCO, Japan** *Submitted by Japan MoF*	Roads	*InfraTech solutions for non-destructive inspection of structures, and surveying road conditions.*	Support the infrastructure owner's data-driven decision-making		A change in data standards / architecture	
34	**Global BIM Network, International**	Infrastructure (all)	*A global network connecting public sector representatives and the investment community to collaborate and share knowledge.*	Development of a national, regional, or sectoral InfraTech strategy			
35	**InfraTech Policy Ecosystem, UK**	Infrastructure (all)	*A policy ecosystem, aligned to national strategies, driving the digital transformation of the UK's construction and infrastructure sector.*	Development of a national, regional, or sectoral InfraTech strategy A change in procurement policy	Integration into project preparation process New platform for InfraTech ecosystem	A change in technical standards A change in data standards / architecture Implementation of cyber-security or improved privacy measures	Public investment
36	**AIIB InfraTech Platform**	Infrastructure (all)	*A 'one-stop shop' for investment leads, clients and partners to apply and develop InfraTech.*		A new / innovative source of revenue Integration into project preparation process New platform for InfraTech ecosystem		The platform also supports financiers of InfraTech-enabled infrastructure projects

APPENDIX B: G20 InfraTech Agenda's Elements and the eight approaches

G20 INFRATECH AGENDA – SIX ELEMENTS	SUB-ELEMENTS	NATIONAL OR SECTORAL INFRATECH STRATEGY	DATA PLATFORM OR DIGITAL TWIN	PUBLIC INVESTMENT	INNOVATIVE DELIVERY MODELS	INNOVATIVE PROCUREMENT TOOLS AND	CYBERSECURITY AND PRIVACY MEASURES	INNOVATIVE FUNDS, PLATFORMS, AND DE-	NEW PLATFORM FOR INFRATECH ECOSYSTEM
1. Leverage InfraTech to enhance economic efficiencies and mobilize private sector investment to promote growth and sustainability	• Reduce financial outlays by capturing economic efficiencies across the asset life-cycle stages. • Update procurement processes to realize economic efficiencies. • Prioritize interventions that enhance the mobilization of private capital and promote innovative financial solutions		X			X		X	
2. Promote technologies that foster inclusivity, sustainability, resilience, and good governance	• Support solutions that help achieve inclusivity by increasing accessibility • Scale-up new and existing sustainable solutions. • Adopt new and existing technologies that improve resilience, adaptability, and response times in cases of natural disasters and pandemics. • Adopt InfraTech solutions that enhance governance by reducing corruption, ensuring high standards, strengthening project preparation, and enhancing transparency.	X	X	X					X
3. Accelerate innovation and economic dynamism in InfraTech related industries to support economic recovery and growth	• Foster an innovation ecosystem for existing and early-stage technologies • Foster domestic InfraTech industries that create jobs, new sources of growth, and dynamism in the economy	X	X	X	**X**	X	X	X	X

4. Foster a robust data ecosystem to improve resilience and better inform infrastructure planning, operation, maintenance, and investment decisions	• Put in place a robust asset performance data ecosystem suited to national objectives • Improved data governance and transparency can also mobilize additional private capital in infrastructure projects. • Capture data across infrastructure sectors to support effective public health and economic response to pandemics and other disasters • Promote interoperability across technology providers, projects, and sectors to better harness data for improved investment decision-making		X			X		X
5. Develop agile and flexible policy tools that promote potential growth, productivity and innovation while mitigating risks	• Ensure forward technological compatibility of infrastructure assets • Adopt forward-looking risk-management frameworks encompassing environmental, social, and technological risks • Improve skills and capabilities foundational to adopting InfraTech					X		X
6. Promote national and international cooperation in R&D and knowledge sharing	• Enhance cooperation in R&D among global public, private, and academic stakeholders to promote innovation in key technologies • Share global best practices, lessons, data, and use cases, particularly in responding to the COVID-19 health and economic crisis • Implement national policies aimed at spurring InfraTech research and development (R&D) to support scaling up of key technologies across the asset life cycle	X	X		X			X	

Case study 1: VIRNECT, South Korea

How an InfraTech solution to support digital transformation within industrial sites attracted investment

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
		Novel core technology	Strategic investment by a corporate partner

Project summary

PROJECT NAME AND LOCATION:	VIRNECT, SOUTH KOREA
Sector:	Other, Commercial and industrial infrastructure
Key benefits:	Enhanced pandemic preparedness and response OPEX efficiency
Additional benefits	Operating cost management Industrial safety Operational efficiency
Organisation, role on project:	STIC Ventures, which is a 100% subsidiary of STIC Investments, General Partner of the fund that invested in VIRNECT
Scale of deployment:	-
Project value:	Enterprise Value: KRW 75.9 billion / Investment Amount: KRW 3 billion
Project start/end dates:	Investment date: December 12, 2021
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment Project preparation (incl. concept, feasibility, appraisal) Construction Operation and maintenance

About the project

The purpose of this investment is to facilitate Digital Transformation within various industrial sites. VIRNECT utilizes Augmented Reality (AR) to allow remote collaboration among multiple industrial sites in different locations. Moreover, their 3D Point Cloud technology enabled development of firmwide monitoring solutions for industrial sites of global enterprises.

It is always very difficult for all industrial sites to have experienced specialists on field. Moreover, it is even more difficult for global companies to have a control tower in every industrial site. Through its AR technology, VIRNECT enables these companies to efficiently manage their industrial sites. VIRNECT aims to distribute its solutions globally so that the

companies and nations can benefit from Digital Transformation of their industrial sites. Its solutions will directly impact various industry infrastructure, which will ultimately improve industrial efficiency and employee safety.

VIRNECT's AR solutions do not require much power or extensive computing resources. They can be operated under harsh environment where there is limited connectivity and hardware. VIRNECT successfully developed its own AR SDK system, which implies that its solutions can be customised to each industrial site.

As described above, VIRNECT has innovative technology that can be fully utilised under limited environment. Many Korean conglomerates that have global operations are quickly adapting VIRNECT's technology to enhance their operational efficiency. VIRNECT will continues its efforts to distribute its solutions in Asia to facilitate Digital Transformation of industrial sites within the region. VIRNECT's solutions can fully benefit the company's clients under pandemic situations. Its solution enables remote collaboration, which is the key technology that's required to prevent the spread of the virus. For example, the company's main client, LG, used VIRNECT's AR solution to remotely manage overseas facilities when technicians could not visit global sites due to pandemic travel restrictions.

Moreover, the company's Smart Factory 3D Control Tower solution can enable remote monitoring of industrial sites, which is an attractive solution to companies that have industrial sites far away from their headquarters.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

The reason STIC invested in VIRNECT is the company's superiority in its core technology. VIRNECT has its own AR SDK technology that allows it to provide customised solutions to its clients. VIRNECT's solutions are fully operatable under limited connectivity.

What was the technological solution deployed for this project?

VIRNECT's solutions are used for Digital Transformation initiatives at various industrial sites. AR Glass enables remote collaboration among headquarters and other sites. VIRNECT Twin enables remote monitoring of industrial sites to prevent industrial hazards from happening.

VIRNECT's solutions are fully operatable under low connectivity and low power environments. The software developed by VIRNECT can identify and accumulate specific data in such environments, which makes it very competitive among its peers that often need certain level of power and stable connectivity.

Case study 2: Low greenhouse gas emission wastewater treatment, Hong Kong SAR, China

A project in Hong Kong SAR, China that deployed InfraTech to reduce greenhouse gas emissions from wastewater treatment.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner

Project summary

PROJECT NAME AND LOCATION:	LOW GREENHOUSE GAS EMISSION WASTEWATER TREATMENT, HONG KONG SAR, CHINA
Sector:	Water, Sewage treatment and collection
Key benefits:	Climate mitigation Improved infrastructure delivery and performance OPEX efficiency
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	The plant can treat up to 1230 m3 per day of landfill leachate with an ammonia concentration of 4500 mg / litre
Project value:	2019 - HK$ 38 million (US$ 4.8 million)
Project start/end dates:	Construction complete March 2019
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Design

About the project

As climate change is critical, the overall objective of this project is to reduce greenhouse gas emissions from wastewater treatment making the process more sustainable. The project seeks to do this through better monitoring technologies to quantify emissions which can help to inform treatment alterations and optimise existing systems to mitigate emissions. It is designed to remove thermal ammonia removal facility to treat leachate from the West New Territories landfill (WENT), the largest landfill in Hong Kong SAR, China operated by SITA Waste Services.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Cobalt Water N2O modelling in the Netherlands, Cranfield University nitrogen and carbon removal in the UK.

Approaches replicated:

- Development of a national, regional, or sectoral InfraTech strategy
- Implementation of a data platform or digital twin for greater transparency over performance

What were the challenges experienced in implementing these approaches?

New technologies may not be suited for current wastewater infrastructure as it might not realise full return on substantial investment. Changing and optimising wastewater treatment plants have the risk of affecting the quality of water or sludge being discharged and disposed of into the environment which can be harmful to local water ecosystems and affect wildlife and increase health risks downstream.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

The low greenhouse gas emissions waste treatment plant is used to remove thermal ammonia to treat leachate. The facility is designed to treat up to 1230 m3 per day of landfill leachate with an ammonia concentration of 4500 mg / litre. The stripped ammonia is oxidised thermally to nitrogen gas. The solution was patented by The Organics group.

By deploying Sensors/IoT, Data & Analytics, and Treatment Technologies to generate secondary revenue streams for the business, the technology design has helped to overcome issues in climate mitigation. Organics' innovative air-stripping process includes various novel characteristics that reduce operational expenses, such as processing at elevated temperatures, which eliminates the need for alkali and reduces operator input.

Case study 3: Infraclear, USA

A venture capital-backed fintech start up using national language processing to unlock insights from infrastructure data

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture Innovative use of machine learning to analyse infrastructure data	Venture capital coming into support infrastructure

Project summary

PROJECT NAME AND LOCATION:	INFRACLEAR, USA
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Additional benefits:	Can lower Solvency 2 capital charges by 60%
Organisation, role on project:	Infraclear, Technology company and developer of the product
Scale of deployment:	Can serve 100+ banks and institutional investors at launch, total addressable market includes 9,000 developers, lenders, government agencies, institutional investors, construction companies' insurers, law firms and other advisors, around the world
Project value:	-
Project start/end dates:	-
Current status of the project:	Pre-launch

Lifecycle stage where technology is applied:	Planning and strategy; Project preparation (incl. concept, feasibility, appraisal); Financing; Procurement; Construction; Operation and maintenance; Disposal / decommissioning; Securitization/ refinancing

About the project

Infraclear is a fintech company that was started by people with experience in project finance and machine learning. It is backed by venture capitalists focused on finding transformational solutions to decarbonisation. Infraclear has gathered one of the world's biggest databases of infrastructure project agreements. It uses machine learning to extract data from these documents. Using this data, it is building benchmarking tools that can reduce the time it takes to develop a project by 50%, increase the supply of bankable projects by 2.5x, reduce negotiation, and help make infrastructure a transparent, standardised asset class.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

The biggest problem is that data is not readily available, and disclosure is uneven. Investors seeking to invest want to be able to analyse how prior projects were structured and citizens and NGOs need to be able to monitor projects. Infraclear believe that the first step to creating an Infratech-driven economy is to be able to make infrastructure project agreements including performance data, ESG data and climate data available, and free to use.

Governments could play a vital role in creating the foundation for an Infratech economy by making infrastructure project agreements, along with associated amendments, annexes, and waivers available on public websites; publishing data in human and machine-readable formats (XML or XBRL); creating a consistent standard for what data is published; and publishing data at a regular frequency. Infraclear strongly recommend that all governments adopt the Creative Commons CC-BY license Creative Commons license (CC-BY version).

Are there other approaches that enabled investment that are not already covered above?

Infraclear is working with an established financial data provider to allow Infraclear to reach thousands of clients and creating new products together.

InfraTech solution What was the technological solution deployed for this project?

Infraclear gathered thousands of prior infrastructure project agreements. It has gathered the largest known collection of prior infrastructure project agreements. It developed machine learning and natural language processing algorithms to extract granular data on terms. It is marrying this with climate, ESG, and performance data.

Case study 4: ORIS, France and UK

A digital materials platform for sustainable roads supported by artificial intelligence

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance Implementation of cybersecurity or improved privacy measures	Strategic investment by a corporate partner

Project summary

PROJECT NAME AND LOCATION:	**ORIS – SOURCING INTELLIGENCE FOR ROAD OPTIMISATION, FRANCE AND UK**
Sector:	Transport, Roads
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	ORIS, Technology company, consulting services, and digital platform
Scale of deployment:	Worldwide coverage in a consulting approach
Project value:	-
Project start/end dates:	The project started in 2015, incubated in a research centre, and ORIS, as an independent entity launched in September 2021.
Current status of the project:	Planning stage, In construction, Operational
Lifecycle stage where technology is applied:	Planning and strategy, Project preparation (incl. concept, feasibility, appraisal), Financing, Design.

About the project

ORIS is an InfraTech solution, developed by materials expert LafargeHolcim in partnership with IBM, for ensuring resilient, sustainable, and cost-efficient roads.

Supported by the latest artificial intelligence, ORIS analyses road designs, at the early stage of a project, in a holistic view to improve sustainability in road construction. With the use of ORIS, sustainability in road networks is improved with costs reduced by 15 to 30%, carbon footprint mitigated by up to 50%, natural resource consumption reduced by up to 80% and durability multiplied by three.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

The funding of ORIS has been incremental, starting with a proof of concept in 2018, to a product market fit in 2020. It was finally agreed internally at Holcim in 2021 to bring the product to market, seed funding was obtained alongside the creation of the company and first 'go to market' strategies. ORIS is targeting self-financing the company in 3 years.

Are there other approaches that enabled investment that are not already covered above?

The emergence of a digital platform on a multi stakeholders, multi dimensions in a still evolutive regulatory landscape requires all those changes and adaptations at the same time.

Multiple functionalities are built-in ORIS for each stakeholder along the value chain. Multidimensional measurement of infrastructure projects is key to support decision-making for owners and financiers, while those dimensions have 'individual' value for the 'chain' itself (logistic, carbon, cost, pavement, cost estimates...), available under a platform approach.

InfraTech solution

What was the technological solution deployed for this project?

ORIS integrates all information of a road project on one single platform, with local pavement designs, construction materials & methods, weather data, etc. Through this digital platform, ORIS helps to provide a holistic analysis for the best road design, connecting road design with the digital transformation to enable an efficient, more sustainable and just transformation of road.

Case study 5: Decentralised Microgrids and peer-to-peer energy transactions, Thailand

Deploying InfraTech to enable peer-to-peer trading of rooftop solar energy in Bangkok.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner

Project summary

PROJECT NAME AND LOCATION:	**DECENTRALISED MICROGRIDS AND PEER-TO-PEER ENERGY TRANSACTIONS, THAILAND**
Sector:	Energy, Electricity transmission and distribution
Key benefits:	Improved infrastructure delivery and performance OPEX efficiency
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	15MWh average peer-to-peer energy transacted per month
Project value:	$2,270 AUD potential monthly proceeds from peer-to-peer
Project start/end dates:	End date – Oct 2018
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Planning and strategy

About the project

Powerledger's software is utilised by Thai renewable energy business BCPG and Thai utility Metropolitan Electricity Authority (MEA) to trade rooftop solar energy between several buildings across two precincts in Bangkok, Thailand. Powerledger has enabled peer-to-peer (P2P) trading in the T77 precinct of Bangkok, Thailand, since 2018.

The project is supporting community collaboration between individuals to function as producer-consumers or just as consumers. The project's overall objective was to reduce utility cost and create greater reliability of electricity networks. The project deploys advanced technology to enable community collaboration and peer-to peer energy transactions at

individual level. Peer-to-peer transaction within microgrids decrease the cost of energy for businesses as prosumers are able to sell electricity at cheaper rate than that of the traditional market. This is made possible by the reduction in electricity transportation costs, as the energy is generated within a set geographical location in which sellers and buyers are in proximity to each other.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Following the success of the initial project stages, BCPG has now expanded the T77 project to include additional buildings and solar assets. The total solar generation capacity of the T77 project has increased from 2.8MWh daily solar generation across four buildings to 4.2MWh across seven buildings.

Power Ledger signed an exclusive partnership agreement with Thai Digital Energy Development (TDED), one of BCPG's subsidiaries, in May 2020 to create a blockchain-based digital energy business developing P2P energy trading and environmental commodity trading solutions across Thailand.

What were the challenges experienced in implementing these approaches?

Pricing challenges were experienced as there are multiple stakeholders who request prosumer energy with competitive objectives.

Are there other approaches that enabled investment that are not already covered above?

No

InfraTech solution

What was the technological solution deployed for this project?

The solution was developed by Power Ledger which is a software technology company which works towards making renewable energy more stable in in responsive markets. The solution was developed to incentivise individuals and industry to include sustainable renewable energy production and distribution systems. The solution is a novel deployment of an existing solution which evolved from integrated electrical grid system distributing energy.

The platform enables BCPG to monitor energy generation and transactions between the participating buildings. It also provides the ability to generate invoicing for settlement and a summary of the trading position for individual participants.

Case study 6: EONEMP: Remote monitoring for algae risk in water bodies, South Africa

Deploying a cost-effective InfraTech solution to dramatically increase South Africa's ability to both monitor and assess changes in water quality on a national scale.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Availability of a government-sponsored innovation sandbox	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	Public investment

Project summary

PROJECT NAME AND LOCATION:	**EONEMP, SOUTH AFRICAN WATER RESEARCH COMMISSION – SOUTH AFRICA**
Sector:	Water, Dams and irrigation
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion OPEX efficiency
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	Total 475 Dams/rivers to be shortlisted (330,000 square miles)
Project value:	USD 78 million (approx.)
Project start/end dates:	Phase one 2015 -2018
Current status of the project:	Pilot project completed – phase two: expanding and replicating in progress
Lifecycle stage where technology is applied:	Enabling environment, planning and strategy, Operation and maintenance

About the project

Monitoring the risk of algal blooms is labour intensive and can involve sending crews to remote and hard to access water bodies to collect physical samples. For health and environmental authorities, it is not feasible to manually monitor potentially hundreds of water bodies. Remote monitoring involves using one or a combination of remote sensors, unmanned aerial vehicles (UAVs), and satellite technology to monitor water bodies for precursors to algal blooms. Increased monitoring, bloom identification, and predictive risk modelling will assist in improving management and mitigation activities by focusing resources in high-risk areas and providing timely alerts.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

The cost of remote monitoring will depend on the resolution required. Satellite technologies are cost effective for large areas. For higher resolution data, in-field sensors or piloted UAVs and drones are needed. With rapid development, the cost of drones has decreased over the past few years. The main cost of drone surveillance programs will be in training operators and pilots as well as optimised strategies and methods for data collection.

Are there other approaches that enabled investment that are not already covered above?

Funding and Financing - Collaboration is needed between government agencies such as water utilities, public health, and environmental protection to ensure data generated can be utilised by all stakeholders and enable funding from all agencies to share financing risks and rewards. This project was funded by the South African Water Research Commission, collaborating with the Department of Water and Sanitation, the Council for Scientific and Industrial Research and the South African National Space Agency.

InfraTech solution

What was the technological solution deployed for this project?

EONEMP integrated remotely sensed estimates of cyanobacteria blooms and eutrophication (chlorophyll-a) into the national water management database of the Department of Water and Sanitation, using the information to assess historical changes in water quality, and for near real time monitoring purposes.

The scope was:

- To develop an operational system based on the Ocean and Land Colour Instrument (OLCI) satellite instrument for near real time monitoring of these water bodies
- To integrate this information into the Department of Water and Sanitation's Water Management System making the information available to the public
- To validate, calibrate and improve the maximum peak heigh algorithm.

Case study 7: Etherna B-Supply, Italy

The deployment of blockchain technologies by Infratel Italia to improve efficiencies by automating manual activities.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Automatization, certification, and notarization of process through Blockchain	Adoption of an innovative partnership / risk sharing model	Implementation of Blockchain technologies	Public investment

Project summary

PROJECT NAME AND LOCATION:	**ETHERNA B-SUPPLY – CERTIFICATION REQUIRED PERMITS ON 'WHITE AREAS' PLAN**
Sector:	Communications, Digital / enterprise solutions
Key benefits:	Improved infrastructure delivery and performance
Organisation, role on project:	Infatel Italia, Customer
Scale of deployment:	400 processes
Project value:	€24,000
Project start/end dates:	April 2022 – August 2022
Current status of the project:	Planning stage
Lifecycle stage where technology is applied:	Enabling environment Project preparation (incl. concept, feasibility, appraisal) Construction Operation and maintenance

About the project

Infratel Italia are deploying InfraTech to automate and consequently make the communication flow of data and documents related to the requested flow of permits from Open Fiber (GISFO) to Infratel (Geo4WIP) more efficient. These permits are currently reported by the two systems through manual activities. The project will introduce the application of Blockchain technology within this flow to confer at the same, through the process certification and notarization mechanisms document, greater transparency, and reliability of the data in all information passages and document them.

The project will bring immediate added value to the current workflow and will assume at the same time an experimentation value in the evaluation of an extension of the Blockchain technology also to other sub-processes.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

Net Service devised Etherna as a distributed platform for providing services based on Blockchain technology (including B-Cert, B-Voting, B-Supply and B-Signature) via high-level API and which allows to overcome any criticality typical of Blockchain. Etherna is a 'blockchain-as-a-service' platform that makes the use of Blockchain technology simple and transparent for any application and process integration.

This is a new solution for Infratel. The introduction of Blockchain technology in this context will make it possible to guarantee:

- Low architectural impact thanks to a high level of interoperability;
- Modularity and extensibility of the solution and its applicability also in future contexts through the high level of reusability components made available;
- High reliability and high level of scalability guaranteed by design features intrinsic to the Blockchain and the micro service architecture of the API infrastructure;
- All process metadata, subject to certification, will be made available to Geo4WIP e GISFO directly from the Etherna platform and from B-Supply services with guaranteed access to certified data only.

Case study 8: Madrid 360 Environmental Strategy, Spain

An ambitious strategy to reduce Madrid's pollutant emissions with the aim of complying with the EU limit values, making progress towards sustainability and neutrality in the city.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy Availability of a government-sponsored innovation sandbox		Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	Public investment

Project summary

PROJECT NAME AND LOCATION:	**MADRID 360 ENVIRONMENTAL STRATEGY, MADRID, SPAIN**
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Enhanced social inclusion Improved infrastructure delivery and performance OPEX efficiency
Organisation, role on project:	Owner and policy maker
Scale of deployment:	3.3 million inhabitants
Project value:	Not disclosed
Project start/end dates:	September 2019 - 2030
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Operations

About the project

The Madrid 360 Environmental Strategy was presented in September 2019 to reduce nitrogen oxides (NOx) emitted into the atmosphere by 11.3% by 2023: a reduction of 1,563 tonnes of NOx less per year. It is the most ambitious Strategy that the city of Madrid has ever had, both in terms of its:

- **Content**: It covers 200 initiatives across six focus areas: a sustainable Madrid, an efficient Madrid, an intelligent Madrid, a global Madrid, a healthy Madrid, and an accessible Madrid
- **Scope**: It is absolutely comprehensive, including all districts and all sources of emissions
- **Execution**: It involves the transformation of the city, mobility and the Administration.

Most of the measures envisioned will be implemented progressively and, for them to be executed, the necessary changes in municipal regulations will be processed.

Madrid 360 makes the fight against climate change compatible with economic development by promoting the transition to efficient air conditioning systems, the renewal of fleets, the promotion of public transport, the integration of all modes of transport, the reinforcement of road safety and innovation. It provides an overarching strategy to drive the development and deployment of InfraTech to support Madrid's path to climate neutrality by 2050.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Madrid 360 Strategy is aligned with the new EU Urban Mobility Framework and with the objectives of the Sustainable Development Agenda 2030 of the United Nations. Madrid City is not aware of any replicas elsewhere, however, it is easily replicable in other municipalities, totally or partially.

What were the challenges experienced in implementing these approaches?

It has been vital to work hard and quick. A public-private partnership approach is important and working together with all stakeholders is essential. The biggest challenge is to achieve a sustainable city that pleases the greatest number of people.

Are there other approaches that enabled investment that are not already covered above?

- Approval of the Air Quality and Sustainability Ordinance.
- Presentation of the Roadmap to Climate Neutrality in March 2021.
- Approval of the Sustainable Mobility Ordinance. Approved in September 2021.
- Signing of the institutional declaration 'Climate Neutral Cities 2030'.
- Pending approval of the Sustainable Mobility Plan, expected for 1st half 2022.

InfraTech solution

What was the technological solution deployed for this project?

The promotion of public transport and renovation of urban buses with the aim of promoting the sustainability of the 2,085 buses that make up the fleet. Coal-fired boilers have been banned in the city. The City Council is giving grants to help the replacement of oil-fired boilers. The implementation of low-emission zones, and two low emission zones of special protection in the areas with the greatest pollution problems. Strong expansion of Bicimad (public bicycle service) and the construction of new bicycle lanes. 'Cambia 360'aid plan.

Case study 9: Electricity Distribution Network Modernisation and Expansion Project, Turkey

The deployment of InfraTech to support the upgrade, modernization, and expansion of the electricity distribution network of the Osmangazi region, in western Turkey.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Tariff incentives associated with performance, efficiency, and quality of service	Improved overall technology maturity (e.g., maturing IoT and 5G applications) Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture	Other innovative financing instrument

Project summary

PROJECT NAME AND LOCATION:	**ELECTRICITY DISTRIBUTION NETWORK MODERNIZATION AND EXPANSION PROJECT. LOCATED IN THE PROVINCES OF AFYONKARAHISAR, BILECIK, ESKISEHIR, KÜTAHYA AND USAK, IN TURKEY**
Sector:	Energy, Electricity transmission and distribution
Key benefits:	Climate mitigation Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	Zorlu Enerji, Project Sponsor and operator
Scale of deployment:	Approximately 1,956 transformers with 1,688MVA of installed capacity, 4,980 km of electricity distribution lines, 3,782 km of low- and mid-voltage overhead lines, 9,785 km of underground lines as well as technology enabled and digital infrastructure projects. The network is currently servicing 191 towns and 1,596 villages serving a population of approx. 2.79 million and 1.88 million electricity users

Project value:	Approx. USD 350-375 million in TRY equivalent, including VAT and is subject to cost escalation and capex efficiencies
Project start/end dates:	January 2021 to December 2025
Current status of the project:	Project involves multiple activities under the TIP-4 capex program, which is planned, approved and implemented on annual basis for 5 years
Lifecycle stage where technology is applied:	Procurement; Design; Construction; and Operation and maintenance

About the project

Since the liberalisation of Turkey's electricity distribution sector in 2004, its distribution networks have required substantial investment to meet the country's growing electricity demand. This project is adopting and applying technology for a network expansion to improve network reliability, operational efficiency, and quality of services. The project benefits from a regulated asset base (RAB) tariff mechanism, that facilitates the mobilisation of commercial and Development Finance Institution (DFI) capital to its critical modernisation and expansion.

Some 19 technological enabled or digital infrastructure projects are planned to be implemented during the TIP-4 capex program, with an estimated budget of TRY 28.5 million for each of the five years. Based on the joint MDB methodology on climate financing tracking, a majority portion of the project financing is qualified as Climate Mitigation by promoting network energy efficiency, T&L control, through brownfield grid renewal investments.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The use of smart metering and smart grid technology is largely tested and replicable. Electricity distribution is a sector typically requiring regular investment and upgrade, as infrastructure ages. The rehabilitation of extensive networks like OEDAS entails complexity due to the large geographical spread across a relatively low-density region. The sector shares similarities with other network industries such as water supply, and gas distribution, and relies on technological solutions to enhance and optimise its performance. The successful application of technology to this project can be replicated by some of the other 21 electricity distribution companies in the country.

What were the challenges experienced in implementing these approaches?

Risk of delays due to funding: OEDAS needs to secure a substantial amount of financing at the start of each five-year tariff period to implement the project. The current macroeconomic situation in Turkey presents challenges to electricity distribution operators, who require certainty of commitments, long-term availabilities, and long tenors. The availability of DFI financing is particularly important in this case.

Macro-economic volatility: The regulated asset base, CAPEX and OPEX are exposed to Consumer Price Index (CPI) movements. Interest rates present volatility. Funding in local currency is subject to the liquidity of the currency swap market.

Covid-19 related delays: OEDAS has managed the implementation of the previous TIP during the pandemic. Business and work continuity plans, as well as an equipment delivery plan, were prepared to mitigate potential risks.

Are there other approaches that enabled investment that are not already covered above?

AIIB and its co-financiers have provided local currency (TRY) finance and liquidity for the development of distribution assets, facilitating the indirect mobilisation of private capital, and supporting the development of the TRY funding market, at a time when other lenders have reached their limits and long-term financing in TRY is limited.

InfraTech solution

What was the technological solution deployed for this project?

The project supports various technological improvements and digitalisation of the network, ranging from the roll-out of state-of-the-art technology into the network, such as Automatic Meter Reading (AMR) and Supervisory Control and Data acquisition (SCADA) projects; to the development of latest IT technologies to improve data gathering and system integration, such as the Security Information and Event Management (SIEM) project.

Case study 10: High-efficiency water-saving irrigation, China

The deployment of InfraTech that uses a high-efficiency water-saving information system for water conservation

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Adoption of an innovative partnership / risk sharing model A new / innovative source of revenue Integration into project preparation process New platform for InfraTech ecosystem		Public-private partnership (PPP)

Project summary

PROJECT NAME AND LOCATION:	**THE PPP PROJECT OF HIGH-EFFICIENCY WATER-SAVING IRRIGATION IN BINGJIAN SECTION OF YUANMOU LARGE-SCALE IRRIGATION DISTRICT IN YUNNAN PROVINCE**
Sector:	Water, Water efficiency solutions
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	Ministry of Finance, China, Project owner
Scale of deployment:	The project covers an area of 7,600 hectares of farmland and its annual water supply is 44.822 million m^3, saving 21.58 million m^3 of water on average annually.
Project value:	307.7852 million yuan
Project start/end dates:	20 years
Current status of the project:	Operational

Lifecycle stage where technology is applied:	Design; Construction; Operation and maintenance

About the project

The project takes the construction of large-scale irrigation area as the carrier, the innovation of system and mechanism as the driving force, introducing the private sector to participate in the investment, construction, operation and management of agricultural and water conservancy facilities. It achieved the goal of 'tripartite win-win':

- **The income of the farmers increases**: The average water cost per mu can be reduced from 1,258 yuan to 350 yuan, and the average income per mu can be increased by more than 5000 yuan.
- **Job creation**: The SPV has 32 employees, including 25 local employees in Yuanmou County and 6 female employees, and the operation of the project is mainly carried out by local people.
- **SPV profits**: It is estimated that the SPV can recover its cost in 5 to 7 years, with an average annual rate of return of 7.95%. At the same time, minimum rate of return of 4.95% for cooperatives is guaranteed.
- **Water savings**: More than 21.58 million m3 of water can be saved every year.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

After this project, the private sector (Dayu Irrigation Group Co., Ltd.) has popularised and applied this technology and management mode in other places in PPP or non-PPP ways, such as Xiangyun County of Yunnan (irrigation area of 50,000 mu), Midu County (irrigation area of 49,000 mu), Mile County (irrigation area of 50,000 mu), Yongsheng County (irrigation area of 16,000 mu), Shaya County in Xinjiang (irrigation area of 153,500 mu) Wushan County in Gansu Province (with an irrigation area of 41,600 mu), Huailai County in Hebei Province (with an irrigation area of 82,000 mu), etc.

What were the challenges experienced in implementing these approaches?

The private sector (Dayu Irrigation Group Co., Ltd.) said there were not any substantial challenges in terms of policy, market, and management they faced. This project was implemented smoothly, and this approach is being replicated in other places. It means that the Infratech used in this project and the approach are successful.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

Dayu Irrigation Group Co., Ltd. Developed and deployed a water network system for farmland irrigation and established the management network and service network that are digital and intelligent. The construction of the water intake project of the reservoir, the water transmission project from the reservoir to the main pipe and trunk pipe for water transfer, and water distribution project including sub-main pipes, branch pipes and auxiliary pipes for water distribution, equipped with smart metering facilities, and drip irrigation facilities, forming an integrated 'water network' system from the water source to the 'diversion, transmission, distribution, and irrigation' of the fields in the project area.

By installing high-efficiency water irrigation control equipment and wireless communication equipment, the Project integrated a smart water meter, electric valve, power supply system, wireless sensor, and wireless communication

equipment to transmit the information to the centre including crop water consumption, fertiliser amount, drug amount, monitor soil moisture, weather change, safe operation of pipes and other information. According to the set value, alarms and data analysis results, the system can control the on/off of the electric valve and send the information to the mobile phone terminal, which can be operated remotely by the user.

This is a novel deployment of an existing solution.

Case study 11: Allego EVCloud™ Platform

An EV charging operator enabling EV mobility across all European countries.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	Adoption of an innovative partnership / risk sharing model A new / innovative source of revenue	Implementation of a data platform or digital twin for greater transparency over performance	Strategic investment by a corporate partner

Project summary

PROJECT NAME AND LOCATION:	**ALLEGO EVCLOUDTM PLATFORM, CENTRED IN ARNHEM, NETHERLANDS, OPERATING A CHARGING INFRASTRUCTURE ACROSS 16 EUROPEAN COUNTRIES**
Sector:	Transport, Zero Emissions Vehicles (ZEV) infrastructure
Key benefits:	Climate mitigation Climate adaptation Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	Allego, Technological infrastructure operating company
Scale of deployment:	Fully Operational, 30 000 connected charging points, selected and operated through the Allego InfraTech, more than 80 GWh of Green Power distributed
Project value:	Investment in technology is several tens of millions of Euros
Project start/end dates:	Project started around 2018, operational, still ongoing development
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment; Planning and strategy; Project preparation (incl. concept, feasibility, appraisal); Financing; Procurement; Design; Construction; Operation and maintenance; Disposal / decommissioning

About the project

Allego is an EV charging operator, listed on the New York Stock Exhange, which deploys and operates charging infrastructure across all European countries. The aim of the Allego InfraTech project is to identify and assess the right charging locations; to onboard, control and operate tens of thousands of connected EV chargers from multiple vendors; and to operate this European-wide distributed energy data-driven infrastructure according to grid constraints. The network is powered by a 100% green energy supply from markets or directly from solar/wind farm production. It has entered strategic partnerships across Europe to expand its networks.

The InfraTech developed by Allego is a strong enabler of EV mobility across all European Countries, as long as EV penetrations takes off. The existence of this infrastructure has enabled 414 million green kilometres in 2021. It has supported the avoidance of approximately 59 million kilograms of CO2 emissions in 2021[13]. It also supports the business of Allego which has achieved a turnover of around € 90 million 2021 with positive operational earnings before interest, taxes, depreciation, and amortization proving the efficiency of its InfraTech solution.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Financing techniques and global approaches used to develop renewable energy infrastructure were used along with the newly developed technology results to finance the whole project. Non-recourse debt for infrastructure investment has been achieved.

Key aspects of the technology and of the project for attracting investment included, providing investors with a high predictability of the EV charging utilisation rate on each location, in the context of a fast-growing market. On-going improvement of the model through usage data of the infrastructure, ensuring a high availability and uptime of the infrastructure through technology, ensuring scalability of the whole infrastructure from chargers onboarding to billing, and managing direct sourcing of green energy through a fully automated platform.

What were the challenges experienced in implementing these approaches?

Several elements of the global Allego InfraTech project were challenging including: the management of electrotechnical equipment (chargers) from various vendors in an emerging market where standards are still in a ‘work in progress’ state; accommodating various grid connection constraints and norms across all European countries; properly assessing the traffic on future sites with a very limited experience curve; convincing financial institutions that the ‘site assessment technology’ was fit for long term investment including through non-recourse debt; and integrating all the different components of the technological platform in a scalable way.

Are there other approaches that enabled investment that are not already covered above?

The technology has enabled Allego to equip, with Ultra-Fast Chargers, sites which were not considered suitable by the rest of the EV charging industry (i.e., non-highway sites).

Undertaking commercial partnership conditions with landowners.

[13] Figures supplied by Allego

InfraTech solution

What was the technological solution deployed for this project?

Allego is the main technological coordinator and for some elements of the infrastructure the developers. It has subcontracted important elements of the platform to a French technological R&D company specialised in energy-related development named MOMA. The solution was developed from scratch but has aggregated existing bricks (e.g., the energy platform). The Allego InfraTech solution is used to manage a network of several tens of thousands of charging points across 16 countries and deliver to tens of thousands of EV drivers certified green energy to fuel their cars.

Case study 12: CityTaps, Kenya

A pilot project deploying InfraTech to bring clean water to rural Kenya

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
A change in regulation	Adoption of an innovative partnership / risk sharing model New platform for InfraTech ecosystem	A change in data standards / architecture	Innovative financing mechanism

Project summary

PROJECT NAME AND LOCATION:	**CITYTAPS SMART PAY-AS-YOU-GO PROJECT IN MALINDI, KENYA**
Sector:	Water, Water treatment and distribution
Key benefits:	Enhanced social inclusion Enhanced pandemic preparedness and response OPEX efficiencies
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	600 Pay-as-you-Go Smart meters on an 18-month capital lease to serve a population of over 3000
Project value:	Fully funded through a grant of Sh53 million from the French Government in partnership with the County Government of Kilifi, which owns the water utility company.
Project start/end dates:	Pilot ran in 2020
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Operation and maintenance

About the project

CityTaps and Malindi Water and Sewerage Company (MAWASCO) piloted CTSuites, a smart and prepaid water meter and software and existing mobile money systems in Watamu, Kilifi County, Kenya. Through this pilot, 600 water connections are now equipped with CTSuites in Malindi. These connections directly benefit 3010 people and indirectly benefit an additional 758 people. The project avoids manual monthly meter readings, manual water access opening and closing, invoicing and payment collection. Through an Automated Metering Infrastructure, smart meters ensure automatic data

collection in near real-time which reduces the OPEX, avoids data errors and identifies meter inaccuracies, fraud attempts and leaks more rapidly.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

CityTaps is running projects in Niger, Namibia, Senegal, Burkina Faso, Rwanda, and Kenya.

What were the challenges experienced in implementing these approaches?

Developing countries often lack access to clean and safe drinking water, especially in non-urban areas. People living in rural areas currently lack access to basic water services. Technical solutions are known and available, but their application remains challenging, primarily because water operators and their funders lack the confidence that investing in the last-mile market will provide a financial return.

Are there other approaches that enabled investment that are not already covered above?

CityTaps enables the scalability and the sustainability of the water pay-as-you-go business model by leasing the smart meters to water utilities. The upfront CAPEX costs are replaced by lease payments over time. The upfront fee is paid by investors whose investments are de-risked by the PAYG technology. It unlocks private capital by creating a direct link between subscriber payments and utilities' lease repayment through the lease company to the investors. The prepaid water meter transfers payments in real-time to the water utilities, improving cash flows that can be leverage for future network expansion.

InfraTech solution

What was the technological solution deployed for this project?

CityTaps offers a smart prepayment solution, CTSuite. This meter-as-a-service comprises a connected water meter, CTMeter, and a billing software, CTCloud. Utility customers load money on their water account using Mobile Money, with any phone, at any time, and for any amount. CTMeter, a Smart Prepaid Water Meter, measures and sends water usage data in near real-time to the CTCloud software. CTMeter automatically closes the water access when the customer has no more credit. The CTCloud software collects payments, data from CTMeter, and controls water access. CTCloud provides water utility companies with live key hydraulic and commercial indicators and identifies thefts, and leaks to reduce Non-Revenue Water.

Case study 13: Smart AI-based waste management in stations, Hong Kong SAR, China

COVID-19 has enhanced the need for establishing better waste management techniques. This case study highlights how AI-based solutions can help in solving the problem.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance	

Project summary

PROJECT NAME AND LOCATION:	**SMART AI-BASED WASTE MANAGEMENT IN STATIONS, HONG KONG SAR, CHINA**
Sector:	Transport, Rail
Key benefits:	Enhanced pandemic preparedness and response OPEX efficiency
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	A fleet of 20 robots deployed to decontaminate areas where COVID-19 is confirmed
Project value:	HK $1 million each (USD 129,000)
Project start/end dates:	March 2020
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Design; Operation and maintenance

About the project

The project's overall objective was to deploy advanced technology during the COVID-19 pandemic to ensure safety, hygiene, and health. It seeks to effectively sanitize mass public transport like trains, by disinfecting the difficult to reach corners of train by spraying hydrogen peroxide solution. The advanced technology of artificial intelligence, robots, and sensors were deployed to sanitise public transport as a pandemic response to ensure public safety.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Artificial Intelligence, sensors, and robots - Japan, France, USA, Australia and New Zealand, South America, Thailand.

Approaches replicated:

- Development of a national, regional, or sectoral InfraTech strategy
- Adoption of an innovative partnership / risk sharing model
- Implementation of a data platform or digital twin for greater transparency over performance
- Public-private partnership (PPP)

What were the challenges experienced in implementing these approaches?

The solution possessed challenges like sensor malfunctions resulting in collision of robots and draining of battery power leading to breakdown. The robots are also vulnerable to vandalism causing damage resulting in financial losses.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

The solution was developed as joint project between MTR Corporation and Avalon Biomedical. MTR Corporation deployed a fleet of robots to sanitise the trains during the COVID-19 pandemic to disinfect small gaps that are otherwise difficult to reach during regular cleaning process. The solution is a novel development of existing solution, as robots were heavily used for vacuuming in in the earlier years. The systems ranged from heavy, large, and expensive industrial cleaning vehicles to small-size, lightweight, and low-cost household devices.

The automated 'Vapourised Hydrogen Peroxide Robot' (VHP Robot) cleaning robots enhanced the protection of health and hygiene for passengers' staff during the COVID-19 pandemic. The solution optimised the operation performance as it can clean an eight-coach train in under four hours resulting in operation costs gain.

Case study 14: Automated pre-fabrication of stainless-steel pipelines, Argentina

The case study highlights how technology and innovation have the potential to encourage private infrastructure investment. Through the means of disruptive technologies, infrastructure investment can be made a more attractive offering.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	Adoption of an innovative partnership / risk sharing model	A change in data standards / architecture	Loan

Project summary

PROJECT NAME AND LOCATION:	**AUTOMATED PRE-FABRICATION OF STAINLESS-STEEL PIPELINES, ARGENTINA**
Sector:	Water, Water treatment and distribution
Key benefits:	CAPEX efficiency OPEX efficiency
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	Nine miles of pipeline fabricated by stainless steel using keyhole TIG welding technology, a high-energy-density variant of GTAW
Project value:	US$170 million
Project start/end dates:	End date – February 2018
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Construction

About the project

The Acueducto Gran San Juan project in Argentina required installation of a new drinking water system to transport water from wells located approximately 25 kilometres west of the city of San Juan to complement the existing water system. The project is part-funded by a 15 million Kuwaiti Dinars loan from the Kuwait Fund. Nine miles of this pipe was fabricated from stainless steel and welded using the automated K-TIG technology which is based on automation of labour-intensive prefabrication.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The pipeline welding technology has been used/replicated in North America, France, and Belarus this process/technology aims to boost productivity and quality of **industry practices.**

Approaches replicated:

- Development of a national, regional, or sectoral InfraTech strategy
- Adoption of an innovative partnership / risk sharing model
- A change in data standards / architecture

What were the challenges experienced in implementing these approaches?

While the stainless-steel pipe is transporting drinking water, requires one operator to monitor the process adjustment to torch alignment to ensure accurate seam tracking of the longitudinal weld. Another operator must monitor the single, full-penetration circumferential pass (square butt joints) during the 14 minutes welding time.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

The solution was developed by K-TIG which develops a high-speed single pass, full penetration welding technology. The technological solution increases productivity and decreases production time by automating repetitive welding tasks, improving welding quality and consistency, and augmenting the skills of welders. It was developed to complement pre-existing water system to transport drinking water. The solution is a novel deployment of existing solution widely used in welding pipelined for across various infrastructure sectors.

Case study 15: Smart City as a Service, South Korea

With the world moving towards more AI driven day-to-day activities, the case study presents how South Korea is trying to make the lives of people safer and convenient with the help of AI.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy Regulatory sandbox	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance	Public-private partnership (PPP)

Project summary

PROJECT NAME AND LOCATION:	**SMART CITY AS A SERVICE - SEJONG CITY, SOUTH KOREA**
Sector:	Communications, Digital / enterprise solutions
Key benefits:	Improved infrastructure delivery and performance
Organisation, role on project:	Case study prepared by KPMG
Scale of deployment:	80 square miles
Project value:	Total investment – US$ ~3.9 bn (Government and the two developers – US$ ~2.3 bn, other private Investments – US$ - 1.6bn)
Project start/end dates:	Start date – July 2018
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Construction

About the project

Smart Cities are a key part of the Korean government's industrial policy. The Smart City projects are designed to achieve twin objectives:

1. Improvements in the lives of Koreans; and
5. Economic growth through the development and commercialisation of emerging Fourth Industrial Revolution technologies.

The Korea Smart Cities initiative is comprised of three types of national projects:

- Flagship Pilot Projects
- R&D Validation Projects
- Urban Regeneration Projects

Sejong was selected in early 2018 as one of the Flagship Pilot projects alongside Busan. The overall objective of this project is to deploy technologies of the Fourth Industrial Revolution through infrastructure networks to create a sustainable platform city that increases the happiness of citizens and directly addresses urban challenges including traffic, pollution, and energy consumption. The outcome seeks to deploy autonomous vehicles, last mile solutions, AI traffic control, and address challenges towards data gathering and collaboration.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

IoT technology - Singapore, New York City, London, Paris, Berlin, Seoul etc.

Approaches replicated:

- Development of a national, regional, or sectoral InfraTech strategy
- Adoption of an innovative partnership / risk sharing model
- Implementation of a data platform or digital twin for greater transparency over performance
- Public-private partnership (PPP)

What were the challenges experienced in implementing these approaches?

The challenges faced during the project implementation were data gathering, collaboration, and synergy.

Are there other approaches that enabled investment that are not already covered above?

The Korean government created regulatory sandboxes in both Busan and Sejong. These regulatory sandboxes, approved in September 2018, lift regulations related to smart city development in areas such as data collection, autonomous vehicles, drones, and land use. If the pilot projects that are rolled out under these sandboxes are successful, the regulations may be revised nationwide to spur the development of smart city projects by other regional and municipal governments.

InfraTech solution

What was the technological solution deployed for this project?

The solution was developed by LH corporation, which capitalises in industrial processes. The IoT technology was used to monitor the transport system in Sejong city. It is an existing solution, deployed globally in developed and developing countries and emerging markets. The project uses an integrated blockchain architecture, Big Data, Artificial Intelligence (AI) and the Internet of Things (IoT).

The integrated management system improved efficiency of transport system saving commuting time and enabling disaster, earthquake, and fire departments to dispatch vehicles within five minutes.

Case study 16: EMIPAV, Spain

EMIPAV is tool to understand the relationship between the conditions of roads, fuel consumption, and vehicle emissions.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	New platform for InfraTech ecosystem	Change in data standards / architecture	Public investment

Project summary

PROJECT NAME AND LOCATION:	**EMIPAV – SPAIN**
Sector:	Transport, Roads
Key benefits:	Climate mitigation
Organisation, role on project:	Construction
Scale of deployment:	Initially in research sections. Subsequently scalable to the entire road network.
Project value:	€250,000 has already been invested in the project. This year and over the next five years, an additional €5 million will be invested
Project start/end dates:	2020 – 2023 (possibility of extension)
Current status of the project:	Research and development
Lifecycle stage where technology is applied:	Operations and maintenance

About the project

Fuel consumption, and by extension emissions, is closely related to the conditions of the roads on which vehicles drive. The Spanish Ministry of Transport and ASEFMA (the Spanish association of manufacturers of asphalt mixtures) have developed EMIPAV - a tool to analyse the impact of the road conditions on vehicle fuel consumption and emissions in Spain in order to implement effective measures and policies against climate change.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

The first challenge was to introduce into the corporate culture of road administrations that environmental aspects translate into environmental and social costs if action is not taken to improve these aspects. The second is to establish a scale linking road surface condition to vehicle emissions. The third is to incorporate these results into maintenance work, as well as to develop technologies that allow constant road condition monitoring.

Are there other approaches that enabled investment that are not already covered above?

One of the objectives of the project is to make concrete proposals to be incorporated into road maintenance policies that favour climate neutrality. Among them would be to set minimum Key Performance Indicators (KPIs) to be met in road surface quality. These criteria could be incorporated as economic and technical requirements in road maintenance contracts.

InfraTech solution

What was the technological solution deployed for this project?

The study consists of measuring the surface characteristics of the pavements of selected sections in poor condition, IRI, texture and longitudinal friction, and the emissions of certain standard vehicles driving on them. Once the pavement has been rehabilitated, the measurements will be repeated to quantify how much greenhouse gas emissions can be reduced with this improvement.

It is estimated that proper maintenance of European road pavements would save 28 million tonnes of CO2 per year, which could be equivalent to €560 million per year. For this reason, the Directorate General for Roads, together with other Spanish administrations, is participating in a research project, EMIPAV, together with companies from the asphalt sector and ASEFMA, to demonstrate this fact in the road networks of our country and in the vehicles that circulate on them.

Case study 17: ÖZEDES and RUHSAD, Turkey

A digital health project in Turkey to connect people with mental health services throughout the COVID-19 pandemic.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy		Change in the supply of healthcare services	Public investment

Project summary

PROJECT NAME AND LOCATION:	**ÖZEDES (SPECIAL CHILDREN SUPPORT SYSTEM) AND RUHSAD (MENTAL HEALTH SUPPORT SYSTEM), TURKEY**
Sector:	Communications, Digital / enterprise solutions
Key benefits:	Enhanced social inclusion Enhanced pandemic preparedness and response Improved infrastructure delivery and performance
Organisation, role on project:	Turkish Ministry of Health, Project owner, developer, financier
Scale of deployment:	1,683 consultations took place on RUHSAD, with 44 psychiatrists, 3,189 registered users. 3,800 consultations took place on ÖZEDES with 41 psychologists, two psychiatrists and 5,963 registered users
Project value:	Not disclosed
Project start/end dates:	ÖZDES was launched on 11 April 2020 (31 days after the first case) and RUHSAD on 30 March 2020 (19 days after the first case). The projects were concluded on 7 August 2020 with the end of the pandemic restrictions
Current status of the project:	Concluded
Lifecycle stage where technology is applied:	Operations and maintenance

About the project

The pandemic has had disproportionate consequences for a proportion of the population and has put them at a disadvantage. In the interests of equitable health and to help the most disadvantaged, Turkish Ministry of Health decided to anticipate and provide support to those most in need during the COVID-19 pandemic by creating the RUHSAD (Mental Health Support System) mobile app for health professionals and the ÖZDES (Special Children Support System) app. Through the application, user could benefit from psychological support with chat or consult with a psychiatrist online at any time.

The ultimate advantage of this solution and its delivery method was that digitisation allowed access to mental health support to all 81 provinces of Turkey without distinction.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

With the pandemic, many initiatives concerning the delivery of health services at a distance have emerged. This project is carried out with public funds from the Ministry of Health. However, there are mobile applications working in the field of online consultation. Depending on the country and the business model, it is possible to opt for different marketing models: B2B to sell the service to health professionals or health structures, B2G for services created by the private sector with the possibility of reimbursement by the state, or B2C for users who can self-pay.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

Data protection: All Ministry of Health projects ensure the security and protection of health data is treated in accordance with the regulations. All users are provided with a secure space and clear consent. All data is stored anonymously with privacy protection.

Accessibility: The developers focused on ensuring applications were user-friendly so that every user with a mobile phone and an internet connection could benefit from these tools.

Speed: In the context of a global crisis where the number of cases is increasing imminently, the provision of these tools needed to be developed in a short time frame while guaranteeing all standards and quality. The project containing these two health apps was launched 31 days after the first case of COVID-19 in Turkey, to provide access to care and support to the most disadvantaged populations.

InfraTech solution

What was the technological solution deployed for this project?

Two mobile apps were developed so that users could communicate with mental health professional both by message and by online consultation.

During the COVID-19 crisis, the Health Information Systems Department deployed over 24 mobile applications. The experience accumulated during the COVID-19 pandemic has allowed the Ministry of Health to build up experience and infrastructure for new projects in the field of mobile health and telehealth. Recently, the Ministry of Health published the Remote Health Care Regulation to provide regulation for remote health care offering and to enable its expansion.

Case study 18: e-Nabiz, Turkey

A project in Turkey to create an integrated system for the electronic collection of citizens' health data produced by health institution so that it is accessible to citizens and authorised health professionals.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance. A change in data standards / architecture. Implementation of cybersecurity or improved privacy measures	Public investment

Project summary

PROJECT NAME AND LOCATION:	**E-NABIZ, TURKEY**
Sector:	Communications, Digital / enterprise solutions
Key benefits:	Enhanced social inclusion Enhanced pandemic preparedness and response Improved infrastructure delivery and performance
Organisation, role on project:	Turkish Ministry of Health, Project owner, developer, financier
Scale of deployment:	66,361,805 registered users. The e-Nabız system exchanges data with 28 604 health facilities, and it works in integration with 39 internal and external systems.
Project value:	Not disclosed
Project start/end dates:	April 2015 onwards
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Planning and strategy

About the project

The e-Nabız system was developed under the General Directorate of Health Information Systems of the Ministry of Health. The objective of creating e-Nabız is to create an integrated system for the electronic collection of citizens' health data

produced by health institutions. Citizens can access all of their health information using e-Nabız at any time by logging into the system with their web browser or via the mobile application installed on their mobile devices.

The health data collected with the e-Nabız system - without personal data - are used on the SINA (Health Statistics and Causal Analysis) platform to analyse, compare, and evaluate data in multiple dimensions to be used in the decision-making process of policy making.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Through the health digital ecosystem, which also includes e-Nabız, the COVID-19 pandemic was fully managed digitally in Turkey, from contact case tracking to the vaccination process. In addition, with medical records sent to the e-Nabız system by health institutions instantly, it has had a significant impact on making quick and correct decisions and determining policies that will positively affect public health in the pandemic process, both with applications within the ministry and with integrations with different institutions.

What were the challenges experienced in implementing these approaches?

During the implementation of e-Nabız, active trainings were organised. The positive reaction of the Ministry staff, health personnel and patients, to the adoption of this system, is one of the important pillars. The difficulties that arose were resolved through the information activities carried out in the post-launch process.

Information technology management, which plays a prominent role in the efficiency of e-Nabız service provision, has been managed in such a way as to safeguard the privacy of individuals in accordance with the relevant legal obligations, using modern technologies and, in this context, making efficient use of human and material resources. Within the framework of the cooperation with our partner, actual or potential risks that may affect the operability of the e-Nabız were revealed, and effective risk management was implemented by taking technical and administrative measures against these anticipated risks.

Are there other approaches that enabled investment that are not already covered above?

As part of the e-Nabız system development process, benchmarking, and studies were conducted to ensure active integration of our institution's information applications. In addition, active coordination with health institutions was carried out to ensure the direct integration of the Health Information Management Systems (SBYS), which provide field data to e-Nabız. In this sense, coordinated work was carried out between the central and different sub level.

Moreover, thanks to the functionalities of e-Nabız, health information can be recorded and shared when needed, repetitive analysis practices, etc are avoided and savings are made in health expenses. According to the protocol signed between the Ministry of Health and the Social Security Institution (SGK) in 2019, a mutual verification of data was made between the e-Nabız system and the SGK MEDULA system. The billing of information on services, drugs and equipment that is not sent to the e-Nabız system is prevented. Through this integration, an important contribution is made to both the projection of future health care expenditure and the prevention of current unnecessary expenditure. To date, through the integration of e-Nabız MEDULA, we save approximately 10 billion Turkish Lira.

InfraTech solution

What was the technological solution deployed for this project?

The e-Nabız system was developed under the General Directorate of Health Information Systems of the Ministry of Health. Health records created by the Health Information Management System (SBYS) software used in the health institutions are

sent to the e-Nabız system in the form of an electronic health record. Health records verified according to the business rules are stored in the e-Nabız system, without personal data. The collected health records are used to produce statistical reports and the health data are shared according to the rules determined with the integrated systems/projects.

Case study 19: Analytics for Renewable Energy Auctions (AreA Platform), Argentina

A start up addressing traditional challenges in infrastructure procurement through the novel deployment natural language processing, neural networks, agent-based models, and the blockchain.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
A change in procurement policy	Integration into project preparation process	Implementation of a data platform or digital twin for greater transparency over performance	Public investment De-risking mechanisms or blended finance

Project summary

PROJECT NAME AND LOCATION:	**AREA PLATFORM (ANALYTICS FOR RENEWABLE ENERGY AUCTIONS), BUENOS AIRES, ARGENTINA**
Sector:	Energy, Renewables (unspecified)
Key benefits:	Climate mitigation Improved infrastructure delivery and performance
Additional benefits	Cost of capital efficiency Risk mitigation Reduction on the end-consumer electricity tariff Equal rights of participation in transparent tender process
Organisation, role on project:	Greenmap ASBL, Technology Company
Scale of deployment:	Expected to serve technical recommendations and directly contribute to auction design for the Renewable Energy Procurement Programs (REPP) in at least eight host countries during the next three years (mid-2024) and 16 during the next five years (mid-2026).
Project value:	USD $5,000,000
Project start/end dates:	Founded July 2020
Current status of the project:	Research and development, pre-commercial demonstration
Lifecycle stage where technology is applied:	Planning and strategy; project preparation; procurement

About the project

AreA is a platform designed to change the way renewable energy is procured in developing countries. It introduces a novel concept to design and conduct online the entire REPP. AreA integrates data from different external sources in an automated process and interprets it by applying Natural Language Processing (NLP) and Neural Networks (NN). AreA introduces an Agent-Based Model (ABM) for price forecasting. The ABM is capable of dealing with the many heterogeneous bidders that can be found in real renewable energy (RE) auctions.

AreA has an Audit Center, which allows users and host Governments to manage project tasks. All official communications take place in a distributed ledger. This is an auditable, providing greater transparency and setting a precedent in procurement. This approach to procurement-design could be easily adapted to other infrastructure procurement needs.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

One of the foremost challenges implementing AreA is to get reliable datasets concerning every particular target country. This is particularly challenging when dealing with developing countries, since a significant amount of data is often missing. To minimise this effect AreA works in sync with several well-known databases and introduces proxy estimators carefully calibrated to deal with missing data.

Another important issue is the analysis of the stakeholders' opinions, especially their perceived risks which may be higher in developing countries. Confidence in the use of the platform is another critical issue. We promote stakeholders' trust in terms of the platform as a reliable technological instrument in conducting tenders by implementing it on blockchain.

Another big challenge is accurate price forecasting. Though critical to evaluate the tender success, the intrinsic complexity of auctions makes it difficult. Moreover, the heterogeneity (in terms of size and cost) and a large number of participants impede the direct application of classical theoretical results. We deal with this issue by an in-depth analysis of the participants, an original Levelized Cost of Electricity Model coupled to a stochastic Monte Carlo Simulation to provide uncertainty over the risks and cost of capital estimations, and our novel approach for price estimations inside the ABM.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

AreA offers a novel online solution for the entire tender process, which is encrypted and stored by blockchain, and allows for a subsequent authentication of every single transaction, providing auditable timestamps of the relevant documentation.

Case study 20: Biomass CHP Project, China

An investment in Biomass Power Generation to promote green and low-carbon development

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	Integration into project preparation process	A change in data standards / architecture	Public investment

Project summary

PROJECT NAME AND LOCATION:	**BIOMASS CHP PROJECT OF HORQIN ZUOYI ZHONGQI HYUNDAI STAR BANNER BIOMASS POWER GENERATION CO., LTD IN BAOKANG INDUSTRIAL PARK, HORQIN ZUOYIZHONGQI, TONGLIAO CITY, INNER MONGOLIA, CHINA**
Sector:	Energy, Biofuels
Key benefits:	Climate mitigation Climate adaptation Improved infrastructure delivery and performance
Organisation, role on project:	Ministry of Finance, China, Lender
Scale of deployment:	The project will provide heating for building area of 110×104㎡ with the annual heat supply of 53.8×104GJ, with the annual power generation of 2.1×108kWh, and with the power supply of 1.89×108kWh.
Project value:	N/a
Project start/end dates:	2020 - 2021
Current status of the project:	In construction
Lifecycle stage where technology is applied:	Enabling environment; Planning and strategy; Project preparation (incl. concept, feasibility, appraisal); and Financing

About the project

China Eximbank actively uses the People's Bank of China's facilities of carbon emissions to promote green and low-carbon development. The project is invested and constructed by Horqin Zuoyi Zhongqi Hyundai Star Banner Biomass Power Generation Co., Ltd.

The project will make full use of the local advantages of abundant agricultural biomass to produce power and heat, improve the heat-supply system for residents, provide thermal energy for industrial parks and develop centralised heating system, which are conducive to saving energy, cutting pollution, and improving the environment.

It includes the building of a circulation fluid-bed boiler with high temperature and pressure, equipped with the steam turbine generator unit, and reserving the expansion space for one boiler and one generator.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

The project produces heat by burning biomass fuels in an incinerator, vaporises liquid water into steam by the boiler, and then generates electricity with water vapor by turbine generator. This InfraTech is an urgent solution for solving the problems of environmental pollution and limited thermal energy.

Case study 21: Future Grid, Australia

A technology company adapting electricity distribution networks for cleaner, greener, energy across Australia and New Zealand

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Market driven - business need to adapt to changing customer needs	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance	Public investment

Project summary

PROJECT NAME AND LOCATION:	**FUTURE GRID, VARIOUS LOCATIONS, GLOBALLY**
Sector:	Energy, Electricity transmission and distribution
Key benefits:	Climate mitigation Climate adaption
Organisation, role on project:	Future Grid, Technology company
Scale of deployment:	Deployed in 11 locations in Australia, Canada and New Zealand
Project value:	On average, project value is between AUD400,000 – AUD 800,000
Project start/end dates:	Ongoing
Current status of the project:	In construction, operational
Lifecycle stage where technology is applied:	Enabling environment; planning and strategy, operations and maintenance

About the project

Future Grid is adapting electricity distribution networks for cleaner, greener energy by cleansing network data to improve GIS topology, reacting to network capacity constraints in real-time, managing voltage and power quality issues, and detecting and managing the impacts of EVs and Solar PV.

Rather than using a static model approach, Future Grid uses a dynamic process that uses data sensors at the grid edge to tell operators what is happening now. Future Grid's innovative software has been successfully deployed in production to utilities across Australia and New Zealand and is available on the global SAP store.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Approaches to attracting investment have been similar across Australia and New Zealand. New Zealand has a more cohesive policy and regulatory environment. However, there is little difference in reality, because the need for Distribution Businesses (DBs) to evolve from a Distribution Network Operator (DNO) to a Distribution Systems Operator (DSO) is being driven by standard policies (photovoltaic (PV) and battery electric vehicles (BEV) incentives) and people's responses.

What were the challenges experienced in implementing these approaches?

The major challenge has been how prepared individual DBs have been with their transition from a DNO to a DSO. Purchases on the low voltage network are less prioritised for a DNO model but critical for a DSO model. These building blocks need to be put in place before data can be extracted and consumed to be provided to analytics engines and visualisation tools. The ultimate is the outcome-based dynamic DSO model.

Are there other approaches that enabled investment that are not already covered above?

Policy approach:

This case study is an example of the indirect impacts of other policy approaches—the need for Distribution Businesses to react to distributed energy resources (DER) from subsidies for PV and BEVs. Federal and State governments have had policies to subsidise PV installations through attractive feed-in tariffs, interest-free loans, and solar rebates (STC and direct financial incentives). This has driven the uptake of PVs, and now we are seeing incentives for BEVs. DBs are responding to this by seeing the need to monitor the low voltage network more sustainably. The DBs detect voltage fluctuations and transformer loadings that need to be managed to ensure the security of the low-voltage electricity network.

Commercial approach:

While in Australia, each DB has set up a project to implement the Future Grid product, we have seen a different approach in North America. Future Grid was selected by EPRI (Electric Power Research Institute), which collaborates globally, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Future Grid implemented its solution on behalf of two DBs, one in the US and one in Canada. This was an innovative partnership that benefited all parties.

Technology approach:

While Future Grid has built its analytics and visualisation, it is the data platform that is the most innovative component and gives DBs the ability to consume data from the grid edge in near real-time. This allows DBs to move from a Distributor Network Model focusing on network stability and reliability from a centre-out electricity system to a Distribution Systems Operator model managing the grid dynamically.

InfraTech solution

What was the technological solution deployed for this project?

Future Grid's solution is innovative. It takes a set of existing technologies, intelligent meters, telecommunications, software, and hardware to develop a platform that can ingest large amounts of data and delivers it in a form that can be consumed by analytics engines and visualised. While Future Grid has its analytics and visualisation tools, these are there to show possible outcomes. The end state of a DSO is to have result-driven solutions. Advanced Distribution Management Systems (previously SCADA) are the systems that control network elements. The aim is that Future Grid's software integrates

seamlessly to the ADMS so that issues identified at the grid edge are managed in near real-time in the low voltage grid, most likely at the LV transformer level by, for example, changing the tap settings.

Case study 22: 5G and Smart Industrial Park Security Application, China

Using 5G and a private mobile edge computing (MEC) network to improve the reliability and security of end-to-end data transmission at an industrial park

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
A change in procurement policy	Adoption of an innovative partnership / risk sharing model Integration into project preparation process	Implementation of cybersecurity or improved privacy measures	Public investment

Project summary

PROJECT NAME AND LOCATION:	**ZHENGZHOU GREE 5G + SMART INDUSTRIAL PARK SECURITY APPLICATION PROJECT IN ZHENGZHOU, CHINA**
Sector:	Communications, Digital / enterprise solutions
Key benefits:	Improved infrastructure delivery and performance
Organisation, role on project:	China United Network Communications Co., Ltd. Zhengzhou Branch, Project Integration
Scale of deployment:	
Project value:	
Project start/end dates:	2019 - ongoing
Current status of the project:	In construction
Lifecycle stage where technology is applied:	Design Construction Operation and maintenance

About the project

In 2019, Zhengzhou Unicom and Zhengzhou Gree signed an eco-strategic cooperation agreement on 5G and Mobile edge computing (MEC) intelligent manufacturing. Zhengzhou Unicom, together with China Unicom digital technology and ZTE, deployed a 5G + MEC private network to improve the reliability of end-to-end data transmission to ensure that the data does not leave the industrial park. This project lays a solid foundation for 5G application security in industrial parks.

It fully applies the advantages of Unicom's network resources, adopts the next-generation active defence theory technology based on the combination of zero trust + dynamic defence, ensures the security of the whole link and the whole process in the form of service provision, and introduces the network-wide joint prevention and control, behaviour clue analysis, dynamic security and other technologies to become passive to active, which can effectively deal with unknown security risks such as zero-day vulnerabilities. The technology is advanced, cost-effective, easy to implement, and easy to replicate.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Based on Gree's deployment experience, the partners have copied and built nine smart factories in the province, such as Sanquan, Yutong, and Zheng Coal Machine, with a signed amount of more than 9 million yuan.

What were the challenges experienced in implementing these approaches?

The demonstration effect of the project can bring confidence to surrounding enterprises, and also help to obtain government policy subsidies, while bringing about the allocation of inputs and the increase of marginal benefits. However, the risk sharing model is uncertain and requires moderate risk assumption in the early stage.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

This project, together with the 5G network, simultaneously builds a security protection capability that runs through the cloud pipe end, realising the protection of the whole link and the whole process.

On the network side of the platform, security capabilities such as differentiated slice security isolation are applied; security measures such as dynamic firewalls are applied for intranet viruses/Trojan horses; cloud-native security is applied for MEC virtualization security risks; and full-life cycle data security capabilities are provided.

5G application terminal security, security detection before the terminal goes online, electronic fence is used when entering the network for authentication, zero trust access control is applied when the terminal is connected, and abnormal monitoring and disposal of matching traffic is handled.

Security operation services, synchronously and on-demand security capabilities when 5G networks are online. Gree security situation awareness and Unicom network side situation awareness linkage, the formation of advance prevention, in-event monitoring, after-the-fact traceability of the active security protection system.

Case study 25: Colouring Cities, UK

The Colouring Cities Research Programme (CCRP) has been set up, at the Alan Turing Institute (UK), to facilitate knowledge exchange and open data sharing about buildings across countries.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy Availability of a government-sponsored innovation sandbox		Implementation of a data platform or digital twin for greater transparency over performance Reuse of existing technology to produce low-cost open data, visual platforms integrating crowdsourcing, building performance tracking and emergency support tools.	De-risking mechanisms or blended finance

Project summary

PROJECT NAME AND LOCATION:	**COLOURING CITIES RESEARCH PROGRAMME, INTERNATIONAL**
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Enhanced social inclusion Improved infrastructure delivery and performance
Additional benefits	Allows for multidisciplinary work across sectors
Organisation, role on project:	Alan Turing Institute, Research institution management, core funding and prototype development
Scale of deployment:	International
Project value:	Alan Turing Institute c £200,000 p.a., UK help in kind is approximately c200,000 (2022). Individual countries secure their own funding/secure help in-kind at national level.
Project start/end dates:	2016 - ongoing
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment; Planning and strategy; Project preparation; Procurement; Design; Construction; Operation and maintenance; Disposal / decommissioning

About the project

The Colouring Cities Research Programme (CCRP) is developing a model for open data platforms that address issues relating to building attribute data fragmentation, omissions, quality, interoperability, range, geographic coverage, granularity, security, and accessibility. The CCRP is unique in that it: a) brings together international academic institutions involved in building research, to co-work on open data platform design, and to set up and manage platforms at country level able to be enriched and maintained by local stakeholders; b) develops a model for platforms able to integrate comprehensive data on the composition, performance and quality, and dynamics of the stock, at building level; c) provides a highly efficient model for low cost open data repositories that double as data visualisation, building performance tracking, and public auditing tools, and free public education resources and mechanisms for data capture in disaster situations; d) tests diverse data capture methods, to improve data richness and quality, and e) uses colour to support inclusivity, promote diversity, and bring together and celebrate the expert knowledge of citizens, and of professionals working across sectors and disciplines, and within science, the humanities and the arts.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

All international Colouring Cities Research Programme partners sign up to test/replicate/co-work on Colouring Cities platform code and design. We currently have partners in Beirut, Bahrain, Australia, Athens, Dresden, London, Indonesia, and China. We are also developing research collaborations with academic institutions in China, Colombia, Switzerland, Sweden, and the US.

What were the challenges experienced in implementing these approaches?

Securing and retaining high quality software engineering expertise over the project lifespan has been a significant challenge, as has obtaining sufficient funds to manage the project in a sustainable way whilst dealing with rapidly growing international interest. A significant number of platform features have been designed at Turing but not yet implemented for reproduction by CCRP partners owing to limits on funding/engineering time.

It has taken seven years to enable international rollout to be supported with relative ease. However, the project is still considered to be at an early development stage, particularly in terms of interface design, feedback loops designed to improve data quality, and application illustration.

Are there other approaches that enabled investment that are not already covered above?

Low management costs are achieved through co-working of international academic teams, already involved in funded building stock research, on open platform design and code. The initiative allows for grant applications directed at diverse funding sources, i.e., research grants relating to building stock analysis (energy, housing etc.); industry collaborations to support efficiency and innovation, and government grants to support sustainable policies relating to housing, construction and retrofit, planning, conservation, risk assessment. Relevant funding sources also exist in the context of data ethics, innovation in community engagement, and the use of AI and machine learning to reveal underlying relationships and patterns in complex urban systems.

Funding is not/cannot be generated from the sale of data or code, both of which are open. Using this code, demo platforms for countries can be quickly and cheaply built. These are used to lever funds and expertise at city, regional or national level, to enable content and interfaces to be tailored, stakeholders to be consulted and data uploaded. As the number of national platforms grows and an increasing amount of data becomes available, joint applications with CCRP partners to analyse collected data across countries will be sought.

InfraTech solution

What was the technological solution deployed for this project?

The technological solution is the development of open-source code for easy-to-set-up-and-run open-source platforms (managed by academia) able to access to the highest quality comprehensive national building footprint data available. These footprints are used to collect, collate, capture and verify, visualise, analyse and release comprehensive spatial data, at building level, on the composition, performance/quality, and lifespan/dynamics of national building stocks. Footprints colour as data are added. This is a novel deployment of existing technologies.

Case study 24: The Trial Reservoir, International

Accelerating the water industry's technology adoption to achieve net zero through a novel approach to funding technology trials.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Adoption of an innovative partnership / risk sharing model Integration into project preparation process	Before each trial, Isle Utilities work with end-user and technology vendor to identify a suitable trial location and format. We undertake due diligence of the technology, vendor, and end-user. Working with end-user and vendor we design a robust, credible trial.	A new fund / investment platform Innovative financing instrument: Loans for trials which remove the exposure from the technology developer and technology user.

Project summary

PROJECT NAME AND LOCATION:	THE TRIAL RESERVOIR, INTERNATIONAL
Sector:	Water, Water (all)
Key benefits:	Climate mitigation Enhanced social inclusion Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organization, role on project:	Isle Utilities, Loan provider; technical support; marketing & communications
Scale of deployment:	Supporting 10+ trials/year to implementation, achieve a success rate of 6/10 trials and 70% by amount invested, to reduce pilot-to-implementation time by 80%, and alleviate 120,000 tons (30,000 people's worth) of carbon emissions p/y.
Project value:	USD$1.5m p/y
Project start/end dates:	November 2018 - ongoing
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment; Planning and strategy; Project preparation; Financing; Design; Construction; Operation and maintenance; Disposal / decommissioning

About the project

The Trial Reservoir is a new and unique partnership model that brings technology users and innovators together. It provides loans for trial running costs, and conditions the loans such that a trial and purchase agreement between innovator and user must be in place prior to the trial that guarantees implementation if the trial is successful. If the trial is not successful, then the loan is written off. To lower the number of trials required to bring an innovation to market Isle Utilities organises joint marketing campaigns with both the technology vendor and the end-user after the successful conclusion of trials.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The Trial Reservoir approach to technology trials has enormous, universal potential globally to increase and accelerate uptake of clean technologies. It has not yet been replicated but Isle Utilities are in advanced talks with the InterAmerican Development Bank (IADB) to replicate the approach in a Latin America-specific project, funded by the IADB.

What were the challenges experienced in implementing these approaches?

Technology end-users are not accustomed to taking new technologies on probation with upfront intent to implement them, so the major obstacle has been changing the mindset of users. The Trial Reservoir provides technology companies with risk-free access to trial funding.

Are there other approaches that enabled investment that are not already covered above?

Commercial: The shift from agreements for trials followed by separate agreements for implementation (with an 8-20 month delay in between) to a single Trial and Purchase Agreement. The agreement contains the success criteria for the trial as well as the post-trial commercial commitment under the most appropriate business model on a case-by-case basis. The technology vendor and end-user have to sign off on the success criteria and post-trial commitment before we lend any money and before the trial begins.

Finance: Loans for trials which remove the exposure from the technology developer and technology user. The Trial Reservoir provides money that only has to be repaid if the trial is a success, measured using success criteria agreed upon by both parties (developer and end-user) prior to trialling.

InfraTech solution

What was the technological solution deployed for this project?

With another ~80 technologies close behind, three of the first to commence are:

- eWATERservices' drinking water collection, treatment, supply and e-wallet billing/metering system in Gambia
- iVAPPS' reusable combined inline sensors and isolation valves for supply networks (trialling with Agbar in Spain)
- The Transcend Design Generator (TDG), trialling in Australia, China and India, allows users to create custom preliminary designs for wastewater treatment facilities from just a few key project-specific inputs.

Case study 25: Guangxi Chongzuo Border Connectivity Improvement

A comprehensive infrastructure project deploying InfraTech and engineering management experience to improve the project management-control capability.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Adoption of an innovative partnership / risk sharing model	Implementation of a data platform or digital twin for greater transparency over performance A change in data standards / architecture Implementation of cybersecurity or improved privacy measures	Partnership with AIIB

Project summary

PROJECT NAME AND LOCATION:	**GUANGXI CHONGZUO BORDER CONNECTIVITY IMPROVEMENT PROJECT, IN CHONGZUO CITY, GUANGXI ZHUANG AUTONOMOUS REGION, CHINA.**
Sector:	Transport, Road
Key benefits:	Improved infrastructure delivery and performance
Additional benefits	Technical innovation Safety enhancement Environment mitigation
Organisation, role on project:	Chongzuo Urban Construction Investment & Development Co., Ltd. Project owner
Scale of deployment:	This infrastructure engineering project consists of a two-way four-lane expressway that is 12.604km in length with the design speed of 100km/h and the subgrade width of 26m; a two-way four-lane class 1 highway that is 5.023km in length with the design speed of 80km/h and the subgrade width of 25.5m; a class 2 highway which has the overall length of 13.728km, design speed of 40-60km/h, subgrade width of 10-16m; and a building

	with planned land area about 18,533.72m2 and total floor area of 11,668.03 m2.
Project value:	Approximately 0.46 billion USD/3.0 billion RMB
Project start/end dates:	October 2021 to October 2026
Current status of the project:	Construction / Set up phase
Lifecycle stage where technology is applied:	Procurement; Design; Construction

About the project

The project aims to enhance the development of areas along the road and to improve economic and cultural connections between China and Vietnam. It requires a fit-for-purpose management solutions to achieve better efficiency, quality, and safety, this includes a BIM model lightweight engine and the deployment of smart site technologies. A Digital Management & Control Platform, implemented by a Master Technology Partner, is proposed and deployed as an InfraTech solution for this project. The digital platform aims to improve the engineering project management and control capability of the engineering owner. It provides an efficient and convenient service for all parties involved in the engineering project in project collaboration, engineering management and control, data management and assets handover, and consequently will facilitate the management and control to be more transparent, efficient, and independent. This approach helps the Chongzuo Border Interconnection Improvement Project to become a demonstrative benchmark project invested by AIIB in China. More importantly, the platform can be replicated and extended to other similar projects to bring benefits into play, and therefore significantly reduce the cost for future engineering projects.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Commercially, the People's Republic of China has applied for financing from the AIIB in the form of a loan toward the cost of this project, this will be the first partnership with AIIB in the transportation field, and the successful cooperation mode can be used as a benchmark and easily replicated in many infrastructure projects in China.

Technologically, the combination of engineering management experience and digital technique produces an innovative solution for modern engineering managements, and has been emerging and replicated in many civil engineering projects in infrastructure facilities, energy and electric power, water resource & environment, etc.

What were the challenges experienced in implementing these approaches?

- Designing of the functional architecture and business procedure of the digital platform to meet the needs and values for all stakeholders
- Integration of a variety of digital technologies
- Smart site implementation for a highway. The construction site of a highway is generally open and long, this makes it difficult to monitor workers' activity and construction vehicles' status, and presented challenges in acquiring electrical power and stable network in long-distance mountainous areas.
- A lack of standardisation of engineering management experiences. To address this, leading engineering company, PowerChina ZhongNan, with years of engineering and technology-enabling implementation experience, was selected as the technology partner to provide a sophisticated and standardised management solution and embed the scheme into the digital platform with user-friendly functions.

Are there other approaches that enabled investment that are not already covered above?

Commercial – the use of a Master Technology partner to create a standardised approach for technology implementation.

InfraTech solution

What was the technological solution deployed for this project?

A Digital Management & Control Platform, implemented by a Master Technology partner responsible to ensure interoperability of all technologies selected throughout the project, is innovatively proposed and deployed in this project as an infratech solutions. The digital platform is to fully improve the engineering project management and control capability of the engineering owner. It provides standardised and visualised management procedure to improve efficiency in office communication and collaboration, and to enhance the control of engineering quality, project cost, construction progress. And it offers smart site solutions with Building Information Modelling (BIM), Geospatial Information System (GIS), Internet of Things, (IoT) and Artificial Intelligence (AI) analysis to optimise construction management onsite including resource allocation, construction safety, environment mitigation, energy saving, etc.

Case study 26: Beijing Energy's Wind Power Project in Kangbao County

A power plant that helped the 2022 Beijing Winter Olympics and Winter Paralympics achieve 100% green operation across all venues for the first time in the history of the Olympic games.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Availability of a government-sponsored innovation sandbox	Adoption of an innovative partnership / risk sharing model	A change in technical standards	Special loan

Project summary

PROJECT NAME AND LOCATION:	**BEIJING ENERGY'S WIND POWER PROJECT IN KANGBAO COUNTY, HEBEI PROVINCE, CHINA**
Sector:	Energy, Wind
Key benefits:	Climate mitigation Climate adaptation
Organisation, role on project:	Ministry of Finance, People's Republic of China, Lender
Scale of deployment:	The project has an installed capacity of 450MW, accounting for 37.5% of the total installed capacity. At full capacity, the annual power generation of the plant will be about 1.04 billion kWh.
Project value:	-
Project start/end dates:	Project was connected to the power grid in December 2021
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment; Planning and strategy; Project preparation (incl. concept, feasibility, appraisal); Financing; and Design

About the project

Beijing Energy's wind power project in Kangbao County is an energy-saving and renewable energy project supported by a special loan on lent to China Eximbank by the Ministry of Finance of P.R.C under its sovereign-level loan agreement with the New Development Bank (NDB). The project is a milestone as it is the first of its kind to be funded by the special loan from NDB with China Eximbank as the implementation agency.

The project, with an installed capacity of 450MW, accounting for 37.5% of the total installed capacity, is part of the Zhangjiakou-Beijing Renewable Energy-Powered Clean Heating Demonstration. It has the largest single investment and the highest construction standard of its kind, and was constructed ahead of the 2022 Beijing Winter Olympics and Winter Paralympics.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

The project is supported by a special loan on lent to China Eximbank by the Ministry of Finance of P.R.C under its sovereign-level loan agreement with the New Development Bank (NDB). The project is a milestone as it is the first of its kind to be funded by the special loan from NDB with China Eximbank as the implementation agency.

InfraTech solution

What was the technological solution deployed for this project?

The wind power project was connected to the power grid in December 2021. At full capacity, the annual power generation of the plant will be about 1.04 billion kWh, which can save 320,000 tons of standard coal and reduce carbon dioxide emissions by 850,000 tons per year. In addition, it can save a large amount of water used by traditional power plants and thus reducing water pollution.

Case study 27: EBRD Sustainable Infrastructure Group, Strategy for Digitalisation of Infrastructure Investments

A project to optimise digitalisation in all future European Bank for Reconstruction and Development (EBRD) infrastructure investments.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
A change in procurement policy Development of a national, regional, or sectoral InfraTech strategy	Integration into project preparation process	Implementation of cybersecurity or improved privacy measures Utilisation of the new EBRD SIG sector specific digitalisation Roadmaps and Compendia	

Project summary

PROJECT NAME AND LOCATION:	**EBRD SUSTAINABLE INFRASTRUCTURE GROUP (SIG), STRATEGY FOR DIGITALISATION OF INFRASTRUCTURE INVESTMENTS, ACROSS ALL EBRD REGIONS AND COUNTRIES OF OPERATION**
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Enhanced pandemic preparedness and response Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	EBRD, Project owner
Scale of deployment:	EBRD Sustainable Infrastructure Group on average achieves €4 billion per annum for approximately 100 different project investments.
Project value:	As 95% of EBRD project investments include some degree of digitalisation, the infrastructure investment value per annum will be in the order of EU 3.8 billion
Project start/end dates:	2022 onwards
Current status of the project:	Ongoing
Lifecycle stage where technology is applied:	All

About the project

The EBRD 2021-25 Strategic Capital Framework (SCF) recognises that digitalisation and technology affect every sector the Bank works in. Consequently, it is accelerating digital transition in its Countries of Operation as one of its three core themes. SIG Digital Roadmaps and Compendium assignments leading to the creation of the SIG online Infrastructure Digitalisation Toolkit for bankers, regional offices, and clients. These roadmaps will help existing and future clients identify strategies for digital optimisation and where to strengthen capacity building alongside investment in design, adoption, and implementation of digital technologies.

Due to the differing natures of the five sectors to be covered, different professional competences and varying inputs will be required for each of the Digitalisation Roadmaps and Compendium developments: Water; Buildings, heating, cooling and energy efficiency; Solid waste; Transport (national and urban); and the Energy Sector.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

Banking teams were unaware of the most appropriate digital technologies and innovations that should be applied for each type or project in each sector in order to optimise benefits that might accrue from digitalisation.

Are there other approaches that enabled investment that are not already covered above?

The development of digitalisation roadmaps for each sector has highlighted what asset owners and operators need to achieve digital maturity, regardless of what level they are currently at. This has opened up opportunities for EBRD to support such organisations with a broader range of digitalisation interventions rather than just project specific ones. EBRD can invest in digital platforms or organisation wide digital upgrades, cyber resilience measures or AI enabled enterprise asset management. EBRD can also invest in citywide data platforms or digital twins.

InfraTech solution

What was the technological solution deployed for this project?

In order to develop each of the five required Roadmaps for Digitalisation, the specialist consultants appointed will undertake the tasks detailed below.

- **Digital maturity roadmaps:** Detailing suitable pathways for transition from early stage, low maturity or 'digital ignorance' to higher stages of maturity such as 'transformative', or similar for all digitalisation benefits that can be achieved in each sector.
- **Digital maturity key performance indicators**: Including a stocktake of relevant digital solutions already in place or with high potential for near-future application across each relevant sector, as well as key performance metrics and timelines for achieving the 'digital maturity roadmap'.
- **Action plan:** Identify what actions are necessary for asset owners or developers in each sector to progress along each 'digital maturity roadmap'.
- **Public sector:** Identify the role of public policy and relevant policy agencies for defining the course of the digitalisation pathway, with regard notably to institutions and roles, sector regulation, funding, incentives and standards. This shall

develop relevant policies and actions for engaging private sector and mobilising funding, with use of country case-studies and illustrations.
- **Private sector:** Details of how private sector involvement can help with digital transformation (regardless of whether the asset owner in each sector is public sector, SOE or private sector).

In addition, specifically for the Energy Sector:

- **Energy value chain (from generation to demand side):** Establish to which subsector of the energy sector they apply;
- **Energy systems and geography:** Establish how they apply to different energy systems in the EBRD region (liberalised energy markets, vertically integrated systems, etc.).

The resulting Roadmaps and Compendium will enable the Bank to better structure its support and investments responding to the SCF requirement of accelerating the digital transition whilst mitigating the risks. This will enable the Bank to truly optimise the interventions made in the advancement of digitalisation across infrastructure and energy sectors over the short and medium term. The end benefit will accrue for a range of both public and private sector clients, supporting a large number of beneficiaries.

Case study 28: The Digitalisation Impact Tool, United Arab Emirates

A tool developed by the UAE government to measure the positive impact of digitalisation on a project or organisation.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment

Project summary

PROJECT NAME AND LOCATION:	DIGITALISATION IMPACT TOOL, UNITED ARAB EMIRATES
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation
Additional benefits	Digitalisation Wellbeing
Organisation, role on project:	Ministry of Energy and Infrastructure (MOEI), United Arab Emirates, Developer and product owner
Scale of deployment:	-
Project value:	-
Project start/end dates:	2021 - 2022
Current status of the project:	Operational
Lifecycle stage where technology is applied:	

About the project

The Digitalisation Impact Tool was developed to support the Green Information and Communications Technology (ICT) strategy for MOEI. Since 2015, converting to the electronic system has supported the UAE government to offset 36,984,147 t-CO2 emissions. The objective of the Digitalisation Tool is to document the positive impact of digitalisation on the environment, MOEI, and MOEI'S customers. This tool will track the different impacts of the transformation from hard-copy transactions to fully digital and online transactions and processes. Using the tools MOEI has better traceability and

accountability on data and transactions, and can keep track of all the work that takes place and its impacts on different areas.

Using the tool, the owner or organisation can accurately and readily identify the annual CO2 emissions offset caused by converting to an electronic system and the amount of water, energy, time, and number of papers saved by the organisation. The tool is very useful in explaining the impact of digital transformation on all aspects for customers, stakeholders, and decision-makers.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The ease of the tool allows it to be used in all projects, and also allows adding other needs that can be measured according to the project requirement.

The tool is applied to measure the impact of digitisation in all online services provided by the Ministry of Energy and Infrastructure in all its sectors, whether through the official website of the Ministry or through online applications. Among the services that measure the number of online transactions are; housing services, geological and petrol services, infrastructure services, maritime transport, land transport, and all requests received according to the projects (renewal, extension, change, etc.).

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

The UAE Digital Government Strategy 2025 is one of the main enablers as it has directly directed entities to digital transformation. From there, the Ministry developed many strategies that support the objective of Digital strategy. The main objective of the UAE digital strategy is to create a broad cross-sectoral political commitment and buy-in for embedding the digital aspects into overall government strategies.

This is crucial to ensure that the UAE Government is digital by design and that all capacities, structures, and opportunities are integrated on a national level and aligned with the UAE's strategic digital government vision. The sustainability strategy was developed to reflect the Ministry's vision, mission and strategic objectives and its desire to set a leading standard for sustainability performance in all major departments and divisions under the Ministry's control.

InfraTech solution

What was the technological solution deployed for this project?

The Ministry of Energy and Infrastructure developed the tool internally using best practices and methods by finding out all aspects that are affected by the digital transformation of transactions in organisations and then measuring this impact on them. This work by input required details in the Calculator sheet, including the number of transactions that were transformed to digital ones in a given months or/and years. The tool then finds the detailed digitalisation impact of the inputted number of transactions.

The financial savings are also calculated from the rate of reducing the papers and the savings on the customer from the value of oil and parking fees. The tool is very useful in explaining the impact of digital transformation on all aspects for customers, stakeholders, and decision-makers.

Case study 29: Understanding Driver Behaviour, United Arab Emirates

A government-backed research project in the United Arab Emirates to understand driver behaviour to design better roads, and tackle C02 emissions.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment

Project summary

PROJECT NAME AND LOCATION:	**DRIVER BEHAVIOUR TOWARD ROAD SIGNBOARDS, SIGNALS, INTERSECTIONS, AND EXITS, UNITED ARAB EMIRATES**
Sector:	Transport, Roads
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Enhanced pandemic preparedness and response
Additional benefits	Enhanced driving safety Measure the CO2 emissions related to driving behaviour
Organisation, role on project:	Ministry of Energy and Infrastructure, United Arab Emirates, Project owner
Scale of deployment:	
Project value:	160,000 AED
Project start/end dates:	March 2022 – March 2023
Current status of the project:	Research and Development
Lifecycle stage where technology is applied:	Driver Behaviour Toward Road Signboards, Signals, Intersections, and Exits, United Arab Emirates

About the project

The aim of this project is to increase road safety by considering driver behaviour through the development of a new mobile application that collects the necessary data to analyse a driver's reaction against the road safety guidelines to improve both road and driver safety.

The project is measuring the actual scale of CO2 emission for roads based on driver behaviour at main accelerating points such as intersections, after speed bumps, etc. The findings will allow planners to design suitable road infrastructure with proper safety guidelines, including signboards, signals, intersections, and road exit depending on driver behaviour.

The challenges that have been addressed in this project are:

- The high number of driver accidents, which can be reduced by identifying the crucial factors and the check the effectiveness of the road infrastructure safety guidelines.
- Measuring the focal points of high CO2 emission due to vehicle acceleration. High acceleration is considered one of the main factors in increasing the CO2 emission, which is difficult to measure without analysing the drivers' driving behaviour.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

The internal researchers from the Department of Studies, Research and Development at the Ministry of Energy and Infrastructure, United Arab Emirates, are developing the InfraTech solution.

The data collection streamed from a developed mobile application to the central server for analysis. The novel method is designed to identify the actual effectiveness of road guidelines and measure the CO2 emission for the vehicles based on acceleration level. Investigating the current situation of driver behaviour in the country would help in future planning and design for roads infrastructure and policies as it varies from country to country.

The project is currently in the research and development phase. It will be released in August 2022, with data collected during September and analysed in February 2023. The project is expected to be completed in May 2023.

The key performance indicators for the project are to:

- Measure the accelerating/ decelerating rate during driving at specific locations
- Measure the wheel steering angle during driving at specific locations

- Collect the latitude and longitude based on a time interval (for example, two seconds)
- Measure the approximate CO2 emission related to driving behaviour

Case study 30: The Sustainability Tools, United Arab Emirates

Tools developed by the Ministry of Energy and Infrastructure (MoEI) in the United Arab Emirates to track air quality, energy performance, carbon emissions, water consumption, and waste diverted from the landfill on its projects.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy		Implementation of a data platform or digital twin for greater transparency over performance	Public investment

Project summary

PROJECT NAME AND LOCATION:	THE SUSTAINABILITY TOOLS, UNITED ARAB EMIRATES
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Enhanced social inclusion OPEX efficiency CAPEX efficiency
Organisation, role on project:	Ministry of Energy and Infrastructure (MOEI), United Arab Emirates, Project Sponsor
Scale of deployment:	Sustainability tools will be implemented and used in all MoEI projects from roads, and buildings to housing projects.
Project value:	28000 AED
Project start/end dates:	28.02.21 / 27.07.21
Current status of the project:	Pilot project
Lifecycle stage where technology is applied:	Planning and design

About the project

The sustainability tools have been developed by the MOEI to help the project teams to track, document, and monitor data relating to sustainability during the project life cycle, to improve decision-making. The sustainability tools were developed

to support the Sustainability Strategy for MOEI; the UAE Energy Strategy 2050, which aims to increase the contribution of clean energy in the total energy mix from 25% to 50% by 2050 and reduce the carbon footprint of power generation by 70 %; and the UAE Water Security Strategy 2036 which aims to reduce average consumption per capita by half.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The sustainability tools will be implemented and used in all MoEI projects from roads, and buildings to housing projects. The tools complement sustainability guidelines which will be mandatory for all MOEI projects. Through tracking and documenting they will help the project team to prove that all requirements in the guideline are met and applied in the right way.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

Policy: The sustainable Procurement Policy that was developed in MOEI is considered one of the enablers of the success of the sustainability tools. Since, sustainable procurement policy considers the social, economic, and environmental consequences of what is procured through all stages of its life cycle. This includes considering design, resource extraction and sourcing, manufacturing and production, transportation, service delivery, operation and maintenance, reuse, recycling, and disposal. Sustainable procurement also considers the capacity of suppliers to address these and the consequences throughout the supply chain. In addition to contributing to the social, economic, and environmental well-being of people and places, sustainable supply chain management can deliver additional benefits to MOEI which stimulate the market and encourage innovation for sustainable products and services, and strong support for the local supply community by engaging with small and medium enterprises to compete for MOEI contracts. The policy applies to the following types of products ongoing consumables, building materials, and electronic equipment.

Technology: The tools developed help to monitor and document certain parameters of all MOEI project. Hence, valuable data will be available for MOEI that can be used as an input for new algorithms or technology.

InfraTech solution

What was the technological solution deployed for this project?

The Ministry of Energy and Infrastructure, represented by the Studies, Research, and Development (R&D) Department, contracted Alpin Limited to develop and implement the sustainability tools in MOEI projects. The implementation of these tools will be in cooperation with the design, execution, and Studies, the R&D team from the MOEI, and the project consultant.

Tools inform the project team about project air quality, as well as carbon emissions during the project life cycle to ensure that there is a least a 5% reduction in the project's embodied carbon compared to business-as-usual practices. Additionally, the project team will be able to document the indoor and outdoor water consumption of the proposed building and determine the percentage reduction over the baseline. The energy performance tool will be used to display and check the energy model inputs and calculate the number of credit points achieved based on the energy modelling results. The expected reduction in energy for road projects is 45% and 16% for buildings projects.

The project team will also be able to track and document the waste diverted from landfills on a monthly basis over the full duration of the construction phase. As one of the MOEI sustainability initiatives is developing and implementing sustainability guidelines on its projects, a submission checklist has also been developed for the purpose of checking if the Ministry guideline requirements are targeted in the project or not.

Case study 31: Cool Pavement, United Arab Emirates

A pilot to understand the performance of coated pavement surfaces to address the heat islands effects in the United Arab Emirates.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy			Public investment

Project summary

PROJECT NAME AND LOCATION:	**THE POTENTIAL IMPACT ON THE APPLICATION OF COOL PAVEMENT: PERFORMANCE EVALUATION OF COATED PAVEMENT SURFACES IN THE UNITED ARAB EMIRATES, ZAYED EDUCATIONAL COMPLEX IN SHARJAH, UAE**
Sector:	Social infrastructure, Education
Key benefits:	Climate mitigation Climate adaptation
Organisation, role on project:	Ministry of Energy and Infrastructure, United Arab Emirates, Project owner
Scale of deployment:	Deployed at Zayed Educational Complex, in Sharjah, United Arab Emirates
Project value:	60,000 AED
Project start/end dates:	May 2020 to May 2022
Current status of the project:	R&D, Operational
Lifecycle stage where technology is applied:	Construction, Operations

About the project

Solar reflection can influence pavement warming, and this warming has the potential to increase urban heat islands and contribute to global warming by warming the local air and transferring heat into the atmosphere. The main objective of this research project is to assess the performance of the cool pavement technology (white coated pavement surface) in Zayed Educational Complex in Sharjah, United Arab Emirates. The cool pavement technology (white coated pavement surface) is considered as a new reflective surface treatment that improves the reflectivity of the pavement.

During the project solar reflectance, thermal emittance, solar reflective index, and solar UVA measurements from the coated and uncoated pavement surfaces were monitored and measured. The pilot found that in the summer raising the albedo of the pavement surface from 20% to 70% lowered the surface temperature from 60°C to 47°C. This represents 22% decrease in pavement surface temperature.

The cool pavement technology project supports the Ministry of Energy and Infrastructure's Sustainability Strategy: Organising, planning, and guaranteeing the sustainability of the infrastructure, and the transport sector. It also supports national and global strategies including the Green Economy for Sustainable Development, National Climate Change Plan of the UAE 2017–2050, UAE strategy for the Future, National Strategy for Advanced Innovation, National Strategy for Wellbeing 203, UAE Circular Economy Policy, goal 11 of the United Nation's sustainable development goals (SDGs), Centennial Plan 2071.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No. However, the technology can be replicated in other applications such as the marking of roads and highways, airplane runways, car parks, playgrounds and sports grounds with asphalt and concrete pavements, and build roofs.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

No.

InfraTech solution

What was the technological solution deployed for this project?

Watergy International Group developed the cool pavement technology to improve albedo control technologies that can compensate the carbon footprint, support sustainability and environment protection and quality of life. The project was tested by the University of Sharjah and supported by the Ministry of Energy and Infrastructure.

The cool pavement technology is a new reflective surface treatment that can be used to reduce the pavement surface temperature. This has many benefits, including more durable pavement that deforms less quickly and last longer because of the decreasing absorption of solar radiation over time, reducing the temperature of the outside air which improves comfort and reduces heat-related sickness and mortality, allowing air conditioners to use less energy to cool buildings; lowering the requirements for night-time electric street lighting, and reducing greenhouse gas emissions.

Case study 32: Pavimenta2, Latin American and the Caribbean

A novel platform for identifying, measuring, and quantifying pavement failures in addition to validating transportation signage using Artificial Intelligence (AI) and Deep Learning.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Adoption of an innovative digital tool based on artificial intelligence (AI), for the roads network assessment and planning processes. Competitive advantage of reducing investment and time required by 98%.	An innovative tool that improves paved roads network planning and reduces maintenance costs for government agencies. It replaces a costly and lengthy manual process. AI application, digitalisation and simplification of road assessment process.	Technical cooperation funds and loans to governments in Latin America and the Caribbean to deploy technological infrastructure (cloud-based, or on-premises if required), and to adapt, operate, maintain, and upgrade the model, as well as keeping it cyber resilient.

Project summary

PROJECT NAME AND LOCATION:	**PAVIMENTA2, LATIN AMERICA AND THE CARIBBEAN**
Sector:	Transport, Roads
Key benefits:	CAPEX efficiency OPEX efficiency Climate mitigation
Additional benefits	Improved road network maintenance planning to minimize interventions and reduce their environmental impact
Organization, role on project:	Inter-American Development Bank Group (IADB), Financial partner for governments in Latin America and the Caribbean
Scale of deployment:	There are 627,418 kilometres of paved roads in Latin America and the Caribbean (LAC), serving a population of over 565 million people
Project value:	Based on first assessments, we estimate an investment of USD 60,000 for a network of about 10,000 kilometres. This may extrapolate to USD 3.6 million for the entire paved road network in the LAC region.
Project start/end dates:	Q4-2022 to Q4-2024

Current status of the project:	Operational, the app has been published in the IDB library and is available for deployment and improvement
Lifecycle stage where technology is applied:	Planning and strategy; Project preparation; Operation and maintenance

About the project

Pavimenta2 is a platform developed by the IADB for identifying, measuring, and quantifying pavement failures in addition to validating transportation signage using Artificial Intelligence (AI) and Deep Learning. It uses computer vision technology to assess the quality of roads and signage. The tool automates and speeds up data collection and delivers cost savings over traditional approaches. Pavimenta2 allows scarce qualified human resources to focus on strategy and planning, resulting in more resilient road systems. Pavimenta2 reduces a process from what may take several months to a few weeks of video collection and processing. Currently, assessing 10,000 km of a road network is a labour-intensive process that requires 18 months and costs an estimate of USD $3.2 million. With Pavimenta2, this assessment takes 2 weeks with an estimated cost of USD $60,000.[14] It can allow IDB to identify transport and pavement patterns to create sector efficiencies.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The IDB has been running pilots in Argentina, Brazil, Uruguay and five other countries in Central America.

What were the challenges experienced in implementing these approaches?

- **Limited access to funds:** To finance the initial stages of product development from concept, MVP, model training, documentation, quality tests, etc. up until final publication in the bank library. The development of the tool was made mainly by IDB's staff. IDB used technical cooperation funds and loans for hiring part time developers and for the initial roll-out.
- **Scaling up the tool:** Requires developing a partnership with each of the numerous transport agencies at both national and sub-national level.
- **Cloud infrastructure:** Client's cloud infrastructure could be different from developer's infrastructure. Moving the solution between different cloud platforms could be tricky and sometimes implies a whole new development. Support from local technical staff that know client's infrastructure is a good practice. Adaptation may include the adequation of client's IT infrastructure, development of front-end (visualisations & reports) and back-end (cloud architecture, integration with existing systems) modules, training and documentation, maintenance, and cyber security.

Are there other approaches that enabled investment that are not already covered above?

Synergies with road infrastructure programs where the loan includes a component for institutional development. This tool may help to prioritise maintenance expenditure and future major capital interventions within the road network, while gaining efficiencies and minimising waste and emissions from construction activities.

[14] All figures supplied by the Inter-American Development Bank

InfraTech solution

What was the technological solution deployed for this project?

Pavimenta2, automates the process from documenting, measuring, and recording each failure by simply driving through the roadway network with a mounted cell phone or GoPro® and uploading the recorded video. The app is published in IDB's library and already trained. According to the licence, anyone can do additional training for defect and signage detection. Pavimenta2 can measure quantities and locations of blurred lines, linear cracking, transversal cracking, crocodile cracking, rutting, and other failures. Additionally, the platform identifies roadway signage, classifies each sign, and decides if it is in good condition or may need maintenance.

Case study 33: NEXCO infrastructure inspection

InfraTech solutions for non-destructive inspection, pavement management and road condition survey

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Support the infrastructure owner's data-driven decision making		A change in data standards / architecture	

Project summary

PROJECT NAME AND LOCATION:	**NEXCO, USA, JAPAN AND INDIA**
Sector:	Transportation, Road/Rail
Key benefits:	Improved infrastructure delivery and performance OPEX efficiency
Additional benefits:	Contributed high-quality infrastructure
Organization, role on project:	NEXCO-West, NEXCO-Central, E-NEXCO
Scale of deployment:	NEXCO-West USA (Non-destructive inspection business) approximately 60 structural assessment contracts as of March 2022. NEXCO-Central (Smart Pavement Management) received 5 orders in the U.S. as of March 2022, aiming to increase orders continuously. E-NEXCO INDIA (E-NEXCO Eye) This project began in December 2021. Full-scale work will begin in FY2022 and surveys of approximately 3,000 km will be conducted with the aim of receiving orders for 10,000 km
Project value:	N/a
Project start/end dates:	Ongoing
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment Operation and maintenance

About the project

In the past, inspectors have mainly conducted visual inspections in close proximity to structures. However, this inspection technology solves the problem of traffic restrictions and significantly reduces the time required to collect data on-site.

In the conventional close-up visual inspection, there were individual differences in the recording of damage at the site depending on the skill level of the inspector. However, this technology ensures objectivity and accuracy of records.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

The technology is originally developed for highway bridge inspection, and now used for the other type of infrastructures such as railway tunnels and building façade. This technology supports the infrastructure owner's data-driven decision-making.

What were the challenges experienced in implementing these approaches?

Understanding the benefits and limitations of non-destructive structural assessment technologies are important and challenging. It is like an X-Ray in the medical exam – an attempt to find an indication of a problem but may not necessarily specify the exact problem with 100% accuracy. On the other hand, a detailed destructive test requires a tremendous amount of labour and traffic interference to obtain the very accurate information for limited number of structures. The users need to understand the purpose of their condition assessment (network level assessment or project level detailed assessment) and select the best choice.

Are there other approaches that enabled investment that are not already covered above?

A change in technical standards.

What was the technological solution deployed for this project?

NEXCO-West USA （Non-destructive inspection business）- NEXCO-West USA attempts to improve the efficiency and sophistication of maintenance management by utilizing concrete slab inspection methods that use infrared cameras and image diagnosis technology capable of inspections at speeds of 100 km/h. It also attempts to improve the efficiency and sophistication of concrete structure inspections, which have been conducted manually, by applying infrared cameras and image diagnosis technology.

NEXCO-Central （Smart Pavement Management）- Pavement images captured by commercially available action cameras are processed by AI to display a five-level pavement health rating in colour on an online map, making pavement maintenance planning and decision-making more efficient and faster, in an easy-to-understand and low-cost manner.

E-NEXCO INDIA （E-NEXCO Eye）- The Pavement inspection using lasers, 3D cameras, and line sensor cameras at speeds from 0 to 100 km/h will improve the efficiency and sophistication of maintenance management and contribute to keeping high quality roads.

Case study 34: Global BIM Network, International

The Global BIM Network connects international public sector representatives and multi-lateral organisations to share knowledge and advance the digitalisation of the built environment.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy			

Project summary

PROJECT NAME AND LOCATION:	**GLOBAL BIM NETWORK, INTERNATIONAL**
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Enhanced social inclusion Enhanced pandemic preparedness and response Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Organisation, role on project:	Connected Places Catapult, Host Organisation
Scale of deployment:	Over 1000 members from 97 countries
Project value:	
Project start/end dates:	Launched March 2021
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Enabling environment Project preparation (incl. concept, feasibility, appraisal) Construction Operation and maintenance

About the project

Public policy is used across the globe to encourage the digital transformation of the construction sector, employing Building Information Modelling (BIM) methodology to drive greater social, economic and environmental benefits from the built environment. These policies are implemented through initiatives and public sector programs that create positive impact at national, organizational and project level. The Global BIM Network connects public sector representatives and multi-lateral organizations to drive national and regional digitalisation agendas for the construction industry and built environment through knowledge sharing, collaboration and co-production. Through public events and knowledge

exchange activities, the Network connects members working on similar developments in different parts of the world with similar challenges to share insights, resources, project outcomes and lessons learned.

The Network collaborates to co-develop an online repository primarily for the global public sector and multi-lateral organizations seeking guidance, accessing and sharing documentation, protocols, operational manuals, case studies, tools, training materials and other resources to facilitate the strategic introduction of BIM worldwide. The Information Collection is also open to everyone with an interest in growing the benefits from the structured use of BIM as part of the larger digital transformation of the sector.

The Global BIM Network's Roadmap 2021-25 outlines a vision and collaborative pathway for public sector leadership across the globe to promote the digitalisation of the built environment. Launched at the Network's first General Assembly on 2 December 2021, the Roadmap aims to support and promote public sector leadership efforts to collaborate with industry on the critical opportunity of digitalisation in response to the pandemic, climate change, and to drive inclusive growth through capacity building and knowledge transfer. The Roadmap has been co-created by representatives from international public sector and multi-lateral organisations and public infrastructure funders connected and collaborating through the Network. Going forward, members of the Network will work together to develop and deliver the knowledge and activities to increase the global public sector's digital capabilities and capacities.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

No.

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

International knowledge sharing and collaboration: The Network is the natural development of the increased level of international collaboration between governments and multi-lateral organisations on the digitalisation agenda in the construction industry and built environment. These collaborations include the EU BIM Task Group, the UK's Prosperity Funded Global Infrastructure Program and CDBB's International programme; Singapore's Regional BIM Symposiums, the Inter-American Development Bank and the Red BIM de Gobiernos Latinoamericanos in Latin America. These partnerships have stimulated national BIM programmes and regional initiatives that promote the use of digital across the public and private sector, aligned with a common language and common benefits.

What was the technological solution deployed for this project?

The Global BIM Network hosts an online, open-access knowledge base of resources from governments and organisations championing BIM in public sector construction and infrastructure projects. The Information Collection is organised geographically and structured under four categories, known as information pillars:

- Public leadership (BIM policy, legislation, programmes, strategy and plans)
- Collaborative framework (legal, procurement, technical references, guidance, templates and tools)
- Communication and communities (references to communities of practice, media publications and websites)
- Capability and capacity building (training materials, case studies and skills development).

Case study 35: InfraTech Policy Ecosystem, United Kingdom

A policy eco-system, aligned to national strategies, driving the digital transformation of the UK's built environment sector.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
Development of a national, regional, or sectoral InfraTech strategy	New platform for InfraTech ecosystem	A change in data standards / architecture Implementation of cyber-security or improved privacy measures	Public investment

Project summary

PROJECT NAME AND LOCATION:	**INFRATECH POLICY ECOSYSTEM, UNITED KINGDOM**
Sector:	Infrastructure (all)
Key benefits:	Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Additional benefits	Optimised planning, delivery, management, operation and performance of individual built assets, related services and the wider eco-system
Organisation, role on project:	Case study developed by the GI Hub
Scale of deployment:	Information Management Mandate, which supersedes the UK government's 2011 BIM Mandate, applies to all public sector clients
Project value:	
Project start/end dates:	2011 - ongoing
Current status of the project:	Operational
Lifecycle stage where technology is applied:	Throughout the built environment lifecycle

About the project

The UK has developed a government-led programme that, working with academia and industry, supports and promotes increasingly sophisticated digitalisation, digital modelling and information management and sharing, to support the optimisation of the built environment across its lifecycle and to ensure this done in way that maintains safety, security and resilience. The programme has driven the adoption of building information modelling (BIM), is improving information interoperability across the built asset lifecycle and, through the government-led National Digital Twin Programme, is seeking to grow national capability in digital twinning. Work is also ongoing, in collaboration with the Centre for Protection

of National Infrastructure[15] to develop the Information Management Framework, a formal mechanism to ensure that the right information can be made available at the right time, to the right people and that the quality of the information is known and understood, Additional work is being done Tech UK[16] which is the InfraTech 'trade association' which is focussing on shaping policy and standards for transformational technologies and the Connected Places Catapult[17] which hosts the Digital Twin Hub and Global BIM Network.

The work is also referenced in a number of government strategies, showing the extent of the reach of the work both within built environment and in the wider data management and sharing context. These strategies include:

- National Data Strategy
- National Infrastructure Strategy
- Transforming Infrastructure Performance – A roadmap to 2030
- Innovation Strategy; and
- Integrated Review.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Yes. Through government-to-government partnerships the UK has supported governments around the world, including Chile, Peru, Colombia, Mexico, the United States of America, to develop national BIM policies and programmes[18].

What were the challenges experienced in implementing these approaches?

None.

Are there other approaches that enabled investment that are not already covered above?

The policies were supported by government-supported and industry-funded socio-technical change programmes to grow sector capacity and capabilities in InfraTech. These programmes included the UK BIM Task Group[19], the National Digital Twin programme[20], the Construction Leadership Council[21] and the UK BIM Alliance[22].

What was the technological solution deployed for this project?

BIM has been key to digital transformation, and the delivery of improved information management, across the UK built environment since the 2011 Government Construction Strategy introduced the requirement for fully collaborative BIM as a minimum by 2016. This is referred to as the UK BIM Mandate.

[15] CPNI, *Centre for the Protection of National Infrastructure* (2021), Available at: https://www.cpni.gov.uk/

[16] TechUK, *The UK's technology trade association* (2021), Available at: https://www.techuk.org/

[17] Connected Places Catapult, further information found at: https://cp.catapult.org.uk/

[18] Further information on Global BIM initiatives can be found at CDBB, https://www.cdbb.cam.ac.uk/subject/international-programme and www.globalbim.org

[19] https://www.gov.uk/government/news/launch-of-digital-built-britain

[20] https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme

[21] https://www.constructionleadershipcouncil.co.uk/

[22] www.ukbimalliance.org

Delivery of the BIM program has enabled the UK to secure 20% savings on CAPEX in 2013 against 2009 / 2010 benchmarks[23] and was identified as a significant contributor to savings of GBP804 million (USD1.1 billion) in construction costs in 2013 / 2014.[24]

BIM is currently defined in the UK by the UK BIM Framework[25] and is based on the emerging ISO 19650 series of standards and any of the remaining BS/PAS 1192 suite of standards. It was previously known as BIM Level 2 until it was superseded by the UK BIM Framework in 2018.

[23] HM Government, *Digital Built Britain Level Three Strategy* (2015)https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/410096/bis-15-155-digital-built-britain-level-3-strategy.pdf p. 8

[24] HM Government, *Digital Built Britain Level Three Strategy* (2015)https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/410096/bis-15-155-digital-built-britain-level-3-strategy.pdf p. 8

[25] www.ukbimframework.org

Case study 36: AIIB InfraTech Platform

A 'one-stop shop' for investment leads, clients and partners to apply and develop technologies in infrastructure sectors.

POLICY ENABLERS	COMMERCIAL ENABLERS	TECHNOLOGY ENABLERS	FINANCE ENABLERS
	Integration into project preparation process New platform for InfraTech ecosystem		Public investment A new fund / investment platform Provide traditional project financing to infrastructure projects that have high technology content / components

Project summary

PROJECT NAME AND LOCATION:	**INFRATECH POLICY ECOSYSTEM, UNITED KINGDOM**
Sector:	Infrastructure (all)
Key benefits:	Climate mitigation Climate adaptation Enhanced social inclusion Enhanced pandemic preparedness and response Improved infrastructure delivery and performance CAPEX efficiency OPEX efficiency
Additional benefits	Financing infrastructure projects with technological components; Investing into technologies that are key to improving infrastructure sectors and outcomes; Connecting and convening insights, services, business opportunities and networks together; and, Creating and ecosystem and facilitating the technology development as well as their applications in infrastructure
Organisation, role on project:	AIIB, Financier and Facilitator
Scale of deployment:	Apply to all AIIB members, projects and partners
Project value:	2019 – 2021: Financed and supported 18 projects applying technology in infrastructure and 3 projects developing technology for infrastructure, USD3.49bn total financing provided (the total project size, including other components)
Project start/end dates:	2019 - ongoing
Current status of the project:	Ongoing
Lifecycle stage where technology is applied:	All

About the project

The AIIB platform takes a holistic approach to support financing the development and deployment of technology for infrastructure projects by offering knowledge, network, capital, innovation services and regulatory dialogues to members, investment leads and clients. The Platform consists of 5 pillars:

- **Insight:** gathering information and developing insights and knowledge tools to support clients to identify technologies during the financing process.
- **Interconnect:** bringing together different partners to share experiences and facilitate collaborations.
- **Invest:** leveraging knowledge and networks to support investment execution from upstream preparation to execution. It also develops longer-term investment relationships with projects.
- **Innovate:** partnering with projects and stakeholders to organize innovation events and support new solutions to be commercialized and adopted.
- **Influence:** contributing to and facilitating international dialogues on the InfraTech and Digital Infrastructure agenda and regulatory discussions through roundtables and workshops for all members.

Approaches for scaling up InfraTech

Have the approaches for attracting investment been used or replicated in other projects?

Similar ecosystems are being built in other organizations – e.g., Macquarie has a dedicated platform (Venture Studio) and department to explore using emerging technologies to Infrastructure assets, same for Ardian and InfraVia. AIIB have also seen major infrastructure sponsors developing their own technology ecosystem and provide value-add service to partners and clients.

What were the challenges experienced in implementing these approaches?

In the beginning, it took a lot of time and effort to facilitate discussions: technology is not a major topic for Infrastructure decision-makers and infrastructure is not a targeted sector for technology companies. There were also early challenges in developing a consistent framework that could consolidate a massive amount of information in a structural manner.

Are there other approaches that enabled investment that are not already covered above?

AIIB has developed knowledge tools and provide support to help clients advance in their digital / technology adoptions. These include: an interactive Infratech Solution Database with more than 300 solutions to support investment teams to quickly identify solutions to apply for their projects; conducting thematic research on key technologies that will transform and optimize infrastructure sectors; partnering with Mott Macdonald to develop a smart infrastructure index to support assessment of the digital readiness and feasibility of using digital technologies in projects; providing independent advisory support to public and private sponsors; and, providing a platform for case studies and knowledge transfer.

What was the technological solution deployed for this project?

The platform has facilitated the deployment of 20+ InfraTech projects with technology applications and technology development. 29% are equity projects and 71% are debt projects. The ratio of digital and non-digital technologies is 13:11.