Smart Green ASEAN Cities

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FMDV

ASEAN-EU Smart Green City Finance Casebook

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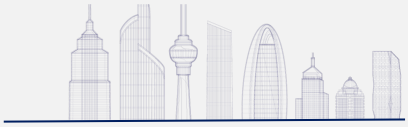

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About the Smart and Green ASEAN Cities Programme

The Smart Green ASEAN Cities (SGAC) programme is a four-year initiative (2021-2024) funded by the European Union (EU), implemented by UN Capital Development Fund (UNCDF) together with FMDV with the support of the ASEAN Secretariat that aims to support the deployment of smart and green city projects across selected ASEAN 'middleweight' cities.

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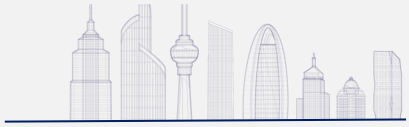

The ASEAN region is the fifth-largest economy globally in 2019 and was the second-largest destination for Foreign Direct Investment (FDI) in 2022. Based on Asean Sustainable Urbanisation Report, it is projected that nearly 56 percent of ASEAN's population will reside in urban areas in 2030, a significant increase from 47 percent in 2015. This rapid urbanization, while reflecting concentrated economic opportunities, also places significant pressure on the environment and public services. According to the ASEAN State of the Environment Report, energy-related CO2 emissions are expected to increase by 61% from 2014 to 2025.

Currently, central governments in Asia provide 90% of infrastructure financing. However, public finance alone cannot bridge the growing gap for green and climate-compatible infrastructure in Southeast Asia, which the Asian Development Bank estimates will require US$210 billion annually by 2030, especially in mid-sized cities. While there is substantial potential for public and private climate investment, the resources, constraints, and solutions available to cities can vary significantly across sectors and countries. Therefore, local governments must explore various market opportunities to enhance and optimize the use of public funding, enabling more efficient leveraging and mobilization of private sector finance.

This casebook aims to show the way by sharing the experiences of cities that have navigated smart green projects. It features profiles of ten cities from ASEAN and the European Union, showcasing sectoral projects with promising smart and green practices and innovative financing approaches. This resource is intended for city officials, urban planners, and other stakeholders, offering insights into regional conditions and visions, challenges, solutions, financing, impacts, critical enablers, and replication strategies.

By highlighting these examples, we aim to inspire other local governments to implement similar projects, tailored to their specific contexts, to achieve their own smart green city visions. We hope to encourage the adoption of best practices in smart and environmental city management across the EU and ASEAN regions through facilitating knowledge exchange and fostering city-to-city partnerships.

We appreciate the contributions of all parties involved in creating this casebook, and hope that readers find the insights and recommendations valuable as we collectively strive towards efficient and sustainable urban development in the region.

Carlos de Freitas
Executive Director
FMDV - Global Fund for Cities Development

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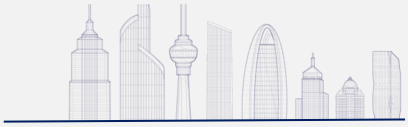


This casebook has been written as part of the EU-ASEAN Smart Green ASEAN Cities (SGAC) programme. In it, we look at ten cities - five in the EU and five in ASEAN countries - and actual projects they have undertaken in the past decade to address some of their smart green city goals. The objective is to provide real examples of steps that cities in both parts of the world have taken to achieve results, and to give some ideas on how other cities can learn from these examples to do similar types of projects to achieve their own smart green city visions.

Although there is a considerable opportunity for both public and private climate investment, the technical, technological, and financial resources accessible to cities can differ greatly across various sectors and countries. By describing some cities' experiences with their smart green projects, this casebook aims to support knowledge exchange and to facilitate EU-ASEAN city-to-city partnerships on smart and environmental city management practices between EU cities and ASEAN cities as well as among cities across all ASEAN countries.

The projects reviewed here fall into several thematic areas, or 'clusters' as shown in Table 1, below. These are mostly sector-based but the last, "Mobilising Private Finance", highlights how cities have used private finance to accomplish city goals with some of the projects. This is not always possible, and depends upon the project in question, what physical assets need to be paid for, and who the users are, but these ten illustrate the range from fully public (indeed, national government) finance to entirely private. Note that several of the projects have impacts in more than one category.

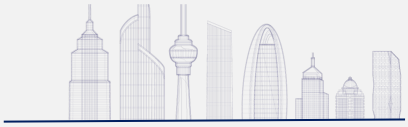
To illustrate with a few examples drawn from the study:

Da Nang's project to encourage the build-out (by various market participants) of a network of electric vehicle (EV) charging stations for the city's growing number of electric cars and scooters, touches on several areas:

1. **Mobility cluster,** as it encourages residents to switch to EVs by making it easy to charge them;
2. **Energy cluster,** because the presence of the charging stations encourages use of electricity instead of fossil fuels;
3. **Tourism cluster,** as one of the EV charging stations is at the Marriott Hotel and tourists now have the option to rent EVs to tour around Da Nang; and
4. **Mobilising Private Finance cluster,** as three of the five stations in the network were built by private firms, the hotel mentioned previously and two at dealerships of VinFast electric cars, one of Viet Nam's leading EV producers.

Similarly, in Malaysia, Seremban's project to close an old municipal landfill and use the land for a new solar park touches on:

1. **Solid Waste Management cluster,** as a hazardous legacy landfill belonging to the city was closed and covered to create the land area;
2. **Energy Use cluster,** as the newly available land was used to construct a ground-mounted solar plant now generating renewable power and supplying it to the Malaysian grid; as well as
3. **Mobilising Private Finance cluster,** as the entire project was done by a private firm not only at no cost to the city, but under a lease and power revenue sharing agreement which gives the city a new source of revenue for years.



In Sweden, the Malmö project to develop a new part of the city around a smart "micro-grid" of interconnected buildings sharing energy from a network of onsite solar panels, heat pumps, thermostats, smart power load-balancing and distribution equipment touches on:

1. **Energy cluster,** as the gist of the project was improving energy by interconnecting the buildings in the district through the smart grid;
2. **Integrated Smart City Data Platform cluster,** in that the power management applications of the microgrid interface with the city's smart city data platform; and also
3. **Mobilising Private Finance cluster,** in that the costs of developing and deploying the core technology for the micro-grid, the 'Ectogrid' power management network and the 'Ectocloud' software had been financed by the city's private power utility, E.ON.

The Paris case, of seeding a dedicated privately managed institutional equity fund, the "Paris Green Fund", to invest in local startups and early-stage businesses bringing to market systems and cleantech products and solutions applicable to Paris' own smart green transport and mobility needs, touches on:

1. **Tourism cluster,** by maintaining and enhancing the city's attractiveness as a tourist destination;
2. **Mobility and Energy clusters**, by supporting the development of more energy-efficient and green ways to move residents and tourists around the city while reducing the use of private automobiles; and
3. **Mobilising Private Finance cluster,** by using the creative approach of having the city act as bellwether investor in a new Paris-focused fund from a Paris-based asset manager raising money to catalyse (by a factor of roughly 10:1) additional investment from private investors elsewhere in France and internationally.

Some projects described in these studies illustrate the value of close cooperation between cities and their national governments in terms of both paying for projects but also the value of shared national-level technology such as Thailand's Phuket and Viet Nam's Ho Chi Minh City national hosting platforms for city data and smart city apps. In Indonesia, Jakarta's smart street lighting project is embedded not only in a national program to replace city street lights but also in the country's international climate adaptation plan (NAMA) filed with the UNFCCC.

In Europe, besides Malmö and Paris we see:

1. Rhenen, in the Netherlands, which illustrates the value of embedding nature-based climate adaptation approaches in a city's everyday road and sewer maintenance work to avoid rainwater overwhelming the sewer and wastewater treatment facility (not everything has to be a discrete "project" – successful climate adaptation strategies should be integrated into regular city operations).
2. Valladolid, Spain, showing how to use private energy service companies (ESCOs) to cut energy use and costs in public housing at little cost to the city; and
3. Porto, Portugal, which achieved better stormwater control with another nature-based solution: a new green city park largely financed by private property developments around the park.

Table 1: Cities, Projects & Thematic Clusters

City / Project	Thematic Cluster						
	Solid Waste	Water/ Wastewater	Tourism	Mobility	Energy Use	Integrated Smart City Data Platform	Mobilising Private Finance
Da Nang VN *Electric vehicle charging stations*			X	X	X		X
Ho Chi Minh City VN *Intelligent Operations Centre (IOC)*						X	
Jakarta ID *Smart Connected Street Lighting system*				X	X		
Malmö SE *Smart District Microgrid System*					X	X	X
Paris FR *Greentech Investment Fund*			X	X	X		X
Phuket TH *Smart Tourism Management*			X			X	
Porto PT *Smart stormwater management*		X					X
Rhenen NL *Smart Stormwater Management*		X					
Seremban MY *Landfill-to-Solar Conversion*	X				X		X
Valladolid ES *Energy Efficiency in Public Housing*					X		

Source: Author's Analysis

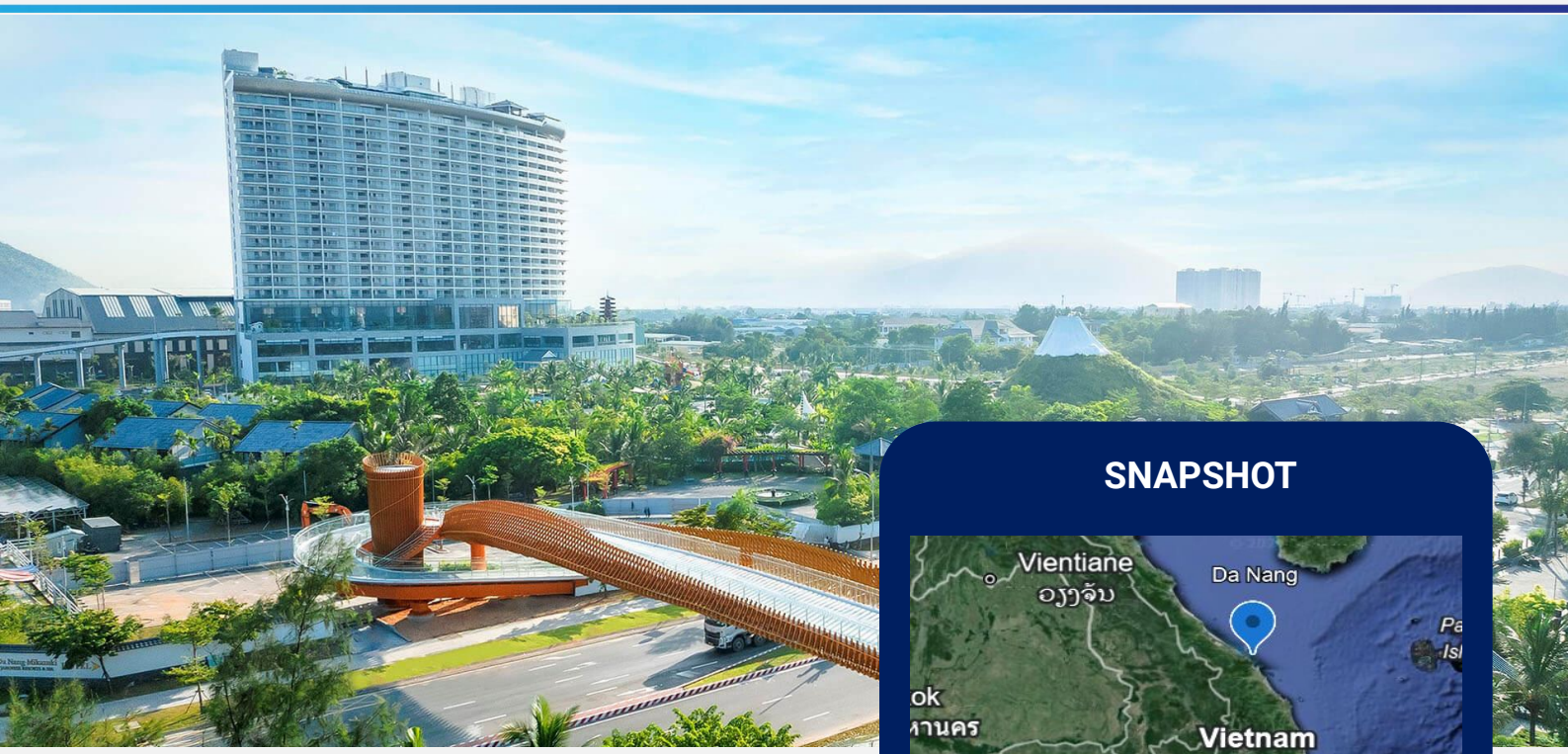
METHODOLOGY

The city case studies all follow a common outline, giving basic population, area, and a brief introduction to each city to summarise its unique history, geography, and how those have influenced their development and economic growth over the years (in most cases centuries and, in some cases, millennia), followed by a brief recap of key points of their respective “smart city” ambitions and goals which articulate how each is or using or plans to use smart technologies to improve quality of life for its residents and delivery of public services.

Following this context-setting, each study describes the selected project, its context, objectives and, to the extent published, how it was financed, as well as reported impacts and results. A final section in each on “Replicability”, briefly discusses how any other city might approach undertaking a similar project. Finally, for each city/ project, footnotes and endnotes are included to guide further research by the reader.

Information was gathered from various sources, including interviews, city reports, city websites, news media reports, materials from vendors and suppliers involved in these projects, economic statistics publications, industry publications, national and municipal city data platforms, and encyclopedia sites.

A conclusion summarises the differences and similarities among the case studies, and gives some next steps and general strategies a city can take to plan and implement smart green projects.



Source: Danang Department of Tourism

Da Nang
Vietnam

Da Nang has developed as the commercial and educational centre and largest city in Central Vietnam partly due to its excellent port and harbour at the mouth of the Han River, and its location on both the principal north–south highway in Viet Nam (NR 1) and the North–South Railway. It has also become a tourist destination, with attractive beaches within 100 km (62 mi) of several UNESCO World Heritage Sites, including the Imperial City of Huế, the Old Town of Hội An, and the Mỹ Sơn ruins.

Like much of Viet Nam, Da Nang's industry has historically been dominated by large State-Owned Enterprises (SOEs) managed from Hanoi, with about half of the rest from Foreign Direct Investment (FDI), and local private businesses comprising the rest. In January 2023, the total city GDP stood at VND 30,746B [EUR 1.12B], up 11% from January 2022.

[1]Hoang, V. (2023) Scale of da nang's economy in 2023 reaches over VND134,247 billion, DaNangToDay. Available at: https://baodanang.vn/english/business/202312/scale-of-da-nangs-economy-in-2023-reaches-over-vnd134247-billion-3962580/

SNAPSHOT

Area in km² (Greater Metro)
1,285 km²

Administrative Status
Class 1 (province-level) Municipality (5th largest city in Vietnam by population)

Administrative Divisions of the Country
Vietnam has three levels of subnational government, consisting of People's Councils and People's Committees at all levels: 63 provincial-level administrative units, 713 district-level, and 11,162 commune-level ones.

Priority Smart Green City Clusters
Smart Mobility (Electric Vehicle Charging Stations)

Population
1.25 million

National Political System
Unitary single-party socialist republic

Geography & Topography
Da Nang low-lying coastal city in Central Viet Nam, with a tropical monsoon (Am) climate, facing East onto the South China Sea at the mouth of the Hán River

City Network Membership
- ASEAN Smart Cities Network
- World Smart Sustainable Cities Organization (WeGO)

Annual Municipal Cash Flow
VND 19,715B (EUR 749M)[1]

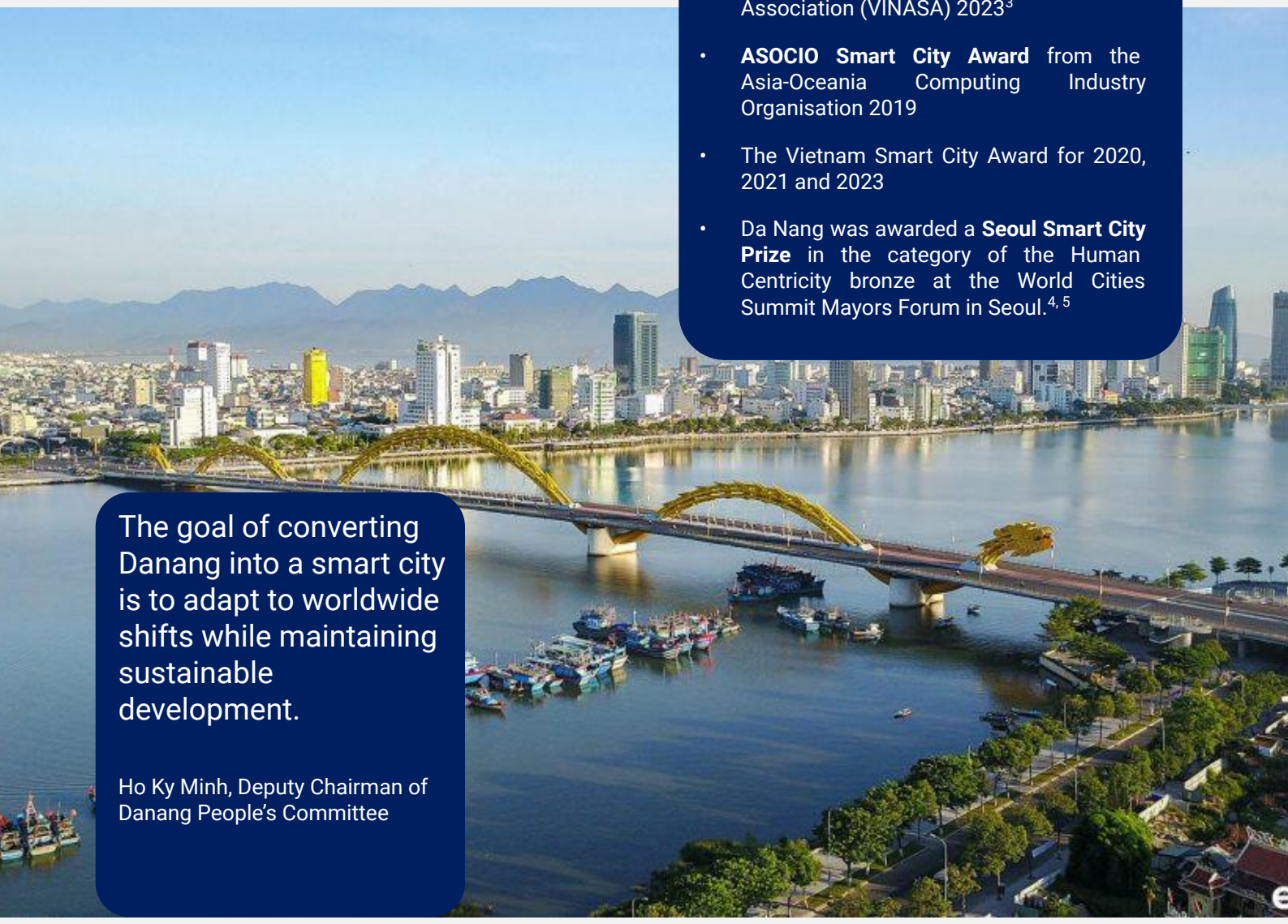
Smart and Green City Vision

Da Nang City Resolution No.43-NQ/TW on the construction and development of Danang by 2030 (with a vision to 2045), seeks to turn the city into a contemporary smart-eco city that is synchronously linked to smart urban networks in the nation and the ASEAN region. Further vision towards 2045 states that "Da Nang will become an ecological and smart metropolis, a centre of innovation and entrepreneurship and a coastal city worth living in Asia."[2]

The city government has embraced an "e-government" model since 2010. Da Nang was the first urban area in Viet Nam that sought to become a smart city in 2012 after signing a collaboration agreement with IBM. It was also the first city in Viet Nam to join the ASEAN Smart City network.

KEY ACHIEVEMENTS

- **Excellent city** in building smart cities in VietNam by the Viet Nam Software and Information Technology Services Association (VINASA) 2023[3]
- **ASOCIO Smart City Award** from the Asia-Oceania Computing Industry Organisation 2019
- The Vietnam Smart City Award for 2020, 2021 and 2023
- Da Nang was awarded a **Seoul Smart City Prize** in the category of the Human Centricity bronze at the World Cities Summit Mayors Forum in Seoul.[4, 5]



The goal of converting Danang into a smart city is to adapt to worldwide shifts while maintaining sustainable development.

Ho Ky Minh, Deputy Chairman of Danang People's Committee

Source: Danang Department of Tourism

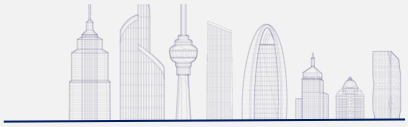
[2] Thu vien phap luat (2019) 43-NQ/TW in Vietnam, Politburo's Resolution 43-NQ/TW 2019 development of Da Nang City by 2030 in Vietnam, THƯ VIỆN PHÁP LUẬT. Available at: https://thuvienphapluat.vn/van-ban/EN/Xay-dung-Do-thi/Politburo-s-Resolution-43-NQ-TW-2019-development-of-Da-Nang-City-by-2030/427198/tieng-anh.aspx

[3] Hiep, H. and Thang, C. (2023) Da Nang honoured as excellent city in building smart cities in Viet Nam, DaNangToDay. Available at: https://baodanang.vn/english/education-science/202312/da-nang-honoured-as-excellent-city-in-building-smart-cities-in-viet-nam-3961059/

[4] Toan, N. (2022) Danang pinning hopes on delivery of eco-smart city, Vietnam Investment Review. Available at: https://vir.com.vn/danang-pinning-hopes-on-delivery-of-eco-smart-city-95118.html

[5] VnExpress International (2023) *Da Nang wins Seoul Smart City Prize - VnExpress International*, *VnExpress International*. Available at: https://e.vnexpress.net/news/news/da-nang-wins-seoul-smart-city-prize-4658811.html

Financial Resources & Management Approaches of the City Government



Local administration in Viet Nam is the most local executive of a hierarchy of People's Committees with the National Congress, Central Committee and National Assembly of the Communist Party of Viet Nam at the top[6], exercising state power at provincial, district and commune levels. City administration, such as in Da Nang, comprises a People's Council and a People's Committee.

Under the Da Nang city People's Committee are 22 operating departments e.g. finance, transportation, construction, natural resources, tourism, home affairs, foreign affairs and other functions, mirroring national ministries. In parallel to the operational departments are offices for the eight districts of the city, and a further five special offices for veteran's affairs, the Peasants' Association, treasury, tax and customs. Of these, responsibility for ' 'smart city" development is shared by the Departments for Information and Communications, Natural Resources and Environment, and Science and Technology.

Most of the annual budget (73%) is raised locally in the city, with some 26% coming from the national government. In 2023, the Da Nang total revenues amounted to VND 19,715 B (EUR 748.5M) -- a decline of 14.8% compared to FY 2022 -- of which central budget revenue comprised VND 5,150B (EUR 192.7M), and local revenue VND14,565B (EUR 545.1M). During that period, investments made were VND8,585B (EUR 321.3M) - up 1.0% from FY 2022, and operating expenses were VND16,408B (EUR 614.1M), up 6.9% from FY 2022[7]. It is understood that there is no external borrowing from e.g. bond markets or commercial banks. Development Finance Institutions do lend for Vietnamese urban projects, but these are structured as sovereign loans earmarked for specific undertakings and overseen by national ministries e.g., by the Ministry of Construction as implementing agencies, working through a city People's Committee's Construction Department.

Besides being a tourist destination, Da Nang has had a broadly diversified industrial economy, producing fabric, clothes, bricks, fertilisers, cement, soap, paper, and pharmaceuticals. Industrial parks are also emerging around the city to cater to inward foreign direct investors, e.g., EADS the European Aeronautic Defence and Space Company, planning to set up a Da Nang industrial park focused on the aviation industry. Industrial growth is slowing, though, in favour of services. From 2022-23, the legacy industrial and construction sectors grew by only 4.74%, and agriculture, forestry and fishery decreased by 0.01%.

As tourism has picked up after COVID, it is the city's service economy which has been driving overall growth:

However, as tourism started again after COVID, Da Nang's private services sector has grown faster than the overall economy: from 2022-2023, the following tourism-driven sectors grew fastest:

- Travel and tourism support services +600%;
- Administrative and support services +96%;
- Personal services +78%;
- Hotels and restaurants +74%;
- Accommodation and food services +70%;
- Food and beverage services +40%;
- Beverages production +36%;
- Wood & wood products +33%;
- Arts and entertainment +21%; and
- Food production +18%.

Da Nang also aims to be an international cargo hub as well. Authorities forecast that the city's airport and seaports (as opposed to roads) will handle 80 percent of cargo traffic passing through Da Nang by 2045. The city plans to invest some USD 600M, to further develop as a key logistics centre for the entire country[8].

[6] Embassy of the Socialist Republic of Vietnam in the United States. *Government Structure*. Available at: https://vietnamembassy-usa.org/vietnam/politics/government-structure
[7] Hoang, V. (2023) *Scale of da nang's economy in 2023 reaches over VND134,247 billion*, *DaNangToDay*. Available at: https://baodanang.vn/english/business/202312/scale-of-da-nangs-economy-in-2023-reaches-over-vnd134247-billion-3962580/
[8] Samuel , P. and Nguyen, D. (2023) Why da nang remains attractive for foreign investors, Vietnam Briefing News. Available at: https://www.vietnam-briefing.com/news/why-da-nang-remains-attractive-for-foreign-investors.html/

Context and Challenges

Vietnam is grappling with severe air pollution, ranking among the worst in the ASEAN region. Vietnam also ranks among the world's top five most vulnerable countries to the impacts of climate change[9]. To address these pressing issues, Vietnam submitted an updated NDC to the UNFCCC in 2020, aiming to cut greenhouse gas emissions by 9% using domestic resources and by 27% with international assistance by 2030. Additionally, Vietnam pledged to achieve net-zero emissions by 2050 at COP26 in November 2021[10].

The transportation sector, particularly road transport, is a significant contributor to Vietnam's greenhouse gas emissions, accounting for 18% of the nation's total. Thus, transitioning to e-mobility is crucial for Vietnam to achieve its NDC and 2050 net-zero emissions goal. Vietnam also has the potential to lead in electric vehicle (EV) demand and production in the ASEAN region, especially in the electric two-wheeler market, which is the second largest globally after China[11].

The adoption of EVs to reduce emissions is also prominent in Da Nang, where increasing EV usage is a priority mitigation measure according to the city's Climate Action Plan. Given that over 30% of Da Nang's emissions come from road-based sources, switching to EVs could significantly reduce greenhouse gas emissions and air pollution levels in the city[12].

In the broader ASEAN and Asia Pacific regions, the market for EV charging stations is expected to grow 30.8% p.a. in value from 2022 to 2029 to reach USD 69.57 B. Over the same period, market volume is forecast to grow 40.8% p.a. to 10.1 million units being installed by 2029[13], driven by initiatives supporting adoption of EVs and charging infrastructure and increasing deployment of EVs by shared mobility operators.

To encourage the uptake of EVs and development of EV charging stations in Viet Nam, the Ministry of Transport has proposed incentives including subsidised interest rates for firms involved in the production and import of related components for building charging stations and posts (particularly for fast charging); discounted electricity rates and prioritisation of electricity supply connections for public charging stations; together with land rent incentives and favourable tax treatment (exemptions and reductions) for companies, organisations and individuals investing in electric charging stations.

Despite the promising outlook for EV market growth, it has faced challenges A major reason consumers are discouraged from buying EVs is concern about their range[14]. Consumers often compare the convenience and cost of charging an EV with traditional petrol stations. Therefore, establishing a widespread and accessible charging network, along with battery swapping systems, is crucial for alleviating customer concerns and promoting EV adoption. Key players in this market include Electricity of Vietnam’s Central Power Corporation, HGPT Mechanical, Mitsubishi Motors Vietnam, Vietnam Oil & Gas Group (PVOIL), VinFast, and others[15].

The industry is still in its early stages, with issues such as inadequate power grid capacity and a lack of standardized charging protocols. Additionally, substantial investments are needed to develop the charging infrastructure, which requires both financial resources and careful logistical planning. While there is a potential benefit of being a first-mover advantage, it could also lead to a double-edged sword as companies may need to invest in developing the market as a whole. Notwithstanding the relative scarcity of EV charging stations compared to gasoline / diesel stations, The Vietnam Automobile Manufacturers Association (VAMA) forecasts that Vietnam will have one million EVs by 2028, with 3.5 million electric vehicles on the road by 2040.

[9] World Bank Group and Asian Development Bank (2021) Climate Risk Country Profile: Vietnam (2021). Available at: https://climateknowledgeportal.worldbank.org/sites/default/files/2021-04/15077-Vietnam%20Country%20Profile-WEB.pdf
[10] Climate Action Tracker (2023) Net zero targets, Viet Nam. Available at: https://climateactiontracker.org/countries/vietnam/net-zero-targets/#:~:text=Viet%20Nam%20announced%20its%20target,Nam’s%20climate%20action%20through%202050
[11] Le, H. and Posada, F. (2022) Promoting the development of electric vehicles in Vietnam. International Council on Clean Transportation. Available at: https://theicct.org/wp-content/uploads/2022/12/asia-pacific-evs-promoting-development-evs-vietnam-dec22-2.pdf

Project Highlight

Da Nang Electric Vehicle (EV) Charging Stations

The Solution

Danang is actively pursuing its transformation into a dynamic, green, and clean city. As part of this vision, the city has taken pioneering steps in promoting electric vehicles (EVs) and clean energy. In November 2017, the Electricity of Vietnam Central Power Corporation (EVNCPC) put into operation two electric cars alongside the country's first charging station in Da Nang, with components from the Japanese firm Mitsubishi Electric and the German firm SMA. This was a modest unit able to charge two EVs at the same time, powered by onsite solar connected to the power grid[16].

In 2021, Da Nang reaffirmed its commitment by revealing plans to propose locations for a charging station system and introduced various mechanisms to encourage EV development. Under the project, Da Nang's aim to increase EV acceptance by making charging stations available throughout the city, like gasoline stations. Its targets (set in 2021) are, by 2025, to have 150 Level 1 and Level 2, and 15 fast charging (Level 3) charging stations, and, by 2030, to have increased the number of charging stations to 250 and 50 respectively.

Vietnam's first domestic car manufacturer, VinFast, has also embarked on an ambitious plan to construct a total of 40,000 EV charging stations nationwide, with Da Nang identified as one of the five centrally-run cities earmarked for development.

Furthermore, Da Nang has announced incentive policies to support EV development, including promoting the procurement and usage of electric cars in governmental departments and agencies, creating a roadmap to support the transition of existing gasoline-powered public buses to EV counterparts, and proposing lower interest rates to support clean technology projects as it would reduce the cost of loans for building charging stations. Wherever possible, this is to be done off-budget, by using public-private partnerships, such as businesses building EV charging stations at public buildings and other locations[17].

The Financing

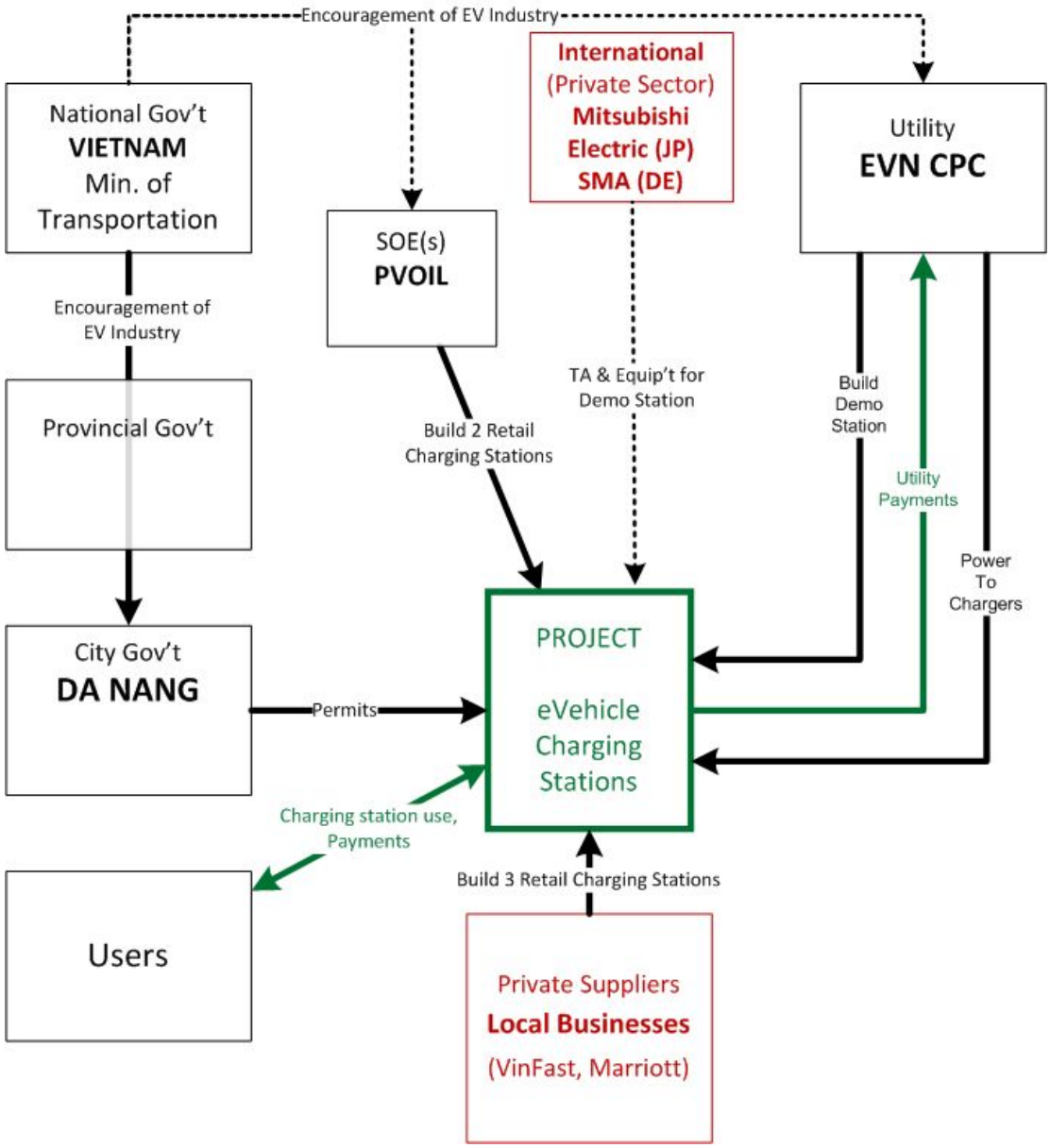
Da Nang's successful implementation of EV charging infrastructure underscores the necessity of substantial investment in developing charging networks to effectively support EV adoption. By leveraging public-private partnerships, such as businesses constructing EV charging stations at public locations, cities can expand charging infrastructure without solely relying on government funds. This approach aligns with Vietnam's broader goals of reducing greenhouse gas emissions and combating air pollution, demonstrating the importance of aligning local initiatives with national objectives.

The Da Nang Department of Finance was tasked under the city plan with evaluating contractors for the procurement of EVs and the development of EV charging stations at public establishments across the city as regulated.

The five EV charging stations currently in operation in Da Nang have been built by various private parties apparently at their own expense as commercial operations (charging stations "charge" customers to charge their car batteries); power is provided to each by the Central Region electric utility EVNCPC. Two stations (Hải Châu and Hoà Phước) at VinFast EV car dealerships, two (Hòa Xuân and Lê Văn Hiến) are at PVOIL gasoline stations owned by Petrovietnam, the state oil company[18], and one is at the Marriott Resort & Spa. The degree of city involvement in e.g. issuance of permits for local charging station sites is unknown.

[12] Kamei, M., Nguyen, A.T., Guibrunet, L., Davide, M., Fennell, P., and Jones, P (2022) Da Nang City Climate Action Plan - A conceptual framework for sectral climate actions. IGES. Hayama Available at: https://www.iges.or.jp/en/publication_documents/pub/policysubmission/en/12419/Da+Nang+climate+action+plan_0.pdf
[13] Meticulous Research Inc (2024) Top 10 companies in Asia-Pacific Electric Vehicle charging stations market, Meticulous. Available at: https://meticulousblog.org/top-10-companies-in-asia-pacific-electric-vehicle-charging-stations-market/
[14] Le Anh Tuan, "Study on the criteria development of pilot city selection."
[15] Kushwaha, D. (2023) Vietnam EV Charging infrastructure market growth 2023, rising trends, global industry share, scope, challenges, business opportunities and forecast, SPER Market Research. Available at: https://www.sperresearch.com/report-store/vietnam-ev-charging-infrastructure-market.aspx
[16] Nhan Dan (2017) *First EV quick charging station put into use in Vietnam*, *Nhan Dan*. Available at: https://en.nhandan.vn/first-ev-quick-charging-station-put-into-use-in-vietnam-post55692.html

Figure 1: Schematic of Parties Involved in Electric Vehicle Charging Stations, Da Nang



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Impact of the Project

At the time of writing (February 2024), the Da Nang network of charging stations has expanded from one station with two ports in 2018 to five stations with 21 parts (all DC fast charging type), distributed around the city as seen here: https://www.evchargingstops.com/vietnam/da-nang. This is above the city's original target, set in 2021, of 15 fast-charging (type 3) stations. Assuming the project continues as planned, the presence of these stations should promote the use of EVs in the city, creating more demand for more charging stations.

[17] Nguyen NH, Tran QT, Nguyen TV, Tran N, Roose L, Sepasi S, Di Silvestre ML. (2023) A Method for Assessing the Feasibility of Integrating Planned Unidirectional EV Chargers into the Distribution Grid: A Case Study in Danang, Vietnam. Energies. 16(9):3741. https://doi.org/10.3390/en16093741
[18] *PVOIL opens Vietnam's first electric car charging stations at petroleum stations. Available at: https://www.pvoil.com.vn/en-US/media/related-news/pvoil-opens-vietnams-first-electric-car-charging-stations-at-petroleum-stations*

Critical Success Enablers

Committed Leadership

Both the national government and local authorities in Da Nang are dedicated to advancing electric vehicles (EVs) and establishing charging infrastructure, firmly positioning Da Nang as a leading city in the Central Region.

Multi-Stakeholder Engagement

Various stakeholders, including the regional electric utility (EVNCPC), international charger and component manufacturers like Mitsubishi Electric and SMA of Germany, prominent foreign-owned businesses in Da Nang such as Marriott Hotels, and EV manufacturers, both Vietnamese (e.g., TMT and VinFast) and Vietnamese subsidiaries of Japanese carmakers, actively contribute to enhancing the EV ecosystem in Da Nang. Their involvement ranges from building charging stations to supplying power, fostering a collaborative environment that supports the initiative.

Growing Public Endorsement

The increasing acceptance and adoption of EVs among the public contribute to the rising demand for fast charging services. This shift towards EVs fuels the need for accessible public charging infrastructure, driving the overall success of the initiative.

Replicability

A city wanting to replicate Da Nang's EV charging stations project has a range of suppliers and business models to choose from. EV charging station equipment is being widely manufactured in Asia and Europe, in Asia by Chinese, Indian and a Taiwanese suppliers, with entry-level DCFC fast charging stations available in a wide range of sizes from less than USD 1,000 to mobile units to USD 19,000+ for large permanent fast charging stations.

A city interested to prime the pump of EV demand locally might examine incentives which could be offered to local entrepreneurs to import and design EV charging stations around such readily-available equipment. A city might also set an example by replacing vehicles in the city motor pool with EVs, for which it could commission a pilot public charger near to its garage similar to that initially sone in 2017 by EVN CPC in Da Nang. Local EV dealers or legacy car dealers should be included in the planning, as well as the local power utility and/or local solar installers to optimise power to the charging station(s).

References:

- **Climate Action Tracker (2023)** Net zero targets, Viet Nam. Available at: https://climateactiontracker.org/countries/vietnam/net-zero-targets/#:~:text=Viet%20Nam%20announced%20its%20target,Nam's%20climate%20action%20through%202050
- **Driver's Maps of World (including EU and ASEAN) EV Charging Station Locations.** EV Charging Stations Worldwide, Available at: https://www.evchargingstops.com/
- **Lăng, T. (2023) The Rise of Electric Vehicle Manufacturing in Vietnam,** Viettonkin. Available at: https://www.viettonkinconsulting.com/global-business/the-rise-of-electric-vehicle-manufacturing-in-vietnam/
- **UN-ESCAP. Da Nang City, Viet Nam.** Available at: https://www.unescap.org/sites/default/d8files/event-documents/Da-Nang_Profile.pdf
- **U.S. Department of Transportation (2023) Charger types and speeds.** Available at: https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds

Source: HCMC Tourism Promotion Center

Ho Chi Minh City **Vietnam**

Ho Chi Minh City (HCMC, also known by its former name, Saigon), is the largest city in Viet Nam by population, with around 9.3 million in 2023. The city is not on the coast, but it has many rivers and canals, the largest of which is the Saigon River.

As the largest financial centre in Vietnam, Ho Chi Minh City has the highest gross regional domestic product out of all Vietnam provinces and municipalities, contributing around a quarter of the country's total GDP. Ho Chi Minh City's metropolitan area is ASEAN's 6th largest economy, also the biggest outside an ASEAN country's capital.

SNAPSHOT

Area in km² (Core/Greater Metro)
2,095 km²/ 30,404 km²

Population (million) (Core/Greater Metro)
9.3 million/ 22 million

Administrative Status
Class 1 Municipality (largest city in Vietnam by population)

National Political System
Unitary single-party socialist republic

Administrative Divisions of the Country
Vietnam has three levels of subnational government, consisting of People's Councils and People's Committees at all levels: 63 provincial-level administrative units, 713 district-level ones, and 11,162 commune-level ones.

Geography & Topography
HCMC is a low-lying city near to, but not on, the coast in southern Viet Nam with a tropical wet and dry (Aw) climate.

City Network Membership
- Beta-city in Globalization and World Cities Research Network
- ASEAN Smart Cities Network

Priority Smart Green City Clusters
Integrated Data Management: Intelligent Operations Centre (IOC)

Annual Municipal Cash Flow
VND 19,715B (EUR 749M)[1]

Introduction

The HCMC area has a very long recorded history beginning with the Champa kingdom in the 4th century AD, then becoming part of the Khmer empire in the late 12th Century. After coming under French control in 1862 when the Treaty of Saigon was signed, the city served as the capital of French Indochina from 1862 onwards, grew to become a large colonial town, with many French-style buildings, a botanical garden, the Norodom Palace, Hotel Continental, Notre-Dame Cathedral, and Bến Thành Market. Saigon was a battleground in the Second World War following invasion by the Japanese, was eventually liberated by the Allies, and became capital of French Indochina again from 1945 until 1954. After the partition of French Indochina into North Vietnam and South Vietnam, Cambodia and Laos in 1954, Saigon became the capital of South Vietnam until it was captured by North Vietnam in April 1975 and renamed after North Vietnamese leader Hồ Chí Minh.

Beginning in the early 1990s, the city's growth again gathered speed and it underwent rapid expansion and modernization as part of Viet Nam's post-war economic recovery and revived its status as a hub for regional international trade. Tân Sơn Nhất International Airport now has about half of all international arrivals to Vietnam and the Port of Saigon is among the busiest container ports in Southeast Asia.

HCMC is also a popular tourism destination. Some of the war and historic landmarks in the city include the Independence Palace, Landmark 81 (tallest building in Vietnam), the War Remnants Museum, and the French period Bến Thành Market. The city is also known for its narrow walkable alleys and nightlife.

Source: HCMC Tourism Promotion Center

Smart and Green City Vision

HCMC's Smart Green City vision is centred on smart information use. It is one of the five cities in Viet Nam selected to lead the country's digital transformation, with most administrative procedures available for use online.

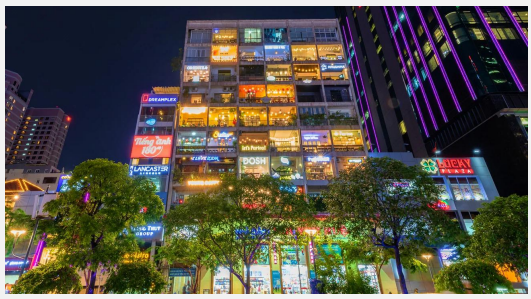
From late 2017, the city issued a project on building the city into a smart city for the 2017-2025 period, and in September 2018, convened a conference of investors to share experience and technologies on building and launching a vision and criteria for building Ho Chi Minh City into a smart city, as well as to select investors for the city's major construction projects.

Their goal was to maintain high, sustainable economic growth, raise residents' living standards while improving city government delivery of social services and providing for greater transparency and public reporting on public sector programs, projects and actions. Other goals of the smart city plans included solutions to regular flooding, traffic jams, and environment pollution[20]. The city has also set targets for its digital transformation by 2030, aiming to become a healthcare centre of Vietnam and the ASEAN region with a medical ecosystem of 6,000 modern clinics and hospitals that provide medical care, and implement AI in disease diagnosis and treatment. Additionally, HCMC is encouraging its booming digital economy which is expected to make up some 25% and 40% of the city's GDP in 2025 and 2030, respectively.

To accomplish this, HCMC city is expanding its IT and data technology economy and infrastructure, including with a new Centre for Digital Transformation (DXCentre), to operate as a data centre and transmission network, support digital and data technologies, expand cooperation, and provide other digital services to public and private sector customers, developing smart and digital government services to in turn, support the growth of a digital and data based economy. It will also be responsible for ensuring data security for the city's data centre, digital platforms, information system, and shared database, as well as offering training consultation on digital transformation to small and medium businesses. There are now more than 7,000 ICT businesses working in the city with a total e-commerce value of USD7.8 B, nearly half of Viet Nam's total.

KEY FEATURE

1. **HCMC received the Smart Applications Award** from the Vietnam Software and Information Technology Services Association (VINASA) at the 11th Vietnam Smart City 2023 Award for its efficient community services.
2. **The city was recognized with the Digital Government Award** by the Asian-Oceanian Computing Industry Organisation (ASOCIO) in Seoul 2023 for its exceptional implementation of digital strategies, improving service quality, and enhancing government transparency.
3. **HCM City ranked 2 from 63 provinces in 2022** Digital Transformation Index (DTI)



Source: HCMC Tourism Promotion Center

[20] TVietNamNet Global (2018) HCM City calls for investment in building Smart City, VietNamNet News. Available at: https://vietnamnet.vn/en/hcm-city-calls-for-investment-in-building-smart-city-E208533.html

[21] Climate Action Tracker (2023) Net zero targets, Net zero targets | Climate Action Tracker. Available at: https://climateactiontracker.org/countries/vietnam/net-zero-targets/#:~:text=Viet%20Nam%20announced%20its%20target,Nam%E2%80%99s%20climate%20action%20through%202050

Financial Resources & Management Approaches of the City Government

Local administration in Viet Nam is the most local executive of a hierarchy of People's Committees with the National Congress, Central Committee and National Assembly of the Communist Party of VietNam at the top, exercising state power at provincial, district and commune levels. City administration, such as in Da Nang, comprises a People's Council and a People's Committee.

Under the HCMC Party Committee is an HCMC overall People's Committee and 23 district People's Committees (for 16 urban districts, six rural districts, and one municipal city, Thủ Đức), plus 36 operating departments for e.g. finance, transportation, construction, natural resources, tourism, home affairs, foreign affairs, and others, mirroring national ministries. There are a further seven special offices for inter alia veteran's affairs, the Farmers' Association, women's and youth unions[22]. Of these, responsibility for "smart city" development and management is shared by the Departments for Information and Communications (particularly the ICT Department's Electronic Information Division)[23], Natural Resources and Environment, and Science and Technology.

HCMC city budget is the largest in Viet Nam – its estimated annual revenues for FY 2023 hit a record high of VND 496,550B (EUR 18.6B), up 16% from VND 427,000B (EUR 16B) in FY 2022 and VND 399,820B (EUR 15B) in FY 2021[24].

It is understood that there is no external borrowing from e.g. bond markets or commercial banks. Development Finance Institutions do lend for Vietnamese urban projects, but these are structured as sovereign loans earmarked for specific undertakings and overseen by national ministries e.g., by the Ministry of Construction as implementing agencies, working through a city People's Committee's Construction Department.

Along with the general trend around the world, Ho Chi Minh City chooses to give top priority to green growth as its future development strategy to achieve economic prosperity and environmental sustainability. We are moving towards a green and carbon-neutral economy, contributing to the goal of limiting global temperature rises

Phan Van Mai
Chairman of Ho Chi Minh City People's Committee

[22] Ho Chi Minh City. Available at: https://hochiminhcity.gov.vn/
[23] Department of Information and Communication. Electronic Information Division. Available at: https://ict-hcm.gov.vn/vi/web/10663900/electronic-information-division
[24] Mai, B. (2022) HCMC's 2023 budget revenue forecast at $20bln, Vietnam Economic Association. Available at: https://en.vneconomy.vn/hcmcs-2023-budget-revenue-forecast-at-20bln.htm

Project Highlight

Intelligent Operations Centre (IOC)

Context and Challenges

The rapid urban growth of Ho Chi Minh City (HCMC), driven by economic development and massive immigration, has put significant pressure on both the natural environment and fundamental infrastructure and services. Challenges such as unsustainable economic growth, flooding, traffic congestion, environmental pollution, inadequate healthcare, education, transport services, and public administration have become prevalent.

Moreover, the fast urbanization also imposes pressure on the local authorities lacking sufficient urban management expertise, particularly in urban planning. Urban planning remains fragmented across various departments, leading to silo-based approaches without adequate integration and coordination, both functionally and spatially[25].

To make city living more manageable, a smart city project was initiated from 2017 to 2020. One of the priorities is developing a shared and open database ecosystem. Operating a mega city like HCM City requires information sourced from diverse channels to formulate and execute strategies effectively. Particularly for the local government, the focus will be on meeting development forecast needs and enhancing operational efficiency through e-governance, facilitating the connection and sharing of information and data to improve government management effectiveness[26].

The Solution

HCMC developed the Intelligent Operations Center (IOC), a central data platform for the city across all parts of government both internal and citizen-facing. An IOC serves to centralise, maintain and make available to the public and to city agencies economic and social statistics and data to support public administration, electronic document processing, health and education systems, environmental data, transportation data, traffic enforcement and other functions. One early step towards the IOC was the roll-out in January 2019 of an integrated traffic light and traffic monitoring system, managed by the Saigon River Tunnel Management Centre[27].

In the national context, the HCMC IOC was and is one of a growing number of similar projects across the country. Developing smart city IOCs is also a national priority in Viet Nam, under the guidance and management of state-owned VNPT, the Vietnam Post & Telecommunications Group in Ha Noi[28]. VNPT owns and manages Viet Nam's national telecommunications infrastructure, from the VINASAT telecommunications satellites to fibre-optic networks to data centres, and also competes with the private sector to provide ICT-related services. VNPT is providing services to 55 Vietnamese provinces and cities, of which 20+ are smart applications such as IOCs[29].

The architecture of the HCMC IOC follows international and Vietnamese models for similar systems developed and implemented by Vietnam Post & Telecommunications Group VNPT, and combines monitoring, regulating, and other systems into a unified platform, allowing more efficient information delivery, better operational management, communication, cooperation, and decision-making.

The HCMC IOC was announced in 2018 and design / development was carried out over the period 2018-2020, including steps for overall system design, provision of data processing and storage equipment, data collection from legacy sources, arrangements for data collection from new sources, data aggregation, software acquisition and integration, development of web interfaces to the databases, operator training, and a public information campaign to promote use of the IOC.

Technical support was provided by VNPT and the DXCentre, drawing on the many IT resources available in the city's IT private sector, some technical assistance from a US consulting firm specialising in city public data systems[30], funded by a grant from USTDA.

[25] Truong, T.H., Thao, T.T. and Tung, S.T. (2017) Housing and transportation in Vietnam's Ho Chi Minh City. Available at: https://library.fes.de/pdf-files/bueros/vietnam/13909.pdf

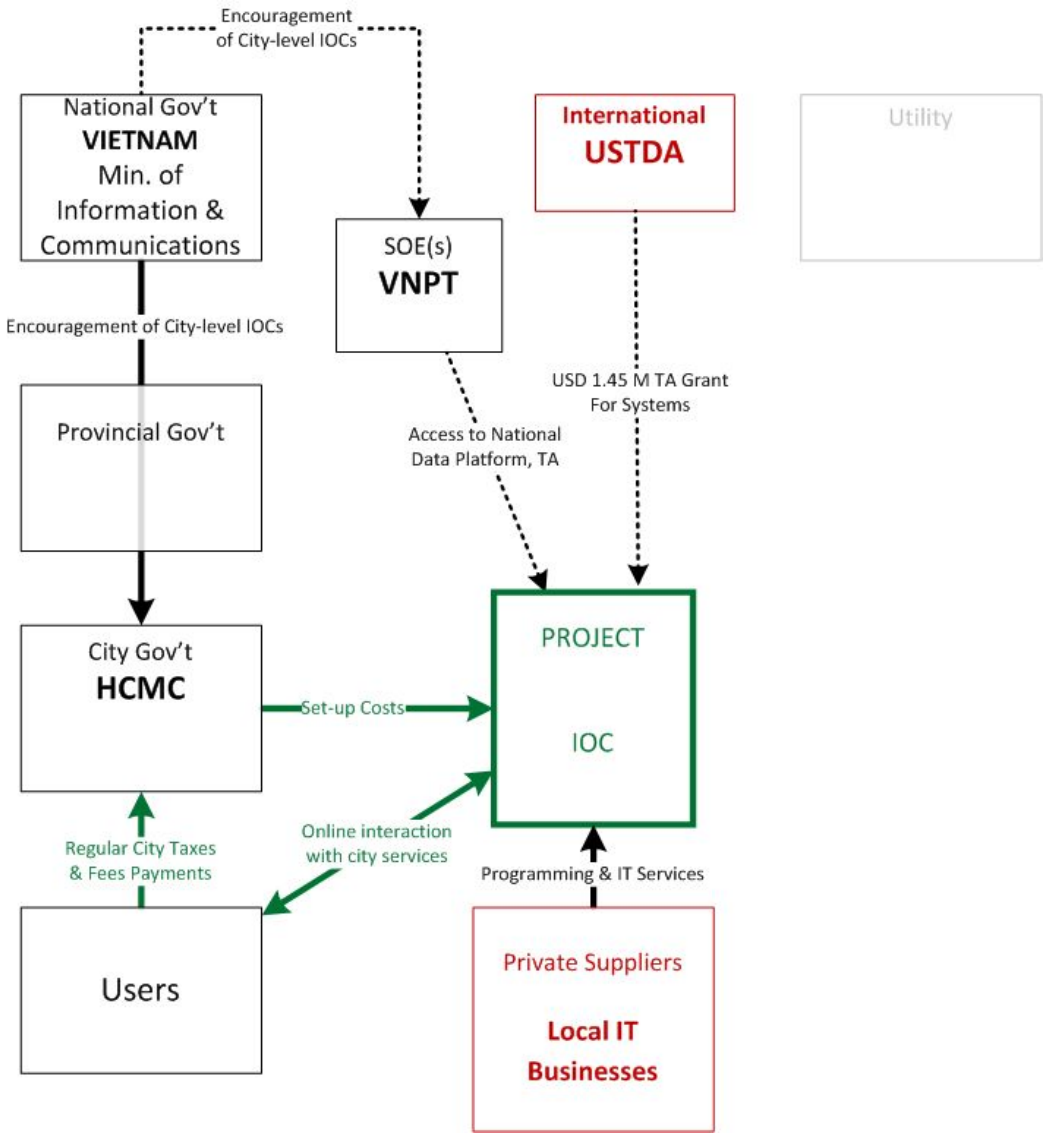
[23] Vietnam News Agency (VNA) (2017) HCM City rolls out smart city plans, Vietnam Plus. Available at: https://en.vietnamplus.vn/hcm-city-rolls-out-smart-city-plans/122344.vnp

[27] Combining CCTV cameras, licence plate recognition software, traffic light control software, electronic driver information annunciator boards and other features, the system connected traffic lights and installed cameras on 78 streets and at 300 intersections to help reduce jams and accidents in the city. See Singh, B.K. (2019) Verdict media limited, Verdict Traffic. Available at: https://www.roadtraffic-technology.com/news/vietnam-open-smart-traffic-centre/

Financing

Apart from a small technical assistance grant from USTDA of USD 1.45M (EUR 1.34M) in August 2020 to assist with design[31], It is understood that the HCMC IOC and associated infrastructure has been financed by the HCMC city government from ordinary revenues stage by stage, through regular budget appropriations starting in 2019. It has a budget reported at USD 43M [EUR 40M] for the period 2021-25[32].

Figure 2: Schematic of Parties Involved in IOC, HCMC



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

[28] Vnpt.com.vn. (2022). IOC – a solution to connect Government and cities in Vietnam - VNPT. Available at: https://vnpt.com.vn/english/news/ioc-%E2%80%93-a-solution-to-connect-government-and-cities-in-vietnam.html
[29] Vietnam News Agency (VNA). "Phu Tho Launches Intelligent Operations Centre." VietnamPlus, 31 Aug. 2020, en.vietnamplus.vn/phu-tho-launches-intelligent-operations-centre/182132.vnp.
[30] Winbourne Consulting, LLC. Vietnam. Available at: https://www.w-llc.com/international-client/vietnam/
[31] Anh, M. (2020). USTDA supports Ho Chi Minh City in smart cities project. Hanoitimes. Available at: https://hanoitimes.vn/ustda-supports-ho-chi-minh-city-in-smart-cities-project-313980.html.
[32] The International Trade Administration, U.S. Department of Commerce. Vietnam - Information and Communication Technologies, 30 Jan. 2024, www.trade.gov/country-commercial-guides/vietnam-information-and-communication-technologies.

Project Highlight

Intelligent Operations Centre (IOC)

Impact

Among the most visible results of HCMC's ongoing IOC development work is the city's public-facing site (site map at https://hochiminhcity.gov.vn/so-do-cong) which provides a wide range of city data, information on city agencies and organisations, facilitating public interaction with the city government from public comments on pending regulations and legislation to public transportation schedules, consumer prices, economic indicators, news on city projects, investment opportunities, public procurement announcements, and other information.It compiles essential information for city leaders and offers integrated analysis and forecasts using gathered data.

Critical Success Enablers

Committed Leadership	Budget Availability	Expertise Access
There is strong national government support for HCMC as the largest city in the country and the strong commitment of the local government of HCMC to engage stakeholders and integrate data management.	There is a large revenue base for the city, and availability of adequate budget for the project.	HCMC leverages the expertise of vendors and has access to an Internet of Things (IoT) framework, platform, and services provided by VNPT. Support from USTDA further enhances capabilities, while the city also learns from the experiences of other Vietnamese cities undertaking similar IOC rollout projects.

Replicability

Any reasonably-sized city in Viet Nam should be able to replicate HCMC's IOC project (and many have, even going online before HCMC), with the assistance of VNPT and their provincial Peoples' Committee. Cities elsewhere in ASEAN are also building centres like IOCs using their own national and local resources including systems architects to design the various layers (data integration, storage, analytics, visualisation and applications), as well as equipment vendors, application developers and providers, and systems aggregators. Much if not all the computer, networking, IoT components (e.g., CCTVs), other hardware and even software can be financed through vendors' customer credit programs or third-party leasing.

References:

- **Vietnam Posts & Telecommunications Group (2019).** About VNPT. Available at: https://vnpt.com.vn/english/about-vnpt
- **VietNamNet Global (2018)** HCM City calls for investment in building Smart City, VietNamNet News. Available at: https://vietnamnet.vn/en/hcm-city-calls-for-investment-in-building-smart-city-E208533.html
- **Department of Information and Communication, Electronic Information Division.** Available at: https://ict-hcm.gov.vn/vi/web/10663900/electronic-information-division
- **Dharmaraj, S. (2023).** Enhancing Smart City Development in Vietnam. OpenGov Asia. Available at: https://opengovasia.com/2023/07/29/enhancing-smart-city-development-in-vietnam/

Source: Jakarta Tourism

Jakarta, Indonesia

Jakarta, with 35 million people in the greater metropolitan area, is the largest urban area in all of Southeast Asia, and the second-largest in the world, after Tokyo. It is also ASEAN's second-largest economy, after Singapore. Jakarta is on the northern coast of Java, the world's most populated island, between the provinces of West Java and Banten, facing north on the Java Sea.

One of the oldest continuously inhabited cities in the entire region, Jakarta was established some 1,500 years ago in the fourth century C.E. as Sunda Kelapa. It rose to prominence as an important trading port for the Sunda Kingdom. It was once the de facto capital of the Dutch East Indies, when it was known as Batavia. Jakarta was officially a city within West Java until 1960 when its official status was changed to a province with special capital region distinction. As a province, its government consists of five administrative cities and one administrative regency. Jakarta is also the home of the ASEAN secretariat, banks, the Indonesia Stock Exchange, and numerous Indonesian and foreign companies. In 2021, the city's GRP was estimated at USD 602.9B [EUR 558.2B].

SNAPSHOT

Area in km² (Core/Greater Metro)
661 km²/ 9,957 km²

Population (Core/Greater Metro)
11.4 million/ 32 million

Administrative Status
National Capital, Municipality, province-level Special Capital Region (largest city in Indonesia by population)

National Political System
Presidential republic with elected legislature

Administrative Divisions of the Country
Indonesia has four tiers of subnational government: 38 provinces (including the province-level Jakarta Special Capital Region), 514 regencies and cities, 8,488 urban villages and 74,953 rural villages.

Geography & Topography
Jakarta is a low-lying coastal city with a tropical rainforest (Af) climate facing north onto the Java Sea

City Network Membership
- Resilient Cities Network
- ASEAN Smart Cities Network

Priority Smart Green City Clusters
Smart Street Lighting

Annual Municipal Cash Flow
IDR 69.82T [EUR 4.1B] (FY 2023 estimate)

Like other ASEAN cities, Jakarta's challenges include population growth, destruction of natural resources, and traffic congestion. Flooding is also a problem: the city is sinking up to 17 cm (6.7 inches) p.a. into the soft coastal ground, making Jakarta one of the most at-risk capitals in the world in terms of water risks. In August 2019, President Joko Widodo announced that the capital of Indonesia would be moved from Jakarta to the planned new city of Nusantara, in the province of East Kalimantan on the island of Borneo. This was approved on 18 January 2022 and the construction of Nusantara has begun.

Smart and Green City Vision

At its core, Jakarta's "Smart City 4.0 Framework" has two central objectives: to be an innovative city and to create a "window of happiness for the people". With the application of cloud computing, big data, artificial intelligence (AI), IoT, and blockchain technologies, the intention is Jakarta will be transformed into the ideal smart city via digitalization, improving the quality of public services, solving city problems, and creating lead a more sustainably friendly life[33].

The Jakarta Smart City (JSC) program was launched on 14 December 2014 with the goal of improving smartness in terms of: governance, people, mobility, economy, living and environment in the city using the web and various smartphone-based apps. Interestingly, Jakarta Smart City, the city government unit founded in January 2015[34], had, as its initial goal, supporting an anti-corruption drive by monitoring city government staff performance with video analytics on CCTV cameras placed in service centres as well as locator apps on officials' phones to report their location to an operations centre. Other priorities were interconnecting public and private modes of transportation such as ride hailing services, motorbike taxis and ride-sharing services.

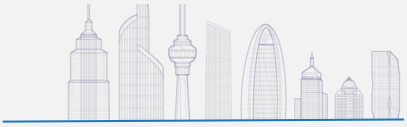
KEY FEATURE

1. DKI Jakarta Province became the first city in Southeast Asia to receive the 2021 Sustainable Transport Award (STA).
2. Jakarta's innovative Jakarta Kini (JAKI) application earned the 2021 ASEAN ICT Award (AICTA) in the public sector category.
3. Jakarta won the Informative Public Agency Award in the Provincial Government Category from the Indonesian Central Information Commission (KIP) for 2023, marking the sixth consecutive year of receiving this award since 2018.

[33] Fitzgerald, M. (2021). Jakarta's Smart City Future & Vision. 365 Access to ASEAN's Largest Power Community. Available at: https://www.enlit-asia365.com/grids/jakartas-smart-city-future-and-vision/
[34] GovInsider (2015). Exclusive Interview: Jakarta's Smart City Chief. govinsider.asia. Available at: https://govinsider.asia/intl-en/article/exclusive-interview-jakartas-smart-city-chief

Source: Jakarta Tourism

Financial Resources & Management Approaches of the City Government



The Jakarta city government[35] is administratively equal to a province with special status. The executive branch is headed by an elected governor and a vice governor, while the Jakarta Regional People's Representative Council (Dewan Perwakilan Rakyat Daerah Provinsi Daerah Khusus Ibukota Jakarta, DPRD DKI Jakarta) is the legislative branch which has 106 directly elected members.

There are five administrative cities in Jakarta (Kota Administrasi), each headed by a mayor (Walikota) and one administrative regency (Kabupaten Administrasi) headed by a regent (Bupati). Unlike other cities and regencies in Indonesia where the mayor or regent is directly elected, Jakarta's mayors and regents are chosen by the governor. Each city and regency is further divided into administrative districts.

Aside from representatives to the provincial parliament, Jakarta sends 21 delegates to the national lower house parliament. The representatives are elected from Jakarta's three national electoral districts, which also include overseas voters. It also sends 4 delegates, just like other provinces, to the national upper house parliament.

Its total revenues, from which the city covers budgeted operating spending, capital spending, unexpected spending, and transfer spending, comprise (projected 2023 end-of-year figures):

1. Regional Original Income ("PAD") of IDR 48.25T, comprising:
    a. Regional taxes: IDR 43T [EUR 2.5B]
    b. Regional Levies: IDR 462B [EUR 27.1M]
    c. Regional Asset Management Income: IDR 539B [EUR 31.6M]
    d. Other income: IDR 4.24T [EUR 248.8B]
2. Transfers from the national government: IDR 19.59T [EUR 1.15B]
3. Other income (incl. grants and tax distributions): IDR 1.99T [EUR 116.7M]

In September 2023, projected full year gross revenues stood at IDR 69.82T [EUR 4.1B] was some 6.12% lower than for FY 2022's IDR 74.38T [EUR 4.36B][36].

"We will implement several changes, including enhancements to digital infrastructure, digital society, digital government, and digital economy. These developments aim to optimize technology use to improve the effectiveness and efficiency of public services"

Yudhistira Nugraha,
Head of Jakarta Smart City (JSC) Management Unit

[35] Dinas Komunikasi, Informatika dan Statistik Pemprov DKI Jakarta. Jakarta. Available at: https://www.jakarta.go.id/
[36] Bhwana, P.G. (2023). Jakarta Revises Down 2023 Revenue Forecast to Rp69.83tn. Tempo. Available at: https://en.tempo.co/read/1770885/jakarta-revises-down-2023-revenue-forecast-to-rp69-83tn

Project Highlight

Jakarta Smart Street Lighting

Context and Challenges

Legacy mercury vapour street lights are expensive to run and maintain compared to LEDs, and, unlike LED streetlights, cannot be harnessed into and controlled in the context of other city assets through a smart IoT network. For that reason, cities all over the world have been switching to LED systems for their road and public space lighting and integrating backward and forward them with existing smart networks as well as those still in development. In many cities, smart streetlights are the first step towards broader "smartness" – once the network infrastructure is in place to support the street lighting, other smart systems e.g. for traffic, security, public transport and other applications can be "piggybacked" on the same network cabling and poles.

Electricity billing to municipalities in Indonesia presented another complication: The national power utility, PLN, recovers the cost of electricity used for street lighting and currently bills cities on a 'lump sum' basis, which tends to overestimate consumption. Many cities are unable to further increase their tax receipts for providing street lighting to inhabitants and are now facing budgetary shortfalls as a result (bills issued by PLN already or will soon exceed the tax receipts). Because of the slow pace of installing electric metering in Indonesian cities and the current billing practices, cities had little incentive to install more energy-efficient street lighting. In part to address this, as one of its Nationally Appropriate Mitigation Actions (NAMAs)[37], the Indonesian national government in 2014 launched a Smart Street Light Initiative (SSLI). By 2020 the SSLI aimed at reducing GHG emissions in up to 22 cities in Indonesia by improving levels of energy efficiency in the area of public street lighting in Indonesian urban areas, at the same time cutting energy use and costs by 50-60% by switching to LEDs. The cost of undertaking this plan and replacing approximately 350,000 lamps in 15 Indonesian cities was estimated in the NAMA filed with UNFCCC at USD 286M [EUR 265M]

Jakarta city began to review its options for smart streetlights in 2015, evaluating areas of the city to cover, best technologies, design approaches, phasing in of the project, appropriate vendors and solutions providers, and other aspects of the undertaking.With its rapid urban expansion and a population exceeding 9 million, Jakarta grapples with the task of overseeing about ± 220,000 public street lighting points across five areas of DKI Jakarta. The primary challenge lies in managing operations still reliant on conventional technology with high wattage consumption.

In addition, the Jakarta Provincial Government is also committed to reducing greenhouse gas emissions by 30 percent by 2030 and ambitiously by 50 percent by 2030. This energy saving has also been regulated in Presidential Instruction number 13 of 2011 concerning Energy Saving, Governor Regulation number 33 of 2008 concerning the Implementation of Energy Saving in the Jakarta Provincial Government Environment, as well as Governor Instruction Number 23 of 2008 concerning Energy and Water Saving.

Solution

Jakarta city collaborates with the private sector to replace and install public street lighting, including the Philips CityTouch program. CityTouch, developed by Phillips, revolutionizes street lighting by centralizing their control. Launched in 2016, this project in Jakarta is the largest and fastest worldwide, replacing more than 90,000 street lights with Philips CityTouch technology in just 7 months. Around 430 light points are linked to the Jakarta Smart City system.

The smart public street lighting system employs the Internet of Things (IoT) principle, enabling internet connectivity with objects for wireless control and usage. This sophisticated system is managed from a control room situated at the local Industry and Energy Department office, overseeing lighting units within its jurisdiction for 24 hours in real-time. With this intelligent system, public street lights can be remotely activated and deactivated from the control room, enhancing efficiency compared to manual operation.

The installation of public streetlights follows three schemes tailored to the lamp power required. Initially, alleys are equipped with 40 Watts lighting, followed by neighbourhood roads and connecting roads with 90 Watts, and finally, main roads utilise 200 Watts lighting[38].

[37] UNFCCC. Smart Street Lighting Initiative Indonesia. Available at: https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=55&viewOnly=1.

Financing

Although actual costs have not been published, on the basis of the NAMA costing estimate (USD 386M for 350,000 lights), the Jakarta smart streetlight project is estimated to have cost up to about USD 122M (roughly 2.9% of the 2023 budget). The funding primarily originates from the city budget, as indicated by the Expenditures for Public Street Lighting Equipment outlined in the DKI Jakarta Regional Revenue and Expenditure Budget each year, along with the allocated budget for purchasing LED lights. Some of the equipment involved in a smart lighting system can be financed or leased through vendors or systems integrators, and software can be contracted on a service basis, paid as an operating expense.

Table 2: Expenditures for Public Street Lighting Equipment and Purchasing LED Lights

	2015	2016	2017	2018	2019
Expenditures for Public Street Lighting Equipment	Rp 319,157,788,007	Rp 793,383,637,794	Rp 913,820,214,623	Rp 559,196,381,968	Rp 307,553,845,484
Budget for Procurement of LED Lights	n.a.	The DKI Jakarta Provincial Government has budgeted IDR 774.6 billion for the procurement of 96,920 LED PJU lights	The DKI Jakarta Provincial Government has budgeted IDR 850 billion for the procurement of 120,000 LED lights	n.a.	n.a.

Source: Jakarta Regional Revenue and Expenditure Budget

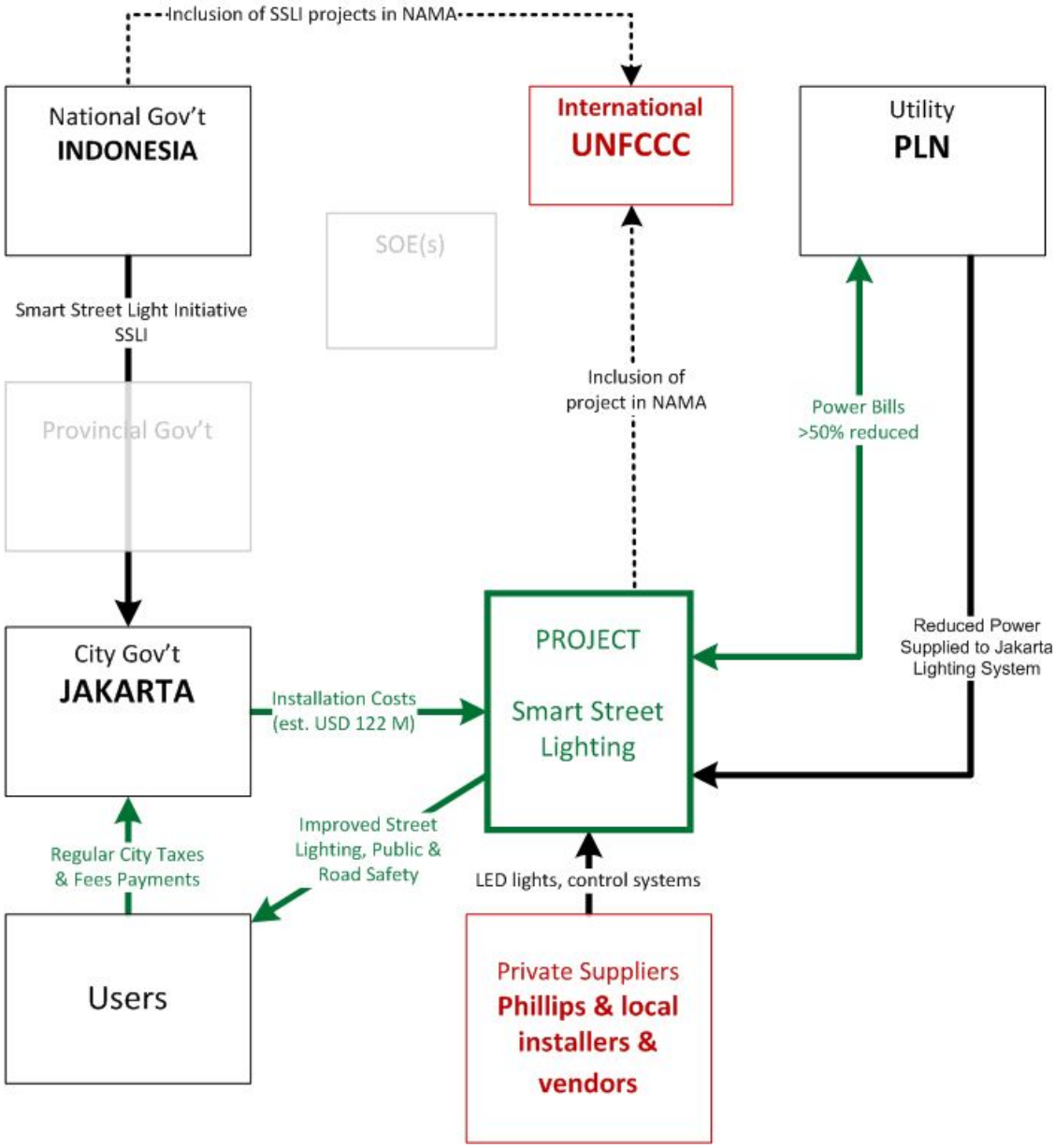
[38] Prayoga, R. (2018). 28,000 smart LED lights installed in East Jakarta. Antara News. Available at: https://www.antaranews.com/berita/782483/28-ribu-lampu-led-pintar-terpasang-di-jaktim

"Besides benefiting the environment, using energy-saving LED lamps has significantly reduced operational costs. Our annual payments to PLN have decreased from IDR 550 billion to just IDR 240 billion."

Yuli Hartono, Assistant Deputy Governor of DKI Jakarta for Environment

Source: Jakarta Tourism

Figure 3: Schematic of parties involved in Smart Connected Street Lighting System, Jakarta



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Project Highlight

Jakarta Smart Street Lighting

Impact

In 2018, Jakarta installed 236,495 LEDs equipped with networked control and monitoring software. The city confirmed that the use of LED lights has resulted in a 50 percent reduction in the capital's electricity consumption compared to previous years. Previously, the city spent approximately Rp 550 billion annually, but in 2018, the DKI Jakarta government's expenditure reduced to Rp 240 billion. Furthermore, the LED lamp provider offers a five-year warranty. Despite the higher initial investment cost of LED lights, their durability extends up to 10 years compared to conventional lights, which typically last around 3 years. Additionally, while conventional street lights consume up to 400 watts, LEDs require only 200 watts, leading to a reduction in greenhouse gas emissions by 0.891%.

Aside from Jakarta, Philips City Touch has implemented pilot projects in multiple Indonesian cities, including Surabaya, Semarang, Surakarta, and Yogyakarta. The Samarinda City Government experienced an 80% reduction in electricity consumption by substituting PJU lights with Philips LED, resulting in savings amounting to IDR 932,725,990 annually.

Critical Success Enablers

COMPETITIVE MARKET

Ready availability of the LED luminaires, networking equipment and management systems from a wide range of commercial suppliers.

STRONG POLITICAL LEADERSHIP

Presence in the existing Indonesian national government NAMA program of a “Smart Street Light Initiative” (SSLI) aimed at streetlight replacement which put the Jakarta project into a national context and gave it international climate change relevance.

EXPERTISE AND AFFORDABILITY

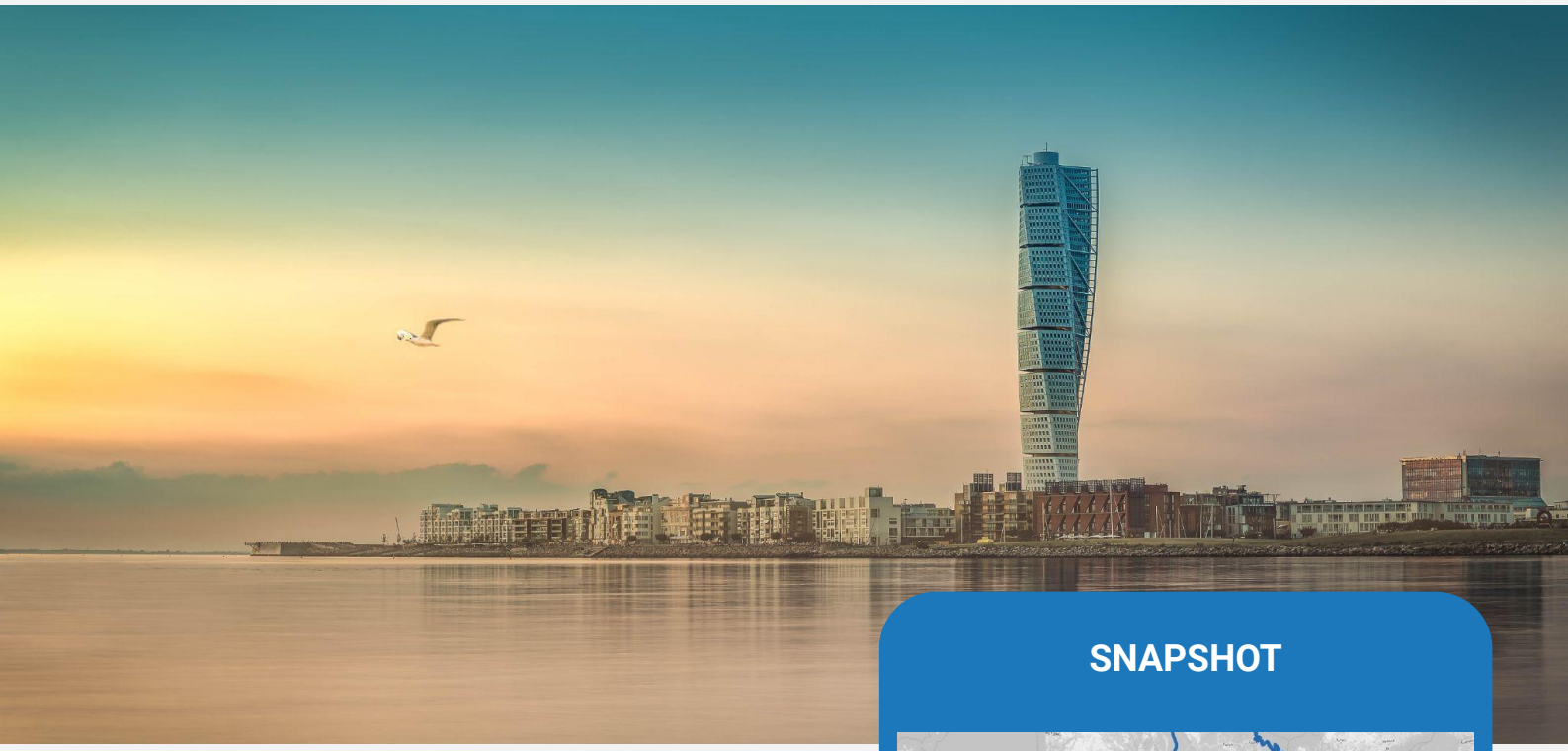
Jakarta has the expertise and resources to design and implement the project, which is relatively affordable within the city's budget.

Replicability

Given the energy and maintenance cost savings which can be realised through smart street lighting, and the global availability of the necessary lighting and networking technology, control software, system design, installation and management expertise, cities anywhere in ASEAN can look to replicate Jakarta’s project. There are numerous suppliers in the municipal LED smart lighting market globally looking to expand to Asia from whom proposals can be sought and solutions procured. Commercial financing (e.g. from vendors) is available, and some systems may possibly be financed through an ESCO system (see the Valladolid project summary, below), where the power cost savings arising from the bulb replacements can be specifically quantified. Payback periods are short, depending on the baseline power costs - Jakarta estimates are about 5 years.

References:

- **Jakarta Smart City (2023).** Building A Smart City. Available at: https://smartcity.jakarta.go.id/en/
- **Communication, Informatics and Statistics Office of DKI Jakarta Provincial Government. Jakarta.** Available at: https://www.jakarta.go.id/
- **UNFCCC.** Smart Street Lighting Initiative Indonesia. Available at: https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=55&viewOnly=1
- **ConFlow power group (2020).** Street Lighting Report The Next Wave of Life. Available at: https://assets-global.website-files.com/6225ec4d016842cb92d1e5d3/627bde04de947f74e3b73678_Conflow-Streetlighting-Report.pdf
- **Rocque, M. (2016).** Philips to deploy 90,000 connected street lights in Jakarta. Smart Cities World. Available at: https://www.smartcitiesworld.net/news/philips-to-deploy-90000-connected-street-lights-in-jakarta-1120
- **Theron-Ord, A. (2015).** GridComm enables 10k smart streetlights in Indonesian capital. Smart Energy International. Available at: https://www.smart-energy.com/regional-news/asia/gridcomm-enables-10k-smart-streetlights-in-indonesian-capital/.
- **Philips (2017).** Jakarta embraces smart city technology. Available at: https://www.assets.signify.com/is/content/PhilipsConsumer/PDFDownloads/Global/PDFs/ODLI20171707_001_en_AA-SmartCity_initiatives_PhilipsLighting_Jakarta_Indonesia_Leaflet.pdf
- **Delta Electronics (2018).** News Center - Delta Smart Street Lights Make a Smart City Blueprint for Jakarta. Available at: https://www.deltaww.com/en-US/news/8423



Source: Patrik Stoltz©

Malmö
Sweden

Malmö is on the southern coast of Sweden, facing Denmark across Öresund, one of the four waterways which connect the Baltic Sea to the Atlantic. One of the earliest- and most- industrialised cities in Scandinavia, Malmö has been Sweden's third largest city for the past 150 years. Interestingly, the city evolved over many centuries as *Denmark's* second largest city (after Copenhagen), until Skåne County was ceded by Denmark to Sweden in 1658. These long historical ties to Denmark, and Malmö's key position in the Öresund region (southern Sweden + eastern Denmark), are key to understanding the city, its development and economic base, as well as the roots of the Smart Green project reviewed here.

Formerly centred on ship-building and related heavy industries, Malmö has evolved over the past 50 years from an industrial port city to an attractive and liveable modern city with a diversified economic base including light industry, services and a leading university, with a focus on sustainability.

SNAPSHOT

Area (km2)
Core/ Greater Metro
75/155

Population
Core/ Greater Metro
352.000/ 700.000

Administrative Status
Municipality and capital of Skåne County, Sweden

National political regime
Unitary parliamentary constitutional monarchy

Multi-level Governance Framework
Decentralised unitary state with a two-tier system of subnational governments: 21 Counties & 290 Municipalities

Geography & Topography
Coastal city with a moderate maritime climate

Smart Green City Clusters
Renewable Energy & Energy Efficiency

City Network Membership
- Member of *Eurocities, ICLEI Europe*
- Signatory of *the Green City Accord*
- Net Zero Cities Laureate

Annual Municipal Cash Flow
SEK 3,419 M (EUR 300 M) (2022)

Smart and Green City Vision

Malmö's evolution into a model smart and green city and regional engine for economic growth has its roots in an economic crisis in the 1970s-80s when the Swedish shipbuilding industry, suffering from the oil shock and Asian competition, fell into recession. Malmö's main shipyard and employer at that time, Kockums Shipyard (in 1952-53, the largest in the world, producing both commercial and Navy ships) failed, was nationalised and reorganised. The ensuing loss of tax revenues and sharp rise in unemployment caused deficits for Malmö's municipal budget and generated social tensions, but the events did free up large tracts of land in Malmö for city-led redevelopment.

On these sites (Western Harbour and others), the Malmö city government was able to pilot completely new ecodistricts. New linkages in regional transport have led to the ongoing development of another new district, Hyllie, featured in this short study, as the first in the world entirely powered by renewable energy.

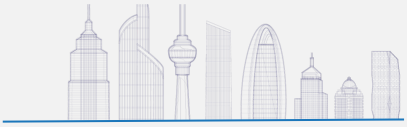
Malmö is capitalising on its regionally and historically important role on the Baltic as the 2nd city in Öresund (after Copenhagen), and is doing so in a sustainable way, aiming to be entirely carbon neutral by 2030 - 20 years ahead of the Paris Agreement deadline of 2050.

KEY FEATURES

- Malmö won the **EUROPEANMOBILITYWEEK Award 2016** for its long-term focus on active transport modes such as cycling and walking. Malmö has implemented a series of permanent measures such as turning a major shopping street into a care-free zone, making its city centre safer and more attractive to local residents; and has set up a new bike-sharing system offering 500 bicycles at 50 stations.
- The city was named as a **Resilience Hub** by the United Nations Office for Disaster Risk Reduction (UNDRR)'s Making Cities Resilient 2030 initiative in May 2022, for its proactive efforts to prepare for and mitigate climate-related hazards.

Source: iStock©

Financial Resources & Management Approaches of the City Government



The Malmö city government operates through programs which bring together city government committees/ departments, the numerous city-owned commercial companies (for parking, vehicle leasing, insurance, property management, the port, and cultural centres), private citizens/stakeholders, and external actors (e.g., property developers, employers, service providers and others.) These committees and working groups are tasked, often in combination, to assess and propose plans to advance various city sustainable development plans. After approval by the city council, responsible agencies are monitored closely and their progress towards goals reported on in detail in the Annual Report. Examples in the 2022 Annual Report are projects to reduce the city's own GHG emissions (city vehicles and buses), to develop a plan for financing of PV solar installations on city buildings, and to explore the establishment of hydrogen fuelling stations for hydrogen-powered vehicles.

Notably, in 2011 the city launched a **"Climate City Contract"** with five Swedish Government Agencies, Viable Cities (NGO), energy utility E.On, VA SYD (the regional water utility for the Malmö – Lund area), local property developers and other local business who wish to be part of the city's green and climate objectives through the various ways in which they engage with the city by providing utilities and other services and undertaking property developments.

In Sweden, the national government allows County and City governments a high degree of financial autonomy, and there are no direct limits on borrowing. Malmö's budget is funded through national income tax transfers, local taxes, national government support (23%), fees and service charges (5%), and others (17%). The city can and has also raised debt financing through various channels. Malmö city government also owns several commercial businesses which contribute their profits to the city budget, including the city parking garages, a city leasing company, the concert hall, theatre, buses, and others. For 2022 the city budget had an overall surplus of SEK + 1.953B (EUR 171M) with a relatively low debt-to-GDP ratio and strong financial reserves.

Because of its long history of good financial management and resulting AAA S&P credit rating, Malmö is able to tap SEK 35B (EUR 3B) in domestic and international capital markets facilities arranged and managed for the city by a group of Swedish and international banks. The city currently has 5 bonds (long term maturities) and 5 floating rate notes (short-term maturities) outstanding, borrowing both in Swedish Kronor (current outstanding SEK 4.15B) and Norwegian Kroner (current outstanding NOK 1.7B), with total principal amount equivalent to EUR 282M. This debt portfolio is short-dated, with the longest current maturity being March 2027. The average issue EUR 10.34M, average coupon is 0.37%. The weighted average years to maturity is 2.33 years. **The city's weighted average cost of capital market debt is 0.37%.**

The city can also borrow, like other Swedish cities, from Kommuninvest, a public debt pooling institution which issues bonds and on-lends to cities. It can also borrow from multilaterals and EU institutions, such as the European Investment Bank (EIB), from which the city received a loan of SEK 3 100m (at the time EUR 332m) earmarked for investment in education, childcare and development projects.

To generate cash, Malmö city can lease and sell city land to developers. Most commercial and residential buildings in Hyllie have been commercially developed, including a large shopping centre, office buildings, hotels, and housing, with developers using their own financing options such as commercial debt and equity.

"Malmo has a longstanding history of good financial management, resulting AAA S&P credit rating"

Project Highlight

"Climate-Smart Hyllie" (Smart Micro-District Energy Grid)

Context and Challenges

In 2000, construction began on the rail-highway Öresund bridge and tunnel, to improve transport connectivity and mobility in the Öresund region, linking Copenhagen in Denmark with Malmö in Sweden. This infrastructure has drastically cut travel time between Malmö and Copenhagen, which had formerly been accessible only by ferry from Malmö harbour. From the new train station in Hyllie, the train now takes only 12 minutes to reach Copenhagen international airport, and the highway crossing the bridge is part of the EU motorway system. This led the Hyllie district south of Malmö centre, through which the road and rail connections run, to emerge as a new transport hub for the Malmö metropolitan area and Öresund generally, with Hyllie station also serving as an intermodal connection point for city and regional buses. This triggered a property boom in what in the 1990s had been a depressed area.

Consistent with Sweden's national positioning as a green country, Malmö formulated its plans to develop Hyllie in a sustainable way. Although ultimately driven by transport links, the Hyllie development had the objectives of 100% renewable energy, zero emissions, sustainable waste management and recycling, and improved public transportation to decrease private automobile use. These objectives have been largely met through the installation in Hyllie of an integrated district grid, including a district power management system connected to building management systems which manage and optimise heat pumps for heating and cooling, onsite and remote energy production, onsite storage, grid-wide power distribution and consumption (the "Ectogrid").

To achieve Malmö's target of connecting all buildings to a smart grid to maximise energy efficiency across the district required the coordinated efforts of both the city government and numerous private participants, from households to building developers and managers to the power and water utilities, in a broad public-private partnership.

The Solution

This project (together with a parallel one in the island of Gotland) was supported from its outset by the Swedish National Energy Agency as a way to encourage renewable energy generation in southern Sweden, at the opposite end of the country from most supply sites in northern Sweden. Malmö's electric supplier, the German power utility E.ON, installed a version of their "Ectogrid" smart grid product. This innovative system integrates district heating and cooling (using heat pumps) which use local and nearby renewable energy sources (geothermal, solar and waste heat), and is integrated with the intelligent systems of buildings connected to the grid, to manage smart buildings' own capacity to generate through onsite solar, and energy management technology.

The Ectogrid was originally intended to be powered solely by renewable energy which was locally-produced, in Malmö and elsewhere in Öresund, however it apparently proved impossible to build needed wind turbines in Malmö itself and energy was sourced from another wind farm in rural Skåne. Additional complications arose in the context of operating a renewables-only local microgrid within the overarching system of Sweden's national grid, power pricing auction system and renewable energy certificates market shared with Norway, but these were overcome.

Currently, power for Hyllie is locally-generated using solar, biogas from organic waste and waste energy from waste incinerators, together with onsite (rooftop) solar on Hyllie buildings. Currently 400 buildings in Hyllie can store energy onsite, produce heating power or redistribute it to other buildings connected to the Ectogrid. A similar system is now installed in neighbouring city Lund, and it is hoped that the entire Malmö – Lund area and, eventually the Öresund region will be able to operate as a larger integrated Ectogrid to expand the benefits.

Project Highlight

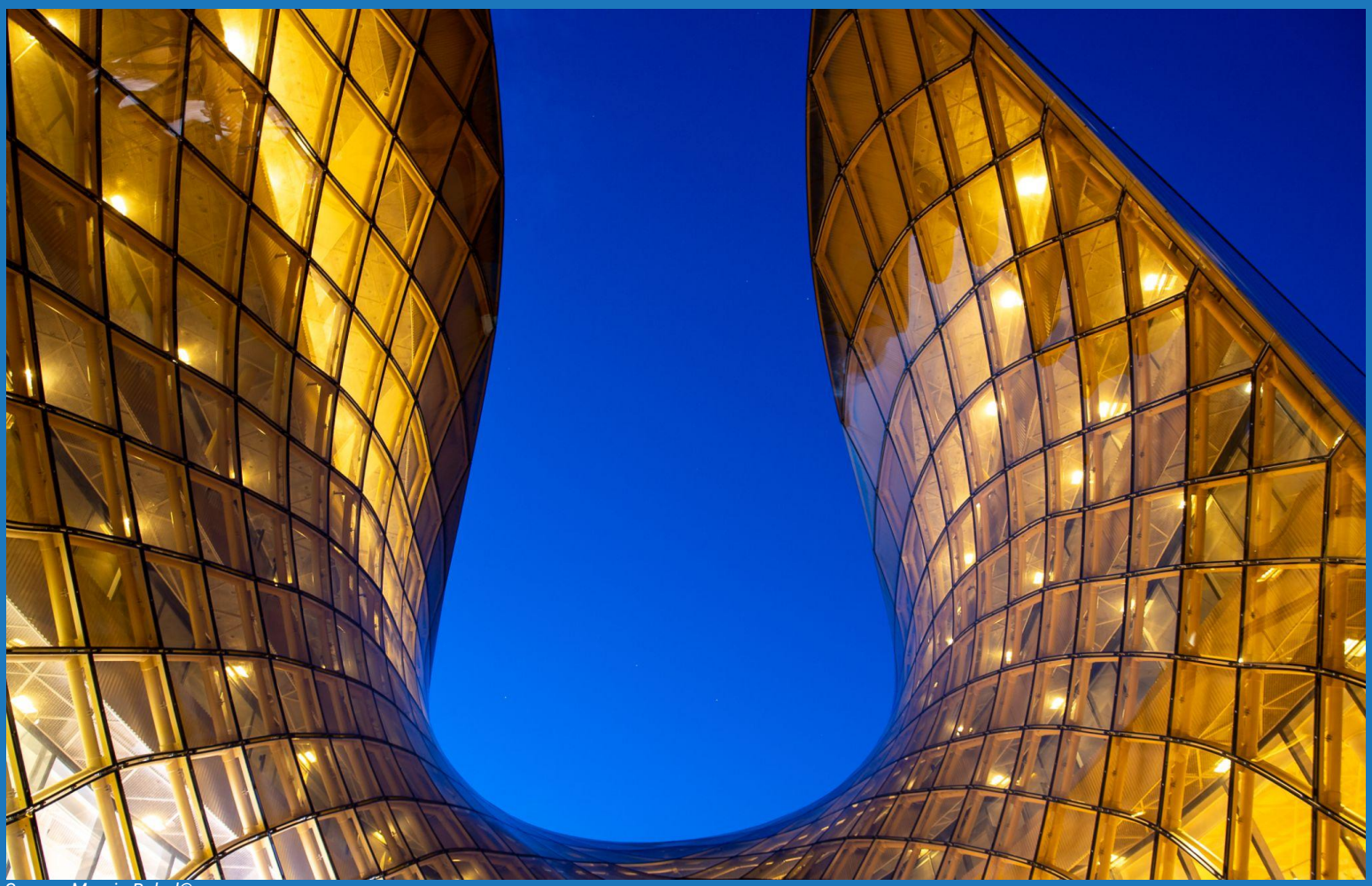
"Climate-Smart Hyllie" (Smart Micro-District Energy Grid)

Financing

Financing of the Hyllie smart District Energy Grid was largely private. The Ectogrid system itself is a technology product developed by E.ON, Malmö's power utility. E.ON, headquartered in Germany, is one of the largest international electric power utilities in Europe and indeed among the top ten in the world, with net income for the first 3 quarters of 2023 of EUR 2.9 B, investments in sustainable energy/ transition of EUR 3.9 B, and overall investments of EUR 6.1 B total for FY 2023.

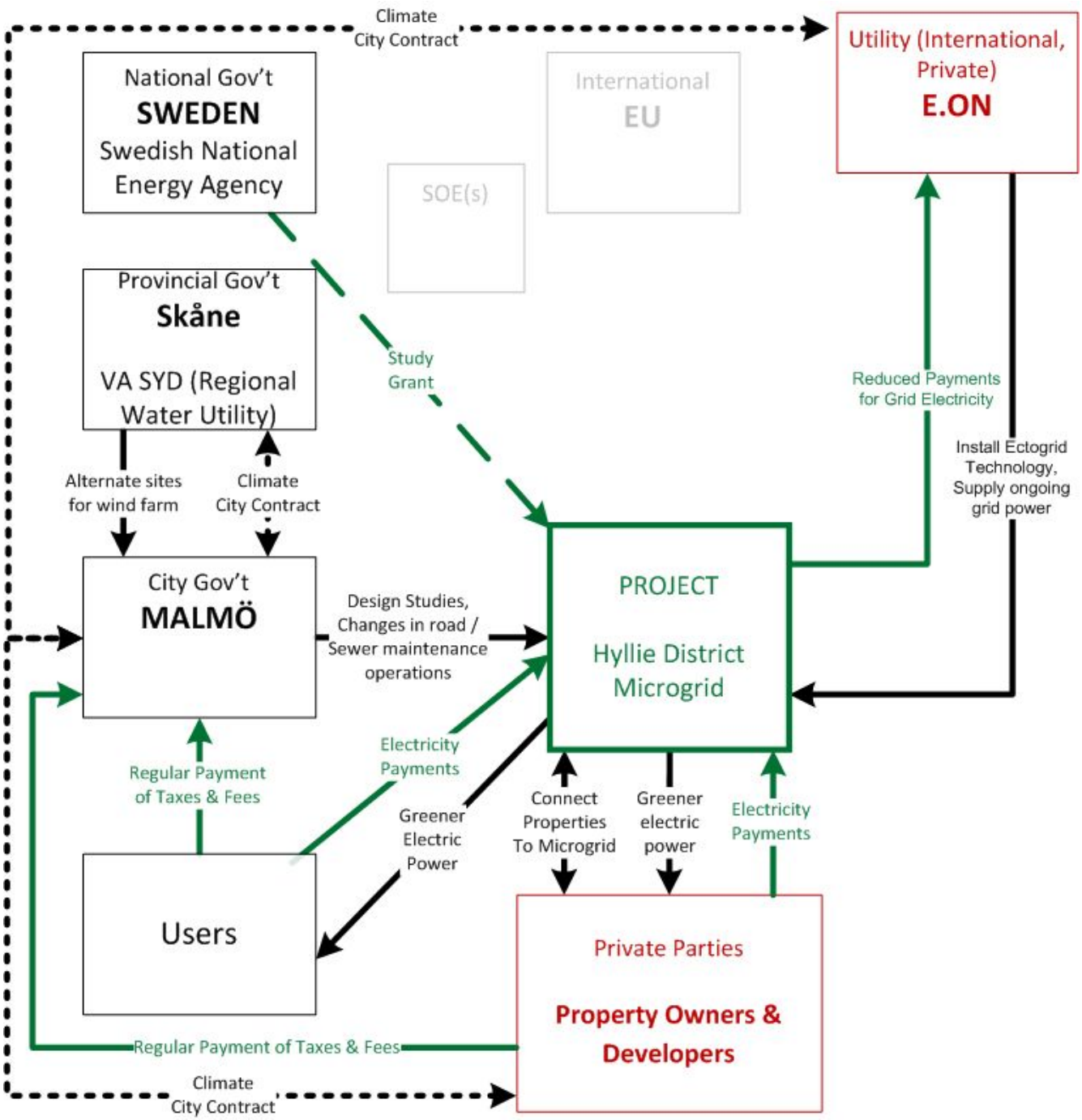
Specific cost numbers are not available for the total E.ON investment in the Hyllie Ectogrid installation, but the population of Hyllie was at the time only 30-35k, so the entire project was modest for a company of E.ON's size, and provided E.ON with a good test-bed for the research & development phase of the technology, which it has replicated for other cities including Malmö's neighbour, Lund. Ultimately the investment costs are recouped through tariffs (user fees) for electricity usage. A key feature of the Ectogrid design is that it also "talks" to buildings' internal energy management systems and draws power from those buildings on site solar power generation capacity and energy storage. The investment in these building-specific systems were made by the individual developers per city building requirements and provisions of the Climate Contract.

Because the Hyllie smart grid project was, with a similar local grid on the island of Gotland, a national pilot, it did receive a small grant of SEK 47 M (EUR 4.12 M) from the Swedish Energy Agency, likely for project preparation in conjunction with E.ON.



Source: Marcin Babul©

Figure 4: Schematic of parties involved in Smart District Microgrid System, Malmo



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Project Highlight

"Climate-Smart Hyllie" (Smart Micro-District Energy Grid)

Impact

Hyllie has attained many of its goals in terms of energy efficiency and carbon neutrality. It is currently powered by solar energy, wind power from elsewhere in Skåne, biogas obtained from organic wastes, as well as heat generated from incinerated waste. Almost all buildings can produce their own energy and store it onsite. Malmö's goal is for Hyllie to run on 100 per cent renewable electricity, with 70% produced locally, and with 13,500 tons of CO_2 savings per year, and to expand the area to cover more of the greater Malmö area.

Hyllie demonstrates, in the Swedish / Scandinavian context, and through investments by one of the largest EU electric utilities in the EU, and by private building owners, an innovative yet workable approach to achieving concrete results through concerted public and private action on climate change. The project has created green business and other economic opportunities for local businesses, positive global attention to the city, and created a platform for smart technologies to improve the quality of life to meet current and future needs.

Critical Success Enablers

MULTI-STAKEHOLDER ENGAGEMENT

The success of the Hyllie district is largely attributable to the Swedish way of operating through interlocking committees and with external stakeholders (Government agencies, developers, service providers, residents, NGOs), as well as being able to attract investment by a sophisticated EU power utility to build and operate the smart grid. The city also worked closely to ensure that the projects were designed to meet residents needs and priorities and were implemented effectively.

STRATEGIC TRANSPORT DEVELOPMENT

Having the Öresund bridge materialise has certainly been a boon in terms of connectivity, but many cities have, and benefit from, transport connectivity projects – often, as in the case of Öresund Bridge, projects of national or international significance and funding. Malmö built upon the benefits of its bridge following a strictly sustainable strategy.

PROGRESSIVE SUSTAINABLE PLANNING

The city government's commitment to sustainable development was embedded, step by step, in a succession of essentially irreversible planning documents which laid out the vision in a way which could be implemented progressively through the normal government management and financial mechanisms.

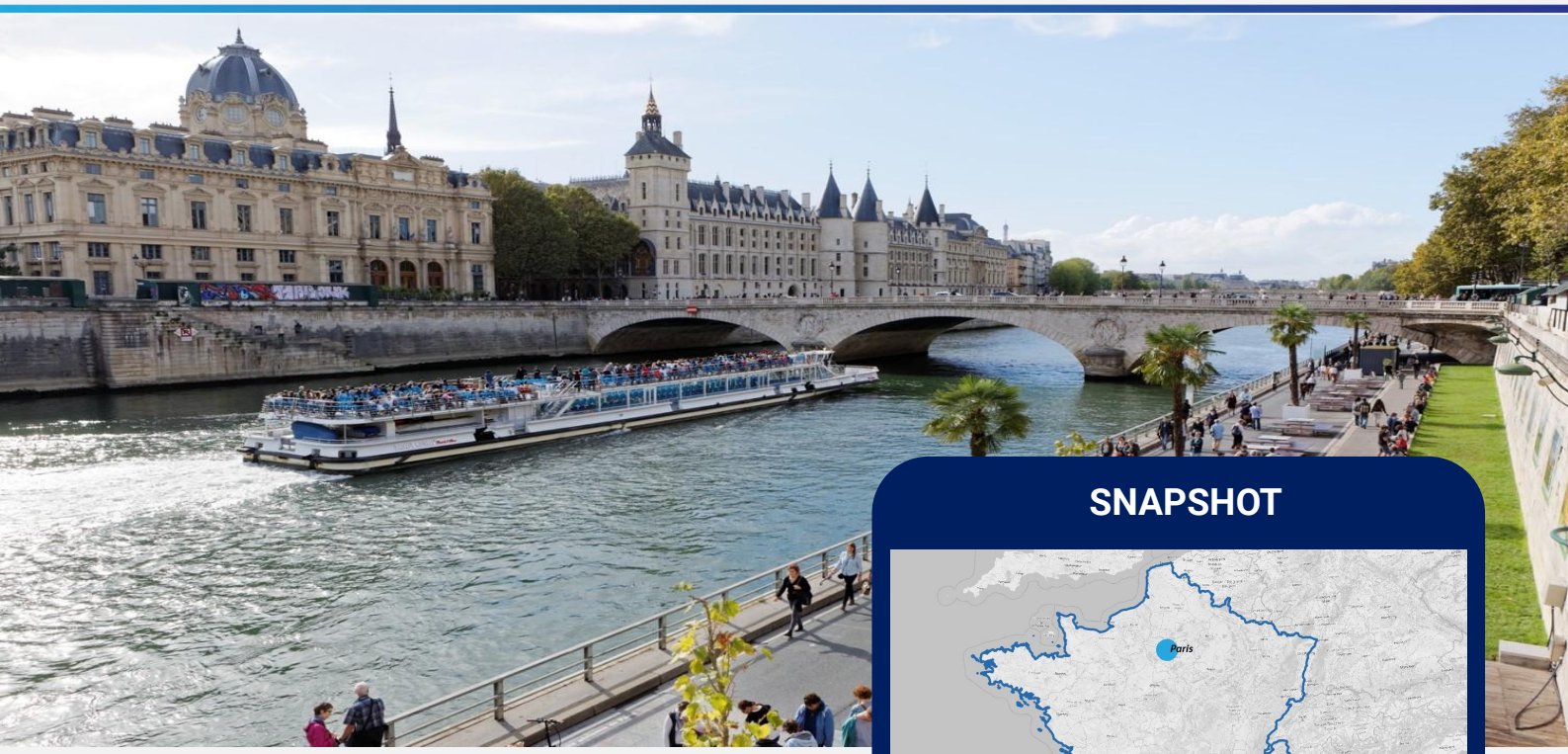
Replicability

An ASEAN city aiming to replicate Malmö's overall success in sustainability might start by following its example in meticulous and very forward-looking planning. The groundwork for Malmö's present status as a leader in smart green development was laid some 15 years ago and steadily built upon through careful financial management. This, in turn, has allowed for access to international credit markets, allowing the city to issue notes and bonds to raise funds for investment projects.

To explore specifically the building of smart energy districts and the necessary microgrids, a city could initially engage with its power utility and large commercial property owners to determine the feasibility of piloting a smart micro-grid in perhaps a designated district of the city (as Malmö did with E.ON and Hyllie), then explore the feasibility of supplying that pilot micro-grid with renewable energy in the context of the city's national grid and power market, then progressively expand the grid to cover more and more of the city. Funding of the necessary technological research and development, followed by actual installation of the necessary equipment by the power utility, as with E.ON, could be explored. Building owners could be incentivised to arrange to lease or purchase the needed solar installations and energy management systems in their respective buildings as costs will likely be recouped through reduced power and other operating costs.

References:

- malmo.se. (2023). Startsida Malmö stad. Available at: https://malmo.se/Welcome-to-Malmo/Sustainable-Malmo/Sustainable-Urban-Development/Hyllie.html
- ICLEI - Local Governments for Sustainability (2021). City of Malmo. Available at: https://renewablesroadmap.iclei.org/wp-content/uploads/2021/11/Malmo-case-study_final.pdf
- Malmö stad (2022). City of Malmö: Annual Report. Available at: https://malmo.se/download/18.70f4a4718bb305e0b44f4a5/1699954837755/City%20of%20Malmo%20Annual%20Report%20and%20Statement%20of%20Accounts%202022.pdf
- Parks, D. and Wallsten, A. (2019). The Struggles of Smart Energy Places: Regulatory Lock-In and the Swedish Electricity Market. Annals of the American Association of Geographers, 110(2), pp.525–534. doi:https://doi.org/10.1080/24694452.2019.1617104.
- E.ON SE (2020). E.ON: City of Tomorrow - Hyllie (episode 4). www.youtube.com. Available at: https://www.youtube.com/watch?v=gSiWiyrLfsc
- Kommuninvest of Sweden (2024). Green Bonds. Available at: https://kommuninvest.se/en/greenbonds/
- Sustainalytics (2017). City of Malmo Green Bond Framework. Available at: https://mstar-sustops-cdn-mainwebsite-s3.s3.amazonaws.com/docs/default-source/spos/green-bond-framework-city-of-malmo_second-opinion-by-sustainalytics_final.pdf?sfvrsn=55ae952_3
- European Investment Bank (2016). Sweden: EIB Signs SEK 3 100m Loan with City of Malmö.Available at: https://www.eib.org/en/press/all/2016-105-eib-signs-sek-3100-mln-loan-with-city-of-malmo



Source: City of Paris

Paris
France

Since the City of Paris adopted its first Climate Action Plan in 2007, the city has managed to reduce its carbon footprint by 20% compared to 2004 levels and local GHG emissions by 25%. Host of the historic COP21, Paris took a proactive stance by co-organizing the first Climate Summit for Local Leaders, and its name is now attached to the first legally-binding international climate agreement (the "Paris Agreement"). The City's third Climate Action Plan, unanimously adopted in 2018, detailed more than 500 actions to set the city on a course to become a carbon-neutral city entirely powered solely by renewable energies by 2050.

SNAPSHOT

Area (km2)
Core/Greater Metro
105 km²/ 19000 km²

Administrative status
Paris is both a Department and the largest Commune (municipality) of the Greater Paris metropolitan area. The city is subdivided into 20 Municipal Arrondissements, each with a local Mayor

Multi-level Governance Framework
Decentralised unitary state with a three-tier system of subnational governments

Smart Green City Clusters
Mobilising private investment in green transition and green mobility

Population
Core/ Greater Metro
2.2 million/ 13 million

National political regime
Unitary semi-presidential republic (with Prime Minister)

Geography & Topography
Inland low-lying city with a continental climate, on the Seine river

City Network Membership
FMDV, C40, WeGo, Metropolis, European Green Cities Network (EGCN), Eurocities, Energy Cities, Resilient Cities Network, Net Zero Cities

Annual Municipal Cash Flow
EUR 9,598 (2022)[41]

[41] *Recettes Réelles de Fonctionnement RRF* (Actual operating revenues) see: City of Paris (2023). The 2023 Budget. Available at: https://cdn.paris.fr/paris/2023/02/15/bp-2023-rapport-vote_partie01-fgCw.pdf.

Smart and Green City Vision

Paris' vision for a resilient and climate-smart urban development is reflected in numerous cross-cutting strategic documents (Paris Climate Action Plan, Paris Resilience Strategy), which are translated into various sectoral plans to support green clusters (e.g. Biodiversity Plan, Circular Economy Plan, Air Quality Plan). Paris has based its "smart city" concept on the three pillars of sustainability (people-centred use of technologies), connectivity (real-time access to information and network), and openness (a collaboration between stakeholders and shared ownership of data flows).

The City of Paris has also been part of a strong international momentum to reinvent "the city for all citizens," that explores ways to support technological advances while reducing inequalities and bolstering urban resilience.

To effectively implement its climate-smart transition, the City of Paris has established a new department directorate dedicated to ecological transition and climate (the DTEC). Together with the Finance directorate, the DTEC runs a climate budget assessment every year, which aims at qualifying the impact of the city expenditures on carbon mitigation. In 2022, within the scope of the analysis, the carbon impact of 95% of the city expenditures was assessed. The results highlight that 22% of the city expenditures, which represents EUR 1.6B, contribute positively to the mitigation of greenhouse gas emissions.

Also, further to Article 6 of the Paris Agreement to expand the use of local carbon markets, the city has launched the *Coopérative Carbone Paris & Métropole du Grand Paris* (Carbon Cooperative of Greater Paris)[42] to accelerate the reduction of the metropolitan area's carbon footprint and facilitate private green transition projects. The City is also an advocate of finance for city sustainability projects and the replication of regional development funds like Paris Green Fund as a founding member of the Network of Financial Centers for Sustainability, and as co-chair of FMDV, *Fond Mondial pour le Développement des Villes* (Global Fund for Cities Development).

[42]Coopérative Carbone Paris & Métropole du Grand Paris. Acting Together Locally Contributing to a low-carbon Region. Available at: https://coopcarbone-parismetropole.fr/

KEY ACHIEVEMENTS

- Paris is receiving the 2023 Sustainable Transport Award (STA) for the city's innovative efforts to promote inclusive and active mobility, expand cycling and pedestrian infrastructure, and reclaim urban space for public use
- City of Paris is a frontrunner when it comes to transportation planning and has an ambitious target to be a carbon-neutral and 100 per cent renewable-energy city by 2050

Source: Lonely Planet / Catherine Le Nevez

Financial Resources & Management Approaches of the City Government

Paris has a highly diversified service-based economy. From tourism to finance, information technology to fashion and cultural events, it is a global centre of the creative arts and related commerce. The financial sector is particularly strong, with many French and international banks, insurance companies and other financial institutions headquartered in the city. The Paris Stock Exchange, founded in 1724 and Europe's second-largest stock exchange, now operates as part of the Euronext group of exchanges. This "financial market ecosystem" gives the city a solid tax base and makes it France's leading city and economic hub. Its financial strength gives the city access to its own capital markets (currently Paris has almost EUR 7B in bonds outstanding), provides a foundation from which it launches initiatives for financing of urban sustainability (such as the Paris Green Fund, described in more detail below) and gives the city the leverage and capacity to influence the development of smart green urban investments in France, Europe and globally.

As part of its commitment to sustainability, Paris aims to become a global hub for green finance by promoting responsible financial products and low-carbon financing strategies. This builds on the city's 250 year-plus history of providing a market platform for private businesses to finance public infrastructure, not only for Paris itself, but on the world stage. Both the first Panama Canal and the Suez Canal were financed through 19th Century bond issues on the Paris Bourse.

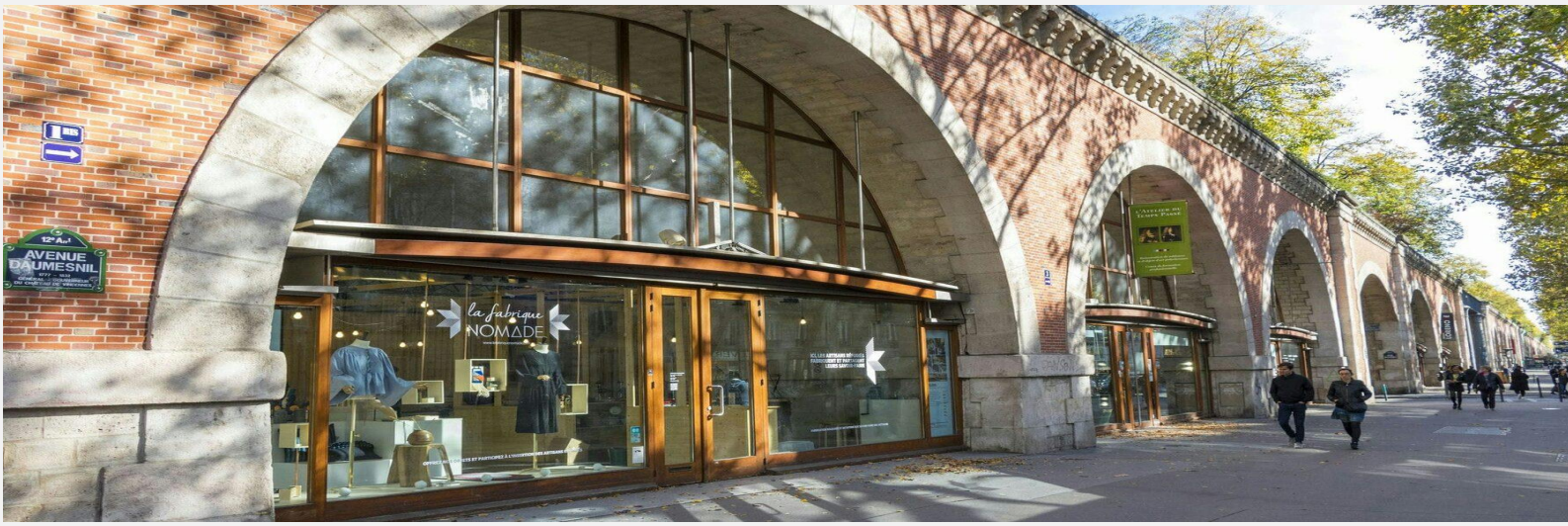
Paris has been the venue for innovative zero carbon transportation for more than 120 years: *The Compagnie Parisienne des Voitures Electriques* produced a range of fully electric and hybrid cars and taxis in Paris in the late 19th and early 20th Century. The company was financed partly through a bond issued on the Paris Bourse.

Today, Paris continues this use of its financial institutions and markets to support innovation with new types of financial support, such as a private equity fund designed to focus private investment on sustainable transportation (the Paris Green Fund, see below). This year, the city is also launching its own carbon cooperative, a public-interest entity of collective ownership that connects carbon offset buyers and decarbonization operators proposing projects to be certified.

Bond issuance:

Paris has been an active bond issuer on capital markets for the past 150+ years. The city currently has some 55 bonds (long term) and 4 floating rate notes (short-term) outstanding, with total principal amount of EUR 6.985B [43]. These bonds mature from 2024 to 2070, the average principal amount is EUR 114M, average coupon is 2.01%. The weighted average years to maturity is 15.48. The city's weighted average cost of capital market debt is 1.93%. The city has also issued municipal green bonds between 2015 and 2022 that supported qualifying projects.

[43]Cbonds. Data Platform for Financial Market Professionals and Investors. Available at: https://cbonds.com/



Source: Paris Je T'aime - Tourist Office 2015-2024

Project Highlight

The Paris Green Fund - An investment fund to accelerate the ecological and mobility transitions in Paris

Context and Challenges

Paris faces significant challenges posed by high levels of greenhouse gas emissions and air pollution, with transportation accounting for 20% of the City's total CO2 emissions. To achieve its target of reducing CO2 emissions by 80% in the City of Paris by 2050, Paris has several sustainable transportation policies aimed at reducing the city's carbon footprint from its transport systems and has put in place incentives and disincentives designed to cut emissions from vehicles in the city.

In the policy area, in 2015, Paris began a program to replace diesel cars and trucks in the city's own fleet with electric, hybrid or petrol-powered cars and has expanded its public transportation networks with new tram lines and metro extensions. The city also encourages zero-emission personal transportation through bike sharing programmes and bike parking facilities. Paris' City's Mobility Plan aims to cut greenhouse gas emissions from the sector by over 30%. An example of a disincentive is a new parking tax for SUVs, approved by referendum at the end of January 2024, to discourage their use in the city.

The challenge was thus to complement these policies and disincentives by setting a positive example to encourage private investors and businesses to invest in and develop commercially-viable products and services to help achieve the City's zero emission targets in the area of green mobility.

Source: Shutterstock / Catarina Belova

"Externalizing the management has not only proved more cost-effective but also helped to build the fund's credibility"

Cécile Bordier

The Solution

In order to integrate private sector innovation and financing into this emissions-reduction strategy, the city helped organise and became an anchor investor in a new cleantech / renewables-focused private equity fund. The resulting Paris Green Fund invests in businesses developing and commercialising new "smart mobility" and other sustainability-oriented products and services applicable to issues confronting Paris and other cities. Paris' participation as an investor, committing to take up 10% of the funds target of EUR 200M encouraged other private and public investors to invest in the fund as it was marketed to institutional investors internationally. The mandate of the Fund is to invest in early-stage businesses developing products and services related to urban energy transition and urban smart mobility from which Paris and other cities worldwide could benefit.

The city of Paris used its regular procurement processes to solicit expressions of interest from managers capable to launch a Paris-focused private urban cleantech investment fund, and selected Demeter Investment Managers S.A., Demeter is a local (Paris-based) mid-sized private equity fund manager with some EUR 1.3B assets under management in 14 funds. Founded in 2005, the firm specialises in early-stage cleantech sector equity investments, raising capital from institutional and other large investors, and identifying and investing clients' capital through its funds in early-stage growth businesses in the cleantech / renewables sectors in France and other European countries.

At the time of writing (March 2024), the firm's aggregate portfolio, across 14 funds, comprises 115 investee companies, in cleantech sectors including e-vehicle charging stations, IoT sensors for smart city networks, energy-efficient building construction under PPP contracts in several French cities, an open city data management platform, hydrogen vehicle fuelling stations, LED lighting, rooftop solar, battery storage, e-scooters, and other areas related to the net zero and energy transitions.

Fund Structure:
As with most private equity funds, as fund manager, Demeter is responsible for raising the Fund and identifying and making and monitoring and exiting investments which are appropriate under the Fund's investment strategy. Typical for this type of fund, the governance structure comprises, in addition to the fund manager, three advisory and oversight committees:

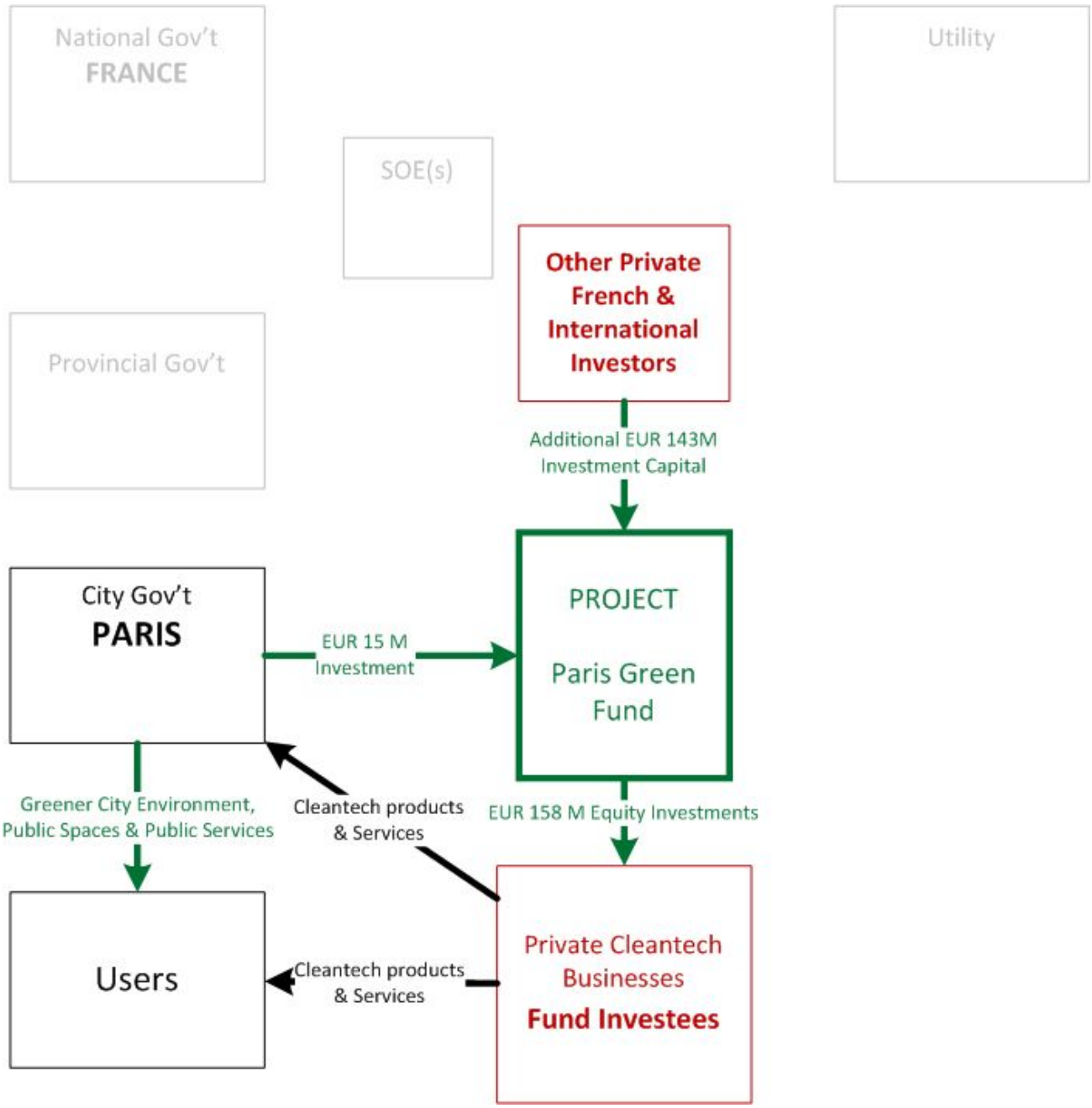
- A Strategy Committee composed of qualified cleantech industry experts provides well-informed insights on market trends and new technologies viable for the ecological transition.
- An Advisory Committee, comprising investors (Paris is represented by its Deputy Mayor for Green Finance) which reviews fund investments to ensure alignment with the environmental and social targets set for the Fund.
- An Investment Committee, which formally approves each investment to be made by the Fund after review of compliance to regulations and investment policies.

The Fund's investment policy requires that all investments it makes are consistent with the City of Paris' environmental and social objectives, and its procurement policy includes environmental and social criteria when selecting suppliers.

Financing

The city's capital commitment as a founding subscriber to the Paris Green Fund (10% of the Fund's target minimum capital of EUR 150) was EUR 15M. Given Paris' annual operating budget and access to capital markets (almost EUR 7BN in bonds currently outstanding), financing an investment of this size would not have presented any issues. A formal process of legal enablement, procurement of a fund manager through a selection process, and approval by the city council of the fund and the city's investment in it ran from late 2017 into early 2018.

Figure 5: Schematic of parties involved in Paris Green Fund, Paris



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Project Highlight

The Paris Green Fund - An investment fund to accelerate the ecological and mobility transitions in Paris

Impact

The Paris Green Fund currently has 158 million euros, just above its original target of EUR 150M, but, with capital of over EUR 140M from other investors, this would represent about 9x leverage of Paris's original capital commitment of EUR15M - a successful leveraging of the City's investment by industry standards. As the Fund takes equity in its investee companies, this would have enabled those investees to raise other forms of financing such other equity and bank loans.

Although specific investments in the Fund's current portfolio are not made public by the manager, its investment restrictions allow for minority equity investments of between EUR 1M and 15M in SMEs operating across the cleantech / renewables space including sustainable building technologies, mobility and urban logistics, renewable energy, air quality, waste management and IT / communications applications supporting these sectors. While the Fund does not focus exclusively on sustainable mobility, mobility-related investments reportedly account for 40%+ of the Fund's total portfolio.

The Fund portfolio includes companies such as Instant System, a French provider of intermodal mobility and ticketing apps and "mobility-as-a-service" platforms to city governments and transit authorities. Another example is IES Synergy, a manufacturer of EV fast chargers. The success of the Paris Green Fund has been recognized internationally, with several other cities and regions reportedly looking to replicate the model.

Source: Paris Je T'aime - Tourist Office 2015-2024

Critical Success Enablers

Capacity to Establish an Enabling Legal Framework Through Legislative Change

An amendment to the French *Code général des collectivités territoriales* (General Local Authorities Code) Article L-2253-1 was passed by the National Assembly in February 2017 to create an exemption for the City of Paris to subscribe for shares in a local venture capital fund whose purpose is to provide equity capital to companies contributing to climate protection, air and energy quality, improved energy efficiency, waste reprocessing and the development of renewable energies, renewable hydrogen or low-carbon energy, and allowing the City to enter into an agreement with the fund management company. This created the enabling environment in which the Paris Green Fund could be developed.

Extensive City Experience with Private and Commercial Finance

Paris has been an active borrower on international and domestic bond markets since at least the 1850s, with some private concessions for city services also funded with bonds. This experience means that Paris has a highly competent and focused city financial management and administration, including a team led by a Deputy Mayor in charge of finance, budget and green finance.

Deep and Long-Standing Ecosystem of Sophisticated Financial Institutions and Financial Markets

Paris has been a European financial centre for several hundred years, and has many domestic and international financial institutions present in its financial market ecosystem. The fund manager selected for the Paris Green Fund is based in Paris and met all of the selection criteria set out in the city's procurement process. The manager was thus, in a sense, a "citizen and resident' of Paris already and no doubt familiar with its green objectives as well as with local circumstances as well as the local pool of potential investee cleantech companies.

National Green Fund Certification Framework

As mandated by the Green Growth Law of 2015, a national 'labelling' standard was put in place for cleantech / renewable funds (Decree No 2015-1615 of 10 December 2015 to use the "*Transition Énergétique et Écologique pour le Climat*" - TEEC - (Energy and Ecological Transition for Climate) label. This was designed to provide quality control and a regulatory framework for compliant asset managers to use when they market 'green' investment funds. The Paris Green Fund uses the TEEC label, and this was likely useful, together with the presence of Paris as lead investor, in persuading other investors to commit to the Fund

Project Highlight

The Paris Green Fund - An investment fund to accelerate the ecological and mobility transitions in Paris

Impact

A city looking to launch an investment fund along the lines of the Paris Green Fund to support emerging technology businesses working in areas relevant to the city's future smart green development might proceed using the following approach: 1. Identify existing fund manager(s) investing in relevant areas of clean and green technologies in the city's own or other countries (possibly with ASEAN-wide investment mandates); 2. Identify regional tech incubators or similar organisations / venues hosting clean or smart tech startups working in relevant areas; ascertain if the city is able to act as a lead / anchor investor in a private fund.. This will likely be a new concept requiring legal review of existing legislation as to what the types of investments of investment assets are allowed for the city (these *may* be restricted to e.g. cash, bank deposits and national government bonds, but may not be). In any case, enabling legislation at national level or city resolutions may need to be adopted. Through this process, an investment fund can be designed and a viable portfolio of suitable investees can be built by a qualified manager. A group of smaller cities with similar smart green technology needs could work together with an experienced fund advisor / manager to develop a regional solution in which their resources can be combined and reach a broader pool of target investees - companies developing solutions to common city problems.

It should be noted that cities' value addition in negotiating with fund managers is two-fold:

- First, as was the case with the Paris Green Fund, their presence as core or bellwether investors (at a level of, say, 10% of a fund's target total) gives the confidence to unrelated institutional investors to come into the fund, thus 'catalysing' private and institutional capital for greater investment impact.
- Second, city investors in an urban cleantech fund can provide real-world market feedback, pilot testing opportunities, and eventually, sales prospects to investee businesses developing smart green services and products for the urban market. This would be invaluable to any investee developing solutions for urban smart tourism, smart transport, public services, or any ot the smart green clusters reviewed here, and also would give their investors (including the fund) the confidence in knowing their investees were closely in touch with their target customers.

References:

- Chrisafis, A. (2024). Parisians vote in favour of tripling parking costs for SUVs. The Guardian. Available at: https://www.theguardian.com/world/2024/feb/04/parisians-vote-in-favour-of-tripling-parking-costs-for-suvs
- Paris Climate Action Plan. (2020). Available at: https://cdn.paris.fr/paris/2020/11/23/a10afc931be2124e21e39a1624132724.pdf
- Mairie De Paris. Paris Smart and Sustainable. Available at: https://cdn.paris.fr/paris/2020/02/26/f7dc822a66de6000cd910a145c7fca39.ai.
- Mairie De Paris (2018). Paris Resilience Strategy. Available at: https://resilientcitiesnetwork.org/downloadable_resources/Network/Paris-Resilience-Strategy-English.pdf
- South Pole. Climate Finance Lab: Catalyzing Climate Action in Cities. Available at: https://www.southpole.com/clients/city-finance-lab-catalysing-climate-action-in-cities-with-innovative-finance-solutions

Source: Tourism Authority of Thailand

Phuket Thailand

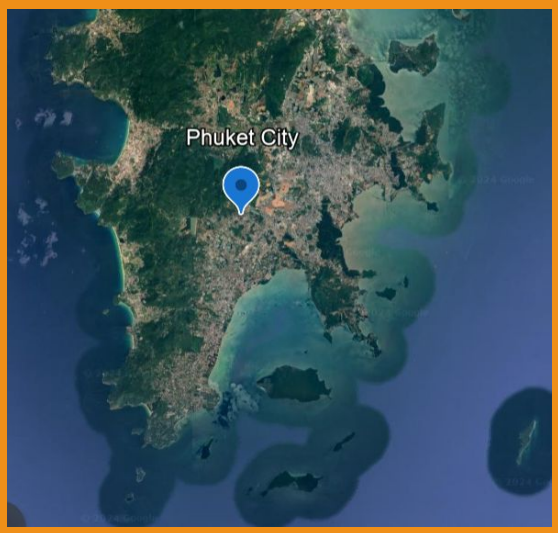
From its origins as a trading port in the 1500s, Phuket city prospered in the tin and rubber boom of the late 1800s and early 1900s, attracting many mine and plantation workers from Fujian Province, China. This gave Phuket a Thai version of the Malay - Straits Chinese/Peranakan cultural heritage[46]. As a result, the old parts of Phuket City have many historic shophouses and commercial buildings in a hybrid Thai-Sino-Portuguese style which give it a unique look reminiscent of the other contemporary Peranakan settlements of old Singapore, Penang and Malacca. Around 60 percent of Phuket is covered with forests, rubber, and palm oil plantations

In the 21st Century, because of these attractions, good climate, beautiful seaside setting and visa liberalisation by the Thai national government, Phuket has become a world tourist and expat retirement / 2nd home destination.

Overcoming setbacks caused by extensive destruction in the city and Island from the Indian Ocean Tsunami of 2004 and later the decimation of its tourism industry by COVID in 2020-22, Phuket's year-round population, less than 100k in 1970, has grown to 380k (2024)[47]. Growth was steady at around 5% p.a. from the 1970s to 2000, then experienced a sharp spurt of high growth from 2001-2010 at 13-15% p.a., then dropped back, currently at 1-2% p.a.

[1]Forbes, A. and Henley, D. (2016). Phuket's Peranakan Community. CPA Media. Available at: https://www.cpamedia.com/article.php?pg=archive&acid=120510162540&aiid=120524153854

SNAPSHOT



Area in km² (Province/Island)
576 km²

Administrative Status
Municipality, Capital of Phuket Province

Administrative Divisions of the Country
Thailand has four tiers of subnational government: 76 provinces (plus Special Administrative Regions for Bangkok and Pattaya), 878 Districts (Amphoe), 5,303 Sub-districts (Tambon) and 74,944 Villages (Muban).

Priority Smart Green City Clusters
- Smart Tourism
- Integrated and Open Data Platform to support a variety of public services: tourism management, public safety/security, public Wi-Fi, energy management, and city application

Population (Core/Greater Metro)
447k / <1m
estimated, depending on tourists, of which there were almost 14m

National Political System
Unitary parliamentary monarchy

Geography & Topography
Phuket has a humid tropical climate and is a varied terrain from beaches to forested hills; Phuket city is at sea level on the Southeast side of the island, facing Krabi Province across the entrance to Phang Na Bay.

City Associations and Programmes Membership
- ASEAN Smart Cities Network
- Smart City Thailand

Annual Municipal Cash Flow (2022
THP 209B (EUR 5.3B)

Smart and Green City Vision

Phuket is an original member of the ASEAN Smart Green Cities Network, as well as the Smart City Thailand program. "Phuket Smart City" is a pilot initiative for a smart province designed to improve quality of life and establish a modern, sustainable business model. Phuket was announced as Thailand's first smart city, with an initial phase started in 2016. Its city development plans set out a vision to develop in a sustainable way on foundations of smart data use to provide[48] improved city services to both permanent residents and visitors alike, not only to support continued growth as a tourist destination, but to broaden and diversify the economy to reduce its dependence upon tourism for revenue.

Phuket Cities are one of the most outstanding smart city projects in the Asia Pacific ex-Japan (APeJ), for the 2018 IDC Smart City Asia Pacific Awards (SCAPA). Phuket Smart Tourism and Living Communities won under "Tourism, Arts, Libraries, Culture and Open Spaces" categories and illustrated the best practice of urban innovation with ultimate focus on the use of technologies (cloud, platforms, analytics, IoT, mobile solutions) and data, unique partnerships, funding models and/or community involvement.

KEY FEATURE

1. Phuket is ranked as the most overcrowded tourist destination in the world in 2023 by MoneyTransfers.com
2. Phuket was recognized for having the most outstanding smart city projects in Asia Pacific (excluding Japan) at the 2018 IDC Smart City Asia Pacific Awards (SCAPA).

[47] Phuket Provincial Office (2024). PHUKET Smile Smart and Sustainable. Smart City Thailand. Available at: https://www.citydata.in.th/phuket/en/homepage/
[48] IoTNews.asia. (2018). Phuket and Khon Kaen Named as Top Smart City Projects in Asia/Pacific for 2018. Available at: https://iotnews.asia/1310/thailand/phuket-and-khon-kaen-named-as-top-smart-city-projects-in-asia-pacific-for-2018

Source: Tourism Authority of Thailand

Financial Resources & Management Approaches of the City Government

Phuket city proper is the largest of 12 municipalities on the island / Phuket Province and is the provincial capital. Planning is done at the municipal level and provincial levels. Additionally, because Phuket is Thailand's biggest tourist destination after Bangkok, the city receives extensive national government attention and support in the areas of both tourism and smart city development.

Before the Covid-19 pandemic in 2019, Phuket had welcomed 14.5 million foreign tourists, generating revenue of 422 billion baht, ranking second after Bangkok. However, the pandemic inflicted a severe blow on Phuket, as 97% of its revenue came from tourism. Although tourism in Phuket is expected to recover rapidly and potentially reach 100% recovery in 2024, the lessons learned from Covid-19 led to a shift in Phuket's tourism strategy.

The current Phuket Provincial Development Plan (2023-27) focuses on seven key objectives to generate new income for Phuket and transform the island into a diversified and sustainable economy, not solely reliant on tourism, ensuring long-term economic stability for the province.

The Phuket provincial government and Thai Department of Tourism is currently working on implementing a 5-year plan to attract visitors from all over the globe to come for: culinary tourism, health/medical tourism, marine tourism, sports tourism, and for meetings, conferences and exhibitions.

They also plan for Phuket to become an international education hub while creating value through digital technology. At the same time, the plan intends Phuket to become a hub for the ASEAN tuna fishing and processing industry.

Phuket's 2023 Gross Provincial Product per capita was THB 165k (EUR 4,226). And the average monthly income per household is estimated at TBH 33.33k per month[49]. The provincial annual budget for 2024 is THB 148B (EUR 3.8B), including investments to upgrade tourist infrastructure such the second airport (Phang Nga/Andaman International - see below), highways and overpasses (roadworks expected to be completed 2026, the airport by 2030.

[48] Statista Research Department (2024). Phuket. Statista. Available at: https://www.statista.com/topics/10978/phuket/#topicOverview

"The beautiful island of Phuket has a problem of unsustainable tourism. Phuket wants to be safer and more comfortable for tourists, and help local businesses make money. Phuket needs to make sure that the growth of the tourist industry will not destroy the environment."

Pracha Asawathira, Phuket Smart City Lead at the Digital Economy Promotion Agency of Thailand.

Project Highlight

Phuket Smart City Open Data Platform to support Phuket's Smart Tourism Objectives

Context and Challenges

Phuket's embrace of smart systems has been driven by a confluence of several factors:

- The pressing need to manage and upgrade the huge and growing numbers of foreign visitors in order to maintain quality of life for residents. The number of tourists arriving each year has grown from 3.6M in 2003 to more than 18M in each of 2018 and 2019. After a sharp drop due to COVID, arrivals are back to 14M in 2023;[50]
- The lost lives and severe property damage from the Indian Ocean Tsunami of 2004 made it clear that land-based disaster monitoring had to be improved[51] through better CCTV monitoring;
- The precipitous drop in tourism during COVID revealed just how dependent on tourist spending the economy had become, pointing to a need for diversification;
- The growing availability of smart city technology in the market; and
- Availability of Thai national government support starting in 2019 when DEPA was launched with responsibility for a national cloud platform for city data and hosting data and applications for Thai cities aspiring to smartness[52]. Local systems such as Phuket's vary in their individual characteristics and combinations of applications, depending on the local needs and conditions, but all must interface seamlessly with the DEPA Data Platform. Phuket, because of its prominence as the country's second biggest tourist destination after Bangkok, receives considerable attention and support from DEPA.

The challenges facing Phuket from tourism are not going to disappear any time soon. At the same time Phuket is seeking to better manage and upgrade[53] its flood of foreign tourists, three airport expansion projects are underway by state-owned Airports of Thailand Plc which together will compound Phuket's tourist crowd management challenge:

- The existing Phuket International Airport is being expanded from 12.5M to 18M pax p.a. by 2027 [cost: THB 6.21B (EUR 160M)]
- The existing Krabi International Airport is being expanded at a cost of THB 2.7B (EUR 69M) (from 5M to 17M pax p.a.
- A new 900 hectare THB 80B (EUR 2B+) Phang Nga / Andaman International Airport is planned for nearby Phang Nga province, to accommodate 40M pax p.a. by 2030.

Together, these three airport expansion projects will more quadruple the Phuket area's tourist arrivals capacity from the current 17.5M to a projected 75 million passengers per year by 2030[54]. The previous (pre-COVID) record for arrivals at Phuket International Airport was 18.32M.

As an indicator of tourist countries of origin, currently, Russia and the CIS countries have 42 different direct air routes to Phuket, China has 29, other Asian countries plus Australia 18 Thailand 16 (domestic) routes, Middle East and Turkey 10, and the UK and Europe 15.

[50]Phuketairport.net (2024). *Phuket International Airport Facts & Figures*. Phuket International Airport. Available at: https://phuketairport.net/statistics/
[51] Thailand's National Disaster Warning Centre (NDWC) installed a Tsunami early warning system around 1,000 km west of Phuket in the Indian Ocean, comprising a group of buoys with transmitters.
[52]There are currently 30 cities all over Thailand, including Phuket and its neighbours Krabi and Phang Nga, using this platform for their local smart city operations.
[53] The Thai Department of Tourism is currently working on implementing a 5-year plan to attract visitors from all over the globe to come for: culinary tourism, Health / medical tourism, marine tourism, sports tourism, and for meetings, conferences and exhibitions.
[54]By comparison, in 2023, Dubai had 57M passengers (largely transit) and London Heathrow had 79M.



Source: Tourism Authority of Thailand

Project Highlight

Phuket Smart City Open Data Platform to support Phuket's Smart Tourism Objectives

The Solution

The solution has been for the Phuket Provincial Government to implement a comprehensive smart city open data system, covering Phuket province (island) as a whole, not only the city *per se*. It runs on the DEPA Data Platform. Developed under DEPA's umbrella Smart City Thailand program, the Phuket project has seven pillars: smart living, smart economy, smart environment, smart people, smart governance, smart mobility and smart energy

The backbone of the system is an island-wide fibre-optic network which connects residents and tourists alike with 1,000 free public Wi-Fi hotspots / wireless connection points in both local communities and popular tourist destinations. These also function as Long-range Wide Area Network (LoRaWAN) and Internet of Things (IoT) stations supporting communications, data collection and transmission from a range of IoT-enabled sensors ranging from CCTVs to air-quality monitors. The open architecture will allow the system to evolve over the years as new types of IoT-compatible sensors are available and installed to monitor e.g. water quality, air quality, rubbish bins, water network conditions, storm drain conditions, and other data.

The system incorporates many integrated, data-sharing features which support tourism management, including, *inter alia*:

- Social media content analytic software monitoring posts made by users of the public Wi-Fi;
- Some 3,500 CCTVs linked to a Disaster Command Center with pedestrian monitors, facial recognition and analytic software supporting maritime and maritime tourist safety and traffic enforcement, as well as to video analytic software watching 14 beaches along the west coast of the island to count people and ensure that safe swimming boundaries are being observed;
- A marine vessel tracking system to monitor traffic (including tourists) by passenger and private boats to and from the nearby tourist destination islands reachable from Phuket harbour;
- Smart tourist vessel ticketing systems using websites, apps and IoT kiosks to issue boat tickets through email and wearable tickets readable at automated gates which control access to piers to board boats to prevent overcrowding of boats;
- Citizen services such as tax payments, business registrations, property transactions; and
- Applications to support healthcare delivery as well as local public safety (fire and police) operations.

The Phuket City Data Platform (PCDP) on which these applications all run is fed by information from the above modules as well as by users of city apps, public Wi-Fi users, tourist data, IoT environment sensors, marine monitoring, energy monitoring and CCTV monitoring. Other data aggregated into the Phuket City Data Platform includes property and economic data of interest to investors in the city.

In turn, being hosted on and part of DEPA's open Data Platform means that Phuket's data is passed up to the national level and is thus available for use aggregated or disaggregated, by all levels of national, provincial and local government, as well as by investors, other businesses, residents and tourists.

Financing

To promote and facilitate the smart cities scheme, the Thai government established a National Smart City Committee, incorporating the Ministries of Digital Economy and Society, Energy, and Transportation. The origin of the Phuket smart city project itself was in 2016, when Phuket was chosen to be one of three pilot smart cities. At that time USD 11M (EUR 10.2M) in national government funding was appropriated to Phuket province for the project. It is understood that development of the core national city data platform was funded internally by DEPA.

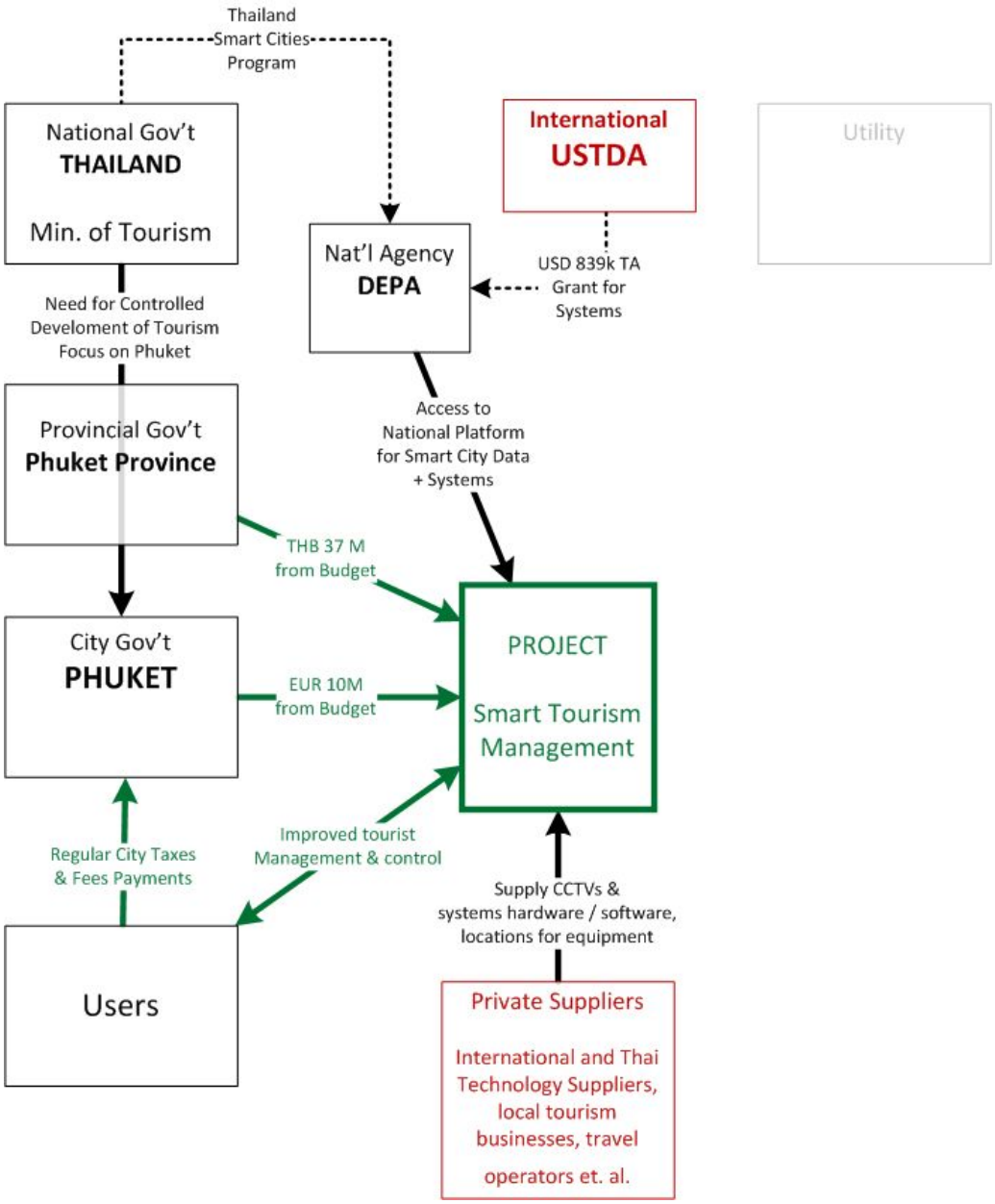
Project Highlight

Phuket Smart City Open Data Platform to support Phuket's Smart Tourism Objectives

To supplement the Provincial budget appropriation, a USD 839,420 technical assistance grant was provided to DEPA in March 2023 by the US Trade Development Agency to support DEPA and the Provincial Government in developing, implementing, and expanding two fundamental pillars of Phuket's smart city program, the Phuket City Data Platform and command centre, as well as in assessing the province's enabling ICT infrastructure[55].

Additionally, for 2024, the Phuket provincial government budget includes an appropriation of THB 37M (EUR 947k) to further develop the Phuket city information management system together with the Upper Southern Thailand Regional Branch of the Office of the National Economic and Social Council (NESDC)[56].

Figure 6: Schematic of parties involved in Smart Tourism Management, Phuket



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

[55] U.S. Trade and Development Agency. Thailand: Phuket Smart Cities Technical Assistance. USTDA. Available at: https://www.ustda.gov/business_opp_oversea/thailand-phuket-smart-cities-technical-assistance/

Project Highlight

Phuket Smart City Open Data Platform to support Phuket's Smart Tourism Objectives

Impact

The project is anticipated to have positive impacts in all of the areas it touches upon, including *inter alia*:

- Controlling crowds and preventing overloading of e.g. boat services to neighbouring islands through smart ticketing and reservation applications;
- Monitoring tourist actions and behaviour;
- Improved water safety through monitoring of ferries and small craft serving Phuket and the neighbouring islands;
- Improved ability by the city and provincial governments to monitor and understand tourist activities and behaviour patterns to improve policies and management.

Critical Success Enablers

Strong Financial and Technical Support	Efficient Coordination and Collaboration	Market Availability and Concrete Rationale
The availability of national financial and technical support through DEPA, as well as grant technical assistance from USTDA, provides a solid foundation for the project's success.	The relatively small size of Phuket island and the close interaction between national, provincial, and municipal levels of government ensure efficient coordination and collaboration, essential for implementing a comprehensive smart city project.	The wide and ready availability of technology on the market, combined with the present and visible needs stemming from the high volume of tourists, gives the project a concrete rationale. This enables the city and provincial governments to marshal public acceptance and support, as the benefits of improved public safety and services are clear and tangible.

Replicability

Phuket faces unique challenges due to unsustainable economic reliance on a high and growing flow of international tourists. Other cities in Thailand also face similar challenges, if on a smaller scale than Phuket. Any city in Thailand should be able to replicate (in a way appropriate to its own circumstances) Phuket's smart tourism management systems by participating in DEPA's Smart City Thailand program, working with its provincial government and the Tourism Authority of Thailand.

Cities outside Thailand may not have the same sheer volume of tourists that Phuket has, or the benefit of a DEPA or a similar national digitisation promotion and support agency. However, all of the network equipment, IoT sensors, CCTVs and software used in the Phuket system are widely available on the market from a variety of suppliers.

Project Highlight

Phuket Smart City Open Data Platform to support Phuket's Smart Tourism Objectives

A city can develop first a technical roadmap first for implementation of the IoT backbone, then specifications for the tourism-relevant apps and features, working in collaboration with other levels of government, look at procurement options then request proposals from equipment vendors and solutions providers. Many vendors should be able to quote prices for system components, both hardware (CCTVs, kiosks, ticket printers and scanners) as well as software (mobile apps for tourists, people counters and view analytics, facial & vehicle recognition apps) on an "as-a-service" basis, in other words, charging the city on a monthly rental for the systems and monthly subscription for software and server use, converting the capital expense into an operating expense. A capacity-building program for local government staff re-development and management on smart tourist and security systems would smooth and reduce risks in the implementation and increase the effectiveness of the system.

References:

- **Statista Research Department (2024).** Total Passenger Traffic at Phuket International Airport (HKT) in Thailand from Fiscal Year 2016 to 2023. Statista. Available at: https://www.statista.com/statistics/1380465/thailand-passenger-traffic-hkt-airport/
- **Digital Economy Promotion Agency. DEPA.** Available at: https://www.depa.or.th/th/home
- **UNDP (2023).** Phuket Sustainable Transformation Vision and Strategy. Available at: https://www.undp.org/sites/g/files/zskgke326/files/2023-11/Phuket%20Sustainable%20Transformation%20Vision%20and%20Strategy.pdf
- **Market analysis of Phuket Tourism Industry: See C9 Hotelworks (2023).** Phuket Economy Report . Available at: https://www.c9hotelworks.com/wp-content/uploads/2023/12/2023-2024-the-phuket-report.pdf
- **The Nation (2021).** Thailands 15 Smart Cities Unveiled. Available at: https://www.nationthailand.com/business/40010424
- **Phuket Provincial Office (2024).** PHUKET Smile Smart and Sustainable. Smart City Thailand. Available at: https://www.citydata.in.th/phuket/en/homepage/
- **Nanthaamornphong, A., Holmes, J. and Asawateera, P. (2020).** A Case Study: Phuket City Data Platform.IEEE Xplore. doi:https://doi.org/10.1109/ECTI-CON49241.2020.9158101
- **Digital Economy Promotion Agency (2020).** Phuket City Data Platform. Available at: https://www.jasca2021.jp/ascnjapan2020/dl/document/pracha_asawateera.pdf
- **Asawateera, P. (2016).** Phuket Smart City Road Map. Available at: https://phuketrealestateassociation.wordpress.com/wp-content/uploads/2016/10/pkt-smartcity-ws-update.pdf
- **Khunpitiluck , C. Phuket Smart City.** Available at: https://www.phuket.go.th/webpk/file_data/smartcity/01.pdf
- **DEPA, HUAWEI and Roland Berger (2019).** Smart City Framework and Guidance For Thailand. Available at: https://mglobale.promositalia.camcom.it/kdocs/1962677/5b9f4d7b-3f7e-4ed4-a9ee-3ecd47d38554smart_city_framework_and_guidance_for_thailand_smart_city_servic
- **DEPA (2021).** Phuket Smart City. Available at: https://www.jasca2021.jp/1st/pdf/WS5/phuket.pdf

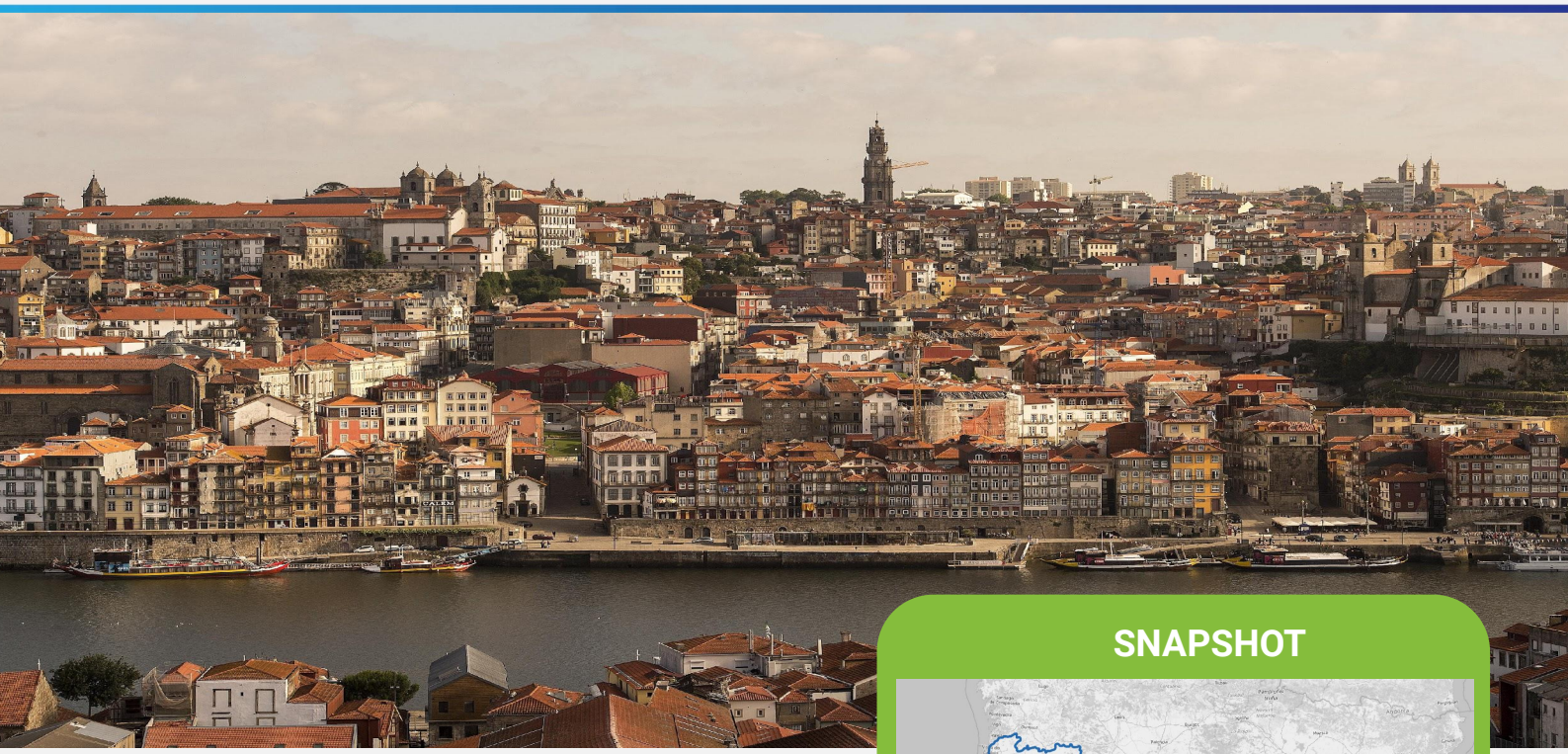


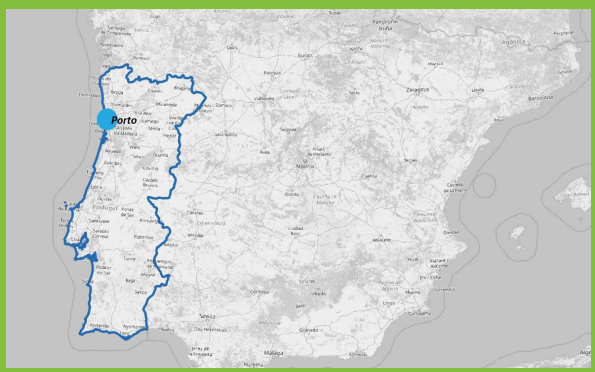
Image Source: City of Porto

Porto PORTUGAL

Porto (also known as Oporto) is the second largest city in Portugal, located on the northwest coast of the country on the Atlantic coast, at the mouth of the Douro River. With a history going back 2,000 years, the city is one contrasted with nearby Roman ruins, 16th-20th Century architecture, and many green open spaces. Port wine, first developed here by English wine merchants as a way to fortify wine and preserve it for shipping, has been an internationally-known Porto export since the 18th Century.

Despite its rich history and cultural heritage, Porto has its eyes firmly fixed on a sustainable future and is committed to leading the way in green and climate action. From its green parks and gardens to its pedestrian-friendly streets and bike-sharing programme, Porto is a city that is putting sustainability at the heart of its urban planning, supported by a vibrant community of entrepreneurs and designers, working together towards these goals to turn Porto into a "City of Opportunities" where innovation, creativity, and environmental stewardship go hand in hand.

SNAPSHOT



Area (km2)
Core/ Greater Metro
43 km/ 2000 km

Population
Core/ Greater Metro
232,000/ 1.7 Million

Administrative status
Porto is the main municipality in the Porto Intermunicipal Community, Portugal

National political regime
Unitary semi-presidential republic (with Prime Minister)

Multi-level Governance Framework
Unitary State with a two-tier system of local governments (308 municipalities and two overseas autonomous regions)

Geography & Topography
Hilly coastal city with a moderate maritime climate, at the mouth of the Douro river on the Atlantic Ocean

Participation in International initiatives
- Eurocities
- Green City Accord
- Net Zero Cities Laureate
- 100 Climate-neutral and Smart Cities

Smart Green City Clusters
Green Spaces
Nature-based Flood Control

Annual Municipal Cash Flow
EUR 300 M (2022)

Smart and Green City Vision

Porto has set itself an ambitious target to become a leader in climate action at national and European levels, aiming for net zero emissions / carbon neutrality by 2030, 20 years ahead of the European Union's target. Porto's Municipal Master Plan, approved in 2021, sets criteria for environmental sustainability and defines a Municipal Ecological Framework (MEF), to provide an inventory of both natural and transformed spaces to be developed or protected, from green and wet areas to green corridors and landscape units.

For Porto, the carbon emissions reduction target is not only a commitment by the municipality but is also a common goal of the entire city. While the role of the Municipality is essential, municipal assets only account for 6% of the total greenhouse gas (GHG) emissions of the city, with most emissions coming from commercial and residential buildings (60%) and transportation (32%). To foster the participation of all stakeholders and develop an inclusive approach to the governance of the city's GHG emission reduction, the City Council announced a "Porto Climate Pact" in 2022 which already has more than two hundred voluntary signatories, including companies, associations and educational institutions committed to influencing and being ambassadors of climate neutrality and adopting sustainable behaviours.

KEY ACHIEVEMENTS

- "The Smart City Innovator Award" in 2020
- Porto is part of the "Intelligent Cities Challenge", promoted by the European Commission
- Porto achieved first place in the "European Cities of the Future" ranking in the fDi Intelligence
- Having been included by the European Commission in the list of "Smart Cities with a Climate neutral Impact" for leading in climate action

Porto seeks to anchor its climate strategy in digital and urban intelligence, while building a culture of data that is open, focused on improving agility in the delivery of services to citizens and privacy-centred. To support data-driven policy decision-making, the City has built an open-access urban data platform[57] based on data shared by several public and private organisations, which in turn supports better management and, consequently, significant energy savings[58]. Based on this premise, the municipality has defined a strategic plan for valuing data and as early as 2004, created the Porto Digital Association in collaboration with the University of Porto and the Portuguese Business Association (AEP), to promote ICT projects, set of indicators, and ensure compliance with a data privacy policy initiated in 2017.

[57]Porto City Hall. Portal de Dados. Available at: https://opendata.porto.digital/
[58]SmartCitiesWorld (2023). How Porto is making climate action the responsibility of all. Smart Cities World. Available at: https://www.smartcitiesworld.net/climate-action/climate-action/how-porto-is-making-climate-action-the-responsibility-of-all-8528

Image Source: European Capital and Green Pioneer of Smart Tourism

Financial Resources & Management Approaches of the City Government

Porto is the second-largest municipal economy in Portugal after the country's capital Lisbon. Porto is a bustling economic hub, boasting a diverse economy that encompasses sectors such as services, industry, commerce, and tourism and more recently, the tech sector. The share of ICT services has more than doubled over the last 10 years, rising from 3.6% to 7.9% in 2020 above the EU average. Porto is now home to a thriving tech ecosystem, hosting more than 290 startups and 1,830 headquarters of major tech companies.

Although belonging to the group of OECD centralised countries where subnational governments have relatively few spending responsibilities and few resources, Portugal stands out due to the importance of tax revenues, which is an important revenue source for regions and municipalities, including Porto, accounting for 38.6% of their revenue in 2020. However, the income derived from subnational government tax revenue is limited, representing 2.6% of GDP and 10.3% of public tax revenue, compared to 4.5% of GDP and 18.7% of public tax revenue in OECD unitary countries on average in 2020[59]. This over-reliance on tax revenues also creates a volatile revenue stream, making it difficult for local governments to plan long-term projects and initiatives. In addition, although the legal and administrative autonomy of Portuguese municipalities has been strengthened in recent years, few important spending assignments have been devolved to local governments and many local governments still rely on transfers from the central government to finance their activities, or contributions from European programme funds.

[59]OECD (2022). Synthesis Report World Observatory on Subnational Government Finance and Investment. doi:https://doi.org/10.1787/b80a8cdb-en

"Local governments shall market the city as a "City of Opportunities, meaning showcasing and operationalizing a vanguard city opened to partnering and innovating".

Ricardo Valente

Image Source: Wallpapercave - Porto

Project Highlight

Attracting Private Investments In Nature-based Solutions for Flood Mitigation

Context and Challenges

Located at the mouth of the Douro River and built on steep hillsides, the city of Porto is prone to flooding during periods of heavy rainfall and has experienced more frequent and severe floods in recent years, partly due to an increase of climate change-related extreme weather events.

The city's topography means that stormwater runoff can flow rapidly down the hillsides, causing erosion and landslides, and overwhelming the drainage systems in the valleys. This has been exacerbated by rapid urbanisation, covering more natural surfaces with impermeable materials, and consequently increasing the amount of runoff during storms.

The city decided to try a sustainable nature-based solution by diverting water from an overloaded sewerage system into a green area where it would be absorbed into groundwater.

The Solution

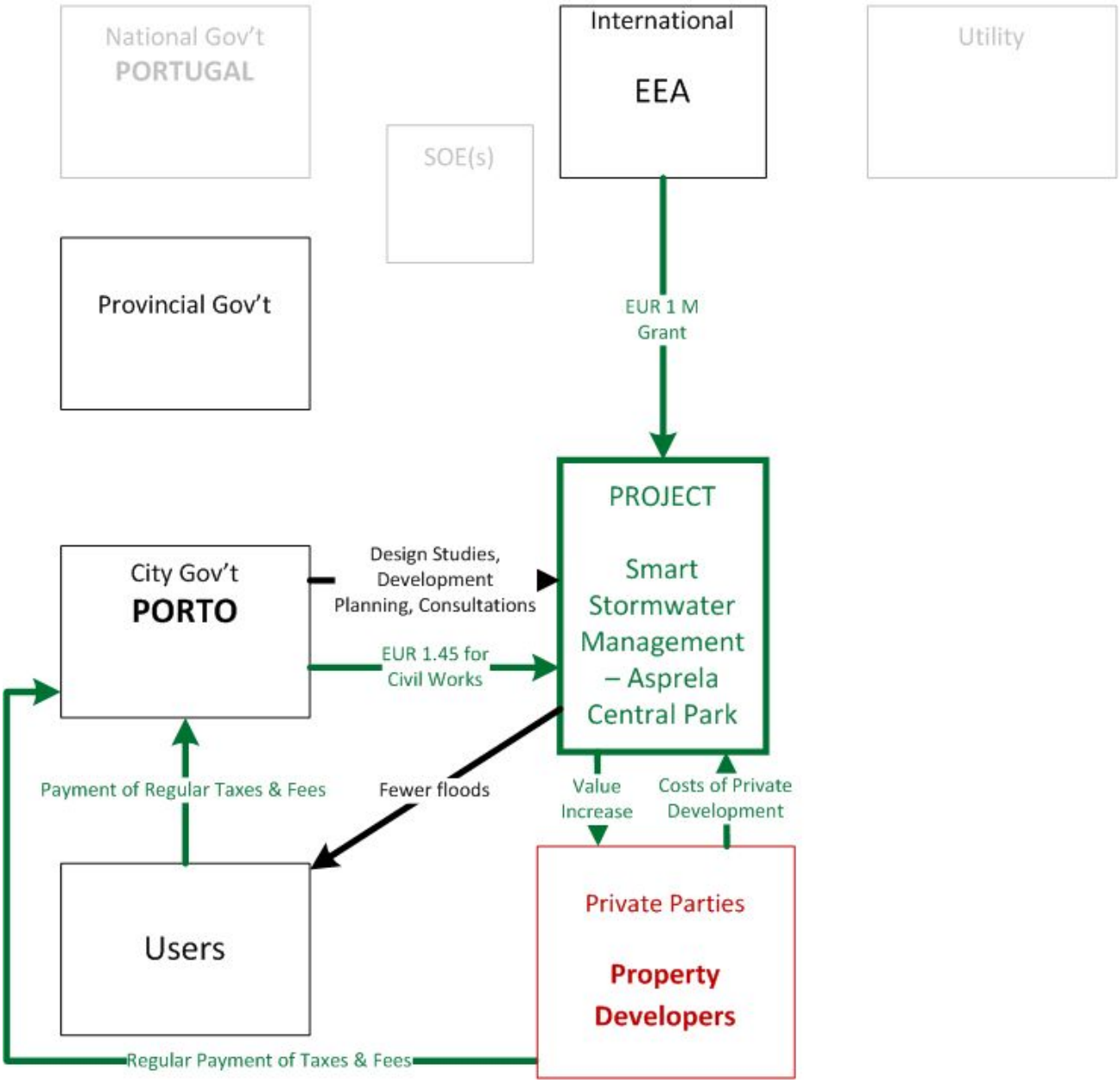
To help the city alleviate water shortages and improve flood management, Porto has adopted the concept of a “sponge-city”. The idea behind a sponge city is to create a city that can absorb and reuse rainwater instead of letting it run off into the sewage system. This approach not only helps to reduce flooding but also replenishes the city's water supply and improves water quality. In Porto, the concept has been put into practice through the implementation of a series of projects and initiatives, including the creation of green spaces and the use of permeable pavement in urban areas. One of the most significant projects was the Asprela Central Park, built as a modulable area to provide both a large rainwater retention zone (10,000m3 capacity), and a green park for the inhabitants of Porto. The works at Asprela Park aimed to build a "new green lung" that will include a stream flow regulation system, the creation of water storage basins, footbridges and bike paths in a total area of 60 thousand square metres.

Financing Approach

The project was financed through a combination of public and private funding sources. Funding from the Municipality and grants from the European Union (European Economic Area / EEA) Grants supported early planning and project preparation / development, and this, in turn helped to mobilise private investment from real estate developers, financial institutions, and construction companies, in exchange for ownership stakes in the various development of the broader Asprela + Sustentável initiative. Reported public investment in the Asprela project totalled to €1.45 million from 14 public and private entities, including the Municipality and €1million of EEA grant, not including the cost of any private property investment around the park attracted by the green space enhancements.

Invest Porto, the municipal investment promotion agency founded by the Porto City Council in 2015, worked closely with the different project stakeholders to promote the Asprela project to domestic foreign investors and companies, providing them general information and specific advisory support to navigate the local regulatory framework. Invest Porto also facilitated the participation of international companies by participating in trade shows and attending conferences to promote investment opportunities and the pipeline of projects associated with the Asprela district.

Figure 7: Schematic of parties involved in Asprela Central Park, Porto



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Impact

The Asprela + Sustentável initiative was the top scoring project selected as part of the "Environment, Climate Change and Low Carbon Economy" programme. The opening of the Asprela Central Park in 2022 has extended the municipal area of public green spaces by 6 hectares, which positively impacted on the attractiveness of the Asprela district, which saw increase in the number of companies settling in the neighbourhood. It also consolidated the credibility of Invest Porto as a critical agency to promote sustainable and innovative development in the region, and create a precedent to leverage investments for other green initiatives in the district and the municipality.

Project Highlight

Attracting Private Investments In Nature-based Solutions for Flood Mitigation

Critical Success Enablers

Committed Leadership

The Asprela project was designed as a long-term project, with a 20-year development plan. This long-term planning enabled the project to take a comprehensive approach to urban development, but also provided investors with a clear vision supported by a firm political commitment through funding and regulatory support from the Municipality to help drive the project forward.

Collaborative Approach

The Asprela Project was a collaborative effort between the Porto City Council, the University of Porto, and private sector partners. The partnership allowed for the pooling of resources and expertise to create a shared vision for the project and to develop a comprehensive master plan.

Proactive Fundraising

Invest Porto played a key role in marketing the Asprela project to potential investors, by working with other project stakeholders to develop a compelling message about the project's unique value proposition and communicate this message effectively to potential investors. It also facilitated partnerships between the project partners and potential investors who had the necessary capital, expertise, and strategic fit to support the project's long-term success.

Replicability

Many cities of all sizes in ASEAN share the hilly riverside terrain which drove Porto to improve its drainage and water management using the nature-based "sponge city" concept. A city wishing to replicate Porto's approach might begin with topographical and engineering surveys of existing city-owned green and unconcreted areas (such as city parks and undeveloped lots of land) to determine their capacities to absorb flood water and rainwater, and how that water might be diverted to those places and away from the sewer system. Civil works would then be costed and initial proposals sought from contractors and a funding model developed.

An assessment would then, in discussion with major property developers in the city, to determine the possible commercial and/or or residential developments which could be built in the areas selected and to forecast the revenue which would be generated to the city from higher property taxes, land sales and land rentals (these could provide part or all of the funding required for the civil works required for the water diversion). At the same time, planning and design should include close consultation with city transportation and utility providers to anticipate transportation and additional power requirements of the new developments, and to model the impact of the proposed project on the overall city development plan and other investment projects.

References

- Porto. City Council (2021). InvestPorto. Available at: https://www.investporto.pt/en/news/porto-city-council-approves-new-municipal-master-plan/
- SmartCitiesWorld (2023). How Porto is making climate action the responsibility of all. Smart Cities World. Available at: https://www.smartcitiesworld.net/climate-action/climate-action/how-porto-is-making-climate-action-the-responsibility-of-all-8528
- Porto. (2022). Porto Climate Pact mobilizes European cities to lead in the environmental transition. Available at: https://www.porto.pt/en/news/porto-climate-pact-mobilizes-european-cities-to-lead-in-the-environmental-transition
- Porto. (2023). Porto Climate Pact. Pacto para o Clima. Available at: https://pactoparaoclima.portodigital.pt/?page_id=5738
- Porto City Hall. Portal de Dados. Available at: https://opendata.porto.digital/.
- AdEPorto-Porto Energy Agency (2024). Asprela + Sustentável. AdEPorto. AdEPorto. Available at: https://www.adeporto.eu/en/projects/asprela-sustentavel/

Source: Milos Ruzicka©

Rhenen
The Netherlands

Rhenen is a small municipality in the province of Utrecht in central Holland, comprising the town of Rhenen and the villages Achterberg, Remmerden, Elst and Laarein. The town of Rhenen is in an agricultural area bounded by the Nederrijn river on the south, a forest reserve on the West, and agricultural areas to the East and North (wooded area accounts for almost 40% of the municipality's area). It has a demarcated light industrial park (Remmerden).

Being on a river in a low-lying area, Rhenen is vulnerable to flooding. Climate change-induced unseasonal and irregular rain leads to waterlogging and flooding from both overflowing rivers and sudden water flows from higher-lying ground backing up in areas with poor drainage due to concreted roads and built-up areas. This led Rhenen Action towards climate change which was echoed at the national level with the adoption of a National Climate Adaptation Strategy (NAS) in 2016.

Area (km²)
42 km²

Population
20,265

Administrative status
Municipality (comprising one town and two adjacent villages) in Utrecht Province, Netherlands

National political regime
Unitary parliamentary constitutional monarchy

Multi-level Governance Framework
The Netherlands has two+ tiers of subnational government: 12 Provinces, 342 Municipalities plus an overlay of 26 district Water Boards[60]

Geography & Topography
Inland low-lying town in an agricultural and wooded area with a continental climate, on the Nederrijn river.

City Network Membership
VNG (Dutch National Association of Municipalities), who is part of the Council of European Municipalities and Regions (CEMR) and UCLG

Smart Green City Clusters
Climate adaptation through improved water management using nature-based solutions

Annual Municipal Cash Flow
EUR 11.106M (2024 budgeted)

[60]Regional Water Boards, or Rijkswaterstaat, are charged with water and wastewater management, flood control, irrigation and drainage. They are also responsible for ensuring a sufficient supply of water and keeping the country protected against flooding. Provinces and municipalities are also involved in water management.

Smart and Green City Vision

Faced with long-term climate change challenges threatening the city, the municipality of Rhenen issued in 2019 a Spatial Adaptation Plan to become more climate-adaptive and water-robust. The plan recognizes that early planning can lead to smarter investment and more robust engagement with both public and private parties. Risk assessment processes were implemented, together with other government authorities, social organizations and citizens

Rhenen's vision of smart adaptation is anchored in the principles of participative intelligence and integrated solutions, acknowledging the urban climate change imperative to "give more room to nature" and to integrate natural assets as distinctive components of urban spatial and strategic planning – for instance through cost-effective nature-based solutions (NBS).

Furthermore, Rhenen's commitment to sustainability is demonstrated through its aspiration to achieve energy neutrality by 2040, such as through solar panels.

"To adapt to climate change, cities need "to give room to nature. Nature based solutions are less costly and easier to implement."

Source: Regionaal Bureau voor Toerisme (RBT) Heuvelrug & Vallei

Financial Resources & Management Approaches of the City Government

Rhenen is part of the Utrecht province, which has a diverse and dynamic economy with the stronger sectors being services, industry, and agriculture. The province contributes about 13% of the national GDP and has a low unemployment rate of 2.9%. Rhenen has a population of about 20.000 people and a land area of about 43 km^2. Like most Dutch municipalities, general grants from the central government (through the Municipal Fund) account for the majority of Rhenen's budget (78% for 2023). Other revenues come from local taxes (mostly property taxes) and levies on sewerage and waste (respectively 4% and 5.6% for 2023).

Revenue Item	Total Rhenen	per capita
Total property tax	5,410	268
Sufferance tax	26	1
Tourist tax	172	9
Sewerage charges[62]	**2,101**	**104**
Waste collection	2,595	128
Administrative fees for civil affairs	245	12
Burial charges	557	28
Total	11,106	550

This breakdown of city revenues[61] budgeted for the year 2024 (in EUR '000) illustrates the city's various sources of revenues.

As can be seen in the table, from a total annual budget of just over EUR 11M, some EUR 2M arise from the sewerage charges used to pay the city's share of the costs of the project described herein. At a population of just over 20,000 people, this equates to a modest per capita annual charge of EUR 104. Sewerage and Waste Collection charges are cost based, and reflect actual and budgeted expenditures. The proceeds of the Sewerage charges are used to finance the storm water management measures described below, with additional contributions from the regional Water Board.

Additional funding for city investments can be sourced from Dutch Local Government Funding Agencies (LGFAs), such as the Municipal Bank of the Netherlands - BGN Bank[63] and NWB Bank[64] . The BNG specializes in providing financing for (semi-)publicly owned organizations, such as municipalities, provinces, public utilities, health care organisations and public housing. Established by the Dutch Association of Municipalities (VNG), BGN Bank helps Dutch municipalities to access credit markets. Half of BGNs share capital is held by the central government and the other half by municipalities, provinces, and the Water Boards.

NWB Bank owned by the district Water Boards and provincial governments, is the second largest public sector bank in the Netherlands and exists exclusively to provide funding for water boards and local government to meet needs related to water management.

[61]Statistics Netherlands (2024). Key Figures Municipal budgets: Levies per Municipality. Available at: https://www.cbs.nl/en-gb/figures/detail/83643ENG?q=rhenen
[62]This is the Rioolheffing – see "Financing of the Solution" below.
[63]BNG Bank (2024). Driven by Social Impact. Available at: https://www.bngbank.com/
[64]Nederlandse Waterschapsbank N.V. The Sustainable Water Bank. Available at: https://www.nwbbank.com/en.

- Hans Boerkamp

The Challenge

Like many Dutch cities, a flat landscape and proximity to one of the country's many rivers and canals (in the case of Rhenen, the Nederrijn river) means the city is susceptible to flooding when rains or rising river levels overwhelm the sewer system and the ground's ability to absorb it, given the amount of surface area which has been concreted over or built upon. Rhenen also has the rare situation in mostly-flat Holland of being hilly with parts 50-60 metres above the surrounding plains.

This hilly terrain means that rainwater flows downhill, especially on paved roads, and tends to overwhelm the city's sewer system (which runs underneath the roads) and wastewater treatment facilities. As outlined in its 2019 Spatial Adaptation Plan prioritising Nature-Based Solutions (NBS), solutions have been developed following that approach.

Source: Roubwan©

Solution

All key stakeholders - the municipality, the residents, the province of Utrecht and the regional Water Board - participated in joint research to analyse and map the flows from heavy rain showers and see where they were entering the sewer system and watercourses.

The solution developed provides for diversion or retention of rainwater so it does not enter the sewer system by:

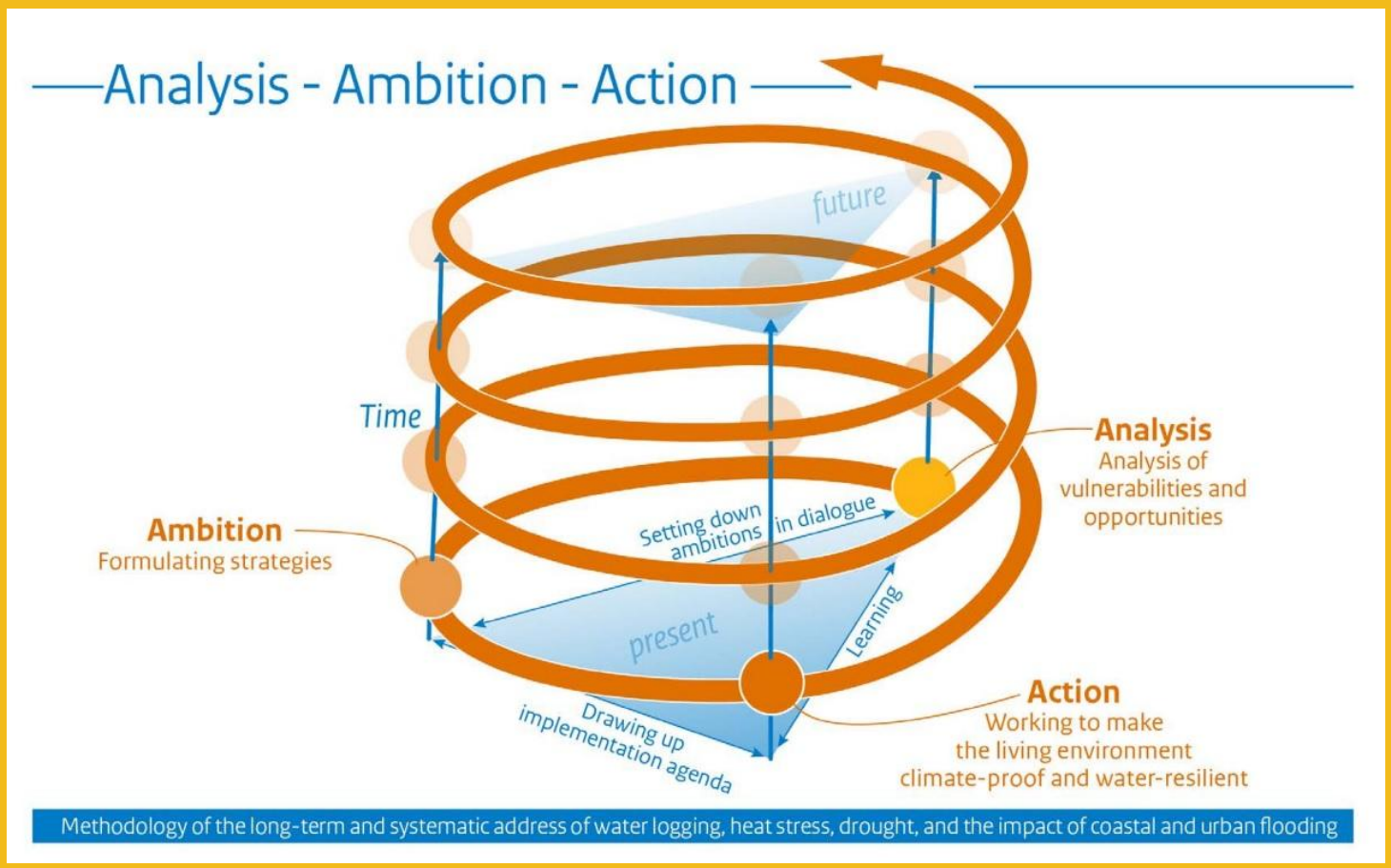
1. disconnecting residential rainwater drains from the sewer system, encouraging homeowners to leave areas of their yards and gardens unpaved so that rainwater can be absorbed into the ground, and also constructing or erecting water storage tanks on their properties to hold rainwater for domestic use.
2. constructing catchment tanks beneath roads to hold excess rainwater and drain it to "wadis" - grassy parklike areas with swales landscaped to channel rainwater and allow it to be absorbed into the ground.

These steps are not so much a discrete 'project' but an ongoing business-as-usual process carried out by the city public works teams and the Water Board, which is responsible for groundwater and wastewater treatment. Because the sewers run beneath the roads, the alterations to the sweet system is being done concurrently neighbourhood by neighbourhood as regularly scheduled road upgrading and maintenance works are carried out. For example, when a section of road is excavated, (a) changes are made to the underlying sewers, e.g. the addition of rainwater catchment tanks, (b) diversion pipes are connected to the nearest wadi, (c) households along that section of road have their roof rainwater drains disconnected from the sewer (residents are simultaneously offered storage tanks, grants, and advice about 'unpaving' their yards), and (d) the road is resurfaced.

Project Highlight

Storm & Flood Water Control and Drainage using Nature-Based Solutions.

(Left) The city conducted risk analysis of all areas to inform public works and ensure private developers consider this data.
(Right) Analysis of roads susceptible to flooding.
Picture Sources: Local Government of Rhenen



Picture Source: Local Government of Rhenen

Project Highlight

Storm & Flood Water Control and Drainage using Nature-Based Solutions.

The city has given rivers more space for excess water, creating new areas for recreation and nature development.
Picture Source: Local Government of Rhenen

In areas prone to rainwater flooding, the city have created "wadis" to divert water away from infrastructure.
Picture Source: Local Government of Rhenen

Financing

The ongoing work to improve storm water drainage in Rhenen is paid for by both the municipality and the water board, each paying half of the construction costs, including two wadis (natural or man-made creeks for drainage of runoff storm or flood water). This work started in 2019 and is ongoing, with additional parts of the city being brought into the new system of water management. As sections of the city's road network come up for scheduled maintenance work, houses along that section of road have their rain collection plumbing disconnected from the sewerage pipes, any additional stormwater retention tanks are installed beneath the road with necessary diversion piped to the nearest wadi, the that section of road is resurfaced. So, rather than being a discrete "project", this is ongoing work integrated into the road maintenance program and carried out by Rhenen own municipal public works department.

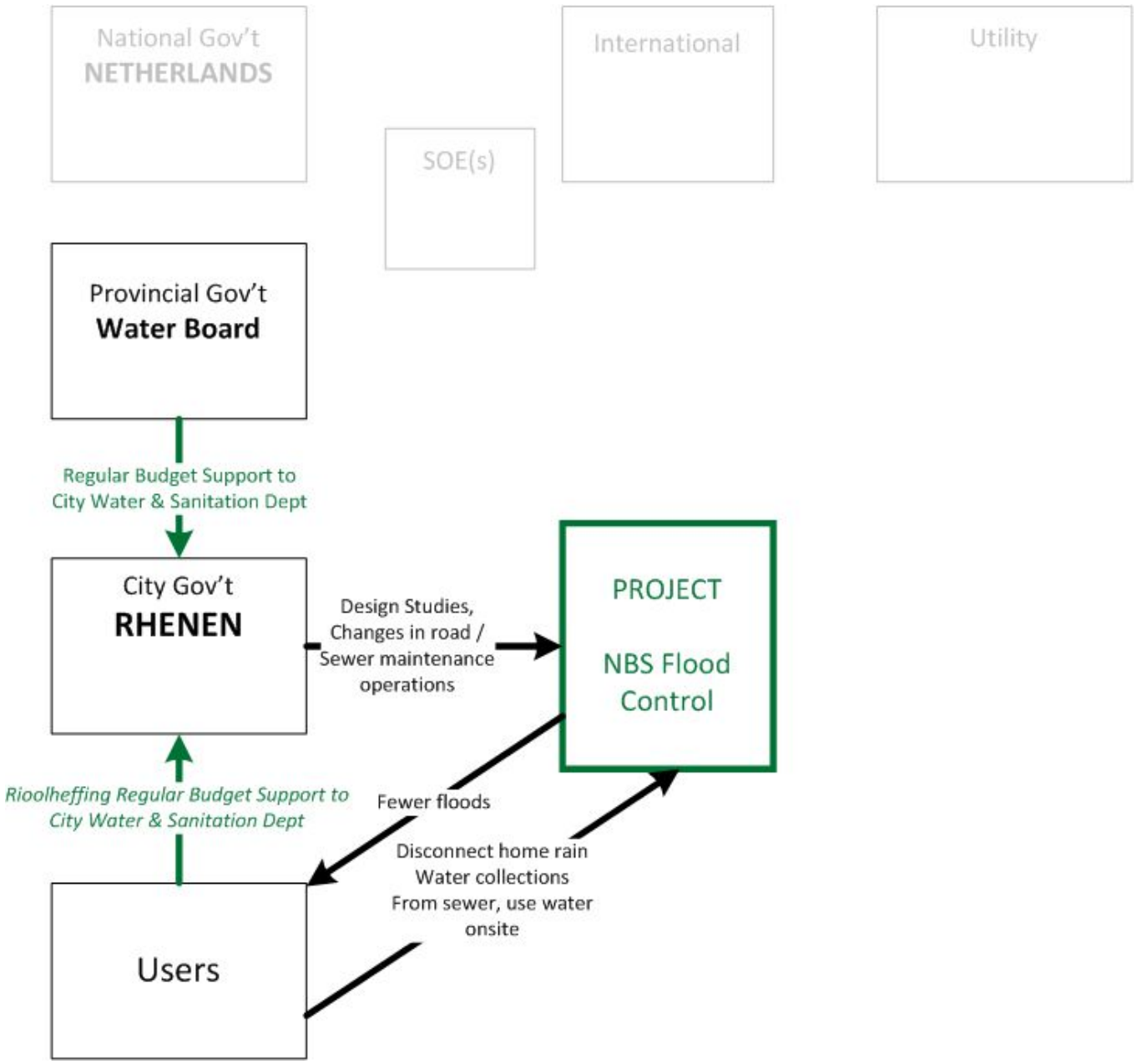
The municipal funds used were sourced from the city's "*rioolheffing*" or "*rioolbelasting*", the sewage tax or waste water charge in the Netherlands. *Rioolheffing* is charged to property owners based on a range of criteria, such as the size of the property, the number of cubic metres of water consumed or the impermeable (concreted surface) area of the property. Funds thus raised are used to maintain and improve sewage systems, sewage treatment plants and related infrastructure. The amount of the *rioolheffing* varies from one municipality to another depending on the size of the municipality, the needs in terms of sanitation and the investments necessary to upgrade the sewage systems and maintain it in good working order.

A new sports complex is currently being built, and the local government has established additional climate adaptation criteria to avoid future rework.
Picture Source: Local Government of Rhenen

"To adapt to climate change, cities need "to give room to nature". Nature based solutions are less costly and easier to implement."

- Hans Boerkamp

Figure 5: Schematic of parties involved in Paris Green Fund, Paris



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Impact

The net result has been to significantly reduce the amount of water entering the sewerage system, reducing strain on the sewers and the wastewater treatment plant, and returning water to the underground water-table.

Critical Success Enablers

NBS Approach

Integration of the NBS approach into city planning and public works regular operations.

Financing Availability

Availability of dedicated local sewerage charge revenues to pay for sewer maintenance / upgrades and wastewater treatment expenses and availability of financing / co-financing and project implementation support from Rhenen's district Water Board.

Sound and Comprehensive Planning

The Rhenen Spatial Adaptation Plan of 2019 recognizes that effective water management and adaptation strategies require collaboration and coordination at all levels, and that a holistic and integrated approach is essential to achieving the desired outcomes.

Community Engagement

The Rhenen Spatial Adaptation Plan promotes a number of community engagement initiatives, such as the establishment of a community flood risk management program, which raised public awareness about water management and flooding risks and encourages residents to take proactive measures on their own properties (such as yard 'de-paving'). There are ongoing regular includes educational activities, workshops and public information sessions.

Replicability

Any municipality in the Netherlands or elsewhere in the world with severe rain and water management issues should be able to replicate some variant of the NBS approach Rhenen used. The topology of each city will have an impact as well, as some cities are hilly than others, and have more or less concreted surface from which water must be diverted into wadis or collection ponds. Each will have to be funded using resources available under the municipal and national systems in place, however, because they are nature-based solutions requiring minimal construction and materials, vertical infiltration deep wells should be among the lowest-cost alternatives.

Cities interested may begin by checking meteorological data on rainfall against information gathered from residents regarding areas observed as flood-prone due in heavy rains, overlaying the resulting data on maps of the city's existing sewerage system (assuming it has an integrated stormwater/ sewerage system), identifying areas where wadis or parks around water retention ponds could be constructed, consulting qualified engineering firms for cost estimates. Financing will depend on each city's circumstances, but such projects have been at least partly funded privately through property developments and upgrading neighbourhoods around wadis and parks.

References

- OECD/UCLG (2022). Netherlands. World Observatory on Subnational Government Finance and Investment (SNG-WOFI). Available at: https://www.sng-wofi.org/country-profiles/
- Foundation CAS. The Climate Adaptation Knowledge Portal. Available at: https://klimaatadaptatienederland.nl/en
- OECD (2014), "Multi-level water governance in the Netherlands", in Water Governance in the Netherlands: Fit for the Future?, OECD Publishing, Paris, https://doi.org/10.1787/9789264102637-9-en
- IT-Technology, the contractor responsible for the vertical infiltration system in Rhenen. See: IF Technology. Samen Van Fossiele Naar Duurzame energie! Available at: https://iftechnology.nl/
- Euronews (2023). Worst Is yet to Come with Floods in the Netherlands, Germany and Norway. Available at: https://www.euronews.com/2023/12/27/worst-is-yet-to-come-with-floods-in-netherlands-germany-and-norway

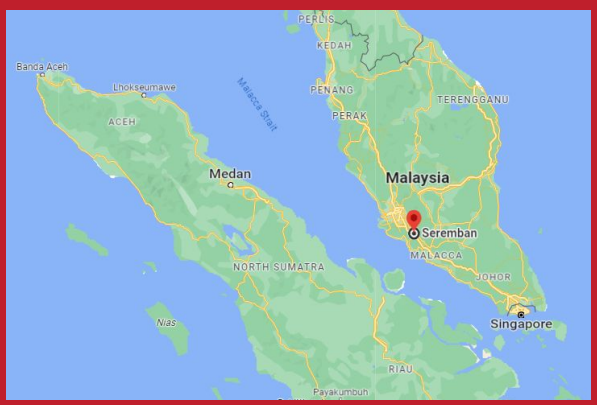
Image source: www.pv-tech.org

Seremban Malaysia

In Peninsular Malaysia, Seremban is located about 60 kilometres south of Kuala Lumpur and 36 kilometres from Putrajaya, the new administrative capital of Malaysia. Seremban is the capital of the state of Negeri Sembilan.

The town originated as a tin-mining settlement in the 1840s. Seremban has been the administrative, business, and agricultural centre for Negeri Sembilan since the late 19th Century. In January 2020, Seremban was upgraded from a Town Council to a City Council status (requiring a minimum population of 500,000 people and an annual income of RM 100 million) when it merged with the adjacent Nilai Town Council. Organised in 2020, the Seremban City Council is known as "MBS" - Majlis Bandaraya Seremban.

SNAPSHOT



Area (km2)
952

Population
608,800

Administrative status
Municipality, Capital of Negeri Sembiran State, Malaysia

National political regime
Federal with parliament and prime minister, plus state-level constitutional monarchies

Multi-level Governance Framework
Malaysia has two tiers of subnational government: 13 states and 155 Cities and Municipalities

Geography & Topography
Hilly inland city with a hot and humid tropical climate, on the Linggi river

Smart Green City Clusters
Renewable Energy & Solid Waste Management

Annual Municipal Cash Flow
MYR 201M (EUR 39.2M) in 2022

Smart and Green City Vision

Further to Malaysia's National Low Carbon City Master Plan (NLCCM) of 2021[65], the city is targeting a 33% reduction in carbon emissions by 2035 and carbon neutrality by 2055. To achieve this goal, MBS' mid-term strategy (developed in 2021) is to become a "low-carbon city" by 2027 through the Seremban Smart and Low Carbon City Action Plan, which provides for 45 key "smart and low carbon" actions across five strategic focuses:

- Community empowerment,
- Digital infrastructure enhancement,
- Environmental sustainability,
- Urban resilience, and
- Ease of mobility.

The Low Carbon City Action Plan is funded at MYR 8M (EUR USD 1.7M) from the City's operating budget for LED streetlights, tree-planting, organising go-green events, and upgrading its web portal to better engage with the public and other stakeholders. Additionally, MBS seeks to serve as a "role model" by setting an example of green practices in its own organisation, e.g., procuring electric two-wheelers for city law enforcement patrolling. In March 2023, MBS brought in a regional (Singapore-based) private "micro-mobility" provider, Beam Mobility Malaysia Sdn. Bhd[66]., to introduce electric scooters and bikes in the new flagship satellite township of Seremban 2.

KEY ACHIEVEMENTS

- The City Council received several distinctions, including the Triple-Diamond Award from MGTC's Low Carbon Cities 2023 challenge, for reducing its greenhouse gas emissions by 16.9% since achieving City Council status.
- In 2020, Seremban received the "Green Neighborhood Award from the Ministry of Housing and Local Government.
- In 2019, Seremban was named "Happiest City" by the Ministry of Housing and Local Government.

[65] Ministry of Environment and Water (KASA) (2021). National Low Carbon Cities Masterplan. Available at: https://drive.google.com/file/d/1ZW51ncz0EdmlB4D3nVjXphO_ER2XNJg7/view?pli=1

[66] The Malaysian subsidiary (https://www.ridebeam.com/my) of Beam Holdings Pte. Ltd. of Singapore (https://www.ridebeam.com/) currently offers rental / shared electric scooters and related charging and maintenance services in six Malaysian cities.

Image source: New Straits Time

Financial Resources & Management Approaches of the City Government

Seremban's local economy is based on industry and manufacturing, and therefore is a strong base from which to generate tax and other local revenues. The area is already home to multinational companies including Coca-Cola, Petron, Kellog, and Ajinomoto. Near Seremban, Negeri Sembilan state boasts several technology parks, including Techpark Enstek, Senawang Integrated Industrial Park, Tuanku Jaafar Industrial Park, Oakland Industrial Park, Nilai 3 Industrial Park, and Galla Industrial Park. The economy benefits from the city's strategic location, near the Kuala Lumpur International Airport (KLIA) and at the southern and of the Greater Kuala Lumpur ("KL") - Klang Valley national capital area, comprising KL proper, Putrajaya (the new administrative capital city), Shah Alam, Klang, Port Klang, and Puchong.

Although Malaysia has a liquid and active bond market for private and national government debt issues in KL's Bursa Malaysia, municipalities do not issue bonds. Municipal resources comprise local taxes, income from municipal operations such as parking garages, income from land leases and land sales, and intergovernmental transfers from the Malaysian Federal Government. The city's gross revenues in 2022, the most recent year for which data is available, were MYR 201M (EUR 39.2M), including revenues from:

- Assessments (property taxes),
- Rental income from use of various public halls and buildings,
- Licence and permit fees,
- Development & building-related fees,
- Municipal-owned parking,
- Funeral- and burial-related payments

Seremban's development is being pursued further to the development strategy "Malaysia Vision Valley (MVV 2.0)", one of 17 nationally-designated Promoted Development Zones. The MVV 2.0 strategy aims to transform an expansive area of 153,411 hectares into an integrated economic development zone, taking advantage of the overall growth of Greater Kuala Lumpur. As part of this strategy, MBS has supported the establishment of a Green Industrial Park to facilitate cleantech research and development, manufacturing of renewable energy products and related logistics businesses. Notably, world-class tech leaders like Samsung SDI Energy Malaysia have already invested in an EV battery cell facility within the park.

Image source: land.plus

Project Highlight

Landfill to Solar Park: Seremban Strategy to Transform Kuala Sawah Municipal Landfill into Solar Power Plant

Context and Challenges

In Seremban, including all waste streams in the municipality, more than 230M kg of waste are produced each year (around 640K metric tons per day, more than 1 metric ton per person per day). Because it was the least expensive option, this had been disposed of in three municipal landfills, Kuala Sawah (20.1 acres), Sikamat 1 (10 acres) and Sikamat 2 (13.4 acres) for many years. However, as is now widely recognised, landfills present long-term health and environmental risks from methane leaks to hazardous chemicals leachate polluting surrounding areas' drinking water, rivers[67] or agricultural land, so closure or excavation (e.g. using accumulated waste as fuel for adjacent waste-to-energy plants) and remediation (treatment / removal of hazardous chemicals, heavy metals and other pollutants) is now seen as the best future for landfills.

The Solution

The city government of Seremban at the time (c. 2010-2013) worked with the Federal (national) and Negeri Sembilan (state) governments to arrive at a package solution to close the largest of the landfills, Kuala Sawah (20 acres), resurface and convert the acreage to a 5.3MW solar farm producing power for the national grid (Tenaga Nasional) under a Feed-In-Tariff scheme under which the grid purchases power from Independent Power Producers (IPPs) and distributes it.

To implement the project, the city entered into an overall contract with Cypark Resources Bhd., a large Malaysian listed[68] energy and engineering company specialising in this sort of landfill-to-solar project. As part of the closure process, the Federal government moved some excavated waste and relocated it to another landfill, and the 20-acre Kuala Sawah landfill was left to settle for 3 years (c.2010-2013). The remaining organic waste will continue to degrade over the years, so an Engineered Capping System on top of the waste to close the landfill and prevent environmental pollution.

Following closure (2013) ground-mounted solar photovoltaic panels were installed. The solar park project was completed in 2014 and is now starting its second decade of operations. The current land lease and operating contracts run through December 31 of 2043.

Financing instruments or mechanisms

The project itself was self-financing from the city's point of view, with no initial investment by the city and all landfill closure costs, as well as the installation costs for the solar park, paid by Cypark (to be recouped through subsequent power sales). The solar plant is operated by independent power producer (IPP) Cypark Renewable Energy Sdn. Bhd., and owned (as is usual in these solar IPP projects) by a special purpose vehicle, in this case Selasih Mentari Sdn. Bhd. The City Council retained ownership title to the 20-acre site land and receives both land rent and a share of the power sales, under a 30-year lease from the city to the solar park operator which began January 1st 2014,

The annual land rent began at MYR 95,756 (EUR 18,665) p.a., escalating in the final seven years (2037-2043) to MYR 127,452 (EUR 24,884) p.a., for a total projected income to the city over 30 years of MYR 3,311,927 (EUR 645,600). The power sales revenue share payable to the city is MYR 150,000 (EUR 29,240) p.a.

Total projected revenue (rent plus power sales share) to the city over the 30-year term is MYR 7,811,927 (EUR 1,493,553) or MYR 260,398 (EUR 50,760) p.a.[69] While this only represents some 0.013% of the city's annual revenues of MYR 201M (EUR 39.2M), the project nonetheless was financed entirely by Cypark and required no investment on the part of the city.

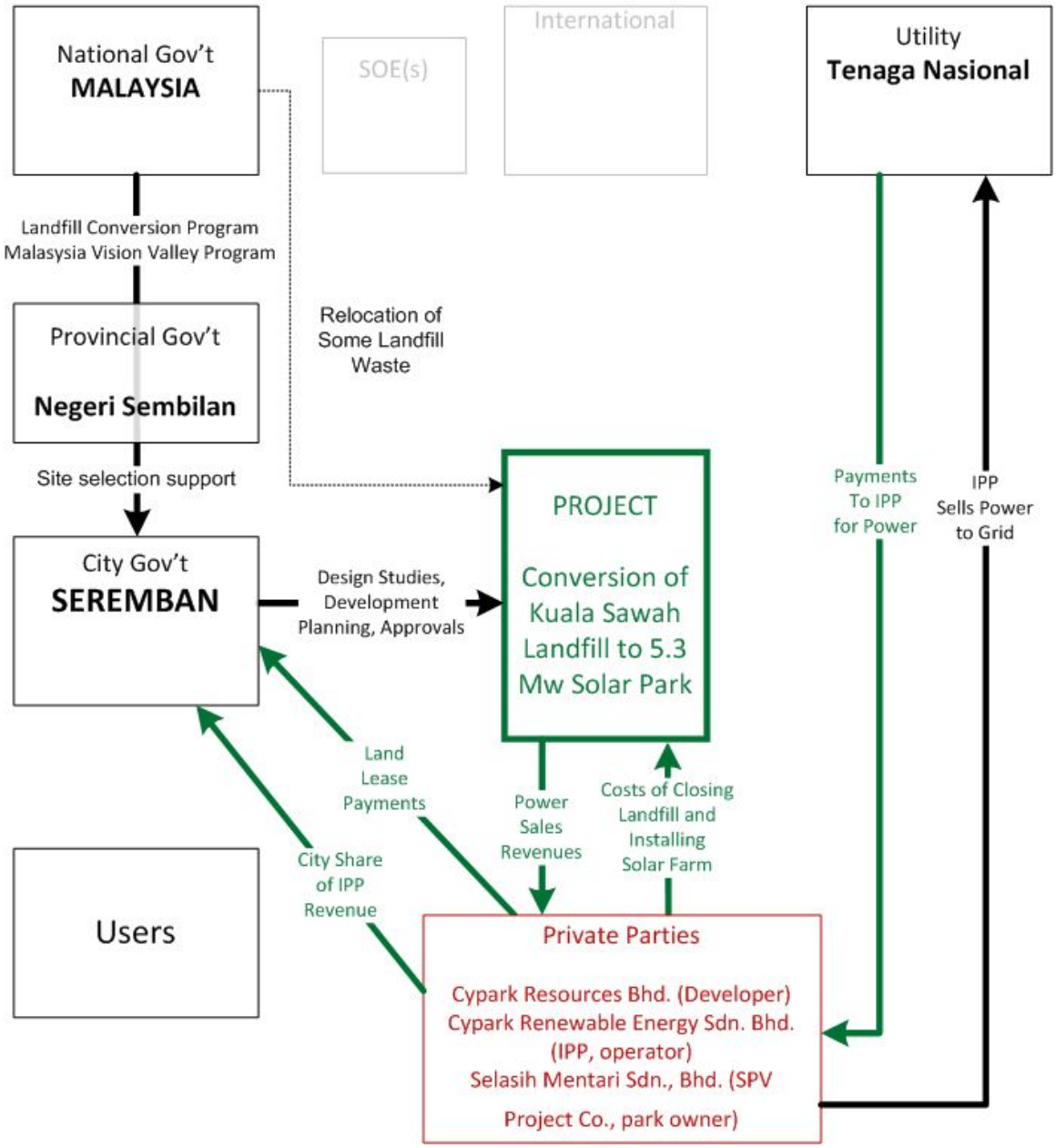
For ongoing solid waste disposal following the closure of the landfill, the city government agreed with the Federal government to transfer all responsibilities of solid waste management to the Federal Government in exchange for an annual contribution by the city to the Federal government of MYR 60M (EUR 11M) per year (representing approximately 50% of the actual costs).

[67] Article on 2022 Landfill issues in Sembaran area: Singh, S. (2022). Negri's Largest Landfill Ordered Shut after Leachate Detected in River. The Star. Available at: https://www.thestar.com.my/news/nation/2022/09/06/negri039s-largest-landfill-ordered-shut-after-leachate-detected-in-river

[68] Cypark Resources Berhad is listed on the Bursa Malaysia (Kuala Lumpur Stock Exchange) main board. To date, it has completed more than 50 renewable energy projects around Malaysia for municipal and state governments, including landfill conversions as in Seremban utility solar, commercial & industrial solar, floating solar, biogas and agricultural solar

[69] The agreement between the city and Cypark provides for a renegotiation of the power sales revenue share in the year 2035. The figures used here assume a renewal at the initial MYR 150,000 p.a. rate, and that the city receives payments in that amount from 2035 through to the end of the lease in 2043.

Figure 9: Schematic of parties involved in Project of Landfill-to-Solar Conversion, Seremban



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Impact

Since its implementation in, the Kuala Sawah Solar Park has generated more than 60,000MWh, and the generation of electricity from renewable resources has successfully prevented the emission of almost 45,000 tons of CO_2, equivalent to approximately 4,785 Gallons of Petrol consumed, 47,000 lbs of coal burned, or 5,360 homes' energy use for one year.

"All of this, we did it without any direct investment from us. All the funds came from the private sector, while improving the quality of the land."

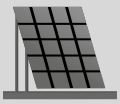
Mr. Mas Midyawan Bin Yahya,
Deputy Mayor

Project Highlight

Landfill to Solar Park: Seremban Strategy to Transform Kuala Sawah Municipal Landfill into Solar Power Plant

Critical Success Enablers

Presence of a Competent and Well-Capitalised Solar Park Developer



Cypark Resources, the solution provider for the landfill closure phase, the solar park construction phase and the ongoing operation of the park paid all costs and is paying the city both rent and a share of power sales through the end of the lease in 2043. This relieved the city of any upfront investment burden.

Multi-Stakeholder Engagement

Multi-stakeholder engagement and information sharing among the three levels of government (city, state and national) was key in this project as the overall solution involving Cypark was facilitated by the Federal and state governments; Cypark was already engaged by the Federal government to pursue this sort of project all over Malaysia

Asset Management

The city made the most of a liability – the landfill – and converted it into an asset, involving efficient resource utilisation, community engagement, creative design, economic viability, and alignment with long-term urban planning goals. By capitalising on existing assets, cities can address various urban challenges and create more liveable, inclusive, and environmentally friendly urban environments.

Replicability

Any landfill in any country can, in principle, be closed and converted to solar -- in fact, it is a widespread approach being used on every continent, so there are many precedents and models. Provided a city has access to a contractor with the required expertise in landfill closure and remediation needed to safely create vacant land with no environmental hazards remaining from the landfill, it is a straightforward proposition to find and work with a solar park developer to build on it. Leases can be designed to pay either land rent or power sales share or both, depending on the parties.

References

- Seremban City Council. Official Portal Seremban City Council (MBS). www.mbs.gov.my. Available at: https://www.mbs.gov.my/en
- Cypark Resources Berhad (2024). Our Projects.Available at: https://www.cypark.com/our-projects.html
- Proctor, D. (2023). Solar Farm at a Landfill Site Brings New Meaning for Waste to Energy. POWER Magazine. Available at: https://www.powermag.com/solar-farm-at-a-landfill-site-brings-new-meaning-for-waste-to-energy/
- United Nations Environment Programme (2007). Solid Waste and Public Cleansing Management Act, 2007. UNEP Law and Environment Assistance Platform. Available at: https://leap.unep.org/en/countries/my/national-legislation/solid-waste-and-public-cleansing-management-act-2007

Image source: City of Valladolid

Valladolid SPAIN

Spain's national capital from 1601-1606, Valladolid is now the major city in the Castilla y León region, on the *Meseta Norte* plateau a major feature of the northern Iberian Peninsula. The city of Valladolid currently lies on both banks of the Pisuerga River, a major tributary of the Douro, surrounded by one of Spain's richest areas for wine grapes, and also known for pine trees and pine nuts.

During the 1960-1970s the city attracted new residents from provincial areas in Castile-Lon and began to expand across the western bank of the Pisuerga. After Spain established the Autonomous Communities level of subnational government in 1980s, Valladolid was designated in 1987 as the seat of the executive and legislative institutions for Castilla y León.

Into the 21st century, more than a thousand years after its founding, Valladolid has kept pace with the times, industrialising in from the 1950s with the arrival of manufacturing firms including FASA-Renault and ENDASA (automobiles) and SAVA (trucks and vans). Valladolid was designated a Pole for Industrial Development in 1964, furthering its attractiveness as a commercial hub.

SNAPSHOT

Area (km2)
197,47

Population
297,129

Administrative status
Municipality, Judicial seat of Castilla y León Autonomous Community, Spain

National political regime
Federal parliamentary constitutional monarchy

Multi-level Governance Framework
Spain has two tiers of subnational government: 17 Autonomous Communities (regions), and 8,131 Municipalities

Geography & Topography
Plateau city surrounded by agricultural areas with a Mediterranean climate, where the Pisuerga and Douro rivers meet.

Smart Green City Clusters
Renewable Energy and Energy Efficiency

City Network Membership
Eurocities, Carbon Neutral Cities Alliance, International Network of Michelin Cities, UNESCO Member of Creative Cities Network, Network of Cities for Artistic Creation (CreArt), Ibero-American Organisation for Intermunicipal Cooperation (OICI)

Annual Municipal Cash Flow
EUR 405M (2023)[70]

[70]Valladolid City Council (2023). Revenue Summary by Chapter and Article. Available at: https://www.valladolid.es/valladolid-client/cm/transparencia/images?idMmedia=814209

Smart and Green City Vision

Valladolid has early demonstrated the key role of cities in the implementation of major international agendas, from the release of a first sustainability action plan in 2001 to the development of an integrated roadmap - Valladolid Urban Agenda 2023 – which sets out the goal of climate neutrality for the city in 2030.

Valladolid has made “Smart City” solutions a key component of its Climate-Neutrality 2030 roadmap, promoting a humanised concept of the Smart City which emphasises on “smart communities” and sees technologies as an enabling tool at the service of the local economy, citizens’ well-being and resilience.

Valladolid's innovative and proactive approach to local climate action has positioned the city as a mentor for many other cities, earning it numerous accolades including the Climate Leaders Award in 2021.

Valladolid aims to be a fully “smart” city while preserving its cultural heritage and natural assets and realising the financial advantages of energy savings. Acting as a mentor city in various peer-to-peer programmes, Valladolid is also one of the 112 European “Mission Cities” paving the way to reach climate neutrality by 2030.

KEY ACHIEVEMENTS

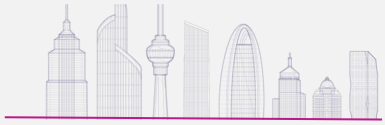
- Signed the Green City Accord – the movement of European Mayors to achieve the vision of the European Green Deal
- Millenium Square in Valladolid received **Certification of GREEN 5** through the Spanish GBC (Green Building Council) and won 1st Prize in the category of ‘Best Performance in Energy 2012’
- Valladolid becoming the **permanent headquarters of the Spanish Network of Smart Cities (RECI)**
- City of Valladolid is one of the cities in Europe that signed the **Green City Accord**
- Valladolid was a case study in the OECD programme “The Circular Economy in Cities and Regions” in 2018-2020

Image source: City of Valladolid

"Cities have to be influencers, but also networkers and join forces to gain momentum and weight"

Rosa Huertas

Financial Resources & Management Approaches of the City Government



Valladolid Municipality has a diverse economy with a mix of traditional and modern industries. It is an important historical industrial centre, characterised by a strong presence of the automotive industry (20% of the city's GDP) with major companies having production facilities in the area (e.g., Renault, Mercedes-Benz). Valladolid is also home to a number of logistics companies, which benefit from the city's strategic location and transportation infrastructure. Due to the city's rich cultural and historical heritage, tourism is at the same time an important economic driver, contributing to around 8% of the city's GDP. These all provide a solid tax base for municipal finances.

The city administration, Ayuntamiento de Valladolid, is comprised of 27 elected municipal councillors who in turn select one of their number to serve a four-year term as Mayor.

Total city revenues from operating activities in 2023 amounted to EUR 405M, from the following sources:

Table 5: City Revenues of Valladolid in 2023 (EUR)

Direct taxes (on income, capital, business tax)	115,509,890
Indirect taxes (incl. VAT)	15,116,070
Fees for Public Services	88,763,526
Current transfers	111,604,434
Property income	5,849,097
Capital transfers	20,123,235
Financial assets	2,915,403
Financial liabilities	35,000,000
Other income	10,368,802
Total:	**405,250,457**

Source: Ayuntamiento de Valladolid

Limitations on public spending imposed on municipalities by the Spanish Budgetary Stability Law (2012) creates challenges for the city to guarantee the volume of investments required to meet a growing demand for social services and finance its sustainable urban transition. To encourage business and attract private investment in sectors aligned with the City's smart and sustainable development blueprint, Valladolid created an Agency for Innovation and Economic Development to take responsibility for leading the climate neutrality roadmap. Through the Agency, the local government has stimulated the setup of circular and innovative businesses through targeted incentives (aids, tax rebate), but also made a smart use of public procurement and European-supported programmes to develop small-scale pilot projects and to de-risk projects.

Project Highlight

Improved Energy Efficiency in Public Housing through ESCO Energy Performance Contracts

Context and Challenges

Valladolid has a Mediterranean climate, which means that it experiences hot temperatures in the summer - often exceeding 30°C, and cold waves in the winter - with frost and fog lasting up to 60 days per year. This creates a substantial demand for energy for both cooling and heating, particularly in older buildings that are less energy efficient.

Most buildings in the city are quite old and were not designed with energy efficiency as a priority, lack modern insulation, efficient heating and cooling systems, and other features that could reduce energy consumption. Consequently, buildings represent a significant portion of energy use in the city accounting for approximately 70% of the city's total CO2 emissions.

Energy Service Companies (ESCO)

Energy Service Companies ("ESCOs") are commercial and provide energy management and energy use optimization services to customers corporate or governmental customers under Energy Performance Contracts ("EPCs") or similar agreements. Under an EPC, the ESCO's compensation can be based on energy expenses savings post retrofit, measured against benchmark billings prior to the retrofit.

The Solution

Retrofitting these older buildings with energy-efficient features such as external insulation, efficient lighting and heating or cooling systems, can reduce energy consumption and improve the overall energy efficiency of the building stock in Valladolid. While the upfront costs of retrofitting can be significant, the energy savings and reduced maintenance costs generally offset these up-front expenses over time, then generate annual energy savings over the long term.

Under the five-year EU programme REMOURBAN[71][72] which ran from 2015 to 2020, Valladolid, together with pilots in Nottingham, England and Tepebasi/Eskisehir, Turkey, Seraing, Belgium and Miskolc, Hungary, developed a new low energy district project to improve energy-efficiency in the central neighbourhood of Las Viudas, which has a high concentration of older residential buildings used for social housing.

To implement the project, Valladolid organised a collaboration between the municipality, contracting private Energy Service Companies (ESCOs) and local residents, who participated in project decision-making through Local Energy Communities.

ESCOs services include assessing a building's or group of buildings' energy efficiency needs, designing systems and specifying component equipment, and installing the energy-saving measures. The ESCO guarantees that the energy savings resulting from the measures will cover the cost of the project over a specified period, typically several years. Building owners benefit from reduced energy bills and improved building energy performance, without having to invest their own capital upfront.
Renovations financed through ESCO contracts may include:

- switching boilers from gas to biomass fuel;
- installing rooftop solar to generate electric power for onsite consumption or, in some cases, to sell surplus power to the grid;
- installing insulation and improved thermostats and heat controls,
- installing heat pumps for heating and cooling,
- switching from incandescent or fluorescent lighting to LED light bulbs;
- upgrading the power distribution system; and
- linking it to a multi-building or district microgrid to balance production and consumption of power, which is more efficient than each building having its own isolated system.

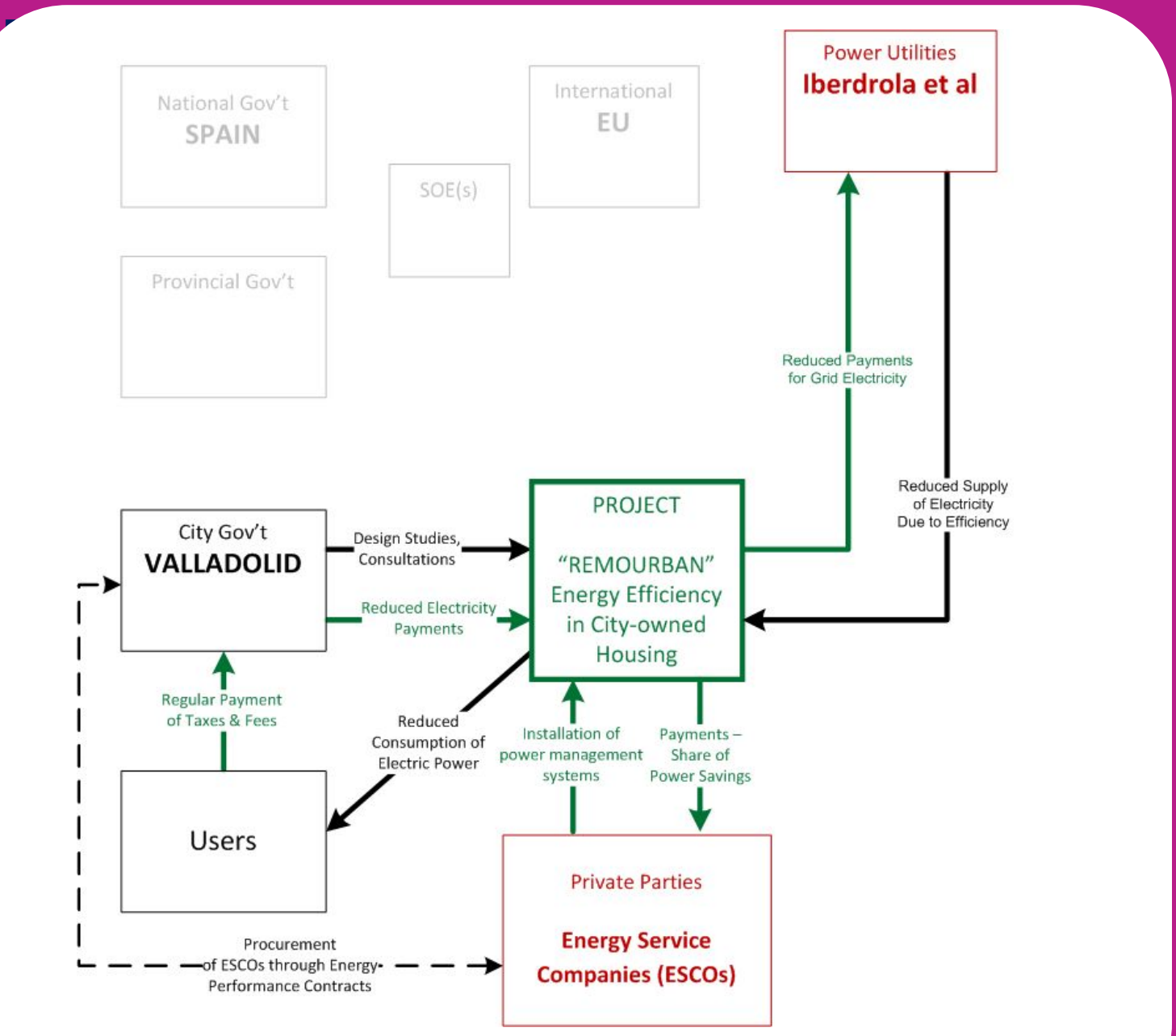
[71]Smart Cities Connect. (2018). REMOURBAN Aims at Urban Regeneration in Three European Cities. Available at: https://smartcitiesconnect.org/remourban-aims-at-urban-regeneration-in-three-european-cities/
[72]European Commission (2023). Urban Regeneration Model from the Smart Cities and Communities project REMOURBAN. Europa.eu. Available at: https://cordis.europa.eu/article/id/418306-urban-regeneration-model-from-the-smart-cities-and-communities-project-remourban

Financing Instruments

Some part of the savings from lower energy costs of the retrofitted building cover the contractual payments to the ESCO, with the balance passed on to or retained by residents, depending on the metering system, or used elsewhere in the building management budget.

In 2002, Valladolid was the first Spanish city to sign an Energy Performance Contract (EPC) for the renovation of its public lighting system, which included the replacement of around 20,000 streetlights with energy-efficient LED lamps. The same model was developed to retrofit social housing buildings through the REMOURBAN programme, and has since been applied to retrofit schools, sports facilities, and cultural centres in Valladolid.

Figure 10: Schematic of parties involved in Energy Efficiency in Public Housing, Valladolid



Source: Authors' illustration.
Note: Funding flows are represented in green, and blurred boxes indicate entities that exist but are not directly engaged.

Project Highlight

Improved Energy Efficiency in Public Housing through ESCO Energy Performance Contracts

Impact

Through the REMOURBAN project, ESCOs contracted by Valladolid have retrofitted some 400 housing units, generating energy savings of 30% on average and reducing the residents' energy bill by 64%, while reducing the CO2 emissions from these buildings by 70%. Valladolid's success in implementing EPC contracts has served as an example for other cities in Spain and around the world, through various peer-to-peer learning and mentoring programmes.

Critical Success Enablers

Strong Political Commitment

The city's commitment to sustainability and climate neutrality has created a conducive environment for EPCs, providing a clear vision and driving force for energy efficiency initiatives. The city government also provided financial incentives, such as subsidies and grants, to encourage the implementation of energy-efficient measures in buildings.

Collaborative Approach

The REMOURBAN project in Valladolid was a collaborative effort between the City Council of Valladolid, the University of Valladolid, and various private sector partners. The project employed a co-creation approach, involving building owners, occupants, energy service companies (ESCOs), and public authorities to identify feasible energy-efficient solutions tailored to the specific needs of each building.

Monitoring and Verification

The city implemented rigorous monitoring and verification protocols to ensure that the energy savings promised by ESCOs are achieved and that the retrofitting measures continue to deliver benefits over the long term. This includes Energy Management Systems (EMS) to track energy consumption in real-time, the definition of Energy Performance Indicators (EPIs) under the EPCs, and an independent building certification.

Replicability

- Any city looking to replicate the Valladolid strategy for ESCO-implemented retrofitting of energy efficiency systems in older buildings might research which ESCOs provide services in the area, research actual heating / cooling costs being paid by residents and commercial / industrial building owners for specific buildings to target the least efficient for retrofitting. ESCO contracts and payments can be structured in several ways, as can ownership of the actual installed equipment, which can be purchased by building owners, leased by building owners, or provided at no cost to the building by the ESCO, in exchange for a generally monthly fee expressed as some agreed percentage of the energy cost savings made possible by the equipment.
- Energy efficiency measures can also be combined at the individual building level with onsite/ rooftop solar to generate some or all of the building's remaining energy needs post retrofit.
- The city may need to bear some initial costs for studies and planning, but actual investment costs for energy efficiency systems installed should be covered by the ESCOs, and in certain cases, for private commercial or residential properties, by building owners. Retrofits of public housing or other city-owned properties should have minimal impact on city budgets aside from project preparation, design, management and monitoring.

References

- Streitferdt, V. (2015). ESCO Market Assessments in ASEAN: an Example from Thailand. Available at: http://esi.nus.edu.sg/docs/default-source/doc/verenaace_presenation_nus-conferencefinal.pdf?sfvrsn=2
- IEA (2018). Energy Service Companies (ESCOs), IEA, Paris https://www.iea.org/reports/energy-service-companies-escos-2 , Licence: CC BY 4.0
- Ralhan, R. (2023). Creating Enabling Conditions for Increased Private and Public Sector Investment into Energy Transition in Southeast Asia. Available at: https://asiacleanenergyforum.adb.org/wp-content/uploads/2023/06/Rajiv-Ralhan.pdf
- Valladolid City Council (2022). Action Plan for the 2030 Urban Agenda. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/es/temas/hacemos/plan-accion-agenda-urbana-2030
- Valladolid City Council (2022). Economy and Finance. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/transparencia/es/economia-finanzas
- Valladolid City Council (2022). The Exhibition on the 2030 Urban Agenda of Valladolid Will Tour the city's Civic Centers. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/es/actualidad/noticias/exposicion-agenda-urbana-2030-valladolid-recorrera-centros
- Valladolid City Council (2023). Valladolid Mission Valladolid Climate Change Strategy. Available at: https://www.ideva.es/sites/default/files/2023-10/4Summary_Climate.pdf

CONCLUSION

Taken together, these ten cases present an interesting cross-section of what can be done to make different cities, in different circumstances, smarter and greener each in their own ways and with the resources available to them.

The projects above used various combinations of the following main types of financing:

Table 6: Principal Smart Green Project Funding Sources

Funding Source(s)/Mix	City Examples
Primarily national government budget funding	Jakarta, Phuket
Mixed City budget + national / regional budgets	Rhenen, Ho Chi Minh City
Mixed city and private funding (little or no national)	Paris, Malmö
Mostly Private (little or no city or national)	Porto, Valladolid, Da Nang, Seremban

Source: Author's Analysis

What Assets Were Actually Financed?

In all cases except Rhenen and Porto (being nature-based solutions, these projects involved more earthworks and sewer system rebuilding than any high-tech equipment) and Paris (where the 'project' was actually a conduit to finance development of technology which could later be applied to city transit needs), solutions to be financed in these projects were combinations of the following costs and assets.

Table 7: Financing Options for Different Smart Green Project Asset Types

Asset / cost type	Examples of Specific Assets	Financing treatments	City as example
Earthworks, landscaping, roadworks	Rebuilding of roads & sewers to incorporate water retention tanks, landscaping of wadis for rainwater run-off	Operating Expenses of labour, heavy equipment can be rented or provided by landscape contractors, if not owned by the city already; plantings likely must be purchased as Capital Expenses, but could be privately sponsored or provided "as-a-Service".	Rhenen, Porto

Asset / cost type	Examples of Specific Assets	Financing treatments	City as example
Core Data Center computer equipment	Storage arrays, monitors, CPUs, onsite networking equipment, etc.	Equipment and software *can* be purchased as a city Capital Expense, but can usually be leased from vendors or third parties through customer financing programs as a city Operating Expense	Ho Chi Minh City (for IOC), Da Nang, Jakarta, Valladolid, Phuket, Malmö (for monitoring centres)
Smart system IoT sensors and networks	CCTVs, LoRaWAN and other Wide Area Networking equipment, fibre-optic cabling, poles, ticketing kiosks, ticket reading barriers, Analytic software (licence plate & facial recognition, people counters, etc.)	Equipment and software *can* be purchased as a city Capital Expense, but can usually be leased from vendors or third parties through customer financing programs as a city Operating Expense	Phuket, Ho Chi Minh City, Malmö
EV charging stations	Plug-in vehicle chargers, power grid connections, station structures (carports), solar (optional), signage, payment kiosk, lighting, etc.	Equipment and software *can* be purchased as a city Capital Expense, but can usually be leased from vendors or third parties through customer financing programs as a city Operating Expense. In the case of Da Nang, some charging stations were constructed by private owners (VinFast and Marriott)	Da Nang
LED street lighting	LED luminaires, poles, LED controllers, communications managers, networking equipment, etc.	Equipment and software *can* be purchased as a city Capital Expense, but can also often be leased from vendors or third parties through customer financing programs as a city Operating Expense	Jakarta
Building-level and inter-building power transmission, HVAC, energy efficiency and networking equipment for heating / cooling systems, energy storage	Heat pumps, solar panels, battery storage systems, thermostatic controls, system management software, networking equipment and poles, etc.	Equipment and software *can* be purchased as a city Capital Expense, but can also often be leased from vendors or third parties through customer financing programs as a city Operating Expense, some grid connection equipment may be provided by power utility	Malmö, Valladolid

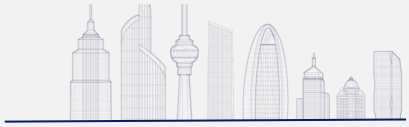
Asset / cost type	Examples of Specific Assets	Financing treatments	City as example
Renewable energy generation	Onsite (commercial / industrial) or ground-mounted (utility) solar panels, battery storage, grid connectors, inverters, power evacuation lines to the grid connection, etc.	Equipment and software *can* be purchased as a city Capital Expense, but can also often be leased or hire-purchased from vendors or third parties through customer or asset financing programs as a city Operating Expense, Some grid connection equipment may be provided by power utility, all may be supplied by a developer if structured as an Independent Power Producer (IPP)	Seremban, Malmö, Da Nang, Phuket (for solar-powered chargers of outdoor equipment)

Source: Author's Analysis

If there is no applicable national government funding available (as there was, for example, for Phuket's smart tourism system), a city will need to systematically assess a contemplated project to break it down into cost and asset components, each of which will be suitable for some different form of financing. Certain cost components such as earthworks and construction will likely have to be financed on the city's operating budget, with work performed by contractors or city departments.

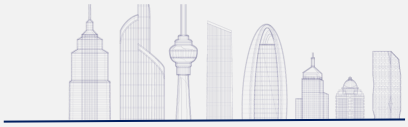
International or national grants may also be available to cover certain types of expenses and costs, such as in-kind technical assistance for project preparation, faded by multilateral or bilateral urban programs. As the project is prepared, hard asset needs will be identified and equipment lists prepared, then bids can be sought from possible providers / EPC contractors. At this stage, cities should be able to identify items, especially hardware and equipment, where vendor customer financing and/or asset finance strategies (such as vendor or third-party leasing) or turning assets into services to convert capital expenses into more easily budgetable operating expenses, not use up a city's bank or inter-government borrowing capacity, and even enable a city to procure a larger better solution.

All of the approaches used in these cases have variants which can be used in almost any city in any country. Cities are welcome to reach out by email to FMDV (contact@fmdv.net) and https://www.uncdf.org/sgac for more information about any of the projects presented here and/or to connect with other cities, or to foster greater city-to-city cooperation on their own Smart and Green projects, regardless of their stage in the planning or implementation process.



ABBREVIATION

- AEP - Portuguese Business Association
- Bhd. - Berhad (Company in Malaysian)
- CCTV - Closed-Circuit Television
- C.E. - Common Era
- DEPA - Digital Economy Promotion Agency (Thailand)
- DKI - *Daerah Khusus Ibukota* (Special Capital Region in Indonesia)
- EADS - European Aeronautic Defence and Space Company
- EDV - Electricity Vietnam
- EDV CPC - Electricity Vietnam Central Power Company
- EEA - European Economic Area
- EIB - European Investment Bank
- E.ON - German-Based European Private Electrical Utility Company (serving Malmö)
- EPC - Energy Performance Contract
- EPC - Engineering & Procurement Contractor
- ES - Spain
- ESCO - Energy Services Company
- EU - European Union
- EUR - Euro, the Currency of the European Union
- EV - Electric Vehicle
- FR - France
- FY - Fiscal Year
- GHG - Greenhouse Gas
- GRDP - Gross Regional Domestic Product
- GRP - Gross Regional Product
- HCMC - Ho Chi Minh City
- HPS - High Pressure Sodium
- IBM - The International Business Machines Corporation
- ICT - Information and Communication Technology
- ID - Indonesia
- IDF - Rupiah, the Currency of Indonesia
- IEA - International Energy Agency
- IOC - Intelligent Operations Centre
- IoT - Internet of Things
- KL - Kuala Lumpur (Malaysia)
- LED - Light-Emitting Diode
- MEF - Municipal Ecological Framework (Portugal)
- MVV - Malaysia Vision Valley
- MY - Malaysia
- MYR - Ringgit, the currency of Malaysia
- MIC - Ministry of Information & Communications (Vietnam)
- NAMA - Nationally Appropriate Mitigation Action
- NBS - Nature-Based Solutions
- NESDC - National Economic & Social Development Council (of Thailand)



ABBREVIATION

- NL - Netherlands
- OECD - Organization for Economic Co-operation and Development
- p.a. - Per Annum
- PAD - Regional Original Income (to municipality) (Indonesia)
- PLN - Indonesia Power, the National Electric Utility of Indonesia
- PPP - Public-Private Partnership
- PT - Portugal
- PVOIL - Petrovietnam Oil & Gas Group
- SE - Sweden
- SGAC - Smart Green ASEAN Cities Programme (EU-ASEAN)
- SSLI - Smart Street Light Initiative (Indonesia)
- UNFCCC - The United Nations Framework Convention on Climate Change
- USTDA - United States Trade Development Agency
- T - Trillion
- TH - Thailand
- THB - Baht, the currency of Thailand
- VN - Vietnam
- VND - Dong, the currency of Vietnam
- VNPT - Vietnam Posts & Telecommunications Group

REFERENCES

AdEPorto-Porto Energy Agency (2024). Asprela + Sustentável. AdEPorto. Available at: https://www.adeporto.eu/en/projects/asprela-sustentavel/

Alibaba.com. DC Car Charger. Available at: https://www.alibaba.com/trade/search?spm=a2700.details.pageModule_fy23_pc_search_bar.keydown__Enter&tab=all&SearchText=DC%2Bcar%2Bcharger

Anh, M. (2020). USTDA supports Ho Chi Minh City in its smart cities project. Hanoitimes. Available at: https://hanoitimes.vn/ustda-supports-ho-chi-minh-city-in-smart-cities-project-313980.html

Bhwana, P.G. (2023). Jakarta Revises Down 2023 Revenue Forecast to Rp69.83tn. Tempo. Available at: https://en.tempo.co/read/1770885/jakarta-revises-down-2023-revenue-forecast-to-rp69-83tn

BNG Bank (2024). Driven by Social Impact. Available at: https://www.bngbank.com/

C9 Hotelworks (2023). Phuket Economy Report. Available at: https://www.c9hotelworks.com/wp-content/uploads/2023/12/2023-2024-the-phuket-report.pdf

Cbonds. Data Platform for Financial Market Professionals and Investors. Available at: https://cbonds.com/

Chrisafis, A. (2024). Parisians vote in favour of tripling parking costs for SUVs. The Guardian. Available at: https://www.theguardian.com/world/2024/feb/04/parisians-vote-in-favour-of-tripling-parking-costs-for-suvs

City of Paris (2023). The 2023 Budget. Available at: https://cdn.paris.fr/paris/2023/02/15/bp-2023-rapport-vote_partie01-fgCw.pdf.

Climate Action Tracker (2023) Net zero targets. Available at: https://climateactiontracker.org/countries/vietnam/net-zero-targets/#:~:text=Viet%20Nam%20announced%20its%20target,Nam%E2%80%99s%20climate%20action%20through%202050

Communication, Informatics and Statistics Office of DKI Jakarta Provincial Government. Jakarta. Available at: https://www.jakarta.go.id/

ConFlow power group (2020). Street Lighting Report The Next Wave of Life. Available at: https://assets-global.website-files.com/6225ec4d016842cb92d1e5d3/627bde04de947f74e3b73678_Conflow-Streetlighting-Report.pdf

Connor, M. (2024). Phuket governor proposes 191 million baht infrastructure and digital modernisation plan. Thaiger. Available at: https://thethaiger.com/news/phuket/phuket-governor-proposes-b191-million-infrastructure-and-digital-modernisation-plan.

Coopérative Carbone Paris & Métropole du Grand Paris. Acting Together Locally Contributing to a low-carbon Region. Available at: https://coopcarbone-parismetropole.fr/.

Delta Electronics (2018). News Center - Delta Smart Street Lights Make a Smart City Blueprint for Jakarta - Delta. Available at: https://www.deltaww.com/en-US/news/8423.

DEPA (2021). Phuket Smart City. Available at: https://www.jasca2021.jp/1st/pdf/WS5/phuket.pdf.

DEPA, HUAWEI and Roland Berger (2019). Smart City Framework and Guidance For Thailand. Available at: https://mglobale.promositalia.camcom.it/kdocs/1962677/5b9f4d7b-3f7e-4ed4-a9ee-3ecd47d38554smart_city_framework_and_guidance_for_thailand_smart_city_servic.

Department of Information and Communication. Electronic Information Division. Available at: https://ict-hcm.gov.vn/vi/web/10663900/electronic-information-division

REFERENCES

Dharmaraj, S. (2023). Enhancing Smart City Development in Vietnam. OpenGov Asia. Available at: https://opengovasia.com/2023/07/29/enhancing-smart-city-development-in-vietnam/.

Digital Economy Promotion Agency (2020). Phuket City Data Platform. Available at: https://www.jasca2021.jp/ascnjapan2020/dl/document/pracha_asawateera.pdf

E.ON SE (2020). E.ON: City of Tomorrow - Hyllie (episode 4). www.youtube.com. Available at: https://www.youtube.com/watch?v=gSiWiyrLfsc

Embassy of the Socialist Republic of Vietnam in the United States. Government Structure. Available at: https://vietnamembassy-usa.org/vietnam/politics/government-structure

Euronews (2023). Worst Is yet to Come with Floods in the Netherlands, Germany and Norway. Available at: https://www.euronews.com/2023/12/27/worst-is-yet-to-come-with-floods-in-netherlands-germany-and-norway.

European Commission (2023). Urban Regeneration Model from the Smart Cities and Communities project REMOURBAN. Europa.eu. Available at: https://cordis.europa.eu/article/id/418306-urban-regeneration-model-from-the-smart-cities-and-communities-project-remourban.

European Investment Bank (2016). Sweden: EIB Signs SEK 3 100m Loan with City of Malmö. Available at: https://www.eib.org/en/press/all/2016-105-eib-signs-sek-3100-mln-loan-with-city-of-malmo.

evchargingstops.com. EV Charging Stations Worldwide, Available at: https://www.evchargingstops.com/

Fitzgerald, M. (2021). Jakarta's Smart City Future & Vision. 365 Access to ASEAN's Largest Power Community. Available at: https://www.enlit-asia365.com/grids/jakartas-smart-city-future-and-vision/.

Forbes, A. and Henley, D. (2016). Phuket's Peranakan Community. CPA Media. Available at: https://www.cpamedia.com/article.php?pg=archive&acid=120510162540&aiid=120524153854.

Foundation CAS. The Climate Adaptation Knowledge Portal. Available at: https://klimaatadaptatienederland.nl/en.

GovInsider (2015). Exclusive Interview: Jakarta's Smart City Chief. govinsider.asia. Available at: https://govinsider.asia/intl-en/article/exclusive-interview-jakartas-smart-city-chief.

Hiep, H. and Thang, C. (2023) Da Nang honoured as excellent city in building smart cities in Viet Nam, DaNangToDay. Available at: https://baodanang.vn/english/education-science/202312/da-nang-honoured-as-excellent-city-in-building-smart-cities-in-viet-nam-3961059/

Ho Chi Minh City. Available at: https://hochiminhcity.gov.vn/

Hoang, V. (2023) Scale of da nang's economy in 2023 reaches over VND134,247 billion, DaNangToDay. Available at: https://baodanang.vn/english/business/202312/scale-of-da-nangs-economy-in-2023-reaches-over-vnd134247-billion-3962580/

ICLEI - Local Governments for Sustainability (2021). City of Malmo. Available at: https://renewablesroadmap.iclei.org/wp-content/uploads/2021/11/Malmo-case-study_final.pdf.

IEA (2018). Energy Service Companies (ESCOs), IEA, Paris https://www.iea.org/reports/energy-service-companies-escos-2, Licence: CC BY 4.0

IF Technology. Samen Van Fossiele Naar Duurzame energie! Available at: https://iftechnology.nl/.

REFERENCES

IoTNews.asia. (2018). Phuket and Khon Kaen Named as Top Smart City Projects in Asia/Pacific for 2018. Available at: https://iotnews.asia/1310/thailand/phuket-and-khon-kaen-named-as-top-smart-city-projects-in-asia-pacific-for-2018.

Jakarta Smart City (2023). Building A Smart City. Available at: https://smartcity.jakarta.go.id/en/.

Kamei, M., Nguyen, A.T., Guibrunet, L., Davide, M., Fennell, P., and Jones, P (2022) Da Nang City Climate Action Plan - A conceptual framework for sectral climate actions. IGES. Hayama Available at: https://www.iges.or.jp/en/publication_documents/pub/policysubmission/en/12419/Da+Nang+climate+action+plan_0.pdf

Khunpitiluck , C. Phuket Smart City. Available at: https://www.phuket.go.th/webpk/file_data/smartcity/01.pdf.

Kommuninvest of Sweden (2024). Green Bonds. Available at: https://kommuninvest.se/en/greenbonds/.

Kulachai, W. (2023). Local government in Thailand: A way forward. Cogent Social Sciences, 9(2). doi:https://doi.org/10.1080/23311886.2023.2268972.

Kushwaha, D. (2023) Vietnam EV Charging infrastructure market growth 2023, rising trends, global industry share, scope, challenges, business opportunities and forecast, SPER Market Research. Available at: https://www.sperresearch.com/report-store/vietnam-ev-charging-infrastructure-market.aspx

Lăng, T. (2023) The rise of Electric Vehicle Manufacturing in Vietnam, Viettonkin. Available at: https://www.viettonkinconsulting.com/global-business/the-rise-of-electric-vehicle-manufacturing-in-vietnam/

Le, H. and Posada, F. (2022) Promoting the development of electric vehicles in Vietnam. International Council on Clean Transportation. Available at: https://theicct.org/wp-content/uploads/2022/12/asia-pacific-evs-promoting-development-evs-vietnam-dec22-2.pdf.

Mai, B. (2022) HCMC's 2023 budget revenue forecast at $20bln, Vietnam Economic Association. Available at: https://en.vneconomy.vn/hcmcs-2023-budget-revenue-forecast-at-20bln.htm

Mairie De Paris (2018). Paris Resilience Strategy. Available at: https://resilientcitiesnetwork.org/downloadable_resources/Network/Paris-Resilience-Strategy-English.pdf.

Mairie De Paris. Paris Smart and Sustainable. Available at: https://cdn.paris.fr/paris/2020/02/26/f7dc822a66de6000cd910a145c7fca39.ai.

Malmö stad (2022). City of Malmö: Annual Report. Available at: https://malmo.se/download/18.70f4a4718bb305e0b44f4a5/1699954837755/City%20of%20Malmo%20Annual%20Report%20and%20Statement%20of%20Accounts%202022.pdf.

malmo.se. (2023). Startsida Malmö stad. Available at: https://malmo.se/Welcome-to-Malmo/Sustainable-Malmo/Sustainable-Urban-Development/Hyllie.html.

Meticulous Research Inc (2024) Top 10 companies in Asia-Pacific Electric Vehicle charging stations market, Meticulous. Available at: https://meticulousblog.org/top-10-companies-in-asia-pacific-electric-vehicle-charging-stations-market/

Ministry of Environment and Water (KASA) (2021). National Low Carbon Cities Masterplan. Available at: https://drive.google.com/file/d/1ZW51ncz0EdmlB4D3nVjXphO_ER2XNJg7/view?pli=1.

Nanthaamornphong, A., Holmes, J. and Asawateera, P. (2020). A Case Study: Phuket City Data Platform.IEEE Xplore. doi:https://doi.org/10.1109/ECTI-CON49241.2020.9158101.

Nederlandse Waterschapsbank N.V. The Sustainable Water Bank. Available at: https://www.nwbbank.com/en.

REFERENCES

Nguyen NH, Tran QT, Nguyen TV, Tran N, Roose L, Sepasi S, Di Silvestre ML. (2023) A Method for Assessing the Feasibility of Integrating Planned Unidirectional EV Chargers into the Distribution Grid: A Case Study in Danang, Vietnam. Energies. 16(9):3741. https://doi.org/10.3390/en16093741

Nhan Dan (2017) First EV quick charging station put into use in Vietnam, Nhan Dan. Available at: https://en.nhandan.vn/first-ev-quick-charging-station-put-into-use-in-vietnam-post55692.html

Nusantara Capital Authority (2023). Supporting the Development of Smart City Nusantara, the NCA Collaborates with LUG Light Factory. Available at: https://ikn.go.id/storage/press-release/2023/en/20231017.press-release-supporting-the-development-of-smart-city-nusantara,-the-nca-collaborates-with-lug-light-factory.pdf.

OECD (2014). Multi-level water governance in the Netherlands in Water Governance in the Netherlands: Fit for the Future?, OECD Publishing, Paris, https://doi.org/10.1787/9789264102637-9-en.

OECD (2022). Synthesis Report World Observatory on Subnational Government Finance and Investment. doi:https://doi.org/10.1787/b80a8cdb-en.

OECD/UCLG (2022). Netherlands. World Observatory on Subnational Government Finance and Investment (SNG-WOFI). Available at: https://www.sng-wofi.org/country-profiles/.

Paris Climate Action Plan. (2020). Available at: https://cdn.paris.fr/paris/2020/11/23/a10afc931be2124e21e39a1624132724.pdf.

Parks, D. and Wallsten, A. (2019). The Struggles of Smart Energy Places: Regulatory Lock-In and the Swedish Electricity Market. Annals of the American Association of Geographers, 110(2), pp.525–534. doi:https://doi.org/10.1080/24694452.2019.1617104.

Philips (2017). Jakarta embraces smart city technology. Available at: https://www.assets.signify.com/is/content/PhilipsConsumer/PDFDownloads/Global/PDFs/ODLI20171707_001_en_AA-SmartCity_initiatives_PhilipsLighting_Jakarta_Indonesia_Leaflet.pdf.

Philips. Lighting creates a sense of security for residents. Philips lighting. Available at: https://www.lighting.philips.co.id/id/dukungan/studi-kasus/road-and-street/pju-samarinda.

Phuket Provincial Office (2024). PHUKET Smile Smart and Sustainable. Smart City Thailand. Available at: https://www.citydata.in.th/phuket/en/homepage/.

Porto City Hall. Portal de Dados. Available at: https://opendata.porto.digital/.

Porto. (2022). Porto Climate Pact mobilizes European cities to lead in the environmental transition. Available at: https://www.porto.pt/en/news/porto-climate-pact-mobilizes-european-cities-to-lead-in-the-environmental-transition.

Porto. (2023). Porto Climate Pact. Pacto para o Clima. Available at: https://pactoparaoclima.portodigital.pt/?page_id=5738.

Porto. City Council (2021). InvestPorto. Available at: https://www.investporto.pt/en/news/porto-city-council-approves-new-municipal-master-plan/.

Prayoga, R. (2018). 28,000 smart LED lights installed in East Jakarta. Antara News. Available at: https://www.antaranews.com/berita/782483/28-ribu-lampu-led-pintar-terpasang-di-jaktim.

Proctor, D. (2023). Solar Farm at a Landfill Site Brings New Meaning for Waste to Energy. POWER Magazine. Available at: https://www.powermag.com/solar-farm-at-a-landfill-site-brings-new-meaning-for-waste-to-energy/.

REFERENCES

PVOIL opens Vietnam's first electric car charging stations at petroleum stations. Available at: https://www.pvoil.com.vn/en-US/media/related-news/pvoil-opens-vietnams-first-electric-car-charging-stations-at-petroleum-stations

Ralhan, R. (2023). Creating Enabling Conditions for Increased Private and Public Sector Investment into Energy Transition in Southeast Asia. Available at: https://asiacleanenergyforum.adb.org/wp-content/uploads/2023/06/Rajiv-Ralhan.pdf.

Republique Francaise. CHAPITRE III: Participation Au Capital De Sociétés (Articles L2253-1 À L2253-7). Available at: https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000006070633/LEGISCTA000006164570/#LEGISCTA000006164570.

Rocque, M. (2016). Philips to deploy 90,000 connected street lights in Jakarta. Smart Cities World. Available at: https://www.smartcitiesworld.net/news/philips-to-deploy-90000-connected-street-lights-in-jakarta-1120.

Samuel , P. and Nguyen, D. (2023) Why da nang remains attractive for foreign investors, Vietnam Briefing News. Available at: https://www.vietnam-briefing.com/news/why-da-nang-remains-attractive-for-foreign-investors.html/

Seremban City Council. Official Portal Seremban City Council (MBS). www.mbs.gov.my. Available at: https://www.mbs.gov.my/en.

Singh, B.K. (2019) Verdict media limited, Verdict Traffic. Available at: https://www.roadtraffic-technology.com/news/vietnam-open-smart-traffic-centre/

Singh, S. (2022). Negri's Largest Landfill Ordered Shut after Leachate Detected in River. The Star. Available at: https://www.thestar.com.my/news/nation/2022/09/06/negri039s-largest-landfill-ordered-shut-after-leachate-detected-in-river.

Smart Cities Connect. (2018). REMOURBAN Aims at Urban Regeneration in Three European Cities. Available at: https://smartcitiesconnect.org/remourban-aims-at-urban-regeneration-in-three-european-cities/.

SmartCitiesWorld (2023). How Porto is making climate action the responsibility of all. Smart Cities World. Available at: https://www.smartcitiesworld.net/climate-action/climate-action/how-porto-is-making-climate-action-the-responsibility-of-all-8528.

South Pole. Climate Finance Lab: Catalyzing Climate Action in Cities. Available at: https://www.southpole.com/clients/city-finance-lab-catalysing-climate-action-in-cities-with-innovative-finance-solutions

Statista Research Department (2024). Phuket. Statista. Available at: https://www.statista.com/topics/10978/phuket/#topicOverview.

Statista Research Department (2024). Total Passenger Traffic at Phuket International Airport (HKT) in Thailand from Fiscal Year 2016 to 2023. Statista. Available at: https://www.statista.com/statistics/1380465/thailand-passenger-traffic-hkt-airport/.

Statistics Netherlands (2024). Key Figures Municipal budgets: Levies per Municipality. Available at: https://www.cbs.nl/en-gb/figures/detail/83643ENG?q=rhenen

Streitferdt, V. (2015). ESCO Market Assessments in ASEAN: An Example from Thailand. Available at: http://esi.nus.edu.sg/docs/default-source/doc/verenaace_presenation_nus-conferencefinal.pdf?sfvrsn=2.

Sustainalytics (2017). City of Malmo Green Bond Framework. Available at: https://mstar-sustops-cdn-mainwebsite-s3.s3.amazonaws.com/docs/default-source/spos/green-bond-framework-city-of-malmo_second-opinion-by-sustainalytics_final.pdf?sfvrsn=55ae952_3.

REFERENCES

The International Trade Administration, U.S. Department of Commerce. Vietnam - Information and Communication Technologies, 30 Jan. 2024, www.trade.gov/country-commercial-guides/vietnam-information-and-communication-technologies.

The Nation (2021). Thailand's 15 Smart Cities Unveiled. Available at: https://www.nationthailand.com/business/40010424

The Socialist Republic of Vietnam (2020) Updated Nationally Determined Contribution (NDC). Available at: https://unfccc.int/sites/default/files/NDC/2022-06/Viet%20Nam_NDC_2020_Eng.pdf.

Theron-Ord, A. (2015). GridComm enables 10k smart streetlights in the Indonesian capital. Smart Energy International. Available at: https://www.smart-energy.com/regional-news/asia/gridcomm-enables-10k-smart-streetlights-in-indonesian-capital/.

Thuvienphapluat.vn, T.V.P.L. (2019) 43-NQ/TW in Vietnam, Politburo's Resolution 43-NQ/TW 2019 development of Da Nang City by 2030 in Vietnam, THƯ VIỆN PHÁP LUẬT. Available at: https://thuvienphapluat.vn/van-ban/EN/Xay-dung-Do-thi/Politburo-s-Resolution-43-NQ-TW-2019-development-of-Da-Nang-City-by-2030/427198/tieng-anh.aspx

Toan, N. (2022) Danang pinning hopes on delivery of eco-smart city, Vietnam Investment Review. Available at: https://vir.com.vn/danang-pinning-hopes-on-delivery-of-eco-smart-city-95118.html

Truong, T.H., Thao, T.T. and Tung, S.T. (2017) Housing and transportation in Vietnam's Ho Chi Minh City. Available at: https://library.fes.de/pdf-files/bueros/vietnam/13909.pdf

U.S. Department of Transportation (2023) Charger types and speeds. Available at: https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds

U.S. Trade and Development Agency. Thailand: Phuket Smart Cities Technical Assistance. USTDA. Available at: https://www.ustda.gov/business_opp_oversea/thailand-phuket-smart-cities-technical-assistance/

UN-ESCAP. Da Nang City, Viet Nam. Available at: https://www.unescap.org/sites/default/d8files/event-documents/Da-Nang_Profile.pdf

UNDP (2023). Phuket Sustainable Transformation Vision and Strategy. Available at: https://www.undp.org/sites/g/files/zskgke326/files/2023-11/Phuket%20Sustainable%20Transformation%20Vision%20and%20Strategy.pdf.

UNFCCC. Smart Street Lighting Initiative Indonesia. Available at: https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=55&viewOnly=1.

United Nations Environment Programme (2007). Solid Waste and Public Cleansing Management Act, 2007. UNEP Law and Environment Assistance Platform. Available at: https://leap.unep.org/en/countries/my/national-legislation/solid-waste-and-public-cleansing-management-act-2007.

Valladolid City Council (2022). Action Plan for the 2030 Urban Agenda. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/es/temas/hacemos/plan-accion-agenda-urbana-2030.

Valladolid City Council (2022). Economy and Finance. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/transparencia/es/economia-finanzas.

Valladolid City Council (2022). The Exhibition on the 2030 Urban Agenda of Valladolid Will Tour the city's Civic Centers. Ayuntamiento de Valladolid. Available at: https://www.valladolid.es/es/actualidad/noticias/exposicion-agenda-urbana-2030-valladolid-recorrera-centros.

REFERENCES

Valladolid City Council (2023). Revenue Summary by Chapter and Article. Available at: https://www.valladolid.es/valladolid-client/cm/transparencia/images?idMmedia=814209.

Vietnam News Agency (VNA) (2017) HCM City rolls out smart city plans, Vietnam Plus. Available at: https://en.vietnamplus.vn/hcm-city-rolls-out-smart-city-plans/122344.vnp

Vietnam News Agency (VNA). “Phu Tho Launches Intelligent Operations Centre.” VietnamPlus, 31 Aug. 2020, en.vietnamplus.vn/phu-tho-launches-intelligent-operations-centre/182132.vnp.

Vietnam Posts & Telecommunications Group (2019). About VNPT. Available at: https://vnpt.com.vn/english/about-vnpt

VietNamNet Global (2018) HCM City calls for investment in building Smart City, VietNamNet News. Available at: https://vietnamnet.vn/en/hcm-city-calls-for-investment-in-building-smart-city-E208533.html

VnExpress International (2023) Da Nang wins Seoul Smart City Prize - VnExpress International, VnExpress International. Available at: https://e.vnexpress.net/news/news/da-nang-wins-seoul-smart-city-prize-4658811.html

Vnpt.com.vn. (2022). IOC – a solution to connect Government and cities in Vietnam - VNPT. Available at: https://vnpt.com.vn/english/news/ioc-%E2%80%93-a-solution-to-connect-government-and-cities-in-vietnam.html

Wijayaka, B. and Tambun, L.T. (2019). Save Energy, Save Billions of Rupiah. beritasatu.com. Available at: https://www.beritasatu.com/fokus/hemat-energi-hemat-miliaran-rupiah

Winbourne Consulting, LLC. Vietnam. Available at: https://www.w-llc.com/international-client/vietnam/

World Bank Group and ADB (2021) Climate Risk Country Profile: Vietnam (2021). Available at: https://climateknowledgeportal.worldbank.org/sites/default/files/2021-04/15077-Vietnam%20Country%20Profile-WEB.pdf

The Smart Green ASEAN Cities (SGAC) is an European Union-funded programme implemented by the United Nations Capital Development Fund (UNCDF) in partnership with the ASEAN Secretariat and FMDV. It aims to promote sustainable urbanization in ASEAN by collaborating with the sub-national governments to design appropriate financing mechanisms for smart green city projects in selected 'middleweight' cities

The Global Fund for Cities Development (FMDV) is an international alliance of local, metropolitan, and regional governments (LMRGs) dedicated to promoting solutions and developing operational strategies to finance urban development, analyzing financial models and new financing approaches, and disseminating tools that support and enable cities to finance and implement their climate action plans. Cultivating a wide network of finance practitioners, FMDV serves as an important intermediary that brings the latest information and techniques on local finance to cities all over the world. Over the past ten years, FMDV has mobilized or collaborated with more than 1,500 cities and regions from more than 110 countries, 250 private companies and most of the technical and financial partners in local development and have contributed to mobilize 1.2 billion USD for local investment.

The UN Capital Development Fund (UNCDF) is the United Nations' flagship catalytic financing entity for the world's 46 Least Developed Countries (LDCs). With its unique capital mandate and focus on the LDCs, UNCDF works to invest and catalyse capital to support these countries in achieving the sustainable growth and inclusiveness envisioned by the 2030 Agenda for Sustainable Development and the Doha Programme of Action for the least developed countries, 2022–2031.

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