

Penang Resilience Strategy

Executive Summary | 2025 edition

A photograph of a man in a pink and white striped shirt and a blue cap, seen from the side, sitting on a bicycle. The bicycle is heavily decorated with several large, colorful umbrellas (blue, red, yellow) and large bouquets of pink and yellow flowers. The background is a blurred street scene with more flowers and greenery. The entire image is set against a solid blue background.

Penang as a resilient, inclusive, and thriving state that embraces diversity, empowers communities, and fosters sustainable growth for all

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Penang Resilience Strategy is produced as a joint effort between Penang State resilience team, MBPP resilience team, MBSP resilience team, in collaboration with the Resilience Cities Network (R-Cities) and Think City. The initiative is made possible by support from Micron.

Penang State

The Honourable Dato' Rozita binti Hamit
Chief Resilience Officer,
Director of Penang State Town Planning Department

Muhamad Husni bin Mahmud,
Undersecretary of Local Government Division, Penang State Government

Surentharan Ramadas,
Senior Assistant Director, Penang State Land and Mining Department

Fatin Aina Safi binti Mohd Kherol Azhar,
Environmental Health Officer of Local Government Division, Penang State Government

Norsuriana binti Suliman,
Deputy Director (Development), Penang State Town Planning Department

Abdul Rahman Madri bin Che Ahmad,
Assistant Director, Penang State Town Planning Department

Ooi Chun Boon,
Senior Assistant Secretary of Local Government Division, Penang State Government

Nurul Hasanah binti Ibrahim,
Assistant Administrative Officer of Local Government Division, Penang State Government

Mohd Azrul Hisyam bin Mohd Fauzi,
Administrative Assistant of Local Government Division, Penang State Government

Muhammad Afiq Arshad bin Abdul Razak,
Administrative Assistant of Local Government Division, Penang State Government

Penang Island City Council (MBPP)

TPr. Gs Mohd Bashir Bin Sulaiman
Chief Resilience Officer
Director of Planning and Development Department

Ma'ruf Suria Erwin Bin Mohamed Adros
Assistant Director of Planning Department

Siti Nor Zalina Binti Mehat
Senior Assistant of Planning Department

Nor Haslini Binti Mat Desa
Assistant of Planning Department

Ts. Mohd Syamim Bin Mohd Dzilal
Assistant Director of Building Department

Ts. Fazreen Dharleila Binti Abdul Jalil
Assistant Director of Building Department

Mohd Nasrul Nizam Bin Nasri
Assistant Director of Engineering Department

Yong Woo Soon
Assistant Director of Engineering Department

Muhammad Farezudin Syah Bin Zafarin
Assistant Director of Landscape Architecture Department

Mushirah Binti Mohd Badaruddin
Senior Architect, Heritage Conservation Department

Mohamad Khairul Hailmie Bin Mohamad Zamzuri
Assistant of Environmental Health Department

Seberang Perai City Council (MBSP)

Kamariah binti Ramli
Chief Resilience Officer
Deputy Director of Town Planning Department

Nursaffrina binti Ropiee
Assistant Director of Town Planning Department

Anis Shazreen binti Azmi
Assistant Director of Town Planning Department

Dr. Izzat Azmeer bin Ahmad
Deputy Director of Health Services Department

Nadia Faradila binti Jalawi
Head of Assistant Director of Engineering Department

Shafida Azyanti binti Mohd Shafie
Senior Assistant Director of Engineering Department

Ts. Gs. Dr. Hj. Mohamad Nasran b. Dato' Prof Dr. Nasehir Khan
Senior Assistant Director of Engineering Department

Mohammad Aidil bin Samsuri
Head of Crisis Management Department

Noor Asyiqin binti Zainal Abidin
Assistant Director of Sustainable Development Department

Siti Fatimah binti Ismail
Senior Assistant Director of Landscape Department

Mohamad Nizam bin Abu Bakar
Assistant Town Planning Officer of Urban Services Department

R-Cities

Lina Liakou
Global Director, City Engagement and Practice

Saurabh Gaidhani
Lead, Programs

Aurora Lokita
Senior Manager, Programs and MEL

Isabel Parra
Lead, Strategic Communications and Events

Nicole Ponce
Associate, Knowledge and Communications

Think City

Dr Matt Benson
Senior Director

Melissa Sivaraj
Senior Associate, Climate Resilience

Dr Yogi Chellappan
Senior Manager, Climate Resilience

Ilana Aqilah Abd Ghafar
Associate, Climate Resilience

Dr Kang Chuen Siang
Senior Manager, Strategy and Analytics



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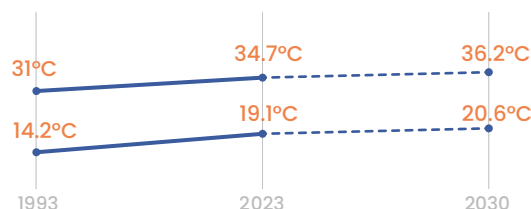
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INTRODUCTION

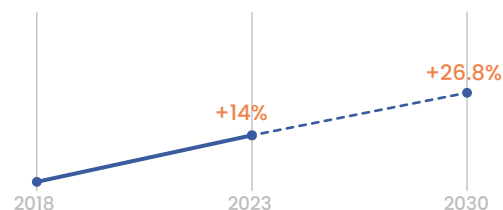
Penang is one of Southeast Asia's most dynamic urban regions—rich in heritage, driven by innovation, and poised for transformation. Like many growing metropolitan areas, it faces urgent and complex challenges: intensifying climate risks, constrained water security, rising urban temperatures, uneven development, and fiscal limitations.

To respond to these challenges, the Penang Resilience Strategy sets forth a clear vision: “Penang as a resilient, inclusive, and thriving state that embraces diversity, empowers communities, and fosters sustainable growth for all.” Developed through Penang’s first Public-Private-Philanthropic Partnership—bringing together the Penang State Government, local councils, Micron, and the Resilient Cities Network, with support from Think City—the strategy was shaped through an inclusive process involving civil society, academia, private sector, NGOs, youth, and other key stakeholders. It serves as a practical roadmap for resilience, uniting actors across sectors to ensure Penang not only adapts to future challenges but thrives in the face of uncertainty.

The strategy works through **Portfolio Projects** – groups of interconnected programs and strategies that drive long-term resilience goals, aligning multiple projects under a cohesive framework to maximize impact. By working together, these portfolios create synergies that accelerate progress toward Penang’s vision far beyond what individual projects could achieve alone. Within each portfolio, **Flagship Projects** serve as high-impact, transformative initiatives that demonstrate innovative solutions and set precedents for replication. These flagship projects act as catalysts, leading with breakthrough approaches that inspire the supporting projects around them. This integrated approach ensures projects work together strategically, creating momentum throughout the community and strengthening Penang’s ability to thrive in an increasingly challenging world.



Penang's temperatures rose from 14.2°C – 31°C in 1993 to 19.1°C – 34.7°C in 2023. Urban temperatures are expected to rise at least another 1.5°C by 2030.



Water use in Penang grew 14% (2018–2023) and could rise another 26.8% by 2030, putting more strain on Sungai Muda, the state's only water source.



In 2017, severe floods displaced over **7,000** residents impacted **159** areas caused economic losses exceeding **RM300** million. In April 2025, flash floods displaced **42** people in Penang



Penang has the highest population density in Malaysia at **1,688/km²**—leading to overcrowding, strained infrastructure, and a diminished quality of life. Congested roads, limited public transport and a lack of green spaces are clear symptoms of this over-densification.



There is an annual infrastructure funding gap: **~RM900 million–1.2 billion**
State governments have limited power to raise their own funds, making them heavily dependent on federal financing to move projects forward.



Penang's strength lies in its people, its culture and its spirit of innovation. The Penang Resilience Strategy reflects our commitment to building a future where communities thrive, economies grow sustainably and every citizen is equipped to face the uncertainties ahead. Together, we are shaping a Penang that stands stronger for generations to come.

Chow Kon Yeow,
Chief Minister of Penang.

“In the face of adversity, Penang stands not only with strength, but with purpose. Our resilience is not merely about recovery — it is about transformation. Guided by data, powered by community, and rooted in heritage, we are building a city that adapts, endures, and thrives. Let Penang be a living testament to how cities can rise stronger — together.”

Dato’ Ir. Rajendran P. Anthony,
Mayor of Penang Island

Seberang Perai is embracing a future that is resilient, inclusive, and community-driven. This Strategy represents our pledge to safeguard our environment, strengthen our economy, and enhance the well-being of every resident. By working together across sectors, we can build a stronger, more sustainable future for Seberang Perai.”

YBhg. Dato’ Hj. Baderul Amin bin Abdul Hamid,
Mayor of Seberang Perai



// At Micron, we believe that building resilient communities is essential to sustaining innovation and long-term growth. In Malaysia, our collaboration with the Penang State Government, the Resilient Cities Network, and the Chief Resilience Officers reflects our deep commitment to advancing urban resilience through technology, community engagement, and sustainable development, helping to shape a stronger, more inclusive future for Penang,”

Amarjit Sandhu, Corporate Vice President,
Assembly and Test NAND Operations for Micron Technology.

// “The Penang Resilience Strategy is a testament to the power of collaboration—where governments, businesses, and communities come together to build a stronger future. At R-Cities, we are honored to support Penang’s leadership in resilience, setting an example for cities across the region on how to turn challenges into opportunities for growth, equity and innovation,”

Lina Liakou,
Global Director of City Engagement and Practice, Resilient Cities Network.



Strategic Pillars of the Penang Resilience Strategy



Urban Water

- Smart Sustainable Water Use
- Efficient & Resilient Water Systems
- Strengthening Coastal & Flood Resilience

Urban Heat

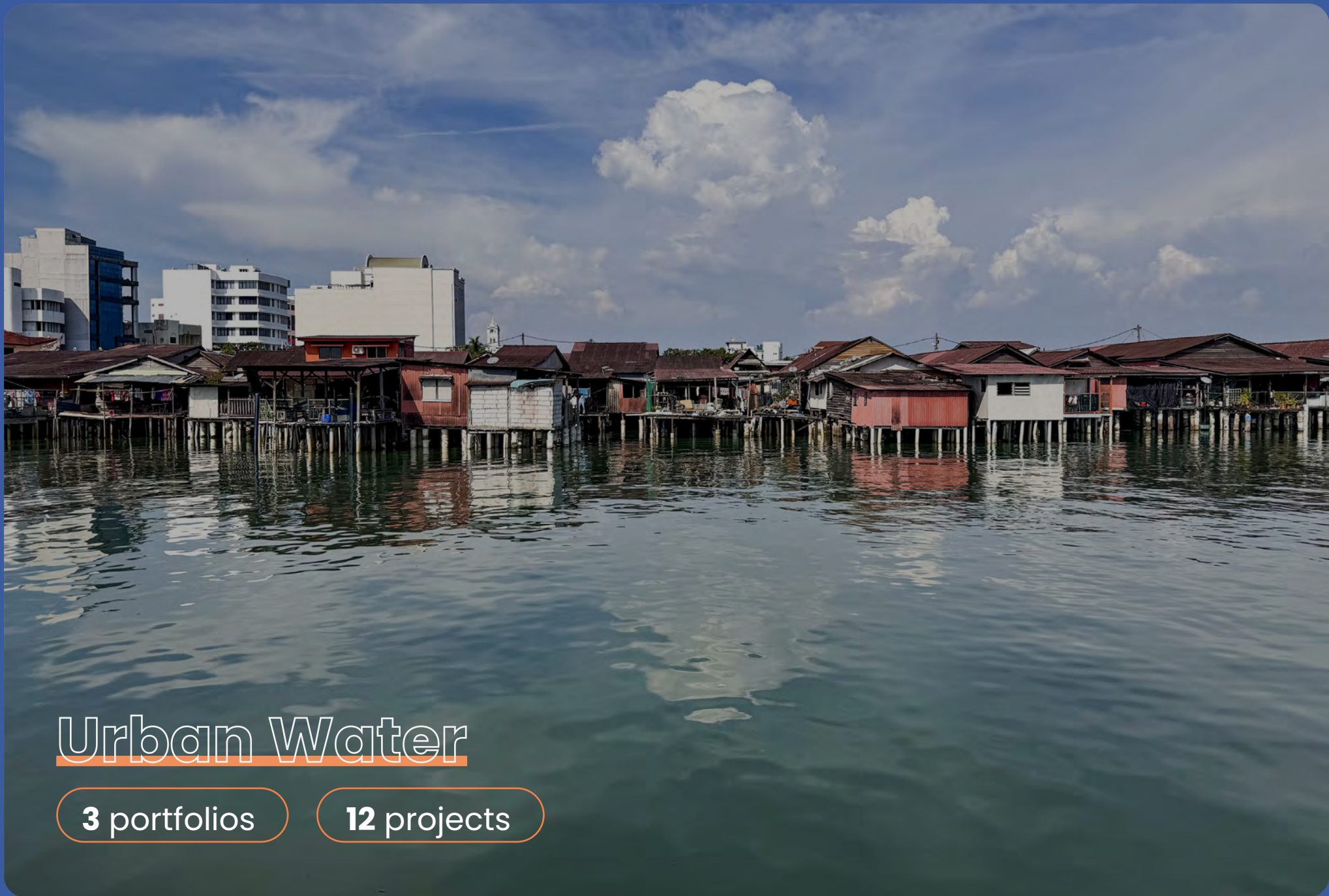
- Building Heat Resilience through Adaptation and Mitigation
- Climate-Resilient Health Systems

Urban Future

- Guiding Resilient Urban Development
- Driving Urban Economic Transformation
- Innovating Urban Mobility

Enabling Environment

- Unlocking Climate Finance
- Strengthening Urban Governance for Resilience
- Empowering Communities for Resilience



Urban Water

3 portfolios

12 projects

Securing Penang's Water Future

The Challenge: Penang's urban water resilience is increasingly at risk. Historically reliant on Sungai Muda and a limited number of surface and groundwater sources, the state now faces mounting pressure from rising domestic and industrial demand, uncoordinated land use, and climate variability. These pressures are straining rivers, aquifers, and catchments—while also worsening flash and tidal flooding across urban and coastal areas. Without integrated management, these dual risks of water scarcity and flooding threaten Penang's long-term sustainability, public health, and economic stability.

The Objective: To achieve a water-secure Penang by protecting natural systems, managing flood and drought risks at the basin scale, and promoting urban practices that reduce consumption, reuse water, and recharge groundwater.

Flagship Projects

- **Penang River Basin Authority** (New Project)— This project establishes a dedicated governance agency to coordinate the planning, restoration, and management of the Perai River across sectors and state boundaries. It aims to improve water quality, manage floods, and unlock the river's potential as a raw water source through integrated catchment governance and investment in green infrastructure.
- **Develop a Comprehensive Water Conservation Plan** (New Project)— This project develops a statewide strategy to reduce water consumption and build supply resilience. It focuses on optimizing water pricing, modernizing infrastructure, promoting efficient technologies, diversifying water sources, and encouraging behavioral change among users.
- **Comprehensive Flood Mitigation and Protection** (Ongoing Project)— This project reduces flood risks through a mix of green and grey infrastructure. It enhances stormwater absorption using Nature-based Solutions while upgrading drainage and flood management systems to address climate-induced rainfall and urban runoff.

Portfolio Projects

- 1 **Smart sustainable water use:** Strategies and actions to reduce water consumption and promote sustainable use of water resources.
- 2 **Efficient and resilient water systems:** Management and enhancement of urban water infrastructure and resources for efficiency and resilience.
- 3 **Strengthening coastal and flood resilience:** Projects and strategies to safeguard coastal areas from erosion, flooding, and climate-driven risks.

Supporting / Aligned Projects

- Mandate Rainwater Harvesting System in City Building Codes
- Securing Water Supply Through Advanced Treatment
- Protection of Water Catchment and Water Resource Management for Water Supply Protection:
- Water Contingency Plan 2030
- Mangrove Restoration and Protection
- Integrated Coastal Zone Management Plan
- Transforming Taman Impian: A Neighborhood Model for Climate Resilience
- Early Warning System for Flooding
- River Water Storage Scheme



Urban Heat

2 portfolios

9 projects

Adapting to Rising Temperatures

The Challenge: Urban heat is becoming a growing hazard in Penang. Rising temperatures—driven by climate change, high-density development, and declining green cover—are compounding heat stress, particularly in underserved neighborhoods with limited shade and cooling infrastructure. The impacts are far-reaching: declining health and well-being, reduced worker productivity, and public spaces that are increasingly unfit for daily use especially for vulnerable communities including the aging communities.

The Objective: To build a cooler and more equitable Penang by expanding green infrastructure, promoting climate-responsive design, and ensuring all communities—especially the most vulnerable—can access safe, comfortable, and inclusive outdoor environments.

Flagship Projects

- **Urban Cooling Study and Urban Heat Toolkit** (Ongoing Project) – This project evaluates the effectiveness of existing cooling interventions in Penang and develops a localized Heat Reduction Toolkit. Its goal is to guide citywide implementation of evidence-based urban cooling measures in planning, development, and community initiatives.
- **Cool Roof and Green Facades** (Ongoing Project) – This project promotes passive cooling solutions, such as reflective roofs and green facades, especially for industrial and strata buildings. It aims to reduce indoor heat, lower energy costs, and ease the urban heat burden on vulnerable communities.
- **City Urban Greening Program** (Ongoing Project) – This project expands tree cover and ground-level vegetation in Penang Island and Seberang Perai. Its objective is to reduce urban heat, improve thermal comfort, and enhance the livability of public spaces through climate-appropriate, sustainable greening.
- **Penang Heat-health Resilience Initiative** (Ongoing Project) – This project strengthens Penang's health system response to extreme heat by improving risk assessment, emergency protocols, and community outreach. Its aim is to protect vulnerable populations and build institutional capacity for climate-health resilience.

Portfolio Projects

- 1 **Building heat resilience through adaptation and mitigation:** Strategies and actions to adapt to rising temperatures and mitigate the urban heat island effect.
- 2 **Climate-resilient health systems:** Assessing and strengthening health systems to respond to climate-related health challenges.

Supporting / Aligned Projects

- Sustainable Building Materials and Procurement for Climate-Resilient Construction
- Transforming Schoolyards into OASIS
- Batu Kawan Eco City
- Green and Community Resilient Seberang Perai
- Heatwave Preparedness



Urban Future

3 portfolios

9 projects

Planning for a Resilient Urban Future

The Challenge: Penang's urban future is shaped by mounting challenges—including rapid urbanization, traffic congestion, and sprawling development. Uneven growth across regions has led to spatial disconnection, underused assets, and limited access to quality public spaces. The economy remains reliant on a narrow set of sectors, lacking diversification and resilience in the face of global shocks. At the same time, weak place identity and fragmented development approaches make it difficult to create cohesive, vibrant, and future-ready communities.

The Objective: To create an inclusive and regenerative urban future where growth is balanced, mobility is efficient, and communities are supported by a resilient, innovative economy and a strong sense of place grounded in cultural and natural assets.

Flagship Projects

- **Positioning Penang as ASEAN's Green Innovation Hub** (New Project)– This project aims to establish Penang as a regional leader in green technology and sustainability-driven industries. It seeks to attract investment, develop a green-skilled workforce, and accelerate the transition to a low-carbon economy to maintain competitiveness in the global market. This project is linked to Resilience Business Forum.
- **Age-Friendly City** (Planned Project) – This project adopts the WHO's Age-Friendly Cities framework to improve accessibility, mobility, and social inclusion for Penang's ageing population. It focuses on enhancing infrastructure, transport, housing, and community engagement to support healthy, active ageing across urban and suburban areas.
- **Promoting Shared and Inclusive Transportation** (New Project) – This project reduces private vehicle reliance by improving public transport efficiency, digital integration, and user experience. It aims to increase public transit uptake through system upgrades, behavior change strategies, and inclusive mobility policies.

Portfolio Projects

- 1 **Guiding resilient urban development:** Innovative guidance to address urbanization, sprawl, and future development challenges.
- 2 **Driving urban economic transformation:** Promoting innovation and transformation to build resilient urban economies.
- 3 **Innovating urban mobility:** Strategies and projects to improve urban mobility through innovation and integrated planning.

Supporting /Aligned Projects

- Climate-responsive Land Use Planning
- Scaling GBI Adoption in Penang
- Infrastructure Capacity Study
- Seberang Perai Circular Economy Roadmap
- Affordable Housing Provision
- Smart and Safe Infrastructure for Mobility Transformation



Enabling Environment

3 portfolios

13 projects

Unlocking Institutional Readiness and Finance

The Challenge: Efforts to build resilience remain fragmented, hindered by siloed institutional mandates, limited local authority, and a lack of long-term, lack of alternative financing schemes. Coordination across government levels and sectors is often weak, making it difficult to implement integrated solutions. At the same time, community engagement in planning and decision-making is inconsistent, limiting the effectiveness and inclusivity of resilience initiatives.

The Objective: To establish an enabling environment where institutions have the mandate and capacity to lead, sustainable financing is mobilized for resilience, and communities are meaningfully engaged in shaping a more inclusive, adaptive, and future-ready Penang.

Flagship Projects

- **Developing Innovative Financing Mechanism for Urban Resilience** (New Project) – This project explores and designs diverse financing tools—such as PPPs, municipal bonds, and specialized funds—to overcome state-level funding constraints and support long-term investment in Penang’s critical infrastructure and urban resilience.
- **Strengthening Enforcement and Compliance Monitoring** (New Project)– This project enhances enforcement capacity through improved monitoring tools, agency coordination, and public reporting via the ePINTAS app. It aims to reduce environmental violations and ensure compliance in urban development and resource management.
- **Penang Climate Task Force** (New Project)– This project strengthens cross-sectoral climate planning through an upgraded Penang Climate Taskforce. It focuses on infrastructure vulnerability assessments and integrated coordination to align resilience upgrades with Penang’s climate adaptation goals.
- **Resilient Business Forum** (New Project) – This project fosters collaboration between the government and private sector to enhance business resilience and unlock co-financing for climate adaptation. It aims to align corporate strategies with Penang’s resilience agenda and reduce climate-related business disruptions.

Portfolio Projects

- 1 **Unlocking climate finance:** Innovate financing mechanisms to attract diverse funding for climate and development initiatives.
- 2 **Strengthening urban governance for resilience:** Establishing integrated policy, technology, and data systems to drive effective governance and implementation.
- 3 **Empowering communities for resilience:** Initiatives to foster community ownership and engagement in strategy and implementation.

Supporting / Aligned Projects

- Penang Green Finance
- Penang Green City Action Plan
- Unified Policy Framework
- Centralized Data Infrastructure for Urban and Environmental
- Community-Led Disaster Preparedness Program
- Youth Empowerment Initiative
- Penang STEM Talent Development
- Resilient Businesses Forum
- Penang Heritage Dialogues
- Seberang Perai Cultural and Tourism Revitalization

The Time to Act is Now

Penang's resilience journey is not the government's job alone. It is a shared mission. This strategy creates a platform for collaboration—where the various stakeholders may lead, innovate, and invest in the solutions that will shape the future of cities. From engineering firms and real estate developers to financial institutions and tech startups and academics, there are direct pathways to contribute and benefit.

The Penang Resilience Strategy is not just a document—it's a call to action. To become connected, inclusive, and resilient is a challenge that everyone in Penang must address. Together, we can build a Penang that's not only protected from future shocks, but actively thriving in a changing world.

Access
the full
strategy:





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