高雄市政府
Kaohsiung City Government

二十一世紀新前線
21st Century Frontiers

Accelerating Innovation for
Flourishing Lives 4 All

Kaohsiung's Climate Action and Carbon Reduction Achievements

Governing a net-zero and sustainable urban transition, supported by smart systems and AI



Kaohsiung's Climate Action and Carbon Reduction Achievements

Governing a net-zero and sustainable urban transition, supported by smart systems and AI

1. An industrial city's climate and development challenge

Kaohsiung's climate transition concerns more than reducing the footprint of municipal services. It involves changing the energy, production and infrastructure systems of a major industrial port while improving the conditions of everyday life. Covering approximately 2,952 square kilometres in southern Chinese Taipei, with around 2.71 million residents, the municipality encompasses dense urban districts, agricultural areas, mountains and coastal settlements. Its geography creates intersecting challenges: typhoons and intense seasonal rainfall, flooding and drought, urban heat, and exposure to sea-level rise. Heavy industry adds substantial greenhouse gas emissions and air-quality pressures to this landscape (KCG, 2021, 2024a, 2026).

Steel, petrochemicals and manufacturing have been central to Kaohsiung's economic development. Industry accounts for approximately four-fifths of its emissions, while the city contributes around one-fifth of the national total. The transformation must therefore engage industrial facilities and their supply chains, not simply encourage greener household consumption. At the same time, ageing, unequal access to services and the differing needs of urban and rural communities require climate policy to address health, mobility, livelihoods and social protection alongside emissions (KCG, 2024a, 2025; EPB, 2025b).

Kaohsiung City Government's (KCG) response combines mitigation and adaptation within a wider sustainable-development agenda. The Net-Zero City Development Autonomous Ordinance establishes a 30% emissions-reduction target by 2030 against 2005 levels and net zero by 2050. The Net-Zero Policy White Paper, successive Voluntary Local Reviews and sectoral programmes translate this direction into governance, infrastructure and investment priorities. These municipal instruments operate within the national Climate Change Response Act and net-zero pathway, requiring coordination between local implementation and national regulation, finance and energy policy (KCG, 2022, 2023a, 2024b, 2024c).

The municipality's elevation range of approximately 3,500 metres and rainfall concentrated between May and September make uniform solutions inappropriate. Coastal protection, urban drainage, heat management and rural access require different interventions, but must be considered together when locating infrastructure and directing investment. This connects climate-risk planning with the distribution of development opportunities across the municipality (KCG, 2021, 2026).

The central question is how to provide reliable energy, accessible mobility, water security, healthy environments and economic opportunity with progressively lower emissions. Smart systems and artificial intelligence can support that task, but they cannot substitute for cleaner energy, effective institutions or public participation. Kaohsiung's experience is therefore best understood as a climate and development transition supported by digital capabilities, rather than a digital transformation with climate benefits presumed to follow.

An expanded urban innovation perspective adds a further dimension: cities can contribute to global sustainability not only by reducing emissions within their boundaries, but also by developing solutions that other cities, industries and communities can adopt. This is particularly relevant for

Kaohsiung, where industrial capabilities, research institutions and digital innovation could support solutions with benefits extending beyond the municipality (Pamlin et al., 2026).

2. From emissions reductions to accountable climate governance

The clearest aggregate achievement is the reduction in Kaohsiung's reported citywide net greenhouse gas inventory from 66.14 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2005 to 50.08 $MtCO_2e$ in 2024. The city reports a 24.3% reduction and a 2024 per-capita figure of 18.33 tonnes. These results show substantial progress, while also demonstrating the scale of the remaining transition. They should not be interpreted as emissions savings attributable to AI, nor as evidence that every sector is progressing equally (KCG, 2025, 2026).

On a consistent inventory basis, the 2030 target implies emissions of roughly 46.3 $MtCO_2e$, about 3.8 $MtCO_2e$ below the reported 2024 level. This comparison is an indication of the remaining absolute reduction, not a forecast. Production cycles, new industrial demand and changes in electricity supply can all affect the trajectory; successive inventories and sectoral explanations are needed to distinguish durable structural progress from temporary changes in activity (KCG, 2024b, 2026).

Institutional arrangements have evolved alongside this trajectory. Building on earlier sustainability structures, the city strengthened cross-departmental coordination in 2023 through its sustainable-development and climate-change response body. The ordinance, promulgated in June 2024 following the preceding legislative process, links biennial carbon budgets, four-year white papers and implementation review. Environmental, economic, transport and urban-development responsibilities are thereby connected to a common emissions objective rather than treated as separate administrative agendas (KCG, 2023a, 2024a, 2024b).

A significant implementation milestone was the City Council's approval of the first carbon budget on 2 June 2025, covering the 2025–2026 cycle. It followed preparatory executive consideration in 2024. The budget is an emissions-governance instrument, not a financial appropriation. It translates the long-term target into a near-term planning ceiling and sectoral action requirements, covering industry, residential and commercial activities, transport, waste and environmental management, agriculture, and forestry (Kaohsiung City Council, 2025; KCG, n.d.-b).

Municipal documentation identifies a 2026 ceiling of approximately 50.9 $MtCO_2e$ against a business-as-usual projection of 54.8 $MtCO_2e$, with approximately 3.83 $MtCO_2e$ of planned abatement. The programme combines 16 quantified measures with 57 supporting measures and was developed through more than ten consultations. These are projected reductions relative to a modelled baseline, not verified results. The ceiling also exceeds the reported 2024 inventory, illustrating why maintaining absolute progress requires scrutiny beyond compliance with a business-as-usual-based budget (EPB, 2025a; KCG, 2026).

The approach provides a framework for negotiating responsibilities with major emitters, but its powers should not be overstated. The city describes the carbon budget as lacking its own monetary allocation or enforcement mechanism. National emissions-inventory obligations remain governed by national legislation and the Mandatory Greenhouse Gas Reporting System. Local oversight, industrial engagement and supporting regulation therefore matter alongside the budget itself; it is not an automatic system of enforceable company-level emissions quotas (EPB, 2025a; KCG, 2026).

Public finance gives these governance arrangements a means of implementation. The city identifies NT$28.5 billion in net-zero-related allocations for 2024, drawing on administrative budgets, dedicated funds and central subsidies. Unlike the carbon budget, this is a monetary allocation. Connecting expenditure to delivered measures allows legislators and residents to assess implementation, while keeping approved funding, completed projects and achieved emissions reductions as distinct milestones (KCG, 2026).

Supporting institutions perform complementary functions. The Kaohsiung Carbon Platform provides information and matchmaking for equipment upgrades and voluntary reduction projects; it is neither an emissions registry nor a trading exchange. Separately, KCG secured the location of the Taiwan Carbon Solution Exchange's headquarters in Kaohsiung in 2023. Keeping these functions distinct clarifies how public coordination, national market infrastructure and corporate action complement one another without conflating their responsibilities (KCG, 2026; Global Views Monthly, 2023).

3. Industrial transformation, cleaner energy and efficient buildings

Kaohsiung's Industrial Net-Zero Alliance provides an organisational bridge between citywide objectives and company decisions. Larger firms can share carbon-management expertise with smaller businesses, while sectoral cooperation addresses production systems that municipal government cannot directly operate. Municipal data record 95 companies with 2030 reduction targets and 77 with 2050 net-zero commitments by early 2026. These commitments expand participation, although their climate significance ultimately depends on implementation and verified absolute reductions (KCG, 2024a, 2026).

Industrial changes combine energy efficiency, resource integration and fuel substitution. A municipal workshop brought together the electricity, petrochemical, steel and semiconductor sectors to examine power reliability and net-zero strategies. China Steel presented cogeneration upgrades, digital temperature control for reheating furnaces, more efficient annealing and top-gas energy recovery. Such examples show where digital controls support changes in physical production processes. They do not establish a separate, citywide quantity of AI-induced abatement (EPB, 2025b).

Beyond reducing emissions from existing production, Kaohsiung's industrial transformation could also create opportunities to develop and export products, processes and services that help other regions meet human needs with substantially lower resource use. Assessing such contributions would require distinguishing reductions within Kaohsiung's territorial inventory from emissions avoided elsewhere through the adoption of its solutions, while accounting for their full life-cycle impacts (Pamlin et al., 2026).

Renewable-energy implementation is coordinated through the Green Power Promotion Task Force, established in 2020 and led at deputy-mayor level. More than fourteen municipal agencies participate. Five lead bureaus organise work on rooftop photovoltaics, fishery-solar development, school energy systems, power-plant transition and energy-service models. The arrangement places responsibility above individual departmental boundaries while assigning specific delivery tasks. Cooperation initiated with the national Bureau of Energy in 2020, now the Energy Administration, also helps address permitting and grid-connection issues (KCG, 2026).

This division of labour offers an implementation discipline: progress can be reviewed against named lead agencies and unresolved matters escalated across departments. This is particularly relevant where delivery depends on Taipower, developers and financial institutions outside direct municipal control. The arrangement gives coordination an operational purpose beyond meetings or broad political commitments (KCG, 2026).

Municipal reporting indicates that cumulative solar-photovoltaic filing capacity during 2021–2025 exceeded 1,200 MW, above the interim target of 1,050 MW and advancing towards the six-year 1.25 GW objective. Filing capacity is not equivalent to commissioned generation and should not be presented as such. Similarly, the fishery-solar programme's 210 MW figure is a target for applications, not proof of completed installations. These distinctions make progress reporting more

useful by identifying where projects still face construction, connection or operational requirements (KCG, 2026).

Rooftops, public facilities and school campuses offer opportunities to expand generation without treating undeveloped land as the default resource. Fishery-solar projects seek compatible production on shared sites, but require a fisheries-first approach, consultation and attention to ecological effects and working conditions. Regulatory clarification, advisory support and access to grid information are therefore as important as panels and sensors. The city's green-energy platform supports information sharing across generation, conservation and storage, covering more than 1,000 renewable-energy sites according to municipal reporting (KCG, 2024a, 2025, 2026).

Energy-service contracting addresses a different barrier: the upfront cost of efficiency improvements. By linking project remuneration to performance and savings, such arrangements can help facilities undertake upgrades that would otherwise be deferred. Municipal promotion, matchmaking, demonstration visits and professional training connect potential users with providers, making finance and implementation capability part of the energy strategy (KCG, 2024a; EDB, 2026).

A concrete example connects these arrangements to measurable efficiency improvements. A March 2026 Economic Development Bureau report describes a completed upgrade at Hanshin Arena Shopping Plaza combining efficient chillers, replacement pumps and smart energy management. A year-on-year comparison before and after the chiller upgrade indicated 23.5% electricity savings, approximately 1.45 million kWh annually, with associated emissions reductions estimated at about 720 tonnes of CO_2 per year. The result applies to the chiller equipment assessed, not the whole building, and cannot be attributed to the management software alone (EDB, 2026; CNA, 2026).

The Kaohsiung House programme and Sustainable Green Building Management Fund complement equipment-level action through building design incentives and longer-term financing. School photovoltaics and energy management also connect infrastructure investment with environmental education. Meanwhile, coal-to-gas substitution may reduce emissions from existing equipment, but it is not a net-zero endpoint: continued fossil-fuel dependence and long-lived assets remain transition risks. The strategic task is to combine efficiency and renewable supply while avoiding new demand or infrastructure commitments that undermine absolute emissions reductions (KCG, 2024a, 2025).

4. Linking low-carbon mobility, urban renewal and finance

Kaohsiung's transport transition illustrates how carbon reduction can be pursued through changes in urban form and service provision. The Circular Light Rail Transit (LRT) system completed its full loop in 2024, with 22.1 kilometres and 38 stations. Reusing former freight-rail corridors, it connects the Red and Orange Mass Rapid Transit (MRT) lines with waterfront redevelopment, cultural destinations and additional residential districts. Its significance lies in reorganising access across the city, not merely substituting one vehicle technology for another (Hsu, 2025; MTBU, 2024a).

Level boarding, accessible platforms, pedestrian connections and first- and last-mile cycling help translate rail investment into usable mobility. Trackside greenery and the removal of infrastructure barriers improve public space, while transit-oriented development seeks to connect land use with the expanding network. These interventions reflect the people-centred direction articulated through Kaohsiung's transport strategies and international exchanges, including the 2017 EcoMobility World Festival. Their long-term mitigation value depends on making public and active transport practical alternatives to private motorised journeys (ICLEI, 2017; Hsu, 2025).

By December 2024, the Mass Rapid Transit Bureau reported more than 12 million passenger trips during the first year of full-loop operation. This is a concrete service-use outcome, not a count of individual passengers or a directly measured emissions saving. Integrated MenGo/TPASS

arrangements, shared payment systems, feeder services and bicycle access complement the physical network. Subsidised fares can reduce barriers to use, but sustained operation and accessibility require continuing public finance and attention to who benefits from network expansion (MTBU, 2024b; KCG, 2024a).

Smart systems support this transport strategy at several levels. AI-assisted traffic optimisation and exchanges of transit, parking, road-safety and weather data help operational decision-making. Light-rail applications support safety monitoring, while better information can assist incident response and crowd management. However, faster traffic flow alone is not equivalent to lower total transport emissions. Assessment must consider modal shift, vehicle kilometres, electricity consumption and the possibility that easier driving increases demand (KCG, 2026; MTBU, 2024b).

Electrification adds another implementation strand, with important distinctions between fleets. Article 18 of the local ordinance addresses official motorcycles before 2030 and official cars before 2040, while city buses are to transition to electric or hydrogen propulsion before 2030, subject to specified exceptions. The differentiated deadlines recognise varying fleet requirements and permit specified non-fossil alternatives. Their effectiveness depends on procurement, charging infrastructure, operating requirements and the carbon intensity of electricity or hydrogen supply (KCG, 2024b).

Financial innovation helps maintain the infrastructure underpinning this transition. Kaohsiung issued NT$2 billion in municipal green bonds in 2024 and NT$10.1 billion across two issuances in 2025, including NT$7.6 billion in December. The resulting NT$12.1 billion total represents municipal issuance, separately from authorised quotas or bonds issued by the Bank of Kaohsiung. The programme refinanced existing Red and Orange MRT debt, linking established low-carbon infrastructure with the city's wider financing strategy (KCG, 2026).

For the inaugural bond, the Finance Bureau reported a 1.27% interest rate and approximately 30% interest-cost savings against the borrowing replaced. Refinancing lowers financing costs without automatically reducing outstanding principal or creating additional emissions reductions. The green-bond framework nonetheless connects debt management to eligible low-carbon infrastructure through project selection, allocation reporting and external assessment. Alongside the Finnovation Hub, green-building finance and photovoltaic energy-service arrangements, it demonstrates that transition finance includes improving the affordability of existing assets as well as funding new ones (Finance Bureau, n.d.; KCG, 2023b, 2025).

The Sustainable Green Building Management Fund further broadens the financing mix. Established in 2023, it draws on sources including regulatory fees, development-related contributions, project revenues, public budgets and grants, donations and investment income. Photovoltaic energy-service models similarly bring banks, property users, developers and the electricity utility into shared implementation arrangements. These mechanisms complement national green-finance policy without making all investment attracted to Kaohsiung inherently climate-aligned (KCG, 2025).

5. Water security and adaptation as conditions for transition

A sustainable industrial transition also requires reliable water. Kaohsiung's alternating wet and dry periods, combined with water-intensive manufacturing, create risks for households, agriculture and production. Reclaiming municipal wastewater provides an additional industrial supply and can reduce competition for conventional freshwater during drought. It does not eliminate hydrological risk or guarantee household water security, but it diversifies the supply portfolio and connects industrial development with circular resource use (Cheng et al., 2023; KCG, 2024a).

The northern reclaimed-water programme builds on experience at Fengshan and Linhai. Municipal reporting places Ciaotou's initial supply at 30,000 cubic metres per day in 2026, with expansion to

35,000 planned for 2027 and an 8.7-kilometre transmission pipeline. Nanzi construction began in April 2025; its first phase is planned to provide 30,000 cubic metres daily in 2028, rising to 70,000 at full development in 2030. The staging matters for planning: ultimate capacity is not immediately available supply, and industrial expansion needs to remain coordinated with the commissioning schedule (KCG, 2026).

Public-private delivery and coordination with central government connect construction, operation and industrial demand. Digital tools support the reliability of that arrangement. At Fengshan, the city describes continuous water-quality monitoring, cameras and smart manhole sensors introduced to identify contamination and abnormal conditions in the sewer network. Cross-agency reporting links monitoring to environmental enforcement and operational response. At Ciaotou, building information modelling and augmented reality support design coordination and construction inspection, helping resolve conflicts between complex systems before they become physical problems (KCG, n.d.-c).

The principal demonstrated value is improved resource management and operational preparedness, not a quantified AI-related carbon saving. Advanced treatment requires electricity, chemicals and maintenance; its mitigation balance depends on treatment requirements, energy sources and the supply option displaced. Water security and carbon efficiency therefore need joint assessment. This is especially important as semiconductor and other industrial investments increase demand: economic upgrading must be evaluated against the resource requirements of the activities it brings, rather than assumed to be environmentally beneficial (Cheng et al., 2023).

6. Human needs, community participation and transition capabilities

Citywide transformation must reach beyond large infrastructure and major emitters. Kaohsiung's Low-Carbon Sustainable Homeland programme links national frameworks with municipal support for community action. Municipal data record participation by 773 of the city's 890 villages, or 86.9%, in 2026. Participation should not be confused with completion of certification, but it indicates a substantial institutional reach through which practical changes in resource use and everyday behaviour can be supported (KCG, 2026; CCA, n.d.).

Tangchang Community in Qishan illustrates the connection between environmental action and local livelihoods. Its community development association has linked banana-residue reuse, food and agricultural education, and low-carbon tourism with local revitalisation. Materials previously treated as waste become inputs to community products and learning activities. National employment-programme documentation also describes youth participation, a care station for vulnerable older residents and reinvestment of 15% of operating surplus in community activities. The significance is not a proven net-negative community footprint, but a practical relationship between circular production, employment and social care (WDA, n.d.; NERA, n.d.).

Municipal accompaniment and national recognition support this work, but different institutions have different responsibilities. The Climate Change Administration oversees Low-Carbon Sustainable Homeland, while environmental-education facility certification falls under the National Environmental Research Academy. These complementary forms of recognition connect community action with environmental learning and practical capacity. More broadly, Tangchang demonstrates why community organisation and trusted intermediaries matter: technologies alone cannot sustain participation, distribute benefits or provide the local knowledge needed to adapt interventions (KCG, 2026).

Agriculture provides another connection between productive livelihoods and resilience. The city promotes AI-enabled Internet of Things (AIoT) applications for crop assessment, pest management and disaster-related decision support through initiatives including the Plant Doctor service and

Agrinfor Ecosystem. Municipal programme figures identify 133 supported sites covering approximately 1,300 hectares by 2025, with smart-agriculture subsidies of up to NT$300,000 per project. Livestock-effluent reuse adds a circular-resource component. These are implementation measures and coverage figures, not evidence of a quantified agricultural emissions reduction attributable to AI (KCG, 2026).

Digital healthcare and integrated welfare services similarly address access rather than emissions alone. Remote connections can help rural and underserved residents obtain medical advice, while shared welfare information supports frontline identification of vulnerable households and older people living alone. Potential travel savings are a secondary benefit unless measured. Inclusive implementation also requires non-digital access routes, appropriate handling of personal information and services designed around users' capabilities rather than assumed technological familiarity (KCG, 2025; Calzada and Eizaguirre, 2025).

A human-needs-based innovation approach would extend the assessment beyond access to individual services towards their contribution to people's ability to live flourishing lives. This includes physical and mental health, meaningful participation, social relationships, learning and opportunities across different stages of life. Such an approach is particularly relevant to Kaohsiung's ageing population and to communities with unequal access to services. It would also encourage the involvement of young people, older residents and local organisations in defining needs and developing solutions, rather than treating them primarily as recipients of municipal services (Pamlin et al., 2026).

An equitable transition also requires attention to people who bear adjustment costs. Industrial workers, small enterprises, fishery operators and households without suitable rooftops do not have identical access to transition opportunities. The ordinance's provisions on identifying affected groups, consultation, employment support and social protection provide a basis for addressing these differences. Assessment should examine the distribution of benefits and burdens, not just aggregate participation (KCG, 2024b).

The Net-Zero Institute, established in 2023, complements these initiatives by developing practical capabilities in carbon inventories, reduction technologies, green finance and related standards. University, industry and professional partnerships connect training with implementation, including learning for civil servants and businesses. Public lectures and school energy programmes broaden participation beyond specialists. Collaboration through ICLEI and the Kaohsiung Capacity Center, including the 2026 CityCOP dialogue, provides opportunities to test local experience against international thinking on science-based, people-centred transitions (KCG, 2025; Net-Zero Institute, n.d.; ICLEI KCC, 2026).

7. Data and AI in service of climate outcomes

The digital foundations of Kaohsiung's transition are organisational as well as technical. Its open-data infrastructure and application programming interfaces enable information exchange across departments and with external partners. An interview with the city's information leadership describes initial reluctance to share data because of perceived risks, alongside subsequent investment in training, common formats and collaborative activities with businesses and schools. The lesson is that data availability becomes useful only when institutions can interpret, maintain and responsibly share it (iThome, 2023).

Within this infrastructure, the Climate Change Adaptation Platform integrates 86 spatial datasets spanning disaster risks, water, agriculture and environmental protection. Its geospatial queries and visualisation support planning, risk communication and engagement. Its contribution is to make spatial risks more accessible for human decision-making. Similarly, the green-energy platform

supports oversight, while industrial and transport systems assist operational decisions. Each tool has a specific function; treating all digital applications as AI obscures both their contribution and their limitations (KCG, 2026).

The Kaohsiung Sovereign AI Project extends these capabilities through a city-level generative-AI platform developed with partners including NVIDIA and Chunghwa Telecom. Vision-language models can assist recognition and reporting of urban incidents, while digital twins and predictive simulations offer potential support for infrastructure and disaster-management decisions. Municipal descriptions contain both deployed applications and future ambitions. These should remain distinguishable: an announced platform or demonstration is not evidence of universal operational coverage or verified climate impact (KCG, n.d.-d; iThome, 2025).

Coordination through the Smart City Promotion Committee and Kaohsiung Project Management Office, together with Asia New Bay Area testbeds, grants and industry-university connections, helps link experimentation with municipal needs. Industrial digital transformation also requires attention to smaller firms' capabilities, rather than assuming that successful demonstrations will diffuse automatically. The relevant test for scaling is whether a solution can deliver durable improvements in energy use, resilience or accessible services under different institutional and resource conditions (CIER, 2020; KCG, 2025).

The expanded urban innovation agenda also suggests a broader role for AI: supporting the identification of unmet human needs, exploring alternative ways of meeting them and assessing their consequences for both human flourishing and planetary boundaries. This requires moving beyond optimising existing infrastructure towards examining whether different systems could deliver better outcomes with fewer resources. For Kaohsiung, an important next step would be to explore how its digital platforms and AI capabilities could support such assessments, while ensuring that decisions remain accountable to public institutions and the communities affected (Pamlin et al., 2026).

8. Lessons for a net-zero and sustainable transition

Kaohsiung's experience shows the value of combining an absolute emissions objective with institutions capable of delivering it. The reported inventory reduction is an important achievement, while carbon budgeting, industrial cooperation, renewable-energy coordination, efficient equipment, public transport, water reuse and community action create complementary routes for further progress. None is sufficient alone, and their results should not be added together without checking boundaries, baselines and overlapping benefits.

A further lesson is that adaptation and mitigation should be planned together. Reliable water, safer mobility and functioning social services help sustain public support and economic continuity during transition. Conversely, new resource-intensive development can increase the scale of the mitigation task. Treating these interactions explicitly is more informative than presenting infrastructure expansion or technological adoption as an unqualified sustainability success.

The next generation of urban climate action requires a broader understanding of innovation and success. Pamlin et al. (2026) argue for an expanded urban innovation agenda that moves beyond reducing the environmental impacts of existing systems towards developing solutions that enable flourishing lives for all within planetary boundaries. This changes both the questions cities ask and the solutions they prioritise. Rather than focusing primarily on how to make existing transport, energy, industrial and service systems less carbon-intensive, cities can explore how to meet people's underlying needs through fundamentally different systems with much lower resource requirements. Kaohsiung provides several entry points for such an approach. Its integrated public transport investments can be assessed in terms of access and mobility rather than vehicle efficiency alone;

industrial transformation can address the services and materials society needs rather than simply the emissions intensity of existing production; and digital technologies can support new ways of delivering health, resilience and public services. The opportunity is to connect these developments into a coherent innovation agenda in which emissions reductions, improved quality of life and reduced pressure on ecosystems reinforce one another. This would also require new ways of assessing progress, combining conventional emissions accounting with indicators of human flourishing, access to essential services and the wider environmental consequences of urban development.

The transferable lesson is not a fixed package of smart-city technologies. It is the alignment of physical investment, administrative responsibility, finance, skills and public participation around human needs. Future assessment should track commissioned assets and verified savings, distinguish commitments from delivery, and test whether new industrial demand remains compatible with absolute reductions. AI should be judged by its net contribution, including energy requirements, reliability, privacy and equitable access. With these safeguards, Kaohsiung can use its industrial, institutional and digital capabilities not only to advance towards a resilient, inclusive and genuinely lower-carbon city, but also to develop and share solutions that help other cities deliver flourishing lives within planetary boundaries. (KCG, 2024b; Calzada and Eizaguirre, 2025).

References and sources

Calzada, I., and Eizaguirre, I. (2025). *Digital inclusion and Urban AI: Strategic roadmapping and policy challenges.* Discover Cities, 2, 73. https://doi.org/10.1007/s44327-025-00116-9.

Central News Agency (CNA) (2026). *AI and net zero: Kaohsiung promotes ESCO energy-saving measures, providing corporate diagnoses and matchmaking services [In Chinese].* 25 March. Original interviews with municipal and facility representatives. Online source.

Cheng, H.-H., Yu, W.-S., Tseng, S.-C., Wu, Y.-J., Hsieh, C.-L., Lin, S.-S., Chu, C.-P., Huang, Y.-D., Chen, W.-R., Lin, T.-F., and Whang, L.-M. (2023). *Reclaimed water in Taiwan: Current status and future prospects.* Sustainable Environment Research, 33, 16. https://doi.org/10.1186/s42834-023-00177-8.

Chung-Hua Institution for Economic Research (CIER) (2020). *A strategic study on how southern industries can bridge the digital transformation gap: A case study of Kaohsiung [In Chinese].* Research project PR2252A1, December. Online source.

Climate Change Administration (CCA) (n.d.). *Low-carbon and sustainable homeland: About certification.* Ministry of Environment, Low Carbon Sustainable Information System. Online source.

CommonWealth Magazine (2025). *Kaohsiung focuses on net-zero transition and energy resilience: From policy planning to industrial integration, a transformation engine from industrial hub to smart and sustainable city [In Chinese].* 19 September. Municipal contributed article by Kaohsiung City Government. Online source.

Economic Development Bureau, Kaohsiung City Government (EDB) (2026). *Advancing practical energy efficiency: Kaohsiung ESCO visit to Hanshin Arena; free corporate energy diagnoses and subsidies launch in April [In Chinese].* Municipal news release, 25 March. Online source.

Environmental Protection Bureau, Kaohsiung City Government (EPB) (2025a). *Government council collaboration drives net zero: Kaohsiung passes nation's first 'Urban Carbon Budget'.* 3 July. Online source.

Environmental Protection Bureau, Kaohsiung City Government (EPB) (2025b). *Net Zero Institute hosts 'Energy Kaohsiung' workshop: Four major industries join forces to promote net zero governance.* 13 October. Online source.

Finance Bureau, Kaohsiung City Government (n.d.). *Nation's first government green bond completes auction: Advancing net-zero sustainability through a three-way benefit [In Chinese].* News release reporting the auction of 29 December 2023. Online source.

Future City (2025). *Senior city officials lead in certification: The Net-Zero Institute becomes an engine of Kaohsiung's green transformation [In Chinese].* 13 March. Online source.

Global Views Monthly (2023). *Taiwan Carbon Solution Exchange opens: Carbon-credit products and the trading timetable explained [In Chinese].* Online source.

Global Views Monthly (2026). *AI evolution: From passive responses to autonomous task completion [In Chinese].* 27 March. Online source.

Hsu, C.-W. (2025). *Completing the circle: The old railways, the new light rail, and existing modernity in Kaohsiung, Taiwan.* City & Society, 37(2), e70014. https://doi.org/10.1111/ciso.70014.

ICLEI – Local Governments for Sustainability (2017). *Kaohsiung strategies for the future of urban mobility.* Online source.

ICLEI Kaohsiung Capacity Center (ICLEI KCC) (2026). *2026 CityCOP Kaohsiung City Climate Summit Forum: Science-based, people-centred pathways for urban transition [In Chinese].* 15 April. Online source.

Institute for Global Environmental Strategies (IGES) (n.d.). *Kaohsiung City.* Voluntary Local Review catalogue. Online source.

iThome (2023). *High-quality cross-departmental data is the foundation: Driving the digital transformation of Kaohsiung City Government through open data [In Chinese].* 24 April. Online source.

iThome (2025). *Kaohsiung uses local sovereign AI for new urban-governance approaches: Automatically reporting anomalies to support immediate decisions and response [In Chinese].* 14 November. Online source.

Kaohsiung City Council (2025). *Council approves carbon budget, establishing a milestone in Kaohsiung's net-zero policy [In Chinese].* 2 June. Online source.

Kaohsiung City Government (KCG) (2021). *Kaohsiung climate mitigation and adaptation white paper [In Chinese].* Online source.

Kaohsiung City Government (KCG) (2022). *Kaohsiung City voluntary local review 2022: Net-zero emission.* Online source.

Kaohsiung City Government (KCG) (2023a). *Kaohsiung City voluntary local review 2023: Sustainable resilience.* Online source.

Kaohsiung City Government (KCG) (2023b). *Kaohsiung City Government green bond framework [In Chinese].* December. Filed with the Taipei Exchange. Online source.

Kaohsiung City Government (KCG) (2024a). *Kaohsiung City voluntary local review 2024: Net-zero sustainability.* Online source.

Kaohsiung City Government (KCG) (2024b). *Kaohsiung Net-Zero City Development Autonomous Ordinance [In Chinese].* Promulgated 3 June 2024. Online source.

Kaohsiung City Government (KCG) (2024c). *Kaohsiung net-zero policy white paper.* Kaohsiung City Government.

Kaohsiung City Government (KCG) (2025). *Kaohsiung City voluntary local review 2025: Co-creating a net-zero and sustainable Kaohsiung.* Online source.

Kaohsiung City Government (KCG) (2026). *Factual validation by municipal bureaus of Kaohsiung climate-action and smart-city initiatives.* Unpublished written responses supplied in October 2026, including corrections to city inventories, programme data and implementation schedules.

Kaohsiung City Government (KCG) (n.d.-a). *Smart City Kaohsiung.* Online source.

Kaohsiung City Government (KCG) (n.d.-b). *Kaohsiung 2025–2026 carbon budget report [In Chinese].* Environmental Protection Bureau. Online source.

Kaohsiung City Government (KCG) (n.d.-c). *Kaohsiung City smart pipeline network monitoring reclaimed water project.* Smart City Kaohsiung. Online source.

Kaohsiung City Government (KCG) (n.d.-d). *Kaohsiung Sovereign AI Project – The largest NVIDIA Metropolis deployment.* Smart City Kaohsiung. Online source.

Liberty News (2026). *CityCOP city climate summit opens in Kaohsiung: Global dialogue on governance models [In Chinese].* Bibliographic details supplied by the commissioning authors. Online source.

Mass Rapid Transit Bureau, Kaohsiung City Government (MTBU) (2024a). *Kaohsiung LRT served more than 6M passengers, increasing by 75% as compared to 2023; C24 Heart of Love River Station ranked No. 1 for both 'Ridership' and 'Ridership Increase Rate'.* 17 July. Online source.

Mass Rapid Transit Bureau, Kaohsiung City Government (MTBU) (2024b). *Kaohsiung Circular Light Rail celebrates one-year anniversary of full operation with five prestigious awards and over 12 million riders: AI-powered smart rail – Transforming Kaohsiung into a mobile city icon.* 20 December. Online source.

National Environmental Research Academy (NERA) (n.d.). *Qishan Tang Chang Environmental Education Centre.* Ministry of Environment, Learn in the Field: Taiwan Environmental Education Centers. Online source.

Net-Zero Institute, Kaohsiung (n.d.). *Official programme and training information [In Chinese].* Online source.

Pamlin, D., Salehi, P., Thioye, M., Nick, S., Creutzig, F. *et al.* (2026). Expanded Urban Innovation for the Twenty-Second Century: From Cutting Emissions to Enabling Flourishing Lives on a Thriving Planet. *Annual Review of Environment and Resources* 51:573-593. https://doi.org/10.1146/annurev-environ-112624-024509

Workforce Development Agency (WDA) (n.d.). *Qishan District Tangchang Community Development Association, Kaohsiung City [In Chinese].* Ministry of Labor, Social Economy Portal. Online source.