



City of Karratha

CORPORATE EMISSIONS PROFILE & EMISSIONS REDUCTION PLAN

NOVEMBER 2025

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Foreword

City of Karratha Emissions Reduction Plan

The City of Karratha is committed to managing its operations in a way that supports long-term sustainability for our region. This Emissions Reduction Plan (ERP) outlines how the City will reduce greenhouse gas emissions across key assets and services, providing a structured pathway to improve efficiency and reduce impacts over time.

The Plan is underpinned by the development of a comprehensive baseline carbon footprint of the City's operations. This has helped us understand where our emissions occur—mainly from landfill, electricity consumption and fleet operations—and where the most practical and cost-effective opportunities for emissions reduction lie.

The actions identified in the ERP are aligned with the City's Environmental Sustainability Strategy and broader strategic direction. They aim to improve how we manage energy, water, waste and infrastructure while setting a foundation for future investment. Many of the measures reflect input from City of Karratha staff and insights gathered through site assessments and engagement.

Most emissions across the Pilbara region come from sectors and activities beyond the City's control – particularly those linked to mining and heavy industry. The Pilbara region accounts for approximately 40% of Western Australia's total emissions. In this context, the City's Emissions Reduction Plan focuses on the areas we can directly influence. It represents an intention to lead by example, embed sustainability in our operations, and contribute to wider regional and national climate goals.

In 2025, the City of Karratha adopted its new Council Plan 2025–2035, which sets the long-term direction for our community. The vision for the City is to be “Australia's most liveable regional city – the place we are proud to call home.”

The Council Plan outlines six commitments that will guide our work over the next decade. Among these is Sustainability – balancing economic, environmental, and social factors to support long-term community wellbeing and resilience. This Emissions Reduction Plan directly contributes to the achievement of that commitment.

We welcome the opportunity to work with government, business and the community as we put these actions into practice. I thank those who have supported the development of this Plan and look forward to seeing progress in the years ahead.

Virginia Miltrup

Chief Executive Officer, City of Karratha

1 Executive summary

The City of Karratha engaged 100% Renewables to develop its organisational carbon footprint (CFP) and an Emissions Reduction Plan (ERP or Plan), based on the period from 1 July 2023 to 30 June 2024 (FY2024). This carbon footprint will be considered the City's base year emissions. The footprint and Plan cover the City's Scope 1 and 2 greenhouse gas emission sources.

1.1 Emissions profile (baseline)

For FY2024, City of Karratha's carbon footprint amounted to **53,198 tonnes of greenhouse gas (GHG) emissions**. The majority (89%) of these are direct emissions, or Scope 1 emissions, with the remaining 11% being emissions from electricity consumption, as shown in Figure 1.

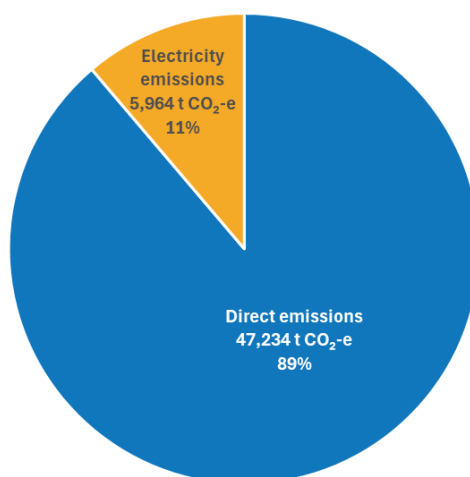


FIGURE 1: CITY OF KARRATHA – FY2024 EMISSIONS PROFILE

As illustrated in Figure 2, the most significant sources contributing to the City's carbon footprint were **landfill emissions (81%), electricity consumption at City assets (9%), and fleet diesel use (8%)**. Emissions from streetlighting power consumption accounted for 2% of the assessed footprint¹.

For this emissions profile, the City of Karratha has used the location-based method as its primary approach for electricity emissions accounting.

¹ Streetlights are owned and operated by Horizon Power with energy and other costs charged to City of Karratha. Whilst technically scope 3 emissions, it is very common for local governments to include streetlighting emissions in their main carbon footprint.

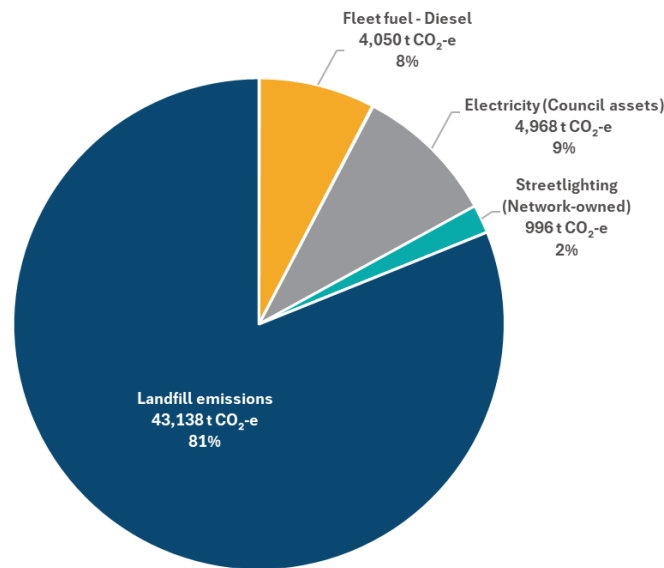


FIGURE 2: CITY OF KARRATHA – FY2024 EMISSIONS DISTRIBUTION BY SOURCE

1.2 Emissions Reduction Plan (ERP)

Following the development of the emissions profile for City of Karratha, a business-as-usual (BAU) emissions projection to FY2050 was modelled. This high-level projection considered factors such as grid decarbonisation, operational expansions, infrastructure upgrades, and projected population growth. Developing an accurate BAU forecast is essential for designing an effective emissions reduction plan.

To guide its emissions reduction efforts, the City of Karratha will employ the mitigation hierarchy, which provides a structured approach to prioritising abatement actions. The hierarchy focuses on:

- Avoiding emissions by eliminating unnecessary energy consumption and activities.
- Reducing emissions through enhanced efficiency in energy use, fleet operations, and other processes.
- Replacing high-emission technologies and fuels with lower-emission alternatives, such as renewable energy systems or electric vehicles.

Using this framework, and informed by targeted workshops with key stakeholders across the City, priority abatement areas were identified. These informed the development of an Emissions Reduction Plan (ERP) model as shown below (see Table 18 for details).

1. On-site solar and battery storage – installation of rooftop solar PV and battery systems across major City facilities, and expanding solar carports
 - For all City sites excluding Leisureplex and Airport:
 - Installation of new 200kW solar PV annually from FY2026 to FY2035
 - Installation of new 200kWh solar battery annually from FY2028 to FY2035
 - For Leisureplex:
 - Installation of new 500kW solar PV in FY2030
 - Installation of new 500kWh solar battery in FY2028

- Generation and retirement of Large-scale Generation Certificates (LGCs) for the City from solar generation starting FY2030
- 2. Energy efficiency – implementation of lighting, HVAC and BMS upgrades; expand submetering; optimise building operations progressively from FY2030 to FY2050
- 3. Streetlighting upgrades – advocate for the conversion of all remaining non-LED streetlights and investigating smart lighting controls
- 4. Renewable Energy Power Purchasing
 - Engagement with Horizon Power or exploration of virtual Power Purchase Agreements (PPAs).
 - Procurement of certified renewable electricity for residual load.
 - Utilisation of LGCs from City-owned solar systems.
 - Goal: 100% renewable electricity supply by FY2030 through PPA, GreenPower®, and LGC retirement.
- 5. Fleet transition - Transition Council fleet progressively to zero-emission vehicles
 - 5% of fleet switched to EVs by FY2030.
 - 40% by FY2040.
 - 80% by FY2050².
- 6. Liquid petroleum gas (LPG) phase-out - Electrification of systems currently using LPG at Leisureplex, Red Earth Arts Precinct, and community centres and replacement of LPG heating systems and BBQs with electric alternatives where feasible.
 - 100% switch to electric by FY2030 (noted as immaterial in total emissions contribution).
- 7. Waste strategy
 - Implementation of the City's Waste Management and Resource Recovery Strategy 2025–2035.
 - Expansion of landfill gas capture efforts to include cells 1 & 2.
 - Investigation of regional waste-to-energy facility options.
 - Assess feasibility of food and garden organics recovery.
 - Improvement of waste classification and data management for emission reporting.
- 8. Governance and Strategy - Alignment of policy and governance with City's emissions reduction goals:
 - Development of a Climate Change Policy.
 - Establish an offsets and divestment strategy.
 - Climate Active certification.
 - Setting KPIs for renewable energy percentage and emissions reduction.
 - Development of an Environmentally Sustainable Design (ESD) Framework for City facilities.
 - Strengthening of monitoring, reporting, education, and promotion.
 - Implementation of a management system for solar generation and usage data.
 - Expansion of the emissions inventory to include Corporate Scope 3, and
 - Calculate community emissions.

² Note that the analysis and figures in this report reflect the earlier 100% target. While the change has a minor impact on the results, the overall conclusions remain valid.

In terms of solar PV, the City's existing solar installations have resulted in self-consumption accounting for approximately 20% of the City's total electricity use across both owned and tenanted facilities. When adjusted to reflect the City's share of consumption, based on the proportion of airport solar output aligned with its grid usage, this figure rises to 22% of the City's facilities electricity consumption. This exceeds the proportion of power met by solar PV of most local governments in Australia, and positions City of Karratha as a leader in developing renewable energy resources to serve its own energy needs.

Using this model, the ERP pathway was developed to illustrate the projected abatement impact of each initiative over time. By FY2030, the City could potentially reduce its emissions by 22%. However, as illustrated in the graph, this reduction falls short of the target pathway recommended by the Science-Based Targets Initiative³, which aligns with limiting global warming to well below 2°C under the Paris Agreement⁴. This gap highlights the challenges faced by local governments in rapidly reducing emissions from complex sources such as landfill and fleet fuel use.

Currently, there is no legislative obligation at the State or Federal level requiring Councils to align with national or international emissions targets. However, this may change with the potential introduction of State Climate Legislation, which could establish formal emissions reduction goals for local governments.

In the broader policy landscape, Australia has committed to and legislated net zero emissions by 2050 and to reduce national emissions to 62-70% reduction below 2005 levels by 2035. Internationally, frameworks such as the United Nations Sustainable Development Goals (SDGs)—specifically Goal 13: Climate Action—call on all levels of government to take urgent steps to combat climate change and its impacts.

While some organisations may avoid direct use of terms like “human-induced climate change” due to audience sensitivities, the scientific consensus remains clear: climate change is primarily driven by human activity. Where preferred, “climate variability” may be used as a less polarising term to maintain engagement while still acknowledging the need for a proactive response.

This context reinforces the importance of the Emissions Reduction Plan—not only as a practical roadmap for local action, but also as a strategic contribution to State, Federal, and global climate efforts.

³ SBTi Corporate Net-Zero Standard ver 1.2 (March 2024)

⁴ <https://unfccc.int/process-and-meetings/the-paris-agreement>

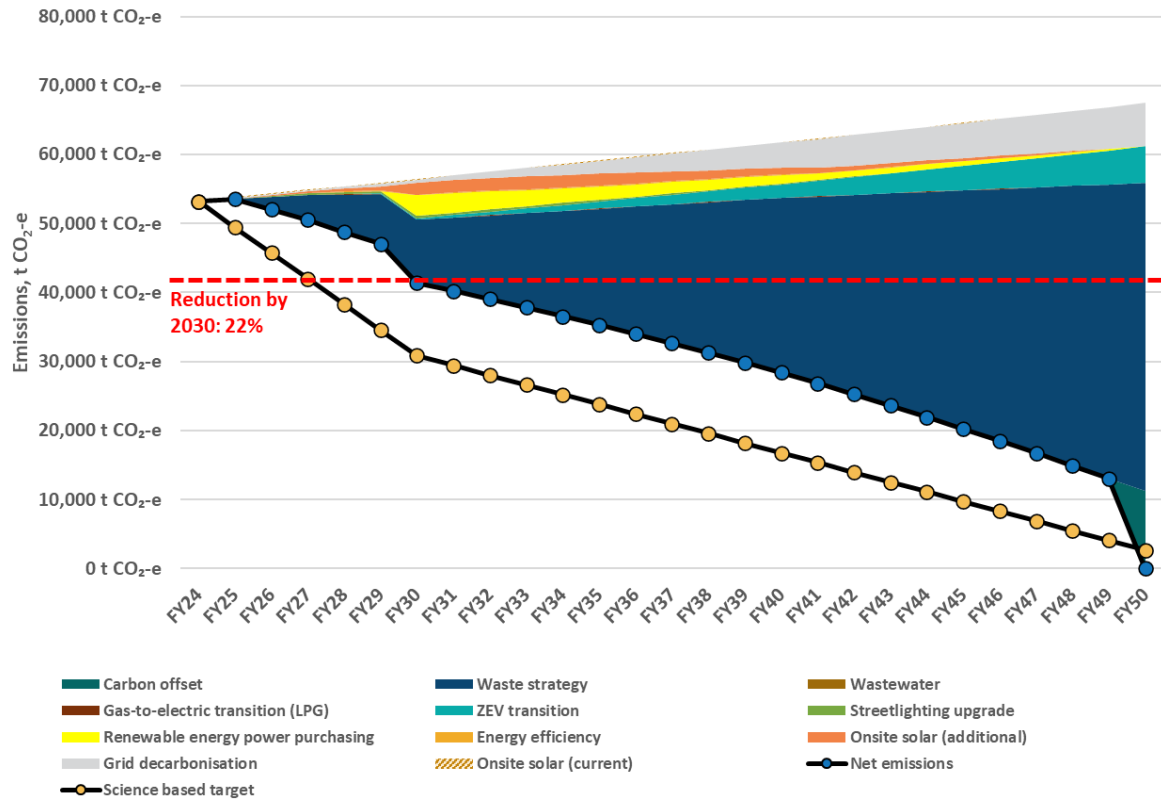


FIGURE 3: POTENTIAL EMISSIONS REDUCTION PATHWAY FOR CITY OF KARRATHA

2 Progress in reducing emissions

The City of Karratha has undertaken a range of initiatives aimed at reducing emissions from its operations. Actions have focused on energy efficiency, increasing renewable energy, reducing landfill emissions through flaring and diversion, and initiating a transition to low-emissions transport and infrastructure. The summary below outlines the main emissions reduction initiatives implemented in recent years.

2.1 Waste management

The City has increased waste diversion from landfill through improved recovery and reuse programs. These include operation of a community tip shop and various drop-off points for a wide range of materials. Diverted waste streams include plastic household containers, paper and cardboard, aluminium and steel cans, glass, oils, scrap metals, white goods, green waste, batteries, paints, tyres, and household hazardous waste, including e-waste. In FY2024, from nearly 84 kt of total waste deposited at the landfill, nearly 7.5 kt (9%) was diverted from landfill, and a further 64% of all waste was classified as inert and originated from commercial, construction, municipal (Community), and business activities. These figures are consistent with the City's Waste Management and Resource Recovery Strategy 2025–2035, which reports annual landfill inputs of ~80,000–85,000 tonnes, diversion rates of 8–10%, and confirms that the majority of incoming waste is inert materials (C&D and mining-related) that contribute minimally to greenhouse gas emissions.

In 2023 and 2024, the implementation of a gas collection and flaring system at 'Cell 0' at the 7-Mile facility contributed to a significant reduction in emissions, avoiding nearly 16,000 tonnes of carbon dioxide. This aligns with the Waste Strategy's identification of landfill gas capture as a priority short-term abatement action and underpins its broader targets of achieving a 20% reduction in landfill emissions by 2030 and 80% by 2050, supported by gas capture expansion, improved diversion, and better waste data management.

2.2 Energy and climate action

The City has installed solar photovoltaic (PV) systems at several key facilities, including both rooftop and ground-mounted solar systems. Sites with solar installations include the Leisureplex, Youth Shed, Operations Centre, Dampier Pavilion, Frank Butler Community Centre and the Wickham Community Hub. In addition, a 1 MW ground-mounted solar array was developed by a third party at the Karratha Airport, and supplies the majority of the airport's daytime electricity demand.

Energy efficiency measures have been implemented across multiple assets. These include converting lighting to LED at major facilities and public areas, implementing Building Management Systems (BMS), heat-recovery ventilation systems on major air conditioning systems, and the installation of variable speed drives on air conditioning and pumping infrastructure. Many of these efficient systems were designed into the design of new facilities, showing that energy efficiency is a key consideration in asset development, particularly given local climate that drives high use of air conditioning. These upgrades and design choices help reduce energy use and associated emissions from grid electricity use.

2.3 Fleet transition

Progress is being made in transitioning the City's fleet to lower-emissions options. Early trials of hybrid and electric vehicles across various categories have occurred, alongside the use of battery-powered tools in place of petrol-powered equipment. These trials are informing further investigation and a longer-term transition approach aligned with scheduled fleet replacement.

2.4 Streetlighting

Horizon Power has upgraded nearly half of the City of Karratha's 4,000 public streetlights to energy-efficient LED, significantly reducing electricity use and ongoing maintenance costs.

2.5 Water efficiency and reuse

Water-related initiatives have been implemented that indirectly support emissions reduction by improving energy efficiency. For example, recycled treated wastewater is used to irrigate public open spaces and airport facilities, reducing demand for potable water. The City has also improved irrigation systems through smart metering and control systems to optimise water use and reduce energy use.

3 Emissions reporting boundary and baseline year

3.1 Emissions reporting boundary

The first step in developing an organisation's emissions profile is to define its control approach and emissions boundary. For local governments, the 'operational control' method is commonly used where the emissions boundary includes all activities over which the organisation has operational control.

Operational control is established when an organisation holds the primary authority to implement operating, health and safety, or environmental policies over an asset or activity. This control signifies responsibility for emissions generated. Complexities can arise in cases involving leases, subleases, or contractor engagements. In the City of Karratha's case, numerous City-owned assets are leased to third parties, the most significant example being the Karratha Airport, where multiple tenancies are in place.

The City's emission boundary includes activities that generate direct emissions from fuel combustion and waste, and indirect emissions from electricity use. These emissions are reported for assets where the City of Karratha has operational control. The emissions boundary for the City is illustrated below.

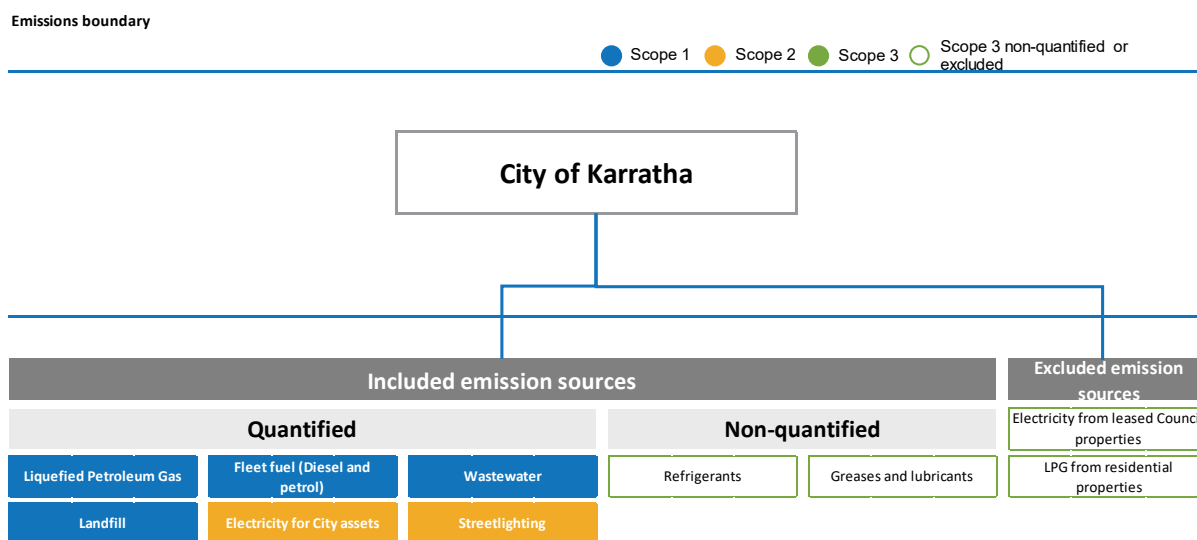


FIGURE 4: EMISSIONS BOUNDARY FOR CITY OF KARRATHA FOR FY2024⁵

3.2 Base year for emissions tracking

The base year is a critical starting point for any organisation's emissions reduction efforts and progress to net zero, as it provides a benchmark for tracking emissions over time. For the City, FY2024 has been set as the base year for its emissions profile. This decision is supported by the availability of comprehensive data; where full-year data was unavailable, estimates were made using documented assumptions. A detailed analysis of the FY2024 emissions profile is provided in Section 4 of this report.

⁵ Note that 'wastewater' refers to a small system at the Karratha Airport, and does not refer to the Karratha and Wickham water resource recovery facility (WRRF) supplied by the Water Corporation, or the Dampier WRRF supplied by Rio Tinto.

4 City of Karratha's carbon footprint

4.1 Scope 1 and Scope 2 emissions

To distinguish between different sources of greenhouse gas (GHG) emissions the GHG Protocol⁶ – Corporate Standard classifies emissions into three scopes:

- **Scope 1.** Direct emissions generated from sources owned or controlled by the organisation. These emissions from activities such as fuel combustion, company-owned vehicles, waste management, and refrigerant leakage from air conditioning equipment.
- **Scope 2.** Indirect emissions from the consumption of purchased electricity. While these emissions are generated off-site (e.g., at a gas-fired power station), but the City is indirectly responsible for them.
- **Scope 3.** All other indirect emissions that occur in the value chain of the organisation, both upstream and downstream. Typical examples include staff commuting, business air travel, the purchase of goods and services, contractor activities, and emissions from leased assets not under operational control.



FIGURE 5: SCOPE 1, SCOPE 2 AND SCOPE 3 EMISSIONS

For this report, the City of Karratha's carbon footprint includes only Scope 1 and Scope 2 emissions. These cover emissions from energy (for facilities and transport), wastewater treatment at the Airport, and landfill waste. Emissions from refrigerants, greases, and lubricants are excluded, as they typically contribute less than 1% of the overall carbon footprint.

Scope 3 emissions are not currently covered, except for electricity used by the City's streetlights, which is commonly reported by local governments. Future emissions reporting may consider selectively or fully accounting for the City of Karratha's value chain emissions.

⁶ <https://ghgprotocol.org/>

4.2 City of Karratha's carbon footprint

The City of Karratha's carbon footprint is estimated to be **53,198 tonnes of carbon dioxide equivalent (t CO₂-e)**. As shown in Figure 6, 89% of these emissions originate from the City's direct sources, such as landfill, fuel use, and wastewater, while the remaining 11% come from indirect sources such as electricity use by City assets and streetlighting. This carbon footprint will be considered the City's base year emissions.

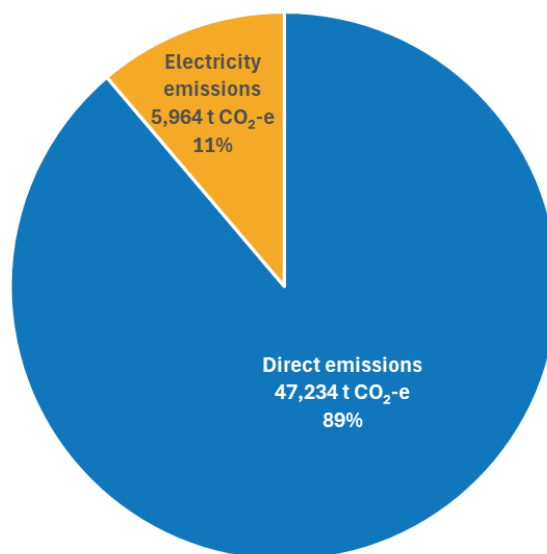


FIGURE 6: CITY OF KARRATHA— FY2024 EMISSIONS PROFILE (SCOPE 1 & 2)

A breakdown of these total emissions show that emissions from solid waste sent to landfill, accounts for 81% of the City's emissions, electricity (Council assets and streetlighting) sourced from the grid contributes 11%, and diesel used for fleet operations represents 8% (see Figure 7 and Figure 8).

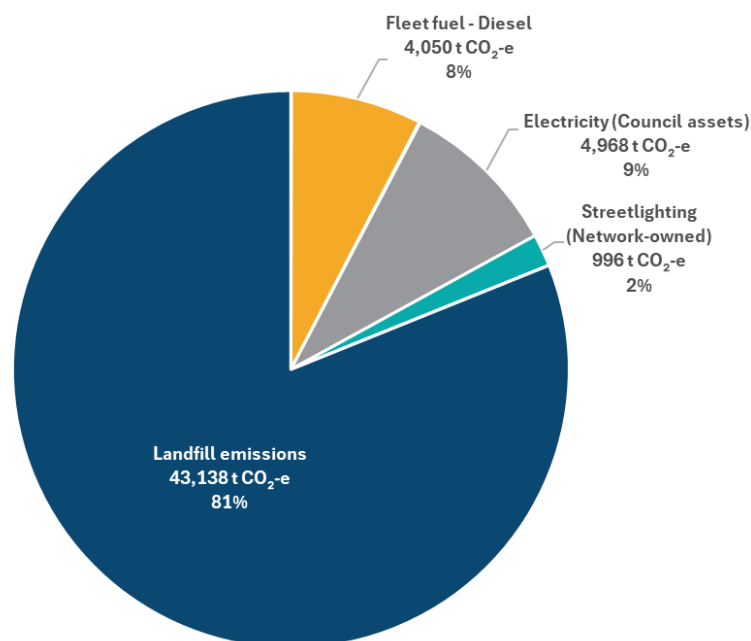


FIGURE 7: CITY OF KARRATHA – FY2024 EMISSIONS PROFILE BY SCOPE

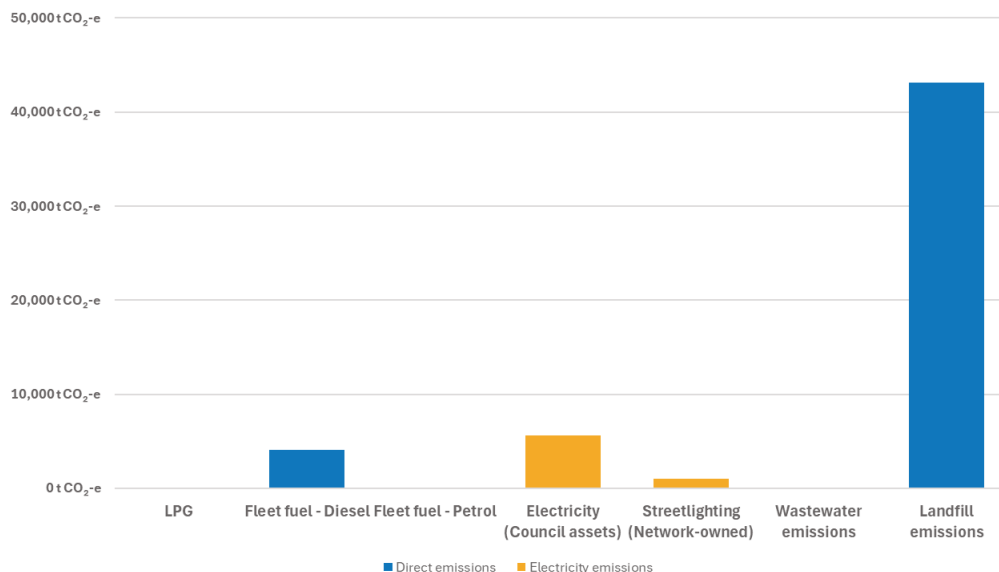










FIGURE 8: CITY OF KARRATHA – FY2024 EMISSIONS PROFILE⁷

The table below lists the Scope 1 and 2 emission sources, with corresponding emissions in tonnes of carbon dioxide (t CO₂-e), and their percentage contributions to the City's overall carbon footprint. Emissions are expressed in t CO₂-e to provide a consistent measure that combines gases with different global warming potentials (GWPs) into a single comparable unit. For example, methane (CH₄) is around 28 times more powerful than carbon dioxide (CO₂) over a 100-year timeframe. This helps explain why emissions from landfill appear so significant in the City's carbon footprint, consistent with the Waste Management and Resource Recovery Strategy 2025–2035 baseline findings.

⁷ Streetlighting assets are owned and maintained by Horizon Power and so are actually scope 3 electricity emissions. Many local governments choose to include these emissions in their electricity footprint, as they are financially responsible for streetlighting on local and main roads. Additionally, local governments are often actively involved in partnerships with network providers to upgrade to energy-efficient LED streetlighting, enhancing community amenity and safety while reducing emissions.

TABLE 1: CITY OF KARRATHA – FY2024 CARBON FOOTPRINT (SCOPE 1 & 2)

| Emission source | | Activity data | Units | Direct emissions | Electricity emissions | Total | % |
|---|--|---------------|---------------------|------------------|-----------------------|---------------|-------------|
|  | LPG (Bottled gas) | 11.62 | kL | 18.1 | | 18.10 | 0.0% |
|  | Fleet fuel - Diesel | 1,490 | kL | 4,050 | | 4,050 | 7.6% |
| | Fleet fuel - Petrol | 11 | kL | 25 | | 25 | 0.0% |
|  | Electricity (Council assets) | 6,411,924 | kWh | | 3,975 | 3,975 | 7.5% |
|  | Self consumed solar (LGCs created & sold/banked) | 1,601,233 | kWh | | 993 | 993 | 1.9% |
| | Self consumed small-scale solar (STCs) | 174,579 | kWh | | - | - | 0.0% |
|  | Streetlighting (Network-owned) | 1,605,781 | kWh | | 996 | 996 | 1.9% |
|  | Wastewater emissions | 3 | | 3 | | 3 | 0.0% |
|  | Net landfill emissions | 43,138 | tCO ₂ -e | 43,138 | | 43,138 | 81.1% |
|  | TOTAL | | | 47,234 | 5,964 | 53,198 | 100% |

The City's material sources of emissions in FY2024 are:

- **Solid waste disposal (81%):** Waste sent to landfill, is the largest contributor to the City's emissions, classified into three main streams: municipal solid waste (MSW), construction and demolition (C&D) waste, and commercial and industrial (C&I) waste. Waste diverted from landfill, such as metals, clean timber, recyclable plastics, e-waste, and cooking oil, is excluded from City's carbon emissions inventory, as these materials do not contribute to emissions. Diverted green waste is assumed to be composted and is therefore also excluded.
- **Electricity consumption (10%):** Electricity use accounts for 10% of total emissions, primarily from high-consuming sites such as the Airport, Leisureplex and Red Earth Arts Precinct. Other contributing facilities include community buildings, halls, administration buildings, sporting fields and streetlighting (owned by Horizon Power but paid for by the City). Electricity used by tenant-operated assets is excluded, as these fall outside the Scope 1 and 2 boundary and are instead classified as Scope 3, Category 13 (Downstream Leased Assets).
- **Diesel and petrol use in fleet (8%):** The City of Karratha's fleet operations account for about 8% of the total emissions. The light vehicle fleet includes utility and passenger vehicles such as Toyota Landcruiser, Prado, Hilux, Isuzu D-Max, MU-X, Nissan Navara, and Mitsubishi Triton. These are used for transport and light-duty tasks. The heavy fleet comprises vehicles such as the Mitsubishi Canter Truck, footpath sweepers, and other machinery for earth-moving and material and waste handling.
- **LPG (<1%):** Bottled LPG (Propane) used mainly for cooking and space heating at Hearson Cove BBQs, Karratha Leisureplex, and the Red Earth Arts Precinct, accounts for less than 1% of total emissions.
- **Wastewater (<1%):** Emissions from wastewater are limited to the airport's water resource recovery facility (WRRF) and contribute less than 1% to the total footprint. This does not include wastewater from the Wickham, Karratha and Dampier Water Resource Recovery

Facilities, as they are owned and operated by Water Corporation and Rio Tinto and are therefore classified as Scope 3 emissions.

Each emission source is presented in greater detail in the succeeding sections below.

4.2.1 Waste

Waste emissions account for 43,138 t CO₂-e or 81% of City of Karratha's total carbon footprint. This estimate is based on the National Greenhouse and Energy Reporting (NGER) Solid Waste Calculator, which applies a 'first-order decay' (FOD) method to estimate landfill emissions over time, based on waste stream composition and disposal history.

For this report, the City provided detailed waste data from the 7 Mile Waste Facility, dating back to FY2012. These records were categorised into specific waste sub-categories in line with NGER classifications and used as input to the NGER calculator to model emissions. Additionally, methane gas capture data from FY2023 and FY2024 was provided and factored into the emission analysis.

The tables below summarise the waste streams and their composition at the 7 Mile Waste Facility for FY2024.

TABLE 2: BREAKDOWN OF WASTE RECEIVED AT 7 MILE WASTE FACILITY

| NGER waste mix type | MSW, tonnes | C&I, tonnes | C&D, tonnes | Transferred, tonnes |
|-----------------------|--------------|---------------|---------------|---------------------|
| Food | 2,830 | 3,801 | - | 554 |
| Paper and paperboard | 1,110 | 2,739 | 112 | 400 |
| Garden and park | 802 | 2,574 | 75 | 1,966 |
| Wood and woodwaste | 84 | 2,213 | 2,433 | 322 |
| Textiles | 119 | 706 | 109 | 103 |
| Sludge | - | 4,895 | - | 39 |
| Nappies | 323 | - | - | - |
| Rubber and leather | 141 | 1,452 | - | 90.2 |
| Inert materials | 2,839 | 23,280 | 26,653 | 1,153 |
| Total received | 8,248 | 41,661 | 29,381 | 4,628 |

TABLE 3: BREAKDOWN OF WASTE DIVERTED FROM 7 MILE WASTE FACILITY

| NGER waste mix type | MSW, tonnes | C&I, tonnes | C&D, tonnes | TRANSF, tonnes | Total |
|-----------------------|--------------|--------------|--------------|----------------|--------------|
| Food | - | 7.04 | - | - | 7 |
| Paper and paperboard | 56.2 | 3.7 | - | - | 60 |
| Garden and park | 528 | 1,773 | - | 1,863 | 4,164 |
| Wood and woodwaste | - | 0.36 | 2,209 | - | 2,209 |
| Textiles | - | 0.04 | - | - | 0.04 |
| Sludge | - | - | - | - | - |
| Nappies | - | - | - | - | - |
| Rubber and leather | - | 0.02 | - | - | 0.02 |
| Inert materials | 540 | 208 | 247 | 143 | 1,138 |
| Total received | 1,124 | 1,993 | 2,455 | 2,006 | 7,578 |

The City does not currently operate a Food Organics and Garden Organics (FOGO) kerbside collection system. However, a green waste drop-off point is provided, and the City has trialled composting using aerobic open composting methods. Collected green waste is either shredded for use as mulch or processed through open composting systems.

4.2.2 Electricity

The City of Karratha's electricity consumption refers to the electricity used by City-owned assets, including a mix of fully owned, fully leased, and partially leased properties.

For this report, it was assumed that electricity consumption at partially leased properties, with the exception of the Airport, would be fully attributed to the City. Electricity use at fully leased assets was excluded, as it is assumed to be the responsibility of tenants. Based on advice received, 54% of electricity consumption at the Karratha Airport has been allocated to the City. For the Karratha Leisureplex and Red Earth Arts Precinct, 100% of the electricity consumption was confirmed to be City-owned.

The table below provides a breakdown of electricity consumption by site.

TABLE 4: ELECTRICITY USAGE BY SITE

| Site name | NMI | Estimated electricity usage in FY 2024 (kWh) |
|--|--|--|
| Karratha Airport (54% grid power to City of Karratha) | 8001011256 | |
| <i>Karratha Airport self-consumed LGC-scale solar PV (54% of output allocated to City of Karratha)</i> | NA | 2,485,770 |
| Karratha Leisureplex (grid) | 8021103784 | |
| <i>Karratha Leisureplex self-consumed LGC-scale solar PV</i> | NA | 2,248,813 |
| Red Earth Arts Precinct | 8021110183 | 1,440,373 |
| Administration, Annex & Gardens | 8001006963 | 399,803 |
| Wickham Community Hub | 211347426 | 375,624 |
| Frank Butler Reserve and Community Centre | 8001409604 | 170,562 |
| Golf Course Irrigation | 8002116576 | 151,417 |
| Operations Centre | 8001008305 | 116,658 |
| Roebourne Swimming Pool | 8001014695 | 94,002 |
| Karratha Seven Mile Waste Facility | 8001506739 | 78,554 |
| Old Karratha Entertainment Centre Carpark Lighting | 8001003333 | 69,655 |
| Tambrey Oval, Pavilion & Recycled Water Pump Station | 8021109995 | 54,370 |
| Roebourne Oval | 8002053908 | 45,960 |
| Nickol West Park | 8021109970 / 8002073711 / 8021110268 | 34,192 |
| Kevin Richards Memorial Oval Lights | 8001360063 | 30,152 |
| Other City facilities (all sites with consumption under 30 MWh pa, combined) | Multiple | 217,252 |
| Total electricity consumption (grid + large-scale solar, excl small-scale solar) | | 8,013,157 |

In FY2024, the City of Karratha reported total electricity consumption of 12,274 MWh from a combination of grid and large-scale onsite solar generation. However, since this report focuses on Scope 1 and 2 emissions, the electricity consumption of fully tenant-operated assets and 46% of the Karratha Airport consumption (allocated to tenants) has been excluded. This reduces the City's reported 'grid' consumption to 8,013 MWh. This figure includes the City's apportioned self-consumption from large-scale (LGC-scale) solar PV systems at the Airport and the Leisureplex. Additionally, electricity generated and consumed by small-scale systems (<100kW) is considered a zero-emissions source for the City and is excluded from Scope 2 emissions.

For FY2024, the City has adopted the **location-based** approach in estimate electricity-related emissions. Under this method, the City's electricity use results in emissions of 4,968 t CO₂-e (see Table 5). Should the City elect to adopt a **market-based** approach in future reporting, emissions could increase to 5,518 t CO₂-e, depending on the treatment of electricity contracts and the use of onsite solar PV systems and associated Large-Scale Generation Certificates (LGC). Further details on the electricity accounting methodology, including treatment of location- and market-based approaches, are provided in Appendix B: Electricity accounting.

TABLE 5: CITY OF KARRATHA'S FACILITY ELECTRICITY EMISSIONS USING LOCATION-BASED APPROACH

| Description | Activity data | Units | Emissions | Total |
|--|---------------|-------|---------------------------------|---------------------------------|
| Grid electricity | 6,411,924 | kWh | 3,975 t CO ₂ -e | 3,975 t CO ₂ -e |
| Onsite renewable electricity | | | | |
| Self consumed solar (LGCs created & retired) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Self consumed solar (LGCs created & sold/banked) | 1,601,233 | kWh | 993 t CO ₂ -e | 993 t CO ₂ -e |
| Self consumed small-scale solar (STCs) | 174,579 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Net electricity emissions | | | 4,968 t CO₂-e | 4,968 t CO₂-e |

Currently, LGCs generated from solar PV systems at the Karratha Airport and Karratha Leisureplex are not considered as an emissions reduction in the City's electricity emissions profile. This is because the LGCs associated with the Airport system are not owned by City of Karratha, while those generated at the Leisureplex are currently held by the City, pending a decision on whether to sell or retire them. If the City chooses to sell the LGCs, the associated solar generation cannot be counted toward emissions reductions under market-based reporting. Conversely, if the LGCs are voluntarily retired, the City can claim the renewable electricity benefit and reduce its reported Scope 2 emissions accordingly.

4.2.3 Streetlighting

The City's streetlighting is managed under two account types – labelled as 'Horizon Power and Main Roads Horizon', and 'City of Karratha.' As the City is financially responsible for the electricity consumption of these assets, it is recommended that this usage be included within the City's emission footprint. This approach aligns with common practice among local governments.

The table below provides a breakdown of electricity usage for streetlighting by account, as recorded from the Azility portal.

TABLE 6: FY2024 STREETLIGHTING ELECTRICITY DEMAND AND USAGE BY SYSTEM

| Account name | System wattage, Watts | Estimated annual electricity consumption (kWh) |
|------------------------------------|-----------------------|--|
| City of Karratha (small accounts) | 2,740 | 12,001 |
| Horizon Power - Main Roads | 52,986 | 232,079 |
| Horizon Power - Shire of Roebourne | 336,583 | 1,474,234 |
| Total | 392,309 | 1,605,781 |

As with other City assets, emissions for streetlighting electricity use in FY2024 were estimated using the **location-based** method. Under this approach, streetlighting contributed 996 t CO₂-e to the City's total emissions. If the **market-based** method were applied, emissions would increase to 1,057 t CO₂-e, depending on the emissions intensity of electricity supply contracts associated with these accounts. Further details on the electricity accounting methodology, including treatment of location- and market-based approaches, are provided in Appendix B: Electricity accounting.

TABLE 7: CITY OF KARRATHA'S EMISSIONS FOR STREETLIGHTING IN FY2024 USING LOCATION-BASED APPROACH

| Description | Activity data | Units | Emissions | Total |
|----------------------------------|---------------|-------|-------------------------------|-------------------------------|
| Grid electricity | 1,605,781 | kWh | 996 t CO ₂ -e | 996 t CO ₂ -e |
| Net electricity emissions | | | 996 t CO₂-e | 996 t CO₂-e |

4.2.4 Fleet fuel

The City of Karratha's fuel usage has been recorded through various platforms, including fleet card systems, credit card transactions, enterprise record system and purchases from bulk fuel inventories.

In the absence of detailed data specifying end-use categories and given the minimal variation in emission factors between transport and stationary fuel use, it was assumed that all fuel consumption was attributable to fleet vehicle operations.

In FY2024, fuel use resulted in emissions of 4,075 t CO₂-e, accounting for 7.7% of the City's total carbon footprint. This was based on the consumption of 1.5 ML of fuel, the vast majority of which was diesel. The table below provides a breakdown of fuel consumption by type for FY2024.

TABLE 8: FLEET FUEL USAGE BY FLEET CATEGORY AND FUEL TYPE

| Fuel type | Estimated fuel usage in FY 2024 (L) |
|--------------|-------------------------------------|
| Diesel | 1,490,289 |
| Petrol | 10,771 |
| Total | 1,501,060 |

4.2.5 Liquefied petroleum gas

Liquefied petroleum gas (LPG) is utilised by the City for various purposes, including commercial kitchens, space heating and fuelling barbeques. In FY2024, The City recorded a total LPG consumption of 14,969 litres, of which 3,344 litres were attributed to residential site usage and are therefore excluded from this report.

This assessment focuses solely on non-residential sites, specifically Hearson Cove barbeques, Karratha Leisureplex, and the Red Earth Arts Precinct. These sites consumed a combined 11,625 litres of LPG, resulting in emissions of approximately 18 t CO₂-e or 0.03% of the total City carbon footprint. Note that the volume of gas used for BBQs is difficult to quantify accurately, as gas cylinders are replaced irrespective of the volume remaining. For the purposes of this analysis, the City has assumed each cylinder is empty when exchanged.

The table below provides a breakdown of LPG usage by site in FY2024.

TABLE 9: CITY OF KARRATHA LPG USAGE BY OWNED ASSETS (SCOPE 1)

| Site address | Estimated LPG usage in FY 2024 (L) |
|-------------------------|------------------------------------|
| Hearson Cove BBQs | 9,649 |
| Karratha Leisureplex | 1,760 |
| Red Earth Arts Precinct | 216 |
| Total | 11,625 |

4.2.6 Wastewater

City of Karratha owns and operates one small Water Resource Recovery Facility (WRRF) located in Karratha Airport. Emissions have been estimated by using the Environmental Protection Authority's Sewage Treatment Water Calculator, based on documented inflow data from the Airport WRRF. For FY2024, these emissions are estimated at 2.7 t CO₂-e, representing 0.01% of the City's total emissions.

The City is also supplied by three other WRRFs that are managed by Water Corporation and Rio Tinto. As these facilities are not under the City's operational control, their associated emissions are classified as Scope 3 and fall outside the boundaries of this report.

TABLE 10: CITY OF KARRATHA'S WASTEWATER INFLOW AND EMISSIONS IN FY2024

| Location | Inflow, kL | Estimated emissions, t CO ₂ -e |
|-----------------------|------------|---|
| Karratha Airport WRRF | 10,133 | 2.7 |

4.3 Emissions data management plan for City of Karratha

The table below provides an overview of the current data collection practices for the City of Karratha's emission sources considered in this project, along with recommended improvements to enhance data accuracy and completeness.

TABLE 11: DATA MANAGEMENT PLAN FOR CITY OF KARRATHA

| Emission source | Current situation | Suggested improvement |
|-----------------------------|---|---|
| Landfill | A detailed breakdown of waste streams and composition was provided for the 7 Mile Waste Facility from weighbridge data. 100% Renewables aligned these waste streams with the classifications in the NGER Solid Waste Calculator to ensure accurate estimation of emissions associated with each waste stream. | Continue the current practice of detailed reporting on waste streams and composition from weighbridge data. To improve accuracy and streamline emissions reporting, consider further aligning waste classifications with NGER waste categories. This alignment will enhance the City's ability to report more accurately and efficiently using the NGER Solid Waste Calculator. In line with the Waste Strategy 2025–2035 (Goal 3: Data, Information and Economics), further improvements should include regular kerbside audits, enhanced monitoring at transfer stations, and whole-of-life cost assessments to strengthen the City's long-term waste planning and emissions reporting. |
| Electricity for City assets | Electricity data were captured from the Azility portal, which provides detailed breakdown of consumption and cost. The portal also provides tagging to indicate whether a property is 'Owned by City', 'Partially leased' or 'Fully leased'. However, for partially leased properties, the | Determining the specific leasing percentage for partially leased sites with significant electricity use would further improve accuracy. |

| Emission source | Current situation | Suggested improvement |
|--------------------------------|--|--|
| | <p>current tagging does not specify the proportion of the consumption attributable to the asset.</p> <p>In the absence of detailed leasing data in the platform, it was assumed that 100% of electricity consumption for partially leased properties is attributable to the City, except for the Airport, where only 54% of electricity use was allocated to the City, based on internal advice. Electricity consumption for fully leased assets was attributed entirely to tenants and excluded from the City's emission footprint.</p> | |
| Streetlighting | Streetlighting data refers to the data associated with the streetlights owned by Horizon Power. Streetlighting energy use was estimated based on the streetlighting inventory and hours of operation based on Horizon Power documentation. | Advocate that Horizon Power provide regular updates to maintain accurate and up-to-date data on the number, size, and electricity consumption (kWh) of streetlighting assets. Engage with Horizon Power and their relevant billing system to better understand consumed power, supporting more precise emission reporting. |
| Fleet fuel (diesel and petrol) | Fuel data were based on fleet cards, reimbursed credit card transactions, reports from the enterprise record system, and bulk fuel purchase summaries. Due to the absence of detailed information on specific end uses and the minimal variation in emission factors across different uses, it was assumed that all fuel consumption was for fleet vehicles. | Continue the current practice of collecting fuel data from multiple sources, while enhancing accuracy by identifying the specific end-use of fuel consumption. This will allow for better allocation of fuel usage between fleet vehicles and stationary equipment, supporting better emissions tracking. |
| LPG | Quarterly usage totals are provided for each site, including details on cost and product type. LPG cylinders are regularly exchanged and are assumed to be empty at the time of replacement. | Continue current practice and regularly updating accounts associated with the City's operational control. |
| Wastewater | Data were sourced from the Airport's monthly Sewage Treatment Works (STW) report. | Continue current practice of monthly reporting. |

5 Emissions forecast

To understand the scale of the task involved in achieving net zero emissions, it is important to establish both the City's current carbon footprint and a projection of future emissions. This forecast considers possible changes in City operations & infrastructure development as well as external influences, such as:

- Population growth
- Grid decarbonisation in line with plans and targets by Horizon Power and Rio Tinto
- Existing emissions abatement projects such as solar PV and LED streetlighting

5.1 Karratha Community Infrastructure Plan

The City of Karratha Community Infrastructure Plan 2025-2035 (CIP) sets out the City's vision for new and upgraded infrastructure to support the City's growing population.

Infrastructure that is in the CIP will include:

- Community & civic - e.g. youth centre, early learning centre, men's and women's sheds
- Arts and cultural facilities - e.g. performing arts, exhibition space, art galleries
- Community facilities and spaces - e.g. community halls, community centres, multipurpose rooms
- Sports and recreation facilities - including aquatics, courts, gyms, playing fields

The CIP accounts for projected population growth of approximately 35% by 2041 (from 2021 levels), addressing two of the above key emissions change factors. Based on this, a detailed analysis of all new and refurbished infrastructure can be undertaken to develop a sound estimate of future electricity demand. For this work a high-level estimate of 1% annual growth is taken (excepting streetlighting where all new lights are LED, so BAU growth of 0.5% p.a. is assumed), which would equate to new electricity use of approximately 2,500 MWh per year by 2050. Some of this growth is expected to be offset by solar and battery energy storage. A similar 1% annual growth rate is also applied to fuel consumption by the City's fleet and to waste generation.

5.2 BAU emissions

Figure 9 illustrates the City of Karratha's projected emissions trajectory through to FY2050 under the BAU scenario. For comparison, Figure 10 below, presents a BAU emissions model that excludes waste-related⁸ emissions, providing a clearer view of trends across other operational areas.

⁸ Includes emissions from waste management and wastewater

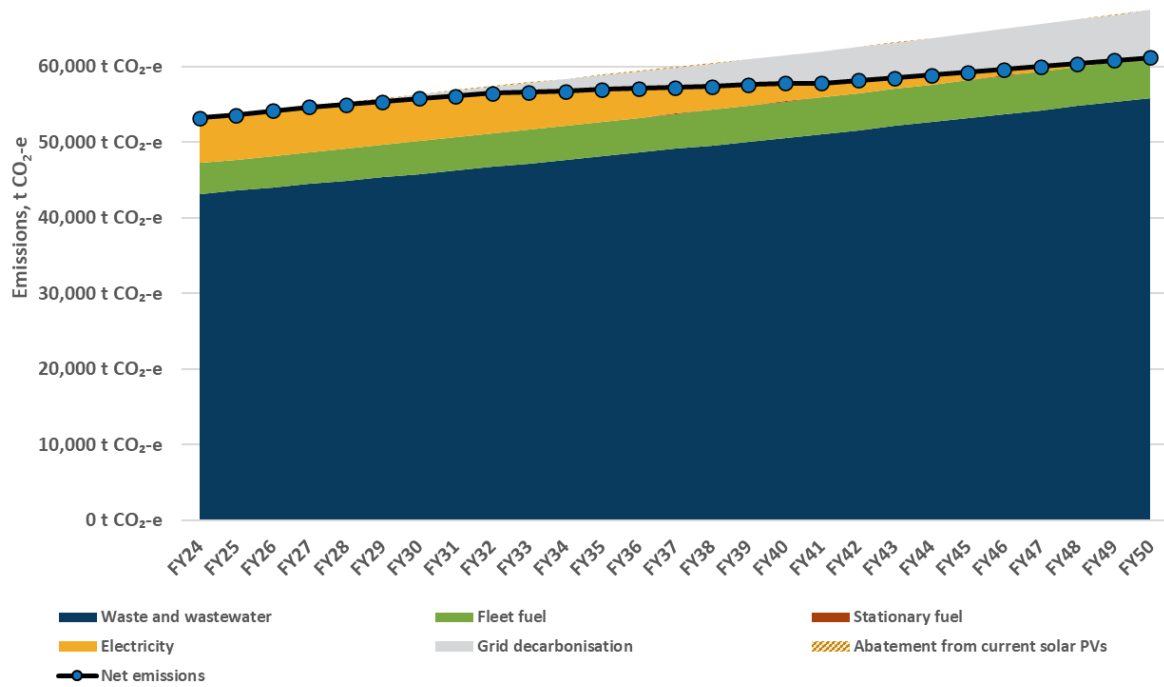


FIGURE 9: BUSINESS-AS-USUAL PROJECTION FOR CITY OF KARRATHA'S EMISSIONS

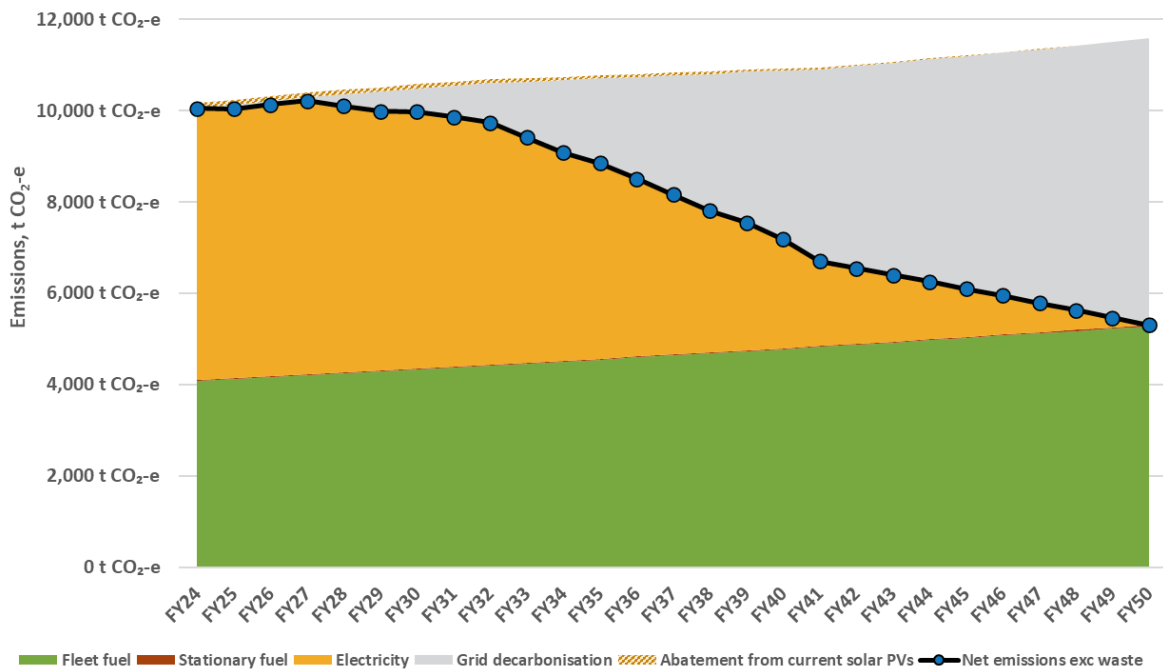


FIGURE 10: BUSINESS-AS-USUAL PROJECTION FOR CITY OF KARRATHA'S EMISSIONS EXCLUDING WASTE EMISSIONS

6 Emissions Reduction Plan

The Emissions Reduction Plan outlines key strategies to reduce emissions across City of Karratha, using a systemic approach to identify, prioritise and implement actions aligned with the mitigation hierarchy. Using FY2024 as a base year and targeting FY2050, the plan focuses on electrification, energy efficiency, renewable energy, and carbon offsetting initiatives to minimise environmental impacts and supporting long-term sustainability.

6.1 Overview and stakeholder engagement

To develop the City's Emissions Reduction Plan (ERP), 100% Renewables facilitated a series of workshops with key internal stakeholders. These sessions aimed to understand the City's current operational context, identify barriers to emissions reduction, and explore opportunities for abatement across key sectors.

The workshops were structured around key operational areas and held over several sessions, as outlined below.

TABLE 12: WORKSHOP SCHEDULE

| Session | Workshop Topic | Date |
|-----------|---|---------------|
| Session 1 | Waste Services, Fleet, Fuel and Operations Centre | 17 March 2025 |
| Session 2 | Community Facilities – session 1 | 19 March 2025 |
| Session 3 | Airport | 19 March 2025 |
| Session 4 | Discussion with Horizon Power | 10 April 2025 |
| Session 5 | Solar – load discussion | 29 April 2025 |
| Session 6 | Community Facilities – session 2 | 30 April 2025 |

A diverse group of stakeholders participated in the workshops, representing various departments and roles across the City's operations. The following sections outline the emissions reduction opportunities identified through these workshops and supporting site assessments. Each subsection focuses on a key operational area, summarising current conditions, barriers to implementation, and potential pathways for reducing emissions. Where applicable, future plans and additional contextual information are also provided. Further details on the workshop discussions and participant input are provided in Appendix C: Workshop notes.

6.2 Methods used to identify and prioritise

To guide its emissions reduction efforts, the City of Karratha will apply the mitigation hierarchy for emissions reduction to identify and prioritise projects across its operations. This approach ensures that the most effective and impactful actions are implemented first, with less preferable measures considered only after higher-priority options have been explored. The mitigation hierarchy for City of Karratha's Emissions Reduction Plan is outlined as follows.

6.2.1 Avoid and electrify

The first priority in the mitigation hierarchy is to avoid emissions at the source through design efficiency, waste diversion and reduction, and electrification. This includes continuing to deliver energy efficient community infrastructure, expanding waste diversion and recovery programs, and transitioning from fossil-fuel-powered vehicles and equipment to electric alternatives. Where feasible, gas-powered systems will also be replaced with electric options. The [State Electric Vehicle Strategy for Western Australia](#) provides a framework for this transition, while acknowledging regional implementation challenges.

By avoiding emissions at the outset, the City of Karratha can significantly reduce its carbon footprint and achieve meaningful, long-term emissions reductions.

6.2.2 Reduce (energy efficiency and local renewable energy)

Where avoidance is not possible, the City will prioritise reducing emissions through energy efficiency measures and the use of local renewable energy. This includes upgrading equipment to energy-efficient models, conducting energy audits, adopting energy-saving technologies, and expanding the installation of solar PV systems and battery storage across its facilities.

6.2.3 Replace (purchase renewable energy, offset procurement)

In cases where emissions cannot be fully avoided or reduced, the City of Karratha will consider replacing high-emission energy sources with low-carbon alternatives. This may include options such as purchasing renewable energy through Power Purchase Agreements (PPAs).

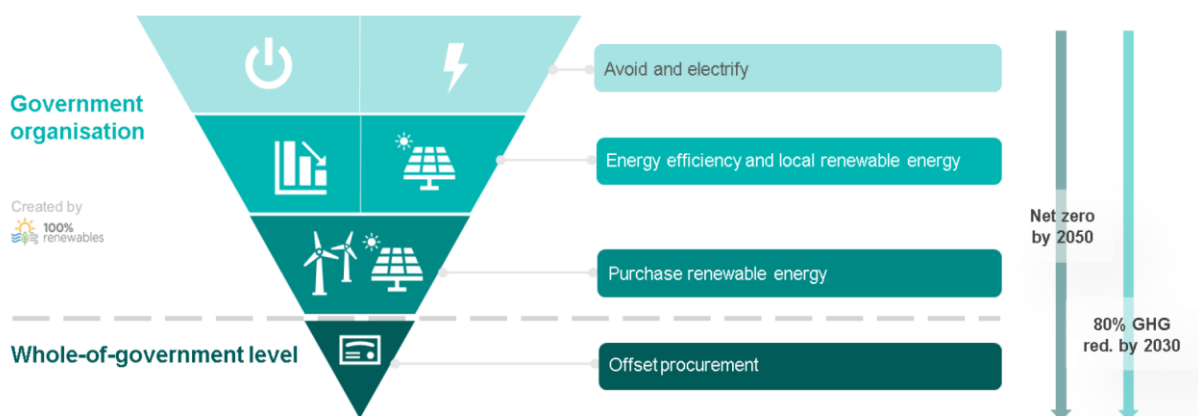


FIGURE 11: MITIGATION HIERARCHY FOR EMISSIONS REDUCTION FOR CITY OF KARRATHA

6.3 Waste management

6.3.1 Current situation

Landfill emissions make up over 80% of the City's total Scope 1 + 2 greenhouse gas emissions (GHG), primarily due to organic materials in municipal and commercial waste deposited at the landfill. When these materials decompose anaerobically, they release methane (CH₄), which is around 28 times more powerful than carbon dioxide (CO₂) over a 100-year timeframe. This is why emissions from organic waste appear disproportionately high compared to other sources. In contrast, large volumes of waste received from the resource sector are mostly inert and contribute minimally to emissions.

In FY2024, the ERP inventory recorded that ~84,000 tonnes of total waste were deposited at the 7 Mile facility, of which 7,500 tonnes (9%) were diverted from landfill, while ~64% of incoming waste was classified as inert (mainly commercial and construction activities).

These results are consistent with the Waste Management and Resource Recovery Strategy 2025–2035, which reports annual landfill inputs of ~80,000–85,000 tonnes, diversion rates of 8–10%, and confirms that the majority of incoming tonnage is inert waste streams (construction, demolition, and mining-related) that contribute little to GHG emissions.

To address the remaining organic fraction, the City has implemented a gas flare in Cell 0 in FY2024, which has already avoided approximately 16,000 t CO₂-e. This aligns with the Waste Strategy's priority actions, which call for expanding landfill gas capture to Cells 1 and 2, increasing diversion of recoverable materials, and strengthening data collection through kerbside audits and transfer station monitoring.

6.3.2 Barriers

Consultation with key stakeholders has identified several challenges to reducing landfill emissions in Karratha. Barriers include:

- **Lack of organics processing infrastructure:** Karratha and the wider region do not have the infrastructure or sufficient waste volumes to support processing of organic waste streams such as food organics and garden organics (FOGO). In the absence of nearby composting or anaerobic digestion facilities, organic waste will continue to be sent to landfill.
- **High transport costs:** Diverted waste streams often need to be transported to Perth, where processing infrastructure exists, adding significant costs.
- **Limited circular industries:** High entry costs have restricted development, leading to valuable materials being stockpiled or discarded to landfill, increasing emissions and waste.
- **Low population and low waste volumes:** The City of Karratha's size makes it difficult to economically justify options like FOGO or waste-to-energy, which may be seen as marginally viable by the private sector without significant funding support.
- **Data systems are still developing:** Current systems do not consistently distinguish between waste types, particularly for the commercial sector. This may affect the accuracy of emissions estimates for landfill and decision-making about where to focus emissions reduction efforts.
- **Landfill gas capture timing:** Emissions reductions from gas capture depend on the timing of cell capping. Cell capping is an inherent barrier to the timing of landfill gas capture.

- **Lack of FOGO increases reliance on education:** Without organics separation, education and waste separation programs are increasingly necessary but limited in their impact.
- **No mandate to align with the WA Waste Avoidance and Resource Recovery Strategy 2030 (WARR):** The City is not classified as a major regional centre, however, is aligning its waste services and activities with the strategic priorities of the WARR to contribute to long-term environmental sustainability.
- **No mandate for organics separation or landfill bans:** The absence of regulatory drivers in the north of Western Australia reduces the likelihood of investment in organics diversion and treatment.

6.3.3 Potential opportunities

While FOGO is not currently a viable emission reduction option for the region, discussions with stakeholders have highlighted several other potential initiatives:

- **Implement the City's Waste Management Strategy:** The City has adopted its Waste Management and Resource Recovery Strategy 2025-2035, creating an opportunity to embed emissions reduction goals across short-, medium- and long-term planning. Priority actions include landfill gas capture expansion, kerbside and transfer station data improvements, and ongoing waste diversion initiatives. The Strategy also highlights opportunities for regional collaboration to support shared emissions reduction outcomes.
- **Improve waste stream measurement:** Enhancing data collection—especially on the organic fraction of residential and commercial waste—will enable more accurate emissions calculations and inform better targeted reduction measures. This may involve upgrades to weighbridge and auditing systems.
- **Strengthen residential education programs:** Expanding community education on waste minimisation and separation is essential, particularly in the absence of more advanced abatement options like FOGO.
- **Expand landfill gas capture:** While gas volumes in Cell 0 are declining, Cells 1 and 2 are approaching end-of-life and expected to be capped around 2027. Extending gas capture and flaring to these cells could significantly increase emissions reductions in the short to medium term, ahead of the activation of Cells 3 and 4.
- **Explore regional waste-to-energy:** Stakeholders identified the potential for a regional waste-to-energy (WTE) facility. The City has previously explored this concept and holds land that could support such a development. While requiring significant investment and coordination, WTE could deliver both energy generation and long-term emissions reductions.
- **Assess feasibility for food and garden organics recovery:** The City's Waste Strategy recommends this action to determine future opportunities.

6.4 Fleet transition

6.4.1 Current situation

Fleet fuel consumption contributes for nearly 8% of the City's operational emissions. The fleet includes on-road vehicles as well as small and large plant, with the majority powered by diesel. At the time of this assessment, the City reported a total of 554 fleet assets in operation. A breakdown of asset types and quantities is in the table below.

TABLE 13: SUMMARY OF CITY OF KARRATHA FLEET

| Row Labels | Number of | Comment |
|--------------------|------------|--|
| Utility Vehicle | 59 | The predominant staff vehicle used by the City and will be a large contributor to total fuel consumption. Predominantly Mitsubishi |
| SUV | 21 | Isuzu, Toyota and Mitsubishi 4 x 4 |
| Hatchback/Sedan | 10 | 8 of 10 vehicles are Hybrid |
| Bus / Van | 2 | 2 community bus / vans are owned by the City |
| Truck | 28 | 7 Mile Waste, Works & Construction team, Parks & Gardens and fire services teams own and operate numerous trucks that will be large users of diesel fuel. Includes a hybrid / electric tip truck |
| Large Plant | 30 | 7 Mile waste and Works & Construction teams own and operate numerous large plant items that will be large users of diesel fuel |
| Pump | 36 | Pumps in use across City facilities, including airport WRRF, 7 Mile waste facility, Parks & Gardens |
| Generator | 25 | Small gensets used for emergency and non-emergency uses |
| Compressor | 15 | Mostly small petrol and diesel powered compressors used across City facilities |
| Pressure Cleaner | 30 | Used across City facilities, including leisure centres and sanitation services in particular |
| Blower | 59 | Predominantly Parks & Gardens, Sanitation and SES-owned small plant items. These 175 plant items will be small petrol and diesel users individually but may be sizeable in aggregate. Mowers and sweepers are likely to be larger items and bigger users of fuel |
| Brushcutter | 37 | |
| Chainsaw | 36 | |
| Mower | 18 | |
| Pruner | 10 | |
| Hedge Trimmer | 9 | |
| Sweeper | 6 | |
| Other Small Plant | 78 | Other small plant items not covered in above categories |
| Trailer | 45 | Non-fuel consuming assets |
| Grand Total | 554 | |

The fleet is predominantly diesel-powered; however hybrid vehicles and light trucks have been introduced, and an electric utility vehicle was trialled. Battery-powered small plant tools (e.g., leaf blowers, chainsaws), have also been introduced in specific operational areas. In addition, planning is underway for community-facing electric vehicle (EV) charging infrastructure, with assessments scheduled for FY25–26. Some EV chargers are being considered for locations such as Wickham and

Dampier shopping centres (installed by Rio Tinto), the Red Earth Arts Precinct, and other facilities where City has ownership of suitable car parking areas.

6.4.2 Barriers

The broader uptake of EVs and battery-powered plant in the City faces several significant challenges, many of which are heightened by the Pilbara's remote location and harsh climate. These factors suggest a longer and more complex transition timeline compared to more temperate, urban regions. Key barriers include:

- Limited battery range, charging times, and operation in a harsh environment
 - Batteries operate best in moderate temperatures (20–25°C); however, the extreme heat in the Pilbara can accelerate the degradation of lithium-ion batteries and reduce usable capacity.
 - Frequent use of rapid (DC) charging places more stress on batteries compared to slower AC charging. While shallow charging can help extend battery life, it may not be practical in the Pilbara due to the long distances typically travelled.
 - While battery life is nominally 8 to 15 years, shorter life spans can be expected in extreme heat.
 - Real-world range of electric cars, trucks, and small plant is often lower than advertised. In the Pilbara, factors such as heavy air-conditioning (which can reduce range or runtime by 10–20%), long distances between charging points, and unsealed roads further limit range and increase operational risk.
- Fitness for purpose
 - For certain equipment types, such as small plant, maintaining service delivery may require rotation strategies or battery swap-out systems to manage reduced runtimes.
 - Suitability of EVs and electric plant must be evaluated on a case-by-case basis, as many vehicle and plant categories—especially those used in road construction and maintenance—currently lack commercially available electric alternatives.
- Procurement and financial challenges
 - While the total cost of ownership for some EV types may now be competitive with petrol or diesel vehicles, this is not yet the case for many fleet categories—particularly in the Pilbara, where harsh operating conditions can limit efficiency gains and cost savings.
 - Acquisition costs for EVs and electric plant are generally higher in remote regions, reducing their cost-effectiveness and availability compared to metropolitan areas.
- Charging infrastructure and grid capacity

- Limited availability of public charging infrastructure in the City of Karratha, increases reliance on overnight charging at depots and other facilities, adding logistical complexity and cost.
- Deployment of fast chargers and regional charging infrastructure is further constrained by local grid capacity and requires coordinated investment and planning across multiple stakeholders.

6.4.3 Potential opportunities

The objectives of a long-term fleet transition to EV for the City of Karratha will include:

- Reduced fuel consumption and emissions from fleet operations
- Improved operational efficiency through fleet modernisation
- Support regional sustainability targets and leadership in clean transport, and
- Align vehicle replacement and infrastructure investment planning.

Given the wide variety of vehicle and plant types in use, and significant barriers to EV adoption, particularly in hot and remote areas like the Pilbara, full transition will take time. However, a strategic and phased approach will allow the City to manage this transition in a steady predictable manner, identifying early opportunities and laying the groundwork for broader adoption over time.

EV transition phases include:

- Short term (0-2 years):
 - Collect and analyse performance data from existing hybrid and EV trials.
 - Prioritise installation of depot-based charging infrastructure and chargers at key sites, such as community facilities.
 - Expand trials of electric small plant (e.g. sweepers, mowers, blowers), informed by other councils' experience and staff feedback.
 - Begin incorporating suitable EVs into the fleet by replacing sedans and passenger vehicles through standard procurement processes
 - Develop formal City policies and procedures for EV usage, charging and performance reporting.
- Medium term (3-5 years):
 - Progressively transition passenger vehicles to electric where feasible during planned replacements.
 - Trial hybrid-electric and full EV utility vehicles, transitioning the utility fleet as technology and models become available.
 - Replace generators, pumps, and compressors with electric or solar-assisted models where possible.
 - Implement charging infrastructure and scheduling systems for both depot-based and in-vehicle charging of small plant.
 - Continue data collection and integration of EV-related considerations into broader fleet planning and procurement.
- Long term (>5 years):

- Continue electrifying passenger and utility vehicles across the fleet.
- Trial and adopt electric and/or low-emission trucks and large plant as technology, service support, and infrastructure availability improve.
- Investigate and evaluate alternate fuels such as hydrogen or biofuels for heavy fleet where electrification is not yet viable.
- Regularly update the City's EV and infrastructure strategy, including planning for depot charging upgrades and assessing grid capacity to support a fully electric fleet.

Complementary strategies to the City's transition plan should include:

- Infrastructure planning:
 - Begin with AC charging at depots and engage early with Horizon Power to assess network capacity. Transition to DC charging in the medium term, with integration of renewable energy where feasible. Over the long term, plan for comprehensive charging infrastructure to support all plant and fleet types at depot and operations centres.
- Policy development:
 - Establish clear policies to guide EV procurement, usage, charging and performance reporting. Policies should be reviewed and updated regularly to reflect evolving vehicle availability, improved performance, and changes in total cost of ownership.
- Stakeholder engagement:
 - Collaborate with key stakeholders including Horizon Power, Rio Tinto, neighbouring councils (to share learnings and explore joint procurement), the WA State Government, WALGA, and others. Engagement will support alignment of plans, funding access, and knowledge sharing. Internally, ensure that all relevant City departments are engaged in an integrated planning process.
- Procurement and funding:
 - Integrate suitable EVs and low emission vehicles into standard procurement cycles. Explore funding opportunities, and bulk or group purchasing arrangements. Maintain and regularly update total cost of ownership models to support evidence-based decision-making.
- Risk management:
 - Identify and mitigate risks to technology, suitability, grid capacity, up front capital costs, changes to service delivery models, and delays in EV supply chains and servicing.
- Continual monitoring:
 - Conduct annual reviews of progress, periodically update the City's fleet strategy, and publicly report on key performance, and transition progress. This ensures transparency and allows for timely adjustments to strategy.

6.5 Solar PV and battery storage

6.5.1 Current situation

The City has installed solar photovoltaic (PV) systems across seven major sites, implemented via both onsite power purchase agreement (PPA) and City-owned systems. The largest installation is a 1MW ground-mounted solar array at the airport, operating under a PPA and supplying the majority of the airport's daytime electricity needs. Other notable systems include an 800 kW rooftop array at the Karratha Leisureplex and a 74 kW ground-mounted system at the City's Operations Centre. Smaller installations are also in place at Wickham Community Hub, Frank Butler Reserve and Community Centre, Dampier Pavillion and the Youth Shed. Details on system locations, capacity, generation, and the proportion of self-consumed versus exported solar energy are in the table below.

TABLE 14: SUMMARY OF CITY OF KARRATHA SOLAR PV SYSTEMS IN FY2024

| Location | Capacity, kW | Generation, kWh | Exported, kWh | Self-consumed, kWh |
|---|--------------|------------------------------------|----------------|------------------------------------|
| Airport solar farm | 1,000 | 1,627,252 (total) 878,716 (CoK) | - - | 1,627,252 (total) 878,716 (CoK) |
| Karratha Leisureplex | 800 | 1,061,379 | 338,862 | 722,517 |
| Operations Centre | 75 | 145,820 | 37,658 | 108,162 |
| Wickham Community Hub | 33 | 16,682 | 1,668 | 15,014 |
| Frank Butler Reserve and Community Centre | 19.6 | 27,440 | 5,017 | 22,423 |
| Dampier Pavillion | 13.0 | 18,200 | 1,820 | 16,380 |
| The Youth Shed | 10.0 | 14,000 | 1,400 | 12,600 |
| TOTAL (behind-the-meter) | | 2,910,773 | 386,425 | 2,524,348 kWh |
| Sub-total (City of Karratha) | | | | 1,775,812 kWh |

This level of solar self-consumption accounts for approximately 20% of the City's total electricity use across both owned and tenanted facilities. When adjusted to reflect the City's share of consumption, based on the proportion of airport solar output aligned with its grid usage, this figure rises to 22% of the City's facilities' electricity consumption. This exceeds the proportion of power met by solar PV of most local governments in Australia⁹, and positions City of Karratha as a leader in developing renewable energy resources to serve its own energy needs.

6.5.2 Barriers

Despite the City's success in delivering several significant solar PV projects, a number of region-specific and operational barriers remain that limit further deployment and increase project complexity and cost:

⁹ 100% Renewables survey and analysis of >50 councils for NSW Government, plus own data for other States.

- National Construction Code (NCC) Wind Region D Compliance:
 - The City of Karratha's cyclone-prone conditions require all solar installations to meet strict structural engineering standards under the NCC. This often more than doubles installation costs and can constrain design flexibility.
- Roof suitability:
 - Many City facilities vary in age, access and structural condition, and few have been designed with future solar PV in mind, meaning some sites are unsuitable or require costly retrofits to enable installation.
- Heat impact on panels:
 - High ambient temperatures in the City reduce the efficiency of solar panels and can accelerate wear and material degradation, lowering long-term system performance.
- Battery thermal management:
 - Battery energy storage systems require active cooling or heat shielding to operate safely in the Pilbara conditions, significantly increasing capital and operational costs.
- Limited qualified local installers:
 - There are often shortages of Clean Energy Council (CEC) accredited tradespeople locally who are experienced in installing cyclone-rated systems, and supply chain constraints may also affect component availability.
- Export curtailment and grid constraints:
 - Horizon Power imposes export and ramp rate limits that reduce the value of excess solar generation and make battery storage systems harder to justify economically.
- Monitoring limitations:
 - Some solar sites lack ready access to inverter yield and export data, so system performance is not routinely tracked in some cases.
- Split incentives:
 - In tenanted facilities, the City may invest in improved energy infrastructure without directly benefiting from cost savings, and may not be able to recoup their investment without collaboration or until leases renew.

6.5.3 Potential opportunities

The City of Karratha has implemented solar at levels consistent with best practice for local councils in Australia. Despite numerous barriers to solar and battery storage in the region and for City facilities, there are clear opportunities to expand and better manage current and future solar PV and battery systems, so that these technologies meet a larger fraction of the city's needs into the future. The City's existing solar installations already deliver a greater share of electricity than is typical among Australian local governments. This positions the City of Karratha as a leader in the deployment of renewable energy to support its operational energy requirements. The following points outline the key opportunities identified to further advance solar and battery adoption across the City's operations.

- A Solar Works Plan is being developed in parallel with the ERP to guide future solar and battery system implementation, based on data and stakeholder input.
- Grant funding is a key component of the City's Solar Works Plan, helping to offset unique regional cost factors. Initiatives such as the Commonwealth's CEUF Grant offers a valuable opportunity to mitigate these and strengthen investment decisions. The City has previously

secured ARENA funding for the Karratha Airport solar farm, and will continue to pursue Commonwealth, State and other sources of funding to support the adoption of solar and battery storage.

- Data for the Leisureplex and the Operations Centre show export levels of 25-30%. At the Leisureplex, this suggests the system may be oversized, while at the Operations Centre, it reflects limited weekend usage. Both cases highlight the importance of accurately sizing solar PV systems based on current load, as well as accounting for future changes, such as energy efficiency upgrades. These factors will be taken into account when carefully designing new systems.
- Both cases also highlight the important role battery storage can play in City of Karratha's Solar Works Plan. Like solar, battery systems require effective thermal management, with up to 10-20% of capacity potentially used to maintain safe operating temperatures, adding to overall costs. These costs must be weighed against the benefits of storing energy that would otherwise be exported to the grid at low or no value.
- Financial considerations for the City's current and future solar and battery systems will include the value of grid exports, key considerations in any future Power Purchase Agreements (PPAs), and the City's approach creating and managing Large-scale Generation Certificates (LGCs) from systems over 100kW.
- Collaboration with Horizon Power enables access to high-resolution energy data, supporting the design of appropriately sized solar PV systems. The City of Karratha will continue to work closely with Horizon Power and other providers to optimise system sizing and align with Distributed Energy Resources (DER) goals for the network.
- The Solar Works Plan has been developed in collaboration with Horizon Power, using data access, facility imagery, site visits, and stakeholder engagement to inform initial designs, costings and life-cycle return on investment (ROI) for proposed solar and storage systems. This approach provides a strong model for developing business cases that can guide future solar systems expansion.
- The City's Community Infrastructure Plan 2025-2035 (CIP) represents a great opportunity to plan and design for the integration of solar and storage with most new community facilities over the coming years. Refer to Appendix G: City of Karratha's Community Infrastructure Plan 2025-2035 for more detail on identified opportunities. The Solar Works Plan will build on this by outlining recommended sites, timing, as identified by City stakeholders. Designing facilities with solar & storage in mind, either for immediate installation or future integration, will help ensure the City maintains its leaderships in onsite solar among local governments.
- The rollout of solar and storage at existing and new City-owned facilities will seek to encompass all areas of the LGA, covering Karratha, Dampier, Wickham, Roebourne, and Point Samson, maintaining the City's leadership in local government solar deployment.

6.6 Energy efficiency

6.6.1 Current situation

Designing and implementing energy efficient upgrades across City and community facilities has been a long-standing focus for the City of Karratha and is considered business-as-usual. As a result, most major energy-using facilities are already equipped with significant energy-efficient technologies and controls. Site visits and stakeholder consultations have helped highlight the progress achieved to date.

TABLE 15: SUMMARY OF ENERGY EFFICIENCY INITIATIVES AT SELECTED CITY OF KARRATHA FACILITIES

| Facility | Energy efficiency initiative |
|-------------------------|---|
| Karratha Airport | <p>Lighting: All building and airside lighting is LED. Car parks use a mix of LED, solar, and HID lighting, with remaining HID lights to be upgraded to LED.</p> <p>HVAC: Mostly modern chillers installed and BMS implemented. The main terminal A/C operates 24/7 to manage condensation, and temperatures are set back at night to minimise excess energy demand.</p> <p>Much of the daytime energy demand is met with the 1 MW onsite solar farm, limiting the value of further daytime energy savings.</p> |
| Karratha Leisureplex | <p>Lighting: Indoor and outdoor covered court lighting is fully LED.</p> <p>Pumps: Pool pumps are all VSD-controlled and operating efficiently.</p> <p>HVAC: Two VSD-driven York chillers installed in 2012 and have at least 10 remaining years of service life; system includes over 20 AHUs. HVAC systems are connected to a BMS, which has recently been upgraded.</p> <p>Heat Pumps: Two 365 kW units (installed 2021) provide heating for pools, which are covered when not in use.</p> <p>Much of the daytime energy demand is met with the 0.8 MW rooftop solar system, limiting the value of further daytime energy savings.</p> |
| Red Earth Arts Precinct | <p>Lighting: All lighting is LED.</p> <p>HVAC: VSDs are used on all AHUs; multistage air-cooled chiller; BMS (Schneider) in use. Heat recovery exchangers assist with pre-cooling.</p> <p>HVAC: despite energy efficiencies, the Library space may require an upgrade to HVAC services.</p> |
| Admin Building | <p>Lighting: All LED lighting installed ~4 years ago.</p> <p>HVAC: Main building uses an air-cooled chiller with CHWPs, one chiller was recently replaced. The annex uses 2011-installed Daikin VRV systems which would be improved when these systems are replaced, however this is not warranted at this time.</p> |
| Wickham Community Hub | <p>Lighting: All lighting is LED.</p> <p>HVAC: Includes three Airchange ERVs and Mitsubishi CityMulti systems. Air conditioning operates throughout the daytime when the facility is open and is scheduled off at night and during unoccupied periods on weekends.</p> <p>Hot Water: Supplied by energy-efficient Stiebel heat pump systems.</p> |
| Operations Centre | <p>Lighting: All lighting is LED.</p> <p>HVAC: Includes several relatively new systems and one older large AC unit was recently replaced. Split systems are also in use across the operations centre.</p> <p>Much of the daytime energy demand is met with the 75 kW ground-mount solar system, limiting the value of further daytime energy savings.</p> |

| | |
|---|--|
| Frank Butler Reserve and Community Centre | As an example of one of the City's sporting complexes – field lighting at this field is HID, but around half of the City's sports fields are LED-lit, and the intent is to migrate other existing as well as new facilities to LED lighting. |
|---|--|

This review demonstrates a strong awareness of, and implementation of, energy efficient technologies and controls across City-owned facilities. While City-owned and community- or business-occupied facilities such as the Youth Shed, Pam Buchanan Centre, Dampier Community Centre and others were not evaluated as part of the site visits, they were discussed with key stakeholder groups. The City's 2025 Community Infrastructure Plan reflects stakeholder input highlighting that efficiency and renewables integration is a priority for future community facilities throughout the City of Karratha.

6.6.2 Barriers

Energy intensity of buildings is inherently high, given the heat and humidity conditions in the region. The City of Karratha established strong practices to design in and operate buildings efficiently, with known efficiency gaps primarily linked to older HVAC/chiller systems, HID lighting and building management systems.

Barriers to further energy efficiency improvements are more likely related to funding and resource capacity for upgrading existing City-occupied facilities, as well as split incentives in tenanted facilities where the City may not derive energy cost savings despite funding improvements.

6.6.3 Potential opportunities

Energy efficiency improvements at City of Karratha facilities will build on past gains, with future efficiency expected to guide the optimal sizing of solar PV and battery storage at existing and planned facilities. As such, key opportunities include:

- Completing the migration of all building and sporting field lighting to LED technology, with integrated controls for occupancy, usage and daylight. With most facilities and all new builds already using LED as standard, this transition is expected to finish in the short to medium term.
- Continuing the design and upgrade of energy efficient HVAC systems, whether large centralised systems (with heat reclaim, VSD / EC fan systems) or packaged and split systems. As many of the City's large HVAC systems being relatively new (<10 years old), significant efficiency gains may occur gradually through incremental upgrades over the long term.
- Implementing effective Building Management Systems to drive further energy efficiencies through comprehensive scheduling (365-day including public holidays), zoning, Variable Air Volume (VAV) control to optimise conditions to individual or small areas, occupancy sensing that can manage both HVAC and lighting services, setpoint control including night or weekend setback (where turning services off is not feasible), load shedding, demand response, and sub-metering to facilitate response to high demand, such as systems left running at night or weekends. Several large facilities show high nighttime energy demand, which may in many cases be necessary. As solar PV expands, BMS will play a key role in integrating solar, storage and building demand, particularly as nighttime grid demand becomes more critical. Given

Horizon Power's L4 tariff does not reduce rates at night or weekends, managing energy use during 'unoccupied' periods will become increasingly important.

6.7 Streetlighting upgrade

6.7.1 Current situation

The City of Karratha's public lighting network, managed by Horizon Power, consists of 4,009 streetlight fittings. As at 2024, 1,988 of these have been upgraded to energy efficient LED, representing approximately 50% of the inventory. The remaining 2,021 lights use older, less efficient technologies such as high-pressure sodium, fluorescent, and mercury vapour lamps. These legacy fittings consume significantly more electricity and require more frequent maintenance than modern LED equivalents.

The energy consumption associated with streetlights is estimated at approximately 1,606 MWh per year, with non-LED lighting responsible for 1,097 MWh of this total. These legacy fittings represent a substantial portion of the City's electricity use and offer a clear opportunity for targeted emissions reduction.

6.7.2 Barriers

Key constraints to full LED conversion can include the residual value of existing non-LED assets, network upgrade / bulk replacement planning, and the capital cost of replacement. Coordinating and engaging with Horizon Power will be important to understand these constraints and to explore opportunities for an accelerated implementation of LED technology across the remaining non-LED part of the network.

6.7.3 Potential opportunities

Completing the conversion of all remaining non-LED streetlights presents a high-impact opportunity to significantly reduce electricity consumption and associated emissions. Based on current estimates, full conversion could result in annual energy savings of nearly 660 MWh, along with operational savings due to reduced maintenance requirements and longer asset life.

In consultation with Horizon Power, the City could explore this implementation of smart lighting controls, such as dimming, adaptive lighting schedules, and integration with broader smart city initiatives, as part of current or future street lighting upgrades.

TABLE 16: STREETLIGHTING INVENTORY AND ELECTRICITY IN FY2024

| Name | Monthly electricity, kWh | Annual electricity, kWh | Count of LED lamps | Count of Fluorescent lamps | Count of High-Pressure Sodium lamps | Count of Mercury Vapor lamps |
|------------------------------------|--------------------------|-------------------------|--------------------|----------------------------|-------------------------------------|------------------------------|
| City of Karratha (small accounts) | 935 | 11,215 | 20 | - | - | - |
| Horizon Power - Main Roads | 18,073 | 216,880 | 48 | - | 173 | - |
| Horizon Power - Shire of Roebourne | 114,807 | 1,377,686 | 1,920 | 795 | 477 | 576 |
| TOTAL | 133,815 | 1,605,781 | 1,988 | 795 | 650 | 576 |

100% Renewables assessed the streetlighting inventory to identify how much energy can be saved from switching streetlighting lamps to their LED counterparts.

TABLE 17: ENERGY SAVINGS POTENTIAL FOR STREETLIGHTING LAMPS IN FY2024

| Name | Count of lamps | Annual electricity consumption, kWh | Energy savings potential, kWh |
|-----------------------------------|----------------|-------------------------------------|-------------------------------|
| LED lamps | 1,988 | 508,885 | - |
| Non-LED lamps | 2,021 | 1,096,896 | 658,137 |
| <i>Fluorescent lamps</i> | <i>795</i> | <i>150,988</i> | <i>90,593</i> |
| <i>High Pressure Sodium lamps</i> | <i>650</i> | <i>684,579</i> | <i>410,747</i> |
| <i>Mercury Vapor lamps</i> | <i>576</i> | <i>261,328</i> | <i>156,797</i> |
| TOTAL | 4,009 | 1,605,781 | 658,137 |

6.8 Renewable electricity supply

6.8.1 Current situation

Horizon Power, in alignment with the Western Australian Government's emissions target, is targeting an 80% reduction in emissions by 2030 (from 2020 levels) and net zero by 2050, across all its operations, including the North West Interconnected System (NWIS). Key initiatives supporting these goals include:

- Smart Distributed Energy Resources (DER) management, such as integrated rooftop solar and grid exports via smart controls, virtual metering, and export management.
- Planning and delivery of solar and storage solutions tailored to regional challenges, particularly overcoming heat challenges.
- Expansion of transmission systems to improve grid resilience and enable greater renewable integration, aligned with the Pilbara Energy Transition (PET) Plan and Pilbara Electricity Reforms (PER).

The City of Karratha sources electricity primarily from Horizon Power for the majority of its operations, with a small amount sourced from Rio Tinto Utilities. Several City facilities consume over 1,200 MWh annually, classifying them as contestable sites, making them eligible to procure electricity from alternative energy retailers under the Pilbara Electricity Reform introduced in July 2021. However, with limited retailers currently servicing the region, and the City has not yet explored alternatives.

6.8.2 Barriers

The City of Karratha faces several barriers to sourcing renewable energy in the short term. including:

- Competitively priced commercial tariffs for large users, which may be difficult for renewable energy PPAs (if available) to match.
- Limited availability of retail electricity products and offers for large users in the region.
- Ongoing policy, funding, transmission and integration challenges in the NWIS, which are being progressively addressed and are necessary to enable planned and proposed renewable energy projects to proceed.

6.8.3 Potential opportunities

In the short term, the City will focus on expanding onsite solar PV systems (both rooftop and ground-mounted), integrating battery storage, and improving energy efficiency. These measures will support emissions reductions while the regional energy market continues to develop in the medium term, as access to renewable energy products improves, the City may explore sourcing accredited GreenPower® or purchasing Large-scale Generation Certificates (LGCs) to offset its grid electricity consumption.

6.9 Emissions reduction pathway

The City of Karratha's pathway to net zero emissions will be shaped by both internal capabilities and external factors. An assessment of major emissions sources highlights key challenges and opportunities, summarised as follows:

1. **Waste to landfill** is by far the City's largest source of emissions and remains a complex issue for all landfill operators. Short- to medium-term opportunities include gas flaring for Cells 1 and 2 and enhanced waste education. Long-term options such as waste-to-energy or FOGO may be constrained by regional viability and infrastructure. In parallel, opportunities to engage with external providers and explore regional partnerships or third-party solutions should also be considered to support the City's waste reduction and emissions goals.
2. **Fleet emissions** are significant. While the City has begun integrating hybrid and EV technology, a transition to a full EV fleet will likely be prolonged, with the 'biggest wins' for emissions reduction likely to occur in the long term. Short-term focus areas may focus on continuing trials, policy development, and data analytics. In the medium term, EV passenger vehicles and small plants, as well as hybrid/EV utilities, may begin to see their way into the City's fleet.
3. **Solar PV and battery storage** present the most immediate opportunity for emissions reduction in the short to medium term. The City already meets 22% of its own power needs from solar, and this can potentially be expanded significantly for existing and new facilities through the implementation of the 2025 Community Infrastructure Plan.
4. **Renewable energy sourcing via PPAs** is not yet viable due to limited regional supply and grid constraints, although these are gradually being addressed. In the interim, the City may consider buying accredited renewable options such as GreenPower® or purchasing LGCs to offset grid-supplied electricity (net of onsite solar and mandated CER Renewable Energy Target purchases). The market for PPAs from current and new retail suppliers may evolve in coming years.
5. **Energy efficiency** remains business-as-usual. While further savings may be modest, continued improvements are expected through finishing the transition to LED lighting, upgrading BMS systems, and progressively replacing HVAC systems with more energy-efficient technology. Significant medium-term savings are likely in street lighting, which is provided by Horizon Power but paid for by the City. Any options to cost-effectively accelerate the implementation of LEDs for streetlights could bring forward significant emissions reductions.

This section presents one modelled pathway of emissions reduction to 2030, 2040 and 2050, aligned with the opportunities outlined above. While many potential pathways exist, this model illustrates what an emissions reduction pathway could look like, but it is acknowledged that any number of actual pathways may be feasible and may eventuate. The emissions pathway illustrated here focuses on emissions that are within the City's footprint, though actions implemented over time may well lower emissions at other tenanted facilities that City of Karratha owns.

The following table shows abatement areas, key projects and actions, as well as their timing and the responsible department. In this pathway model, the City achieves an estimated 22% reduction by 2030, ~50% by 2040, and near-net zero by 2050, subject to the actions outlined in the table below and offsetting of residual emissions.

TABLE 18: EMISSIONS REDUCTION PATHWAY MODEL FOR FY2030, FY2040 AND FY2050

| | Abatement area | No. | Key project/action | FY2026-2028 Immediate | FY2028-2030 Short-term | FY2030-2035 Medium Term | FY2035-2050 Long-term | Lead Department | Support Department |
|---|--|-----|--|---|--|---|---|--------------------|---|
| 1 | On-site solar PV (e.g., Rooftop, free standing, solar carports and solar-ready infrastructure designs) | 1.1 | Install approximately 200kW PV capacity annually on City facilities (any site) 2026-2035. Refer to the Community Infrastructure Plan 2025-2035 | \$1,140,000 per year * | \$1,140,000 per year * | \$1,140,000 per year * | - | Asset Maintenance | City Projects Airport Community Facilities Community Planning City Growth |
| | | | | *Note: Costs are based on average Perth commercial rooftop solar costs are ~\$1.70–\$1.90/W, equating to ~\$340k–\$380k for a 200-kW system. Costs have been multiplied to reflect regional pricing, consistent with KLP PV capital costs and REAP solar carport estimate. Domestic PV on small facilities have a lower \$/kW cost. | | | | | |
| 2 | Battery Energy Storage Systems | 2.1 | Install 500kWh BESS annually 2028-2035 (i.e. KLP & Airport as priority sites). Refer to the Community Infrastructure Plan 2025-2035 | - | \$1,950,000 per year ** | \$1,950,000 per year ** | - | Asset Maintenance | City Projects, Airport Community Facilities Community Planning City Growth |
| | | | | | **Note: Costs are based on Perth averages (~\$1,000–\$1,300/kWh capacity), tripled for regional pricing and excluding rebates. | | | | |
| 3 | Large-scale Generation Certificates (LGC) | 3.1 | Generate LGCs for solar plants >100kW & retire to Clean Energy Regulator from 2030 | BAU | BAU | BAU | BAU | City Growth | Community Facilities |
| 4 | Energy Efficiency | 4.1 | Implement LED lighting; upgrade HVAC & BMS; expand submetering; optimise building operations; and smart lighting controls | 5% Reduction | Linear progression | | 15% reduction | Asset Maintenance | City Projects Information Technology |
| | | | | Refer to the Asset Maintenance Upgrade Program and Long-Term Financial Plan | | | | | |
| | | 4.2 | Install irrigation smart systems and VSD at POS and sportsgrounds | Refer to the Asset Maintenance and Parks & Gardens Upgrade Programs, and the Long-Term Financial Plan | | | | Asset Maintenance | Information Technology |
| | | 4.3 | Consolidate all solar generation into Niagara system for improved visibility, management, & reporting | \$50,000 | - | - | - | Asset Maintenance | Information Technology City Growth |
| 5 | Streetlighting Upgrades | 5.1 | Convert all non-LED streetlights and investigate smart lighting controls. | 40% Reduction | | No additional savings till next replacement cycle | 30% new benefit from bulk switch to next gen LED & controls by 2045 | Asset Maintenance | |

| | Abatement area | No. | Key project/action | FY2026-2028 Immediate | FY2028-2030 Short-term | FY2030-2035 Medium Term | FY2035-2050 Long-term | Lead Department | Support Department |
|---|--|-----|---|--|---|---|--------------------------|--------------------|---|
| 6 | Renewable Energy Power Purchasing Agreements (PPA) | 6.1 | Engage with Horizon Power and other wholesalers where available, and/or explore virtual PPA options to procure certified renewable electricity and/or GreenPower® | - | - | Purchase 100% of residual electricity from PPAs | | Corporate Services | Asset Maintenance City Growth |
| 7 | Fleet Transition (Transition ICE engines to low/zero-emission alternatives [hybrid, plug-in hybrid, battery EV, hydrogen fuel cell]) | 7.1 | Progressively transition fleet and fixed/mobile plant to low/zero emissions | 5% switching to EV | 5% switching to EV | 40% switching to EV | 80% switching to EV | Asset Maintenance | |
| | | | Refer to the Fleet Management & Replacement Program | | | | | | |
| | | 7.2 | Conduct EV feasibility for corporate/community use | \$50,000 | - | - | - | City Growth | Asset Maintenance Community Planning |
| | | 7.3 | Progressively install EV and plant charging infrastructure at depots and City facilities in line with CIF and infrastructure developments | TBD | TBD | TBD | TBD | Asset Maintenance | Community Planning City Growth |
| 8 | Liquified Petroleum Gas | 8.1 | Progressively phase out LPG use across facilities (KLP, REAP, BBQs, building heating) where feasible | - | 100% switching to electric by 2030 (where feasible) – noting this is an immaterial emissions source | - | | Asset Maintenance | Community Facilities |
| 9 | Waste | 9.1 | Implement the City's Waste Management and Resource Recovery Strategy 2025-2035 | Refer to Waste Management and Resource Recovery Strategy 2025-2035 Implementation Plan | | | | Waste Management | City Growth |
| | | 9.2 | Conduct feasibility to expand landfill gas capture at cells 1 & 2 to generate energy and/or earn ACCUs | \$50,000 | - | - | - | Waste Management | City Growth |
| | | 9.3 | Undertake feasibility assessment for a regional advanced waste-to-energy facility | - | \$100,000 | - | - | Waste Management | City Growth |
| | | 9.4 | Assess feasibility for food and garden organics recovery | - | \$60,000 | - | - | Waste Management | City Growth |
| | | 9.5 | Improve waste data classification for emission reporting | BAU | - | - | - | Waste Management | City Growth |

| | Abatement area | No. | Key project/action | FY2026-2028 Immediate | FY2028-2030 Short-term | FY2030-2035 Medium Term | FY2035-2050 Long-term | Lead Department | Support Department |
|----|-------------------------------|------|---|--------------------------|---------------------------|----------------------------|--------------------------|--------------------|--|
| 10 | Governance and Strategy | 10.1 | Set targets and KPIs to increase renewable energy and reduce emissions | BAU | - | - | - | City Growth | Governance |
| | | 10.2 | Develop a Climate Change Policy and Climate Adaptation & Mitigation Plan | \$50,000 | - | - | - | City Growth | Governance Community Experience |
| | | 10.3 | Develop Environmentally Sustainable Design (ESD) Policy and Framework for City infrastructure | \$50,000 | - | - | - | City Growth | Community Planning City Projects Asset Maintenance |
| | | 10.4 | Expand corporate emission inventory and Emission Reduction Plan to include Scope 3 emissions | - | \$50,000 | - | - | City Growth | Corporate Services |
| | | 10.5 | Calculate community emissions & develop a Community Emission Reduction Plan | - | \$60,000 | - | - | City Growth | Community Engagement & Partnerships |
| | | 10.6 | Review progress of ERP every 5-years and update abatement strategies | - | BAU | BAU | BAU | City Growth | |
| | | 10.7 | Achieve and maintain Federal Government Climate Active certification | - | - | BAU | BAU | City Growth | Governance |
| | | 10.8 | Achieve Eco Certification for tourism by 2035 | - | \$10,000 | BAU | BAU | City Growth | |
| 11 | Procurement & Supply Chain | 11.1 | Embed low-carbon procurement policies and prioritise suppliers with sustainability & carbon reduction commitments | - | BAU | - | - | City Growth | Governance |
| 12 | Offset Programs (Last Resort) | 12.1 | Implement offset program for residual emissions, prioritising accredited local biodiversity and revegetation projects, supplemented by purchased ACCUs or other verified carbon credits | - | - | - | TBD | City Growth | Corporate Services |

Key actions in the table above have been translated into the following Emissions Reduction Pathway graphs, which show the projected abatement impact of each initiative over time.

Figure 12 shows an estimated:

- 22% reduction by 2030, largely from energy-related initiatives (onsite solar, streetlighting LED conversion, early stages of EV transition).
- ~50% reduction by 2040, achieved by expanding fleet electrification, progressing toward 100% renewable electricity sourcing, and deeper landfill emissions cuts via landfill gas capture and waste strategy implementation.
- Near-net zero by 2050, assuming residual emissions are offset (e.g., via removal offsets, community-scale carbon sinks or accredited units).

The dominant emissions source—landfill—limits early abatement impact. The emission curve flattens in the 2030–2040 period, reflecting the slower pace of change in hard-to-abate areas.

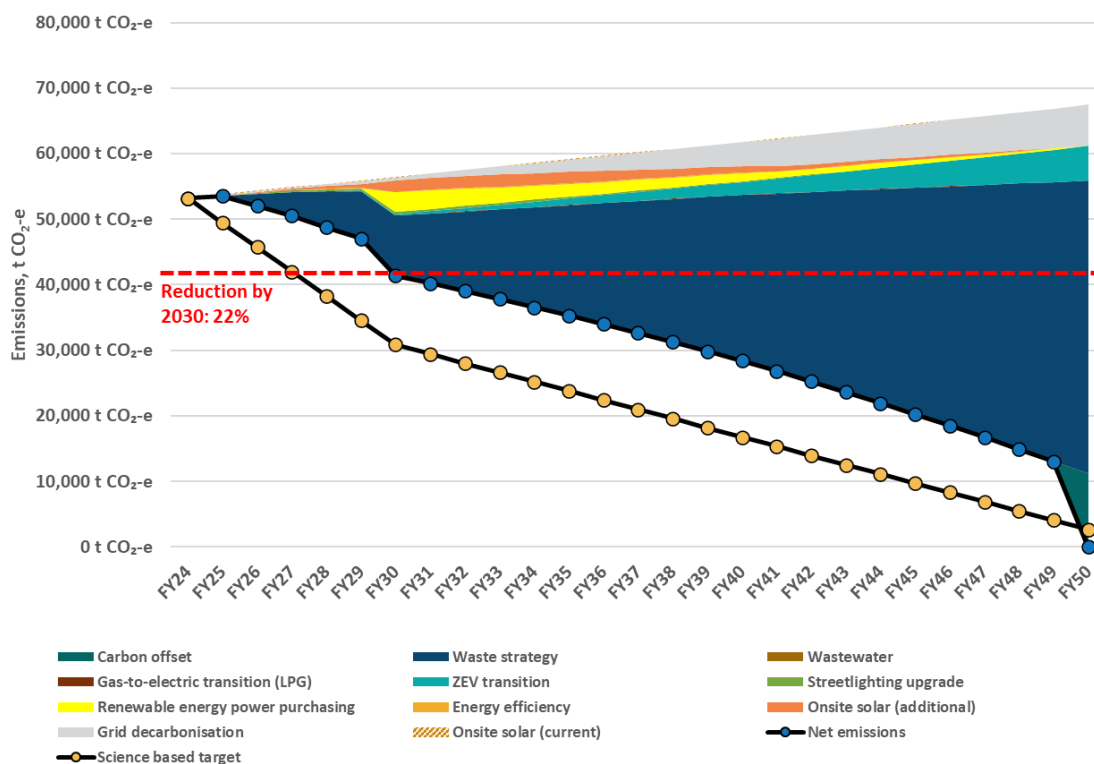


FIGURE 12: EMISSIONS REDUCTION PATHWAY FOR CITY OF KARRATHA TO 2050¹⁰

A version excluding waste-related emissions has been developed to highlight the impact of abatement activities targeting the City’s energy-related emissions. As shown in Figure 13, the City could:

¹⁰ Note that the emissions reduction roadmap model reflects a 100% fleet transition target (rather than 80%). While the change has a minor impact on the results, the overall conclusions remain valid.

- Achieve a 53% reduction by 2030, driven by rapid deployment of renewables (onsite and through procurement), electrification of fleet, and streetlighting upgrades.
- Reach ~85–90% reduction by 2050, illustrating that energy emissions can be nearly eliminated with current technology and planning.

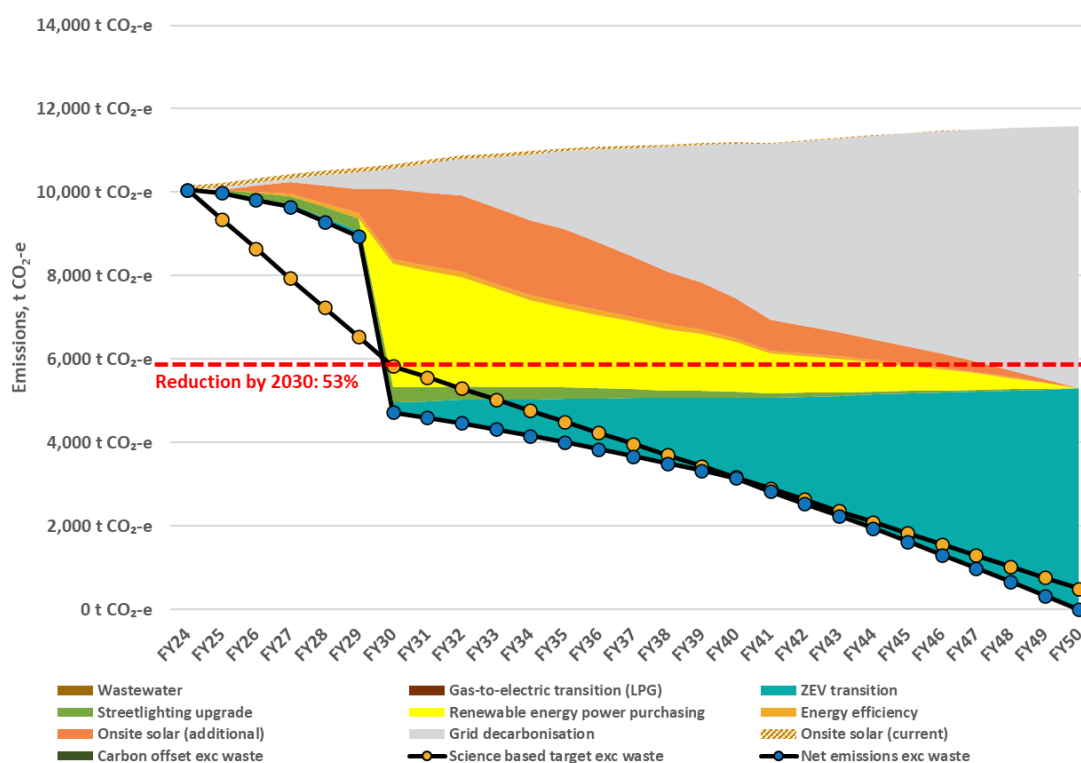


FIGURE 13: EMISSIONS REDUCTION PATHWAY OF CITY OF KARRATHA TO 2050¹¹

In conclusion, this Emissions Reduction Plan sets the City of Karratha on a clear pathway toward net zero emissions. The modelled reductions of approximately 22% by 2030, ~50% by 2040, and near-net zero by 2050 demonstrate both the challenges and opportunities ahead. By addressing landfill emissions, advancing solar and storage, transitioning the fleet, and pursuing renewable energy purchasing, the City will significantly lower its operational footprint.

These efforts reflect the City's broader sustainability ambitions, as outlined in the Council Plan 2025–2035, to balance economic, environmental and social priorities and ensure that Karratha remains Australia's most liveable regional city—the place we are proud to call home.

¹¹ Note that the emissions reduction roadmap model reflects a 100% fleet transition target (rather than 80%). While the change has a minor impact on the results, the overall conclusions remain valid.

Appendix A: Details of emissions data sources

To be included and sent as an Excel file. Template in alignment with DWER guidelines 'template to record emissions data sources'

| Dataset | Data sources (preferred) | Data sources (less preferred) | Relevant City team | Contact person and contact details | Data source/link to data source (to assist collection for subsequent years) |
|-------------------------------------|---|---|---|---|--|
| Landfill emissions | <ul style="list-style-type: none"> EPA report (EPA compliance report) of waste volumes by waste type NGER Solid Waste Calculator of City's landfill/s emissions accounting (NOTE: Users should account for each individual landfill using NGA factors OR the NGER Solid Waste Calculator, not both. Some Cities may have more than one landfill and should choose only one method for each landfill). | n/a | Waste team | Manager, Waste, Fleet and Depot | City of Karratha Landfill Data FY 23-24.xls' - Waste report with breakdown on waste type and destination from Mandalay Weighbridge Report. NGER Solid Waste Calculator for City of Karratha |
| Electricity (City assets) | <ul style="list-style-type: none"> Electricity retailer Electricity consumption data from software platform | <ul style="list-style-type: none"> Supplier invoices Finance system | Asset Management, City Growth (Sustainability) and Financial Services | Sustainability Officer, Horizon Power Customer Account Coordinator Rio Tinto Compliance Specialist | Azility |
| Streetlighting | <ul style="list-style-type: none"> Electricity retailer Electricity consumption data from software platform | <ul style="list-style-type: none"> Supplier invoices Finance system Streetlighting inventory report and load table | Asset Management | Manager Asset Maintenance | Azility |

| Dataset | Data sources (preferred) | Data sources (less preferred) | Relevant City team | Contact person and contact details | Data source/link to data source (to assist collection for subsequent years) |
|--|--|---|--|--|--|
| Fleet fuel (diesel and petrol) | <ul style="list-style-type: none"> Bulk fuel purchase report Fleet card report | <ul style="list-style-type: none"> Vehicle logs Supplier invoices Finance system | Fleet, Waste and Depot Services | Manager, Fleet, Waste and Depot Fleet Coordinator Depot Coordinator | Bulk fuel purchase: https://fmtdata.com Credit card purchases for unleaded petrol: https://www.wex.bpplus.com.au/IFCSWeb-bp/faces/secure/home/homepage.xhtml |
| LPG and propane | <ul style="list-style-type: none"> LP gas/propane retailers LP gas/propane consumption data from software platform | <ul style="list-style-type: none"> Supplier invoices Finance system | City Growth (Sustainability) Building Maintenance | Sustainability Officer Building Maintenance Coordinator | LPG Invoices_City Of Karratha.xls |
| Wastewater emissions (Airport water resource recovery facility (WRRF) only) | <ul style="list-style-type: none"> Population served (or STW inflow) + treatment type EPA report (EPA compliance report) | n/a | Waste Team Airport Management | Manager Waste, Fleet and Depot Airport Manager | Wastewater emissions estimated based on wastewater inflow to airport WRRF as per 'City of Karratha Airport Waste Water Treatment Data', Azility |

Appendix B: Electricity accounting

According to the Australian government's Climate Active Electricity Accounting Guidelines ¹² ([Homepage | Climate Active](#)), there are two international best-practice methods for calculating electricity emissions – the **location-based method** and the **market-based method**. Reporting electricity emissions under both methods is called **dual reporting**. Dual reporting of electricity emissions is useful, as it provides different perspectives of the emissions associated with a business's electricity usage.

Location-based method

The **location-based method** shows a business's electricity emissions in the context of its location. It shows the physical emissions from a business's electricity consumption, as it reflects the emissions intensity of the electricity grid(s) it relies on to operate.

For instance, a business operating in a State with a high amount of renewable generation will report lower electricity emissions than if it operates in a State with a high amount of fossil fuel electricity generation. This method relies on State average emission factors to convert a business's electricity consumption into an emissions equivalent.

Market-based method

On the other hand, the **market-based method** shows a business's electricity emissions in the context of its electricity purchases. It reports emissions according to a business's investments in different electricity products and markets, including from voluntary purchases of renewable electricity and mandatory schemes like the Renewable Energy Target.

This method assigns an emissions factor of zero for a business's investments in renewables and uses a residual mix factor to calculate emissions from any remaining electricity consumption. This method may result in different reported emissions than what is calculated from the electricity network the business is locally connected to.

Organisations reporting to Climate Active must report their electricity emissions under both methods. However, they will be able to choose one of these methods as primary which will determine how many offsets are required to reach carbon neutrality.

All claims on renewable electricity, with the exception of direct usage ('behind-the-meter' consumption), must be made under the market-based method.

The tables below summarise the emissions associated with the electricity use of City of Karratha for its City assets and streetlighting using the location-based method and the market-based method:

¹² Published in August 2023

Electricity emissions summary for City assets

Location-based

| Description | Activity data | Units | Emissions | Total |
|--|---------------|-------|---------------------------------|---------------------------------|
| Grid electricity | 6,411,924 | kWh | 3,975 t CO ₂ -e | 3,975 t CO ₂ -e |
| Onsite renewable electricity | | | | |
| Self consumed solar (LGCs created & retired) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Self consumed solar (LGCs created & sold/banked) | 1,601,233 | kWh | 993 t CO ₂ -e | 993 t CO ₂ -e |
| Self consumed small-scale solar (STCs) | 174,579 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Net electricity emissions | | | 4,968 t CO₂-e | 4,968 t CO₂-e |

Market-based

| Description | Activity data | Units | Emissions | Total |
|--|---------------|-------|---------------------------------|---------------------------------|
| Grid electricity | 6,411,924 | kWh | | |
| Voluntary LGCs - purchased and retired | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| GreenPower® purchased | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Mandatory LGCs - Large Scale Renewable Energy Target | 1,200,312 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Jurisdictional renewables (for ACT only) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Residual (Standard) electricity from the grid | 5,211,611 | kWh | 4,221 t CO ₂ -e | 4,221 t CO ₂ -e |
| Onsite renewable electricity | | | | |
| Self consumed solar (STCs) | 174,579 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Exported solar (STCs) | 47,563 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Self consumed solar (LGCs not created, OR created & retired) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Exported solar (LGCs not created) | 0 | kWh | | |
| Exported solar (LGCs created & retired) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Self consumed solar (LGCs created & sold/banked) | 1,601,233 | kWh | 1,297 t CO ₂ -e | 1,297 t CO ₂ -e |
| Exported solar (LGCs created & sold/banked) | 338,862 | kWh | | |
| Net electricity emissions | | | 5,518 t CO₂-e | 5,518 t CO₂-e |

Electricity emissions summary for City streetlighting

Location-based

| Description | Activity data | Units | Emissions | Total |
|----------------------------------|---------------|-------|-------------------------------|-------------------------------|
| Grid electricity | 1,605,781 | kWh | 996 t CO ₂ -e | 996 t CO ₂ -e |
| Net electricity emissions | | | 996 t CO₂-e | 996 t CO₂-e |

Market-based

| Description | Activity data | Units | Emissions | Total |
|--|---------------|-------|---------------------------------|---------------------------------|
| Grid electricity | 1,605,781 | kWh | | |
| Voluntary LGCs - purchased and retired | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| GreenPower® purchased | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Mandatory LGCs - Large Scale Renewable Energy Target | 300,602 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Jurisdictional renewables (for ACT only) | 0 | kWh | 0 t CO ₂ -e | 0 t CO ₂ -e |
| Residual (Standard) electricity from the grid | 1,305,179 | kWh | 1,057 t CO ₂ -e | 1,057 t CO ₂ -e |
| Net electricity emissions | | | 1,057 t CO₂-e | 1,057 t CO₂-e |

Please note that organisations with their own solar or other eligible renewable energy generation system can directly consume electricity from that system ‘behind the meter’ e.g. Karratha Leisureplex solar. Behind the meter usage of renewable generation is treated as zero emissions under both location- and market-based methods, provided no LGCs were created, transferred or on sold for that generation. The generation asset must be under the operational control of the claimant, or Climate Active may also consider evidence of ownership of the generation in the form of a contractual instrument between the system owner and the claimant.

Behind the meter usage from small-scale systems can be treated as zero emissions regardless of the creation, sale or transfer of STCs. Businesses that export electricity to the grid cannot claim this electricity as zero emissions in their carbon account except where LGCs have been created and voluntarily surrendered.

Currently, the solar PV systems at the airport and Leisureplex are registered for LGCs, and the city of Karratha has or does not retire LGCs from these systems. As such self-consumed solar from these systems is treated as ‘grid’ electricity in market-based accounting.

Appendix C: Workshop notes

| Opportunity area | Key opportunities identified | Current situation | Barriers | Future plans |
|-------------------------------------|---|---|--|---|
| Waste management | <ul style="list-style-type: none"> Waste-to-energy facility (regional hub) Improved landfill gas capture (new lined cells) Refine data on organic content of waste Residential diversion and education | <ul style="list-style-type: none"> 90,000 t/year of waste (mostly commercial, inert) Emissions mainly from landfill organics Some material recovery (steel, timber) | <ul style="list-style-type: none"> Limited local processing No FOGO facility Poor data on commercial organics High transport costs (~\$9,000/load to Perth) Waste strategy still in development | <ul style="list-style-type: none"> Complete waste strategy (~3 months) Cap cells 1 & 2 by 2027, build 3 & 4 Explore waste-to-energy for residential & some commercial organics Continue education |
| Fleet transition | <ul style="list-style-type: none"> Trial EVs (e.g. BYD utility) Expand hybrid replacements Trial battery-operated tools Right-sizing vehicles to task Install EV charges at Wickham and Dampier community centres Scope public EV charging infrastructure (FY25-26) | <ul style="list-style-type: none"> Mostly diesel fleet (5.5% of emissions) Some hybrid light vehicles & trucks in use Electric tools like chainsaws/blowers trialled One EV utility under trial | <ul style="list-style-type: none"> Extreme heat reduces EV and battery performance Charging infrastructure is lacking Long equipment delivery times Equity issues for third-party chargers | <ul style="list-style-type: none"> Ongoing hybrid rollout Trial EV on courier route Apply for funding for EV study Monitor battery tech improvements Prioritise EV chargers in Wickham and Dampier Community Centres |
| Solar PV and battery storage | <ul style="list-style-type: none"> Battery at Leisureplex to store 339 MWh/yr exported solar Expand rooftop/ground solar at Airport Add solar to new community facilities (e.g. Wickham Rec Recinct) Car park solar at community facilities Include battery where feasible | <ul style="list-style-type: none"> 1 MW solar at Airport (constrained) 800 kW at Leisureplex (large export) Some solar at Ops Centre, Wickham Community Hub Youth Shed has 10kW system | <ul style="list-style-type: none"> Airport can't export to grid Leisureplex solar not monetised yet (LGCs created) Battery tech not heat-tolerant Rooftop constraints (e.g. Red Earth aesthetics, admin age) | <ul style="list-style-type: none"> Battery feasibility at Leisureplex Review PPA contract at Airport, especially if CoK can build own solar Include solar-readiness in facility planning Consider solar carports and system expansion at community hubs or where viable |

| Opportunity area | Key opportunities identified | Current situation | Barriers | Future plans |
|--|---|---|--|--|
| Energy efficiency | <ul style="list-style-type: none"> Complete LED lighting upgrades Continue HVAC upgrades Implement smart meters & submetering Optimise building automation (BMS) Upgrade sports field lighting (e.g. Frank Butler) | <ul style="list-style-type: none"> LEDs in most buildings Some HVAC upgrades pending (Airport chiller) Niagara system in place Partial submetering of tenants | <ul style="list-style-type: none"> Some outdated systems remain Heat load increases HVAC burden Submetering may reduce revenue Asset age limits viability of retrofit | <ul style="list-style-type: none"> Replace final chiller at Airport Complete car park/apron lighting upgrades Integrate smart meters via BMS Use data to fine-tune HVAC operation Upgrade Frank Butler Reserve lighting |
| Streetlighting | <ul style="list-style-type: none"> LED switching for energy efficiency | <ul style="list-style-type: none"> ~50% of lamps are LED | <ul style="list-style-type: none"> Capital costs for LED replacement Pole or bracket replacement may be needed Unclear asset ownership in some areas | <ul style="list-style-type: none"> Potential savings of 658MWh if all streetlighting were transitioned fully to LED Advocate to Horizon Power for a staged LED rollout |
| Electrification and load shifting | <ul style="list-style-type: none"> EV charging to absorb excess solar Shift HVAC/pool loads to daytime Align new loads (e.g. hangars, indoor courts) with solar Include EV charging in community hubs | <ul style="list-style-type: none"> High solar export during day Terminal and Leisureplex have consistent night loads Minimal EV infrastructure to date | <ul style="list-style-type: none"> Electrical infrastructure capacity unclear Equity concerns from hire companies accessing constrained power infrastructure for EVs Load shifting limited by operational needs | <ul style="list-style-type: none"> Study power capacity (airport) Add EVs and chargers gradually Assess demand timing in Community Infrastructure Plan and other masterplans Evaluate backup generation + solar pairing |
| Renewable electricity | <ul style="list-style-type: none"> Source electricity from renewable PPA Expand green power to Scope 3 assets (e.g. council owned housing) | <ul style="list-style-type: none"> Most remaining electricity is sourced from Horizon Power; some from higher-cost PPA (e.g., Airport), and some from RTIO | <ul style="list-style-type: none"> No feed-in tariffs Solar PPA contract limits flexibility No current LGC offset or green energy procurement | <ul style="list-style-type: none"> Explore green power purchasing Use LGC revenue for reinvestment Assess retail renewable options Evaluate renewable scope for City housing |
| Policy and planning | <ul style="list-style-type: none"> Develop climate change policy & declaration | <ul style="list-style-type: none"> Emissions reduction not yet embedded in all strategies | <ul style="list-style-type: none"> Competing priorities for staff No mandate for climate consideration in capital works | <ul style="list-style-type: none"> Propose climate declaration & policy |

| Opportunity area | Key opportunities identified | Current situation | Barriers | Future plans |
|---------------------------|---|--|--|--|
| | <ul style="list-style-type: none"> Create ESD framework for new builds Embed emissions in infrastructure planning | <ul style="list-style-type: none"> Sustainability strategy exists but ESD framework missing | <ul style="list-style-type: none"> Uncertainty in policy support | <ul style="list-style-type: none"> Develop ESD framework in 2025–26 Integrate ERP findings into new Community Infrastructure Plan and Long Term Financial Plan |
| Data and reporting | <ul style="list-style-type: none"> Improve waste data from Mandalay weighbridge system Register and use green certificates (LGCs) Use energy/emissions data for planning and procurement | <ul style="list-style-type: none"> Baseline emissions and facility energy use mapped LGCs registered since Oct 2023 Reporting improving but still limited in some areas | <ul style="list-style-type: none"> Historic data gaps Waste system doesn't distinguish commercial organics Solar PPA may restrict data visibility | <ul style="list-style-type: none"> Continue refining datasets Align metering with BMS Use LGC revenue for further sustainability investments |

Appendix D: Solar PV and energy efficiency opportunities

| Site name | Current situation | Barriers | Energy efficiency opportunity | Solar PV opportunity |
|---------------------------------|---|--|--|---|
| Karratha Leisureplex | <ul style="list-style-type: none"> High-usage facility 800kW solar PV LED lighting Efficient HVAC and pool heat pumps | <ul style="list-style-type: none"> None identified | <ul style="list-style-type: none"> Optimise HVAC and pool operations further if possible | <ul style="list-style-type: none"> Enhance self-consumption of existing 800kW solar system Investigate battery storage |
| Red Earth Arts Precinct | <ul style="list-style-type: none"> Daily operations All LED lighting VSDs on HVAC No solar PV installed | <ul style="list-style-type: none"> Suitability for rooftop solar installation unclear | <ul style="list-style-type: none"> Review ventilation in library Ensure HVAC operating efficiently | <ul style="list-style-type: none"> Assess feasibility and install solar PV – rooftop if viable, or on carpark shade structures |
| Operations Centre | <ul style="list-style-type: none"> Weekday operations 75kW solar PV installed LED lighting One older HVAC unit Site master planning underway | <ul style="list-style-type: none"> Pending site redevelopment; avoid new investment until plan is finalised | <ul style="list-style-type: none"> Upgrade older HVAC unit when site plans are finalised | <ul style="list-style-type: none"> Improve solar self-consumption Review export levels |
| Admin Building - main and annex | <ul style="list-style-type: none"> Daily operations LED lighting Modern but DOL chiller HVAC No solar PV Carport solar option identified | <ul style="list-style-type: none"> Potential future redevelopment Structural limits to rooftop solar | <ul style="list-style-type: none"> Upgrade HVAC efficiency Implement energy monitoring | <ul style="list-style-type: none"> Install 140-160kW system on roof or carpark, subject to future use |
| Wickham Community Centre | <ul style="list-style-type: none"> Modern facility with LED lighting 33kW solar PV system installed; low generation recorded | <ul style="list-style-type: none"> Low solar generation Unclear load profile Possible underperformance of existing system | <ul style="list-style-type: none"> Review HVAC and hot water heat pump performance | <ul style="list-style-type: none"> Investigate solar underperformance and consider system expansion Instal NIM (Non-intrusive load monitoring) for load profile study |

| Site name | Current situation | Barriers | Energy efficiency opportunity | Solar PV opportunity |
|---|---|--|--|---|
| Dampier Community Centre (Scope 3) | <ul style="list-style-type: none"> Older and newer facility with mixed lighting Low weekday use Third-party operated | <ul style="list-style-type: none"> Small scale and likely low load may limit further investment | <ul style="list-style-type: none"> Upgrade remaining non-LED lighting Assess HVAC needs Assess HVAC system if upgrades are viable | <ul style="list-style-type: none"> Monitor existing system performance; potentially through load profile analysis; unlikely to justify expansion |
| Pam Buchanan Community Centre (Scope 3) | <ul style="list-style-type: none"> All LED lighting HVAC and appliance performance unverified; community-run facility | <ul style="list-style-type: none"> System size and load may limit benefits of further upgrades | <ul style="list-style-type: none"> Verify HVAC and appliance efficiency Maintain LED standards | <ul style="list-style-type: none"> Small-scale system likely sufficient; No major new opportunities |
| Frank Butler Reserve and Community Centre | <ul style="list-style-type: none"> Newer facility with LED lighting 19.6kW solar PV installed | <ul style="list-style-type: none"> Small size; low consumption likely | <ul style="list-style-type: none"> Ensure HVAC controls are optimised for usage patterns | <ul style="list-style-type: none"> Maintain existing system; Expansion not required |
| Golf course | <ul style="list-style-type: none"> Irrigation facility with night-time operation; minimal infrastructure | <ul style="list-style-type: none"> Unclear load profile Unlikely to justify investment | <ul style="list-style-type: none"> Review any remaining non-LED lighting or irrigation pumps | <ul style="list-style-type: none"> The predictability of water pumping would make it a good candidate for a solar array with a large battery (e.g. 99kW solar with 400kWh BESS) but would need a large grant to be (potentially) viable. |
| Youth Shed (Scope 3) | <ul style="list-style-type: none"> Community space with LED lighting 10kW solar PV installed Installed in 2012, leased to tenants, youth programs and events | <ul style="list-style-type: none"> System size aligns with load Limited value in expansion | <ul style="list-style-type: none"> Assess HVAC and appliance performance | <ul style="list-style-type: none"> Monitor current system Expansion may not be cost-effective for the City if the benefits are received by the tenants. Cost or benefits sharing may be required. Scope 3 emissions would be reduced. |

| Site name | Current situation | Barriers | Energy efficiency opportunity | Solar PV opportunity |
|------------------|--|---|---|--|
| Karratha Airport | <ul style="list-style-type: none"> High-energy site with existing 1000kW solar PV system and mixed energy loads Airport expansion may change energy demand | <ul style="list-style-type: none"> Complexity of systems and airport regulations Export limitations | <ul style="list-style-type: none"> Review HVAC, lighting and operational controls for optimisation | <ul style="list-style-type: none"> Consider expanding solar system based on roof/land availability Assess feasibility of solar expansion on roof, on carport shade or ground mounted |

Appendix E: Basis for solar PV assessment for major sites

The following sites were identified as potential sites for solar PV installation and/or expansion:

1. Karratha Leisureplex
2. Red Earth Arts Precinct
3. Operations Centre
4. Admin Building – main and annex
5. Wickham Community Centre
6. Dampier Community Centre
7. Pam Buchanan Community Centre
8. Frank Butler Reserve and Community Centre
9. Golf Course
10. Youth Shed (Scope 3)
11. Karratha Airport

The subsequent sections provide an assessment of each site's load profile and an aerial survey to determine the available rooftop area suitable for solar PV installation. Matching load data with roof / ground space is a key initial assessment tool, that can be refined via onsite review, structural assessment and electrical connection aspects.

1. Karratha Leisureplex

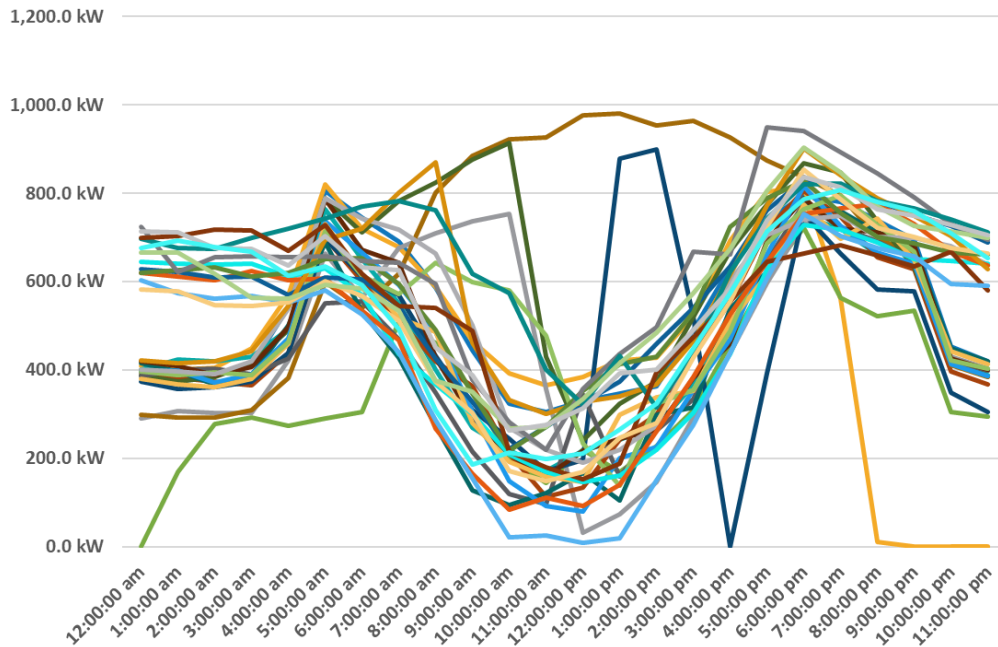


FIGURE 14: LOAD PROFILE FOR KARRATHA LEISUREPLEX



FIGURE 15: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF KARRATHA LEISUREPLEX

2. Red Earth Arts Precinct

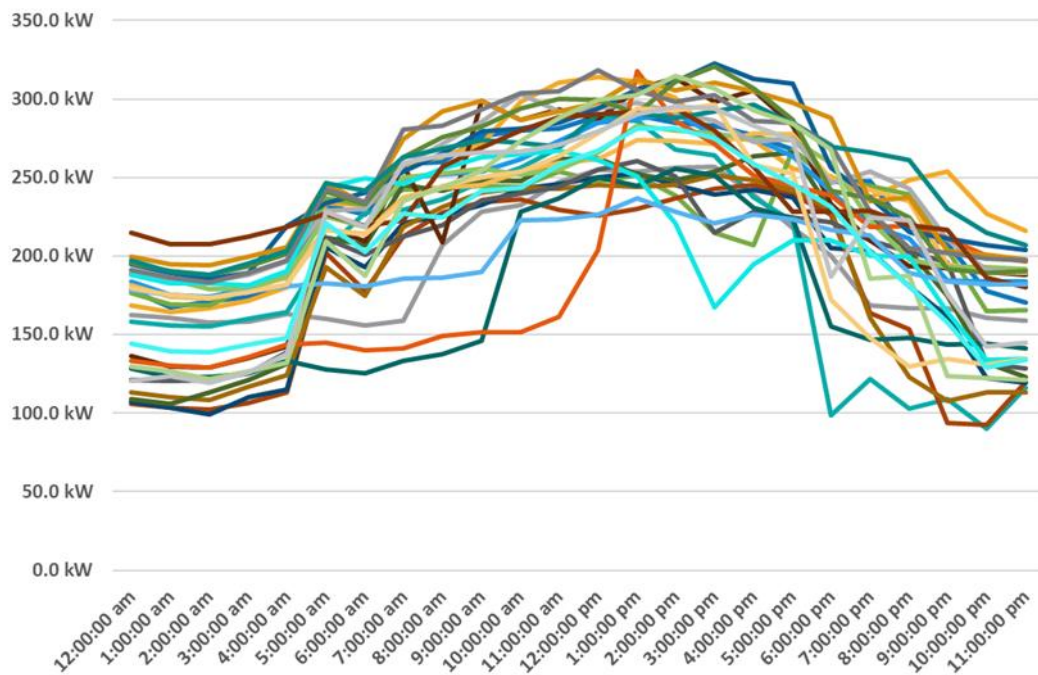


FIGURE 16: LOAD PROFILE FOR RED EARTH ARTS PRECINCT

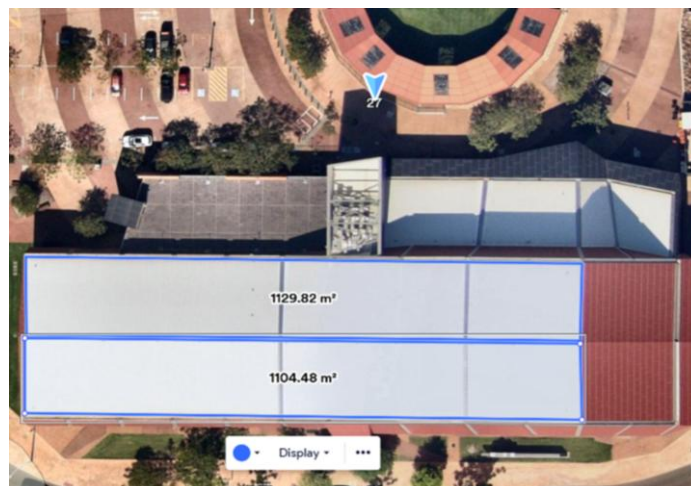


FIGURE 17: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF RED EARTH ARTS PRECINCT

3. Operations Centre

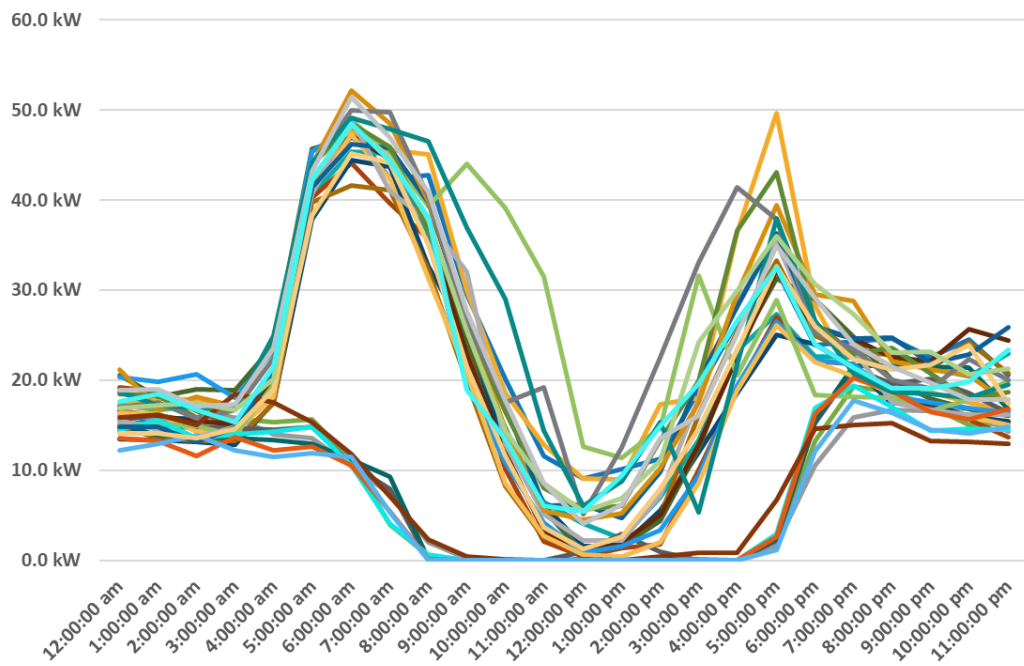


FIGURE 18: LOAD PROFILE FOR OPERATIONS CENTRE



FIGURE 19: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF OPERATIONS CENTRE

4. Admin Building – Main and Annex

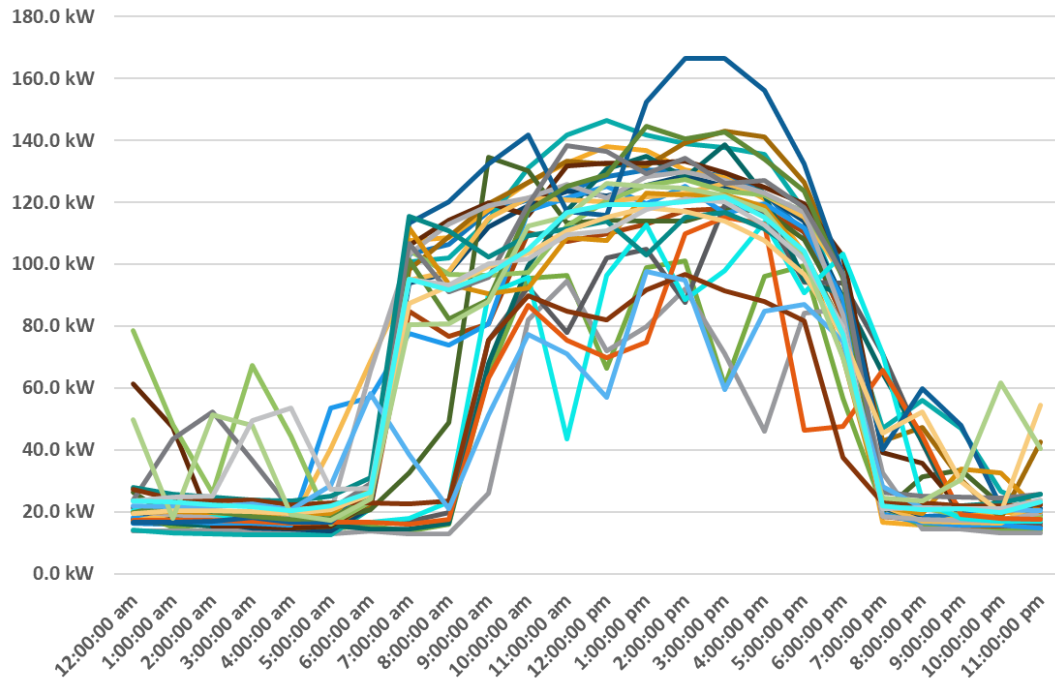


FIGURE 20: LOAD PROFILE FOR ADMIN BUILDING



FIGURE 21: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF ADMIN BUILDING

5. Wickham Community Centre



FIGURE 22: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF WICKHAM COMMUNITY CENTRE

6. Dampier Community Centre



FIGURE 23: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF DAMPIER COMMUNITY CENTRE

7. Pam Buchanan Community Centre

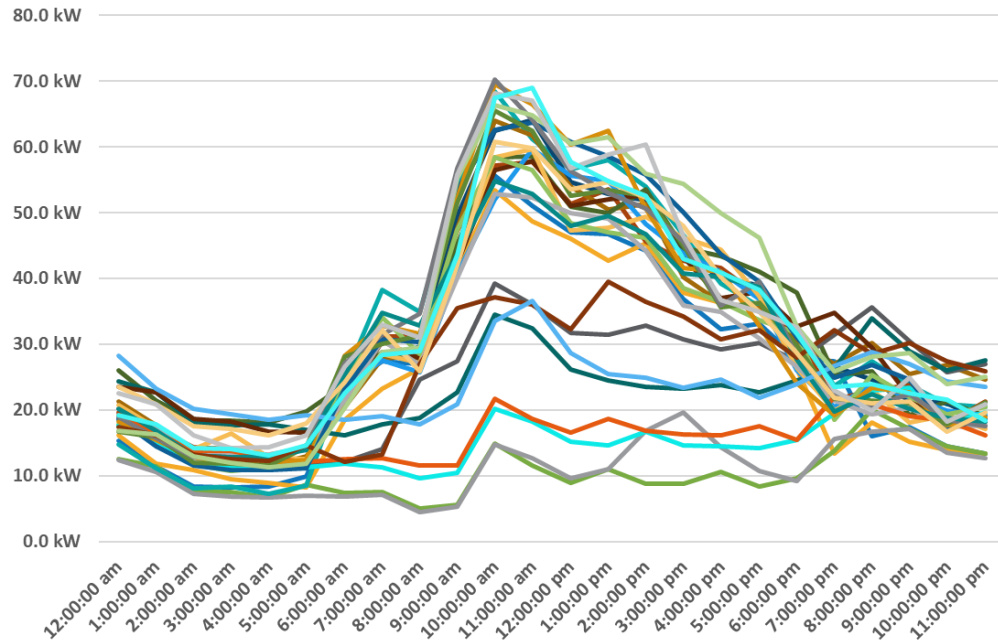


FIGURE 24: LOAD PROFILE FOR PAM BUCHANAN COMMUNITY CENTRE



FIGURE 25: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF PAM BUCHANAN COMMUNITY CENTRE

8. Frank Butler Reserve and Community Centre

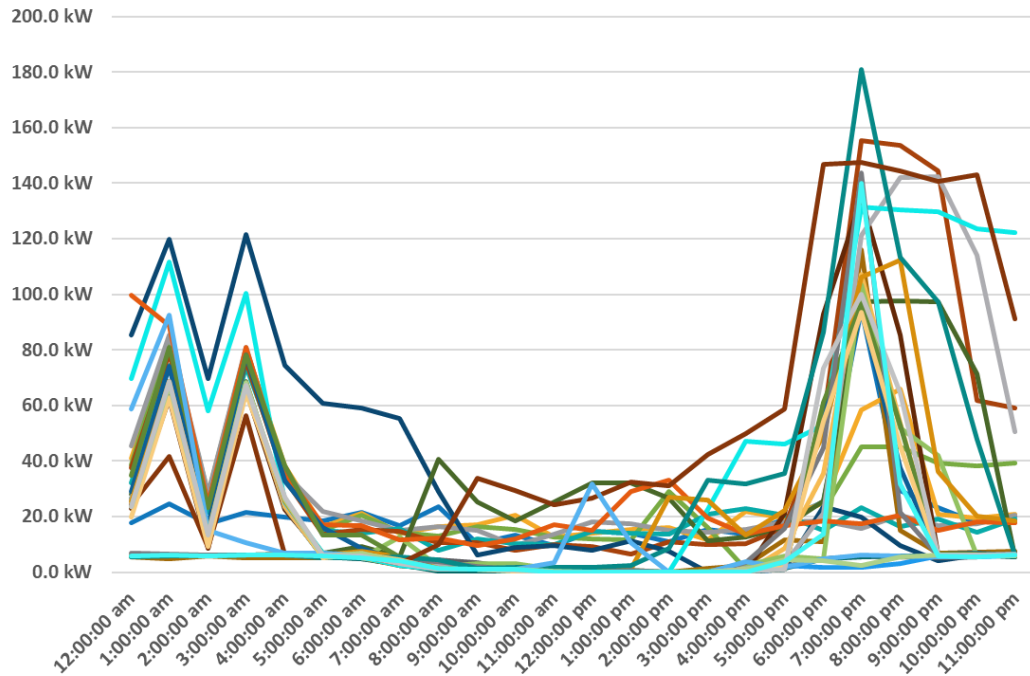


FIGURE 26: LOAD PROFILE FOR FRANK BUTLER RESERVE AND COMMUNITY CENTRE



FIGURE 27: AERIAL VIEW AND AVAILABLE ROOFTOP AREA FOR FRANK BUTLER RESERVE AND COMMUNITY CENTRE

9. Golf Course

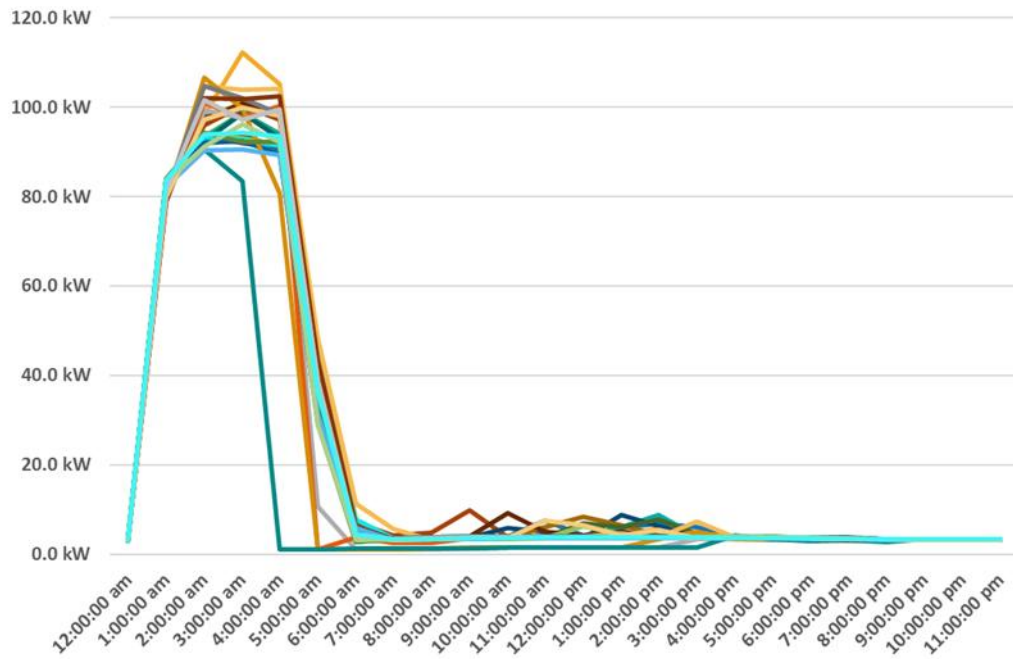


FIGURE 28: LOAD PROFILE FOR GOLF COURSE

10. Youth Shed (Scope 3)

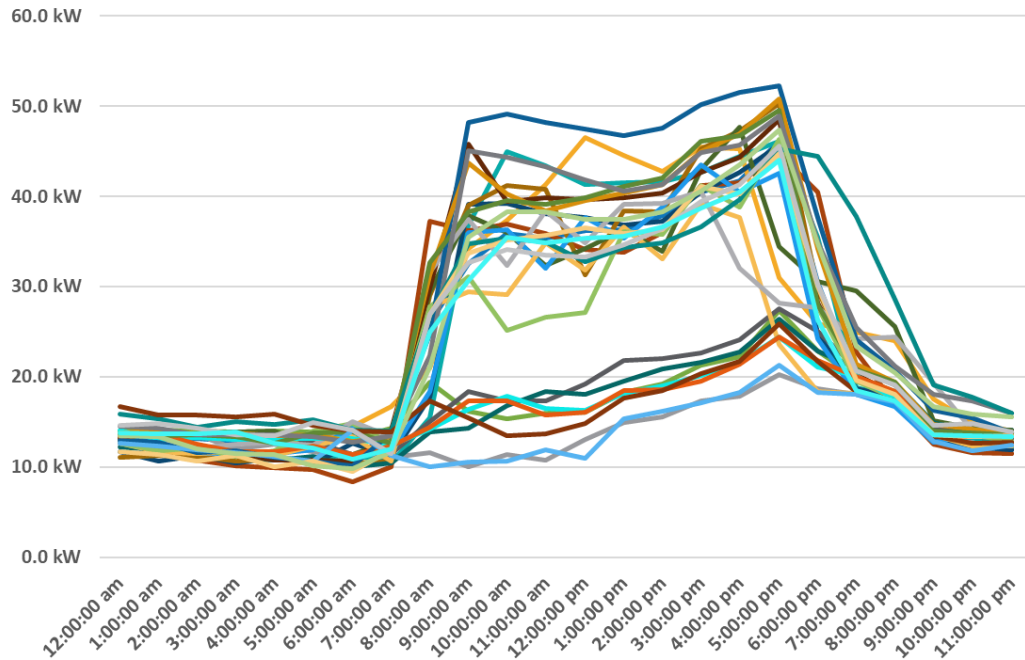


FIGURE 29: LOAD PROFILE FOR YOUTH SHED



FIGURE 30: AERIAL VIEW AND AVAILABLE ROOFTOP AREA OF YOUTH SHED

11. Karratha Airport

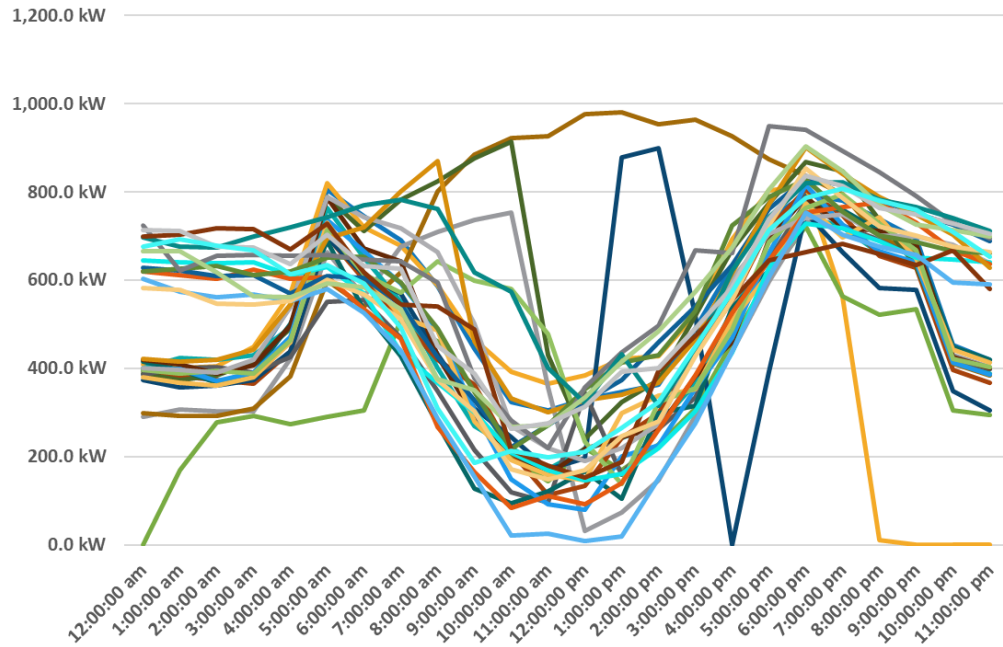


FIGURE 31: LOAD PROFILE FOR KARRATHA AIRPORT

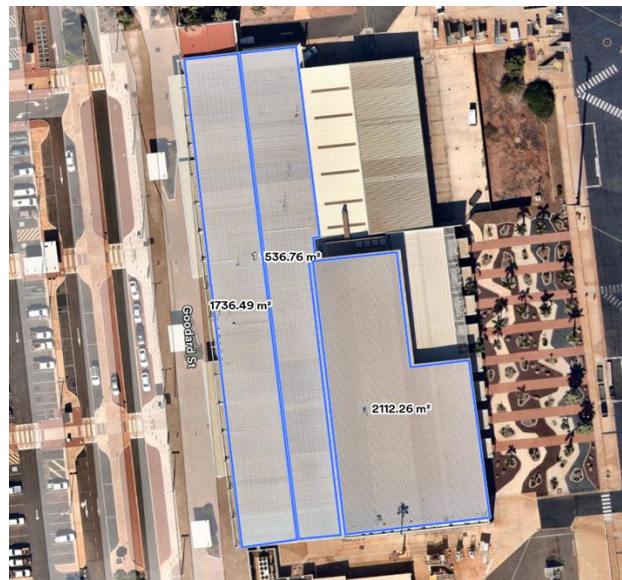


FIGURE 32: AERIAL VIEW AND AVAILABLE ROOFTOP AREA FOR KARRATHA AIRPORT

Appendix F: Forecasted growth based on City's Community Infrastructure Plan

TABLE 19: PROJECTED ENERGY DEMAND GROWTH RATE

| Year | Growth % from 2025 | Justification |
|------|-----------------------|---|
| 2030 | 12% | 40 short-term projects across the LGA (majority in Karratha) are either ongoing or scheduled to begin during 2025–2030. These include major recreational and community facilities, which typically consume significant power (e.g., HVAC, lighting, IT). Population is forecast to grow by ~15.4% between 2021 and 2031. Adjusted for solar PV offsets, the electricity demand increase is conservatively projected at ~12%. |
| 2035 | 23% | An additional 14 medium-term projects will come online from 2030–2035, sustaining development momentum. These include more distributed community hubs and youth centres, increasing site-level energy draw. Cumulative population growth from 2021 is projected to exceed 24.1%, and demand grows faster due to infrastructure lag. |
| 2045 | 35% | 5 long-term projects will be underway or completed by 2045, and the population is expected to increase by ~34.7%. While efficiencies and solar PV will moderate some of the load, increased electrification of community infrastructure (e.g., electrified HVAC, EV charging at hubs, smart lighting systems) drives demand growth to near-parity with population. |
| 2050 | 45-50% | While not formally forecasted, the Community Infrastructure Plan contemplates a “City of 50,000+” vision, suggesting post-2045 planning for expansion in Mulataga, Baynton East, Nickol West, and the Karratha City Centre. New recreational and cultural precincts, more electrified systems (e.g. EVs, all-electric buildings), and increased service expectations drive demand up to ~45–50% over 2020 levels. This assumes continuation of previous growth patterns and only modest efficiency offsets. |

Key Supporting Evidence from Karratha Community Infrastructure Plan

Population growth

- Karratha LGA expected to grow from 23,509 in 2021 to 31,657 in 2041 (34.7% growth)
- Most growth is concentrated in Karratha township (from 18,749 to 25,115)

Infrastructure load profile:

- Leisureplex, airport, arts precinct already exceeds 1.4–1.6 million kWh/year individually
- New facilities will add hundreds of MWh per site, especially those with HVAC, lighting, water filtration, IT/security, and solar PV components

Project phasing:

- 40 short-term (2025–2030), 14 medium-term (2030–2035), 5 long-term (2035–2045) projects mapped
- Most of these are City-owned and will impact their electricity bill directly

Renewable offsets:

- Karratha Airport and Leisureplex already self-consume >700,000 kWh/yr in solar PV each
- However, increasing floor area and asset intensity will outpace efficiency savings, justifying net increases

Modelling assumptions summary

| Assumption | Description |
|------------------------|---|
| Efficiency gains | Gradual improvements in HVAC, lighting, and controls reduce demand per m ² |
| Renewable uptake | Solar PV offsets ~10–15% of new load (based on current generation trends) |
| Electrification trends | Partial electrification of transport, heating, and water systems is assumed |
| Building scale | Average new infrastructure sites estimated to consume 75–300 MWh/year |

Appendix G: City of Karratha's Community Infrastructure Plan 2025–2035

Potential projects identified by stakeholders for solar PV and battery integration (Short-term 2025-2030)

A wide range of short-term initiatives (2025-2030) across Karratha, Dampier, Wickham, Roebourne, and Point Samson present practical and cost-effective opportunities to install solar PV systems and potential battery storage at both new and existing community facilities. Initiatives without project numbers reflect opportunities from stakeholder discussions but do not feature in the CIP.

In Karratha, key projects include:

- The Bulgarra Oval Masterplan, including a new boxing facility
- Construction of indoor courts and a gymnastics space at the Leisureplex
- A large multi-purpose community venue, community arts and cultural centre, a larger library at REAP, and a multi-purpose youth and seniors' venue
- Infrastructure improvements at the indoor cricket and tennis facilities
- A new Community Men's Shed
- A proposed bike park (BMX/MTB), suitable for basic PV installation

Energy upgrades are also planned at the Red Earth Arts Precinct and Karratha Airport, with scope to extend solar PV, BESS, and incorporate EV charging (both community and corporate), alongside shaded carparks.

In Dampier, projects include shade structures and a new pavilion at Windy Ridge Oval, while Wickham is targeting a major upgrade to its sporting precinct, including lighting, indoor court roofing, new pavilion facilities, and an extended gymnasium—all flagged for renewable energy integration and LED lighting.

In Roebourne, the Recreation Master Plan proposes upgrades to basketball courts, aquatic shade structures, and ovals, with solar and battery systems planned throughout. A refurbishment of the 50c Hall is also proposed. Meanwhile, Point Samson will develop a Youth Recreation Precinct, with emphasis on shaded structures and embedded energy systems.

Please refer to Table 20 for a full summary of short-term projects.

TABLE 20: POTENTIAL SOLAR PV PROJECTS IDENTIFIED BY STAKEHOLDERS (SHORT-TERM)

| Location | Project number ¹³ | Strategy | RECOMMENDED ESD |
|----------|------------------------------|---|---|
| Karratha | 1 | Develop Masterplan for Bulgarra Oval – including new boxing facility | PV, EV |
| | 3, 4 | Build rectangular sports field development including lighting and pavilion/facility | PV, BESS, EV, Carpark Shade, LED lighting |

¹³ Reference number to City of Karratha's draft Community Infrastructure Plan 2025–2035 (CIP)

| | | | |
|---------------------|-------------|--|--|
| | 5 | New indoor courts and gymnastics space at KLP | PV, BESS, EV, shaded carparking |
| | 7 | Provide roof and compliant lighting at indoor Cricket facility (part of KCC Sport Master Plan) | PV, LED Lighting |
| | 8 | New/improved Tennis Club amenities as part of Bulgarra Sporting Precinct Master Plan | PV, EV, LED Lighting, shaded carparking |
| | 9 | Develop bike park facility (BMX/MTB) | PV |
| | 12, 14 & 16 | Develop a large multi-purpose community venue (youth & seniors space) | PV, BESS, EV, shaded carparking |
| | 13 | Develop additional space or new larger library (>660sqm) to replace existing at REAP | PV, EV |
| | 17 | New large Community Arts and Cultural Centre | PV, BESS, EV, shaded carparking |
| | 20 | Community Men's Shed | PV, shaded carparking |
| | - | Upgrade Airport | Extend PV, BESS, Corporate EV Fleet, Community EV, shaded carparking |
| | - | Red Earth Arts Precinct energy upgrade | PV, BESS, EV, shaded carparking |
| Dampier | 22 | Shade structures at Windy Ridge Oval | PV |
| | 23 | New pavilion at Windy Ridge Oval | PV |
| | 25 | Lighting upgrades at Hampton Oval | LED Lighting |
| Wickham | 33 | Upgrades to Wickham Oval and Sporting Precinct including: <ul style="list-style-type: none"> Oval lighting Roof structure and lights to netball/basketball courts Roof structure and lights to indoor cricket facility (Medium) New pavilion Extend gymnasium facility | PV, BESS, EV, LED Lighting, shaded carparking |
| Roebourne | 37-42 | Implement Roebourne Recreation Master Plan: <ul style="list-style-type: none"> Upgrade existing basketball courts and add solar PV Aquatic Centre - Shade structures (Medium) Ovals – Shade Structures | PV, EV |
| | 43 | Refurbish 50c Hall | PV |
| Point Samson | 47 | Develop Youth Recreation Precinct including shade structures. | PV, EV |

Potential projects identified by stakeholders for solar PV and battery integration (Short- to medium-term 2025-2035)

A smaller number of projects are considered short-to-medium term opportunities, typically requiring more detailed planning or feasibility work. These initiatives also represent strong candidates for clean energy integration. Initiatives without project numbers reflect opportunities from stakeholder discussions but do not feature in the CIP.

In Karratha, these include:

- An upgrade or relocation of the Administration and Annex buildings
- Development of an Operation Centre Masterplan to accommodate new operational buildings and EV fleet infrastructure

Each of these initiatives includes potential for solar PV, BESS, EV charging, and shaded carparks. Carport-mounted solar is likely to be especially relevant at administration sites where rooftop installations may be constrained.

In Dampier, the Hampton Oval lighting project would see a shift to energy-efficient LED lighting, supported by EV charging infrastructure.

In Wickham, a feasibility study is underway to assess heating options for the aquatic centre, with potential for solar and battery integration, EV infrastructure, and shaded carparking.

Please refer to Table 21 for a summary of these short- to medium-term projects.

TABLE 21: POTENTIAL SOLAR PV PROJECTS IDENTIFIED BY STAKEHOLDERS (SHORT- TO MEDIUM-TERM)

| Location | Project number | Strategy | ESD |
|----------|----------------|--|---|
| Karratha | 11 | Investigate options for boxing facility | PV |
| | - | Administration and Annex -upgrade/relocate | PV, BESS, EV, shaded carparking |
| | - | Develop Operations Centre Masterplan – New buildings, workshops etc | Extending existing PV, BESS, fleet EV charging, shaded carparking |
| | - | Solar PV at the Karratha Welcome Centre | PV |
| Dampier | 24 | Lighting at Hampton Oval | LED Lighting |
| Wickham | 31 | Progress a feasibility study to heat pool and upgrade Wickham aquatic facilities | PV, BESS, EV, shaded carparking |
| | 33 | Roof structure and lights to indoor cricket facility | PV, LED Lighting |

Potential projects identified by stakeholders for solar PV and battery integration (Medium-term 2030-2035)

Several larger, more strategic projects are flagged for the medium term, offering high-value opportunities to embed renewable energy at scale, even if timeframes are not yet fixed. Initiatives without project numbers reflect opportunities from stakeholder discussions but do not feature in the CIP.

In Karratha, these include:

- An airport upgrade, building on the existing 1 MW PV system with additional BESS, EV infrastructure (commercial and community), and shaded carparking
- Energy upgrades at the Red Earth Arts Precinct, including expanded solar and battery capacity
- Improvements at the Kevin Richards Memorial Oval precinct, with new multi-use courts and renewable energy integration
- A planned extension of solar PV and storage at the Youth Shed, replacing the undersized existing system

In Dampier, a new tennis and squash clubhouse is proposed, with potential for PV and BESS to be embedded from the design stage.

In Roebourne, the vision for a Cultural and Country Learning Zone includes shaded gathering spaces and fully integrated solar, and EV infrastructure—aligning environmental sustainability with cultural programming.

Please refer to Table 22 for a full summary of these medium-term projects.

TABLE 22: POTENTIAL SOLAR PV PROJECTS IDENTIFIED BY STAKEHOLDERS (MEDIUM-TERM)

| Location | Project number | Strategy | ESD |
|-----------|----------------|--|--|
| Karratha | - | Upgrade Airport (<i>unknown timeframe</i>) | Extend PV, BESS, Corporate EV Fleet, Community EV, shaded carparking |
| | - | Red Earth Arts Precinct energy upgrade (<i>unknown timeframe</i>) | PV, BESS, EV, shaded carparking |
| | - | Energy upgrades at Kevin Richards Memorial Oval precinct and new multipurpose courts | PV, BESS, shaded carparking |
| | - | Extend Youth Shed PV | PV, EV |
| Dampier | 26 | New clubhouse for tennis & squash | PV, BESS |
| Roebourne | 37 | Pool shading | PV |
| | 42 | New cultural / Country Learning Zone includes shade structures | PV, EV |

Appendix H: Glossary

| Terminology | Description |
|---|--|
| Abatement | Actions taken to reduce the intensity or total amount of greenhouse gas emissions. |
| Azility | An energy management platform used by local governments like the City of Karratha to track electricity usage, emissions, and associated costs. |
| BAU (Business-As-Usual) | A projection of future emissions assuming no additional climate action beyond current practices and policies. |
| Base year | The year against which future emissions are compared for tracking reductions. For City of Karratha, this is FY2024. |
| Battery storage | Energy storage systems used to store electricity, typically from solar PV, for use at a later time. |
| BMS | Building Management System. |
| CEC (Clean Energy Council) | The peak body for clean energy in Australia, responsible for accrediting solar installers and products. |
| Carbon footprint | Total greenhouse gas emissions caused directly and indirectly by an organisation, measured in CO ₂ -equivalent units. |
| Climate Active | An Australian Government initiative that certifies organisations and products as carbon neutral. |
| Climate variability | A neutral term sometimes used in place of 'climate change,' referring to natural fluctuations in climate, though often used to acknowledge human influence in a less polarising way. |
| Divestment strategy | A plan to withdraw investments from industries or sectors that contribute heavily to emissions, such as fossil fuels. |
| Emissions intensity | A measure of the amount of emissions per unit of activity, such as per kWh of electricity consumed. |
| Energy efficiency | Using less energy to perform the same task or produce the same result, often through improved technologies or practices. |
| FOGO (Food Organics and Garden Organics) | A waste collection system separating organic waste from other waste streams to enable composting and reduce landfill emissions. |
| GreenPower® | A government-accredited program enabling electricity consumers to support renewable energy generation. |
| Greenhouse gas (GHG) | Gases that trap heat in the atmosphere, including CO ₂ , methane (CH ₄), and nitrous oxide (N ₂ O). |
| HVAC | Heating, Ventilation, and Air Conditioning systems, often a major contributor to energy use in buildings. |
| LGA (Local Government Area) | A geographical region governed by a local council, such as the City of Karratha. |
| LGC (Large-scale Generation Certificate) | A certificate created for every megawatt hour of eligible renewable electricity generated by accredited power stations. |
| Location-based method | A method of calculating emissions using the average emissions factor of the electricity grid in a particular location. |
| Market-based method | A method of emissions accounting that reflects the emissions intensity of the electricity actually purchased by the user, including renewable energy purchases. |
| Mitigation | Actions taken to reduce or prevent greenhouse gas emissions. |

| Terminology | Description |
|--|---|
| Mitigation hierarchy | A framework to guide emissions reduction strategies, prioritising avoidance, reduction, and replacement of emissions sources. |
| Net zero | A state in which greenhouse gases emitted are balanced by those removed from the atmosphere. |
| PV (Photovoltaic) | Converting sunlight directly into electricity using semiconducting materials (like solar panels) |
| PPA (Power Purchase Agreement) | A contract to purchase electricity, often from renewable sources, at agreed terms over a set period. |
| Residual emissions | Emissions that remain after all possible abatement measures have been applied, typically requiring offsetting. |
| Scope 1 emissions | Direct GHG emissions from owned or controlled sources, such as fuel combustion. |
| Scope 2 emissions | Indirect GHG emissions from the consumption of purchased electricity, heat, or steam. |
| Scope 3 emissions | All other indirect emissions in a company's value chain, like commuting or waste processing. |
| Smart metering | Technology used to monitor energy or water consumption in real time, helping improve efficiency and performance tracking. |
| Solar PV (Photovoltaic) | Technology that converts sunlight directly into electricity using solar panels. |
| Submetering | Installation of meters on specific systems or tenants within a facility to monitor and manage individual consumption. |
| Sustainability | Practices that meet present needs without compromising the ability of future generations to meet theirs. |
| VSD (Variable Speed Drive) | A motor control system that adjusts motor speed to match demand, improving energy efficiency in HVAC and pump systems. |
| WRRF (Water Resource Recovery Facility) | A facility that treats wastewater and recovers resources such as water, energy, and nutrients. |
| Waste-to-energy | The process of generating energy in the form of electricity or heat from the primary treatment of waste. |



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