# Priority Climate Action Plan

Draft April 2024

## Prepared for:

Prairie Band Potawatomi Nation

## Prepared by:

Sustainability Solutions Group (SSG)
Ad Astra

## Designed by SSG

April 2024

# Executive Summary

With its enactment of the Inflation Reduction Act (IRA) of 2022, the US Congress provided many tools to pursue greenhouse gas (GHG) pollution reductions, including the US Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program. The overall strategy of the CPRG is to address climate change by identifying initiatives that reduce GHGs, provide good-paying jobs, and address environmental injustices and inequalities. CPRG planning grants support the development of climate action plans for states, local governments, tribal nations, and territories. CPRG implementation grants are a competitive opportunity to implement specific measures included in the climate action plans.

## 0.1 Climate Pollution Reduction Grants Program

The Prairie Band Potawatomi Nation (PBPN or "the Nation") received a grant from the US EPA's CPRG program to develop plans to reduce the PBPN's GHG emissions. This Priority Climate Action Plan (PCAP) is the first of two plans that the PBPN will develop with funding from the CPRG. The primary objective for the PCAP is to identify near-term, high-priority, and implementation-ready measures that will reduce GHG emissions. These measures are designed to be eligible for CPRG Phase 2 funding and other grants.

This PCAP includes a background review, a GHG inventory, business-as-usual GHG emissions projections, and priority measures that will reduce GHGs and provide additional social, economic, and environmental co-benefits for the PBPN. This PCAP will be followed by the development of a Comprehensive Climate Action Plan (CCAP). The CCAP will describe a more comprehensive set of measures to reduce GHG emissions that will be developed by undertaking further technical analysis and broad and meaningful engagement with the Tribal Council, staff, and community members.

# 0.2 The Prairie Band Potawatomi Nation

The Prairie Band Potawatomi Nation is a federally recognized tribe that governs a reservation located in north-central Jackson County, Kansas, about 80 miles northwest of Kansas City, Missouri. Currently encompassing 121 square miles, the PBPN Reservation was established by treaty in 1846 and is the largest reservation in the state of Kansas.[1] The PBPN has 4,841 registered members in North America and a reservation population of 1,529.[2]

Climate action measures were identified based on a synthesis of findings from a context review, a GHG inventory, and engagement. Measures were prioritized using the Reduce-Switch-Produce-Offset & Sequester framework and criteria that integrate the Tribe's priorities with the EPA's evaluation criteria for the CPRG Phase 2 implementation grants. The PBPN Tribal Council served as the key decision-making and advisory body over the development of the PCAP.

The PCAP engagement process focused on gathering insights from diverse perspectives and identifying implementation-ready projects. The process focused on integrating input from across the Nation to ensure the unique priorities, community norms, and capabilities of its people were considered.

[1] Ian Fanning-Hughes, University of Kansas Graduate Student et al., "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," Final report (Kansas: University of Kansas, May 2020).
[2] US Census Bureau, "Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile."

# 0.3 PBPN Greenhouse Gas Inventory

In 2021, PBPN's GHG emissions total was 22,554 $MtCO_2e$, or about 15 $MtCO_2e$ per person, which is about the same as the US average per person. These emissions were produced by energy use in residential buildings (13%), commercial/institutional buildings (46%), and transportation (40%) (Figure E1). These emissions are primarily due to the burning or combustion of fossil fuels, such as gasoline to power vehicles, coal and natural gas to generate electricity, and propane for heating and cooking.


*Figure E1. PBPN's GHG emissions by sector, excluding natural and working lands, 2021. Source: SSG analysis.*

Natural and working lands sequester 77,600 $MtCO_2e$ annually (Figure E2). This is 3.4 times the Nation's total GHGs emitted. Although this natural carbon sequestration offsets the Nation's GHG emissions from human activities, global deforestation emissions are currently higher than global natural carbon sequestration or drawdown. As such, the Earth's carbon budget is currently not enough to offset global GHG emissions from human activities.[3] Only additional increases in total global natural carbon sequestration will provide a true offset to human-generated GHG emissions. Through the priority measures identified in this PCAP, the Nation has an opportunity to contribute to reducing emissions from energy-using activities and increasing the natural carbon sequestration within the reservation.

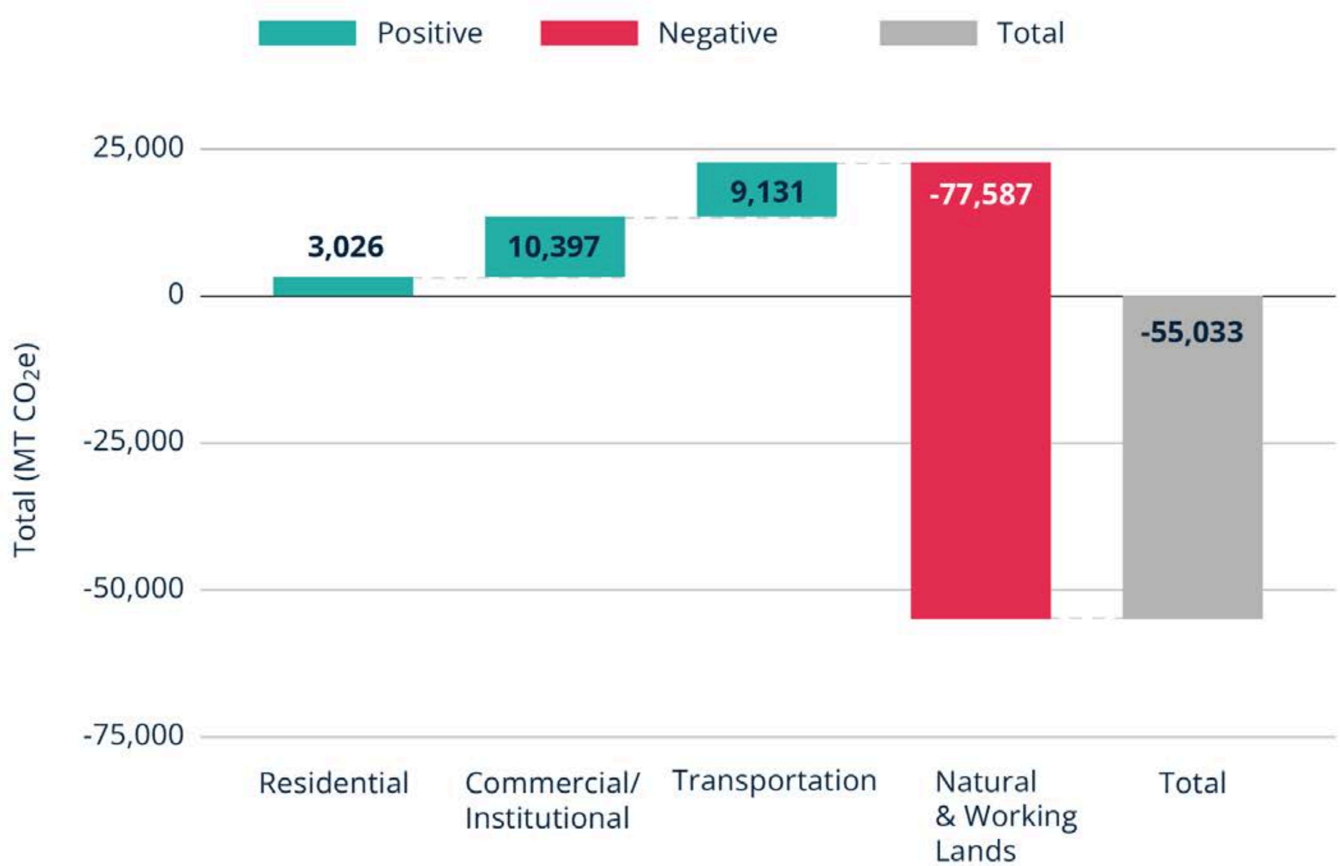



*Figure E2. PBPN's GHG emissions by sector, including natural and working lands (agriculture and land use), 2021. Source: SSG analysis.*

[3] Pierre Friedlingstein et al., "Global Carbon Budget 2023," Earth System Science Data 15, no. 12 (December 5, 2023): 5301–69, https://doi.org/10.5194/essd-15-5301-2023.

# 0.4 Business-as-Usual (BAU) Projections

Based on PBPN's population, energy use, and energy generation, the Nation's GHG emissions are projected to almost halve by 2030, while total energy consumption will remain fairly stable (Figure E3).[4] GHG emissions are expected to decline due to the phaseout of coal-fired electricity generation and a decline in the costs of renewable energy (wind and solar).[5]

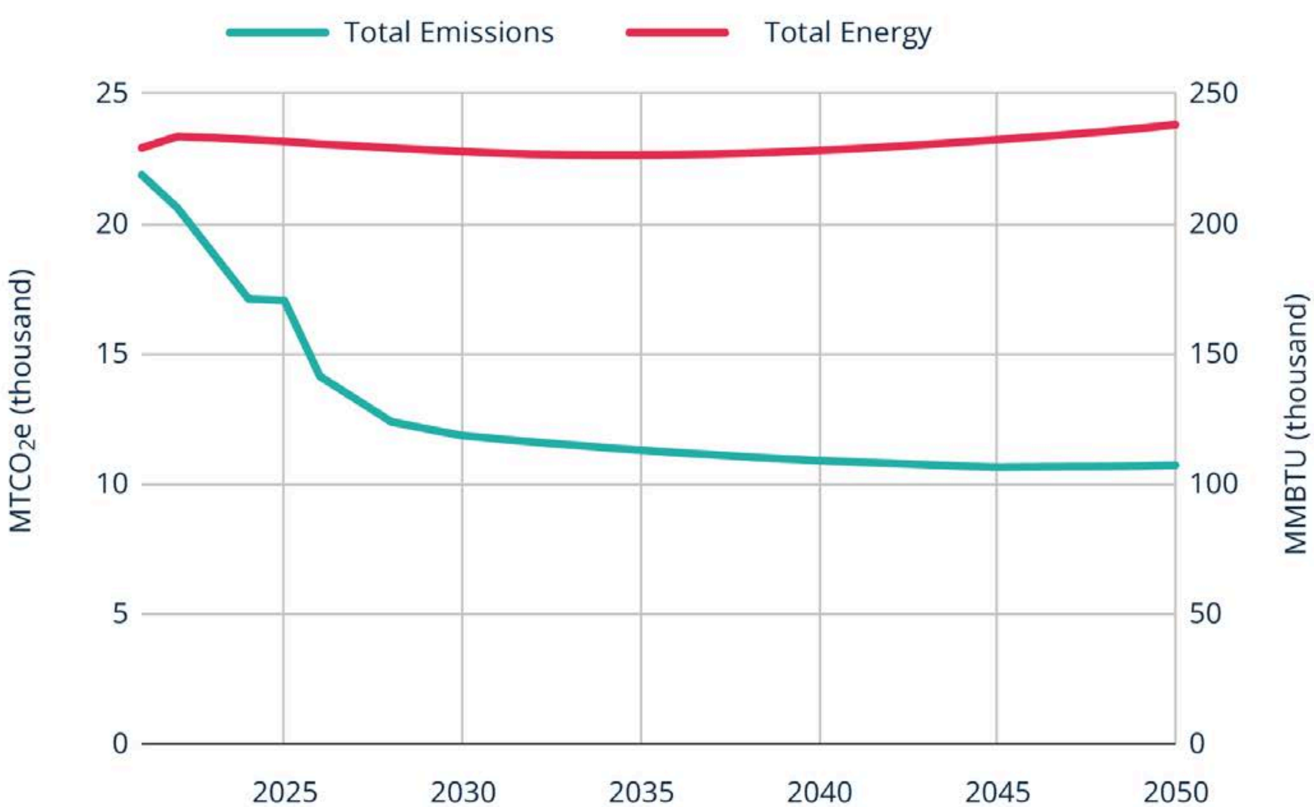



*Figure E3. PBPN's projected business-as-usual GHG emissions pathway (green) and projected energy use (red), 2021–2050. Source: SSG analysis.*

[4] US EPA, "State Inventory and Projection Tool."
[5] Gagnon, Pieter; Cowiestoll, Brady; Schwarz, Marty (2023): Cambium 2022 Data. National Renewable Energy Laboratory. https://scenarioviewer.nrel.gov - Mid case scenario.

Figure E4 summarizes the BAU trajectories for each type of energy use within the Nation's reservation.This BAU pathway provides a reference case for future climate action planning.

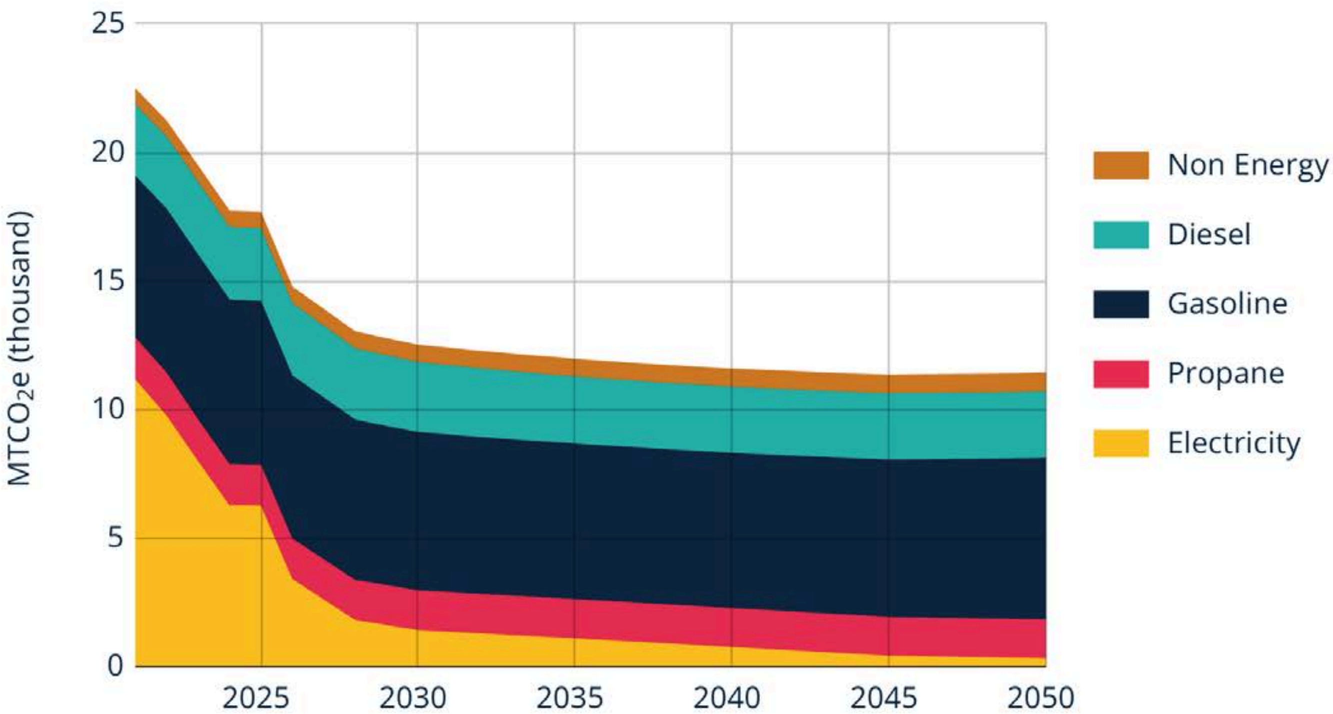



*Figure E4. PBPN's projected business-as-usual GHG emissions pathway by fuel and non-fuel sources. Non-energy sources include waste and wastewater, 2021–2050. Source: SSG analysis.*

# 0.5 Priority Measures

The following priority measures were identified as actions that will significantly reduce GHG emissions in the near term, are implementation-ready, and will provide significant co-benefits (Table E1). Included in the description of each priority measure are estimated GHG emissions reductions, estimated air pollutant reductions (where applicable), an implementation authority and timeline, metrics for tracking progress, a quantitative cost/benefits analysis, and an analysis of the expected co-benefits.

*Table E1. PCAP priority measure projects for Prairie Band Potawatomi Nation.*

| | Project Title | Description |
|---|---|---|
| 1 | Efficient, Affordable Buildings  | Reduce energy use in buildings and increase the resilience of PBPN's buildings by developing a green building standard, an energy efficiency strategy, energy efficiency retrofit programs for Tribal housing and commercial buildings, and an incentive program for home energy efficiency and resilience retrofits for non-Tribal reservation residents. |
| 2 | Clean and Active Transportation  | Reduce emissions from vehicles used on the reservation by switching the Nation's operational fleet to EVs and its buses to electric buses; create supports for residents to purchase EVs, EV chargers, and e-bikes; expand PBPN transportation services; develop EV infrastructure and ebike rentals and incentives; and expand bike path network across the reservation. |
| 3 | Electricity Generation and Procurement  | Reduce emissions from electricity consumption and increase PBPN's energy self-sufficiency by producing and storing renewable energy (solar, wind, battery storage, and geothermal) for housing, Tribal government buildings, casino buildings, and wastewater treatment facilities. Develop a clean energy workforce and staff training to support implementation of clean energy projects. |
| 4 | Natural and Working Lands  | Restore and enhance ecosystem services for the community while sequestering carbon, and modify agricultural and farming practices to preserve the quality of natural assets, including supporting and promoting water conservation and no-till regenerative practices for soils, natural land area protection and restoration for habitat, riparian buffer restoration, and pilot projects for best practices on Tribal cropland and pastureland on the reservation. |

## 0.6 Summary of PCAP Greenhouse Gas Emission Reductions

The PCAP priority measures provided in Table E1 would provide 18,804 $MtCO_2e$ in GHG reductions by 2030 and 116,063 $MtCO_2e$ by 2050 for the PBPN Reservation (Table E2).

*Table E2. Summary of GHG emission reductions from proposed PCAP priority measures.*

| Priority Measures | Reductions by 2030 ($MtCO_2e$) | Reductions by 2050 ($MtCO_2e$) |
|---|---|---|
| Efficient, Affordable Buildings | 8,358 | 37,549 |
| Clean Transportation | 4,987 | 44,245 |
| Energy Generation | 1,373 | 6,834 |
| Natural and Working Lands | 4,086 | 27,435 |
| **Total** | **18,804** | **116,063** |

## 0.7 PCAP Measure Prioritization

The PCAP measures were prioritized for CPRG's Phase 2 implementation grants (Table E3). Each PCAP measure was scored using a combination of CPRG project evaluation criteria (GHG reductions, funding need, transformational impact, environmental benefits, social/economic co-benefits, and feasibility) and priorities expressed by PBPN Tribal Council, staff, and community members. The three highest scoring measures are the Adoption of EVs and Supporting Infrastructure, Home Energy Retrofits, and Restore Riparian Buffers and Promote No-Till Agricultural Practices (Figure E5).

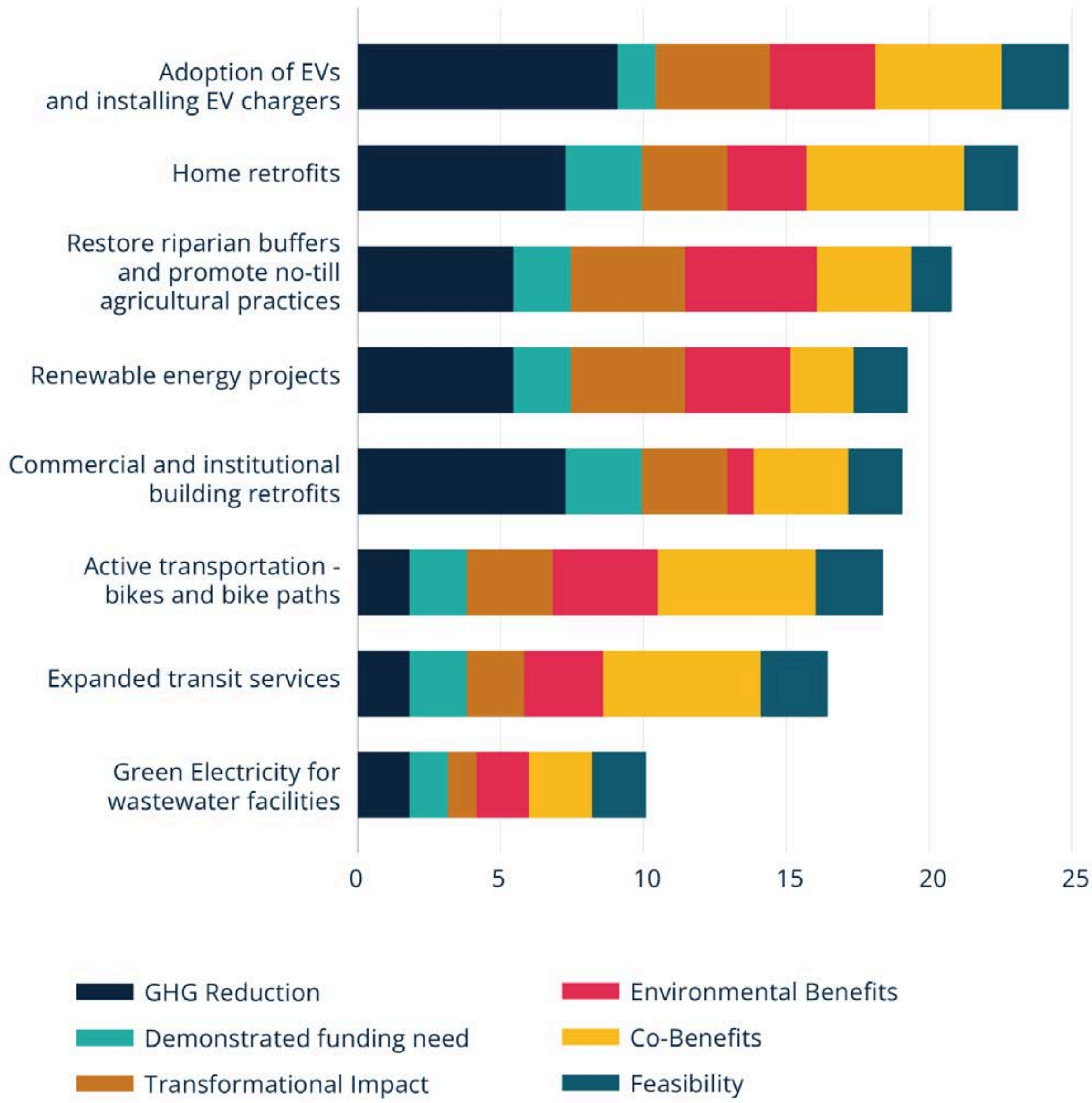



*Figure E5. PCAP measures prioritized according to CPRG scoring criteria (GHG reductions, funding need, impact, co-benefits, and feasibility) and weightings from the CPRG grant and community priorities.*

## 0.8 Federal Funding Opportunities

Phase 2 of the EPA's CPRG can provide funding opportunities for PBPN's priority GHG reduction measures and initiatives. There are also many other sources of federal funding that can be leveraged to develop and implement the PCAP measures, such as other grant programs in the Inflation Reduction Act and Tax Credit programs. Where applicable, these have been noted along with the relevant priority measure. Funding sources to support implementation will also be explored in more detail during the development of the CCAP.

## 0.9 Next Steps

The PCAP provides the foundation for a more comprehensive analysis in the CCAP. The CCAP will identify all GHG sources, sinks, and sectors of the Nation and will include mid- and long-term GHG emissions reduction strategies. The engagement process for the CCAP will begin in June 2024. Engagement will include meaningful and targeted outreach events with all interested and affected parties. Meetings will include high-functioning meeting technology, online tools (when applicable), and adequate time for in-depth discussions. In addition to meetings, other engagement techniques, including a survey, pop-up events, and outreach at the Nation's annual Pow Wow, will be used. The process will enable opportunities for conversations and collaboration among a diverse set of participants.

The success of the CCAP Engagement Plan will depend on:

- Working with community leaders, organizations, and networks from across the Nation;
- Connecting the CCAP with people's everyday experiences;
- Tailoring engagement and messaging to various segments of the Nation's population; and
- Effectively managing divergent perspectives among interested and affected parties.

# Disclaimer

This report has been undertaken to address the requirements of the Environmental Protection Agency's CPRG program. Reasonable skill, care, and diligence have been exercised to assess the information provided for this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and the factors associated with the implementation of the Priority Climate Action Plan are subject to changes that are beyond the control of the authors. The information provided by others is believed to be accurate (e.g., Census data, data from the Energy Information Administration) but has not been verified.

This analysis applies to the Prairie Band Potawatomi Nation and cannot be applied to other jurisdictions without additional analysis. Any use by the Nation, project partners, sub-consultants or any third party, or any reliance on or decisions based on this document, are the responsibility of the user or third party.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement 5D-96706301-0. The contents of this document do not necessarily reflect the views and policies of the EPA nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

# Table of Contents

# Acknowledgements

## Prairie Band Potawatomi Nation

Virginia Leclere, Environmental Manager
Verna Potts, Lead Environmental Technician
Billie Toledo, Environmental Technician
Members of the Tribal Advisory Committee
Prairie Band Potawatomi Nation Tribal Council

## Consulting Teams

### Sustainability Solutions Group (SSG) Workers Cooperative

Carol Fraser
Chris Strashok
Sophie Lévesque
Sara Wilson
Soraya Sarshar
Bas Straatman
Erica Brook

### Ad Astra

Laurie Brown
Scott Schulte
Trisha Moore
Becca Pruett

# Abbreviations and Acronyms

| Abbreviation | Definition |
|---|---|
| BAU | Business-as-usual |
| BOD | Biochemical demand |
| CCAP | Comprehensive Climate Action Plan |
| CEJST | Climate and Economic Justice Screening Tool |
| $CH_4$ | Methane |
| CO | Carbon monoxide |
| $CO_2$ | Carbon dioxide |
| CPRG | Climate Pollution Reduction Grants |
| EJScreen | Environmental Justice Screening Tool |
| EPA | Environmental Protection Agency |
| EV | Electric vehicle |
| EVSE | Electric vehicle supportive infrastructure |
| GHG | Greenhouse gas emissions |
| GWP | Global warming potential |
| HC | Hydrocarbons |
| HVAC | Heating, ventilation, and air conditioning |
| IRA | Inflation Reduction Act |
| LIDAC | Low-income and disadvantaged communities |

| Abbreviation | Definition |
|---|---|
| LIHTC | Low-Income Tax Credit Housing |
| MSA | Metropolitan Statistical Area |
| $MtCO_2e$ | Million tons of carbon dioxide equivalent |
| MW / MWh | Megawatt/megawatt hour |
| NAAQS | National Ambient Air Quality Standards |
| $NO_2$ | Nitrous oxide |
| PBPN | Prairie Band Potawatomi Nation |
| PCAP | Priority Climate Action Plan |
| PM2.5 | Particulate matter with diameter <= 2.5 micrometers |
| RNG | Renewable natural gas |
| SSG | Sustainability Solutions Group |
| TAC | Tribal Advisory Committee |
| TSS | Total suspended solids |
| VMT | Vehicle miles traveled |
| WRRF | Water resource recovery facilities |

# Key Energy and Emissions Units

## GHG emissions

1 $kMtCO_2e$ = 1,000 $MtCO_2e$

1 $MMtCO_2e$ = 1,000,000 $MtCO_2e$

## Energy

1 MMBTU = 1.055 GJ

1 MJ = 0.0001 GJ

1 TJ = 1,000 GJ

1 PJ = 1,000,000 GJ

1 GJ = 278 kWh

1 MWh = 1,000 kWh

1 GWh =1,000,000 kWh

# List of Figures

# List of Tables

# 1 Introduction

## 1.1 Climate Pollution Reduction Grants (CPRG) Overview

With its enactment of the Inflation Reduction Act of 2022 (IRA), the US Congress provided many tools to pursue greenhouse gas (GHG) pollution reductions, including the Climate Pollution Reduction Grants program. The CPRG program under the EPA seeks to achieve three broad objectives:[6]

- Tackle damaging climate pollution while supporting the creation of good jobs and lowering energy costs for families.
- Accelerate work to address environmental injustice and empower community-driven solutions in overburdened neighborhoods.
- Deliver cleaner air by reducing harmful air pollution in places where people live, work, play, and go to school.

The overall strategy is to address climate change by identifying opportunities that will provide well-paying jobs and address historic environmental injustices and inequities. CPRG includes two phases designed to enable the EPA to work in partnership with state, territory, local, and tribal officials to advance climate action planning and implementation that is tailored to each recipient's unique needs and socio-economic and environmental makeup. Phase 1 provides planning grants to develop plans to reduce GHG emissions, and Phase 2 provides implementation grants to implement measures from the GHG reduction plans. The program will advance the goals of the Justice40 Initiative (Executive Order 14008) with the aim to deliver 40% of overall benefits of federal investments to low-income and disadvantaged communities (LIDACs).

Priorities for the planning grant (CPRG Phase 1) are described in Table 1.

[6] United States Environmental Protection Agency, "Climate Pollution Reduction Grants Program: Formula Grants for Planning."

*Table 1. CPRG planning grant priorities for tribes, tribal consortia, and territories.*

| ***Theme*** | ***Description*** |
|---|---|
| Analytics | Improve understanding of current and future GHG emissions so that tribal and territorial governments can prioritize actions that reduce such emissions and harmful air pollution (criteria air pollution and toxic air pollutants) where community members live, work, play, and go to school, particularly in non-attainment areas for the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. |
| Programs | Adopt and implement ambitious policies and programs to reduce GHG emissions and accelerate decarbonization across multiple important sectors (e.g., industry, electricity generation, transportation, commercial and residential buildings, agriculture/natural and working lands, and waste and materials management). |
| Partnerships | Collaborate closely with other entities (states, municipalities, air districts, other tribes) as appropriate to develop coordinated plans based on best practices. |
| Financing | Explore opportunities to leverage sources of funding and financing from the Inflation Reduction Act of 2022, the Bipartisan Infrastructure Law of 2021, the American Rescue Plan Act of 2021, and the Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022. |
| Innovation | Stimulate innovative technologies and practices to reduce GHG emissions and associated co-pollutants in hard-to-abate sectors. |
| Transformation | Prioritize actions and policies that will be durable and replicable and will provide certainty in pollution reductions. |
| Economic development | Reduce climate pollution while building the clean energy economy in a way that benefits all Americans, provides new workforce training opportunities, and effectively addresses environmental injustices in disadvantaged communities. |
| Monitoring and evaluation | Adopt robust metrics and reporting programs to track emissions reductions and important co-benefits throughout Indian Country and territories. |

For tribes, tribal consortia, and territories, funding recipients are required to submit two deliverables over the course of a four-year program period (2023–2027). These deliverables include:

1. A Priority Climate Action Plan (PCAP), due April 1, 2024 and
2. A Comprehensive Climate Action Plan (CCAP), due at the end of the grant period, which can be up to four years.

## 1.2 The Priority Climate Action Plan

The Prairie Band Potawatomi Nation, a federally recognized tribe, is participating in the CPRG planning program. This Priority Climate Action Plan, the first deliverable of the program, aims to help tribes improve their understanding of current and future greenhouse gas emissions, identify priority strategies to reduce these emissions and the other potential benefits of those strategies, and engage a variety of interested and affected people in an emissions reduction planning process.

The primary objective of the PCAP is to identify near-term, high-priority, implementation-ready measures to reduce GHG emissions, which can be submitted as projects under the CCAP implementation phase of CPRG. This PCAP includes a background review, a GHG inventory, business-as-usual GHG emissions projections, and priority measures that will reduce GHGs and provide additional social, economic, and environmental co-benefits for the PBPN.

A Comprehensive Climate Action Plan will be completed following the PCAP. The CCAP will involve detailed modeling, technical analysis, and community engagement. The CCAP will address all significant GHG sources, sinks, and sectors; establish near- and long-term GHG emissions reduction goals; and provide strategies and identify measures addressing the highest priority sectors to help the PBPN achieve those goals. The CCAP will provide a detailed roadmap for decarbonizing the Prairie Band Potawatomi Nation.

## 1.3 The Role of Tribal Governments

Land-use and infrastructure planning decisions made today will have environmental and socio-economic impacts over the next 100 years. The impacts of planning and investment decisions can "lock-in" development patterns and GHG emissions that increase future costs and limit options to transform today's energy use. In the context of climate change, planning decisions regarding longer-term investments are among the most urgent.

Climate action planning directly influences and creates new economic development opportunities. Reducing emissions in any sector requires new investments and innovations (e.g., new technologies, new business models, new practices), which, in turn, generate entrepreneurial opportunities. In addition, investments in energy efficiency result in energy cost savings that can stimulate spending in other economic activities. Climate action investments also require training people to acquire new skills and increasing the workforce available to install heat pumps, retrofit homes, and build infrastructure. The scale of these investments and the employment opportunities created by them means that a climate action plan is simultaneously an economic development strategy.

Tribal governments can have a considerable impact on reducing GHG emissions in their communities. By developing a quantitative understanding of the community's GHG emissions (i.e., GHG inventory) and identifying the actions required to reduce emissions (i.e., climate action planning), tribal governments can influence the community's emissions trajectory into the future. The Prairie Band Potawatomi Nation can exert direct influence over the land it owns and holds in trust and can work with landowners and other organizations to support change on privately held land within the bounds of the reservation.

Tribal governments can take on multiple roles that support reducing energy use and GHG emissions, including acting as:

- **A mobilizer:** Tribal governments can engage tribal members, residents, staff, other tribes, and partner organizations around a vision, goals, objectives, and targets. For example, tribal governments can lead community engagement activities or bulk purchasing of renewable energy on behalf of tribal members;
- **An innovator:** Tribal governments can directly or indirectly support innovation through targeted investments, partnerships, and/or policies that support low-carbon projects or enterprises, reducing risk for investors, partners, and

community members. For example, tribal governments can develop electric vehicle (EV) infrastructure to support EV adoption;

- **A collaborator:** There are multiple opportunities for collaboration in the energy transition, including with transit authorities, utilities, businesses, non-profit organizations, and governments in other parts of the region, state, and world. Collaboration can take the form of shared targets, policies, joint projects, and investments;
- **An investor:** Tribal governments can use access to low-interest capital to make investments directly in building retrofits and renewable energy technologies. Alternatively, or in tandem, tribal governments can enable investments by third parties. For example, tribal governments can levy grants and loans as a way to finance building retrofits;
- **An implementer:** Through policies and incentives, tribal governments can support businesses and households in making the clean energy transition. For example, tribal governments can amend building code requirements to mandate or incentivize energy-efficient new construction; and
- **An incubator:** Tribal governments can cultivate the development of new technologies or applications that enable the low-carbon economy by supporting and attracting new and existing businesses and creating a hub or ecosystem in which the businesses and organizations support each other. Examples include a low-carbon business park or incentives for different levels of building performance that stimulate innovation by builders.

## 1.4 Approach to Developing the PCAP: A Framework for Climate Action Planning

This PCAP uses the Reduce-Switch-Produce-Offset & Sequester framework (Figure 1). This framework guides energy and emissions planning priorities in a similar way as Reduce-Reuse-Recycle in the waste sector and Avoid-Shift-Improve in the transportation sector.[7]

Using this approach, the first priority is to reduce energy consumption. This reduces GHG emissions from existing energy sources. It also reduces total energy costs and per kilowatt energy costs by decreasing the need to build additional generation and

[7] GIZ. "Sustainable Urban Transport: Avoid-Shift-Improve," 2011. https://sutp.org/publications/sustainable-urban-transport-avoid-shift-improve-a-s-i/

transmission capacity. The next priority is to switch energy production to renewables. The third priority is to produce as much renewable energy within the PBPN as possible. This maximizes energy independence, local economic benefits, and the resilience of the electricity system.

The fourth and fifth priorities are to offset and sequester remaining emissions. This has a relatively limited impact on absolute GHG emissions; however, it provides several co-benefits, such as improved air quality and well-being.

In addition, the PCAP measures are investments that will reduce current high-carbon or energy-intensive activities in the short term and allow flexibility to tackle longer-term challenges. For example, land-use planning, infrastructure policies, and investments influence how densely a community develops, its mix of land uses, the size and location of its energy supply infrastructure, and its transportation choices.

PCAP measures were prioritized using the above criteria in combination with insights from the PBPN engagement process.

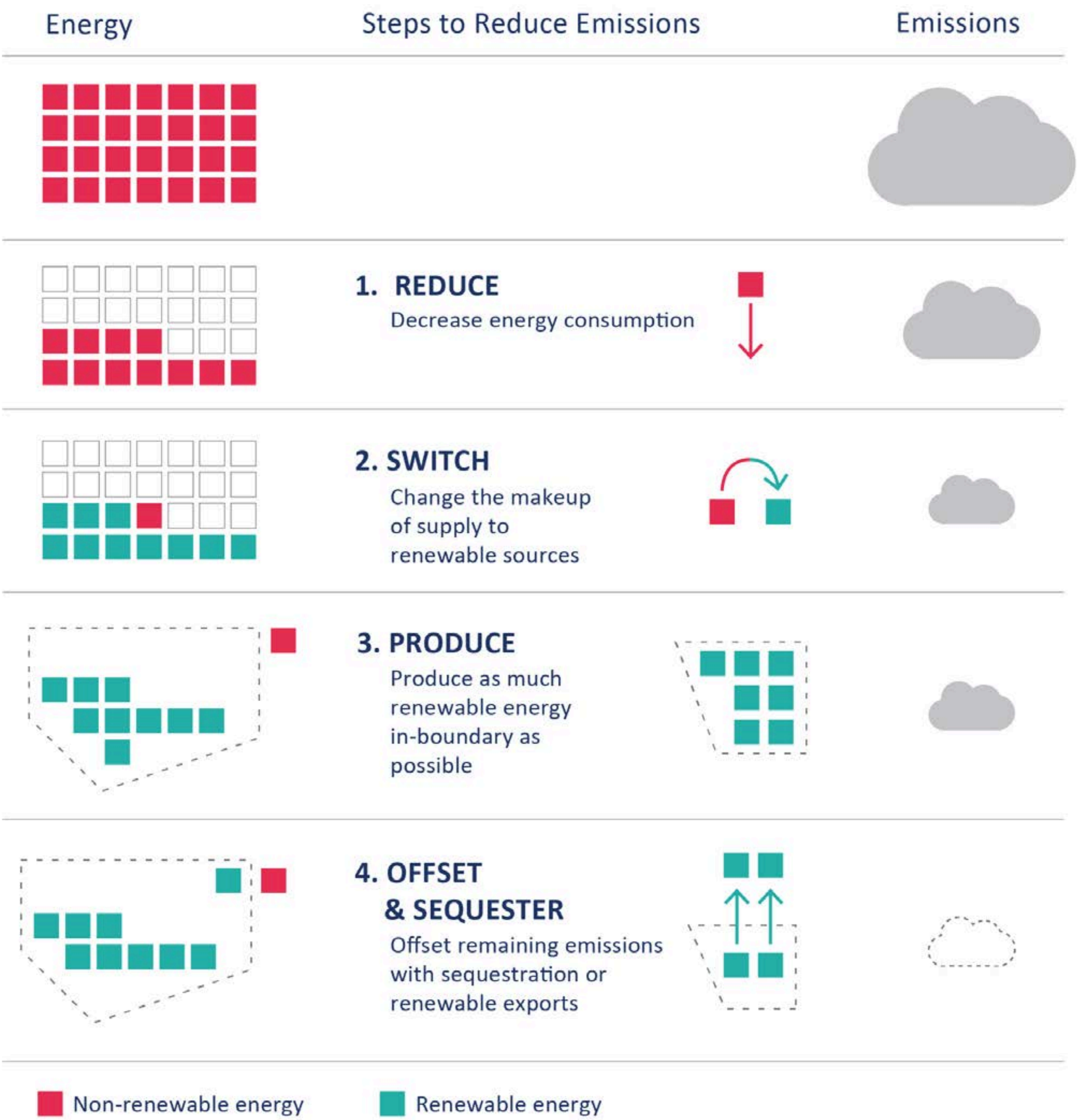



*Figure 1. A systematic approach to reducing GHG emissions.*

## 1.5 Scope of the PCAP

The geographic scope for the PCAP is the Prairie Band Potawatomi Nation Reservation (Figure 2). The PCAP provides a GHG inventory and GHG reduction measures for buildings, transportation, electricity generation, wastewater, waste, and natural and working lands. Our approach is to build on the actions, knowledge, and planning that the Nation has already identified to mitigate the impacts of the changing climate.

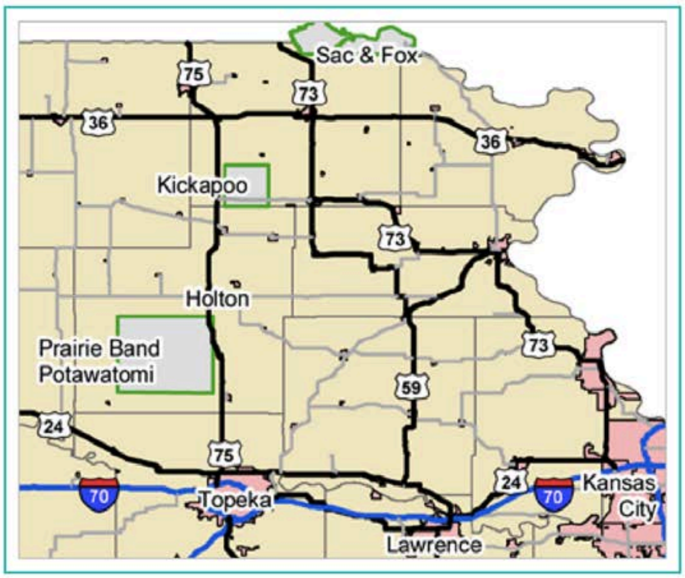



*Figure 2. Location of the PBPN in northeast Kansas. Source: Ian Fanning-Hughes, University of Kansas Graduate Student et al., "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," Final report (Kansas: University of Kansas, May 2020).*

The PCAP and CCAP target GHG emissions reductions in the highest-emitting sectors. The approach also aligns with the federal environmental justice mandates (e.g., Justice40 Initiative) set forth in Executive Order 14008, which aims to deliver 40%of the overall benefits of relevant federal investments to low-income and disadvantaged communities, sometimes referred to as "overburdened and underserved communities."[8] According to the EPA, federally recognized tribes are considered disadvantaged communities; therefore, any actions taken that will benefit the PBPN will align with the Justice40 Initiative.[9]

[8] "EPA CPRG Planning Grants Program Guidance for Tribes-Tribal Consortia-Territories."

[9] Council on Environmental Quality, "EJScreen Tool."

## 1.6 PCAP Process

The PCAP's development included four streams of activities: coordination, technical analysis, engagement, and outcomes.

Climate action measures were identified based on a synthesis of findings from a context review, a GHG inventory, and engagement. Measures were prioritized using the Reduce-Switch-Produce-Offset & Sequester framework (Figure 1) and using criteria that integrate the Tribe's priorities with the EPA's evaluation criteria for the CPRG Phase 2 implementation grants. The PBPN Tribal Council served as the key decision-making and advisory body over the PCAP's development.

The PCAP engagement process focused on gathering insights from diverse perspectives and identifying implementation-ready projects. The process focused on integrating input from across the Nation to ensure the unique priorities, community norms, and capabilities of its people were considered.

## 1.7 Engagement Findings

Prior to beginning engagement, a pre-engagement memo was developed. This memo summarized findings from previous engagement with the PBPN around climate change and resilience and provided recommendations to the PBPN on how to engage during the PCAP process. In addition, a questionnaire was developed to gather input on the PCAP priority measures from members of the Tribal Advisory Committee (TAC).

Engagement for the PCAP included meetings with the TAC, the Tribal Council, and members of the greater PBPN community. Each group was provided with an overview of the climate pollution reduction planning project and the intent of the two phases, the short-term priority climate action plan, and the longer-term comprehensive climate action plan. In general, all three groups are most excited about the potential development of renewable energy sources that can be used in buildings and homes. Their greatest concerns are having or acquiring staffing for the implementation of the proposed projects, both in the short and long term, and having the ability (staffing and finances) to maintain these new resources over time.

The first two meetings were held with members of the TAC and the Tribal Council in an effort to obtain their input and insights on goals, objectives, issues, and concerns related to reducing greenhouse gas emissions within their respective departments. Members noted a variety of current and proposed projects happening in various stages from planning to construction, along with some issues such as limitations placed on the Nation regarding solar and their ability to reduce their dependence on outside utility companies (energy sovereignty). This was seen as an opportunity to update and add codes that would promote long-term sustainability practices, from land management to building codes, and was noted as essential to achieving a variety of their goals. They were also very excited about the potential to create greater connectivity throughout the Nation by expanding their existing trail system, which would provide the community with options for getting from their homes to important locations like the casino and the health center without needing to use a car. Outreach and education of all members were seen as other important elements that should be included in projects. In their words, “Let's do it all!”

The community meeting was an opportunity to discuss climate change and action over a shared meal. Members of the community, including young people, shared their concerns and ideas about how climate change has been impacting them and the Nation. They want to play a role in the solutions but also want to know how small actions can result in big changes. They, like the TAC and Tribal Council, are excited about the potential for using renewable energy and the ability to make electricity more affordable and efficient. Protecting and conserving water resources and working with landowners to improve water quality throughout the Nation was also expressed as being very important. They also noted the importance of education and outreach efforts to provide homeowners with the necessary information to conserve resources like water and electricity and improve the health of their homes and families. They suggested getting elder tribal members involved, as well as reaching out to the Boys and Girls Club and the school to get young people involved. The community members also had the mindset of not holding back and “doing it all.”

# 2 Project Background

## 2.1 Prairie Band Potawatomi Nation Overview

The Potawatomi Nation consists of several groups that originated in the present-day Great Lakes Region. Since the first contact with non-Indians in 1641, the Potawatomi Nation has experienced a history of stolen land, broken treaties, and forced migration that led to the establishment of the Prairie Band Potawatomi Nation Reservation and community in 1846. Other Potawatomi bands include the Nottawaseppi Huron Band of the Potawatomi, Citizen Band Potawatomi Nation, Forest County Potawatomi, Wasauksing First Nation, Pokagon Band of Potawatomi, Match-E-Be-Nash-She-Wish Band of Potawatomi Indians, and Walpole Island First Nation.[10]

The Prairie Band Potawatomi Nation is a federally recognized tribe. The Nation is sovereign and has a government-to-government relationship with the federal government and the state of Kansas. The Nation has 4,841 registered members spread primarily across North America. Approximately 870 registered Tribal members live on the Nation's reservation, making up roughly 60% of the reservation population of 1,529.[11] In terms of demographics, the PBPN community has a high proportion of veterans (10% of the population are veterans, higher than the US average of 6%) and of youth under 18 years old (28% are under 18 years old, which is higher than the US mean of 22%).

### 2.1.1 Tribal Governance

The Prairie Band Potawatomi Nation's Tribal government office handles the management of health and social services, police and fire stations, planning and environmental protection services, land management, and other general and administrative services. Other amenities of the Nation include the Firekeeper Golf Course, a language program building, a Boy and Girls Club facility, and an early childhood education and senior center. Overall, the Nation has 56 commercial structures.[12]

[10] "Other Potawatomi Nations," Prairie Band Potawatomi Nation, accessed March 19, 2024, https://www.pbpindiantribe.com/other-potawatomi-nations/.

[11] US Census Bureau, "Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile."

[12] Prairie Band Potawatomi Nation. "Request for Proposal - Climate Pollution Reduction Planning for the Prairie Band Potawatomi Nation," 2023.

The Prairie Band Potawatomi Nation's Tribal Council includes seven elected leaders with both legislative and executive powers.[13] This Council comprises the chairman and six council members. Additionally, a general manager is appointed by the Council to administer daily operations. The Tribal Council is elected every four years by enrolled Tribal members who are 18 years old and older.[14]

The Prairie Band Potawatomi Nation's vision as a sovereign nation is to ensure self-sufficiency that respects diversity and equality while working within a spirit of cooperation and fairness for a high standard of living and quality of life. As a sovereign nation, it strives to provide an environment of improved well-being by providing education, health, safety, and welfare services that value Potawatomi culture, traditions, and all resources. The Nation aims to accomplish this for all generations with a system of value-based management that respects all views.[15]

## 2.1.2 Community Context

### 2.1.2.1 Geography and Land

The Nation governs a reservation located in north-central Jackson County, Kansas, about 80 miles northwest of Kansas City, Missouri, and 20 miles north of Topeka, Kansas. Currently encompassing 121 square miles, the PBPN Reservation was established by treaty in 1846 and is the largest reservation in the state of Kansas.[16] The Nation has 4,841 enrolled Tribal members, with 300 Tribal employees. Land ownership in the reservation is divided between Tribal ownership or trust (approximately 46.2%), which includes Tribal Trust, Tribal Fee, Tribal Allotment, and Individual Allotment, and non-Tribal/private ownership (53.8%), which includes land that is owned and controlled by non-Tribal members and that is not held in trust.[17]

The PBPN Reservation is situated in the Soldiers Creek Watershed and within three distinct ecoregions, including Flint Hills, Corn Belt Plains, and Central Irregular Plains. Ecosystem types historically transitioned from oak/hickory forests in the east to tallgrass prairie in the west. The Flint Hills ecoregion has the largest remaining intact tallgrass prairie across the

---

[13] Prairie Band LLC. "Profile." Accessed February 28, 2024. https://prairiebandllc.com/prairiebandllc_dir/Profile.
[14] Prairie Band Potawatomi Nation. "Request for Proposal - Climate Pollution Reduction Planning for the Prairie Band Potawatomi Nation," 2023.
[15] "Vision and Values," Prairie Band Potawatomi Nation, accessed March 19, 2024, https://www.pbpindiantribe.com/government/values-and-vision/.
[16] Ian Fanning-Hughes, University of Kansas Graduate Student et al., "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," Final report (Kansas: University of Kansas, May 2020).
[17] Prairie Band Potawatomi Nation, "9 Critical Element Plan Soldier Creek Watershed," October 2023.

Great Plains region. Current vegetation in this ecoregion is a mix of native grasslands, cool season pasture, agricultural crops, and wooded riparian corridors along streams.[18]

PBPN is in the process of reacquiring unceded land in Dekalb County, Illinois (Figure 3). The area is not included in the scope of this PCAP because the legal process is still underway. It will be considered during the development of the CCAP.

[18] Prairie Band of Potawatomi. 2021 Land and Water Management Plan. Prepared by Ad Astra Collaborative, LLC.

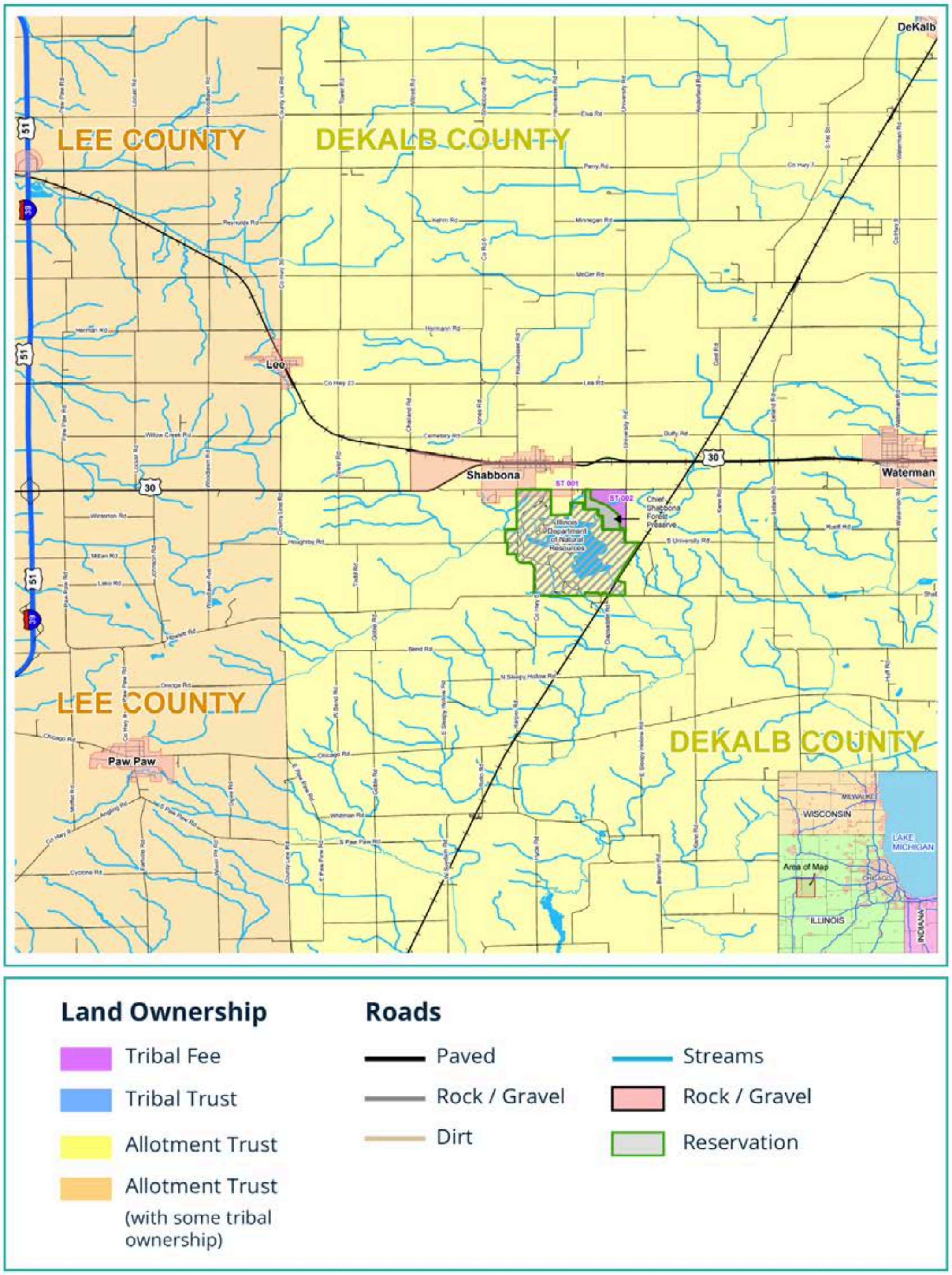



*Figure 3. Area of PBPN land reacquisition in Dekalb County, Illinois. Source: Prairie Band Potawatomi Nation.*[19]

[19] Provided by PBPN by e-mail on March 18th, 2024.

### 2.1.2.2 Water

The Nation considers water to be one of its most important natural and cultural resources. Water resources play a vital role in the overall health of the community and in many aspects of cultural heritage. Waterways provide sources of medicinal plants, recreation, and food, as well as wildlife habitat. High importance is placed on protecting and restoring the Soldiers Creek Watershed to enhance the water quality and water resources on the reservation, as well as downstream within the watershed and the Kaw (Kansas) River (Figure 4).[20] Aquatic resource protection is linked to terrestrial resource protection, cultural resources, and community values. Water quality is partially impaired within the watershed due to sediment from runoff from agricultural land (nutrient, pesticide, fecal coliform bacteria) and from septic/sewage systems.

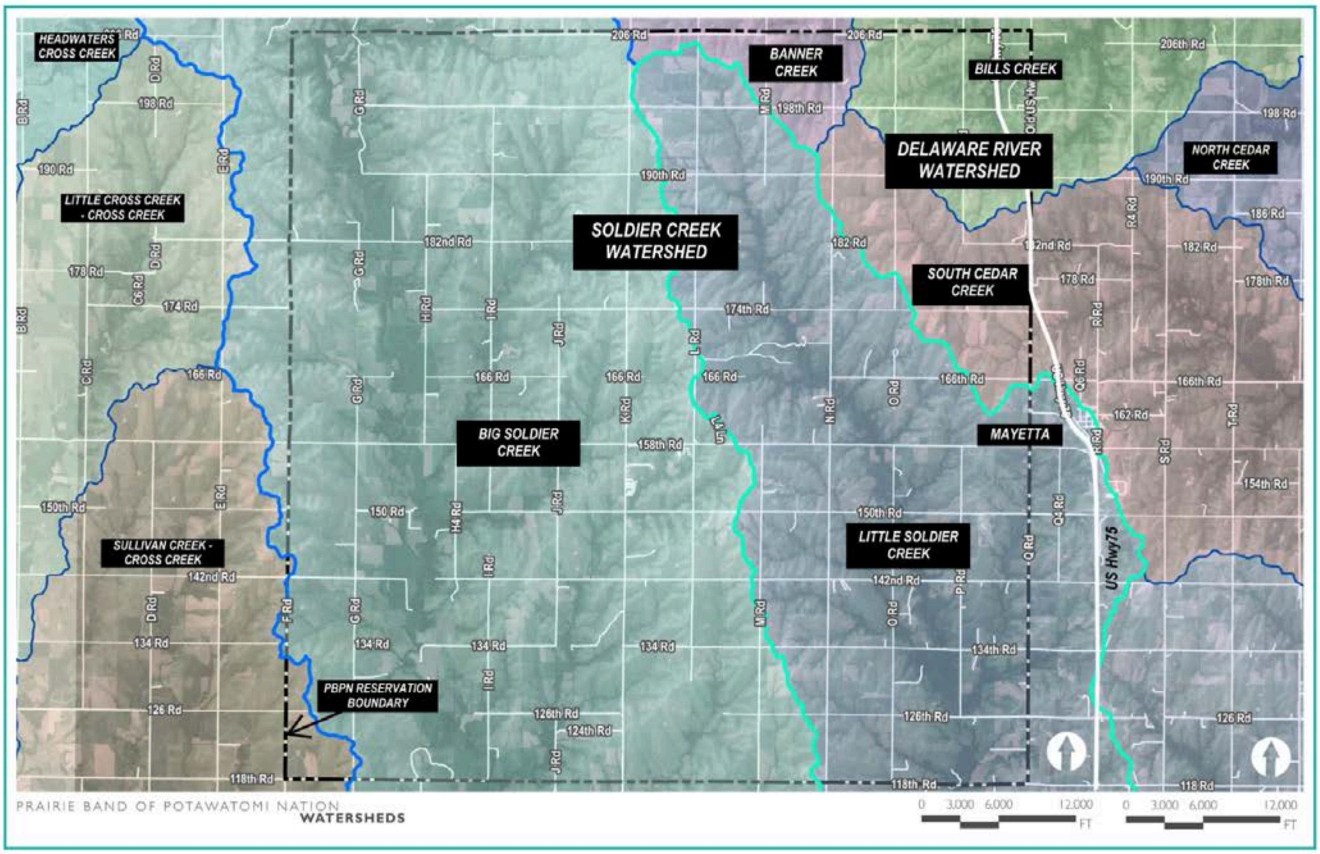



*Figure 4. Watersheds within the PBPN Reservation boundaries.[21]*

[20] Prairie Band Potawatomi Nation. "9 Critical Element Plan Soldier Creek Watershed," October 2023.

[21] Prairie Band Potawatomi Nation, "9 Critical Element Plan Soldier Creek Watershed."

The quality and quantity of groundwater is currently considered insufficient for long-term, sustainable use, so most drinking water is purchased from Rural Water District #3 (Jackson County). The primary source is from the Banner Creek Reservoir located outside of the northeastern boundary of the reservation in the Delaware River watershed.

#### 2.1.2.3 Forests and Grasslands

The PBPN Reservation contains approximately 7,200 acres of forests (about 9% of the total reservation lands). The majority of forest cover is riparian, located along streams. Grasslands constitute approximately 65% (50,500 acres) of the land cover across the reservation. Most grasslands are brome, with some areas comprising native hay meadows, grasses, and wildflowers. Native grasses are also adjacent to the wooded riparian corridors and in restored native pasture and hay meadows along the northern end of the South Branch of Soldier Creek.[22]

#### 2.1.2.4 Agricultural Land Use

Agricultural land use includes row-crop production, native and non-native grasslands, and livestock pastures. Croplands cover 18% (18,400 acres) of the reservation's lands. A total of 16,426 acres of croplands are on Tribal trust or restricted fee lands, and therefore, are mostly managed by the PBPN (i.e., over 98%). Crops grown are 75% hay and 25% row crops. The Agricultural Resource Management Plan provides information on conservation practices, vegetation cover, grassland and vegetation management, soil erosion mitigation, tillage, and buffers for riparian and windbreak plantings. In addition, the Nation stewards a herd of more than 300 bison.

[22] Prairie Band Potawatomi Nation and Ad Astra Collaborative, "Prairie Band Potawatomi Nation Land and Water Management Plan," December 22, 2021.

### 2.1.2.5 Economy

The PBPN's economy predominantly relies on agriculture (in collaboration with the Kansas Department of Agriculture), the Prairie Band Casino and Resort (opened in 1996 and in collaboration with the US Department of Interiors), and Prairie Band LLC, the Nation's business entity, which operates a diverse economic portfolio.[23]

The median household income, the employment rate, and the poverty rate are about the same as the US national average. In 2022, the median household income was $75,000; the employment rate was 58%; and the poverty rate was 13%. About 8% of the population living within the bounds of the reservation does not have health insurance.

### 2.1.2.6 Housing

There are 191 fully occupied Tribal homes on the reservation. Approximately 74% of the 575 residential units on the reservation are owner occupied, higher than the US average of 65%.[24] Eighty percent of the population lives in single-detached homes.[25] Median gross monthly rent averages $550.[26] PBPN Housing provides rental, senior rental, and rent-to-own housing opportunities for Tribal members. Rental housing includes 16 apartment units (one to three bedrooms), four single-family units with three bedrooms, 30 additional housing units acquired through Tribal land acquisition purchase (one to six bedrooms), and Low-Income Housing Tax Credit (LIHTC) units (13 single-family units and 12 duplex units). Senior housing is available to Tribal members aged 55 years and older. Senior housing includes 20 duplex units, 16 low-rent units, and 15 LIHTC 2-bedroom apartments. Twenty-six single-family units, ranging from three to six bedrooms in size, are available via the rent-to-own housing program.[27]

---

[23] Fanning-Hughes, and Schweinberg. "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," May 2020.
[24] Prairie Band Potawatomi Nation. "Request for Proposal - Climate Pollution Reduction Planning for the Prairie Band Potawatomi Nation," 2023.
[25] Federal Reserve Bank of Minneapolis, "Native Community Data Profiles | Federal Reserve Bank of Minneapolis," accessed March 19, 2024, https://www.minneapolisfed.org/indiancountry/resources/native-community-data-profiles.
[26] "Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile," accessed March 5, 2024, https://data.census.gov/profile/Prairie_Band_of_Potawatomi_Nation_Reservation,_KS?g=2500000US2980.
[27] "Housing," Prairie Band Potawatomi Nation, accessed March 19, 2024, https://www.pbpindiantribe.com/housing/.

### 2.1.2.7 Transportation

PBPN's General Public Transportation provides transportation service to all residents of the reservation, Jackson County, and Shawnee County. Public transportation is used for medical-, nutrition-, recreation-, and employment-related trips. There are three accessible lift minivans and one back-up 12-passenger bus. In addition to transport, vehicles provide emergency communication services in bad weather. Road conditions (i.e., unpaved roads) limit service availability. Seventy-one percent of people drive alone to go to work, while 18.4% carpool. Public transportation is only used by 0.5% of people, while 9.2% work from home.[28]

Electric vehicles are not widespread within the reservation or in the region. There are only about 11,900 registered EVs, compared to more than 2 million gas and diesel powered vehicles.[29] Kansas has 518 EV stations, and 1,119 charging ports, which is more than Iowa or Nebraksa but about half as many as Missouri.[30] The nearest EV charging station to the Nation is at the Kickapoo Tribe's Golden Eagle Casino, and there are no EV charging stations between Topeka and Holton.[31] This gap represents a potential economic opportunity for the PBPN.

[28] "Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile," accessed March 5, 2024, https://data.census.gov/profile/Prairie_Band_of_Potawatomi_Nation_Reservation,_KS?g=2500000US2980.
[29] "Alternative Fuels Data Center: Vehicle Registration Counts by State," accessed March 19, 2024, https://afdc.energy.gov/vehicle-registration.
[30] "Alternative Fuels Data Center: Alternative Fueling Station Counts by State," accessed March 29, 2024, https://afdc.energy.gov/stations/states.
[31] Native Energy Resources Counsel, LLC et al., "Prairie Band Potawatomi Nation Tribal Utility Feasibility and Options Analysis Report," January 20, 2023.

### 2.1.2.8 Energy Systems and Clean Energy Potential

PBPN is served by non-Tribal water, sewer, energy, communications, solid waste, and other utility service providers.[32] Electricity is the primary type of energy used. Grid electricity does include some renewable resources, but Evergy, the utility that generates the electricity used by PBPN, still relies on coal and natural gas to provide electricity (Figure 5). Evergy has a goal to achieve a 70% carbon reduction by 2030 and net-zero emissions by 2045 relative to 2005 levels.[33]

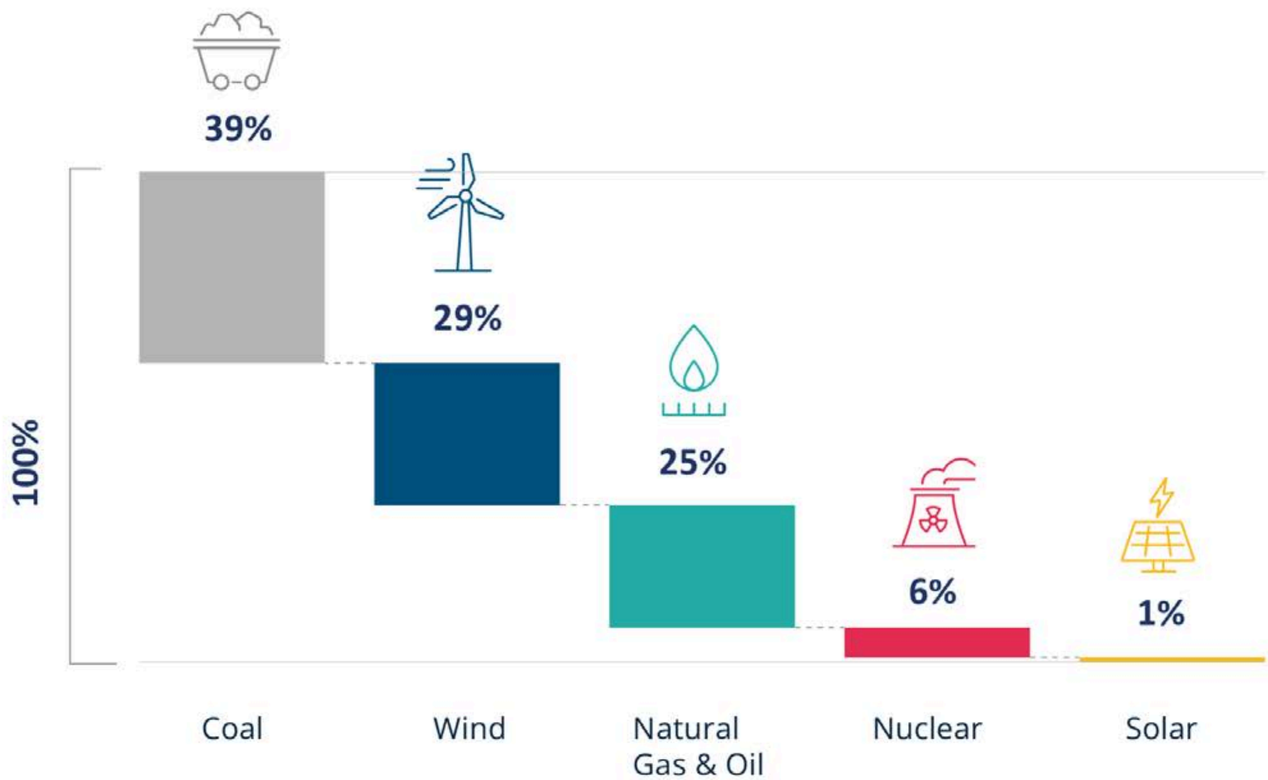



*Figure 5. Evergy's electricity generation by resource (2022).*[34]

[32] Native Energy Resources Counsel, LLC et al., "Prairie Band Potawatomi Nation Tribal Utility Feasibility and Options Analysis Report," January 20, 2023.
[33] Evergy, "Fourth Quarter 2023 Earnings Presentation," https://investors.evergy.com/static-files/eba56800-70a1-46b4-84e4-925ef1b7cc4f.
[34] Evergy, "Our Energy Mix," evergy.com, accessed March 19, 2024, https://www.evergy.com/smart-energy/renewable-resources-link/our-energy-mix. Percentages have been rounded to add up to 100%.

Propane is commonly used on the reservation for space and water heating, cooking, and as fuel for machines such as forklifts. The propane used on the reservation is sold by Prairie Band Propane, one of the six subsidiaries of Prairie Band, LLC.[35]

Wood stoves are also used for heating. The Nation keeps track of the wood stoves that are being used on the reservation as part of the wood delivery program through a spreadsheet titled, “Wood Stove Inventory Database.” The Nation’s Building Maintenance Program provides wood to Tribal members who are 50 years old and older. There are at least 36 wood stoves ranging from new to 20+ years old currently in use on the reservation.

Areas within the PBPN have great potential for renewable energy projects. In general, wind power classes are rated from one to seven. A wind power class of three or above is suitable for utility-scale power generation. A comprehensive study conducted by the Nation in 2006, and reviewed by the National Renewable Energy Laboratory in 2022, found that wind resources on the reservation are mostly class 2 and class 3, with some class 4 in the northeast portion. According to the Tribal Energy Atlas, the total potential capacity for utility-scale wind energy on the reservation is 820 MW, with a generation potential of 3,048,387 MWh. The reservation has a similarly high solar energy potential estimated at 6,756 MW of potential utility-scale PV and potential generation of 10,965,043 MWh.

The Nation is already using renewable resources in conjunction with some facilities. For example, the Boys and Girls Club is in the process of installing a 34 kW ground-mount solar generation system. In addition, the Nation’s Justice Center has an operational ground-source heat pump, which runs on a combined 224 kW solar and geothermal system.

[35] Native Energy Resources Counsel, LLC et al., “Prairie Band Potawatomi Nation Tribal Utility Feasibility and Options Analysis Report,” January 20, 2023.

# 2.2 Climate Change Impacts, Risks, and Actions

Human activities such as fossil fuel burning, industrial processes, deforestation, agriculture, etc. are changing the climate.[36] These activities release large amounts of carbon dioxide, methane, nitrous oxide, and other gases that trap heat in the atmosphere, contributing to the Earth's greenhouse effect. These gases remain in the atmosphere for significant periods of time, contributing to long-term changes in the climate, and they vary considerably in terms of Global Warming Potential (GWP), a concept developed to compare the ability of each GHG to trap heat in the atmosphere.

As a result of increases in the atmospheric concentrations of these heat-trapping gases, the average temperature of the planet has increased about 2°F (1.1°C) since the late 1800s.[37] The Paris Agreement calls for limiting global warming to "well below 2°C" relative to preindustrial temperatures, and preferably to 1.5°C. If the global average temperature increases above 2ºC, the average temperature across the United States is very likely to increase between 4.4°F and 5.6°F (2.4°C and 3.1°C), with the northern and western regions experiencing proportionally greater warming.

Climate change is a particularly complex challenge because it occurs over a relatively long timescale, with impacts that vary from region to region. Equally complex are its solutions. Climate actions that reduce GHG emissions, change energy and transportation systems, and provide resiliency will transform all aspects of human endeavors over a short and urgent time frame.

[36] USGCRP, 2023: The Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. US Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.
[37] USGCRP, 2023: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. US Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023

## 2.2.1 Impacts and Risks to the Prairie Band Potawatomi Nation

PBPN undertook a community vulnerability assessment to inform its Community Resilience Plan.[38] The goal was to identify the community's risks and vulnerabilities to human-induced and natural hazards and to identify the critical infrastructure, services, and assets necessary for the operational resiliency of the community. The climate-related hazards include extreme precipitation, hailstorm, winter storm, flooding, windstorm, extreme temperature, tornados, and drought.[39]

According to the US Vulnerability Index,[40] the PBPN reservation is in an area that ranks at the 74th national vulnerability percentile for social and economic vulnerabilities, vulnerability to extreme events, and health vulnerabilities (Table 2). While the US Vulnerability Index gives general indications about a region's vulnerability to certain impacts of climate change, it is not specific to PBPN. However, considering that agriculture is an important part of the Nation's economy, the consequences of a severe drought, river flooding, or wildfires could be dramatic. Extreme weather is a high risk for PBPN, and it poses a high risk to human life, natural systems, and property. Residential energy costs are also expected to increase significantly by 2100. The PCAP measures have taken these risks and vulnerabilities into consideration.

[38] Fanning-Hughes, and Schweinberg. "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," May 2020.
[39] Prairie Band Potawatomi Tribal Land Office and Tribal Emergency Response Committee, "Hazard Mitigation Plan."
[40] Environmental Defense Fund, "Climate Impacts in Mayetta, KS."

*Table 2. Most important risk and vulnerabilities due to climate change for the region where PBPN is situated, according to the US Vulnerability Index.*

| Risk or Vulnerability Category | Subfactor | Percentile |
|---|---|---|
| **Social and economic** | | |
| **Expected economic and productivity losses due to climate change** | | **94th percentile** |
| | **expected annual loss of agriculture value** | **94th percentile** |
| | **expected lower crop yields** | **93rd percentile** |
| | expected annual loss of population | 88th percentile |
| | risk for outdoor workers | 67th percentile |
| | high climate risk jobs productivity | 66th percentile |
| | expected annual loss of building value | 65th percentile |
| Transition risks[41] | | 87th percentile |
| | residential energy expenditure | 89th percentile |
| | state energy-related carbon dioxide emissions | 78th percentile |
| Projected costs of climate disasters | | 70th percentile |
| | expected risks of requiring **Federal Emergency Management Agency hazard mitigation grants** | **98th percentile** |
| | wildfire risks to property | 84th percentile |

[41] Indicates how climate change threatens farming and energy costs.

| Risk or Vulnerability Category | Subfactor | Percentile |
|---|---|---|
| Extreme events | | 60th percentile |
| | Extreme temperatures | 83rd percentile |
| | Wildfire risk | 82nd percentile |
| | Extreme storms | 43rd, which includes **tornadoes at 99th**, winter weather at 52nd |
| Health | | 27th percentile |
| | vulnerability to temperature-related death | 65th percentile |
| | **increase in ozone-related mortality** | 91st percentile |

## 2.3 Other PBPN Climate Policies and Plans

PBPN has undertaken several climate mitigation and adaptation studies and plans to gain a better understanding of the impacts and opportunities the Nation faces due to climate change. The Nation has detailed multiple opportunities and challenges in regard to the changing climate. Most of the PCAP measures included in Section 4 have been identified and integrated as priority measures from the following documents:

- Agriculture Management Plan (2015)
- Hazard Mitigation Plan (2017)
- Strategic Energy Plan (2020)
- Utility Feasibility Study (2023)
- Community Resilience Plan (2020)
- Tribal Resilience Outreach (2023)
- PBPN Land and Water Management Plan (2021)
- PBPN Tribal Resilience Outreach (2022)
- PBPN 9 Critical Element Plan—Soldier Creek Watershed (2023)

## 2.4 Key Observations

The Prairie Band Potawatomi Nation's vision as a sovereign nation is to ensure self-sufficiency that respects diversity and equality while working within a spirit of cooperation and fairness for a high standard of living and quality of life. As a sovereign nation, it strives to provide an environment of improved well-being by providing education, health, safety, and welfare services that value Potawatomi culture, traditions, and all resources. The Nation aims to accomplish this for all generations with a system of value-based management that respects all views.[42] The PBPN considers water to be one of its most important natural and cultural resources. Water resources play a vital role in the overall health of the community and in many aspects of cultural heritage. Waterways provide sources of medicinal plants, recreation, and food, as well as providing wildlife habitat.

[42] "Vision and Values," Prairie Band Potawatomi Nation, accessed March 19, 2024, https://www.pbpindiantribe.com/government/values-and-vision/.

The PBPN's economy predominantly relies on agriculture, the Prairie Band Casino and Resort, and the Prairie Band LLC, the Nation's business entity that operates a diverse economic portfolio.[43] Agricultural land use includes row-crop production, native and non-native grasslands, and livestock pastures. Croplands cover 18% (18,400 acres) of the reservation's lands. A total of 16,426 acres of croplands are on Tribal trust or restricted fee lands, and therefore, are mostly managed by the PBPN (i.e., over 98%). Crops grown are 75% hay and 25% row crops.

PBPN is served by non-Tribal water, sewer, energy, communications, solid waste, and other utility service providers.[44] Grid-supplied electricity is the primary type of energy used, which still relies primarily on coal and natural gas to provide electricity. Evergy, the local utility, has set a goal to achieve a 70% carbon reduction by 2030 and net-zero emissions by 2045 relative to 2005 levels.[45] In addition to electricity use, propane and wood heating are commonly used for space and water heating, cooking, and as fuel for machines such as forklifts. These uses represent opportunities to switch to renewable energy to improve resilience and reduce energy costs in addition to reducing emissions.

PBPN has a high potential for renewable energy projects, including wind power classes suitable for utility-scale power generation, a total potential capacity for utility-scale wind energy of 820 MW, and a generation potential of 3,048,387 MWh. The reservation has a similarly high solar energy potential estimated at 6,756 MW of potential utility-scale PV and potential generation of 10,965,043 MWh.

The Nation is already using renewable resources in conjunction with some facilities. For example, the Boys and Girls Club is in the process of installing a 34 kW ground-mount solar generation system. In addition, the Nation's Justice Center has an operational ground-source heat pump, which runs on a combined 224 kW solar and geothermal system.

---

[43] Fanning-Hughes, and Schweinberg. "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," May 2020.
[44] Native Energy Resources Counsel, LLC et al., "Prairie Band Potawatomi Nation Tribal Utility Feasibility and Options Analysis Report," January 20, 2023.
[45] Evergy, "Fourth Quarter 2023 Earnings Presentation," https://investors.evergy.com/static-files/eba56800-70a1-46b4-84e4-925ef1b7cc4f.

PBPN has undertaken several climate mitigation and adaptation studies and plans to gain a better understanding of the impacts and opportunities it faces due to climate change. It has detailed multiple opportunities and challenges in regard to the changing climate. Most of the PCAP measures included in Section 4 have been identified and integrated as priority measures from these plans.

**Given the research and analysis that the PBPN has undertaken over the past decade, there is a solid foundation of local and regional information on climate impacts, opportunities, and threats that can be built upon to reduce GHG emissions and strengthen the Nation's resilience.**

# 3 Greenhouse Gas Inventory

## 3.1 GHG Emissions by Sector

In 2021, PBPN's GHG emissions totaled 22,554 $MtCO_2e$, or about 15 $MtCO_2e$ per person. These emissions were produced by activities in residential buildings (13%) and commercial/institutional buildings (46%) and by transportation (40%) (Figure 6). These emissions are primarily due to direct or indirect fossil fuel use—for example, the use of gasoline to power vehicles, the use of coal and natural gas to generate electricity, and the use of propane to provide heating and cooking energy.


*Figure 6. PBPN's GHG emissions by sector, excluding natural and working lands, 2021. Source: SSG analysis.*

Natural and working lands provide annual sequestration of 77,600 Mt$CO_2$e (Figure 7). This is 3.4 times the reservation's total GHGs emitted. Although this natural carbon sequestration offsets the reservation's GHG emissions from human activities, global deforestation emissions are currently higher than the global natural carbon sequestration. With an increasing global GHG emissions trajectory and increasing atmospheric GHGs, the Earth's carbon budget is unable to offset global GHG emissions from human activities.[46] In this case, only new and additional increases in total global natural carbon sequestration will provide a true offset to human-generated GHG emissions.

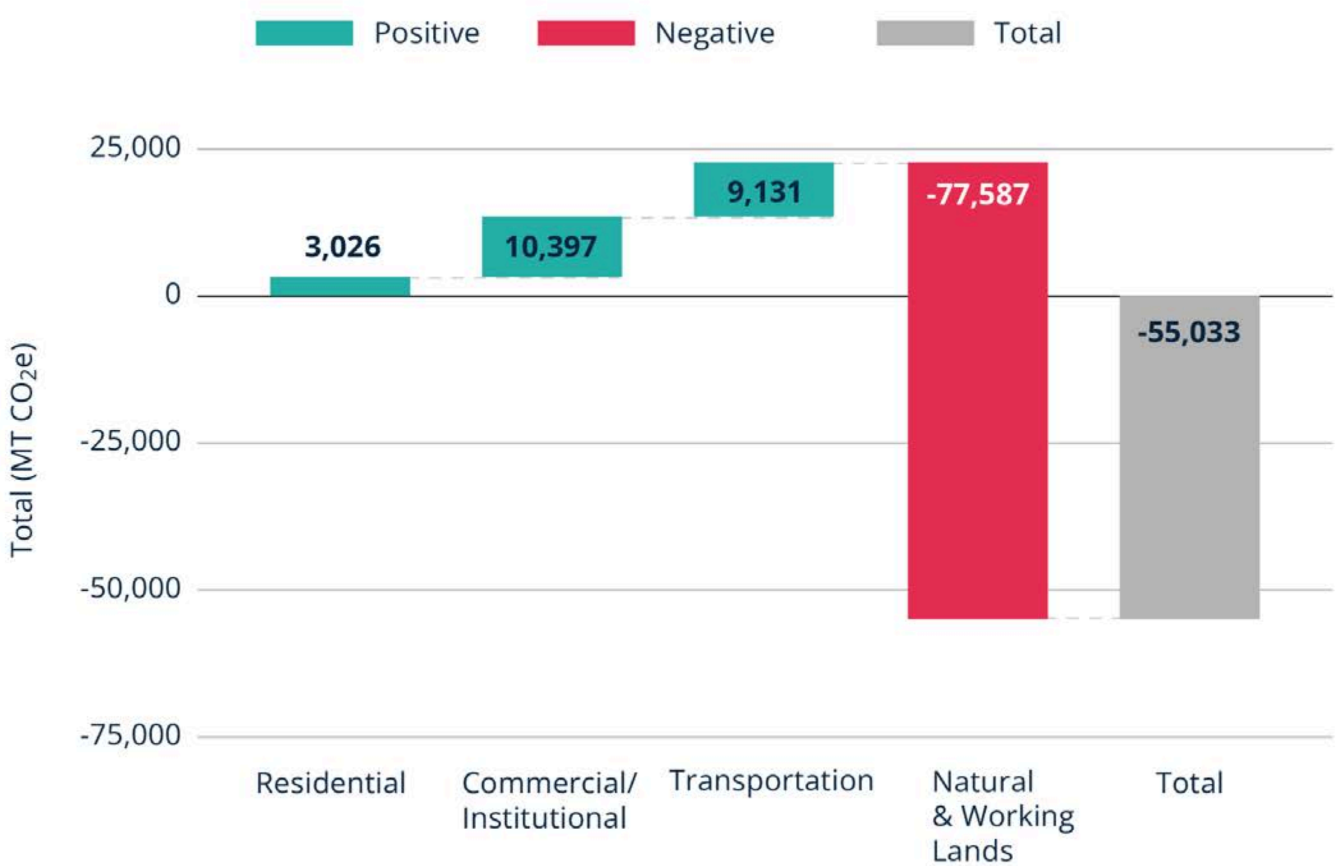



*Figure 7. PBPN's GHG emissions by sector, including natural and working lands, 2021. Source: SSG analysis.*

[46] Pierre Friedlingstein et al., "Global Carbon Budget 2023," Earth System Science Data 15, no. 12 (December 5, 2023): 5301–69, https://doi.org/10.5194/essd-15-5301-2023.

Figure 8 illustrates the breakdown of the PBPN's GHG emissions by type of energy use (e.g., stationary, electricity, mobile, solid waste, wastewater) for each sector. Emissions in the residential, commercial, and institutional sectors result predominantly from electricity use, which accounts for 50% of total GHG emissions (11,175 $MtCO_2e$).

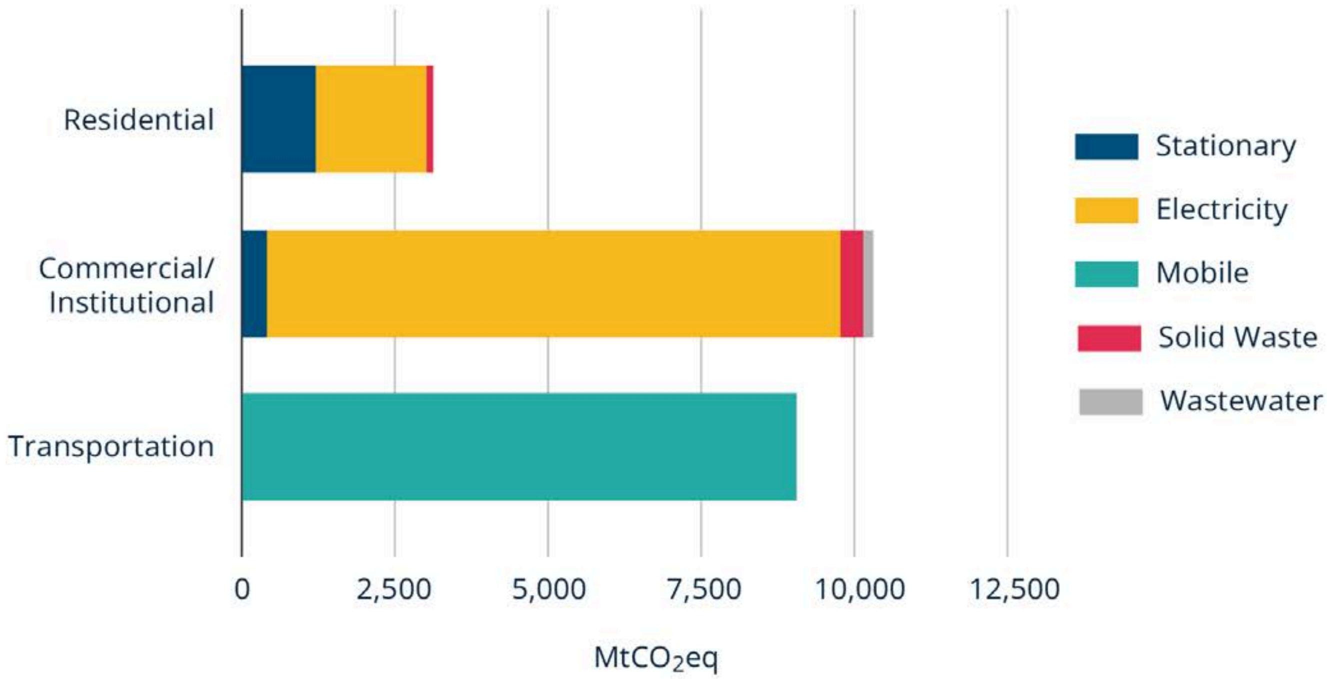



*Figure 8. PBPN's GHG emissions by energy use type for each sector, 2021. Source: SSG analysis.*

# 3.2 GHG Emissions by Energy Use Type

Overall, electricity use is the primary source of GHG emissions on the reservation (50% of the total), followed by transportation emissions (40%), stationary emissions due to propane use (7%), and solid waste and wastewater treatment (3%) (Figure 9). Reducing GHG emissions from electricity use could cut the Nation's total GHG emissions by nearly half (up to 11,000 $MtCO_2e$ annually).

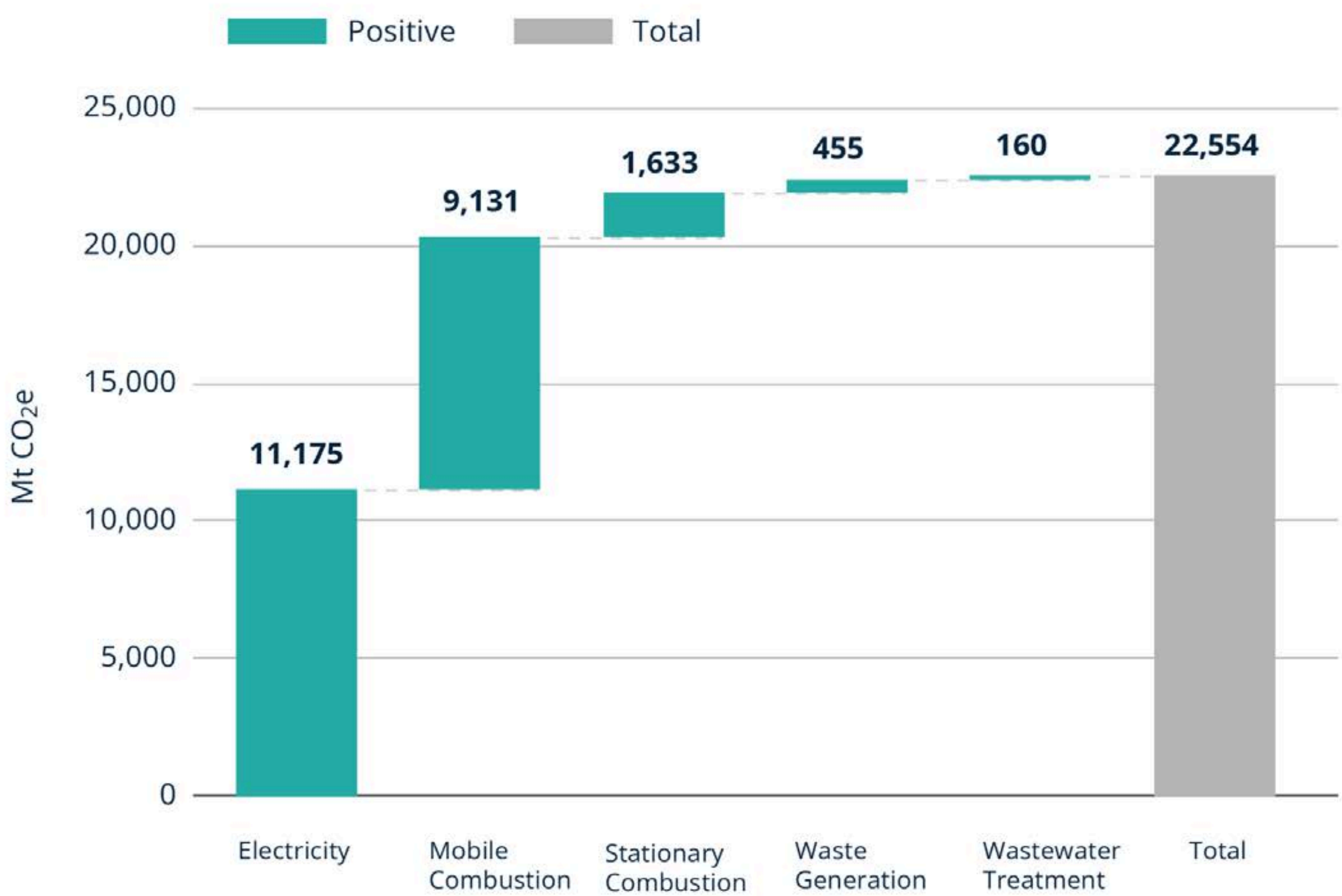



*Figure 9. PBPN's GHG emissions by energy use type, 2021. Source: SSG analysis.*

## 3.3 Emissions by Scope

GHG emission scope types are defined in Table 3, and sources by scope are illustrated in Figure 10.

*Table 3. Scopes for reporting emissions.*

| Scope | Definition |
|---|---|
| Scope 1 | GHG emissions from sources located within the boundary of the Nation. |
| Scope 2 | GHG emissions occur as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the boundary of the Nation. |
| Scope 3 | All other GHG emissions that occur outside the Nation boundary as a result of activities taking place within the boundary of the Nation. |

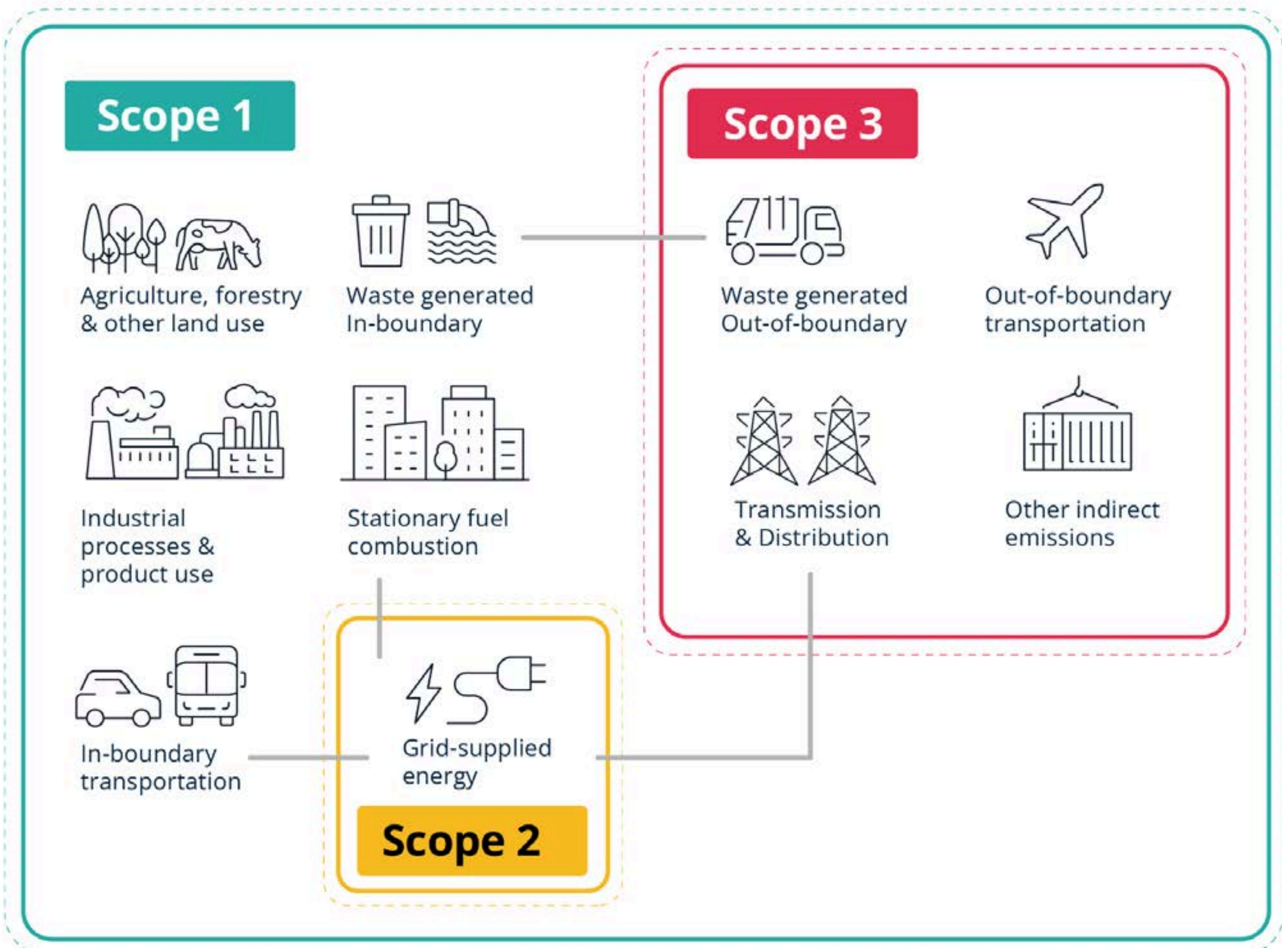



*Figure 10. Illustration of scopes. Source: SSG own elaboration.*

For the base year 2021, PBPN's scope 1 GHG emissions totaled 10,924 $MtCO_2e$, and its scope 2 GHG emissions were 11,175 $MtCO_2e$ (primarily from electricity generation outside of PBPN's boundaries). Scope 3 emissions were 455 $MtCO_2e$, resulting from waste generated within the reservation and exported outside of the Nation's boundary. Figure 11 shows the reservation's GHG emissions by scope.

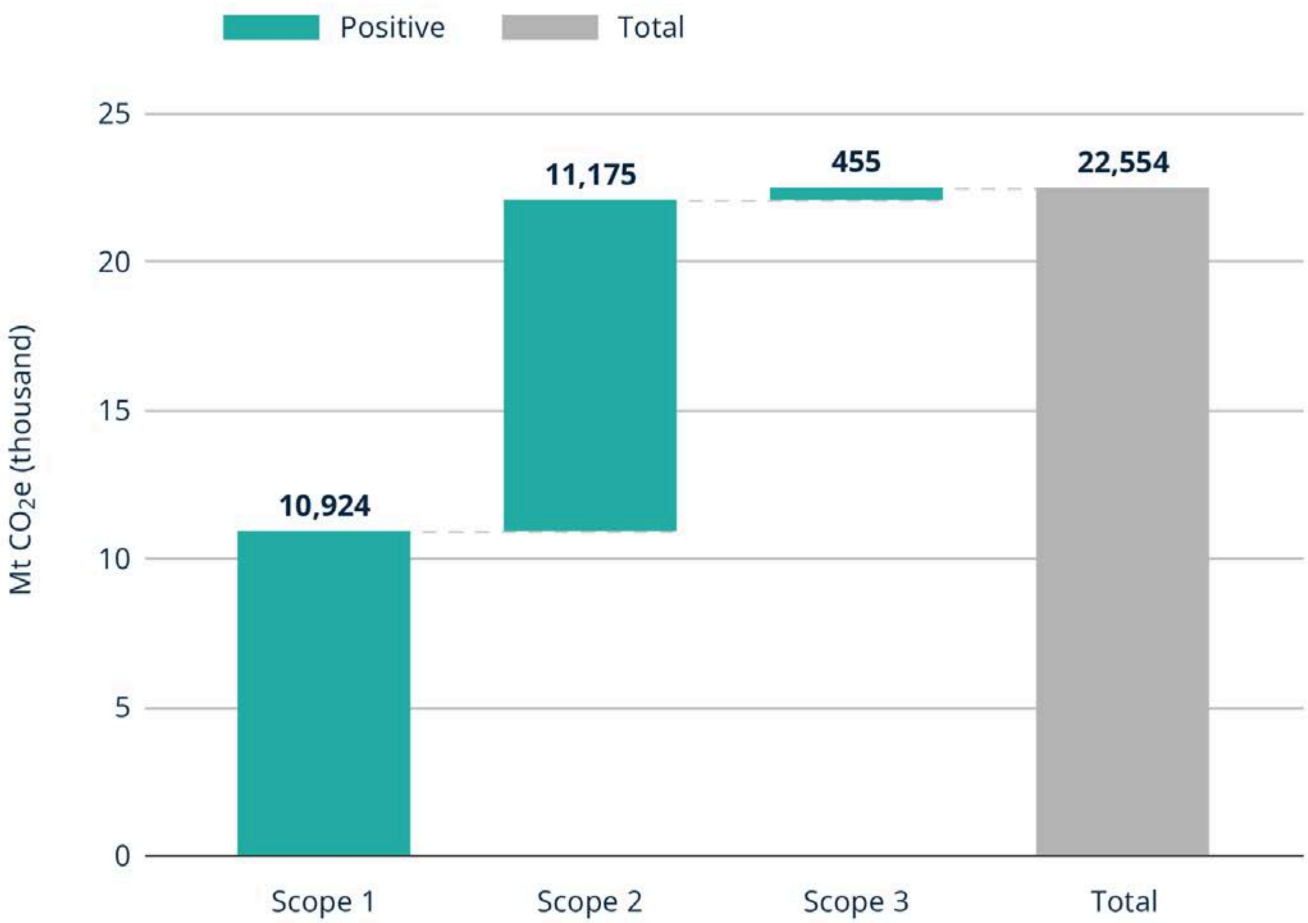



*Figure 11. PBPN's GHG emissions by scopes 1, 2, and 3, 2021. Source: SSG analysis.*

# 3.4 Emissions by GHG Type

All GHG emission types, including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxides ($N_2O$), are generally normalized to carbon dioxide equivalents or $CO_2e$ to report total emissions in a uniform manner and to incorporate the global warming potential of each gas type in relation to carbon dioxide ($CO_2$). PBPN's GHG emissions are predominantly in the form of $CO_2$ (Figure 12).

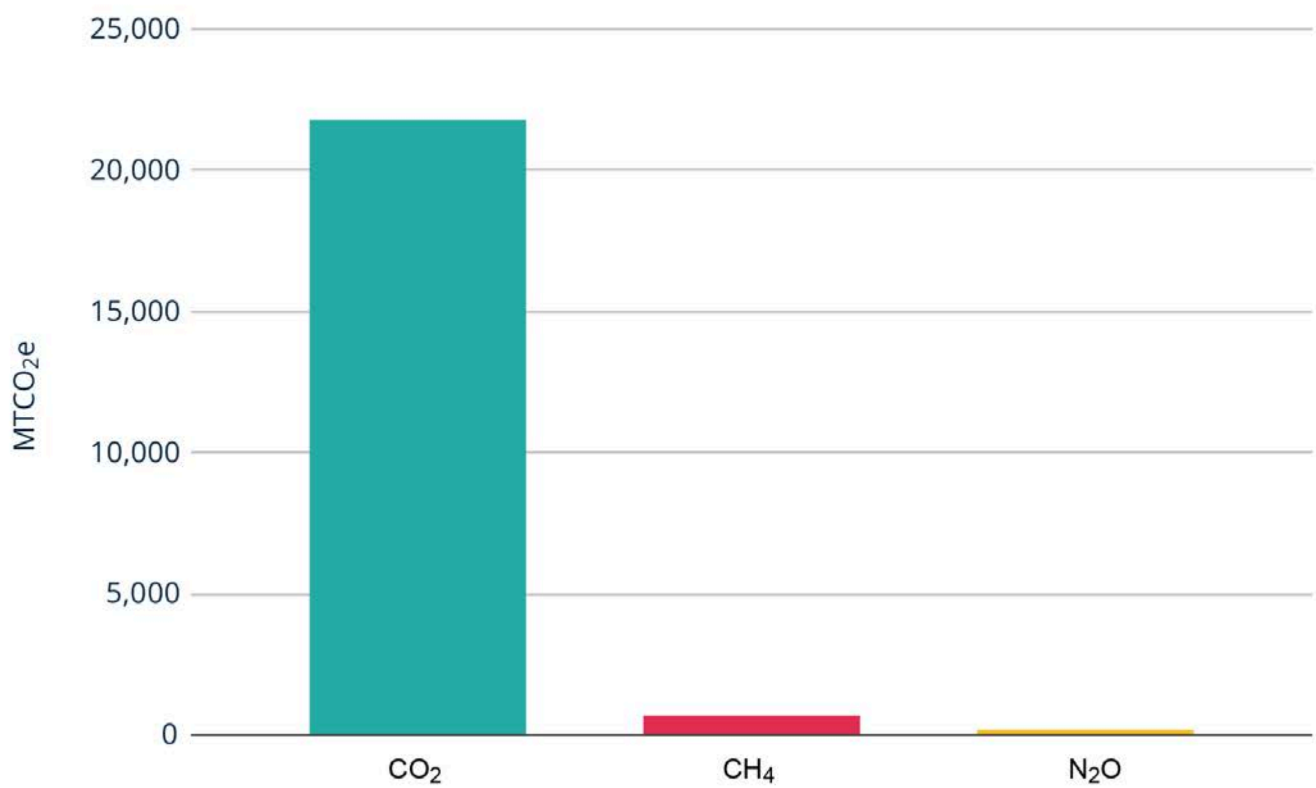



*Figure 12. PBPN's GHG emissions by GHG type, 2021. Source: SSG analysis.*

Carbon dioxide ($CO_2$) emissions are directly correlated to the combustion of fossil fuels, such as coal, oil, and natural gas. PBPN's $CO_2$ emissions are predominantly emitted due to electricity use and mobile combustion for transportation, with a smaller proportion resulting from stationary combustion (Figure 13).

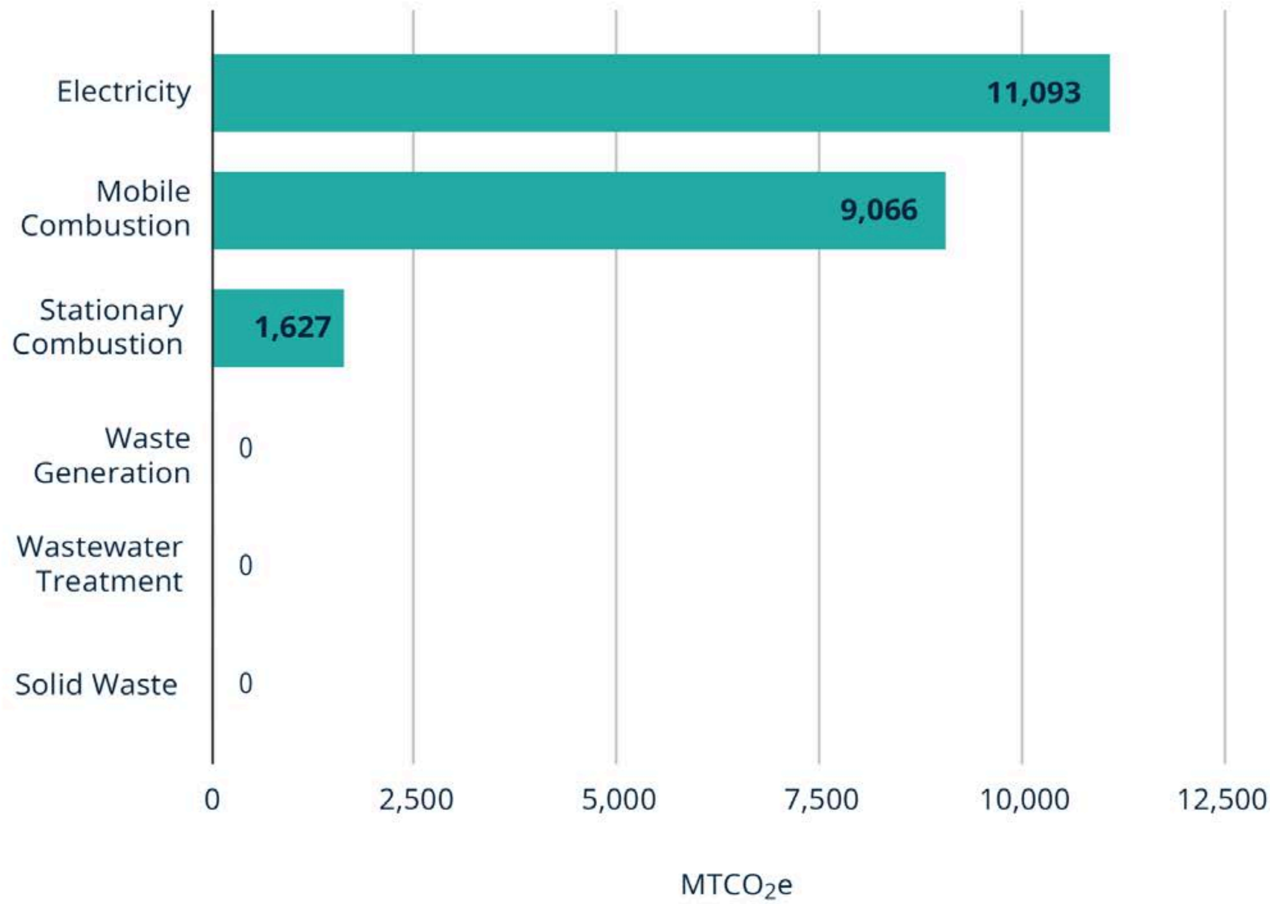



*Figure 13. PBPN's carbon dioxide ($CO_2$) emissions by activity, 2021. Source: SSG analysis. Note that the region's electricity includes coal-fired electricity.*

The largest source of methane ($CH_4$) emissions is solid waste, followed by wastewater treatment (Figure 14). Note that methane's long-term GWP is used here, shown as $MtCO_2e$. GWP is the relative ability of a gas to trap heat, and each gas has a different GWP. If methane's short-term (20-year) GWP were used instead, methane emissions would nearly triple. The impact of methane's 20-year GWP reflects the importance of reducing methane emissions in the near term, but it is not standard in GHG emissions reporting protocols to convert to carbon dioxide equivalents.


*Figure 14. PBPN's methane emissions (CH4), 2021. Source: SSG analysis.*

Nitrous oxide ($N_2O$) emissions are primarily from mobile combustion (transportation) sources and fossil fuels burned for generating electricity (Figure 15).

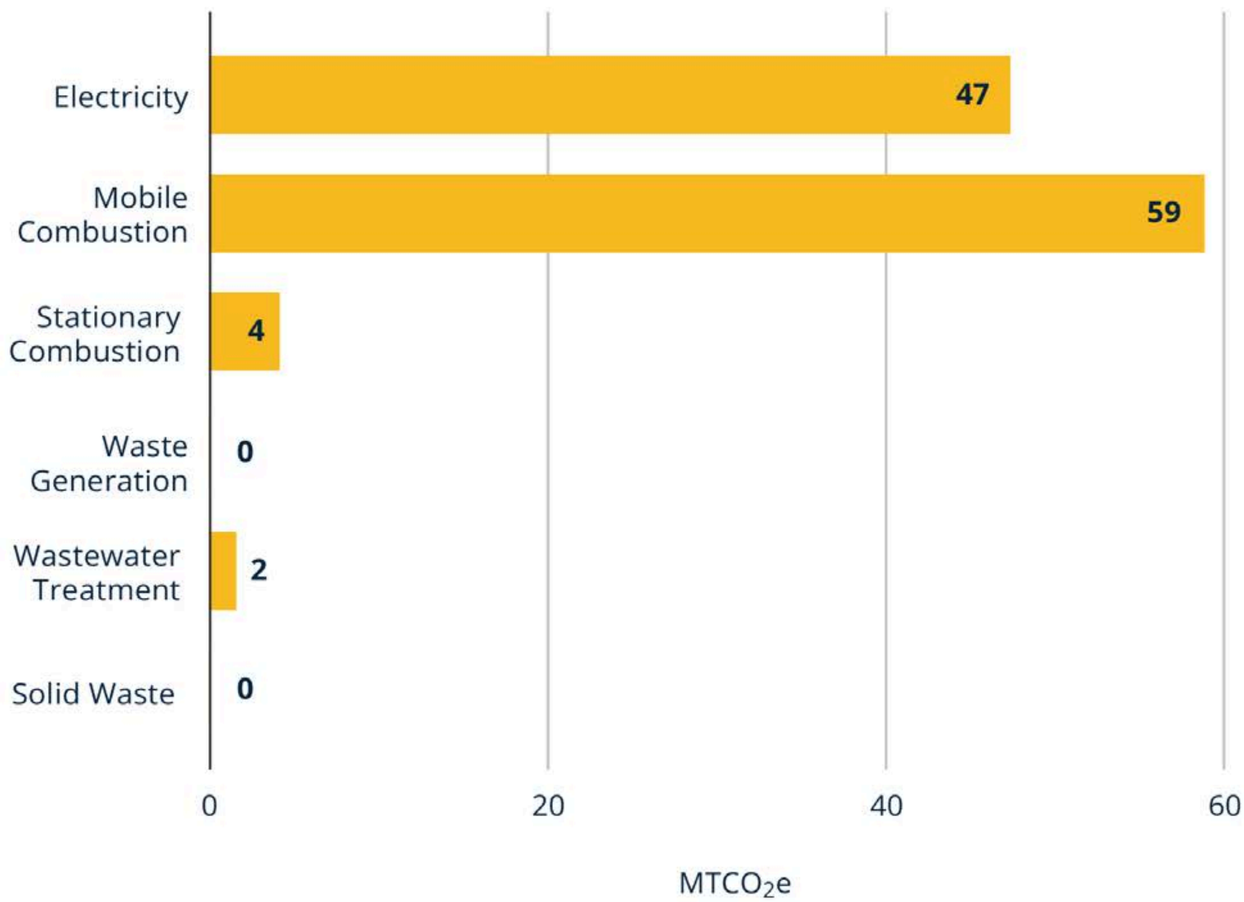



*Figure 15. PBPN's nitrous oxide ($N_2O$) emissions, 2021. Source: SSG analysis.*

## 3.5 Energy Use and Emission Shares

The proportion of electricity use and fossil fuel consumption as energy use shares and emissions shares for the PBPN are shown in Figure 16. Electricity use accounts for 35% of total energy supply, yet it contributes 51% of the total GHG emissions, illustrating the potential for GHG emissions reductions in this sector. Although the Nation's electricity supply is mainly generated using fossil fuels, the direct use of fossil fuels within the reservation (i.e., combustion for heat and transportation) accounts for 65% of total energy use.

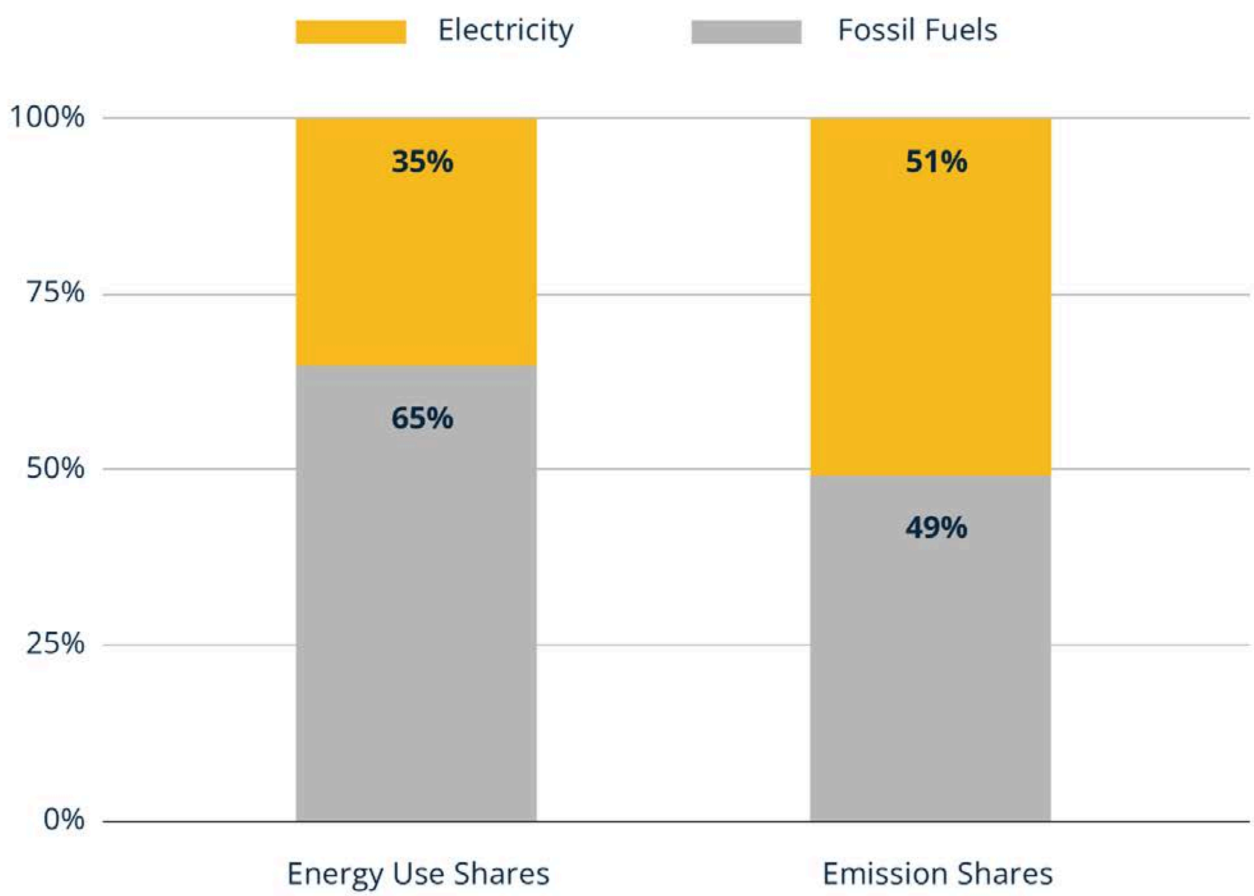



*Figure 16. PBPN's proportion of electricity use versus fossil fuels use as the percentage of energy use and emissions, 2021. Source: SSG analysis.*

# 3.6 Total Energy Consumption

The PBPN's total energy consumption was 229,170 MMBTU in 2021, with 54% of the total energy consumed for transportation, 32% consumed by the commercial and institutional sectors, and 14% consumed within the residential sector (Figure 17).


*Figure 17. PBPN's total energy consumption by sector, 2021. Source: SSG analysis.*

## 3.7 Electricity Consumption

Total electricity consumption by the PBPN is shown in Figure 18. The total electricity used in 2021 was 84,146 MMBTU. The majority of electricity is used by the PBPN's commercial and institutional sector with the casino being a primary electricity consumer (70% of electricity used) (Figure 18).


*Figure 18. PBPN's electricity consumption by sector, 2021. Source: SSG analysis.*

# 3.8 Natural and Working Lands

The PBPN Reservation is located in a rural setting where carbon is emitted from livestock and agricultural practices and carbon is sequestered in natural and working lands. Figure 19 displays the current emissions and the annual carbon sequestration for the lands within the reservation and demonstrates that native pasture and riparian canopy provide the largest carbon sink opportunities in the area.


*Figure 19. Carbon sequestration and GHG emissions by source for natural and working lands within the boundaries of the PBPN Reservation, 2021. Source: SSG analysis.*

# 3.9 Business-as-Usual Projections

Based on the PBPN's current trends, policies, and projections in population, energy use, and energy generation, its GHG emissions are projected to almost halve by 2030, with total energy consumption remaining fairly stable (Figure 20).[47] This business-as-usual (BAU) pathway to the year 2050 can be used as a reference case for future climate action planning.

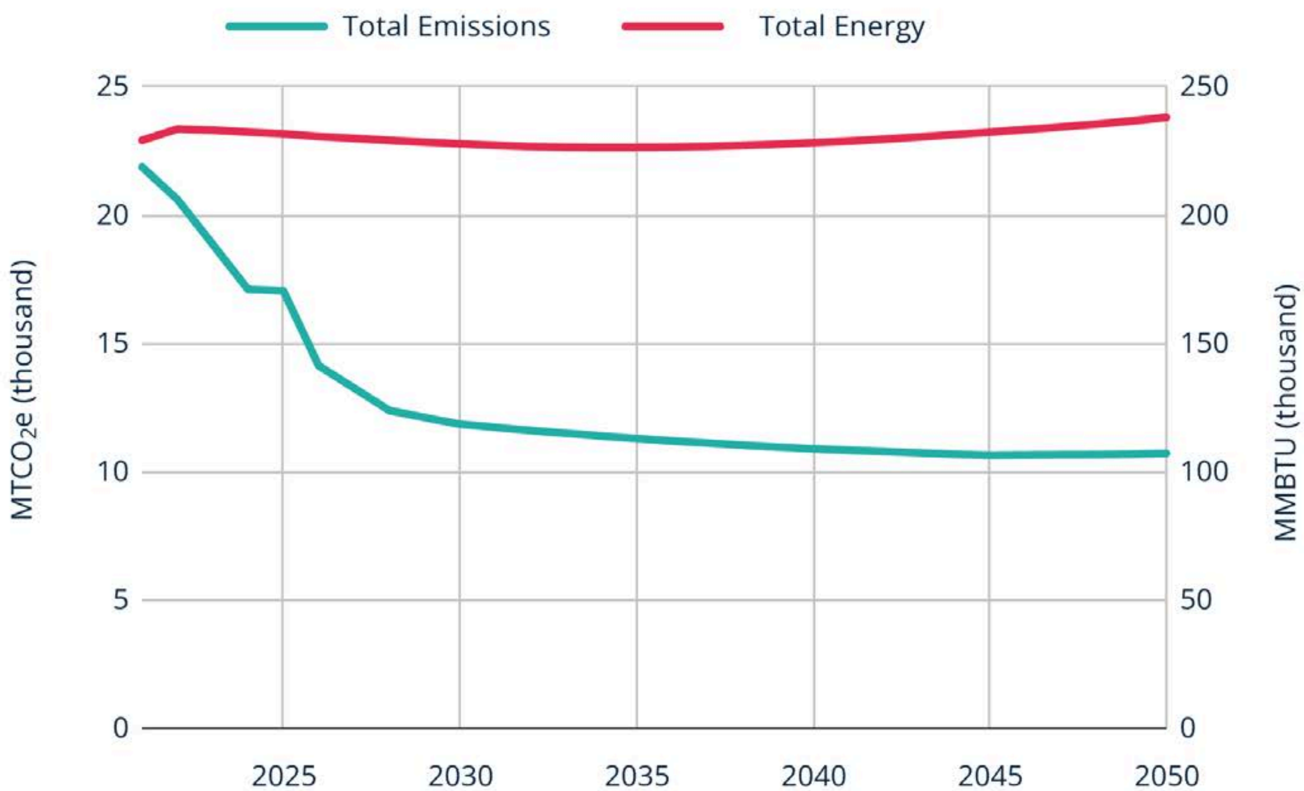



*Figure 20. PBPN's projected BAU GHG emissions pathway (left-hand vertical axis) and total energy consumption (right-hand vertical axis), 2021–2050. Source: SSG analysis.*

[47] Population projections come from the EPA State Inventory Projection Tool. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

The decrease in GHG emissions is the result of planned actions that will clean the electricity grid driven by the phaseout of coal-fired electricity generation and the decline in costs for wind and solar.[48] Figure 21 summarizes the BAU emissions trajectories for each type of fuel and electricity used on the PBPN Reservation.

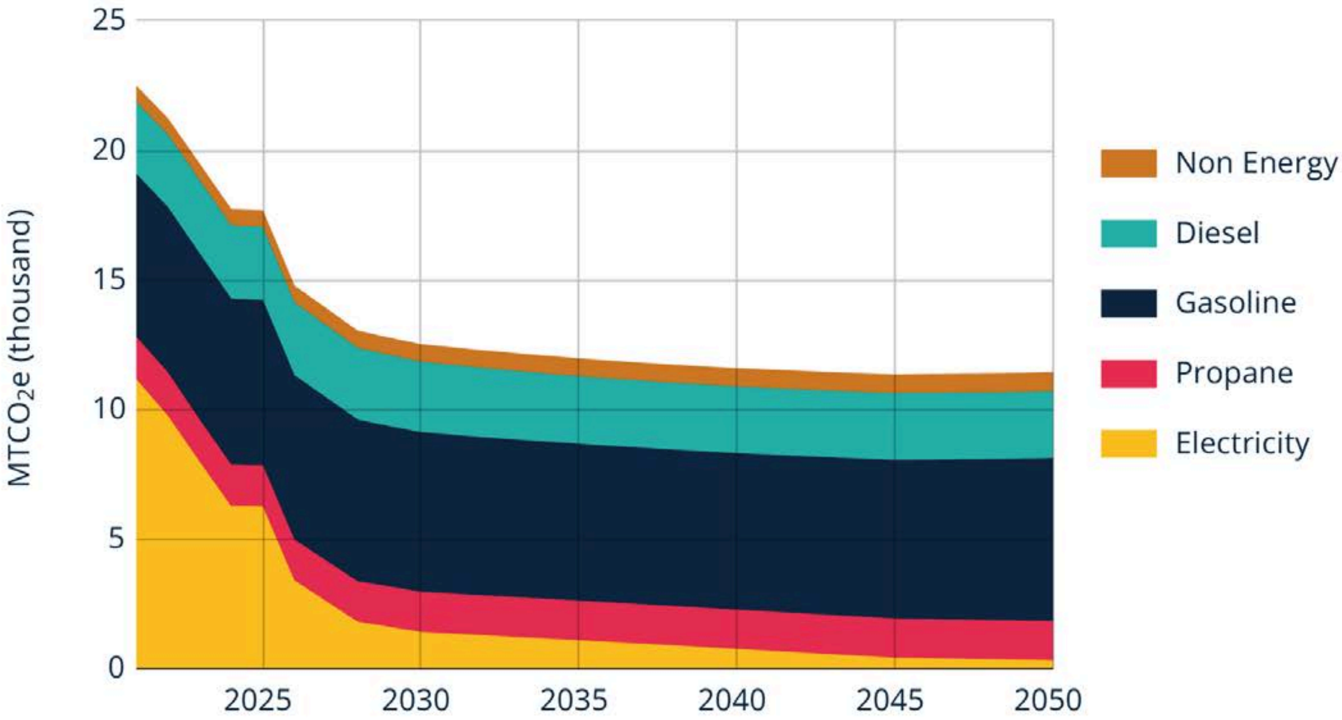



*Figure 21. PBPN's projected BAU GHG emissions pathway by fuel and non-fuel sources, 2021–2050. Source: SSG analysis.*

[48] Gagnon, Pieter; Cowiestoll, Brady; Schwarz, Marty (2023): Cambium 2022 Data. National Renewable Energy Laboratory. https://scenarioviewer.nrel.gov - Mid-case scenario.

Under the BAU projected pathway (2021–2050), GHG emissions from the residential and commercial sectors decline over time as a result of cleaner electricity from the grid. Projected GHG emissions produced by transportation remain fairly constant over this time period, demonstrating that transportation provides the greatest opportunities for GHG emissions reductions (Figure 22).

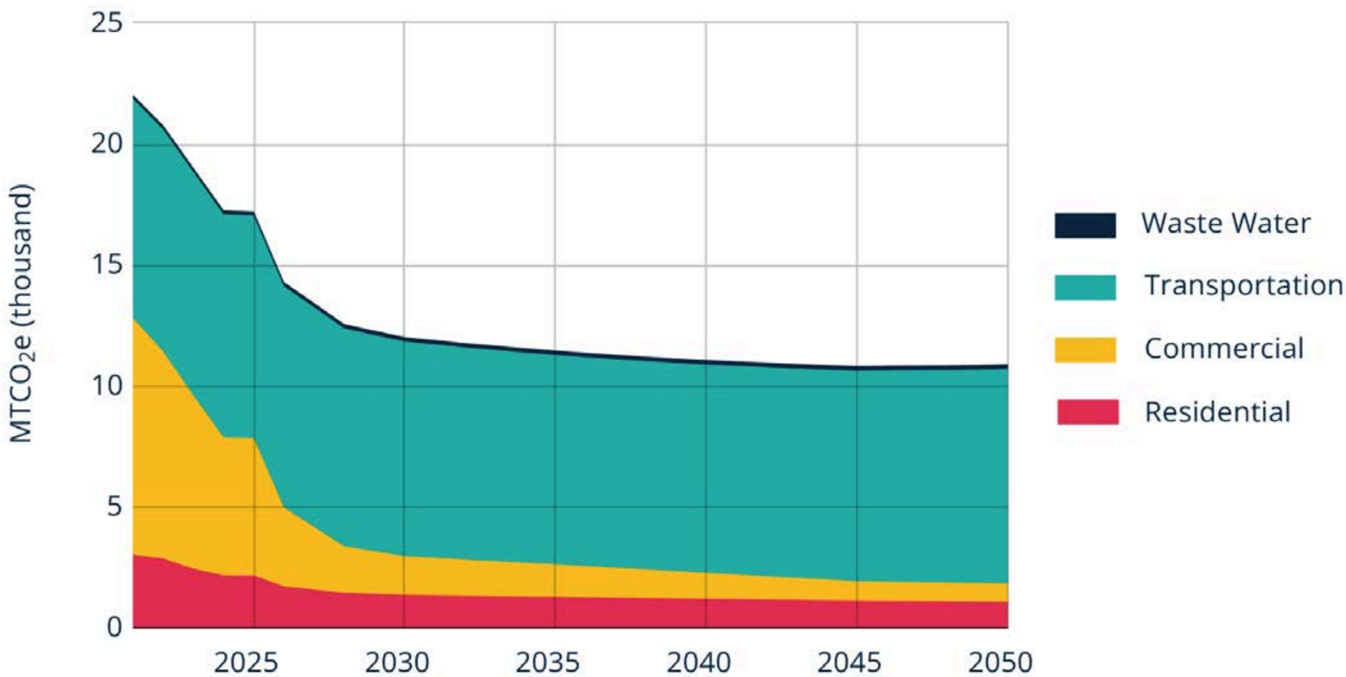



*Figure 22. PBPN's projected BAU GHG emissions pathway by sector, 2021–2050. Source: SSG analysis.*

## 3.10 Observations

At 15 $MtCO_2e$, PBPN's current per-capita emissions are the same as the national average of 15 $MtCO_2e$. This is largely due to the use of electricity produced using coal and natural gas in residential and commercial/institutional buildings. PBPN residents are also highly dependent on personal vehicles for getting to and from destinations, which generates substantial emissions from gasoline and diesel use. Over time, emissions will decrease in the building sector due to some coal- and natural-gas-fired electricity generation phaseout. However, there is little change in the emissions levels expected in the transportation (gas, diesel use), industry (electricity, natural gas, diesel use), waste, and wastewater sectors over the next 30 years.

Like many communities, PBPN faces the twin challenges of electrifying heating and transportation and cleaning the electricity system, which will require major investments. Reducing GHG emissions in transportation and heating involves technologies (e.g., heat pumps) that may have bigger upfront costs but offer lower costs to operate. These technologies are readily available.

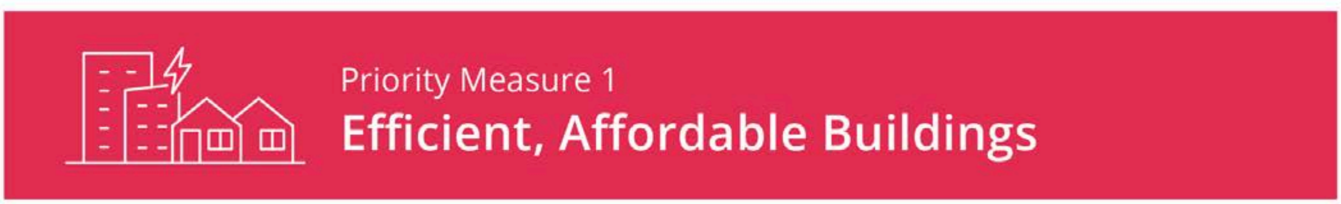
The transition to lower emissions will be aided by opportunities to improve energy efficiency, including measures such as implementing building retrofits; increasing trips made by walking, cycling, and transit; and electrifying equipment (electric vehicles and heat pumps are more efficient than existing technologies). Maximizing energy efficiency minimizes the need for additional electricity generation and transmission capacity, which reduces the cost of transitioning to cleaner energy systems. Increased efficiency also reduces energy costs for households and businesses.

# 4 Priority GHG Reduction Measures

## 4.1 Priority Measures

The following measures were identified from the context review, engagement, and a technical analysis.

### 4.1.1 Efficient, Affordable Buildings




| **Priority Measure 1: Efficient, Affordable Buildings** | |
|---|---|
| *Description* | This measure aims to reduce energy use in buildings and increase the resilience of PBPN's buildings.<br><br>Actions within this measure include:<br><br>• Develop a **green building standard** for new construction within the reservation.<br>a. Incorporate the use of sustainable and locally produced materials, such as hempcrete.<br>b. Focus on electricity as a primary fuel source.<br>c. Ensure interconnections to Tribe's renewable energy sources as they grow over time.<br>d. Incorporate traditional ecological knowledge and wisdom from Potawatomi and other Indigenous architectural practices in the region.<br>e. Incorporate considerations of future climate patterns (i.e., increased temperatures, more extreme storms). |

**Priority Measure 1: Efficient, Affordable Buildings**

   f. Work with Prairie Band Construction to develop and implement the standard.

- Develop an **energy efficiency strategy** that includes energy audits on the Tribe's buildings and housing, efficiency retrofits according to green building standards, and monitoring of energy savings.
- **Retrofit 100% of housing** owned by the Tribe and/or Tribal citizens, on and off the reservation, through the existing housing program, within five years, starting with housing where elders and vulnerable populations live, to reduce energy use and improve resilience to extreme weather. These retrofits could include:
    a. Replacing inefficient, high-polluting wood stoves with electric ones;
    b. Installing heat pumps to increase electric efficiency;
    c. Enhancing insulation, possibly with locally grown material (hemp);
    d. Adding rainwater harvesting and greywater systems;
    e. Installing low-flow water fixtures; and
    f. Installing geothermal wells, where applicable.
- **Retrofit existing commercial buildings** owned by the Tribe to improve tornado/wind safety, resilience to extreme temperatures and weather (passive survivability) and reduce energy use. These retrofits could include:
    a. Installing heat pumps to increase electric efficiency;
    b. Enhancing Insulation, possibly with locally grown material (hemp);
    c. Adding rainwater harvesting and greywater systems;
    d. Installing low-flow water fixtures.
- For residents of housing not owned or controlled by the Tribe, develop **an incentive program for home energy efficiency retrofits** to reduce energy use, improve tornado/wind safety, and enhance resilience to extreme temperatures and weather (passive survivability).
- **Reinvest money saved on energy** due to energy efficiency improvements into funding for maintenance and service of renewable energy installations and other related projects.
- **Hire and train Tribal government staff** to support building $_{2}$code and sustainability code development.

## Priority Measure 1: Efficient, Affordable Buildings

*Estimate of the quantifiable GHG emissions reductions (e.g., through 2030 and 2050)*

2025–2030: 8,358 $MtCO_2e$
2025–2050: 37,549 $MtCO_2e$

*Estimate of the quantifiable criteria air pollutant emissions reductions (e.g., through 2030 and 2050)*

| Air Pollutant Type[49] | Cumulative Air Pollutant Emissions Reductions 2025–2030 (lbs) | Cumulative Air Pollutant Emissions Reductions 2025–2050 (lbs) |
|---|---|---|
| HC/VOC | 4,386 | 30,842 |
| CO | 32,685 | 228,789 |
| NOx | 112,829 | 793,096 |
| SO2 | 479 | 3,368 |
| PM 2.5 | 342 | 2,407 |

*Implementing agency or agencies*

- Prairie Band Potawatomi Nation Housing Department
- Prairie Band Potawatomi Nation Administration
- Prairie Band Construction Management
- Prairie Band Potawatomi Nation Tribal Council
- Prairie Band Potawatomi Nation Human Resources Department
- Prairie Band Potawatomi Nation Planning and Environmental Protection

[49] HC = hydrocarbons; CO = carbon monoxide; NOx = nitrogen oxides; PM2.5 = particulate matter with diameter <= 2.5 micrometers

| **Priority Measure 1: Efficient, Affordable Buildings** | |
|---|---|
| *Implementation schedule and milestones* | 2024: Hire and train staff, begin retrofit program design, develop an energy efficiency strategy, plan for workforce development.<br>2025: Retrofit 60 homes and five commercial/institutional buildings, develop a green building standard, implement an incentive program for energy efficiency retrofits of homes not owned/controlled by the Nation.<br>2026: Retrofit 107 homes and seven commercial/institutional buildings, begin implementing a green building standard.<br>2027: Retrofit 107 homes and six commercial/institutional buildings.<br>2028: Retrofit 107 homes and five commercial/institutional buildings.<br>2029: Retrofit 107 homes and five commercial/institutional buildings.<br>2030: Retrofit 107 homes and seven commercial/institutional buildings. |
| *Other funding sources* | **DOE Tribal Home Electrification and Appliance Rebates Program**<br>This program provides up to $14,000 per eligible household for energy efficiency and electrification home upgrades.<br><br>**DOE Resilient and Efficient Codes Implementation (RECI) Program**<br>This program provides awards of between $500,000 and $10,000,000 to Tribal energy offices or other similar subdivisions of a tribal government to support the development and implementation of resilient and efficient building codes (i.e., green development standards).<br><br>**Home Electrification and Appliance Rebates**<br>*$225,000,000 is allocated for tribes.*<br>This program aims to provide single-family and multi-family households with discounts for high-efficiency home appliances and equipment.<br><br>**Clean Energy Tax Credits for Consumers**<br>Thirty percent of cost on battery storage; heat pumps; efficient heating, ventilation, and air conditioning (HVAC) equipment; electric panel; insulation materials; windows; exterior doors; and home energy audits, up to a limit. |

| **Priority Measure 1: Efficient, Affordable Buildings** | |
|---|---|
| *Metrics for tracking progress* | • # of homes retrofit<br>• Average energy savings per retrofit<br>• Average energy cost savings per retrofit<br>• Direct jobs created<br>• Indirect jobs created<br>• GHGs reduced<br>• Co-pollutants reduced<br>• Number of residences with energy self-sufficiency (i.e., off-grid capability) |
| *Quantitative cost estimates* | **Capital Costs**<br>2025–2030: $48,793,236<br>2025–2050: $48,793,236<br><br>**Fixed Operating and Maintenance Costs**<br>2025–2030: -$4,827,316 (savings)<br>2025–2050: -$33,341,769 (savings) |
| *Co-benefits* | • Creates jobs in housing renovation and construction<br>• Creates economic opportunities (i.e., hempcrete production)<br>• Reduces energy costs<br>• Enhances air quality through reduced use of propane and wood-burning stoves<br>• Enhances thermal comfort within buildings, especially for elders and other vulnerable community members<br>• Enhances resilience of buildings and community to extreme weather and climate change<br>• Conserves water<br>• Empowers community-driven solutions |

### 4.1.2 Clean and Active Transportation

Priority Measure 2

**Clean and Active Transportation**

| Priority Measure 2: Clean and Active Transportation | |
|---|---|
| *Description* | This measure aims to reduce emissions from vehicles used to travel within and to and from the PBPN Reservation by switching to using electricity as a fuel instead of gasoline and diesel.<br><br>Actions within this measure include:<br><br>• **Switch PBPN operational fleet, minivans, and buses to electric vehicles and plug-in hybrids** that have GPS and similar technologies for optimizing performance.<br>• Develop **EV charging infrastructure** to support fleet electrification and personal EV charging.<br>• **Support residents in purchasing electric vehicles and EV chargers** for personal, commercial, and agricultural use.<br>• **Promote the benefits of electric vehicles** (i.e., air quality, reduced maintenance, cheaper fueling costs) through education and outreach.<br>• **Expand PBPN transportation services** (i.e., number of vehicles and drivers).<br>• Develop an e-bike **rental** or sharing program for residents and visitors to the casino.<br>• Develop an **e-bike incentive or rebate program** for Tribal members.<br>• **Expand the bike network** on the reservation for use by residents and visitors.<br>    ○ Expand the trail so it connects housing, Prairie Peoples Park, the language center, the casino, and the health center.<br>    ○ Purchase right-of-way.<br>    ○ Design paths.<br>    ○ Move fencing and construct the trail and bridges.<br>    ○ Add three crosswalks with safety lights. |

| Priority Measure 2: Clean and Active Transportation | |
|---|---|
| | ○ Include lighting powered by solar panels.<br>○ Incorporate pollinator plants and native prairie restoration along the trail.<br>○ Include signage with culturally relevant information in English and Potawatomi..<br>● **Plan for and support workforce development in clean and active transportation** (planning, construction, installation, maintenance, repair, and recycling).<br>● **Hire and train Tribal government staff** to support implementing actions within this measure. |
| *Estimate of the quantifiable GHG emissions reductions (e.g., through 2030 and 2050)* | 2025–2030: 4,989 $MtCO_2e$<br>2025–2050: 44,245 $MtCO_2e$ |
| *Estimate of the cumulative quantifiable criteria air pollutant emissions reductions (e.g., through 2030 and 2050)* | See table below. |

| Air Pollutant Type[50] | Cumulative Air Pollutant Emissions Reductions 2025–2030 (lbs) | Cumulative Air Pollutant Emissions Reductions 2025–2050 (lbs) |
|---|---|---|
| HC | 7,007 | 55,090 |
| CO | 79,370 | 644,416 |
| NOx | 2,358 | 17,373 |
| PM 2.5 | 398 | 3,107 |

Note: Includes cumulative air pollutant emissions reductions for adoption of EVs (minivans and cars), mode shift to ebikes, expanded transit services and shift to electric buses, and shift to electric fleet. vehicle measures.

[50] HC = hydrocarbons; CO = carbon monoxide; NOx = nitrogen oxides; PM2.5 = particulate matter with diameter <= 2.5 micrometers.

| **Priority Measure 2: Clean and Active Transportation** | |
|---|---|
| *Implementing agency or agencies* | • Prairie Band Potawatomi Nation General Public Transportation<br>• Prairie Band Construction Management<br>• Prairie Band Potawatomi Nation Administration<br>• Prairie Band Potawatomi Nation Road and Bridge Department<br>• Prairie Band Potawatomi Nation, LLC<br>• Prairie Band Potawatomi Nation Planning and Environmental Protection<br>• Prairie Band Casino and Resort |
| *Implementation schedule and milestones* | • 2024: Hire and train Tribal government staff, train existing transportation and fleet services staff, plan for EV chargers and e-bike programs, promote the benefits of electric vehicles, finalize planning and design for bike network expansion.<br>• 2025: Switch 25% of PBPN's operational fleet to EVs and plug-in hybrids, implement e-bike programs, purchase right of way for bike network expansion and begin construction, expand PBPN transportation services, implement workforce development programming, install 50% of casino EV chargers.<br>• 2026: Finalize bike network expansion, switch 50% of PBPN operational fleet to EVs and plug-in hybrids, continue to implement e-bike programs, install 50% of casino EV chargers, continue workforce development programming.<br>• 2027: Switch remaining PBPN operational fleet to EVs and plug-in hybrids, continue to implement e-bike programs and expand transportation services, install remaining casino EV chargers, continue workforce development programming. |
| *Other funding sources* | **Energy Efficiency and Conservation Block Grant Program**<br>*Funding amount: $550,000,000*<br>*Deadline: May 31, 2025*<br><br>This competitive grant is provided for implementing strategies to reduce energy use, reduce fossil fuel emissions, and improve energy efficiency.<br><br>**Tribal Transit Formula Grants**<br><br>*Funding amount: About $10,000,000 each year* |

| Priority Measure 2: Clean and Active Transportation | |
|---|---|
| | Federally recognized tribes may use the funding for capital, operating, planning, and administrative expenses for public transit projects that meet the growing needs of rural tribal communities.<br><br>**Low- or No-Emission Grant Program—5339(c)**<br>*Funding amount: If less than $1,000,000, streamlined application possible for tribes only.*<br>The program provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses, as well as acquisition, construction, and leasing of required supporting facilities.<br><br>**Clean Energy Tax Credits for Consumers**<br>Thirty percent of the cost of a home electric vehicle charger, up to $1,000. |
| *Metrics for tracking progress* | • Annual GHG emissions from fleet<br>• % of fleet vehicles electrified<br>• % of vehicle miles traveled (VMT) electrified<br>• Cost savings from reduced fuel use in fleet operations<br>• Annual public EV chargers installed<br>• Annual private EV chargers installed<br>• Number of new routes created<br>• # of vehicular trips shifted to e-bike usage |
| *Quantitative cost estimates* | **Capital Costs**<br>2025–2030: $6,408,460<br>2025–2050: $6,408,460<br><br>**Fixed O&M**<br>2025–2030: -$23,173 (savings)<br>2025–2050: -$171,769 (savings) |
| *Co-benefits* | • Improves air quality<br>• Reduces in fuel and maintenance costs for vehicles<br>• Increases tribal energy sovereignty (when paired with on-site renewable energy generation)<br>• Increases health benefits from physical activity<br>• Increases mobility options for low-income households and youth |

### 4.1.3 Electricity Generation and Procurement

Priority Measure 3
**Electricity Generation and Procurement**

**Priority Measure 3: Electricity Generation and Procurement**

*Description*

This measure aims to reduce emissions from electricity consumption and increase PBPN’s energy self-sufficiency by producing and storing renewable energy (solar, wind, and geothermal).

Actions within this measure include:

- **Update the Nation’s existing renewable energy resources study.**
- **Research opportunities for developing micro-grids** at and around key facilities on the reservation.
- **Install solar panels or small-scale wind turbines on or near 100% of housing** owned by the Tribe and/or Tribal citizens, on and off the reservation, within 5 years.
    - Start with housing where elders and other priority and/or vulnerable populations live.
- Pair solar installations with **batteries and inverters** to allow for living off-grid.
    - Consider using battery technologies that have a low environmental impact and/or are easily recyclable.
- Develop and connect **existing solar panel** installations on Tribal government facilities.
- **Develop new renewable energy generation and storage installations** (i.e., solar panels, geothermal systems, distributed wind, battery storage).
    - Aim for an equivalent to 100% of non-casino building electricity use—this includes electricity generation for the new travel plaza and manufacturing plant in development near US-75.
    - Aim to provide enough battery storage for 2+ days.
- **Procure renewable energy** for K Road wastewater treatment facility.

| Priority Measure 3: Electricity Generation and Procurement | |
|---|---|
| | • **Plan for and support workforce development in renewable energy projects** (planning, construction, installation, maintenance, repair, and recycling of clean energy projects).<br>• **Hire and train Tribal government staff** to support renewable energy development and coordination with utilities and other governments. |
| *Estimate of the quantifiable GHG emissions reductions (e.g., through 2030 and 2050)* | 2025–2030: 1,373 $MtCO_2e$<br>2025–2050: 6,834 $MtCO_2e$ |
| *Implementing agency or agencies* | • Prairie Band Potawatomi Nation Tribal Government<br>• Prairie Band Potawatomi Nation Energy Sovereignty Taskforce<br>• Prairie Band Potawatomi Nation Utility Committee |
| *Implementation schedule and milestones* | • 2024: Hire staff, initiate update to renewable energy resources study, research micro-grids, begin planning for workforce development and renewable energy installations.<br>• 2025: Develop and connect existing solar panel installations on Tribal government facilities.<br>• 2026: Procure renewable energy for K Road wastewater treatment facility, procure and install solar and/or wind for housing where elders and other vulnerable populations live.<br>• 2027: Procure and install solar and/or wind for remaining housing. |
| *Funding sources* | **Clean Energy Technology Deployment on Tribal Lands—2024 (DE-FOA-0003298)**<br>• Install clean energy generating systems and energy efficiency measures for Tribal buildings.<br>• Deploy community-scale clean energy generating system(s) or community energy storage on Tribal lands.<br>• Install integrated energy systems for autonomous operation to power a single or multiple essential Tribal buildings during emergency situations or for Tribal community resilience. |

| Priority Measure 3: Electricity Generation and Procurement | |
|---|---|
| | **Clean Energy Innovator Fellowship**<br>• Increase access to Tribal clean energy career opportunities.<br>• Fund fellows for a professional development allowance to advance their skills and expertise.<br>**Tribal Energy Financing Loan Guarantee Program**<br>This program can provide guarantees of up to 90% of the Tribe loan obligation for:<br>• Electricity generation, transmission and/or distribution facilities, using renewable or conventional energy sources;<br>• Energy storage facilities, whether or not integrated with any of the above; and<br>• District heating and cooling facilities.<br>**Clean Energy Tax Credits for Consumers**<br>Thirty percent of the cost of solar panels for electricity. |
| *Metrics for tracking progress* | • MW of solar PVs installed<br>• MW of wind turbines installed<br>• MWh of battery storage capacity installed<br>• MW of geothermal systems installed<br>• Number of residences equipped with renewable energy |
| *Quantitative cost estimates* | **Capital Costs**<br>2025–2030: $6,018,884<br>2025–2050: $6,018,884<br>**Fixed O&M**<br>2025–2030: -$1,821,203 (savings)<br>2025–2050: -$12,926,969 (savings) |
| *Co-benefits* | • Improves air quality<br>• Increases energy sovereignty and tribal resilience<br>• Creates jobs and new economic opportunities<br>• Diversifies revenue |

## 4.1.4 Natural and Working Lands

Priority Measure 4
**Natural and Working Lands**

**Priority Measure 4: Natural and Working Lands**

*Description*

This measure aims to restore nature's services to the community while sequestering carbon and modifying the agricultural/farming practices to preserve the quality of natural assets on the reservation.

Actions within this measure include:

- **Update the Nation's comprehensive land use plan** to designate priorities and areas of conservation and restoration, renewable energy siting, housing and commercial development.
- Promote **conserving water** and encourage residents and visitors to do so..
- Educate the greater community of both Tribal and non-Tribal landowners about **no-till, regenerative agricultural practices.**
    - Work with Cooperative Extension Service, Jackson County Conservation District, Natural Resource Conservation Service, etc.
    - Provide technical assistance, presentations, citizen science projects, etc.
    - Incorporate traditional language and culture in education and outreach.
- Promote **natural area protection/restoration** to enhance wildlife preservation and increase resilience by supporting activities that are part of the PBPN hunting traditions (i.e., increase rabbit populations).
- **Restore riparian buffers** (up to 150 ft) along stream corridors with native grasses, forbs, trees, and shrubs;

| **Priority Measure 4: Natural and Working Lands** | |
|---|---|
| | stabilize stream banks; provide information and education.<br>• Develop **demonstration projects to showcase best practices** on Tribally operated **parkland**, **cropland, and pastureland.**<br>  ○ E.g,. Prairie Peoples Park amphitheater, along existing and expanded bike trail. |
| *Estimate of the quantifiable GHG emissions reductions (e.g., through 2030 and 2050)* | 2025–2030: 4,086 $MtCO_2e$<br>2025-2050: 27,435 $MtCO_2e$ |
| *Implementing agency or agencies* | • Prairie Band Potawatomi Nation Land Maintenance Department<br>• Prairie Band Potawatomi Nation Division of Planning and Environmental Protection<br>• Prairie Band Potawatomi Nation Tribal Land Office |
| *Implementation schedule and milestones* | • 2024: Begin update to comprehensive land management plan and continue to expand education and promote no-till, regenerative agricultural practices; water conservation; and natural area protection and restoration and plan for demonstration projects.<br>• 2025: Expand work restoring riparian buffers, update lease language to reflect riparian buffer restoration. implementation at least 1 demonstration project<br>• 2026–2030: Continue outreach, education, and demonstration projects, continue updating leases to reflect riparian restoration and environmental protection goals. |
| *Funding sources* | **Environmental and Climate Justice Community Change Grants Program (EPA)**<br><br>Eligible entities include a partnership between a community-based non-profit organization (CBO) and a federally-recognized tribe. |

| Priority Measure 4: Natural and Working Lands | |
|---|---|
| | Through this program, $2 billion in funding is available to support community-driven projects that build capacity for communities to tackle environmental and climate justice challenges, strengthen their climate resilience, and advance clean energy (Nov 21, 2024).<br><br>It can be used for:<br>● Climate resilience and adaptation;<br>● Mitigating climate and health risks from extreme heat, wood heater emissions, and wildfire events;<br>● Community-led air and other (including water and waste) pollution monitoring, prevention, and remediation;<br>● Investments in low- and zero-emission and resilient technologies and related infrastructure;<br>● Workforce development that supports the reduction of greenhouse gas emissions and other air pollutants;<br>● Reducing indoor toxics and indoor air pollution; and<br>● Facilitating the engagement of disadvantaged communities in state and federal advisory groups, workshops, rulemakings, and other public processes. |
| *Metrics for tracking progress* | ● # of people reached in the education program<br>● Acres of restored riparian buffers<br>● Water quality improvement (BOD, TSS, and pesticide concentration, etc.) |
| *Quantitative cost estimates* | **Capital Cost Estimates**<br>2025–2030: $9,280,000<br>2025–2050: $35,520,000 |
| *Co-benefits* | ● Increases biological diversity<br>● Improves water quality<br>● Reduces flood and wildfire risk<br>● Enhances tribal resilience<br>● Supports food sovereignty<br>● Supports language and culture programming<br>● Facilitates youth education and engagement to environment |

## 4.2 Summary of PCAP Greenhouse Gas Emissions Reductions

The PCAP priority measures outlined in Table 4 would provide a total of 18,804 $MtCO_2e$ reductions by 2030 and 116,063 $MtCO_2e$ by 2050 for the PBPN Reservation.

*Table 4. Summary of GHG emissions reductions from PCAP priority measures.*

| Priority Measures | Reductions by 2030 ($MtCO_2e$) | Reductions by 2050 ($MtCO_2e$) |
|---|---|---|
| Efficient, Affordable Buildings | 8,358 | 37,549 |
| Clean Transportation | 4,987 | 44,245 |
| Energy Generation | 1,373 | 6,834 |
| Natural and Working Lands | 4,086 | 27,435 |
| **Total** | **18,804** | **116,063** |

## 4.3 Federal Funding Opportunities

Phase 2 of the EPA's CPRG can provide funding opportunities for PBPN's priority GHG reduction measures and initiatives. There are many other sources of federal funding that can also be leveraged to develop and implement the PCAP measures, such as other grant programs in the Inflation Reduction Act and related tax credit programs. These have been included where relevant within each of the priority measures described in the previous section (4.2). Additional funding sources will be explored in detail during the development of the CCAP.

## 4.4 PCAP Measure Prioritization

The PCAP measures were prioritized for CPRG's Phase 2 implementation grants (Table E3). Each PCAP measure was scored using a combination of CPRG project evaluation criteria (GHG reductions, funding need, transformational impact, environmental benefits, social/economic co-benefits, and feasibility) and priorities expressed by thePBPN Tribal Council, staff, and community members. The three highest scoring measures are the Adoption of EVs and Supporting Infrastructure, Home Energy Retrofits, and Restore Riparian Buffers and Promote No-Till Agricultural Practices (Table 5).

*Table 5. CPRG criteria analysis and weighting used for evaluating the prioritization of PCAP measures.*

| Criteria | Assigned weighting | Analysis |
|---|---|---|
| GHG reduction | 5 | How much GHG emissions does the measure reduce? |
| Demonstrated funding need | 2 | Is there funding available for this type of measure from a different funding stream? |
| Transformational impact | 3 | Is the measure something that would be applicable to other jurisdictions and that has a transformative impact? |
| Environmental benefits | 3 | What environmental benefits does the measure achieve beyond GHG emissions reductions? |
| Co-benefits | 4 | What co-benefits does the measure provide? |
| Feasibility | 2 | What is the political, social, and economic feasibility of the project? Has it been done before in this form or in another form? |

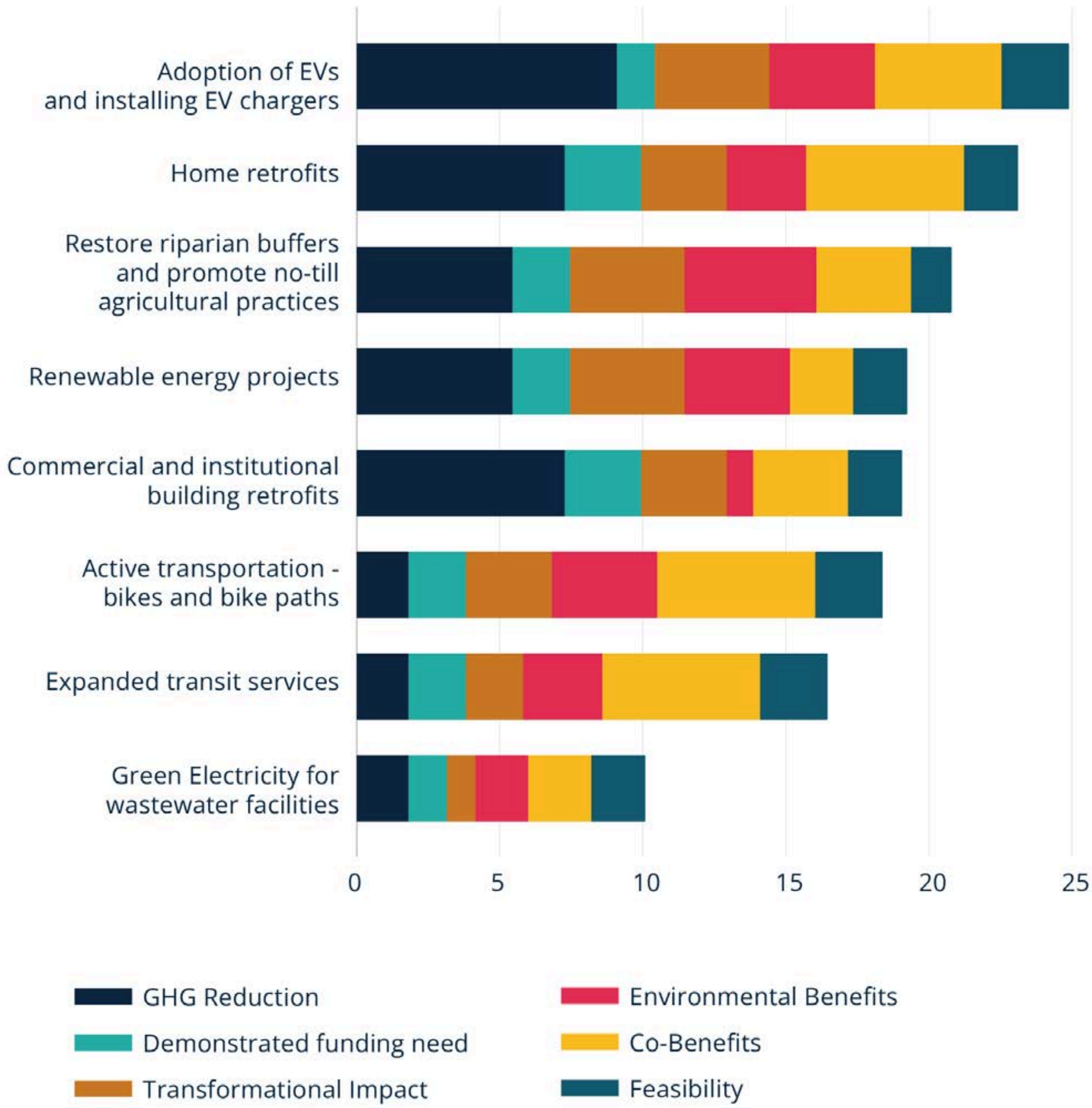



*Figure 23. PCAP measures prioritized according to CPRG scoring criteria (GHG reductions, funding need, impact, co-benefits, and feasibility) and the CPRG weightings.*

# 5 Next Steps

## 5.1 Developing the Comprehensive Climate Action Plan

The PCAP provides the foundation for a more comprehensive analysis in the CCAP. The intent of the PCAP is to identify near-term and implementation-ready strategies, initiatives, and other projects that aim to reduce GHG emissions and other pollutants. The intent of the CCAP is to build upon the PCAP by identifying all GHG sources, sinks, and sectors present and establishing near- and long-term reduction strategies. The CCAP will continue to describe how measures can benefit the PBPN, both directly and indirectly, and will include GHG reduction targets, a plan to leverage other federal funding, and a workforce planning analysis.

## 5.2 Engagement Next Steps

Engagement during the CCAP process will include meaningful and targeted outreach events with all interested and affected parties, including the Tribal Council, the Tribal Advisory Committee, and community members. Comments or suggestions to improve outreach and engagement efforts are encouraged and always ongoing.

Developing a long-term vision for the CCAP and the community will be an important first step. Gaining community input on the chosen direction will be critical to the success of the plan and the implementation of climate measures. In addition to developing the vision, it will be important to find local ambassadors —community members who are interested and willing to help move the plan forward. Collaborating with local ambassadors as liaisons would allow the planning effort to build on existing community connections and relationships while ensuring engagement better reflects the community. This role would promote inclusion and equity through the engagement process and could include:

- Making connections with residents, community groups, and stakeholders;
- Facilitating engagement sessions; and
- Promoting engagement activities.

It will also be important to engage non-Tribal landowners and other partners to expand efforts to all lands and people within the reservation and adjacent areas that may influence the outcome of implementation, such as the portion of the Soldier Creek Watershed upstream of the reservation.

# References

Council on Environmental Quality. “Climate & Economic Justice Screening Tool.” Explore the map. Accessed March 19, 2024. https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.

Environmental Defense Fund. “Climate Impacts in Mayetta, KS.” The US Climate Vulnerability Index, 2018. https://map.climatevulnerabilityindex.org/report/climate_change/tract-20085082800-mayetta-ks?mapBoundaries=Tract&mapFilter=0&reportBoundaries=Tract&geoContext=State.

Evergy. “Fourth Quarter 2023 Earnings Presentation.” February 29, 2024. https://investors.evergy.com/static-files/eba56800-70a1-46b4-84e4-925ef1b7cc4f.

Evergy. “Our Energy Mix.” evergy.com. Accessed March 19, 2024. https://www.evergy.com/smart-energy/renewable-resources-link/our-energy-mix.

Fanning-Hughes, Ian. University of Kansas Graduate Student et al., “Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation,” Final report (Kansas: University of Kansas, May 2020).

Fanning-Hughes, Ian. University of Kansas Graduate Student, Verna Potts, Prairie Band Potawatomi Nation Senior Environmental Technician, Terri Woodburn, University of Kansas Professional Science Masters - Program Director, Laurie Brown, Vireo Conservation Ecologist, and Scott Schulte, Vireo Senior Environmental Planner. “Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation.” Final report. Kansas: University of Kansas, May 2020.

Federal Reserve Bank of Minneapolis. “Native Community Data Profiles.” Federal Reserve Bank of Minneapolis. Accessed March 19, 2024. https://www.minneapolisfed.org/indiancountry/resources/native-community-data-profiles.

Friedlingstein, Pierre, Michael O’Sullivan, Matthew W. Jones, Robbie M. Andrew, Dorothee C. E. Bakker, Judith Hauck, Peter Landschützer, et al. “Global Carbon Budget 2023.” *Earth*

*System Science Data* 15, no. 12 (December 5, 2023): 5301–69. https://doi.org/10.5194/essd-15-5301-2023.

Gagnon, Pieter; Cowiestoll, Brady; Schwarz, Marty (2023): Cambium 2022 Data. National Renewable Energy Laboratory. https://scenarioviewer.nrel.gov - Mid case scenario

GIZ. "Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)." *SUTP* (blog), 2011. https://sutp.org/publications/sustainable-urban-transport-avoid-shift-improve-a-s-i/.

Haddaway, Neal R., Katarina Hedlund, Louise E. Jackson, Thomas Kätterer, Emanuele Lugato, Ingrid K. Thomsen, Helene B. Jørgensen, and Per-Erik Isberg. "How Does Tillage Intensity Affect Soil Organic Carbon? A Systematic Review." *Environmental Evidence* 6, no. 1 (December 18, 2017): 30. https://doi.org/10.1186/s13750-017-0108-9.

IPCC 2019, "2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories." E. Bonnema, K. Tanabe, A. Kranjc, J. Baasansuren, M. Fukuda, S. Ngarize, A. Osako, and Y. Pyrozhenko, Volume 4: Agriculture, Forestry and Other Land Use. Switzerland: IPCC, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol4.html.

McCulley, Rebecca L., Ingrid C. Burke, Jim A. Nelson, William K. Lauenroth, Alan K. Knapp, and Eugene F. Kelly. "Regional Patterns in Carbon Cycling across the Great Plains of North America." *Ecosystems* 8, no. 1 (2005): 106–21. http://www.jstor.org/stable/25053806.

Native Energy Resources Counsel, LLC, Margaret Schaff, Evan DeWitt, Woven Energy, LLC, and Jake Glavin. "Prairie Band Potawatomi Nation Tribal Utility Feasibility and Options Analysis Report," January 20, 2023.

Prairie Band Potawatomi Nation (PBPN). "Vision and Values." Prairie Band Potawatomi Nation. Accessed March 19, 2024. https://www.pbpindiantribe.com/government/values-and-vision/.

Prairie Band Potawatomi Nation. "9 Critical Element Plan Soldier Creek Watershed," October 2023.

Prairie Band Potawatomi Nation and Ad Astra Collaborative. "Prairie Band Potawatomi Nation Land and Water Management Plan," December 22, 2021.

Prairie Band Potawatomi Nation. “Housing.” Prairie Band Potawatomi Nation. Accessed March 19, 2024. https://www.pbpindiantribe.com/housing/.

Prairie Band Potawatomi Nation. “Request for Proposal - Climate Pollution Reduction Planning for the Prairie Band Potawatomi Nation,” 2023.

Prairie Band Potawatomi Tribal Land Office and Tribal Emergency Response Committee. “Prairie Band Potawatomi Nation Tribal Mitigation Plan,” 2017. https://documentcloud.adobe.com/gsuiteintegration/index.html?state=%7B%22ids%22%3A%5B%221t0gfDV3sp6DkxrbwuDuN9Jo-V2sNaWBg%22%5D%2C%22action%22%3A%22open%22%2C%22userId%22%3A%22107607903781153785304%22%2C%22resourceKeys%22%3A%7B%7D%7D.

US Census Bureau. "Age and Sex," 2022. *American Community Survey, ACS 5-Year Estimates Subject Tables, Table S0101*, 2022. Accessed on March 5, 2024, https://data.census.gov/table/ACSST5Y2022.S0101?g=2500000US2980.

U. S. Global Change Research. “Fifth National Climate Assessment.” *Fifth National Climate Assessment*. US Global Change Research Program, Washington, DC, 2023. https://nca2023.globalchange.gov/.

United States Environmental Protection Agency, Office of Air and Radiation. “CPRG Planning Grants Program Guidance for Tribes-Tribal Consortia-Territorie,” March 1, 2023. https://www.epa.gov/system/files/documents/2023-02/EPA%20CPRG%20Planning%20Grants%20Program%20Guidance%20for%20Tribes-Tribal%20Consortia-Territories%2003-01-2023.pdf.

United States Environmental Protection Agency, Office of Air and Radiation. “CPRG Planning Grants Program Guidance for States-Municipalities-Air Agencies,” March 1, 2023. https://www.epa.gov/system/files/documents/2023-02/EPA%20CPRG%20Planning%20Grants%20Program%20Guidance%20for%20States-Municipalities-Air%20Agencies%2003-01-2023.pdf.

US Department of Energy. “Alternative Fuels Data Center: Vehicle Registration Counts by State.” Alternative Fuels Data Center, 2022. https://afdc.energy.gov/vehicle-registration.

US Department of Energy. “Alternative Fuels Data Center: Alternative Fueling Station Counts by State,” accessed March 29, 2024, https://afdc.energy.gov/stations/states.

US Census Bureau. “Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile,” 2020. https://data.census.gov/profile/Prairie_Band_of_Potawatomi_Nation_Reservation,_KS?g=2500000US2980.

US EPA, OAR. “State Inventory and Projection Tool.” Data and Tools, June 30, 2017. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

# 6 Appendices

## 6.1 Appendix A: GHG Inventory Method

### 6.1.1 Accounting Protocol

The accounting protocol for this GHG Inventory is the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC).[51]

### 6.1.2 Background Information

Table A1 provides background information that informed the development of the GHG inventory.

*Table A1. Background information.*

| | |
|---|---|
| **Name of jurisdiction** | Prairie Band Potawatomi Nation |
| **State** | Kansas |
| **Inventory year** | 2021 |
| **Geographic boundary** | Prairie Band Potawatomi Nation Reservation |
| **Land area (sq miles)** | 121[52] |
| **Resident population** | 1,529[53] |
| **Climate** | The Prairie Band Potawatomi Nation's climate features variable temperatures and precipitation. Summers can be hot and dry, and winters are milder with the occasional cold snap. The area is also subjected to strong wind gusts.[54] |

[51] World Resources Institute et al. (2021). Global Protocol for Community-Scale Greenhouse Gas Inventories. Retrieved from: https://ghgprotocol.org/ghg-protocol-cities
[52] "Community Resilience Plan Prepared for the Prairie Band Potawatomi Nation," Final report (Kansas: University of Kansas, May 2020).
[53] US Census Bureau, "Prairie Band of Potawatomi Nation Reservation, KS - Census Bureau Profile."
[54] National Weather Service. Retrieved from: Black Hills Climate Overview (weather.gov).

### 6.1.3 Reporting Sectors

Table A2 describes the sectors included and the rationale for exclusions according to the requirements of the GPC. Table A3 describes the acronyms used for the rationale for exclusions.

*Table A2. Reporting sectors.*

| Sector | Inclusion | Rationale |
|---|---|---|
| Stationary Energy | | |
| Residential buildings | Yes | |
| Commercial and institutional buildings and facilities | Yes | |
| Manufacturing industries and construction | No | NO |
| Energy industries | No | NO |
| Agriculture, forestry, and fishing activities | Yes | |
| Non-specified sources | No | NO |
| Fugitive emissions from mining, processing, storage, and transportation of coal | No | NO |
| Fugitive emissions from oil and natural gas systems | No | NE |
| Transportation | | |
| On-road | Yes | |
| Railways | No | NO |
| Waterborne navigation | No | NO |
| Aviation | No | NE |
| Off-road | No | NE |
| Waste | | |
| Solid waste disposal | Yes | |
| Biological treatment of waste | No | NO |
| Incineration and open burning | No | NO |

| Sector | Inclusion | Rationale |
| --- | --- | --- |
| Wastewater treatment and discharge | Yes | |
| Industrial Processes and Product Use | | |
| Industrial processes | No | NO |
| Product use | No | NO |
| Agriculture, Forestry, and Other Land Use (AFOLU) | | |
| Livestock | Yes | |
| Land | Yes | |
| Aggregate sources and non-$CO_2$ emission sources on land | Yes | |

*Table A3. Exclusion rationale notations.*

| Notation | Definition | Description |
| --- | --- | --- |
| IE | Included Elsewhere | GHG emissions for this activity are estimated and presented in another category of the inventory. |
| NE | Not Estimated | Emissions occur but have not been estimated or reported; justification for exclusion shall be noted in the explanation. |
| NO | Not Occurring | An activity or process does not occur or exist within the city. |
| C | Confidential | GHG emissions, which could lead to the disclosure of confidential information and can therefore not be reported. |

## 6.1.4 Inventory Tool

EPA's Local Greenhouse Gas Inventory Tool ("Inventory Tool") was used to develop the GHG Inventory. The Inventory Tool is attached as Appendix B.

## 6.1.5 Data Sources

Table A4 describes the data sources used to develop the GHG inventory.

*Table A4. GHG Inventory data sources.*

| Inventory Tool Sector | Data Source |
|---|---|
| Stationary | US Energy Information Administration<br>Annual household site propane end-use consumption in the United States by state—averages, 2020<br>PBPN Strategic Energy Plan 2019 |
| Electricity | US Energy Information Administration<br>Annual household site propane end-use consumption in the United States by state—averages, 2020<br>PBPN Strategic Energy Plan 2019 |
| Mobile | US Federal Highway Administration<br>Highway Statistics, 2021<br>Table VM-2 Vehicle-miles of travel, by functional system |
| Mobile | US Federal Highway Administration<br>Highway Statistics, 2021<br>Table VM-4 Distribution of Annual Vehicle Distance Traveled |
| Mobile | National Renewable Energy Laboratory State and Local Planning for Energy, Reference Case[55] |
| Agriculture and Natural Working Land | National Agriculture Library, LCA Commons<br>Haddaway et al. 2017 McCulley et al. 2005; Intergovernmental Panel on Climate Change, 2019 |
| Solid Waste | PBPN—Waste Disposal Tracking |
| Wastewater | PBPN—Direct Reporting |

[55] Data used to allocate Kansas energy consumption to Potawatomi Nation.

## 6.1.6 Global Warming Potential

Table A5 describes the global warming potentials of the GHGs quantified in the GHG inventory.

*Table A5. Global warming potentials (100 yr).[56]*

| | |
|---|---|
| $CO_2$ to $CO_2e$ | 1 |
| $CH_4$ to $CO_2e$ | 30 |
| $N_2O$ to $CO_2e$ | 273 |

## 6.1.7 Fuel Emissions Factors

Table A6 describes the fuel emissions factors of the fuels quantified in the GHG inventory. Table A7 describes the emission factors per MMBTU of the fuels quantified in the GHG inventory. Table A8 describes the eGRID electricity emission factors for SPNO Subregion.

*Table A6. Fuel emissions factors.[57]*

| Fuel | kg $CO_2$ | kg $CH_4$ | kg $N_2O$ | Heat Content (MMBTU/Unit) | Unit |
|---|---|---|---|---|---|
| Natural Gas | 54.863 | 0.0049 | 0.0001 | 1.0370 | mcf |
| Digester Gas | 34.106 | 0.0021 | 0.0004 | 0.6550 | mcf |
| Diesel | 10.21 | 0.0004 | 0.00008 | 0.1381 | gal |
| LPG | 6.02 | 0.0003 | 0.00006 | 0.0920 | gal |
| Gasoline | 8.50 | 0.0004 | 0.00007 | 0.1202 | gal |
| Residual Fuel Oil No. 5 | 10.21 | 0.0004 | 0.00008 | 0.1400 | gal |
| Residual Fuel Oil No. 6 | 11.27 | 0.0005 | 0.00009 | 0.1500 | gal |
| Propane | 5.72 | 0.0003 | 0.00005 | 0.0910 | gal |
| Butane | 6.67 | 0.0003 | 0.00006 | 0.1030 | gal |

[56] Arias, P.A., N. et al. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 33−144. doi: 10.1017/9781009157896.002.

[57] The Climate Registry. (2021). Default Emission Factors and Emissions Factors for Greenhouse Gas Inventories, U.S EPA April 2022.

| Fuel | kg $CO_2$ | kg $CH_4$ | kg $N_2O$ | Heat Content (MMBTU/Unit) | Unit |
|---|---|---|---|---|---|
| Jet Fuel | 9.75 | 0.0004 | 0.00008 | 0.1350 | gal |
| Residential Coal | 2390.90 | 0.2742 | 0.03989 | 24.9300 | short tons |
| Commercial Coal | 2051.40 | 0.2353 | 0.03422 | 21.3900 | short tons |
| Industrial Coal | 2138.58 | 0.2459 | 0.03576 | 22.3500 | short tons |
| Electric Power Coal | 1890.52 | 0.2170 | 0.03157 | 19.7300 | short tons |
| Distillate Fuel Oil | 10.281 | 0.0004 | 0.00008 | 0.1387 | gal |
| Kerosene | 10.150 | 0.0004 | 0.00008 | 0.1350 | gal |

*Table A7. Emission factors per MMBTU.*[58]

| Fuel | kg $CO_2$ | kg $CH_4$ | kg $N_2O$ | MMBTU/Unit | Unit |
|---|---|---|---|---|---|
| Natural Gas | 52.91 | 0.0047 | 0.0001 | 0.001037 | MMBTU/scf |
| Digester Gas | 52.07 | 0.0032 | 0.00063 | 0.000655 | MMBTU/scf |
| Jet Fuel | 72.22 | 0.003 | 0.0006 | 0.135 | MMBTU/gal |
| Residential Coal | 95.90 | 0.011 | 0.0016 | 24.93 | MMBTU/short ton |
| Commercial Coal | 95.90 | 0.011 | 0.0016 | 21.39 | MMBTU/short ton |
| Industrial Coal | 95.69 | 0.011 | 0.0016 | 22.35 | MMBTU/short ton |
| Electric Power Coal | 95.82 | 0.011 | 0.0016 | 19.73 | MMBTU/short ton |

*Table A8. eGRID electricity emission factors for SPNO Subregion.*[59]

| Fuel | lbs $CO_2$/MWh | lbs $CH_4$/MWh | lbs $N_2O$/MWh |
|---|---|---|---|
| Electricity | 1,158.86 | 0.109 | 0.016 |

[58] Ibid.

[59] Emissions & Generation Resource Integrated Database (eGRID). https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

### 6.1.8 Business-as-Usual (BAU) Projection

The BAU projection is an extrapolation of GHG emissions from 2022 to 2050 using EPA's State Inventory and Projection Tool.[60] The primary input into this tool is a population projection, which is derived from state projections from the US Census Bureau[61] through 2030 and national projections[62] through 2050, apportioned to states based on the 2030 population. The tool uses the population projection to calculate future fuel use by sector and fuel type.

The projected fuel consumption is divided by the state population to derive a per-capita fuel consumption rate by sector and fuel type through 2050. This per-capita consumption is multiplied by city population projections to estimate future fuel use by sector and fuel type.

Emissions factors are applied to the fuel used to determine emissions. The emissions factors for non-electricity fuels are shown in Table A7, above. The projected emissions factor for grid electricity is the National Renewable Energy Laboratory's (NREL) Cambium 2022 mid-case projection.[63]

Solid waste and wastewater emissions are scaled based on projected population. Agriculture and natural working lands emissions/sequestration are held constant from 2021 through 2050.

[60] Environmental Protection Agency. State Inventory and Projection Tool. 2023.
https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool
[61] US Census Bureau. "Current Population Reports, 1995-2030."
[62] US Census Bureau. "The Baby Boom Cohort in the United States: 2012 to 2060."
[63] NREL Cambium. 2022.
https://scenarioviewer.nrel.gov/?project=82460f06-548c-4954-b2d9-b84ba92d63e2&mode=download&layout=Default

## 6.2 Appendix B: GHG Inventory Tool

This is an external document (spreadsheet).

# 6.3 Appendix C: Data Methods and Assumptions

This appendix describes the data, methodologies, and assumptions used to calculate emissions reductions for all measures/projects, as well as the uncertainty factor based on the methodology used.

## 6.3.1 Buildings

To quantify emissions reductions from residential and non-residential building retrofits, the methodology compares a building's total energy use and resulting emissions before retrofits with its total energy use and emissions after retrofits.

Note that these retrofits include both energy efficiency improvements and switching from systems using fossil fuel energy to heat pumps that can use zero-emissions electricity. As the Nation's energy in buildings is primarily provided by propane and electricity, the formulas provided here estimate changes in energy consumption and emissions from these two energy sources to either air or ground-source heat pumps.

### 6.3.1.1 Changes in Total Energy Use

In the formulas below, for the purposes of measures pertaining to retrofit projects:

- The "Energy Reduction %" was set to 50% to reflect a desired reduction in non-space conditioning energy consumption in these buildings by 50%;
- The "Thermal Energy Reduction %" was set to 50% to reflect a reduction in space conditioning energy consumption by 50%; and
- The coefficient of performance (COP) reflects the increase in efficiency of heat pumps relative to natural gas or electric systems.

*For Electricity*

To determine the impact of retrofits on buildings' **non-space-conditioning electricity consumption** (i.e., energy used for appliances, lighting, plug load, etc.) we use the following formula:

$$Retrofit\ NonSpace\ Conditioning\ Electricity\ Use\ (MMBTU) = (1 - Energy\ Reduction\ \%) \times Baseline\ NonSpace\ Conditioning\ Electricity\ Use\ (MMBTU)$$

To determine the impact of retrofits on buildings' **space-conditioning electricity consumption** (i.e., space heating and cooling and water heating) we use the following formula:

$$Retrofit\ Space\ Conditioning\ Electricity\ Use\ (MMBTU) = (1 - Thermal\ Energy\ Reduction\ \%) \times Baseline\ Space\ Conditioning\ Natural\ Gas\ Use\ (MMBTU)/COP + (1 - Energy\ Reduction\ \%) \times Electricity\ of\ Baseline\ Buildings\ (MMBTU)$$

The final total electricity consumption after retrofits are complete is calculated as:

$$Retrofit\ Electricity\ Use\ (MMBTU) = Retrofit\ Space\ Conditioning\ Electricity\ Use\ (MMBTU) + Retrofit\ NonSpace\ Conditioning\ Electricity\ Use\ (MMBTU)$$

*For Propane*

To determine the impact of retrofits on buildings' **non-space-conditioning propane consumption** we use the following formula:

$$Retrofit\ NonSpace\ Conditioning\ Propane\ Use\ (MMBTU) = (1 - Energy\ Reduction\ \%) \times Baseline\ NonSpace\ Conditioning\ Propane\ Use\ (MMBTU)$$

To determine the impact of retrofits on buildings' **space-conditioning propane consumption** (e.g., space heating and hot water heating) we can generally use the following formula to show, for example, a **reduction** in natural gas use due to increased insulation:

$$Retrofit\ Space\ Conditioning\ Propane\ Use\ (MMBTU) = (1 - Thermal\ Energy\ Reduction\ \%) \times Baseline\ Space\ Conditioning\ Propane\ Use\ (MMBTU)$$

However, in order to achieve significant emissions reductions, the projects for this PCAP will include completely removing propane systems for space conditioning and replacing them with heat pumps. In this case, the following formula is used:

$$Retrofit\ Space\ Conditioning\ Propane\ Use\ (MMBTU) = 0$$

The final total propane consumption after retrofits are complete is calculated as:

$$Retrofit\ Propane\ Use\ (MMBTU) = Retrofit\ Space\ Conditioning\ Propane\ Use\ (MMBTU) + Retrofit\ NonSpace\ Conditioning\ Propane\ Use\ (MMBTU)$$

### 6.3.1.2 Changes in Total Emissions

The resulting changes in emissions are calculated by applying the appropriate emissions factors to the change in energy consumption (both electricity and natural gas) calculated above:

$$Net\ Electricity\ Emissions\ (MtCO_2e) = Baseline\ Electricity\ Use\ (MMBTU) - Retrofit\ Electricity\ Use\ (MMBTU) \times Emission\ Factor\ of\ the\ Grid\ (MtCO_2e/MMBTU)$$

$$Net\ Propane\ Emissions\ (MtCO_2e) = Baseline\ Propane\ Use\ (MMBTU) - Retrofit\ Propane\ Use\ (MMBTU) \times Natural\ Gas\ Emission\ Factor\ (MtCO_2e/MMBTU)$$

The final total emissions reductions ($MtCO_2e$) are the sum of electricity and propane emissions.

$$Net\ Emission\ Reduction\ (MtCO_2e) = Net\ Electricity\ Emissions\ (MtCO_2e) + Net\ Propane\ Emissions\ (MtCO_2e)$$

### 6.3.1.3 Calculating Capital Costs

The capital costs of retrofitting buildings for the projects in this PCAP were assumed to consist of two elements. The first addresses the thermal envelope of the building, affecting the heating/cooling required to keep the building comfortable. The extent or 'depth' of the thermal retrofit dictates the cost of this action, such that the more the thermal envelope is improved, the greater the cost. The formulas for calculating retrofit capital costs for residential and non-residential buildings are as follows:

$$Residential\ Thermal\ Envelope\ Capital\ Cost\ (USD) =$$

$$number\ of\ dwelling\ units \times Costs\ for\ Percent\ Energy\ Reduction\ (USD/unit)$$

$$NonResidential\ \ Thermal\ Envelope\ \ Capital\ Cost\ (USD) =$$

$$floorspace\ retrofit\ \ \times Costs\ for\ Percent\ Energy\ Reduction\ (USD/sqft)$$

The second element addresses the equipment used to heat/cool the building. For these projects, it was assumed that propane furnaces or electric radiator heating would be replaced by either electric air-source heat pumps or ground-source heat pumps. Capital costs to make these replacements are calculated by multiplying the number of units being replaced by the cost per unit, as follows:

$$Space\ Conditioning\ Capital\ Cost\ (USD) =$$

$$number\ of\ installed\ units \times unit\ cost\ (USD/unit)$$

### 6.3.1.4 Calculating Energy Costs/Savings

Changing the fuel used to heat and cool buildings also results in a difference in ongoing energy costs when operating the buildings. Actions such as retrofitting the thermal envelope of the building will reduce energy consumption, reducing energy costs. The formula used for calculating annual energy costs or savings is as follows:

$$Annual\ Energy\ Cost\ (USD) =$$

$$Change\ in\ energy\ consumption\ by\ fuel\ (MMBTU)\ *\ Cost\ by\ fuel\ (USD/MMBTU)$$

### 6.3.1.5 Calculating Costs/Savings per Ton of Emissions Avoided

The final cost/savings per metric ton of emissions avoided was calculated using the following formula:

*Cost/Savings per MT of Emissions Avoided =*

*Capital Costs + (Annual Energy Cost/ Savings X Total Time) / Net Emission Reduction*

Calculating a cost/savings per MT of emissions avoided allows SEMCOG to compare the cost-effectiveness of different actions to reduce emissions over a period of time (or the Total Time). For the purposes of this PCAP, the Total Time for each measure began when emissions reductions would first be realized and continue until 2050.

### 6.3.1.6 Co-Pollutants Reduction Calculations for Natural Gas

Eliminating natural gas combustion in buildings also reduces the presence of pollutants, including carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), particulate matter (PM2.5), and volatile organic compounds (VOCs). Quantifying the reductions of these pollutants was done using emissions data from the EPA National Emissions Inventory (NEI). For each pollutant, its emission rate per MMBTU of natural gas consumed is calculated by dividing the total emissions of each co-pollutant by the total natural gas consumption, as shown in the formula:

$$Pollutant's\ Emission\ Rate\ by\ Type\ (metric\ tons/MMBtu) = \frac{Total\ Emissions\ of\ Pollutant\ (metric\ tons)}{Total\ Natural\ Gas\ Consumption\ (MMBtu)}$$

Subsequently, the reduction of the pollutant can be calculated by applying the reduction in natural gas consumption to the pollutants emission rate by type using this formula:

$$Reduction\ of\ Pollutant\ (metric\ tons) = Natural\ Gas\ Consumption\ Reduction\ (MMBtu) \times Pollutant's\ Emission\ Rate\ by\ Type\ (metric\ tons/MMBtu)$$

In this formula, Natural Gas Consumption Reduction represents the amount of the reduction in natural gas use due to the retrofit (in million British thermal units, or MMBTU).

Each Pollutant's Emission Rate by Type (metric tons/MMBTU) specifies the amount of pollutant emitted per unit of natural gas consumed. This rate varies by pollutant type and reflects the average emissions associated with the combustion of natural gas.

## 6.3.2 Transportation

### Electric Vehicle Adoption Emissions Reduction

The calculation for electric vehicle adoption and its impact on emissions reduction involves several steps, each leveraging specific data points to quantify the net emissions reduction achieved by transitioning from conventional vehicles to EVs. A detailed explanation of the process and relevant equations are provided in the following sections:

### 6.3.2.1 Calculating Total Distance (Vehicle Miles Traveled) That Will Shift to EVs

This step calculates the total miles that will be transitioned by type of vehicle from gasoline or diesel to electric vehicles:

$$VMT\ to\ shift\ (miles) = Number\ of\ Vehicles\ to\ shift \times Annual\ VMT\ per\ vehicle\ (miles)$$

This equation multiplies the number of vehicles by type being transitioned to EVs by the annual vehicle miles traveled per vehicle, giving the total miles that will now be covered by EVs instead of conventional vehicles.

### 6.3.2.2 Calculating Gross Emissions Reductions

This step calculates the gross emissions reduction, which is the total potential reduction in emissions **if** the shifted VMT were no longer contributing to greenhouse gas emissions from conventional vehicle tailpipes.

$$Gross\ Emissions\ Reduction\ (MtCO_2e) =$$

$$VMT\ to\ shift\ (miles) \times Emission\ Factor\ (MT\ CO_2e/miles)$$

The emission factor (MT $CO_2e$/mile) represents the amount of $CO_2e$ emissions produced per mile by conventional vehicles. Multiplying this factor by the VMT to shift gives the total emissions that could be avoided by switching to EVs.

### 6.3.2.3 Calculating Emissions From EVs

This step calculates the emissions from the electricity consumed by EVs for the shifted VMT. It considers the average electricity consumption by type of EV and the emission factor for electricity generation.

$$Emissions\ EVs\ (MtCO_2e)\ =\ VMT\ to\ shift\ by\ type\ of\ EV\ (miles) \times$$
$$Average\ Electricity\ consumption\ by\ Type\ of\ EV\ (GWh/miles) \times$$
$$Emission\ Factor\ Electricity\ (MtCO_2e/GWh)$$

This equation takes into account the average electricity consumption (GWh/mile) by the type of EV for the shifted VMT and multiplies it by the emission factor for electricity ($MtCO_2e$/GWh). If the vehicles are being charged using grid electricity, the emission factor used is that of the grid. If the vehicles are charged using renewable power, then the emissions factor used will reflect that no emissions are generated from charging these vehicles.

### 6.3.2.4 Calculating Net Emissions Reduction

The net emissions reduction is the difference between the gross emissions reduction (potential emissions savings from not using conventional vehicles) and the emissions attributable to the electricity used by EVs.

$$Net\ Emission\ Reduction\ (MtCO_2e)\ =$$
$$Gross\ Emissions\ Reduction\ (MtCO_2e)\ -\ Emissions\ EVs\ (MtCO_2e)$$

This final step provides the overall emissions reduction benefit of transitioning to EVs, taking into account the emissions from electricity generation for EV charging.

### 6.3.2.5 Electric Vehicle Adoption Costs and Savings

The net costs/savings associated with switching to an electric vehicle are calculated by adding the purchase cost to the operations (or fuel) costs/savings and maintenance costs/savings for the lifetime of the vehicle. This is shown in the two steps below.

### 6.3.2.6 Calculating Capital Costs

The capital cost reflects the investment needed to purchase a zero-emissions vehicle(s). It is calculated using the following formula:

$$Capital\ Cost\ (USD)\ =\ Number\ of\ Vehicles\ *\ Cost\ \ (USD/vehicle)$$

In most cases in this PCAP, the capital costs presented are “incremental capital costs.” This means that they represent the difference between what would be paid for the traditional option (e.g., an

ICE vehicle) and what will be paid for the new option (an EV). The column labels in the PCAP indicate when the costs provided are incremental versus total.

#### 6.3.2.7 Calculating Operation and Maintenance Costs

Vehicle operation costs include the costs of fuel or charging. Maintenance costs include the costs of vehicle upkeep and servicing. These two values are calculated using the formulas below. If the calculation is being made for more than one vehicle, the Vehicle Miles Traveled and the Energy Consumed must be the total values for all the vehicles being considered:

$$Maintenance\ Cost\ (USD) = Vehicle\ Miles\ Traveled\ (miles) * Cost\ (USD/mile)$$

$$Operation\ Cost\ (USD) = Energy\ Consumed\ (MMBTU) * Cost\ (USD/MMBTU)$$

#### 6.3.2.8 Mode Shift Emissions Reduction

The calculation for mode shift begins with estimating the reduction in vehicle miles traveled as a result of shifting transportation modes from personal gasoline-powered vehicles to alternative modes such as public transit, biking, walking, or electric vehicles.

#### 6.3.2.9 Calculating VMT Reductions

The formula provided here calculates the total reduction in distance driven that is attributable to the mode shift and is expressed in millions of VMT:

$$VMT\ reduction\ (million\ VMT) = Total\ VMT\ with\ Gasoline\ (million\ VMT) - \left(Total\ VMT\ with\ Gasoline\ (million\ VMT) \times \frac{Share\ of\ VMT\ by\ auto\ Baseline\ (\%)}{Share\ of\ VMT\ by\ auto\ After\ action\ (\%)}\right)$$

**Total VMT with Gasoline (Million VMT):** This represents the total miles traveled by gasoline-powered vehicles before any interventions to encourage a mode shift. It serves as the baseline against which the reduction in VMT is measured.

**Share of VMT by auto Baseline (%):** This is the baseline share of total VMT traveled by gasoline-powered vehicles before any interventions to encourage a mode shift.

**Share of VMT by auto After action (%):** This percentage reflects the projected share of total VMT that is traveled by gasoline-powered vehicles after interventions have been implemented to promote a mode shift.

The equation subtracts the adjusted VMT (considering the action-induced change in the share of VMT by auto) from the baseline total VMT with gasoline to calculate the reduction in VMT due to the mode shift, quantifying how much vehicle travel has been avoided by shifting away from gasoline-powered vehicles toward more sustainable modes of transportation.

#### 6.3.2.10 Calculating Emission Reductions

The emission reductions from a transportation mode shift are calculated by multiplying the reduction in vehicle miles traveled by the emission factor of the vehicle fuel being used (e.g., gasoline), yielding the total emissions avoided in metric tons of $CO_2$ equivalent ($MtCO_2e$). The formula is as follows:

$$Emission\ Reduction\ (MtCO_2e)\ =$$

$$VMT\ reduction\ (Million\ VMT) \times Emission\ factor\ (MtCO_2e\ /\ Million\ VMT)$$

This equation translates VMT reduction into greenhouse gas emissions savings, providing a clear measure of the environmental benefits of shifting away from gas- and diesel-powered vehicles towards more sustainable transportation modes.

#### 6.3.2.11 Calculating Capital Costs

For this analysis, the capital costs to support the desired transportation mode shift are calculated by multiplying the miles of infrastructure required by the cost per mile. The formula is as follows:

$$Capital\ Cost\ (USD)\ =$$

$$Miles\ of\ infrastructure\ (mile) \times Costs\ per\ mile\ (USD/mile)$$

Note that other costs, such as education and safety programs, as well as savings such as avoided health care costs (e.g., from conditions arising from inactivity) could also be incorporated into a "total" assessment of financial costs and benefits; however, these values were not included in the calculations made for this PCAP.

#### 6.3.2.12 Co-Pollutants Reduction Calculations

For the transportation sector, the calculation of emissions reductions for co-pollutants entails analyzing the decrease in vehicle miles traveled and applying designated emissions rates for various vehicle types. The co-pollutants in focus—Total Hydrocarbons (HC), Carbon Monoxide

(CO), Nitrogen Oxides (NOx), and Particulate Matter (PM2.5)—are evaluated for their emissions impact. The formula to calculate the emissions reductions for each co-pollutant is given by:

$$Emissions\ Reductions\ per\ co - pollutant\ (metric\ ton) =$$

$$VMT\ reduction\ (miles) \times Emissions\ Rates\ per\ Vehicle\ Type\ (metric\ ton/mile)$$

In this context:

VMT reduction (miles) denotes the decrease in vehicle miles traveled, achieved through increased adoption of electric vehicles, greater use of public transit, and encouragement of biking or walking.

Emissions Rates per Vehicle Type (metric ton/mile) specifies the rate at which each vehicle type emits HC, CO, NOx, and PM2.5 per mile. These rates vary by vehicle type and fuel used, reflecting the different contributions to air pollution.

## 6.3.3 Energy Systems

To accurately assess the emissions reduction attributable to renewable installations, the methodology uses two key “factors”:

1. A “capacity factor” for each type of technology and for each state, as provided by NREL. These factors estimate the energy generation potential of solar and wind installations based on geographical and climatic variations that will affect wind patterns and solar irradiance and, consequently, energy production.
2. The “grid emissions factor” from the EPA eGRID database. This factor represents the average emissions intensity of electricity generation and distribution on the region’s electricity grid. This provides a baseline against which the impact of renewable-generated electricity can be measured. Additionally, projections of emission factors based on Michigan’s clean energy targets are used to anticipate the grid's future carbon intensity.

### 6.3.3.1 Calculating Annual Generation

The annual electricity generation from installed renewable systems is calculated using the formula:

$$Annual\ Generation\ (GWh) = Installed\ Capacity\ (GWh) \times 8760 \times Capacity\ Factor$$

This equation multiplies the installed capacity (in gigawatt-hours, GWh) by the total number of hours in a year (8760) and the capacity factor, providing an estimate of the total energy produced by solar installations annually.

#### 6.3.3.2 Calculating Emissions Reductions

The reduction in emissions resulting from the generated renewable electricity is quantified as follows:

$$Emissions\ Reduction\ (MtCO_2e)\ =\ Emission\ Factor\ (MT\ CO_2e/GWh)\times Annual\ Generation\ (GWh)$$

This calculation applies the emission factor (in metric tons of $CO_2$ equivalent per gigawatt-hour, or $MtCO_2e$/GWh) to the annual generation from renewable energy installations, estimating the total emissions avoided by displacing grid electricity with renewable energy.

#### 6.3.3.3 Calculating Capital Costs

The capital costs of renewable energy depend on the installed capacity and the technology. The formulas for calculating renewable energy capital costs are as follows:

$$Renewable\ Energy\ Capital\ Cost\ (USD)\ =\ Generation\ Capacity\ (kW)\times Costs\ (USD/kw)$$

#### 6.3.3.4 Calculating Energy Costs

In cases such as rooftop solar, the amount of electricity a customer requires from the grid will be reduced by the amount they generate from their solar system. This translates into lower utility bills for the customer. The formula for calculating these energy savings is as follows:

$$Energy\ Cost\ (USD)\ =\ Change\ in\ energy\ consumption\ by\ fuel\ (MMBTU)\ *\ Cost\ by\ fuel\ (USD/MMBTU)$$

## 6.3.4 Restore Landscapes and Sequester Carbon

The methodology for calculating the carbon sequestration potential from land cover carbon accumulation and agricultural operation initiatives incorporates emission sequestration intensities from work done at Kansas State University. The used sources allow us to align with the physical characteristics of vegetation types being planted or restored and operational shifts being planned.

### 6.3.4.1 Emissions Reduction

The emissions reduction is quantified by calculating the carbon sequestration potential of the vegetation at maturity. This calculation takes into account the area covered by the vegetation once the plants have reached their full growth potential, as well as the carbon sequestration factor, which represents the amount of carbon dioxide ($CO_2$) that can be absorbed per unit area. The formulas to estimate the emissions reduction in metric tons of $CO_2$ equivalent ($MtCO_2e$) are as follows:

### 6.3.4.2 Calculating Sequestration From Regenerative Land Cover management

$$Carbon\ Sequestered\ (MtCO_2e) = number\ of\ acres \times Carbon\ Sequestration\ Factor\ (MtCO_2e/acre)$$

In this formula:

Carbon Sequestration Factor ($MtCO_2e$/acre) indicates the amount of $CO_2$ that can be sequestered per acre per year, reflecting the capacity of the land cover to absorb $CO_2$ from the atmosphere and store it in vegetation or soil.

### 6.3.4.3 Calculating GHG reduction from agricultural operations shift

$$Emissions\ Reduction\ (MtCO_2e) = area\ for\ agricultural\ operations\ (acres) \times Carbon\ Sequestration\ Factor\ (MtCO_2e/acres)$$

In this formula, the Carbon Sequestration Factor ($MtCO_2e$/acre) indicates the amount of $CO_2$ that can be sequestered per acre per year for tilling and no-tilling operations. By shifting from tilling to no-tilling, the capacity of agricultural lands to absorb $CO_2$ from the atmosphere is increased.

#### 6.3.4.4 Calculating GHG Impact From Livestock

$$Emissions\ (MtCO_2e) =$$
$$number\ of\ head\ (animal\ unit\ (au)) \times Carbon\ emissions\ Factor\ (MtCO_2e/au)$$

In this formula, the carbon emissions per animal unit ($MtCO_2e$/au) indicates the amount of $CO_2$ that is emitted per animal unit per year. By reducing the number of head or by changing operations, and thus, emission factor per animal unit, GHGs from livestock can be reduced.

### 6.3.5 Data Sources

This table describes the data and assumptions used for the calculations outlined above and their sources.

*Table C1. Data sources.*

| Source | Data Set |
|---|---|
| Federal Highway Administration | Vehicle miles traveled data by vehicle type[64] |
| NREL's BC Transit Fuel Cell Bus Project | Alternative fuel vehicle consumption metrics[65] |
| Replica | Detailed mode-specific transportation data, including trip numbers, lengths, and occupancy rates by county[66] |
| U.S. Department of Energy's resources, Alternatives Fuel Data Center, and 2023 Fuel Economy Guide | Vehicle mileage and fuel consumption rates[67] |

[64] Federal Highway Administration. "Vehicle Miles Traveled (VMT) data by vehicle type." Policy Information, Statistics 2020. https://www.fhwa.dot.gov/policyinformation/statistics/2020/.
[65] National Renewable Energy Laboratory. "BC Transit Fuel Cell Bus Project: Evaluation Results." https://www.nrel.gov/docs/fy14osti/60603.pdf.
[66] Replica. "Detailed Mode-Specific Transportation Data, Including Trip Numbers, Lengths, and Occupancy Rates by County." https://studio.replicahq.com/.
[67] U.S. Department of Energy. "2023 Fuel Economy Guide." Published January 2024. https://fueleconomy.gov/feg/pdfs/guides/FEG2023.pdf.

| Source | Data Set |
| --- | --- |
| American Council for an Energy-Efficient Economy and average vehicle emissions rates from the U.S. Department of Transportation | Heavy-duty vehicle fuel consumption[68] |
| United States Department of Transportation, National Transportation Statistics | Estimated national average vehicle emissions rates per vehicle by vehicle type using gasoline and diesel[69] |
| U.S. Energy Information Administration Annual Energy Outlook 2023 | Residential, commercial, and transportation energy prices[70] |
| California HVIP | Bus and heavy-duty vehicle capital and O&M costs[71] |
| International Council on Clean Transportation, Argonne National Laboratory and American Automobile Association | Light-duty Vehicle capital and O&M costs[72][73][74] |
| Portland State University Cost Analysis of Bicycle Facilities | Capital Cost of active transportation infrastructure[75] |

[68] Nadel, Steven, and Eric Junga. "Electrifying Trucks: From Delivery Vans to Buses to 18-Wheelers." An ACEEE White Paper, January 2020. https://www.aceee.org/sites/default/files/pdfs/electric_trucks_1.pdf.

[69] United States Department of Transportation. "Estimated National Average Vehicle Emissions Rates per Vehicle by Vehicle Type using Gasoline and Diesel." National Transportation Statistics. https://www.bts.gov/product/national-transportation-statistics.

[70] U.S. Energy Information Administration. “Annual Energy Outlook 2023 - Table 3 Energy Prices by Sector and Source”. https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2023&sourcekey=0

[71] California HVIP. “Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project”. https://californiahvip.org/

[72] The International Council on Clean Transportation. “Update on electric vehicle costs in the United States through 2030.” https://theicct.org/wp-content/uploads/2021/06/EV_cost_2020_2030_20190401.pdf

[73] Argonne National Laboratory. “Assessment of Vehicle Sizing, Energy Consumption, and Cost Through Large-Scale Simulation of Advanced Vehicle Technologies.” https://publications.anl.gov/anlpubs/2016/04/126422.pdf

[74] American Automobile Association. “Your Driving Costs: How Much Are You Really Paying to Drive?” https://exchange.aaa.com/wp-content/uploads/2019/09/AAA-Your-Driving-Costs-2019.pdf

[75] Portland State University. ”Cost Analysis of Bicycle Facilities: Cases from cities in the Portland, OR region.” https://activelivingresearch.org/sites/activelivingresearch.org/files/Dill_Bicycle_Facility_Cost_June2013.pdf

| Source | Data Set |
| --- | --- |
| Energy Information Administration (EIA) forms 861 and 176 | Electricity and natural gas consumption data for both residential and non-residential buildings[76][77] |
| US Census Bureau | Dwelling units by building type[78] |
| Replica | Non-residential building floorspace |
| National Renewable Energy Laboratory's ResStock and ComStock databases | Residential and commercial buildings' energy use by type and end use |
| EPA National Emissions Inventory | Co-pollutants emissions by natural gas combustion in residential and commercial/ institutional buildings[79] |
| U.S. Energy Information Administration 2023 Building Sector Appliance and Equipment Costs and Efficiencies | Residential and commercial heat pump capital costs[80] |
| Environmental Protection Agency's inventory tool | eGRID electricity and fossil fuel emission factors[81] |
| NREL Rooftop Solar Photovoltaic Technical Potential | Energy production potential of solar rooftop installations[82] |

[76] U.S. Energy Information Administration. "Electricity Sales." https://www.eia.gov/electricity/data/eia861m/.
[77] U.S. Energy Information Administration. "Natural Gas Consumption." https://www.eia.gov/naturalgas/data.php.
[78] U.S. Census Bureau. "Population and Housing Unit Estimates Datasets." https://www.census.gov/programs-surveys/popest/data/data-sets.html.
[79] Environmental Protection Agency. "2020 National Emissions Inventory (NEI) Data." https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data.
[80] U.S. Energy Information Administration. “Building Sector Appliance and Equipment Costs and Efficiencies, 2023.” https://www.eia.gov/analysis/studies/buildings/equipcosts/
[81] Environmental Protection Agency. "Emissions & Generation Resource Integrated Database (eGRID)." https://www.epa.gov/egrid.
[82] National Renewable Energy Laboratory. "Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment - Table 6. Total Estimated Technical Potential (All Buildings) for Rooftop PV by State." https://www.nrel.gov/docs/fy16osti/65298.pdf.

| Source | Data Set |
|---|---|
| Pembina Institute | Residential and non-residential building envelope retrofit incremental costs[83] |
| NREL System Advisory Model (SAM) | Capacity factor for photovoltaic plants and wind farms[84] |
| NREL 2021 Electricity Annual Technology Baseline | Solar and wind renewable electricity production capacity capital costs[85] |
| Mid-America Regional Council | iTree Eco analysis of riparian canopy cover[86] |
| Mid-America Regional Council | Blue River Watershed Ecosystem Services Study[87] |
| PBPN | Soldier Creek 9 Element Watershed Plan[88] |
| Environmental Protection Agency's (EPA) US Environmentally Extended Input-Output (USEEIO) model | Emission intensities from vegetables, melons, and potatoes[89] |
| Biogeosciences | Methane efflux from an American bison herd[90] |

[83] Pembina Institute. "Building Energy Retrofit Potential in B.C.". https://www.pembina.org/docs/event/netzeroforum-backgrounder-2016.pdf
[84] National Renewable Energy Laboratory. "System Advisory Model (SAM) 2023.12.17, SSC 288." https://sam.nrel.gov.
[85] National Renewable Energy Laboratory. " 2021 Electricity Annual Technology Baseline". https://atb.nrel.gov/electricity/2021/data
[86] Mid-America Regional Council, 2020. i-Tree Tools. https://www.itreetools.org/tools
[87] Mid-America Regional Council, Little Blue River Watershed Flood Risk and Ecosystem Restoration Project General Investigation Study, https://www.marc.org/environment/environment-plans/little-blue-river-watershed-study
[88] PBPN, "Middle Kansas WRAPS 9 Element Plan Overview ." 2023. https://kswraps.org/wp-content/uploads/2020/10/middlekansas_plansummary_0.pdf
[89] EPA 2022, "USEEIO v2.0, The US Environmentally-Extended Input-Output Model v2.0", https://www.nature.com/articles/s41597-022-01293-7
[90] Stoy, P. 2021, "Methane efflux from an American bison herd", https://bg.copernicus.org/articles/18/961/2021/

## 6.3.6 Uncertainty

The quantification of GHG emissions is largely the result of applying emissions factors, as measured in metric tons per unit of activity, to an estimated amount of activity, as measured in MMBTU, kWhs, vehicle miles traveled, etc. Different methodologies and assumptions used in determining these emissions factors can introduce uncertainty into the process. To mitigate this, when possible, we have used emission factors derived from EPA tools and calculations, ensuring that our calculations align with EPA data and methodologies.

The projected transformation of the modeled activity also introduces uncertainties to the calculations. An assumption that crosses all action is the rate of adoption of various technologies or behaviors. We assume uniform adoption rates for zero-emission vehicles (ZEVs), building retrofits, renewable energy, etc., which may not align with real-world market dynamics, consumer behavior, or policy shifts. The projected action also simplifies the logistical and technical challenges involved in its deployment, such as spatial planning, required workforce, materials, and electrical grid impacts. Furthermore, the methodology might not accurately capture the dynamic effects on emissions one action has on another action—for example, overlooking how increased use of one mode (e.g., biking) affects others (e.g., public transit). These technical limitations underscore the need for cautious interpretation of projected emissions reductions, highlighting the complexity of decarbonization.

Additionally, aggregating or averaging, such as the application of uniform capacity factors across counties, can create uncertainty. In reality, local variations in rooftop orientations would allow for different levels of energy generation.

Finally, when dealing with natural and working lands, the methodologies may not fully account for the variability in vegetation types and carbon sequestration capacities or the long-term survival rates of vegetation and potential risks to regenerative land covers. Additionally, assumptions of linear growth and sequestration rates do not accurately reflect the dynamic growth patterns of vegetation types. The potential indirect effects on local ecosystems and the lack of a robust framework for verification and ongoing monitoring of sequestration outcomes also pose challenges.

## Contact Info:

**Prairie Band Potawatomi Nation**

16281 Q Road, Mayetta, KS 66509 Toll Free 877.715.6789