TAMPA 100% CLEAN AND RENEWABLE MUNICIPAL ENERGY PLAN

TAMPA, FLORIDA

Prepared for Applied Sciences and the City of Tampa

June 2023
by Greenlink Analytics, Inc.

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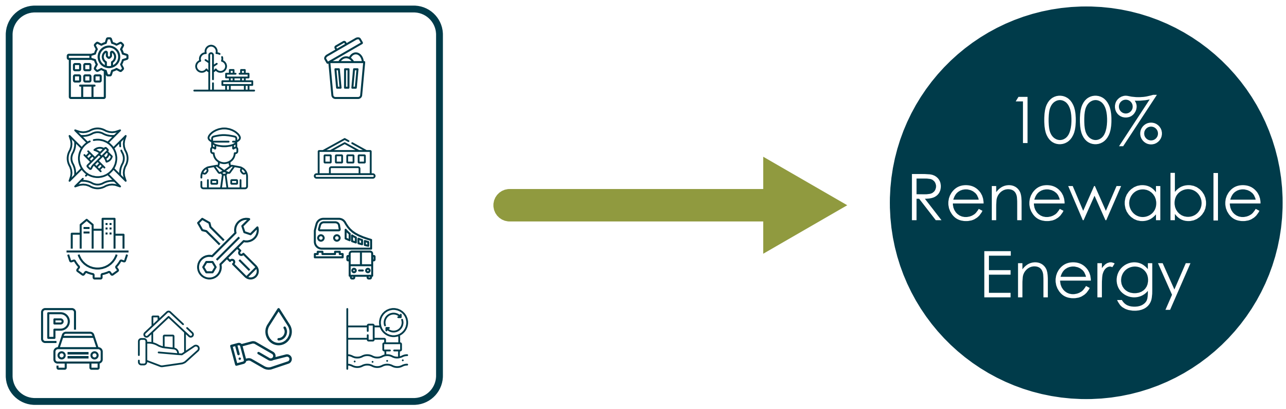
EXECUTIVE SUMMARY

In May 2021, Tampa Mayor Jane Castor issued the Resilient Tampa roadmap, a plan for building resilience by addressing the impacts of climate change and social inequities across the city. That document included the bold ambition to *"Ensure All Municipal Operations Are Powered by 100 Percent Renewable Energy."* Shortly after, Tampa's City Council passed a resolution to pursue 100% clean and renewable electricity in its municipal operations by 2035; however the path was not defined.

The Mayor's Office brought together a team of experts to analyze the City's energy budget and provide evidence-based options for reaching its 100% Clean & Renewable Municipal Energy target while highlighting associated costs, benefits, and tradeoffs.

This study used advanced data analytics to develop three energy-use forecasts for the City of Tampa – Business-as-Usual (BAU), Moderate (MOD), and Ambitious (AMB) Electricity Scenarios. Each describes different trajectories of electricity use. The analysis incorporates a sophisticated understanding of the energy landscape by accounting for the interconnectedness of local energy systems, changing costs of energy resources, innovative new technologies, market dynamics, and complex energy policies.

City of Tampa Municipal Operations



BAU

MOD

AMB

BUSINESS-AS-USUAL (BAU)

The BAU Scenario envisions a world where the City of Tampa's municipal energy consumption will continue in line with historical trends and expected growth. In this scenario, electricity consumption is expected to grow by 14% over the next 20 years, resulting in 1,850,000 metric tons of carbon dioxide emissions and resulting in total public health damages of $139 million.

MODERATE (MOD)

The MOD Scenario adds nine clean energy initiatives that could be pursued and implemented by the City. In this scenario, grid-supplied electricity demand is reduced by 26% over the next 20 years. This scenario is expected to avoid 400,000 metric tons of carbon dioxide emissions, $28 million in public health damages, and $69 million in municipal utility bill expenses.

AMBITIOUS (AMB)

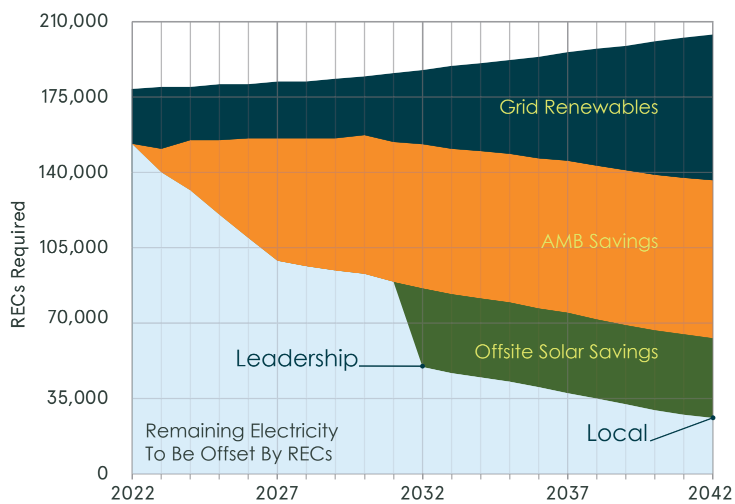
The AMB Scenario assumes that the City implements all clean energy initiatives identified in this report, leading to demand reductions exceeding 50% over the same time period. Cumulative impacts avoid 710,000 metric tons of carbon dioxide emissions, $50 million in public health damages, and $122 million in municipal utility bill expenses, compared to the BAU Scenario. The vast majority of initiatives are cost effective; three initiatives account for over 70% of costs and about 10% of total energy savings. These three may be justified for reasons other than energy cost savings. If these three are excluded, this scenario is cost-effective in addition to driving the greatest emissions benefits.

While both the MOD and AMB Scenarios help the City move closer to its goal of 100% clean and renewable energy, no scenario will reach this target on its own due to the City's dependence on fossil-fuel generated electricity supplied by Tampa Electric Company (TECO), the region's electricity provider. To bridge the gap between the MOD or AMB scenarios and 100% clean and renewable energy, three pathways have been identified using renewable energy credits (RECs).

Each 100% clean energy pathway builds on either the MOD or AMB electricity scenario's energy efficiency investments and renewable energy initiatives as well as a target date for achieving 100% clean energy with the additional use of RECs.

The Leadership Pathway (shown in ES.1), when aligned with the AMB's energy savings, is the most accelerated and would require more years of buying RECs. The Local Pathway, aligned with the AMB savings, reflects the same commitment to local clean energy efforts as the Leadership Pathway but affords a longer horizon before utilizing RECs. The Market Pathway (shown in more detail in Section 8) was aligned with the MOD scenario's initiatives and a longer timeline. Thus, becoming the most heavily relient on RECs to achieve 100% clean and renewable energy.

ES.1 - Leadership (2032) and Local (2042) 100% Clean Energy Pathways



You will find more detailed information on how the MOD and AMB electricity scenarios align with the 100% clean energy Pathways in Section 8 starting on page 22.

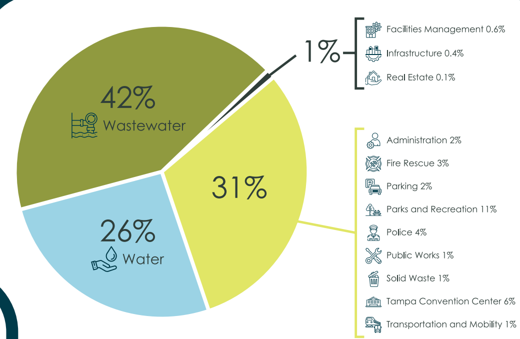
Pathways to 100% Clean + Renewable Energy

The pathways presented in this report offer directions to 100% clean and renewable energy. The City could surpass the Intergovernmental Panel on Climate Change's recommended timeline to achieve global net-zero operations by 2050.[1] The "right" 100% clean pathway for Tampa is not a clear pathway that can be evaluated by metrics alone, as it will require the consideration of multiple factors simultaneously. Therefore, the City should use this report as context for planning in conjunction with community values and the Climate Action and Equity Plan.

1. STARTING POINT

Understanding Tampa's electricity consumption history and operational context

Sections 1-3



2. CLEAN INITIATIVES

Reduce City's needs for electricity by selecting and implementing effective initiatives

Sections 4-7

Clean Energy Initiative	Department(s)	Energy Savings Potential (MWh)	Total Capital Cost (2022 $)
Reaching Industrial EE Potential	Water Wastewater	28,800	$10M - $34M
CAEP Solar Initiatives	Municipal-Wide	23,700	$14M
Solar Installations - Multiple Facilities	Water	19,400	$6M
HVAC Upgrades	Facilities Management	19,300	$20M
LED Lighting Retrofit in Municipal Parking Garages	Parking	4,000	$4M

3. RENEWABLE ENERGY CREDITS

Use RECs to offset any remaining non-clean / non-renewable electricity requirements

Section 8

4. ACHIEVING 100%

With a combination of strategies, initiatives, target dates, and RECs

Section 9

100%

Clean+Renewable Energy for Municipal Operations

1. Intergovernmental Panel on Climate Change (IPCC). Intergovernmental Panel on Climate Change (IPCC): 30 Years Informing Global Climate Action. Accessed March 17, 2023. https://unfoundation.org/blog/post/intergovernmental-panel-climate-change-30-years-informing-global-climate-action/

SECTION 1: INTRODUCTION

In response to Tampa's growing number of climate impacts, including rising sea levels and elevated temperatures, the Tampa City Council passed a resolution in August 2021 to transition all municipal operations to 100% clean and renewable energy by 2035.

Building on two important efforts,Transforming Tampa's Tomorrow & Resilient Tampa[2], the City began working on a recently finalized Climate Action and Equity Plan (CAEP), which identifies three overarching goals: reducing greenhouse gas emissions; adapting to the future impacts of climate change; and supporting all Tampanians along the way. The CAEP aligns strategic goals for housing, food, and community interests with climate actions.

In that Plan, Mayor Castor centered climate action as a challenge and opportunity to improve and sustain Tampa's future.

The first climate action initiative in the CAEP, "Transition All Municipal Operations to 100% Clean and Renewable Energy," is the main focus of this companion 100% Clean and Renewable Municipal Energy Plan.

To assist in its ongoing equity work, the City was provided the Greenlink Equity Map (GEM).[4] GEM has over 600 City and Community-Based Organization members and is helping to direct over $200 million in equity-centered programming, having enabled over 90 equitable processes nationwide.

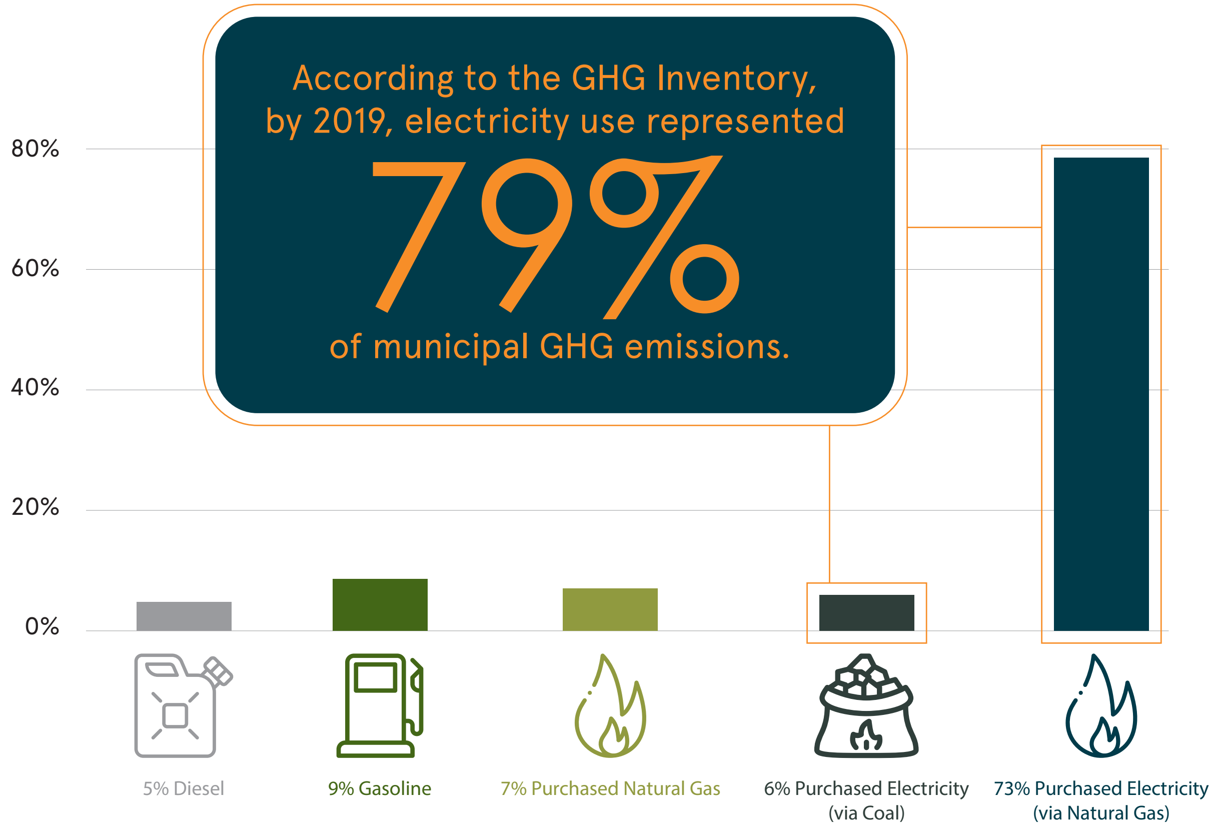
2. City of Tampa (2023). Strategic Goals. Accessed April 11, 2023. https://www.tampa.gov/mayor/strategic-goals

3. Applied Sciences. (2023). City of Tampa Climate Action & Equity Plan (CAEP).

4. For more details on the Greenlink Equity Map, see Appendix B.

"Tampanians are increasingly feeling the impacts of a changing climate…Tampanians are ready to rise to the challenge… [The Climate Action and Equity Plan] is the next step forward in what must be a collaborative effort. By working together…we can ensure a climate resilient future for every Tampanian."[3]

Mayor Jane Castor



Note: The information shown above can be found in Figure 3.17 of the 2019 City of Tampa GHG Inventory; page 63

Scope of Analysis and Methodology

This analysis is intended to help the City of Tampa develop a plan and timeline for 100% clean and renewable energy for municipal operations. In June 2022, Greenlink engaged researchers involved in the City of Tampa Greenhouse Gas (GHG) Inventory[5] to understand the assumptions and associated uncertainties. This analysis uses the GHG Inventory to determine each municipal department's electricity consumption. Emissions from the Solid Waste Department's waste-to-energy plant were not included.

The City's electricity provider, TECO, was engaged to provide historical electricity consumption and billing data. Simultaneously, key city staff were asked to participate in an energy survey related to the GHG Inventory. This survey was used to verify the largest electricity consuming buildings in each department and historical electricity use for each department.

The responses identified many of the City's largest electricity consumers and ultimately helped TECO provide historical electricity consumption data. This data was cleaned and prepared as one of several inputs into Greenlink's ATHENIA model, a machine learning tool used to forecast electricity demand, utility asset generation, energy-sector emissions, and resulting public health damages for every hour. For this report, a 20 year electricity forecast was prepared through 2042. This report does not attempt to quantify additional electricity savings beyond 2042 because the baseline forecast ends, not because clean energy opportunities do not exist after this year.

Beginning in January of 2023, City staff were contacted to determine potential clean energy initiatives on the horizon. During these engagements, staff were asked to provide general estimates of energy savings, expected capital costs, anticipated implementation timelines, and expected feasibility, to the extent possible.

From these responses, the team created forecasts representing steady implementation of these clean energy initiatives. City staff were recontacted to verify the representation of costs and savings before final publication.[6]

5. City of Tampa. (2021, November 02). Greenhouse Gas Inventory - Government Operations and City-Wide. Tampa, FL: City of Tampa. https://www.tampa.gov/document/city-tampa-green-house-gas-inventory-86621

6. Additional information on methods used is provided in Appendix A

Background

The Greenhouse Gas Inventory demonstrated that electricity is responsible for more than 75% of Tampa's municipal greenhouse gas emissions, excluding those from the city-owned waste-to-energy plant.* There are 13 separate municipal operations for the City of Tampa (see full list below), which use varying amounts of energy based on department and function. Historically, departments have planned for and managed energy use independently from one another. **Electricity management specifically is handled in a decentralized manner.** This can pose challenges to long-term, strategic energy planning which are discussed in this report.

This report highlights a nuanced way forward both in terms of energy use and management. It builds on work by the City of Tampa, combined with cutting-edge, generator-level analysis to more precisely understand the electricity fuel mix serving municipal buildings and quantify associated emissions.

Using this data enables the City of Tampa to identify the best avenues for reducing energy consumption and emissions. For example, knowing the energy habits of each department allows for the development of a holistic approach to municipal energy planning to ensure departments are energy efficient and drive down emissions effectively.

STATE PREEMPTION DISCLAIMER:

In 2021, the Florida Legislature passed Section 366.032, Florida Statutes, which prohibits local governments from restricting the types of fuels and energy sources that utilities may offer their customers, including policies such as building electrification mandates. Given this broad preemption, the City of Tampa is not considering any actions as part of this plan that would have the effect of restricting the energy options available to the City's residents and businesses. The scope of this plan and any policies resulting from it, is limited to City of Tampa government facilities such that it would not impact utility customers' energy options in any way.

CITY OF TAMPA MUNICIPAL OPERATIONS

- Facilities Management
- Fire Rescue
- Infrastructure
- Parking
- Parks and Recreation
- Police
- Public Works
- Real Estate
- Solid Waste
- Tampa Convention Center
- Transportation and Mobility
- Water
- Wastewater

*The McKay Bay waste-to-energy facility is owned by the City of Tampa and sells electricity to a non-TECO utility. This facility is not part of the 100% clean electricity assessment. This facility is the biggest greenhouse gas emitter in the city.

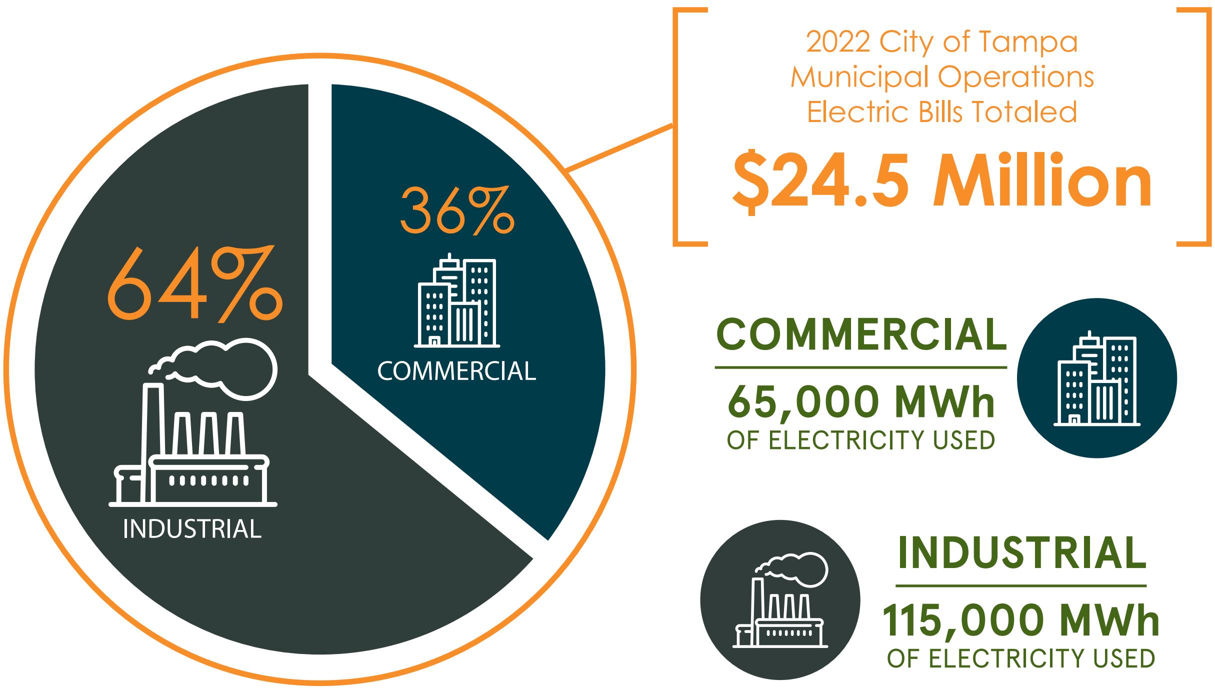
SECTION 2: MUNICIPAL ELECTRICITY IN THE CITY OF TAMPA TODAY

Electricity Production and Consumption in 2022

Tampa Electric Company (TECO) is the City of Tampa's electric utility provider. In 2022, TECO generated approximately 20,300,000 megawatt hours (MWh) of electricity for its 800,000 customers. The City of Tampa's municipal operations account for a small fraction of that total, approximately 180,000 MWh.

Figure 2.1 shows that 64% of this energy (115,000 MWh) was used by industrial processes such as water treatment facilities. The remaining 36% (65,000 MWh) powered commercial buildings such as administrative offices. In 2022, the City's electricity bills totaled $24.5 million.

Figure 2.1 - City of Tampa Municipal Electricity Consumption by Sector, 2022 [7]

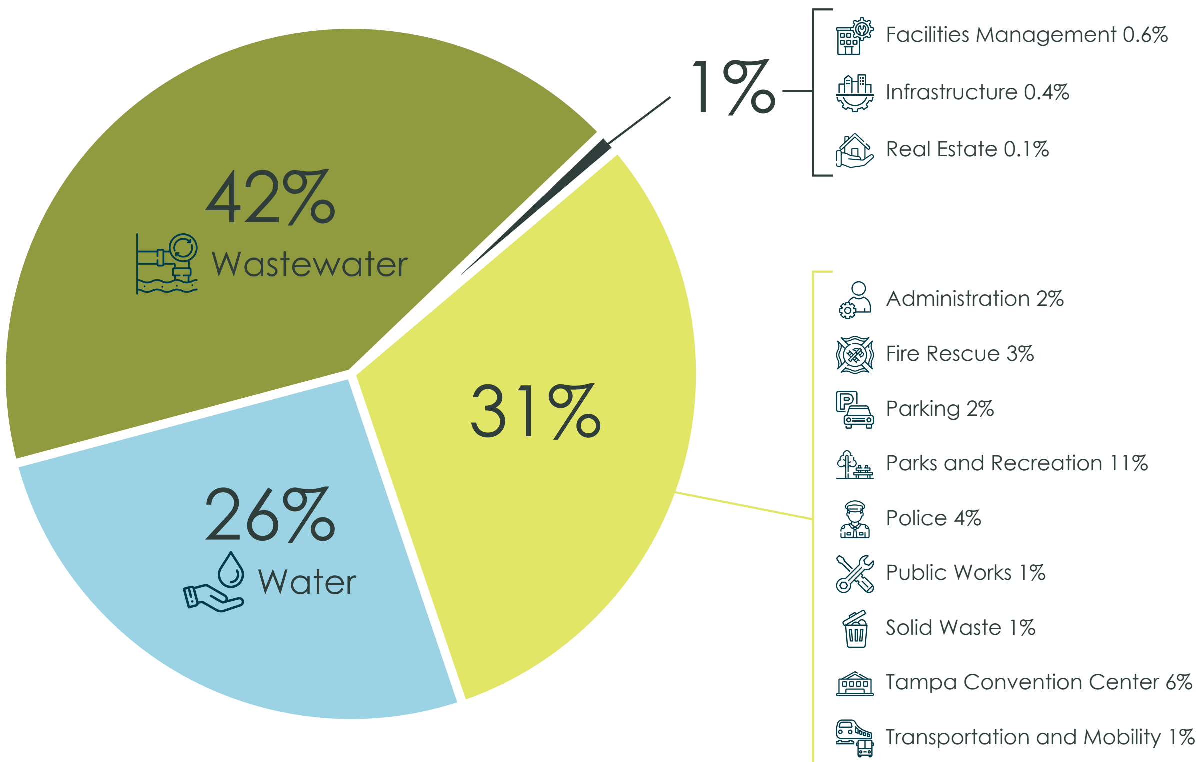


7. The City of Tampa's electric vehicle fleet and associated electricity consumption is relatively small. In this report, electricity loads from electric vehicles are represented, though they are categorized here as either commercial or industrial depending on the facility type at which these vehicles are charged.

Figure 2.2 shows that there is a wide range of electricity use between various municipal operations. For example, the Wastewater and Water are the two largest consumers, accounting for 68% of the City's municipal electricity use.

In fact, just two facilities – the Howard F. Curren Advanced Wastewater Treatment Plant and the David L. Tippin Water Treatment Facility – account for more than half (55%) of the City's municipal electricity demand.

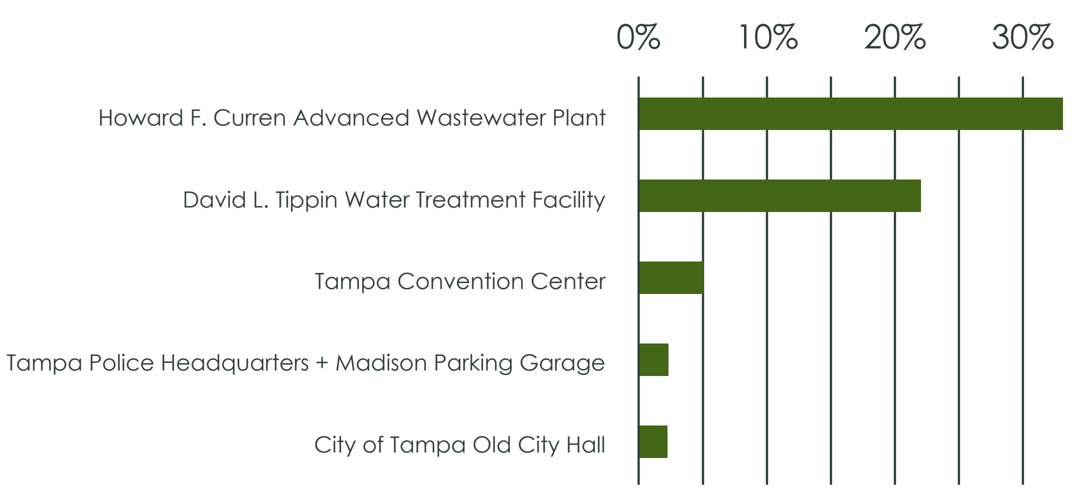
Figure 2.2 - City of Tampa Electricity Consumption by Municipal Operations [8]



Six of the top ten electricity consumers are industrial water and wastewater treatment facilities. Figure 2.3 highlights a significant opportunity for strategic engagement with industrial locations to implement energy saving measures.[9]

Other notable commercial facilities include the Tampa Convention Center, Tampa Police Headquarters, and City Hall. This snapshot of Tampa's current municipal operations is the basis for developing a baseline, or Business-as-Usual, electricity forecast.

Figure 2.3 - Top Municipal Electricity Consumers in the City of Tampa, 2022



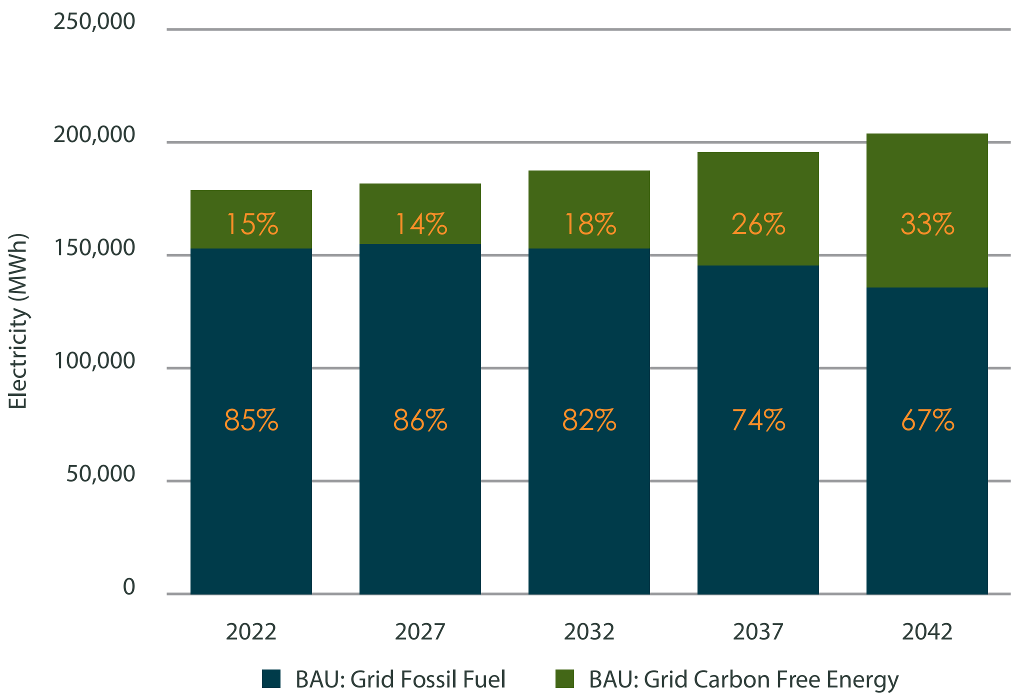
8. The Greenhouse Gas Inventory in Table 3.2 and Figure 3.4 had mischaracterized electricity consumption and GHG from Water and Wastewater departments as part of the Parks and Recreation department. This has been corrected in Figure 2.2. In addition, an adjustment was made to account for facilities that were characterized as "Other" in the GHG study.

9. A list of the 14 largest municipal electricity consumers, representing over 73% of municipal electricity use, is provided in Appendix A.2.1.

SECTION 3: BUSINESS-AS-USUAL (BAU) SCENARIO

The BAU Scenario assumes that municipal electricity consumption is consistent with historical consumption and expected demand growth. The electricity forecast is explained in Appendix A. The clean energy initiatives highlighted in Section 4 are not part of the Business-as-Usual forecast. For Business-as-Usual, the City of Tampa's electricity consumption is expected to grow by 14% between 2022 and 2042, to about 204,000 MWhs (Figure 3.1).

Figure 3.1 - Expected City of Tampa Municipal Electricity Consumption Under Business-As-Usual, 2022-2042



TECO's Generation of Carbon Free Electricity

The share of clean electricity from TECO is forecast to more than double from about 15% to 33% over the next 20 years.

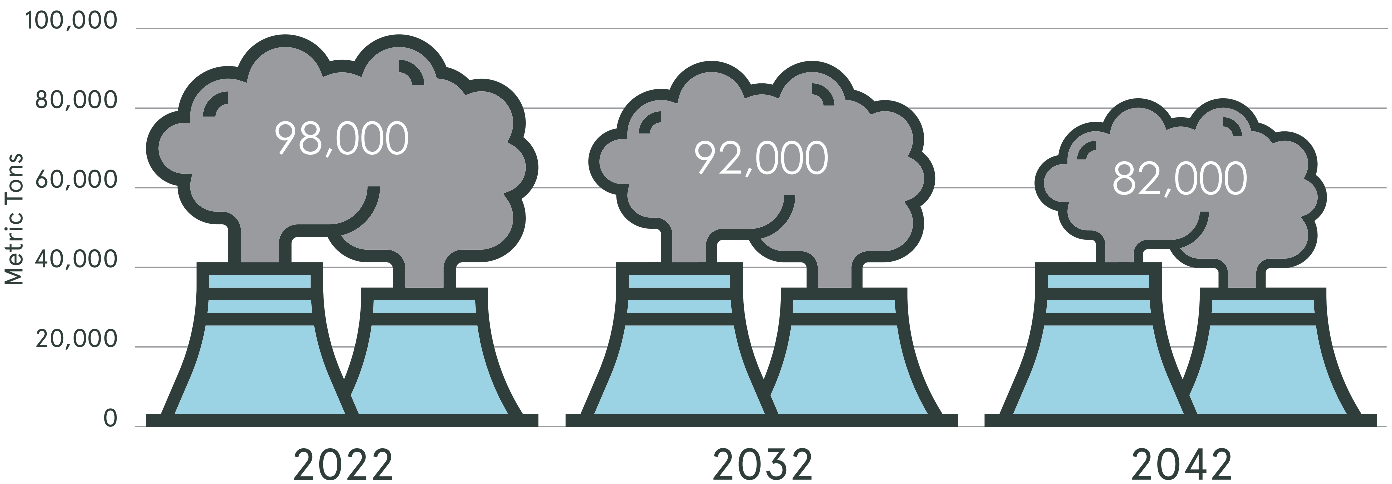
Carbon Emissions and Electricity Consumption

In 2022, the City's municipal emissions resulting from electricity use totaled approximately 98,000 metric tons of carbon dioxide (CO_2). To accurately determine how these emissions will change over time, demand growth and TECO's changing carbon intensity are important to understand. Appendix A explains more details about power generation forecast and electricity growth forecast.

The City's municipal electricity demand is expected to steadily increase through 2042. Resulting CO_2 emissions (Figure 3.2) are expected to slowly drop as demand growth is more than offset by utility-level decarbonization. Over a period of 20 years, Business-as-Usual electricity use is expected to lead to emissions of about 1,800,000 metric tons of carbon dioxide.

10. Additional information about public health damages explained in Appendix A.6.

Figure 3.2 - Business-As-Usual Municpal CO_2 Emissions from Electricity Consumption, 2022-2042



SECTION 4: CLEAN ELECTRICITY OPPORTUNITIES

There are 2 types of renewable energy that are important to distinguish for this report. The renewable energy that comes from the utility (TECO). Or, the renewable energy not owned by the utility such as rooftop solar.

The best form of clean energy is that which is never used, so our primary focus is on energy reduction and efficiency. Both renewable types will be important contributors in progressing to a 100% clean and renewable goal. City-owned renewable power options are usually solar, wind or hydropower. In Tampa, most of the best renewable opportunities are solar installations. Energy efficiency opportunities exist in almost any electricity-consuming situation.

Solar

The City is exploring opportunities to add on-site solar generation to City buildings and other facilities, developing larger utility-scale solar projects on City property, and pursuing partnerships with TECO to include more solar in the City's energy mix. Because the costs and benefits of solar options are project-specific and change over time, the City should evaluate potential projects on a regular basis to accelerate the City's clean energy progress.

Energy Efficiency

The National Renewable Energy Lab (NREL)[11] recommends some starting points for commercial facility energy efficiency improvements, including:

- Upgrading aging HVAC equipment
- Upgrading interior, exterior, and outdoor lighting to LEDs
- Upgrading rooftop unit direct-expansion (RTU DX) air conditioning
- Adding window film to reduce indoor heating from direct sunlight
- Upgrading roof and wall insulation to an R-value of R-30

Large industrial facilities like those mentioned in Section 2 need a different energy efficiency approach than commercial buildings. An in-depth analysis of opportunities and barriers to industrial efficiency was performed by the Department of Energy in 2015, building on prior work conducted by Oak Ridge National Laboratory and the Georgia Institute of Technology.[12] Some typical improvements suggested included:

- Upgrading to high-efficiency boilers
- Upgrading to combined heat and power (CHP) systems
- Incorporating waste-to-energy (WTE) systems
- Industrial process equipment-level energy consumption metering
- Implementing modern building management system (BMS) and controls

11. National Renewable Energy Laboratory. Accessed December 22, 2022. https://maps.nrel.gov/slope/

12. Department of Energy. Accessed January 12, 2023. Barriers to Industrial Energy Efficiency. https://www.energy.gov/sites/prod/files/2015/06/f23/EXEC-2014-005846_6%20Report_signed_v2.pdf; Lapsa, Melissa Voss, Marilyn Ann Brown, Roderick K Jackson, Matt Cox, Rodrigo Cortes, Benjamin H. Deitchman. Making Industry Part of the Climate Solution. United States: N. p., 2011. Web. doi:10.2172/1016041.11.

SECTION 5: MODERATE (MOD) SCENARIO

The Moderate (MOD) Scenario forecast includes five energy efficiency opportunities and four renewable initiatives. City experts helped determine the cost and savings estimates, which are briefly described in Table 3. These experts also provided information as to which initiatives were higher priorities within their departments, anticipated project timelines, and estimated energy impacts.[13]

By 2042, the MOD Scenario achieves 50% clean and renewable energy, a 27% increase over the BAU. Additionally, the MOD Scenario requires 26% less grid electricity than the BAU. The cost of MOD initiatives is estimated at $184 million. Initiatives with the highest impact include solar projects, the largest of which are ongoing solar investments at the Water Department. Costs are shown initiative by initiative because those with very high capital costs skew the average cost-effectiveness.

13. Additional details on the methods used to estimate savings are presented in Appendix A.5

MOD SCENARIO
by 2042
50%
Clean / Renewable

Table 3 - Energy Savings and Capital Costs in Moderate Scenario

Department	Clean Energy Initiative	Percent Municipal Energy Savings in 2042	Total Capital Cost
Water	Complete solar installations at multiple facilities	8%	$6,000,000
	Make upgrades at high service pump station	5%	$100,000,000
	Proceed with municipal hydroelectric power plant	< 1%	$4,000,000
Facilities Management	Complete half of identified HVAC upgrades in commercial buildings	4%	$10,000,000
	Retrofitting interior and exterior lighting with LEDs in City Hall	1%	$4,000,000
	Complete half of identified energy efficient window retrofits in commercial buildings	1%	$50,000,000
Parking	Retrofit half of identified lighting with LEDs in municipal parking garages	1%	$2,000,000
Municipal Wide	Install half of identified solar capacity in the CAEP	5%	$7,000,000
	Install solar on new construction	1%	$1,200,000
Moderate Scenario Total		26%	~ $184,000,000

SECTION 6: AMBITIOUS (AMB) SCENARIO

The Ambitious (AMB) Scenario forecast includes all the initiatives from the MOD Scenario and harder to realize targets or initiatives. The AMB Scenario therefore assumes the City aggressively pursues these additional six initiatives and also includes a strategy to pursue and realize aggressive additional energy efficiency measures.

1. All identified HVAC upgrades in commercial buildings
2. All identified energy efficient window retrofits in commercial buildings
3. All identified LED lighting retrofits in municipal parking garages
4. All identified solar capacity in the CAEP
5. The development of a 20 MW off-site solar farm (as a source of RECs), possibly in Thonotosassa
6. The installation of rooftop energy-efficient Siplast covering for commercial buildings

The estimated energy efficiency potential for municipal industrial facilities is 1.9% improvement year over year.*

Table 4 shows the expected energy savings and costs for the Ambitious scenario, including all the clean energy initiatives from the Moderate Scenario.

By 2042, the AMB Scenario achieves 85% clean and renewable energy, a 53% increase over the BAU. Additionally, the AMB Scenario requires 54% less grid electricity than the BAU. Total estimated capital costs in the Ambitious scenario were estimated to close to $300 million. Initiatives identified by staff included more considerations beyond energy savings and cost-effectiveness, which is why two initiatives dominate the overall scenario costs.

* Industrial buildings in the City consume the majority of municipal electricity, as indicated in Figure 1.2. For this reason,the most important additional opportunities for clean energy savings lie in Wastewater and Water Departments. Further details on the energy efficiency estimation methodology are provided in Appendix A.5.

AMB SCENARIO
by 2042
85%
Clean / Renewable

Table 4 - Energy Savings and Capital Costs in Ambitious Scenario

Department(s)	Clean Energy Initiative	Percent Municipal Energy Savings in 2042	Total Capital Cost
Facilities Management	Complete all identified HVAC efficiency upgrades in Commercial Buildings	8%	$20,000,000
	Install rooftop energy efficient Siplast covering	3%	$25,000,000
	Complete all identified energy efficient window retrofits in Commercial Buildings	1.5%	$100,000,000
	Complete interior and exterior LED lighting retrofit in City Hall	1%	$4,000,000
Water	Complete solar installations - at multiple facilities	8%	$6,000,000
	High Service Pump Station	5%	$100,000,000
	Municipal Hydroelectric Power Plant	< 1%	$4,000,000
Municipal Wide	Install all identified solar capacity in the CAEP	10%	$14,000,000
	Add solar on new construction	1%	$1,800,000
	Build offsite regional solar farm (20MW)	RECs Only	$5,000,000
Parking	Complete all identified LED lighting retrofits in Municipal Parking Garages	2%	$4,000,000
Initiatives Total		40%	$284,000,000
Wastewater Water	Upgrade to reach industrial EE potential*	14%	$10M-$34M
AMB Scenario Total		54%	$294M - $318M

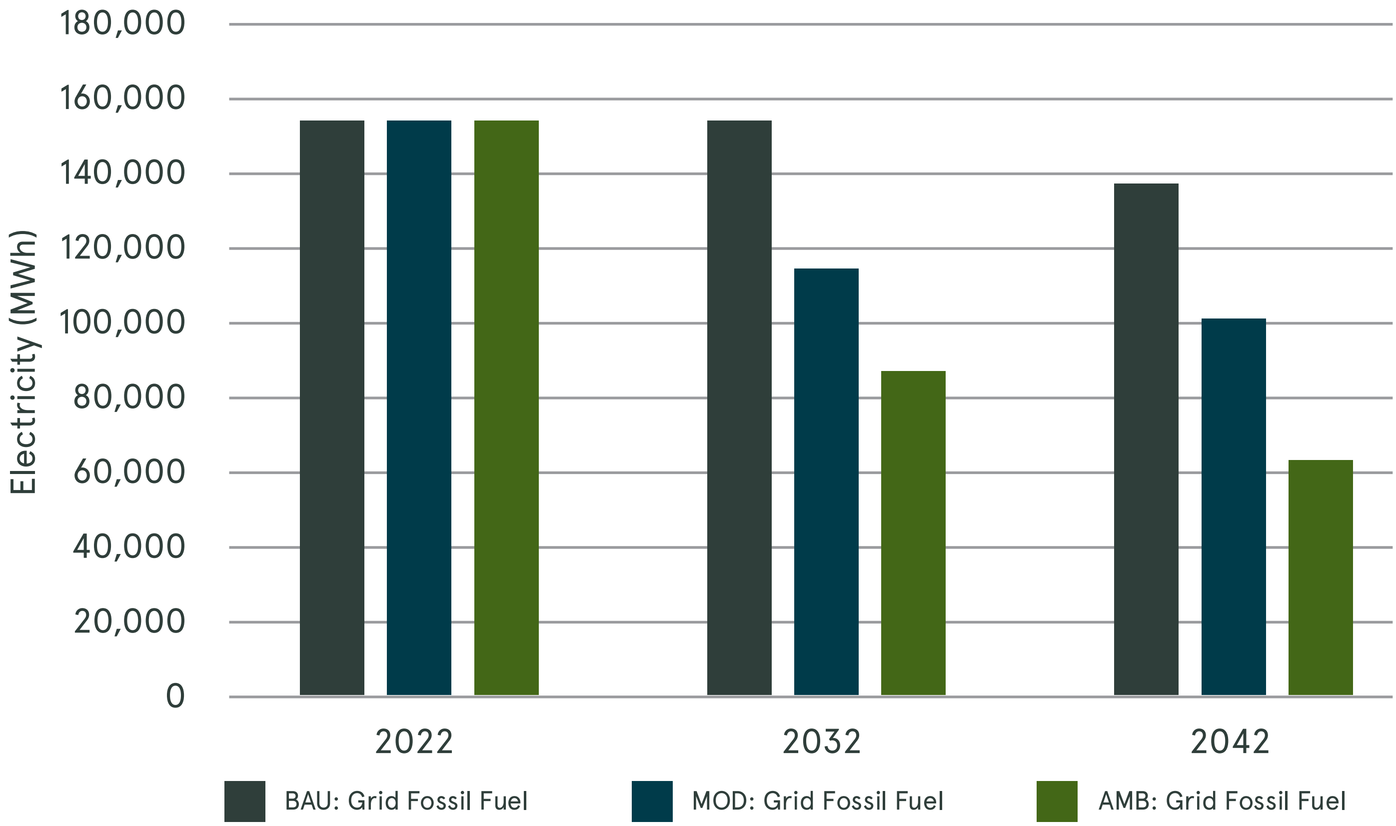
*The levelized cost of saved electricity for municipal industrial users can range from an approximate $0.07 to $0.24 per kilowatt-hour of energy savings.[14] Additional details on this calculation are provided in Appendix A.6.3

14. Lawrence Berkeley National Laboratory (LBNL). The Total Cost of Saved Electricity for Utility Customer-Funded Energy Efficiency Programs (2015). Accessed April 4, 2023. https://eta-publications.lbl.gov/sites/default/files/tcse_webinar_051315_final.pdf

SECTION 7: COMPARING SCENARIO IMPACTS, COSTS, AND BENEFITS

Following either alternative scenario results in significant reductions in electricity purchased from TECO. The Moderate Scenario projects 26% less demand in 2042 when compared to Business-as-Usual expectations. The Ambitious Scenario forecasts over 54% less purchased electricity. Electricity generated by fossil fuels used to meet the city's demand in each scenario is shown in Figure 7.1.

Figure 7.1 - City of Tampa Fossil-Fueled Electricity by Scenario



Pollution from power generation (including CO_2, NO_X, and SO_2 pollutants)* would also be reduced relative to Business-as-Usual. Ambitious Scenario pollution reductions are nearly double the reductions of the Moderate Scenario, as noted in Table 6 below.

Table 6 - Cumulative Pollutant Reductions through 2042, relative to BAU

Scenario	Pollutant Type	Pollutant Reduction (Metric Tons)	Percent Pollutant Reductions (%)
Moderate	CO_2	403,000	22%
	NO_X	130	22%
	SO_2	0	0%
Ambitious	CO_2	712,000	40%
	NO_X	230	38%
	SO_2	120	38%

For this report, avoided health damages from SO_2 and NO_x were monatized. Quantified financial benefits and costs are shown in Table 7.[15] A more comprehensive accounting of total benefits resulting from each scenario would include those resulting from the non-energy benefits related to improved operations and the value of electricity and RECs from the 20 MW offsite Solar Farm. Therefore, these benefits represent a conservative estimate of what might actually occur.

Table 7 - Net-Present Value of Benefits and Costs through 2042 by Scenario in 2022 Dollars

Scenario	Public Health Benefits	Electricity Bill Savings	Scenario Costs
Moderate Scenario	$28 Million	$69 Million	$157 Million
Ambitious**	$50 Million	$122 Million	$231 Million

15. The public health benefits shown in Table 7 are further explained in Appendix A.6.1. Electricity bill savings are explained in Appendix A.6.2

*Numerous pollutants representing the comprehensive impacts of industrial pollution were modeled in this analysis. These pollutants included VOCs and $PM_{2.5}$ in addition to CO_2, NO_x, & SO_2. The amounts of VOCs and $PM_{2.5}$ released specifically are not reported because these pollutants were not released in significant amounts. The public health impacts associated with these two pollutants are represented however.

** Ambitious benefits do not include the value of offsite Solar Farm RECS or electricity.

The AMB and MOD initiatives were not chosen from a cost-effective perspective. Table 8, below, ranks each initiative by its energy savings potential. Most notable is that Table 8 reveals that just two initiatives (Energy Efficient Windows and High Service Pump Station) account for two-thirds of the capital costs in the Ambitious Scenario but only 10% of the energy savings. Some of the largest energy savings come from less expensive initiatives.

While some renewable and energy efficiency measures are more cost effective than others, the list in Table 8 is just one method to prioritize clean energy investments. Another important angle to consider is that regardless of relative costs, some initiatives are important for other reasons. For example, improving the High Service Pump Station is a high priority because it would improve water management operational reliability. The energy efficiency benefits are secondary.

Cost and benefit information should be considered carefully as context to guide planning or to evaluate individual initiatives. Broadly speaking, the Ambitious Scenario leads to about twice as much clean electricity as in the Moderate Scenario, and unlike the Moderate Scenario, creates a new source of local RECs.

Table 8 - Clean Energy Initiatives Ranked by Energy Savings Potential

	Clean Energy Initiative	Department(s)	Energy Savings Potential (MWh)	Implementation Timeframe (Years)	Total Capital Cost (2022 $)
1	Reaching Industrial EE Potential	Water Wastewater	28,800	20	$10M – $34M
2	CAEP Solar Initiatives	Municipal-Wide	23,700	10	$14M
3	Solar Installations – Multiple Facilities	Water	19,400	5	$6M
4	HVAC Upgrades	Facilities Management	19,300	20	$20M
5	High Service Pump Station	Water	10,800	5	$100M
6	LED Lighting Retrofit in Municipal Parking Garages	Parking	4,000	10	$4M
7	Energy Efficient Windows	Facilities Management	3,200	20	$100M
8	Solar Initiatives on New Construction	Municipal-Wide	2,000	5	$2M
9	Interior and Exterior LED Lighting Retrofit in Old City Hall	Facilities Management	1,400	10	$4M
10	Municipal Hydroelectric Power Plant	Water	1,000	5	$4M
11	Rooftop Energy Efficient Siplast Covering	Facilities Management	300	30	$25M

Investment in clean energy is also expected to stimulate the local economy and increase demand for clean energy jobs. The table below shows the number of new clean energy jobs expected locally over the next 20 years as a direct result of the clean energy investments.[16]

Table 9 - Cumulative Jobs Created through 2042 by Scenario

Scenario	Jobs Created
Moderate	**210**
Ambitious	**490**

16. Additional job creation details are provided in Appendix A.6.5.

SECTION 8: ACHIEVING 100% CLEAN AND RENEWABLE ENERGY

The previous section highlighted a number of elements to consider as the City determines how to be strategic about reaching 100% clean and renewable energy, including public health benefits, non-energy benefits, bill savings, jobs, and costs that should be considered on a case-by-case basis. Ultimately though, until TECO becomes 100% carbon-free, the City will need to use renewable energy credits (RECs) to meet its goal.

Renewable Energy Credit (REC) Procurement and Accounting

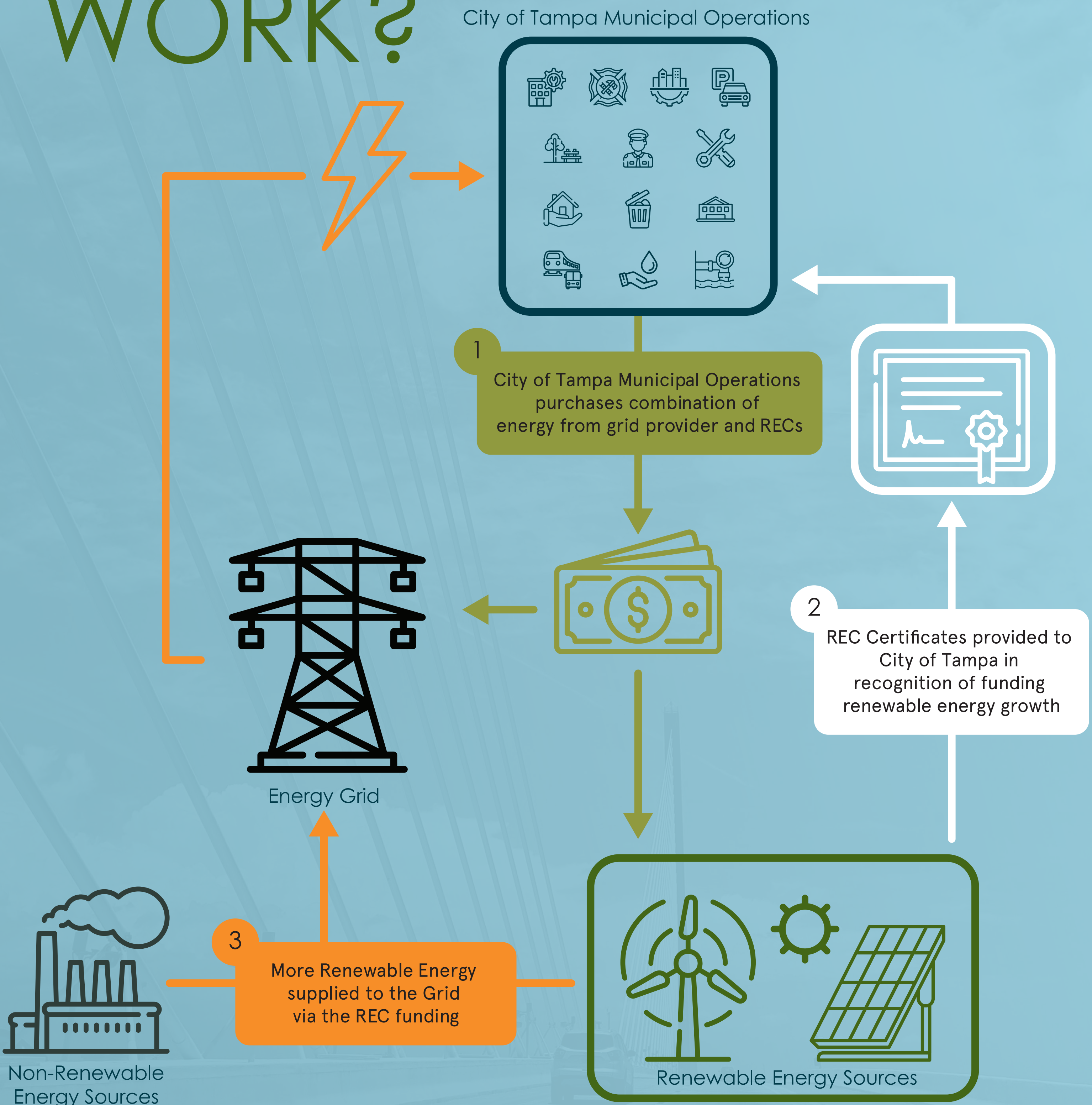
Serving as a market-based option that entities use to offset their use of fossil-fueled electricity and encourage new renewable energy projects, RECs are verifiable and trackable certificates that represent the ownership rights to the social and environmental attributes that are associated with renewable generation.[17] Essentially, RECs are used as an accounting mechanism. Each REC represents the attributes of 1 MWh of renewable generation put onto the grid. Selling a REC transfers the ability to claim who is responsible for renewable attributes from the originator of the generation to the REC purchaser. RECs are bought for both voluntary and compliance reasons.[18] Renewable Energy Credits make it feasible to become 100% clean anytime the City is able to afford it. Nonetheless, the carbon-free share of TECO's generation (from Figure 3.1) is expected to increase over time, which means that fewer RECs should be required the longer the City waits.

Typically, cities purchase RECs from external power producers. The City of Tampa however, is conducting site evaluations on city-owned properties for development of a utility-scale solar project that could generate RECs to help meet the City's clean energy goals. This initiative, included in the Ambitious Scenario, could generate nearly 37,000 RECs per year.

17. US EPA. Renewable Energy Certificates (RECs). Accessed March 16, 2023. https://www.epa.gov/green-power-markets/renewable-energy-certificates-recs

18. EnergySage. What are Renewable Energy Credits (RECs)? Accessed March 17, 2023. https://www.energysage.com/other-clean-options/renewable-energy-credits-recs/

HOW DO RECs WORK?



Pathways to 100% Clean and Renewable Energy in Tampa

Three pathways to 100% clean and renewable energy are described below. The pathways have two dimensions that differentiate them. First, how assertively will the City pursues energy efficiency and renewable energy (illustrated by MOD vs. AMB Scenarios). Second, setting the target year that the City commits to obtaining RECs.

MARKET PATHWAY

- Most reliant on purchasing RECs
- Target year: 2042
- Moderate policies pursued
- The distinguishing characteristic of this pathway is the heavy reliance on the purchasing of RECs, i.e. "market" purchases

LEADERSHIP PATHWAY

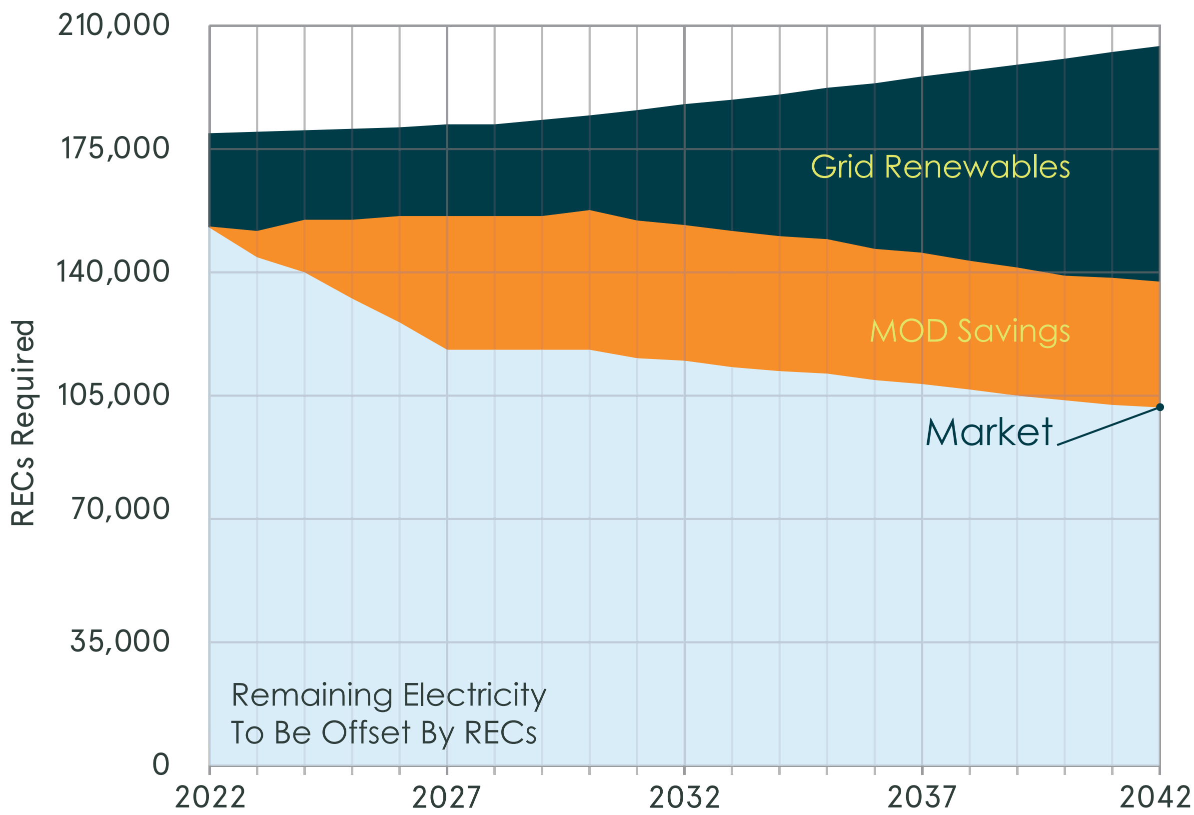
- Earliest and aggressive timeline
- Target year: 2032
- Ambitious policies pursued
- "Leadership" refers to the idea that following this pathway the City would become one the foremost leaders in advancing towards 100% clean and renewable energy.

LOCAL PATHWAY

- Most local efforts, least RECs
- Target year: 2042
- Ambitious policies pursued
- The term "local" makes refence to fact that this pathway relies most heavily on local initiatives performed by the City's municipal operations.

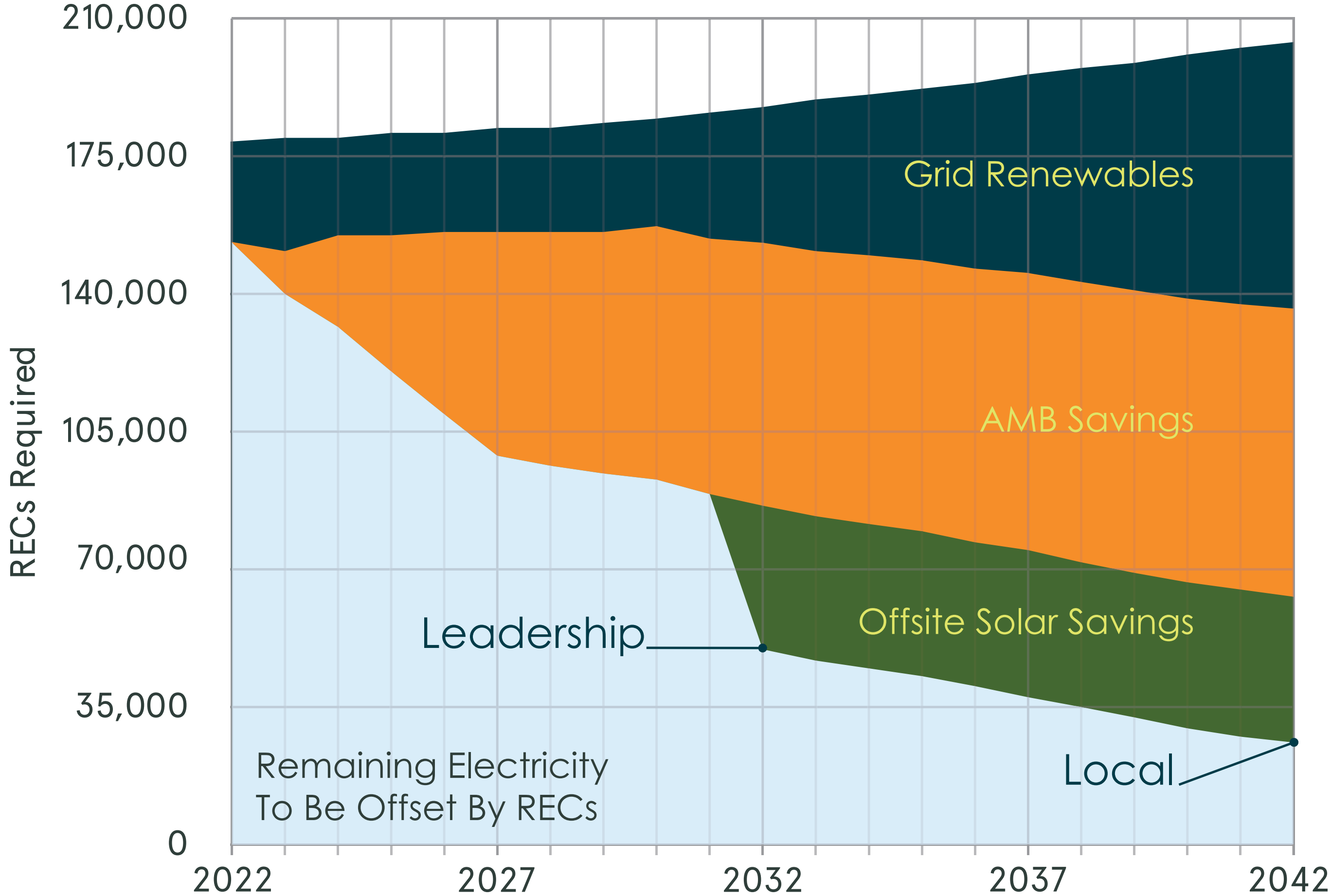
The Market Pathway requires over 100,000 RECs in 2042 (represented by light blue area in Figure 8.1) to supplement grid renewable savings (dark blue) and MOD scenario savings (orange) to reach 100% clean and renewable electricity. This Pathway may be preferred if decision makers are comfortable with the market risk of REC prices and believe utility decarbonization goals will be achieved on accelerated timelines.

Figure 8.1 - Getting to 100% Clean, Market Pathway



The Leadership and Local Pathways are both represented in Figure 8.2 since both Pathways pursue Ambitious policies. These Pathways include a new 20 MW offsite solar farm which would generate RECs (illustrated in the green area). By 2042, these solar RECs would reduce the remaining total RECs required (light blue area) by more than half. The Local Pathway achieves the 100% target in 2042 and projects the City purchasing about 26,000 RECs. An accelerated achievement of the goal to 2032, representing a Leadership Pathway, results in the need to purchase approximately 50,000 RECs in that year based on the forecast.

Figure 8.2 - Getting to 100% Clean, Local and Leadership Pathways



All available pathways to achieve 100% clean and renewable energy would involve the purchase of RECs, which can be done at any time. Retaining the City's 100% clean and renewable status will require RECs purchases in each subsequent year.

The REC strategy the City decides to implement depends on the City's financial interests and community values. The City may prefer to pursue all clean energy opportunities available and incorporate RECs later on in the planning horizon to minimize REC investments. An alternative strategy would be to use RECs earlier on in the planning horizon in order to achieve 100% clean and renewable energy as early as possible.

REC Prices and Uncertainty

The cost of procuring RECs can vary significantly, depending on the origin of the generated electricity that represents the REC.[19] A REC recently purchased at the national level costs $5 to $10 per MWh.[20] Duke Energy Florida estimates future REC prices at $3.30 per MWh. REC prices have fluctuated over the past several years and drivers of market prices are not consistently agreed upon. It is important to keep the large degree of uncertainty in mind when selecting the best course of action.

Table 10 below details how many RECs are expected to be needed for the first year of meeting the 100% target. For the Leadership pathway, this would amount to about 400,000 RECs through 2041.

Table 10 - Required RECs by Pathway (MWh)

Year	Market	Leadership	Local
2032	-	50,000	-
2042	100,000	26,000	26,000

Table 11 compares the estimated cost of purchasing RECs for 2042, assuming prices remain relatively stable.[21] As these prices are hard to forecast, the most straightforward things to note are that the Market Pathway will require about four times the RECs procurement as the other two Pathways in 2042 and that an ongoing focus on clean energy actions will reduce the RECs needs. If TECO accelerates or slows down its own clean energy transition that will have a significant impact on how many RECs the City will need.

Table 11 - Estimated Cost of Market REC Procurement in 2042 by Scenario

REC Pricing*	Market	Leadership	Local
At $3.30/REC	$330,000	$86,000	$86,000
At $10.00/REC	$1 Million	$260,000	$260,000

*As future REC prices are uncertain, these REC costs should be understood as current estimates and may change considerably

19. For example, waste-to-energy RECs are not as marketable as solar RECs, since in many states with Renewable Portfolio Standards, Waste-to-energy RECs do not help to satisfy compliance targets.

20. National Renewable Energy Laboratory (NREL). Status and Trends in the Voluntary Market. Accessed January 10, 2023. https://www.nrel.gov/docs/fy22osti/81141.pdf

21. This report does not attempt to forecast the variability in REC prices due to the high level of uncertainty and the potential for market variability.

SECTION 9: CONCLUSIONS AND RECOMMENDATIONS

This report highlights three pathways for the City to get to 100% clean and renewable energy between 2032 and 2042. TECO and parent-company Emera's plans to increase its carbon-free portfolio could further enable progress towards a 100% clean and renewable energy goal. Any path the City chooses to pursue will require the use of RECs. The main factors in any of the pathways are selecting the target year and the City's internal ambition applied to achieving this goal. Earlier achievement will require more effort and earlier investments. A later target date allows for more time to develop cleaner power locally (both for the City and TECO), as well as fewer years where RECs would be procured. These tradeoffs must be considered alongside significant scientific warnings regarding the urgency of reducing greenhouse gas emissions.[22] Community values, financial considerations, climate risk, and tolerance for uncertainty should all contribute to the choice of a date for achieving 100% clean and renewable energy. Whichever path the City elects to take, effective tracking and benchmarking of the City's goals is necessary to ensure progress is measured and evaluated accurately.

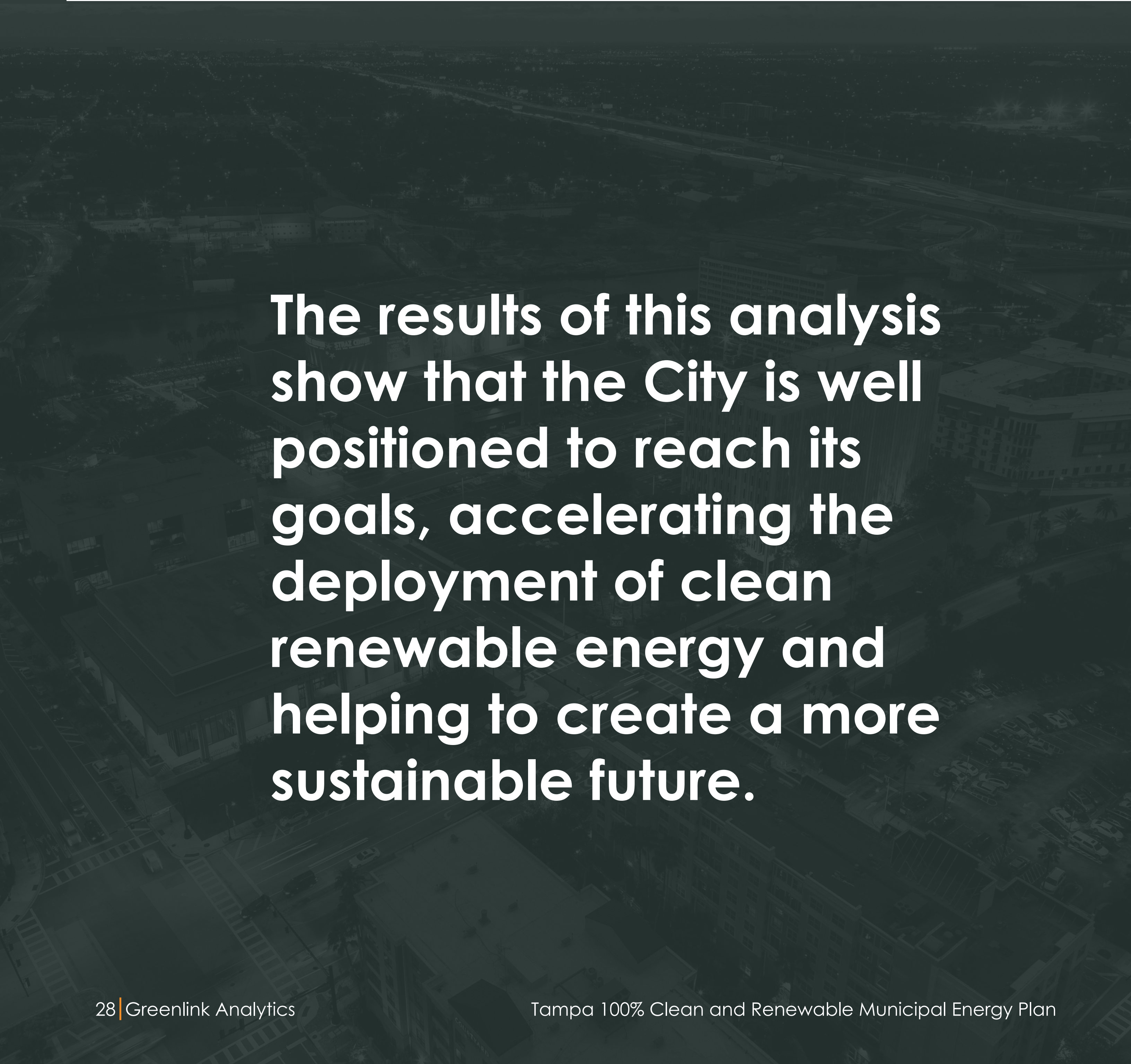
The main takeaways from this analysis are:

- Opportunities for cost-effective clean energy initiatives are plentiful and can get the City well on its way to its goals
- Aggressive renewable and efficiency actions can get the City most of the way to 100%
- All Pathways to 100% clean and renewable energy will require the use of RECs
- The quantity of RECs required varies significantly depending on how the City pursues energy efficiency and renewable energy
- Future REC prices are uncertain
- A few City initiatives dominate the costs in this report. Most actions are more cost-effective than the two most expensive. Justifications for pursuing those initiatives may be for reasons beyond clean electricity
- Most of the initiatives in this report are cost effective based on energy savings and public health benefits alone. The other three, Rooftop Siplast, Energy Efficient Windows and High Service Pumps, have other benefits that were not monetized for this report.

22. (IPCC), Summary for Policymakers. https://www.ipcc.ch/sr15/chapter/spm/

This report also points to the following clean energy actions that will help the City achieve its 100% clean and renewable energy targets:

- Prioritize the departments that consume the largest amounts of electricity for clean energy investment, especially Wastewater and Water
- Continue to rapidly expand solar installations identified in the Climate Action and Equity Plan
- Continue to expand identified solar installations at the Water department
- Replace aging HVAC systems
- Regularly additional opportunities for energy efficiency
- Create a centralized database to benchmark municipal energy use



The results of this analysis show that the City is well positioned to reach its goals, accelerating the deployment of clean renewable energy and helping to create a more sustainable future.

ACKNOWLEDGEMENTS

The writers of this Plan would like to acknowledge and thank the following for their contributions and efforts towards the completion of this Plan.

City of Tampa Florida

The Office of Sustainability & Resilience

APPLIED SCIENCES

REAL BUILDING CONSULTANTS

Sun Belt Strategies

A.1 General

Commonly, energy forecasting relies on the use of annual energy data. The basis of the three scenario forecasts developed in this study is the use of hourly energy demand data and hourly generator-specific energy supply data representing the grid serving the City of Tampa. This level of consideration allows for a significantly more accurate assessment of the City's municipal electricity use, and consequently, a more accurate understanding of the opportunities for clean energy.

All dollars referred to in this report have been converted to 2022 dollars.

A.2 Municipal Demand

The City of Tampa's municipal departments assisted with the collection and verification of historical annual electricity demand and municipal building data through the completion of a data survey. These responses were used to collect the historical hourly electricity demand profiles (representing most of the City's municipal consumption) from the City's primary utility provider, Tampa Electric Company (TECO). Table A.2.1. shows a summary of the data for the municipal buildings with the most energy consumption. This historical usage was then augmented to reflect the electricity use of the entire City's municipal sector according to the distribution of commercial and industrial buildings reflected in the 2021 City of Tampa Greenhouse Gas Inventory. Demand growth was projected by combining historical hourly demand with regional, sector-specific annual consumption forecasts from NREL SLOPE.

Table A.2.1. Annual Energy Consumption of Top Municipal Energy Consumer

Department	Facilities	Annual Energy Consumption (kWh)	Percent of Total City of Tampa Municipal Energy Consumption (%)
Wastewater	Howard F. Curren AWT Plant	58,490,000	33%
Water	David L. Tippin Water Treatment Facility	37,570,000	22%
Miscellaneous	Tampa Convention Center	10,550,000	5.00%
Police	Tampa Police Headquarters and Madison Parking Garage	4,500,000	2.30%
Administration	City of Tampa City Hall	3,820,000	2.30%
Wastewater	Sulphur Springs Pump Station	2,170,000	1.20%
Water	City of Tampa Water Treatment Facility	1,930,000	1.10%
Wastewater	Ybor Pump Station	1,970,000	1.10%
Water/Wastewater	City of Tampa University Area Pump Station	1,370,000	0.70%
Administration	City of Tampa Municipal Offices	1,30,000	0.70%
Police	Tampa Police and Fire Rescue Communication Center	1,060,000	0.60%
Wastewater	Krause Pump Station	1,119,000	0.60%
Wastewater	San Carlos Pump Station	1,200,000	0.60%
Parking	Fort Brooke Parking Garage	1,190,000	0.60%
Fire Rescue	Tampa Fire Rescue Headquarters	1,060,000	0.50%
Public Works	City of Tampa Public Works	660,000	0.40%
Top Buildings Total		**128,700,000**	**73%**
City of Tampa Total		176,380,000	

A.3 Generation Forecast

Greenlink's ATHENIA grid forecasting tool is a machine learning model that incorporates all approved utility plans and historical system operations to anticipate the behaviors of regional power systems. Model inputs gathered from FERC filings and City records are adjusted using Standard & Poor's (S&P) Capital IQ Pro sales records and AURORA model projections to create an hourly forecast demand signal for each year in the modeling horizon. From these forecasts, the City's municipal consumption and carbon impact are predicted for twenty years, to 2042.

A.4 Business-as-Usual Scenario Forecast

The basis of the Business-As-Usual scenario is the City's electricity demand and expected demand growth. BAU includes no further efforts are made by the City to reduce its energy consumption.

Table A4.1. City of Tampa Total Municipal Electricity Forecast Business-as-Usual (MWh)

	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042
BAU	180,000	181,000	183,000	185,000	188,000	191,000	194,000	197,000	201,000	204,000

A.5 Clean Energy Savings Methodology

CLEAN ENERGY SAVINGS

Defining the full array of clean energy initiatives included in this analysis and the feasibility of each was an objective of this analysis. The incorporation of these initiatives was heavily informed through engagements with City staff. Staff from numerous departments were engaged multiple times, including but not limited to: Facilities Management, Fire Rescue, Mobility and Transportation, Parks and Recreation, Solid Waste, Wastewater, and Water. They assisted in communicating initiatives that are underway and that would have direct impacts on municipal energy savings. For solar installations, REAL Building Consultants and Sun Belt Strategies provided input.

City staff assisted in providing estimates of the amount or percent of electricity savings each initiative could produce. Other information gathered included: estimated capital costs, the approximate number of years each would take to fully implement, and the likelihood implementation.

From these initial estimates, an annual forecast of expected energy savings from each clean energy initiative was calculated. Savings were calculated based on the assumption that initiatives would be implemented at a steady rate over the modeling horizon.

APPLICATION OF ENERGY SAVINGS TO SCENARIO FORECASTING

Energy savings from initiatives that were categorized as more than 70% likely were included in the Moderate Scenario. Any initiative described as less than 70% likely was only included in the Ambitious Scenario. Every Moderate Scenario initiative was included in Ambitious Scenario.

INDUSTRIAL ENERGY EFFICIENCY POTENTIAL IN AMBITIOUS SCENARIO

Annual industrial energy efficiency savings potential was estimated to be 1.9% based on taking an average of energy efficiency estimates from American Council for an Energy Efficient Economy (ACEEE) and National Renewable Energy Lab. The first source is the methodology adapted from an ACEEE study,[22] which estimates cost-effective efficiency savings under aggressive policy cases and is adaptable to different geographical regions through a combination of Annual Energy Outlook data inputs. The second relies on two estimates of energy efficiency potentials identified by the National Labs (economic and highly achievable potentials), available at the state-level. All estimations involve computationally heavy simulations of energy usage behaviors, building stock characteristics, equipment lifetimes, technology development and adoption curves, economic conditions, and consumer behaviors.

This analysis uses the median results when such distinctions are available, ensuring that these figures are not making heroic assumptions regarding technology development, consumer "enlightenment", etc. A third estimate relies on capturing state-level estimates of cost-effective efficiency potentials that exist right now, also as estimated by the National Labs (only available for the commercial sector). In each case, NREL's SLOPE tool was used to access the findings from the National Labs.

The average rate across these sources (1.9%) was calculated as a reasonable estimate of achievable potential for energy efficiency in Tampa's industrial electricity users. An estimate of the Wastewater and Water Departments electricity use was determined by multiplying the BAU forecast each department's proportional electricity use reported in the GHG Inventory. The average energy efficiency rate was then applied to these forecasts to determine an estimate of each department's

23. Nadel, Steven. Pathway to cutting energy use and carbon emissions in half. American Council for an Energy-Efficient Economy, 2016. https://www.aceee.org/sites/default/files/pathways-cutting-energy-use.pdf

savings resulting from energy efficiency. For the Water department only the incremental value of efficiency beyond the existing initiative (High Service Pumps) was included. The calculated Water Department's efficiency potential only exceeded the initiative's value after 2036.

TOTAL ESTIMATED SOLAR OPPORTUNITIES IN AMBITIOUS SCENARIO

Rooftop and ground-mount potentials have been assessed for Tampa in the past, identifying opportunities at 26 locations. The capacity at these locations exceeds 26 MW and implementation of these systems by 2035 is considered achieving aggressive decarbonization efforts in this analysis.

Rooftop and ground mounted systems do not use the same generation curve. Rooftop systems are assumed to be fixed axis systems while ground mounted systems are assumed to be single axis tracking installations. NREL's PVWatts model is used to produce hourly generation curves for each system type and applied according to the quantity of capacity deployed of each system type.

Additionally, some new small-scale hydroelectric generation capacity is a candidate technology for the Water Department. The potential for this generation was provided to Greenlink at about 840 MWh per year. This is included in the analysis as a constant reduction of about 100 kW per hour for industrial load, how most of the Water/ Wastewater load is categorized.

Energy Savings from Clean Energy Initiatives and from Additional Estimated Clean Energy Opportunities

Table A.5.1. Annual Megawatt Energy Savings from Clean Energy Initiatives in Moderate and Ambitious Scenarios (MWh)

	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042
MOD	17,400	34,800	44,300	45,900	47,500	48,500	49,400	50,400	51,400	52,400
AMB	23,500	47,000	60,600	64,200	67,900	70,500	73,200	75,700	78,200	80,800

Table A.5.2. Annual Megawatt Energy Savings from Additional Industrial Energy Efficiency in Ambitious Scenario (MWh)

	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042
AMB	2,840	5,580	8,240	10,800	13,300	15,800	18,300	21,800	25,500	28,800

Table A.5.3. City of Tampa Total Municipal Purchased Electricity Forecast by Scenario (MWh)

	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042
BAU	180,000	181,000	183,000	185,000	188,000	191,000	194,000	197,000	201,000	204,000
MOD	163,000	147,000	138,000	139,000	140,000	142,000	144,000	147,000	149,000	152,000
AMB	154,000	129,000	114,000	110,000	107,000	104,000	102,000	99,900	97,200	94,400

A.6 Benefits

The benefits included here are not comprehensive. There are other benefits that could be expected as a direct result of clean energy investment, including social benefits (reduced CO_2 emissions), and operational (improved pumps) that are not included in this analysis.

A.6.1 PUBLIC HEALTH SAVINGS

Public Health Savings Methodology

Greenlink's ATHENIA model was used to determine the hourly, monetary public health damages associated with emissions from CO_2, NO_x, and SO_2 over the next 20 years, incorporating the Gaussian plume damage functions of the AP2 model. Public health damages were discounted through 2042 assuming an annual discount rate of 4% . The resulting discounted public health damages formed the basis of the public health damage forecast, which were aggregated to determine the cumulative public health damages. This analysis was completed for each of the three scenarios detailed in this report.

A.6.2 BILL SAVINGS METHODOLOGY

Bill savings were estimated based on the historical utility bills for municipal accounts. As a close approximation, rather than a precise calculation, an average kWh rate was calculated using the total amount spent by the City on utility bills and the total electricity usage used by the City over the same period of time. This average rate was determined to be $0.14 per kWh and multiplied by the total energy savings expected in the Moderate and Ambitious Scenarios to determine annual bill savings in each case. The two resulting forecasts were discounted through 2042 using a discount rate of 4%.

Table A.6.1. Annual Bill Savings by Scenario (in Millions $)

	2023	2025	2027	2029	2031	2033	2035	2037	2039	2041	2042
MOD	$1.10	$3.00	$4.50	$4.30	$4.10	$3.90	$3.70	$3.50	$3.20	$3.00	$2.90
AMB	$1.70	$4.50	$6.80	$6.90	$6.90	$6.90	$6.70	$6.50	$6.40	$6.20	$6.10

A.6.3 CAPITAL COST METHODOLOGY

The capital costs associated with the Moderate and Ambitious Scenarios were determined by adding the capital costs from Tables 3 & 4 and the appropriate implementation schedule.

The generalized energy efficiency related costs were informed by an ACEEE (2014) study on the levelized cost of energy efficiency. The approximate cost of energy efficiency from this study was taken to be between $0.07 and $0.24 per per kWh of energy savings. In Table A.6.2, AMB low includes $0.07/kWh and AMB high uses $0.024/kWh.

After multiplying the additional annual clean energy potential by this estimated clean energy cost, an annual capital cost forecast representing annual capital investments for additional clean energy was determined. This annual capital cost forecast was discounted through 2042 assuming a discount rate of 4%. Total initiative and efficiency costs are in table A.6.2. Last row shows costs without 3 most expensive initiatives found in Table 8, page 20.

Table A.6.2. Annual Capital Costs by Scenario in Millions

	2024	2026	2028	2030	2032	2034	2036	2038	2040	2042
MOD	$26.50	$24.50	$2.85	$2.64	$2.44	$1.87	$1.73	$1.60	$1.48	$1.37
AMB - Low	$33.30	$30.80	$6.44	$5.95	$5.50	$4.32	$4.00	$3.71	$3.44	$3.17
AMB - High	$33.50	$31.00	$6.62	$6.11	$5.64	$4.45	$4.11	$3.87	$3.59	$3.30
AMB - w/o Expensive Initiatives	$9.61	$8.88	$2.00	$1.85	$1.70	$0.81	$0.75	$0.75	$0.71	$0.64

A.6.4 BENEFIT-COST ANALYSIS

Table 7 benefits and costs are the sum of the cumulative public health savings, bill savings, and capital expenditures assumed in this report. These are not the only costs and benefits associated with the clean energy actions described in this report. For example, Table 7 does not include the value of the electricity generated from the $5 million offsite solar farm initiative.

A.6.5 ECONOMIC DEVELOPMENT METHODOLOGY

The economic development indicators in this report were determined using the Impact Analysis for Planning (IMPLAN) tool, which provided total expected industry growth in the City of Tampa because of municipal investment in clean energy. IMPLAN identifies three types of jobs created from clean energy investments: direct job-years, indirect job-years, and induced job-years.

Direct Jobs refer to new jobs expected in industries directly impacted by monetary investments. For example, significant investment in solar production will drive the creation of direct jobs in solar photovoltaic manufacturing.

Indirect Jos refer to growth in businesses associated with an investment due to business-to-business purchases. In the previous example, if a solar manufacturer impacted by new investment in solar production purchases related services from a logistics company, the logistics company would benefit from indirect job creation as a result of the solar investment.

Induced Jobs refer to growth in other industries due to increased household spending of employees directly impacted by increased investment.

Direct, indirect, and induced job creation is assessed with respect to specific industries that would be impacted by an investment. In this analysis, the following four industries were taken to be representative of the impacted industrial categories following the clean energy investments described in this report: commercial energy efficiency (a composite industry created by Greenlink within the IMPLAN model reflective of the combination of industries typically required for commercial energy efficiency improvements), rooftop solar photovoltaic (PV), electric power solar generation, and water and sewage systems.

A job-year is an economic concept that represents the economic activity of one full-time equivalent position maintained for one year. For example, one new, full-time job that lasts for five years is equal to five job-years. For the purpose of this report, it is assumed that the average duration of a job is 4 years as the conversion factor between job-years and jobs. Measuring job-years is the best method of assessing employment changes in this analysis because it allows us to account for both non-permanent and/or project-driven employment and when new jobs are created during the relatively long timeline included in this analysis.

Table A.6.3 presents the anticipated job-years and jobs created as a result of the clean energy investments made in the Moderate and Ambitious Scenarios.

Table A.6.3. IMPLAN Job-Year Multipliers for the City of Tampa

	Job-Years per Million Dollars Invested				Calculated Job-Years by Scenario	
Industry	Direct	Indirect	Induced	Total	MOD	AMB
Commercial Energy Efficiency	3.9	2.5	2.1	8.5	396	865
Rooftop Solar PV	5.4	2.2	2.3	9.9	66	109
Electric Power Generation – Solar	0.9	1	1.2	3	14	24
Water, Sewage, and Other Systems	1.3	1.2	2.1	4.6	360	360
Total Job-Years					**836**	**1,358**

Determining the amount of investments made in each of these industries involved categorizing each clean energy initiative into its representative industry category. Table A.6.4 details the categorization assumptions made for Tampa's clean energy initiatives.

Table A.6.4. Clean Energy Initiatives and Associated IMPLAN Multipliers

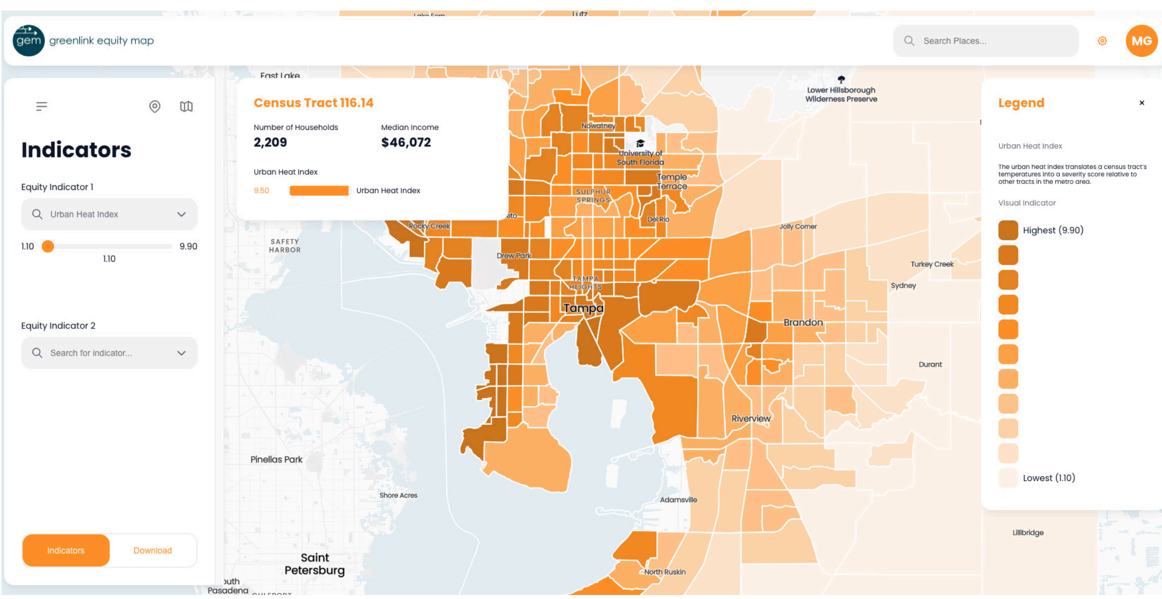
IMPLAN Industry Categories	Clean Energy Initiatives
Commercial Energy Efficiency	Identified LED Lighting Retrofits in Municipal Parking Garages
	Interior and Exterior LED Lighting Retrofit in City Hall
	Rooftop Energy Efficient Siplast Covering
	Identified HVAC Efficiency Upgrades in Commercial Buildings
	Half of Identified Energy Efficient Window Retrofits in Commercial Buildings
Rooftop Solar PV	Solar on New Construction
	Identified Solar Capacity in the CAEP
Electric Power Generation - Solar	Offsite Solar Facility (in Thonotosassa)
	Solar Installations - At Multiple Facilities
Water, Sewage, and Other Systems	Municipal Hydroelectric Power Plant
	High Service Pump Station

As this report is a companion to the Climate Action and Equity Plan, the Greenlink Equity Map (GEM)[23] is briefly described as its primary purpose to contextualize the intersection of equity and climate issues. GEM is currently available for City Staff. GEM is an interactive mapping platform that guides users to understand how equity-related burdens are spread across their communities, allowing them to locate where high inequitable burdens exist helping them to make informed, data driven decisions. There are numerous indicators of equity that may be used to assess these burdens - the GEM tool allows users to explore over 40 equity indicators at the census tract level.

These indicators may be visualized individually, or users may view multiple indicators at once to highlight the most burdened neighborhoods. Representations of the City of Tampa using GEM are provided.

Figure B1 reveals census tracts in the City of Tampa that have a high urban heat index, representing higher levels of the urban heat island effect in these communities.

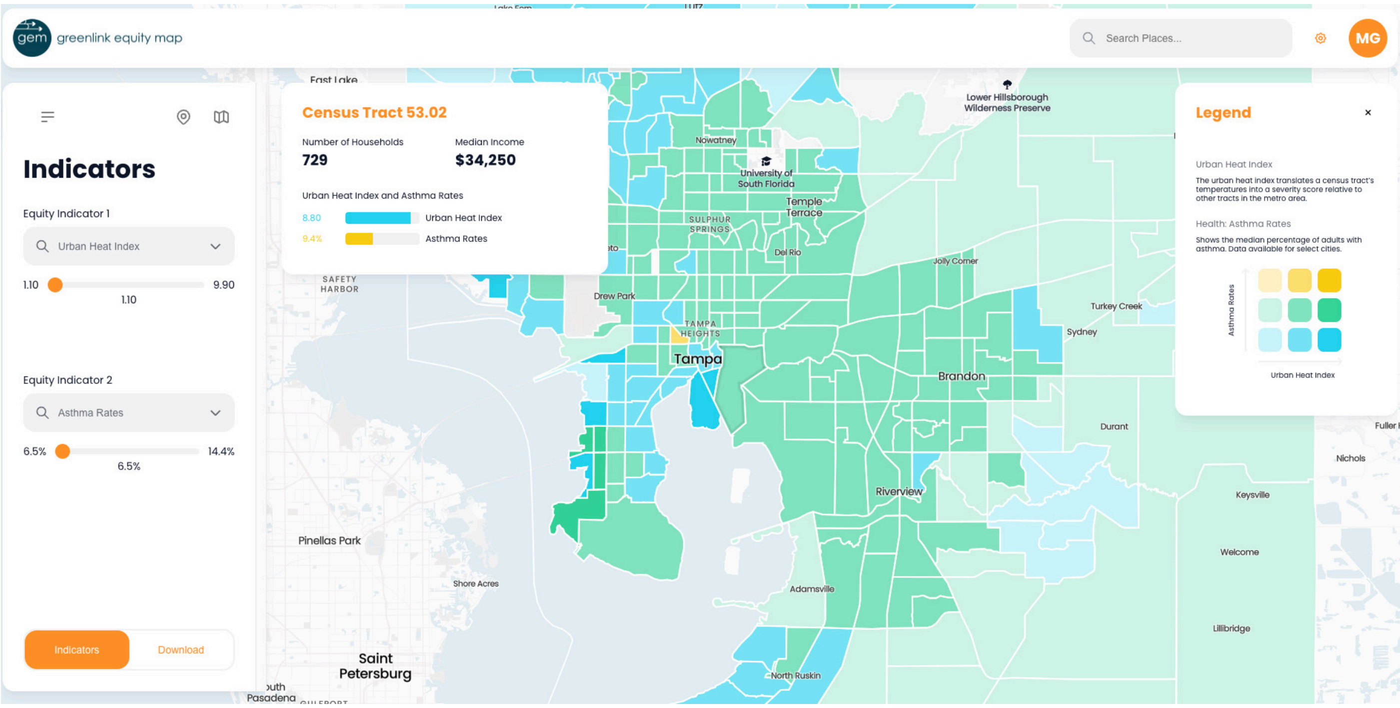
Figure B1. GEM Map: Urban Heat Index in the City of Tampa



24. Greenlink Equity Map (GEM). (2022). Retrieved March 1, 2023, from https://www.equitymap.org/

If asthma rates are applied as a second indicator as in Figure B2, overlapping tracts with both high urban heat indexes and high asthma rates can be visualized. Notably, many census tracts with high urban heat indexes also experience relatively high rates of asthma.

Figure B2. GEM Map: Urban Heat Index and Asthma Rates in the City of Tampa



The GEM tool is a powerful visual in establishing the corollary relationship between seemingly disconnected factors and identifying areas with multiple levels of burdens. Tampa's commitment to a municipal transition to clean energy will not directly impact the vast majority of census tracts in the same way that residential actions like updated building codes would. Nonetheless, the City's efforts to reduce greenhouse gas emissions would reduce community-level burdens associated with climate change, including the urban heat island effect and asthma rates, among many others.

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