Assessing Potential Benefits of Greenhouse Gas Mitigation Measures for Low-Income and Disadvantaged Communities in Wisconsin

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Summary

The U.S. Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program provides state and local governments resources to mitigate greenhouse gas (GHG) emissions with the stated objectives to create jobs, lower energy costs for families; address environmental injustice, and reduce harmful air pollution (EPA, 2023). When developing their Priority Climate Action Plans (PCAPs), EPA requests planning grant recipients include a preliminary analysis of benefits for low-income and disadvantaged communities (LIDACs) anticipated to result from the GHG reduction measure(s) in their PCAP. To support the State of Wisconsin's PCAP submission to the EPA we have conducted a benefits analysis focused on potential high-priority and implementation-ready measures identified to reduce greenhouse gas pollution. These measures were developed by the State of Wisconsin's Office of Sustainability and Clean Energy (OSCE), in consultation with communities, stakeholders, and partners, with the goal of benefiting LIDACs. This report is based on guidance prepared on behalf of U.S. EPA (ICF, 2023) and provides the following information in four sections:

1. Identification of LIDACs with Census Block ID numbers.
2. Discussion of existing climate risks, impacts, and vulnerabilities among LIDACs.
3. Summary of emission reduction potential for GHG and co-pollutants.
4. Qualitative benefits analysis for each GHG mitigation measure, including direct (for GHG sources within LIDACs) as well as indirect (reduction measures to GHG sources outside of LIDACs that will impact LIDACs) benefits.

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1.0 Identifying Low-Income and Disadvantaged Communities

The Justice40 Initiative makes it a goal to deliver 40 percent of the overall benefits of certain Federal investments to disadvantaged communities. The categories of investment are climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure (The White House, 2022). EPA guidance defines low-income disadvantaged communities as "communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens". In identifying Wisconsin's LIDACs, we followed EPA's recommended definition from the LIDAC Technical Guidance: (1) any Census tract that is included as disadvantaged in the Climate and Economic Justice Screening Tool (CEJST); (2) and/or any census block group that is at or above the 90th percentile in any Supplemental Index[1] of the Environmental Justice Screening and Mapping Tool (called EJScreen) when compared to the nation or state; (3) and/or any geographic area within Tribal lands and indigenous areas as included in EJScreen.

We constructed a list of Wisconsin LIDACs by downloading the "EPA IRA Disadvantaged Communities" layer as a table from EJScreen (under the "Places" icon), which includes all LIDACs in the U.S. We deleted the non-Wisconsin IDs, and removed the block group IDs that were not categorized as LIDAC. The LIDACs identified in Wisconsin have been listed as block group IDs in a Microsoft Excel Workbook.[2] To provide more detailed information on each LIDAC block group, we matched the block group IDs from the "EPA IRA Disadvantaged Communities" layer, with the block group IDs from EJScreen. The EJScreen data was downloaded from EPA's website using their "Download EJScreen Data" page (EPA, 2014b).

Figures 1a-b illustrate the geographic distribution of LIDACs in Wisconsin, and Southeast Wisconsin, respectively. The preliminary evaluation of the data sources described above has found that:

- 34% of Wisconsin's block groups (1,475 out of 4,292) are considered disadvantaged. The map below shows these communities and their location throughout Wisconsin (Figure 1a).

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[1] Additional information on EJScreen's Supplemental Indexes can be found at: https://www.epa.gov/ejscreen/ejand-supplemental-indexes-ejscreen

[2] List of block group IDs that were identified as LIDACs in Wisconsin: https://uwmadison.box.com/s/im350xu9r5qa6wc7m8vwwbz0ysvtw9m2

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- 27.5% of Wisconsin's population (1,617,485 individuals living in the 1,475 LIDAC block groups, based on the census population of each) are considered disadvantaged.
- 8.9% of the LIDACs are tribal block groups (132 out of the 1,475).

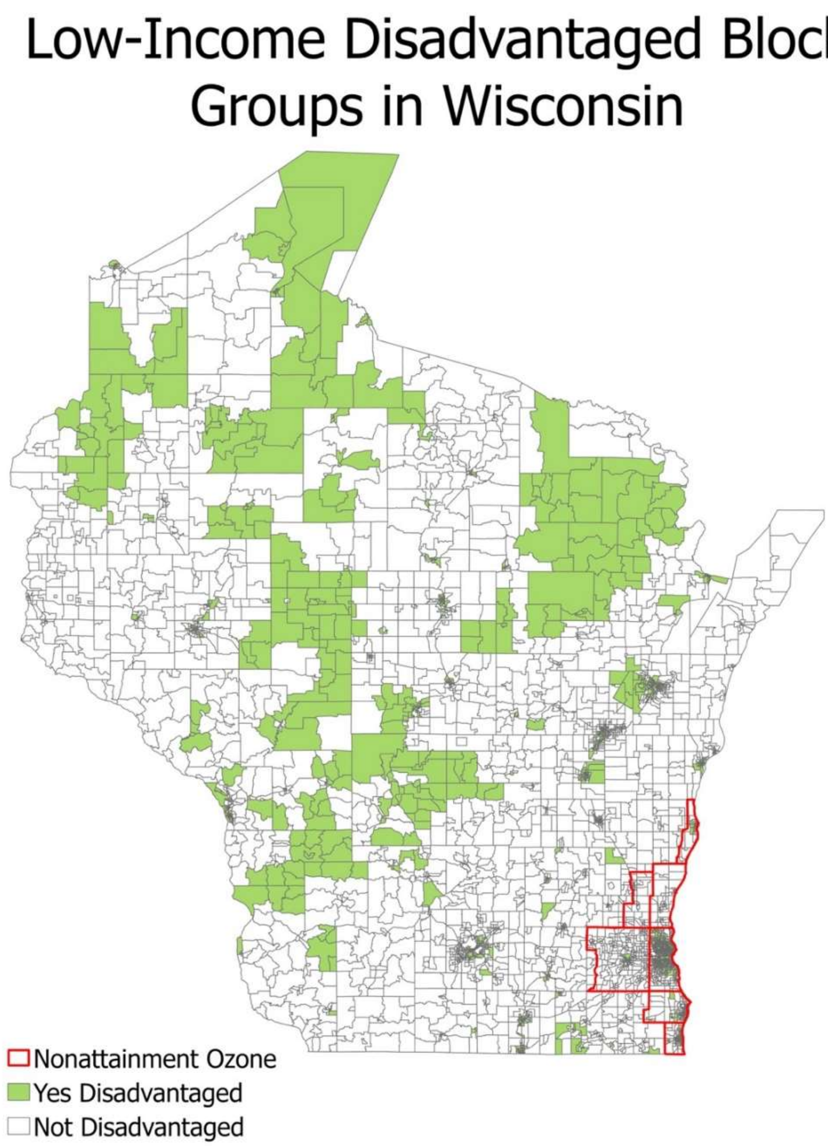

Figure 1a. Wisconsin's LIDACs are the green colored block groups. The red lines are Wisconsin's nonattainment areas, which are only for 2015 ozone nonattainment. Non-attainment area designation is based on data provided by the Wisconsin Department of Natural Resources.

Low-Income Disadvantaged Block Groups in Wisconsin's Nonattainment Areas

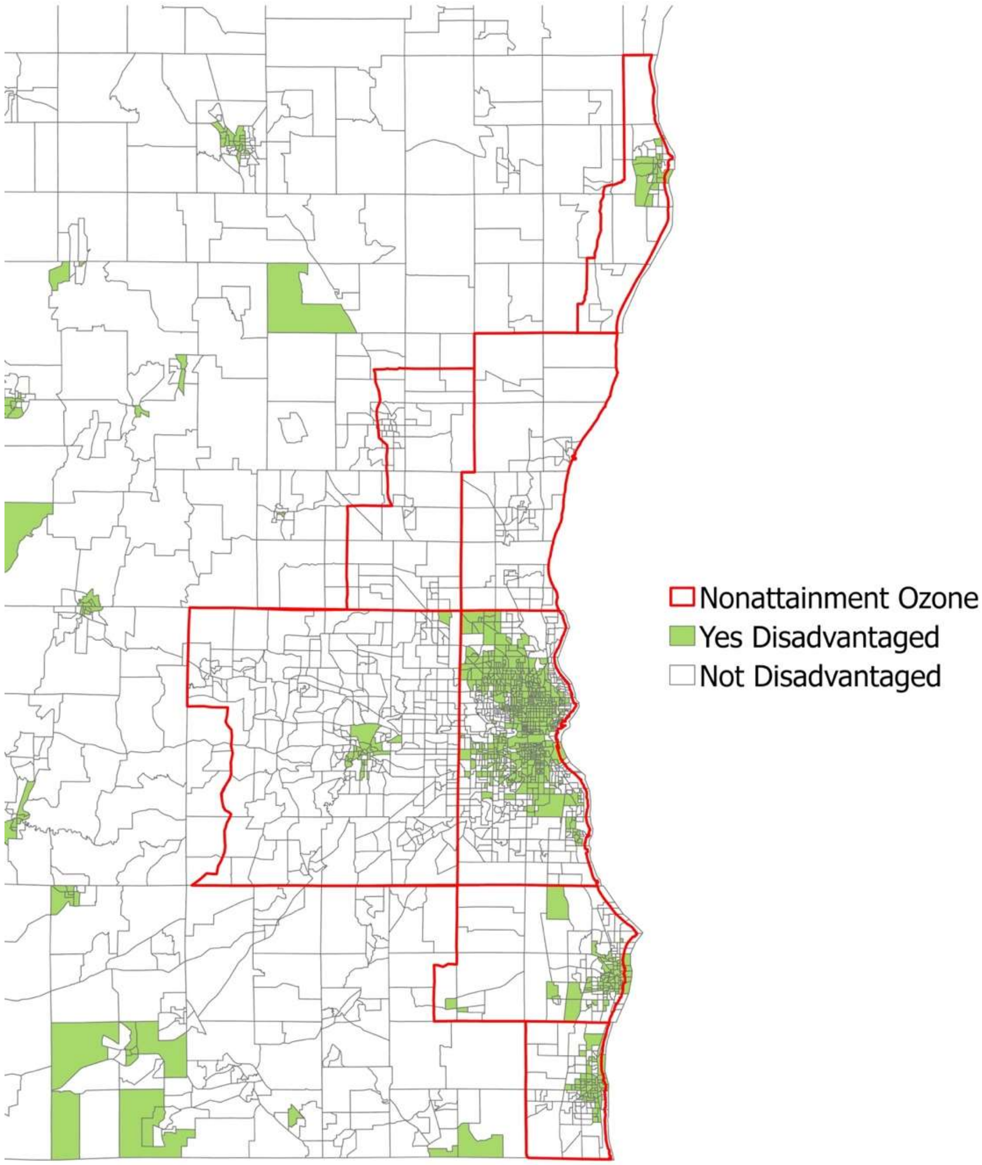

Figure 1b. A map of the LIDAC block groups located in the nonattainment areas of southeastern Wisconsin: Milwaukee area (five counties), Kenosha county, and Sheboygan county.

2. Climate Risks, Impacts, and Vulnerabilities among LIDACs

This section briefly summarizes the climate risks, impacts, and vulnerabilities within Wisconsin, with a particular emphasis on low-income disadvantaged communities. Wisconsin is susceptible to various climate risks, including extreme weather events, rising temperatures, changes in precipitation patterns, and worsening air quality (Wisconsin Department of Health Services, 2014; Wisconsin Initiative on Climate Change Impacts, 2021). Heat waves, intense storms, and flooding events have become more frequent and severe, posing threats to infrastructure, agriculture, and public health. The effects of climate change disproportionately affect marginalized groups, exacerbating existing social and economic disparities (EPA, 2021). LIDACs in Wisconsin face greater impacts from climate change due to a combination of social, economic, and environmental factors. Vulnerabilities arise from inadequate infrastructure, limited access to resources, and the inability to adapt to changing conditions.

The disproportionate impacts of climate risks on LIDACs are partly due to the underlying conditions that lead to vulnerabilities, including but not limited to:

- Economic Disparities: The economic repercussions of climate change hit disadvantaged communities harder. Limited financial resources hinder LIDACs' ability to invest in resilient infrastructure and secure insurance against climate-related damages. Property damage from flooding or storms often results in increased financial burdens for those without adequate insurance or resources to recover. Disrupted agriculture can lead to job losses, especially in sectors sensitive to climate variability. For instance, the Midwest produces more than 30% and 32% of the world's corn and soybeans, respectively, making it one of the most agriculturally intensive regions in the world (Wilson et al., 2023).

- Housing Inequality: In many cases, low-income communities are forced to settle in areas prone to climate-related hazards. Limited access to secure land and housing options leaves these communities more exposed to climate risks. Additionally, low-income households often lack the financial means to invest in climate-resilient housing or retrofit existing homes. As LIDACs transition to cleaner technologies, there is a risk of increased property values and potential gentrification. Strategies should be in place to avoid the displacement of existing residents, ensuring that the benefits of environmental improvements are shared equitably.

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- Social Vulnerability: Per the Fifth National Climate Assessment, a person's age, gender, color, and ethnicity, resource accessibility, level of local adaptive capacity, and prior health issues all affect how exposed and sensitive they are to climate change (Bernstein et al., 2022; Liu et al., 2021; National Academies of Sciences & Medicine, 2022; Sampson et al., 2019). Consequently, the effects of climate change on health are not felt equally across communities (Wilson et al., 2023). People of color and those with lower incomes are particularly susceptible to climate-related dangers due to historical policies and systematic racism (Hoffman et al., 2020; Muñoz & Tate, 2016; National Academies of Sciences & Medicine, 2022; Sampson et al., 2019). The Midwest is particularly vulnerable to climate-related hazards due to a combination of social and environmental factors, including aging or dilapidated housing stock, insufficient tree cover, poor or deteriorated stormwater infrastructure, increased exposure to air pollution, restricted access to transportation, and a lack of preventive healthcare services (Hoffman et al., 2020; Hsiao et al., 2021; Liu et al., 2021).

Climate impacts in Wisconsin disproportionately intensify the vulnerabilities of low-income disadvantaged communities, amplifying the challenges related to economic stability, affordable housing, and social vulnerability. Midwestern climate impacts include, but are not limited to:

- Disrupted Natural Resources: Extreme precipitation events and rising temperatures harm Midwestern aquatic ecosystems; for instance, mass fish die-offs are predicted to double by 2050, increased river erosion, more invasives species, habitat degradation, nutrient pollution, and more (Paukert et al., 2021; Till et al., 2019; Wilson et al., 2023). These negative ecosystem impacts especially harm the Tribal groups (which are considered LIDACs) since many Tribal communities respect and depend on the land, waterways, wildlife, and fish. The decline in aquatic ecosystems not only threatens the traditional practices of these communities but also diminishes the recreational value of natural resources in the region.

- Public Health: Rising temperatures contribute to the spread of vector- and waterborne diseases, the increase of wildfires and heatwaves, and the increase of particulate matter and ozone production (Donald De Alwis & Vijay Limaye, 2021; Wilson et al., 2023; Wisconsin Department of Health Services, 2015). The geographic spread of disease-carrying vectors (such as ticks and mosquitoes) into and throughout the Midwest is facilitated by rising temperatures, especially during the winter, and increased precipitation (Alkishe & Peterson, 2022; Sonenshine, 2018). Now endemic to the Midwest, Lyme disease is the most common vector-borne illness in the U.S. (N Hauser et al., 2021). Additionally, the Midwest is expected to experience more intense heat waves, which increases the risk of respiratory and heat-related conditions. In July 2012, Wisconsin had an intense heat wave that caused damages estimated at $290.3 million (in 2022 USD) from fatalities, hospital stays, missed income, and other health-related expenses (Limaye et al., 2019). Lastly, particulate matter and ozone exposure can cause or exacerbate cardiovascular and respiratory diseases, as well as lead to premature death (ALA, 2022; Dedoussi et al., 2020). Limited access to healthcare and resources further compounds the health risks faced by disadvantaged communities, creating a cycle of vulnerability.

- Water Quality: Climate change is harming the quality and quantity of streams, rivers, and lakes – all vital to urban, rural, and Tribal communities (Wilson et al., 2023). These changes are increasing risks to sufficient food production, surface and groundwater use, recreational activities, and ecosystem health. The Mississippi River basin and the Great Lakes are expected to experience more droughts, floods, and runoff events, which will negatively affect ecosystems by increasing erosion, causing damaging algal blooms, and allowing invasive species to spread (Kunkel et al., 2020; Wilson et al., 2023). LIDACs may lack the resources to implement adaptive measures to cope with changing water quality. This can result in increased vulnerability to extreme events, such as floods or droughts. Building resilience in these communities requires targeted policies and investments to enhance adaptive capacity.

Greenhouse gas mitigation measures can be designed to alleviate the impacts of climate change on LIDACs, emphasizing the crucial link between equity and effective climate action. By prioritizing the needs of vulnerable populations, these solutions aim to address environmental challenges while promoting social justice, ensuring that the most marginalized communities receive the necessary support to adapt and thrive in a changing climate.

- Green Infrastructure: Temperature changes and extreme rainfall are already challenging Wisconsin's aging infrastructure. Shifts in the precipitation patterns are projected to increase flooding and disrupt river transportation (Wilson et al., 2023). However, GHG mitigation measures that focus on building green infrastructure can benefit the LIDACs disproportionately affected by these extreme weather events. By safeguarding these communities against climate risks, these solutions promote equity by reducing the impact of environmental disasters on marginalized populations.

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- Energy transition: Transitioning from fossil fuels to renewable energy sources like solar, wind, hydroelectric, and geothermal power can significantly reduce carbon emissions. A transition to in-state energy resources would help Wisconsin regain dollars and jobs (David Abel & Katya Spear, 2019). GHG mitigation measures that prioritize renewable energy infrastructure can provide equitable access to clean energy resources, reduce energy poverty, and provide employment.

- Affordable and Sustainable Transportation: Investing in sustainable transportation options like public transit, cycling infrastructure, and electric vehicles not only reduces greenhouse gas emissions but also improves access to affordable and reliable transportation for LIDACs. By prioritizing public transportation and ensuring equitable distribution of electric vehicle charging infrastructure, GHG mitigation measures can promote transportation equity.

- Green Job Creation: Implementing GHG mitigation measures such as renewable energy projects and energy-efficient technologies can create employment opportunities in sectors like construction, manufacturing, and renewable energy. Prioritizing workforce development and job training programs in LIDACs ensures equitable access to these new green jobs, fostering economic empowerment.

We identified the following publications and tools for additional data, assessment, and learning on the climate vulnerabilities for Wisconsin's disadvantaged communities:

- Fifth National Climate Assessment - Chapter 24: Midwest (Wilson et al., 2023)
- Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts (EPA, 2021).
- Wisconsin's Changing Climate: Impacts and Solutions for a Warmer Climate (Wisconsin Initiative on Climate Change Impacts, 2021).
- Milwaukee Heat Vulnerability Index (Wisconsin Department of Health Services, 2014).
- Climate and Health: Vulnerability Indices (Wisconsin Department of Health Services, 2015).
- Wisconsin Opportunity in Domestic Energy Production: The Economic and Health Benefits of 100% In-State Energy Production (Abel & Spear, 2019).
- The Costs of Inaction: The Economic Burden of Fossil Fuels and Climate Change on Health in the United States (De Alwis & Limaye, 2021).

Accelerating Decarbonization in the United States: Technology, Policy, and Societal Dimensions (National Academies of Sciences, Engineering, and Medicine, 2023).

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3.0 Greenhouse Gas and Co-pollutants Emission Reduction Potential from Priority Measures

This section provides an estimate of the state-wide potential for greenhouse gas and co-pollutant emission reductions resulting from sector-level deployment of selected emissions reduction measures. We utilized the Energy Policy Simulator (EPS) (Energy Innovation LLC, 2024) to analyze the emission impacts of the proposed mitigation measures. The EPS tool refers to individual measures as "policies" and collections of measures as "energy policy scenarios".

The OSCE developed a suite of GHG mitigation measures in consultation with representatives from Energy Innovation, the authors of the EPS tool. The resulting EPS scenario is intended to represent the total potential of all proposed measures calculated on EPS, implemented state-wide. Our group extracted the sector-level emissions reported by the EPS tool for this scenario. We report GHG-equivalent emissions, excluding land use, directly from the EPS tool. We report co-pollutant emissions for fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and carbon monoxide (CO), which are regulated under the Clean Air Act to protect human health and public welfare (EPA, 2014a). For these co-pollutants, we multiplied the % emission change (relative to 2020) reported by the EPS tool, by the state-wide pollutant total reported in EPA's National Emission Inventory for 2020 (excluding biogenic and fire sources). Table 1 reports projected emissions reductions (relative to 2023) for 2030, 2040, and 2050.

Table 1. EPS-reported emission trajectory changes relative to EPS-reported 2023, in tons.

	GHG	PM2.5	NOx	SO_2	VOC	CO
By 2030	-32,211,000 -27%	-3,996 -5%	-6,837 -6%	-910 -43%	-3,547 -2%	-71,577 -9%
By 2040	-47,382,600 -40%	-5,190 -7%	-15,326 -14%	-749 -36%	-8,295 -4%	-144,909 -19%
By 2050	-55,285,000 -46%	-5,270 -7%	-17,741 -16%	-664 -32%	-1,896 -1%	-173,548 -23%

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4.0 Qualitative LIDAC Benefit Assessment

The implementation of the measures included in Wisconsin's PCAP are anticipated to have a broad range of benefits. Anticipated benefits, and any potential disbenefits associated with measure implementation, are summarized in the following sections. We reviewed the categories of burden from the CEJST tool[3] and will consider adoption of additional metrics for future reporting.

For our initial qualitative assessment, we categorized burdens as follows:

- Economic Development
  - The economic development category encompasses issues such as insufficient access to resources, education, and employment opportunities; often perpetuating a cycle of poverty and inequality.
- Environmental Justice
  - The environmental justice category signifies LIDACs' disproportionate exposure to environmental hazards and pollution, amplifying health risks and exacerbating socio-economic disparities within these communities.
- Air Quality & Health
  - The air quality and health category encapsulate the heightened vulnerability of LIDAC residents to adverse health effects resulting from poor air quality, often stemming from proximity to industrial activities and traffic emissions and volume.
- Energy Burden
  - The burden of energy refers to the challenges associated with inadequate access to affordable and reliable energy sources.
- Transportation Access
  - The transportation access category encompasses the challenges associated with limited availability of affordable and reliable transportation options, hindering residents' mobility, access to essential services, and economic opportunities, thereby contributing to social and economic disparities within these communities.
- Safe & Affordable Housing
  - The burden of safe and affordable housing for LIDACs involves the challenges associated with insufficient access to secure and reasonably

[3] CEJST methodology for its' categories of burden: https://screeningtool.geoplatform.gov/en/methodology

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priced housing, leading to substandard living conditions, homelessness, and perpetuation of socio-economic disparities within these communities.

EPA's April 2023 Technical Guidance (EPA, 2023) defined direct and indirect benefits based on the measures' geographic proximity within or near the LIDACs:

- Direct Benefits - projected benefits of GHG reduction measures that could be implemented on GHG emission sources located within LIDACs.
- Indirect Benefits - expected advantages of actions that might be taken on sources outside such communities but could nonetheless have benefits for identified LIDACs.

To develop a qualitative scoring rubric, we assigned a score between zero to three for each burden category to each measure, where a higher number reflects a higher correlation with positive benefits. For direct benefits:

- none, or not readily apparent (score = 0),
- limited (score = 1),
- moderate (score = 2),
- high (score = 3).

Our approach to scoring indirect benefits was simplified to score measures between zero and one, based on the following approach:

- none, or not readily apparent (score = 0),
- burden category is directly benefited (score = 1)[4],
- burden category realizes a secondary (less direct) benefit (score = 1)[5].

By considering a score of zero as "not readily apparent", we recognize that the interactions between people and their environment is complex and interconnected. Our estimated scores within benefit categories are preliminary and anticipated to evolve with ongoing stakeholder communications.

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[4] For example, if a measure is known to reduce air pollution, it will do so within or outside of the LIDAC. In the latter case, the LIDAC receives an indirect benefit. In some cases, this indirect benefit could be quite high, such as an air pollution reduction directly upstream from the LIDAC. In other cases, the indirect benefit could be quite low and even non-existent. Hence, we use a simpler 0 and 1 scoring to simply reflect that an indirect benefit, as geographically defined by EPA, may be present.
[5] For example, industrial electrification does not necessarily comport as a direct benefit to residential energy burden, however, could result in a more cost-effective regional grid and more etc.

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The following GHG mitigation measures are evaluated below, having been identified as potential "priority measures" for the purposes of pursuing funding through the CPRG[6]. The measures are discussed below in the following section:

- 4.1 Industrial Efficiency, Electrification, and Decarbonization
- 4.2 Building Electrification and Retrofitting
- 4.3 Clean Transportation, Fuels, and Infrastructure
- 4.4 Transit Planning and Expansion
- 4.5 Distributed Renewable Energy
- 4.6 Agriculture and Soil Solutions

[6] This list is not exhaustive of Wisconsin's priorities.

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4.1 Industrial Efficiency, Electrification, and Decarbonization

Improving energy efficiency for industrial processes and buildings leads to lower manufacturing costs, more competitive local businesses and, particularly where combustion sources are electrified, reduces harmful emissions. Better energy management by industrial businesses will reduce overall energy usage, potentially at peak times, thus reducing grid-operation costs for all customers. Implementing a greenhouse gas (GHG) measure focused on industrial efficiency and electrification can have direct and indirect benefits for low-income and disadvantaged communities. We identify potential impacts below.

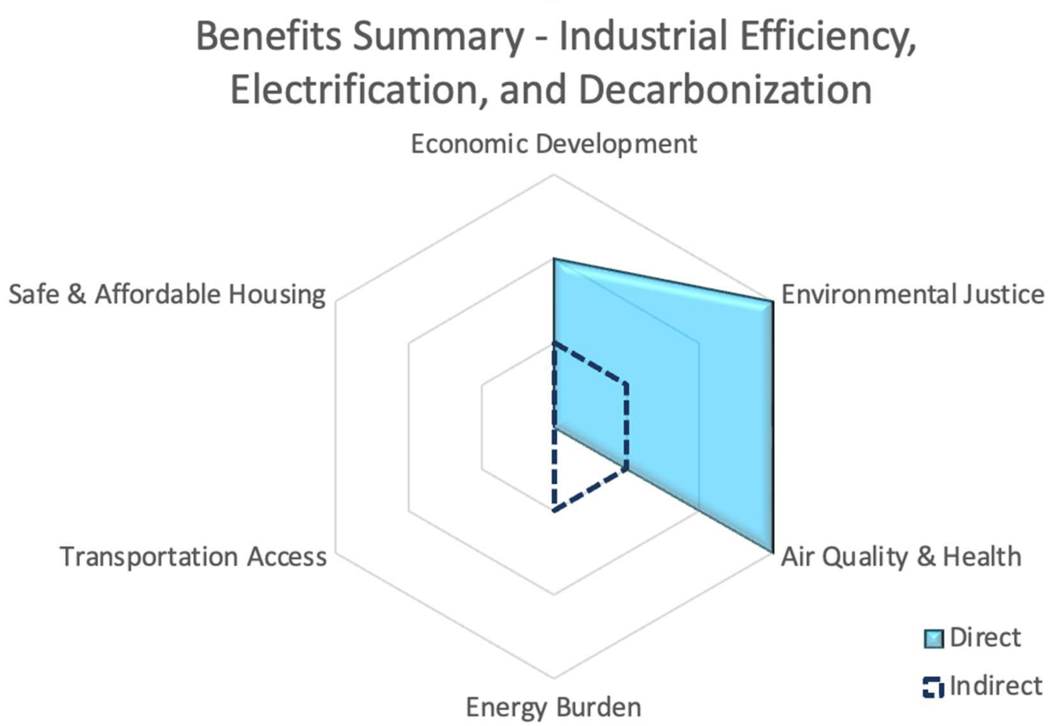

Figure 2. Schematic representation of the direct and indirect benefits for the industrial efficiency, electrification, and decarbonization measure.

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<u>Direct benefits of the Industrial Efficiency, Electrification, and Decarbonization measure:</u>

Economic Development (direct) The transition to electrification and hydrogen could create new jobs in clean energy industries, providing employment opportunities for local residents. Training programs can be implemented to ensure that individuals from disadvantaged communities have the necessary skills to participate in the green economy. *Score: 2*

Environmental Justice (direct) LIDACs often bear a disproportionate burden of the negative impacts by industrial operations compared to other non-disadvantaged communities. Low-income communities are frequently located near industrial zones due to factors such as cheaper land costs and historical patterns of urban development. This proximity exposes residents to higher levels of pollution and emissions from industrial activities. *Score: 3*

Air Quality & Health (direct) Industrial facilities that rely on fossil fuels, emit pollutants into the air and water. Reduction in emissions from industrial processes leads to improved air and water quality, benefiting communities residing near industrial zones. Lower levels of pollutants contribute to better cardiovascular and respiratory health, particularly for vulnerable populations like children and the elderly. These sources pose the highest health risks to nearby communities. *Score: 3*

<u>Indirect and Secondary Benefits of the Industrial Efficiency, Electrification, and Decarbonization measure:</u>

Economic Development (indirect) The adoption of cleaner technologies in industrial processes can stimulate technological innovation, potentially leading to the development of new solutions and industries that can benefit LIDACs. *Score: 1*

Environmental Justice (indirect) By transitioning to cleaner and more efficient industrial processes, industrial efficiency may help mitigate environmental injustices. This includes reducing the disproportionate exposure of LIDACs to harmful pollutants and emissions associated with traditional fossil fuel industrial activities. *Score: 1*

Energy Burden (indirect) A more efficient system-wide grid could potentially lower overall energy costs for the regional grid over time. This can help mitigate the impact of energy costs, which often disproportionately affect low-income communities. *Score: 1*

Air Quality & Health (indirect) Improved air quality has many health benefits. It can avoid premature deaths, emergency room visits, asthma onset and symptoms, stroke/lung

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cancer, and more. Therefore, improved air quality results in lower healthcare costs for treating these cases (e.g. respiratory illnesses), benefiting both individuals and the broader healthcare system. *Score: 1*

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4.2 Building Electrification and Retrofitting

The electrification of buildings, energy storage, and energy efficiency projects and practices have the potential to substantially reduce utility bills and increase energy reliability. Therefore, these strategies hold tremendous promise for increasing equity and decreasing the high energy burdens experienced by low-income households, communities disproportionately impacted by climate change, and Tribal Nations. The building electrification and retrofitting measures could help address environmental injustices by mitigating the impact of indoor air pollution and improving building comfort, performance, and affordability. Implementing a greenhouse gas measure focused on building electrification and retrofitting, particularly in low-income disadvantaged communities, can bring about several direct and indirect benefits identified below.

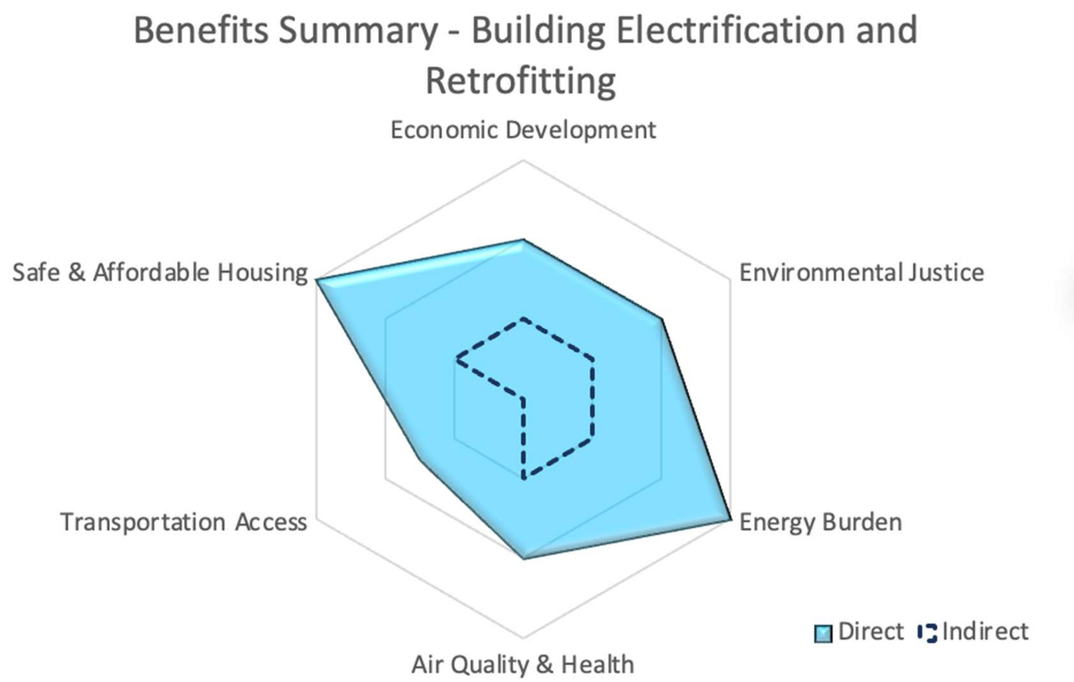

Figure 3. Schematic representation of the direct and indirect benefits for the building electrification and retrofitting measure.

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<u>Direct benefits of the Building Electrification and Retrofitting measure:</u>

Economic Development (direct) The implementation of building electrification and retrofitting projects would create jobs in various sectors, including construction, manufacturing, and technology. This can be particularly advantageous for residents seeking employment. *Score: 2*

Environmental Justice (direct) By decarbonizing the energy system for homes and buildings, electrification directly reduces the environmental burden on communities that are often disproportionately affected by pollution and climate change. This helps address environmental justice concerns by mitigating the negative impacts of industrial and energy-related activities on vulnerable populations. *Score: 2*

Energy Burden (direct) Retrofitting buildings involves upgrading insulation, windows, and HVAC systems, leading to lower energy consumption and improved overall efficiency. Increased energy efficiency means reduced utility bills for homeowners and businesses, providing direct financial benefits. This can significantly benefit low-income households that spend a larger percentage of their income on energy. *Score: 3*

Air Quality & Health (direct) Upgrading ventilation systems and using cleaner electric appliances can contribute to better indoor air quality. Shifting from fossil fuel-based energy sources to electrification reduces the direct ambient emissions associated with heating, cooling, and powering buildings. Improved indoor air quality and reduced exposure to combustion-related pollutants would lead to better public health outcomes. This is crucial for the health and well-being of residents, particularly in LIDACs where substandard housing conditions are prevalent. *Score: 2*

Safe & Affordable Housing (direct) Due to climate change, Wisconsin is likely to experience extreme temperatures more frequently. Upgrades such as better insulation, modern heating, and cooling systems can enhance the comfort and livability of homes, but also reduce vulnerability to climate change impacts. The retrofitting measures are especially important for LIDACs as they are more susceptible to extreme weather events. Additionally, retrofitting can involve the removal or mitigation of hazardous materials in buildings. This directly reduces the exposure of residents to toxins, contributing to a safer and healthier living environment, especially in areas where environmental hazards are prevalent. *Score: 3*

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Indirect and Secondary Benefits of the Building Electrification and Retrofitting measure:

Economic Development (indirect) The push for building electrification can drive innovation in clean energy technologies, spurring the development of more efficient appliances and systems. Additionally, energy-efficient buildings and homes allows residents to allocate more of their income to other essential needs, such as education, healthcare, and local businesses. This increased financial stability can contribute to greater economic productivity at both individual and community levels. *Score: 1*

Environmental Justice (indirect) Electrification and retrofitting contribute to climate resilience by reducing carbon emissions. This not only helps combat climate change but also makes LIDACs more resilient to the impacts of climate-related events. *Score: 1*

Energy Burden (indirect) By focusing on low-income communities, the measure ensures that all socioeconomic groups have access to affordable energy. This promotes equity in the transition to sustainable practices. *Score: 1*

Air Quality & Health (indirect) Safe and well-maintained housing can improve indoor air quality and lead to improved health outcomes, reducing the need for healthcare services. This, in turn, can result in lower healthcare costs for individuals and the community. *Score: 1*

Transportation Access *(indirect)* Electrification may facilitate future electric vehicle (EVs) infrastructure. By facilitating the integration of EVs, building electrification directly promotes sustainable and environmentally friendly transportation. This aligns with broader goals of reducing reliance on fossil fuels and decreasing greenhouse gas emissions associated with traditional vehicles. Improved access to charging infrastructure encourages residents to adopt electric vehicles, as they can confidently charge their vehicles at home. This contributes to increased adoption rates of EVs within the community. *Score: 1*

Safe & Affordable Housing (indirect) Safe and affordable housing contributes to community stability by reducing the likelihood of displacement and providing residents with a sense of permanence. Also, stable housing environments positively impact children's educational outcomes. When families have secure and affordable housing, children are more likely to attend school regularly and perform better academically. *Score: 1*

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4.3 Clean Transportation, Fuels, and Infrastructure

Low-income communities and communities of color are disproportionately affected by air pollution from transportation. Emissions from gasoline and diesel vehicles, such as NO_X, PM2.5, and hydrocarbons, are a major source of the pollution causing significant health problems such as asthma, cancer, and lung and heart diseases. Compared to conventional fuels, electric vehicles eliminate tailpipe emissions that can greatly impact the health of communities. Pursuing clean transportation solutions is expected to result in economic, health, and social benefits including improved air quality, safer streets, local economic development, and improved mobility for low- and moderate-income communities. There are direct and indirect benefits from transportation electrification and clean fuels deployment is further delineated below.

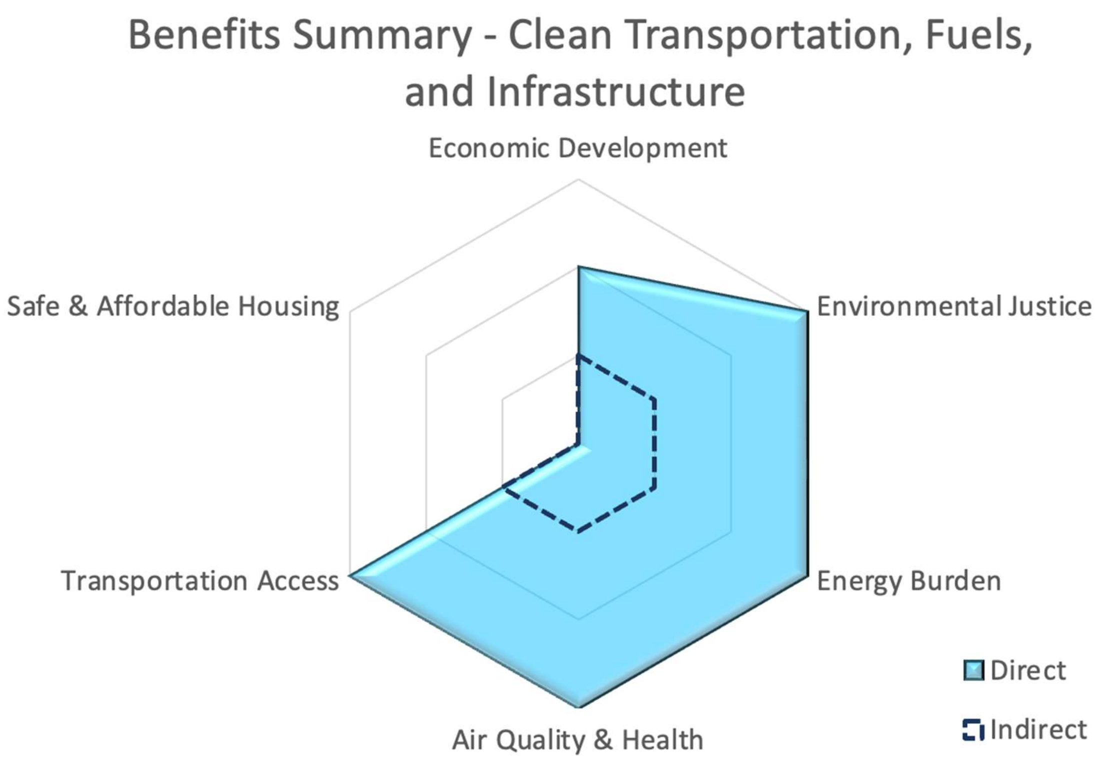

Figure 4. Schematic representation of the direct and indirect benefits for the clean transportation, fuels, and infrastructure measure.

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Direct benefits of the Clean Transportation, Fuels, and Infrastructure measure:

Economic Development (direct) The push for electrification and clean fuels deployment often requires new infrastructure, such as charging stations and maintenance facilities. This can create job opportunities in construction, manufacturing, and maintenance, providing employment opportunities for residents of the LIDACs where this new infrastructure would be implemented. *Score: 2*

Environmental Justice (direct) Transitioning to cleaner vehicles and fuels can directly mitigate local environmental hazards associated with traditional transportation, such as noise pollution and hazardous emissions. This directly benefits residents by creating safer and healthier environments. *Score: 3*

Energy Burden (direct) Electrified vehicles and clean fuels are often more energy-efficient, resulting in lower fuel costs for consumers. This can be particularly beneficial for low-income individuals who spend a significant portion of their income on transportation. *Score: 3*

Air Quality & Health (direct) Electrification of transportation and the use of clean fuels can lead to a reduction in air pollution. Disadvantaged communities, often situated near highways or roads with high traffic volume, experience a disproportionate burden of air pollution. Therefore, LIDACs can directly benefit from improved air quality, resulting in better respiratory health and a lower incidence of related illnesses. *Score: 3*

Transportation Access (direct) Subsidies on passenger vehicle sales and small engine replacement can directly benefit low-income communities by reducing the financial burden of purchasing cleaner vehicles or upgrading existing ones. This can lead to lower transportation costs for individuals and families. *Score: 3*

Indirect and Secondary Benefits of the Clean Transportation, Fuels, and Infrastructure measure:

Economic Development (indirect) Investments in clean energy and sustainable development projects can lead to increased property values, benefiting homeowners and potentially attracting further private investment. Diversification of the local economy through the introduction of clean energy projects can increase the community's economic resilience. A broader economic base makes the community less vulnerable to downturns in specific industries, promoting long-term stability. *Score: 1*

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Environmental Justice (indirect) The implementation of clean transportation measures can contribute to the overall development of low-income communities. Investments in infrastructure and technology can attract additional funding and resources, fostering a more sustainable and resilient community. *Score: 1*

Energy Burden (indirect) By specifically targeting LIDACs with subsidies and incentives, the measure ensures more equitable access to cleaner energy solutions. This promotes a more inclusive transition to sustainable transportation, preventing marginalized communities from being left behind in the shift towards cleaner technologies. *Score: 1*

Air Quality & Health (indirect) The indirect impact of improved air quality is better overall health for community members. Reduced pollution levels can lead to a lower prevalence of respiratory diseases and related health issues, resulting in decreased healthcare costs for both individuals and the community. *Score: 1*

Transportation Access (indirect) Enhanced access to reliable and cleaner transportation options for low-income individuals can improve mobility, allowing residents to access job opportunities, education, and essential services more easily. *Score: 1*

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4.4 Transit Planning and Electrification

This suite of measures is aimed at reducing carbon intensity and overall demand for passenger or freight transportation. Examples include:

- Advancing the objectives of regional vehicle electrification coalitions,
- Incentives for vehicle electrification and charging infrastructure,
- Planning for improved public transit systems, more walking and bike paths, zoning for higher density along transit corridors,
- Mode-shifting efforts (e.g., air to rail) or travel demand reduction efforts,
- Improved logistics for heavy and medium duty trucks

Implementing a greenhouse gas measure on transit planning and electrification with a focus on LIDACs may yield several direct and indirect benefits identified below.

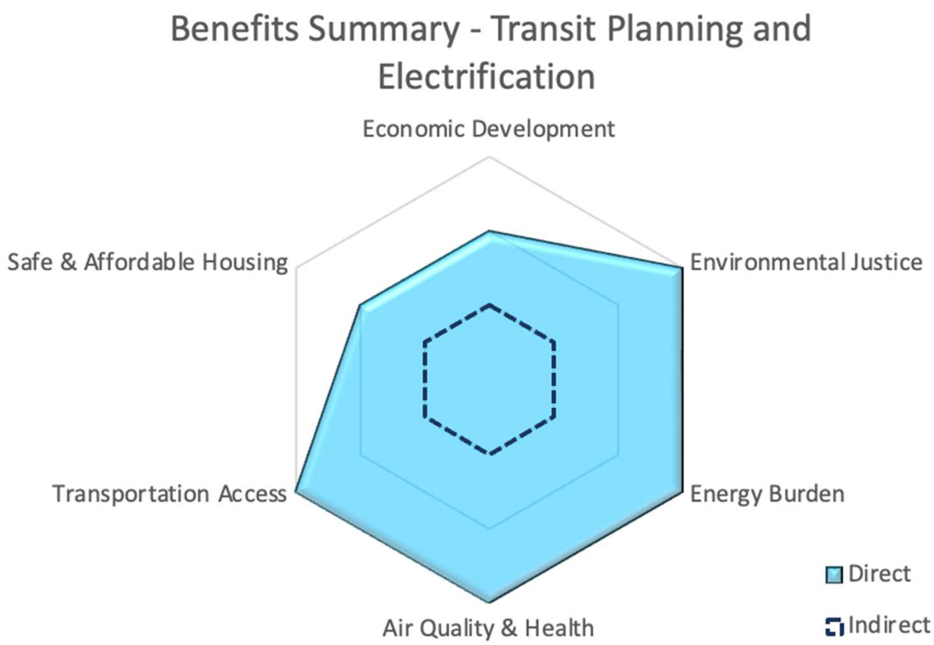

Figure 5. Schematic representation of the direct and indirect benefits for the transit planning and electrification measure.

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<u>Direct benefits of the Transit Planning and Electrification measure:</u>

Economic Development (direct) Lowering transportation costs through mode shifting and electrification allows individuals to redirect funds towards other essential needs, reducing the overall economic burden on their household budget. Also, the transition to electrified public transit systems may generate employment opportunities in manufacturing, maintenance, and operation of these new systems. *Score: 2*

Environmental Justice (direct) Accessible and sustainable transportation options contribute to social inclusion, ensuring that all community members have equal access to transportation resources and opportunities. Thoughtful transportation planning can contribute to community stability, reducing the risk of gentrification and displacement that often disproportionately affects low-income communities. *Score: 3*

Energy Burden (direct) Electrification and mode shifting measures can result in lower fuel and maintenance costs for LIDAC residents, directly reducing their energy burden associated with transportation. Likewise, improving and electrifying public transit can make it a more affordable option, impacting the energy burden for individuals who rely on public transportation. *Score: 3*

Air Quality & Health (direct) Electrification of public transit and mode shifting to non-polluting options (e.g. biking, walking) directly reduces the emissions from fossil fuel vehicles which improves air quality in LIDACs. This improved air quality results in reduced exposure to harmful pollutants, contributing to lower rates of respiratory illnesses and decreased cardiovascular risks. A reduction in air pollution can lead to fewer cases of pollution-related health issues, resulting in lower healthcare costs for both individuals and the community. *Score: 3*

Transportation Access (direct) Sustainable transportation measures provide low-income residents with more affordable and accessible transportation options. Electrification, mode shifting, and transportation planning leads to more reliable and efficient public transit services, also ensuring that residents have dependable transportation for daily needs. *Score: 3*

Safe & Affordable Housing (direct) Improved public transit and walkable infrastructure make it easier for individuals to access affordable housing options, reducing the likelihood of housing being situated in remote or inaccessible areas. Furthermore, well-planned transit and sustainable transportation systems can encourage the development of affordable housing near transit hubs, providing residents with convenient and cost-effective housing options. *Score: 2*

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Indirect and Secondary Benefits of the Transit Planning and Electrification measure:

Economic Development (indirect) Sustainable transit initiatives can attract investments and support local businesses, fostering economic growth in disadvantaged areas. Also, accessible transportation can make it easier for residents to access educational opportunities, including schools, libraries, and training programs, contributing to personal and community development. *Score: 1*

Environmental Justice (indirect) Electrification and sustainable transit practices contribute to climate resilience, helping LIDACs adapt to the impacts of climate change. Specific transit planning focused in LIDACs ensures that their unique needs are considered, promoting social equity. Furthermore, investments in walkable infrastructure and public spaces can contribute to development in those LIDACs. *Score: 1*

Energy Burden (indirect) Investments in sustainable transit may lead to broader energy-efficient infrastructure improvements, contributing to reduced energy costs in the long term for both transportation and residential purposes. Similarly, sustainable transportation measures contribute to overall community resilience, potentially reducing the impact of economic shocks and fluctuations in energy prices on low-income households. *Score: 1*

Air Quality & Health (indirect) Promoting walkable and bikeable areas encourages increased physical activity, leading to improved cardiovascular health and reduced rates of obesity and related health issues. Electrification and mode shifting can lead to quieter transportation options, indirectly contributing to better mental health by reducing noise-related stressors. *Score: 1*

Transportation Access (indirect) Improving public transit and promoting active transportation can enhance connectivity, making it easier for residents to access education, employment, and healthcare facilities. *Score: 1*

Safe & Affordable Housing (indirect) Sustainable transportation initiatives can be part of broader community revitalization efforts, making neighborhoods more attractive for investment, including in affordable housing developments. *Score: 1*

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4.5 Distributed Renewable Energy

This measure is intended to lower costs and barriers for new distributed renewable energy systems. Relevant activities may include incentives for industry, municipalities, universities to install renewable energy systems including battery storage to support grid resiliency and lower emissions. Implementing a greenhouse gas measure for renewable energy can have several direct and indirect benefits for LIDACs as identified below.

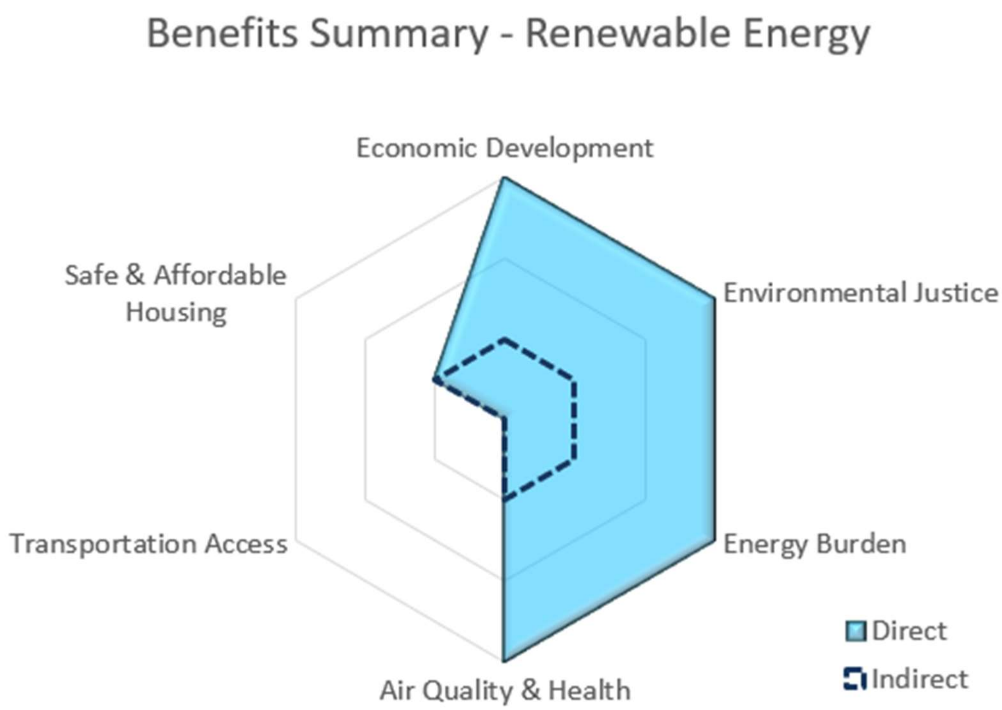

Figure 6. Schematic representation of the direct and indirect benefits for the renewable energy measure.

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Direct benefits of the Distributed Renewable Energy measure:

Economic Development (direct) The growth of the renewable energy sector, including solar and wind installations, creates job opportunities. These jobs can be accessible to residents of low-income communities, providing employment and economic opportunities. *Score: 3*

Environmental Justice (direct) The policy encourages the installation of renewable energy systems in various forms (solar, wind, geothermal, biogas, storage). This can lead to infrastructure improvements in disadvantaged areas, promoting overall development. *Score: 3*

Energy Burden (direct) LIDACs could take advantage of decentralized renewable energy systems, such as community solar or wind projects. These initiatives allow community members to collectively own, control, and benefit from the energy generated, creating a more inclusive and participatory energy market. By promoting the installation of renewable energy systems, especially in low-income housing, residents can benefit from reduced energy costs. *Score: 3*

Air Quality & Health (direct) A decrease in air pollution from the adoption of cleaner energy sources can lead to improvements in respiratory health among LIDAC members, particularly for vulnerable populations like children and the elderly. *Score: 3*

Safe & Affordable Housing (direct) By reducing energy burden this measure may reduce overall home ownership cost. *Score: 1*

Indirect and Secondary Benefits of the Distributed Renewable Energy measure:

Economic Development (indirect) The renewable energy sector requires skilled workers. Initiatives to install renewable energy systems can create opportunities for education and training programs in these communities, equipping residents with valuable skills for future employment. *Score: 1*

Environmental Justice (indirect) By promoting renewable energy installations, the measure can facilitate greater access to solar panels and battery storage in LIDACs, reducing the technology gap. Shifting to clean energy helps mitigate the negative environmental impacts associated with traditional energy sources, contributing to a more equitable distribution of environmental benefits. *Score: 1*

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Energy Burden (indirect) Solar plus storage systems enhance grid resiliency, ensuring a more reliable power supply during outages. This is particularly important for LIDACs that may face challenges during extreme weather events. *Score: 1*

Air Quality & Health (indirect) Improved air quality can result in reduced healthcare costs for residents of low-income communities. Fewer cases of respiratory illnesses and related health problems mean less strain on the healthcare system and lower medical expenses for individuals and the community. *Score: 1*

Safe & Affordable Housing (indirect) By reducing energy burden this measure may reduce overall home ownership cost. *Score: 1*

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4.6 Agriculture and Soil Solutions

Waste-to-energy systems offer a dual solution to economic and environmental challenges. For example, methane digesters convert organic waste into usable energy, reducing reliance on fossil fuels and decreasing greenhouse gas emissions. This not only addresses waste management issues but also generates renewable energy, creating new economic opportunities in the renewable energy sector.

Climate-smart agriculture encompasses agricultural practices and systems that mitigate greenhouse gas emissions, enhance carbon sequestration, and adapt to climate change while promoting sustainable food production and increasing resilience to climate-related challenges. Adopting these practices can lower production costs for farmers, increase market access for sustainably produced goods, and contribute to rural economic development. Potential benefits are identified below.

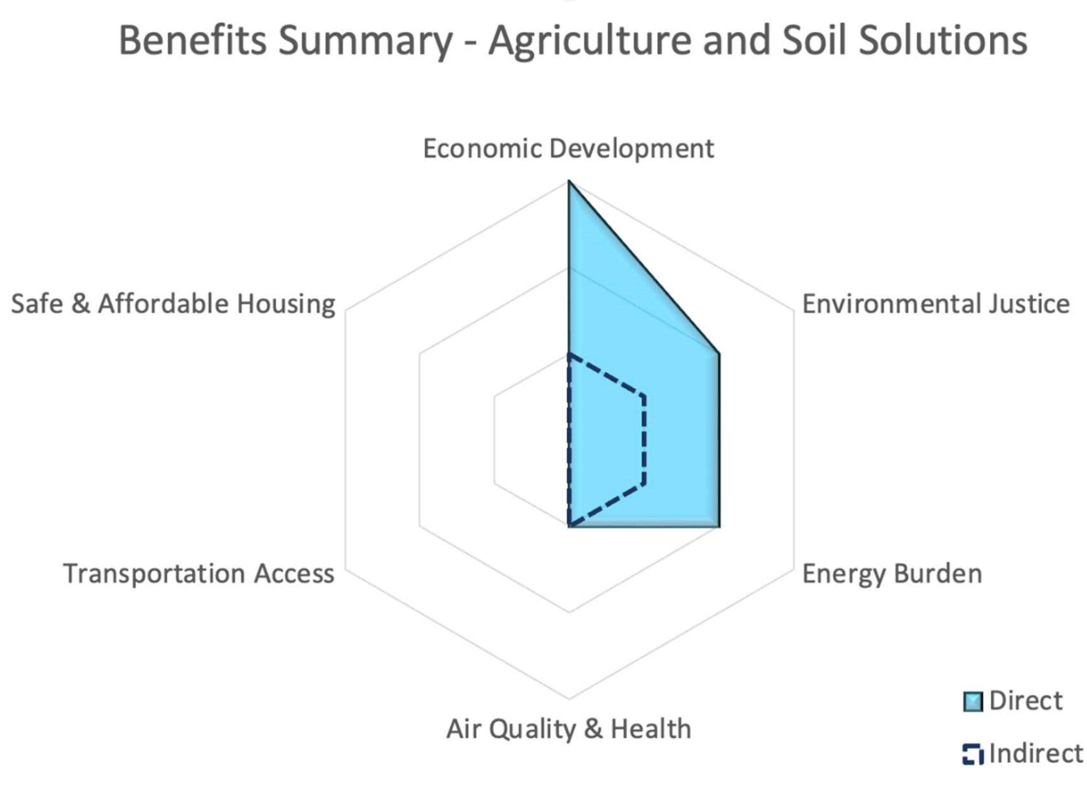

Figure 7. Schematic representation of the direct and indirect benefits for the agriculture and soil solutions measure.

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<u>Direct benefits of the Agriculture and Soil Solutions measure:</u>

Economic Development (direct) By involving LIDACs in the planning and execution of these initiatives, there is potential for economic empowerment. This could include training programs, skill development, and the creation of small businesses associated with waste management and agricultural initiatives. For example, it could create businesses focused on the collection, sorting, and processing of organic waste, providing inputs for anaerobic digesters. *Score: 3*

Environmental Justice (direct) By implementing sustainable waste and agriculture solutions, particularly those aimed at reducing methane emissions and improving soil health, environmental justice is served by minimizing the negative impacts on LIDACs. This can include reducing exposure to air pollutants, preventing contamination of water sources, and promoting overall environmental well-being in areas that may have historically borne a disproportionate burden of pollution. *Score: 2*

Energy Burden (direct) Waste-to-energy systems can provide a local source of clean energy. While adding to energy supply, it is not certain that residents in these communities would direct realize a positive impact via household energy costs. *Score: 2*

Air Quality & Health (direct) Anaerobic digesters can help capture methane emissions from waste, preventing them from being released into the atmosphere. This not only reduces greenhouse gas emissions but also improves air quality, benefiting the health of residents in the surrounding areas. *Score: 1*

<u>Indirect and Secondary Benefits of the Agriculture and Soil Solutions measure:</u>

Economic Development (indirect) The implementation of waste-to-energy systems and anaerobic digesters can create job opportunities in construction, operation, and maintenance. These jobs can be accessible to individuals with various skill levels, providing employment opportunities for the local community. *Score: 1*

Environmental Justice (indirect) Sustainable waste and agriculture practices contribute to climate resilience by mitigating the impacts of climate change. This can include reduced vulnerability to extreme weather events, which often disproportionately affect LIDACs. *Score: 1*

Energy Burden (indirect) Waste-to-energy systems generate clean energy locally, potentially providing a reliable and sustainable energy source for the community. This

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reduces dependence on external energy providers and minimizes transmission and distribution losses. *Score: 2*

Air Quality & Health (indirect) Initiatives aimed at understanding and improving soil carbon intensity often involve sustainable agricultural practices. These practices can reduce the need for harmful pesticides and fertilizers, contributing to cleaner air and a healthier environment for both residents and agricultural workers. *Score: 1*

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