Item #	Color Code	Sector	Emissions Category	Measure Name	Measure Description	Metrics for Tracking Progress	GHG Emission Reductions 2030	GHG Emission Reductions 2050	Implementation Cost ($-$$$$)	Cost Information	Overall Benefits and disbenefits	LIDAC benefits and disbenefits	Place Types	No/Low-Regret	Time Frame	Implementing Authorities	Has Authority to Implement?	Implementation schedule and milestones	Funding Opportunities (Grants, funding programs)	Funding Already Secured?	Occupations to Implement
3 C1-1	🟩	3. Electricity	Decarbonize Purchased Electricity	Community enrollment in renewable energy government aggregation/community choice aggregation	Communities enroll in a government/community choice aggregation contract through SOPEC or NOPEC to purchase 100% renewable energy for residential and small business electricity customers in their geography	% of communities enrolled county-wide, tracked at County level	100% of residential electricity emissions, minus municipal utility residential customers.	100% of residential electricity emissions, minus municipal utility residential customers.	$	$. Negligible cost increase to rate-payer as of 2025; no cost to community.	- Straightforward; - Accelerates electrification; - Signals market to build more renewable energy; (DisBen) - None	- Straightforward; - Accelerates electrification; - Signals market to build more renewable energy; (DisBen) - None	All	Low-Regret	2025-2030	Municipalities, local elected officials	Yes - CCA permitted in Ohio	Signed up by 2030	Not needed - CCA does not require a downpayment.	N/A	Sustainability Analyst (City/Village);
3 C1-2	🟨	3. Electricity	Decarbonize Purchased Electricity	Opt-in Public Pricing Program , including local govts, political subdivisions, non-profit and faith-based orgs (SOPEC)	For public-sector mercantile customers, including local govts, non-profit and faith-based orgs in a SOPEC community, or statewide political subdivisions, to receive 100% renewable power.	% of eligible entities participating, tracked at community and County level: 20% by 2030, 100% by 2050	20% of electricity emissions from eligible entitites	100% of electricity emissions from eligible entitites	$	$. Negligible cost increase to participating organization.	- Straightforward; - Accelerates electrification; - Signals market to build more renewable energy; (DisBen) - None	- Straightforward; - Accelerates electrification; - Signals market to build more renewable energy; (DisBen) - None	All	Low-Regret	2025-2030, 2030-2040	Public sector mercantile customers, including local governments, political subdivisions and faith-based organizations	Yes - permitted in Ohio	20% by 2030; 100% by 2050	Not-needed - Opt-in requires only that the entity is located within a SOPEC member. Any Ohio political subdivision can join.	N/A	Sustainability Analyst or Energy Manager (Organization);
3 C1-3	🟩	3. Electricity	Decarbonize Purchased Electricity	Physical Purchase Power Agreements (PPAs)	Non-CCA eligible entitites - Larger mercantile, commercial and industrial - purchase renewable or zero emissions energy generated out-of-region	% of entitites enrolled county-wide, tracked at Community & County level	20% of commercial and industrial electricity from renewable or net-zero sources	100% of commercial and industrial electricity from renewable or net-zero sources	$	$. Low cost increase to participating organization	- Accelerates electrification; - Signals market to build more renewable energy; (DisBen) - Usually long-term offtake agreements: More complex	None	All		2025-2030, 2030-2040	Larger mercantile, commercial and industrial	Yes - individual entities can enter PPAs	20% by 2030; 100% by 2050	The terms of a PPA may be improved, depending on the incentives the out-of-state project qualifies for; most renewable projects continue to qualify for ITC and PTC federal tax credits.	N/A	Sustainability Analyst or Energy Manager (Organization);
3 C2-1	🟩	3. Electricity	Grid Modernization	Intelligent grid management systems	Modernize distribution system management to improve Demand Response, peak management, engagement of grid-scale storage for Frequency Regulation and Voltage control	% of distribution grid upgrades across community; % of smart meters installed in the communityz	2% electricity sector emissions reductions by 2030	9% Electricity Sector Emissions Reductions by 2050	$$	$$ Capital Investment; $ Operational expenditure; based primarily upon the twin pillars of cost-effective operation and improved reliability	necessary for the development of complex grid management, demand response, energy efficiency systems, and high EV/PHEV adoption	- Improves power quality in LIDAC neighborhoods	All		2025-2030, 2030-2040, 2040-2050	Municipal Utilities, Investor-owned utilities	Yes - Municipal utilities can make grid investments; local governments can work with IOUs to support implementation	20% by 2030; 100% by 2050	Self-pay; Public Utilities Commission of Ohio (PUCO) is managing a grid reslience formlua grant: https://puco.ohio.gov/utilities/electricity/resources/ohio-grid-resilience-formula-grant-program-faq	No	Traditional utility workers, electrical engineers, network engineers, cybersecurity analysts, and policy experts
3 C2-2	🟩	3. Electricity	Grid Modernization	Grid-scale power systems modernization	Reduce line losses through equipment modernization across the distribution grid	Number of communities with 100% substation and power systems equipment modernized.	1% electricity sector emissions reductions by 2030	Up to 4% electricity emissions savings across the system. Higher in rural areas, and during peak. https://www.4cleanair.org/wp-content/uploads/Documents/Chapter_10.pdf	$$$	$$$ Capital Investment; ROI within 2.5 years per: https://www.4cleanair.org/wp-content/uploads/Documents/Chapter_10.pdf	necessary to support high-electrification and high EV/PHEV adoption	- Improves power quality in LIDAC neighborhoods	All		2025-2030, 2030-2040, 2040-2050	Municipal Utilities, Investor-owned utilities	Yes - Municipal utilities can make grid investments; local governments can work with IOUs to support implementation	25% by 2030; 100% by 2050	Self-pay	No	Traditional electric utility workers; electrical engineers; network engineers; electricians
3 C2-3	🟩	3. Electricity	Grid Modernization	Community-serving microgrid and minigrid systems.	Microgrid and mini-grid systems provide resilience for critical community infrastructure; average size 5 MW renewable energy + 20 MWh storage	(2) 5 MW Microgrid by 2030; (50) 5 MW equivalent by 2050	See calculations Columns M-Q; 8,869 MTCO2e avoided by 2030	1,475,211 MTCO2e avoided by 2050	$$	$$ capital investment for communities; ROI depends on size of microgrid (wires, cables capital intensive) presence of energy storage.	-Significant benefit if paired with warmnig / cooling center for community members; increases resiliency of emergency services; strong ROI for communities. Modest emissions reductions.	Same	All		2030-2040, 2025-2030	Municipal Utilities; campus or large farm operators	Yes - municipal utilities can implement these projects in partnership with local governments and other stakeholders	2 Microgrids by 2030, 22 by 2040, 50 by 2050	OH Dept of Development has a program that can support microgrid development for grid resiliency, up to $500K	Yes - Cuyahoga Green Energy (CGE) secured $1.8 million from U.S. DOE to launch three microgrid projects in region	Solar panel installers, Traditional electric utility workers; electrical engineers; network engineers; electricians
3 C3-1	🟩	3. Electricity	Energy Efficiency - non-buildings	Convert lighting to energy efficient light-emitting diode (LED) light bulbs	Finish transition to LED for street, security and outdoor ambient lighting	% of communities to report 100% transition	Estimate 1% electricity sector emissions reductions by 2030	Estimate 2% electricity sector emissions reductions	$	$ Capital Investment; high ROI.	- Improves safety, Reduces maintenance requirements	- Better lighting in urban LIDAC neighborhoods improves safety	All	Low-Regret	2025-2030, 2030-2040, 2040-2050	Municipalities, political subdivisions, park districts	Yes - local governments can implement in partnership with municipal utilities/IOUs	50% by 2030, Complete by 2040	Brightening Ohio Communities Grant Program: https://development.ohio.gov/community/redevelopment/brightening-ohio-communities	Yes - funding available from NOPEC and SOPEC for CCA communities, from IOUs for other communities	Traditional electric utility workers
3 C4-1	🟩	3. Electricity	Renewable Energy Generation	Utility-scaled solar (in-region)	Construction of MW-scale utility solar in region in support of municipal utilities. Could also address PPA with in-region supply	Number of 10MW installations	Average of 10 MW put in service/yr with 50 MW by end of 2030. for 88,690 cumulative MTCO2e avoided	Average 20MW put in service/yr from 2030-2050. By 2050, 266,070 MTCO2e avoided annually, with 3,163,279 MTCO2e avoided in total	$$	$$ Capital Investment; ROI 7-10 years	- Reduces cost of electricity over time; Mitigates risk of contract cost increases.	- In-MSA impact improves air quality; provides in-MSA jobs	All		2025-2030, 2030-2040, 2040-2050	Municipal Utilities, Investor-owned utilities; or Larger mercantile, commercial and industrial through in-region PPA	Yes - utilities can implement, local governments can support via PPAs	50 MW by 2030, 450 MW by 2050	Depending on how the project is structured, the Federal Solar Investment Tax Credit of 30% applies; The Ohio Air Quality Development Authority may approve additional Solar Developers for Solar RECS of up to $9 per MWh - current program ends in 2028.	Yes - funding available from CPRG, ITC/PTC available for installers	Solar panel installers, Traditional electric utility workers; electrical engineers; network engineers; electricians
3 C4-10	🟩	3. Electricity	Renewable Energy Generation	Offshore wind	Utility scale off shore wind in Lake Erie; using Capacity Factor 41%, per IRENA 2023	Construction announced for Pilot project; construction started for pilot project; system operational. Succesful 2 years of operation; construction announced for larger scale system.	NA	Adding 50 MW in 2035, 100 MW in 2040 and 100 MW 2045, results in 331,325 MTCO2e avoided annually by 2050, and 1,987,950 MTCO2e cumulative avoided emissions by 2050.	$$$	$$$ Capital Investment; High Initial infrastructure investment, but subsequent savings on each additional turbine/project in-region	B: High Job Creation Potential	LIDAC communities may be more dependent on emissions reductions within the grid to decarbonize, rather than community or rooftop solar.	Legacy City		2040-2050	Clean-energy developer; Municipal Utilities, Investor-owned utilities; or Larger mercantile, commercial and industrial through in-region PPA	Maybe - Icebreaker project received approval from Ohio Power Siting Board in 2020 but has been on hold	Adding 50 MW in 2035, 100 MW in 2040 and 100 MW 2045	renewable electricity production tax credit (PTC) is a per kilowatt-hour (kWh) federal tax credit included under Section 45; wind equipment eligible for 10 years after entering service. https://www.epa.gov/lmop/renewable-electricity-production-tax-credit-information	No	boat operators, wind turbine maintenance technicians, power plant operators, electric utility workers, crane operators, longshoremen
3 C4-2	🟩	3. Electricity	Renewable Energy Generation	Repurpose brownfields into clean energy hubs	75% of the 1107 brownfield acres in the MSA converted to solar, or 830 acres. At 4.25 acres/MW, potential for 195 MW	% brownfield acres converted, per community and per County	Average of 7 MW put in service/yr with 35 MW by the end of 2030, for 62,083 cumulative MTCO2e avoided	Average 8 MW/yr put in service/yr from 2030-2050. By 2050, 115,297 MTCO2e avoided annually, with 1,469,299 MTCO2e avoided total	$$	$$ Capital Investment; ROI 6-9 years	- Improves land use for under-utilized or degraded sites (tax benefits), reduces cost of electricity over time, mitigates risk of contract cost increases	- Improves land use for under-utilized or degraded sites (tax benefits), reduces cost of electricity over time, mitigates risk of contract cost increases	Legacy City, Established City & Town, Rural Community		2025-2030, 2030-2040	Municipal Utilities, Investor-owned utilities; or Larger mercantile, commercial and industrial through in-region PPA	Yes - municipal utilities and IOUs can implement in partnership with local governments (e.g. Brooklyn Landfill solar project)	35 MW by 2030, 195 MW by 2050	Depending on how the project is structured, the Federal Solar Investment Tax Credit of 30% applies; "energy community" designation can earn additional 10%; low-income communities qualify for additional 10%. https://rmi.org/time-for-communities-to-embrace-clean-energy-on-brownfields/	Yes - Cuyahoga County, City of Painesville, and City of Cleveland secured $129 million CPRG implementation grant for solar and battery storage on brownfields	Solar panel installers, Traditional electric utility workers; electrical engineers; network engineers; electricians
3 C4-3	🟩	3. Electricity	Renewable Energy Generation	Residential rooftop solar	Adding an average standard 200 sq ft / 3.45 kw array to a single-family house. *(Behind the meter solutions)*	50kw installed per year, per 1000 single family residences in cities/1st ring suburbs; 100kw installed / per year / per 1000 stand-alone houses in outer ring, rural communities	Average of 49.6 MW put in service / yr; 440,367 cumulative MTCO2e avoided	9,541,295 cumulative MTCO2e avoided. https://docs.google.com/document/d/18RlePIRXv4Ins7HuGC3RmrpoRCwsobyTsaK10buGam0/edit?usp=sharing	$$	solar cost-benefit; $$ Capital Investment for homeowners	Reduces the demand on the grid, especially during summer peak; pays for itself in a few years, then saves homeowners money. When paired with household electrification and smart home management, can save even more money. Disbenefit - no incentive for landlords to install for renters; insurance costs go up; not suitable for every roof.	- Adds to home value; typically installed on a new roof, so a motivation for home investment. Once paid for, saves homeowners money. Disbenefit - price out of reach for many residents.	All	Low-Regret	2025-2030, 2030-2040, 2040-2050	Homeowners, Homeowner Associations	Yes - property owners can implement, and local governments can support	248 MW by 2030; 1.241 GW by 2050	(1) Federal Solar Investment Tax Credit - up to 30% through 2032. (2) For Ohio homeowners, Ohio Treasurer's ECO-Link program offers an interest rate reduction of up to 3% on loans up to $50K for energy efficiency and renewable energy improvements on homes.	Yes - City of Cleveland and Cuyahoga County are part of Industrial Heartland Solar Coalition (IHSC), which secured $156 million Solar For All grant from U.S. EPA; State of Ohio Air Quality Development Authority (OAQDA) also secured $156 million for Solar For All	solar panel installers, electricians, traditional utility workers
3 C4-4	🟩	3. Electricity	Renewable Energy Generation	Commercial-scale rooftop & parking lot solar	Adding an average standard 1000 sq ft / 17.25 kw array to a commercial building or school. *(Behind the meter commercial solutions)*	150kw installed / per year / per 300 stand-alone businesses/ schools / mercantile establishments.	Average of 16.7 MW put in service/yr; 148,400 MTCo2e cumulative avoided	3,215,347 cumulative MTCO2 e avoided. https://docs.google.com/document/d/18RlePIRXv4Ins7HuGC3RmrpoRCwsobyTsaK10buGam0/edit?usp=sharing	$$	solar cost-benefit; $$ Capital Investment for businesses/schools	Reduces the demand on the grid, especially during summer peak; pays for itself in a few years, then saves business owners, schools money. When paired with electrification and smart building management systems, can save even more money. Disbenefit - no incentive for landlords to install for renting businesses; insurance costs go up; not suitable for every roof.	- Once paid for, saves businesses, school districts money.	All	Low-Regret	2025-2030, 2030-2040, 2040-2050	Building owners, school management.	Yes - property owners can implement, and local governments can support	83.6 MW by 2030; 418 MW by 2050.	(1) Solar systems that are placed in service in 2022 or later and begin construction before 2034 are eligible for a 30% Federal ITC or a 2.75 ¢/kWh5 PTC if they meet labor requirements issued by the US Treasury, or are under 1 MW. https://www.energy.gov/sites/default/files/2024-02/508%20Federal%20Solar%20Tax%20Credits%20for%20Businesses_Feb24.pdf in size.(2) Ohio's Facilities Construction Commission's "School Energy Performance Contracting Program allows K-12 schools to borrow money to make energy savings facilities improvements without passing a ballot issue. https://ofcc.ohio.gov/our-programs/k-12-schools/energy-services/school-energy-performance-contracting-program	Yes - Cuyahoga County providing funding for solar installations at four local school districts	solar panel installers, electricians, traditional utility workers
3 C4-5	🟩	3. Electricity	Renewable Energy Generation	District thermal energy systems	District thermal energy systems will primarily be geothermal systems where sufficient land and geology permit; may also be waste water or industrial or data center cooling water in very dense areas	1 System by 2030; 12 systems by 2050	Per site, 100% reduction NG combusion per site. Assuming an average "district" uses 3,000,000 MMBTU/yr is 159,300 MTCO2e avoided in 2030.	1 new system added every second year. 23,257,800 cumulative MTCO2e avoided - see calculations tab	$$$	$$$ Capital Investment; high ROI; $3,050/ton - see: https://docs.nrel.gov/docs/fy23osti/86678.pdf	Improved air quality; reduction of critical air pollutants from burning NG	Improved air quality; reduction of critical air pollutants from burning NG	All		2025-2030, 2030-2040, 2040-2050	Campuses, District energy operators	Yes - property owners can implement, and local governments can support	Not counting Oberlin system, 1 new by 2030, 12 new systems by 2050	(1) Property-Assessed Clean Energy (PACE) Financing (in PACE-eligibile communities); (2) Green-Bonds for bond-financing; (3) Tax-exempt municipal bonds. Also an opportunity for public-private financing, esp. if the "district" includes industry.	No	Power plant operators, maintenance technicians, electricians, pipefitters, HVAC technicians, well-drillers
3 C4-6	🟩	3. Electricity	Renewable Energy Generation	District or utility-scale battery storage - Long duration (>10 hrs)	Long duration energy storage (>10 hours) at district-scale or utility scale implementation, due to complexity of operation	(1) 200MW / 2000 MWh system by 2045	NA - technology not available	436,379 cumulative MTCO2e avoided.	$$	Speculative: $$ Capital Investment	Improved air quality, avoids engaging most polluting electricity generation source at peak periods.	Improved air quality, avoids engaging most polluting electricity generation source at peak periods.	Legacy City		2040-2050	Most likely a large municipal utility - CPP or Cuyahoga Green Energy.	Yes - municipal utilities and IOUs can implement in partnership with local governments	1 system by 2045	(1) Property-Assessed Clean Energy (PACE) Financing (in PACE-eligibile communities); (2) Green-Bonds for bond-financing; (3) Tax-exempt municipal bonds. Finances for projects can be supported by maximizing tariff-eligible use cases approved by the PUCO, such as Demand Response programs, Frequency Regulation, and Voltage regulation.	No	Traditional electric utility workers; electrical engineers; network engineers; electricians
3 C4-7	🟥	3. Electricity	Renewable Energy Generation	Hydrogen as an energy carrier	(Low-carbon) Hydrogen as a solution for energy storage, transportation, and industrial processes.	1 production facility by 2040 making 50MT/day; second by 2045 producing 100MT/day; Construction announced by 2035; begun by 2037, complete by 2039.	NA	5,157,762 MTCO2e cumulative emissions avoided	$$$	$$$.$850M to $1B to build a new green H2 production facility producing 100 MT per day. https://www.cascadiadaily.com/2024/jun/02/altagas-hydrogen-plant-proposal-facing-two-important-checkpoints/	Shifting to Hydrogen for industrial uses and heavy transportation will have significant air quality benefits, particularly for communities adjacent to highways and factories. Reduction in most critical air pollutants, to include PM10 and 2.5, SOX and NOX. Disbenefit - cost from 2025-2035.	LIDAC communities are often next to industry or highways, and may disproportionately benefit from industry and heavy transportation shifting to H2.	Legacy City, Established City & Town, First Ring Suburb		2030-2040, 2040-2050	Factory owners / operators. Heavy lift transportation operators. Ohio Dept of Transportation, Turnpike Authority	Yes - technology still under development, could implement in the future	1 production facility by 2040; second by 2045; Construction announced by 2035; begun by 2037, complete by 2039.	A hydrogen production facility would qualify for JobsOhio incentives, based on construction employment and full-time hires. (2) Green Bonds	Yes - State of Ohio is part of Appalachian Regional Clean Hydrogen Hub (ARCH2)	For H2 production: factory operators, electrolyzer technicians, maintenance technicians, pipefitters. For H2 operations, quality engineers, safety engineers, truck drivers, fueling station operators, fueling station construction.
3 C4-8	🟩	3. Electricity	Renewable Energy Generation	New Nuclear at Perry	Add an additional 2 GW of zero-emissions nuclear power at Perry. May be existing or new technology	1 new reactor online by 2046, second online by 2047. Construction announced by 2035; construction commenced by 2038; construction complete by 2044	NA	In adding 1 GW to Perry in 2046 and a 2nd GW of new nuclear to Perry by 2047, results in 5,980,014 MTCO2e avoided annually, with 26,910,063 MTCO2e cumulative emissions avoided by 2050.	$$$$	$$$$ Capital Investment; $$ Operational Investment; Long-term ROI; LCOE $88/MWh (2022 EIA estimate)	Provides abundant baseload electricity generation to support grid-scale electrification.	LIDAC communities may be more dependent on emissions reductions within the grid to decarbonize, rather than community or rooftop solar.	Outer Ring Suburb		2040-2050	Vistra (current Perry owner), Investor owned utility, or new nuclear power developer (like Elementl Power)	Maybe - capacity exists at site, but building new reactor would require federal approval	1 new reactor online by 2046, second online by 2047. Construction announced by 2035; construction commenced by 2038; construction complete by 2044	(1) Civil Nuclear Credit Program under the US DOE; (2) §45U (zero-emission nuclear power production) Federal Tax Credits; (3) Expansion of Perry, in creating new jobs, would qualify for JobsOhio incentives. (4) Green Bonds offer attractive financing.	No	Nuclear certified power plant operators, security guards, electric utility workers
3 C4-9	🟩	3. Electricity	Renewable Energy Generation	Geothermal electricity generation	Geothermal electricity generation using new drilling and heat-exchange technology to generate electricity; e.g. https://fervoenergy.com/about/; using capacity factor 82%, per IRENA 2023	Construction announced by 2035; construction commenced by 2038; construction complete by 2044	NA	In adding 300 MW in 2046, results in 795,180 MTCO2e avoided annually, with 3,975,901 MTCO2e cumulative emissions avoided.	$$$	Speculative: $$$ Capital Investment;	Provides abundant baseload electricity generation to support grid-scale electrification.	LIDAC communities may be more dependent on emissions reductions within the grid to decarbonize, rather than community or rooftop solar.	Legacy City, Rural Community		2040-2050	Investor owned utility, or geothermal electrical company like Fervo	Yes - projects would require regulatory approval	Construction announced by 2035; construction commenced by 2038; construction complete by 2044	renewable electricity production tax credit (PTC) is a per kilowatt-hour (kWh) federal tax credit included under Section 45; geothermal electricity equipment eligible for 10 years after entering service. https://www.epa.gov/lmop/renewable-electricity-production-tax-credit-information	No	Power plant operators, maintenance technicians, electricians, pipefitters, well-drillers
3 C2-4	🟩	3. Electricity	Grid Modernization	District or utility-scale battery storage - short duration (<4 hrs)	Short duration energy storage (<4 hours) at district-scale or utility scale implementation, due to complexity of operation - for peak shaving, frequency regulation, and short-outages	*(1) 5 MW / 20 MWH system by 2030, (21) systems by 2040, (40) systems by 2050*	181.8 MTCO2e by 2030; see calculations	80,003 MTCO2e by 2050 - see C2-2 above.	$$	$$ Capital Investment; ROI 7-9 years	Stablizes local distribution grid or microgrid, mitigates brownouts and blackouts. Reduces emissions from most polluting sources of generation during peak loads.	Stablizes local distribution grid or microgrid, mitigates brownouts and blackouts. Reduces emissions from most polluting sources of generation during peak loads.	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb		2025-2030, 2030-2040, 2040-2050	Campus or district facilities or municipal utilities	Yes - municipal utilities and IOUs can implement in partnership with local governments	*(1) 5 MW / 20 MWH system by 2030, (21) systems by 2040, (40) systems by 2050*	(1) Property-Assessed Clean Energy (PACE) Financing (in PACE-eligibile communities); (2) Green-Bonds for bond-financing; (3) Tax-exempt municipal bonds. Finances for projects can be supported by maximizing tariff-eligible use cases approved by the PUCO, such as Demand Response programs, Frequency Regulation, and Voltage regulation.	No	Traditional electric utility workers; electrical engineers; network engineers; electricians
4 C1-1	🟩	4. Commercial & Residential Energy	Energy Efficiency Retrofits	Increasing Retrofit Envelope Efficiency (Deep retrofit)	This involves building inspection and prioritization of the energy efficiency strategy. Examples include; Compliance with current building codes for retrofits of wall and roof insulation, air sealing, Low-E windows, and advanced framing to reduce energy costs related to heating.	Percentage of buildings retrofitted, or a percentage decrease in average power use of buildings.	30% of pre-1975 homes retrofitted	Near full saturation of retrofittable stock	$$$	Based on average house estimates and expected inflation, the costs are projected to be $1.5 billion by 2030 (ROI, 1.1%) and $5 billion by 2050 (ROI 1.1%).	Large-scale demand reduction, improved indoor health, lower utility bills, reduced energy insecurity	Reduced energy bills and improved Comfort and health in residential spaces. Increased cost of renting or owning a home and gentrification. However, Affordability barriers will occur due to the high cost of deep retrofit strategies. Increase risk of gentirification	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	Low-Regret	2025-2050	* Federal, State, and local governments. * Utilities. * Building owners and managers.	Yes - municipal utilities can implement retrofit programs with support of local governments; IOUs would require authorization from State of Ohio	Beginning in 2026, 30% reduction in 2030 and 100% in 2050	For Ohio homeowners, (1) Home Weatherization Assistance Program (HWAP) provides home energy audit and assistance with weatherization improvements. https://development.ohio.gov/individual/energy-assistance/6-home-weatherization-assistance-program (2) Ohio Treasurer's ECO-Link program offers an interest rate reduction of up to 3% on loans up to $50K for energy efficiency and renewable energy improvements on homes.	Yes - State of Ohio received $124.6 million for HOMES program; Enbridge operations Housewarming Program https://www.enbridgegas.com/ohio/save-energy/housewarming-program	Building Inspectors, Energy Auditors, Weatherization installers, other construction trades
4 C1-2	🟩	4. Commercial & Residential Energy	Energy Efficiency Retrofits	Building System Electrification (Deep Retrofit)	Replace inefficient HVAC systems with Air-to-air and ground-coupled heat pumps, water heating, and electrical systems; lighting, appliances, and equipment with high-efficiency electric systems; and water heating, gas furnaces, and boilers with electric high-efficiency systems. Addition of roof-mounted Solar Panels	Percentage of homes electrified and upgraded	20% of homes electrified	85–100% electrification, 70% Solar Panels	$$$	The total projected costs in 2030 and 2050 are $1.2 billion and $4.2 billion, respectively (ROI=4.6%).	Sharp emissions drop from heating; utilities shift to supporting clean peak demand	Reduced energy bills and improved Comfort and health in residential spaces. Increased cost of renting or owning a home and gentrification	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	Low-Regret	2030-2040, 2040-2050	* Federal, State, and local governments. * Utilities. * Building owners and managers.	Yes - municipal utilities can implement energy audit and retrofit programs with support of local governments	Beginning in 2026, 20% reduction in 2030, and 100% in 2050	179D Energy Efficient Commercial Buildings Tax Deduction GGRF Home Efficiency Rebates (HOMES) program High-Efficiency Electric Home Rebate Act (HEEHRA) program	Yes - Ohio has funds for HOMES and HEEHRA programs; funds for solar available through Solar For All	Building and Utilitiy Inspectors, Energy Auditors, Retrofit installers, Electricians, HVAC technicians, Solar installers, other construction trades.
4 C1-3	🟥	4. Commercial & Residential Energy	Energy Efficiency Retrofits	Incentive programs	Provide financial incentives for energy efficiency retrofits and renewable energy installations. Support and expand existing green programs	Leverage Federal, State, and local sources to support incentive house retrofit programs	20-30% of homes retrofitted and electrified	Near full saturation of retrofittable stock	$$	The cost includes technical support, director cost, monitoring, and reporting	Expand the program's potential reach and increase adoption rates.	Reduce Energy Burden, improve indoor air quality, thermal comfort, and health,	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb		2025-2030, 2030-2040, 2040-2050	Federal agencies, State and Local Governments, Utilities, and non-Government partners such as Ohio Partners for Affordable Energy and CHN Housing Partners	Yes - municipal utilities can implement energy efficiency & renewable energy programs with support of local governments; IOUs would require authorization from State of Ohio	Beginning in 2026, a 20% reduction in 2030, and 100% in 2050	Incentive programs may rely significantly on Community Foundation Support, or local municipality self-pay. From Ohio, See C1-1 and C1-2; also OH's Electric Partnership Plan (EPP), which provides in-home energy audits, guidance on reducing energy use, and support electrification and energy efficiency measures to reduce energy use. https://development.ohio.gov/individual/energy-assistance/5-electric-partnership-plan	Yes - Ohio has funds for HOMES and HEEHRA programs; funds for solar available through Solar For All	Program administrators, outreach coordinators, and reporting specialists
4 C2-1	🟧	4. Commercial & Residential Energy	High-Performance New Construction	Implementation of the latest state adopted building standards and codes	Constructing new buildings to high-performance standards to reduce energy consumption and associated emissions. This includes compliance with ASHRAE 90.1 and 62.1 for energy efficiency and indoor air quality, the use of passive solar design to minimize heating and cooling needs, installation of triple-glazed windows for better insulation, and integration of intelligent controls to optimize and electrify lighting, HVAC, and other building systems.	Percentage of new homes meet >30% efficiency gain over 2024 OBD baseline, or new homes that are net-zero ready	30% of new homes meet >30% efficiency gain over the 2024 OBD baseline	All new residential/commercial buildings achieve net-zero or better	$$	Comparison between Code-Compliance Baseline (10,250 kW/home/year) and the High-performance Net-Zero energy (4,500 kW/home/year).	Long-term energy cost stabilization; new housing stock aligned with climate targets	This could result in improved housing stock for the future, along with better occupant comfort and health. However, it is essential to consider that if such constructions occur in LIDAC areas, these buildings may increase property values and rents, leading to gentrification.	All	No-Regret	2025-2030, 2030-2040, 2040-2050	Municipalities and City officlas	Yes - local governments are responsible for overseeing building code compliance	Beginning in 2026, a 10% reduction in 2030, and 30% in 2050	45L tax credit; GGRF; Self-Pay; OH Dept of Commerce is providing additional training from 2025-2027 to municipalities on buidling codes standards and enforcement. https://com.ohio.gov/about-us/media-center/news/Ohio-Department-of-Commerce-Board-of-Building-Standards-receives-1.6-million-grant-to-streamline-building-code-modernization-enforcement-process	Yes - OAQDA is part of Coalition for Green Capital's GGRF coalition, so funds are available for Ohio property owners	Permit officers, Building Inspectors, and Enforcement officers
4 C2-2	🟥	4. Commercial & Residential Energy	High-Performance New Construction	Smart Energy Management Systems - SEMS (**Commercial Buildings**)	A sophisticated and integrated technological solution designed to monitor, analyze, control, and optimize energy consumption within a building or across a portfolio of buildings. It involves digital monitoring and controls of HVAC, lighting, and plug loads for continuous efficiency.	Percentage of new commercial buildings install SEMS	30% of renovated commercial buildings install SEMS and 100% of new commercial buildings	All new commercial and 85% of renovated buildings with installed SEMS.	$$$	$75 million investment with annual savings of $10-13 million and a high ROI	Long-term energy cost stabilization; new housing stock aligned with climate targets	Improved energy savings, indoor air quality, and health. Increase resilience by reducing reliance on the grid. However, this can be potentially expensive and may increase the risk of gentrification. The digital divide and lack of tech literacy may be potential barriers.	All	Low-Regret	2025-2030, 2030-2040, 2040-2050	Local and Regional Government authorities, utilities, Housing Development Agencies, Cleveland Energy Bank, Midwest Energy Efficient Alliance	Yes - property owners can implement, and local governments can support	Beginning in 2026, a 10% reduction in 2030, and 30% in 2050	Primarily self-pay with private financing.	Yes - OAQDA is part of Coalition for Green Capital's GGRF coalition, so funds are available for Ohio property owners	Architects, planners, and MEP Engineers, energy audotors, Commissioning Agents,
4 C3-1	🟥	4. Commercial & Residential Energy	Low-Embodied Carbon Construction	Material Substitution	Use of mass timber construction, low-carbon concrete, sustainably sourced timber, and recycled steel in new construction. In addition, create open-access databases for manufacturers and recycled materials, or with low-embedded energy in the region to be made available to designers and developers.	Percentage of new public housing that follows low-carbon embodied specifications.	25% of new residential and 100% of new commercial buildings follow low-embodied-carbon specs	100% of new resdiential and commercial buildings (per code) use low-carbon materials	$$$$	By 2030, a total CO2e reduction of 308,000 Tons, equivalent to $17.3 million (ROI 14.7%). In 2025, the expected total CO2e reduction is 1.24 MT CO2e, equivalent to $69.1 million (ROI of 13.8%)	Reduced life-cycle carbon intensity of regional building stock; increased demand for low-carbon supply chains	Improved housing quality, lower utility cost, reduced construction reliability on international trade uncertainties, improved health for building occupants, and improved building resilience.	All		2025-2030, 2030-2040, 2040-2050	County and Municipal Housing authorities, Ohio Department of Development, and Ohio Board of Building Standards.	Yes - developers/property owners can implement, and local governments can support	Beginning in 2026, a 25% reduction in 2030, and 100% in 2050	Primarily self-pay with private financing; tax financing available for sustainable construction through OADQA	Yes - OAQDA funded INTRO project in Ohio City	Architects, Construction Engineers, Urban planners, and housing policy analysis. In addition to the Mass Timber construction-related trades, concrete trades, insulation, and weatherization workers.
4 C3-2	🟥	4. Commercial & Residential Energy	Low-Embodied Carbon Construction	Modular and Prefabricated Construction	Support local full home manufacturing or partial building components in the region. this will reduces waste and energy use in manufacturing and assembly and produce higher performing buildings.	Percentage of new public housing that follows low-embodied-carbon specs	5% of new homes	15% of New homes	$$$$	Improved housing quality, lower utility costs, reduced construction reliance on international trade uncertainties, improved health for building occupants, and improved building resilience.	Can offer cost-neutral to cost-saving pathways while delivering measurable operational and embodied carbon reductions. Early investments unlock bigger benefits by 2050 through supply chain learning and technology advances.	Improved home affordability, improved indoor health and comfort, lower utility bills, Local jobs, climate resilience	All		2030-2040, 2040-2050	City housing authority or city building departments. County planning commission, NOACA, public utilities, local developers, local labor unions, and research institutions.	Yes - developers/property owners can implement, and local governments can support	Beginning in 2026, a 10% reduction in 2030, and 30% in 2050	GGRF	Yes - City of Cleveland partnering with Habitat for Humanity to construct modular housing	Urban and regional planners, building code officials and inspectors, housing program managers, architects, structural engineers, MEP engineers, and Local manufacturers of modular and prefabricated building components

4 C4-1	🟥	4. Commercial & Residential Energy	Grid-Interactive Buildings & Demand Flexibility	Automated Building Systems and Smart Devices	This topic refers to the technology within a building that makes it "smart." These systems, like smart thermostats, intelligent lighting, and automated window shades, work together to make the building more comfortable and energy-efficient.	Total percentage of buildings with at least one grid-interactive system (e.g., smart thermostat, responsive HVAC, etc.).	Launch GEB pilot programs; install smart meters in 20% of homes	Peak loads shifted through automation in 70% of homes	$	Approximately $6 million (high ROI) by 2030 and $157.5 million (high ROI) by 2050	Grid resilience improves; reduced blackouts; higher renewable penetration without infrastructure overbuild	Low energy bills, improved comfort and health of occupants, equitable access, local job creation, improved grid reliability	All	No-Regret	2030-2040, 2040-2050	Local electric Utilities, Public Utility Commission of Ohio, Regional Planning bodies, State Energy Office	Yes - municipal utilities could implement, but IOUs would require approval from PUCO	Beginning in 2026, a 20% reduction in 2030, and a 70% in 2050	179D Energy Efficient Commercial Buildings Tax Deduction GGRF	Yes - OAQDA is part of Coalition for Green Capital's GGRF coalition, so funds are available for Ohio property owners	Advanced metering technicians, energy program managers, Electricians, Energy Management program Analysts, community related jobs (outreach coordinators, energy planners), architects, and building inspectors.	
4 C4-2	🟥	4. Commercial & Residential Energy	Grid-Interactive Buildings & Demand Flexibility	Active Energy Adjustment for Grid Support (Demand Response)	This topic focuses on how a building interacts with the larger electrical grid. It's about the building actively changing its energy consumption when asked to do so by the utility company or in response to signals from the grid.	Percentage of new buildings enrolled in the program	30% of new homes and commercial buildings	85% of new homes and commercial buildings	$$$	Approximately $15-$25 million in savings (reduction of 8K-13K TCO2e & high ROI) by 2030 and $130-$180 million in savings (reduction of 60K-105K TCO2e & high ROI) by 2030	Lower energy bill, peak cost avoidance for the utilities, CO2 reduction, and reduced blackouts and outages, create local jobs	Lower energy burden for vulnerable households, reduce blackouts in disadvantaged areas, and explore potential opportunities for local job creation in smart technology equipment and systems installations, as well as energy reduction programs administration and management.	All		2030-2040, 2040-2050	Local electric Utilities, Public Utility Commission of Ohio, Regional Planning bodies, State Energy Office	Yes - municipal utilities could implement, but IOUs would require approval from PUCO	Beginning in 2026, a 30% reduction in 2030, and a 85% in 2050	Demand Response programs where utilities/PJM currently pay enrolled commercial or industrial customers to reduce electricity consumption during high use events could provide a mechanism to finance these building improvements. Additional funding sources beyond private financing are not available.	No	Advanced metering technicians, energy program managers, Electricians, Energy Management program Analysts, community related jobs (outreach coordinators, energy planners), architects, and building inspectors.	
5 C1-1	🟩	5. Industrial Energy	Energy Efficiency	Energy audits	Conduct energy audits at all facilities	20% energy consumption reduction across industry by 2030; creation of facility decarbonization plans	audits themselves actually don't do anything - but if solutions are adopted there are reductions, this should lead to ~ 20% energy consumption reduction. These emissions reductions are reflected in the other energy efficiency solutions, they are just identified here	audits themselves actually don't do anything - but if solutions are adopted there are reductions, this should lead to ~ 20% - 40% energy consumption reduction. These emissions reductions are reflected in the other energy efficiency solutions, they are just identified here	$	Audits themselves are free for small - medium industries	reduces demand on grid	Improved grid quality due to the reduction of demand from industrial facilities	All	No-Regret	2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - Individual property owners can undergo energy audits, and municipal utilities could support via programs/incentives, but IOUs would require approval from PUCO	audits done ASAP; sustainability plans created for each industrial facility by 2030 outlining their specific path to net-zero	Free industrial energy assessments using the Industrial Assessment Centers (IAC); historical DOE funding for energy efficiency projects; Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing	No, but OAQDA provides funding for industrial energy efficiency projects	energy auditor; mechanical engineers; electrical engineer; building systems specialists; data analyst; energy modeler	
5 C1-2	🟩	5. Industrial Energy	energy efficiency	Waste heat recovery and utilization systems	determine whether a waste heat recovery and utilization system would be benefitial in a facility. incorporate it into building heating, energy generation, or preheating industrial processes	20% of waste heat recovered	reduce total industrial energy demand by 9%	10% energy demand reduction	$$$	$100,000 - $10 M depending on size and application. Typically payback in under 10 years	reduces demand on grid	improved grid quality due to reduction of demand from industrial facilities	All		2025-2030, 2030-2040	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	installed by 2030	Federal Tax Credits in §48C for Industrial Decarbonization; Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing	No, but OAQDA provides funding for industrial energy efficiency projects	thermal systems engineer; mechanical engineer; project manager; industrial maintenance technician; energy modleler	
5 C1-3	🟥	5. Industrial Energy	Energy Efficiency	Monitoring Systems	Installing energy monitoring systems in industrial buildings or along key processes give real-time updates of energy usage and identify energy waste and process inefficiencies, leading to energy savings of 5-10%. Digital monitoring equipment gives real-time updates on energy consumption and can give insights into where settings could be optimized. This allows for better energy management, consistency in operations, and reduced energy	100% energy monitoring by 2050 for all industrial processes	monitoring systems themselves do not reduce emissions but identify issues earlier	monitoring systems themselves do not reduce emissions but identify issues earlier	$	$10,000 - 500,000 depending on sizea and application. payback in <5 years	reduces demand on grid	improved grid quality due to reduction of demand from industrial facilities	All	Low-Regret	2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	installed by 2030	Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing	No, but OAQDA provides funding for industrial energy efficiency projects	Controls engineer; instrumentation technician; software developer; facilities engineer	
5 C1-4	🟩	5. Industrial Energy	Energy Efficiency	Energy Efficient Equipment	Energy efficient equipment depends on the industry subsector and are discussed in more detail in the appendix, but on average, energy efficient motors, pumps, variable drive motors, high-efficiency coolers and furnaces and other high-efficiency equipment can reduce energy consumption by 10-20%.	establish an end of life switch to highest effiency models	reduced electricity emissions by 20%	reduces electricity emissions by 40%	$$	$5,000 - $50,000 depending on specific application; payback in ~ 5 years	reduces demand on grid	improved grid quality due to reduction of demand from industrial facilities	All	Low-Regret	2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	installed by 2030	Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing	No, but OAQDA provides funding for industrial energy efficiency projects	electrical engineer; hvac specialist; procurement officer; maintenance technician	
5 C1-5	🟩	5. Industrial Energy	Energy Efficiency	Automation	Installing automatic shutoffs for when equipment isn't in use reduces the emissions from idle power consumption and can reduce electricity consumption by 5-10%. Using smart scheduling to schedule on/off times for areas of the hospital or other facilities that operate constantly, that don't need to be operating continuously (e.g., operating rooms) reduce energy consumption by turning off HVAC, lighting, and non-critical equipment during low-demand times. This can save up to 10% power consumption.	100% industrial processes evaluated for automation by 2050	10% energy savings	10% energy savings	$	<$1000 per sensor	reduces demand on grid	improved grid quality due to reduction of demand from industrial facilities	All		2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	installed by 2030	Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No, but OAQDA provides funding for industrial energy efficiency projects	automation engineer; controls engineer; industrial electrician; software developer; energy manager	
5 C2-1	🟥	5. Industrial Energy	Process & Material Efficiency	Reduce industrial waste	Looks different for specific industries, but, developing processes that create less waste and finding opportunities to recycle materials within a process to reduce waste.	waste reduction of 30% by 2030 and zero waste by 2050	n/a	n/a	$$$	Extremely variable depending on the actual application but process audits alone cost ~$50,000	reduces other pollutants beyond emissions reducing the amount of industrial pollution put into water sources	improved air quality	All	No-Regret	2025-2030, 2030-2040, 2040-2050	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	30% waste reduction by 2030	self pay	No, but OAQDA provides funding for industrial energy efficiency projects	process engineer; material scientist; industrial ecologist; environmental compliance	
5 C2-2	🟩	5. Industrial Energy	Process & Material Efficiency	Use lower GWP gases for anesthetics	Use lower GWP gases for anesthetics	switching to sevoflurane or IV anesthetics when possible	Reduce overall industrial emissions by 0.2%	Reduce overall industrial emissions by 0.2%	$	minimal capital cost	air quality	air quality	All		2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	standard practice of IV first and lower GWP if needed established immediately	self pay	No	clinical pharmacist; anesthesiologist; sustainability officer; health systems administrator	
5 C2-3	🟥	5. Industrial Energy	Process & Material Efficiency	Install leak detection equipment	Install leak detection equipment	# of facilities with detection equipment installed	Leak detection equipment itself would have a small increase in electric load, but earlier detection of leaks would lead to faster response to leaks, saving energy and capturing gases once leaks were fixed.	Leak detection equipment itself would have a small increase in electric load, but earlier detection of leaks would lead to faster response to leaks, saving energy and capturing gases once leaks were fixed.	$	$2,000 - $20,000 per detector	reduction of waste gas, water, and energy	improved grid quality due to reduction of demand from industrial facilities	All	No-Regret	2025-2030	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	installed by 2030	Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No, but OAQDA provides funding for industrial energy efficiency projects	pipeline technician; utility workers; instrumentation technician; GIS analyst; water/wastewater engineer	
5 C3-1	🟩	5. Industrial Energy	electrification	Electrification of industrial process heat (boilers, industrial heat pumps, eaf) in synergy with grid development	electrification of industrial process heat (boilers, industrial heat pumps, eaf) in synergy with grid development	80% of processes converted to electrified alternatives	electrification of all low temperature process heat reduces emissions from natural gas and non-utility fuels by ~50%	electrification of all process heat reducess emissions from natural gas and non-utility fuels by 100%	$$$	~$200 per kW	improved air quality; reduced noise pollution and vibration	Many industrial facilities fall within LIDAC communities, so they would have the highest benefit of air quality improvements and noise and vibration reduction	All	Low-Regret	2040-2050, 2030-2040	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - businesses can implement, and local governments can support	begin an "end-of-life" replacement standard for low temperature heating that replaces all boilers at the end of life ~10 years. All low temperature boilers would be replaced with alternatives by 2035	Federal Tax Credits in §48C for Industrial Decarbonization; Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No, but OAQDA provides funding for industrial energy efficiency projects	thermal process engineer; electrical engineer; HVAC specialist; grid engieer; industrial electrician	
5 C3-2	🟩	5. Industrial Energy	electrification	Replace BF-BOF system at Cleveland Works with a green steel alternative	Molten oxide electrolysis for green steel	H2DRI + EAF or MOE by 2050	Electric furnaces produce 75% less CO2 than basic oxygen furnaces; H2-DRI replaces all of the emissions from a blast furnace. Not going to happen in the next 5 years - maybe by 2040 for the H2-DRI/EAF; for MOE, it won't be until 2050	100% green steel production reduces total industrial emissions by 67%	$$$$	Grants already awarded for other facilities - likely future opportunity. Costs ~$2 billion based on funding committed by Cleveland - Cliffs and proposed grants for the Middletown plant	improved air quality since Cleveland Cliffs is the single greatest emitter in the area	improved air quality	Legacy City		2030-2040	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - technology still under development, steelmakers could implement in the future	alternative solution chosen by 2040 and installed by 2050	Federal Tax Credits in §48C for Industrial Decarbonization; Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies; University partnerships; hydrogen production partnerships to offset hydrogen costs; combined effort across industries	No	metallurgical engineer; steel plant engineer; environmental engineer; laboratory technician; construction manager; heavy equipment operator	
5 C3-3	🟩	5. Industrial Energy	electrification	Electrify machine drives in synergy with grid decarbonization	electrify machine drives in synergy with grid decarbonization	100% of machine drives converted - establishment of switching at end of life	reduces natural gas consumption and total industrial emissions by 8%	reduces natural gas consumption and total industrial emissions by 8%	$$$	depends on the specific application	improved air quality; reduced noise pollution and vibration	improved air quality; reduced noise pollution and vibration	All		2030-2040, 2040-2050	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes - individual	begin an "end-of-life" replacement standard for low temperature heating that replaces all machine drives with electrical alternatives at end of life	Ohio Department of Development State Energy Program funded implementation of energy efficiency projects for manufacturers with the Ohio Energy Efficiency Program (OEEP) – Implementation funds for energy efficiency retrofits; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No, but OAQDA provides funding for industrial energy efficiency projects	electrical engineer; industrial controls specialist; grid planner; energy efficiency consultant	
5 C4-1	🟩	5. Industrial Energy	Carbon Capture & Sequestration	Carbon capture at Cleveland Works w/ geologic sequestration in Geauga, Portage, Summit, Trumbull, Mahoning, and/or Stark Counties.	Carbon capture at Cleveland Works w/ geologic sequestration in Geauga, Portage, Summit, Trumbull, Mahoning, and/or Stark Counties.	~60-90% carbon capture	90% of Cleveland-Cliffs Cleveland Works annual stationary combustion CO2 emissions (~3 MMT * 0.9 = 2.7MMT/year). 15-20 years of CCS, until cost of other green steel technologies (hydrogen and electrolysis) falls below CCS	Phased out CC in favor of Green Steel production	$$$$	sent to Fowler center >$1 billion for capture portion (not including pipeline or storage site)	improved air quality since Cleveland Cliffs is the single greatest emitter in the area	Cliffs is located near multiple LIDAC communities. Those communities would have the greatest benefit from improved air quality, reduction of ash, could come to a community benefits agreement with the carbon pipeline implementation.	Legacy City, First Ring Suburb, Outer Ring Suburb		2030-2040	specific industry; industry standards board; ohio manufacturing association; ohio department of agriculture for pipeline construction; ohio EPA; incentive system at the city or county level	Not Currently - Cleveland-Cliffs can install carbon capture at Cleveland Works, but it would require support and permitting from State of Ohio and local governments to enable geologic sequestration	if chosen as a solution, should be operational by 2030 at the latest	45Q Federal tax credit could return / survive; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No	carbon capture engineer; geoscientist; pipeline engineer; permitting specialist; technicians	
5 C4-2	🟩	5. Industrial Energy	Carbon Capture & Sequestration	In cases where processes cannot electrify or switch to hydrogen due to production costs or processes, post combustion carbon capture (relevant to cement making)	In cases where processes cannot electrify or switch to hydrogen due to production costs or processes, post combustion carbon capture (relevant to cement making)	~60-90% carbon capture	CC is between 60-90% efficient	reduces process emissions due to cement making by 90%	$$$	Cost of capture is ~$100 / MTCO2	improved air quality	potential for community benefits agreements with carbon pipeline implementation	Legacy City, Established City & Town		2025-2030	specific industry; industry standards board; ohio manufacturing association; ohio department of agriculture for pipeline construction; ohio EPA; incentive system at the city or county level	Not Currently - would require legislative/regulatory approval	installed point source capture by 2030	45Q Federal Tax credit; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No	process engineer; chemical engineer; technician; instrumentation engineer; safety engineer	
5 C4-3	🟥	5. Industrial Energy	Carbon Capture & Sequestration	Invest in a regional direct air capture facility to help decarbonize industries that are challenging to decarbonize and serve as an additional source of CO2 for utilization industries.	Invest in a regional direct air capture facility to help decarbonize industries that are challenging to decarbonize and serve as an additional source of CO2 for utilization industries.	capture <500,000 MTCO2 annually	likely unfeasible before 2030	captures 500,000 MTCO2 annually	$$$$	needs to be $200 per ton CO2 to be remotely viable. Currently $600 / ton CO2	improved air quality	potential for community benefits agreements with carbon pipeline implementation	All		2040-2050	specific industry; industry standards board; ohio manufacturing association; ohio department of agriculture for pipeline construction; ohio EPA; incentive system at the city or county level	Not Currently - would require legislative/regulatory approval	DAC location identified by 2030 and operational by 2050	45Q Federal tax credit could return / survive; bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No	mechanical engineer; chemical engineer; technician; energy systems analyst; geological storage engineer	
5 C6-1	🟥	5. Industrial Energy	alternative fuels	in cases where processes cannot electrify - switch to hydrogen (relevant for steel, cement, and chemical manufacturing - all others should be able to electrify)	in cases where processes cannot electrify - switch to hydrogen (relevant for steel, cement, and chemical manufacturing - all others should be able to electrify)	100% of fuel switched	reduces emissions from natural gas, non-utility fuels, and process emissions. Likely not to be implemented in the next 5 years	reduces emissions from natural gas, non-utility fuels, and process emissions. Reduces total industrial emissions by ~	$$$$	Hydrogen currently costs $6 / kg to generate, but there is optimism about reducing this cost by 2030	improved air quality	Many industrial facilities fall within LIDAC communities, so they would have the highest benefit of air quality improvements	Legacy City, Established City & Town		2025-2030, 2030-2040, 2040-2050	specific industry; industry standards board; ohio manufacturing association; incentive system at the city or county level	Yes, but contingent on availability of H2	process evaluated for electrification by 2030; establishment of fuel switching and fuel completely switched by 2040 if that is the route	bank financing; venture capital investors for new technologies; partnerships with emerging industries to test decarbonization technologies	No	hydrogen process engineer; fuell cell specialist; saftey engineer; infrastructure engineer; technician	
6 C1-1	🟩	6. Transportation	Clean Vehicle and Fuel Transition (light-duty)	Expand BEV charging infrastructure	Buildout of publicly accessible EV charging infrastructure for light-duty vehicles that can support 99% electric vehicle adoption by 2050.	# of public Level 2 and DC fast charger ports/plugs	4,206 Public Level 2 charging ports and 396 Level 3 Fast Charging ports by 2030 align with a path to 99% adoption across all sectors and vehicles classes by 2050; this would reduce on-road vehicle emissions by 4.7% by 2030 compared to the BAU trend (reduction of 326,590 metric tons annually across Cleveland MSA).	36,930 Public Level 2 charging ports and 2,358 Level 3 Fast Charging ports by 2050 align with 99% electric vehicle adoption across all sectors and vehicles classes by 2050; this would reduce remissions by 99.0% compared to the BAU trend (reduction of 5.138.235 metric tons of CO2-equivalent annually across Cleveland	$$	$48.2 million in equipment and installation costs by 2030 and $358.3 million by 2050 based on EVI-X Electric Vehicle Infrastructure Toolbox.	Air quality Cost Savings	Improvements in air quality	All		2025-2030, 2030-2040	Municipal utilities; investor-owned utilities; PUCO; municipalities	Yes - local governments and municipal utilities have authority to implement; IOUs would need approval from PUCO to own EV charging infrastructure	13.3% electric vehicle adoption by 2030; 58.2% by 2040; 99% by 2050	CFI grants NEVI program Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	Yes - NOACA secured $15 million Charging and Financing Infrastructure (CFI) grant for its EV Charging Program; City of Cleveland secured $3.95 million CFI grant	Maintenance technician; service technician; automation & controls specialist; safety engineer	
6 C1-2	🟩	6. Transportation	Clean Vehicle and Fuel Transition (light-duty)	BEV/FCEV adoption in government fleets	Adoption of electric vehicles in local government fleets at a rate that is consistent with 99% of the light-duty vehicle stock in the region being electric by 2050; utilitze cooperative purchasing programs available to governments to lower procurement costs.	% of government vehicles, including transit, that are BEVs or FCEVs	Being on track to reach 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 4.7% by 2030 compared to the BAU trend (reduction of 326,590 metric tons annually across Cleveland MSA).	Reaching 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 99.0% compared to the BAU trend (reduction of 5.138.235 metric tons of CO2-equivalent annually across Cleveland MSA).	$$	Cost savings through collaborative procurement; cost competitive with ICEVs under longer useful life since maintenance costs are lower for BEVs.	Air quality Cost Savings	Improvements in air quality	All	Low-Regret	2025-2030, 2030-2040, 2040-2050	Municipal utilities; investor-owned utilities; municipalities (codes & standards offices); industrial gas companies	Yes - local governments control fleet purchasing decisions	13.3% electric vehicle adoption by 2030; 58.2% by 2040; 99% by 2050	Climate Mayors EV Purchasing Collaborative; Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	Yes - $8.7 million in Clean School Bus Program grants to invest in electric buses (City of Euclid); $10.6 million in Low- and No-Emission Grant funds to purchase electric transit buses (GCRTA); Laketran has secured $4 million in grants for EV buses	Maintenance technician; service technician; automation & controls specialist; safety engineer	
6 C1-3	🟩	6. Transportation	Clean Vehicle and Fuel Transition (light-duty)	BEV adoption of light-duty passenger vehicles by households	Adoption of electric vehicles by households at a rate that is consistent with 99% of the light-duty vehicle stock in the region being electric by 2050; utilize a local EV rebate program for passenger vehicles to incentivize adoption.	% of registered light-duty vehicles in the MSA that are electric.	Being on track to reach 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 4.7% by 2030 compared to the BAU trend (reduction of 326,590 metric tons annually across Cleveland MSA).	Reaching 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 99.0% compared to the BAU trend(reduction of 5,138,235 metric tons of CO2-equivalent annually across Cleveland MSA	$$	$3,000 per vehicle rebate for BEVs likely sufficient to induce increased household adoption; repayment of debt issuance depends on revenue stream from operating charging stations.	Air quality Cost Savings	Improvements in air quality	All	Low-Regret	2030-2040, 2040-2050	Individual vehicle owners	Yes - individuals can purchase EVs; local governments can provide incentives, but they cannot ban or disincentivize ICEVs	13.3% electric vehicle adoption by 2030; 58.2% by 2040; 99% by 2050	Federal EV Tax Credit of up to $7,500 for new BEVs and FCEVs, and up to $4000 for used vehicles. In force in 2025. https://afdc.energy.gov/laws/409	No	Maintenance technician; service technician; automation & controls specialist; safety engineer	
6 C1-4	🟥	6. Transportation	Clean Vehicle and Fuel Transition (light-duty)	Reducing Fuel Cost Access to Electric Vehicle Infrastructure	Install X new EV charging stations in parking lots of LIDAC apartment building parking lots. These buildings have been identified using the LIDAC census tract analysis (see LIDAC analysis section) and were chosen based on their proximity to other community amenities (grocery stores, recreation centers, schools, etc.) to increase user access among LIDAC residents.	Number of EV chargers installed; number of EVs purchased within LIDACs			$$				All		2025-2030	City Department of Transportation; Local Utility	Yes - local governments and municipal utilities have authority to implement; property owners could also install charging stations; IOUs would need approval from PUCO to own EV charging infrastructure	*Funding obtained for EV charger installation end of 2025* *RFP submitted for installation contractor by mid-2026* *Installation contractor hired by end of 2026* *Work begins at the beginning of 2027* *Chargers complete by mid-2027* *Electric interconnection complete by mid-2027* *Chargers open to public by end of 2028*	CFI grants NEVI program Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	Yes - NOACA secured $15 million Charging and Financing Infrastructure (CFI) grant for its EV Charging Program; City of Cleveland secured $3.95 million CFI grant	Maintenance technician; service technician; automation & controls specialist; safety engineer	
6 C1-5	🟩	6. Transportation	Clean Vehicle and Fuel Transition (medium & heavy-duty)	Expand BEV charging infrastructure	Buildout of publicly accessible higher-powered EV charging infrastructure for medium and heavy-duty vehicles that can support 99% electric vehicle adoption by 2050.	# of publicly accessible higher-powered (350-1500 kW) on route public chargers charging within the Cleveland MSA.	833 higher-powered on route public chargers align with 99% electric vehicle adoption by 2050.	833 higher-powered on route public chargers align with 99% electric vehicle adoption by 2050. Falling share of BEVs relative to FCEVs for medium and heavy-duty applications from 2030 to 2050. The number of 833 on route chargers are how many needed by 2050.	$$	$256.6 million in equipment and installation costs by 2050 based on EVI-X toolbox and International Council on Clean Transportation	Air quality Cost Savings	Improvements in air quality	All		2025-2030, 2030-2040	Municipal utilities; investor-owned utilities; PUCO; municipalities	Yes - local governments and municipal utilities have authority to implement; IOUs would need approval from PUCO to own EV charging infrastructure	8.0% electric vehicle adoption by 2030; 50.7% by 2040; 99% by 2050	CFI grants NEVI program Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	Yes - NOACA secured $15 million Charging and Financing Infrastructure (CFI) grant for its EV Charging Program; City of Cleveland secured $3.95 million CFI grant	Maintenance technician; service technician; automation & controls specialist; safety engineer	
6 C1-6	🟩	6. Transportation	Clean Vehicle and Fuel Transition (medium & heavy-duty)	Expand FCEV fueling infrastructure	Buildout of hydrogen refueling stations for battery-dominant medium and heavy-duty FCEVs.	# of public hydrogen refueling stations capable of serving medium- and heavy-duty FCEVs.	6 hydrogen refueling stations for medium and heavy-duty vehicles align with a path to 99% electric vehicle adoption by 2050; this is also consistent with reducing on-road vehicle emissions by 4.7% by 2030 compared to the BAU trend (reduction of 326,590 metric tons annually across Cleveland MSA).	98 hydrogen refueling stations for medium and heavy-duty vehicles align with 99% electric vehicle adoption by 2050.	$$$	$367.8 million in equipment and installation costs by 2050 based on Argonne's Hydrogen Delivery ScenarioAnalysis Model (HDSAM)	Air quality Cost Savings	Improvements in air quality	All		2030-2040, 2040-2050	Municipalities (codes & standards offices); industrial gas companies	Yes - Individual property owners could implement, including through support of local governments; IOUs would require approval from PUCO before making investments	8.0% electric vehicle adoption by 2030; 50.7% by 2040; 99% by 2050	Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	No	Maintenance technician; service technician; automation & controls specialist; safety engineer	

6 C1-7	🟩	6. Transportation	Clean Vehicle and Fuel Transition (medium & heavy-duty)	BEV/FCEV adoption in government fleets	Adoption of electric vehicles in local government fleets at a rate that is consistent with 99% of the medium- and heavy-duty vehicle stock in the region being electric by 2050; utilitze cooperative purchasing programs available to governments to lower procurement costs.	% of government vehicles, including transit, that are BEVs or FCEVs	Being on track to reach 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 4.7% by 2030 compared to the BAU trend (reduction of 326,590 metric tons annually across Cleveland MSA).	Reaching 99% adoption across all sectors and vehicles classes by 2050 would reduce remissions by 99.0% compared to the BAU trend(reduction of 5,138,235 metric tons of CO2-equivalent annually across Cleveland MSA).	$$$$	🟨	🟨	Improvements in air quality	Legacy City, Established City & Town	Low-Regret	2025-2030, 2030-2040, 2040-2050	Municipal utilities; investor-owned utilities; municipalities (codes & standards offices); industrial gas companies	Yes - local governments control fleet purchasing decisions	8.0% electric vehicle adoption by 2030; 50.7% by 2040; 99% by 2050	Climate Mayors EV Purchasing Collaborative; Congestion Mitigation and Air Quality (CMAQ) program administered by NOACA. https://www.noaca.org/home/showpublisheddocument/32640/638778119536900000	Yes - $8.7 million in Clean School Bus Program grants to invest in electric buses (City of Euclid); $10.6 million in Low- and No-Emission Grant funds to purchase electric transit buses (GCRTA); Laketran has secured $4 million in grants for EV buses	Maintenance technician; service technician; automation & controls specialist; safety engineer
6 C1-8	🟩	6. Transportation	Clean Vehicle and Fuel Transition (maritime)	Advance the use of sustainable liquid and gaseous fuels at regional maritime ports	Advance the use of sustainable liquid and gaseous fuels at regional maritime ports	% of fuel used at port that is low-carbon (by energy content or volume)	unlikely to get going by 2030	100% reduction in maritime vehicle emissions	$$$$	🟨	air quality	air quality	Legacy City, First Ring Suburb, Established City & Town	Low-Regret	2030-2040, 2040-2050	Port authorities	Yes - Port Authorities can implement, provided there is support from marine freight	100% adoption of sustainable fuels by 2050.	Clean Ports Programx CMAQ	Yes - Port of Cleveland secured $94.2 million Clean Ports Program grant	Maintenance technician; service technician; automation & controls specialist; safety engineer
6 C1-9	🟩	6. Transportation	Clean Vehicle and Fuel Transition (aviation)	Advance the use of sustainable aviation fuel at regional airports	Advance the use of sustainable aviation fuel at regional airports	% of total jet fuel volume replaced with SAF annually	unlikely to get going y 2030	100% reduction in aviation emissions	$$$$	🟨	air quality	air quality	All		2030-2040, 2040-2050, 2025-2030	Municipalities or counties with airport oversight.	Yes - airports can provide infrastructure and incentives for use of SAF, but airlines will have to make purchases	95% adoption of sustainable fuels by 2050.	Section 45Z SAF tax credit	No	Maintenance technician; service technician; automation & controls specialist; safety engineer
6 C2-1	🟥	6. Transportation	VMT Reduction	Intercity Passenger Rail and Coordinated Transportation Planning	Aligned with the Study Network in ODOT's 2025 Strategic Transportation Analysis, which carries 40% of the state network's total VMT and 80% of statewide truck VMT	Travel time to intercity rail station	unlikely to get going by 2030	lack sufficient data to calculate	$	transportation infrastructure CBA	Air quality Cost savings Safety (fewer accidents compared to driving car	Time burden for LIDACs	All	No-Regret	2030-2040	ODOT, Amtrak, Federal Railroad Administration	Not Currently - local governments and NOACA can conduct planning and encouage implementation, but rail expansion will require support and approval from State of Ohio, Federal Railroad Administration, etc.	In flux	Federal-State Partnership for Intercity Passenger Rail (FSP) Grant Program provides funding for capital projects that expand or establish new intercity passenger rail service. IIJA provides significant funding for rail projects, though "most funding in this bill must be allocated by the end of 2026.	No	Transportation planners, engineers, public officials
6 C2-2	🟨	6. Transportation	VMT Reduction	Expand networks of protected bike lanes, off-street trails, and lane conversions	Protected bicycle infrastructure expands the range of people willing to shift from cars to bicycles for at least some of their trips	Estimate 10 miles per year of protected bike lanes, trails, and lane conversions	If 1 mile of protected bike lane generates 40 new daily bike trips and 25% replace car trips, averaging 3 miles each: Daily VMT reduction: 10 trips × 3 miles = 30 VMT Annual: 30 × 365 = 10,950 VMT CO2 reduction: 27,375 × 0.404 kg x 10 miles/year = 44,240 kg CO2/year	based on an estimated 10 miles/year CO2 reduction: 27,375 × 0.404 kg x 10 miles/year x 25 years = 1.106 million kg CO2	$$	transportation infrastructure CBA	Active transportation confers health benefits Mobility options for people below the driving age and for those without cars	Safer options for people in LIDAC communities who don't own cars	Legacy City, First Ring Suburb, Established City & Town	Low-Regret	2025-2030	Cities, counties, ODOT, NOACA	Yes - local governments can implement, may require coordination with ODOT and NOACA	10 miles per year	ODOT Transportation Alternatives Set-Aside / Highway Safety Improvement Program (HSIP) grants; also CMAQ program under NOACA. Active Transportation Infrastructure Investment Program (ATIIP) focuses on building networks of connected bicycle and pedestrian infrastructure improvements	Yes - several communities have secured state and federal funding and/or are expending local funds. Secured funding sources include CMAQ, Transportation Alterantives (TA), and and Safe Streets for All (SS4A)	Transportation planners, engineers, public officials
6 C2-3	🟩	6. Transportation	VMT Reduction	Increase density and mix of uses around transit stations and BRT stops	Vehicle miles traveled (VMT) reduction per household in Transit Oriented Development (TOD) vs. conventional development	Mode shift rates (increased transit ridership, walking, cycling usage - GCRTA tracks ridership at each stop and station in the system; NOACA tracks bicyclists and pedestrians periodically at key intersections and corridors) Trip generation reductions in mixed-use vs. single-use areas Reduced energy consumption per unit for denser housing types Reduced infrastructure needs per capita	VMT reduction: estimated 20-40% reductions for TOD residents Each transit trip typically replaces 8-12 miles of driving Building efficiency gains of 15-30% in dense, mixed-use areas (due to shared walls, smaller unit sizes, district energy systems)	Depends on the size and number of TODs that can be implemented and occupied. Assuming average vehicle emissions of 0.44 metric tons CO_2 per 1,000 VMT and 15-25% higher transit usage for TOD residents over regional average; and 13,500 VMT per resident per year and 2 residents per household; then 500 TOD households (approx. # of households in catchment area for W. 25th Street TOD) would result in: 20-30% VMT reduction (approx. 2,400-3,600 miles) per year per household x 500 households = 1.2-1.8 million miles per year VMT reduction CO_2 reduction of 530-790 metric tons per year	$$	Cost of transit-oriented development varies widely depending on size of housing units, materials and finsihes, land values, and intended market	Benefits: improved air quality, reduced infrastructure needs, building energy efficiency in denser developments, induced demand effects from improved transit accessibility. Disbenefits: gentrification risks; dramatic increases in density can be disruptive and destabilizing for existing residents; increased traffic congeston if residents of denser neighborhoods choose to drive rather than walk, bike, or take transit	Benefit: Increased transit access for households without cars Disbenefit risk: potential displacement	All	No-Regret	2025-2030, 2030-2040, 2040-2050	GCRTA; municipal and county governments/zoning authorities	Yes - local governments control zoning codes, which they can use to promote TOD; local transit authorities have ability to implement BRT and promote TOD, depending on availability of funding	Already underway in Cleveland and Cuyahoga County (especially first ring suburbs) - Cuyahoga County Planning Commission tracks TOD implementation across the county	FTA Pilot Program for Transit-Oriented Development Planning funds the integration of land use and transportation planning, economic development, accessibility, and multimodal connectivity, and mixed-use development in new capital projects.	Significant funding of TOD projects in the region has been secured, including OAQDA tax financing for INTRO project in Cleveland	Architects, planners, engineers, developers, builders
7 C1-1	🟩	7. Waste & Material Management	solid waste	install gas capture systems for landfill methane	install gas capture systems for landfill gas	~35-90% gas capture at landfills	35% solid waste gas captured	90% solid waste gas captured	$$	$1 M - $10M depending on landfill size; payback in ~10 years	potential development of renewable natural gas	maybe a community benefit agreement for RNG pipeline?	All	Low-Regret	2025-2030	municipal landfills	Yes - landfill operators can install	all landfills have gas capture by 2030	If landfill gas used for electricity generation, renewable electricity production tax credit (PTC) is a per kilowatt-hour (kWh) federal tax credit included under Section 45; landfill gas-electricity equipment eligible for 10 years after entering service. https://www.epa.gov/lmop/renewable-electricity-production-tax-credit-information	No	environmental engineer; mechanical engineer; landfill operations manager; gas technician; instrumentation technician; construction crew; heavy equipment operators
7 C1-2	🟩	7. Waste & Material Management	solid waste	Restaurant and grocery food waste reduction/composting program	Restaurant and grocery food waste reduction/composting program	15% of landfill waste is from food waste, goal should be 0% food waste	Assuming 100000 short tons food waste avoided per year, 105085 MT CO2e avoided by 2030	Assuming 300000 short tons (15% of current solid waste) food waste avoided per year starting in 2030 and beyond, 2214801 MT CO2e avoided by 2050	$$	Initial implementation ~$200k and $100,000 annual operational costs	reduction of waste	if there are LIDAC communities near landfills, there would be a reduction of pests due to the reduction of organic waste	All	Low-Regret	2025-2030	local government	Yes - individual businesses can compost, and local governments can support	municipal composting programs established by 2030	USDA composting and food waste reduction cooperative; closed loop partners composting consortium	City of Cleveland Secured $340,961 USDA composting grant	program coordinater; waste reduction specialist; compost haulers; sustainability consultant; facility operator
7 C1-3	🟩	7. Waste & Material Management	solid waste	Add compost bins to public facilities, parks, and sports stadiums to divert organic waste from land fills	Add compost bins to public facilities, parks, and sports stadiums to divert organic waste from land fills	15% of landfill waste is from food waste, goal should be 0% food waste	Assuming 100000 short tons food waste avoided per year, 105085 MT CO2e avoided by 2030	Assuming 300000 short tons (15% of current solid waste) food waste avoided per year starting in 2030 and beyond, 2214801 MT CO2e avoided by 2050	$$	$1k per bin; program costs ~$100k	reduction of waste	if there are LIDAC communities near landfills, there would be a reduction of pests due to the reduction of organic waste; access to composting programs	All	Low-Regret	2025-2030	local government	Yes - individual businesses can compost, and local governments and parks districts can support	municipal composting programs established by 2031	USDA composting and food waste reduction cooperative; closed loop partners composting consortium	City of Cleveland Secured $340,961 USDA composting grant	program coordinater; waste reduction specialist; compost haulers; sustainability consultant; facility operator
7 C1-4	🟩	7. Waste & Material Management	solid waste	Support composting and food waste reduction with organic waste diversion from landfills	Support composting and food waste reduction with organic waste diversion from landfills	15% of landfill waste is from food waste, goal should be 0% food waste	Assuming 100000 short tons food waste avoided per year, 105085 MT CO2e avoided by 2030	Assuming 300000 short tons (15% of current solid waste) food waste avoided per year starting in 2030 and beyond, 2214801 MT CO2e avoided by 2050	$$$	central compost facility ~$2 M; haulers ~$500k	reduction of waste	if there are LIDAC communities near landfills, there would be a reduction of pests due to the reduction of organic waste; access to composting programs	All	Low-Regret	2025-2030	local government; municipal landfills	Yes - individuals can compost, and local governments and parks districts can support	municipal composting programs established by 2032	USDA composting and food waste reduction cooperative; closed loop partners composting consortium	City of Cleveland Secured $340,961 USDA composting grant	program coordinater; waste reduction specialist; compost haulers; sustainability consultant; facility operator
7 C2-1	🟩	7. Waste & Material Management	Waste & Wastewater	Post incineration scrubbers installed at wastewater treatment facilities with fluidized bed incinerators	post incineration scrubbers installed at wastewater treatment facilities with fluidized bed incinerators	capture 88% CO2	88% reduction of water and wastewater emissions	88% reduction of water and wastewater emissions	$	$5 M - $25M per facility	improved air quality and other harmful emissions	improved air quality and other harmful emissions	All	Low-Regret	2025-2030	wastewater treatment facilities; local government	Yes - wastewater treatment utilities can install, and local governments can support	scrubbers installed and current combustion switched to fluidized bed incinerators by 2040	Great Lakes Environmental infrastructure loan	No	environmental engineer; wastewater process engineer; construction crew; maintenance technician; air quality compliance officer; laboratory technician
7 C2-2	🟥	7. Waste & Material Management	waste & wastewater	Invest in high-tech equipment to help detect water leaks in municipal water infrastructure - saving water and energy once repaired	Invest in high-tech equipment to help detect water leaks in municipal water infrastructure - saving water and energy once repaired	100% of facilities with detection equipment installed by 2050	saves energy consumed at wwtf for pumping water	saves energy consumed at wwtf for pumping water	$$	$500 - $2000 per sensor	water and energy savings	potential water infrastructure quality improvement and decreased cost	All	Low-Regret	2025-2030, 2030-2040	wastewater treatment facilities; local government	Yes - water/wastewater treatment utilities can install, and local governments can support	all water monitored by 2030	Great Lakes Environmental infrastructure loan; H2Ohio program	No	water systems engineer; instrumentation technician; utility worker; pipefitter; GIS technician; smart infrastructure specailiat; project manager
7 C3-1	🟩	7. Waste & Material Management	HFCs (Refrigerants)	Use climate friendly refrigerants	use climate friendly refrigerants	100% of refrigerants switched by 2050	alternatives have <20x lower GWP, leading to a reduction in refrigerant emissions of 80%	alternatives have <20x lower GWP, leading to a reduction in refrigerant emissions of 80%	$$	New units cost 10% more than traditional; retrofits are ~10k per commercial unit	can be expensive and can have other issues that need to be handled in engineering design (e.g., ammonia is corrosive and may be toxic when inhaled; propane is extremely flammable, but these have been addressed at large scale in industries such as the commercial food storage industry	these refrigerants may be more espensive (disbenefit)	All	Low-Regret	2030-2040	Ohio EPA	Yes - businesses can explore, property owners can implement, and local governments can encourage	established standards for climate friendly refrigerants by 2030	EPA HFC Reclaim and Innovative Destruction Grants	No	hvac technician; building manager; energy consultant
7 C3-2	🟩	7. Waste & Material Management	HFCs (Refrigerants)	End of equipment life facilities, dropoff/collection programs to ensure proper containment of refrigerants	end of equipment life facilities, dropoff/collection programs to ensure proper containment of refrigerants	87% decrease in vented refrigerants from proper end of life handling. Updating local policies to require proper handing of equipment at end of life	90% of hfc emissions come from end-of-life leaking, so proper handling could reduce up to 90% hfc emissions	90% of hfc emissions come from end-of-life leaking, so proper handling could reduce up to 90% hfc emissions	$	initial setup $25,000 - 100,000; collection programs ~$100k per year	air quality; safe handling of materials	air quality; safe handling of materials	Outer Ring Suburb, Rural Community	Low-Regret	2025-2030	Local governments; waste management companies	Yes - Solid Waste Management Districts can implement, with support of private companies and local governments	program for end of equipment life refrigerants established by 2030	EPA HFC Reclaim and Innovative Destruction Grants	No	refrigerant recovery technician; public works staff; environmental compliance officer; drop-off site operator
8 C1-1	🟩	8. AFOLU	Natural Ecosystem Restoration	Support habitat restoration and conservation to increase carbon sequestration, prevent land degradation, and promote healthy lands	Support habitat restoration and conservation to increase carbon sequestration, prevent land degradation, and promote healthy lands	Acres of land put into conservation or restored	Assume that the net change in land use sequesters 1 ton of CO_2 ac^{-1} yr^{-1}. 5000 acres per year added means 25,000 tons of CO2e/yr by 2030.	Assume that the net change in land use sequesters 1 ton of CO_2 ac^{-1} yr^{-1}. 5000 acres per year added means 100,000 tons of CO2e/yr by 2050.	$$	Minimal cost. Land rental rates help determine easement rates	The benefits are carbon sequestration, flood water storage, excess nutrient attenuation, providing ecological habitat. Disbenefit is taking land out of potential development.	Minimal benefits	Rural Community	Low-Regret	2030-2040	Ohio Dept of Agriculture, Ohio DNR	Yes - property owners, local governments, parks districts, and others can implement	Programs already in place. Expanded marketing of the programs and growing incentives by 2030 would help grow these programs significantly by 2050.	Cleveland Tree Coalition for tree plantings, H2Ohio for wetland restoration	Yes - $129 million CPRG implementation grant includes funds for restoration of former Diamond Shamrock chemical plant in Painesville	Environmental Scientists
8 C1-2	🟩	8. AFOLU	Natural Ecosystem Restoration	Expand Wetland Restoration Programs	Wetland restoration sequesters carbon and provides multiple other flood-reduction and water quality improvement co-benefits	The change in % wetland cover across the region using annual NLCD land cover data	Goal of 500 acres restored would result in 2000 t CO2/yr	Goal of 2500 acres would result in 10,000 t CO_2 yr^{-1}	$	$15-30k per acre for restoration if the land is already owned	The benefits are carbon sequestration, flood water storage, excess nutrient attenuation, providing ecological habitat, and recreation opportunities. The disbenefit is providing biting insect habitat.	Less flooding, more recreational areas	Rural Community		2030-2040, 2025-2030, 2040-2050	Ohio Dept of Agriculture, Ohio DNR, County Soil Water Districts	Yes - property owners, local governments, parks districts, and others can implement	Grow incentives by 2030 to encourage more restoration before 2050.	Great Lakes Restoration Initiative (GLRI) EPA Wetland Program Development Grants (WPDG)	Yes - multiple communties and organizations have received GLRI funds for wetland restoration, including Chagrin River Watershed Partners, Cleveland Metroparks, Cleveland Museum of Natural History, and WRLC	Wetland scientists, hydrologists, civil engineers
8 C2-1	🟧	8. AFOLU	Agricultural Practices	Reforest agriculture lands no longer in use, increasing the regional tree canopy	Reforesting marginal ag land is a good net change in decarbonization	Compare 2025 agriculture land use cover with future forest land use cover	Sequesters 1 to 3 tons of CO_2 ac^{-1} yr^{-1}. Convert 1% of the region by 2030 would result in 13,000 to 39,000 tons CO_2 yr^{-1}	Sequesters 1 to 3 tons of CO_2 ac^{-1} yr^{-1}. Convert 3% of the region by 2030 would result in 39,000 to 117,000 tons CO_2 yr^{-1}	$$	Let natural regeneration handle the reforestation, so little cost	Decarbonization	Land would be remote from population centers, so little benefit to LIDAC communities	Established City & Town, First Ring Suburb	Low-Regret	2025-2030, 2030-2040, 2040-2050	Farmers and Farm Owners; Ohio Dept of Agriculture, Ohio DNR, Local governments	Yes - property owners, local governments, parks districts, and others can implement	Convert 10% of agricultural land to forest by 2050.	Ohio's Ag-Link Program allows farm owners to receive a 3% interest rate reduction on operating loans.	No	Farmers, Foresters
8 C3-1	🟩	8. AFOLU	Creating & Protecting Land Sinks	Tree carbon-capture	Any net improvement in the number of street trees and regional forest cover will sequester carbon and provide numerous co-benefits	100 street trees, Change in % forest canopy using national Tree Canopy Cover data	1 metric ton CO2e / year / 100 trees. Target 28,000 trees for the region per year over five years results in 1400 metric tons of CO2e of sequestration	Continue at that rate linearly results in 5600 metric tons of CO2e sequestered by 2050.	$	$20k (total cost over 2 years) NBS Cost-benefit	shading/cooling and canopy interception of rainfall	Less energy needed for cooling, less storm water in yard, but more tree maintenance cost	All	No-Regret	2025-2030, 2030-2040, 2040-2050	Cle Tree Coalition, Cle Metro Parks, Local governments	Yes - property owners, local governments, parks districts, and others can implement	Cleveland's canopy to 30% by 2040, regional canopy to 40% by 2050	Urban and Community Forestry Program (US Department of Agriculture) Ohio Department of Natural Resources (ODNR) forestry grants Cleveland Tree Coalition grants Healthy Urban Tree Canopy Grant Program Foundations/Philanthropy	Yes - City of Cleveland secured $3.4 million USDA community forestry grant; the City of Euclid received a $525,000 USDA Urban and Community Forestry Grant; the City of Lyndhurst received a $100,000 USDA Urban and Community Forestry Grant; various communities have received forestry grants from USDA, CTC, HUTCP, and ODNR	Foresters
8 C3-2	🟥	8. AFOLU	Creating & Protecting Land Sinks	Reduce tree loss Model mature tree protection ordinance	Reducing the loss of forest results in a net improvement in emissions.	Tree canopy cover using the natinoal Tree Canopy Cover data	Preventing a 1% loss of forest aross the NOACA region results in 13,000-39,000 metric tons of CO2e per year.	Goal of no net forest loss by 2050	$	No cost	shading/cooling	Less energy needed for cooling, less storm water in yard, but more tree maintenance cost	Rural Community	Low-Regret	2025-2030, 2030-2040, 2040-2050	Local governments	Yes - property owners, local governments, parks districts, and others can implement	Establish policies by 2030 to protect mature trees	Urban and Community Forestry Program (US Department of Agriculture) Ohio Department of Natural Resources (ODNR) forestry grants Cleveland Tree Coalition grants Healthy Urban Tree Canopy Grant Program Foundations/Philanthropy	Yes - City of Cleveland secured $3.4 million USDA community forestry grant; the City of Euclid received a $525,000 USDA Urban and Community Forestry Grant; the City of Lyndhurst received a $100,000 USDA Urban and Community Forestry Grant; various communities have received forestry grants from USDA, CTC, HUTCP, and ODNR	Foresters
8 C3-3	🟩	8. AFOLU	Agricultural Practices	Expand agriculture practices to restore soil health and increase carbon sequestration in rural parts of the region, through peer-to-peer learning exchange	Moving to low- and no-till agriculture and using cover cropping can reduce emissions from ag fields	Track the number of acres practicing different conservation agriculture techniques	Net reduction of 0.5 tons of CO_2 ac^{-1} yr^{-1} when going from conventional to conservation ag practices. 500 acres per year changed to conservation ag from trad ag is a reduction of 250 tons per yr, so 1250 tons of CO2e by 2030.	Net reduction of 0.5 tons of CO_2 ac^{-1} yr^{-1} when going from conventional to conservation ag practices. 500 acres per year changed to conservation ag from trad ag is a reduction of 250 tons per yr, so 5000 tons of CO2e by 2050.	$$	Minimal cost to implement	Increased local food production	Enhance agricultural community that may help alleviate food desertification	Legacy City		2025-2030, 2030-2040, 2040-2050	Ohio Dept of Agriculture	Yes - farm owners can implement, with support from local and state officials and agricultural extensions	Make a concerted push to grow these activities by 2030 to attain optimal sequestration by 2050.	USDA Conservation Innovation Grants	No	Farmers
8 C3-4	🟥	8. AFOLU	Creating & Protecting Land Sinks	Digital twin to track trees planted, removed, or replaced annually, including old growth trees	Three-dimensional digital model, created and maintained at the municipal, county-wide, or MSA-level to track tree plantings and removals in real time	changes in # and configuration of urban trees	No direct reductions - this measure is a tool for measuring reductions	No direct reductions - this measure is a tool for measuring reductions	$	Cost to hire team to build the twin. Probably in the $100s of thousands	Visualization of tree canopy expansion and depletion may lead to increased public understanding of reforestation measures	Educational opportunity	Legacy City, Rural Community	Low-Regret	2025-2030, 2030-2040, 2040-2050	Municipalities	Yes - local governments can pursue in partnership with universities, community organizations	Built by 2030	NSF Smart and Connected Communities (S&CC)	No	Computer scientists, geographers
8 C3-5	🟩	8. AFOLU	Creating & Protecting Land Sinks	Land bank set-asides for carbon storage	Identify land in four county land banks that could be conserved for potential carbon removal and storage	# and acreage of sites identified	Assume that the net change in land use sequesters 1 ton of CO_2 ac^{-1} yr^{-1}. Maybe 100 acres per year, so 500 tons of CO2e by 2030.	Assume that the net change in land use sequesters 1 ton of CO_2 ac^{-1} yr^{-1}. So keeping the same rate, 2000 additional tons of CO2e by 2050.	$	Minimal cost to implement	Productive use of surplus real estate; disbenefit of limiting future redevelopment opportunities	Carbon storage sites might be concentrated in LIDAC communities where market forces do not support traditional real estate development	All	Low-Regret	2025-2030	Municipalities, Counties	Yes - municipal and county land banks can implement	Add language about decarbonization to land bank ownership transfers by 2030 to encourage land uses that sequester	Land bank resources	No	Foresters, Urban planners
8 C3-6	🟥	8. AFOLU	Creating & Protecting Land Sinks	Support community greenspace programs for small scale community-based native urban gardens, greenspaces, and tree planting	Support community greenspace programs for small scale community-based native urban gardens, greenspaces, and tree planting	Number of acres converted to greenspace	negligible	negligible	$	community garden CBA	Community building, aras for cooling, mental health benefits	Green spaces for cooling off and better mental health& emotional health	all	🟨	2025-2030	Municipalities	Yes - local governments and parks districts can implement with support from others, including community organizations (e.g. Cleveland Tree Coalition, Holden Forests & Gardens, Western Reserve Land Conservancy)	Build educational materials by 2030 that describes how these actions sequester carbon	Neighborhood Connections, NEORSD green infrastructure grants	Yes - several communities have secured funds from these programs	Landscape architects, urban planners