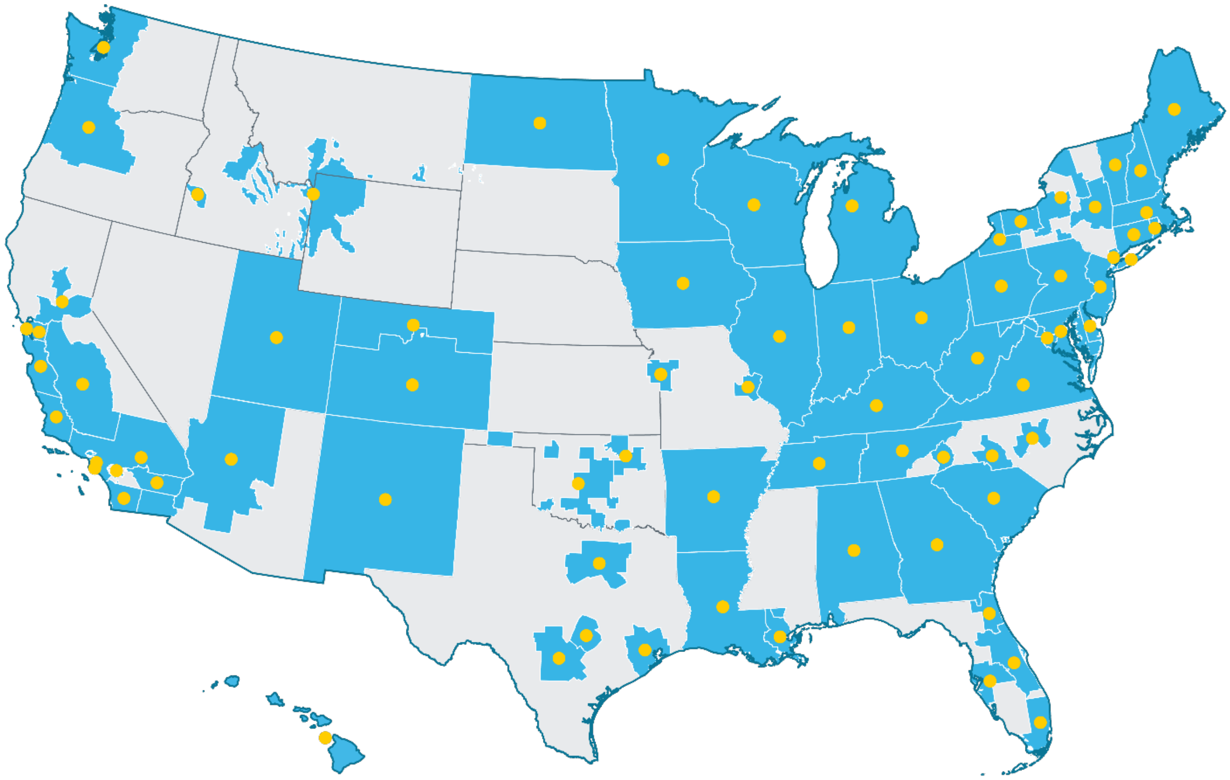

Clean Cities Coalitions 2022 Activity Report

Mark Singer, Caley Johnson, and Alana Wilson

National Renewable Energy Laboratory

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The authors would like to acknowledge the efforts of thousands of Clean Cities coalition stakeholders and coalition directors who provided the basis for this analysis by reporting data from their alternative fuel and energy-saving transportation projects.

This publication is part of a series. Past Clean Cities Coalitions Activity Reports and multiyear data compilations can be found at *www.afdc.energy.gov*.

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List of Acronyms

AFV	alternative fuel vehicle
APU	auxiliary power unit
B20	blend containing 6% to 20% biodiesel
BIM	Behavioral Impact Model
CEJST	Climate and Environmental Justice Screening Tool
CNG	compressed natural gas
CO_2e	carbon dioxide-equivalent
DAC	disadvantaged community
DOE	U.S. Department of Energy
E85	high-level ethanol blend
EEJUC	energy and environmental justice underserved community
EUI	energy use impact
EV	electric vehicle
GGE	gasoline gallon equivalent
GHG	greenhouse gas
GREET model	Greenhouse gases, Regulated Emissions, and Energy use in Technologies model
HDV	heavy-duty vehicle
HEV	hybrid electric vehicle
IR	idle reduction
LDV	light-duty vehicle
LNG	liquefied natural gas
MGGE	million gasoline gallon equivalents
NCFP	National Clean Fleets Partnership
NEVI	National Electric Vehicle Infrastructure
NREL	National Renewable Energy Laboratory
RNG	renewable natural gas
VMT	vehicle miles traveled
VTO	Vehicle Technologies Office

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Introduction

The U.S. Department of Energy's (DOE's) Vehicle Technologies Office (VTO) works with local Clean Cities coalitions across the country as part of its Technology Integration Program. These efforts help businesses and consumers make smarter and more informed transportation energy choices that can save energy, lower costs, provide resilience through fuel diversification, and reduce emissions. This report summarizes the success and impact of coalition activities based on data and information provided in their annual reports.

A national network of more than 75 Clean Cities coalitions active in nearly every state brings together stakeholders in the public and private sectors to use alternative and renewable fuels, electric vehicles, idle-reduction (IR) measures, fuel economy improvements, and new transportation technologies as they emerge. To ensure success, coalitions leverage a robust set of expert resources and tools provided by DOE and its national laboratories. From technical assistance and handbooks to websites and targeted analyses, these resources contribute to every facet of coalition success. This strong national framework of resources, which facilitates a consistent vision and informed coalitions, is a hallmark of Clean Cities.

Clean Cities coalitions use an online tool to report advanced vehicle technology activity, infrastructure development, and relevant energy/fuel use information for their regions.

Each year, Clean Cities coalition directors submit annual reports of their activities and accomplishments for the previous calendar year. Data and information are submitted via an online reporting tool that is maintained as part of the Alternative Fuels Data Center at the National Renewable Energy Laboratory (NREL). Directors submit a range of data that characterize the membership, funding, projects, and activities of their coalitions. They also submit data about sales of alternative fuels; use of alternative fuel vehicles (AFVs), including electric vehicles (EVs[1]), and hybrid electric vehicles (HEVs); IR initiatives; fuel economy improvement activities; and programs to reduce vehicle miles traveled (VMT).

This report compiles the accomplishments of all coalitions throughout the nation in calendar year 2022. Coalition leaders assembled the data based on voluntary reports from their stakeholders—the private and public entities that are members of the coalitions. As such, each individual coalition report represents a subset of the national network of coalition activities. Taken together, they are an important indicator of how data, information, and resources can be effectively leveraged through the national network of Clean Cities coalitions and stakeholders to achieve significant results. Accomplishments from the National Clean Fleets Partnership (NCFP) are also reported directly by the national partners.

NREL analyzes the submitted data to determine how broadly energy use in the United States has shifted as a result of coalition activities. The two main components of energy use tracked by NREL are (1) energy savings from efficiency projects, measured in gasoline gallon equivalents (GGE), and (2) alternative fuel use. The alternative fuel use numbers in this report have been adjusted to account for any gasoline or diesel content (e.g., with biodiesel or ethanol blends), as well as for any conventional fuels used upstream to produce, distribute, or deliver alternative

[1] EVs include all-electric vehicles and plug-in hybrid electric vehicles, but not hybrid electric vehicles in this report.

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fuels. Analysis also accounts for the efficiency differences between AFVs and conventional vehicles.[2] Ultimately, these two components are combined and reported as energy use impact (EUI) in GGE. EUI is a metric that measures combined progress in energy savings from efficiency projects and increased fuel diversity through use of alternative fuels. Both components provide consumers and businesses with more energy choices. When achieved at scale, these strategies support DOE's mission to pursue more affordable, efficient, and clean energy choices. This report summarizes the EUI and related greenhouse gas (GHG) emissions reduction impacts of coalition activities.

A compilation of data from this report, along with reports from previous years, can be accessed on the Alternative Fuels Data Center's Maps and Data page (https://afdc.energy.gov/data/categories/clean-cities). Reports from previous years can be downloaded in their entirety at *www.afdc.energy.gov*.

Summary of Key Findings

Clean Cities coalition activities in 2022 resulted in an EUI of over 1 billion GGE, comprising net alternative fuels used and energy savings from efficiency projects. Table 1 represents the combined results of all strategies to increase fuel diversity and energy efficiency in the nation's fleets. Clean Cities coalition and stakeholder participation in vehicle and infrastructure development projects remained strong, and the resulting EUI increased in 2022.

Coalitions achieved an EUI of over 1 billion GGE in 2022.

Table 1. Energy Use Impact of Each Portfolio Element

Project Type	Coalition Impact (MGGE [a])	Percent of Total Coalition Impact [b]	Change From Last Year
AFVs	744.8	70%	↑ 15%
EVs	71.6	7%	↑ 48%
HEVs	56.6	5%	↓ -1%
Off-road	52.9	5%	↑ 85%
Idle reduction	50.5	5%	↑ 23%
Fuel economy	39.7	4%	↓ -11%
VMT reduction	31.9	3%	↓ −21%
Estimated outreach impact	17.6	2%	↓ −65%
Total EUI [c]	1,065.6	100%	↑ **12%**

[a] Million gasoline gallon equivalents
[b] Totals and subtotals may differ from the sums due to rounding.
[c] The *Clean Cities Coalitions 2022 Activity Report* is focused on the impacts of coalition activities and projects and excludes related DOE-led efforts that were included in this report series prior to 2016.

[2] Net alternative fuel used and energy savings from efficiency projects are expressed in GGE in this report using the lower heating value ratio of the fuels.

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Clean Cities coalition activities reduce GHG emissions as they impact energy use. Table 2 shows that coalition-reported activities prevented 5.4 million tons of carbon dioxide-equivalent (CO_2e) emissions. The GHG benefits increased 8% in 2022.

Coalitions averted 5.4 million tons of GHG emissions—the equivalent of removing 1.5 million conventional cars from the road.

Table 2. GHG Emissions Reduced by Clean Cities Coalitions in 2022

Project Type	Tons CO_2e of GHG Emissions Averted	Equivalent of Conventional Cars Removed [a]	Percent of Coalition Total
AFVs	2,277,850	630,147	42%
HEVs	669,224	185,135	12%
EVs	599,383	165,814	11%
Idle reduction	597,945	165,416	11%
Fuel economy improvements	470,825	130,250	9%
VMT reduction	375,949	104,003	7%
Off-road vehicles	248,859	68,845	5%
Outreach events estimate	138,434	38,297	3%
Coalition total	**5,378,470**	**1,487,906**	**100%**

[a] Calculated as total passenger car GHG emissions (Tables 2–13 in the U.S. Environmental Protection Agency's "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2021") divided by total short-wheelbase light-duty vehicles (Table VM-1 in the Federal Highway Administration's "Highway Statistics 2021").

Coalitions were successful in securing project grant awards from numerous outside (non-DOE) sources. For other federal, state, and local agencies and private sector foundations, see the Funding section. The 227 project grant awards in 2022 generated $164 million in funds from coalition members and project partners, in addition to $18.1 million in DOE grant funds. Coalitions also collected $1.3 million in stakeholder dues and $4.7 million in operational funds from host organizations. In macro terms, this non-DOE supplemental funding represents a leveraging of over 2:1 of the $80 million included in the VTO Technology Integration budget in 2022.

Clean Cities coalition directors spent 133,000 hours pursuing their coalitions' goals in 2022. The average director is quite experienced and has held the director position for over 7 years. Directors logged 4,600 outreach, education, and training activities in 2022, which reached an estimated 6.7 million people. Activities that reached energy and environmental justice underserved communities were tracked for the second time in 2022 and accounted for 27% of all activities.

Of all coalition outreach, education, and training activities in 2022, 27% reached energy and environmental justice underserved communities.

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Attribution and Fuel Use Factors

To clarify the link between coalition activities and end results, this *Clean Cities Coalitions Activity Report* includes an attribution factor that accounts for the percentage of a project's outcome that is likely to be a result of coalition activities, rather than the activities of other project participants. This attribution factor was used in the estimates of impacts for fuel economy, VMT reduction, IR, alternative fuel use, and outreach projects. Directors estimated the percentage of each project's outcome that the coalition was responsible for, and then the project's overall outcome was multiplied by that percentage to determine the individual coalition's impact. Although subjective, this method attempts to address the issue of attribution where a coalition is one of several partners involved in a project. To reduce the subjectivity of this factor, NREL provides a tool to help a coalition estimate its contribution to a given project.

Coalition-Reported Data

Coalition directors submitted information about their stakeholders' alternative fuel use and energy savings, broken down according to the technologies in the Technology Integration portfolio, using an online reporting tool. NREL analyzed the data, converted them into an equivalent net quantity of gasoline for each element of the portfolio, and reported the data in GGE. As shown in Table 1, Clean Cities coalition efforts impacted 1,066 MGGE of energy in 2022.

Clean Cities coalitions' work with local fleets led to a substantial reduction in GHG emissions. To estimate the GHG reductions resulting from coalition activities, NREL used a version of the Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) model.[3] This model accounts for the fuel life cycle, or "well-to-wheels" factor of GHG emissions for transportation fuels, which includes fuel production, transport, and usage in the vehicle. It does not consider emissions from indirect land use changes or vehicle manufacturing and decommissioning.

Alternative Fuels and Vehicles

As shown in Figure 1, alternative fuels (used in AFVs including EVs, and in biodiesel blends) and fuel savings from HEVs collectively accounted for 873 MGGE, or 83% of the coalition-reported net alternative fuel use and energy savings from efficiency projects (excluding outreach in Table 1).

In 2022, coalitions reported a total inventory of 1.6 million AFVs, split among 10 fuel and technology types. The total number of vehicles reported by coalition directors increased by 17% from 2021.

[3] Argonne National Laboratory. 2020. The Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) Model.

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Among the fuel types with greater than 100,000 vehicles reported, EVs increased by 51% to 475,330. Compressed natural gas (CNG) vehicles increased by 33% to 123,463. Vehicles operating on ethanol blends grew by 10% to 568,837. These vehicles are dominated by a single coalition reporting an estimate of 275,000 vehicles using mid-level ethanol blends. Biodiesel vehicles decreased by 4% to 155,978, and HEVs decreased by 13% to 154,089.

The EUI due to CNG use grew by 22% in 2022 and remains the technology with the greatest impact.

Among vehicle technologies with lower vehicle counts, vehicles operating on renewable diesel grew by 43% to 27,377. Propane vehicles increased by 5% to 33,716. Vehicles operating on renewable natural gas (RNG or biomethane) were steady at 11,002, while liquified natural gas (LNG) vehicles decreased by 28% to 2,860 vehicles. The least common vehicle technology type, hydrogen vehicles, decreased by 26% to 276.

The EUI increased by 16% across all vehicle technologies and increased for most technologies individually: EVs increased by 48%, renewable diesel vehicles by 27%, RNG vehicles by 25%, CNG vehicles by 22%, ethanol EUI (as reported as E85, a high-level ethanol blend) grew 18%, and propane vehicles grew by 4%. HEVs and propane vehicle EUI decreased by 1%. LNG vehicle EUI decreased by 18% and hydrogen vehicle EUI decreased by 34%.

Figure 1 shows the percentage of EUI according to fuel type. CNG remains at the top of the list, accounting for 49% of the EUI, even though only 8% of the total vehicle population uses CNG. This contrasts with E85, a high-level ethanol blend, which accounts for only 10% of the AFV EUI, although 37% of reported AFVs can use E85.

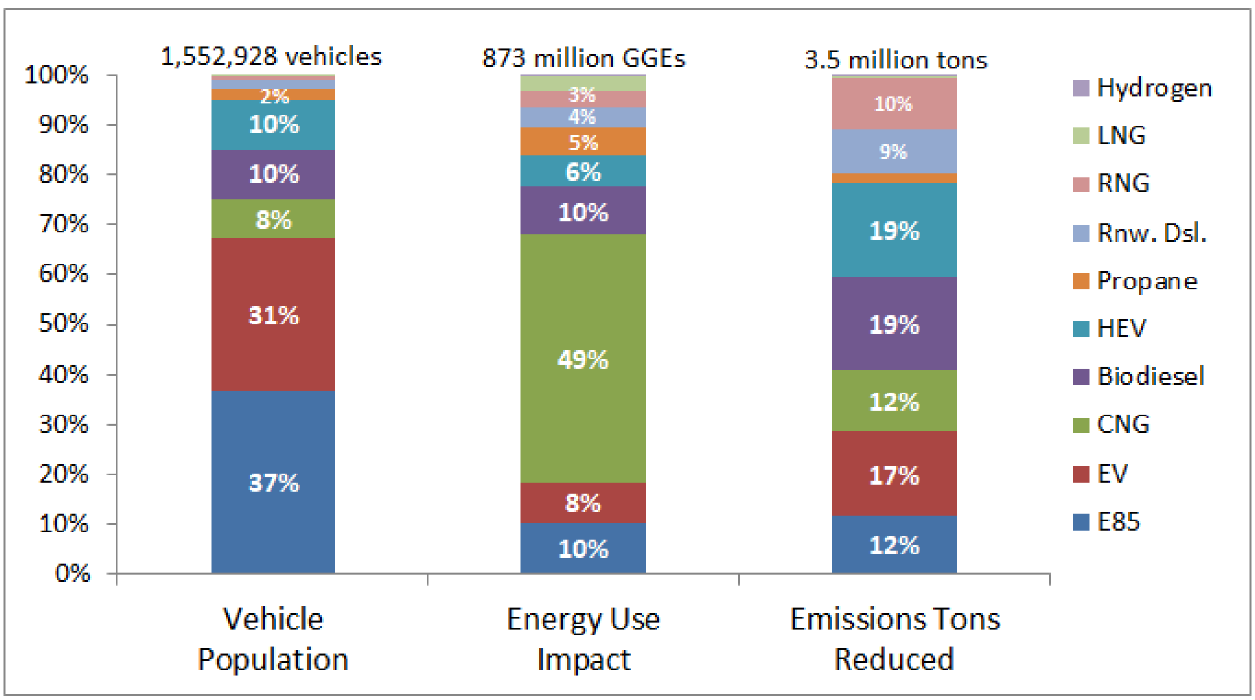

Figure 1. 2022 percentage of AFVs, EUI, and GHG emissions reductions by fuel type

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The average EUI per vehicle, shown in Table 3, reveals some interesting trends. For a given vehicle, this number is influenced by five factors:

1. Dedicated AFVs (those that can only operate on alternative fuel) have a higher EUI than flex-fuel, dual-fuel, or bi-fuel vehicles that can switch between fuels. Simply stated, dedicated AFVs use alternative fuel 100% of the time, while those with interchangeable fuel systems may only use alternative fuel some of the time.
2. The number of miles per year that the AFV travels (higher mileage uses more alternative fuel).
3. The AFV's fuel consumption. Large vehicles that are doing more work tend to consume more fuel. Therefore, Table 3 separates light-duty vehicles (LDVs) and heavy-duty vehicles (HDVs) to increase fidelity.
4. The amount of conventional fuel contained in an alternative fuel blend (e.g., B20 still contains 80% conventional diesel, so only a portion of the B20 fuel consumed counts toward the alternative fuel usage).
5. The amount of conventional fuel used to produce or transport the alternative fuel. For example, the diesel used to grow the corn that is turned into ethanol is subtracted from the EUI.

Table 3. Average Annual EUI per Vehicle in 2022

Fuel	GGE per HDV	# of HDVs	GGE per LDV	# of LDVs
LNG	9,269	2,860	NA	NA
RNG	6,886	3,867	489	7,135
Hydrogen	5,416	70	390	206
CNG	5,004	81,847	532	41,616
HEV	4,387	6,270	197	147,819
EV	3,699	6,295	103	469,035
Propane	1,810	18,154	911	15,562
Renewable diesel	1,408	23,777	476	3,600
E85	1,322	6,160	145	562,677
Biodiesel	932	84,236	77	71,742

Alternative fuels and AFVs were responsible for greater total GHG emissions reductions than any other coalition-reported activity. These reductions were calculated by subtracting the life cycle GHG emissions resulting from the use of an alternative fuel in a vehicle from the life cycle GHG emissions resulting from the use of gasoline or diesel fuel in an equivalent vehicle. For these calculations, gasoline is considered the baseline fuel for all LDVs, and diesel is considered the baseline fuel for HDVs. An exception is made for school buses, where gasoline is considered the baseline fuel for buses using E85, CNG, LNG, and propane because many baseline buses use gasoline, and these vehicles are equipped with spark-ignition (gasoline-like) engines.

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As shown in Figure 1, the emissions reductions are not necessarily proportional to the alternative fuel used because the various alternative fuels result in different levels of life cycle emissions. RNG is a prime example of a fuel that has extremely low life cycle emissions because it has the net effect of reducing methane (a GHG) emissions from landfills, wastewater treatment facilities, and farms. It is also worth noting that VMT reduction, HEVs, IR, and fuel economy improvement projects have a disproportionately high emissions reduction compared to their EUI because these conservation measures “eliminate” 100% of the emissions that would have resulted from the fuel they save. AFVs generally demonstrate a net “reduction” in emissions compared to vehicles that use conventional fuels but usually do not “eliminate” all the GHG emissions.

VMT reduction, HEVs, IR, and fuel economy improvement projects have a disproportionately high emissions reduction compared to their EUI.

High-Impact Fleets and Vehicle Segments: Although HDVs represented only 15% of the reported AFVs, these HDVs are responsible for 76% of the EUI from AFV and HEV projects. The average HDV that operates on alternative fuels impacts 18 times as much fuel use as the average LDV. The use of LNG is confined exclusively to HDVs. Likewise, the overwhelming majority of renewable diesel, CNG, biodiesel, RNG, and hydrogen is used by HDVs (95%, 95%, 93%, 88%, and 83%, respectively). Technologies with contributions more evenly split between LDVs and HDVs include propane vehicles, HEVs, and EVs, where HDVs accounted for 70%, 49%, and 33%, respectively. The only technology whose contributions were dominated by LDVs was E85 (with only 9% from HDVs).

The average EUI of an HDV in the Technology Integration Program is 18 times as much as an LDV.

Idle Reduction

The estimated energy savings in 2022 for IR technologies and policies was 50.5 MGGE. The number of IR projects increased 1% in 2022, and the quantity of energy that these projects saved increased 23%. As shown in Figure 2, at 14.5 MGGE, automatic engine shutoff was responsible for the greatest percentage (35%) of energy savings. IR policies at 12.9 MGGE, auxiliary power units at 11.7 MGGE, the “other” category at 4.9 MGGE, direct-fired heater at 2.1 MGGE, and driver training at 2.0 MGGE followed with significant percentages (31%, 28%, 12%, 5%, and 5% respectively). Truck-stop electrification at 1.3 MGGE, thermal storage at 0.6 MGGE, and onboard batteries at 0.4 MGGE represented 3%, 1%, and 1%, respectively, of the IR energy savings. The remaining methods combined to represent less than 1% of the total savings.

Savings from automatic engine shutoff accounted for 35% of idle reduction savings in 2022.

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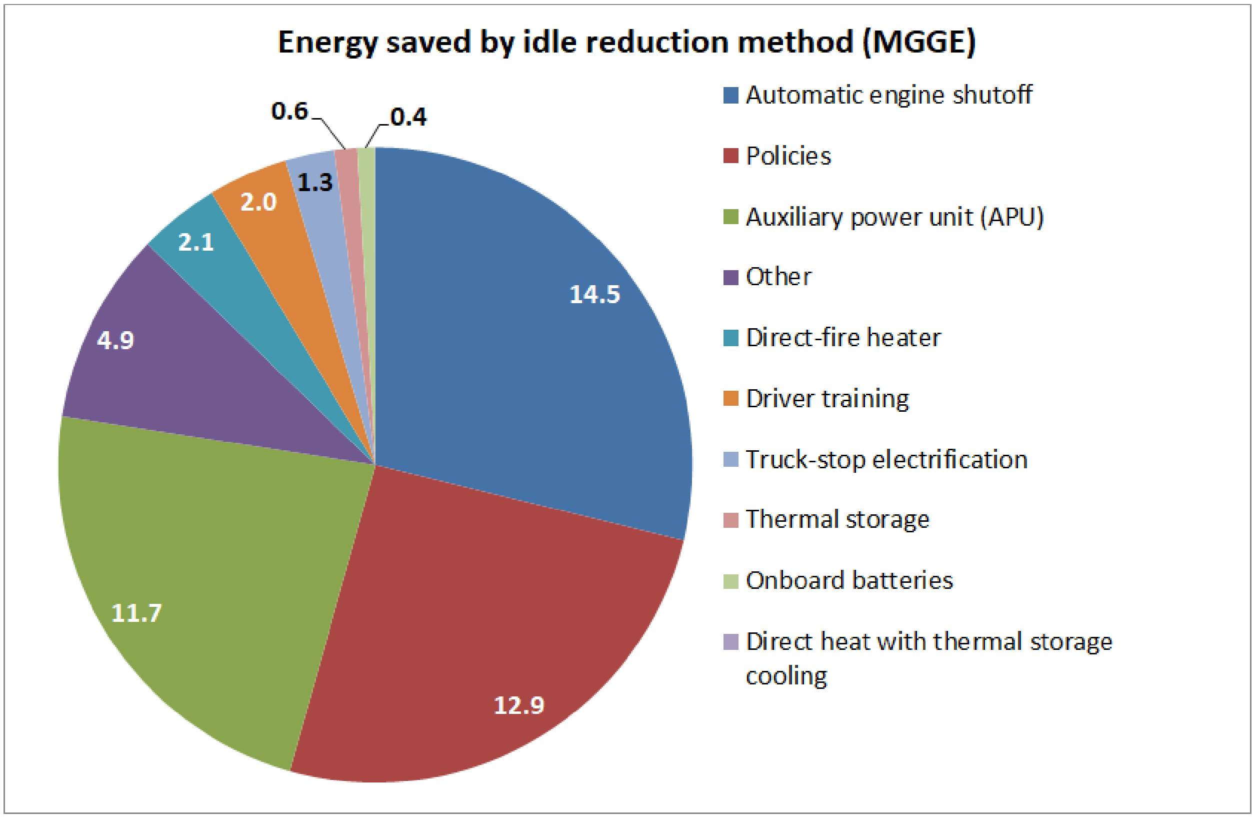

Figure 2. Energy savings measured in MGGE from IR projects, 2022

Fuel Economy

Coalitions completed a range of fuel economy projects aimed at using energy more efficiently. Non-HEV coalition-reported fuel economy projects accounted for a total savings of 39.7 MGGE, which was an 11% decrease from the reported 2021 savings. Figure 3 includes the range of fuel economy technologies advanced by coalitions. There were 90,729 vehicles in the non-HEV fuel economy technology category, equating to an average annual EUI of 437 GGE per vehicle. Figure 3 shows the fuel economy improvement projects with the largest improvements were those from the “other” category and those replacing vehicles with more efficient vehicles (including diesel vehicles). Hydraulic hybrid vehicles, cylinder deactivation, driver training and lightweight materials all showed improvements over 400 GGE per year per vehicle.

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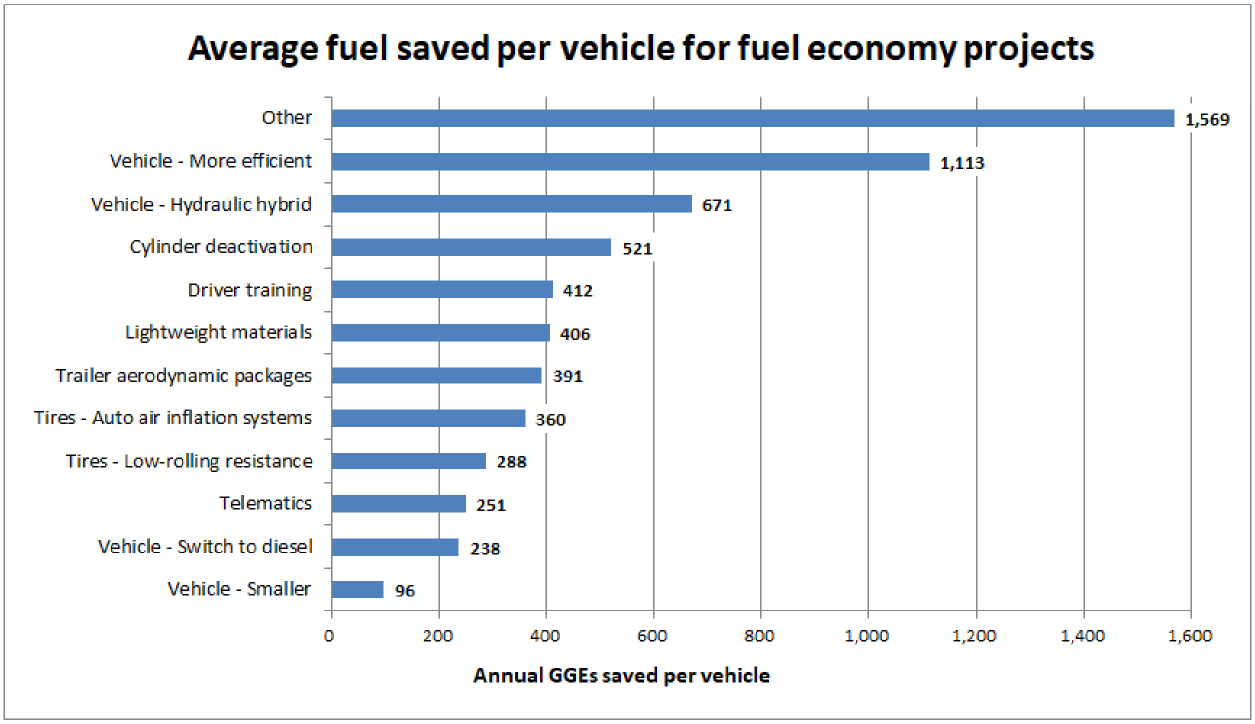

Figure 3. Average energy saved per vehicle for 2022 Clean Cities coalition fuel economy projects

Vehicle Miles Traveled Reduction

VMT reduction projects save fuel, and therefore money, while simultaneously curbing emissions. These types of projects include strategies such as carpooling, biking, teleworking, and public transportation. Of the 76 reporting coalitions, 54 (71%) reported at least one VMT reduction project in 2022, with a total of 391 projects reported. VMT projects have historically been outside the traditional scope of advanced vehicle, fuel, and systems research addressed by VTO. Since the primary purpose of this report is to analyze and document the impact of Clean Cities coalition efforts related to VTO technologies, the contribution of VMT projects to this analysis has been limited to 25% of any given coalition's total energy savings. This cap affected four coalitions; however, even with this limit in place, coalitions saved 31.9 MGGE of fuel with VMT activities. The project types, numbers, and sizes of the VMT projects are shown in Table 4.

Table 4. VMT Reduction Project Types, Number, and Energy Savings in 2022

Project Type	Number of Projects	Increase in # of Projects Over 2021 [a]	GGE Saved per Project [b]	DOE-Capped GGE Saved per Project
Route Optimization	106	-37	55,259	50,608
Non-motorized locomotion (e.g., bicycles)	69	10	25,810	25,807
Mass transit	57	-6	365,159	235,849
Carpooling	49	-5	247,524	84,207
Telecommute	46	-1	33,661	33,656
Other	23	-7	171,287	156,317

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Project Type	Number of Projects	Increase in # of Projects Over 2021 [a]	GGE Saved per Project [b]	DOE-Capped GGE Saved per Project
Car sharing (e.g., Zipcar)	16	5	20,967	17,186
Compressed work week	14	3	93,733	93,724
Vanpooling	11	-5	92,144	43,143
Grand Total	**391**	**-43**	**124,630**	**81,636**

[a] Negative numbers indicate decreases since 2021.
[b] GGE per project calculated before the 25% limit of coalition overall energy savings was implemented.

Off-Road Vehicles

Coalition impact extends beyond the road. Off-road project EUI was nearly 53 MGGE in 2021.

Vehicles used in off-road applications contributed to coalitions' overall accomplishments. These projects support VTO's increasing interest in the potential impacts of off-road vehicles toward reducing transportation energy use. Many of these projects were born out of synergies with on-road projects with existing stakeholders using several of the same alternative fuels, technologies, and strategies. Table 5 shows the number of off-road vehicles (or pieces of equipment) reported by coalitions in 2022. These categories are self-descriptive, except for three. "Construction equipment" includes cranes, earth movers, and similar equipment. The "recreation equipment" application includes jet skis, snowmobiles, and all-terrain vehicles. The "other" category includes vehicle speed limitations and improvements to hydraulic pump efficiency.

Table 5. Number of Off-Road Vehicles or Equipment and EUI in 2022

Application	Number of Vehicles	Energy Use Impact (GGE)	GGE Saved per Vehicle
Construction equipment	14,239	1,825,832	128
Forklifts	5,356	3,868,730	722
Other	3,182	1,386,018	436
Landscaping and lawn equipment	2,132	368,613	173
Mining equipment	925	416,408	450
Recreational equipment	806	197,211	245
Farm equipment	256	35,275	138
Ships	198	41,061,488	207,381
Street sweeper	76	85,418	1,124
Railroads	49	3,684,217	75,188
Planes	3	3,337	1,112
Total	**27,222**	**52,932,547**	**1,944**

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Overall EUI contributions from off-road vehicles totaled 52.9 MGGE. Ships used the most fuel, despite having a relatively low number of vehicles. This is largely due to four large LNG vessels that use a considerable amount of fuel per vessel per year and a large shore power project supporting electricity use to ships while in port. Vehicles using biodiesel and electricity each accounted for 29% of the AFVs included in this category. Other fuels with large numbers of off-road vehicles in the off-road total include propane vehicles (21%) and renewable diesel vehicles (12%). Biodiesel was primarily used in ships, construction equipment applications, and mining equipment. All-electric vehicles were primarily used in the other equipment, recreational equipment, forklifts, and construction equipment categories. Propane vehicles were primarily reported as forklifts and landscaping equipment. Applications varied widely in number of GGE saved per vehicle, as shown in Table 5.

National Clean Fleets Partnership Contributions

In April 2011, DOE began partnering with national fleets that operate in more expansive geographic areas than any one coalition covers. The NCFP currently has 27 partners, who lead by example and are pacesetters for local stakeholder fleets. Five of them reported their fuel use data directly to NREL. NREL then allocated NCFP fuel use from these data to 70 individual coalitions based on fleet garage locations, refueling locations, and partner estimates. Coalition directors then verified that they did assist the NCFP fleets operating in their regions and claimed full, partial, or no credit for the partner's alternative fuel use that was attributed to them. Table 6 shows the contributions to total Clean Cities EUI that were attributed to national partners. Their EUI of 208 MGGE represents a 2% increase from 2021.

Five national fleets have partnered with Clean Cities coalitions, sharing data reflecting efforts that span geographic areas larger than that of any single coalition.

Table 6. Vehicles, EUI, and Emissions Reduction From National Partners

Fuel	Vehicles	Energy Use Impact (GGE)	GHG Reduced (tons)
CNG	23,428	142,771,940	127,417
LNG	1,631	23,742,926	20,815
EV	3,514	11,252,412	84,292
Propane	3,796	13,026,857	17,121
Fuel economy	17,954	10,522,954	125,073
HEV	526	1,365,787	16,233
RNG	587	2,462,470	24,541
Biodiesel	389	2,924,576	21,367
Hydrogen	3	39,818	220
Idle reduction	1,817	345,702	4,109
VMT	102	25,822	307
Total	**53,747**	**208,481,265**	**441,494**

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Estimated Contributions From Outreach Activities

This category estimates impact from behavior changes such as vehicle purchases, fuel choice, driving habits, vehicle maintenance, and transportation patterns that were influenced by coalition outreach activities. Calculating these contributions involves a fair degree of uncertainty, but it is nevertheless important to quantify the impacts of educational and outreach activities as much as possible. Not doing so would inaccurately imply that these activities had no impact. This section outlines our approach and provides the results.

Methods Used To Estimate Energy Use Impact From Outreach Activities

To estimate net alternative fuel use and emissions reductions from outreach events, NREL and Oak Ridge National Laboratory developed the Behavioral Impact Model (BIM) and added related functionality to the Clean Cities coalition annual reporting tool to make it compatible with the BIM.

Clean Cities coalition directors reported the type of outreach event, number of people reached by each event, technologies presented, and percent that should be attributed to the coalition. To determine the number of people reached by a given event, the total number of people attending the event was multiplied by the percent of the event that the coalition claimed credit for. When multiple technologies were presented at a given event, the annual report assumed the number of people reached to be divided evenly among the technologies. These data are then entered into the BIM as "persons reached by the coalition about a given technology."

Impacts from coalition outreach events are estimated using standard analytical methods derived from advertising and marketing industries.

The BIM multiplies this number of people reached by the probability a person will take an action as a result of the outreach (defined as purchasing an AFV or more efficient vehicle, or as changing driving or fueling behavior). This probability is derived by comparing the outreach event and technology to comparable marketing media and products. Ten of these media-product combinations have a "customer conversion rate" that is recorded by various marketing firms, as shown in Table 7. The customer conversion rate is the ratio of purchases made (desired action) divided by the total number of people contacted through the outreach activity. The code column in Table 7 is provided for trackability through the calculation process, as continued to Table 9.

Table 7. Benchmark Customer Conversion Rates and Their Sources

Code	Benchmark Conversion Rate	Reference
1	0.6% for electronics (expensive, complicated) websites	Fireclick.com, accessed June 16, 2011
2	1.3% for environmentally related, incremental cost purchase	Bird, Lori. 2004. *Utility Green Pricing Programs: Design, Implementation, and Consumer Response*
3	2% for common websites and website ads	Nielsen and Facebook. 2010. *Advertising Effectiveness: Understanding the Value of a Social Media Impression*. And Fireclick.com, accessed June 16, 2011
4	2.5% for industry-specific mail	Direct Marketing Association. 2011

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Code	Benchmark Conversion Rate	Reference
5	3.2% for email	Fireclick.com, accessed June 16, 2011
6	7% for affiliates and 8% for "social ads" that are endorsed by peers	Fireclick.com, accessed June 16, 2011. Nielsen and Facebook. 2010. *Advertising Effectiveness: Understanding the Value of a Social Media Impression*
7	0.6% AdMeasure product: LDVs	GfK Mediamark Research & Intelligence, LLC. 2011
8	5.5% AdMeasure product: Gasoline	GfK Mediamark Research & Intelligence, LLC. 2011
9	17% AdMeasure smoking cessation "actions taken"	GfK Mediamark Research & Intelligence, LLC. 2011
10	2% for direct mail to current customers	Eisenberg, B. "The Average Conversion Rate: Is it a Myth?" ClickZ. February 1, 2008

For activity-type/audience-action combinations that were not directly addressed by research, NREL adjusted the customer conversion rates based on the Ostrow Model of Effective Frequency, Krugman's Three Exposure Theory, and the authors' assumptions. Table 8 lists a set of relationships that increase or decrease the impact of advertisements.

Table 8. Relationships for Media Effectiveness and Their Sources

Code	Relationships	Source
A	Degree of media interactivity increases impact	Ostrow Model of Effective Frequency
B	Brand recognition increases impact	Ostrow Model of Effective Frequency
C	Long purchase cycle increases impact	Ostrow Model of Effective Frequency
D	Less frequent usage of item increases impact	Ostrow Model of Effective Frequency
E	Affordability of item increases impact	Ostrow Model of Effective Frequency
F	Simple message increases impact	Ostrow Model of Effective Frequency
G	Media clarity (not cluttered) increases impact	Ostrow Model of Effective Frequency
H	Message in relevant environment increases impact	Ostrow Model of Effective Frequency
I	Audience attentiveness increases impact	Ostrow Model of Effective Frequency
J	More steps in processing the media increases impact	Krugman's Three Exposure Theory
K	Availability of item increases impact	Authors' assumptions
L	Length of vigilance required decreases impact	Authors' assumptions

We adjusted the benchmark conversion rates shown in Table 7 by the relationships for media effectiveness shown in Table 8. The direct application of these rates and relationships is shown in Table 9, where the number relates to the code in Table 7 and the letters relate to the code in Table 8. The final customer conversion rates used are displayed in Table 10.

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Table 9. Combination of Benchmarks and Relationships

Activity Type	Purchase New AFV	Use Alt. Fuel in Existing Vehicle	Use Biodiesel Blends in Diesel Vehicle	Purchase More Efficient Car	Operate Vehicle More Efficiently	Purchase HEV	Reduce Idling	IR HDV (Equipment Purchase)	Reduce VMT
Advancing the choice	6+H+I+J-E	6+H+I+J	6+H+I+J	6+H+I+J	6+H+I+J	6+H+I+J-E	6+H+I+J	6+H+I+J-E	6+H+I+J
Advertisement	7-K	8-K-L	8-K-L	7+E	9-G-L	7-K	9-L	7+E	9-L
Conference	6+H+J-E	6+H+J	6+H+J	6+H+J	6+H+J	6+H+J-E	6+H+J	6+H+J-E	6+H+J
Literature distribution	4+B+H-E	4+B+H	4+B+H	4+B+H	4+B+H	4+B+H-E	4+B+H	4+B+H-E	4+B+H
Media event	7-E-G-H-K	8-G-H-K	8-G-H-K	7-G-H+E-K	9-G-H-K	7-E-G-H+B-K	9-G-H-K	7-E-G-H-K	9-G-H-K
Meeting	6+A+B+I-E	6+A+B+I	6+A+B+I	6+A+B+I	6+A+B+I	6+A+B+I-E	6+A+B+I	6+A+B+I-E	6+A+B+I
Website	1+B+J	3+B+J	3+B+J	3+B+J	3+B+J	1+B+J	3+B+J	1+B+J	3+B+J

Table 10. Customer Conversion Rates Used in the BIM

Activity Type	Purchase New AFV	Use Alternative Fuel in Existing Vehicle	Use Biodiesel Blends in Diesel Vehicle	Purchase More Efficient Car	Operate Vehicle More Efficiently	Purchase HEV	Reduce Idling	HDV IR Equipment Purchase	Reduce VMT
Advancing the choice	2.0%	6.0%	6.0%	5.0%	7.0%	2.0%	5.0%	4.0%	8.0%
Advertisement	0.6%	5.5%	5.5%	2.0%	10.0%	2.0%	10.0%	3.0%	4.0%
Conference	2.0%	6.0%	6.0%	5.0%	7.0%	2.0%	5.0%	4.0%	8.0%
Literature distribution	2.0%	3.0%	3.0%	2.5%	3.0%	2.5%	3.0%	2.5%	5.0%
Media event	0.6%	2.5%	3.0%	1.2%	3.0%	1.2%	4.0%	2.0%	2.0%
Meeting—other	2.0%	7.0%	6.0%	5.0%	7.0%	2.0%	5.0%	4.0%	8.0%
Website	2.0%	4.0%	3.0%	3.0%	4.0%	3.0%	3.0%	3.0%	3.0%

The number of people reached multiplied by the appropriate customer conversion rate (from Table 10) results in the number of people assumed to take the intended action. After the conversion factors have been applied, the BIM is like the Clean Cities coalition annual reporting tool, as it converts the estimated number of vehicles purchased or number of people changing their driving habits into an EUI. We make downward adjustments of 30%–40% to the estimates, based on subject matter estimates, to account for probable overlaps between audiences attending outreach events and entities reporting their own EUI via a Clean Cities coalition. We apply the

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estimated EUI only to the reporting year in question, even though many of the vehicle purchases and behavioral changes will likely last beyond that year.

Estimated Outreach Accomplishments

Coalitions' outreach, education, and training activities were classified into 10 categories, as shown in Table 11. A total of 4,635 activity days were reported, which were estimated to have reached over 6.7 million people and 1,441 people per event on average. Media events continued to be the activity that reached the largest audience at 4.9 million people. Social media was estimated to have reached nearly 900,000 people. The reach of conference participation was up 215% from 2021 and rebounded to pre-COVID-19 pandemic levels. Estimated persons reached through outreach decreased by 74% in 2022. However, the decrease was due to a single large media event reported in 2021 that was estimated to reach 19.6 million people. Excluding that event from 2021 would result in a 17% increase in persons reached in 2022, which more closely aligns with the 23% increase in overall activities. Using the BIM, NREL estimates that Clean Cities coalition outreach events prompted and enabled actions that impacted nearly 18 MGGE of energy use in 2022, after accounting for a substantial overlap with reported impacts.

Outreach events increased 23% in 2022 after the pandemic impacts receded.

Table 11. Outreach, Education, and Training Activities

Activity Type	Number of Activity Days	Share of Total Activities	Activities Increase Since 2021	Persons Reached	Share of Total Persons Reached	Persons Increase Since 2021
Meeting - other	1,448	31.2%	30%	170,618	2.6%	95%
Meeting - stakeholder	959	20.7%	13%	15,857	0.2%	30%
Social media	559	12.1%	74%	869,174	13.0%	-14%
Workshop held by coalition	482	10.4%	25%	139,955	2.1%	-5%
Conference participation	418	9.0%	35%	171,620	2.6%	215%
Literature distribution	239	5.2%	-13%	76,632	1.1%	-63%
One-on-one fleet outreach	239	5.2%	-6%	2,141	0.0%	26%
Media event	214	4.6%	38%	4,932,752	73.8%	-78%
Website	40	0.9%	-13%	202,189	3.0%	196%
Advertisement	37	0.8%	-30%	99,075	1.5%	-90%
Total	**4,635**	**100.0%**	**23%**	**6,680,013**	**100.0%**	**-74%**

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Figure 4 shows the range of technologies covered by the 4,635 outreach activity days. Each activity could, and often did, cover multiple technologies; each activity covered nearly four different technologies. Coalition outreach events covered EVs much more than any other technology type. The remaining technologies were included in 18%–40% of outreach activities.

EVs continue to be the most common topic of coalition outreach events.

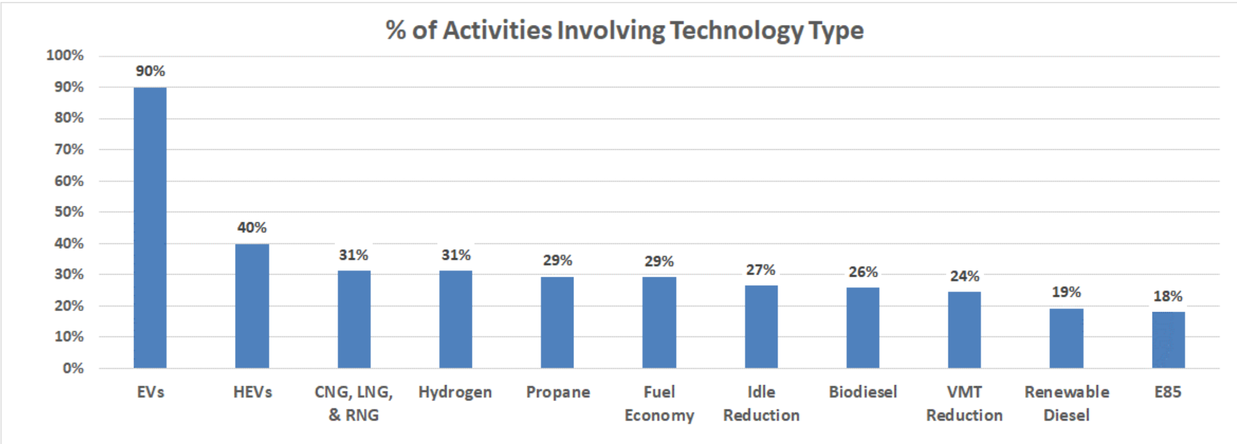

Figure 4. Percentage of outreach activities by technology type

Figure 5 shows government fleets were the most cited target audience, followed by the general public, and private fleets. Mass transit fleets, the "other" audience group, and utility fleets each were targeted by 36% of activities. Fleets with delivery trucks, waste management, and airport applications were identified as audiences in less than 30% of the outreach activities. Just as with technology types, each activity could be, and often was, aimed at multiple audiences; each activity targeted nearly four different audiences. This composition of outreach activity audiences was consistent with 2021.

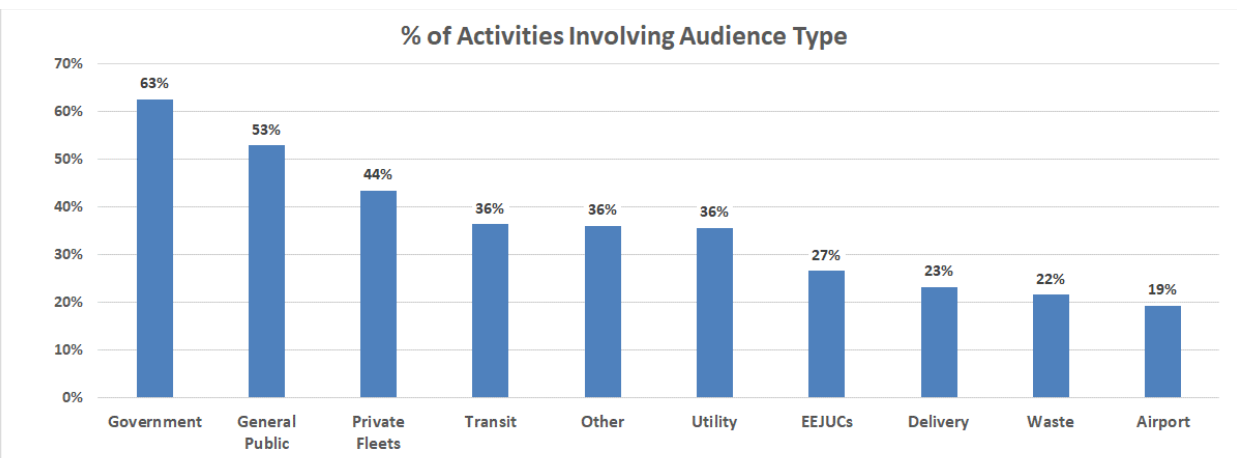

Figure 5. Percentage of outreach activities reaching each audience type

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Figure 5 shows that activities with audiences that included energy and environmental justice underserved communities[4] (EEJUCs) represented 27% of activity days. The reporting tool does not provide a method to determine the portion of persons reached that were among each audience type. However, the portion of activity days (by activity type) that reached each audience type does allow a measure of how the activities including EEJUCs differed from activities overall. Figure 6 shows activities including EEJUC audiences were much more likely to include social media than activities overall. This is likely attributable to the fact that social media activities generally reach a much broader audience, and should not be directly compared to other types of activities. EEJUC-reaching activities were less likely to include meetings.

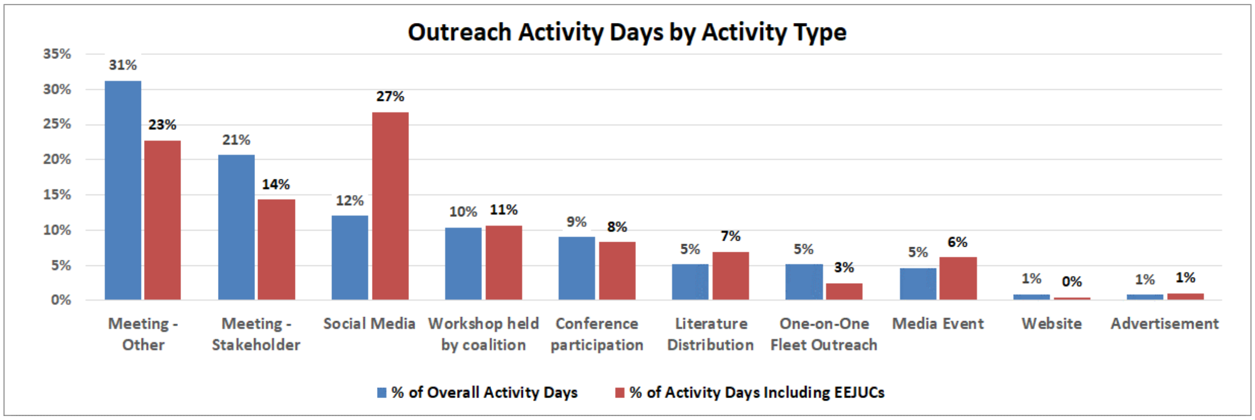

Figure 6. EEJUC activity types

Activities including EEJUC audiences covered EVs even more consistently than activities overall, as shown in Figure 7. In addition, activities that included EEJUC audiences covered each of the other technologies more often than activities overall. This suggests outreach activities including EEJUCs tended to be more well-rounded and broader in scope than activities overall.

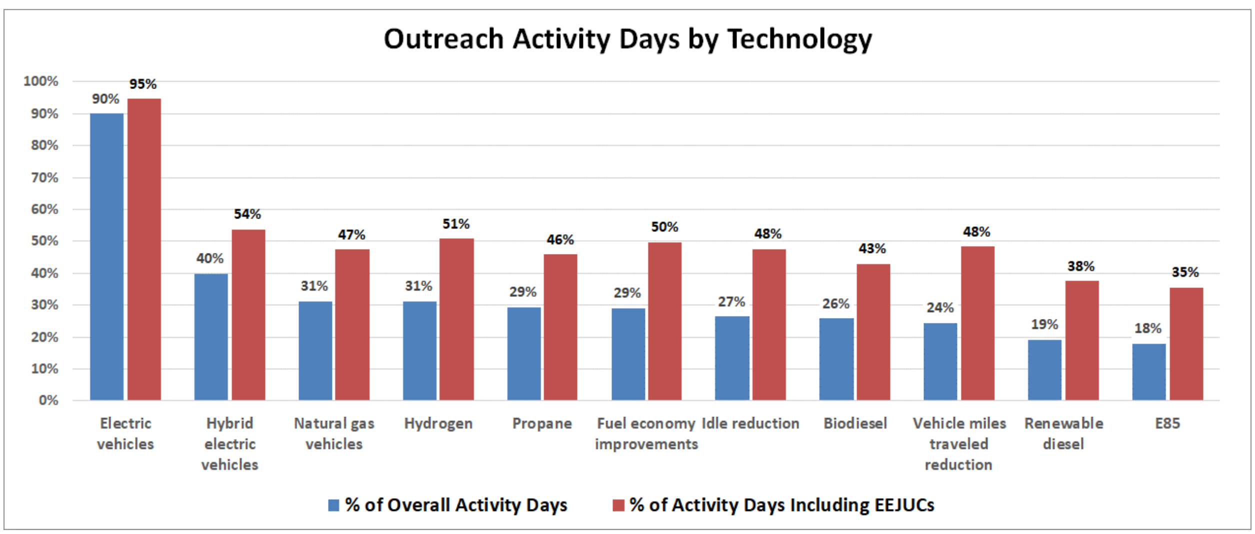

Figure 7. EEJUC activities by technology

[4] EEJUCs are communities at the front line of pollution and climate change, communities with high energy expense or fossil dependence, indigenous communities, and those historically overburdened by racial and social inequity.

Cumulative Energy Use Impact

Clean Cities coalitions have steadily increased their annual EUI as projects have been expanded and built upon each year. Figure 8 shows coalition annual EUI reached its highest level in 2022. In the last 7 years of tracking (2016–2022), annual coalition EUI has been near or above 1 billion GGE. The 2022 reporting year showed the coalitions continued the trend and achieved an annual EUI of 1.1 billion GGE, with a slight increase from 2021.

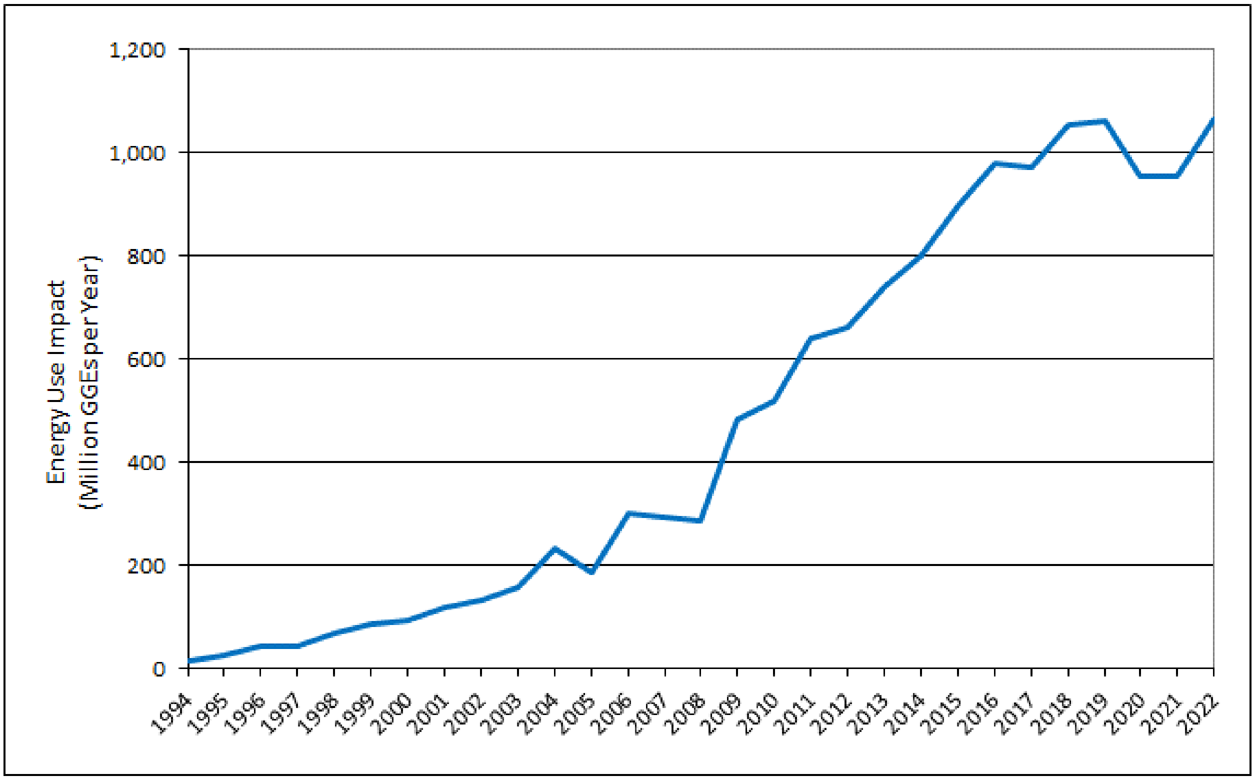

Figure 8. Increasing EUI from coalitions

The impacts of Clean Cities coalition efforts have added up considerably over the years. The full extent of the program's effect can be seen when the annual EUIs shown in Figure 8 are aggregated to a cumulative EUI. This cumulative measure, shown in Figure 9, is now nearly 14 billion GGE.

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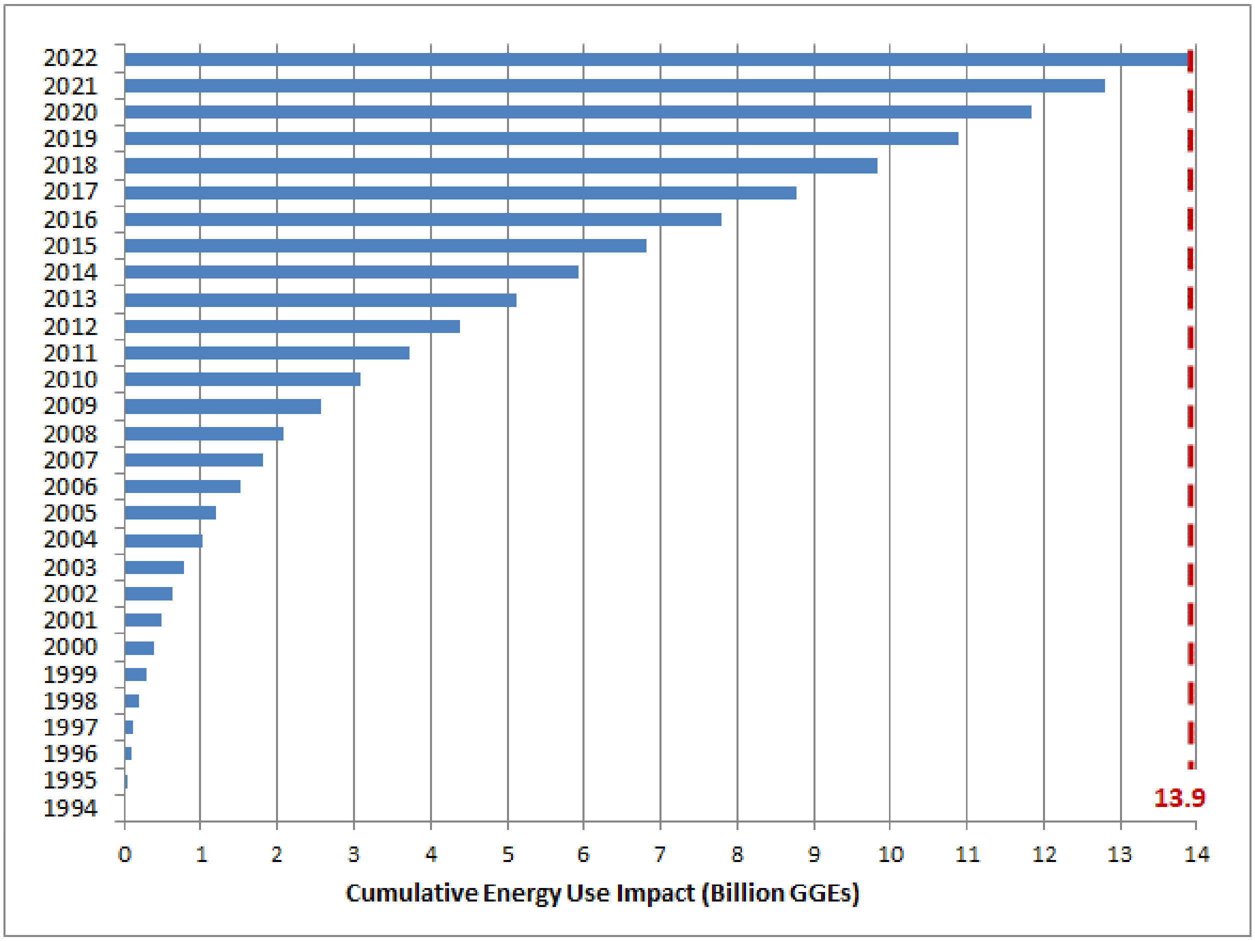

Figure 9. Cumulative accomplishments of all Clean Cities coalition activities

Notable GHG and Criteria Pollutant Emissions Trends

Clean Cities activities reduced 5.4 million tons of GHG emissions in 2022—8% more than in 2021. These efforts have led to a cumulative emissions reduction of 72 million tons over the years, as shown in Figure 10. The relationship between the two has not always been consistent, since some technologies can be more effective at increasing EUI or reducing emissions than others (see Figure 3), and the Technology Integration portfolio evolves over time to stay relevant. Therefore, Figure 9 and Figure 10 do not reflect one another exactly. Furthermore, an update in the reporting tool to be consistent with periodic updates of the GREET model resulted in a shift in the emissions calculations in 2020.

The average Clean Cities HDV reduced over 9 times as many GHGs as the average LDV. This is largely for the same reasons that HDVs have a larger EUI per vehicle ratio relative to LDVs. Other notable trends in GHG emissions that have been mentioned in other sections have been called out in boxes in this section.

RNG is a prime example of a fuel that has extremely low life cycle emissions because it reduces methane emissions (a potent GHG) from landfills, wastewater treatment facilities, and farms.

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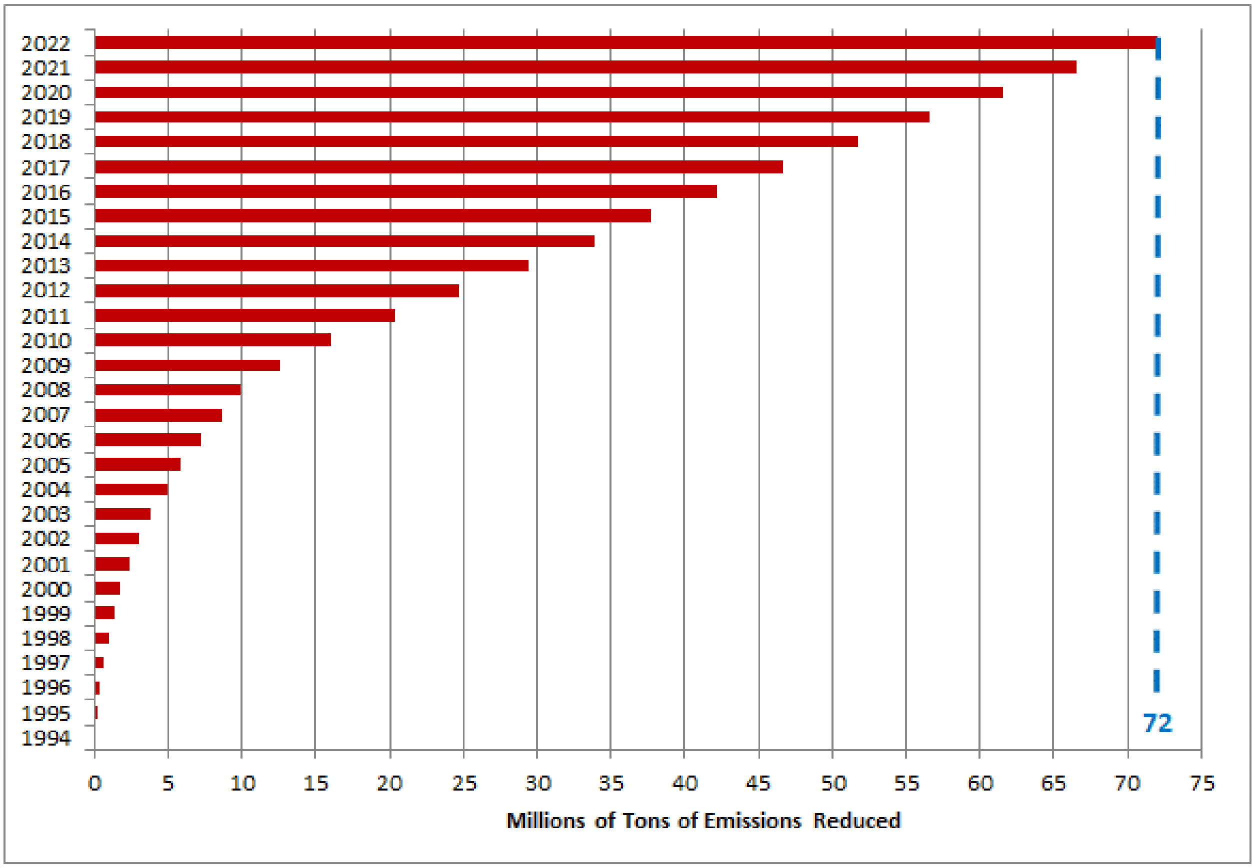

Figure 10. Cumulative emissions reductions from all Clean Cities coalition activities

Conservation measures "eliminate" 100% of the emissions that would have resulted from the fuel they save.

In addition to reducing GHG emissions, Clean Cities activities improve air quality by reducing nitrogen oxides and volatile organic compounds. These are two categories of emissions that react to form tropospheric (ground-level) ozone or smog and are frequently linked to health impacts and respiratory issues. Clean Cities reduced over 930 tons of nitrogen oxide emissions in 2022, with CNG, EVs, and HEVs being the dominant reduction technologies. The coalitions also reduced 1,520 tons of volatile organic compounds, with EVs, HEVs, CNG, and VMT reduction being the leading technologies achieving these reductions. Furthermore, they reduced over 18,000 tons of carbon monoxide, 117 tons of 10-micron particulate matter (PM_{10}), and 56 tons of $PM_{2.5}$.

Clean Cities' Benefits to Disadvantaged Communities

Coalitions first provided location-related information about vehicles that were part of their alternative fuel, EV, and fuel efficiency projects in 2021. This reporting of operation areas continued in 2022 with the same five categories of locations:

- Cities: Project operated mainly within a set of cities or towns.
- Counties: Mainly within a set of counties.
- Coalition boundaries: Mainly within a coalition's boundaries

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- Statewide: A range of locations across one or more states.
- Unknown.

Out of a total of 7,048 records submitted in 2022, 6,295 (89.3%) were submitted with an operation area type assigned by coalition respondents. Respondents could list multiple cities, counties, and states if applicable. Another 242 records (3.4%) were submitted with "unknown" operation areas, but an operation area was assigned based on the project name. This was only done in cases where the operation area was clear, such as a specific city, county, or transit agency. The remaining 511 records (7.3%) remained unknown and were not used in the analysis.

For the previous analysis with 2021 data, all projects with a statewide operating area were excluded from the analysis, regardless of the size of the state. For the 2022 analysis, a more nuanced approach was taken to account for the fact that the area of many states is smaller than the area of coalitions that don't cover their entire state. The exclusion of very large areas was done because the methodology distributes the impact of projects evenly across the reported operational area. The larger the area of operation, the more uncertainty is introduced into the analysis. Therefore, the analysis of 2022 data was limited to areas of operation (including states) that were smaller than the coalition area of Valley of the Sun in Phoenix, Arizona. Valley of the Sun is the Clean Cities coalition with the largest area that is not an entire state, covering 53,986 square miles. Records for projects within coalition boundaries or statewide projects that were reported by coalitions with an area smaller than that of Valley of the Sun were retained for further analysis, as were all coalitions with sub-state areas, including Valley of the Sun. Of the records with an assigned state location, 486 of them were for areas that exceed that area threshold and were excluded from further analysis.

Projects that operated in multiple cities, counties, or states (a total of 280 projects) were also excluded because of the additional time that would be required to clean the data and conduct additional geospatial analyses for this relatively small proportion of records (4.6% of total). Therefore 5,771 records were used in the full analysis (81.9% of the total reported). This compares to 72% of the records in the 2021 report that were included in the full analysis, attributable to improved reporting processes and the higher threshold for exclusion of large-area projects.

Based on these locations, an estimate of the benefits to disadvantaged communities (DACs) using federal definitions was generated. The analysis of 2021 reporting data used the interim definitions of DAC that were in use in 2022, including a DOE interim definition and an interim definition in use by the Joint Office of Energy and Transportation for the National Electric Vehicle Infrastructure (NEVI) Formula Program.[5] DOE shifted in 2023 to use of the Climate and Environmental Justice Screening Tool (CEJST), developed by the Council on Environmental Quality. So, the CEJST definition of DAC was used for analysis of the 2022 reporting data about the operating area of vehicles, in addition to the interim NEVI definition used previously, for comparison. As an example of how these definitions differ, two maps of Maricopa County,

[5] The DOE, U.S. Department of Transportation, and NEVI DAC data layers are all available for download at https://www.anl.gov/es/electric-vehicle-charging-equity-considerations. An online interactive map showing the DOE definition of DAC is at https://energyjustice.egs.anl.gov/.

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Arizona, are shown. One highlights census tracts designated as DAC using the NEVI definition (Figure X), and the other highlights designated DACs using the CEJST definition (Figure Y).

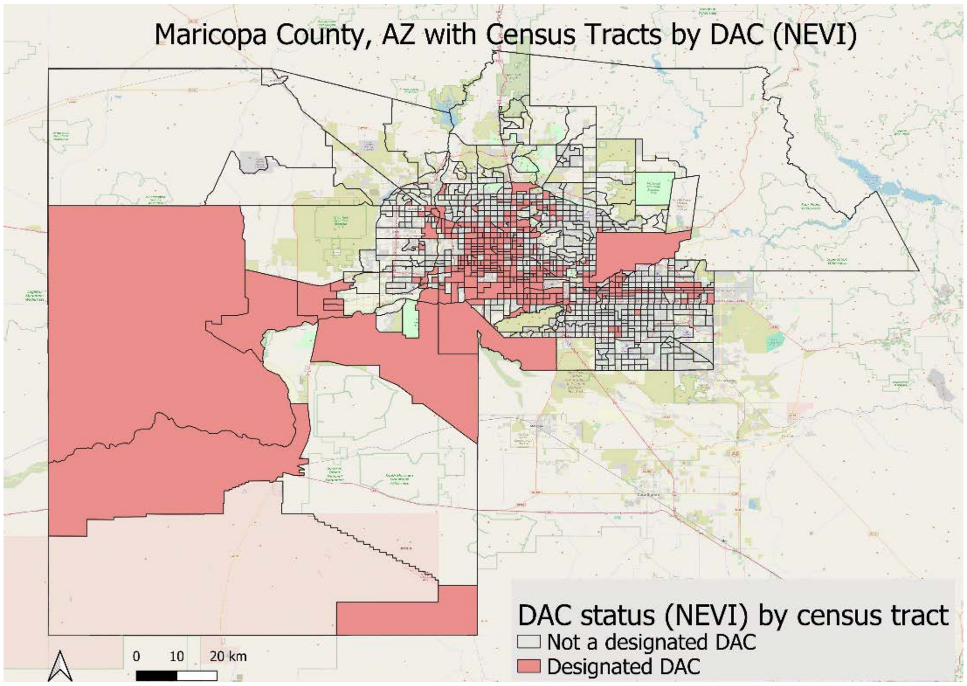

Figure 11. Using the NEVI definition of DAC, 35.1% of the population of Maricopa County, Arizona, lives in a designated DAC.

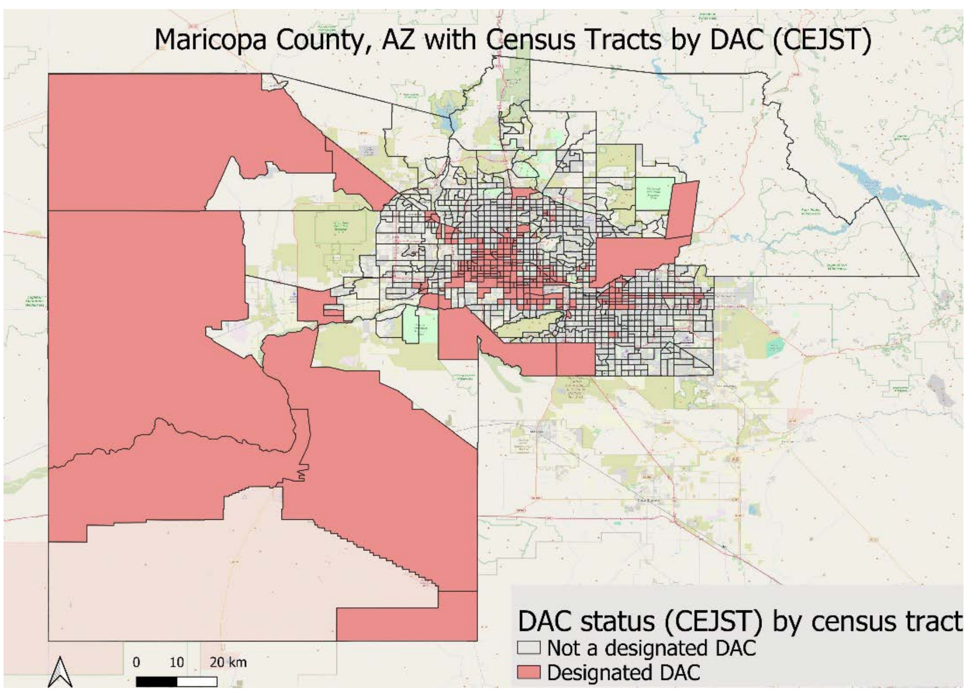

Figure 12. Using the CEJST definition of DAC, 25.7% of the population of Maricopa County, Arizona, lives in a designated DAC.

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The total impact of benefits that may be accrued to DACs was estimated by multiplying the percent DAC for each geographic area (tabulated in GIS) by the reported percent of each project in that area attributable to a coalition's contribution. Results for the 5,771 projects analyzed based on the CEJST and NEVI definitions of DAC are shown in Table 12. The differences in DAC definitions are also reflected in the relatively higher estimate of DAC impacts using the NEVI definition, which is the combination of both the DOE and DOT interim definitions and therefore contains more square miles of DAC. The results from 2021 reporting data using the DOE and NEVI definitions are also shown for comparison. Differences between the 2021 and 2022 DAC impacts are due to differences in which coalitions reported the most impactful projects, and the locations of those projects. The table includes general estimates based on the geospatial analysis that assumed impacts are evenly distributed across the population of each geographic area of operation. While the estimates have some uncertainty, the method is an early effort at a replicable, national-scale analysis of this nature that can inform efforts to comply with the Justice40 Initiative[6].

Table 12. Estimated Percent of Total Benefit Accrued to DACs from 2022 Coalition Projects That Were Attributed to a Specific Operating Area

All Coalitions	2022 DAC Impact Based on CEJST Definition	2022 DAC Impact Based on NEVI Definition	2021 DAC Impact Based on NEVI Definition
GGE reduced	27.2%	31.8%	39.6%
GHG reduced	25.7%	30.0%	39.7%
CO reduced	26.4%	30.4%	43.4%
NOx reduced	26.9%	31.0%	43.7%
PM_{10} reduced	27.1%	31.2%	44.7%
$PM_{2.5}$ reduced	27.0%	31.1%	44.2%
VOC reduced	24.1%	27.7%	40.8%

The GGE reduced in Table 12 are related to fuel expenditures, and therefore can be used as a proxy for cost savings to DACs. The five air pollutants listed in Table 2 (carbon monoxide [CO], nitrogen oxides [NOx], 10-micron particulate matter [PM10], 2.5-micron particulate matter [PM2,5], and volatile organic compounds [VOCs]) have health impacts. Therefore, Table 2 percentages can be broadly interpreted as the percentage of health benefits that Clean Cities projects provided to DACs. The differences between pollutant types within one column are largely due to the differing impacts that various fuels have on specific pollutants.

Alternative Fuel Vehicle Types and Applications

The online reporting tool allows directors to categorize their AFVs into key vehicle types and fleet applications. Figure 13 shows that the largest portion (32%) of AFVs were unknown LDVs—which are usually vehicles reported in conjunction with a Clean Cities coalition-supported fueling station. Cars represented 29% of vehicles, and 63% of reported cars were EVs.

[6] https://www.energy.gov/justice/justice40-initiative

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Light trucks, vans, and SUVs represented 23% of vehicles. These were dominated by a coalition reporting an estimate of registered vehicles using high-level ethanol blends. Unknown HDVs—typically reported in conjunction with public biodiesel fueling stations—accounted for 6% of vehicles, while heavy-duty trucks without trailers, or delivery trucks, accounted for 4%. All remaining categories individually accounted for 2% or less of the vehicle population.

E85 vehicles in the light truck segment were the most frequently reported fuel/vehicle combination at 312,585. EVs in the car segment followed at 284,058. EVs in the unknown LDV segment were the next largest group, with 181,406 vehicles. E85-capable vehicles were the second largest portion (161,514 vehicles) of the unknown light-duty segment and were the most common fuel type reported across all vehicle types (568,837 vehicles).

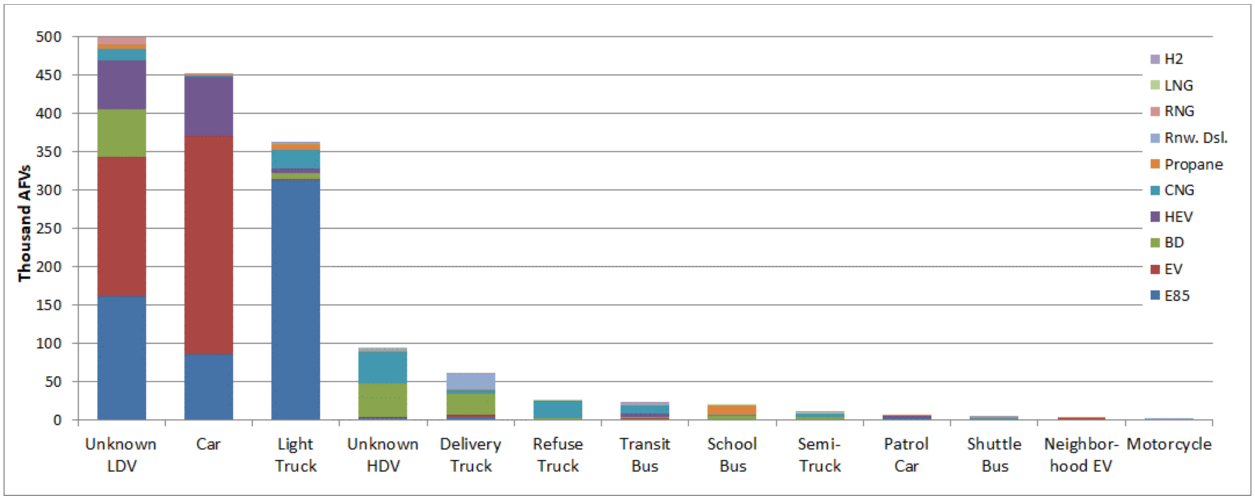

Figure 13. AFVs by vehicle and fuel type.

Note: Neighborhood EVs are small EVs only allowed on low-speed roads.

In addition to reporting vehicle types, directors also provided information about vehicle ownership and vehicle end use applications. As shown in Figure 14, more than half of the reported vehicles (63%) were owned by the general public or an unknown entity. Many of these vehicles were reported by fuel retailers to the director, often back-calculated from fuel sales and an assumption for how much fuel the average car uses per year. The next largest ownership groups of AFVs were commuters, local government fleets, state government fleets, and corporate fleets at 16%, 9%, 5%, and 4% of the total vehicles, respectively. If commuters are combined with the general public category, 79% of vehicles are owned by the general public.

79% of coalition-reported vehicles are owned by the general public and have benefited from Clean Cities coalition projects.

Of the fleet application types composing more than 4% of reported vehicles, local government fleets decreased by 2% to 134,160, state government fleets decreased by 1% to 72,017, and corporate fleets decreased by 10% to 65,793.

Flex-fuel vehicles and biodiesel vehicles were most often reported as being used by the general public. EVs and HEVs comprised 85% of commuter vehicles (73% and 11%, respectively). CNG and propane vehicles made up the largest portion of corporate vehicles at 62% combined (47% and 15%, respectively).

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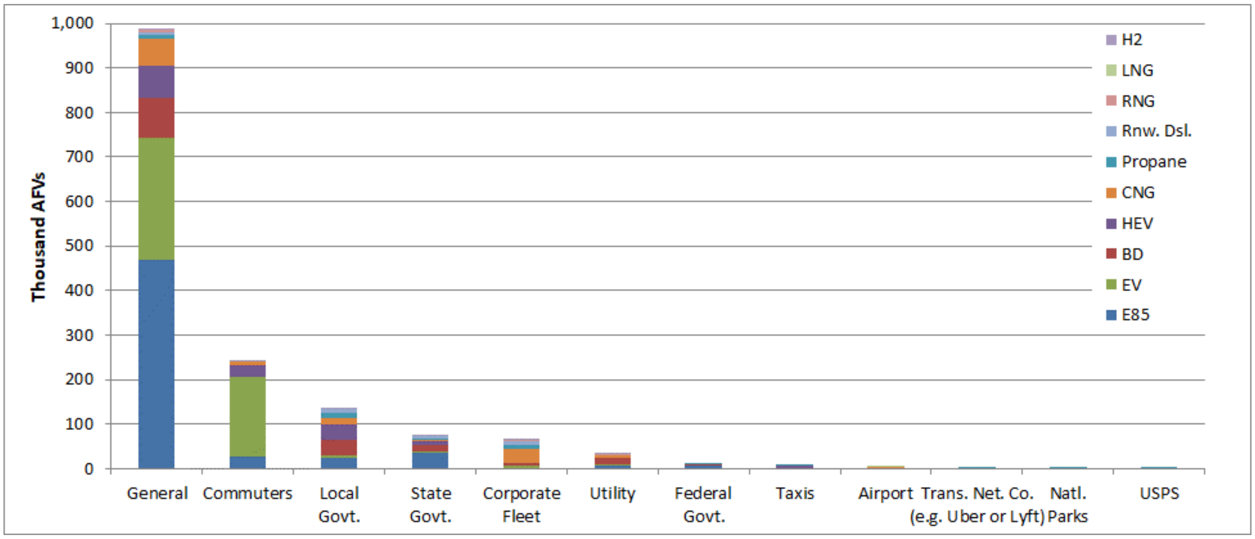

Figure 14. AFVs by application and fuel type

Emerging Technologies—Experimental, Prototype, and Demonstration Vehicle Projects

A small number of Clean Cities coalitions have worked with fleets and stakeholders who have an interest in field-testing advanced vehicle technologies such as hydrogen and fuel cell electric vehicles. This subset of vehicles represents less than 0.1% of the total number of alternative fuel or advanced technology vehicles reported by coalitions. Some of these projects involve limited-production, experimental, or prototype/demonstration models that vehicle manufacturers make available under special lease arrangements. This is a way for the manufacturers to gather in-use performance data, evaluate durability, and refine engineering designs for future vehicle models that may be under development. In 2022, 276 hydrogen vehicles were reported, and the largest portion were for general public owners as reported for fueling stations. Data reported to Clean Cities coalitions for some of these vehicles show the noteworthy potential of these technologies for both energy and environmental benefits, but no significant market trends could be drawn from this limited data set.

Directors and Coalition Types

The average Clean Cities coalition director has over 7 years of experience.

Collectively, coalition directors and staff reported spending a total of 4,983 hours per week on Clean Cities coalition tasks, which is equivalent to more than 249,150 total hours during the year.[7] This translates into over 124 full-time, experienced technical professionals working to increase the use of alternative fuels and electric vehicles and reduce transportation energy use. For an individual coalition, the average amount of time spent completing Clean Cities coalition business per week was 65.6 hours. The average decreased from 67.9 hours in 2021, while the median was stable at 50 hours. The reporting tool also gathered information on coalition director experience. Coalition directors have been on the job for an average of over 7 years; 50% have

[7] Assuming 50 work weeks per year.

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held their position for 5 years or less, and 33%, or 25 coalition directors, have 10 years or more of experience as a coalition director.

Table 13. Coalition Metrics by Coalition Type

Coalition Type [a]	Total # of Coalitions	Average # of Stakeholders	Average Funds Raised	Average Program Impact (GGE)	Average Persons Reached
Nonprofit - standalone	34	221	$5,069,991	13,514,172	31,988
Regional governing coalition	15	182	$4,737,166	11,160,522	157,329
Government - state	11	418	$814,313	7,643,827	2,541
Nonprofit - hosted	9	83	$3,632,476	18,307,626	274,152
University	5	837	$14,049,950	18,710,696	91,359
Government - city or county	2	101	$39,161,611	11,115,729	140,186
Total/overall weighted average	**76**	**263**	**$5,706,051**	**13,046,386**	**87,895**

[a] Coalition types are defined in Appendix B.

Coalition types were tracked, and the relationships between coalition type and general metrics were analyzed. The coalition types correspond to their host organizations (which generally pay the coalition director's salary) and are listed in the first column in Table 13 and defined in Appendix B. Stand-alone nonprofits are coalition types that are self-sustaining and do not operate as part of a larger host organization.

The number of coalitions in each grouping is listed in Table 13, followed by the average number of stakeholders, average funds (including grants and dues) received in 2022, average GGE of energy impacted, and average number of people reached through outreach events. The range of all metrics overlaps heavily between groups, and the low sample size precludes statistical significance. Furthermore, many variables affecting the metrics in this table were not controlled for, so no cause/effect relationships can be inferred between coalition type and specific metrics.

The most common coalition type was the stand-alone nonprofit. Coalitions hosted in universities had the highest average number of stakeholders and the highest average EUI. Coalitions hosted by city and county governments were the least common, but raised the most funds on average, driven primarily by one coalition's grants from the Federal Transit Administration. Coalitions in hosted nonprofits reached the most people in outreach events, primarily through media activities for two coalitions.

Coalitions based in universities created the highest average EUI and had the highest average number of stakeholders.

Funding

In 2022, 37 coalitions reported receiving 227 new project awards (project-specific grants) worth a total of $134.6 million. These coalitions also reported garnering $47.5 million in leveraged or matching funds for a combined total of $182.1 million in new grant and matching contributions. Nineteen of the 227 awards were at or above $1 million each. Table 14 presents a breakdown of the number and value of awards reported by the coalitions without the matching funds.

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Table 14. Breakdown of 2022 Project Awards by Number and Value

Grant Range	Number of Grants	Share of Total Number	Total Value	Share of Grand Total Value
<$50,000	129	57%	$2,179,190	2%
$50,000–$99,999	21	9%	$1,443,779	1%
$100,000–$499,999	53	23%	$10,843,874	8%
$500,000–$999,999	5	2%	$3,241,472	2%
$1,000,000+	19	8%	$116,892,639	87%
Total	**227**	**100%**	**$134,600,954**	**100%**

Of the $134.6 million in primary grant dollars received, $18.1 million (13%) was reported as coming from DOE. The largest nongovernment funding source was from the Volkswagen Clean Air Act Civil Settlement which was involved with $10.3 million in grant funding—8% of the total. The largest federal contributor was the U.S. Department of Transportation's Federal Transit Administration which contributed $75.1 million or 56% of the total. State governments were involved in the second largest portion of the funding at 18%. Other federal contributors included the U.S. Department of Transportation's Congestion Mitigation and Air Quality Improvement Program, the U.S. Environmental Protection Agency, the U.S. Department of Agriculture, and a grouping of other federal agencies.

Coalitions leveraged $2 of project funding for every $1 directed to coalitions by DOE.

In addition to new 2022 awards, coalition directors reported the portions of previous multiyear awards spent during the calendar year. If a coalition failed to report the amount spent during 2022, the total amount of the award divided by the number of years of award duration was assumed. Coalitions reported spending 32% of the funds they were awarded in 2022, suggesting that projects start quickly after being awarded. In 2022, coalitions used a total of $79.1 million in project funds that were awarded and matched between 2016 and 2022.

In addition to project-related funds, coalitions reported collecting $1.3 million in stakeholder dues and receiving $4.7 million in operational funds, primarily from their host organizations. Combining these funds with non-DOE grant and matching funds totaled $170 million in supplemental non-DOE funds. This total represents 2:1 leveraging of the $80 million included in the VTO Technology Integration budget for 2022.

About the Stakeholders

Coalitions included nearly 20,000 stakeholders in 2022, with 37% of them from the private sector.

In 2022, 76 coalitions reported a total of 19,972 stakeholders, for an average of 263 stakeholders per coalition, similar to the average of 253 stakeholders in 2021. Coalitions drew local stakeholders from the public, private, and nonprofit sectors. Stakeholders included local, state, and federal government agencies; large and small businesses; auto manufacturers; vehicle dealers (of light-, medium-, and heavy-duty vehicles); fuel suppliers; public utilities; nonprofits; and professional associations. Coalitions reported that 37% of

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stakeholders were from the private sector. This composition is more than the 35% reported in 2021 and shows a balance between public and private stakeholders.

Data Sources and Quality

Gathering data is often challenging for coalitions because they rely on voluntary reporting from numerous stakeholders. To share best practices for data collection, the annual reporting tool asks coalitions how they obtained their data. They could choose one or more of the following: online questionnaires (e.g., SurveyMonkey), written questions (paper, electronic, or spreadsheet based) to stakeholders, phone interviews with stakeholders, coalition records (e.g., from project participation earlier in the year), or coalition estimates. Figure 15 displays the percentage of coalitions that rely on each method and implies that each coalition uses a mix of methods to collect project data across diverse projects.

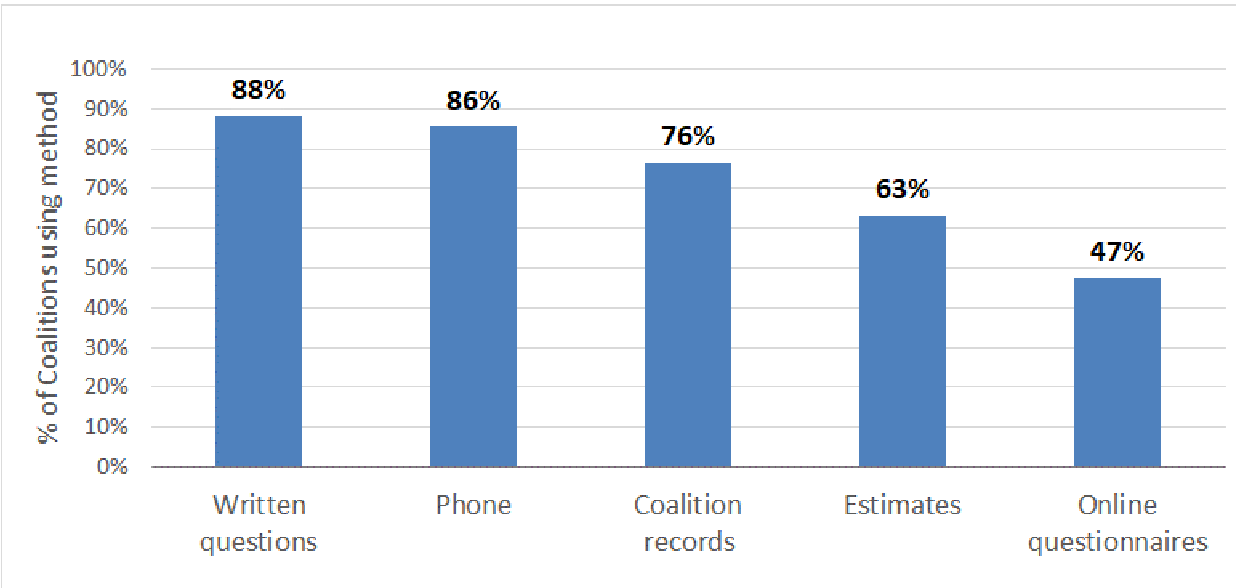

Figure 15. Project data sources

Conclusion

The 2022 *Clean Cities Coalitions Activity Report* helps quantify accomplishments and the impact of the coalition network. The report shows that Clean Cities coalitions had a year of many successful projects. The data indicate that the EUI reached a new high of 1.1 billion GGE for activities reported by coalitions in 2022. This was an increase from 2021 and led to a continued growth in reductions of GHG emissions.

Overall, Clean Cities coalitions maintained a high level of accomplishments. Coalition efforts continued to increase the number and diversity of AFVs and advanced vehicles on U.S. roads in 2022. The combined efforts of local Clean Cities coalitions, DOE, and DOE national laboratories bring together otherwise disparate groups to leverage people, funding, and resources to accelerate the nation's progress in increasing affordable, efficient, and clean transportation options.

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Appendix A: Clean Cities Coalitions That Completed 2023 Annual Reports

State	Coalition
AL	Alabama Clean Fuels Coalition
AR	Arkansas Clean Cities
AZ	Valley of the Sun Clean Cities Coalition (Phoenix)
CA	Central Coast Clean Cities Coalition
CA	Clean Cities Coachella Valley Region
CA	East Bay Clean Cities Coalition (Oakland)
CA	Long Beach Clean Cities
CA	Los Angeles Clean Cities Coalition
CA	Sacramento Clean Cities Coalition
CA	San Diego Regional Clean Cities Coalition
CA	San Francisco Clean Cities Coalition
CA	San Joaquin Valley Clean Cities
CA	Silicon Valley Clean Cities (San Jose)
CA	Southern California Clean Cities Coalition
CA	Western Riverside County Clean Cities Coalition
CO	Drive Clean Colorado, a Clean Cities Coalition
CO	Northern Colorado Clean Cities Coalition
CT	Capitol Clean Cities of Connecticut
CT	Connecticut Southwestern Area Clean Cities
CT	Greater New Haven Clean Cities Coalition
DC	Greater Washington Region Clean Cities Coalition
DE	State of Delaware Clean Cities
FL	Central Florida Clean Cities Coalition
FL	North Florida Clean Fuels Coalition
FL	Southeast Florida Clean Cities Coalition
FL	Tampa Bay Clean Cities Coalition
GA	Clean Cities-Georgia
HI	Sustainable Transportation Coalition of Hawaii
IA	Iowa Clean Cities Coalition
ID	Treasure Valley Clean Cities
ID, MT, WY	Yellowstone-Teton Clean Cities Coalition
IL	Illinois Alliance for Clean Transportation
IN	Drive Clean Indiana

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State	Coalition
KS	Central Kansas Clean Cities
KS, MO	Kansas City Regional Clean Cities
LA	Louisiana Clean Fuels
LA	Southeast Louisiana Clean Fuel Partnership
MA	Massachusetts Clean Cities
MD	State of Maryland Clean Cities
ME	Maine Clean Communities
MI	Michigan Clean Cities
MN	Minnesota Clean Cities Coalition
MO	St. Louis Clean Cities
NC	Centralina Clean Fuels Coalition
NC	Land of Sky Clean Vehicles Coalition (Western North Carolina)
NC	Triangle Clean Cities (Raleigh, Durham, Chapel Hill)
ND	North Dakota Clean Cities
NH	Granite State Clean Cities Coalition
NJ	New Jersey Clean Cities Coalition
NM	Land of Enchantment Clean Cities (New Mexico)
NY	Capital District Clean Communities Coalition (Albany)
NY	Clean Communities of Central New York (Syracuse)
NY	Clean Communities of Western New York (Buffalo)
NY	Empire Clean Cities
NY	Greater Long Island Clean Cities
NY	Greater Rochester Clean Cities
OH	Clean Fuels Ohio
OK	Central Oklahoma Clean Cities (Oklahoma City)
OK	Tulsa Clean Cities
OR	Columbia-Willamette Clean Cities
PA	Eastern Pennsylvania Alliance for Clean Transportation
PA	Pittsburgh Region Clean Cities
RI	Ocean State Clean Cities
SC	Palmetto Clean Fuels Coalition
TN	East Tennessee Clean Fuels Coalition
TN	Middle-West Tennessee Clean Fuels Coalition
TX	Alamo Area Clean Cities (San Antonio)
TX	Dallas-Fort Worth Clean Cities
TX	Houston-Galveston Clean Cities

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State	Coalition
TX	Lone Star Clean Fuels Alliance (Central Texas)
UT	Utah Clean Cities
VA	Virginia Clean Cities
VT	Vermont Clean Cities
WA	Western Washington Clean Cities
WI	Wisconsin Clean Cities
WV	State of West Virginia Clean Cities

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Appendix B: Definition of Clean Cities Coalition Types

Coalitions have categorized themselves into six different types, depending on their organizational structures and relationship to hosts.[8] Some coalitions fit within multiple types. These types are:

1. "Government—City or County" coalitions are hosted by a city or county government such as a city department of transportation or municipally owned utility.
2. "Government—State" coalitions are hosted by a state government. This is generally in the state department of energy or department of environment. Coalitions hosted by a state university are not included in this category.
3. "Hosted in a Nonprofit" coalitions are hosted within a larger nonprofit or community service organization with 501(c)(3) status. The host organization's activities are broader in scope than the Clean Cities coalition, such as the American Lung Association.
4. "Stand-Alone Nonprofit" coalitions are nonprofits typically with 501(c)(3) status and operate with no or minimal oversight and management of a host organization.
5. "Regional Governing Coalition" coalitions are hosted in a multigovernmental body such as a council of governments, municipal planning organization, or regional planning commission.
6. "Hosted in a University" coalitions are hosted by a university (public or private).

[8] The relationship between a host organization and the coalition varies across the country. Typically, the director of the coalition is an employee of the host organization, and the coalition benefits from the resources available at the host organization.

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