



Clean Cities: A Model of Collaborative Technology Innovation Built Over 30 Years

Paty Romero-Lankao, Nicole Rosner, Lauren Reichelt,
and Joanna Allerhand

National Renewable Energy Laboratory

**NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
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List of Acronyms

AFDC	Alternative Fuels Data Center
DOE	U.S. Department of Energy
EPAct	Energy Policy Act
EV	electric vehicle
NETL	National Energy Technology Laboratory
NREL	National Renewable Energy Laboratory
PMP	project management plan
VTO	Vehicle Technologies Office

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1 Introduction

Transportation is responsible for 27% of greenhouse gas emissions in the United States. Decarbonizing transportation is critical to reduce greenhouse gas emissions by 50% to 85% by 2050 to limit global warming to 4°F (2°C) (Steinberg et al. 2017). Over the past three decades, reducing petroleum use in the transportation sector has remained a national priority, necessitating the need for the interplay of local actions and national efforts to achieve this goal.

Historically, efforts to reduce petroleum use and mitigate environmental issues through “transformative science and technology solutions” have faced a series of challenges to generating shared motivation (www.energy.gov/about-us). It has been difficult to integrate conflicting sectoral and local interests (e.g., market value versus equity) into national collaborative efforts (e.g., emission mitigation), and local stakeholders’ own goals have often not aligned with overarching national objectives (Koontz and Johnson 2004; Scott, Thomas, and Magallanes 2019). Local stakeholders lack authority or leadership to initiate collaborative processes (Emerson, Nabatchi, and Balogh 2012), and have lacked incentives to devise rules that balance out issues of unequal distribution of decision-making power and resources (Newig et al. 2018).

The Clean Cities Coalition Network is an example of successful government-sponsored efforts to address these challenges and facilitate collaborative governance across sectors and levels of government within the transportation sector. In 1993, under what is now the Vehicle Technologies Office (VTO), the U.S. Department of Energy (DOE) established Clean Cities in response to a requirement in the Energy Policy Act (EPAct) of 1992 to implement voluntary alternative fuel deployment activities.¹ VTO’s Technology Integration Program is responsible for the Clean Cities Coalition Network and many other activities. DOE created a collaborative governance effort that has translated higher-level policy goals into multiple local collaborative practices for more than 30 years.

Since its creation, the Clean Cities Coalition Network, facilitated by support from the National Renewable Energy Laboratory (NREL), has expanded considerably to include over 75 active coalitions that cover nearly every state and 84% of the U.S. population. Coalitions boost the nation’s energy security, economic vitality, and quality of life by advancing affordable, efficient, and clean transportation fuels and technologies. Thriving on a culture of collaborative change, coalitions are moving our nation’s transportation systems into the future by leveraging local relationships in communities across the United States. These coalitions create local networks of public and private sector stakeholders, most recently totaling over 20,000. The national network engages in local implementation to help stakeholders meet their climate, financial, and energy goals, leveraging expertise from federal agencies, national laboratories, and other coalitions (DOE 2023) and helping carry out the mission of DOE.

The goal of this report is to explain the long-term success of Clean Cities as a collaborative form of governance. In what follows, we describe what Clean Cities is and point to a series of attributes explaining Clean Cities coalitions’ long-term success as a collaborative platform (Newig et al. 2018):

¹ See https://afdc.energy.gov/laws/key_legislation#epact92 for why Clean Cities was established.

- Nimble institutional structure
- Semi-autonomy
- Interdependent modularity
- Adaptability.

We then show how these attributes are at the heart of a governance model for collaborative technology innovation that has created and been enhanced by the interplay of four positive feedbacks that will be analyzed in section 3:

- Attractor effect
- Learning
- Leverage
- Synergies.

We close with some concluding remarks on the relevance of Clean Cities and the way forward for future policy priorities, technology deployment initiatives, and partnership building, including achieving a more just transition to clean energy.

1.1 Clean Cities: Decades of Collaborative Technology Innovation

Over the last few decades, social science scholarship (Newig et al. 2018; Emerson, Nabatchi, and Balogh 2012) has explored how federal agencies, such as DOE, have opted for collaborative modes of governance as an effective means to realize policy goals such as those of Clean Cities of advancing affordable, domestic transportation fuels; energy-efficient mobility systems; and other fuel-saving technologies and practices (DOE 2023). These collaborations are highly intensive modes of interaction embraced by governmental organizations as a means to orchestrate mutual interdependence and joint action and benefit (e.g., fuel switch) while preserving the autonomy of collaborating parties (Clean Cities coalitions in this case). This report focuses on how Clean Cities has orchestrated collaborative efforts among public, civil society, and private sector entities. Their method of orchestration can also be called collaborative governance because they go beyond the governmental sphere and involve private and civil society stakeholders in processes and structures of public policy decision-making and management that:

- Engage members constructively across the margins of public agencies, local to national levels of government, and/or the public, private, and civic society domains
- Are formal, consensus-oriented, and iterative, involving processes of coproducing goals, strategies, and the means to share responsibilities, capabilities, and resources
- Foster a sense of shared purpose, belonging, and trust.

1.2 What Is the Clean Cities Coalition Network?

The Clean Cities Coalition Network is a **collaborative platform**, defined as an “organization with dedicated competences and resources for facilitating the creation, adaptation, and success of multiple or ongoing collaborative projects or networks” (Ansell and Gash 2008).

As such, Clean Cities fills a niche in the world of collaborative governance in the United States and worldwide by:

- Engaging members constructively across the boundaries of national to local levels of government (e.g., DOE Vehicle Technologies Office and local coalitions), as well as the public, private, and civic sphere (e.g., public and private sector transportation stakeholders)
- Orchestrating multilateral collaborative relationships, including facilitating, enabling, and to some degree regulating “many-to-many” collaborative relationships.

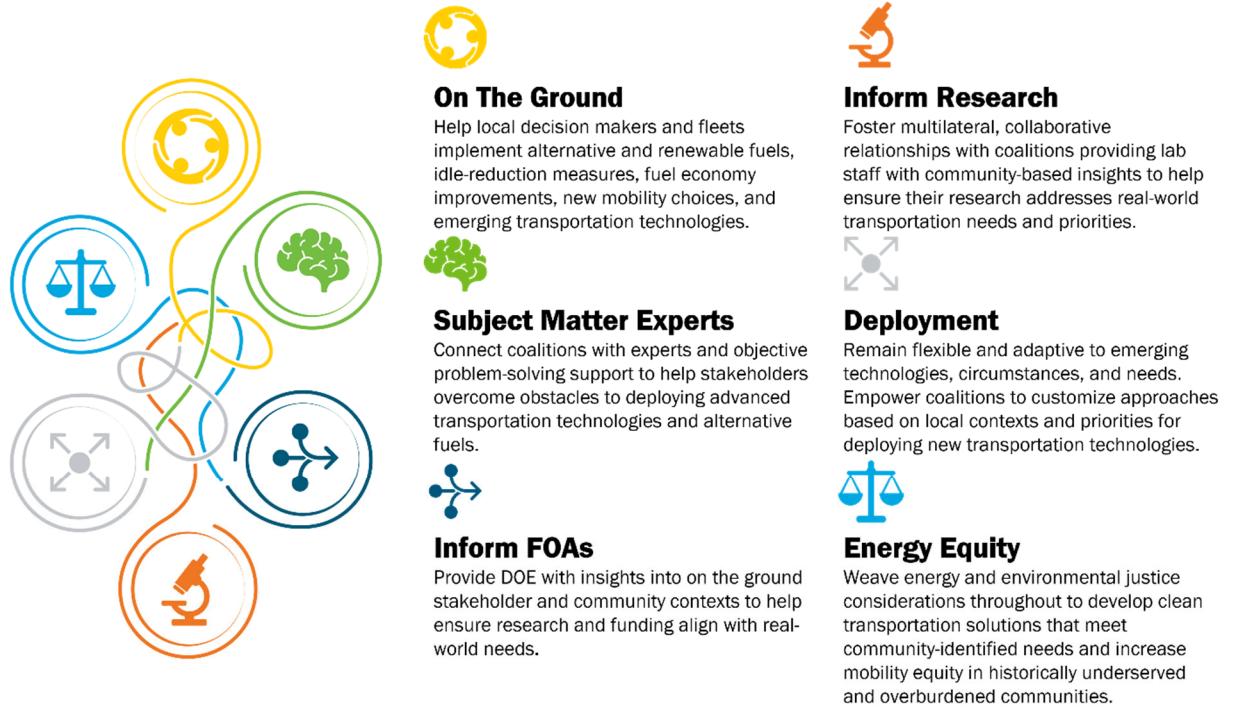


Figure 1. Iterative, interactive facets of the Clean Cities process

2 Attributes Explaining Clean Cities' Long-Term Success

Over the years, Clean Cities has developed a series of institutional attributes that explain its long-term success (Figure 2). Clean Cities has a stable, flexible, and nimble **institutional structure** that has allowed members to be **semi-autonomous** while benefiting from and contributing to Clean Cities' success. Clean Cities has developed an **interdependent modularity**, a reciprocal form of interdependencies between its members that allows for interorganizational coordination while lessening the need for overt managerial control. Finally, it has a high level of **adaptability**, or the ability to adjust itself to and take advantage of a complex array of interlocking challenges (Ansell and Gash 2008).

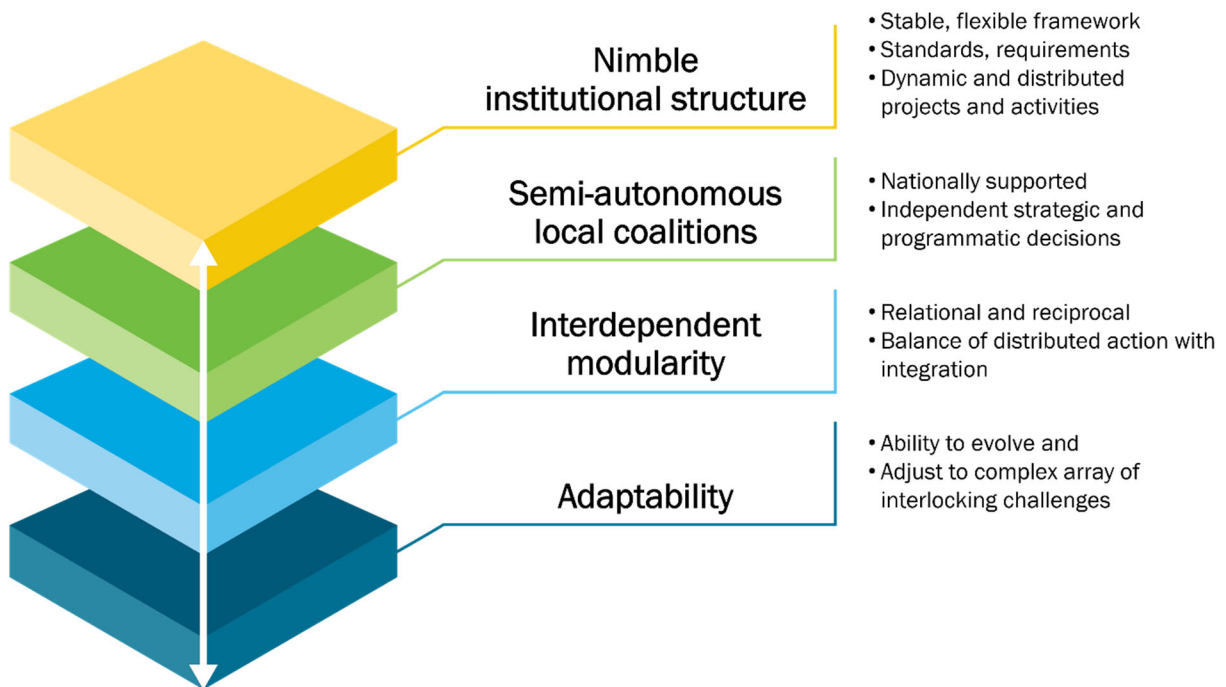


Figure 2. Attributes of Clean Cities' collaborative platform

2.1 Nimble Institutional Structure

Clean Cities provides a stable and flexible institutional structure upon which and through which more dynamic and distributed processes and activities are organized. Within this framework, DOE and the national laboratories require that coalitions are held to the following standards and requirements to ensure minimum levels of engagement: formal designation and redesignation, cooperative agreements with DOE, and annual reports, along with other expectations guiding their participation in Clean Cities activities (DOE 2023).

Formal designation is the process to become an official DOE-designated Clean Cities coalition whereby a multiyear plan is agreed upon and a regional manager is made available to support a

coalition through this multiyear process. To become designated and join the Clean Cities network, a coalition must have:

- An active network of public and private stakeholders who meet regularly and have defined roles
- A clear organizational structure
- A director to lead the coalition
- Reliable funding for the director position
- Specific, attainable goals and a strategic plan for achieving them
- Strong partnerships with air quality officials, energy officials, and other decision makers who control resources and help guide policy.

Coalitions must renew their formal designation every 4 years by showing active stakeholder networks, engagement, and coalition impacts and presenting to Vehicle Technologies Office staff on their progress, creating a minimum standard for inclusion in the Clean Cities network and access to the resources, tools, and support provided by DOE and national labs.

The cooperative agreements signed by coalitions annually outline the tasks coalition members will be responsible for over the following year that will contribute to the objectives of the national Clean Cities Coalition Network. This “statement of project objectives” first includes a base list of required tasks that coalitions must agree to, which may include submitting a project management plan (PMP); annual progress report; quarterly alternative fuel retail price reports; fueling station openings and closings; and vehicle, station, and equipment costs. Data collection demonstrates the progress and impact not only of each coalition, but also the collective effect of Clean Cities coalitions to DOE and policymakers. This process also becomes a unique mechanism for funneling local data and information to national laboratories and DOE. Real-world data assist labs in analysis to build robust tools for future decision makers. The statement of project objectives also includes optional subtasks, from which coalitions can select a limited number of additional projects they would like to implement locally for additional funding support.² This customizable cooperative agreement design creates options for coalition directors and allows for variation in coalition efforts while maintaining a structure for the network.³ After selecting their task options, coalition directors draft and submit a PMP that includes goals, metrics, and timelines to help them plan the upcoming year. They provide regular updates to that PMP as initiatives progress. Those PMP updates are shared with national labs on a quarterly basis alongside quarterly reports. PMPs also provide a focus point for coalitions to ensure their activities reflect the needs of their stakeholders.

Each Clean Cities coalition is also required to submit an annual report detailing their activities and accomplishments of the previous year. This information is submitted online through a reporting tool maintained by NREL. Coalitions provide organizational information, including

² This was the case for the National Energy Technology Laboratory (NETL) and NREL cooperative agreements with coalitions. As of April 2023, the cooperative agreement with NETL requires coalitions to perform activities among all tasks, eliminating the requirement to select subtasks.

³ Each coalition will get a statement of work from NETL that includes all the tasks, and it will be asked to conduct activities that enable the coalition to reach goals such as reductions in greenhouse gas emissions.

membership, funding, projects, and activities (outreach events and trainings, impact on number of people reached—particularly underserved groups) of their coalition. Directors also collect voluntary data from their stakeholders about the volume of alternative fuels used, the number of alternative fuel vehicles including electric vehicles (EVs) and hybrid electric vehicles, idle reduction initiatives, fuel economy improvements, and programs to reduce vehicle miles traveled, to be provided in the annual report. The compiled report is an important indicator of coalition impact and allows Clean Cities coalitions and their stakeholders to track progress over time. It also allows NREL to compile and analyze the annual reports of the entire Clean Cities network, documenting national impacts and determining how energy use in the United States has shifted because of coalition activities (Singer and Johnson 2021).

Additional expectations for coalitions include attending monthly regional conference calls and regional and national Clean Cities training workshops to maintain standards and share best practices across the network.

This institutional structure is relatively stable through time because these standards ensure high levels of engagement, help coalitions plan for success, encourage consistency, and maintain the network’s reputation. Furthermore, the structure enables coalitions to address unique local needs while concurrently meeting national goals and objectives as they evolve and change across federal administrations. The reporting requirements additionally confirm that coalitions execute the work for which they receive funding and help NREL compile and communicate the national results and impacts of the Clean Cities Coalition Network. Furthermore, this framework facilitates a more flexible mode of governance (to be described in the following sections) in which:

- Diverse and semi-independent members and activities are easily and flexibly organized and reorganized
- Integration is fostered through **interfaces** (online resources such as the Alternative Fuels Data Center [AFDC] and the Coalition Toolbox, as well as in person with technical working groups and regional and national meetings) to share knowledge, tools, and skills and facilitate collaboration. These are configurable to local contexts and accessible to all audiences.

2.2 Semi-Autonomous Local Coalitions

Although supported by national institutions and resources, each Clean Cities coalition is semi-autonomous and makes independent strategic and programmatic decisions. Coalition directors are not representatives of the federal government. Instead, they are independently hired, local leaders who dedicate themselves to the Clean Cities mission. This independence has multiple benefits that allow coalitions to build networks, design creative funding streams, and tailor messaging to local contexts in a manner that national labs or other federal entities cannot. However, forming a coalition necessitates significant support from the local host organization (i.e., local government, planning organization, university, nonprofit). This “buy-in” at the local level contributes to the success of this model by grounding these independent efforts in an existing support structure.

Because coalitions are semi-autonomous and manage their own staffing and hiring plans, coalition staff are frequently hired by and from the community. Coalition directors and employees (full-time, permanent, and interns) have existing knowledge of the local context and experience with the factors that affect the local transportation system. This can expedite familiarization and trust-building with stakeholders and build bridges between DOE, national labs, and transportation stakeholders at national, state, and local levels. Some community-based stakeholders, including local government entities and nonprofit organizations, may have negative associations related to working with the federal government or national labs, but those concerns are less likely to translate to local organizations from within their communities. The degree of separation between coalitions and federal entities can help expand coalition networks to sectors and demographics that national organizations may be unable to connect with themselves.

Funding can be a limiting factor for small organizations, especially stand-alone nonprofit organizations or coalitions housed within another nonprofit. But because coalitions are semi-autonomous vis-à-vis the federal entities they work with, they can identify and create additional funding streams to supplement the funding they receive through DOE. Business models, local partnerships, dues-paying membership structures, consulting services, and external grant funding have all been utilized by various coalitions to increase organizational capacity and financial stability. For example, some Clean Cities coalitions have created “Green Fleets” consulting services that work directly with partner organizations to help identify improvements to the efficiency and environmental impact of their vehicles.

With this semi-autonomy also comes an ability to craft messaging that is tailored to specific local context and priorities. Federally driven initiatives typically develop tools, data, and scientific knowledge that are technology- or fuel-neutral, with priorities that flex with variations in federal administrations. However, coalitions can take those neutral sources of expert information and rework them to connect with local audiences, which may prioritize certain technologies, fuels, or solutions over others based on local resources, political will, existing infrastructure, and other local factors. This semi-autonomous arrangement means that national labs can provide coalitions with neutral national-level priorities, data, and information, and coalitions can adapt those items to add maximum value to their stakeholders. Additionally, coalition staff can organize and collaborate with organizations to educate policymakers about Clean Cities and its impact in ways that DOE and national labs cannot.⁴

2.3 Interdependent Modularity: Balancing Distributed Action With Integration

Modularity is an organizational property that allows network participants to adapt to complex environments. In a platform context, modularity is organized around a network structure that allows interorganizational coordination while lessening the need for overt managerial control (Furlan, Cabigiosu, and Camuffo 2014). Modularity entails partnerships with broader and less focused goals—such as advancing cost-effective, domestic transportation fuels and energy-

⁴ Clean Cities coalitions educate policymakers through Transportation Energy Partners, a national nonprofit organization established to support deployment of advanced vehicle technologies and alternative fuels. Through TEP, coalition leaders organize an annual [Energy Independence Summit](#).

efficient mobility systems—which tend to expand and change over time, incorporating multiple coalition stakeholders and elaborating new projects and activities.

This network structure operates in a way that leverages both national lab resources and expertise, while remaining rooted in communities and stakeholder networks across the United States. On the local level are individual coalitions, led by coalition directors, that work to advance transportation projects in their communities. For example, they provide support to local partners and fleets as they work to reduce their transportation impacts, and they cultivate teams for technology deployment projects. Coalitions share local insights, data, and understanding with national labs and DOE, which improves national data sets, resources, and technical response capabilities.

Those coalitions operate within a structure and are held to rules and standards provided within the overarching framework. Coalitions are divided into seven regions, led by regional managers from DOE’s National Energy Technology Laboratory (NETL), which connect monthly to share progress, exchange ideas, and collaborate on regional projects. Tools, resources, and support are available to coalitions from technical teams at the national labs, keeping coalitions on the cutting edge and increasing their value to local stakeholders. National labs recognize local innovation, collect and package lessons learned and models for success from individual coalitions, and distribute them to other coalitions or bring them to the national level, creating networkwide efficiencies.

Rather than only aggregated or approached from the top down, over the years Clean Cities has developed a relatively intense or reciprocal form of interdependencies between its members. Because of the reciprocal nature of the interdependencies, intermediaries like NREL must engage in more “relational” and catalytic work of orchestration and facilitation to help coordinate them. For instance, NREL and other national labs often act as a conduit between DOE and individual coalitions, identifying synergies between national objectives and local challenges, which is essential to making progress and keeping everyone rowing in the same direction.

In many intentional ways, NREL, Argonne National Laboratory, Oak Ridge National Laboratory, and AFDC—some of Clean Cities’ catalyzers—have created opportunities for relationship-building and collaboration throughout the network. Examples of strategies and tools deployed by NREL and other national laboratories to proactively build an interdependent community include:

- A Peer-to-Peer program where directors can connect one-on-one with another director to strategize and share knowledge
- Peer-to-peer sharing opportunities, including webinars where directors present on their experiences or projects or participate in monthly subject working groups with lab subject matter experts
- “Director 101,” where new directors gather in person to learn about the Clean Cities network’s tools, resources, and expectations from NREL and other directors; connect with a cohort of new directors; and build relationships in their earliest days with the network

- Annual conferences where directors from across the country gather in person to learn, share, socialize, and solidify the long-distance community
- Communications products like fact sheets and guidebooks with science-based information that all coalitions can use, thereby creating a single informational resource for coalitions.

Some of the interdependencies facilitated by the labs’ orchestration efforts are *vertical* (e.g., between DOE, Vehicle Technologies Office, national labs, and coalitions). The Clean Cities network has facilitated cooperation among the national labs (NREL, Argonne, and Oak Ridge) and between the national labs and coalitions at a scale that is atypical in the federal government space. Clean Cities is predicated on cooperation and effective use of resources, and the goals of the network umbrella transcend across all participating parties. National lab teams don’t need to infringe on others’ work because they all have essential roles to play. Collective leadership and the agreed-upon coalition network goals are more important than individual branding or ownership. The impact of this collaboration is shown in the fact that there were 1 million file downloads of publications from the AFDC in fiscal year 2022 alone.

Other interdependencies are *horizontal*—between the constituents and the coalitions themselves. There are several good examples of horizontal partnerships and collaborations that highlight the potential benefits of coalitions working together. Midwest Electric Vehicle Opportunities: Learning, eEvents, Experience (Midwest EVOLVE) was a multi-year, seven-state project that raised awareness and acceptance of EVs across the Midwest. Leaders from Clean Cities coalitions in Illinois, Indiana, Michigan, Minnesota, North Dakota, Ohio, and Wisconsin established local partnerships and reached over 290,000 people through events, digital promotion, social media, and test drives. Intrastate coordination can also add value. The Philadelphia and Pittsburgh directors have developed an informal partnership over the years that leverages their differing skill sets and facilitates information sharing between their two coalitions. Over time, this partnership has developed into a shared reputation for being the “go-to” experts within the state, strengthening the quality of their funding applications, enhancing their networks, and bolstering their coalitions.

This tiered modular network structure has multiple catalytic functions. It allows Clean Cities to stay attuned to federal resources and goals; tap into high-quality analysis, tools, and technical support from national labs; and remain rooted in local context and priorities. This structure also allows for state and local initiatives to be brought to the attention of federal policymakers, helping to inform national policy decisions and provide examples of successful deployment and alternative energy use strategies. One recent example of this is the deployment of EV chargers in Oklahoma. Oklahoma has been extremely successful in deploying their state EV charging network, and coordination between the Oklahoma Department of Environmental Quality and the local Clean Cities coalitions was instrumental in this success. Initial development was prompted by the state’s tax credit for alternative fuel infrastructure, and further build-out occurred as a result of the distribution of Volkswagen Mitigation Trust funds, resulting in Oklahoma having the largest growth of EV charging ports among states since 2018. NREL’s awareness of the Oklahoma Clean Cities activities ultimately led to the state’s success story included in a White House briefing on the Bipartisan Infrastructure Law (DOE 2022).

2.4 Adaptability

Over 3 decades, Clean Cities has been able to adaptively facilitate and manage an array of collaborative networks and projects to evolve and adapt to changing circumstances. Adaptability, or the ability to adjust itself to a complex array of interlocking challenges, is a crucial feature because collaborative platforms such as Clean Cities must frequently identify and/or rediscover their value-added role nimbly and flexibly. Adaptability has been achieved in the following ways.

First, as required by law, Clean Cities has remained technology- and fuel-neutral, allowing the network to pivot with changing DOE and community priorities and resulting in a high level of adaptability. In this context, technology and fuel neutrality means that Clean Cities work does not prescribe specific technologies and fuel types, but rather identifies what coalitions and stakeholders need and adapts its tools and information to address these needs, thus allowing for adaptable and flexible decision-making. Remaining nonprescriptive helps Clean Cities maintain relevance nationwide and is one of the reasons that coalitions of vastly different communities, resources, politics, opportunities, and challenges can all operate under the same network. It also encourages coalitions to support a strategic set of solutions within their community that make sense for different business and use cases, providing informed advice to local stakeholders without being limited by technology-specific funding. The long-standing, consistent, and straightforward goal of petroleum reduction has also contributed to Clean Cities' adaptability. This unifying goal has remained paramount regardless of shifts in administrative priorities and strategies to achieving it are adaptive, utilizing a wide array of technologies, fuels, equipment, and vehicles. Such broad national goals also increase network agility by increasing the ability of coalitions to pivot as new technologies and fuels approach deployment readiness and their communities begin to explore new options.

Second, the Clean Cities Coalition Network has been able to be agile, nimble, and flexible. To maximize inclusion and impact, coalition options are designed to be flexible, and coalitions are offered a variety of ways to engage so they can create the projects and structures that fit their local needs. Many coalition elements are customizable, meaning they can be tailored to the abilities, interests, needs, and limitations of each individual coalition. This is essential to making the coalition network relevant to as many communities as possible and encouraging innovative solutions that fit specific local contexts.

Additionally, coalition activities are designed to be dynamic, changing from year to year as market and stakeholder priorities change. DOE and national labs recognize that community transportation needs evolve and new technology innovations can change the landscape. The network is structured to respond to those changes, maintaining relevance over time by allowing and encouraging coalitions to change direction in response to local indicators and feedback. Examples of this programmatic flexibility and agility include:

- Annual statement of project objectives agreements between DOE and coalitions offers a list of optional subtasks, which encourages coalitions to capitalize on local opportunities, leverage their unique skills, and do work that they are excited about. Coalitions know best how to engage with their communities and stakeholders and what unique role they can serve among their partners, and different coalitions may be better suited for certain

project types than others. This annual task selection also allows for year-to-year variation as the market and stakeholder priorities change.

- Under a pilot in which NREL managed the Clean Cities subcontracts for a set of 12 coalitions, NREL launched a new initiative to allow for even more individualization of subtasks, offering a “flex-fund-project option.” This option is a strategy to create more project innovation, recognizing that local coalitions are well-suited to identify projects that further the goals of Clean Cities, but the identified projects might not be achievable under the contract with NETL. The flex-fund model allows coalitions to propose those projects for funding.

Third, DOE and the national labs have decided to remain nimble to use and adapt their tools and knowledge to the needs and priorities of Clean Cities coalitions. DOE and NREL’s extensive communication with coalitions and the upward transfer of insights from end users, local stakeholders, and community members allows DOE to respond swiftly to changing markets and community priorities. The quantitative and qualitative data that coalitions collect and share are packaged by NREL and transferred to DOE, where, importantly, they are *used* to inform DOE strategy. DOE can design national funding opportunities and projects to align with market trends and local needs and challenges, and they can adapt to rapid changes in transportation technologies and systems. National laboratories can use the information to inform their activities. The work with Clean Cities helps DOE stay on the same page with community needs and technology deployment—and stay relevant and impactful.

3 Institutional Continuity and Positive Feedbacks

The Clean Cities network is unique as a technology deployment and technical response initiative in that it has been funded continuously by DOE for 30 years and has lasted through six federal administrations. This consistent funding and mission are both an outcome of the network’s demonstrated impact and a key determinant of success, as this funding consistency has allowed coalitions to flourish over time. They are given the time and resources to build trust, lasting relationships, and successful coalition teams and projects in their region because they have a reliable funding stream and constant presence.

However, money is not enough to explain success. Scholarship suggests that positive feedbacks or network effects generate collaborative platform ecosystems (Ansell and Gash 2008). These positive feedbacks are often created when the platform facilitates “open innovation,” which in the Clean Cities ecosystem has allowed directors to access and utilize its resources and infrastructure for their own purposes and create value via collaboration. Four types of positive feedbacks are at the heart of Clean Cities’ success in widening and deepening innovation: attractor effect, learning, leverage, and synergies (Figure 3).

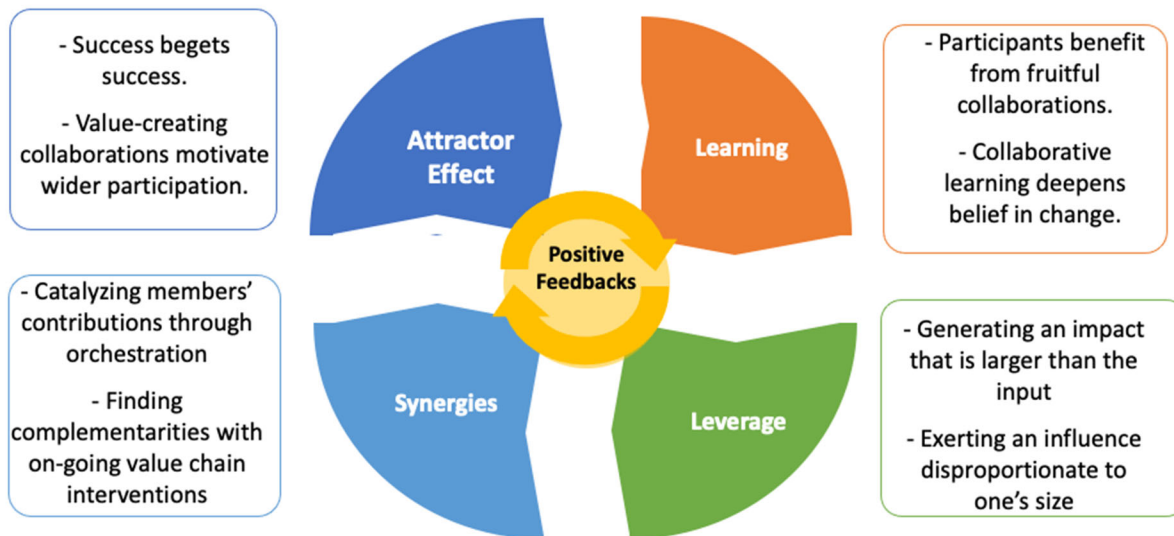


Figure 3. Institutional continuity and positive feedbacks

3.1 Attractor Effect

Success begets success, and reputation, trust, and collaboration are some of the key components of Clean Cities' attractor effect. DOE has allowed coalitions to build and maintain reputations as local, trusted, and knowledgeable sources of support and information. As opposed to traditional national laboratory technology deployment or technical support projects, where the lab joins partners with a community on a limited-term basis to execute a limited scope, Clean Cities coalitions operate within communities over years or decades. They remain embedded in local contexts and can be uniquely successful at developing trust and a positive reputation among local transportation stakeholders. This trust—a harbinger of success—can increase communities' willingness to partner and minimize the introductory period for technical response or deployment projects because there is already familiarity among collaborators and the coalition is already familiar with local circumstances.

Clean Cities has promoted value-creating collaborations, which then feed back to motivate wider participation. For instance, if a coalition decides to launch a new local project, NREL can connect them with someone that already has experience, templates, and tools from a similar past project to help them leap ahead in their planning process. Templates and guidance from successful projects can be shared across the network either through one of the online platforms (e.g., AFDC, Coalition Toolbox, online document sharing platform) or in response to a direct request. This documentation allows coalitions to tap into the collective knowledge and expertise of the network to create new programs, support local stakeholders, or develop new skills. As one NREL staff member explained, “What coalitions are looking for might already exist in a public document or resource,” and it's the lab's role to connect them with that information.

3.2 Learning

By working collaboratively, all parties in the Clean Cities network have been able to learn something about the nature of the issue that leads them to expand or adapt their collaborative effort. For instance:

- Clean Cities directors are provided training and educational opportunities from the time they join their coalitions, but they are not specialists on every vehicle, fuel, or transportation technology. There is a network of technical experts at national labs that are poised and ready to provide support, information, and resources as necessary to help bridge knowledge and experience gaps. Furthermore, given the diversity of coalition types, host organizations, and the educational and professional backgrounds of coalition directors and staff, expertise is also leveraged horizontally in peer-to-peer exchange among directors. Beyond highly technical skills, this expertise includes membership building, working with state agencies, and grant writing. At times, NREL and other national labs facilitate this peer-to-peer learning through dedicated workshops and events.
- Systems like the Technical Response Service and Tiger Teams are in place to allow coalition staff to access a diverse pool of experts through a single access point, knowing they will be connected to the right expert for a given issue. Technical Response Service representatives are seasoned experts who help directors find answers to technical questions about alternative fuels, fuel economy improvements, idle reduction measures, advanced vehicles, and Clean Cities and related resources.
- For more complicated technical and market challenges, Tiger Teams can be deployed to provide more in-depth consultation services to help fleet stakeholders plan their technology or deployment strategies or tackle vehicle operational or technical issues after deployment has begun (DOE 2016).
- Coalitions are provided with robust, high-quality resources such as the AFDC and Coalition Toolbox, developed at national labs, that bring expertise to the coalition as they engage with local stakeholders.

Collaborative knowledge acquisition can deepen the commitment of members to participate and has been found to be related to belief change (Lee 2022). Because collaboration and open communication are encouraged, it is rare that a coalition must start from scratch on a new project. Project documents, templates, and guides can be taken from one successful project and adapted to kick-start another project in an entirely different location. Clean Cities coalitions are also encouraged to help other directors brainstorm solutions, which they do with great success. Under the Peer-to-Peer program, NREL supports experienced directors to act as mentors for other directors. Coalition directors are connected with others who are interested in launching similar projects, tackling challenges they have already mastered, or operating in parallel circumstances and could use some insight forged from experience. National labs also facilitate coalition-led skills trainings, working groups, panels, and strategy sessions that allow coalitions to learn from the expertise of their peers. This type of network exchange and collaboration places each coalition's starting point far ahead of a local project propping itself up independently, which makes implementation more efficient and effective.

These are some examples of how Clean Cities has created feedback loops of positive learning precisely because all members from DOE, national labs, and coalitions have learned how to work together in fruitful ways and build upon this knowledge in their subsequent interactions.

3.3 Leverage

Leverage is the “process of generating an impact that is disproportionately larger than the input” or “exercising an influence disproportionate to one’s size” (Thomas et al. 2014). Clean Cities has successfully utilized leverage through strategies such as developing shared information resources, online training, data, and analysis tools that can be recombined, thereby facilitating coordination and adaptive innovation. For instance, NREL communicates trends in cutting-edge research through new informational resources including brochures, fact sheets, trainings, webinars, and podcasts, ensuring coalitions have the breadth of resources they need to continue to be knowledgeable, trusted assets to their state and local decision makers, stakeholders, and fleets. Coalitions can be on alert for future funding opportunities that might align with these new trends, identify local projects, and establish project teams.

Clean Cities has built on members’ preexisting efforts and motivations by starting where members are and seeing value in and supporting coalitions’ ability to connect with stakeholders early and often, even before funding opportunities arise or projects require a certain expertise. The network recognizes that each partner can bring value to a project at any particular time, and their connections, resources, and insights will eventually be needed. Having a broad array of partners already established along the technology and functional continuum is critical to successful project planning, proposals, and execution in the future.

For example, the three coalitions in Connecticut worked together to provide critical and timely support for school districts in their state to apply for Volkswagen Mitigation Trust funding for electric school buses. Coordinating resources, the coalitions were able to guide and support grant teams at the interested school districts over a 6-week period. Each coalition supported several districts, ultimately enabling them to secure \$12.7 million for seven school districts and 42 electric buses. The ability to leverage relationships and funding—to cite some—has been quintessential in the Clean Cities network. The network is built on them, and without them the coalition network would not exist. The success of a coalition is predicated on its ability to build and maintain these relationships. While this project was specific to an upcoming funding opportunity, the work done by the coalitions enables the fleets to be prepared for other funding opportunities.

Furthermore, despite coalition staff turnover that occurs at a rate of 15% to 25% annually, the longevity of the coalition network, combined with that turnover, has had the benefit of creating a robust network of coalition alumni—former Clean Cities directors, staff, and interns—who have leveraged their time with Clean Cities to launch into new roles within industry, government, environmental organizations, and other nonprofits and community-based organizations. Those alumni are familiar with the Clean Cities network and its contribution to clean transportation technology deployment and technical support and are well suited in their new roles to act as advocates for collaboration and engagement with their local coalitions. They expand the network’s reach, becoming connectors to new stakeholders and partners on future projects. Because the Clean Cities Coalition Network is so dependent on relationships and stakeholder networks, this alumni network is a great leverageable asset.

3.4 Synergies

Clean Cities coalitions have created synergies by bringing members together with interactive knowledge, information, skills, tools, resources, and perspectives. Unlike many technical support and deployment programs in which information and technology are delivered to a stakeholder unidirectionally, the Clean Cities network is built on omnidirectional flow of knowledge and information that creates synergies by enhancing national understandings of local problems while providing technically sound solutions that fit local needs. Resources, data, and insights flow from DOE to coalitions and national labs, from national labs to coalitions and DOE, from coalitions to national labs and DOE, and among/between coalitions. National labs are often in the middle of this flow of knowledge and information, acting as an orchestrator, conduit, and translator between communities, coalitions, industry partners, stakeholders, and DOE. In some cases, DOE will have direct feedback loops with coalitions, which happens more frequently after a coalition has received direct funding for a project from DOE through a funding opportunity announcement.

Synergies are (re)created through constant communication between Clean Cities, national labs, and DOE that takes place through many different avenues: monthly regional calls, webinars, trainings, working groups, listening sessions, one-on-one discussions, regional meetings, Technical Response Service and Tiger Teams, local and national conferences, and the annual networkwide meeting. Resources and tools are also constantly being created, published, and updated, and are communicated using an online discussion forum, social media, a web-based collaborative document management platform, Clean Cities University (online training), an online toolbox, quarterly and annual reports, fuel price reports, station and vehicle data reports, newsletters, case studies, and even a podcast. These robust communication channels create trusted relationships and allow intermediaries such as NREL to represent members' diverse perspectives in a fair way through good orchestration and by finding complementarities with ongoing value chain interventions that reach all coalitions where they are, through their preferred means.

4 Concluding Remarks

This report has laid out the collaborative framework, nimble structure, and iterative feedback mechanisms that have made and continue to make Clean Cities a powerful model of long-term collaborative governance. As calls for equity, inclusion, and community-driven research and development are increasingly structured into policies and programs, Clean Cities can also become a model for how to design community-centered innovations and solutions that align national objectives with local goals and visions. Local communities—their knowledge, expertise, and vision—are embedded in the *modus operandi* of Clean Cities.

The current Clean Cities Energy and Environmental Justice Initiative is taking the Clean Cities collaborative model a step further by training coalitions how to center, work with, and benefit the most disadvantaged communities in their regions. This process builds on the existing coalition skills of meaningfully engaging their communities and building trusted relationships. The goal of this new initiative is to begin redressing the structural inequities of the past by focusing projects and programs on meeting the needs, addressing the barriers, and realizing the aspirations of historically overburdened and underserved communities.

Future programs aiming to impact local communities at a national scale have much to learn from this process. This includes how to center people and communities, utilize various forms of expertise, balance diverse stakeholders' interests and needs, and ultimately design solutions that do not require changes in behavior or motivation for actual use because they are designed *with* and *for* the very communities of practice that utilize them.

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