POLICY PAPER

# Enhancing Community Acceptance of Small Modular Reactors

**Dr. Minji Jeong**
Senior Research Specialist
mjeong@efifoundation.org

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900 17th Street NW, Suite 1100, Washington, DC 20006

# About the Author

## Dr. Minji Jeong, PhD

*Dr. Minji Jeong is a Senior Research Specialist at the EFI Foundation, where she provides research and analysis on evidence-based solutions for the clean energy transition based on her background in business, research, and policy. Prior to EFI Foundation, Jeong was a post-doctoral fellow at the Brookings Institution, where she researched sustainable infrastructure finance and a framework to scale up sustainable infrastructure investment in collaboration with Inter-American Development Bank, Harvard University, and Boston University. Jeong also spent eight years working for SK Innovation, a Seoul-based energy company. She developed corporate climate change strategies, coordinated across the business units to implement the strategies, and managed several low-carbon energy projects, such as establishing the company's greenhouse gas inventory system and internal emission trading system, and supporting developing countries' efforts to respond to climate change in Vietnam, Malaysia, and Thailand.*

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# Executive Summary

As the U.S. attempts to stand up a small modular reactor (SMR) industry to meet domestic and global net zero goals, successful deployments rely upon communities that are willing to accept the costs and benefits associated with these new projects. Project developers need willing communities to host SMR power plants, in addition to the upstream and downstream infrastructure, such as SMR component manufacturing, fuel fabrication and spent nuclear fuel facilities (taken together as “SMR facilities”). Aside from financial return considerations, capital providers (e.g., commercial lenders, private equity, etc.) are unlikely to place new nuclear in their portfolios if surrounding communities reject these projects. This is especially the case as many institutional investors increasingly weigh social impact as part of their portfolio screening criteria.

Given that SMR facilities will not be deployed without interested host communities, a well-informed understanding of specific communities’ perception of hosting SMR facilities, rather than generalized public perceptions of nuclear, is salient from a bankability perspective.

Despite this importance, there has been little research on the drivers that shape potential host communities’ positions regarding SMR facilities. Existing studies on social acceptance of nuclear technology largely focus on the public’s acceptance of the technology (i.e., a generalized, “macro” view), whose drivers are different from those of specific communities’ acceptance. Moreover, most examinations of nuclear energy are focused on legacy conceptualizations of large scale reactors, rather than SMRs. While a few papers have focused on community-level impacts of advanced nuclear through techno-economic analyses or the lessons learned from siting other energy infrastructure, these papers have little analysis on how communities would perceive broader impacts of SMR facilities.

This study investigates the factors shaping community positions on hosting SMRs and relevant facilities, from upstream (e.g., manufacturing and fuel front end) to downstream (e.g., spent nuclear fuel repositories). Given the urgency of successful first deployments of SMRs, this study focuses on the communities that have already expressed interest in learning more about SMRs. These are likely to be the first movers in hosting SMR facilities.

This study aims to better understand how communities that accept nuclear energy *technology* may become those that host nuclear energy *infrastructure*. Through an administered survey and semi-structured interviews with community residents interested in SMRs, local and state leaders, industry, and federal employees, this study offers research several findings and nine recommendations to policymakers and industry decision-makers to enhance community acceptance of SMRs.

Table 1
**Summary of Findings and Recommendations**

| Finding | Recommendation | Purpose |
|---|---|---|
| Finding 1. **Economic and social benefits are the strongest drivers of community acceptance of SMR facilities**. | **Recommendation 1.** Project developers should place SMRs within a larger economic development narrative, working with potentially new as well as existing industries to ensure long-term and recurring economic and social benefits to host communities. | To enhance community acceptance of the first instances of SMR facilities |
| Finding 2. **Energy is a critical part of the residents' lives in nuclear legacy communities and coal communities; hosting a facility has identification significance** | **Recommendation 2.** Project developers should reach out to diverse and small groups of local stakeholders in potential host community before project public announcements. This will help developers understand the energy industry context of the community and align SMR facilities' contributions to the community's preferred development path. | |
| Finding 3. **Communities want full information on the impacts of SMR facilities from an unbiased group that knows technologies, their communities, and how to communicate and engage.** | **Recommendation 3a.** Nuclear industry associations, in collaboration with project developers, independent scientists, and scholars, should build a database to inform potential host communities on cost estimates, risks, and benefits of SMR facilities. | |
| | **Recommendation 3b.** The Office of Nuclear Energy at the Department of Energy (DOE-NE), working with the Office of State and Community Energy Programs (DOE-SCEP), should fund and support local groups for building and disseminating knowledge regarding SMRs. | |
| Finding 4. **Communities willing to host SMR facilities find that challenges regarding public acceptance to nuclear projects exist at the state level, rather than at the community level.** | **Recommendation 4a.** DOE-NE, working with national labs, should develop educational materials for the general public, focusing on how SMRs mitigate and manage health, environmental, and accidental risks. | To enhance general acceptance of SMR technology broadly for ongoing deployments |
| | **Recommendation 4b.** State governments, with the support of DOE-NE and DOE-SCEP, should build internal knowledge of the role SMRs can play in achieving the economic, environmental, and social goals of the state and communities. | |

| | | |
|---|---|---|
| Finding 5. **The lack of a clear and implementable national pathway for nuclear waste management is a top concern of all stakeholders, including potential host communities.** | **Recommendation 5a.** At the planning and capacity-building stage of the consent-based siting process for federal consolidated interim storage of spent nuclear fuel, DOE-NE should develop the options for creating long-term and recurring economic and social benefits to host communities. These should be based on the needs and preferences of interested communities. | |
| | **Recommendation 5b.** DOE-NE, in collaboration with the Office of Congressional and Intergovernmental Affairs (DOE-CI), should start communicating with states when communities in their jurisdictions express interest in being considered as a potential host community of spent fuel facilities. | |

These recommendations aim to i) increase the likelihood of acceptance from interested communities that may host the first SMR facilities, and ii) lay the groundwork for continued deployment of SMR facilities.

For the first few deployments, project developers will likely pursue siting with communities that have already expressed some interest in nuclear. To enhance the probability of “yes,” developers must engage early, demonstrate projects will provide sufficient benefits to interested communities, and, with partnership from the nuclear industry and trusted, local groups, provide complete and trustworthy information (Recommendation 1-3b).

For long term scale-up of SMR deployments, general public acceptance of SMR technologies is required in addition to host community acceptance. To achieve this, recommendations on public education, knowledge and capacity building, engagement with a broad range of stakeholders, and nuclear waste management are proposed (Recommendation 4a-5b).

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# 1. Introduction

As the U.S. attempts to stand up a nationwide, small modular reactor (SMR) industry to meet domestic and global net zero goals, successful deployments rely upon communities that are willing to accept the costs and benefits associated with these new projects. Project developers need willing communities to host SMR power plants, in addition to the upstream and downstream infrastructure, such as SMR component manufacturing, fuel fabrication and spent nuclear fuel facilities (taken together as “SMR facilities”). Aside from financial return considerations, capital providers (e.g., commercial lenders, private equity, etc.) are unlikely to place new nuclear in their portfolios if surrounding communities reject these projects. This is especially the case as many institutional investors increasingly weigh social impact as part of their portfolio screening criteria.

Given that SMR facilities will not be deployed without interested host communities, a well-informed understanding of specific communities’ perception of hosting SMR facilities, rather than generalized public perceptions of nuclear, is salient from a bankability perspective.

Public opinion of nuclear energy in the U.S. has been consistently split in recent decades; SMRs may inherit this divided public acceptance of nuclear energy. SMRs may also carry a different perception than traditional nuclear reactors, namely due to their not-yet-demonstrated economic viability and enhanced safety features. Potential host communities may also perceive SMRs differently than large nuclear plants, or other energy production facilities, due to the smaller number of jobs created during construction and operation, and facility siting closer proximity to the host community. Beyond the SMR power plants themselves, other facilities in the SMR supply chain, such as i) fuel production and assembly facilities, ii) manufacturing plants of SMR-related components or equipment, and iii) spent nuclear fuel storage facilities (taken together herein as “SMR facilities”) must also be accepted by nearby communities yet may pose differentiated perceived risks and benefits.

In the near term, investors' focus should be placed on the potential host communities' acceptance of SMR facilities rather than the general public's acceptance of the technology. However, there has been little research on how potential host communities of SMR facilities shape their positions on hosting SMR facilities, specifically. There has been extensive research on the social acceptance of nuclear energy in general, yet it is not clear the extent to which this general perception applies to the specific SMR setting. A few recent studies on advanced nuclear technology in communities tend to focus on techno-economic impacts on communities or the lessons learned from the examples of siting other energy infrastructure. Taken together, these existing studies provide little analysis on how communities would perceive the impacts of SMR facilities.[1,2,3] This attempts to close this gap.

Overall, three groups of communities have emerged as potential host communities of SMRs: legacy nuclear communities, communities with retired/retiring fossil fuel-fired power plants, and communities with industrial facilities committed to decarbonization (Table 1). Some nuclear legacy communities may be interested in hosting SMRs due to familiarity with nuclear technology, an experienced workforce, and additional resources or infrastructure, like national laboratories. On the other hand, some communities with fossil fuel-fired power plants are motivated to host SMRs to maintain the local economy and employment after their existing fossil fuel-fired plants retire. To the communities already hosting industrial facilities, SMRs may be more accepted if existing industrial facilities with net-zero goals or high demand growth deem them to be critical to maintaining operations. For example, communities surrounding DOW's Seadrift Operations welcomed the company's selection of the Seadrift site for new SMR deployment to produce zero-carbon power and steam for its facilities.[4]

Table 2
**Emerging groups of potential host communities of SMRs**

| Group | Motivation | Emerging examples |
|---|---|---|
| Nuclear legacy communities | Existing familiarity and experience in nuclear facilities and resources (e.g., national laboratories, legacy fuel production sites, etc.) | • BWRX-300 (GE Hitachi) in Clinch River, Tennessee: Early site permits, Oak Ridge National Laboratory located nearby<br>• Aurora (Oklo) in Piketon, Ohio: Former site of Portsmouth Gaseous Diffusion Plant |
| Communities looking to replace retired/retiring fossil fuel-fired power plants | Maintain local economy and employment after fossil plants retire | • Aurora (Oklo) in Piketon, Ohio: Former site of Portsmouth Gaseous Diffusion Plant |
| Communities with industrial facilities committed to decarbonization | Industrial facilities within the community need clean energy for decarbonization | • Aurora (Oklo) in Piketon, Ohio: Former site of Portsmouth Gaseous Diffusion Plant |

**This study focuses on these emerging groups of communities, and how these communities that notionally accept nuclear energy *technology* are inclined to become those that host nuclear energy *infrastructure*.** According to DOE's 2023 Advanced Nuclear Commercial Liftoff Report, a committed order book of at least 5-10 deployments of a single reactor design must be started by 2025 to catalyze commercial liftoff of advanced nuclear reactors in the United States.[5] Part of enabling this demand is to quickly find suitable sites in which the proximate communities are amenable to hosting such facilities.

This study aims to shed light on the factors that shape the positions of interested communities in hosting SMR facilities, and the challenges for these communities to host SMR facilities. This study defines "communities" through a geographic lens; a community includes all individuals and groups, such as local policymakers, local interest groups, and proximate residents, who share physical, overlapping public places.[6]

To examine the forces which determine community perceptions of SMR facilities, a survey approach coupled with semi-structured interviews were conducted with representatives of

the communities notionally interested in SMRs, as evidenced by their participation at the second annual Nuclear Development Forum of the Energy Communities Alliance (ECA) in May 2023.[a]

The 2023 ECA Forum was designed to "bring communities, SMR and advanced nuclear project developers, federal and state governments together to enable shared learning and to build the partnerships necessary to address opportunities for new nuclear development."[7] The goals of the Forum included providing resources for communities considering "whether and how to support advanced nuclear energy projects." Given the purpose of the ECA Forum, this study presumed that the majority of Forum participants were at least tepidly interested in SMRs, a fundamental parameter that was later verified by the responses of survey participants.[b] The survey was distributed to 225 participants at the ECA Forum, resulting in 95 responses with a 42 percent response rate. Findings were also gathered from 23 semi-structured interviews selected from a subset of the survey respondents. Lastly, participant observations of the sessions of the 2023 ECA Forum and author composed case studies also provided data for this study.

In sum, this study marks one of the first attempts to understand the key drivers in how potential communities perceive host SMR facilities. As this study focuses on the communities already supportive of SMRs, the results of this study have implications for stakeholders looking for first mover communities. The findings of the study, however, should not be generalized to all communities across the United States, only those that are potential hosts.

This report reviews the current understanding of social acceptance of nuclear technology, describes five findings on community acceptance of SMR facilities, and provides recommendations to policymakers and industry decision-makers to enhance community

[a] The Energy Communities Alliance (ECA) is a membership organization of local governments adjacent to or impacted by U.S. Department of Energy activities. In 2020, ECA established a new initiative, the *New Nuclear Initiative,* to help define the role of local governments in supporting the development of new nuclear technologies, for both DOE and non-DOE legacy communities alike. ECA's annual New Nuclear Forum is held under the auspices of the New Nuclear Initiative.
[b] A 92 percent of survey participants responded that they were positive or very positive on SMRs. An 8 percent of the participants responded that they were neutral. None of the participants responded that they were negative on SMRs.

acceptance of SMR facilities and mitigate the challenges that potential host communities face.

# 2. Background: Current Understanding of Nuclear Technology Social Acceptance

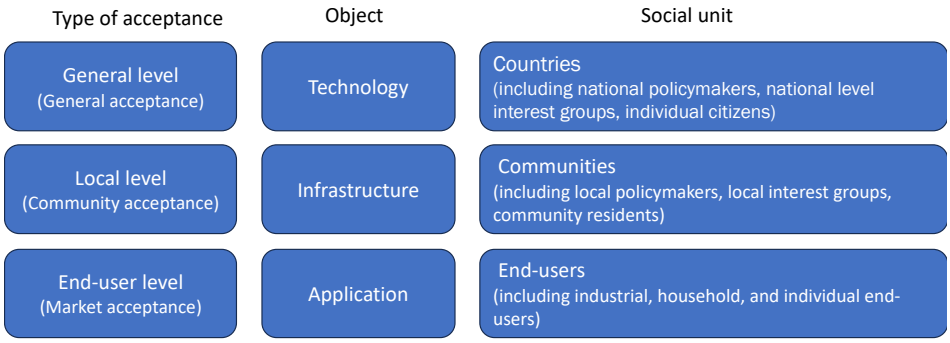
Social acceptance of new energy technology and infrastructure has become increasingly important given the urgency to build new, carbon-free energy infrastructure at an accelerated pace. Many economic, sociological, and psychological studies have investigated the factors affecting social and public reactions to various energy technologies, infrastructure, and applications from the country, local, and household levels. The concept of "social acceptance" can be defined as "a favorable or positive response relating to a proposed or in-situ technology or socio-technical system, by members of a given social unit."[8] Put another way, it refers to the general public's attitude towards a specific energy technology, reflecting support or opposition to specific energy infrastructure.

## 2.1 Differentiating General vs. Community Acceptance

For successful deployment of a specific energy technology, three levels of social acceptance are needed: general, local, and end-user (Figure 1). At the general level (general acceptance), the object for acceptance is a specific energy technology in general (e.g., advanced nuclear energy technology, solar power, wind power, etc.), and the social unit of acceptance is typically a particular country. At the local level (community acceptance), the object for acceptance is a specific, proposed project (e.g., proposal to construct and SMR facility within a specific community), and the social unit of acceptance is the community living nearby. At the end-user level (market acceptance), the object for acceptance is a specific energy application (e.g., a utility's plan to build SMRs and the implications to ratepayers from a cost and benefit standpoint), and the social unit of acceptance is end-users.

There is an interrelationship across levels. For example, a community resident may oppose building SMRs in her community due to her opposition to nuclear energy in general. Therefore, these different types of acceptance should be considered together for the successful deployment of an energy technology. [c]

**Figure 1: Types of social acceptance of energy technology[9]**



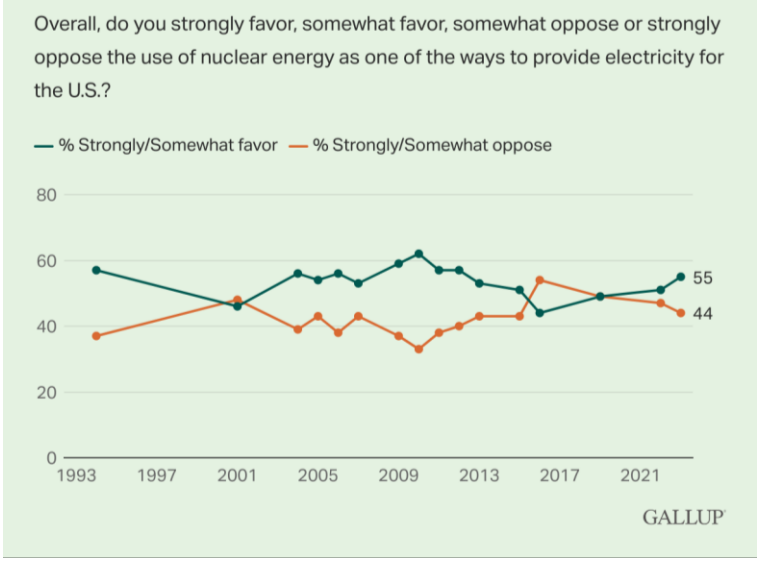

*Source: Adapted from Upham et al. (2015)*

General acceptance of nuclear energy is divided. A systematic literature review of public opinions of U.S. citizens shows nuclear energy with a 62 percent favorability rating at its height in 2010 at the country (U.S.) level; since then, it has been less than 60 percent (Figure 2).

A few surveys show the potential for higher general acceptance of "advanced" nuclear technologies vis-à-vis traditional ones. The national survey conducted by Bisconti Research showed that more than 80 percent of the survey respondents agreed that "our nation should prepare now so that advanced-design nuclear power plants will be available to provide electricity" in the last three years.[10,11,12] According to the survey conducted by ClearPath, Potential Energy Coalition, Third Way, and RePlanet in 2023, 76 percent of U.S. respondents agree that "advanced nuclear should be an important part of the solutions to the energy challenge."[13] However, these surveys did not clearly answer how the U.S. public would perceive the actual "use" of advanced nuclear technologies to provide energy within the United States.

[c] Among three levels of social acceptance, this section focuses on general acceptance and community acceptance. Market acceptance will be covered in the companion study on cost stabilization for SMR orderbooks.

**Figure 2: Americans' opinions of nuclear energy, 1994-2023**[14]




*Source: Brenan (2023)*

General acceptance of nuclear energy is driven by various factors, such as knowledge, perceptions of risks, benefits and costs, trust, gender, and education. Research on public perceptions of energy technologies, including nuclear energy technology, suggests that providing information about the technology is not enough to enhance general acceptance; rather, value propositions, such as trust, and perceptions of benefits, risks, and costs, significantly influence general acceptance.[15] A meta-analysis of 34 empirical studies on the acceptance of nuclear energy found that general acceptance of nuclear energy was primarily affected by benefit and cost perceptions, while science knowledge, perceived risks, trust, and gender have relatively smaller impacts.[16]

# 2.2 Community Acceptance and its Drivers

Community acceptance, in contrast to general acceptance just discussed, is more relevant to developers and industry stakeholders, as infrastructure can impact a local community's economy, workforce, and identity. Importantly, community acceptance of nuclear energy infrastructure is driven by different factors from those of general acceptance**,** as community residents consider the direct impact of projects due to proximity.

Community acceptance of nuclear energy infrastructure is affected by multiple factors and are contextual based on the local conditions of the community. Previous studies have identified no single dominant driver of community acceptance. Moreover, obtaining acceptance within a community is a complex, dynamic process whose actors are continuously being reconsidered and redefined.[17] Thus, local contexts of each potential host community need to be thoroughly understood when considering nuclear infrastructure development.

The not-in-my-backyard (NIMBY) phenomenon has been commonly used to describe the discrepancies between general acceptance and community acceptance of various energy infrastructure, but recent studies showed mixed results on the existence of NIMBYism depending on local contexts.[18,19,20,21] A review of NIMBY literature identified that less than half of the studies detected the presence of NIMBY phenomenon.[22] For siting nuclear facilities, several studies observed the “reverse-NIMBY” phenomenon. An experiment in Japan showed that low-income people residing near nuclear power plants saw more benefits, such as the mitigation of local air pollution, than risks.[23] A case study of the Waste Isolation Pilot Project (WIPP) identified that acceptance of WIPP was greater among the residents living the closest to the WIPP facility, and acceptance was also greater among the residents living closest to the nuclear waste transportation route.[24] A study of nuclear waste repository siting in Nevada found that opposition to the repository was the strongest in the communities farthest from the site, Yucca Mountain.[25] In the Czech Republic, the residents located near nuclear power plants supported rebuilding the plants, primarily influenced by their general perceptions of the benefits of nuclear power.[26]

Physical proximity alone does not fully explain community acceptance of energy infrastructure. Scholars have studied other factors influencing community acceptance, such as trust, perceived benefits, perceived risks, attitudes to the technology, and the values and identities of a community. A study found that the residents living in polluted and stigmatized places were more likely to support hosting relatively greener energy infrastructure.[27] The more the residents valued their community and its future, the more likely they were to accept a spent nuclear fuel repository in a municipality in Finland.[28] There have been mixed results on the impact of the nuclear experience of the community and its acceptance of nuclear

facilities.[29,30] Perceived risks were also found as a significant factor influencing community acceptance of nuclear facilities in multiple studies.[31,32]

# 3. Research Method to Illuminate Drivers of Community Acceptance of SMRs

This study takes a mixed methods approach, combining depth and breadth in understanding the community acceptance of SMR facilities. Using an online survey tool coupled with in-depth interviews and event observation, data concerning community acceptance of SMRs was gathered from 2023 Energy Communities Alliance (ECA) Nuclear Development Forum participants. The ECA is a non-profit, membership organization of local governments adjacent to or impacted by U.S. Department of Energy (DOE) legacy nuclear activities. ECA brings together local government officials to share information, establish policy positions, and promote community interests to address an increasingly complex set of constituent, environmental, regulatory, and economic development needs.[33] The ECA Forum is an annual event highlighting topics related to nuclear energy for local community, state, and federal decisionmakers; developers; utilities; Tribes; experts; financiers; lawyers; legislators; community groups; and economic development organizations.[34] New nuclear, i.e. SMRs featured prominently in the 2023 ECA Forum.

An online survey was carried out from May 10 to June 7, 2023. Prior to distribution, the survey questions were tested multiple times internally by the research team and externally by representative participants. 95 responses were received out of 225 participants who received the link to the survey, resulting in a 42% response rate. The survey respondents were asked to select one stakeholder group with which they most identify among four groups:

- Local, Tribal, or state leadership (local, tribal, or state government representatives; appointed, elected or career staff)
- Nuclear industry (developer, operator, manufacturer, EPC, etc.)
- Federal government

- Other (members of Tribal Nations[d], community residents, community organizations, advocacy groups)

Given that both “local, Tribal, or state leadership” and “other” are individuals and groups sharing places, they are defined as communities in this study. Federal government was separated from the rest of the communities with the assumption that leaders representing a certain region may have different perspectives. Respondents selecting “other” were regarded as residents who do not make decisions as the representative of a community. The term “community” was not used in any survey question because it can be interpreted differently by respondents.

Given these definitions, 32 respondents (34%) selected “other” (community residents), 36 respondents (38%) selected local/Tribal/state leadership, 17 respondents (18%) selected nuclear industry, and 9 respondents (10%) selected federal government. A markedly high proportion of respondents (92%) expressed that they were positive or very positive about SMRs, with the remaining 8% as neutral. This verified the study’s assumption that the Forum participants were interested in SMRs.

Except for several common questions in the beginning, each stakeholder had differentiated questionnaires. Community residents and local/Tribal/state leadership were asked to respond to a series of questions on their perceptions, positions, and how they would like to be engaged on hosting each of four kinds of SMR facilities:

- SMR power and heat plant
- Nuclear fuel production and assembly
- SMR manufacturing plant of components and equipment
- Spent nuclear fuel storage

[d] Although the survey intended to have Tribal leaders and members, none of the respondents were from Tribal Nations.

Industry and federal government respondents were asked to respond to a series of questions on their perceptions of the impacts of four SMR facilities and their opinions on community engagement.

At survey conclusion, all survey respondents were asked if they would be interested in being interviewed. Those that responded in the affirmative, along with those recruited onsite at the Forum were asked to sit for a semi-structured interview. Taken together, this lead to 23 interviews: 12 community residents, 10 local and state leaders, and one federal employee. Five interviews were virtual, and 18 interviews were in-person. The interviews lasted 15 to 60 minutes, depending on the interviewee. A pre-determined interview protocol and semi-structured questions were used for each interview. All interviews were transcribed with the consent of the interviewees.

Four project team members participated in the ECA Forum, observed the sessions, and conducted informal conversations with the participants. The transcripts and memos obtained through participant observation were also used as input data to the analysis.
Survey data was analyzed using Microsoft Excel. The transcripts and memos collected through semi-structured interviews and participant observation were coded and analyzed using MAXQDA. Both deductive and inductive coding processes were utilized based on research questions and emerging themes.

# 4. Findings and Recommendations

Five themes on community acceptance of SMRs emerged from the data analysis:

- Finding 1: Economic and social benefits are the strongest drivers of community acceptance of SMR facilities.
- Finding 2: Contributing to the energy economy is a critical part of the residents' lives in nuclear legacy communities and coal communities; hosting a facility has identification significance.
- Finding 3: Communities want full information on the impacts of SMR facilities from an unbiased group that knows technologies, their communities, and how to communicate and engage.
- Finding 4: Communities willing to host SMR facilities perceive that the locus of challenges exists at the state level rather than at the community level.
- Finding 5: The lack of a clear and implementable national pathway for nuclear waste management is a top concern of all stakeholders, including potential host communities.

Based on these findings, this chapter offers recommendations to policymakers and industry decision-makers.

## 4.1 Finding 1: Economic and social benefits are the strongest drivers of community acceptance of SMR facilities.

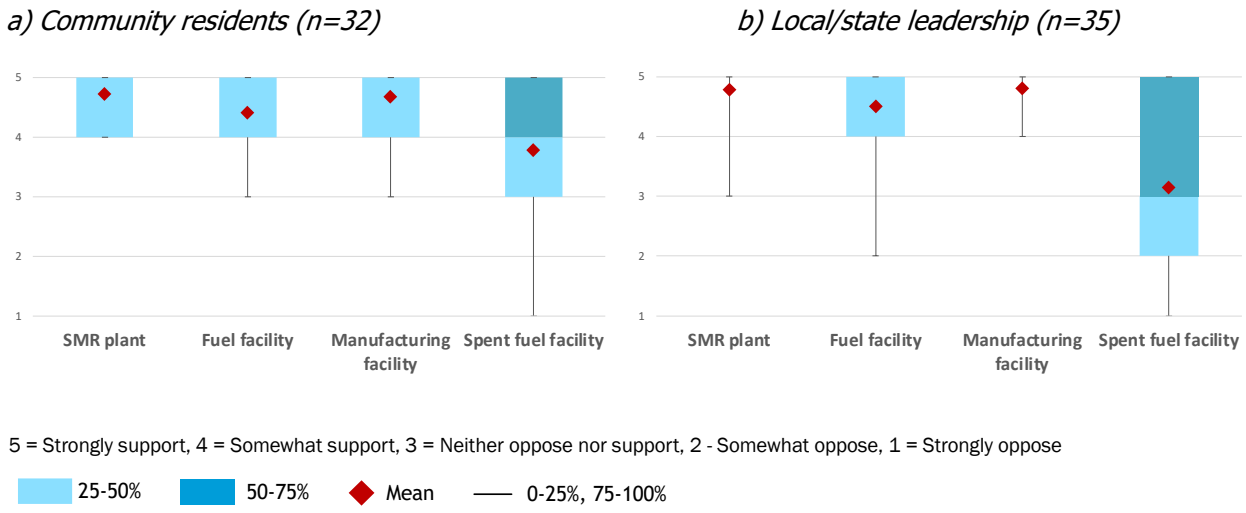
In sum, economic and social benefits are the most important drivers of community acceptance of SMR facilities. The expected benefits are long-term and recurring, such as attracting industries, creating new jobs, and providing reliable energy sources to the community and the state, rather than short-term compensation. An SMR plant was a preferred facility for communities because it would provide sustainable benefits. A spent fuel

facility was the least preferred for communities, as the perceived job benefits from the facility are modest, and a negative reputation could deter other industries and jobs.

Communities that accept SMR technology generally support hosting any of the four facilities in their communities, with different degrees of support depending on the facility. Community residents strongly support hosting an SMR plant and a manufacturing facility, while support was modest for hosting a spent fuel facility (Figure 3-a). Local/state leaders showed similar patterns of positions with community residents except for a spent fuel facility; they were neutral in hosting a spent fuel facility on average, but the variance of the position was high (Figure 3-b).

**Figure 3: Positions on hosting SMR facilities**

*What would be your position on hosting [a facility] within 10 miles of where you live/in a community under your jurisdiction?*



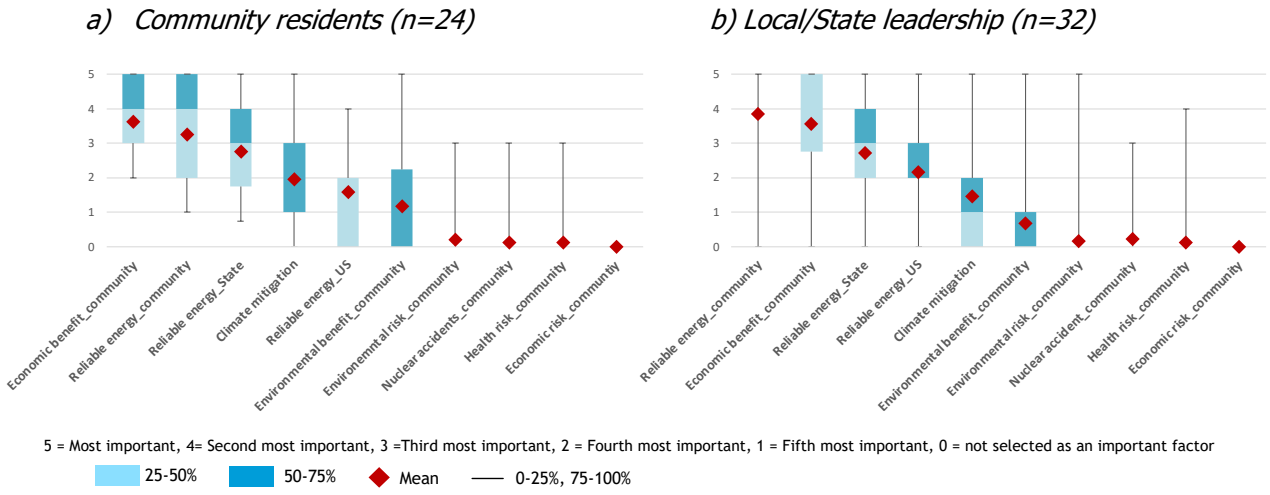

## 4.1.1 SMR Plant: Economic benefits and energy security are the strongest drivers of acceptance

For both community residents and local/state leaders, economic benefits and energy reliability are the strongest motivators to host an SMR plant (Figure 4). Both groups strongly prioritized the benefits of SMRs over the risks. Such risks—environmental risk, nuclear

accident risk, health risk, and economic risk—were rarely selected as one of the top five most important factors.

**Figure 4: The factors shaping the position on hosting an SMR plant**

*Please rank in order of importance the [by the respondent in the previous question] factors influencing your position on hosting an SMR plant within 10 miles of where you live/in a community under your jurisdiction.*




Communities supported hosting an SMR plant as they believed it would be a new "economic powerhouse," attracting jobs and industries seeking clean baseload power and heat.[35] Communities with substantial energy-intensive industries predict that an SMR plant could replace retiring fossil assets that provide energy to industries. An interviewee from a coal community said, "we have a lot of these industries that consume very high amounts, large amounts of energy, and with these coal-fired plants shutting down, we've got to find another source."[36] Another interviewee agreed with the potential role of an SMR plant as a replacement for carbon-intensive power plants: "We also have three power generators, natural gas power generating stations here, and eventually those are going to go offline….We think that small modular reactors are the most ideal replacement for that power."[37] In addition to providing energy to existing industries, communities also expected that an SMR plant would attract new industries: "You can attract additional industries. There is an opportunity for hydrogen plant to come in…when Georgetown [Kentucky] built Toyota, there were about 25 smaller industries that followed behind."[38]

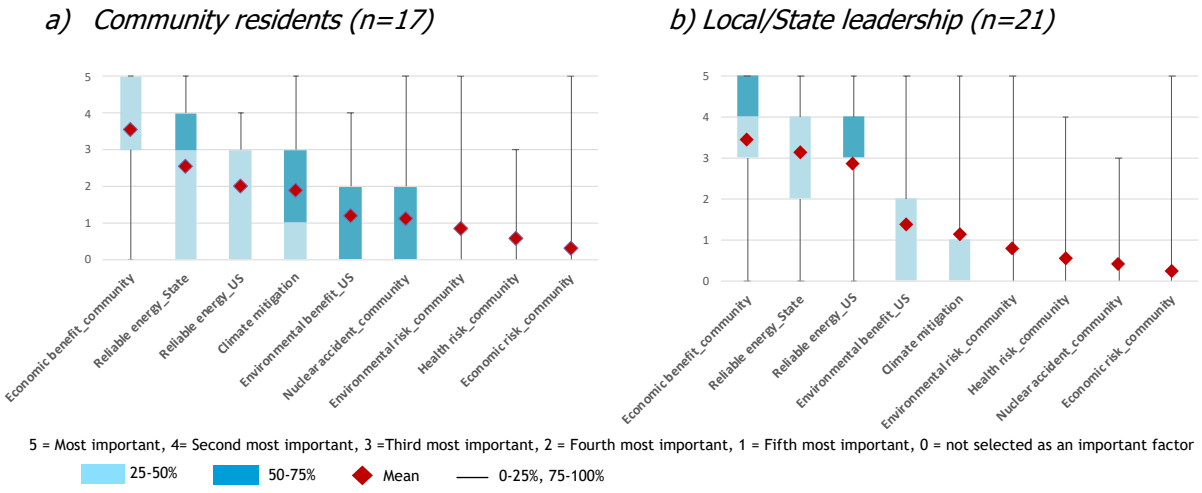
A few interviewees expressed concerns regarding the affordability and safety of SMR plants. An interviewee from the community with plans to deploy an SMR plant said, “The cost (of an SMR plant) is much higher than we first started.”[39] Local government officials’ concerns on the cost impact were also pointed out: “…in that [city council] meeting… a local elected official got up and said, I’m worried about the price impacts to all of my citizens.”[40] Safety concerns were not a major factor affecting the positions, but a few interviewees mentioned its significance. An interviewee said the project developer should prove that “it’s a safe model and it’s not a Three Mile Island model” to get his support.[41] Another interviewee pointed out that the risks were acceptable to him, but others in his community may be concerned.[42]

## 4.1.2 Fuel Facility: Economic benefits and energy security are the strongest drivers of acceptance, despite a modest level of perceived environmental and accidental risks

Community economic benefits and state and national level energy reliability were the most important factors affecting community acceptance of a fuel facility. Although both groups strongly prioritized benefits over risks, on average, the risk of nuclear accidents and the risk to the host community's environment were selected as the fifth most important factor among nine factors, affecting the positions of community respondents and local/ state leaders, respectively (Figure 5). This result infers that community residents and local/state leaders have more concerns about hosting a fuel facility than an SMR plant on a comparative basis.

**Figure 5: The factors shaping the position on hosting a fuel facility**

*Please rank in order of importance the selected [by the respondent in the previous question] factors influencing your position on hosting a fuel facility within 10 miles of where you live/in a community under your jurisdiction.*



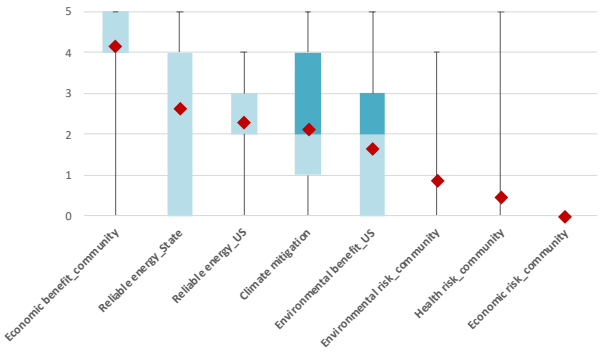
## 4.1.3 SMR Manufacturing Facility: Economic benefits and energy security are the strongest drivers of acceptance

Community economic benefits and state and national level energy reliability were the primary drivers of community acceptance of an SMR manufacturing facility. Like the perceptions of an SMR plant, the benefits were strongly prioritized over the risks, and the risks were barely selected as one of the important factors affecting community positions (Figure 6).

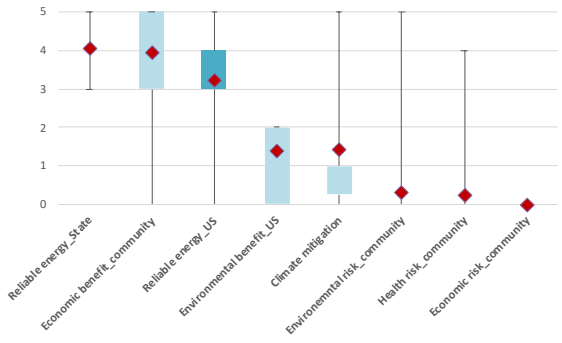
**Figure 6: The factors shaping the position on hosting an SMR manufacturing facility**

*Please rank in order of importance the selected [by the respondent in the previous question] factors regarding your position on hosting a manufacturing facility within 10 miles of where you live/in a community under your jurisdiction.*

*a) Community residents (n=17)*




*b) Local/State leadership (n=16)*




5 = Most important, 4= Second most important, 3 =Third most important, 2 = Fourth most important, 1 = Fifth most important, 0 = not selected as an important factor

25-50% 50-75% Mean 0-25%, 75-100%

## 4.1.4 Spent Fuel Facility: Economic benefits and energy security are the strongest drivers of acceptance, but concerns regarding economic, environmental, and accidental risks are more prevalent compared to other SMR facilities

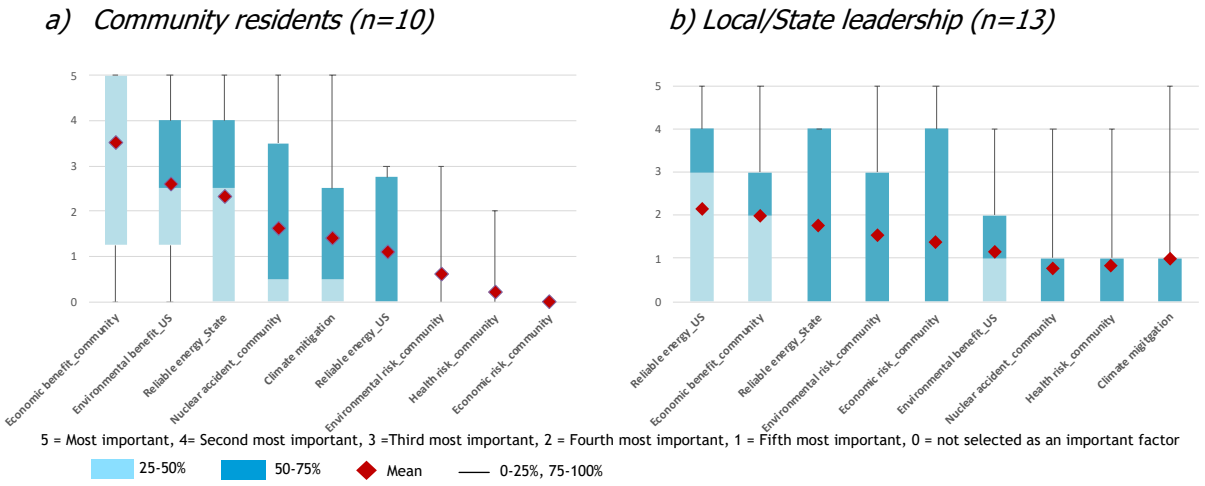
Both community residents and local/state leaders showed the most concern about hosting a spent fuel facility compared to other SMR facilities. This explains the community residents' modest support and a high variance of positions among local/state leaders for hosting a spent fuel facility, as shown in Figure 3.

Community economic benefits, state and national level energy reliability, and national level environmental benefits were key considerations to host a spent fuel facility. Although these benefits were prioritized over risks, both communities and local/state leaders showed concerns about the risks of hosting a spent fuel facility. Risk of nuclear accidents was the fourth most important factor for community residents out of nine factors (Figure 7-a) and environmental risks and economic risks to the community were the fourth and the fifth most important factors of out of nine factors for local/ state leaders (Figure 7-b). It is notable that economic risks were significant concerns of local/state leaders, but the least important factor for community residents.

Data from interviews and case studies indicate that local/state leaders care about economic risks, such as a negative image of the region, since economic risks broadly affect their constituents or at least are perceived by most constituents.

**Figure 7: The factors shaping the position on hosting a spent fuel facility**

*Please rank in order of importance the selected [by the respondent in the previous question] factors influencing your position on hosting a spent fuel facility within 10 miles of where you live/in a community under your jurisdiction.*




Communities indicated that a spent fuel facility may not bring measurable economic benefits. Most interviewees regard spent fuel as a byproduct that should be managed rather than a product creating economic benefits, except for a few supporters of fuel recycling. Several interviewees mentioned that a spent fuel facility would create a modest number of jobs.[43] Alternatively, some interviewees expressed that a spent fuel facility could bring economic risks. One interviewee indicated that the community with waste disposal "already had a hard time attracting jobs because there's like a perception that there's not a skilled workforce."[44]

Communities were also concerned that a spent fuel facility might create concerns of safety and fear. One interviewee pointed out that hosting a spent fuel facility is "more fear-based" since "the half-life of radioactive material will outlast my generation and the next generation and my grandchildren's generations."[45] She added that new technology may mitigate the risks for now, but there is uncertainty related to future risks, such as war or natural disasters: "Who ever thought that there would be a war that would put a nuclear facility not only in jeopardy of being shot up, but not being maintained? … You've got Japan, who's a recent example when the tsunami hit, so there's lots of cases out there that enhance the fear level."[46]

### 4.1.5 High-level Recommendation: Ensure community long-term and recurring economic and social benefits

Pairing industrial facilities with SMRs to provide clean power and heat is perceived to increase economic and social benefits to the host community, thus enhancing social acceptance. Securing energy sources for industrial facilities may also alleviate concerns of many communities with retiring fossil plants.

***Recommendation 1. Project developers should place SMRs within a larger economic development narrative, working with potentially new and existing industries to ensure long-term, recurring economic and social benefits to the host communities.***

Project developers should coordinate with industries in need of clean firm power and consider co-locating their facilities with SMRs. Additionally, if project developers build partnerships with industries at the early phase of community engagement, developers and local stakeholders can align on the industrial future of a community.

Co-location can offer benefits to the host community, such as a job creation, larger tax revenues, or a positive reputation for innovation. While SMR plants alone may lead to a modest number of permanent jobs, co-location enhances job growth prospects. For example, the construction phase of an SMR project in Idaho Falls would create 1,000 construction jobs, but is expected to drop to 360 annual, permanent jobs in the operational phase.[47] On the other hand, an integrated green energy center project, including data

centers, hydrogen hub, and SMRs, in Surry County, Virginia expects to generate up to 3,000 jobs in the area. The influx of thousands of employees would reverse a 20-year population decline in this county of about 6,500 residents.[48]

Project developers should work with existing industries in the potential host communities as well. One concern of communities is that, if local fossil plants retire, existing industrial facilities would lack reliable energy. Project developers need to discuss with existing industries how SMRs can provide clean power and heat to their facilities. If the project developer earns the support of the existing industrial facilities, communities will likely be more supportive of SMRs.[e]

## 4.2 Finding 2: Energy is a critical part of the residents' lives in nuclear legacy communities and coal communities; hosting a facility has identification significance.

Energy is a way of life for legacy nuclear and coal communities. Energy has provided employment, sustained the local economy, attracted industries, and created a source of pride.

Nuclear energy is a critical part of identity in legacy nuclear communities. Interviewees from these communities said that nuclear facilities have been part of their families', friends', and neighbors' lives. One interviewee said, "We all grew up with [the uranium enrichment plant] here, and so it was part of our lives. Families worked there. It provided a living for everybody here."[49] Another interviewee said he went to a high school named after a DOE nuclear site, and they were very supportive of nuclear technology.[50] An interviewee shared her experience studying with "crazy smart" kids whose parents worked at the national labs; to her, nuclear technology has always been something smart people understand.[51] For some

[e] As mentioned, the Sea Drift community welcomed an SMR project brought to the facilities of the local industrial company, DOW.

communities, nuclear facilities have been a source of pride: “I think this is a community that [feels] really strongly about the contributions it’s made for the Cold War and Post-Cold War, and there’s a strong sense of pride in the contributions that they’ve made.”[52]

People from nuclear legacy communities rarely expressed negative perceptions of nuclear facilities. An interviewee said, “there’s potential danger associated with nuclear, but [it] really hasn’t been a part of the fabric of this community.”[53] Another interviewee added: “I’ve lived in a DOE community my entire life. My parents worked at a DOE site. So, for me, it doesn’t bother me.”[54] One interviewee pointed out that his community is “much more comfortable with nuclear” because many people in the community “work in the science,” and the nuclear power plant nearby has safely operated for 40 years.[55]

Legacy nuclear communities tend to prefer nuclear facilities over other energy facilities. For example, a 2011 survey of residents on the future use of a former nuclear enrichment site in Piketon, Ohio, identified a nuclear power plant as the most preferred option for new development, followed by green energy production, industrial park, and national research and development facility, respectively.[56] This support for nuclear facilities led to the Southern Ohio Diversification Initiative’s (SODI) agreement with Oklo to deploy two nuclear reactors at the site of former enrichment site.[57]

People from coal communities also emphasized how important coal is for their communities. A state government official said that “[coal] has just been a way of life” in his state.[58] Local governments depend on taxes from coal mining. This creates serious issues when plants retire.

Though coal communities prefer coal, interviewees also know the future of coal is limited—“we like coal in Kentucky, but nobody, hardly anyone else does. So, we’ve got to do something different.”[59] Another interviewee added, “I know that coal mines cannot operate forever, and I think there is a lot of opportunity for…that next generation of who would-have-been coal miners to… get involved in the new energy economy.[60]
As a critical part of their communities, coal community members hoped that new energy facilities could embrace coal in some ways. An interviewee indicated that state officials

would be more supportive if coal was incorporated into the conversations about the energy pathways.[61] A speaker at the ECA Forum also emphasized the importance of "bringing coal into the conversation about nuclear" to promote nuclear energy across Kentucky.[62]

### 4.2.1 High-level Recommendation: Align SMR facilities' contributions to the host community's preferred development path.

Project developers should work with communities to create benefits that align with a potential host community's long-term development path. This requires early engagement.

***Recommendation 2. Project developers should reach out to diverse, small groups of local stakeholders in a potential host community before a public announcement of the project. This will help developers understand the energy industry context of the community and align SMR facilities' contributions to the community's preferred development path.***

New energy facilities will become a critical part of the community's identity. As such, the impacts of SMR facilities should be aligned with a host community's development pathway. In the early phases of project development, project developers should understand the priorities and concerns of a potential host community to inform the SMR facilities' potential contributions to community development. For example, coal communities prefer incorporating coal into the conversation of an energy transition. As such, project developers could work with a coal community on developing plans for repurposing coal facilities or using transferable skills of coal workers.

Aligning project development with a potential host community's preferred development path requires substantial conversations with diverse and small groups in the community. Only through sufficient breadth and depth of conversation can the developer understand the identity, priorities, and concerns of a community.

## 4.3 Finding 3: Communities want full information on the impacts of SMR facilities from an unbiased group that knows technologies, their communities, and how to communicate and engage.

Survey results indicate that communities prefer to receive i) full information on the impact of a facility and ii) direct engagement from key non-community stakeholders. These actions are likely to be most influential in determining a communities' position on hosting an SMR facility.

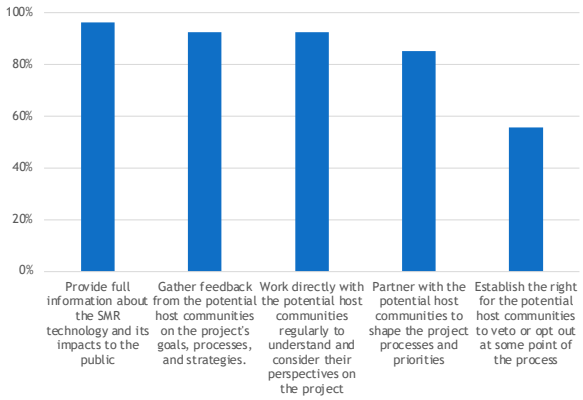
Communities want full information about SMR facilities and an opportunity to absorb, react, and provide feedback to information.

When asked what actions a non-community member can take to influence a community's position on hosting an SMR facility, more than 95 percent of the community residents and local/state leaders preferred receiving full information about the SMR technology and its impacts on the public (Figure 8). Community residents also showed strong interest in direct engagement. More than 90% of the respondents indicated that working directly with the host community and gathering feedback as approaches that could influence their position (Figure 8-a). Several survey respondents commented that non-community stakeholders should be "a good listener" and understand communities' concerns.

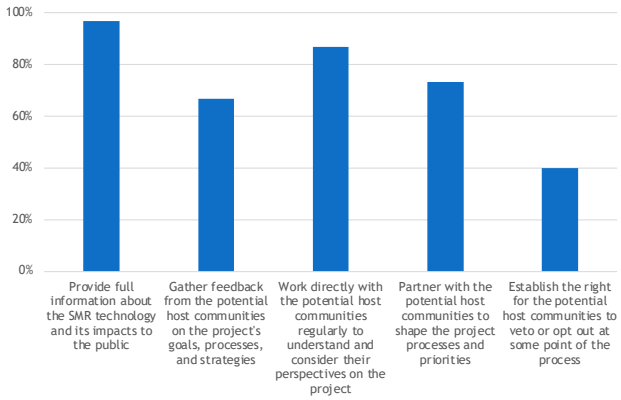
**Figure 8: Non-community stakeholders' actions to influence community acceptance of SMRs**

*Please select all actions that a non-community stakeholder could take to influence your position on hosting an SMR-related facility*

*a) Community residents (n=27)*




*b) Local/State leadership (n=30)*

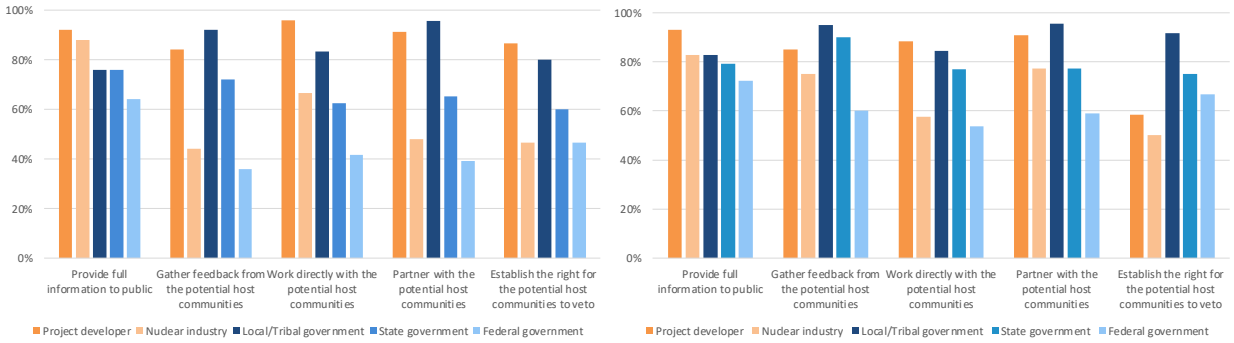



Project developers and the nuclear industry (e.g., industry associations, industry experts) are expected to play a key role in providing information to the public, while local and Tribal governments are expected to be involved in direct engagement with the host communities. Project developers and the nuclear industry were selected by 92 percent and 88 percent of the community residents, respectively, to provide information about SMRs to the public (Figure 9-a). For direct engagement, such as partnering with potential host communities, local and Tribal governments play key roles. 96 percent of community residents and 95 percent of local/state leadership responded that local and Tribal governments should be involved in partnering with potential host communities (Figure 9).

**Figure 9: Role of stakeholder groups in community engagement**

*In your opinion, which of the following stakeholder groups should be involved in each action that you selected?*

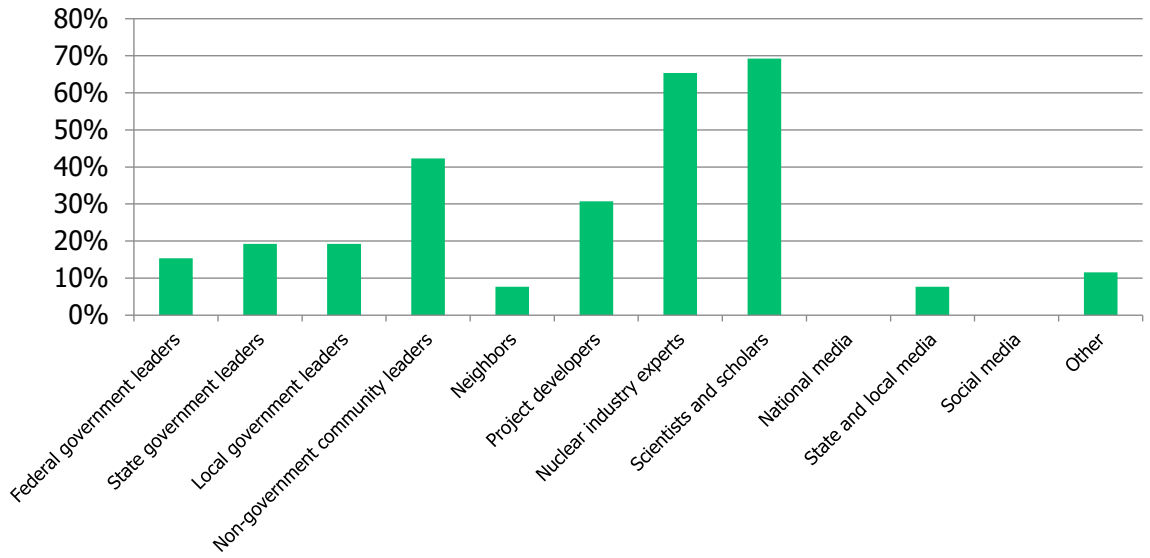
a) Community residents (n=26) b) Local/State leadership (n=30)




**Although communities want project developers to provide information to the public, communities prefer other sources of expertise**. Community residents selected nuclear industry experts, scientists and scholars, and non-government community leaders as the most trusted sources of information about the impact a local nuclear facility (Figure 10). Only about 30 percent of respondents selected project developers as a trusted source of information. Federal, state, and local government leaders were trusted by less than 20 percent of the respondents. This suggests that scientists and scholars, nuclear industry experts, and community leaders ought to play an important role in community outreach and education activities.

**Figure 10: Communities' most trustworthy sources of information**

*Please select up to three most trustworthy sources who you would seek for reliable information about the impacts of a project to build a nuclear facility within 10 miles of where you live. (n=26)*




**Communities want to base their decision to host an SMR facility on facts that are made accessible.** One survey respondent commented that scientists and scholars need to share the "facts" and "let the community decide whether the facility aligns with their priorities and values." An interviewee indicated that communities need "scientists and chemists who really can tell you everything that's going on, not somebody who's trying to sell you something."[63] Another survey respondent commented, "(nuclear industry's) promises without definitive proof will not be enough." Communities need scientific information about the health and environmental risks of the technology and proof showing the new nuclear technology poses minimal risk to human health and the environment.

Both community residents and government officials emphasized the importance of basic education on nuclear technology for diverse audiences. A community representative suggested that DOE and industry need to give civic leaders a "nuclear 101" education.[64] "Fun nuclear programs" included in K-12 education were recommended as the single best thing that state and local governments can do.[65] A local government official emphasized that government officials should learn about nuclear facilities or at least know the experts they could consult.[66] Another government official suggested a forum for state government

officials to learn the basics of nuclear energy.[67] They commonly indicated that education needs to be done in the language that non-technical citizens understand. One interviewee mentioned that “most engineers talk in languages that the average person doesn’t understand or doesn’t care.”[68]

Several interviewees recommended that project developers start small-scale engagements with local leaders. An interviewee suggested “finding local partners early on that already have the trust in the community,” such as the Chamber of Commerce, school boards, unions, or community colleges.[69] He continued that they may host conversations with community residents even if they are not supportive. Another interviewee recommended that project developers “reach out a little further in the community” slowly before “get the politicians.” He suggested getting “the guy that runs the ball field,” the head of the Lions Club, and local pastors and bringing more people in gradually from the community.[70] Before town hall meetings, “there has to be multiple layers of information” at the schools or on the local news.[71]

There were some cautionary perspectives from communities directed to project developers and other non-community stakeholders. One interviewee argued that nuclear companies “[don’t] give a damn about communities over anybody” or do “PR rather than real engagement.”[72] A survey respondent commented that state and federal employees have also done little for meaningful community engagement; “too often the industry and state/federal employee-complex send folks who the general public reads as arrogant or distant, folks who are afraid to share bad news equally with good news, or folks that are such whole-hearted cheerleaders for the facility that no one trusts their evaluation of risks.”

### 4.3.1 High-Level Recommendations: Empower knowledgeable and trusted groups to lead knowledge dissemination and educate communities and relevant stakeholders

**Communities want complete information about SMR facilities. Communities also want to be informed by groups they trust, namely those that listen to and understand communities’ priorities and concerns.** A single entity cannot fully conduct this role.

Nuclear industry associations in combination with the national labs and academia could build the information that communities need to make a hosting decision. Local groups could disseminate the information and educate communities based on the understanding of their communities and the trust of their communities.

***Recommendation 3a. Nuclear industry associations, in collaboration with project developers, scientists, and scholars, should start building a database for community engagement, including the costs, risks, and benefits of SMR facilities. This data can come from aggregating data from simulated, planned and ongoing projects.***
Academic and non-commercial nuclear industry experts are one of the most trusted sources of information about the impacts of a nuclear facility on interested communities. Since communities have more trust in these kinds of nuclear industry experts over project developers, nuclear industry associations could serve a role in informing interested communities by gathering and integrating the data on the costs, risks, and benefits of SMRs. The aggregated data should be based on simulated, planned, and ongoing projects rather than on overall industry assumptions. Communities interested in SMRs will likely see proof at the project-level rather than optimistic industry-level assumptions. Gathering project-level data requires collaboration with project developers. Scientists and scholars should be involved in the process to ensure that the database is robust, unbiased, and complete. Since scientists and scholars are trusted by communities, their participation in the process likely will enhance the trustworthiness of the database.

Although cost concerns were not frequently mentioned among interested communities, plant cost is likely to become critical as the high cost and cost uncertainty of first-of-a-kind (FOAK) SMRs are better understood. For example, a community moving forward with and facing the financial realities of hosting an SMR plant showed concerns about the rising cost estimates of the plant. If SMR project developers do not transparently communicate these risks and uncertainty around project implementation at the early phase of engagement, rising cost estimates and delays over the project lifecycle could damage the trust between project developers and communities.

Nuclear industry associations in collaboration with national labs and academia should start gathering data from planned and ongoing SMR projects, including all available data on costs, environmental and health risks, and economic and social impacts on host communities. This database should be available for interested communities, project developers, and even the public to use to make informed decisions. Project developers should inform the potential host community about the risks and uncertainty of the project based on the database, enabling the community to work on mitigating or sharing the risks and uncertainty with relevant stakeholders in the early phases of the project.

***Recommendation 3b.*** ***The Office of Nuclear Energy at the Department of Energy (DOE-NE), working with the Office of State and Community Energy Programs (DOE-SCEP), should fund and support local groups for building and disseminating knowledge on SMRs and advanced nuclear technology.***

Many community leaders and residents do not have sufficient knowledge of SMR technologies and their impacts on communities to make informed decisions. This makes it difficult for project developers to facilitate constructive discussions with local stakeholders on specific benefits and risks of an SMR facility. Educating communities about SMRs can lay the groundwork for meaningful stakeholder engagement.

DOE-NE and DOE-SCEP should collaborate to fund and support local groups as the channel for on-the-ground knowledge building and education of SMRs. Local groups would be better educators since they are trusted by communities and can act on behalf of their communities' identities, priorities, and concerns. DOE selected 13 groups located in diverse regions in the U.S., which would serve as information, engagement, and resource hubs for consent-based siting for spent nuclear fuel in June 2023. A similar initiative could be pursued to inform and educate communities about SMRs.

Many local groups are knowledgeable on nuclear technology, such as grassroots nuclear advocacy groups, active community reuse organizations (CROs), or local universities with nuclear programs. Among these groups, DOE-NE and DOE-SCEP should select and fund groups that have or potentially could develop robust SMR knowledge. These organizations could communicate with diverse stakeholders, including citizens without familiarity with new

nuclear technologies. A coalition of multiple groups could be effective. For example, a nuclear engineering program in a local university can collaborate with a social science department and a grassroots advocacy group to better message and communicate their knowledge with communities. CROs could also be considered as educators since they have knowledge and experience in nuclear technology, community development, and experience in engaging with diverse stakeholders (Box 1).

Box 1

### The Potential of CROs as SMR Educators

CROs were originally funded by federal grants for communities affected by DOE's legacy nuclear weapons production mission. DOE hoped CROs would help communities affected by legacy site issues chart their own economic development future. From 1993 to 2001, 15 CROs emerged across the country. Although no CRO remains funded by DOE, several CROs are still active, including Savannah River Regional Diversification Initiative (SRSCRO), Tri-City Development Council (TRIDEC), Community Reuse Organization of East Tennessee (CROET), Southern Ohio Diversification Initiative (SODI), Paducah Area Community Reuse Organization (PACRO).

Active CROs can serve the role of educating communities and stakeholders by leveraging their knowledge and experience at the intersections of nuclear technology, community development, and engagement with diverse stakeholders. As CROs are led by local stakeholders, such as mayors, commissioners, scholars from state and community colleges, industry representatives, and non-government community leaders, they are experienced in incorporating different perspectives on technology, energy infrastructure, and community development. In addition, many of them are interested in hosting nuclear facilities in their communities. For example, SODI signed an agreement to host two micro modular reactors (MMRs) at the former site of Portsmouth Gaseous Diffusion Plant.

## 4.4 Finding 4: Communities willing to host SMR facilities perceive significant challenges exist at the state level rather than at the community level

The communities interested in hosting SMR facilities see siting challenges at the state level rather than within their communities. Although the host community, project developer, and the federal government may agree on siting a nuclear facility, the project will not progress without agreement from a wider group of stakeholders at the state level. Currently, eleven states have restrictions on the construction of new nuclear power facilities.[f] Even in the

[f] The states with nuclear ban include California, Connecticut, Hawaii, Maine, Massachusetts, Minnesota, New Jersey, New York, Oregon, Rhode Island, and Vermont. Connecticut partially repealed the moratorium to allow new build in the existing plant in 2022.

states without a nuclear ban, state stakeholders, such as legislators, governors or anti-nuclear groups could pose challenges for siting nuclear facilities by establishing new laws or advocating anti-nuclear policy changes.

Communities that are willing to host SMR facilities are concerned about state stakeholders preventing the siting of nuclear facilities in the state. If the technology is unlikely to be accepted by the state stakeholders, a community in the state may not accept hosting SMR facilities due to concerns about the eventual failure of the project.

Multiple interviewees pointed out that getting an agreement from the "state community" on hosting SMR facilities could be challenging. An interviewee said, "I think our community would embrace further nuclear, but…trying to get a larger community, in our case, the state community, the state political base, to see it the same way… that's what's really hard."[73] Another interviewee indicated that the positions on nuclear facilities are divided in her state: "We have heard that folks in big cities, particularly coastal cities, say we don't want nuclear, we don't want nuclear in our backyard, we also don't want nuclear in our state. And then we have folks in a little bit further inland saying we need jobs, we have a history with nuclear, we would be happy to host that nuclear and provide power."[74]

Expected negative reactions of anti-nuclear groups outside the community were also a concern of the communities. An interviewee said, "We have a very strong anti-nuclear group up in northern New Mexico, and they seem to think that they have domain over our area…we know the risks, and we understand the risks, and it really is bothersome that people up in the northern part of the state, who will not anyway be affected by this project, tend to think that they are stakeholders."[75] Another interviewee added, "there's a lot of kind of watchdogs, and there's a lot of maybe skepticism about the safety of nuclear and all that waste that somewhere over there in eastern Washington and so I'm concerned that if we proposed having expanded our waste storage in our area, then that would cause a knee jerk reaction, negative reaction or pushback from people outside the community, and it might make it a lot harder for us to do the things we really want to do, like new nuclear reactors and new advanced fuel manufacturing."[76]

State stakeholders outside the community may be less accepting of nuclear facilities as risks are more salient than benefits. An interviewee explained, “A lot of times people see that well, I’m not going to benefit from (a nuclear plant located three hours away by car), but if something happens, I could be in danger. Truthfully, that’s probably not the case…but the perception of risk is there.”[77] Another interviewee also indicated that the people in his state had “mental, psychological” barriers to nuclear energy: “You can throw SMRs, then they think bomb.”[78] He added that the three accidents—Three Mile Island, Chernobyl, and Fukushima—scared people, stayed in people’s mind for decades, and it is very difficult to change.

State legislators and governors are influenced by their constituents’ concerns about nuclear technology. A speaker at one of the sessions of the ECA Forum indicated that the main population centers in Washington, New Mexico, and Nevada are not close to nuclear facilities, but have different opinions about nuclear facilities, and these populations are more influential in state politics.[79] Showing support or opposition to nuclear facilities could create political risks for state legislators or governors in the states where opinions on nuclear energy are split.

The influence of state stakeholders in siting decisions, and the different perceptions of benefits and risks between local and state stakeholders, suggest that the efforts to site nuclear facilities should include engagement with a wide array of stakeholders beyond the host community. Further, efforts to tailor projects such that benefits are created, and risks are mitigated, should consider both local and state stakeholders. While expected benefits from nuclear facilities may be enough for the host community, they may not be enough for the state to take accompanying risks.

### 4.4.1 High-Level Recommendations: Educate and work with a broad group of stakeholders

Governors, legislators, and the state citizenry outside of the community must be informed about SMR technology and its impacts. As the concerns of state stakeholders focus on the risks of the facilities rather than the benefits, the information on SMR facilities risks and the

measures to minimize these risks should be provided to potential state stakeholders. In addition to public education, state governments should be equipped with knowledge on SMRs, with the support of the nuclear industry and the federal government. The current nuclear community--such as DOE-NE, national labs, and the nuclear industry—should engage with various groups of people to gain more support for nuclear energy and SMRs.

***Recommendation 4a.* DOE-NE, working with national labs, should develop educational materials for the non-technical public, focusing on how SMRs mitigate and manage health, environmental, and accidental risks.**

Educating a wider array of stakeholders, such as state government officials, state citizens, media, or advocacy groups, on SMR technology and its impacts can help protect an interested communities' nuclear ambitions. Many educational materials on SMRs exist, but most do not focus on the public's most significant concern—how SMRs mitigate and manage health, environmental, and accidental risks. While the potential host communities prioritize the benefits of SMRs, a wider group of stakeholders are concerned with SMR risks.

Current information about SMRs, developed by DOE-NE, national labs, and the nuclear industry, tends to focus on the economic benefits of SMRs. For example, the DOE-NE's webpage on "benefits of small modular reactors" lists "modularity, lower capital investment, siting flexibility, greater efficiency, safeguards & security/nonproliferation, U.S. industry, manufacturing, and job growth, and economic development" as the benefits.[80] These are the benefits that the nuclear industry, the supporters of nuclear energy, or an interested community might care, but this may not resonate with the broader public. Alternatively, this study's findings indicate that the public would be more interested in whether SMRs minimize the risks of accidents like the Three Mile Island, Chernobyl, and Fukushima.

Building upon emerging and existing information on SMRs, DOE-NE should develop publicly available materials for non-technical citizens in collaboration with the national laboratories that have expertise in both advanced nuclear technology and stakeholder engagement. The materials include the assessment of health, environmental, and accident risks of SMRs, and how the risks could be minimized by technology development, policy measures, or industry

actions. The materials should be disseminated via websites of DOE-NE and national labs for the public and actively be shared with the state, Tribal, and local governments interested in new nuclear facilities, as well as the local groups educating communities.

***Recommendation 4b. State governments should start building knowledge of advanced nuclear technology's role in achieving the economic, environmental, and social goals of the state and communities, with the support of DOE-NE and DOE-SCEP.***

Several states have made policy changes to support nuclear energy, such as eliminating a moratorium on nuclear power, including nuclear in a clean energy standard, or establishing a plan to deploy an SMR.[81] In addition to policy changes, state governments must also build capacity and expertise in SMRs to determine how nuclear energy fits into a state's development path.

State governments, in collaboration with the federal government, nuclear industry and academia, should start building knowledge and capacity to identify the potential role SMRs can play in achieving the state's economic, environmental, and social goals. One potential model is a state nuclear advisory council.

In 2023, the State of Tennessee created a nuclear advisory council that will recommend the state's legislative, policy, and budgetary changes and the necessary federal actions to create a nuclear energy ecosystem in Tennessee. The members of the council include the governor's administration, the General Assembly, the state's congressional delegation, and nuclear industry stakeholders.

States interested in nuclear energy could take a similar approach in organizing an advisory or study group. The group should include both state officials and technical experts, enabling the identification of the role of technology in the specific contexts of each state. DOE-NE and DOE-SCEP should provide needed support to interested states.

***Recommendation 4c**. DOE-NE, national labs, and nuclear industry associations should augment the work currently undertaken by the Idaho National Laboratory (INL)'s Gateway for Accelerated Innovation in Nuclear (GAIN) and reach out to various groups of people outside the "nuclear community," to build more support for nuclear energy across society.*

Nuclear technology can be difficult to understand, complex, and risky from the perspectives of the general public. Nuclear technology is also isolated from other clean energy technologies and solutions. While many communities are interested in hosting nuclear facilities, ultimate deployment may be limited without general support for nuclear. Therefore, the nuclear industry, with the help of DOE, must build broad support for this energy source, and the role in can play in accomplishing the nation's decarbonization, reliability, and security objectives.

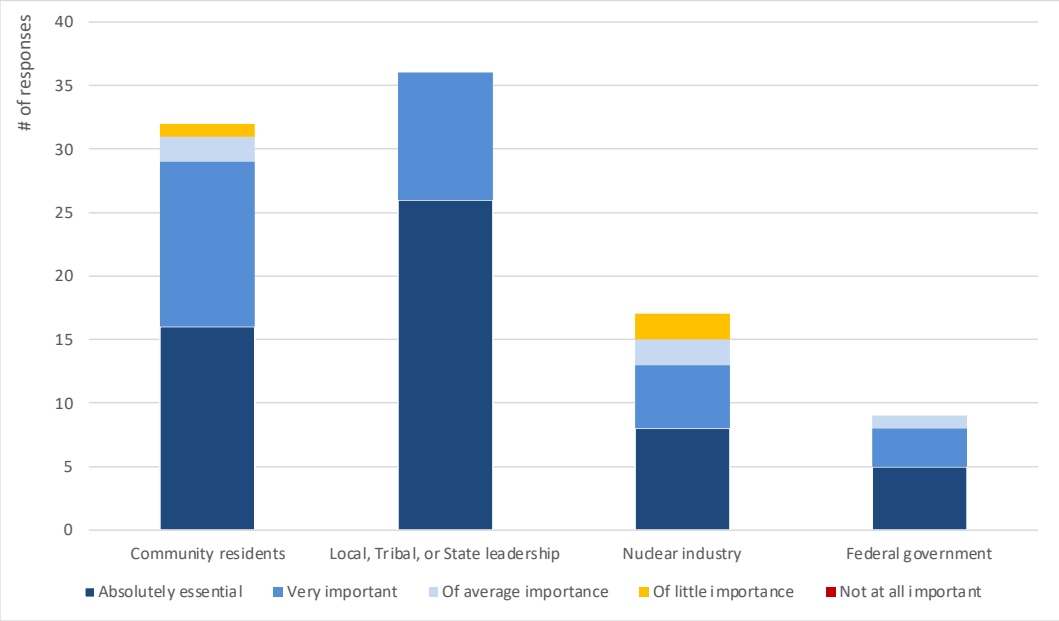
GAIN has strengthened the nuclear community by supporting, partnering, and collaborating with stakeholders for the commercialization of advanced nuclear technologies. Building upon the work of GAIN, the nuclear community should better integrate itself with groups outside the current nuclear community and strongly insert itself into the clean energy conversation. The nuclear industry could consider sponsoring research on various topics of clean energy, climate change, energy security, and sustainability.

## 4.5 Finding 5. The lack of a clear and implementable national pathway for waste management is a top concern of all stakeholders, including potential host communities

An uncertain pathway for nuclear waste management, in combination with a history of unsuccessful efforts to permanently address this issue, challenges community acceptance for SMR deployment. **More than 90 percent of survey respondents said that a clear national pathway for nuclear waste disposal is "very important" or "absolutely**

**essential" for their position on new nuclear facilities (Figure 11).** The national pathway for nuclear waste disposal is a critical agenda across all stakeholders—communities, federal, state, and local governments, and the nuclear industry. Local/ state leadership showed a stronger interest in this agenda than the other groups. Concerns stem from relatively high perceived risks of spent fuel by their constituents. Political leaders are motivated to remove the risks of spent fuel from their jurisdictions to earn the trust of the constituents. One interviewee indicated that they want to get reelected by "saying you've got nothing to worry about" to their constituents.[82]

**Figure 11: How important is a clear national pathway for nuclear waste disposal regarding your position on building new nuclear facilities? (n=95)**




One interviewee indicated that nuclear waste is the "last gap out there between the west side and the east side (of my state)." Nuclear waste paints a "bad picture that could affect the agricultural side" in his state, which has a significant agricultural industry.[83] Another interviewee from a nuclear legacy community said that the community is "stuck with waste here with no disposition path.. that's the biggest issue I think facing a lot of the communities. What's the disposition? Give us something."[84] One respondent to the survey indicated that communities need to see "the whole picture," the ultimate end of the project that their community would host.

**The federal government is not trusted to solve this problem.** An interviewee indicated: "I can't tell you how many interim storage siting efforts I've been involved in. None of them have clearly been successful." She added that the series of unsuccessful trials of the federal government have built distrust in the government: "Every time you start something and you don't finish it… you build more mistrust, more cynicism, or skepticism.[85] A survey respondent commented that "we have learned the hard way that we cannot rely on our governments to get [the waste storage problem] done." Another interviewee argued that the waste management needs to be privatized since the federal government "mishandled it."[86] A consent-based siting approach, DOE's approach to siting interim storage of spent nuclear fuel, raised some communities' concerns about implementation. One interviewee said that it is not "realistic" that "the state, local, federal, tribal governments, all the regulatory authorities, all in agreement, yes, we want to do this storage facility here."[87] She added that, in every case of siting nuclear waste facilities in the U.S., there have been some entities that were not supportive.

Another concern was that consent does not last because decision-makers come and go. One interviewee took the example of siting an interim storage facility in New Mexico; "when we first started this project… we had all our legislators in this area supporting it…we also had the governor supporting it, so we had clear support up and down. Well, four years later, when the governor's attorney comes out, and we get a progressive legislature in place and a progressive governor…. they fight it tooth and nail."[88]

Multiple cases demonstrate that community concerns regarding a consent-based approach are valid. The most recent case is the consolidated interim facility in New Mexico. Since April 2015, the alliance of local leaders has pursued building a consolidated interim storage facility in southeastern New Mexico with the support of the legislators and the former governor. The U.S. Nuclear Regulatory Commission (NRC) even issued a license for this project in May 2023. However, two months before NRC's approval, the governor of New Mexico signed a law to prohibit the issuance of state permits for the construction and operation of a disposal facility for spent fuel unless the state consented.

Box 2

## Reaching Consensus on the Waste Isolation Pilot Plant

The case of the Waste Isolation Pilot Plant (WIPP) illustrates the challenge of reaching a consensus for siting a waste management facility.

Siting WIPP took more than 20 years of negotiation, coordination, and decision-making among different levels of governments, whose positions on siting WIPP have not been constant during these years. In 1972, the local leaders of Carlsbad, New Mexico, invited the Atomic Energy Commission (AEC) to examine their communities for possible use as a storage site for defense-related nuclear waste. The state of New Mexico was supportive, but state support eroded after i) the Three Mile Island accident in 1979 and ii) Congress's efforts to include the spent fuel from commercial reactors in addition to defense-related waste. In 1981, the state of New Mexico filed suit against DOE since DOE announced plans to move forward with the construction of the WIPP. As a result, DOE and the governor of New Mexico signed a "consultation and cooperation" agreement, giving the state of New Mexico a formal role in the siting procedures of the WIPP. After this resolution, a long political debate lasted throughout the 1980s. Some state officials and environmental groups organized an opposing coalition and local officials, national labs, and DOE organized a supportive coalition. Inside and outside New Mexico, Republican elected officials were in favor of WIPP, while Democratic elected officials were in opposition. After a long partisan debate over WIPP in the 1980s, the President signed WIPP legislation, including EPA as the regulator of WIPP and the requirement of DOE's submission of a scientific and technical assessment of the site. In 1998, EPA approved the opening of the WIPP site, and in 1999, the WIPP began accepting shipments of nuclear waste.[89]

Different perceptions of the benefits and risks of hosting a spent fuel facility between state stakeholders and local stakeholders could be a barrier to reaching a consensus. This is demonstrated in the case of siting a Monitored Retrievable Storage (MRS) in Tennessee.[g] Despite the consensus of the community and DOE on siting an MRS facility, the project was stopped by the legal challenge of the state of Tennessee.

In 1985, DOE announced its intention to build an MRS facility in Oak Ridge, the former Clinch River Breeder Reactor site, and offered a grant to the state of Tennessee to study the proposal and develop the state's position. The state gave part of the grants to the two communities so that an MRS facility would allow them to conduct their own studies. One of the two communities, the Oak Ridge City Council and the Roane County Commission, organized the Clinch River MRS Task Force, a citizen evaluation group consisting of local political leaders and both technical and non-technical citizens. Through a three-month intensive evaluation of the project by three study groups, the task force concluded that an

[g] Monitored Retrievable Storage facilities store nuclear waste prior to final disposal.

MRS facility was acceptable if DOE and Congress would agree with the measures to mitigate the impacts and compensate the area.[90] The other community, the five counties surrounding the Hartsville site, concluded with firm opposition.

The state of Tennessee studied the MRS proposal by organizing a joint legislative committee that voted to oppose the project in 1986. The governor, based on several studies by state agencies, opposed the project because the facility was unnecessary, would unnecessarily raise TVA's electric rates, and would impose a "negative and economically harmful" image on the Oak Ridge region.[91] The state of Tennessee had a different vision for the East Tennessee region, namely, to establish a center of high-tech research and manufacturing. From the state's perspective, the MRS facility did not provide economic benefits enough to sacrifice this vision, even with expected compensation from DOE.

The nuclear waste management agenda is the most difficult to resolve among the issues of nuclear energy. Many stakeholders weigh the risks of a nuclear waste facility much greater than the benefits. It is difficult to reach a consensus among all relevant stakeholders on this issue. A consent-based siting approach is ideal to enable the broad participation of stakeholders, but it should accompany implementable measures to reach a siting decision by coordinating different perceptions and opinions of a wide range of stakeholders.

### 4.5.1 High-Level Recommendations: Engage with communities and states in the early phases of siting interim storage of spent nuclear fuel

The uncertain path of nuclear waste management, along with the lack of permanent siting solutions, may become an increasing challenge to SMR development at scale. The lack of a clear national pathway for waste management is a top concern of all stakeholders regarding the deployment of SMR facilities. Communities with nuclear power plants expressed concern about being stuck with accumulated nuclear waste with no path forward. A spent fuel facility was the least favorite of the communities interested in hosting nuclear facilities.

Given the importance of the topic, one of the companion white papers of this study, *US Spent Nuclear Fuel Policy: The Current Stalemate and Policies to Generate Momentum and Support Advanced Reactor Investment,* investigates pathways for nuclear waste management and makes recommendations to address key dimensions of this protracted issue. Since detailed analyses and recommendations are included in the companion paper, this study focuses on recommendations aligned with the aforementioned findings.

***Recommendation 5a. Recipients of DOE funding for planning and capacity-building for the consolidated interim storage of SNF should focus on what benefits are critical to community acceptance of a spent fuel facility***

DOE's road map for a consent-based siting process to site federal consolidated interim storage facilities for spent nuclear fuel, released in April 2023, highlights ensuring equity, environmental justice, and meaningful community participation throughout the process.[92] As part of the planning and capacity-building stage, DOE offered $26 million to groups of university, nonprofit, and private-sector partners that will work with communities in June 2023. The work of these groups will help DOE refine the process, and DOE will move to the second stage of site-screening and assessment, during which DOE's direct outreach and engagement activities with communities will start.

The work of DOE fund awardees should include informing DOE-NE about which economic and social benefits communities would expect from hosting the facility. The benefits would be critical for community acceptance of a spent fuel facility, as the findings of this study show. Each awardee of the DOE fund should provide whatever benefits are prioritized by the communities they work with. Based on this work, DOE-NE should develop options for creating long-term and sustainable benefits to host communities. These options need to be refined through community outreach and engagement during the second stage of site screening and assessment.

***Recommendation 5b. DOE-NE, in collaboration with the Office of Congressional and Intergovernmental Affairs (DOE-CI), should start communicating with states when the***

***communities in their jurisdictions express their interest in being considered as a potential host community of the spent fuel facility*.**

For siting a spent fuel facility, early engagement with the state of the host community is as important as community engagement. The MRS case at Tennessee demonstrates that engagement activities with local and state stakeholders should be coordinated, since the perceptions of benefits and risks of hosting a facility could differ between the two groups. However, in DOE's consent-based siting process, it is unclear how DOE would engage with states in each stage of the siting process.

DOE-NE should engage with states when communities express interest as a potential host community of the spent fuel facility.[h] States should be informed of the activities of the interested communities and participate in conversations prior to negotiations between DOE and the community. At the negotiation stage, states should be involved in the community's development of terms and conditions for hosting a facility and continued negotiation with DOE. DOE-CI should support DOE-NE in coordinating different opinions between state, federal, and community stakeholders.

[h] This would likely occur at the site-screening and additional criterial development phase of the roadmap.

# 5. Conclusion

This study identified the drivers of the acceptance of SMR facilities for communities generally accepting of SMR technology. Communities' willingness to host SMR facilities was most significantly driven by economic and social benefits, such as new jobs created, attracting new industries, and securing reliable energy sources. An SMR plant and an SMR manufacturing facility were the most preferred facilities due to the larger perceived economic and social benefits. A spent fuel facility was the least popular facility as the communities perceive modest economic benefits and significant economic, environmental, and accidental risks from hosting the facility.

Community residents and local and state leaders all emphasize the role of information and education. They agreed that currently available information on SMRs is not the information that they care about or understand. In addition, communities expressed their interest in being informed or educated by local groups they trust. They also argued that educating people that lack familiarity with nuclear technology, including state policymakers, is critical for the future deployment of new nuclear facilities.

Even if there is community acceptance of SMR facilities, there could be opposition at the state level. Since the negative reactions of state stakeholders to SMR facilities could impede or eventually stop the project, communities would not want to proceed with any project that state stakeholders might be against. This finding infers that the community acceptance of SMR facilities should accompany state stakeholders' general acceptance of SMR technology.

The uncertainty of nuclear waste management is a key challenge for community acceptance of SMR facilities as well as general acceptance of SMR technology. Overall, the communities would be fine with hosting a spent fuel facility, but many do not expect state stakeholders to accept the facility within the state. In addition, communities are doubtful the federal government can provide a solution in the current policy landscape given the historically unsuccessful federal effort for siting a spent fuel facility.

The findings of this study infer that there would be moderate challenges to finding the first mover communities to deploy the first set of SMRs. Since many communities are already supportive of hosting SMRs in their communities, project developers would be able to find potential host communities with ease if they find the communities whose states are positive, or at least neutral, about nuclear facilities, provide sufficient economic and social benefits to the communities, and engage with the communities early with sufficient and trustworthy information.

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