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WIPP Lessons for State and Local Officials Considering Hosting a Nuclear Waste Repository

By **Dr. Matt Bowen**, **Hamna Khan**, and **Rama T. Ponangi**

- The Waste Isolation Pilot Plant (WIPP) is the world's only operating deep geologic repository for nuclear waste disposal and thus offers a unique case study to learn from as the US government likely embarks on a new effort to develop additional repositories.
- But data on WIPP is limited and not particularly accessible to state and local officials who want to learn more about the safety aspects and economic impacts of hosting such a facility.
- The Department of Energy could provide more such data on the WIPP experience to prospective states/locales to inform their decisions.

As part of a future consent-based approach by the federal government to site new deep geologic repositories for nuclear waste, local communities and states that are considering hosting such facilities are sure to have many questions. The Waste Isolation Pilot Plant (WIPP) in New Mexico is currently the only example of such a repository in operation,[1] and it offers the opportunity for state and local officials to visit and judge for themselves the risks and benefits of hosting a similar facility. But its history can also provide lessons for these officials, particularly the political process leading up to the opening of WIPP, the safety of WIPP operations and transportation of waste from generator facilities to the site, and the economic impacts the project has had on the local area of

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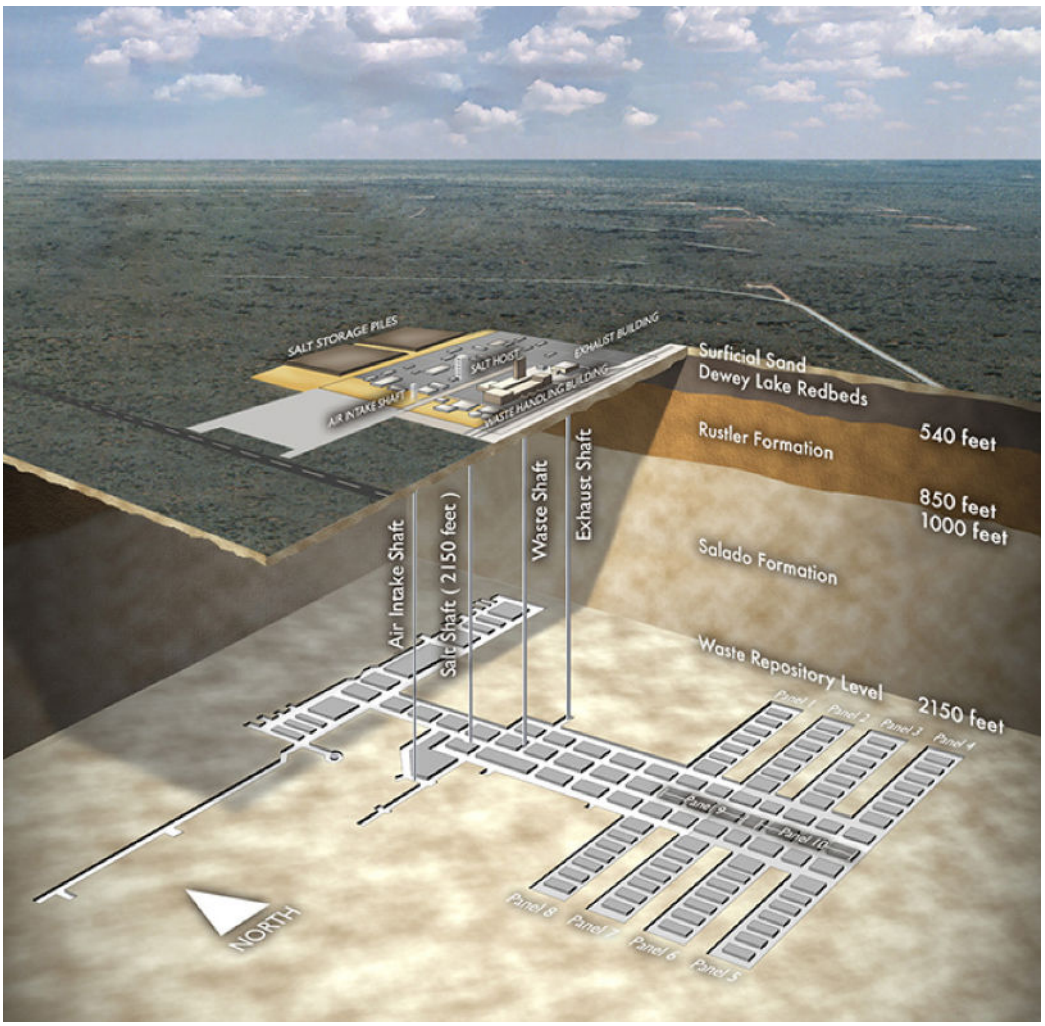
Carlsbad, as well as the rest of the state of New Mexico.

This commentary explores this history and finds that, while the development of WIPP was lengthy and contentious at times, the state and federal governments negotiated various measures to satisfy state interests, and the local political leadership in Carlsbad supported the project through its development without the state ever reaching a place of firm opposition. Second, the transportation of WIPP nuclear waste shipments has been conducted safely, and the facility has had an overall solid operational track record, marred by two accidents in 2014. Third, while WIPP has denied the state and local area the value of hydrocarbons and minerals that otherwise could have been extracted at the site, the repository project has provided substantial jobs and does not appear to have negatively affected tourism and property values—two concerns in the lead-up to its opening. Because of the limited data available, however, this commentary identifies opportunities for the federal government to provide more information on WIPP's track record to state and local policymakers to further inform their considerations, as well as ways all stakeholders might better engage to smooth the path toward actualization of a new repository.

Background

WIPP opened in 1999 near Carlsbad, New Mexico, and is the only operating deep geologic repository for disposal of long-lived nuclear waste in the world. Nuclear waste packages at WIPP are emplaced about 2,000 feet below the earth's surface in an underground salt deposit (see Figure 1). Long-lived radionuclides are isolated from the biosphere there permanently.

Figure 1: Waste Isolation Pilot Plant configuration



Source: Department of Energy, https://www.energy.gov/em/articles/quick-facts-about-ems-waste-isolation-pilot-plant.

WIPP's mission is legally restricted to the disposal of materials and equipment from US defense activities that are contaminated with transuranic (TRU)[2] radionuclides. However, the United States has other inventories of long-lived radionuclides that will eventually need to be isolated from the biosphere with facilities likely similar to WIPP. Those inventories include spent nuclear fuel (SNF) and/or high-level nuclear waste (HLW) from commercial nuclear power plants or research and test reactors, naval submarines and aircraft carriers, and nuclear weapons programs.

Congress passed the Nuclear Waste Policy Act of 1982 (NWPA) to create disposal options for these SNF and HLW inventories. The goal was to create two deep geologic repositories, but so far that effort has not been successful. In 1987, the NWPA was amended by Congress to name Yucca Mountain in Nevada as the only site to be characterized for a potential repository. However, the state of Nevada has opposed the project, and that opposition has prevented any appropriations to move the Yucca Mountain project forward since 2010.

President Barack Obama opposed the Yucca Mountain project as well, and early in his administration the Department of Energy (DOE) moved to withdraw the license application to build Yucca Mountain. His administration also created the Blue Ribbon Commission on America's Nuclear Future (BRC) to chart a new course for US SNF and HLW policy.[3] The BRC issued its report in 2012 and recommended that the United States begin a new "consent-based"[4] effort to develop at least one new repository. Part of the reasoning that went into the BRC's recommendation for a consent-based approach was the example of WIPP, and one of the BRC members was former New Mexico Senator Pete Dominici, who played a key role in WIPP's development.

One of the essential elements of WIPP's story is that many local political leaders supported the project from its earliest beginnings through decades of development. Today, now 25 years since the beginning of operations at the site, the local government remains in support of the facility. The state of New Mexico's (i.e., the governors, state legislatures, and congressional delegations over time) relationship with WIPP has been more complicated. Some officials have supported the project, others have been neutral, and still others have opposed it. The state sued the federal government on multiple occasions for concessions with respect to the project. Still, the state never got to a position of firm opposition during the project's development, nor during its quarter century of disposal operations. The New Mexico congressional delegation did not oppose federal appropriations for the WIPP project during those time periods, and the state government has now renewed the operating permit for WIPP under both Republican and Democratic administrations.

Political History of WIPP's Development

The story of how WIPP came to be, from a political lens, is a unique and winding one.

1971–1979: Earliest Origins to Congressional Authorization as a Defense Activity

The Atomic Energy Commission (AEC) had been trying to site a nuclear waste disposal project in Lyons, Kansas, but it ended in both technical and political failure. New Mexico State Senator Joe Gant Jr. had seen a newspaper article about those efforts in 1971 and talked with a friend in the New Mexico congressional delegation, Rep. Harold Runnels, about whether the Carlsbad area in New Mexico might work as an alternate location.[5] The reasons for his interest were economic in nature—the decline in potash mining operations in the Carlsbad area prompted local leaders to seek new economic opportunities.[6]

One reason the local leadership might have been willing to consider an underground nuclear waste disposal project was the community's familiarity with mining activities and professions that entailed risks in general. According to a history of WIPP by Chuck McCutcheon, former mayor of Carlsbad Walter Gerrells said in 1979: "When you say something is dangerous, it has to be judged compared to other things. There are five farm-related deaths every day; if that isn't danger, I don't know what is. But by no means is that a reason to stop farming."[7] WIPP would be a mine, though a very small one compared to conventional mines, and one built for a mission unlike any other: to take in and house radioactive materials.

Those in the area organizing in favor of the project made an effort to shore up political support before going public. They found an absence of immediate political opposition at both state and local government levels. Backers urged the governor of New Mexico, Bruce King, to invite the AEC to consider New Mexico for a nuclear waste storage project, which he did.[8] But an aide to the governor recalled that "Bruce was too smart to get caught with an outright commitment early on. He'd say, 'Some of my friends support it, and some oppose it, and I'm for my friends.'"[9]

Nine months after the initial contacts between Carlsbad and the AEC, the idea for the project was explained at a news conference and thus to the general public in New Mexico. The initial projection from an AEC official was that a pilot facility could be ready by about 1979 or 1980.[10] A New Mexico state official told reporters that the state would not take a position on the project until more facts were known. (This position of neutrality would be reiterated by the next governor, who declined a

request by the state's Environmental Improvement Board in 1977 to veto the project.[11])

The state undertook several actions to strengthen its oversight capacity for the project. In 1978, it formed an expert scientific group, the New Mexico Environmental Evaluation Group, to provide independent technical evaluation of the WIPP project using full-time and outside consultants.[12] In addition, the state legislature enacted a law in 1979 to establish the interim Radioactive and Hazardous Materials Committee, made up of state legislators, to carry out an oversight role over WIPP.

While WIPP had support in the Carlsbad area, a locus of opposition to the project emerged elsewhere in the state, such as in Albuquerque and Santa Fe. Residents there saw little in the way of direct benefits from WIPP, while perceiving themselves to be exposed to safety risks from the project. Some opposition to WIPP was also motivated by an antinuclear power agenda. The Southwest Research and Information Center (SRIC),[13] headquartered in Albuquerque, would lead the criticism. Peter Montague, who started SRIC with his wife, Katherine, would later explain, "It dawned on us that if we could make waste disposal the focus of attention, that so long as we could keep waste out of the ground, it could keep nuclear power plants from opening."[14] Polls in 1978 and 1980 found New Mexico residents opposed to WIPP by a ratio of nearly 2:1.[15]

Congress authorized the WIPP facility[16] in 1979, and when it did, it answered two questions regarding WIPP's mission: whether the facility would dispose of commercial waste, defense waste, or both, and whether the facility would be licensed by the Nuclear Regulatory Commission (NRC). The question of commercial waste versus defense waste was a pivotal one,[17] and House Armed Services Committee Chair Melvin Price would drive legislative efforts that ultimately culminated in sections of Public Law 96-164 that limited WIPP's mission to disposal of defense waste—and exempted the facility from NRC licensing.[18]

1980–1981: Lawsuit Leading to a Written Agreement Between DOE and New Mexico

One issue not completely resolved by the 1979 congressional authorization was how New Mexico and DOE would work together, or perhaps what power the state would have over the project. The 1979 law directed the secretary of energy to seek to enter into a written agreement with New Mexico state officials by September 30, 1980, to set forth the procedures under which the "consultation and cooperation" agreement would be carried out, and transmit the agreement to Congress.

But the two sides did not reach agreement, and DOE announced plans to move ahead with

repository development without the state's involvement. The state asked for an additional 45 days to challenge the environmental impact statement (EIS; a review conducted under the National Environmental Policy Act) for WIPP, but DOE refused. One DOE official stated that the department no longer needed anything from the state to proceed with WIPP.[19] Later, the US Bureau of Land Management and DOE's office in New Mexico announced a cooperative agreement between the two federal agencies that they said allowed shafts to be excavated for the facility. Governor Bruce King said he would just as soon prefer that the facility be located in a different state.[20]

Governor King asked the state attorney general, Jeff Bingaman, to look into legal options for challenging DOE's decision to proceed without state involvement. Bingaman would file a lawsuit in May 1981 that claimed violations of the National Environmental Protection Act, the Federal Land Policy and Management Act of 1976, and the WIPP authorization act passed by Congress in 1979.[21] Before the lawsuit went to trial, DOE and the state reached a stipulated agreement, which was, in turn, followed by a consultation and cooperation agreement.[22] The agreement addressed issues related to transportation, emergency preparedness, and more. The DOE also agreed to consider and address the state's concerns (e.g., related to public health and safety) before constructing or shipping waste to WIPP, and it also acknowledged the state's right to seek judicial review of DOE's actions with regard to WIPP.

The first exploratory shaft at WIPP would be drilled in September.

1982–1991: Construction of the Facility, and Another State Lawsuit

While DOE was constructing WIPP in the 1980s, several unsettled policy issues were resolved. For example, DOE agreed that radioactive waste shipped to WIPP would comply with applicable Department of Transportation (DOT) and NRC regulations (and all waste shipped to WIPP would be in packages certified by the NRC),[23] state and DOE officials agreed to require WIPP to comply with any Environmental Protection Agency (EPA) radiation protection standards promulgated in the future (EPA first published these standards for SNF, HLW, and TRU disposal in 1985), and the consultation and cooperation agreement was amended to limit the mission of WIPP to the disposal of defense-generated TRU waste, not HLW.

In 1987, an agreement with the New Mexico attorney general stipulated that DOE would fund road improvements. Additionally, members of the New Mexico congressional delegation introduced a bill that would transfer the roughly 10,000 acres of land at the WIPP site from the Department of Interior to DOE—otherwise known as "land withdrawal." The legislation would give New Mexico $50 million as compensation for lost abilities to mine materials and extract fossil fuels (this bill was never enacted into law).

Tensions between the state and DOE rose again in 1991. New Mexico Attorney General Tom Udall (like Jeff Bingaman, later to become a US senator) filed a lawsuit against DOE and the US Department of Interior to stop shipments of waste to WIPP, alleging violations of the National Environmental Policy Act, the Federal Land Policy and Management Act, and the Administrative Procedure Act. Later decisions by federal courts led to an injunction prohibiting transportation or disposal of waste at WIPP.[24]

1992: Congress Passes the New Mexico Senators' WIPP Land Withdrawal Act

The policy threads mentioned above would get resolved and codified in legislation introduced by the two senators from New Mexico, Pete Domenici and Jeff Bingaman. Congress passed the WIPP Land Withdrawal Act (LWA) of 1992,[25] which withdrew the land for WIPP from the Department of Interior and transferred it to the secretary of energy and recognized the cooperation and consultation agreement and modifications that had been negotiated with New Mexico, codifying some of the requirements therein. Among other provisions, it put the following in statute:

- The mission for WIPP would be exclusively the disposal of defense-generated transuranic waste, and the total capacity of the facility for transuranic waste disposal would be 6.2 million cubic feet.
- EPA would be required to certify that WIPP met EPA's environmental radiation protection standards for disposal of transuranic waste (contained in 40 CFR 191) and to promulgate certification criteria for WIPP.
- DOE would be required to seek a hazardous waste permit[26] from New Mexico to operate the facility (see below).
- NRC licensing would be required for all shipping packages to WIPP.
- Fifteen years of economic assistance would be provided to New Mexico (in total $300 million), primarily in the form of road-building funds, and transportation-related assistance would be provided to states and tribal nations along shipping corridors.
- A bypass around the city of Santa Fe would be built for WIPP shipments.
- The National Academy of Sciences would have a formal role in reviewing WIPP-related technical matters.

1993–1999: EPA Certification and the Start of Disposal Operations

As required by the WIPP LWA, EPA officials issued final amended environmental and health standards for WIPP at the end of 1993.[27] In 1996, the agency published WIPP-specific compliance certification criteria,[28] and New Mexico Attorney General Tom Udall filed a petition for review of that criteria (which was ultimately denied by the US Court of Appeals for the DC Circuit in 1997).[29]

In October 1996, DOE submitted the Compliance Certification Application to the EPA demonstrating compliance of WIPP with long-term disposal standards. Also in October, the National Academy of Sciences issued a report stating that WIPP "has the ability to isolate transuranic waste for more than 10,000 years" as long as it is sealed effectively and is not disturbed by human activity.[30] In May 1998, EPA certified that predicted releases of radioactive materials from the repository would be below limits set by EPA's radiation protection standards. By this time, public support for WIPP had grown in New Mexico: A poll in spring 1998 from the University of New Mexico's Institute for Public Policy found 49% of New Mexico residents supported opening the facility (compared to 26% in 1980), while 46% opposed it.[31]

At the time of certification, New Mexico had not yet issued a permit for mixed-waste disposal at the WIPP site,[32] though most of the waste to be disposed of at WIPP was "mixed"—that is, it contained both chemical and radioactive components. The same judge who had ordered an injunction against the facility in 1992 said in March 1999 that his earlier ruling did not prevent DOE from shipping Los Alamos nonmixed wastes to WIPP. On March 26, the first shipment of (nonmixed) TRU waste traveled wholly within New Mexico: from Los Alamos National Laboratory (LANL) to WIPP. And the New Mexico Environment Department granted a Resource Conservation and Recovery Act (RCRA) permit to DOE in October 1999, clearing the way for disposal of mixed waste.

In former Secretary of Energy Bill Richardson's estimation, the WIPP facility faded as a political and environmental issue in New Mexico after EPA certification.[33] He had fought for EPA oversight of the project as a congressman from New Mexico, then later sent the first shipment of TRU waste to WIPP as secretary of energy, and would afterward run for governor of New Mexico, winning by a large margin.[34]

Safety Record

Perhaps the first question state and local officials will ask with respect to hosting a deep geologic repository is whether such facilities are safe.[35] This section first explains regulatory responsibilities related to safety. It then reviews the safety record of the WIPP transportation program, as well as the operational safety record at the WIPP site over its 25 years.

A third aspect of WIPP safety is postclosure—that is, after operations cease and the repository is sealed, which likely will not happen for many years, as the facility is not close to the capacity limits outlined in the WIPP LWA of 1992. This aspect cannot be analyzed retrospectively at this point, as can be done with the WIPP transportation and operational records. To understand associated safety issues after WIPP is closed, readers are referred to publications by the National Academy of Sciences and the EPA. The EPA continues to regularly certify that WIPP is in compliance with standards regarding protection of public health after closure.[36] As noted, a 1996 National Academy of Sciences report found WIPP could isolate TRU waste for more than 10,000 years if it is sealed effectively and remains undisturbed by human activity. The geologic stability and isolation capability of the bedded salt in the area were primary factors leading to this finding.[37] The probability of human intrusion thousands of years from now is of course unknown, and one area of concern that opponents of WIPP continued to raise even after the facility began operations (specifically concerns over the potential migration of radioactive materials due to future drilling and extraction of hydrocarbons and minerals inside the WIPP area, such as has been taking place adjacent to the site in recent years with the advent of hydraulic fracturing).[38]

For current transportation and operational matters, however, regulators have clear responsibilities and a track record of safety that is available for consideration.

Regulatory Responsibilities

The WIPP program has several different regulators. Two of those regulators are involved with the transportation program:

- The Department of Transportation has regulatory authority[39] over the WIPP transportation program, including waste packaging requirements and waste transportation surveillance by tracking and communication.
- The Nuclear Regulatory Commission has regulatory authority for certifying the shipping containers used in the WIPP program.[40]

Two other regulators are involved with operations at the site (as well as the postclosure phase):

- EPA regulates the radiological aspects of WIPP waste, which is certified by the Radiation Protection Program at the agency.[41] As mentioned, EPA has issued generic radioactive waste disposal standards and also WIPP-specific certification criteria.[42]
- The state of New Mexico, under the New Mexico Hazardous Waste Act and RCRA, regulates mixed-waste disposal at WIPP.[43]

While not a formal regulator of the WIPP site, DOE and the Mine Safety and Health Administration (MSHA) at the Department of Labor have a memorandum of understanding (MOU) for health and safety inspections at WIPP. The MOU contains various provisions, including that MSHA will conduct unannounced health and safety inspections at the WIPP facility no fewer than four times a year and that citations will be issued if any safety or health deficiencies are identified. The results of all inspections are published on the MSHA website.[44]

MSHA conducts inspections at all mines in the United States. For perspective, the agency started eight inspections of WIPP in 2023 and wrote 59 citations for violated standards, and the same year started a collective 26 inspections for the three active underground potash mines in Eddy County, New Mexico, with a collective 310 citations (the three potash mines are larger mines than WIPP).[45]

Finally, the Defense Nuclear Facilities Safety Board (DNFSB) is an independent organization chartered to provide recommendations and advice to the president and the secretary of energy regarding public health and safety issues at DOE defense nuclear facilities.[46] It has produced monthly reports on WIPP since 2015.

Transportation

TRU nuclear waste packages come by truck from DOE sites with defense missions around the country to the WIPP facility, which has enabled the cleanup of 22 legacy TRU waste sites.[47]

The WIPP transportation program operates under strict requirements for driver experience and transportation planning, communication and surveillance (see Box 1), and packaging of wastes for transport (see Box 2). As of February 26, 2024,[48] there had been 21 incidents/accidents associated with the WIPP transportation program since operations began in 1999 (see appendix A). The incidents/accidents are summarized as follows:

- Seven involved shipments in which the waste packages were empty—that is, they did not contain any TRU waste.
- Fourteen were caused by non-WIPP drivers on the road.
- Seven were caused by WIPP drivers, of which three were due to driver health issues (e.g., loss of consciousness and persistent coughing, resulting in loss of vehicle control), and one occurred when the driver was trying to avoid road debris from another private vehicle accident.

No WIPP packages were damaged during any of these incidents/accidents, which in total resulted in seven injuries and no fatalities.

Box 1: Driver requirements and shipment coordination

WIPP drivers must be US citizens with extensive driving experience: They must have driven 325,000 miles in the previous five years, and 100,000 miles per year in two of the previous five years. They must have no repeated chargeable incidents, no moving violations or driving while impaired (DWI)/driving under the influence (DUI) offenses in their private vehicles, and no moving violation in a commercial vehicle in the previous five years. WIPP drivers work in pairs and have to pass stringent safety and emergency response examinations.[49]

Trucks used to transport waste to WIPP are linked by a continuous satellite tracking system to a central control at the WIPP site. The trucks also have redundant two-way communication systems.

Each waste shipment is inspected to the Commercial Vehicle Safety Alliance Level VI standards—the industry's highest level—prior to departing the waste generator site. WIPP drivers are required to stop and check their trucks and payload every 150 miles or three hours while en route. The trucks are also subject to inspection at state ports of entry.

In addition, the WIPP program has provided training and equipment to emergency responders along all New Mexico WIPP shipping routes.

Box 2: NRC requirements for WIPP transportation casks

Casks used to transport TRU waste to the WIPP facility are NRC certified "Type B" packages (i.e., designed to transport material with high levels of radioactivity and provide shielding against radiation). NRC certification requires Type B packages to withstand a series of hypothetical accident scenarios, including the following:

- Free-drop test: "The transportation cask is dropped from 30 feet onto a flat, unyielding surface (such as a steel-reinforced concrete pad), striking the surface at the container's weakest point."
- Puncture test: "The transportation cask is subjected to a 40-inch free drop onto a six-inch diameter steel bar at least eight inches long."
- Burn test: "The transportation cask is drenched with jet fuel and ignited, subjecting it to a temperature of 1,475 degrees Fahrenheit for 30 minutes."
- Immersion test: "Using specialized analyses, a separate transportation cask of the same design is subjected to external pressure equivalent of being immersed under 50 feet of water."[50]

The regulations allow computer-simulated, scale-model, or full-scale-model testing to demonstrate a package's suitability for certification, and a combination of these methods is regularly used.

The next section will highlight other programs for transporting hazardous materials to give some perspective on the WIPP transportation record to date.

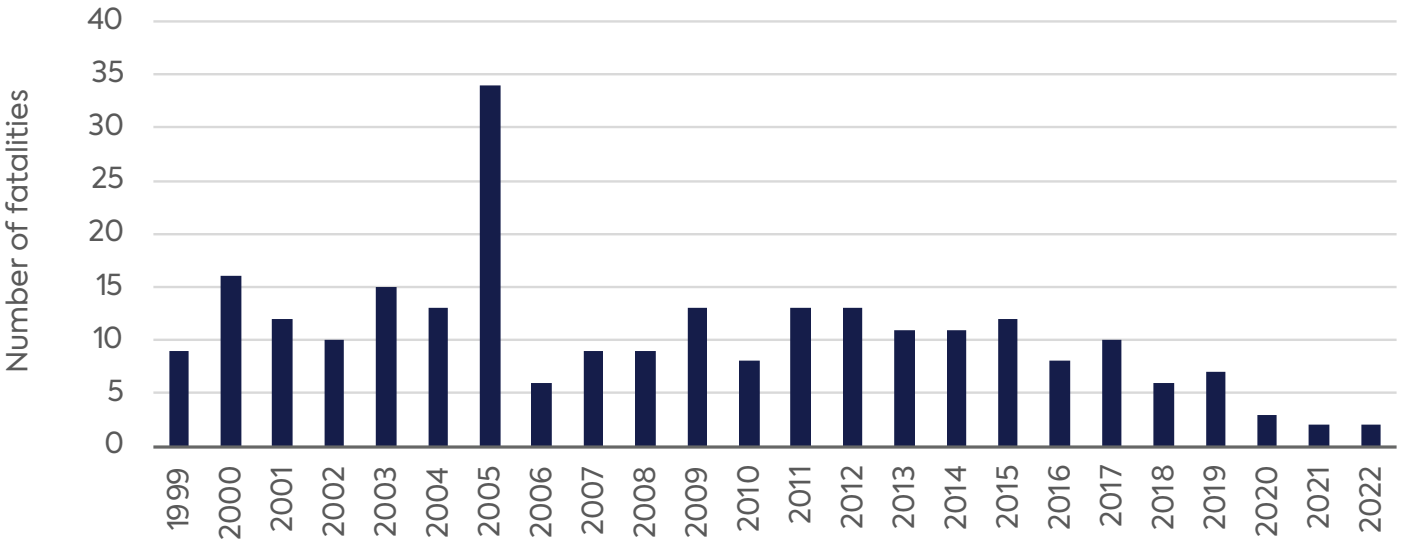
Hazardous Materials Transport

As defined by EPA,[51] hazardous waste has "properties that make it dangerous or capable of having a harmful effect on human health or the environment." The EPA notes that it is generated from many sources, such as industrial manufacturing process wastes and batteries, and can be liquids, solids, gases, and sludges.

According to the US DOT, 1.2 million shipments of hazardous materials occur in the United States every day, and 1.6 billion tons are shipped each year.[52] Hazardous materials are transported on highways, railroads, airways, and waterways. These activities are not without risk. An estimated 250 fatalities were associated with the transportation of hazardous materials from 1999 to 2022

(see Figure 2), a period roughly corresponding to WIPP's first 23 years of operation. The release of hazardous materials from their containers can harm or kill people in different ways, including from explosions or inhalation of toxic gases. For example, a 2005 train derailment in South Carolina led to a large release of chlorine gas that resulted in nine deaths and 631 injuries, contributing to a 2005 fatality spike.[53] Most fatalities involving hazardous materials transportation, however, come from truck shipments, not rail.[54]

Figure 2: Fatalities associated with the transportation of hazardous materials in the United States



Note: Deaths are caused by the hazardous material being transported.
Source: US Department of Transportation, https://www.bts.gov/content/hazardous-materials-fatalities-injuries-accidents-and-property-damage-data.

When WIPP reached 25 years of operations on March 27, 2024, shipments of transuranic waste to WIPP had traveled over 16 million miles and led to the disposal of 285,000 waste containers.[55] While WIPP shipments have been considerably fewer in number of miles and quantities than those for hazardous waste, it is worth noting that there has been no single accident in the span of the WIPP transportation program that led to a release of radiological material, let alone a release that harmed any person. A 1989 National Academy of Sciences projection anticipated that WIPP's shipping program, because of the rigorous regulations and requirements, would be "safer than that employed for any other hazardous material in the United States today and will reduce risk to very low levels."[56]

Site Operations

After TRU waste packages arrive at the WIPP facility, they are off-loaded, inspected, stored, and eventually moved into the mine for emplacement. All of these operations involve some level of risk to personnel at the WIPP facility, and there have been accidents of the kind that take place at other industrial sites—for example, falls and dropped heavy items that lead to injuries such as broken bones.

A 2002 report from DOE concluded that the WIPP site had one of the best safety records within the DOE complex, measured by indicators such as injury rates and environmental incidents.[57] By 2011, WIPP had received the state of New Mexico's top mine safety award from the New Mexico Bureau of Mine Safety and the New Mexico Mining Association in 23 out of 25 years, which was based on having a low injury rate and no fatalities.[58] Chris Hefner, an associate state mine inspector with the New Mexico Bureau of Mine Safety, said at the time, "The safety culture at WIPP is second to none," and he praised the facility for going out of its way to share best practices with other mines.

Two Accidents

Despite its good early track record, two separate accidents occurred 10 days apart in February 2014, raising safety concerns at WIPP. The accidents led to a stoppage in disposal operations for about three years.

The first accident occurred on February 5, 2014, when a fire started in the engine compartment of a truck used to haul mined salt in the repository near the main elevator shaft. The operator of the truck noticed flames, and after unsuccessful attempts to extinguish the fire, workers were directed to evacuate. There were 86 workers underground at the time, all of whom were successfully evacuated. Six workers were transported off-site for treatment for smoke inhalation, and seven other workers were treated on-site. Mine rescue teams arrived at the truck in the evening and found no fire, but used fire extinguishers on embers found on the front tires.[59]

A DOE accident investigation report would later identify the direct cause of the accident to be "contact between flammable fluids (either hydraulic fluid or diesel fuel) and hot surfaces (most likely the catalytic converter)" on the truck, leading to a fire that consumed both the engine compartment, as well as the two front tires.[60]

Unlike the February 5 fire, the second accident was of a nature that could not happen at a conventional mine. On February 14, 2014, a drum containing TRU waste that had been emplaced in WIPP spontaneously ruptured, releasing radioactive materials into the repository. The release was detected by an air monitor in the repository. There were no workers in the repository at the time of the release.[61]

The DOE Accident Investigation Board[62] identified the direct cause of the accident to be a reaction of incompatible materials in a waste drum from LANL that generated heat, thereby overpressurizing the drum, leading to its breach and a release of the drum's contents into the WIPP underground. The Board identified root causes of the release that included a failure of Los Alamos National Security (which managed and operated LANL under contract to DOE) to understand and effectively implement the hazardous waste facility permit, as well as broader failures to ensure that LANL had adequately developed and implemented sufficient repackaging and treatment procedures. The Board also identified 12 contributing causes to the radiological release, including failures among organizations to ensure a strong nuclear safety culture at Los Alamos National Laboratory and a failure of DOE headquarters to perform adequate or effective management oversight. The analytical results led to conclusions and "judgments of need" as to the managerial controls and safety measures needed to prevent or minimize the probability or severity of a recurrence.

The EPA would conclude that radiation releases from the WIPP site did not pose a public health concern.[63] New Mexico State University's Carlsbad Environmental Monitoring & Research Center similarly concluded that no negative radiation-related health effects among local workers or the public should be expected.[64] A DOE recovery plan report in September 2014 estimated the related levels of exposure to 22 workers on-site were less than 10 millirem over 50 years—the equivalent exposure from one chest X-ray—and no long-term adverse health effects were expected.[65] WIPP ceased disposal operations for three years while DOE held public meetings and put in place additional measures to prevent such accidents from happening again and to rebuild community trust.

WIPP reopened in 2017 under limited operations. The state had alleged violations of the New Mexico Hazardous Waste Act, the hazardous waste management regulations, and the WIPP permit.[66] The DOE ended up paying New Mexico $74 million to settle the state's claims against the agency and its contractors regarding these incidents.[67] The settlement also required DOE to implement corrective actions at WIPP to improve the safety of operations at the site. Recovery from the accidents added large costs (hundreds of millions of dollars) to the WIPP project.

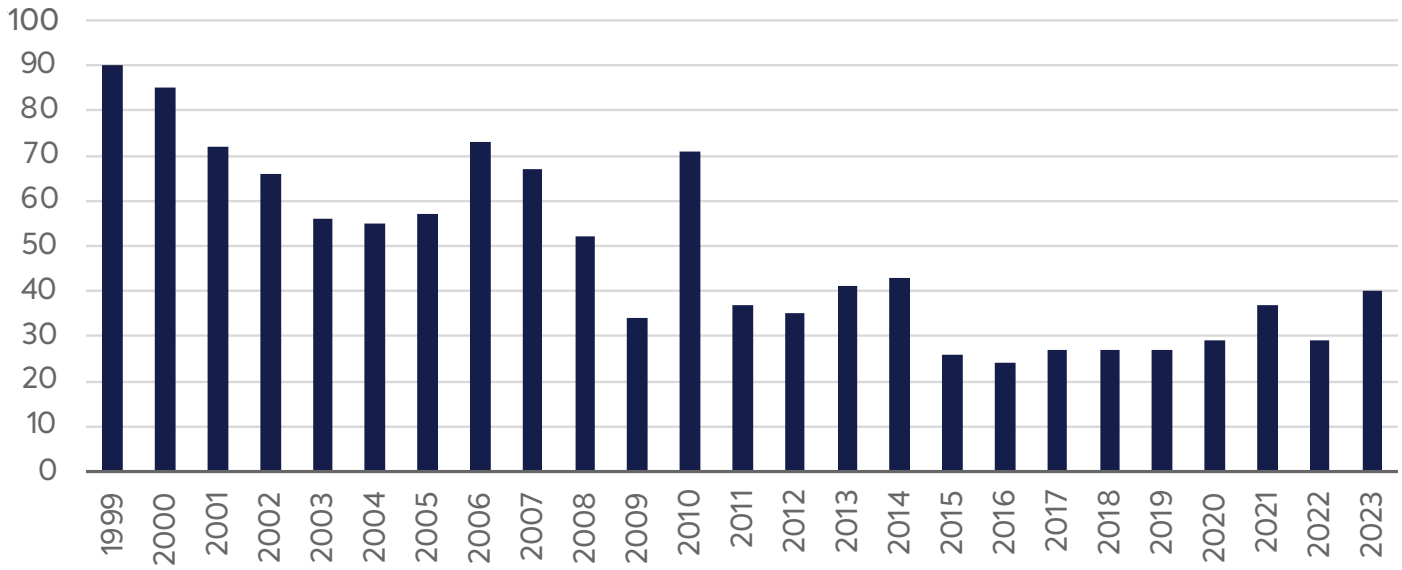
There have been other, smaller-profile accidents at WIPP since it commenced operations (see appendix B for examples), including rock falls, cart collisions, accidents while bolting the roof, and electrical shocks. The next section discusses general mining safety issues to provide some context for the WIPP experience.

Mining Industry Safety

WIPP involves the mining of salt deep below the earth's surface, similar to operations in

underground iron ore, copper, and coal mines. Conventional mining operations involve safety risks to mine workers from cave-ins, equipment malfunction or misuse, falls, fires, explosions, and more. Over 10,000 mines are in operation in the United States,[68] and injuries and fatalities at these mines have been tracked for years by federal agencies. Annual fatalities at US mines have declined by more than 50% during the period 1999–2023 (see Figure 3), which includes the span WIPP has been in operation.

Figure 3: Fatalities at US mines, 1999–2023



Source: Centers for Disease Control and Prevention, NIOSH Mining, "Number and Rate of Occupational Mining Fatalities by Year, 1983–2023," accessed August 5, 2025, https://wwwn.cdc.gov/NIOSH-Mining/MMWC/Fatality/NumberAndRate.

In 1999 (the start of WIPP's operations), the fatality rate per 100,000 full-time employees in the total US mining sector was 31 people, declining to 16 in 2023. Between 1999 and 2023, there were five "mining disasters"—defined as an incident with five or more deaths—at mines, and those five disasters alone killed 65 people.[69]

The fatality rate does not cover all aspects of safety but is discussed here to give some perspective on the very real risks facing mining industry personnel. Through this one lens, workers at the WIPP site have functioned in a fairly safe environment to date: There have been no fatalities to the roughly estimated 1,000 annual full-time workers at WIPP (as reviewed in the next chapter) during its 25 years of operations.

Economic Factors

Economic anxiety in Carlsbad over declining potash mining was a key local driver for the WIPP project. Federal spending elsewhere in New Mexico had created "pockets of prosperity"[70] around nuclear weapons facilities in the state (e.g., Los Alamos National Laboratory), which Carlsbad hoped to create with WIPP. This chapter reviews some economic figures associated with the project for Carlsbad and the surrounding area.

DOE published an EIS for WIPP in 1980, along with supplemental EISs (SEISs) in 1990 and 1997.[71] Those documents estimated future job creation, and the SEISs provided details on the jobs that had been created by the project before the start of operations. The 1980 EIS also discussed one opportunity cost of the WIPP project: the denial of mineral and hydrocarbon extraction inside the site border, which is reviewed below. It further recorded concerns expressed about other potential adverse impacts to the state and local area with respect to tourism and property values, and these topics are also discussed in this section.

Jobs and Other Impacts

The 1980 EIS for WIPP discussed how the project would affect the social and cultural environment of New Mexico, primarily in Eddy and Lea counties (WIPP is located in Eddy County, near the border with Lea County), which were expected to be most impacted. It discussed general economic factors, including employment and personal income, impacts to the private sector (industry, trade and services, tourism), housing and land use, population growth, community services, and government finances. For example, the EIS projected that WIPP would increase annual Carlsbad municipal expenditures, but also that WIPP would increase Carlsbad's municipal revenues by a greater amount, for a net benefit of $100,000 in 1982–1983.

WIPP employed a large number of workers during the decade before it began operations. The SEIS published in 1990 stated that WIPP's direct activity had created an average of 530 jobs in fiscal year 1987 and 661 jobs in fiscal year 1988; the total estimated employment impacts were 1,434 in fiscal year 1987 and 1,814 in fiscal year 1988. For scale, Carlsbad's population in 1988 was about 29,500 people.[73] The 1990 SEIS estimated that WIPP activities had represented about 5% of the economies in Eddy and Lea counties.

The 1990 SEIS also noted that contracts had already been given to local and New Mexico companies for WIPP-related business. In 1987, for example, the DOE Albuquerque Operation Office announced a commitment to assemble the TRUPACT-I[74] containers (for use in transporting TRU waste) in southeastern New Mexico, and also noted that the contract for this assembly facility had been awarded to a Carlsbad firm. The assembly of the TRUPACT-II containers created 17 new jobs

in Carlsbad during 1987, and about 40 additional jobs in 1988.[75] In addition, the DOE Albuquerque Operations Office signed a contract with a Farmington, New Mexico, firm to transport waste in TRUPACT-II containers to WIPP from generator sites. The contract was estimated to be worth up to $5.8 million over a period of up to five years.

The final SEIS, published in 1997, assessed that WIPP played a role in diversifying Carlsbad's economy, including through private ventures in the city for WIPP-related science and technology. It noted that, while at the time of the 1990 SEIS, $24.3 million was paid in direct WIPP wages and salaries to 661 site personnel, and WIPP-related employment and annual wages had since grown to 1,005 jobs and $44.56 million in 1994. This accounted for 2.6% of the total employment and approximately 5.2% of covered wages (wages covered by unemployment insurance) in Eddy and Lea counties in 1994. In 1995, WIPP-related employment and covered wages dropped slightly to 952 jobs and approximately $43.48 million.[76]

Job figures are hard to come by for years succeeding these reports—there do not appear to be DOE records of employment statistics at WIPP in the public realm—but the 1997 SEIS did estimate the number of jobs and income for the Carlsbad area (see Table 1).

Table 1: Estimated annual impacts on employment and income in Carlsbad during operations

	Employment (full- and part-time jobs)	Labor income (in 2024 dollars)
Direct	979	$97,000,000
Indirect and induced	2,185	$141,000,000
Total	3,164	$238,000,000

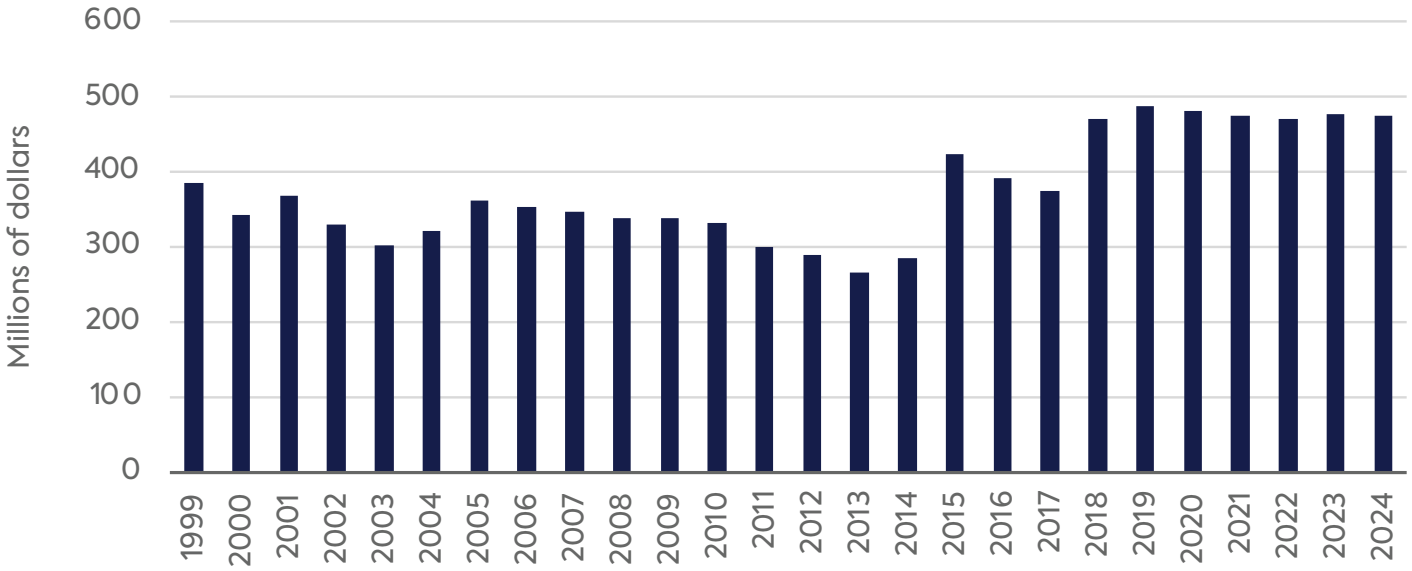
Note: The labor incomes have been converted from September 1994 dollars to August 2024 dollars using a conversion factor of 2.11 (from https://data.bls.gov/cgi-bin/cpicalc.pl).
Source: DOE, "Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement," DOE/EIS-0026-S-2, Table 5.3, September 1997, https://www.energy.gov/nepa/articles/eis-0026-s2-final-supplemental-environmental-impact-statement. .

Another estimate in a 2002 ABC News article after the start of WIPP operations stated that there were nearly 1,000 jobs at the site.[77] It further noted that the high-paying administrator and scientist jobs at the facility had contributed to the local economy and that the specialists at WIPP had aided local education efforts. Finally, a July 2023 presentation from WIPP's new management and operations contractor, SIMCO, assessed there were 1,700 jobs in all of New Mexico related to WIPP.[78]

Congressional Spending

During its first 25 years of operations (1999–2024), Congress appropriated close to $10 billion (in 2024 dollars) for the WIPP project (see Figure 4).

Figure 4: Appropriations for the WIPP project during its 25 years of operations



Note: The yearly appropriations amounts have been converted to 2024 dollars.
Source: Congressional documents.

Several DOE presentations and publications in recent years provide additional granularity on this spending, as well as employment in the state and local area:

- A 2021 presentation by DOE stated that economic contributions in fiscal year 2020 were: New Mexico Environment Department ($1,484,164); Energy, Minerals, and Natural Resources Department ($1,306,273); Carlsbad Environmental Monitoring & Research Center ($2,925,085); and four tribal governments—Tesque ($50,964), San Il ($50,000), Poj ($57,246), and Nambe ($50,000).[79]
- A January 2023 presentation by WIPP's previous management and operations contractor, Nuclear Waste Partnership (NWP), stated that it had awarded about $320 million of subcontract dollars to New Mexico businesses related to WIPP between fiscal years 2013 and 2022 (see Table 2).[80]

Table 2: WIPP contractor (NWP) financial awards to New Mexico businesses

	Total awarded fiscal year 2022	Total over fiscal years 2013–2022
NE New Mexico	$904,992	$3,859,596
NW New Mexico	$6,946,113	$81,090,090
SE New Mexico	$25,735,167	$233,418,903
SW New Mexico	$49,500	$1,920,623
Total (all of New Mexico)	$33,635,772	$320,289,213

Source: Keith Stone, "2022 WIPP Year in Review," presentation, Nuclear Waste Partnership, WIPP, January 24, 2023, https://wipp.energy.gov/Library/documents/2023/2023_Legislative_Breakfast_Presentation.pdf.

In addition, the Waste Isolation Pilot Plant LWA authorized payments to the state of New Mexico in the amount of $20 million (plus inflation) for each of the 14 fiscal years starting with fiscal year 1998. The purpose of this funding was for road improvements in connection with waste shipments to WIPP. A portion of the payment was made available: (1) to units of local government in Eddy and Lea counties, and (2) to provide for independent environmental assessments and economic studies associated with the Waste Isolation Pilot Plant.

The congressional appropriations quoted in this chapter illustrate the billion-dollar scale of repository projects. The jobs and investment estimates indicate the type of economic impacts a repository project can have on state and local economies. Of course, not all impacts will necessarily be positive, and the next section explores some concerns raised early in WIPP's development, and what observationally has occurred since.

Mineral/Hydrocarbon Extraction Denial and Other Potential Adverse Impacts

The 1980 EIS discussed the preclusion of mineral and hydrocarbon extraction at the WIPP site and several other potentially negative economic impacts.

No Mining and Drilling to Extract Mineral and Hydrocarbon Resources

Land withdrawn for WIPP would not be useable for other purposes, according to the 1980 EIS, which would include denial of access to mineral and hydrocarbon resources. It assessed that potassium salts (sylvite and langbeinite) and hydrocarbons (crude oil, natural gas, and distillate) were the only resources of practical significance that could be considered economic at the current market prices and existing technology. The EIS estimated that the amounts of these five reserves in the WIPP site were small percentages of the region's totals, at: 3.4%, 10%, 0%, 1.15%, and 0.07%, respectively.[81] The estimated product gross values (the price the end product would bring when sold on the market at average 1977 prices) of the sylvite and langbeinite reserves were $206 million ($1.056 billion in 2024 dollars) and $679 million ($3.481 billion in 2024 dollars), respectively, and the undiscounted gross value of the hydrocarbons was estimated at $146 million ($749 million in 2024 dollars).[82] Estimates would be updated in 1995,[83] though still well before advancements in hydraulic fracturing and horizontal drilling changed the picture for oil and gas exploration in the United States.[84] WIPP is also located in the Permian Basin, which was only relatively recently identified as having the largest oil and gas reserves in the country.[85] While it's not possible to predict technological breakthroughs and the like ahead of time, any local and state government considering siting a nuclear waste repository will need to weigh tradeoffs of land use known at the time: positive economic development from a repository program versus potential lost economic development.

Tourism to the Local Area and State

The 1980 EIS assessed that "past experience indicates that the WIPP will exert no significant adverse impacts on tourism over an extended period,"[86] though there might be short-term impacts on hotels, motels, and other facilities serving tourists. However, in discussions with individuals as part of the EIS preparation, some voiced concerns about potential negative impacts to the tourist industry from storing radioactive materials.[87] (Concerns about the same impacts to the state at large were raised in other forums, as well.[88])

WIPP began disposal operations on March 26, 1999, and, according to the statewide New Mexico Tourism Department 1999 Annual Report, taxable gross receipts in hotels, amusement and recreation, and eating and drinking establishments showed growth of about $12.5 million between the third quarter of 1998 and the third quarter of 1999.[89] This was a greater increase in total gross receipts for these categories than the increase in the previous year (2.5% versus 0.7%). According to the New Mexico Tourism Department, growth in the number of visitors to New Mexico Visitor Information Centers statewide was the highest in 1999—the year of WIPP's opening—within a five-year span around that year.

Likewise the two operational accidents at WIPP in February 2014 do not appear to have obviously

impacted tourism to the state: According to the New Mexico Tourism Department 2016 Annual Report, visitation to the state increased in 2014 compared to 2013, and the year-on-year increase from 2013 to 2014 (1.7%) was greater than the previous year-on-year increase of 0.7%.[90]

Visitors to the biggest tourist attraction near WIPP—Carlsbad Caverns—had been in decline since reaching a high in 1976, averaging a decrease of 18,721 visitors per year between 1976 and 1998. The decrease from 1998 to 1999, when WIPP opened, was 7,658, and the previous year's decrease was 18,721. The visitor numbers increased by 8,743 from 2013 to 2014, the period of the two noted accidents, which was greater than the increase in visitors of 7,508 from 2012 to 2013.[91]

A better dataset than the ones found in author searches would involve year-by-year tourist numbers and expenditures in, for example, the decade leading up to WIPP's opening and the decade following the start of operations, including state and local numbers. Still, available data do show that tourist interest in New Mexico continued to grow during WIPP construction and operations, and tourism to New Mexico today is higher than ever: The state reports that 2022 saw record visitations and a record $8.3 billion in direct visitor spending.[92]

On a much smaller level, the WIPP facility itself has been a source of tourism to the state and local area. As the only operating deep geologic repository for long-lived nuclear waste in the world, it has hosted officials and scientists from around the world during its operations. In addition to US officials, people from other nations, especially from countries with nuclear power programs (e.g., Finland, France, Germany, Spain, Sweden, Switzerland, and the United Kingdom), have visited New Mexico for meetings in Carlsbad on repository technology and to tour WIPP.[93]

Property Values

Potential impacts from WIPP on property values in the local area and elsewhere in the state were discussed in the 1980 EIS, but the report did not include an estimate for property value changes near the site or along transportation routes. The EIS stated that most of the property in the immediate area was administered by the Bureau of Land Management and the nearest center of commercial activity and residential population was more than 23 highway miles from the site.[94]

One highly publicized legal case related to WIPP's transportation program focused on its impact on property values, for which a later analysis of property values was conducted. It had been argued by some that a bypass constructed around the city of Santa Fe, which was stipulated in the WIPP LWA, would negatively impact property values in areas along the bypass. A couple living in the area, who owned property where the bypass was to be built, sued the city of Santa Fe in 1988,[95] anticipating loss of value for their property. During the trial, a public opinion poll was cited as evidence that these negative impacts would happen, and a jury awarded the plaintiffs compensation before any

nuclear waste had been transported through the area. (Opponents would later cite this case as evidence of adverse impacts on property values from radioactive waste transportation.[96])

However, a 2003 analysis, published years after the bypass actually began carrying TRU waste shipments to WIPP, found the opposite impact: On average, properties in areas adjacent to the bypass had increased in value more than properties in the Santa Fe city/county area as a whole.[97] The authors of the analysis suggested that the bypass had instead "unlocked" the adjacent areas for economic development and that "more people [were] buying more expensive houses than ever before" along the bypass.

The Santa Fe bypass episode is only one instance, and far from a comprehensive study of the issue, but it does provide one example of claims of adverse economic impacts stemming from a nuclear waste repository project that did not materialize to any obvious degree.

WIPP Lessons for the Federal Government to Better Inform and Engage State and Local Officials

Some measures that were utilized as part of the WIPP project could be helpful in future efforts to develop geologic repositories. In terms of securing public acceptance, the following actions may prove useful:

- Using independent entities, such as the National Academy of Sciences or a new body similar to New Mexico's Environmental Evaluation Group, to provide technical reviews of projects
- Creating EPA standards and attaining EPA certification before a facility begins operations
- Securing a written agreement—or a series of agreements and modifications—between the host state and the federal government that identifies measures each wants, though in particular elements the state desires
- Enacting congressional legislation affirming those elements

Moreover, there is an opportunity for the federal government to learn from mistakes made during WIPP's development and to apply that knowledge in the future to the development of a repository for HLW, such as:

- Setting out a clear repository mission (e.g., exclusively for defense HLW/SNF or commercial SNF, or commingling the two) at the start, and not deviating from it unless through clear consultation and agreement with the state

- Actively and frequently communicating with state officials so the state is not surprised by developments related to the project, which can harm trust and potentially instigate lawsuits
- Establishing a conservative time frame for repository development and the beginning of repository operations, understanding the potential for delays
- Having relevant disposal standards and supporting regulatory requirements completed well before candidate repositories are identified (this would help avoid schedule delays and also allay concerns that the standards and regulations were being tailored to a particular site)

DOE could take several actions related to WIPP that could help further future repository efforts, including the following data gathering and engagement efforts with state and local officials:

- Organizing tours to WIPP for state and tribal nations to increase their knowledge about geologic repositories and operations and associated risks and benefits. For example, DOE could invite the National Governors Association, the National Conference of State Legislatures, and the National Congress of American Indians, who could all report their findings on the facility to the public.
- Publishing a comprehensive list of accidents and injuries at the WIPP site over its 25 years of operation. This could include, for example, metrics from reporting to the Occupational Safety and Health Administration in the US Department of Labor each year.
- Funding the National Academy of Sciences to review the WIPP transportation program to see if it matches the prediction of the Academy in 1989 that it would be safer than that of other hazardous materials.
- Publishing a retrospective study on employment and other economic impacts associated with WIPP over the past 50 years.
- Funding the state of New Mexico (or the University of New Mexico, or other public universities in the state) to study the impacts of WIPP on the state's image and tourism, as a report on this topic published by a state entity could be viewed as more credible to other states than one from DOE. The DOE might separately publish a retrospective report on international visits to Carlsbad for technical meetings and WIPP tours from US and foreign citizens.
- Similarly funding an organization to study what impacts, if any, the WIPP project has had on property values in the surrounding area.

These steps would provide additional information on the WIPP experience to help inform state and local officials in their consideration of hosting another deep geologic repository.

Conclusions

For states and localities considering hosting a nuclear waste management facility, the experience of WIPP is worth examining. WIPP opened almost two decades later than DOE had initially envisioned,[98] and the path to the start of operations was circuitous: contemplated changes to the disposal mission, congressional legislation to authorize construction of the project (and limit the mission to defense), a lawsuit from the state, construction of the facility, another lawsuit from the state, congressional legislation to withdraw the land from public use and require EPA certification (among other changes), another lawsuit from the state, EPA certification, another lawsuit from the state, and then, finally, the start of operations.

State officials had raised concerns that DOE did not consult them on changes to the WIPP program—at one point declaring that the facility might never get built if New Mexico was not made an "equal partner."[99] Some DOE decisions that circumvented state involvement led to hostile relations with the state, in the process forfeiting for a time the chance to build a stronger consensus on WIPP and avoid damage to public support for the project.

Eventually, though, WIPP was sited with the consent of the local community, the state government (governor and legislature), and congressional delegation. There were individuals and groups opposed to WIPP, in Carlsbad and statewide, and a clear majority of the population of New Mexico was initially against the project. But public support in New Mexico rose over time, showing the possibility for a deep geologic nuclear waste repository to gain public acceptance.[100]

While a high level of concern about potential accidents was voiced prior to facility construction, a small number of WIPP-related accidents has actually occurred. Overall, the transportation program has had a fairly strong safety record to date: While WIPP trucks have been involved in traffic accidents, none of those involved the release of radioactive materials, and there have been no transportation-related fatalities. The WIPP transportation program has stringent regulations and requirements that greatly limit risks to the public today. WIPP site operations also had a solid safety record prior to two 2014 accidents. There had been a low injury rate during both construction and operations, and the site received numerous safety awards from the state of New Mexico. The two accidents in 2014 marred this record, and the radiological release event associated with the second accident was an especially serious safety violation. Fortunately, neither case led to fatalities. There have been no serious safety violations since 2014.

As part of both construction and operation, the WIPP project has had economic impacts on the Carlsbad area, and to a lesser extent the state of New Mexico, including with high-paying and high-skill jobs, support for local businesses, tax revenues, and contributions to education and

research. The use of land at the WIPP site for nuclear waste disposal, however, has precluded other potential uses, such as the extraction of hydrocarbons and minerals. The opportunity costs of one choice for land use over another will need to be weighed by state and local authorities with the best information available at the time of any decision as to whether to host a nuclear repository.

The authors did not find evidence that the WIPP project, including its transportation program, has adversely impacted tourism in the state or local region or property values, though more research could help quantify specific outcomes and any net effect in these areas.

A new HLW repository effort will face many of the same public acceptance challenges that WIPP did: safety concerns from local citizens, and perhaps even more so from citizens in other parts of the state who are not likely to gain direct economic benefits from the project. A version of the dynamic between New Mexico and the locale where WIPP is housed is likely to be repeated. Repository projects can also be targets of state and national groups that are opposed to nuclear power and see preventing waste disposal as a key element of their strategy. A second deep geologic repository, however, would no longer be a "first of a kind" project in the United States, and the knowledge gained by the WIPP experience could temper some concerns. Today, state and local officials can visit an operating deep geologic repository to judge for themselves the risks and benefits—something that was not possible when WIPP was in development.

Appendix A: WIPP Transportation Program Incident/ Accident Summary

Date	Incident/Accident Summary
June 4, 2019	WIPP shipment with empty packages traveling north on US 491 in southwest Colorado had oncoming vehicle cross into the WIPP truck lane. Driver avoided a head-on collision by moving to his left, but the privately owned vehicle (POV) glanced off the trailer side rail. No damage to WIPP truck. Colorado Commercial Vehicle Safety Alliance (CVSA) officer inspected truck, and shipment was allowed to resume.
August 8, 2013	WIPP shipment with loaded TRUPACT III from Savannah River Site in stop-and-go traffic. WIPP truck rolled up and bumped the vehicle in front of him when driver's foot slipped off clutch. There was no damage to either vehicle or injuries involved. No citations issued.
July 27, 2013	WIPP shipment with loaded packages was parked at the Flying J truck stop in Cheyenne, Wyoming, awaiting Colorado inspector support at the port of entry (POE) when another commercial motor vehicle (CMV) impacted the rear bumper of the trailer while pulling into parking area. Damage was limited to the rear placard holder and toolbox. Shipment was CVSA VI inspected by Wyoming state police and allowed to resume trip.
December 19, 2012	WIPP shipment with loaded packages was parked at the TA truck stop in Sweetwater, Texas, I-20 mile marker 242 waiting end of weather delay. A truck pulling a flatbed attempted to park next to the truck, and his trailer rubbed the WIPP trailer. Minor damage was noted. Law enforcement was contacted but did not wish to respond. The shipment was allowed to continue after the weather delay.
June 3, 2012	WIPP shipment with empty packages was traveling eastbound on I-20 about 5.4 miles west of Cisco, Texas, in the right lane. Another truck began to pass on the left. The vehicle drifted into the WIPP truck's lane while attempting the pass and made contact with the left rear drive axel of the WIPP truck.
November 2, 2011	WIPP shipment with empty packages near Cookeville, Tennessee, was struck by POV on right side of tractor as POV was merging onto interstate as WIPP truck was changing lanes. POV received damage sufficient to be towed. WIPP truck received minor damage, but truck and driver team were replaced pending investigation. WIPP driver was cited for improper lane change, but charges were later dismissed by Tennessee court.
August 18, 2010	WIPP shipment with loaded packages was parked at a truck stop in Colorado when another CMV clipped the front bumper, causing minor damage to truck bumper and scuffed the tire.

Date	Incident/Accident Summary
November 13, 2009	WIPP shipment with empty packages was traveling north on I-15 in Utah near mile marker 310 when a tractor traveling in the left lane veered out of its lane into WIPP transport lane. Trailer of the other tractor hit the left mirror of WIPP transport tractor, causing damage to the mirror. The offending tractor failed to stop. WIPP transport continued to a safe place to exit and then made notifications. Utah state police were notified but, due to the minor damage, did not respond. The mirror was repaired at Pocatello, Idaho, and the shipment resumed. No injuries reported.
June 1, 2009	WIPP shipment with loaded packages was rear-ended by private vehicle in Idaho on I-15 south near mile marker 38. No damage to packages, trailer had minor scuffs, and tail light wire came loose. Idaho state police responded and issued a citation to the driver of the private vehicle. The private vehicle had to be towed, and the driver of the private vehicle was transported by ambulance to a local hospital. WIPP transport was released to continue after complete CVSA VI inspection by Idaho state police. No injuries to WIPP drivers.
April 25, 2009	WIPP shipment with loaded packages was in an accident northeast of Echo, Utah, on I-84 near mile marker 171. Private vehicle spun out when attempting to pass WIPP truck, impacting WIPP trailer driver side rear axles. Minor damage to WIPP trailer's plastic fender. WIPP shipment was inspected and allowed to resume trip to WIPP. No injuries reported.
April 24, 2009	WIPP shipment with loaded packages was in an accident near Federal Heights, Colorado, on south I-25. Private vehicle struck left front fender of WIPP truck. The accident involved a private vehicle, which was struck from behind then crossed into WIPP transport's lane and impacted the WIPP transport truck driver's side front bumper. Minor damage to WIPP truck bumper. One injury reported from a driver of one of the private vehicles. WIPP shipment was cleared to resume trip after Colorado state police inspection. No injuries to WIPP drivers.
March 11, 2008	WIPP shipment with loaded packages was involved in an accident when the shipment ran off the road in New Mexico near Las Vegas, New Mexico, on I-25. No damage to tractor, trailer, or packages. Accident occurred when WIPP driver had onset of persistent coughing and lost control of the vehicle. New Mexico state police responded and assisted with surveillance of the shipment. Driver was sent to medical facility for evaluation. Replacement drivers were dispatched from the Carlsbad terminal, and shipment resumed after CVSA inspection was complete with new drivers. No injuries reported.
December 6, 2007	WIPP shipment with empty packages in Utah on Highway 6, near mile marker 207 struck by private vehicle impacting both tractor and trailer. Damage to two tires, rims, and axle on WIPP trailer. Accident resulted when driver of the private vehicle crossed over center line into WIPP transport's lane. Driver of the private vehicle was issued a citation by Utah state police and was transported by ambulance from the scene. WIPP shipment was released by Utah state police from the scene to proceed to the nearest Kenworth facility for repairs. No injuries to WIPP drivers.

Date	Incident/Accident Summary
July 7, 2007	WIPP shipment with empty packages was struck by a private vehicle near Leeds, Alabama, on I-20 near mile marker 41. The private vehicle driver was trying to avoid another private vehicle that had crossed into their lane when they struck the WIPP transport rear driver's side axle of the tractor. WIPP driver notified Alabama state police and assisted private vehicle driver. Only minor damage to the WIPP transport, which was allowed to resume trip.
May 11, 2007	WIPP shipment with loaded packages on westbound I-20 in Texas near mile marker 356 was involved in an accident while avoiding battery box cover and center median debris caused from another commercial vehicle hitting the center median (concrete). The WIPP transport hit a concrete block, which blew out left steering axle tire and resulting damage to four tires. Texas state police responded and assisted as a tire repair truck repaired two flat tires. Truck was then released to travel to next exit to a tire shop for repair of the other two damaged but not flat tires. After CVSA VI inspection, shipment was released to resume trip. No injuries reported.
June 26, 2006	WIPP shipment with loaded packages was involved in an accident on I-20 near Madison, Georgia. Private vehicle struck WIPP trailer as a result of contact with other private vehicles. Only minor damage to WIPP trailer. There were two injuries reported of private vehicle passengers. No injuries to the WIPP drivers. Shipment was allowed to resume trip to WIPP.
December 27, 2005	WIPP shipment with empty packages was involved in an accident in Idaho on I-15 near Blackfoot, Idaho. The WIPP driver lost consciousness and control of the vehicle, causing vehicle to roll onto its side and detachment of all three TRUPACT II packages. All three packages sustained surface damage, but the integrity of the packages remained intact. Although these were empty packages, the Idaho state police conducted radiation surveys, which resulted in no measurable detection. The WIPP drivers were removed from service and sustained minor injuries.
December 7, 2005	WIPP shipment with empty packages was traveling eastbound on I-20 about 5.4 miles west of Cisco, Texas, in the right lane. Another truck began to pass on the left. The vehicle drifted into the WIPP truck's lane while attempting the pass and made contact with the left rear drive axel of the WIPP truck.
June 2, 2005	WIPP shipment with empty packages near Cookeville, Tennessee, was struck by POV on right side of tractor as POV was merging onto interstate as WIPP truck was changing lanes. POV received damage sufficient to be towed. WIPP truck received minor damage, but truck and driver team were replaced pending investigation. WIPP driver was cited for improper lane change, but charges were later dismissed by Tennessee court.
September 7, 2002	WIPP shipment with loaded packages was parked at a truck stop in Colorado when another CMV clipped the front bumper, causing minor damage to truck bumper and scuffed the tire.

Date	Incident/Accident Summary
August 25, 2002	WIPP shipment with loaded packages was involved in an accident when the driver of a private vehicle hit driver side rear of WIPP trailer while attempting to pass near Carlsbad, New Mexico, on US 62/180 near mile marker 39. Driver of private vehicle was cited for driving under the influence of alcohol, reckless driv-ing, and not being a licensed driver. Driver of the private vehicle was transported to a Carlsbad hospital with minor injuries. No injuries to WIPP drivers. After inspection by DOT, the shipment continued on to WIPP.

Appendix B: Examples of Site Incidents/Accidents as Recorded by the DNFSB since 2017

This is a sample of events since 2017, when Defense Nuclear Facilities Safety Board reporting became more regular. It is merely to illustrate the types of incidents and accidents that have occurred at the WIPP site in that time period.

Date of DNFSB report	Incident/accident details
December 1, 2017	Accidental discharge of a fire suppression system occurred due to an outdated operator round sheet, leading to the release of nitrogen...a smoking electric cart motor underground prompted a successful evacuation of all personnel within the hour using breathing devices.
October 5, 2018	Radiumrich waste from Oak Ridge National Laboratory exceeding WIPP's contamination limits, with ongoing evaluations of compliance data. Underground ventilation faced problems after workers fell ill near panel 7, possibly due to heat stress or high nitrous oxide levels. Maintenance and Inspection revealed over 40 noncompliances with technical safety requirements (TSR)-related procedures and issues with underground vehicle maintenance and preventive procedures.
November 2, 2018	Unsafe exposure levels for sulfur dioxide and carbon tetrachloride affecting underground and surface workers, respectively, and identified immediate an long-term air quality improvements...Maintenance issues persist with underground vehicles...missed surveillance testing of a fire suppression system. Waste handling and emplacement activities were halted in late October due to health concerns, leading to a pause in additional waste shipments until operations resume.
December 7, 2018	Rocks fell in room 6 of panel 7, halting underground work and leading to an evacuation. The area, housing abandoned diesel equipment and blocked by emplaced waste, showed no radiological release. Ground control issues persist with failing stabilization bolts, raising concerns from the Carlsbad field office. Conduct of Operations noted a TSR violation for processing shipments with external contamination exceeding limits and plans for corrective actions.

Date of DNFSB report	Incident/accident details
February 7, 2020	Nuclear Waste Partnership discovered a potential puncture in a 10-drum overpack (TDOP) from the Idaho National Laboratory, halting work and notifying key personnel. After a radiological survey found no contamination, the TDOP was placed back in its container. On January 7, 2020, brake failure on a box cart led to an impact with another cart, revealing inconsistent documentation of preoperational checks. Additionally, on January 11, 2020, grout pieces fell from the wall in the underground control station area, but no injuries occurred.
July 3, 2020	Three incidents with roof bolting machines in the last 18 months in which personnel were injured.
August 7, 2020	Roof falls in two underground areas.
January 7, 2022	Several underground vehicle incidents...a transporter collided with a parked transporter while backing up, and on December 9, another transporter hit a wall while maneuvering around a parked cart. While there were no injuries or radiological releases, these incidents highlighted a lack of attention to detail that could increase the risk of future radiological events.
April 1, 2022	Two vehicle-related incidents. The first occurred underground when a haulage truck struck a wall while turning, causing a fuel line to detach...The second incident involved a trailer with empty TRUPACTs disconnecting from a trailer-jockey in the parking area unit, resulting in minor damage to the trailer but no harm to the TRUPACTs.
August 5, 2022	NWP reported a near-miss incident where a miner trainee injured his middle and fourth fingers while operating a roof bolter.
March 1, 2024	The man cage in the waste hoist stopped working 1,500 feet below the surface with two miners inside as it was traversing the underground.
May 3, 2024	Multiple incidents occurred within one week this month, including two recordable injuries, a fire in a mop bucket located outdoors near a welding facility, and a drop of the tail end of a hoist rope approximately 15 feet onto the facility floor while replacing it.

About the Authors

Dr. Matt Bowen is a Senior Research Scholar at the Center on Global Energy Policy at Columbia University SIPA, focusing on nuclear energy, waste, and nonproliferation. He is also nonresident senior fellow with the Atlantic Council's Global Energy Center. He was formerly a Nuclear Policy Fellow at Clean Air Task Force and a Senior Policy Fellow at the Nuclear Innovation Alliance.

Dr. Bowen has written reports on federal and state policies to encourage advanced reactor development, and has also published papers on reforming U.S. nuclear export controls. During the Obama Administration, he was an Associate Deputy Assistant Secretary in the Office of Nuclear Energy and a Senior Advisor in the Office of Nonproliferation and Arms Control at the U.S. Department of Energy (DOE). Previous to working at DOE, he was an AAAS/APS Science Fellow for Senate Majority Leader Harry Reid.

Dr. Bowen received a Bachelor of Science degree in physics from Brown University and a Ph.D. in theoretical physics from the University of Washington, Seattle. He has held positions at the National Academies with the Board on Physics and Astronomy, the Board on Energy and Environmental Studies, and the Division on Engineering and Physical Sciences. Dr. Bowen has also done work outside of Columbia University as an independent consultant for EFI Foundation and Third Way.

Hamna Khan works as an ORISE Fellow at the U.S. Department of Energy, Office of Asian Affairs. Hamna previously worked as an electrical engineer for four years. She has a Bachelor of Science in Electrical Engineering from the University of California San Diego where she focused on power systems and power electronics. Hamna also has a Master of International Affairs from Columbia University School of International and Public Affairs in Energy and Environment.

Rama T. Ponangi is an India-trained lawyer specializing in nuclear law and policy. Prior to joining to CGEP, Rama worked as a Research Assistant under Professor Donna Attanasio, Director, Energy Laws, The George Washington University Law School, where he organized a 4-day conference titled "Investable Nuclear Energy" covering topics of Environment, Social and Governance aspects of nuclear energy, supply chain for the advanced nuclear reactors, future of the nuclear technology, garnering public support and role of academia in shaping next generation of nuclear law and policy experts. Rama is also a Policy Fellow at the Nuclear Innovation Alliance.

In the past, Rama interned at the Office of Legal Affairs, International Atomic Energy Agency (IAEA), Vienna, Austria, where he primarily assisted its Legislative Assistance activities such as reviewing the draft nuclear legislation of Member States and assisted in conducting bilateral and multilateral meetings such as Role of a Legal Advisor in a Regulatory Body and International Nuclear Liability

Expert (INLEX). Rama also undertook research on the topic of safety, security and liability aspects of Transportable Nuclear Power Plants (TNPPs).

Rama has completed his Bachelors in Law – B.A., LL.B. (Specializing in Energy Laws) from University of Petroleum & Energy Studies, Dehradun, India. He has completed a diploma in International Nuclear Law from the International School of Nuclear Law (ISNL), University of Montpelier, France organized by Nuclear Energy Agency, OECD. Rama has completed his Masters in Law – LL.M. in Energy and Environmental Laws from The George Washington University Law School as GW Merit Scholar and Randolph C. Shaw Environmental Graduate Environmental Fellow. Rama has completed several other niche certifications in nuclear energy and law.

Notes

1. New opportunities for such visits may also arise outside of the United States, in countries such as Canada, Sweden, Finland, and France, which are among a group of nations making progress toward developing their own repositories.
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