Offshore Drilling, Onshore Damage

Broken pipelines, dirty refineries and the pollution impacts of energy infrastructure

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The authors bear responsibility for any factual errors. The recommendations are those of Environment Washington Research & Policy Center. The views expressed in this report are those of the authors and do not necessarily reflect the views of our funders or those who provided review.

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Cover: An onshore pipeline carrying oil from offshore drilling ruptured and spilled oil on a beach west of Santa Barbara, California, in 2015. Used with permission ©Paul Wellman/ Santa Barbara Independent

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Executive summary

The Trump administration has proposed opening much of the Atlantic, Pacific and Arctic oceans off the U.S. coast to offshore oil and gas drilling. The environmental dangers posed by offshore oil spills, such as the 2010 *Deepwater Horizon* spill in the Gulf of Mexico, are well known. The damage to the environment, communities and public health from the onshore infrastructure needed to support offshore drilling is less well known, but no less real.

Offshore drilling relies on onshore pipelines, waste disposal facilities, ports and refineries that endanger public health by polluting the air and water, and threaten wildlife and ecosystems.

State leaders should protect coastal communities and the environment by blocking any expansion or construction of onshore infrastructure that enables offshore drilling.

The onshore infrastructure needed to support offshore drilling has serious impacts on the environment, public health and coastal communities.

Pipelines: Oil and gas produced offshore are often delivered via pipelines to onshore storage or processing facilities. The expansion of offshore oil and gas production could require the construction of new pipelines, disrupting coastal ecosystems and threatening further damage in the event of leaks.

- Constructing pipelines can damage sensitive and fragile ecosystems such as wetlands and estuaries. A study by the U.S. Geological Society found that across Louisiana, for example, some pipelines built to carry oil and gas from offshore production have contributed to habitat loss.[1]
- Pipelines can fail, spilling oil. For example, a rupture in an underground, onshore pipeline transporting oil from drilling platforms in the Santa Barbara Channel to inland refineries spilled more than 120,000 gallons of crude oil in 2015.[2] Oil flowed into the ocean, coated birds and mammals, and forced the closure of two state beaches.[3]

Waste disposal: Offshore drilling often creates waste containing oil, toxic contaminants and radioactive material. Some of this waste may be transported onshore for disposal.[4] Transporting and disposing of this waste creates risks.

- Liquid waste may be injected into disposal wells, which are porous underground rock or sand formations.[5] However, injection wells may leak, polluting nearby freshwater supplies.[6] Texas, Louisiana and California, which are close to current offshore and onshore production facilities, have thousands of injection disposal wells.[7]
- Other waste may be spread on soil, exposing oil to microbes capable of digesting it and diluting other contaminants.[8] Land application may create water pollution if heavy rain or flooding washes soil off the site, and it adds pollutants and salts to the soil.[9]

Ports and marine oil terminals: Ports support the production of offshore oil and gas by providing a base for the equipment and personnel needed for offshore operations and by serving as an important waypoint for waste generated at offshore drilling operations. Marine oil terminals – berths or piers where tankers can unload oil from offshore production or other sources – help move crude oil to refineries. These activities can be harmful for the environment and public health.

- Spills in ports or at oil terminals can occur during routine operations such as unloading oil from barges and tankers. From 1990 to 2013, there were eight spills of 42,000 or more gallons of oil from tankers while in port.[10] Smaller spills can also threaten public health. Regulators issued public nuisance violations to Phillips 66 in Rodeo, California, and a ship docked at the facility for an oil sheen found on the water in 2016.[11] People nearby complained of foul odors and more than 100 residents went to the hospital.[12]
- Oil spills in port can be devastating for the function of the surrounding ecosystems, coating wildlife in oil and damaging estuaries that are critical for shrimp, crabs and fish.[13]

Refineries: Increased offshore oil production may require new or expanded refineries to convert crude oil into useful products such as gasoline, diesel fuel or jet fuel. Oil refineries are a major source of air pollution that threatens public health.

- Even when operating normally, refineries release particulate pollution, which exacerbates asthma and has been linked to lung cancer.[14] They also release pollutants that are major contributors to smog, which can cause respiratory irritation, reduce lung function, and worsen asthma.[15]
- Malfunctions at refineries can create acute air pollution episodes that threaten public health. A fire at ExxonMobil's Baytown, Texas, refinery in March 2019 led to releases of sulfur dioxide, hydrogen sulfide and benzene for more than a week.[16]

To protect coastal communities and ecosystems, the nation should refrain from expanding offshore oil and gas production. At the federal level, the Trump administration should permanently withdraw its proposal to expand offshore oil and gas production in the Atlantic, Pacific and Arctic oceans. Separately, states should protect coastal areas by blocking construction of new oil and gas infrastructure or the expansion of existing infrastructure needed to support expanded offshore drilling.

Introduction

On May 19, 2015, a rupture in an onshore pipeline transporting oil from drilling platforms in the Santa Barbara Channel to onshore refineries spilled 120,000 gallons of crude oil near Refugio State Beach, west of Santa Barbara, California.[17] The Santa Barbara Fire Department initially responded to a report of a petroleum smell, and the response grew to include 1,300 responders from local, county, state and federal agencies.[18] The spill forced the closure of both El Capitan and Refugio state beaches — El Capitan State Beach for over one month and Refugio State Beach for almost two.[19] Oil from the spill was found at beaches in Los Angeles County, 80 miles away.[20] The spill killed nearly 100 mammals and more than 200 birds,

Photo: U.S. Coast Guard

Oil from a ruptured pipeline coats Refugio Beach near Santa Barbara, California, in 2015.

and affected a range of marine life, including brown pelicans, California sea lions, elephant seals and dolphins.[21] Local fisheries were closed.[22]

The pipeline operator, Plains All American Pipeline, was convicted in 2018 on a number of criminal charges related to the oil spill. A jury found that the company had failed to maintain the pipeline and failed to notify emergency responders promptly once it detected the oil spill, among other violations.[23] The company subsequently was fined $3.35 million.[24]

Plains All American Pipeline has applied for permits to build a replacement pipeline.[25] If permits are approved, the pipeline would begin operating after 12 to 18 months of construction, once again transporting crude oil from three platforms in the Santa Barbara Channel to onshore refineries and other pipelines.[26]

Portions of the new 123-mile long pipeline, which would mostly follow the same route as the existing pipeline, would impact areas on and near the coast.[27] It would run through Santa Barbara, San Luis Obispo and Kern counties. Sixteen miles of it would cut through Los Padres National Forest, Carrizo National Monument, Bitter Creek Wildlife Refuge and Gaviota State Park.[28] These places are irreplaceable and ecologically important, with several providing habitat for endangered species, including the California condor, Southwestern willow flycatcher and San Joaquin kit fox.[29]

The Santa Barbara County pipeline rupture is representative of how the production, transportation and processing of oil – including oil produced from offshore drilling – can affect the health and well-being of people, wildlife and the environment. An increase in offshore drilling – particularly in areas of the country that do not currently produce large volumes of oil – will require the development of new fossil fuel infrastructure onshore and increase the use of existing infrastructure. These activities, as much as offshore drilling itself, pose threats to residents of coastal communities and sensitive coastal ecosystems.

Increased offshore drilling may mean new pipelines will be constructed to carry oil and gas onshore from offshore wells, increasing the risk of leaks that endanger sensitive coastal ecosystems. Or, it may result in more oil tankers and barges coming and going from U.S. ports, either delivering crude oil from offshore production sites or picking up oil for export. Increased offshore oil production may lead to construction of new refineries or the expansion of existing ones, adding to the air pollution already burdening nearby communities.

This report describes in more detail how increased offshore oil and gas production may affect people and the environment onshore as new infrastructure is built or as existing facilities are used more intensively.

Expanded offshore drilling will require onshore facilities

The Trump administration has proposed opening extensive areas of the nation's Atlantic, Pacific and Arctic ocean coastline to new oil and gas drilling. Though the administration has put the proposal on hold as it awaits the outcome of legal challenges, it has not withdrawn it.[30] In many areas, increased offshore oil and gas production would require construction or expansion of onshore infrastructure to transport, store and process oil and gas.

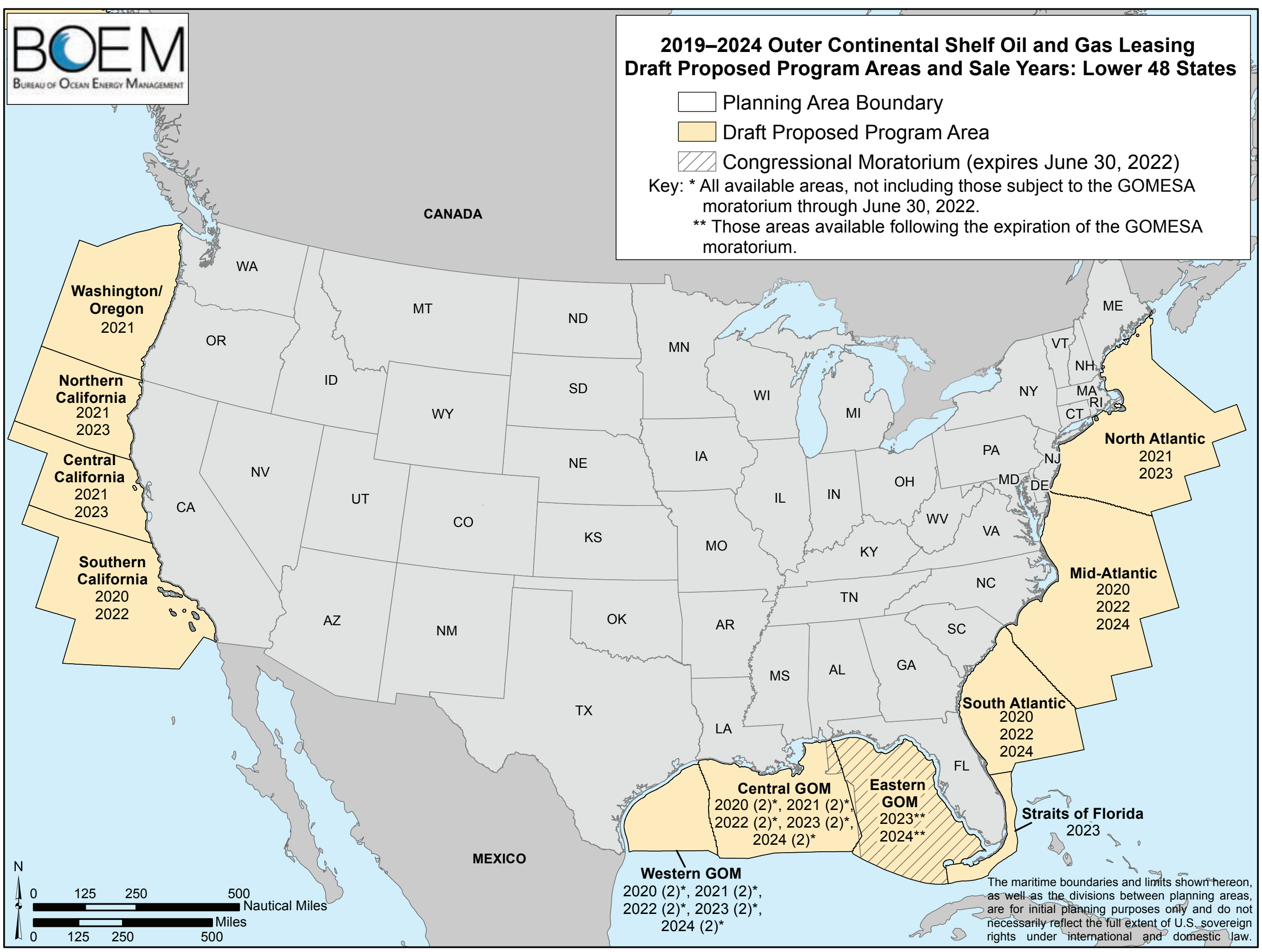


Figure 1. Map shows proposed dates when oil and gas leases would be available in the Atlantic and Pacific oceans[36]

The Trump administration has proposed more offshore drilling

States have jurisdiction over the three miles of ocean immediately off their coastline, except for Texas and the Gulf coast of Florida, where state control extends nine miles.[31] Beyond the area of state control, the federal government has control for at least 200 miles from shore.[32] Some portions of this area, including the outer continental shelf, contain oil and gas deposits that the Trump administration would like to open for development.

The administration has proposed allowing drilling in most of the area off the nation's Atlantic and Pacific coasts, as well as areas off the coast of Alaska.[33] The only exemptions are for marine sanctuaries that were protected before 2008, the Northeast Canyons and Seamounts Marine National Monument, and limited areas in the Gulf of Mexico and off the coast of Alaska.[34] The government would offer leases for bids from oil and gas companies in stages until 2024.[35] (See Figure 1.)

The administration's proposal for increased offshore drilling includes an estimate of how much oil and gas it might be possible to produce from offshore regions. The Bureau of Ocean Energy Management estimates that the Gulf of Mexico contains 33 billion barrels of oil that might be economically feasible to recover (if oil costs $100 per barrel) and that regions off the coast of California might contain 7 billion barrels.[37] More than 4 billion barrels of oil might be economically feasible to recover offshore from Maine to Florida. Alaska's coastal regions could produce more than 17 billion barrels. Table 1 shows the Bureau of Ocean Energy Management's estimates for regions in the Atlantic, Pacific and Arctic oceans, the Bering Sea, and the Gulf of Mexico.[38]

Table 1. Unleased, undiscovered, economically recoverable resources by offshore drilling region, assuming $100 per barrel of oil[39]

Coastal region	Coastal states	Million barrels of oil
North Atlantic	Maine to New Jersey	1,640
Mid-Atlantic	Delaware to North Carolina	2,180
South Atlantic	South Carolina to northern Florida	180
Eastern Gulf of Mexico	Florida	3,060
Central Gulf of Mexico	Louisiana, Mississippi and Alabama	20,990
Western Gulf of Mexico	Texas	8,690
Southern California	California	3,580
Central California	California	2,080
Northern California	California	1,340
Washington/Oregon	Washington and Oregon	230
North Pacific/Gulf of Alaska	Alaska	1,290
Bering Sea	Alaska	660
Arctic Ocean	Alaska	15,370

Data on historic production from current offshore oil and gas facilities can help put the future production estimates in Table 1 in context. Oil companies produced 12,621 million barrels of oil from 1981 to 2017 from federal waters off the coast of Louisiana, Mississippi, Alabama and Florida.[40] Wells in federal waters off the coast of Texas produced 1,295 million barrels, and wells off the coast of Southern California produced 1,047 million barrels.[41] (See Figure 2.) Several states produce additional amounts from production facilities in state-controlled offshore areas.[42]

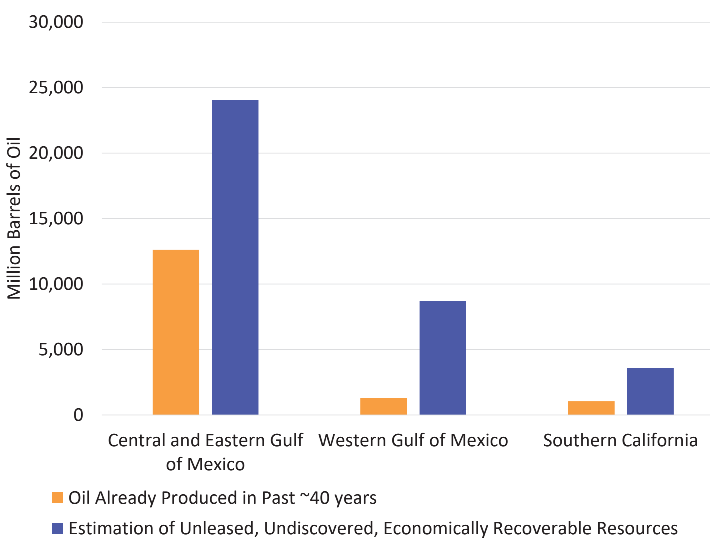


Figure 2. Historic production is less than estimation of unleased, undiscovered, economically recoverable resources, assuming $100 per barrel of oil[43]

Oil and gas produced offshore will be transported, stored and processed onshore

Development of offshore oil and gas drilling sites will affect communities and ecosystems onshore. That's because most of the infrastructure needed to support offshore drilling is located on land. As the Minerals Management Service (the precursor agency to the Bureau of Ocean Energy Management) noted in a 2010 presentation, "Every offshore oil & gas producing basin in the world requires an extensive amount of onshore support infrastructure."[44]

As an offshore drilling site is being developed, crews and equipment will operate out of a port. Trucks or marine freight vehicles will bring equipment and staff to the port, and boats or helicopters will take everything to the drilling site. As a well is drilled, some waste from the drilling process may need to be brought back to the port for onshore disposal. Depending on the nature of the waste, it may need to be hauled to a site designated for disposal of hazardous or radioactive waste, since naturally occurring radioactive material in geologic formations has the potential to contaminate drilling wastes, requiring special disposal.

Oil from offshore production sites may be brought to shore by tankers that unload at marine oil terminals. In other places, new pipelines may be needed to deliver oil and gas from offshore production sites. Underwater pipelines carry oil onshore, and then onshore pipelines deliver it to storage facilities or refineries. Underwater offshore pipelines carrying gas feed into onshore gas pipeline networks.

The onshore infrastructure needed to support offshore production can be seen in states that currently have significant offshore oil and gas production. For example, Texas and Louisiana have dense networks of natural gas pipeline networks offshore connected to onshore pipelines and production facilities. In contrast, coastal areas without offshore gas production have far fewer natural gas pipelines. (See Figure 3.)

As discussed in the following sections, new or expanded onshore infrastructure has the potential to harm the health of people living nearby and to damage the environment.

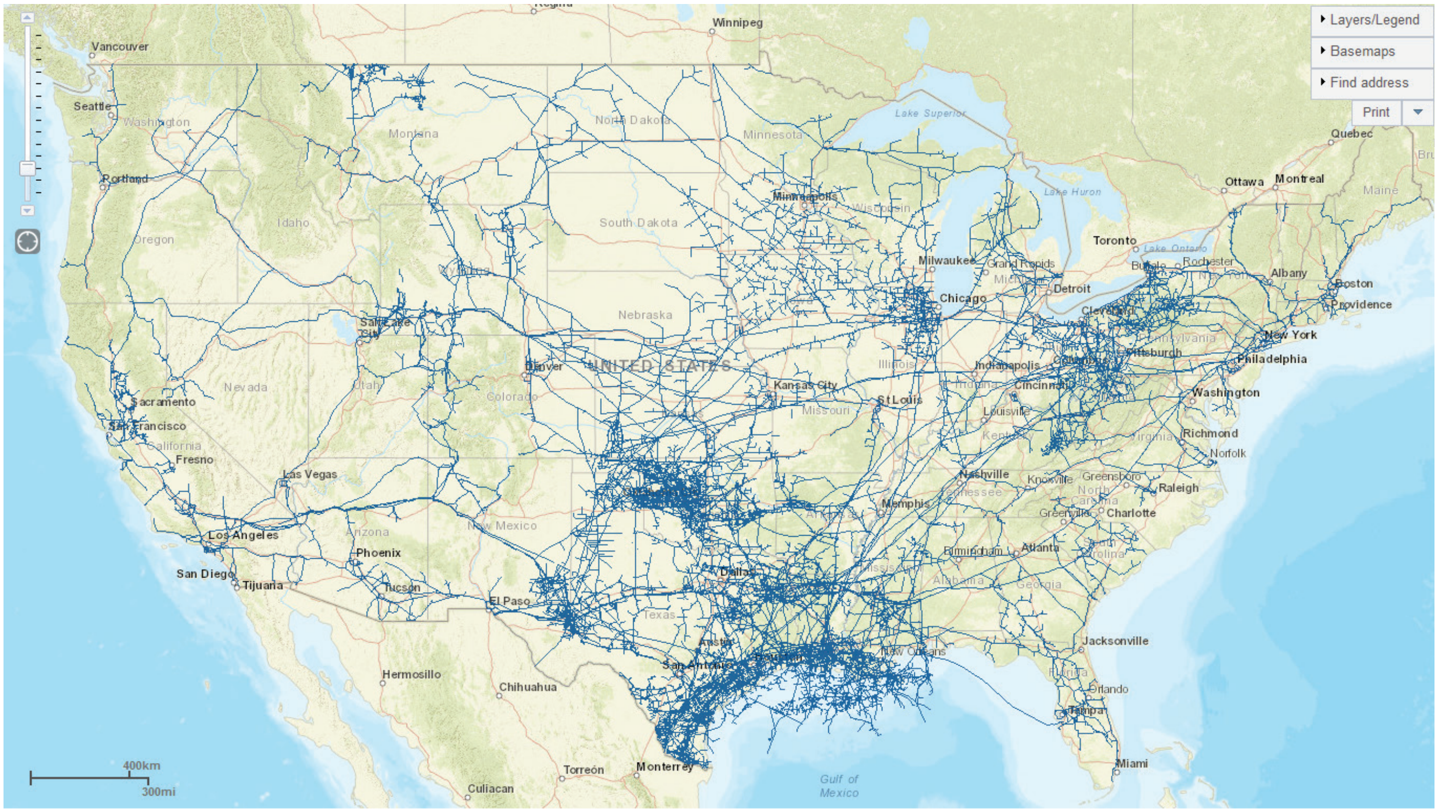


Figure 3. Natural gas pipeline networks are concentrated in areas with natural gas production[45]

Pipelines

Oil and gas produced offshore are often delivered via pipelines to onshore storage or processing facilities. Onshore pipelines can create environmental damage during construction and when oil and gas spill or leak.

The pipeline systems that connect operating platforms to onshore facilities can be extensive. For example, the Gulf of Mexico offshore pipeline system alone is composed of roughly 33,000 miles of pipeline connecting roughly 3,200 platforms.[46] Onshore pipeline networks are even more extensive. Louisiana alone has 50,000 miles of pipeline, much of it concentrated near the Gulf of Mexico.[47] (See Figure 4.)

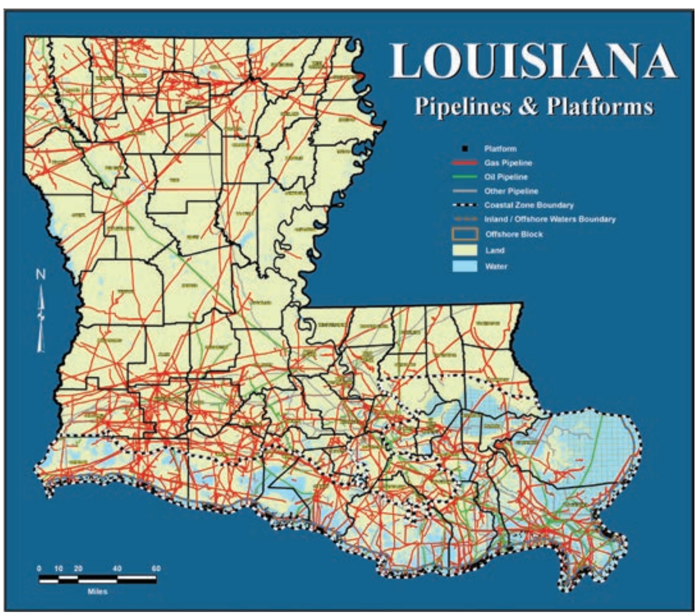
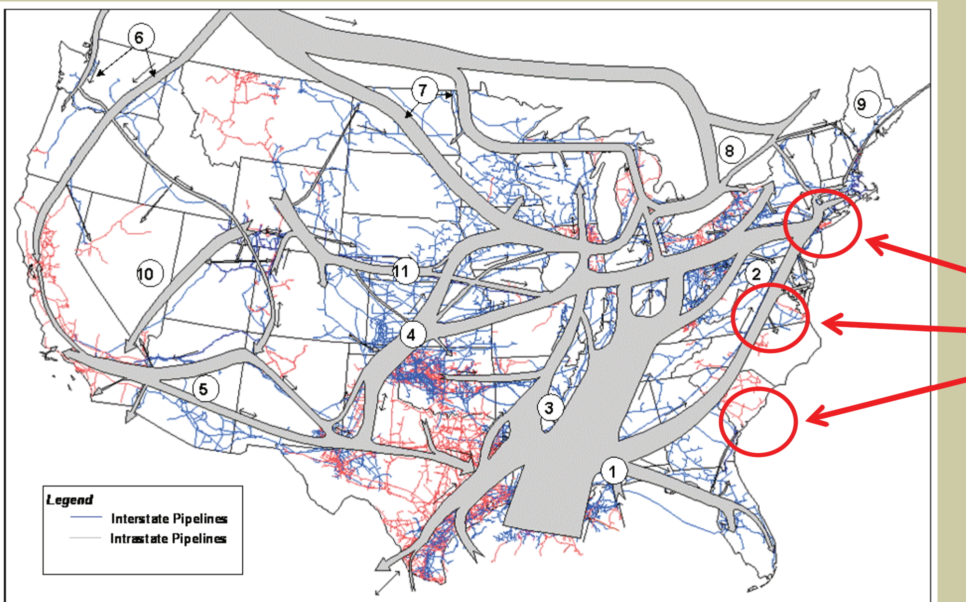


Figure 4. Onshore oil and gas pipelines in Louisiana[48]

Expanding offshore oil and gas production will likely require construction of new pipelines. For example, existing gas pipeline networks in the Mid-Atlantic region are located far from the coast.[49] Assuming recovery of natural gas in the Atlantic is economically viable, bringing it to markets along the Eastern Seaboard would require new pipelines extending westward from the coast to connect to existing intrastate pipelines. Potential access points for connecting offshore gas to the existing pipeline network exist in South Carolina, Virginia and the New York/New Jersey area.[50] See Figure 5.

Pipeline construction can damage sensitive and fragile ecosystems such as wetlands and estuaries. Laying a pipeline on the ocean floor or burying a pipeline stirs up sediment, disturbing or burying organisms, and potentially damaging coral reefs, according to a 1980 Environmental Protection Agency analysis.[52] Organisms such as zooplankton, invertebrates and fish are harmed by water that contains too much floating sediment.[53] As sediment settles, it can smother plants.[54]

Where pipelines come onshore, they may change how barrier islands, dunes and wetlands function. A pipeline built across a barrier island, for example, may increase the risk of erosion along the pipeline's path and lessen the ability of barrier islands to protect shoreline areas.[55] When constructed without sufficient mitigation measures, pipelines can damage coastal wetlands. A study by the U.S. Geological Society found that across Louisiana, for example, some pipelines built to carry oil and gas from offshore production have contributed to habitat loss.[56]



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, GasTran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.

Note: The width of the gray line indicates the volume of gas carried in various pipelines.

Figure 5. A 2010 presentation suggested possible Eastern Seaboard pipeline access points[51]

Further onshore, pipelines may be routed away from urbanized areas, which might mean going through pristine natural areas. In North Carolina, for instance, many undeveloped coastal areas include nature preserves or state parks.[57]

Once overland pipelines begin carrying oil or gas, leaks and spills can harm scenic and ecologically important areas. Disruptions caused by human activities, geological activity, or operation or equipment failures can lead to leaks or ruptures.[58] Leaks can be highly damaging to local ecosystems and public health.

Natural gas pipelines are a source of air pollution and noise because they rely on compressors. Natural gas pipelines require compressors every 40 to 100 miles.[59] Though noise from interstate pipelines is restricted by federal rules, compressors may be audible at the nearest homes.[60] Even though the total decibels emitted by compressors may be modest, the sound may affect people and wildlife.[61] Compressors create air pollution from burning natural gas and also when they release unburned natural gas during maintenance or safety operations.[62] Oil pipelines typically rely on electric-powered pumps to move fuel and thus do not create local air pollution (though they add to pollution from the electric power plants used to generate the electricity).[63]

Waste disposal sites

Offshore drilling creates many kinds of waste, some of which cannot be discharged at sea because it contains oil, toxic contaminants or radioactive material.[64] These materials may be brought onshore for disposal. Expanded offshore drilling could require construction of new waste disposal capacity in regions that currently have little or none, such as the Mid-Atlantic.[65]

Waste produced by offshore drilling includes:

- Drill cuttings, which are pieces of rock broken during drilling.[66]
- Drilling mud, a mix of clay, chemicals, water and/or oil that is used as lubrication and coolant during drilling. As the mud flows back to the surface, it carries drill cuttings, which then are coated in the chemicals and lubricants from drilling mud.[67]
- Produced water, which is water trapped in the oil or gas reservoir that is released during drilling and production. It often contains oil and salt from the oil formation, naturally occurring radioactive material and chemicals used during drilling.[68]
- Produced sand, which is pumped from the oil and gas formation. The sand may be mixed with oil and other contaminants.
- Sediment and pipe scale, which is a mineral deposit that forms inside pipes. This waste may also contain naturally occurring radioactive material.[69]
- Sanitary waste, kitchen waste and trash generated by workers on offshore platforms.[70]

Most waste from offshore drilling exploration and production – including produced water, drilling cuttings and drilling mud – is dumped directly into the ocean if it has a low level of contamination.[71] Waste that is contaminated with oil-based drilling fluid cannot be released into the ocean and may be transported to shore for disposal. Solids containing naturally occurring radioactive materials from the oil and gas formation also may be transported onshore.[72]

Waste is moved from offshore facilities to a disposal facility or an onshore transfer facility via boat, in which case it may be moved again from the transfer location to a disposal facility via truck, boat or barge. There is a risk of a spill or leak each time the material is transferred on or off a vessel or transported to the next facility. In addition, the boat, truck or other container that carried the waste must be cleaned afterward and the contaminated wash water must be disposed of.[73]

Once at the disposal facility, waste can be dealt with in various ways. Waste may be:

- Injected into onshore disposal wells. Drilling mud, contaminated drill cuttings, drilling chemicals and produced sand contaminated with oil can be injected into porous underground rock or sand formations.[74] However, injection wells may leak, polluting nearby freshwater supplies.[75] Injection wells have also been implicated in increased earthquake activity in regions that have not previously had many earthquakes.[76] States close to current oil and gas production facilities – both onshore and offshore – have a number of injection disposal wells. The Environmental Protection Agency classifies wells that receive fluids from oil and gas production as Class II wells, which may be used for disposal, storage or increased production from oil wells.[77] As of 2016, Texas had 13,418 Class II disposal wells, Louisiana had 3,195 and California had 1,794.[78] In contrast, most states on the Atlantic coast had fewer or none. New Jersey, Delaware, Maryland, North Carolina, South Carolina and Georgia had none, while Pennsylvania had 15 and Virginia had 13.

- Spread on soil. Wastes such as drilling mud made with synthetic materials and oil-contaminated sand may be applied to soil for disposal. Spreading the waste allows the contaminants to be diluted, for some hydrocarbons to evaporate, and for microbes to digest oil in the waste.[79] Land application, also known as "landfarming," may create water pollution if heavy rain or flooding washes soil off the site, and it adds pollutants and salts to the soil.[80] In regions of the country with extensive onshore oil and gas production, application of waste on individual farms is common.[81] Waste from offshore production facilities may go to commercial landfarms, which accept larger volumes of waste. As of 1993, a federal analysis found three commercial landfarms in Texas and seven commercial landfarms in Louisiana that were expected to be used for disposal of offshore oil production waste if production were increased in the Gulf of Mexico.[82]

- Pumped into salt caverns. Salt caverns, natural formations that are 500 to 6,000 feet underground, are excavated by pumping in fresh water, which dissolves the salt.[83] The brine solution is then brought to the surface, where it can be sold for other uses or injected into a disposal well. If this brine spills, it can kill vegetation and damage soil for decades.[84] Once room has been created in the salt cavern, liquid and solid wastes from offshore can be pumped in, including waste contaminated with oil or radioactivity.[85] Coastal regions with salt deposits where salt caverns could be developed exist along the Gulf Coast in Texas and Louisiana.[86]

Photo: Ingvar Tjostheim, via shutterstock

Shale shakers separate drilling mud from drill cuttings, which are one type of waste generated by offshore drilling that may be brought onshore for disposal.

- Recycled or treated. Treatment facilities can remove oil and salt from waste. The oil can be resold and salt can be mixed with water and injected in a disposal well.[87] Any solid material remaining after usable components have been removed can be landfilled.

- Buried in a landfill. Drilling waste that has been processed to remove water and oil can be buried in a landfill. Trash from the offshore facility can be sent to a municipal landfill like any other household waste. Though modern landfills are lined to protect the groundwater beneath them from contamination, water pollution remains a risk from landfills.[88]

Expanded offshore oil and gas production could spur construction of new onshore disposal facilities. For example, in the mid-2000s, an Argonne National Laboratory study found that disposal operators were considering opening new salt caverns near the Gulf Coast to handle waste from offshore drilling.[89] According to a 2010 presentation by the Minerals Management Service, the eastern seaboard has few existing commercial oil and gas waste handling or disposal facilities for solid or liquid wastes.[90]

Ports and marine oil terminals

Ports and marine oil terminals are key transport nodes that support the production of offshore oil and gas. They provide a base for equipment and personnel needed for offshore operations. They also are an important waypoint for bringing crude oil and gas onshore, for receiving waste generated at offshore drilling operations, and for exporting natural gas and petroleum products. These activities can be harmful for the environment and public health.

The U.S. coastline is punctuated with numerous ports and marine terminals used to support oil and gas production. Marine oil terminals, which are berths or piers where tankers can unload oil, may be located at ports, refineries or other petroleum receiving facilities.

Photo: skeeze via pixabay

The Houston ship channel and petroleum facilities.

Ports are locations where ships load or unload people and cargo. Not all ports have marine oil terminals for handling oil shipments. As of 2017, there were several dozen ports located along U.S. coasts where oil is exported or imported.[91]

Ports serve as launch points for ships delivering equipment, crew members, drilling muds and other supplies needed for offshore operations.[92] They also host transfer facilities where waste is taken from supply boats and transferred to a barge or truck that takes the waste to disposal sites.[93]

Equipment failure or human error can cause spills in ports or at oil terminals during routine operations such as transit or unloading oil. From 1990 to 2013, there were eight spills of 42,000 or more gallons of oil from tankers while in port in U.S. waters.[94] Barges can also spill oil. Examples of tanker and barge spills include:

- In 2000, 80,000 gallons of oil were released into the Houston Ship Channel when a tank barge was overfilled.[95]
- A tank barge spilled 98,000 gallons of oil in Buzzard's Bay, Massachusetts, in 2003, after colliding with a ledge of bedrock.[96] Damage from the spill included harm to aquatic and shoreline habitats, boating and shellfishing activities, and bird populations.
- Regulators issued violations to Phillips 66 in Rodeo, California, and a ship docked at the facility for an oil sheen found on the water in 2016.[97] People

nearby complained of foul odors and more than 100 residents went to the hospital.[98]

- In March 2016, an oil spill occurred at the Port of Los Angeles as fuel was being transferred from an oil tanker.[99] Heavy fuel oil and an oily-water mixture contaminated the pier, the seawall and the tanker.[100]

According to the National Oceanic and Atmospheric Administration, "even relatively small oil spills can cause major environmental and economic harm."[101] Oil spills and leaks can harm surrounding ecosystems, coat wildlife in oil, and damage estuaries that are critical for shrimp, crabs and fish.[102] Oil is toxic to the eggs of many fish species and can result in lower reproduction rates.[103] Adult fish may suffer a range of physical harms, including the erosion of their fins.[104] Oil can be lethal to both birds and mammals. When oil contaminates an animal's feathers or fur, it may be unable to insulate itself from the cold.[105] Animals may also ingest or inhale oil as they groom themselves, causing long-term damage to internal organs, reducing reproductive success, and weakening the immune system, increasing their vulnerability to secondary infections.[106]

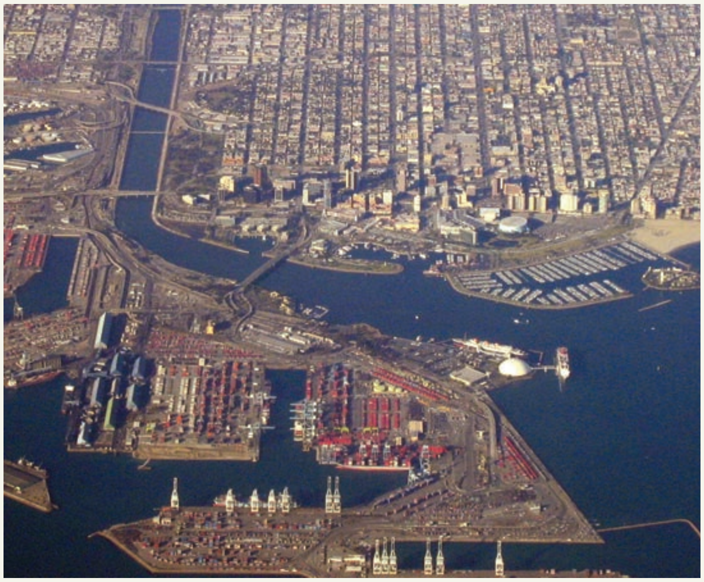
Case study: air pollution from oil tankers in port

For two years, people living in Southern California's Long Beach, Seal Beach and Huntington Beach communities complained of periodically smelling petroleum, chemicals and sulfurous odors.[107] Tests confirmed the air contained hydrocarbons and hydrogen sulfide, air pollutants that are released by crude oil and natural gas.[108] Residents filed more than 2,000 complaints with the regional air quality regulator, which worked with local fire departments to search for the source of the odors.

Finally, in late 2018, air quality regulators identified a likely source of the air pollution: oil tankers at the nearby Port of Long Beach.[109]

For example, in October 2018, investigators using gas-imaging cameras found vapors leaking from a loaded oil tanker upwind from a location where residents had recently complained of odors.[110] When investigators boarded the ship, seven of the 10 valves they inspected were leaking hydrocarbon vapors.

Hydrocarbon air pollution can cause headaches and dizziness, and smelled bad enough to degrade residents' quality of life.[111]



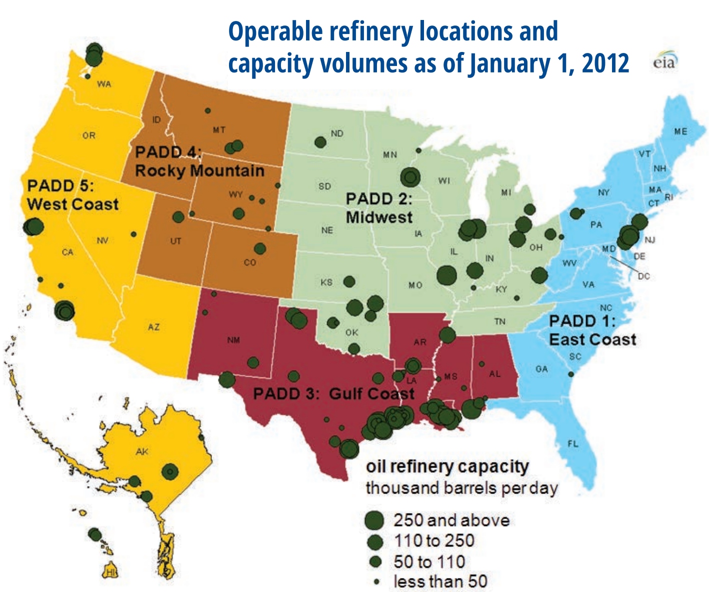
The City of Long Beach sits next to the Port of Long Beach, where in late 2018 an oil tanker was discovered to be leaking hydrocarbon vapors and creating air pollution.

Air quality regulators believe that this ship is not the only source of the air pollution that has been bothering residents, and officials are inspecting more ships as part of a "large and ongoing" investigation, they told the Long Beach Post.[112]

Oil refineries

The first large-scale commercial extraction of petroleum in the United States took place in 1859 in Titusville, Pennsylvania, when Edwin Drake used a steam engine to drill a well in an oil field.[113] The first oil refinery quickly followed at the same site, because crude oil has only a few uses until it is refined into products such as gasoline, diesel fuel and jet fuel.[114]

If offshore oil drilling expands, the increased volume of oil production may require construction of new refineries or expansion of existing refineries. Six refineries have been built since 2014 in Texas and North Dakota, states that have seen increased onshore oil production in recent years.[115] The largest of these has a capacity of 84,000 barrels per day, which would not be big enough to process the amount of oil the Trump administration estimates is economically recoverable from the Mid-Atlantic region if it were produced over a 40-year period.[116] Figure 6 shows the location of existing refineries in the United States as of 2012 (the refinery shown in Georgia has since closed).[117]



Note that the refinery shown in Savannah, Georgia, has since closed.

Figure 6. Location of refineries as of 2012[118]

Expansion of existing refineries has been an important route of increasing refining capacity in recent years. For example, in 2012 a Motiva refinery in Port Arthur, Texas, increased its capacity from 285,000 barrels per day to 600,000 barrels per day.[119] A Valero refinery in Corpus Christi, Texas, has expanded repeatedly, most recently in 2015.[120]

Refineries are immense industrial complexes. ExxonMobil's Baytown Refinery in Texas, the second largest refinery in the nation, covers 2,400 acres.[121] Chevron's refinery in Richmond, California, includes thousands of miles of pipelines and hundreds of storage tanks for holding millions of barrels of crude oil and refined products.[122]

Even when operating normally, oil refineries are a source of air pollution that threatens public health.[123] Common pollutants include:

- Particulate pollution, which exacerbates asthma, has been linked to lung cancer and can cause low birth weight in babies.[124]
- Nitrogen oxides, which can cause headaches, trouble breathing, and eye irritation in the short

term.[125] Long-term exposure to nitrogen oxides can cause asthma and respiratory infections.[126] Nitrogen oxides are a major contributor to smog, also known as ground-level ozone, which can cause respiratory irritation, reduce lung function, and worsen asthma.[127]

- Benzene, toluene, ethylbenzene and xylene, which are volatile organic compounds that facilitate the formation of smog.[128] Workers in industrial facilities may be exposed to levels of benzene that can cause cancer and may damage the blood.[129]
- Carbon monoxide, which decreases the ability of blood to deliver oxygen to the body. Elevated levels of carbon monoxide can cause headaches, slow reaction times, lead to chest pain during exercise for people with heart conditions, and increase hospital admissions for heart problems.[130]
- Sulfur dioxide, which is a severe respiratory irritant.[131] Sulfur dioxide can cause breathing problems, sneezing and coughing in healthy adults. People with asthma are especially sensitive and have a harder time breathing when sulfur dioxide pollution is even slightly elevated.

Case study: air pollution from refineries in Port Arthur, Texas

The city of Port Arthur, Texas, is home to three major refineries, including the largest oil refinery in the United States.[140] Oil refineries in Port Arthur release health-damaging air pollution.[141]

Refineries in Port Arthur create air pollution both when they are operating normally and when they have breakdowns and malfunctions. An analysis of pollution data by the Environmental Integrity Project shows that from 2009 through 2015, the three Port Arthur refineries released thousands of tons of air pollution annually in the course of permitted operations.[142] Common pollutants include benzene and toluene.[143] In that same period, the three refineries also released air pollution during "upset" events, or mishaps that caused unpermitted releases.[144]

A separate analysis of 2003 to 2006 emissions from refineries in Port Arthur found that their combined "upset" emissions were large enough to equal routine emissions from a small refinery.[145] The study authors concluded that having multiple refineries in one community results in a significant, additional pollution load beyond what permitted emission levels suggest.

Air pollution from oil refineries and other industrial facilities may contribute to a wide variety of health ailments for Port Arthur residents. Children's asthma rates in the community are double the national average.[146] Cancer mortality rates among African Americans in Jefferson County, where Port Arthur is located, are about 40 percent higher than the Texas average.[147]

The Valero refinery in Port Arthur, Texas, at dusk.

While offshore drilling may promise to be out of sight, the onshore infrastructure it requires ensures its impacts will be felt by nearby communities. Oil refineries are a necessary piece of infrastructure for any drilling endeavor, and whether new or expanded, they are a threat to public health, ecosystems and the environment.

Malfunctions or sudden shutdowns at refineries can create acute air pollution episodes that threaten public health.

- In 2012, a fire at the Chevron refinery in Richmond, California, released a large cloud of black smoke.[132] As a result, 15,000 people sought medical care in the following weeks for breathing problems, chest pain and other problems.[133]
- During Hurricane Harvey in 2017, multiple refineries in Houston released large volumes of air pollution. ExxonMobil's Baytown refinery released more than 550,000 pounds of pollution, Valero's Houston refinery released 235,000 pounds of pollution, and the Phillips 66 Sweeny refinery released 175,000 pounds of pollution.[134] Releases from these refineries and other industrial facilities in the region contributed to high smog levels in Houston.

"Floating production" still harms onshore communities and ecosystems

In response to efforts by coastal states to ban new onshore infrastructure that would be needed to support new or increased offshore drilling, oil producers have suggested they may use "floating production" techniques that reduce the need for some types of new onshore infrastructure.[148] Even with floating production, increased offshore oil and gas production will harm communities and ecosystems onshore.

With floating production, oil and gas from an offshore well are not transported back to shore via pipeline. Instead, oil and gas are collected on a special vessel that is moored at the production site.[149] The vessel may have a production system for initial processing of the oil and gas to remove water and impurities. The oil and gas can then be stored on board the vessel. Periodically, the oil will be transferred to a shuttle tanker or barge, while gas may be reinjected in the well.[150] Floating production techniques are commonly used in very deep water, in places where pipeline construction would be too expensive, and where severe storms may damage production equipment unless it is moved out of the way.[151]

Though floating production avoids the need to build new pipelines to bring oil and gas onshore, it requires all the other onshore infrastructure associated with offshore production, including ports and marine oil terminals, waste disposal facilities, and oil refineries. New facilities may be constructed, or existing onshore oil and gas facilities may be used more intensively. For example, if oil production increases off the coast of California and oil producers use floating production techniques, it could increase tanker traffic at the state's existing marine oil terminals.[152]

Photo: Alf van Beem via Wikimedia, public domain

Floating production, storage and offloading vessels temporarily store oil at the offshore production site until it can be transported to shore by a barge or shuttle tanker.

Floating production does not mitigate many of the onshore impacts of offshore drilling. Onshore communities still face air pollution, water pollution and toxic waste from the land-based infrastructure that supports offshore drilling.

- After an explosion at a Philadelphia refinery in June 2019, authorities told nearby residents to stay indoors.[135]
- A fire at ExxonMobil's Baytown refinery in March 2019 led to releases of sulfur dioxide, hydrogen sulfide and benzene for more than a week.[136]
- An explosion and fire at an ExxonMobil facility in Baytown in July 2019 led to a "shelter in place" order for nearby residents.[137]

In addition, wastewater generated by refineries is a threat to water quality.[138] Refineries use water at many points while processing oil, and it can become polluted with salts, sulfides, ammonia, sediment and other compounds.[139] While wastewater typically is treated before it is released, leaks and spills can lead to the pollution of groundwater and surface waters.

Policy recommendations

As the *Deepwater Horizon* disaster showed, the dangers of offshore drilling to marine life and coastal habitats are all too clear. But damage from offshore drilling occurs not only from spills at sea, but also from activities closer to shore or onshore, endangering the health and well-being of the people in coastal communities and of shoreline ecosystems.

That's because offshore drilling requires an extensive supporting network onshore. This necessary infrastructure includes pipelines to deliver oil and gas to refineries or distribution networks; refineries to produce gasoline, diesel and other petroleum products; ports for sending equipment and maintenance boats to offshore rigs; and waste disposal facilities.

Onshore infrastructure and onshore activity that support offshore drilling create multiple risks to public health and the environment, during both routine operations and unplanned events. The risks include air pollution, groundwater contamination and oil spills.

By refraining from new offshore oil and gas production – particularly in areas of the country that have not yet experienced drilling off their shores – the United States can prevent these harmful onshore impacts and protect the environment and quality of life of coastal communities.

- The nation should permanently prohibit the expansion of offshore drilling and close existing offshore facilities. The Trump administration should withdraw its proposal to expand offshore oil and gas production in the Atlantic, Pacific and Arctic oceans. This will avoid the need for new or expanded onshore infrastructure to support increased production of oil and gas, as well as the risks to marine ecosystems and beaches posed by offshore drilling itself.
- States should seek to protect coastal areas by blocking construction of new infrastructure or the expansion of existing infrastructure needed to support expanded offshore drilling. States, not the federal government, control permitting and siting decisions for onshore infrastructure. They should use this authority to help protect communities and ecosystems. For example, both California and New Jersey have banned construction of pipelines and other infrastructure that could be used to support new offshore drilling.[153] The ban applies to state-controlled waters, which extend three miles from shore along the entire length of the state.
- Federal, state and local officials should pursue public policies to reduce America's dependence on oil and gas, including through efforts to replace burning of fossil fuels for electricity generation with electricity from renewable sources, encourage energy efficiency and conservation throughout the economy, and expand adoption of electric vehicles.[154] Reducing our dependence on oil and gas will reduce the environmental threats posed by fossil fuels throughout their lifecycle and minimize the pressure to open up new offshore and onshore areas to fossil fuel production.

Notes

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