



ADELANTE
CONSULTING, INC.
environment economy equity

New Mexico Clean Fuel Standard Evaluation

CONTENTS

EXECUTIVE SUMMARY	ES-1
1.0 NEW MEXICO TRANSPORTATION FUEL SUPPLY CHAIN	1
1.1 NEW MEXICO PETROLEUM FUEL SUPPLY, DISTRIBUTION, AND DEMAND	1
1.1.1 CRUDE OIL PRODUCTION.....	1
1.1.2 CRUDE OIL DISTRIBUTION.....	1
1.1.2.1 CRUDE OIL PIPELINES.....	1
1.1.2.2 CRUDE OIL RAIL TERMINALS.....	1
1.1.2 REFINERIES	3
1.1.3 PETROLEUM PRODUCT DISTRIBUTION	3
1.1.3.1 PETROLEUM PRODUCT PIPELINES	3
1.1.3.2 PETROLEUM PRODUCT TERMINALS.....	3
1.1.4 PETROLEUM PRODUCT DEMAND	3
1.2 NEW MEXICO NATURAL GAS AND HGL FUEL SUPPLY, DISTRIBUTION, AND DEMAND.....	4
1.2.1 NATURAL GAS PRODUCTION	4
1.2.2 NATURAL GAS AND HGL DISTRIBUTION	4
1.2.3 NATURAL GAS AND HGL DEMAND.....	6
1.3.1 ALTERNATIVE FUEL PRODUCTION	6
1.4 ELECTRICITY	9
1.4.1 ELECTRICITY SUPPLY	9
1.4.2 ELECTRIC VEHICLES.....	12
1.4.3 EV CHARGING PROVIDERS.....	12
2.0 CFS COSTS, BENEFITS, AND OPPORTUNITIES	13
2.1 MACROECONOMIC IMPACTS	13
2.1.1 FINANCIAL INVESTMENT	13
2.1.2 EMPLOYMENT TRENDS.....	14
2.2 TRANSPORTATION FUELS	14
2.2.1 CONVENTIONAL FUEL PRICES	14
2.2.2 PETROLEUM REDUCTIONS	14
2.2.3 SECTORAL IMPACTS	15
2.2.4 CFS REGULATED PARTIES	15
2.3 FUELS AND CREDIT GENERATION.....	16
2.3.1 LIQUID BIOFUELS	16
2.3.1.1 ETHANOL.....	16
2.3.1.2 BIODIESEL.....	16
2.3.1.3 RENEWABLE DIESEL.....	17
2.3.2 ELECTRICITY	17
2.3.3 NATURAL GAS AND RENEWABLE NATURAL GAS.....	17
2.3.4 HYDROGEN.....	17
2.3.5 REFINERIES	18
2.3.5.1 REFINERY EFFICIENCY.....	18
2.3.5.2 RENEWABLE HYDROGEN.....	18
2.3.6 CARBON CAPTURE AND SEQUESTRATION (CCS).....	18
2.3.7 OFF-ROAD	18

2.3.7.1	ELECTRICITY AND ELECTRIFICATION	18
2.3.7.2	INNOVATIVE HYDROCARBONS.....	18
3.0	CONCLUSIONS	19

TABLES AND FIGURES

TABLE 1	PUBLICLY ACCESSIBLE EV CHARGING OUTLETS IN NEW MEXICO	12
FIGURE 1	PETROLEUM REFINERIES, CRUDE OIL RAIL TERMINALS, AND PETROLEUM PIPELINES IN NEW MEXICO	2
FIGURE 2	INTERSTATE NATURAL GAS PIPELINES AND PROCESSING FACILITIES AND HGL PIPELINES IN NEW MEXICO.....	5
FIGURE 3	INTRASTATE NATURAL GAS PIPELINES IN NEW MEXICO	7
FIGURE 4	ELECTRICAL TRANSMISSION LINES IN NEW MEXICO	11

Executive Summary

With the passage of the Energy Transition Act in 2019, the State Legislature set New Mexico on a path to reduce its greenhouse gas (GHG) emissions from electrical power generation to net zero by 2050. The New Mexico Environment Department and the Energy, Minerals and Natural Resources Department have issued draft regulations designed to curb methane emissions from oil and gas exploration and production. With transportation fuels contributing 22 percent of statewide emissions of GHGs in 2018, instituting a program to reduce GHG emissions from the transportation sector is the logical next step.

This report presents a preliminary evaluation of the environmental and economic impacts of implementing a clean fuel standard (CFS)¹ in New Mexico. A CFS is a market-based trading program under which the State specifies a schedule on which the carbon intensity (CI) of transportation fuels must be reduced, and the regulated entities must either adjust their operations to meet the rate of reduction, or buy credits from those whose reductions have exceeded the requirements. This type of program incentivizes investment in innovative technologies that deliver early, deep reductions, with a revenue stream from the sale of carbon credits accelerating the return on investment. It also relieves the financial pressure on entities for whom technology upgrades would cost more than purchasing carbon credits. Importantly, a CFS is fuel neutral; each regulated entity is incentivized equally for innovation, and each such entity can choose instead to pay the going market rate for carbon credits. Fuel diversification, including the buildout of infrastructure and the increased use of a diversified transportation fuel mix, would facilitate economic and employment growth in New Mexico.

Similar programs have been implemented in the U.S. by California and Oregon, and are currently being considered by other states including Washington², Nevada³, Colorado⁴ and New York⁵. Policy experts are forecasting that by 2025, half of the states in the U.S. will have adopted a CFS⁶ -- muting the advantage that early adopters will enjoy in recruiting innovative enterprises and attracting investment dollars to build a 21st Century Energy Economy.

A New Mexico Clean Fuel Standard can provide significant economic benefits to the state and have very minimal, if any, impact on fuel costs to customers. Our analysis determined that a CFS will generate up to \$46.3M/yr in investments in New Mexico decarbonization projects.⁷

As for the cost of a CFS to the consumer, we relied on two data sources: California and Colorado's worst-case estimates of an increase of \$0.12/gal in the retail price of fuel⁸ assuming that the full cost of

¹ The terms Clean Fuel Standard and Low Carbon Fuel Standard are used interchangeably throughout this report to describe the same type of program.

² Washington State Energy Strategy 2021 (Draft), November 2020. <https://www.commerce.wa.gov/wp-content/uploads/2020/11/WA-2021-State-Energy-Strategy-FIRST-DRAFT.pdf>

³ State of Nevada Climate Initiative, December 2020. <https://climateaction.nv.gov/our-strategy/>

⁴ [Low Carbon Fuel Standard Feasibility Study Final Report](#), ICF, September 2020.

⁵ NY State Senate Bill S4003A. <https://www.nysenate.gov/legislation/bills/2019/s4003>

⁶ Jim Lane, Biofuels Digest, in a presentation at the Advanced Bioeconomy Leadership Conference, Washington, DC, April 2019.

⁷ Based on statewide transportation fuel consumption in 2018, and assuming 1) that a clean fuel standard would require a one percent reduction in carbon intensity (CI) per year, and 2) that a credit is valued at \$200/MT, which was the 2019-2020 trading price under CA's Low Carbon Fuel Standard (LCFS).

⁸ California Petroleum Market Advisory Committee 2017.

<https://efiling.energy.ca.gov/GetDocument.aspx?tn=221306&DocumentContentId=22709>

compliance is passed through to the retail customer, and an analysis by Biofuels Digest⁹ of California fuel prices compared to the nationwide average in 2010 (baseline), 2014 (LCFS), and 2020 (present day). The author concluded that *“There is no difference between fuel prices for gasoline or diesel, that can be assigned from price data to the impact of a Low Carbon Fuel Standard.”*

Adoption of a Clean Fuel Standard would offer benefits across industry sectors. It is well established that the oil and gas industry contributes significantly to the New Mexico economy, and the elements of a CFS can, and should, be tailored to assure that oil and gas operations are afforded ample opportunity to incentivize reductions in the CI of fossil fuels. Such incentives will not diminish the opportunities available to alternative fuel producers. Alternative fuels and related products could be provided by electricity providers, the dairy industry, agriculture, and forest management activities. The bottom line is that, regardless of industrial sector, a project that delivers the greatest reduction in CI will be the most valuable. The remainder of the Executive Summary will provide examples (by no means an exhaustive list) of the types of projects that might be available to producers of different types of fuels.

Crude Oil and Natural Gas Production

The persistence of a methane cloud over the San Juan Basin has been reported nationwide, and attributed to vented, flared and fugitive methane from coal seams and natural gas operations. Oil and gas operations in the Permian Basin are also a significant source of methane emissions. There are some installations that are of themselves significant sources of methane emissions, and these will be regulated under the NMED’s and EMNRD’s impending regulations. However, there are also many more sources – insignificant when appraised individually, but collectively very significant – that will not fall under the new regulations because it is economically infeasible for them to comply. A CFS could be naturally complementary to the regulatory program if the CFS’ economic incentives allow small-scale methane capture projects to pencil out.

As an example, fugitive methane emissions, captured and aggregated to a sufficient volume, could become a feedstock for hydrogen fuel production and its carbon dioxide by-product could be used for enhanced oil recovery (EOR) and sequestered geologically. Alternatively, production equipment could be converted from fossil fuel to solar- or wind-powered electric; or solar arrays could be used to generate steam for thermal EOR. Larger companies such as Occidental Petroleum Corporation (OXY) – which in August 2020 committed to reducing its GHG emissions to net-zero by 2040 – can leverage the market incentives of a CFS to accelerate construction of a direct air capture unit on the New Mexico side of the Permian Basin. Captured carbon dioxide could then be used as a feedstock for low carbon fuels or products, further amplifying the local positive economic impact.

Refineries

HollyFrontier owns New Mexico’s sole operational refinery. Located in Artesia, it has a production capacity of 110,000 barrels/day.¹⁰ Early in 2020, the company announced its intention to make a \$350M capital expenditure to add a renewable diesel production line to the refinery¹¹ Then, on June 1, 2020, the

⁹ Jim Lane, “What Effect do Low carbon Fuel Standards Have on Fuel Prices?,” Biofuels Digest, Feb. 17, 2020. <https://www.biofuelsdigest.com/bdigest/2020/02/17/what-impact-do-low-carbon-fuel-standards-have-on-fuel-prices/>

¹⁰ <http://www.eia.gov/petroleum/refinerycapacity/>

¹¹ Robert Brelsford, “HollyFrontier lets contract for renewable diesel unit at Navajo refinery,” Oil and Gas Journal, March 23, 2020. <https://www.ogj.com/refining-processing/refining/construction/article/14170289/hollyfrontier-lets-contract-for-renewable-diesel-unit-at-navajo-refinery>

company issued a press release¹² on the construction of a pretreatment unit at the Artesia refinery. The press release reads, in part, as follows: “HollyFrontier also plans to construct a PTU that will process over 80% of the feedstock for both of HollyFrontier’s renewable diesel plants. The PTU is expected to provide feedstock flexibility, mitigating single feedstock risk and generating value through the use of lower carbon intensity feed. HollyFrontier estimates the capital cost of the PTU to be \$175-\$225 million and the in-service date to be in the first half of 2022. The PTU has an expected internal rate of return of 10-15% but is intended to protect the returns of HollyFrontier’s renewables business against potential volatility in the feedstock markets.” With a NM CFS, HollyFrontier could generate and sell credits for projects such as these.

Alternative Fuels

Ethanol

New Mexico is brimming with unrealized potential in the alternative fuels arena. It imported 100 percent of the 2,400,000 barrels of ethanol it consumed. With the market-based incentives provided by a CFS, New Mexico could be positioned to attract a second-generation, cellulosic ethanol producer to the state. Such a plant could be located in the eastern part of the state, and use as its feedstock agricultural waste such as corn stover, if an ample supply exists. Alternatively, a cellulosic ethanol plant could be built in the central part of the state and use low/no-value woody biomass as its feedstock. A feedstock supply chain analysis performed for Sandoval County under a USFS Wood Innovations Grant determined that there is a 25-year supply of forest, green waste and agricultural biomass, combined, that could be delivered to a production facility at rate of 80,000 bone-dry ton (BDT)/yr and a cost of \$45/BDT.¹³ A cellulosic ethanol plant would present an opportunity to co-locate it with a bio-based carbon fiber manufacturing plant that uses waste lignin from ethanol production as its feedstock.

Biodiesel

New Mexico does not currently produce biodiesel and all biodiesel is supplied from out of state. The statewide demand of 400,000 barrels in 2018 would be tripled, but for the continuous renewal of the statewide exemption from the biodiesel blending mandate due to cost considerations. Such cost considerations could disappear under a NM CFS, given that the current CI market value of biodiesel is approximately \$1.57/gal.¹⁴

Renewable Natural Gas

Renewable natural gas (RNG) is currently collected and beneficially reused onsite (e.g., for heating or electrical power generation) at nine municipal wastewater treatment plants and two municipal landfills (out of nine candidates)¹⁵ The largest, and as yet untapped, source of RNG in New Mexico is its dairies. New Mexico has approximately 130 dairies, with the largest average herd size (2,357) in the nation. New Mexico is currently ranked 9th in the nation for milk production and 5th in the nation for cheese

¹² <https://www.hollyfrontier.com/investor-relations/press-releases/Press-Release-Details/2020/HollyFrontier-Announces-Expansion-of-Renewables-Business/default.aspx>

¹³ Adelante Consulting, Inc., “Final Report to Sandoval County: Biomass Utilization Feasibility Study for Bio-Based Manufacturing,” December 9, 2020.

¹⁴ Biofuels Digest, “A Digest Connect Presentation: California’s Green Rush,” August 2020. <https://www.biofuelsdigest.com/bdigest/2020/08/18/17-projects-with-4-billion-gallons-9-fast-emerging-players-the-digests-2020-multi-slide-guide-to-californias-green-rush/>

¹⁵ Project and Landfill Data by State, USEPA, <https://www.epa.gov/lmop/project-and-landfill-data-state>

production.¹⁶ On December 31, 2019, Biofuels Digest reported that Tucumcari Bio-Energy would start construction in February on an \$8M project to convert New Mexico's sole (and shuttered) ethanol plant into a cellulosic biogas producer, converting cattle waste to RNG; the current status of this project is unknown. In March 2020, Dominion Energy and Vanguard Renewables Ag announced a \$200M partnership to fund such projects at dairy farms in five states, including New Mexico.¹⁷ Additionally, at least one California-based company that produces a low-carbon fuel blend from renewable natural gas expressed interest in early 2020 in exploring partnerships with New Mexico dairies on livestock manure projects.¹⁸ The availability of credits under a New Mexico CFS would surely accelerate such projects.

Renewable Electricity

New Mexico is a net exporter of both conventional and renewable electricity, which as a transportation fuel is used primarily to charge electric vehicles (EVs). Of the approximately 650,000 passenger vehicles registered in New Mexico¹⁹, 1,260 are EVs.²⁰ Growth in this sector is currently constrained by the lack of incentives and statewide availability of public charging stations. Consequently, EVs are most frequently charged at home, and are typically used for intracity travel. There remains significant potential for growth in the EV market as the charging infrastructure becomes more robust. Electric utilities could use revenues from CFS credits to invest in EV infrastructure and incentives to increase EV adoption.

Hydrogen

New Mexico neither produces nor consumes hydrogen as a transportation fuel. The current situation belies the potential for New Mexico to develop a robust hydrogen economy. Nearly all hydrogen is produced from methane, via the process of steam methane reformation. Traditional steam methane reformers are large pieces of equipment that are fixed in place, once constructed. Now, a New Mexico-based company, BayoTech, is building mobile, modular reformers – which can be transported to places where methane is being generated. If fugitive methane emissions from the Permian and the San Juan Basins can be captured in sufficient quantity and used for feedstock in hydrogen fuel production, it could incentivize the development of a network of hydrogen fueling stations.

¹⁶ Dairy Producers of New Mexico. www.nmdairy.org

¹⁷ <https://www.sltrib.com/news/nation-world/2020/02/03/project-seeks-convert/>

¹⁸ Confidential client, Adelante Consulting, Inc.

¹⁹ <https://www.statista.com/statistics/196060/number-of-registered-automobiles-in-new-mexico/>

²⁰ USDOE Alternative Fuels Data Center, August 2020. <https://afdc.energy.gov/data/10962>

1.0 New Mexico Transportation Fuel Supply Chain

The following discusses the transportation fuel supply chain in New Mexico, including supply, distribution, and demand. The evaluation includes petroleum fuels, natural gas and hydrocarbon gas liquids (HGL), and alternative fuels. The transportation fuel supply chain evaluation provides information needed to help identify strategies for implementing a clean fuels program in New Mexico.

1.1 New Mexico Petroleum Fuel Supply, Distribution, and Demand

Petroleum fuels currently provide the majority of transportation fuels used in New Mexico. New Mexico is supplied with refined petroleum products produced in state, as well as refined petroleum products supplied from out-of-state via pipelines, rail, and tanker trucks. The following sections describe production, distribution, and refining of crude oil in New Mexico; distribution of refined petroleum products, and demand for petroleum transportation fuels within New Mexico.

1.1.1 Crude Oil Production

New Mexico is one of the largest producers of crude oil in the United States. Crude oil is produced primarily in southeast New Mexico, in the Permian Basin region, and in the northwest corner of New Mexico. The total production of crude oil in New Mexico in 2018 was 248,958,000 barrels (682,000 barrels/day)²¹, which was third in the U.S. behind Texas and North Dakota.

1.1.2 Crude Oil Distribution

Crude oil in New Mexico is distributed within New Mexico using pipelines and by rail.

1.1.2.1 Crude Oil Pipelines

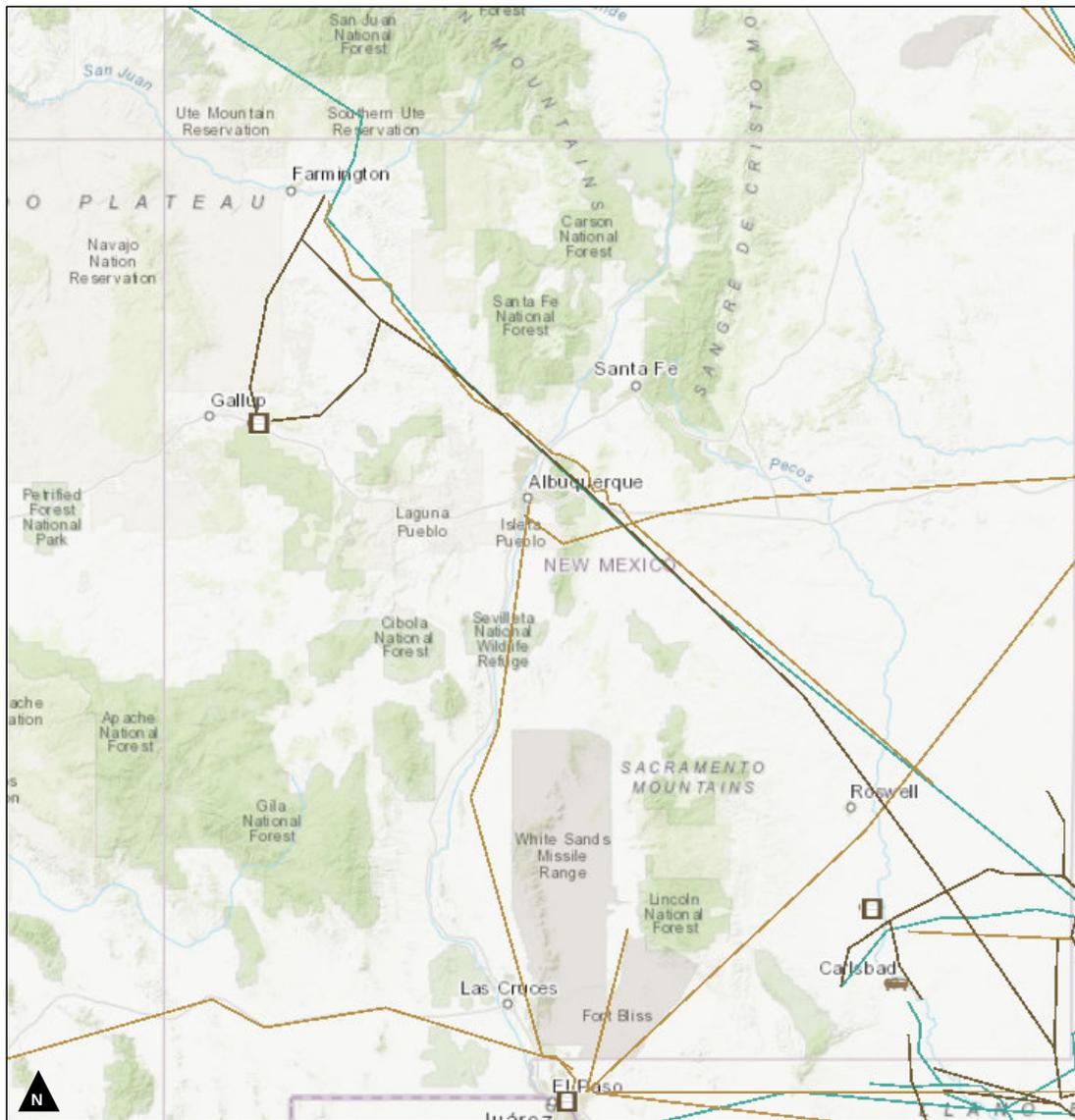
Western Refining operates a pipeline between the southeast corner of New Mexico and the Farmington area (Figure 1). The southern end of the line is connected to other pipelines operated by Centurion Pipeline, which connect to the Carlsbad, NM, area and to western Texas, and by Magellan Midstream, which connects to the Hobbs, NM, area. The northern end of the pipeline includes a loop that connects with the Marathon refinery in Gallup, NM.

1.1.2.2 Crude Oil Rail Terminals

The following crude oil rail terminals are operated in New Mexico (Figure 1) (<https://www.eia.gov/state/maps.php>):

- Centane Rail Loading Terminal – Carlsbad
- Gallup Refinery – Gallup
- Navajo Refinery – Artesia

²¹ https://www.eia.gov/state/seds/sep_prod/pdf/P1.pdf



layer0:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

0 20 40 80 Miles

-  Petroleum Refinery
-  Crude Oil Pipeline (z)
-  Petroleum Product Pipeline (z)
-  HGL Pipeline (z)
-  Crude Oil Rail Terminal

Figure 1 Petroleum refineries, crude oil rail terminals, and petroleum pipelines in New Mexico (<https://www.eia.gov/state/?sid=NM>)

1.1.2 Refineries

There are two refineries in New Mexico. The HollyFrontier Navajo Refinery is located in Artesia and has an operating capacity of 110,000 bbl/day²². The Marathon refinery is located in Gallup and has an operating capacity of 27,000 bbl/day²³. Operations at this facility were recently halted and there are no plans to resume. The total in-state refining capacity is far less than the in-state crude oil production rate (section 1.1.1), so New Mexico is a net exporter of crude oil.

1.1.3 Petroleum Product Distribution

Petroleum products are distributed throughout New Mexico via pipelines, rail, and trucks. Pipelines and rail are used to transport products to distribution terminals where they are loaded onto trucks for delivery customers.

1.1.3.1 Petroleum Product Pipelines

The petroleum product network within New Mexico is shown in Figure 1. Nustar Energy operates two pipeline segments within New Mexico. One connects Albuquerque with Amarillo, TX, and the other connects Sunray, TX, with El Paso, TX, passing through New Mexico. The Magellan Midstream Pipeline connects Albuquerque with El Paso, TX and the Enterprise Rocky Mountain Pipeline connects Borger, TX, with Farmington, NM.

1.1.3.2 Petroleum Product Terminals

Petroleum Product Terminals

Twelve petroleum product terminals are located in New Mexico. The operators and locations are as follows (<https://www.eia.gov/state/?sid=NM>):

- Andeavor Logistics²⁴, Albuquerque (2)
- Andeavor Logistics, Bloomfield
- Andeavor Logistics, Jal
- Andeavor Logistics, Wingate
- Dansk Wholesale, Lordsburg
- Holly Energy Partners, Moriarty
- IMTT Epic, Alamogordo
- NK Asphalt Partners, Albuquerque
- NK Asphalt Partners, Artesia
- Nustar Energy, Santa Domingo
- Phillips 66, Albuquerque

1.1.4 Petroleum Product Demand

Total consumption of motor gasoline in New Mexico in 2018 was 24,100,000 barrels (66,000 barrels/day)²⁵.

²² <http://www.eia.gov/petroleum/refinerycapacity/>

²³ (<http://www.eia.gov/petroleum/refinerycapacity/>)

²⁴ Andeavor was acquired by Marathon in October 2018

²⁵ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

Total consumption of distillate fuel oil in New Mexico in 2018 was 18,600,000 barrels (51,000 barrels/day), including biodiesel blended into distillate fuel oils²⁶.

Total consumption of jet fuel in New Mexico in 2018 was 1,300,000 barrels (3560 barrels/day)²⁷.

Although refinery capacity was not broken out into specific products (section 1.1.2), based on total refinery capacity and total transportation fuel use, the total consumption of petroleum transportation fuels in New Mexico exceeds the in-state production capacity.

1.2 New Mexico Natural Gas and HGL Fuel Supply, Distribution, and Demand

Natural gas and HGL are not widely used as transportation fuels in New Mexico. A clean fuels program, however, provides an opportunity for increased use of natural gas and propane for transportation use. The following sections summarize natural gas and propane production, distribution, and demand in New Mexico.

1.2.1 Natural Gas Production

New Mexico is one of the largest producers of natural gas in the United States. As with crude oil, natural gas is produced primarily in southeast New Mexico, in the Permian Basin region, and in the northwest corner of New Mexico. The total production of natural gas in New Mexico in 2018 was 1485 billion cubic feet (4.1 billion cubic feet/day)²⁸, which was ninth in the U.S. Natural gas processing facilities are shown in Figure 2 and are concentrated in the southeastern corner of New Mexico and the Farmington area.

1.2.2 Natural Gas and HGL Distribution

Natural gas and HGL are distributed in New Mexico through pipelines. Interstate natural gas pipeline locations are shown in Figure 2 and are similar to petroleum pipeline locations, connecting major production areas in southeast and northwest New Mexico with the neighboring states of Arizona, Colorado, and Texas. El Paso Natural Gas and Transwestern Gas Company each operate a pipeline running from the Permian Basin region of Texas through Gallup, NM, to Arizona. From Gallup, the lines also connect north through Farmington to Colorado. El Paso Natural Gas also operates multiple pipelines from the Permian Basin to the Carlsbad, NM, area as well as from El Paso, through Deming, NM, to Arizona. The TransColorado Gas Transport pipeline and the Questar Southern Trails Line run from Farmington to Colorado.

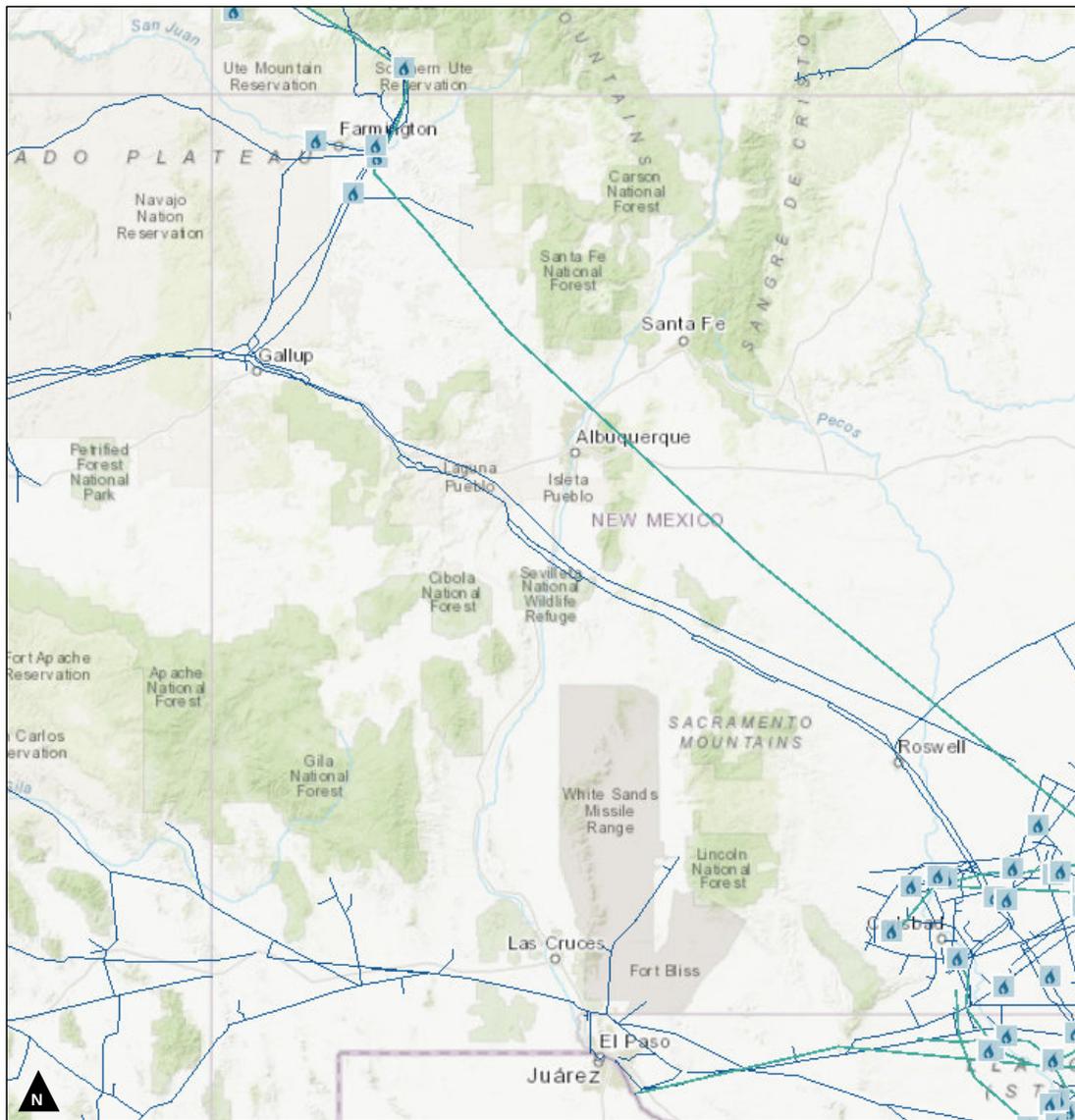
HGL is transported through the Enterprise Mid-America pipeline from the Permian Basin through Farmington and north to Colorado (Figure 2).

Natural gas is also transported within the state through intrastate pipelines (Figure 3). Gas Company of New Mexico operates a series of pipelines in the northern portion of the state serving the Albuquerque, Farmington, Gallup, Grants, Santa Fe, and Taos areas. Public Service Company of New Mexico also operates a series of pipelines in southeast New Mexico serving the Carlsbad, Hobbs, and Roswell areas.

²⁶ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

²⁷ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

²⁸ https://www.eia.gov/state/seds/sep_prod/pdf/P1.pdf



layer0:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

0 20 40 80 Miles

-  Natural Gas Processing Plant
-  HGL Pipeline (z)
-  Natural Gas Interstate Pipeline (z)

Figure 2 Interstate natural gas pipelines and processing facilities and HGL pipelines in New Mexico (<https://www.eia.gov/state/?sid=NM>)

1.2.3 Natural Gas and HGL Demand

Total consumption of natural gas in New Mexico in 2018 was 271.5 billion cubic feet²⁹. This amount is equal to approximately 18% of the natural gas produced in the state during the same period. Natural gas consumption in New Mexico in 2018 in the transportation sector was 28.4 trillion BTU, which is equivalent to approximately 27.4 billion cubic feet, or approximately 10% of the total consumption (https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_btu_tra.html&sid=NM). Natural gas consumption in the transportation sector is gas consumed in the operation of pipelines, primarily in compressors, and compressed natural gas (CNG) consumed as vehicle fuel. As of November 2020, there were 11 CNG fueling stations (8 public and 3 private), 1 public LNG fueling station, and 55 public LPG fueling stations in New Mexico³⁰.

Total consumption of HGL in New Mexico in 2018, which included natural gas liquids and refinery olefins was 1,900,000 barrels³¹. HGL consumption in the transportation section, which is assumed to be propane, was 100 billion BTU, which is equivalent to approximately 26,000 barrels, or approximately 1.4% of the total consumption.

1.3 New Mexico Alternative Fuel Supply, Distribution, and Demand

1.3.1 Alternative Fuel Production

Alternative transportation fuels currently include fuel ethanol, biodiesel, renewable diesel, renewable natural gas, and hydrogen.

Ethanol, which can be produced from corn, sugar cane, or cellulosic biomass (e.g., wood waste), is blended into gasoline, typically at 10%, to reduce air pollution. Ethanol may also be blended at 85% (E85) for use in “flex fuel” vehicles. There was no production of fuel ethanol in New Mexico in 2018³², although almost all of the gasoline sold in the state contains at least 10% ethanol. As of November 2020, there were 14 E85 fueling stations in New Mexico (9 public and 5 private)³³. These are located in Albuquerque, Artesia, Clovis, Las Cruces, Santa Fe, and Taos.

Biodiesel is an alternative fuel that can be used in diesel engines and is produced from vegetable oils, animal fats, or recycled restaurant grease. Biodiesel is blended into petroleum diesel (typically 5% to 20%). New Mexico has a mandate that all diesel fuel sold for use in on-road motor vehicles to state agencies, political subdivisions of the state, and public schools must contain at least 5% biodiesel (B5). All diesel fuel sold to consumers for use in on-road motor vehicles is mandated to contain at least B5.

Since the introduction of the mandate in 2010 the New Mexico Department of Agriculture has suspended the mandate every six months citing insufficient supply of biodiesel fuel and biodiesel prices exceeding those of diesel fuel³⁴.

²⁹ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

³⁰ <https://afdc.energy.gov/states/nm>

³¹ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

³² <https://www.eia.gov/state/data.php?sid=NM#Environment>

³³ <https://afdc.energy.gov/states/nm>

³⁴ <https://www.nmlegis.gov/Sessions/17%20Regular/firs/HB0245.PDF>



layer0:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

0 20 40 80 Miles

— Natural Gas Intrastate Pipeline (z)

Figure 3 Intrastate natural gas pipelines lines in New Mexico
(<https://www.eia.gov/state/?sid=NM>)

There is currently no production of biodiesel in New Mexico. Biodiesel consumption in New Mexico in 2018 was 400,000 barrels³⁵. As of November 2020, there were 3 biodiesel (B20 or above) fueling stations in New Mexico. These were located at Holloman Air Force Base, Kirtland Air Force Base, and Sandia National Laboratories³⁶.

Renewable diesel is produced from similar sources as biodiesel, but uses a production process similar to petroleum diesel so that it is chemically more similar to petroleum diesel than biodiesel. As a result, renewable diesel may be used as a direct substitute for petroleum diesel rather than as a blend stock like biodiesel.

In 2019 HollyFrontier announced the construction of a renewable diesel unit (RDU) at its Artesia Refinery. With a scheduled completion date in Q1 2022, the Artesia RDU is projected to produce 125,000,000 gallons of renewable diesel per year (6,000 bbl/day) utilizing soybean oil, bleachable fancy tallow and distillers corn oil feedstocks. In June of 2020 HollyFrontier announced the additional construction of a pre-treatment unit at the Navajo Refinery which will process 80% of the feedstock used within the Artesia RDU and the HollyFrontier Cheyenne Refinery³⁷.

Renewable natural gas is typically produced from anaerobic degradation of organic matter (e.g., sewage sludge, animal manure, agricultural waste, etc.). After cleanup to remove moisture, carbon dioxide, and other impurities, this biogas may be used as a vehicle fuel in the same manner as compressed natural gas. Biogas is produced in New Mexico from anaerobic digesters and from landfill gas, but none of this is currently undergoes sufficient cleanup to produce renewable natural gas.

The Water Environment Federation database of wastewater treatment facilities producing biogas with anaerobic digestion includes treatment plants located in Albuquerque (two plants), Anthony, Carlsbad, Farmington, Los Cruces, Rio Rancho, Roswell, and Santa Fe³⁸. Most of the facilities use the biogas for heating, on-site electrical generation, and/or powering machinery. The database indicates the plant in Rio Rancho injects gas into a pipeline. The production of biogas at facilities digesting sewage sludge can be enhanced through addition of food waste as digester feed. EPA's 2016 survey of facilities digesting food waste did not identify any facilities in New Mexico³⁹. EPA's 2020 database of livestock anaerobic digester facilities did not identify any facilities in New Mexico⁴⁰.

EPA's 2020 database of landfill gas energy projects identified two projects in New Mexico⁴¹. The Waste Connections Inc. facility at the Camino Real Landfill in Sunland Park uses landfill gas to generate electricity from reciprocating engine generators. The project has a capacity of 3.2 MW and sells the electricity to El Paso Electric. The City of Albuquerque operates a project at the Cerro Colorado landfill in Albuquerque. The project uses landfill gas to fuel three boilers at the county detention center to heat water. The gas is transported from the landfill to the detention center through a 2-mile pipeline.

Argonne National Laboratory's 2020 database of renewable natural gas projects generating gas from food waste, landfills, livestock manure, or wastewater treatment residues for pipeline injection or vehicle

³⁵ https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=NM

³⁶ <https://afdc.energy.gov/states/nm>

³⁷ <https://www.hollyfrontier.com/investor-relations/press-releases/Press-Release-Details/2020/HollyFrontier-Announces-Expansion-of-Renewables-Business/default.aspx>

³⁸ <http://www.resourcerecoverydata.org/biogasdata.php>

³⁹ <https://www.epa.gov/anaerobic-digestion/anaerobic-digestion-facilities-processing-food-waste-united-states-survey>

⁴⁰ <https://www.epa.gov/agstar/livestock-anaerobic-digester-database>

⁴¹ <https://www.epa.gov/sites/production/files/2020-08/opprjmlmopdata-detailed.xlsx>

fuel did not identify any projects in New Mexico⁴². However, since New Mexico is the nation's sixth-largest dairy state, with approximately 130 dairy farms and an average herd size of 2,350, there is ample opportunity for the dairy industry to capitalize on manure-to-renewable natural gas projects. In March 2020, Dominion Energy and Vanguard Renewables Ag announced a \$200M partnership to fund such projects at dairy farms in five states, including New Mexico⁴³. Additionally, at least one California-based company that produces a low-carbon fuel blend from renewable natural gas expressed interest in early 2020 in exploring partnerships with New Mexico dairies on livestock manure methane projects⁴⁴.

There is no production of hydrogen for use as vehicle fuels in New Mexico. As of November 2020, there were no hydrogen fueling stations in New Mexico. The current situation belies the potential opportunity for New Mexico to develop a hydrogen economy. Nearly all hydrogen is produced from methane, via the process of steam methane reformation. Traditional steam methane reformers are large pieces of equipment that are fixed in place, once constructed. Now, a New Mexico-based company, BayoTech, is building mobile, modular reformers – which can be transported to places where methane is being generated. If fugitive methane emissions from the Permian and the San Juan Basins can be captured in sufficient quantity and used for feedstock in hydrogen fuel production, it could incentivize the development of a network of hydrogen fueling stations.

1.4 Electricity

1.4.1 Electricity Supply

Electricity is generated in New Mexico using fossil fuels and renewable sources. New Mexico produces more electricity than it consumes. In 2018, New Mexico exported 69.8 trillion BTU (20,500,000 MWH) of electricity. Figure 4 shows major electrical transmission lines in New Mexico.

There are three coal-fired power generating facilities in New Mexico. Public Service Company of New Mexico and Arizona Public Service operate coal-fired power plants in San Juan County. The plants have a combined nameplate capacity of 2560 MW. A third coal-fired power plant is operated by Tri-State G&T Association in Prewitt, NM. This plant has a nameplate capacity of 257 MW. Total electrical generation from coal in New Mexico in 2019 was 14,692,000 MWH⁴⁵. All three coal-fired power generating facilities are slated for closure. The Tri-State, Prewitt, NM power generating facility will close by the end of 2020. The San Juan Generating station operated in part by the Public Service Company of New Mexico is slated for closure in 2022 while the Four Corners Power Plant operated by Arizona Public Service is slated for closure in 2031.

Natural gas is a major source of the electricity generated in New Mexico. There are 5 natural gas-fired power plants in New Mexico with nameplate capacities greater than 200 MW. The Afton power plant in La Mesa and the Luna power plant in Deming, operated by Public Service Company of New Mexico, have nameplate capacities of 287 MW and 650 MW, respectively. The Cunningham power plant and Maddow power plant in Hobbs are operated by Southwestern Public Service Company and have nameplate capacities of 519 MW and 212 MW, respectively. The Lea Power Partners facility in Hobbs has a nameplate capacity of 665 MW. There are also 13 natural gas-fired power plants having nameplate capacities less than 200 MW. Nameplate capacities of these facilities range from 4.7 MW to 186 MW, with

⁴² <https://www.anl.gov/es/reference/renewable-natural-gas-database>

⁴³ <https://www.slttrib.com/news/nation-world/2020/02/03/project-seeks-convert/>

⁴⁴ Confidential conversation, Adelante Consulting, Inc.

⁴⁵ <https://www.eia.gov/electricity/data/browser>

a total combined nameplate capacity of 970 MW. Total electrical generation from natural gas in New Mexico in 2019 was 11,803,000 MWH⁴⁶.

Electricity is generated from petroleum fuel at three facilities in New Mexico. The TSGT Mobile Generator facility in Dulce has a nameplate capacity of 2 MW. The Southwestern Public Service facility in Tucumcari has a nameplate capacity of 27 MW. The Freeport McMoRan facility in Tyrone has a nameplate capacity of 30.4 MW. Total electrical generation from petroleum liquids in New Mexico in 2019 was 184,000 MWH⁴⁷.

Renewable electricity is generated in New Mexico from wind, solar, and hydro power and geothermal energy and from biomass.

Wind generating facilities are located primarily in eastern New Mexico. Total electrical generation from wind in New Mexico in 2019 was 6,892,000 MWH⁴⁸.

Solar generating facilities are located throughout the state, with the highest concentration in the Albuquerque metropolitan area. Total electrical generation from solar in New Mexico in 2019 was 1,366,000 MWH⁴⁹. Of this total, 317,000 MWH was from electrical utilities and 1,049,000 MWH was from independent producers.

Four hydroelectric plants operate in New Mexico. These are located at Abiquiu Dam near Abiquiu, Elephant Butte Dam near Truth or Consequences, El Vado Dam near Tierra Amarillo, and Navajo Dam near Farmington. The Abiquiu plant is operated by the U.S. Bureau of Reclamation and has a nameplate capacity of 27.9 MW. The Abiquiu and El Vado plants are operated by the County of Los Alamos and have nameplate capacities of 15.6 MW and 8 MW, respectively. The Navajo plant is operated by the City of Farmington and has a nameplate capacity of 30 MW. Total electrical generation from hydropower in New Mexico in 2019 was 158,000 MWH⁵⁰.

There is one power plant in New Mexico generating electricity from geothermal energy. The Lightning Dock Geothermal plant in Animas has a nameplate capacity of 19.7 MW. Total electrical generation from geothermal in New Mexico in 2019 was 58,000 MWH⁵¹.

There is one power plant in New Mexico generating electricity from biomass. The Four Peaks Camino Real plant in Sunland Park generates electricity from landfill gas and has a nameplate capacity of 3.2 MW. Total electrical generation from biomass in New Mexico in 2019 was 23,000 MWH⁵².

⁴⁶ <https://www.eia.gov/electricity/data/browser>

⁴⁷ <https://www.eia.gov/electricity/data/browser>

⁴⁸ <https://www.eia.gov/electricity/data/browser>

⁴⁹ <https://www.eia.gov/electricity/data/browser>

⁵⁰ <https://www.eia.gov/electricity/data/browser>

⁵¹ <https://www.eia.gov/electricity/data/browser>

⁵² <https://www.eia.gov/electricity/data/browser>



layer0:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

0 20 40 80 Miles

- Electric Transmission Line \geq 345 kV
- Electric Transmission Line $<$ 345 kV

Figure 4 Electrical transmission lines in New Mexico (<https://www.eia.gov/state/?sid=NM>)

1.4.2 Electric Vehicles

Electric vehicles are charged using EV supply equipment (EVSE) categorized both by location and the level of charging EVSEs can provide. EVSEs are distinguished between at-home charging stations incorporating EV charging stations at a place of residence and away-from-home charging which encompasses charging stations present at workplaces, shopping malls and other destinations.

On average over 80% of EV charging occurs at home using level 1 or level 2 EVSEs with delivered power ratings of 1.5 kW at 110 V for level 1 EVSEs and 19kW at 240 V for level 2 EVSEs⁵³. Away-from-home charging primarily utilizes level 2 EVSEs and DC fast charging which can deliver electricity between 50 and 150 kW. As of June 2019, there were over 1,100 battery EVs and 1,300 plug-in hybrid EVs registered in New Mexico⁵⁴. Based on an average EV efficiency of 189 Wh/km and an average of 14,900 miles traveled per vehicle in New Mexico the typical battery EV will consume about 2,800 kWh per year⁵⁵. It is assumed that 45% of plug-in hybrid (PHEV) electric vehicle travel will utilize electricity versus gasoline constituting an average electricity consumption of 1,200 kWh per PHEV vehicle per year⁵⁶.

It is estimated that battery and PHEV vehicles consume about 4.9 GWh of electricity annually.

1.4.3 EV Charging Providers

There are over 90 public EV charging stations in New Mexico. Table 1 identifies the number of total charging stations by provider and provides a count available charge ports by the type of charging, level 1, level 2 and DCFC.

Table 1 Publicly Accessible EV Charging Outlets in New Mexico⁵⁷

Entities Providing EV Charging	Level 1	Level 2	DC Fast Charging (DCFC)	Total Outlets	Total Charging Stations
ChargePoint Network	2	93	1	96	39
Tesla	0	52	56	108	32
Electrify America	0	0	42	42	9
eVgo Network	0	0	2	2	2
Greenlots	0	0	6	6	2
Other	1	25	1	27	11
Total	3	170	108	281	95

⁵³ <https://www.energy.gov/eere/electricvehicles/charging-home>

⁵⁴ <https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/>

⁵⁵ <https://www.bts.gov/state-highway-travel>

⁵⁶ <https://ev-database.org/cheatsheet/energy-consumption-electric-car>

⁵⁷ <https://afdc.energy.gov/stations#/analyze?region=US-NM>

2.0 CFS Costs, Benefits, and Opportunities

This section evaluates the costs, benefits, and opportunities of a CFS program, including supply, distribution, and demand. The evaluation includes petroleum fuels, natural gas and HGL, and alternative fuels. The various costs, benefits and opportunities relevant to a potential LCFS program in Colorado were evaluated by ICF⁵⁸. The ICF evaluation was based primarily on comparison of conditions in Colorado to California, which has the largest and longest running LCFS program. This section discusses how conclusions presented in the report relative to Colorado may apply to a CFS program in New Mexico. It also incorporates calculations made by Adelante Consulting, Inc. of the annual statewide economic investment that a CFS will stimulate based on annual statewide fuel demand, and information from two Adelante reports on biomass feedstock availability in central, north central, and northeastern New Mexico to support power generation and biofuels/bio-products production^{59 60}.

2.1 Macroeconomic Impacts

The Colorado evaluation concluded that greater fuel diversification related to an LCFS program, including increased use of electricity and natural gas as transportation fuels, facilitates economic and employment growth. Given the limited alternative fuel infrastructure in New Mexico, there should be opportunities for economic and employment growth associated with infrastructure development.

The Colorado report noted that over the long-term, participants in carbon-intensive fuel supply chains (e.g., petroleum) may experience slowed or lower growth. Such an outcome can be mitigated in an oil and gas state like New Mexico by assuring that a CFS builds in incentives for producers of petroleum fuels to lower the carbon intensity of such fuels through process improvements, carbon capture and sequestration, and other initiatives. Overall, the Colorado report noted that the direct impacts from an LCFS program are likely to be negligible relative to broader macroeconomic factors and trends, and that the net impacts of an LCFS on employment and economic growth trends are typically in the region of less than 0.1%. Short-term macroeconomic impact can be mitigated by a backloaded carbon intensity (CI) compliance curve, such as has been adopted in California and Oregon.

2.1.1 Financial Investment

Investment related to implementation of a CFS program can fall into four areas:

1. alternative fuel production,
2. fueling infrastructure,
3. alternative fuel vehicles, and
4. carbon capture and sequestration.

Implementation of a CFS does not necessarily require all fuel producers and suppliers to make such investments. In the absence of investment, however, fuel producers and suppliers will have to purchase credits. The value of credits will then create an incentive for investment by alternative fuel producers and suppliers.

⁵⁸ [Low Carbon Fuel Standard Feasibility Study Final Report, ICF, September 2020.](#)

⁵⁹ Adelante Consulting, Inc., “Final Report to NM Energy, Minerals and Natural Resources Department: North Eastern and North Central New Mexico Wood Biomass Electric Generating and Biochar Production Facility: Feasibility Assessment and Business Model,” December 31, 2018.

⁶⁰ Adelante Consulting, Inc., “Final Report to Sandoval County: Biomass Utilization Feasibility Study for Bio-Based Manufacturing,” December 9, 2020.

Adelante calculated the potential magnitude of the CFS credit market in New Mexico based on reported transportation fuel consumption. As noted in section 1.1.4, the consumption of gasoline in New Mexico in 2018 was 24,100,000 bbl. Based on an energy content of 121 MJ/gal and a CI of 100.8 g CO_{2e}/MJ, the total CO₂ equivalence of gasoline use in New Mexico would be 12,300,000 MT/yr. A typical LCFS target for CI reduction is 1% per year, which would result in a target reduction for gasoline use of 123,000 MT/yr. Assuming a credit price of \$200/MT, which is the approximate current price for the California market, these credits would have a value of \$24.7M/yr. A similar analysis for diesel use in New Mexico, based on 18,600,000 bbl/yr use (section 1.1.4), an energy content of 138 MJ/gal, and CI of 100.4 g CO_{2e}/MJ, yields a credit value of \$21.6M/yr. Thus, the current use of carbon-intensive transportation fuel in New Mexico has the potential to generate approximately \$46.3M/yr in carbon reduction investments.

2.1.2 Employment Trends

Investments in developing alternative fuels production, infrastructure, and vehicles has the potential to generate additional jobs needed to sustain this development. The Colorado report indicated that employment impacts need to be assessed relative to regional economies. The report also indicated that at a high level, industries related to the in-state production of low carbon fuels could have the potential to experience job growth, and that these fuels can be produced in rural and non-urban areas, stimulating job growth in these areas. Similar conditions exist in New Mexico, creating potential opportunities for rural and non-urban areas.

2.2 Transportation Fuels

2.2.1 Conventional Fuel Prices

CFS compliance costs for refineries and other fuel distributors are generally assumed to have full pass-through to the end user of the fuel, leading to an increase in wholesale and retail fuel prices paid by consumers. For fossil fuel producers and distributors purchasing credits, the compliance costs will depend on the price of credits. The Colorado report referred to a study performed in California which showed a credit price of \$60 per credit would result in a cost of approximately 3 cents per gallon for retail sales of gasoline or diesel. The current California trading price of approximately \$190 per credit would result in a compliance cost of approximately 12 cents per gallon. The report notes, however, that this compliance cost is less than the historic changes in fuel prices due to crude oil price fluctuations. Further, the report notes that over time, credit and revenue generation through the CFS has the potential to deliver lower consumer prices for lower carbon fuels, which could reduce energy expenditures, particularly over the long-term.

2.2.2 Petroleum Reductions

A CFS program will facilitate the displacement of high carbon intensity petroleum fuels with alternative fuels, including lower intensity petroleum fuels. Nationally, reduced dependence on fossil fuel and diversification of the transportation fuel pool should improve fuel security and buffer large swings in energy prices from external economic shocks. In the case of New Mexico, petroleum production is a major part of the economy, and petroleum reductions will have larger economic impacts than for states which do not produce petroleum (e.g., Oregon) or are large importers of petroleum (e.g., California). This may require a different implementation strategy for New Mexico to dampen impacts on the in-state petroleum industry. For example, a New Mexico program might need to offer incentives for decarbonizing petroleum products or transitioning petroleum processing infrastructure to producing bio-based products.

2.2.3 Sectoral Impacts

Implementation of a CFS program will impact various sectors of the economy differently. The objective of phasing-in CI reductions is to avoid large immediate impacts and allow impacted sectors to adapt to changes. Impacts on the transportation sector are evaluated in the Colorado report and summarized below.

Credit Generators – Current fossil and renewable carbon fuel producers and distributors could see an increase in revenue through sales of credits for in-state fuel use.

Consumers – Consumers will see slightly higher fuel prices due to compliance costs. As previously noted, these costs will initially be low and small compared to normal price fluctuations. The costs of alternative-fuel vehicles are expected to decrease over time, providing an incentive to switch from conventionally produced and refined fossil fuels. This will increase demand for low-carbon fuels, which should increase production and result in lower costs.

Fleets – Initial impacts to fleets are expected to be low due to initial low compliance costs. Over time, fleets may be able to realize lower lifetime fuel and operations and maintenance costs through fuel switching.

Vehicle Producers – Demand for alternative-fuel vehicles should increase over time, which should increase research and development investment, leading to improvements in technology. This could result in increased opportunities for New Mexico's national laboratories and universities. Advances in vehicle technology could spin off advances in off-road applications, such as forklifts or light rail, which are less directly affected by the CFS program.

Petroleum and Natural Gas Producers – An LCFS program will provide incentives for petroleum and natural gas producers to increase the efficiency of their operations and lower the CI of the fuels they produce. Given that New Mexico is a net exporter of petroleum and natural gas, impacts from a state program are expected to be less than from a national program. Increased emphasis in decarbonization on a national scale is expected to occur, regardless of whether New Mexico implements an LCFS program.

Transportation Fuel Infrastructure – An LCFS program will require improvements to the low-carbon fuel distribution infrastructure. For example, there will be a need for improved electric vehicle charging networks. Similarly, there may be a need for improved compressed natural gas (CNG) or hydrogen distribution. Infrastructure improvements should result in increased employment opportunities in engineering, construction, and related sectors.

2.2.4 CFS Regulated Parties

Regulated parties in New Mexico would include those producing and distributing transportation fuels. The major producer of carbon-intensive fuel in New Mexico would be HollyFrontier's Artesia refinery. An LCFS program would generate a compliance obligation for this refinery – and at the same time, its renewable diesel production unit would generate credits. This refinery does not produce all the carbon-intensive transportation fuels used in New Mexico, however, and the balance is imported from out of state. These out-of-state producers would be subject to the same compliance obligation as the in-state producers, and would not have an advantage over in-state producers.

Similarly, the in-state distribution network would incur compliance obligations. As previously described, these compliance costs are typically passed through to consumers and are not borne by the distributors.

2.3 Fuels and Credit Generation

The Colorado report notes while low carbon fuel policies can spur local investment in alternative fuel production, the potential for new conventional refineries is limited by high upfront capital costs and competition from existing producers. The potential for a new biorefinery is greater, given federal grants and loan guarantees available through USDA Rural Development and the US Department of Energy.⁶¹

The report explains that there could be increased opportunity for local production in Colorado compared to California due to greater local resources, including a variety of potential feedstocks for low-carbon fuel. A similar situation could exist in New Mexico, which generates enough biomass from low/no-value wood waste, agricultural waste, urban wood waste, and municipal solid waste in north central New Mexico alone to support a biorefinery⁶². New Mexico additionally can access resources such as livestock manure to generate biogas.

2.3.1 Liquid Biofuels

Liquid biofuels may be blended into petroleum fuels to lower CI, or used as replacements for petroleum fuels (i.e., “drop-in fuels”). Fuel blending may generate credits through use of low carbon feedstocks and process improvements, and by increasing the level of blending.

2.3.1.1 Ethanol

There is currently no production of fuel ethanol in New Mexico. Conventional (or first generation) fuel ethanol is produced from corn, and significant production in New Mexico is unlikely. However, the production of cellulosic (second generation) fuel ethanol has recently been optimized and New Mexico has sufficient cellulosic feedstock to support production. It is important to note here that the value stack (e.g., energy value +federal RFS value + LCFS value) for conventional ethanol was \$1.57/gal in Q3 2020, while the value stack for cellulosic ethanol was \$4.55/gal⁶³. Ethanol can also be produced from processes such as LanzaTech’s, which ferments municipal solid waste to produce gaseous carbon monoxide, which then can be converted to ethanol and a range of other bio-based chemicals and products.

2.3.1.2 Biodiesel

There is currently no production of biodiesel in New Mexico, and there is currently insufficient supply to meet the state’s mandate for 5% blending. Recent impacts from the COVID pandemic have likely impacted the supply of yellow grease and used cooking oil used to produce biodiesel. Supplies should increase once COVID restrictions have been removed. An LCFS program would provide incentives for production in New Mexico. All 20% biodiesel (B20) fueling stations in New Mexico are currently on federal facilities (military bases and Sandia National Laboratories). An LCFS program could help establish private fueling stations to increase biodiesel use.

⁶¹ Adelante Consulting, Inc., “Final Report to Sandoval County: Biomass Utilization Feasibility Study for Bio-Based Manufacturing,” December 9, 2020

⁶² Ibid.

⁶³ California’s Green Rush, Biofuels Digest, August 18,2020.

<https://www.biofuelsdigest.com/bdigest/2020/08/18/17-projects-with-4-billion-gallons-9-fast-emerging-players-the-digests-2020-multi-slide-guide-to-californias-green-rush/>

2.3.1.3 Renewable Diesel

There is currently no production of renewable diesel in New Mexico. HollyFrontier, however, is planning to add a renewable diesel production line to its Artesia refinery. The planning of these actions without an in-state CFS program is an indication of the current market for renewable diesel. Establishing an LCFS program in New Mexico should further bolster this market. It is unknown whether the currently shuttered Marathon refinery in Gallup could be used to produce renewable diesel, but it could almost certainly be used to produce ethanol (via bolt-on equipment) or other bio-products.

2.3.2 Electricity

Electricity providers in New Mexico will be able to generate credits under an LCFS program from the residential charging of EVs. Under the California program, the CI of electricity used for residential charging is based on a grid average, considering all generating sources. Credits generated from residential charging may be used to fund improvements to the EV charging infrastructure, and this is being done in California.

Use of renewable energy used for vehicle charging can result in substantially lower CIs than grid electricity. Given the relative abundance of renewable energy sources in New Mexico (e.g., wind and solar), there is the opportunity for significant generation of credits with renewable electricity.

The Colorado report notes that electricity will likely generate limited credits, relative to ethanol, at the outset of the LCFS program, but as EV adoption increases so would credits from electricity. Renewable electricity and clean energy policies could work in tandem with an LCFS, reducing the GHG emissions intensity of the electricity grid over time and reducing the CI of electricity consumed by EVs. The resulting increase in credits could be used to further develop charging infrastructure.

2.3.3 Natural Gas and Renewable Natural Gas

The CI for natural gas is approximately 12% lower than diesel, so substitution of CNG for diesel offers an immediate opportunity for credit generation. The potential for credit generation would decrease over time as CI targets drop, but initial credits would offer the opportunity to develop fueling infrastructure while sources of renewable natural gas (RNG) are developed. If a book-and-claim LCFS accounting program similar to California's were implemented, New Mexico's existing natural gas distribution system could be used with RNG. RNG sources that eliminate release of methane to the atmosphere (e.g., anaerobic digestion of dairy manure) can produce RNG with large negative CIs and the potential for significant credit generation. The Colorado report notes that the potential for development of RNG for in-state use will be limited by the market for natural gas vehicles.

2.3.4 Hydrogen

There is currently no production or use of hydrogen as a transportation fuel in New Mexico. Hydrogen produced from petroleum-based methane (gray hydrogen) has a CI much higher than gasoline or diesel, and hydrogen produced from biomethane has a CI similar to gasoline or diesel. Hydrogen produced from electrolysis using zero-CI electricity (green hydrogen), however, has a CI approximately 10% those for gasoline and diesel. Given the availability of zero-CI electricity in New Mexico, hydrogen could become an attractive transportation fuel under an LCFS program. There is also the potential for generation of (blue) hydrogen from captured methane currently released to the atmosphere, which should generate low CIs. Blue hydrogen also offers the potential to lower the CI of refined petroleum fuels, which could be a short-term use during development of a hydrogen transportation infrastructure.

2.3.5 Refineries

An LCFS program could offer incentives for refineries to implement measures to reduce the CIs of the fuels they produce. This would allow refineries to generate credits, which could generate revenues. Specific opportunities are summarized below.

2.3.5.1 Refinery Efficiency

The Colorado report identifies several measures that could be used to increase refinery efficiency, including:

- Flare modifications;
- Fuel switching;
- On- or off-site solar generation projects;
- Renewable steam generation;
- Waste heat recovery;
- Energy and thermal efficiency process improvements; and
- Carbon capture and sequestration.

Any of these measures could be implementable in New Mexico.

2.3.5.2 Renewable Hydrogen

The Colorado report notes that about 35% of the natural gas use at refineries is for hydrogen production. This represents a substantial opportunity to generate credits by using renewable natural gas for green hydrogen production.

2.3.6 Carbon Capture and Sequestration (CCS)

CCS offers a significant opportunity to reduce CO₂ emissions and generate credits. The Colorado report describes 2018 amendments to California's LCFS program which include new provisions for regulated parties to undertake CCS projects and subsequently lower the CI of conventional and alternative fuels. Approved potential CCS projects include CO₂ captured at ethanol production plants, on-site CO₂ capture at oil and gas extraction sites, CO₂ capture from refineries using steam methane reforming, and direct air capture. These projects would also have applicability in New Mexico.

2.3.7 Off-Road

2.3.7.1 Electricity and Electrification

Opportunities specifically identified in the Colorado report include use of electric forklifts in warehouse operations, material and cargo handling equipment at airports, and light rail. The magnitude of these opportunities are related to population and should be relatively minor in New Mexico.

2.3.7.2 Innovative Hydrocarbons

The Colorado report identifies potential credit generation opportunities upstream from fossil refinery and processing operations related to innovative practices that reduce the greenhouse gas (GHG) emissions intensity of crude oil and natural gas production. Methods to reduce the CI of crude oil and natural gas include:

- Solar steam generation from solar arrays to generate steam for thermal enhanced oil recovery;

- CCS of GHG emissions associated with the processing of crude oil and natural gas;
- On-site solar or wind electricity generation at oil and natural gas fields;
- Solar heat generation;
- Well efficiency measures;
- Venting avoidance measures, including flaring; and
- Additional reductions in methane leakage rates from natural gas gathering, transmission and distribution pipelines

All of these methods should be applicable to oil and gas production in New Mexico.

3.0 Conclusions

As a major producer of crude oil and natural gas and a net exporter of these commodities, New Mexico is unique from states that have implemented, or are considering, an LCFS program. A New Mexico CFS would have to be tailored to the unique characteristics of the state, rather than simply adopting an existing program. This report has enumerated a variety of the potential adaptations. One of the most promising is to decarbonize petroleum fuel production, including use of CCS, which provides an opportunity to reduce CI while maintaining the existing petroleum fuel infrastructure. Additionally, New Mexico has an abundant supply of low-carbon electricity (solar and wind), and this could be a component of the decarbonization strategy (e.g., production of green hydrogen for use in refining).