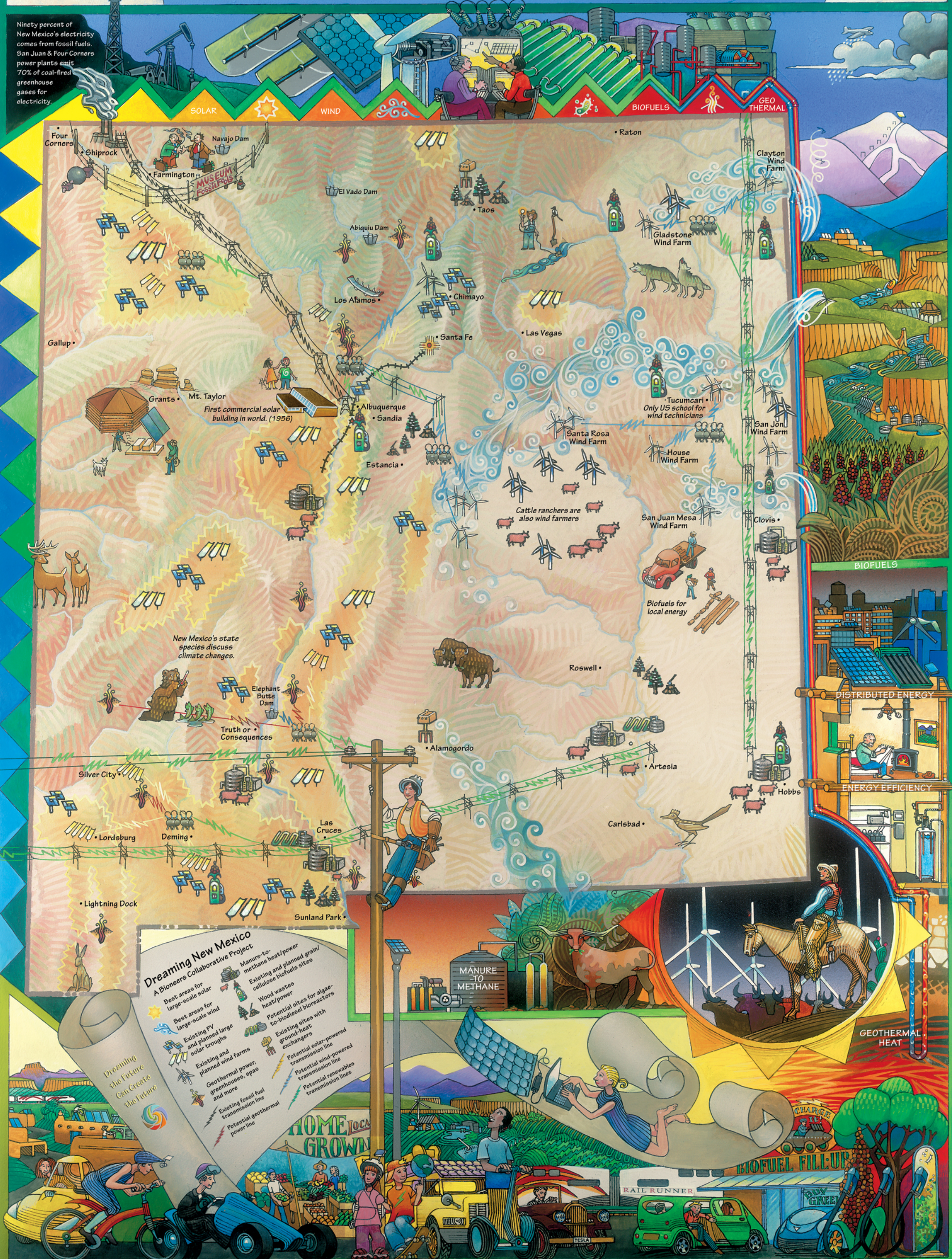


Dreaming New Mexico

A MAP TO THE AGE OF RENEWABLES

Ninety percent of New Mexico's electricity comes from fossil fuels. San Juan & Four Corners power plants emit 70% of coal-fired greenhouse gases for electricity.



Dreaming New Mexico A Bioneers Collaborative Project

- Best areas for large-scale solar
- Best areas for large-scale wind
- Existing PV and planned large solar troughs
- Existing wind farms
- Geothermal power, geysers, and more
- Existing fossil fuel transmission line
- Potential geothermal power line
- Manure-to-methane heat/power
- Existing and planned grain/cellulose biofuels sites
- Wood wastes heat/power
- Potential sites for algae-to-biodiesel bioreactors
- Existing sites with ground heat exchangers
- Potential solar-powered transmission line
- Potential wind-powered transmission line
- Potential renewables transmission lines

Dreaming
the Future
Can Create
the Future

HOME LOCAL GROWN

MANURE
TO
METHANE

GEOTHERMAL
HEAT

BIOFUEL FILL-UP

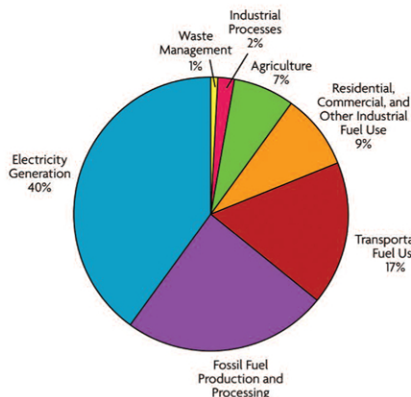
CHARGE TO GO

BUY GREEN

RAIL RUNNER

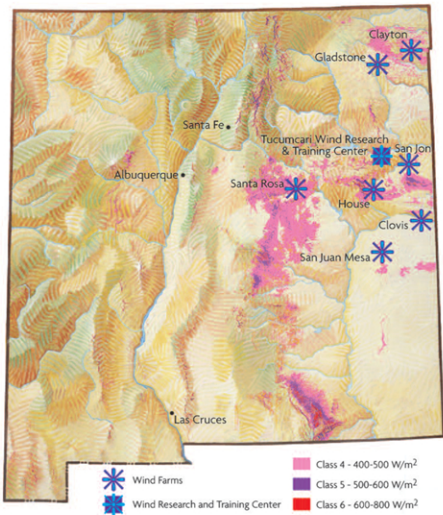
TESLA

GREENHOUSE GAS EMISSIONS



What is New Mexico's "fair share" of greenhouse gases that can be sent into the atmosphere of the planet? New Mexico produces twice the per capita amount of greenhouse gases than the US average because it is so fossil fuel rich. Two-thirds of its fossil fuel emissions can be traced to exports that supply other citizens in other States with energy. Should the producer or consumer be "billed" for these emissions? Eighty-three million metric tons of carbon dioxide equivalent come from our power plants, energy extraction, vehicles, commercial and industrial buildings, and agriculture. Electricity is the largest source but transportation is the fastest growing source. Positivists claim that New Mexico's greenhouse gas emissions will double by 2020 from new coal-fired power plants. Our dream tries to search out the cheapest places for greenhouse gas reductions with the most impact (the number of million metric tons of carbon dioxide equivalent, MMTCO₂ per activity). Preventing new coal-fired power plants seems essential to meeting New Mexico's responsibilities.

WIND POWER



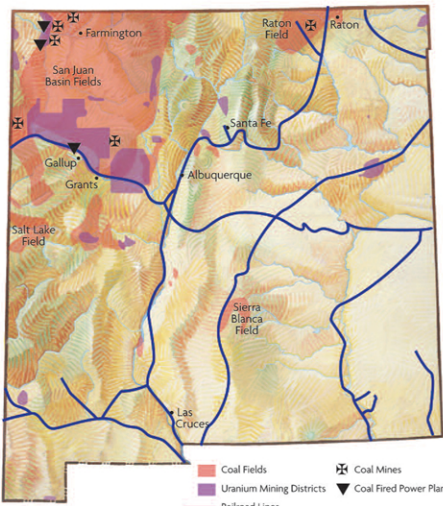
New Mexico's dream of wind power is swiftly becoming a doable dream. New Mexico is among the top ten States for land-based wind power. Large wind farms can be built on the high plains and east-facing slopes of the front range; the gap between the Sacramento and Sangre de Cristo ranges, and the eastern slopes of the Guadalupe mountains. Smaller areas can be found on higher ridges throughout New Mexico. These areas have commercial grade Class 4-6 wind power (above about 400 watts per square meter). The dream envisions 20,000 MW of electricity per year. In 2008, there are eight built or under-construction windfarms. Clovis (2MW), San Jon (80MW), San Juan Mesa (120MW), House (204MW), Santa Rosa (220MW), Gladstone (20MW), and Clayton (120MW). The Wind Research and Training Center in Tucuman is unique in the nation. Lack of nearby transmission lines (especially for ranchers favoring wind power), the fickleness of wind, and long delays for permitting are the main obstacles. Small wind power (Class 3) can be built throughout the State (not shown).

REGIONAL GRID



Two-thirds of the greenhouse gases generated within New Mexico are associated with power export. Our dream: to continue to receive revenues from power exports and to minimize greenhouse gases. New export lines are necessary that carry only renewable sources. This map shows very rough routes of proposed lines. Many pass through areas with high wind and solar potential and can connect to Phoenix, Denver, and beyond. The Navajo Transmission Line is to feed Los Angeles, Phoenix and Las Vegas but is planned to utilize coal-fired power. The Navajo Transmission Line and others are very controversial. High-voltage transmission lines could be part of the Age of Renewables or used for coal-fired electric transmission. Some existing lines that now carry fossil-fueled electricity could be switched to wind or solar. How to arrange the switch-over is not yet determined. New Mexico also imports electricity from out-of-State nuclear power, coal and natural gas power plants, and from Colorado River hydropower.

NON-RENEWABLES: COAL & URANIUM



New Mexico is second to Wyoming in proven coal reserves. Its three coal-fired power plants, fed by its three largest coal mines, produce about 80% of the State's electricity. Over 70% of the coal-electricity comes from just two coal-fired power plants (the San Juan and Four Corners power plants). After sales and gas/oil taxes, coal is the third largest source of State revenues. Despite greenhouse gas, water use, health and other concerns, the Navajo Nation would like to build a 1500 MW coal-fired power plant at Desert Rock. New Mexico has no nuclear power plants. The electricity from nuclear generation comes from "wheeling" electricity from other States. Public Services of NM (PSNM) owns a 10% stake in Arizona's Palo Verde nuclear power plant and claims that 30% of its customers' needs come from nuclear. Within the State, the "nuclear legacy" addresses military affairs (not shown) and mining pollution.

Dreaming New Mexico

THE AGE OF RENEWABLES

When it comes to energy management, climate change, and costs, what is it we desire? What is our dream relationship with "energy"? The Dreaming New Mexico Project began as a refuge — a place to step back and consider the limits we had placed on our sense of possibility. Imagine the year is 2020 and we've done everything right. What might New Mexico's Age of Renewable Energy look like?

We conjured an Age of Renewables futures map — envisioning the future. We engaged a small circle of deeply involved citizen-experts, gathered masses of data, and conducted strategic research in areas that had been neglected. Collectively, we custom-designed a Big Picture of "Energy in the Land of Enchantment" and distilled the dream into a single sentence.

New Mexico's energy dream: A reliable and secure energy supply for heating, cooling, transport and electricity (largely from renewable sources with excess for export), delivered at a fair price that helps create jobs and new businesses, curtails global warming, and does no harm to the health of the State's citizens.

There are specific milestones in our dream. New Mexico moves dramatically away from fossil fuels and their greenhouse gas and toxic emissions. The State moves away from imported power. It moves

toward much greater energy efficiency and using its best renewable power sources (solar, wind, geothermal and biofuels). The dream envisions "local power grids" that encompass "islands" of homes and businesses. These local grids produce their own electricity and heat, and feed each other through "smart" substations. They save money by generating their own power and earn money by feeding excess into the big grid. Urban roofs, from Albuquerque outward, become covered in photovoltaic plates.

Our dream contradicts those who predict that rising demand prevents us from arresting climate change. Instead, New Mexico curtails global warming by well-targeted public funding, green-collar jobs, renewables research and manufacturing, tax incentives, intelligence, imagination, and educational facilities. County and local governments nurture walkable neighborhoods, and leaner end-use efficiencies. Distributed solar and wind systems as well as parked cars feed the grid while you work, answering the peaking power challenge.

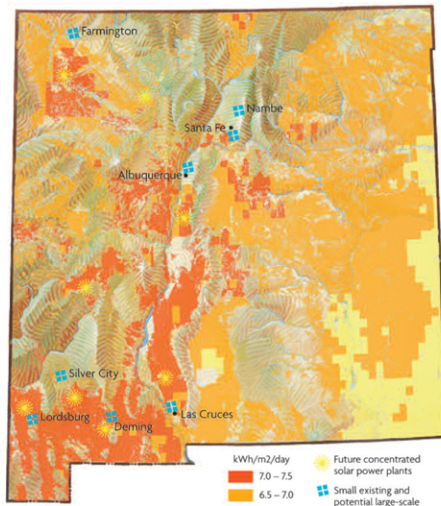
We diagrammed a "green grid" that transports solar and wind electricity, not coal-fired electricity. And, hardest, we looked at challenges that unfortunately cannot be mapped visually — the best human organizations for aligning prices and

energy in a "restorative" economy. Because energy is essential to human life, energy systems need governance. Who gets to participate? Makes the rules? Decides what's a fair profit, the right price, or a reasonable rate of return on investment? Who enforces the rules? Energy governance—by local, State, tribal, regional, federal as well as private utilities and co-ops—is the most complex part of transitioning to an Age of Renewables.

New Mexico is a paradoxical leader. Endowed with abundant oil, gas, uranium and coal as well as wind and solar, it sometimes goes in opposite directions at the same time. Governor Bill Richardson has led with important executive orders, the legislature with some good new laws, and the Climate Change Advisory Group framed a potential future. New Mexico, the paradox of old and future, will need to make clear but difficult conscious collective choices to govern harvesting and processing fuels, generating power, distributing and using energy. The grid connects us to all of North America and greenhouse gases connect us to the entire planet.

The map's front depicts the dream. The back provides some of this doable dream's strategic research. The Dreaming New Mexico pamphlet discusses the bridges and barriers to our energy future.

SOLAR POTENTIAL



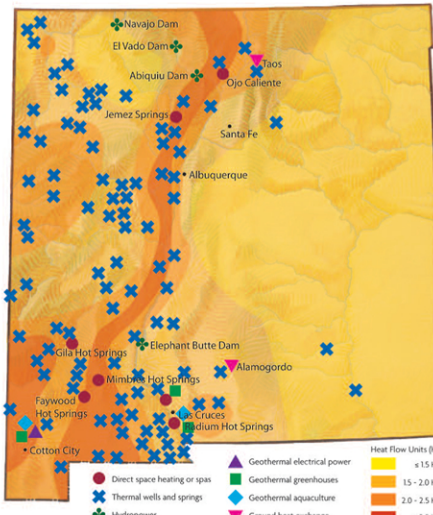
New Mexico sits at the heart of one of the highest potential solar energy areas of the planet. It ranks second in the nation. In one dream, NM solar produces 1.1 million megawatts (MW) of electricity on about 9,000 square miles. Our map shows areas for large concentrated solar power plants (CSP), usually above 50 MW, which is enough to export electricity. In the mid-range (1-50 MW), CSP and photovoltaic cell (PV) "farms" produce electricity for nearby cities. Within cities, on the roofs of private homes and commercial structures, PVs can produce from 5 kWh to 10,000 kWh. In local or distributed grids, excess solar energy can be sold back into grid. Imagine 75% of Albuquerque covered in solar generators. Local generation with storage can produce reliable, secure and high quality energy.

BIOFUELS



New Mexico's dream is local, renewable biofuels at a competitive price. Biofuels are made from "biomass" which, in turn, comes from organic material produced by living microbes, plants, and animals. Biofuels, to reduce climate change, should produce zero net carbon dioxide equivalent during their life cycle — from growth to fuel use. Biofuels include fuels from crops like sorghum, milo, and corn, "crops" like oil-rich algae, woodwastes from thinning, cow manure, sewage biosolids, and landfill gas. New Mexico has limited potential for biofuel crops and woodwaste because of the scarcity of water and the high costs of production. Estancia will attempt a woodwaste biofuel plant. A few bioethanol plants will use field crops. A biofuel facility in Anthony uses waste tortilla grease. Dairies are planning electricity from manure. Albuquerque recycles some sewage biosolids and landfill gas for heat and electricity. The greatest vision is biodiesel from algae, especially growing algae in brackish waters.

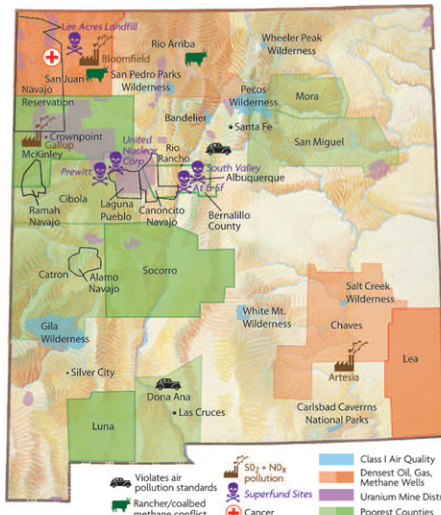
GEOTHERMAL + HYDROPOWER



New Mexico's geothermal dream envisions local use, competitive prices, and multi-tasking. New Mexico has the most geothermal greenhouse acreage in the nation. Geothermal is most profitably utilized in combination-enterprises: electricity plus greenhouse-heating plus fish-farming, or electricity generation plus home-heating and spas. Multiple-use makes geothermal energy economic. High temperature (>350° F) is best for 20 MW electric generation, mid-temperature (190° to 350° F) is best for 3-10MW; and low temperature (<190° F and 15-30° F above surface temperature) can be used for greenhouse, aquaculture, space and district heating, ground-heat pumps, cooking, curing, drying onions or chilies. In the dream, 30 to 200 MW of electricity and heating equivalents would come from geothermal.

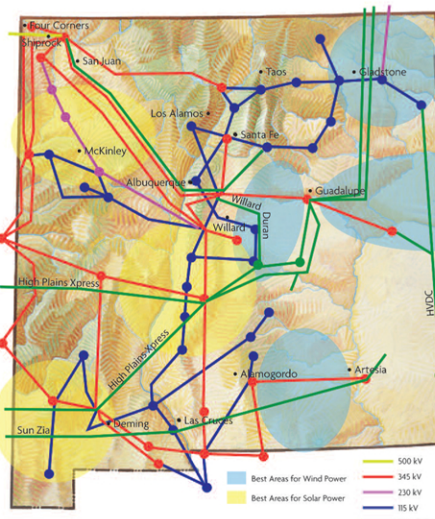
New Mexico has limited hydropower. In the San Juan River Basin, the Navajo Dam can produce 30 MW and the Farmington 0.2MW. In the Rio Grande basin, Elephant Butte Dam produces 24.3MW, Abiquiá 15MW and El Vado 8.8 MW. There is little micro-hydro power development.

ENVIRONMENTAL JUSTICE



New Mexico dreams of energy development with no harm to citizen health, lands, water, or property rights. Navajo communities experienced health harms from uranium mining. Now, they fight leaching of uranium. However, one Navajo coal-fired generating plant is the top 50 dirtiest in the US for greenhouse gases and mercury. Coal and gas rich San Juan county suffers from the highest rates of cancer in NM. Power plant, petroleum refinery and heavy traffic air pollutants harm human health. Sulfur dioxide (SO₂), nitrogen oxides (NO_x), heavy metals and radioactive particles (from coal) are worst in Bernalillo and San Juan Counties. Five energy-related superfund sites exist: Albuquerque (railroads), Lee Acres, South Valley and Previtt sites (petroleum wastes), and United Nuclear (uranium mill wastes). Poverty hurts energy efficiency and health. Low income families cannot afford weatherization. Urban sprawl also penalizes lower income families by requiring increased gas expense with more greenhouse gas emissions. The ranching community has been hurt by coalbed methane extraction.

NEW MEXICO GRID



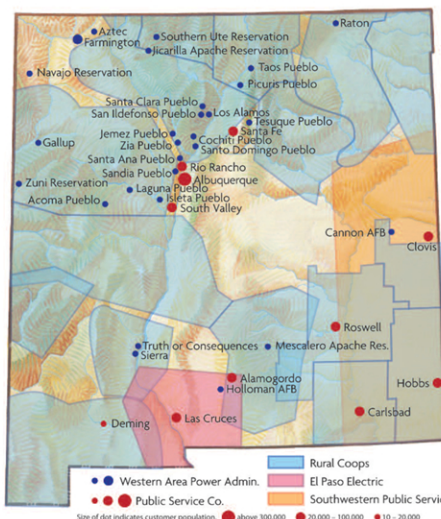
Transmission and distribution lines are as important as power generators. In our dream, all new transmission lines are near solar, wind and geothermal sources. Congested lines do not increase their capacity by upgrading to even more coal-fired electricity. Congested lines seek relief with renewables and modernization. In this dream, new transmission lines export electricity for sale only from renewables. The Willard-Duran line can reduce coal-fired electricity to Albuquerque and Santa Fe with wind power. The Four Corners-Albuquerque line replaces coal-fired electricity with solar — without a new line. The other lines shown are, in part, for export, import and in-State use. Not shown is the most efficient, reliable, least damaging and secure system: locally distributed power from renewables on small "smart grids" managed by "smart substations." Distributed energy projects eliminate the need for rights-of-way controversies, high voltage lines (which are highly inefficient), and environmental destruction.

REGIONAL ENERGY GOVERNANCE



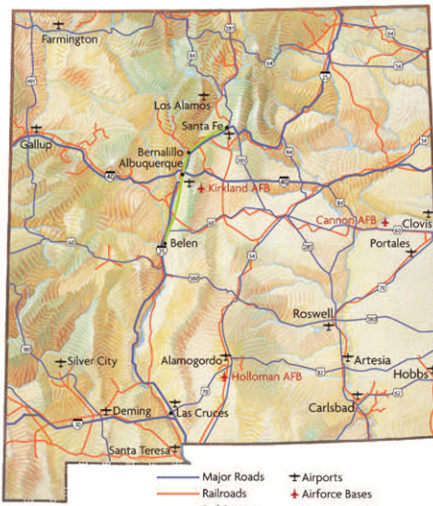
Governance structures for gas and electricity have been shaped by fossil fuel extraction, processing, and distribution. Who gets to design the governance and finances needed to adjust to the Age of Renewables? Who gets to participate? Make the rules? Enforce them? New Mexico belongs to three regional "governors" of electricity: Western Area Power Administration governs what gets what in NM from hydropower on the Colorado, the Western Electric Coordinating Council governs the reliability, power flows and renewable credits of the Western regional grid, as does the Southwest Power Pool for eastern NM. The North American Reliability Corporation oversees WECC. On the federal level, the Federal Energy Regulatory Commission can determine where transmission lines in the national interest should go and prevent illegal market manipulation of energy and prices. Congress, through its laws (e.g., Energy Policy Act, National Environmental Policy Act, Clean Air Act) governs what gets built and how. The Security Exchange Commission oversees financial integrity of public companies.

NM ENERGY GOVERNANCE



Our dream: New Mexican utilities and co-ops provide renewable energy at reasonable prices and earn fair profits — with organizational transparency and participation of its customers and shareholders in their operations and future planning. And, the State legislature, Environmental Improvement Board, Renewable Energy Transmission Authority, and Public Regulation Commission pass rulings to encourage these goals. Three investor-owned utilities in New Mexico (El Paso Electric, Public Service Resources' subsidiary Public Service of NM, and Xcel's Southwest Public Service) serve about 85 percent of the State's customers. Twenty rural electric cooperatives cover about 85 percent of New Mexico's land area, and serve about 22 percent of the customers. Tri State Co-op and the Transmission Association supplies wholesale electricity to 13 co-ops, Xcel supplies four. The remaining eight percent comes through municipal, tribal and military utilities, mostly hydropower from the Colorado River "wheeled" by the Western Area Power Administration. The governance of natural gas is not displayed.

TRAFFIC DENSITY



The dream for New Mexico's cars, trucks, railroads, and aircraft is: improve fuel efficiency, improve the fuels, reduce idling times of engines, minimize empty seats and empty freight space, and improve traffic management to minimize idling. Railroads are three times more efficient than trucks for hauling freight and reduce highway congestion and greenhouse gas emissions. A typical freight train takes several hundred trucks off the road. The Albuquerque-to-Santa Fe I-25 route supports 50% of New Mexico's population with over 38,000 vehicles/day. The Rail Runner should save commuters both time and money. To reduce greenhouse gases, cars and trucks will reduce the amount of fuel consumed by driving vehicles with much greater miles per gallon, fill-up with new fuels that release less carbon dioxide per vehicle mile, and cut back on the number of miles traveled. Smart growth and walkable and bikeable neighborhoods are an essential part of the dream.

DREAMING NEW MEXICO

A Bioneers Collaborative Initiative (www.bioneers.org/dreamingnm)

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To purchase or download maps and pamphlets and for more information, please visit: www.dreamingnewmexico.org.

Dreaming New Mexico seeks to reconcile the interdependence of nature and cultures at a State level with pragmatic and visionary strategies and systemic approaches that address our most pressing ecological and societal challenges.

Dreaming New Mexico was selected 2009 runner-up for the prestigious Buckminster Fuller Challenge. Learn more at: <http://challenge.bfi.org>.

Collective Heritage Institute/Bioneers is a 501(c)(3) nonprofit organization whose mission is to inspire a shift to live on Earth in ways that honor the web of life, each other and future generations.

BIONEERS
 Revolution from the Heart of Nature

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