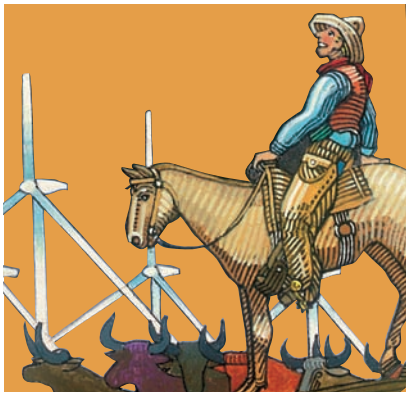

DREAMING NEW MEXICO

A MAP TO THE AGE OF RENEWABLES

THE DREAMING NEW MEXICO MAP **Our poster-map envisions New Mexico in the Age of Renewables. This 25"x 38" poster-map is available for single and group purchases at www.bioneers.org (click "Store"). It displays the best areas for wind and solar energy, some of the "green grid," existing biofuel areas, and vehicles which consume less fuel, lower carbon fuels and travel fewer miles. The back of the map displays all the more technical maps in this pamphlet plus additional information, graphs and energy-related maps.**

Introduction
The Dreaming New Mexico Project

"We are now faced with the fact, my friends, that tomorrow is today. We are confronted with the fierce urgency of now." — MARTIN LUTHER KING, JR.

SELDOM DO WE step back and ask: What is it we really desire? What would success look like? What is our dream — what are our many shared dreams? *Dreaming New Mexico* is a collaborative project to imagine a positive future for the people, energy systems, land, waters and the future generations of our beloved State. It's an invitation to work together to find our common vision and bring our dreams into reality.

Crucial to New Mexico is the future of energy. New Mexico is a paradoxical leader in difficult times. New Mexico and the southwest have been singled out as a major region of severe climate change. The State is endowed with abundant "old-time fuels" such as oil, gas, uranium and coal as well as "new-time fuels" such as wind and solar. The State sometimes goes in opposite directions at the same time. New Mexico — the beautiful entangled knot of old and future — will need to make clear, difficult, conscious, collective choices to govern its harvesting and processing of fuels, generation of power, distribution and use of energy.

What is our dream relationship with "energy?" How can New Mexico build an energy sector that uses preferred, low-carbon fuels and radically reduces greenhouse gas over the next fifty years? What does it take to turn from an oil, gas, coal, and uranium State to a prosperous producer of renewables in five to ten years? Can we envision New Mexico's role in the design of renewable energy management and the ways to pay its costs?

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. We took a systemic approach. As John Muir said, "Everything is hitched to everything else." Human systems and natural systems are one entangled system. We cannot solve "issues" in isolation — cashflows, energy flows, water flows, our sense of comfort and conscience web together. We heard the message: taking care of nature means taking care of people, and taking care of people means taking care of nature. Collectively, we custom-designed this Big Picture of "Energy in the Land of Enchantment" and distilled the dream into one long sentence.

Climate change requires a fundamental shift in the relationship between human and natural systems.

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 and environment of the State's citizens.

Our dream works well with Governor Bill Richardson's 2005 Executive Order, most of the goals of the Climate Change Advisory Group, and much of the presently passed legislation. New Mexico has set itself an ambitious task, more ambitious than most other Western States. New Mexico

New Mexico, energy and climate change

Rapid warming has occurred year-round since the 1960s and continues today and into the future. Temperatures have increased roughly 2°F in the cold season and nearly 3°F in the warm. These increases are more than twice the annual global average over the entire 20th century.

Winter heating needs have been decreasing with warmer winters; and cooling needs have increased with hotter, longer summers. The changes are dramatic — more than 15% since the beginning of the 20th century.

Climate change will diminish water supply, soil moisture, and snowpack; and droughts will be more severe. All this will change the amount of hydropower, coolant for power plants and mine reclamation, as well as the demand for more electricity for cooling in the summers.

law says it should attain 2000 levels of greenhouse gas emissions by 2012; be 10% below 2000 by 2020; and 75% below by 2050. However, even with New Mexico's slowish population growth (1.5% per year) and seemingly small growth in greenhouse gas emissions (1% per capita per year and 3% overall), it is hard to conceive how the State can reach its goals.

The State of energy

- New Mexico's population: 2 million (2006). Per capita income $29,673 (lowest in nation).
- New Mexico's capacity to produce electricity: 7,100 megawatts (2002). Energy is produced in northwest and southeast corners, and moves toward the urban hub of Albuquerque/Santa Fe as well as out-of-state by transmission lines and natural gas pipes. About 30 to 40% of the electricity generated, mostly from coal, is exported. Forty per cent of the mined coal goes by rail to Arizona for power production.
- In-state New Mexico electricity: natural gas (22%), coal (67%), dual-fired (9%), hydropower (1%); less than 1% from petroleum, nuclear and renewables.
- New Mexico is a leading US producer of crude oil and natural gas. Less than 10% of New Mexico's natural gas is used within the State. Most goes to the West Coast and (via Texas) to the Midwest. The Blanco Hub is a major collector and distributor of natural gas for the west. The San Juan Basin located in New Mexico and Colorado contains the nation's largest field of proved natural gas reserves.
- Coalbed methane (a powerful greenhouse gas) is one third of New Mexico's natural gas. The San Juan Basin is the leading coalbed methane basin, producing about 30% of all US coalbed methane. New Mexico rivals Colorado as the Nation's top coalbed methane producer.
- Home heating. A little more than 10% of New Mexican households use electricity. Two thirds of households use natural gas as the primary source.
- New Mexicans consume 11.9 barrels of gasoline per capita per year.
- New Mexico's Permian Basin holds three of the 100 largest oil fields in the United States.
- There are over 40,000 oil and gas wells, three oil refineries, tens of thousands of miles of natural gas transit and distribution lines and thousands of miles of transmission and distribution electricity lines.
- New Mexico imports electricity from Palo Verde Nuclear, Western Association of Power Authorities (Colorado River), El Paso Electric (Texas) and Tri-State Coop (various).

We avoided these "numbers games." All dreams and nightmares (and their numbers) will change with time. Our strategy must be a kind of adaptive management. To realize the dream, New Mexico must tinker and reconstruct the most complex nature/society system it has ever built. Uncertainties abound. What will energy demand be in the future? Can conservation and energy efficiency equal this demand? How fast will electric vehicles come on line? Can regulations and utilities be flexible and change with the needs of the times?

Given the cloudy nature of all dreaming, we asked: How can we move forward with the best tools, political will and understanding that we know? Can we avoid "mid-initiative" mistakes and bring on the right resources and infrastructures at the right moment? Timing and thinking holistically are everything.

We "simplified" the tasks to: preferred resources (renewables), energy efficiency (least cost), distributed energy (best price and efficiency), and the Green Grid (recognizing New Mexico's need for export revenues). In each initiative, we considered what tools were perverse (hurt the initiative), which helped (incentives), and which were needed to govern fairly (including disincentives). And, hardest, we looked at challenges that unfortunately cannot be mapped visually — the best human organizations for aligning prices and energy in a "restoration" economy.

Dreaming New Mexico explored five "common resources" that we all must share: the Earth's biosphere (climate change); the global financial web; the energy system infrastructure of generating plants and delivery systems; the lands and water of New Mexico; and the ethical commons that believes in democracy and honest brokering.

These five common resources are, in today's world, essential to human life. They need governance. Who gets to participate in the energy system's design and operation? Who makes the

What is our dream relationship with energy? How can New Mexico build an energy sector that uses low-carbon fuels?

rules, decides what's a fair profit, the right price, or a reasonable rate of return on investment? Who monitors and enforces the rules? The most complex part of transitioning to an Age of Renewables is the governance of energy by a labyrinth of local, State, tribal, regional, and federal jurisdictions as well as private utilities and coops.

Nevertheless, it is a doable dream and there are specific milestones:

- New Mexico moves dramatically away from fossil fuels and their greenhouse gas and toxic emissions.
- The State perfects generating its power from renewable power sources, capitalizing on its abundant solar, wind, geothermal and biofuels resources.
- The State moves toward much greater energy efficiencies: zero-emission buildings, improved power production, low-carbon fuel, more work per unit energy, fewer miles traveled and demand response around peak power periods.
- The State moves away from imported power with its inefficient line losses and its price insecurity.
- New Mexico builds hundreds of local power grids that encompass islands of homes and business that generate their own power. These distributed micropowers and microgrids produce their own electricity and heat and feed each other through "smart substations" and short, low voltage wires.
- New Mexico designs a "green grid" that transports solar and wind electricity (not coal-fired electricity) with more local, secure, efficient, and reliable power generation and distribution. All new export power lines carry renewable energy.
- The State and region reconfigure and invent new human organizations (in business, town-city-State-tribal-regional governments) that can better align pricing and energy supply with climate change, security, and equity concerns.
- New Mexico curtails global warming by well-targeted public funding, green-collar jobs, renewables research and manufacturing, tax and rate structure 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 and industries feed the grid while you work, answering the peaking power challenge.

The grid connects us to all of North America, and cashflows and greenhouse gases connect us to the entire planet. The Age of Renewables offers hope. It invites us to unleash our dreams to create a future we would like to live in, one we want for our grandchildren. Imagine our grandchildren looking back and saying: "Thank you for rising to the energy supply and climate change challenge. Thank you for daring to dream a beautiful dream that honors nature, each other and future generations."

Peter Warshall and Kenny Ausubel
Project Co-Directors

NUMBERS *The numbers in this pamphlet are gross emissions or savings of greenhouse gases (GHG). GHG are measured in million metric tons of carbon dioxide equivalent ($MMTCO_2e$). Many come from the Climate Change Advisory Group (CCAG). Many estimates are controversial and change with historical circumstances. They should be taken as indicators of the size of the problems or solutions.*

Dimensions of the Dream

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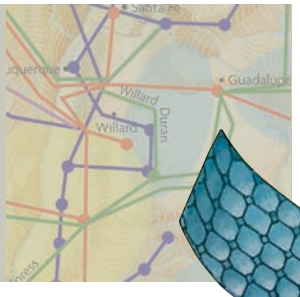

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NEW MEXICO'S DREAM has five dimensions: renewables; distributed energy (micropowers, microgrids); a Big Green Grid; energy efficiency; governing what we share (the energy commons), and building an economy that does not damage the atmosphere or ourselves (the restoration economy). Initiatives to implement all of these five dimensions are necessary to make our energy dream a doable dream.

THE AGE OF RENEWABLES *page 8*

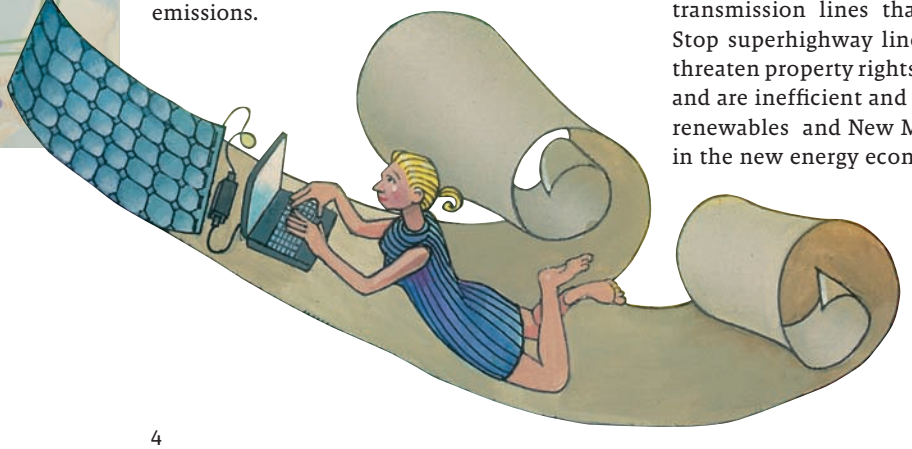
The land guides us to locate power generators customized to the best energy sources within each energy region of the State. Western New Mexico boasts some of the best solar potential on the planet. Eastern New Mexico sports some of the best wind. The Rio Grande valley is rich in geothermal energy. The mountains offer some forested biomass, while the south has pecan trimmings. The Pecos River area has dairies for biogas. Albuquerque provides roofs and wastewater biosolids. The whole State is conducive to micropowers. Renewables can replace coal and radically reduce greenhouse gas and toxic emissions.

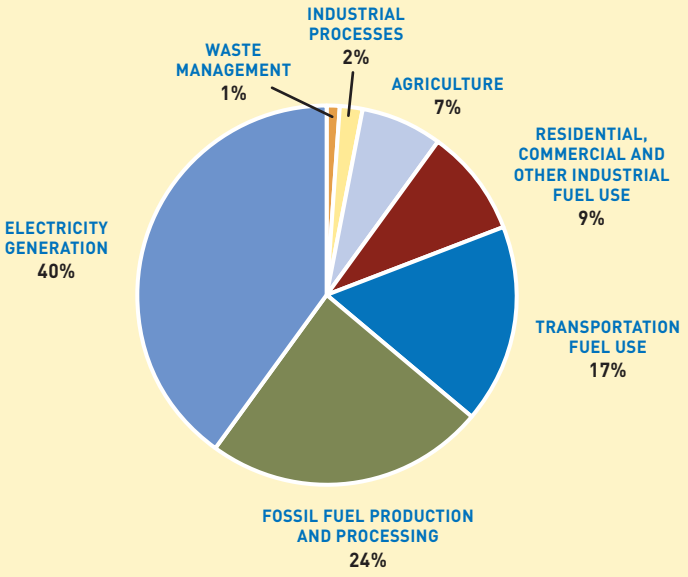
MICROPOWERS, MICROGRIDS AND ENERGY FARMS *page 13*

Get the size right! Give up the illusion that humongous power plants (500–1500MW) are the best ways to produce and deliver electricity. Build mid-size solar, wind, biofuel and geothermal power plants close to cities and towns ("energy farms"). Install distributed power generators on roofs of homes, businesses, manufacturing plants, and industries. Distributed energy is delivered energy. It avoids the inefficiency of long-distance transmission. It's non-polluting, reliable and more secure. The dream emphasizes robust, dynamic microgrids with real-time, high-speed, two-way communication so that citizens, neighborhoods and business complexes can both sell and buy electrons.

THE GREEN GRID *page 17*

The grid is as important as the power generating plants. A simple truth: if there are no wires to renewable sources, there can be no delivery. Get the configuration right. Allow only new transmission lines that feed off renewables. Stop superhighway lines that connect to coal, threaten property rights, blemish the landscape, and are inefficient and unreliable. Export more renewables and New Mexico can take the lead in the new energy economy.





GREENHOUSE GAS EMISSIONS **In 2000, New Mexico produced about 83 MMTCO$_2$e gross of greenhouse gases. The combustion of fossil fuels in power plants, vehicles, and their use in buildings and industry account for 68% of the total. The release of methane from oil and gas production, coal mines, agriculture and waste management accounts for 33%. Included in these percentages are miscellaneous emissions such as those from industrial processes and nitrous oxide from farmed soils, which equal five percent.**

Greenhouse gases

Greenhouse gases in New Mexico include: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydroflourocarbons (HFCs), perflourocarbons (PFCs), and sulfur hexaflouride (SF_6). *Emissions are presented as carbon dioxide equivalents.* For instance, methane is a greenhouse gas twenty times more powerful (per unit mass) than carbon dioxide. Emissions come from direct combustion of oil, gas, and coal (CO_2 and CH_4), the release of CO_2, HFCs and PFCs from industry (predominantly cement and semi-conductors), the use of SF_6 by the utilities industry, the escape of CH_4 and N_2O in agriculture, and the leakage of HFCs from refrigerators and related equipment. CO_2 from the CO_2 mines and leakage of methane from transmission pipes are not well documented.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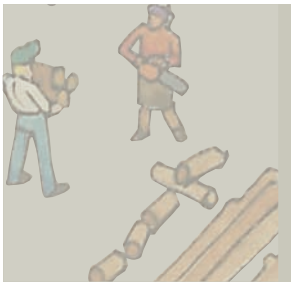
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POLITICAL WILL, ENERGY EFFICIENCY AND SAVING MONEY *page 19*

The quickest and most profitable way to move away from fossil fuels is to use less or get much more work from the same amount. By not wasting energy, by building an energy efficient world, residential, commercial and industrial sectors also save money. Energy efficiency bridges to the foreseeable future when solar and other renewables become cost-competitive, and distributed energy is widespread.

GOVERNING THE ENERGY COMMONS *page 22*

New Mexico's energy system has five major "common resources" that all citizens share, whether they like it or not. The common "energy pools" include: the atmosphere of the planet; the global financial system; the technical components of the energy system such as the grid; the land and waters within the State; and our commitment to democratic decision-making and honorable ethics. At its best, governance can increase efficiency, lower prices, reduce unintentional harms, show compassion for the most vulnerable, and prevent crises. In the dream, New Mexicans organize themselves to provide energy at all stages of the economy that does no harm to themselves and their environment, and to sell energy services at a fair price and profit.

ENVIRONMENTAL JUSTICE *page 26*

When juggling cashflows, comforts and conscience, environmental justice (EJ) puts compassionate working rules for the most vulnerable at the top of its agenda. The double whammy of poverty and energy development hits the vulnerable parts of New Mexico's population hardest. The dream must heal past wrongs and prevent future generations from bearing the burdens of energy system harms.

THE RESTORATION ECONOMY *page 28*

A restoration economy shapes fiscal policy and financing to help return our damaged atmosphere to its earlier health. Restoring the atmosphere capitalizes on the expertise and imagination of environmentally-friendly businesses, venture capitalists, public funding and incentives, green collar jobs, and educated citizens who purchase goods and services that curtail greenhouse gas emissions. In the dream, the market and regulatory framework quickly level the playing field between the old system (centralized fossil fuel power plants feeding superhighway transmission lines) and the new system (the Age of Renewables, energy efficiency, and distributed energy).

New Mexico's climate change nightmare
Business-as-usual runs out the clock

The 2004 drought: piñon trees dying (top) Same scene after needles have dropped (above)

PHOTO: CRAIG D. ALLEN, US GEOLOGICAL SURVEY.

May 2020

Channel KXNM reports another incessant heat wave and the hottest scorcher on record. What little snow fell has melted and streams run perilously low. The Chamber of Commerce announces what's likely the terminal year for the long-failing ski industry. New Mexico Game and Fish has closed all trout streams. The State fish, the cutthroat trout, has been declared federally endangered.

June 2020

KXNM warns of spreading diseases. Pockets of hanta virus in Hildago County, the plague in Luna, and dengue and Valley fever in Bernalillo. Urgent health alerts rock the southern and western counties. Elders and the poor in non-insulated structures are vulnerable to heat-related collapse and should keep in touch with friends.

Mid-July 2020

Dust storms close I-10 and truckers seek a more northern route. Flights have been re-routed to Denver. The asphalt runway has heated beyond the Federal safety standard — too soft for larger aircraft. The Forest Service announces the closure of most campgrounds and trails because of extreme fire danger. The KXNM radio commentator remembers the 1990's when the State tree, the piñon, grew in Santa Fe and biofuel entrepreneurs predicted that forest growth would become a "renewable" fuel. Bewildered, starving bears, New Mexico's State mammal, roam into Albuquerque. It hardly make the news anymore.

Cutthroat trout

Greenhouse gas emissions

- The State is responsible for almost twice the per capita emissions of greenhouse gases than the American average (42 vs. 25 $MMTCO_2e$) because of its intensive gas, oil and coal industries.
- The State ranks 48 among 50 in its use of alternative energy. It is 41st for use of recycled waste. It is 14th in air pollution and toxic releases.
- About 60% of all electricity generated in New Mexico is used in-State. Depending on how calculated, 30–40% is exported.
- Over 90% of the State's power-related GHG emissions occur at coal-fired power plants. Just two coal-fired power plants — San Juan and Four Corners — produce 75% of the total.
- New Mexico government oversight does not yet track CO_2 and methane emissions from the oil, gas, and CO_2 industries. There are over 40,000 oil and gas wells, three oil refineries, several gas processing plants and tens of thousands of miles of gas pipelines. Most methane emissions come from mining coalbed methane and related processing plants and pipelines.
- Because of distances, New Mexicans consume almost twice the US average gasoline per capita. New Mexico consumes 23.3 million barrels of gasoline each year; 2 million more just to asphalt and oil its roads; and 2.4 million in aviation gas and jet fuel. About 20% of all greenhouse gas emissions come from transport. Transportation, which reflects population growth, is the fastest growing emitter of greenhouse gases (29% increase in the 1990's).

In the 1989 drought, bears wandered into Albuquerque. This youngster climbed a pole to get his bearings. Droughts will increase wildlife movement and risk.

August 2020

The Farm Bureau announces that State agriculture is near collapse. It renews its request for drip irrigation subsidies and tax breaks on all groundwater pumping. Not since the Dust Bowl have ranchers and sheep herders de-stocked so severely. The UNM extension service reports that high carbon dioxide levels have favored invasive grasses and greatly reduced the productivity of the range. The once grand dairy industry has slowly vacated New Mexico. Acequia associations and the governor seek federal aid to repair and re-structure their watersheds. The monsoons, increasingly erratic and super-intense, have destroyed their irrigation systems for the third time in five years.

New report from the State water engineer

Elephant Butte is so low that managers cannot harmonize hydropower with irrigation needs. They lowered the lake below the level required for boaters and recreation. New Mexico has missed its Rio Grande obligations to Texas and Mexico for five straight years. Mexico will go to the World Court to pursue fair allocations, and threatens to divert the Rio Conchos in retaliation for water shortages from the middle Rio Grande. Texas is threatening Mexico with a border shutdown. The tribes receiving hydropower from the Colorado dams request the Bureau of Reclamation increase emergency programs or provide them with off-grid solar.

December 2020

The largest investor-owned New Mexican utility has defaulted on its bond obligations; a debt incurred when it insisted on building a new nuclear power plant ten years ago. Half the staff has been laid off. Repair requests and other complaints stop at a messaged recording. Customers threaten the lives of meter-readers, while an organization called "Keep the Lights On" has encouraged customers to stop paying bills — now the highest default rate on record. The Public Regulation Commission daily emergency meetings have produced no bailout fund programs except the purchase of the utility by a Chinese multinational. Security issues abound, and the Federal Energy Regulation Commission has indicated it might take control of the State's energy system. The Governor has declared downtown Albuquerque a disaster area as power has been down for seven days. Police patrol the streets wary of furious customers locked out of work.

Solar, wind, geothermal, biofuels . . .
The Age of Renewables

RENEWABLE ENERGY, like the daily rising of the sun, is any form of energy that can last forever (on human time scales) without reducing the energy supply available for future generations. New Mexico needs renewables to reduce to a minimum the emission of greenhouse gases and fossil-fuel generated toxics such as mercury, sulfur dioxide and nitrous oxides. New Mexican renewables can help wean us from fossil fuel imports and from the wars they provoke. New Mexico's renewables already create jobs and attract new manufacturers. Once the transition picks up steam, the Age of Renewables should lower costs and utility rates, create a revenue stream from export and green-collar jobs and businesses.

Imagine the Renewables future. The diverse lands of our State — its "energy regions" — guide the construction of place-specific power plants and power lines. Each energy region builds power generation customized to its best energy local sources.

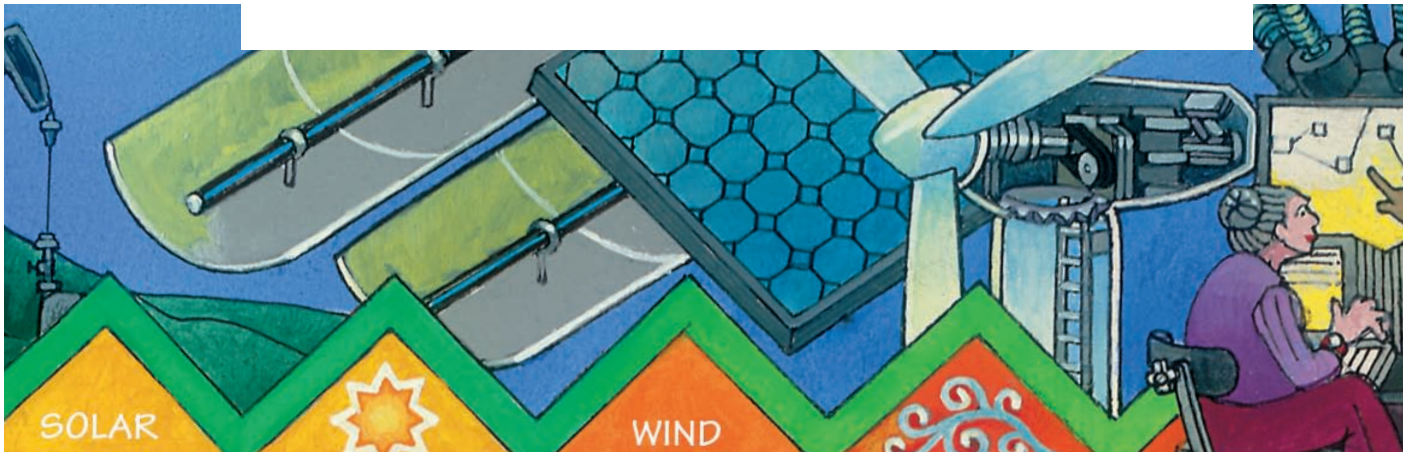
Western New Mexico, rich with some of the strongest solar radiance on the planet, develops exemplary concentrated solar power plants, concentrated photovoltaics, and solar power towers. Eastern New Mexico harvests some of the best on-shore wind, blossoming wind farms. The Rio Grande valley taps its geothermal energy. The mountains use of some their forests, the south uses "waste" pecan trimmings, and the Pecos River cuts salt cedar for biofuel. The 170 dairies and feedlots recycle manure for biogas. Albuquerque and other cities' roofs cover themselves with photovoltaic plates and solar water heaters. Each city's sewerage treatment plant recycles wastewater biosolids for heat and power. Devastated lands — mine tailings and some open-pit mines — are covered in solar "farms." The remaining fossil-fuel power plants have been plumbed to algal-fed bioreactors to sequester carbon dioxide. Algal-fed biodiesel bioreactors compete with the oil fields. The State government adopts micropowers to power itself, including new fuel cells.

Honor the energy regions of the State and custom-design power generation to the best energy sources.

Honor the energy regions of the State and custom-design power generation to the best energy sources.

DREAM *Honor the energy regions of the State and custom-design power generation to the best energy sources.*

In the Age of Renewables, the northeast sector of the State stops importing power and replaces it with wind farms. Northwestern coal-fired power is increasingly replaced by solar and wind. Renewables demand from Arizona, Utah, Nevada and California promotes the export of renewable electricity on the high-voltage transmission lines. The southern part of the State combines solar and wind into a business as profitable as the obsolete coal-based power generators.



THE SUN RUSH

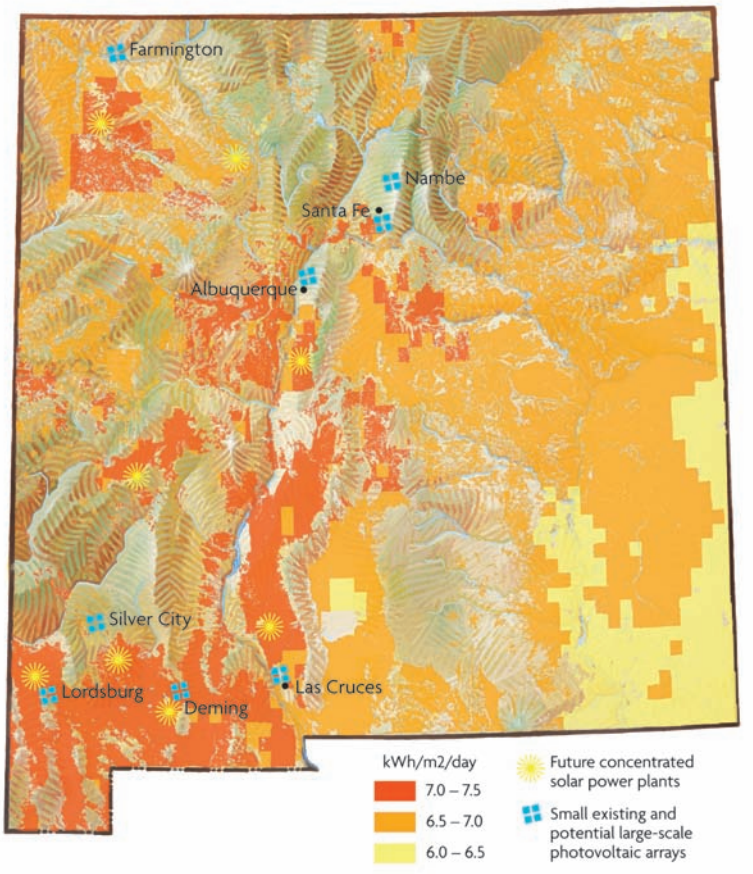
The sun, as long known to indigenous peoples of New Mexico, is the key to the State's future. Solar has almost no need for fossil fuels. Solar generation prices have been falling fast and some predict will be competitive by 2015. Solar can begin the job of reducing greenhouse gases sooner than coal or nuclear. Solar generators exhale no pollutants. Large photovoltaic farms avoid water use (though solar thermal farms can consume as much coolant water as coal). On-site solar can be hooked into your home and fed back into the grid, which can help the community meet peak power demands.

New Mexico, with the second best potential for solar power in the US, sits at the heart of one of the most radiant areas of the planet. *Scientific American,* in a "Grand Plan," asserted that New Mexico could generate 1,119,000MW of solar utilizing a piece of land 95 by 95 miles. It could replace our dirtiest, biggest coal-fired power plant (San Juan) with solar trough technology covering 3 by 5 miles. With State encouragement, manufacturers, investors, researchers and service companies have joined the "sun rush." Sandia Labs now tests new solar technologies like the solar power tower. The dream unfolds but, for many, it's too slow with too many flaws.

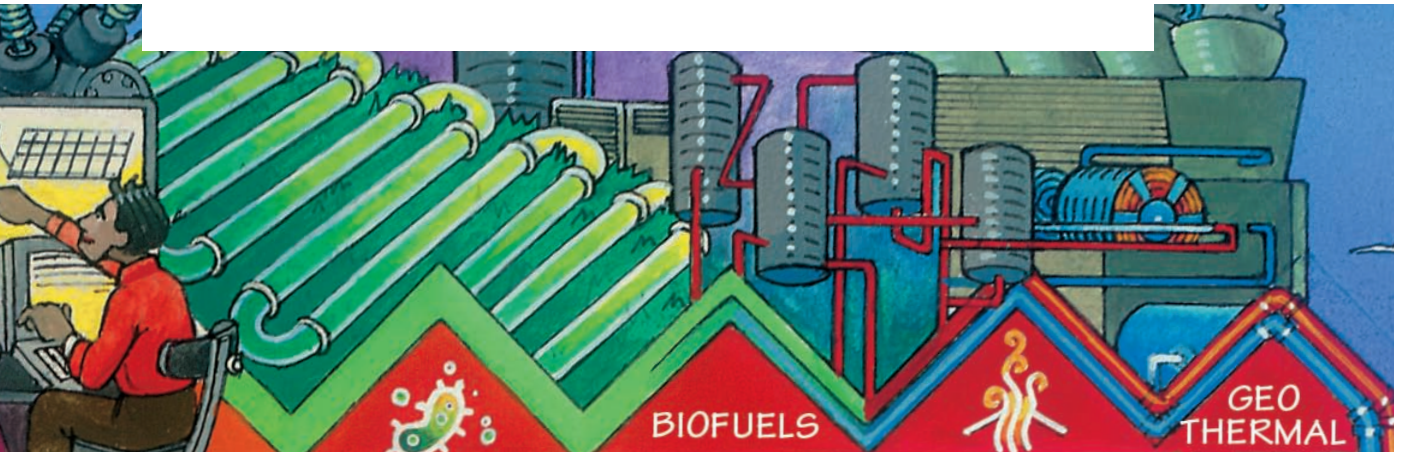
Three size ranges guide solar installation. Small photovoltaics (from 1 kW–10,000 kW) are for roofs and free-standing arrays (see *Micropowers*). With the right incentives and local government enthusiasm, installed small PVs could be our largest and most cost-saving collective generator.

Mid-size solar facilities (photovoltaic arrays and power towers) range from 1–50MW. They can cluster in "parks" near cities to avoid long-distance line losses (load-side distribution). Large solar farms (50–100MW) feed the high voltage transmission lines from farms of solar troughs, solar concentrated photovoltaics and, in the future, concentrated power towers. By exporting clean energy, they will help New Mexico compensate for tax revenues lost from reducing output from its coal and, eventually, natural gas power plants.

There are some downsides to large solar. It can take up lots of land. It requires high-voltage power lines that blemish landscapes. Glass solar collectors can crack in hail. The costs and price margins require public fund tax breaks and subsidies. Power storage and "firm" flow can be a problem. Coolant water may not be available.



SOLAR POWER **New Mexico holds one of the planet's best solar areas. This map shows the best areas for concentrated solar power, though the whole State has sun for photovoltaics on roofs and PV freestanding arrays.**



Wildcard technologies

A breakthrough technology could re-direct our energy future almost overnight. A new method to make hydrogen from biomass would accelerate fuel cell use and new kinds of cars. A bio-syngas from the smokestacks of coal would reduce the need to sequester greenhouse gases. A bacterium that eats coal and makes biomethane would completely alter our energy mix. A vastly improved solar photovoltaic cell at the right price could change our cities. A brackish-water algae that makes bio-diesel would drastically reduce trade in some fossil fuels. A proven method to store compressed air in caverns in the earth would accelerate wind farm development. A new "organic" battery with superior storage would accelerate wind and solar energy installations. Our dream is not an agenda or predetermined strategic plan. It invites imagination and invention.

For inland wind power generation, New Mexico ranks in the top five in the nation. Wind "speculators" prowl 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. They are trying to secure leases for wind farms before anyone else. They even bargain for smaller, more difficult locales like the high ridges throughout New Mexico.

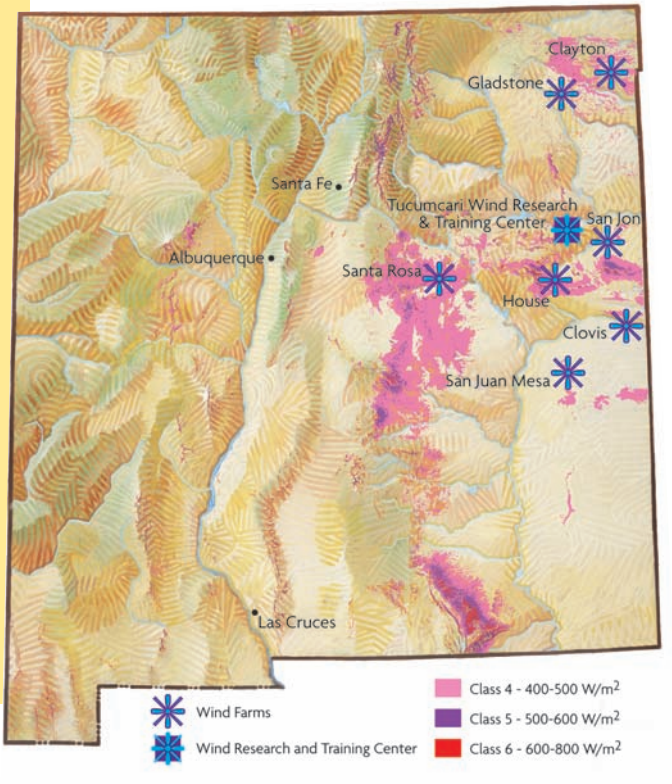
Wind uses no fuel, and overall production costs are cheaper than coal (the cheapest fossil fuel). A wind farm can be built in perhaps a year (very fast for a power plant), and at a fraction of the cost of a coal- or gas-fired power plant. Wind power consumes no water, and causes no more pollution than it takes to build the generators, towers and blades. The durability and efficiency of the turbines are increasing. Maintenance is cheap and predictable. And they don't heat up the planet.

Large-scale wind farms (500MW) could generate 20,000MW in New Mexico, more than enough to met the State's needs. (Commercial grade starts with Class 4–7 wind power, above about 400 watts per square meter). Right now, New Mexico generates less than 1,000MW — so the opportunity is great. Existing farms include: Clovis (2MW), San Jon (80MW), Elida (120MW), House (204MW), Santa Rosa (220MW), Gladstone (20MW), and Clayton (120MW).

Wind farms are a great economic hope in many rural, ranching communities such as the Corona Ranchers in Torrance County. By collective bargaining for land leases, they can match the value of raising cattle (on a per-acre basis). Wind is a great hope for new green collar jobs. The Wind Research and Training Center in Tucumcari is unique in the nation.

The biggest barriers to rapid expansion are: no nearby transmission lines, and the permitting process for rights-of-way, inter-connection, and transmission line approvals. Bird and bat mortality requires special design and scheduled shut-off times. Lower noise turbines make better neighbors.

The demand for wind turbines is so great that there is the multi-year delay between ordering and delivery. Storage of wind power also remains a major concern. Some wind plants are sited near small natural gas generators to augment the transmission of power when the wind dies. New technologies install air compressors to deliver compressed air (wind) to storage aquifers, caves, old gas wells, and old pipelines. The compressed air subsequently pumps water or powers an electric generator. This is an infant technology. Wind generators can charge batteries that, in turn, power flywheels to spin generators, but the capacity is very limited. Because wind farms can't provide power on demand, they are likely to be paid somewhat less for the power.



WIND POWER **New Mexico dreams of 20,000MW of wind power. Today it is less than 1,000MW. Commercial grade requires Class 4–6 wind power. Note wind potential on ridges throughout the State. Lower classes are still useful for decentralized power on roofs or ranches.**

What slows the renewables renaissance?

The transition away from fossil fuels and towards renewables is too slow. Why?

- Solar, algae, biobutanol, cellulosic bioethanol, and biodiesel technologies are not yet price competitive. (Wind is very competitive, if power lines are nearby.)
- Transmission lines are too far from renewable sources (sun, wind, geothermal) and not connected to major customers.
- Wind and solar are "intermittent" (vary with weather and time). Renewables need storage or complex networking to even the flow of electrons. Soon solar will have cheap, molten salt thermocline storage. Wind can store energy as compressed air in underground caverns. The technology is not proven.
- Coal, nuclear and natural gas lobbyists assert "load growth" (demand) cannot be met by renewables and energy efficiency. They compete for transmission line routes, tax breaks, and subsidies. They lobby to slow renewables until they figure out how they can make a profit from the new energy economy and wring every last dime from fossil fuels.
- When wind approaches 15 percent of a power line's capacity, the price soars because the "wires business" must compensate for voltage fluctuations to harmonize wind with other sources of electrons. In short, wind can become a hassle.
- Price arrangements for renewables (solar and wind) are new, and dealers have not learned how to price supplies which cannot be as "firm" as coal, nuclear or natural gas.
- Until solar thermal plants can directly heat salt, solar trough technologies will need lots of water for coolant. Water is scarce in New Mexico for all energy development.
- America's love of big, fast, tricked-out cars and the conveniences to get up and go where and when you want definitely slows the shift to smaller, slower vehicles.

BIOFUELS **include fuels from crops (sorghum, corn); oil-rich algae for biodiesel; wood wastes from thinning; manure, sewage biosolids and landfill gas. Rainfall and heat limit crop and tree resources.**

SOLAR/HYDRO-BIOFUELS


CROPS


WOOD WASTE


MANURE


ALGAE

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. To reduce climate change, biofuels 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; wood wastes from thinning forests or pecan orchards; cow manure; sewage biosolids, and landfill gas.

New Mexico has limited potential for biofuel crops and wood waste because of the scarcity of water and high costs of production. Estancia will attempt a wood waste biofuel plant. A few bioethanol plants (Tucumcari) will use field crops but the competition with food production of crops like corn will limit their numbers. 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: New Mexico becomes the US leader in algal-based biodiesel for trucks, engines, and some aircraft, especially algae grown in brackish waters. Algal bioreactors can produce 7,000 gallons of biodiesel per acre (much more than other biofuels) and some labs claim yields of 18,000. When mixed with low sulfur diesel, the fuel can run diesel cars and trucks, generators, and some aircraft. The bioreactors have been attached to flue gas pipes from coal-fired power plants and to carbon dioxide mines. They may significantly reduce greenhouse gas and toxic emissions in the near future.

Transport

Because of distances, New Mexicans consume almost twice the US average per capita in gasoline. New Mexico consumes 23.3 million barrels of gasoline each year; 2 million more just for asphalt and to oil its roads; and 2.4 million in aviation gas and jet fuel. About 20 percent of all greenhouse gas emissions come from transport. Greenhouse gas emissions in the transportation sector (cars, buses, trucks. trains, aircraft, tramways and ski-lifts) grow faster than any other sector. The CCAG predicts five additional million metric tons of carbon dioxide equivalents between 2010 and 2020, second only to electricity production.

GEOTHERMAL AND HYDROPOWER

New Mexico's geothermal dream envisions local use, competitive prices and multi-tasking. 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. Already, New Mexico has the most geothermal greenhouse acreage in the nation. High temperature (>350˚F) is best for 20MW electric generation; mid-temperature (190˚–350˚F) is best for 3-10MW; and low temperature (<190˚F and 15–30˚F above surface temperature) can be used for greenhouses, aquaculture, space and district heating, ground-heat pumps, and cooking and drying onions or chilies or curing foods. In the dream, 30–200MW of electricity and heating equivalents would come from geothermal. Geothermal can be used to "firm" up (even out) the power flow from the more erratic production of solar and wind.

New Mexico has limited hydropower. In the San Juan River Basin, the Navajo Dam can produce 30MW and the Farmington 0.2MW. In the Rio Grande basin, Elephant Butte Dam produces 24.3MW, Abiqui 15MW and El Vado 8.8MW. New Mexico receives 215-250MW from the Colorado River. Micro-hydro power development could help farmers in our southern Rocky Mountain region.

New Mexico's dream is local, renewable biofuels at a competitive price.

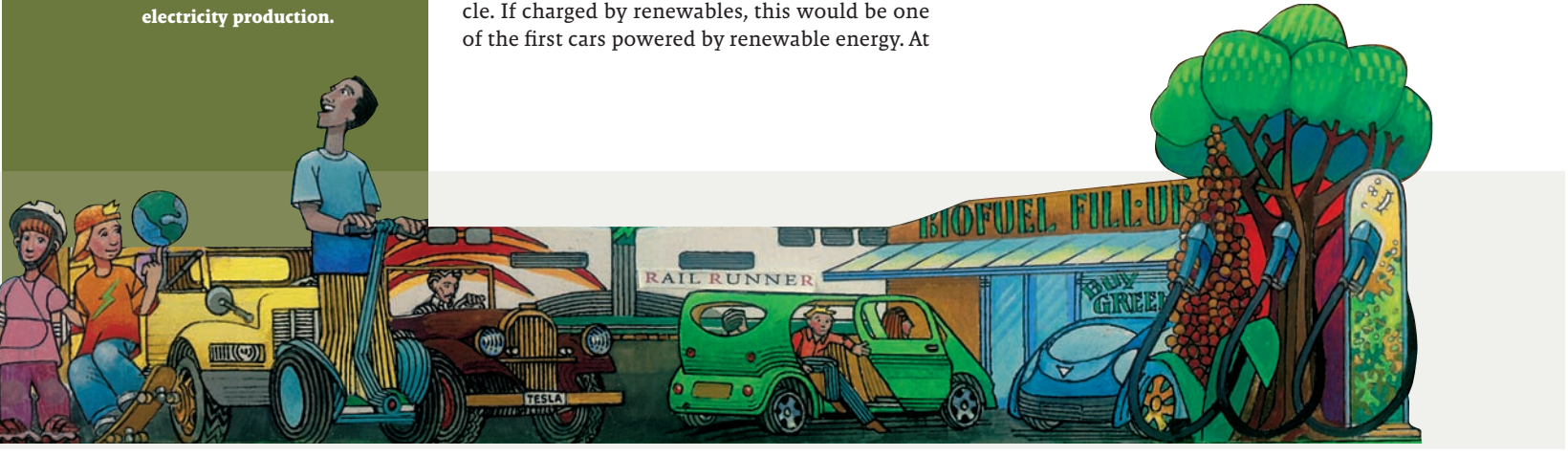
VEHICLE FUELS

America's love affair with cars and its nightmare visions of climate change find it hard to share the same pillow. In Albuquerque, Tesla Cars has been inventing high-end all-electric cars that it hopes will lead to a commoner's affordable vehicle. If charged by renewables, this would be one of the first cars powered by renewable energy. At the moment, we must dream of small increases in transport greenhouse gas emissions, not no increases, while betting on the future smorgasbord of breakthrough technologies that will yield clean vehicle winners.

DREAM *Cars, buses, trucks, railroads, and aircraft improve fuel efficiency and use low-carbon fuels at a competitive price. Ultimately the dream has become: How long before fuel-cell-powered vehicles?*

There are three parts to the vehicle dream: reduce the amount of fuel used (see *Political will*); reduce the vehicle miles traveled (see *The Energy Commons*); and change the fuel type. To reduce greenhouse gases, drivers must fill up with new fuels that release less carbon dioxide per gallon. Changing fuel type — from fossil to less carbon-intense fuels — is New Mexico's most vivid dream. Low-sulfur diesel and homegrown renewable fuels from algae — or electrons-in-place-of-fuels (hybrid cars or plug-in hybrids using renewable energy) — herald a future of economic growth and clean air. Low-sulfur diesel without toxics (common in Europe) has just been introduced into the US. Can we overcome our distaste for diesel's old-time black smoke and cranky fuel?

State government has taken the lead, switching many vehicles from gasoline to natural gas. It's considering a requirement that increases the renewables content of gasoline every five or so years. The legislature can pass a State Clean Car program (as found in California and eleven other States), and through tax breaks, encourage the purchase of hybrids, low speed vehicles, and renewable fuels. Twenty percent renewable fuel in everybody's gas tank by 2020 is the Climate Change Advisory Group (CCAG) goal.



Distributed energy's big impact
Micropowers, microgrids and energy parks

DISTRIBUTED ENERGY is power generated on-site (or nearby) that, at times, connects to a community microgrid. Distributed energy is generated by micropowers that are just outside the window. You know where your electricity comes from because the homeowner or business supplies his or her own electricity and/or heat and cooling. Micropowers may even power an electric or hybrid car. If there is excess, micropower owners sell electricity back to the utilities that own the grid. Or, if a community of homes and businesses "aggregates" (forms a kind of cooperative), they can sell electricity to each other.

Micropowers could be one of the largest sources of New Mexico electricity — with the right incentives, political will and local governmental enthusiasm. Covering the roofs of buildings, they can supply daily needs and make the owner money by feeding energy back to grid. Feedback micropowers are cheap because battery storage is unnecessary.

In the dream configuration, meters sense your in-building needs and manage your business or home energy needs on a microsecond-by-microsecond basis. They shut off electric lights when you leave the room or shed appliances like dishwashers when there is a sudden drop in voltage.

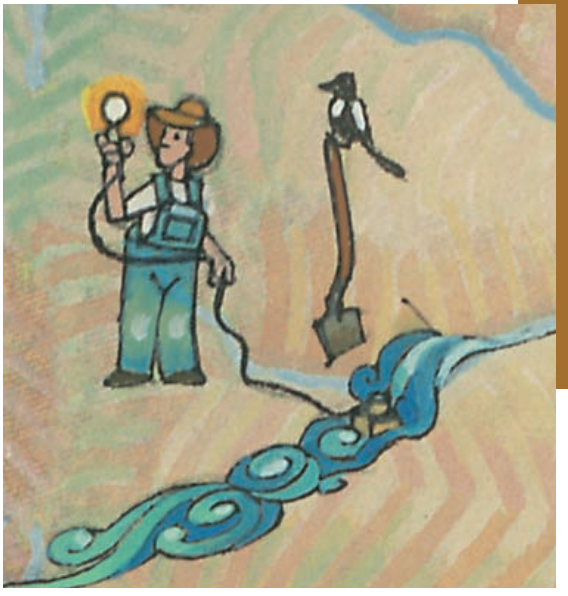
Computerized smart substations use software to manage the fluxes from wind and clouds, day and night. They interface among the many micropowers on the building or in the neighborhood as well as with microgrid and the Big Grid. Besides "load control," smart substations can also store power to even out electricity flows, and recover heat to increase efficiency. Distributed energy with a microgrid and smart substation is information intensive and energy intelligent.

DREAM *Much more decentralized (distributed) energy with energy generation and distribution close to the user with smaller wires over shorter distances, and more control over security, reliability and quality (optimized load).*

This new configuration of micropowers and microgrids has many benefits over the old configuration (a big power plant feeding superhighway transmission lines). It reduces toxic and greenhouse gas emissions. It saves land, protects property rights, and reduces controversies over rights of way and eminent domain. It is more efficient, eliminating line-loss inefficiencies and the water required for cooling large power plants. It can resolve peaking power problems and postpone the need for new power plants and transmission lines. It avoids financing problems for large power plants and high-voltage lines — the capital, taxes or bonds otherwise required. It is frugal. Distributed micropower is delivered power.

Micropower "islands" could be among the largest sources of electricity.

Distributed energy offers the larger com-



Distributed energy 101

***Intermittency*:**
Used to describe the ups and downs of electric current from wind or solar into distribution and transmission lines.

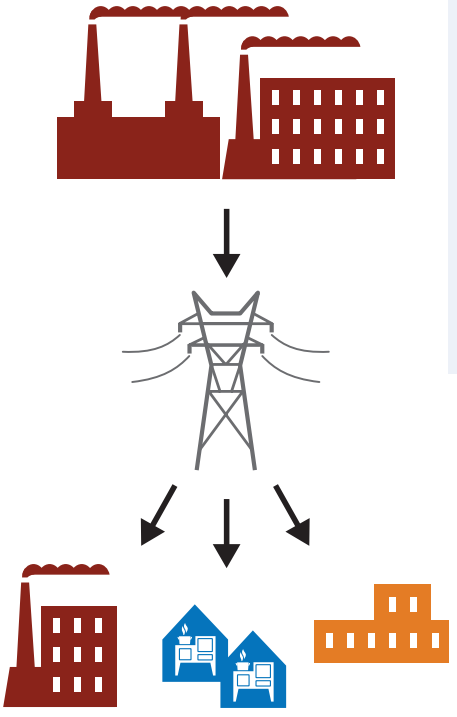
***Shedable*:**
During brownouts or low voltage flux, these appliances can be turned off. Includes washing machines, dryers, and dishwashers.

***Sensitive*:**
Certain appliances such as computers and hospital monitors are very sensitive to load flux. Reliable micropowers and local storage favor these appliances.

***Micropower*:**
Any electric generation source between 4kW and 10MW.

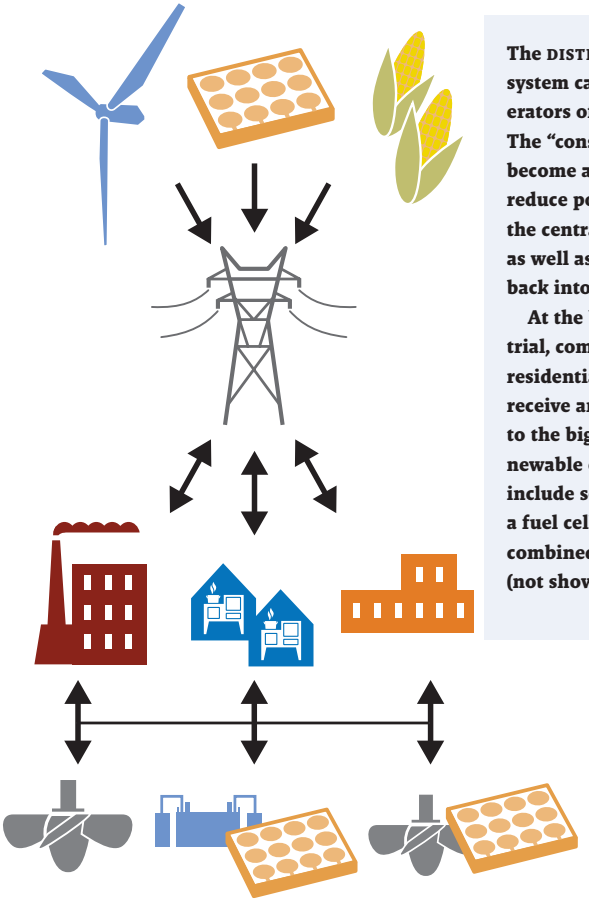
***Microgrid*:**
Any distribution line smaller than 115kV that feeds a substation and can re-route the arriving electric current to other nearby customers. Definitions vary.

CENTRALIZED POWER SYSTEMS



CENTRALIZED POWER is one-way transmission with the line-losses of 7.5 per cent or more. Image shows a central power plant that feeds a high-voltage transmission line to lower-voltage distribution lines (not shown) to industrial, commercial and residential uses.

DISTRIBUTED POWER SYSTEMS



The DISTRIBUTED POWER system can have many generators of electricity. The "consumer" can also become a "generator" and reduce power needs from the centralized system as well as feed electricity back into the big grid.

At the bottom, industrial, commercial and residential buildings receive and send electricity to the big grid. These renewable energy generators include solar photovoltaics, a fuel cells, wind and combined heat-and-power (not shown).

munity many benefits: a cleaner atmosphere; more disposable income (since the owner generates his or her own energy); relief from brownouts, rolling blackouts and other forms of congestion, and more secure, reliable and higher quality energy. Among heavily electricity-dependent businesses such as brokerage firms, airlines and car rentals, a key motivation for micropowers is the desire to have more control over power reliability and quality so that each load can be optimized. Distributed energy enters the market faster because of reduced conflict and permitting time, speeding the reduction of greenhouse gas emissions.

DREAM *Islands of multi-modal renewables (with a few gas turbines) share each others electricity production, feeding excess to the Big Green Grid and using the Big Grid only as back-up in emergencies and periods of heavy loads.*

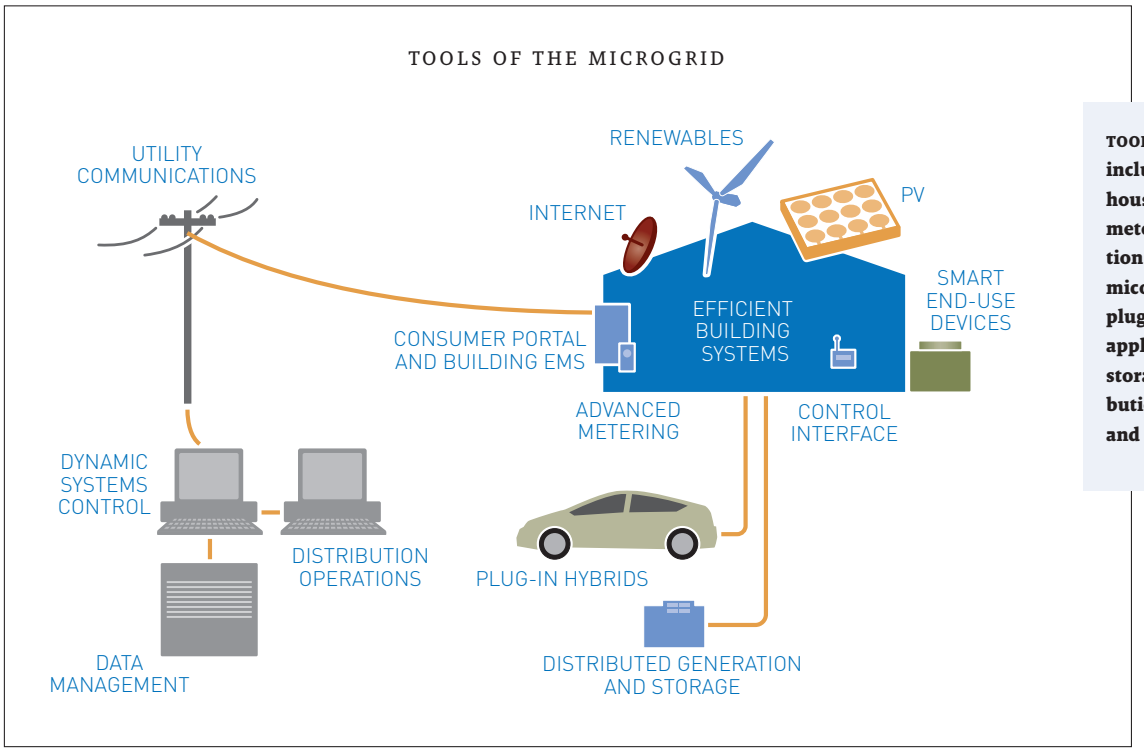
DREAM *Building owners earn profits from selling "green" electrons back to the bulk utility.*

MICROPOWERS

To fully embrace the Age of Renewables demands a change of perception. Generating large amounts of electricity does not require large power plants. Many distributed small generators can do the job. As they say in West Texas: "Little winds work where big winds won't." Small wind generators, for instance, do not need big Class 4 winds nor 35% capacity (the bottom line for large wind farm investors). Small wind is helping rural (and some urban commercial operations) reduce or eliminate their electric bills or, when near a transmission line, actually earn income. They also eliminate greenhouse gas emissions. This change to micropowers is at the heart of the Age of Renewables.

DREAM *Install many more micropowers from renewables, bridging with natural gas as a transition fuel. Custom-design a diversity of micropowers to the security, reliability and quality needs of user.*

DREAM *Generate large amounts of electricity, with distributed small generators. No more (or very few) large (500MW), distant power plants using high voltage power lines (>215 kV).*



TOOLS OF THE MICROGRID include two-way and in-house metering ("advanced" metering), "smart" substation that manages loads, micopowers (including plug-in hybrid cars), "smart" appliances, short-term storage and special distribution lines for low voltage and communication.

Micropowers vary from 4kW to 10 MW. They can be built on-site or nearby in energy "parks" of solar, wind or geothermal ("load-size generators"). Among European businesses, high efficiency combined-heat-and-power (CHP) and industrial energy recycling have blossomed as sources for on-site power. Micropower renewables include small solar photovoltaic arrays and roof shingles, plug-in hybrid vehicles, micro-CHP, micro-hydro, ground heat-storage, wood waste generators, renewable-energy-powered fuel cells, geothermal, and small wind turbines on roofs. Increasingly popular are thermal-based engines and steam turbines from biofuels and biogases as well as gas turbines and micro-turbines.

Energy parks (1–50MW)can include pumped storage (where hydro power water is caught after generating electricity and returned to the reservoir), landfill gas collection, wastewater treatment plant gases, and multiple-use micropower (e.g., geothermal for heat, spas and greenhouse crops or microhydro for irrigation and power).

This incomplete list gives a feel for how each home, farm and business can custom-design its micropower to its sources and needs. It will not be long before there are cars that plug-in at night, make no sound when they start in the morning, and plug in at work to feed the grid. Or, ground heat-storage equipment buried in the front yard will reduce or eliminate the need for electricity for winter heating and summer cooling.

Some micropowers can be rapidly turned up or down. They will help "firm" the more erratic energy supplies of wind and solar. Geothermal, seasonal hydro, biomass, natural gas and customer demand response (see *Waste Not, Want Not*) will go a long ways to helping shift to renewables. New Mexico needs a lot more passionate political will.

MICROGRIDS

DREAM *New Mexico transforms the existing metering architecture to a system that allows re-metering, a two-way feed of electrons, profits and costs between private citizen and bulk-providing utility.*

The dream envisions a dynamic communications network for microgrids to the Big Grid, providing micro-second adjustments in this dialog of micro- and macro-. The microgrid transition has five basic tools: two-way meters, smart substations, new 6–12kV distribution lines, in-house monitoring of appliances, and a "virtual"

power sharer (load manager). Some microgrids switch to direct current (DC) to improve digital device reliability.

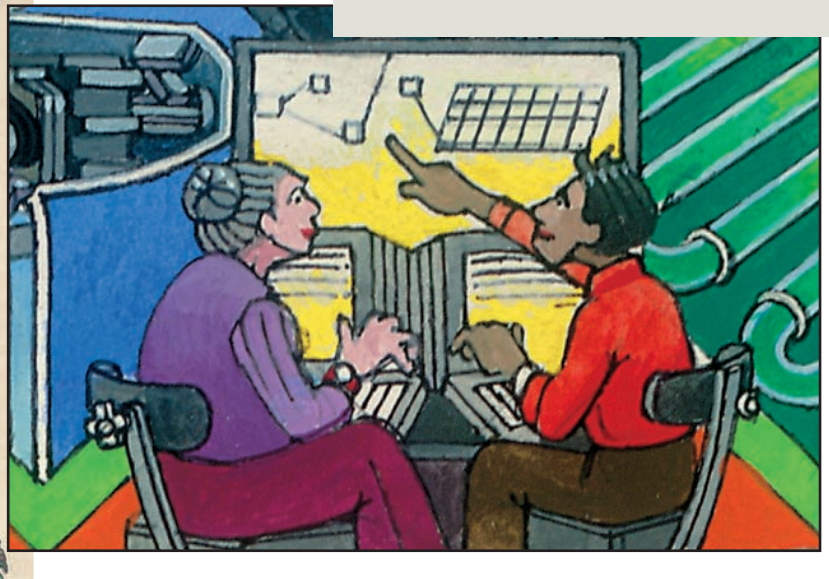
The smart substation is the system's hero or heroine because: It can monitor all the fluxes of both nature (clouds, night, wind) and human infrastructure (demands, breakdowns); and work remotely and optimize performance to save electricity, costs and greenhouse gas emissions. It will require installation of thousands upon thousands of on- or in-building control devices to fully automate the accounting of electricity flows, time-of-day, and the cash flows that result. Many of the small wires will need re-conductoring. Distributed energy is a major job generator.

The major obstacle to distributed energy is the relationship between micro-producers and bulk-utility providers. The micros want to be paid for: feeding their excess into the Big Grid; reducing congestion duirng peak demand; preventing grid failures; helping the utility defer costs for grid upgrades and new generators; and maintaining the distribution system. Macros (the "bulk" providers) want to be paid for: allowing intermittent feed-in from distributed energy islands;"avoidance costs" (micros avoid storing electricity on windless days or night), and emergency assured power (if micropowers fail). Cost sharing and management responsibilities have not been settled.

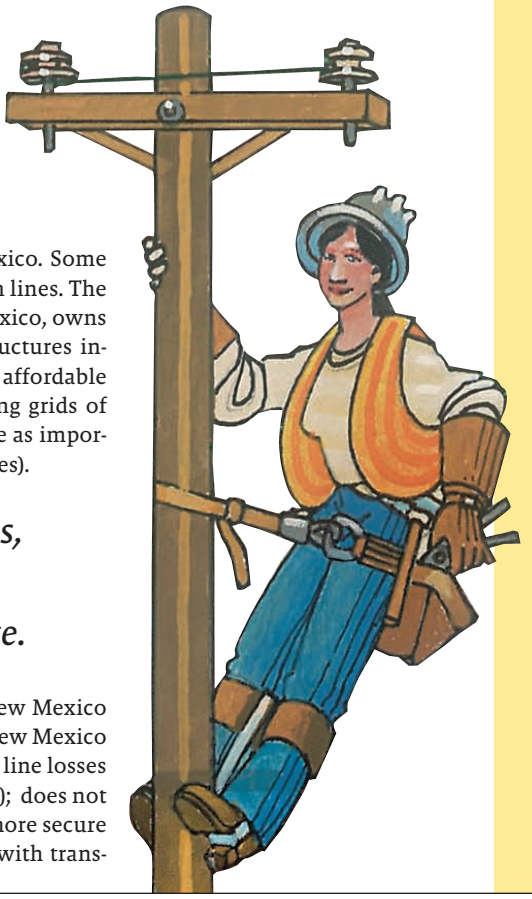
DREAM *Microgrid architecture assures that the individual provider or aggregator is a good citizen and that each island of multi-modal generation complies with the rules of the grid, doing no more harm than is acceptable from a single home or business.*

Why is the micro-renaissance so slow?

- Utilities stand to lose money if electricity is locally generated and want to be compensated for their losses. Power markets do not justly reward distributed energy for its contributions. They favor the central power plant generation model.
- The Big Grid was not designed to accommodate distributed energy and two-way power flows. Installing micropowers and connecting them to a microgrid and smart substations are so new that utilities, community aggregators, and governments shy away. They do not know how to safely and reliably interconnect micro-grid into macro-grid.
- The financial framework for distributed energy needs more work. Rate-based returns on investment, service payments, management responsibilities, ownership, and skilled labor education have just emerged as barriers. In New Mexico, there is controversy over the application process, feed-in tariffs, exit fees, load retention rates, insurance and liability, and stand-by fees.
- Renewables — especially geothermal, manure-to-gas, and co-generation — start with local economic development. This is new for many local entities and enthusiasm has just begun to brew.



New Mexico's clean energy
The Green Grid



A MANTLE OF WIRES covers the lands of New Mexico. Some estimate 40,000 miles of transmission and distribution lines. The main purveyor of electricity, Public Service of New Mexico, owns 186,000 power poles and 16,000 transmission line structures including substations. To deliver reliable, secure, and affordable energy, the current delivery system requires sprawling grids of electric wires, gas pipes, and roadways. These grids are as important as the power generators (power plants and vehicles).

For the next 20 or more years, energy export will remain a major "product" of the State.

Two-thirds of greenhouse gases generated within New Mexico are associated with power exported out of State. The New Mexico dream: favors micropowers and microgrids; eliminates line losses (7.5% of all power generated is lost in high voltage lines); does not disturb huge acreages of land for rights-of-way, and is more secure and reliable. (Over 95% of all US service failures start with transmission-line congestion, accidents, and force majeure). In addition, superhighway transmission lines (115 kV and above) require long permitting times, and generate controversy and contentious delays. Climate change demands accelerated solutions.

Export revenues complicate the conversion from fossil fuels. New Mexico has many public programs (especially schools, see page 30) that survive on revenues from our energy exports of electricity, coal, oil and natural gas. To transition to the Age of Renewables, the State will need to generate different sources of public revenues. For the next 20 or more years, energy export will remain a major "product" of the State. The dream switches the transmission lines from carrying coal-fired electrons to wind- and solar-generated electrons.

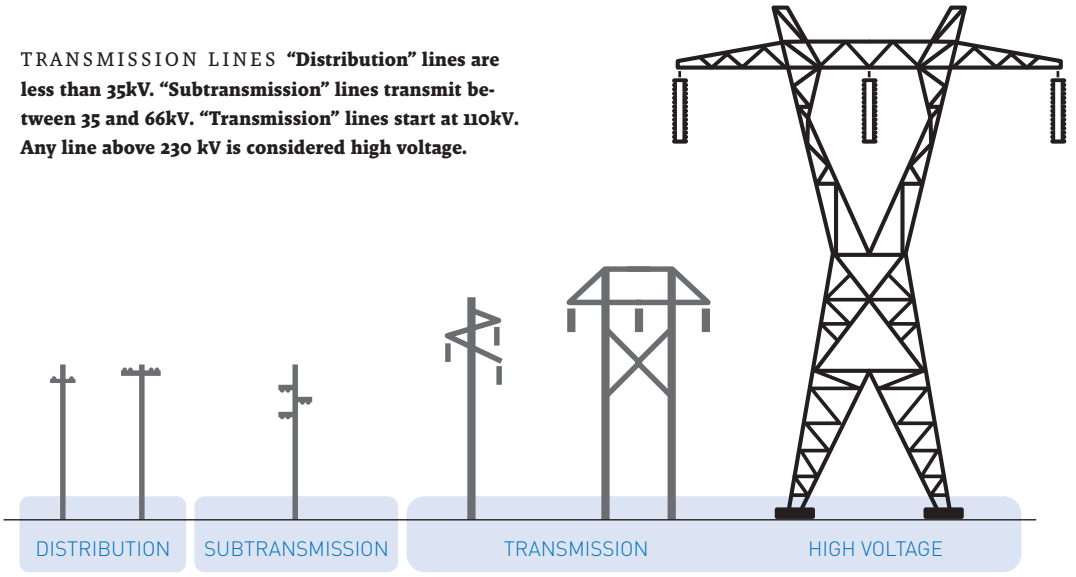
DREAM *All new transmission lines of 115kV and above connect to solar, wind and geothermal sources. Congested lines do not increase their capacity with upgrades to yet more coal-fired electricity, but seek relief with renewables and modernization. New transmission lines export electricity for sale solely from renewables.*

THE REGIONAL GRID
Two-thirds of the greenhouse gases generated in New Mexico are associated with export to the Western Grid. New export lines (green) should only export renewable energy.

The grid now

The nation's grid sprawls irrationally, is unreliable, inefficient, and in need of updating and a new configuration to accommodate renewables. Nearly 95 percent of the nation's problems with electric service come from congestion, blackouts, interrupted service and forced outages. Credit card companies, for instance, lose $2.6 million per hour from service problems. Brokerage firms lose $6.5 million per hour. The unwieldy national grid has encouraged businesses to build their own local micropower generators and use the Big Grid for backup.

TRANSMISSION LINES **"Distribution" lines are less than 35kV. "Subtransmission" lines transmit between 35 and 66kV. "Transmission" lines start at 110kV. Any line above 230 kV is considered high voltage.**



Import, export, and in-State

No one really knows very precisely the sources of imported power into New Mexico because the power is "wheeled" by traders who own neither power lines nor power plants. They simply broker the power and, like a toll booth on a highway, charge a fee for delivering. NM imports electricity from out-of-State nuclear power, coal and natural gas power plants, and from Colorado River hydropower.

DREAM *New Mexico continues to receive energy export revenues and radically reduces greenhouse gases. New Mexico selects new export lines that carry only renewable sources.*

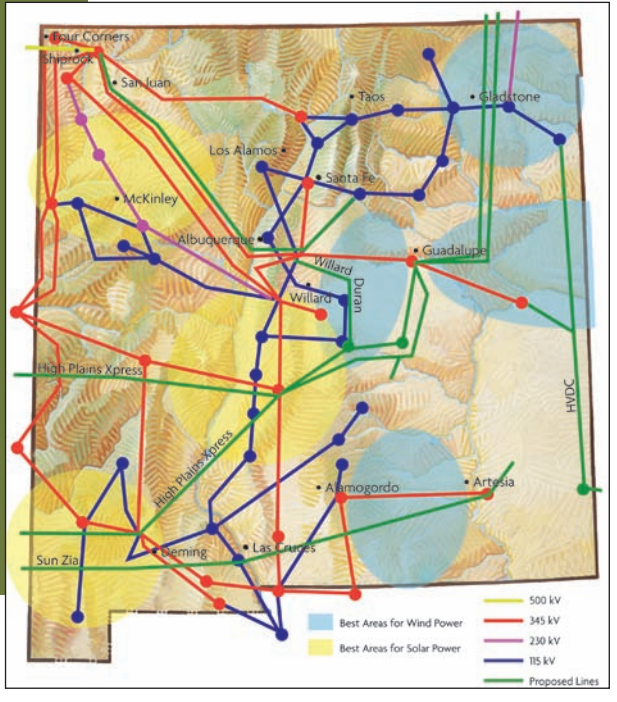
The energy business designed the old web of wires to go to coal and other fossil fuel generators in New Mexico. The new power lines need to target the best sources for wind and solar. The proposed SunZia line, for instance, passes through some of New Mexico's best solar areas, some geothermally rich areas that might produce enough electricity to "firm" (even out) the flow, and terminates in the great wind power locales of eastern New Mexico. In addition, SunZia already has three natural gas plants, which, compared to coal, emit one-third the greenhouse gases for the same number of kilowatts.

The switch to renewables for export is the future of energy markets. California, for instance, which buys power from New Mexico, has mandated that all new contracts for energy from power plants must meet natural gas combined-cycle emission standards. To maintain its export revenues, New Mexico needs to switch from coal.

Not all new transmission lines of 115kV or above must be for export. A few, like the Williard-Duran line, will help supply the urban demands from Albuquerque to Santa Fe. Ranchers in Torrance and surrounding counties have formed an "energy grange" to contract with wind and power line companies .

No one claims the green grid will come easy. Computerized management for renewables will be necessary to supply reliable power flows. Out-of-State grid management is new regulatory turf. The owners of power plants may differ from the owners of transmission lines. "Contract paths" for power flow may differ from actual "physical infrastructure paths." Here's a typical brain teaser: Why would a private company build a new transmission line when it can create high demand on a congested line and raise access rates? How does the energy-system avoid these artificial shortages? Who gets to decide if a renewables power plant should have priority access to the transmission lines? Who will invest in new lines for the green grid in this uncertain world? How much public subsidy for what private investment?

NEW MEXICO GRID
New in-State transmission lines (green) should maximize electrons from wind, solar and geothermal. Not shown are the areas of distributed energy — the most efficient, reliable environmental energy system.



Waste not, want not
Political will, energy efficiency and saving money

DREAM *Every year from now to 2020, New Mexico increases its efficiency in its use of vehcles, heating, cooling, buildings, industries and appliances by two percent annually.*

The quickest and most profitable way to move away from fossil fuels is to use less, or obtain much more work from the same amount of fuel. By not wasting energy, by building an energy efficient world, we can also save money. Energy efficiency bridges to the time when renewable solar and other renewables become cost competitive and distributed energy is widespread. Greenhouse and toxic gases quickly diminish with energy efficiency and reduce power line congestion and blackouts. "Waste not, want not," as Benjamin Franklin told early America. The only missing ingredient is political will.

Every citizen participates directly in this effort. New Mexicans choose: which appliances or cars to purchase; how to heat or cool their home; whether to install weatherization or combined heat-and-power. Governments officials choose whether to build green schools and purchase clean-energy vehicles. There is a return on each investment taken to increase energy efficiency. The dream looks first to the low-hanging fruit and asks: What is the cost to reduce each metric ton of greenhouse gas for each industry?

DREAM *The amount of greenhouse gas reduction (million metric tons of CO_2 equivalent, $MMTCO_2e$) will be balanced by the costs per ton of reduction. Cheaper tons come first.*

OIL AND GAS INDUSTRIES

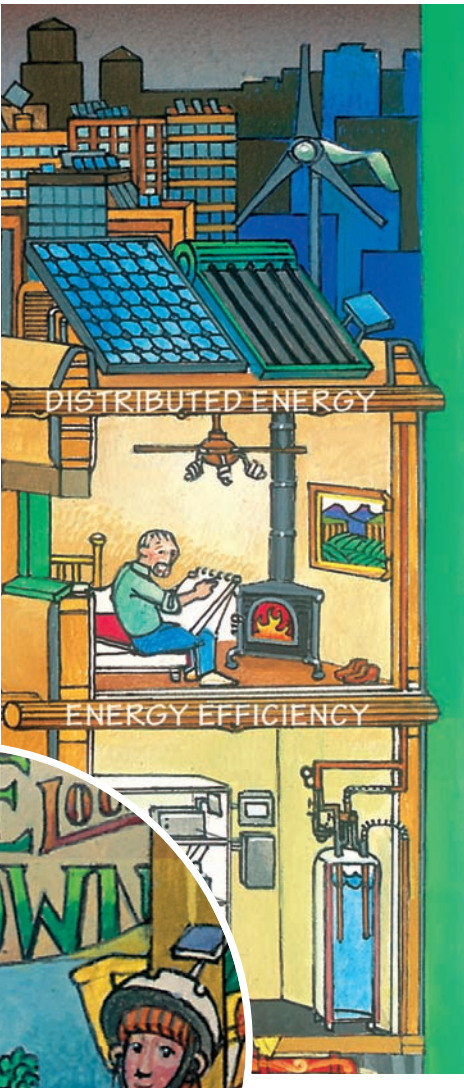
Twenty percent of New Mexico's greenhouse emissions (27 $MMTCO_2e$) come not from making electricity, heating or cooling homes or driving cars, but from mining, extracting and processing fuels: natural gas processing plants, pipe leaks, gas injection plants, fluid-cracking plants and more. The more efficient the industry, the more gas it should have available to sell. But, despite this logic, there seems to be little commitment to efficiency by the oil and gas sector to join in curtailing climate change. The dream — requiring both carrots and sticks — includes effective public monitoring and enforcing a greenhouse gas reduction program.

METHANE

The largest, most effective industry effort to reduce greenhouse gases would focus on the reduction of methane emissions (a natural gas that has more than twenty times the impact of carbon dioxide). During coalbed methane extraction and transport, 36 $MMTCO_2e$ enter the atmosphere. The Climate Change Advisory Committee projected the industry might reduce methane emissions 20% by 2020 on a voluntary basis. Work to raise the stakes is under way. Our dream pushes for 80% reduction.

GREEN BUILDINGS

It may seem surprising, but building construction and remodeling comprise one of the top ten most effective ways to save energy and money. Nationally, buildings consume 67% of all the nation's produced electricity and emit 48% of all its greenhouse gases. Perhaps 17 $MMTCO_2e$ could be saved



by design strategies and on-site renewable power. In New Mexico, the costs of installation and remodeling are quickly recovered and, overall, the owner saves $12 for each ton of CO_2e reduced. Tools to achieve building energy efficiencies include: weatherizing homes and offices, solar-friendly roofs, daylighting, pre-insulated pipes, laws to prevent solar blockage, special landscaping, green materials, designed ventilation, ground-heat storage, smarter home heating management, micro-combined heat and power, Energy Star Programs, and LEED standards. The dream requires mutual enthusiasm for and commitment to the Age of Renewables by contractors, suppliers, county building departments, State legislators, and home buyers.

All buildings should be carbon neutral by 2030.

DREAM *All new buildings and developments are designed to meet greenhouse gas performance standards at 50% reduction of the present New Mexico average for the building type. In any one year, an equal amount of older building square footage will be renovated to meet the same standard established for new buildings. All building should be carbon neutral by 2030 (no greenhouse gas emissions to operate building).*

New Mexico has just begun the initiative with exceptional buildings such as the Rio Grande Conservatory and Edward Gonzales High School, and the passage of an energy efficiency bill. Santa Fe is the home of Architecture 2030, a major driver in changing building codes to curtail climate change.

CLEAN VEHICLES: MORE MILES PER GALLON

DREAM *Increase the number of miles per gallon for all vehicles. Plug-in hybrid dealers believe their vehicles will gross 100 to 150 miles per gallon within fifteen years.*

Transport now emits 10 $MMTCO_2e$ per year. Energy efficiency is one of three prongs in the transportation curtailment strategy for greenhouse gases. (The others are lower-carbon fuel (page 12) and reducing vehicle miles traveled (page 25). How to start? Sell old cars (before 1988) at a subsidized premium, if the owner agrees to buy a clean car replacement. Pass tax policies to encourage accelerated purchase of hybrids and plug-in hybrids. Purchase low greenhouse gas vehicles for use by county and State staffs. The State legislature could also pass legislation that requires tire dealers to offer the same tires that were on your new vehicle — tires that produced greater miles per gallon (the CAFE standard). They are not now available in New Mexico

Tesla Cars in Albuquerque already manufactures an all-electric vehicle — with costs only affordable by movie stars. Nevertheless, when connected to renewables, it is a prototype for the future. By 2020, the dream envisions special parking lot spaces where plugged-in cars earn money feeding the grid during their owner's working hours, and which recharge at cheaper rates at night. The electricity comes from renewables and natural gas.

In 2020, dream truck stops have not only better food but also electrification so that truckers no longer need to idle fossil fuel engines. The trucks have switched to less carbon intense fuels (mixes of biodiesel). Similarly, the State offers incentives for inter-modal freight, switching to railroads when possible.

HIGH VOLTAGE LINES

After about 100 miles, 7.5 percent (or more) of the electrons speeding through power lines are lost as heat. New Mexico probably loses 350 to 600 MW each year from line losses. No one has calculated these greenhouse gas emissions emitted for no purpose at all. The fewer long-distance power lines, the more energy can actually be deployed and the less greenhouse gas emissions per power plant.

DREAM *Higher voltage power lines use direct current (HVDC) that is more efficient. Distribut-*

ed energy replaces most new high voltage lines. Small power lines and 69kV are upgraded.

PUMPING, PURIFYING, AND MOVING WATER

Pumping groundwater for irrigation and pumping water to move it around the State require energy. No one has calculated how many tons of greenhouse gases result from pumping. Santa Fe, for instance, will pump over 8,700 acre-feet of water from the Rio Grande to the city. For ranchers and farmers, the energy/dream is a doable dream. They are rushing to change from imported electricity to on-farm wind and solar — great cost-savers and climate change preventers.

Purifying water also takes energy. The Albuquerque wastewater treatment plant, for instance, receives 54 million gallons per day and extracts the biosolids which, in a bioreactor, generate electricity and heat to save the operation $70,000 per month. Cash and conscience work together.

CONSUMER GOODS

The Federal government sets standards for appliances, and States can make stricter standards only for items not covered. New Mexico does have the ability to encourage coolers (which require less electricity) over air conditioners in the half of the State where they work best. They can encourage new motors, which can save two-thirds of an electric bill. They can encourage solid waste deconstruction and sorting with burnables used for energy. The Climate Change Advisory Group believes that energy efficient light bulbs and other appliances could save 2 $MMTCO_2e$.

LANDS: FARMS, FORESTS, AND URBAN GROWTH

The ecology of climate change can boggle the mind. Forests and rangelands can be sinks for greenhouse gases if they are able to grow. But, in most climate change scenarios, the forests hurt for water, have been stressed by heat, and do not grow very fast. Some simply die or burn, releasing more greenhouse gases.

Ecologists know that land conversion — from forest and range to urban — increases greenhouse gas emissions per acre. With population growth, settlement patterns can be better planned but come with the political difficulties of changing county and State land use policy, which, at times, seem insurmountable. Similarly, organic and no till farming reduce greenhouse gas emissions but, given the soils and climate, how many New Mexican farmers can make the change profitably? The CCAG hopes to achieve a 5% reduction in greenhouse gas emissions by 2020 by changing land use patterns.

DREAM *Good land use patterns reduce vehicle miles traveled by 20–40%. Farming practices receive conversion cost subsidies to lower greenhouse gas emissions. Forest and rangeland managers adopt new policies to adapt to climate change.*

HEAT

When energy users waste electricity or gas, the waste is most often heat. By weatherizing homes, homeowners can save 40% on their bills. Gasoline in our cars produces 85% waste heat and only 15% mechanical energy to make the car move. Hybrids and plug-ins can reduce the waste heat losses by 60%. By placing heat and power in one industrial gadget called a combined heat-and-power (CHP) co-generator, industries can cut greenhouse emissions by two-thirds and save up to 75% on electricity and heating bills. Unknown and not-so-glamorous absorption chillers, on-site space heating, and cogeneration facilities need more PR.

DREAM *Minimize heat loss when there is "waste" heat, and treat it as a resource to do more things.*

New Mexico has a great opportunity to use its geothermal energy to heat and to cool villages, towns and a few small cities. District heating is highly developed in Europe and the breakthrough technology (pre-insulated pipes) saves even more energy and costs. New Mexico can look forward to weaning itself from natural gas and electricity in the geothermal regions of the State.

...quickly move us away from using fossil fuels

The atmosphere, the grid, finance, watersheds and democracy…
Governing the Energy Commons

The State mammal, the black bear, and the State fish, the cutthroat trout, are players in energy governance — in hunting and fishing rules, forest closures and wildlife legislation.

Mayor's climate protection center

Alamagordo, Albuquerque, Capitan, Ruidoso, Las Cruces, Santa Fe and Taos mayors have all agreed to implement the goals of the Kyoto Protocol (7% reduction of GHG by 2012).

Can we dream of a human organization that effectively harvests, produces, transports, and uses low-carbon sources of energy?

IN THIS MODERN URBAN WORLD, energy services call for special forms of governance because delivered energy is crucial to our survival for cooling, heating, refrigeration, cooking and travel. An essential task of governance is deciding on the working rules — and the rules for monitoring and enforcing the rules — for each step of the energy system, from source to use to disposal. New Mexico's energy system has five major "common resources" that all citizens share, if they like it or not, and that need to be governed. The common "energy pools" include: the atmosphere of the planet; the global financial system; the technical components of the energy system, such as the grid; the land and waters within the State; and our commitment to democratic decision-making and honorable ethics. At its best, governance can increase efficiency, lower prices, reduce unintentional harms, show compassion for the most vulnerable, support innovation and prevent disabling conflicts and crises.

DREAM *New Mexicans organize themselves to provide energy (heating and cooling, electricity and transportation fuels) at all stages of the economy (harvest, processing, transport, use, and waste handling) that does no harm to themselves and the environment; and to sell energy services at a fair price and profit.*

To transition to the new energy economy, some projects need to be stopped, others altered, and others invented. Who is allowed to participate in decision-making? Who makes the rules? Who assures transparency? Who monitors, for instance, the release of greenhouse gases? Who is paid to do the energy accounting? Who enforces the standards? Who provides what incentives? As one of hundreds of examples, consider Congressional tax credits in 2007. Congress failed to renew the tax credit for wind, but passed $17 billion dollars in credits for the oil and gas industry for the next five years. Did your Congressional representative vote with the desires of his/her constituency? Rule-making includes the rules for selecting elected vs. appointed officials, open vs. closed meetings, financial reporting, contract conditions and ethical behavior.

DREAM *Affected citizens have a place at the decision-making table — a right to know and an ability to bargain and engage on all aspects of the new energy economy.*

GOVERNING THE ENERGY COMMONS

In New Mexico there are three major investor-owned utilities, twenty cooperatives that are under limited State regulatory authority, and a federal government wholesaler to tribes, military bases and public utilities that is not subject to State regulatory authority. The State, besides the governor and legislature, supports a half-dozen crucial decision-making bodies. The 33 counties largely decide on energy-related planning and building codes (within State laws).

There are three regional and over a dozen federal agencies (besides Congress) involved in energy regulation and development. Governance has become baroquely complex and irritating. Harmonious governance of our common "energy pools" is perhaps the hardest and most difficult barrier to the dream of an Age of Renewables.

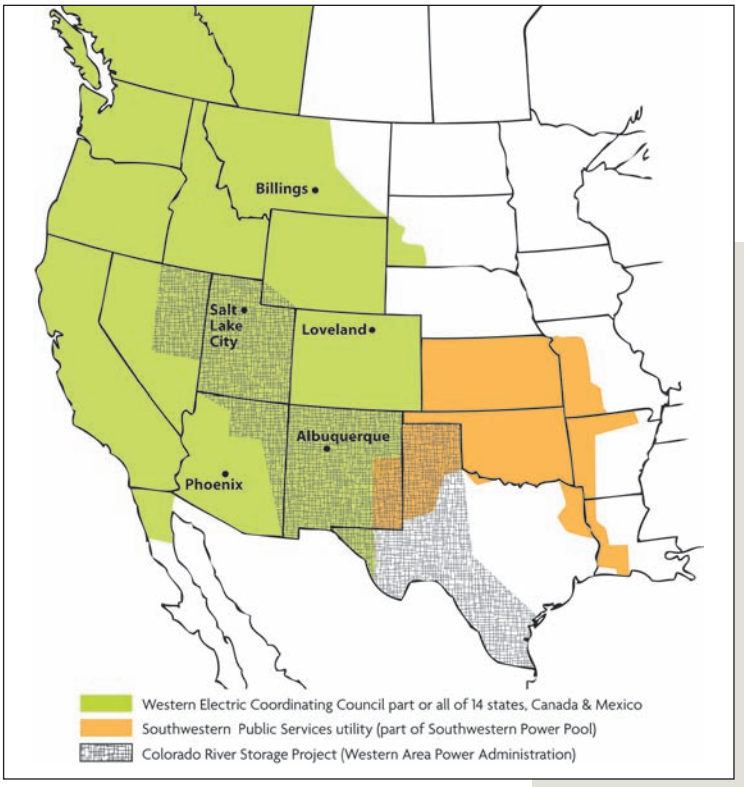
THE BIOSPHERE COMMONS OF THE PLANET

Greenhouse gas and toxic emissions are volatile and they cross State, national, and ocean boundaries. There is only one Earth, and this planetary commons seems to ask: How on Earth are we going to live harmoniously together? The management of greenhouse gases requires new working rules.

DREAM *Each State and nation accepts its fair share in the task of reducing greenhouse gases. The investor-owned utilities, public utilities, cooperatives, tribal authorities, federal agencies and military in New Mexico collaborate to actively pursue the reduction of greenhouse gases.*

New Mexico asks: What is our fair share? Given other States and nations, how many tons of greenhouse gases, can we emit into, remove and prevent from entering the biosphere? Is it a fair share compared to New Mexico and Arizona, Nevada, California and Utah? Should we measure emissions by the amount consumed? produced? per capita or Statewide?

New Mexico has joined the Western Governors Alliance to figure out equitable accounting. The State government has joined the Chicago Carbon Exchange to find market mechanisms to calibrate responsibilities. California laws require new New Mexican electricity contracts to meet air quality standards equivalent to low carbon combined-cycle natural gas plants. Is California's "imperial demand" fair? Florida has purchased wind power in New Mexico to offset its greenhouse gas emissions. Is this a case of double-accounting in which two States both claim greenhouse gas reduction credits? Who gets to decide?



REGIONAL GOVERNANCE
New Mexico has three regional "governors" of energy: Western Area Power Administration governs hydropower from the Colorado; the Western Electric Coordinating Council governs the Western grid; and the the Southwest Power Pool governs the Eastern grid.

OUR COMMON FUEL, LAND AND WATER WEALTH

All energy development makes a footprint on the land and waters of New Mexico. Governance includes a dialog between property owners and energy providers. Who makes the working rules that limit or extend the footprint? Almost all energy enterprises impact both private and public lands and water—wind farms, rights-of-way for power lines, cooling waters for coal or solar thermal.

The federal government owns about one-third of all New Mexico, including many places with both "old" and "new" resources (especially geothermal and wind). These are owned "in common" by all US citizens. The State government owns 12% of the land, also with many old and new resources. Native American tribes own a little less than 10% of New Mexico and have major uranium and coal deposits as well as solar and wind potential. Private land covers about 44% of the State, but private owners do not necessarily own the mineral and energy resources beneath the surface of "their" land. Gas and oil exploration can and does occur on private lands, even if the property owner objects.

New Mexico's energy governance

Almost every decision requires input from multiple layers of energy governance:

Investor-owned utilities: El Paso Electric, Public Service Resources' subsidiary Public Service of NM (PNM), and Xcel's Southwest Public Service serve about 70 percent of the electricity in-State customers.

Cooperatives: Twenty rural electric cooperatives cover about 85 percent of New Mexico's land area, and serve about 22 percent of customers. Tri-State Co-op and Transmission Association supplies wholesale electricity to 13 co-ops; Xcel supplies four.

Government utilities: The remaining eight percent comes through municipal, tribal and military utilities, mostly hydropower from the Colorado River "wheeled" by the Western Area Power Administration.

State governance: The State legislature makes laws. The Governor can hand down executive orders. The Renewable Energy Transmission Authority can organize the grid and float bonds to pay for them. The Public Regulation Commission can pass rulings and review protests concerning rates and other aspects of energy development and services. The Environmental Improvement Board can look at impacts of the energy business. The State Lands Commission leases for energy development. Other agencies work with health, water, poverty and other issues that interact with energy policies.

County governance: Counties have a strong influence of building codes, planning and zoning that can encourage efficiency, smart growth, transit-oriented development, agricultural and open space land, and distributed energy.

Regional governance: New Mexico belongs to three regional "governors" of electricity. The Western Area Power Administration governs who gets what in New Mexico 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 New Mexico. The North American Reliability Corporation oversees WECC.

Federal governance: The Federal Energy Regulatory Commission can determine where inter-State transmission lines must go as well as what it considers fair utilities pricing. Congress, through its laws (e.g., Energy Policy Act, National Environmental Policy Act, Clean Air Act) governs how and what gets built. Land use agencies can encourage or discourage biomass, wind and solar development. The Securities and Exchange Commission oversees financial integrity of public companies.

Other National and Global: The Chicago Carbon Exchange coordinates carbon credits nationally. The Kyoto Agreement influences the actions of all levels of government.

New Mexico energy: the working rules

To see rules, regulations and policies that create incentives for renewables and energy efficient building, interconnection, green power options, net metering, renewable portfolio standard, solar access law, alternative fuel and vehicle policies and more go to: www.dsireusa.org and enter New Mexico.

DREAM *A minimal human footprint reduces the land and waters disturbed from energy development. The footprint maximizes human desire for health, beauty, working landscapes and future generations.*

DREAM *State and federal lands are leased only for renewable generation, supplemented with natural gas leases in these transition times.*

OUR ENERGY COMMONS: INFRASTRUCTURE

New Mexico has: tens of thousands of miles of transmission lines and natural gas pipes; over a dozen large-scale power generators; and thousands of miles of federal highways, State roads, county/neighborhood streets, private and publicly-owned train tracks, and a dozen airports. These infrastructures are shared by all energy users (sometimes, ambiguously called "public works"), yet only a few make decisions about how their future should be designed.

DREAM *From power line to bread toaster, all governing orgnanizations encourage components of the energy system to use electrons most efficiently, to power themselves with the least carbon-emissions, and to do the least collateral damage. The configuration of these components into the energy web favors distributed energy and local and renewable sources as the highest and best design.*

A major decision in the new energy economy is the location of transmission lines or, asking the question: "Are they needed?" The private sector could intervene and establish islands of micropowers that reduce the need for more high-voltage lines. Cities could intervene and build neighboring wind and solar farms ("energy parks") that also eliminate the need for long-distance power. Government agencies, predominantly staffed by appointed officials, could open up to more public influence over power line sighting. To avoid chaos, all these levels of government need to coordinate.

An even harder task for governance is transit-friendly development rules ("smart growth" communities) which require building codes, infrastructure regulations from the county planning and zoning departments, and cooperation among dozens of agencies.

DREAM *Optimize the settlement patterns for towns and cities (their buildings, roads, railroads, farm-to-city freight) to reduce greenhouse gas emissions.*

In New Mexico, governance takes on added meaning when one investor-owned utility holds monopoly control, as PNM does, over access and delivery of gas for heating or electricity infrastructure. It takes on further urgency when the public desires to accelerate a change in a utility in order to reduce greenhouse gas emissions and those changes may also hurt the utility's bottom line. On the other hand, New Mexico has six public utilities that all can benefit from tax-free borrowing on bonds and loans, cheap hydropower from federal dams, small executive salaries and no dividend payments to stockholders. They (and newly formed aggregators of distributed energy) may be in a better position to manifest the renewables dream.

DREAM *Citizens have the ability to choose whether a regulated monopoly, rural cooperative, aggregated distributed energy coop or public utility is best suited to address the issues resulting from climate change.*

OUR GRAND GLOBAL FINANCIAL COMMONS

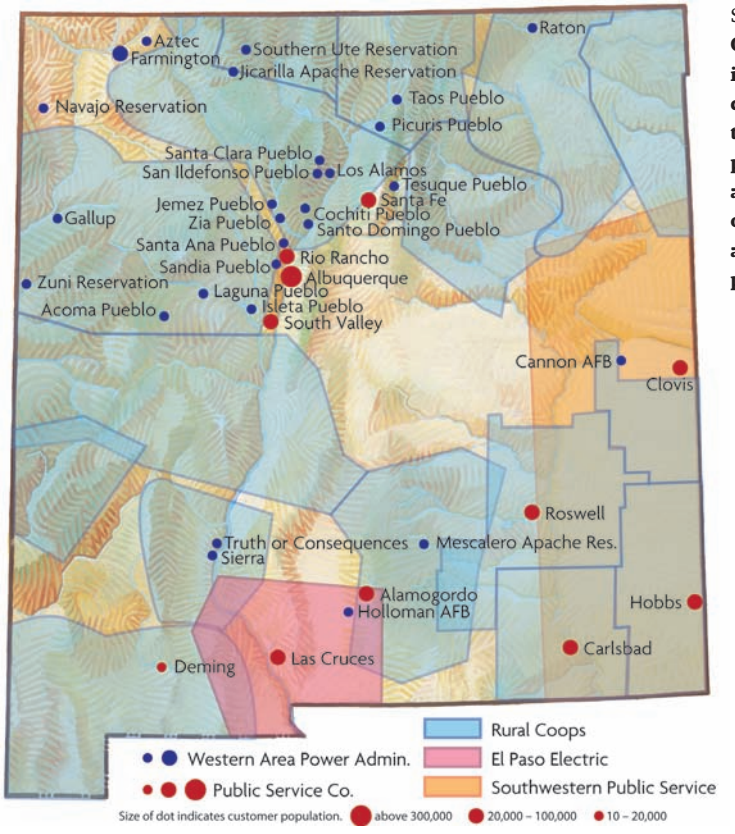
Rules of finance — and ultimately monetary policy — bring all citizens into the cashflow commons. Almost all energy-delivery services combine public and private finance: federal and State taxpayers, private investors, government grants, stock market shareholders, private or public funded bonds and other secuirties.

DREAM *Financial investments align with renewables, energy efficiency and distributed energy.*

THE "ETHICAL" COMMONS: GOOD GOVERNANCE OF ENERGY

As much as energy resources, our ethical resources carry human energy. Native American and Hispanic citizens of New Mexico honor their power spots (sacred places), that help re-energize one's faith to say good words, think kind thoughts, and practice good works. Today the ethical commons also resides in schools, religious traditions and houses of worship, media, and conversations in the workplace and home. Ethics tries to find a place of integrity within the temptations of the business world. The foundation of the Age of Renewables politics is a common passionate ethic to heal the atmosphere and the harms of climate change.

DREAM *New Mexican utilities and government agencies provide organizational transparency and strong anti-corruption rules, encourage citizens to participate in energy-system operations and future planning, and help educate through schools, churches and businesses.*



STATE GOVERNANCE

Our dream has the three investor-owned utilities, 20 cooperatives and municipal, tribal and military utilities provide renewable energy at reasonable prices with organizational transparency and customer/shareholder participation.

Renewables education in New Mexico

To transform the energy commons, New Mexico needs a new workforce. The "green collar" jobs include new skills for: constructing, fixing and operating solar and wind generators; building and retrofitting energy-efficient houses; monitoring greenhouse gases; running co-generation plants; and installing new kinds of distribution lines and meters.

Already, Advent, Schott and Emcore have centered their solar energy production in Albuquerque, and Tesla operates a factory to manufacture all-electric cars.

The only school in the nation to train technicians in wind power is at Mesalands Community College in Tucumcari . San Juan Community College (Farmington) has a solar PV technician program. Northern New Mexico College in Española is creating a new BA and MA curriculum for mechanical engineering, focused on solar and storage technologies.

Dozens of organizations (including *Dreaming New Mexico*) are producing educational materials for schools on energy efficiency, distributed and renewable energy, smart growth, low-carbon farming, and new transportation systems.

The interfaith community has embraced the conversation about faith, good works, creation care, and energy security.

***Education, governance* and *political will* are almost identical words for an Age of Renewables.**

Cash flows and energy flows always entangle

The Restoration Economy will heal the atmosphere

"Socialized" costs

New Mexico (and the US) have never had a coherent policy on how much the costs of energy should come from public coffers. How much of energy production, transport, processing, use and waste handling should be at taxpayer expense? Nuclear power is the most "socialized" of all energy production, enjoying the largest energy subsidies in US history at almost every step from mine to waste burial. Oil and gas receive huge tax breaks — regardless of market price. Public financing must place renewables on a level playing field wtih fossil fuels and nuclear power.

A Restoration Economy reshapes fiscal policy and financing to help return our damaged atmosphere and lands and waters to its earlier state of health — a time of fewer greenhouse gases and volatile toxics, a time when climatic change was more predictable and less cruel. Restoring the atmosphere capitalizes on the expertise and imagination of environmentally friendly industries (like renewables manufacturers), businesses, venture capitalists, well-targeted public funding and incentives, new and quality jobs, economic development with multiple benefits (such as geothermal greenhouses-spas-and-heating), and educated citizens who purchase goods and services that curtail greenhouse gas emissions. It also succeeds when bank bonds, loans and investors direct their cash to renewables, energy efficiency appliances and equipment, and smart computer software for distributed energy.

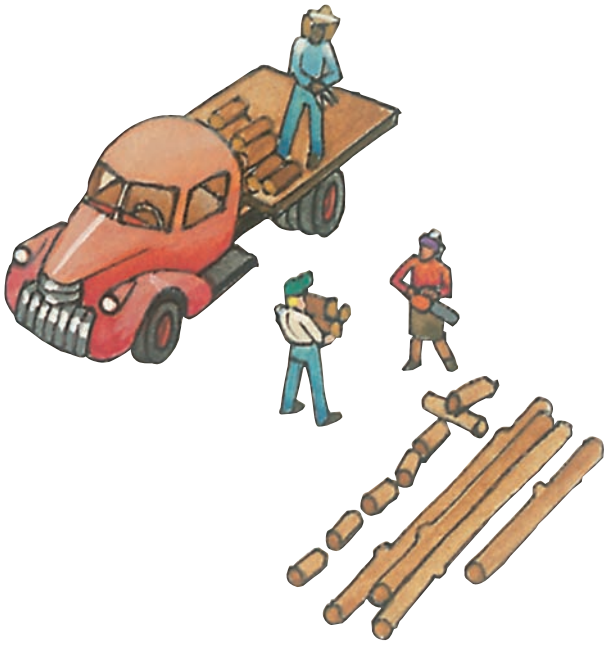
Aligning prices in the Age of Renewables may be the most complex undertaking ever attempted by humans.

DREAM *The market and regulatory framework quickly level the playing field between the old system (centralized fossil fuel feeding superhighway transmission lines) and the new (renewables, energy efficiency, and distributed energy).*

How to accomplish this dream may be the most complex undertaking humans have ever attempted. Transmission lines, for instance, were never designed for competitive pricing nor for distributed energy. In areas with congested lines, the power line owner can raise access charges and demand higher prices. There is no competition or incentive to upgrade or build new lines. Or, if two power line companies merge, the price to the customer may skyrocket because the merged company averages costs of the two service areas. If the acquired service area has higher costs, the old customers pay more for electricity that they never receive. This amazingly intricate complex of cash flows and energy flows can bewilder even experts.

New Mexico's dream envisions:

- accelerated market penetration of renewables, energy efficiency and distributed energy;
- assistance to local businesses to help them enter emerging green energy markets;
- shrinking price margins between fossil fuels and renewable power generation;
- tax structures that benefit renewable technologies and, once established, treat all power and heat technologies equally;
- private and public investment (subsidies, tax breaks, loan guarantees) that spur large wind and solar farms for energy export and replace coal-fired generation and gasoline-powered vehicles;
- local "aggregators" who finance micropowers and microgrids, and negotiate fair contracts with Big Grid owners and operators;
- rate structures that favor energy efficiency, not more profits for more electrons sold.



The market, by itself, cannot shift to the Restoration Economy. Energy is too important to allow wild price swings, the manipulation of prices by traders or accountants (Enron), or the burdening of innocent customers with "inherited" or "stranded" costs from bad investments, mergers, previous mismanagement and unanticipated bills (e.g., decommissioning nuclear power plants). The restoration of the atmosphere — and the lands and waters damaged by the fossil fuel and uranium economies — requires public oversight as well as public funding.

DREAM *Accounting is transparent to prevent market manipulation and artificial shortages. Customers and tax payers pay for what they receive — with no burdens of stranded, inherited, or mismanagement costs.*

CONVERSION COSTS

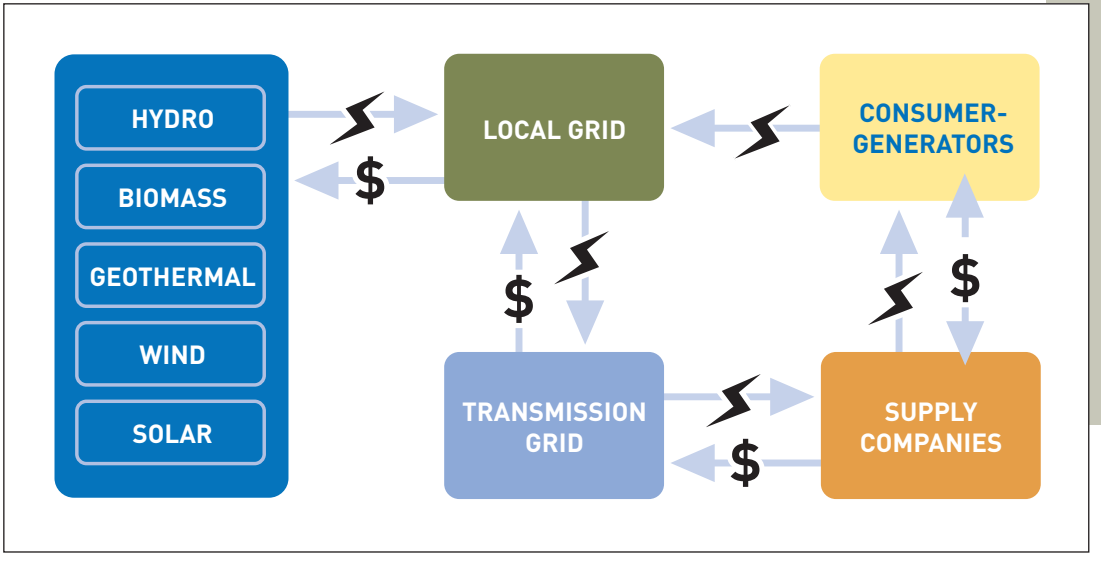
New Mexico's economy and fiscal rules have been shaped by a century of fossil fuels. Major amounts of greenhouse gases come from the oil, gas and coal industries. Taxes on these industries contribute to the State coffers and have become crucial to financing public education.

No one is quite sure who should pay how much for the transition to an energy system of renewables, distributed energy, and energy efficiency. State and federal governments have initiated production tax credits, accelerated depreciation, and other benefits such as green tags and renewable energy certificates. These types of credits are crucial to investors and local businesses. Investors dream not just of the kind of power generator, but of a stable investment climate, a reasonable rate of return, and a clear contract. Congress has treated tax incen-

Green collar jobs

Green collar jobs are good jobs with health insurance, benefits, meaningful work and job staisfaction. One study says that wind energy in New Mexico could provide 20,000 construction jobs for large-scale wind projects with 52,000 jobs in operation and maintenance over 20 years, yielding an income of $6.4 billion. Another study estimates 6,000 jobs from occupations related to energy efficiency. The full blossoming of the Age of Renewables holds thousands more jobs for re-metering and re-conductoring the microgrids, residential retrofits, green building and energy efficiency as well as large and small solar manufacturing (already over 600 jobs in three companies).

THE NEW ENERGY ECONOMY **Two big changes are (1) nearby "renewable energy parks" (left column) that feed the local grid, and (2) consumers who are also generators of renewable electricity from their homes, businesses and vehicles. The consumer-generator feeds the local grid and receives credits or payments from the supply company.**

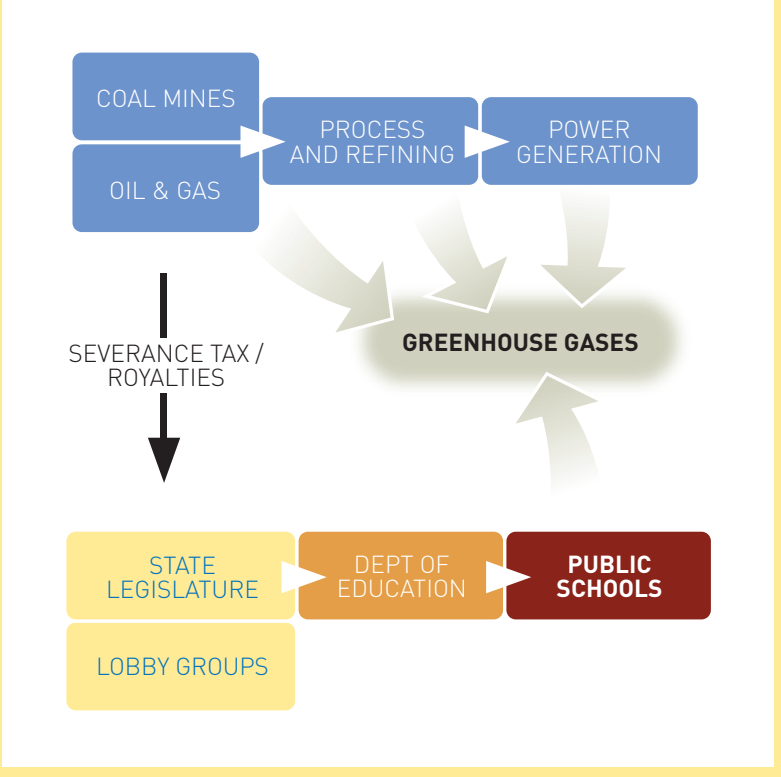


tives in a fickle manner — here one year and gone the next. Congress has long awarded the fossil fuel and nuclear industries with tax breaks on a scale unavailable to renewables.

Fossil fuel taxes and public schools

After State sales taxes, the fossil fuel energy sector is the second largest contributor to the State's coffers. Oil and gas account for 90% of all extractive industry revenues. The coffer can lose or gain $100 million or more in any year with changes in oil and gas prices. In 2001, $330 million of the oil and gas severance tax went to the public school system. As crude petroleum decreases (as it has since the 1970s), the tax burden shifts to coal seam methane gas production. The future is unclear. The public schools could suffer from tax breaks for the fossil fuel industries to improve their environmental performance, carbon emissions taxes, lower production rates, world prices, or other environmental costs. Transitioning to the Age of Renewables requires skillfully revising the tax codes.

The flow chart outlines the complex entanglement of cash flows, energy flows and human participants. Elected legislators, citizen and business lobbyists, state agency personnel, fossil fuel suppliers and utility gifts to political campaigns — all influence the funds available to public education.



DREAM *Public tax funds help support the conversion to the new energy economy. Production tax credits and similar financial instruments balance market price and start-up needs. Conversion costs — such as stability charges — have sunset clauses to encourage utilities and coops to incorporate the new energy system into their normal accounts.*

DREAM *Incubator technologies have public funding for research, development, demonstration and deployment. No established technology receives more subsidies and/or accelerated depreciation than another.*

TAX AND RATE STRUCTURES

Fuel harvesters, power generators, investor-owned utilities, traders and other private sector players have earned greater profits by selling more and more electricity, gas and fuel. The more sold, the greater the profits. This rate structure has discouraged energy efficiency. If households can save money by energy efficiency, they have reduced their percentage of income going to home operations costs and can spend it on other items. There is a need to change financial policy. In the dream, the more work per kwh or miles per gallon or BTUs per cubic foot of natural gas, the more profitable. "Performance-based" rate structures and time-of-day pricing have jump-started the shift. But utilities concerned with fixed costs and lost revenue have protested. In New Mexico, some bills contain "conservation surcharges" and "stability charges." In other words, the customer is a good citizen (saves energy and greenhouse gas emissions) but also pays extra for his/her actions.

DREAM *Consumer bills go down when consumers conserve energy and improve energy efficiency.*

DISTRIBUTED ENERGY

Power markets do not justly reward distributed energy for their contributions to affordable energy and reduction of greenhouse gas emissions. Distributed energy, for instance, has very low

Incorporating renewables, energy efficiency and distributed energy into our lives is not a sacrifice but a celebration of interdependence.

delivery costs. Long-distance delivery from central power plants adds about 20 percent to your energy bill. To be justly rewarded, the markets must be restructured or distributed energy owners must "aggregate" so that they are large enough to meet entrance requirements into the market system.

Distributed energy may require: tax credits or exemptions to encourage the purchaser to buy on-site renewables and install two-way meters; incentives and assurances of cost recovery for utilities that invest in customer-owned renewable energy; and research and development funds to help new technologies such as load-sharing computer software for smart substations. Financial tools including "load ordering" favor financial rewards for renewables over non-renewables. Load ordering can require a utility to give preference to distributed energy.

DREAM *Financing in high-growth areas such as Las Cruces and Albuquerque establishes the first aggregated micropower/microgrid complexes, two-way metering, and accommodations for rooftop renewables.*

NO FINANCIAL INCENTIVES FOR GREENHOUSE GAS EMISSIONS

When Sithe Global, a New York-based multinational, and the Navajo Nation asked the State of New Mexico for an $85 million tax credit to build a new coal-fired power plant, many legislators and citizens thought this was the wrong direction. The plant would emit so many metric tons of greenhouse gases that the Climate Change Advisory Group's reduction goals would become unachievable. The tax credit died in committee after a tough fight.

This tax incentive, called a "perverse incentive," illustrates the close ties of politics and economics. There are many perverse incentives shaped by the fossil fuel era. The Natural Gas Processors Tax, for instance, is based on the number of BTUs entering the processing plant. Processors gain deductions for gas lost to flaring or lost through plant malfunction. They are rewarded financially for increasing greenhouse gas emissions and wasting energy.

Positive incentives move the dream faster. But, if there is insufficient cooperation between the private and public sectors, then disincentives (the punishing sticks) must be considered. Typical disincentives include steep fines for emitting too many toxic chemicals from smokestacks, polluting groundwater or blocking someone else's solar access. This tool, while not preferred, may be all that is effective. A carbon tax, for instance, punishes those with higher greenhouse gas emissions and may raise electric bills so much that customers rebel and oppose all actions to curtail climate change. Balancing cash and conscience takes the dream another step, to the doable dream.

This short pamphlet cannot comprehensively review all the opportunities to stimulate the restoration economy and reduce greenhouse gases. We know that simple tools such as better energy labels can be very effective, or recycling aluminum cans which eliminates all the greenhouse gases required for mining and processing ore. The message is simple: New Mexicans do not have to sacrifice their comforts and can even achieve more disposable income by thoughtfully incorporating energy efficiency, renewables, and distributive energy into their lives.

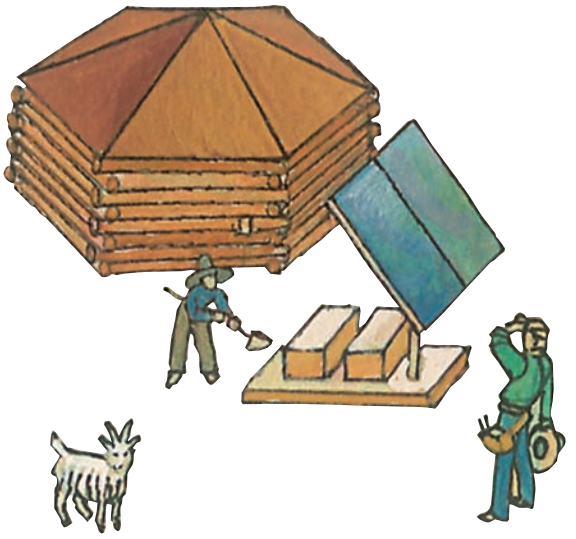
New Mexico's electricity rates (2007):

9.2 cents per kwh (residential), 7.86 cents (commercial), 6.02 cents (industrial).

Research

New Mexico benefits from America's wealth through federal financing of new technologies. Technological innovation and testing occurs at Sandia and Los Alamos National Labs and at colleges such as the community colleges in Española and Tucumcari and universities (e.g., UNM's Alliance for a Carbon-Neutral Foodshed). New Mexico has a great opportunity of moving from nuclear to renewables research, development, demonstration and deployment, as well as to innovative grid management software, composite conductors and capacitors.

Compassionate rules for the most vulnerable: Environmental justice



Personal health, environmental welfare and energy security cannot be compromised.

DESERT ROCK

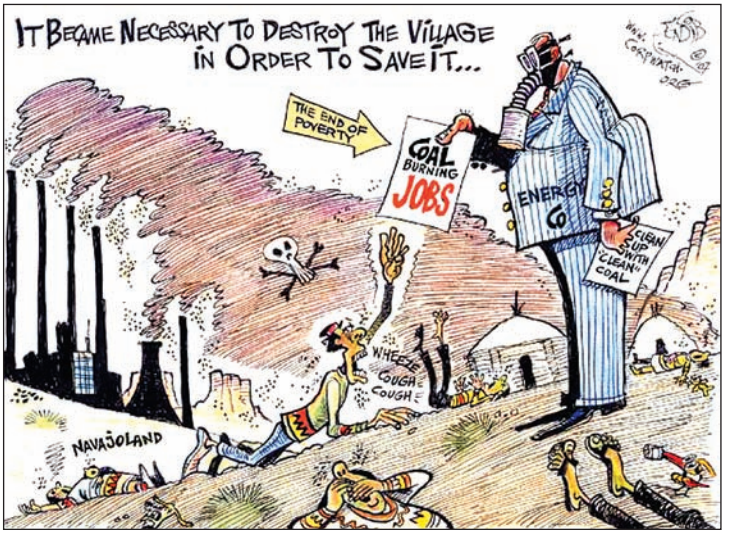
New Mexico's most contentious energy decision is whether to construct a new coal-fired power plant at Desert Rock, which is on Navajo nation land. New Mexico State government has tried to discourage its construction which would undermine the State's plan to reduce greenouse gas emissions by 2020. The Navajo people are divided.

SOME PUT CASHFLOWS FIRST, others their comfort. Environmental justice (EJ) puts compassionate working rules for the most vulnerable at the top of its agenda. Environmental justice seeks rules for those whose electricity may be cut off because they cannot afford to pay, or strives to deliver food to elders or isolated families who cannot afford trasnsportation. EJ works to set standards and rules to align energy development with the health, security, and environmental welfare of affected communities.

ENERGY AND POVERTY

DREAM *Every family obtains and maintains utility services or is supplied with off-grid energy; and every family whose bills exceed its ability to pay, knows and can take advantage of a safety net.*

DREAM *To achieve affordable utility rates, governments and utilities help low-income homes with energy efficiency costs, which also reduce greenhouse gas emissions.*



Most New Mexicans spend four percent of their income on utility bills. Because New Mexico is the lowest income earner in the nation, about one in five families spends 20% of its income for electricity or gas. In addition, over 10,000 New Mexicans, mostly Native American, have no electricity. The lack of electricity and gas for heating or cooling can be life threatening.

Energy affordability is a key component of housing affordability. These twin barriers require funding to assist low-income households. The EJ movement lobbies to make energy bills more affordable through energy efficiency, fair rates and strong consumer protection. Energy efficiency is the best long-term solution to unaffordable bills and it has the perq of reducing greenhouse gases. The task is large but achievable — about 40,000 homes cannot afford weatherization. (The legislature currently provides some funds for low-income home weatherization and laws prohibit shutting off electricity or gas because of an inability to pay. The State requires utilities to enter into reasonable payment plans.) Groups like Community Action of New Mexico lobby for energy efficiency codes for all low-income housing developments (wherever public dollars contribute to the development).

Urban sprawl also penalizes lower income families. Home and work may be distant, causing both increased gas expense and greenhouse gas emissions per capita. The working rules for transit-designed communities are a dream not yet realized in New Mexico. How to design the change?

ENERGY DEVELOPMENT IMPACTS

DREAM *New Mexico heals past and continuing harms that came from the fossil fuel and uranium economies (mine tailings, groundwater pollution and erosion).*

The legacy of coal, oil/gas and uranium is more nightmare than dream. Many Navajos have suffered energy-related health harms from ura-

nium mining. The Navajo Nation has banned all new uranium mining and leaching. Now, it struggles against leaching of uranium on adjacent non-Indian lands that may impact the Nation's groundwater.

To increase family income, the poor — especially in Mora, Chama and Rio Arriba Counties — are vulnerable to predatory contracts for oil and gas leases. The leases provide no protection from toxic and carcinogenic emissions, and no method to ensure land reclamation if the well is dry. EJ fights for working rules ("best practices") in all oil and gas leases to ensure health, safety and income during the multi-decade transition to renewables.

The legacy of oil, gas and uranium has left New Mexico with five energy-related superfund sites: Albuquerque (railroads); Lee Acres, South Valley and Prewitt (petroleum wastes); and United Nuclear (uranium mill wastes). Although rules exist, these sites are examples of how implementation can be subverted by lack of funding.

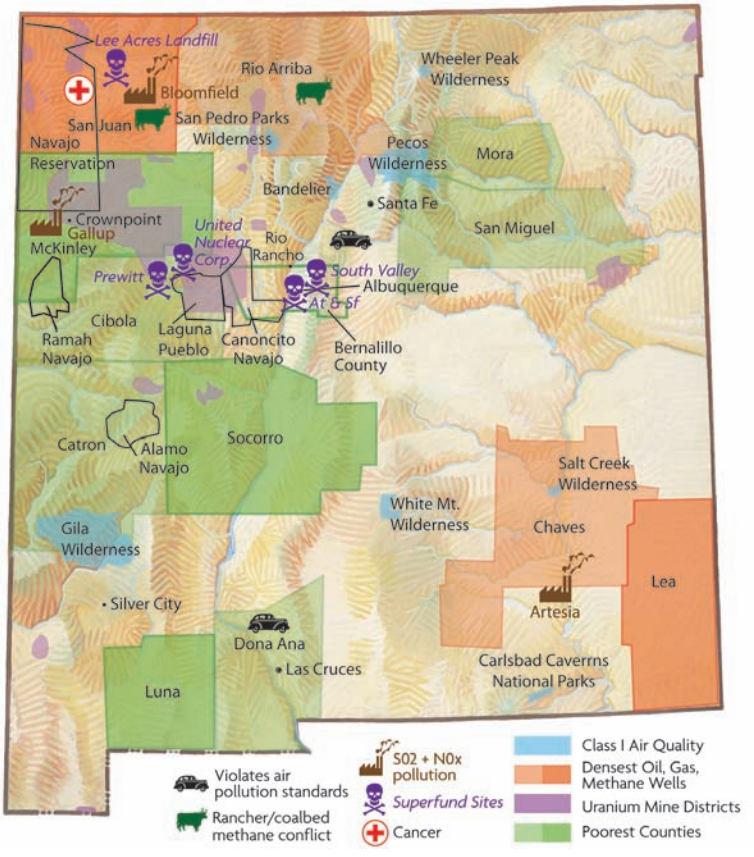
Pollutants from power plants, combusted coal piles, petroleum refineries and heavy traffic harm human health (SO_2, NOx, heavy metals, benzene, toluene as well as radioactive particles from coal-fired power plants). Bernalillo and San Juan counties have the State's worst air quality. The two coal-fired generating plants near Four Corners rank in the top 50 dirtiest in the US (for both greenhouse gases and mercury). Coal- and gas-rich San Juan county experiences New Mexico's highest rates of cancer. The dust from already combusted coal appears to be an additional contributor to global warming, but is unregulated. Who creates and enforces pollutant standards in an energy-system commons, where influence by low-income workers is limited?

DREAM *All energy extraction, processing, transport, use and waste disposal follow rules that keep these activities from harming the citizens, lands and waters of New Mexico. The energy system does not burden this and future generations with costly clean-up costs and legal and health expenditures.*

Social equity is seldom straightforward. Poor working conditions or not, a job is a job. In San Juan county, for instance, conscience and cash duke it out: Hold down a job, even if it hurts your health. The Navajo Nation's council chooses jobs over health and greenhouse gas emissions. It supports Desert Rock, a proposed coal-fired power plant, which many of the Nation's members fiercely seek to stop.

The federal Mining Act of 1872 is the clearest example in NM and the nation of the need to alter archaic rules. It allows oil/gas companies to enter private property to explore and extract fuels. Surface owners cannot prevent "trespass" and may not be able to stop destruction of the surface features of their land. This "split estate" rule threatens the livelihood of ranchers in northwest New Mexico and the future vision of Galisteo basin. These injustices are not related to ethnic group or poverty, but to obsolete laws. The commons, in this case, includes Congress, which is the only decision-maker that can change the working rules.

HOUSEHOLD POLLUTANTS **Especially in San Juan County, homes sit too close to natural gas and coal infrastructure. San Juan has the highest cancer rates in New Mexico.** Source: NRDC



ENVIRONMENTAL JUSTICE
EJ works to stop the health impacts of energy development (mines, gas wells, cars); to prevent vulnerable citizens from losing their electric power; to help them with weatherization and energy efficiency; and to minimize energy development's footprint on New Mexico's lands and waters.

DREAMING NEW MEXICO

WWW.DREAMINGNEWMEXICO.ORG

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

Dreaming the future can create the future...

Revolution from the Heart of Nature

BIONEERS

A Bioneers Collaborative Project (www.dreamingnewmexico.org)

The *Dreaming New Mexico* project seeks to reconcile nature and cultures at a State level with pragmatic and visionary solutions, using systemic approaches that address our most pressing ecological and societal challenges.

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.

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THIS MAP AND PAMPHLET are the products of many wise and generous citizens of New Mexico. Deep thanks to our DNM partners John Fogarty (New Energy Economy and 1Sky) for exceptional insights and vision, and Eli Lee and the staff of the Center for Civic Policy for important political perspectives. Norty Kalishman of the McCune Charitable Foundation was a crucial advisor, collaborator and convener. Special thanks to former Bioneers President Ginny McGinn, who ardently supported Dreaming New Mexico at its seed stage, as well as to Executive Team (Peter Mattair, Nina Simons, Jill van Nortwick).

Special thanks for research, advice and exceptional knowledge to John Fogarty (energy and health), Charles Bensinger (biofuels), Jim Witcher (geothermal), Ben Luce (solar, grid, policy), David Griscom (wind, grid, policy), Tom Singer (policy), Gail Ryba (energy efficiency/policy), and Erik Schlenker-Goodrich (environmental justice).

The following groups and individuals helped us develop this project and keep the New Mexican spirit thriving:

Regenesis (especially Ben Haggard and Shannon Murphy), Castor Armijo (Sacred Power), Ernest Atencio (environmental justice), Dolph Barnhouse (1000 Friends of New Mexico), Colorado College (State of the Rockies Report Card), Consuelo Bokum, Joan Brown, Jeff Burks (PNM Resources), Gay Dillingham (Environmental Improvement Board), Bob Gough (tribal energy), Diana Hadley, Ken Hughes (NM Department of Finance and Administration), Richard Kamp (E-Tech International), Kegan King (green jobs), Sharon Leach, Jivan Lee (CCP), Leanne Leith (NM Conservation Voters Alliance), Amory Lovins (Rocky Mountain Institute), Tom Luebben, Bob Mang (New Voices of Business), Rebecca Moore (Google Outreach), James Palmer (NRG Engineering), Elizer Pena (NMDOT), Arturo Sandoval (Voces), Karma Shore (Bureau of Business and Economic Development), Nina Simons (Bioneers), Robert Stang, Robb Thomson (NM Conference of Churches).

Very special gratitude to the funders who shared and helped evolve *Dreaming New Mexico*: AEPOCH, Angelica Foundation, Blackstone Ranch Institute, The Christensen Foundation, Civil Society Institute, Art Gardenswartz and Sonya Priestly, Garfield Foundation, Google.org Fund of Tides Foundation, LIVINGRY Fund of Tides Foundation, on the recommendation of Gay Dillingham and Andrew Ungerleider, Lumpkin Family Foundation, MAC Fund at The Pittsburgh Foundation, McCune Charitable Foundation, Panta Rhea Foundation and Effie Westervelt.

To purchase the poster map and pamphlet:

Visit www.dreamingnewmexico.org or call 1-877-BIONEER (246-6337) to speak to a live human being. More information and downloadable maps at: www.dreamingnewmexico.org

DREAMING NEW MEXICO

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