Chapter 9

SUMMARY AND CONCLUSIONS

Texas' vast size, abundant resources, favorable business and political climates, and innovative, hard working citizens have helped to make Texas a national and international leader when it comes to energy. Texas leads all other states in both the production and consumption of energy. Its leads the states in both oil and gas production[2] and is the nation's leading refining state with more than one fourth of U.S. oil refining capacity. The Texas power grid, which serves most of the State, is one of only three power grids in the continental United States and has served as a national and international model for transitioning to a competitive retail environment.

To a large extent, Texas' native energy resources and the success of industries built around them fueled Texas' population and economic growth for the past hundred years. They have enabled the state to play a large role in shaping national and even international energy policies, in part because Texas is disproportionately impacted by the effects of those policies.

As with fossil fuels, Texas is fortunate to contain a large and disproportionate share of the nation's renewable energy resources. Among the contiguous 48 states, Texas has the highest potential for generating renewable energy from its solar, wind, biomass and geothermal resources.[3] Furthermore, these available renewable energy resources are almost entirely untapped.

As of September 2008, Texas had 5,871 MW of installed wind capacity;[1] more than double that of California, the state with the next highest level of installed capacity. But Texas' installed wind capacity comprises only about 4 percent of the state's estimated developable wind capacity, so there is plenty of potential for additional growth.[4] The same is true for Texas' other renewable energy resources including solar, biomass, and geothermal. Of the state's enormous developable solar and geothermal capacity, Texas has only begun to scratch the surface with large-scale and small-scale, distributed projects developed to date.

Texas possesses current energy demand and future growth rates that suggest the need to encourage development of the state's renewable energy resources. This fact is significant as new energy facilities, renewable or otherwise, will be constructed most rapidly in the context of declining fossil fuel production and a large, growing economy.

Looking ahead, renewable energy represents a real opportunity for Texas to leverage its hard-earned energy knowledge, leadership, and proven track record well into the next century, to meet its own – and the nation's – energy needs, and to maintain its leadership role in shaping the energy policies of the future.

But this will not happen automatically. Capitalizing on the opportunities presented by Texas' renewable energy resources will require careful consideration of the technical, political, economic and regulatory landscapes on which all energy development projects depend. It will require consideration of long-term strategies, formulation of shorter-term priorities, and identification and removal of barriers to development, all of which have the potential to affect the eventual outcome.

Renewable Energy has many advantages, but cannot and will not solve all of Texas', our country's, or the world's energy problems on its own. Certainly, renewable resources have an important role to play within the context of a diverse, stable energy supply, which includes consideration of all available fuels and of the benefits, costs and consequences of each. All in all, however, renewable energy resources are certain to play a LARGE AND growing role in the next century, a role in which Texas is well-positioned to lead.

Other chapters of this report have presented detailed information about Texas' renewable energy resources – solar, wind, biomass, geothermal, water, and efficiency – and have presented specific recommendations pertaining to those resources. This chapter synthesizes common themes and presents additional contextual information applicable to all resource types. It is structured around these main themes:

- Accommodating Intermittency
- Delivering Renewable Energy to Markets
- Valuing Distributed Generation
- Incorporating Energy Storage
- Economics of Renewable Energy Investments
- How Carbon Changes the Picture
- Government Subsidies
- Jobs and Economic Development
- Resource Allocation Consequences and Tradeoffs

Accommodating Intermittency

Resource intermittency is a significant issue for some renewable energy resources more than others. Texas' geothermal energy resource is generally stable and available year-round. Much of the state's biomass and water resources are created seasonally or intermittently, but their intermittentcy is not problematic since they can largely be stored for use when needed. Wind and solar resources are intermittent over short time periods and generally cannot be economically stored, so their intermittency poses unique challenges for integrating them into the electricity system at a large scale. Wind generation has achieved sufficient penetration on the Texas power grid that intermittency is beginning to emerge as an operational issue.

In February 2008, ERCOT cut service to several large customers in the Houston area after losing about 1,400 MW of wind power over the previous three hours. The drop coincided with rising electricity demand in the early evening hours and with a weather front pushing colder weather into the state. In response, ERCOT activated an emergency plan to curtail power to interruptible customers and shaved 1,100 MW within 10 minutes. No other customers lost power during the declared emergency and the affected interruptible customers were fully restored after about 90 minutes.[5] This provided a reminder that the intermittency associated with some forms of renewable energy can create some challenges. Fortunately, these operational risks can be managed.

Strategies for Accommodating Intermittent Resources

- **Forecasting**. Generators and Grid Operators may anticipate Intermittency through development and utilization of better short-term resource forecasting models.

- **Diversification**. The effects of intermittency may be alleviated by diversifying generation among intermittent resources and by obtaining intermittent generation from diverse locations. For example, the combined intermittency of wind and solar generation in west Texas may be less extreme than the intermittency of either resource alone, and the combined intermittency of distributed solar generators installed over a wide area may be less extreme than that of a single large solar power plant.

- **Demand Response, Storage, and Backup Generation**. Options for responding to resource intermittency include relying upon demand response (such as ERCOT's curtailment of interruptible customers), or drawing on energy storage or other rapidly-available generation resources. In addition to other benefits, "smart meters" may enable customers to respond to intermittency by shedding loads in real-time. On the supply side, if other energy resources are available or can be made available within a short period of time, they may be used to "back up" the intermittent resource.

Delivering Renewable Energy to Markets

Some renewable energy resources are located far from major energy markets, posing unique challenges in delivering renewable energy to customers. Wind energy is a prime example, with most Texas wind energy development to date occurring in west Texas while the largest retail energy markets are in the Dallas/Fort Worth, Houston, San Antonio and Austin metropolitan areas. Concentrating solar power plants face a similar electricity transmission challenge, since the state's best direct solar resource exists in far west Texas. Biomass is typically transported to processing facilities for the production of liquid fuels, which in turn are transported by pipeline networks and public highways to retail outlets.

The degree to which renewable energy sources must be transported has a large influence on the economics and energy return of utilization.

Energy transmission is an intra-state as well as an inter-state issue. Given Texas' abundance of renewable energy resources, it is just as important to consider how to export Texas renewable energy to other states and regions.

Strategies for Delivering Renewable Energy to Markets

- **Intra-state transmission.** Texas' efforts to develop electric transmission infrastructure to connect renewable energy resource-rich areas of the state with load centers through the designation of Competitive Renewable Energy Zones (CREZ) has the potential to stimulate development of these resources. In August 2008, the Texas PUC approved a nearly $5 billion plan to construct 2,400 miles of transmission lines that will accommodate over 18 GW of wind capacity, just 1,000 MW shy of the current installed wind capacity in the United States. While the CREZ transmission projects were developd primarily with wind energy in mind, they may also benefit new non-wind RENEWABLE and (delete traditional) fossil power plants as well.

- **Interstate transmission.** Some proposals for large wind farms in the Texas panhandle and throughout the upper Midwest call for wind energy to be transmitted to load centers on the east and west coasts via new high-capacity electric transmission lines. Development of new transmission projects tend to be guided by regional transmission authorities, and few pathways currently exist for review, approval and development of transmission infrastructure which would cover the distances necessary to make these transactions possible. New transmission planning structures are needed to enable such development.

- **Non-transmission solutions to transmission problems**. Transmission network upgrades are typically paid for by ratepayers through regulated processes. But network upgrades aren't the only measures which can help resolve transmission problems. Other measures, such as energy storage, demand response, efficiency and distributed generation, can perform similar functions as transmission and alleviate the need for, and cost of, new transmission and distribution infrastructure improvements. Changes are required to ensure these technologies have access to the same ratepayer-backed funding mechanisms available to traditional transmission upgrades.

Valuing Distributed Generation

Small renewable energy generation systems located at the point of use capture the benefits of renewable energy while reducing utility costs. One study identified 19 key values of distributed generation, including values associated with energy generation, available capacity, transmission and distribution cost deferrals, reduction in system losses, reactive power, improved system resiliency, increased reliability, electricity price protection, and pollutant and greenhouse gas emission reductions.[6]

Examples of distributed renewable generation include rooftop solar water heaters and solar electric systems, small wind energy generating systems, and ground-source heat pumping systems. Most distributed generation systems produce enough energy to meet a portion of a home's or business' energy needs, reducing the amount of electricity purchased from the utility. Such reductions are equivalent to reductions in consumption derived from efficiency or conservation measures. Some technologies at times produce more than enough energy to meet a home's or business' energy needs, and during those periods export electricity to the grid. Capacity, exported energy and other key values provided by distributed generation should earn the generation owner compensation at a fair value. If efficient, transparent markets are efficient, transparent markets are unavailable or impractical to enable distributed generation owners to be compensated for the value they create, then that value should be made available.

Strategies for Valuing Distributed Generation

- **Incentive programs**. Policies and programs supporting adoption of distributed renewable generation, including the efficiency programs offered by Texas electric utilities, should recognize and account for the total value of distributed renewable energy delivered to the utility and its ratepayers.

- **Interconnection policies**. Policy makers should encourage adoptions of consistent interconnection requirements and processes by all Texas electric utilities.

- **Net metering**. All customers with distributed renewable generation should have the opportunity to earn a fair price for energy outflows without having to switch retail electric providers or renegotiate the terms of existing retail energy purchase contracts.

Incorporating Energy Storage

Energy storage refers to wide range of technologies which can be used to store energy and release it later to perform some useful task. Like distributed generation, energy storage is another example of an energy service which does not fit neatly into the traditional electricity system model consisting of generation, transmission, distribution, and retail sales. From a grid operator's perspective, storage can act like load (when it is being charged), generation (when it is releasing energy), and can be used to improve utilization of transmission assets. Development of economical storage is useful to intermittent energy resources, in particular, because it enables intermittent resources to comprise a larger portion of available capacity without compromising grid operations.

Texas has a number of mature oil fields that could be used for compressed-air energy storage (air is pumped in during off-peak periods when power prices are low and extracted for extra power generation during peak periods when power prices are high), and market participants are exploring other options for compressed air storage or large-scale batteries.[7] Solar thermal power plants often make use of thermal storage which can smooth and shift output to capture higher energy values later in the afternoon and evening. Distributed storage concepts have been proposed, including dispatching of energy stored in the batteries of plug-in hybrid vehicles during peak demand periods or as back-up power during emergencies.

Strategies for Incorporating Energy Storage

- The Governor's Competitiveness Council recommended in July 2008 that the state "establish an innovation prize or prizes, funded with private-public revenue, for the commercialization of large-scale energy storage."

- The PUC and ERCOT should consider energy storage, demand-response, and distributed generation in conjunction with transmission planning and authorize rate recovery for all cost-effective solutions.

Economics of Renewable Energy Investments

All energy generation projects are capital intensive. Most renewable energy projects tend to be even more so, in part because they lack ongoing fuel costs. As a result, financial returns on capital investments in renewable energy tend to be highly stable and predictable over the life of the project. This stands in sharp contrast to the fuel price volatility associated with some fossil fuel generation, which can result in highly volatile energy prices for consumers. The stability and predictability of renewable energy investments creates value which can be passed on to consumers of renewable energy through long-term, fixed price energy sales contracts. Similarly, investments in energy efficiency and conservation act as buffers against fuel price volatility.

In the case of distributed renewable generation, the high initial cost and long payback term does not always align with the interests of home- and building-owners who may not plan to own the home or building long enough to reap the financial reward from an investment in a distributed renewable generation system. Additionally, for many commercial projects, the developer and building owner are not responsible for energy costs, and therefore have no incentive to invest in efficient design and construction. These misalignments mean some cost-effective distributed renewable generation and efficiency projects will not be built absent some kind of intervention, such as up-front rebates offered through efficiency programs.

Conclusions relating to the Economics of Renewable Energy Investments

- **Long-term economic predictability**. For many renewable energy generation projects, "fuel" costs are non-existent, making financial returns on capital investment highly stable, predictable, and non-volatile. This stability has a value which can and should be recognized in energy markets.

- **High initial investment and owner/operator mismatch**. Due to misalignment of interests, some cost-effective distributed renewable energy and energy efficiency projects may not proceed without policy intervention. Up-front incentive payments, policies to promote energy efficient building construction, and financing mechanisms tied to the property rather than the owner, can encourage customers to make otherwise cost-effective capital investments.

How Carbon Changes the Picture

Regulation of greenhouse gases such as carbon dioxide (CO_2) by the federal government could have a pronounced impact on Texas' energy future. The Kyoto Protocol, an international agreement between more than 170 countries, first formalized a mechanism for establishing a maximum amount of greenhouse gases which could be emitted by participating countries, and for tracking and trading greenhouse gases through the use of carbon credits and offsets. The mechanism functions by creating a market for carbon credits, which provide their owners with permission to emit a fixed amount of CO_2 into the atmosphere. The additional cost of obtaining credits increases the cost of emitting CO_2, thereby increasing the cost of fossil fuel-derived energy. Since 2005, the Kyoto mechanism has been adopted by all countries within the European Union.

In the U.S., mandatory carbon regulation has been considered but not adopted by the federal government. Some voluntary and regional efforts have taken hold, however. The Chicago Climate Exchange has been operating as North America's only voluntary, legally-binding greenhouse gas reduction and trading system for emission and offset projects since 2003. The Regional Greenhouse Gas Initiative (RGGI), a mandatory, cooperative effort between 10 northeastern states with the goal of stabilizing and then reducing CO_2 emissions from power plants by 10 percent by 2018, held its first carbon credit auction in September 2008.[8]

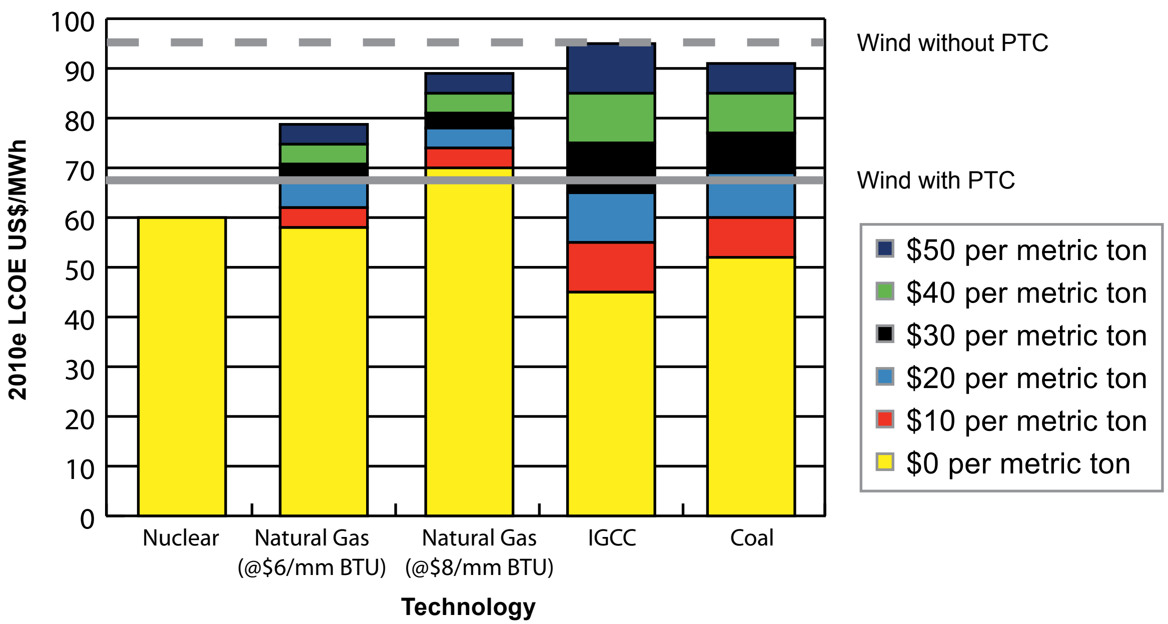
By increasing the cost of fossil fuel-derived energy, carbon regulation can make non-carbon emitting energy resources, such as many renewable energy resources, more cost-competitive. A recent evaluation illustrated how different market prices for CO_2 could affect the competitiveness of wind energy under RGGI regulation in the northeast (**Exhibit 9-1**).

Conclusions Relating to Potential Carbon Regulation

- **Disproportionate Effect**. Federal regulation of carbon dioxide and other greenhouse gases will have a large and disproportionate effect on Texas, due to the state's abundance of fossil fuel resources and the industries which have developed around them.

- **Opportunity for Texas Renewables**. Texas' abundance of renewable energy resources means the state has a natural hedge against potential carbon regulation. Texas can profit from and maintain its leading position in development and integration of renewable energy resources and policy.

Exhibit 9-1 Effects of CO_2 Prices on Wind and Fossil Energy Costs in the Northeastern U.S.



Source: Ernst & Young, Presentation: United States renewable energy attractiveness indices: Q2 2008; Impact of the Regional Greenhouse Gas Initiative and IRS Notice 2008-60 on renewable energy, September 23, 2008.

Government Subsidies

All energy resources, renewable and non-renewable, benefit from subsidies and are subject to policy and regulatory frameworks that promote or impede each resource's competitiveness in the Texas, U.S. and global energy marketplaces. Unraveling the complex interrelationships between energy utilization and government policy can make comparing the true economic costs and benefits of each energy resource, and quantifying the extent to which each resource is economically advantaged or disadvantaged by government, a formidable task. Nonetheless, a number of conclusions can be reliably drawn by investigating direct and indirect incentives provided at the federal and state/local levels.

Energy subsidies may be either "direct" or "indirect." Direct subsidies include payments from the government directly to producers or consumers, and tax expenditures. Indirect subsidies include government actions that do not involve direct payments to producers or consumers but which affect the cost of consumption or production of some form of energy.

Federal Subsidies

According to the Energy Report released by the Texas Comptroller in May 2008, at the federal level, direct financial subsidies attributable to specific renewable energy sources totaled about $6.2 billion in 2006 and comprised about 45 percent of all direct federal energy subsidies. More than three quarters of federal renewable energy subsidies, about $4.7 billion, went to ethanol production alone, mostly for use as a gasoline additive. Wind, solar, hydroelectric and biomass technologies comprised a second tier of federal subsidies, together receiving another $1.3 billion. Biodiesel and geothermal together received smaller amounts.

Another way of looking at direct financial subsidies is to compare the amount of subsidies to the total amount of consumer spending on energy. From this viewpoint, federal subsidies as a percent of total consumer spending on energy amounted to just 1.4 percent overall, but comprised a greater share of spending, 4.5 percent, on renewable energy resources than for non-renewable sources. This average is not consistent among all fuels, however. Federal subsidies are highest for ethanol (26.5%) and nuclear power (20.9%), while solar (12.3%), wind (11.6%), biodiesel (9.9%) and coal (6.9%) comprise a second tier. Hydroelectricity, biomass, and geothermal resources join oil and gas as the least subsidized fuels from this perspective. **Exhibit 9-2** presents an overview of federal energy subsidies.

Federal direct financial subsidies critical to renewable energy markets in Texas include the production tax credit (PTC) for wind, the investment tax credit (ITC) for solar, and the ethanol blender tax credit. In October 2008, Congress extended the wind PTC through 2009 and the solar ITC through 2016.

State and Local Subsidies

At the state and local level, Texas provided approximately $1.4 billion in direct financial subsidies to renewable and non-renewable energy sources in 2006, almost all of which, 99.6 percent, went to oil and gas production. The remaining 0.4 percent, or about $6.2 million, went to solar, biodiesel, wind, and geothermal. It should be noted that of the $2.5 million listed for solar, over $2 million was a local subsidy provided by the City of Austin through its municipal electric utility, Austin Energy.

When viewed as a percent of total spending on energy, Texas state and local subsidies for non-renewable sources are on average more than seven times higher than those for renewable energy sources. Texas state and local subsidies comprised about 1.5 percent of consumer spending on energy from non-renewable resources, and about 0.2 percent of spending on renewable resources. Of renewable energy sources, solar energy emerges as the resource with the largest combined state and local subsidy, with subsidies comprising 9.2 percent of total spending in Texas (the state share of this solar subsidy is about 1.8% of total spending, near the state's 1.5% subsidy of oil and gas, but lower than the state's 3.1% subsidy of biodiesel energy). Texas also subsidizes geothermal and wind power of about 0.2% of consumer spending. **Exhibit 9-2** summarizes Texas state and local energy incentives.

Indirect Subsidies

Of course, direct subsidies represent only part of the complex environment in which energy resources compete. Other policies, market structures, and regulatory frameworks also affect the economic viability of individual energy resources but are not counted as direct subsidies. An example of an indirect energy subsidy at the federal level is the limitation on liability afforded to owners of nuclear power facilities, which effectively reduces the cost of nuclear-derived energy by eliminating the need to insure nuclear facilities against losses associated with nuclear accidents.

Exhibit 9-2 Estimated Federal Government Taxpayer Subsidies as a Share of Total Spending on Energy Sources in 2006*

Energy Source	Federal Taxpayer Subsidies	Total Energy U.S. Consumer Spending	Total Spending on Energy Source	Federal Taxpayer Subsidies as a Percent of Total Spending
Oil and Gas**	$3,502,732,143	$772,404,554,400	$775,907,286,543	0.5%
Coal	$2,754,908,000	$37,228,867,200	$39,983,775,200	6.9%
Nuclear	$1,187,426,000	$4,506,192,000	$5,693,618,000	20.9%
Subtotal Nonrenewable	**$7,445,066,143**	**$814,139,613,600**	**$821,584,679,743**	**0.9%**
Ethanol	$4,708,277,549	$13,082,400,000	$17,790,677,549	26.5%
Biodiesel	$92,315,835	$840,350,000	$932,665,835	9.9%
Wind	$457,924,289	$3,502,105,629	$3,960,029,918	11.6%
Solar	$382,756,318	$2,731,644,481	$3,114,400,799	12.3%
Hydroelectric power	$295,234,608	$56,123,748,494	$56,418,983,102	0.5%
Biomass	$209,641,875	$50,421,528,417	$50,631,170,292	0.4%
Geothermal	$29,158,534	$5,825,057,818	$5,854,216,352	0.5%
Subtotal Renewables	**$6,175,309,008**	**$132,526,834,839**	**$138,702,143,847**	**4.5%**
Total Subsidies	**$13,620,375,151**	**$946,666,448,439**	**$960,286,823,590**	**1.4%**

*Federal fiscal years run from October 1 to September 30.
**'Oil and gas' includes natural gas production, crude oil production and natural gas plant liquids production.

Source: U.S. Energy Information Agency and Texas Comptroller of Public Accounts.

Exhibit 9-3 Estimated Texas State and Local Taxpayer Subsidies as a Share of Total Texas Energy Consumer Spending in 2006

Energy Source	Texas State and Local Subsidies	Total Texas State and Local Consumer Spending	Total Spending on Energy Source	Texas State and Local Subsidies as a Percent of Total Texas Spending on Energy
Oil and Gas	$1,417,434,337	$93,326,324,400	$94,743,758,737	1.5%
Coal	n/a	$2,207,721,600	$2,207,721,600	0.0%
Nuclear	n/a	$197,251,200	$197,251,200	0.0%
Subtotal Nonrenewable	**$1,417,434,337**	**$95,731,297,200**	**$97,148,731,537**	**1.5%**
Ethanol	n/a	$93,539,160	$93,539,160	0.0%
Biodiesel	$2,107,420	$65,967,475	$68,074,895	3.1%
Wind	$1,508,800	$833,501,140	$835,009,940	0.2%
Solar	$2,574,101*	$25,458,927	$28,033,028	9.2%
Hydroelectric power	n/a	$276,128,843	$276,128,843	0.0%
Biomass	n/a	$1,401,718,490	$1,401,718,490	0.0%
Geothermal	$45,400	$18,698,436	$18,743,836	0.2%
Subtotal Renewables	**$6,235,721**	**$2,715,012,471**	**$2,721,248,192**	**0.2%**
Total Subsidies	**$1,423,670,058**	**$98,446,309,671**	**$99,869,979,729**	**1.4%**

n/a: not applicable
*$2,074,101 of this total comes from Austin Energy utility company.

Source: U.S. Energy Information Agency and Texas Comptroller of Public Accounts.

At the state level, the Renewable Portfolio Standard (RPS) and the construction of transmission to Competitive Renewable Energy Zones (CREZ) may improve the economics of renewable energy, while market structures in non-competitive areas may present barriers to the installation of customer-sited, distributed renewable generation. None of these policies shows up in a tabulation of direct financial subsidies.

Conclusions Relating to Government Subsidies

- Subsidies should be quantified and aligned with Texas' strategic priorities for energy.
- Texas provided $1.4 billion in direct financial subsidies to energy in 2006:
  - $1.394 billion (99.6%) went to oil and gas production;
  - $6.2 million (0.4%), went to solar, biodiesel, wind, and geothermal. Of this $6.2 million, over $2 million was a local subsidy provided by the City of Austin through its municipal electric utility, Austin Energy.
- Out of every dollar Texas consumers spend on energy, direct state and local subsidies made up 1.5 cents for fossil fuel-derived energy but only 0.2 cents for renewable energy in 2006.

Jobs and Economic Development

Expanding the use of renewable energy in Texas may have a significant positive impact on employment. Research has shown that renewable energy creates more jobs in the construction and manufacturing sectors, per megawatt of installed power capacity, than does fossil fuel generation.[9] This reflects the facts that renewable energy resources tend to be more diffuse and, therefore, more labor intensive to capture, and that development of renewable energy resources tends to be up-front capital- rather than fuel cost-dependent, compared with fossil fuel generation. And because of the fact that renewable energy resources are dispersed throughout the state, developing renewable energy can create new economic opportunities in rural areas of Texas.

One study addressed potential job growth in Texas under differing national energy policies and estimated that Texas, under a scenario of "climate protection strategies," would gain 123,000 net jobs by 2020, the majority in the construction and services sector.[10] Another study considered the economic development impacts of investing in 100 MW of solar energy by 2020 in Austin, and found that the local economy would receive the benefits of a $952 million net increase in gross regional product, 293 net new jobs, $283 million in increased earnings, $8.8 million in net sales tax revenue, and $0.6 million in net property tax revenue.[11] Other states, including Colorado, California, and Pennsylvania, have moved aggressively to capture this job growth potential in renewable energy by enacting incentive programs to encourage the type of "demand-pull" economic activity that such programs initiate.[12]

Renewable energy jobs are diverse and involve manufacturing, sales, construction, maintenance, service, and other skills. In order to meet the anticipated demand for installers the renewable energy industry has worked to create accreditation and certification standards. One such standard is the Institute for Sustainable Power Quality Standard (ISPQ 01021). The Interstate Renewable Energy Council provides third-party assessment of workforce training programs, such as the ISQP 01021 North American licensee, including accreditation for training programs, accreditation for continuing education providers, certification for independent master trainers, certifications for affiliated master trainers, and certification for instructors. The North American Board of Certified Energy Practitioners (NABCEP) has developed an entry-level solar certification program that is currently offered in Texas through Austin Community College. ACC's program is a 48-hour course that was offered for the first time January 2006.[13] NABCEP also offers professional certification for installers of solar electric and solar thermal systems, and is working on a certification for installers of small wind energy systems.

Conclusions Relating to Jobs and Economic Development

- **Rural economic development**. Renewable energy can provide jobs and economic development opportunities for Texas, especially in rural areas.
- **Manufacturing jobs**. Utilization of renewable energy can provide economic stability in the manufacturing and service sectors.
- **Workforce development**. Workforce development is needed to prepare Texans for jobs in the renewable energy sector.

Resource Allocation Consequences and Tradeoffs

Utilization of all energy sources presents differing impacts on air and water quality, land and water use, and wildlife, and requires decisions concerning competing uses of associated land and water resources. Many energy production technologies require vast amounts of water for use in steam turbines. Allocation of water between competing energy, agricultural, industrial, commercial and domestic demands will become a more important issue as each of these demands continues to increase. Certain distributed renewable energy generation technologies, such as wind, solar, and geothermal systems, can help reduce water consumption by water-consuming power plants, freeing those water resources for other uses. Wind facilities require small dedicated footprints over large land areas and can coexist with and minimally disrupt agricultural and ranching land uses, while solar facilities typically cannot.

Renewable energy resources are no different than fossil resources in this respect – whether "from wells to wheels," or "from winds to wall sockets," utilization of all energy resources requires careful consideration of resource allocation consequences and tradeoffs.

Conclusions Relating to Resource Allocation

- **Competing uses**. Large-scale implementation of renewable energy technologies will require decisions concerning competing uses of associated land and water resources.

Additional Barriers to Development

In September 2006, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy reviewed recent literature discussing the "non-technical barriers" to renewable energy use.[14] While the study focused on solar, its conclusions are applicable to a broad range of renewable energy technologies. The study identified marketing, institutional, and policy impediments that are holding back the acceptance of renewable energy technologies. These key barriers are listed here, from most frequently cited to least:

- **Lack of government policy support**. This includes the lack of policies and regulations supporting development of renewable energy technologies and the presence of policies and regulations hindering renewable energy development and supporting conventional energy development. Examples include fossil-fuel subsidies, insufficient consumer-based renewable energy incentives, government underwriting for nuclear power plant accidents, and difficult zoning and permitting processes for renewable energy.

- **Lack of information dissemination and consumer awareness.** Utilization of renewable energy and energy efficiency can be increased through educating consumers concerning the availability, economics, and other benefits of these technologies.

- **High up-front capital cost.** Renewable energy technologies tend to have a higher up-front cost compared with conventional energy technologies.

- **Difficulty overcoming established energy systems.** This includes difficulty introducing innovative energy systems, particularly for distributed generation such as photovoltaics, because of technological lock-in, electricity markets designed for centralized power plants, and market control by established generators.

- **Inadequate financing options.** Private markets may not have developed mature financing models applicable to small- and mid-scale renewable energy projects.

- **Failure to account for all costs and benefits of energy choices.** This includes failure to internalize all costs of conventional energy (e.g., effects of air pollution, risk of supply disruption) and failure to internalize all benefits of renewable energy (e.g., cleaner air, energy security).

- **Inadequate workforce skills and training.** This includes lack in the workforce of adequate scientific, technical, and manufacturing skills required for renewable energy development; lack of reliable installation, maintenance, and inspection services; and failure of the educational system to provide adequate training in new technologies.

- **Lack of adequate codes, standards, and interconnection and net-metering guidelines.** In Texas, interconnection and net metering standards are consistent within ERCOT and for investor-owned utilities outside ERCOT, but no standards, voluntary or mandatory, exist for municipal utilities or rural electric cooperatives.

- **Poor perception by the public of renewable energy system aesthetics.** Some neighborhood associations prohibit the installation of solar panels on rooftops; some communities object to the siting of wind turbines or other energy facilities nearby.

- **Lack of stakeholder/community participation in energy choices and renewable energy projects.** Energy consumers often feel they have little say over what kind of generation is built and integrated into the retail energy product they purchase.

Closing

The U.S. is one of the world's major energy producers and consumers, and Texas is at the epicenter of U.S. renewable energy development. Texas' success in developing its wind resource, coupled with its enormous solar, geothermal and biomass potential, lead one study to conclude in mid-2008 that Texas was the most attractive U.S. state for long-term renewable energy development, ranking first among the states in wind and infrastructure, second in solar, and third in biomass and geothermal (**Exhibit 9-4**).[15]

As renewable energy sources emerge as a dominant contributor to future energy supplies, benefits will accrue to those regions with abundant renewable energy resources and policies that successfully encourage their development. With the right focus, Texas can be well-situated to benefit from its renewable energy resources and to maintain and expand its leadership role in energy well into the next century.

EXHIBIT 9-4 United States Renewable Energy Attractiveness Index

Ranking*	State	All Renewables Index	Long-Term Wind Index	Long-Term Solar Index**	Biomass Index	Geothermal Index	Infrastructure Index***
1 (1)	Texas	81	85	75	67	69	81
2 (2)	California	71	68	80	76	78	74
3 (3)	New Mexico	70	71	73	56	67	74
4 (3)	Colorado	69	71	72	53	66	67
5 (5)	Oregon	67	68	63	67	66	68
6 (6)	Montana	66	69	61	58	67	70
6 (9)	Washington	66	69	55	64	60	66
8 (6)	New York	65	68	59	61	57	57
8 (9)	Iowa	65	68	57	65	53	60
8 (9)	Massachusetts	65	65	62	67	66	73
8 (12)	Pennsylvania	65	67	59	63	62	70

* Ranking in prior quarter in brackets
* Solar Index represents the index scores for both large- and small-scale solar
*** Combins with each set of technology factors to generate the individual technology indices

Source: Ernst & Young, United States renewable energy attractiveness indices, Q2 2008.

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