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The future of energy in Mississippi: policy and politics

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THE FUTURE OF ENERGY IN MISSISSIPPI: POLICY AND POLITICS

By

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This study analyzes the elements surrounding renewable energy development in Mississippi, with emphasis on the aspects related to government intervention. This study addresses the question: how can energy policy in the state of Mississippi support a transition from fossil fuels to non-traditional sources of energy?

Drawing from existing literature, renewable energy was analyzed on the cost, development, and environmental concerns, while GIS analysis was utilized to determine generation capacity. Additionally, literature was reviewed to indicate the effectiveness of policy instruments in promoting renewable energy. Finally, the political influences that may affect renewable energy development or policy formulation were analyzed through a review of literature.

The study indicates that renewable energy, particularly biomass, has some potential in Mississippi. Although the political environment may not be conducive to policy innovation, a renewable energy policy from the state level should be the most effective tool in promoting renewable development.

DEDICATION

I would like to dedicate this research to my parents, Jody and Regina Fowler, and my brother, Kyle, for all their support.

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The author expresses his sincere gratitude to the many people with whose assistance this thesis has been possible. First of all, sincere thanks are due to Dr. Jeffrey Cavanaugh, my committee chairman, whose time, instruction, and guidance have been paramount to my success on both this thesis and graduate program. Expressed appreciation is due to the other members of my thesis committee, Dr. Gerald Emison and Dr. Dagmar Radin, for their assistance in undertaking this project. Finally, the author would like to thank those, too numerous to name individually, who provided support and encouragement through this arduous process.

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INTRODUCTION

Background:

In recent years oil prices, energy independence, and energy policy have taken a position on center stage in American politics. With oil becoming a less desirable source for reasons ranging from national security to economics, the arguments that support non-traditional sources of energy have become increasingly important over the last decade. Essentially, the question at hand for this study is: How can energy policy in the state of Mississippi support a transition from fossil fuels to non-traditional sources of energy?

Oil has been a piece of American history for more than 150 years. The first commercial oil well in the world first struck petroleum on August 27, 1859 in Titusville, Pennsylvania, with that the oil industry began. The petroleum industry hit in its stride as new oil fields were found in Texas and California, and the United States became the world's largest oil producer. Petroleum quickly became a growing industry capable of creating a vast amount of wealth for those involved.[1] Standard Oil, which was broken up in 1911 following an antitrust ruling, was divided into several entities that through various means now constitute at least part of ExxonMobil, ChevronTexaco, ConocoPhillips, and British Petroleum; those are four of the seven largest oil companies in the world today. It was during this same period that Henry Ford's

[1] Daniel Yergin. The Prize: The Epic Quest for Oil, Money, and Power. (New York: Free Press, 1992).

Model T came on the market and oil as a transportation energy source established its hold on the American way of life.[2]

It was during World War II that oil integrated itself into the very basics of modern life. The US and, arguably, the USSR were the only belligerent nations with a secure supply of oil within their borders; much of military strategy on both sides was aimed at securing oil supplies for the military machine.[3] According to Daniel Yergin, if General Patton had not run out of gasoline for his trucks, he would have taken Berlin weeks earlier and the Battle of the Bulge would have never been fought.[4] It was in the course of World War II that oil stopped being predominantly a matter of business and became a matter of geopolitics as much as anything else. With the end of the war, GI's returned home, began purchasing automobiles, and the US demand for oil began to swell to unforeseen heights. For the first time, in the 1950's the US made the transition from oil exporting country to oil importing country. Oil production and consumption increased unrestricted in the post-War period.[5]

By 1970, the US had hit domestic peak oil production. Peak oil production is when half of all oil reserves, proven and estimated, have been removed from the Earth. From there forward, US oil production would be on the decline. The 1970's, though, were marked by major energy crises leading to a dwindling supply and rising prices. In the US, everyday motorists were waiting in gas lines, and President Carter's solutions proved politically unpopular.[6] However, throughout the 1980's, the price of oil declined and stabilized, and American consumption

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[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Ibid.

increased more than ever, due to increased production from Saudi Arabia and new fields in the North Sea and Alaska. In 1992, the Gulf War, the first major overt US war fought over oil, incurred a minor energy crisis, fought over Kuwaiti oil reserves.[7] The US intervened to protect an important ally and major oil exporter, making it painfully apparent that oil was a defining aspect of US foreign policy. By the mid-1990's, oil consumption in the US was higher than ever before and US oil production was steadily decreasing.[8] [9] Then, the world changed again. The attacks of September 11, 2001, set off military intervention in Middle East. The wars in Iraq and Afghanistan put a tremendous toll on oil supply and prices. Between the decreased production, the increased demand from military forces, and the withering economy as a result of the pressures from paying for the war, oil prices hit their all time height in the summer of 2008. From April 2008 to July 2008, every time the price of oil rose, it was a new record high.[10] The 2000's may prove to be the most tumultuous time for oil since the energy crises of the 1970's.

In the latter half of the 20th century, US consumption of oil has steadily increased, while production has decreased. The United States was once the world's leading oil producer, but since the 1950's has been an oil importer with domestic production peaking in 1970.[11] In 1970, oil production in the US was 9,637,000 barrels a day compared to 5,064,000 barrels a day in

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[7] Ibid.

[8] US Department of Energy. Energy Information Administration. 2008. "US Crude Oil Field Production." http://tonto.eia.doe.gov/dnav/pet/hist/mcrfpus1m.htm

[9] US Department of Energy. Energy Information Administration. 2008. "US Total Crude Oil and Petroleum Products Supplied." http://tonto.eia.doe.gov/dnav/pet/hist/mttupus1m.htm.

[10] US Department of Energy. Energy Information Administration. 2008. "Weekly United States Spot Price FOB Weighted by Estimated Import Volume." http://tonto.eia.doe.gov/dnav/pet/hist/wtotusaw.htm.

[11] US Department of Energy. Energy Information Administration. 2008. "US Total Crude Oil and Petroleum Products Supplied." http://tonto.eia.doe.gov/dnav/pet/hist/mttupus1m.htm.

2007.[12] In 1973, oil consumption in the US was 17,308,000 barrels a day compared to 20,680,000 barrels a day in 2007.[13] Between 1973 and 2007, US oil consumption increased by 16%, while production fell by 45%.[14] In 2007, the US oil consumption outpaced oil production by more than 15 million barrels a day.[15] In 1973, the US was 35% dependent on foreign oil imports; by 2006, that dependence had grown to 60%.[16] The US experience with domestic production could be a prelude to a similar series of event on the world stage. The world is expected to hit peak oil production sometime this decade. There are only three oil producing nations that have yet to hit peak oil: Iraq, Kuwait, and Saudi Arabia.[17] World oil production will be on the down-slope by the end of the decade. Once peak oil has been reached, half of all oil reserves have been depleted.[18] The US may be the example by which the rest of the world follows on oil. At the current rate of production and consumption, oil will run out by the middle of this century. Even the most liberal estimates of oil reserves suggest that by 2050 oil will have run out.[19] Oil has never been a sustainable energy supply, and we are on the verge of having exhausted it as a natural resource.

For a long time, the oil question has been concerned with when it will run out but the better question may be: when will its economic viability run out? As the economics of exhaustible resources indicates, oil may no longer be economically viable well before it runs out.

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[12] Ibid.

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Godfrey Boyle. Energy Systems and Sustainability (Oxford: Oxford University Press, 2003).

[18] Ibid:

[19] Ibid:

The economics of exhaustible resources suggests that oil will become exponentially more expensive with every barrel consumed. As an exhaustible resource, the first barrel of oil removed from the Earth was the cheapest and every subsequent barrel has become more expensive for two reasons. First, for every barrel consumed less oil exists; the Earth has a finite amount of oil. Thus, as oil becomes scarcer, it becomes more valuable. Second, for every barrel removed from the ground the reservoir becomes more depleted. To remove the next barrel of oil involves more work, cost, and time.[20] This is supported by the expense associated with US oil production. The oil fields in the US contain some of the most expensive oil in the world to produce; they are also some of the oldest fields still producing. Domestic oil production has been down since the 1970's, when Arabian oil was more economically viable. Although, Texas and Oklahoma still have large reserves production is not as high as it once was because extracting the oil from the ground has become very expensive as compared to other sources. Alaska, on the other hand, is a major source of cheap US domestic production with oil wells that are only a few decades old at the most.[21] Oil may never actually run out because it will become so expensive that it will no longer be economically viable to use. The more oil that is consumed, the more expensive the remaining oil will become.[22]

In the 1970's, oil prices skyrocketed in response to political upheavals in the Middle East. Oil consumption in the United States decreased during that time because oil was quickly becoming uneconomical for many consumers. Consumer behavior during the energy crises of the last half of the 20th century clearly indicated that when oil prices rise too high they are

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[20] Robert Solow. "The Economics of Resources or the Resources of Economics." American Economic Review 64: 2 (1974).

[21] Daniel Yergin. The Prize: The Epic Quest for Oil, Money, and Power. (New York: Free Press, 1992).

[22] Robert Solow. "The Economics of Resources or the Resources of Economics." American Economic Review 64: 2 (1974).

uneconomical for use, leaving consumers searching for alternatives.[23] In recent years, oil price increases have lead to energy companies as well as consumers seeking cheaper sources of energy. Alternatively, energy production from renewable sources follows a different economic path. Typically, the cost of energy is dependent on running costs, the costs of fuel and maintenance, and fixed costs, the capital costs.[24] Based on Boyle (2003), renewable energy systems have no fuel costs and few moving parts, running costs for renewable energy systems are extremely low. New innovations in technology and manufacturing are most likely to only lead to reduce capital costs.[25] Ultimately, the costs of renewable energy will only decrease. Therefore, on the one hand we have an energy source that will only get more expensive (fossil fuels) and on the other hand we have an energy source that will only get less expensive (renewable energy).[26] The market has had difficulty adapting alternative energy sources because of the development timeline and problems of scale. Although there has been much experience with economies of scale for oil, there has been little with scale for renewable energy which may present problems in the market transition, leading to uncertainty of the most economically favorable conditions to employ. Market failures lead to a gap between when the current source gets too expensive and the new source can be more economically viable. These failures, though, are not the markets alone; the failure is a government failure to properly regulate the market.[27] It is obvious that oil is not a sustainable energy source, and eventually

[23] Daniel Yergin. The Prize: The Epic Quest for Oil, Money, and Power. (New York: Free Press, 1992).

[24] Godfrey Boyle. Energy Systems and Sustainability (Oxford: Oxford University Press, 2003).

[25] Ibid.

[26] Ibid.

[27] Anne Krueger. "Government Failures in Development." 1990. Journal of Economic Perspectives 4(3): 9-23.

transition into alternative sources will be necessary.[28] If the market can not facilitate the transition, government policy must be cultivated to do so.

Oil has a plethora of additionally issues that complicate its use such as international relations, national security, and growing demand from India and China, not to mention most oil production is focused in one of the most volatile regions in the world, the Middle East. In the last 20 years, the United States has fought two wars over oil. The US petroleum needs are in many ways dictating foreign policy with many oil producing countries, whereby the US has prioritized security of supply over all other consideration. Additionally, the economies of both China and India are growing at a rapid pace leading to a growing demand on oil, which has the potential to cause price increases or edge the US out as a primary consumer, further threatening its supply. Since the 1950's, the political situation in Middle East has consistently effected the supply of oil. The US reliance on oil makes the political situation in the region of a national security issue, which only further complicates both trade and foreign policy. The costs of continuing to utilize oil as a primary energy source far out weigh the benefits. With the prospect of a post-oil economy on the horizon, it is necessary to prepare for a transition to new sources of energy.

To facilitate the transition, government energy policy should support the growth of alternative energy. While the federal government has taken the lead on energy policy for most of the 20th century, state governments may prove to play just as vital a role. Currently, 23 states have renewable portfolio standards requiring a certain amount of all energy be obtained from

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[28] Godfrey Boyle. Energy Systems and Sustainability (Oxford: Oxford University Press, 2003).

renewable sources.[29] (See Chapter 4) These new portfolio standards range from obtaining 4% of energy from renewable production in Massachusetts by 2009 to obtaining 25%, in Oregon by 2025.[30] The goals refer to electricity sales and megawatts of absolute capacity. For these states, energy needs are more and more being met by renewable energy rather than oil and fossil fuels.[31]

The national government, on the other hand, has yet to adopt any such standards for renewable energy production. The Department of Energy is charged with oversight of US energy needs, but for most of the 20th century the federal government has only stepped in to address energy during a crisis. The first significant pieces of Congressional legislation to address energy did not come about until the late 1970's, as a belated result of the energy crises of that decade. Between 1975 and 1980, four major pieces of legislation were passed by Congress: the Energy Policy and Conservation Act, the Department of Energy Organization Act, the National Energy Act, and the Energy Security Act.[32] No other energy legislation was passed until the Energy Policy Act of 1992.[33] Since then, only three other pieces of national energy legislation have been passed starting with the Energy Policy Act of 2005.[34] All the federal energy legislation

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[29] Database of State Incentives for Renewables and Efficiency. "Rules, Regulations, and Policies for Renewable Energy." North Carolina State University, North Carolina Solar Center, http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7&EE=0&RE=1.

[30] Ibid.

[31] US Department of Energy. Energy Efficiency and Renewable Energy. 2008. "States with Renewable Portfolio Standards." http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.

[32] US Department of Energy. Energy Information Administration. 2009. "Energy Timeline: 1971-1980." http://www.energy.gov/about/timeline1971-1980.htm.

[33] US Department of Energy. Energy Information Administration. 2009. "Energy Timeline: 1991-2000." http://www.energy.gov/about/timeline1991-2000.htm

[34] Nuclear Energy Institute. 2005. "Congress Passes First Comprehensive Energy Bill in 13 Years." http://web.archive.org/web/20070710094024/http://www.nei.org/documents/Energy_Bill_2005.pdf

has been a reaction to a crisis, not a prescription to prevent a crisis. The energy crisis of the 1970's, the Gulf War, and currently the war in Iraq are the only events that have compelled Congress to act. Arguably, federal legislation has only been aimed at treating the symptoms of a much larger problem.

As a result of federal political inaction, the state governments have become the leaders of renewable energy policy innovation. All energy for consumption in the United States is produced on the state and local level therefore the states have taken a more proactive approach in guiding the future of energy production. States are in a much better position to address the energy needs of their citizens than the federal government. The diversity of the national geography of the United States means that renewable systems in one state may not work as well in another. Therefore, it should be the individual states that support the growth of these systems. Even though the state energy markets operate within the national market, states have a greater flexibility in policy innovation. Furthermore, only 11 states produce more energy than they consume. On the other hand, there are seven states that produce less than 10% of the energy they consume.[35] Wyoming produces 1982% of the energy consumed in state, while Delaware produces 0.5%. Mississippi produces around 32%, placing it 27th among the states.[36] Nationally, the United States only produces 70% of the energy it consumes; 14 states currently have a production-consumption ratio above the national average.[37]

The energy being consumed in a state should be produced in that state for two very vital reasons. First, trade efficiency, for every dollar spent on energy in a state if it is not produced

[35] US Department of Energy. Energy Information Administration. Energy Production and Consumption Estimates in Trillion BTU by State (Washington, DC, 2007).

[36] Ibid.

[37] Ibid.

there the money leaves the state. Theoretically, if all energy consumed in Mississippi is produced in Mississippi, then every energy dollar stays in the state, creating jobs and economic growth. Though halting energy trading with other states is most likely not the most efficient approach, like any trade relationship a negative energy production-consumption ratio means an inflow of energy and an outflow of money to purchase that energy. Second, energy return on energy invested; transporting energy over any distance results in energy loss. Transporting oil from the Middle East to the United States takes energy, which subtracts from the total energy gain from the oil being transported, resulting in less energy for more money. If the states can begin to make up the disparity between production and consumption, the nation can move away from reliance on foreign sources of fuel. Moreover, byproducts of this growth would mean less loss of power through distribution and transmission and more money kept in state. Regardless of where the policy originates, alternatives sources of energy should be supported by government to ease the transition to a post-oil economy. Just as tariffs protect domestic oil production from cheap foreign oil sources, tax incentives, mandates, and tariffs can encourage the growth of non-traditional energy systems leading to less reliance on oil, domestic or foreign.

The location of the production of energy is one of the most influential elements on US energy conditions. Since we can have little influence on natural resources, nuclear and renewable energy can be further developed, especially in states with few resources, to bolster production. Oil may not be able to be found in every state, but various types of renewable energy systems can theoretically be located anywhere. A state by state look at total production and total consumption statistics are descriptive of the problem. The problem lies not as much in high consumption as it does in low production. The production-consumption ratio is highly dependent on energy production, seeing as states with high production rates have a much more favorable ratio than states with low production.[38] The production-consumption ratio is a ratio that shows the equivalent amount of energy consumed by a state that is produced within the state; it is essentially a measure of energy independence by state.[39]

Table 1.1.

Energy Production-Consumption Ratio by State in 2007.[40]

State	Prod-Con Ratio	State	Prod-Con Ratio
1 Wyoming	1982%	26 Maine	33%
2 West Virginia	512%	27 Mississippi	32%
3 New Mexico	408%	28 Indiana	29%
4 Alaska	302%	29 Connecticut	24%
5 Montana	272%	30 Michigan	24%
6 Louisiana	187%	31 Ohio	23%
7 North Dakota	167%	32 Tennessee	23%
8 Colorado	158%	33 Idaho	22%
9 Kentucky	157%	34 New York	22%
10 Oklahoma	149%	35 Maryland	21%
11 Utah	131%	36 North Carolina	21%
12 Texas	94%	37 Nebraska	20%
13 Alabama	76%	38 Georgia	17%
14 Kansas	72%	39 South Dakota	17%
15 Pennsylvania	67%	40 New Jersey	13%
16 Washington	48%	41 Minnesota	13%
17 Virginia	47%	42 Florida	12%
18 Illinois	45%	43 Wisconsin	11%
19 Arkansas	42%	44 Iowa	9%
20 New Hampshire	42%	45 Massachusetts	8%
21 Arizona	41%	46 Nevada	8%
22 South Carolina	39%	47 Missouri	7%
23 California	38%	48 Hawaii	5%
24 Vermont	38%	49 Rhode Island	2%
25 Oregon	34%	50 Delaware	0.5%
US Average	70%		

[38] US Department of Energy. Energy Information Administration. Energy Production and Consumption Estimates in Trillion BTU by State (Washington, DC, 2007).

[39] Ibid.

[40] Ibid.

Delaware has the lowest consumption rate in the country, but it also has the lowest production rate causing it to have the least favorable production-consumption ratio.[41] Conversely, Wyoming is among the lowest energy consumers and highest energy producers leading to the most favorable production-consumption ratio in the country.[42] With a production-consumption ratio of 0.5%, Delaware has to import 99.5% of its energy.[43] Although most of the current production is from fossil fuels, the gap between production and consumption can be closed with renewable energy. Of the 10 states with the lowest energy production, six of those states also have the least favorable energy production-consumption ratios.[44] Of the 10 states with the highest energy production, seven of those states also have the most favorable energy production-consumption ratios (See Tables 1.1 and 1.2).[45] Texas is the only state that is among the highest for production and consumption, though it also enjoys a production-consumption ratio above the national average.[46] Of the 10 states with the highest energy consumption, Florida is the only state to be among the states with the least favorable production-consumption ratio.[47] Of the 10 states with the lowest energy consumption, North Dakota and Wyoming are the only states to be among the states with the most favorable production-consumption ratio (See Tables 1.1 and 1.3).[48] A boost in production would most effectively support energy independence for the United States.

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[41] Ibid.

[42] Ibid.

[43] Ibid.

[44] Ibid.

[45] Ibid.

[46] Ibid.

[47] Ibid.

[48] Ibid.

Table 1.2.

Top and Bottom States for Energy Production in 2007.[49]

Top 10	*Trillions of BTU's	Bottom 10	
1 Texas	10830	41 Nebraska	131
2 Wyoming	9154	42 Massachusetts	123
3 Louisiana	6760	43 Iowa	116
4 West Virginia	4062	44 Idaho	113
5 California	3198	45 Vermont	64
6 Kentucky	3098	46 Nevada	56
7 New Mexico	2752	47 South Dakota	47
8 Pennsylvania	2694	48 Hawaii	17
9 Alaska	2417	49 Rhode Island	3
10 Oklahoma	2306	50 Delaware	1
US - Total	69380	US - Average	1388

Table 1.3.

Top and Bottom States for Energy Consumption in 2007.[50]

Top 10	*Trillions of BTU's	Bottom 10	
1 Texas	11558	41 Maine	482
2 California	8360	42 Wyoming	462
3 Florida	4563	43 Montana	419
4 New York	4180	44 North Dakota	412
5 Illinois	4122	45 New Hampshire	335
6 Ohio	4082	46 Hawaii	333
7 Pennsylvania	4050	47 Delaware	313
8 Louisiana	3613	48 South Dakota	274
9 Georgia	3173	49 Rhode Island	228
10 Michigan	3167	50 Vermont	167
US - Total	100134	US - Average	2003

The key to US energy independence lies in growing domestic energy production more than it does in shrinking domestic energy consumption; although energy conservation should be included in any energy policy, since reducing consumption can only be beneficial in the end.

[49] Ibid.

[50] Ibid.

Based on the statistics, if every state raised its production-consumption ratio to 40% the nation would have to import 10% less energy; if the ratio was raised to 70%, the current national average, the US would no longer be a net energy importer.[51] [52] To do so, though, would mean to boost production in many states, which means the development of nuclear and renewable energy. Coal, natural gas, and oil cannot be created as new sources of energy production. For fossil fuels, we are limited to the finite amount currently available.[53] Wind and solar power are readily available and are consistently replenished by the environment. Energy from biomass takes a little more effort to produce, but we are not limited to a finite amount.[54] Better utilizing the available natural resources to increase production would have a tremendous impact on energy independence on both a state and national level. The production sources that are sustainable have the greatest potential to increase energy production, and in turn support US energy independence. Many states are not utilizing the natural resources that they have in abundance, such as wind, solar radiation, and geothermal, for production in any significant way.

To answer the question, an analysis of the potential of renewable energy systems will be performed to determine the feasibility of an energy system based on non-traditional sources. The analysis will ascertain the strengths and weaknesses as compared to the current system. For reasons of convenience, proximity, and availability of resources, Mississippi was chosen for assessment. Additionally, Mississippi is a "middle of the pack" state for energy production compared to consumption. Essentially, the analyses will indicate how the state of Mississippi

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[51] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production (Washington, DC, 2007).

[52] US Department of Energy. Energy Information Administration. Consumption, Prices and Expenditures Through 2006 (Washington, DC, November 2008).

[53] Godfrey Boyle. Energy Systems and Sustainability (Oxford: Oxford University Press, 2003).

[54] Ibid.

can develop energy systems without an overwhelming dependence on oil. With energy becoming an important topic in American politics, analysis of the political and policy based solutions can provide valuable information. The arguments for moving away from oil are vast, ranging from cost to the environment. This study should provide a plan for non-oil based energy on the state level. Through research and analysis, I intend to answer the questions surrounding the transition away from oil for Mississippi. The remainder of this chapter will summarize the research findings with regards to the current energy conditions, the renewable energy potential, renewable policy options, and the politics surrounding renewable energy in Mississippi.

Executive Summary:

Current Energy Conditions in Mississippi:

The current energy conditions in Mississippi are an important place to start in considering the potential of renewable energy. Mississippi is the 12th highest consumer of energy per capita in the United States.[55] Mississippi consumed 1,216 trillion BTU's of energy in 2006, and it is forecasted that will rise by approximately 13% by 2030.[56] The biggest sources of energy consumption were from petroleum products and natural gas, accounting for approximately 39% and 26% of consumption respectively.[57] Natural gas was mostly utilized for electricity production while petroleum products were used in transportation. Renewable sources only accounted for 5% of energy consumption.[58] Additionally, the state consumes

[55] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

[56] Ibid.

[57] Ibid.

[58] Ibid.

49,880 thousand MWh from electricity production, which should rise by approximately 23% by 2030.[59] The majority of electricity was generated from natural gas and coal, accounting for approximately 42% and 35% of electricity generation, respectively; although, nuclear power did generate around 19%. Petroleum products only account for less than 1% of electricity production.[60]

Mississippi produces much less energy than it consumes. Total state production accounts for about 31% of energy consumption. In 2006, the state only produced 382.85 trillion BTU's of energy, mostly from nuclear power and petroleum products, with around 27% each.[61] However, natural gas and renewable energy produced around 20% and 16%, respectively.[62] The majority of petroleum and natural gas production comes from the southern region of the state, while nuclear production is result of the single plant in Port Gibson.[63] Petroleum and natural gas production does not keep pace with consumption in the state. The current use of renewable energy has not particularly taken off, with most production coming as a result of agricultural products that are easily put to use.[64]

Mississippi enjoys electricity prices of less than the national average on electricity prices, although fossil fuel prices tend to be slightly above the national average in the state, with the exception of natural gas. The residential electricity prices average 9.64¢ per kWh, but it is

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[59] Ibid.

[60] Ibid.

[61] Ibid.

[62] Ibid.

[63] Ibid.

[64] Ibid.

forecasted to rise to 10.82¢ per kWh by 2030.[65] The average electricity price for all sectors is 8.08¢ per kWh, and is forecasted to rise to 9.27¢ per kWh by 2030.[66] Petroleum averaged $17.75 per million BTU's through the end of 2007 and beginning of 2008[67] and gasoline averaged $21.68 per million BTU's.[68] Residential natural gas averaged $15.25 per million BTU's.[69] Overall, energy prices in Mississippi are not burdensome.

Finally, Mississippi is not a major producer of greenhouse emissions yet there is significant room for improvement. In 2005, Mississippi produced 63,560 thousand metric tons of carbon emissions, which should increase to approximately 8.5% by 2030.[70] The vast majority of those emissions are a result of the transportation and electric power sectors. In 2006, there were an estimated 5,162 alternative fueled vehicles in use in the state, which included both alternative fuels and electric power.[71] A renewable energy program would particularly target those two sectors by replacing petroleum in fueling vehicles and fossil fuels in producing electricity, and could have a positive impact on emissions in the state.

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[65] US Department of Energy. Energy Information Administration. Electric Power Monthly (Washington, DC, March 2008).

[66] Ibid.

[67] US Department of Energy. Energy Information Administration. "Mississippi Crude Oil Wellhead Acquisition Price by First Purchasers (Dollars per Barrel): Petroleum Navigator." http://tonto.eia.doe.gov/dnav/pet/hist/f003028__3m.htm

[68] US Department of Energy. Energy Information Administration. "Mississippi Regular Gasoline Through Company Outlets Price by All Sectors (Cents per Gallon): Petroleum Navigator." http://tonto.eia.doe.gov/dnav/pet/hist/d120430282m.htm

[69] US Department of Energy. Energy Information Administration. "Mississippi Natural Gas Residential Price (Dollars per Thousand Cubic Feet)." http://tonto.eia.doe.gov/dnav/ng/hist/n3010ms3m.htm

[70] US Environmental Protection Agency. Office of Environmental Information. 2008. "CO2 Emissions from Fossil Fuel Combustion – Million Metric Tons CO2 (MMTCO2)." http://www.epa.gov/climatechange/emissions/downloads/CO2FFC_2005.pdf

[71] Ibid.

Renewable Energy Potential in Mississippi:

Wind energy has a mixed potential in Mississippi due mostly to low generation capacity. According to the research methodology employed in Chapter 3, there is approximately 2900 square kilometers of available land for wind energy generation in the state of Mississippi. Further calculations determined that wind energy generation capacity is approximately 2930 thousand MWh a year, or the equivalent of 5.8% of the forecasted electricity generation for 2010. Wind energy generation capacity is high enough to warrant some attention. Economically, wind energy is a fairly attractive energy source, and has the potential to be competitive with the conventional fuel sources currently in use. Most sources estimate the cost of wind energy at between 3¢ and 6¢ per kWh for large scale projects. Although generation costs may vary by project size, estimations indicate that wind energy would still remain competitive with fossil fuel based projects conducted at the same level; due not only to the fuel costs but also with the increased operations, maintenance, and capital costs associated with fossil fuel projects as compared to wind energy projects.

Depending on the size, a wind energy project can be developed in a fairly reasonable timeframe. Most case studies indicate that from groundbreaking to generation is somewhere between 18 months and 2 years, with early planning and licensing stages varying. Although as technology advances and experiences with these projects gains, it is likely that this time frame can be reduced. Wind energy generation has the capability of reducing greenhouse emissions by replacing fossil fuels as an energy sources and thereby nullifying those emissions. Most estimations indicate that wind power can reduce emissions from a similar size fossil fuel project by around 90%. However, some emissions are associated with wind energy due to the production and manufacturing of wind turbines and other wind system components. Wind energy is far more environmentally friendly than conventional sources, although there is the potential for a few minor environmental impacts. While the generation capacity for wind energy in Mississippi is estimated to be low, the economics, development timeline, and environmental impact are all estimated to be much more favorable for its potential to be utilized.

Solar energy lacks a strong potential in Mississippi due mostly to low generation capacity and unfavorable economics. According to the research methodology employed in Chapter 3, there is approximately 3700 square kilometers of available land for solar energy generation in the state of Mississippi. Further calculations determined that solar photovoltaic cells generation capacity is approximately 1665 to 1850 thousand MWh per year, or the equivalent of between 3.3 to 3.7% of the forecasted electricity generation for 2010. Additionally, because solar concentrated power systems require more land, calculations determined that solar concentrated power systems generation capacity is approximately 1295 to 1665 thousand MWh per year, or the equivalent of between 2.6 to 3.3% of the forecasted electricity generation for 2010. Solar energy generation capacity will not yield a large portion of necessary energy but the capacity is not so small as to ignore. Solar energy does not appear to have particularly favorable economics compared to current fuel sources. Cost estimates for solar energy generation range between 7¢ to 18¢ per kWh for solar photovoltaic technologies and 5¢ to 14¢ per kWh for solar concentrated systems. However, solar energy generation costs are expected to be drastically reduced by 2030, due to advancements in both technology and manufacturing techniques. Solar energy does not currently appear to be able to compete with conventional fuel sources unassisted by government policy.

Depending on the size and type, a solar energy project can be developed in a short timeframe. Most case studies indicate that from groundbreaking to generation is somewhere between 6 months and 1 years, with preconstruction phases varying for several reasons.

Although just as the case with wind energy as technology advances and experiences with these projects gains, it is likely that this time frame can be reduced. Solar energy generation can reduce greenhouse emissions through the reduction of fossil fuel use as an energy sources and thereby nullifying those emissions, in the same way as wind energy. While solar energy can be beneficial in terms of emissions, there is certain risk of environmental impact resulting from manufacturing processes and to a lesser extent land use. The processes by which photovoltaic cells and certain components of concentrated solar systems are produced create potentially environmentally harmful byproducts. The large construction and land requirements necessary to implement solar energy only add to the environmental impact. Although, solar energy has a far more positive environmental impact than fossil fuels or nuclear power does. Solar power is not a particularly attractive option for renewable energy in Mississippi, but as potential costs improve solar power should become a much more viable alternative.

Biomass energy seems to have the most potential of any renewable source in Mississippi due both high generation capacity and fairly favorable economics. According to the research methodology employed in Chapter 3, there is approximately between 15.2 and 17.7 million dry tons of biomass products available per year.[72] Further calculations determined that biomass energy generation capacity is approximately between 28,120 thousand and 32,745 MWh a year, or the equivalent of between 55.5% and 64.7% of the forecasted electricity generation for 2010. Biomass has the highest potential for energy generation capacity of any renewable source, although this estimation does not balance energy with other uses of these products which may deflate those estimates. Based on economics, biomass energy is an

[72] A Milbrandt. "A Geographic Perspective on the Current Biomass Resource Availability in the United States." 2005. National Renewable Energy Laboratory Technical Report; Samuel Jackson. "Mississippi Biomass and Bioenergy Overview." 2007. Southeastern Sun Grant Initiative: 1; and Burton English, et al. "25% Renewable Energy for the United States by 2025: State Level Agricultural and Economic Impact Tables." 2007. Department of Agricultural Economics University of Tennessee.

attractive option which can compete with conventional sources; although, the economics is highly variable depending on a few components. For electricity generation, it is estimated that biomass generation costs will range between 2¢ and 13¢, with much of that variability attributed to transportation costs. As long as the biomass products are readily available geographically, generation costs can be kept at the lower end of that spectrum. Additionally, as long as gasoline remains at or above $2 a gallon, both ethanol and biofuels are economically competitive. However, the major economic drawback to biomass as an energy source is the impact on those products used for other purposes.

Biomass projects differ from other renewable projects in that biomass products are widely available and it is just a generation plant equipped for biomass that is necessary to start production. Biomass generation can begin fairly quickly depending on the strategy but most can offer generation within 6 months to a year. Overall, biomass energy leads to a reduction in emissions, through both growing more agricultural products which sequester gases and lower emissions than fossil fuels. Unlike other renewable sources, combustion is necessary to produce energy from biomass which results in emissions, albeit less than those of conventional sources. Additionally, biomass has the potential to utilized land in a productive way that it would not otherwise. However, there is a certain agricultural impact through both impacts on food supply and soil nutrient depletion. Ultimately, the positive environmental impacts of biomass can most likely overshadow the negative, especially if projects are managed appropriately. Major aspect of exploiting biomass will be balancing energy needs with the other uses. If handled properly, biomass energy should emerge as the most appealing renewable energy option.

Renewable Energy Policy Options:

Mississippi is very limited in current state sponsored renewable energy programs with only a loan and grant program, although there are some utility supported programs. Renewable energy policy in Mississippi is thin at best. The federal government has adopted several programs, the majority of which are financial based incentives. Many of the federal programs were in one way or another affected by the American Recovery and Reinvestment Act of 2009. The most successful of federal programs are the tax incentives, which help to reduce the costs associated with renewable energy generation. The federal government also administers several loan and grant programs which have performed well. Although there is no federal renewable portfolio standards, federal facilities have been mandated to acquire a certain level of energy from renewable sources. Additionally, the federal government does provide certain financial programs to encourage state and local governments to explore renewable energy through grants and bonds. The US government has implemented an array of smaller programs to fill out its renewable energy policy but has not employed any broad policies to promote renewable generation. The renewable production credit has performed very well in promoting renewable generation, but has proven to have higher social costs associated with it as well as not being as cost effective as a renewable portfolio standard. The loan, grant, and subsidy programs are crucial in getting research and development off the ground but as technology emerges these programs become less important and less effective in reducing costs and advancing technology. Federal programs have not been overwhelmingly effective in employing renewable energy for generation but have managed to keep down energy costs. Overall, federal policies have been effective in developing renewable energy technology and encouraging some production, but those goals have not included widespread adoption of renewable energy. Therefore, government policy to promote renewable energy has been relegated to the states, who have done a much more effective job of it.

State governments have emerged as leaders of renewable energy policy in recent years. The most successful and popular of the state level programs are renewable portfolio standards and state net metering. Renewable portfolio standards institute a minimum level of energy production from renewable energy systems. Currently, 29 states have mandatory renewable portfolio standards and four more have implemented voluntary standards or goals. Nearly three-quarters of renewable energy additions in 2007 were a result of renewable portfolio standards, with little or no effects on energy prices. However, success with renewable portfolio standards does rely on both proper policy design and implementation. A successful renewable portfolio standard must balance energy costs, long term energy strategy, and environmental impacts with the objectives of the program. Texas enacted a clear policy strategy to meet its goals and has found much success in doing so; however, Pennsylvania implemented a complex, highly regulated system that has seen only limited success. Although renewable portfolio standards have up to this point been a creation of state government, there have been some calls for a national renewable portfolio standard. A national standard could encourage renewable growth across the country, while applying a remedy to some of the inconsistency with current state programs, though this may restrict states from pursuing their own renewable goals. If properly designed and implemented at the state level, a renewable portfolio standard can have a significantly positive impact on the growth of renewable energy without sacrificing consumer costs.

State net metering is aimed at smaller renewable energy generation systems, whereas renewable portfolio standards are aimed at larger scale renewable generation. State net metering allows for consumers to produce their own electricity from renewable sources, which offset electricity purchased from the grid on their energy bills; they are only charged for the net electricity used. Currently, 44 states have implemented state net metering with similar results across the country. State net metering has proven to be an easy policy to employ to encourage the growth of small renewable systems, through what amounts to financial incentives, with little impact on costs. Unlike, renewable portfolio standards, formulating and implementing state net metering is much easier process with a fairly standard policy design across the nation. While state net metering has proven to benefit consumers, there are some drawbacks for public utilities who have to maintain distribution and transmission lines without compensation for the electricity generated through these small systems. However, there is little evidence to suggest that there is a significant impact on consumer costs. State net metering is not responsible for nearly the kind of growth as renewable portfolio standards, but has been able to get the public involved renewable generation which may go a long way in garnering further political support. Overall, both renewable portfolio standards and state net metering have been successful programs at promoting renewable energy generation without sacrificing energy costs.

International experience indicates that many nations have had varying results with renewable energy initiatives. Many European countries have found success with renewable energy initiatives, the most popular being renewable portfolio standards and feed in tariffs. Most evidence suggests that the feed in tariff is a very effective policy, whereby renewable energy generators are granted a fixed price to produce electricity.[73] Germany has found particular success with renewable energy policy, being one of the international leaders in renewable generation; much of the success can be attributed to institutional reforms that support renewable development. The German system has also adopted a strategy to employ

[73] Doerte Fouquet and Thomas Johansson. "European Renewable Energy Policy at Crossroads – Focus on Electricity Support Mechanims." 2008. Energy Policy 36.

further financial incentives, such as loans, investments, and tax allowances, to support renewable growth.[74] Criticism of the British renewable portfolio standard suggest that under that system the market is much less stable compared to the feed in tariffs used in Germany and the Netherlands.[75] Australia has made some attempts to implement renewable energy policy at both the state and national levels. Australian initiatives have been greatly disadvantaged by the lack of coordination between state and national policies which only further complicate attempts to develop renewable energy.[76] South Africa has no found any great success with their renewable energy policies, due to both lack of government initiative and proper infrastructure. Though the South African government indicated a need to explore renewable energy, no real initiative or interest on their part has been shown since. Furthermore, the country lacks the infrastructure to deliver electricity which further hampers efforts. Although, the government has begun to set targets for renewable energy, little policy to support those goals has been implemented.[77]

China is attempting to make strides in renewable energy but has been met with limited success. The Chinese system has emphasized the government's role in renewable growth, rather than the role of interests which has severely limited development.[78] Additionally, the

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[74] Mischa Bechberger and Danyel Reiche. "Renewable Energy Policy in Germany: Pioneering and Exemplary Regulations." 2004. Energy for Sustainable Development 8.

[75] Judith Lipp. "Lessons for Effective Renewable Electricity Policy from Denmark, Germany, and the United Kingdom." 2007. Energy Policy 35.

[76] Stephen Jones. "The Future of Renewable Energy in Australia: A Test for Cooperative Federalism?" 2009. Australian Journal of Public Administration 68.

[77] AB Sebitosi and P Pillay. "Renewable Energy and the Environment in South Africa: A Way Forward." 2008. Energy Policy 36.

[78] Judith Cherni and Joanna Kentish. "Renewable Energy Policy and Electricity Market Reforms in China." 2007. Energy Policy 35.

large land mass and lack of infrastructure only exacerbates the problem of delivering energy.[79] Brazil has been utilizing renewable energy policy for a while with a major focus on biomass. The Brazilian program has emphasized renewable energy as a means of social and economic development for the underdeveloped portions of the country. The major obstacle of the Brazilian program, though, is the institutional system set up whereby local communities have been encouraged to participate but have later been edged out and private interests are encouraged to provide develop in areas that have little promise for profitability.[80] Middle Eastern nations, which have the least amount of pressure of any region to explore renewable energy, have begun to explore some programs. The programs mostly emphasize research and development, and implementing some solar power projects. Nevertheless, there has not been an overwhelming push for renewable energy in the region, because of the abundant, readily available fossil fuel supply.[81] Generally, there has only been mixed success with renewable energy policy around the world, with much results being affected by the policy instrument design.

Politics of Renewable Energy in Mississippi:

The political culture will have a strong impact on public support for renewable energy policy. In Elazar's famous inventory of political culture, he defined Mississippi as a traditionalistic political culture. The traditionalistic culture is exactly what it sounds like, a culture that supports traditional values, elitism, and opposition to change. The culture is

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[79] Dan Shi. "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Circumstances." 2009. China and World Economy 17.

[80] BJ Ruiz, V Rodriguez, and C Bermann. "Analysis and Perspectives of the Government Programs to Promote the Renewable Electricity Generation in Brazil." 2007. Energy Policy 35.

[81] Konstantinos Patlitzianas, Haris Doukas, and John Psarras. "Enhancing Renewable Energy in the Arab States of the Gulf: Constraints and Efforts." 2006. Energy Policy 34.

resistant to innovation and change and supports government to work only to maintain the existing social and political order.[82] Across the country, traditionalistic political cultures are not favorable of renewable energy policy. Of the traditionalistic states none have renewable portfolio standards, except for a voluntary standard in Virginia, and only half have state net metering, including the voluntary measures in South Carolina. On the other hand, of the moralistic states, all have renewable energy policy, though three states are only voluntary, and all have state net metering; of the individualistic states, only two of nine lack renewable portfolio standards and none lack state net metering.[83] Moralistic cultures are those where the greater good is held above that of the individual and the government tends to be seen in a positive light. Individualistic cultures encourage a limitation of government intervention into private areas. All in all, traditionalistic political cultures are the least likely to support basic renewable energy policies. For the most part, Mississippi as well as the other traditionalistic states have a long history of resisting innovation and change in government. Threats to the existing social and political order are typically met with opposition, which a strong renewable energy policy has the potential to do through economic development and growing new industries.[84] The traditionalistic cultures have several elements that will not be cohesive with a renewable energy policy.

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[82] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984).

[83] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984): 109 and Database of State Incentives for Renewables and Efficiency. "Rules, Regulations, and Policies for Renewable Energy." North Carolina State University, North Carolina Solar Center, http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7&EE=0&RE=1.

[84] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984): 109.

The political culture of Mississippi can be summed in three fundamentals that may affect renewable energy policy. First, the community-based political culture encourages a disjunction from the rest of the globe.[85] The arguments for both sustainability and environmental protection quickly go out the window when the public has little or no interest in what happens outside their own communities. However, certain alternative energy policies could place renewable energy systems within local communities, thereby garnering support by forging a local connection with renewable energy. Second, the Mississippi public is infamously uninformed about government affairs.[86] Renewable energy is not a black and white issue and requires comprehension to understand the costs and benefits of policies that may inhibit or encourage it. Therefore, one of the major barriers is gaining public support will be simply informing the public on the issue rather than leaving them in the dark as has been the practice in the past. Finally, the political culture supports limited government intervention which extends to limiting the ability of public entities to pursue public goods, which could inhibit a renewable energy policy.[87] For a variety of reasons, government policy must promote renewable energy which will involve intervention from public entities. The political culture at its heart may be at odds with the pursuit of a renewable energy policy, but there are variables that can be exploited to gain public support.

Political interests play an important role in influencing any government operations. In Mississippi, the most influential political interests come from the business community, mostly as

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[85] Dale Krane and Stephen Shaffer. "Culture and Politics in Mississippi: It's Not Just Black and White." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 16.

[86] Stephen Shaffer and Dale Krane. "Tradition Versus Modernity in Mississippi Politics." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 286.

[87] Ibid.

public utilities, industry, and oil and natural gas companies, as a result of both financial resources and community impact. However, there are less influential political interests that have the potential to affect renewable energy policy. Lobbyists in Mississippi enjoy a special relationship with most government officials. The structure of the state legislature has allowed lobbyists to become an important source of information for legislators, and as goals intertwine lobbyists tend to work hand-in-hand with state agencies. Lobbyists fit into a special niche in Mississippi government and therefore have special influence over government operations.[88]

Public utilities should take a major interest in renewable energy policy because of the implications for their business. Regulation policy, like renewable portfolio standards and state net metering, may not work in their favor but are not likely to draw to much opposition because of public relations reasons, while financial incentives could serve as a benefit and should gain some support. The oil and natural gas interests at face value may be opposed to renewable energy because it may erode their primary market. However, the major oil and natural gas companies have made significant investments into renewable technology research and development and may want to see those investments pay off, which could account for the renewable policies in Texas and California. The influence of industrial interests may vary depending on the policy instrument and potential effects on energy prices. As long as any policy adopted is likely to have positive impact on their business, the industrial interests should support the initiative, though the opposition is true if the policy has the potential to raise energy prices or affect their business practices.

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[88] Thomas Handy. "Mississippi: An Expanding Array of Interests." In Interest Group Politics in the Southern States, eds. Ronald Hrebenar and Clive Thomas (Tuscaloosa, Alabama: University of Alabama Press, 1992): 294.

Agricultural interests should only have one major interest in influencing renewable energy policy, and that would be to emphasis biomass. Biomass energy could open a new market for most of the agricultural industry in the state. Although, changing from old ways to new ways has never been a strong point in the state so there may be some opposition found within the agricultural interests. Environmental interests in the state are not very strong, but renewable energy legislation could draw the attention of national environment interests. If the national environmental interests become active in influencing renewable legislation, the financial resources and potential for national spotlight could bring significant support for renewable energy policy. There are a few public interest groups active in renewable energy policy in the state. While these groups are not directly influential in legislative affairs, they should be important in lobbying other interests and the public. Garnering both public support and organizing other interests into supporting renewable energy could amount to a major role in influencing legislative outcomes for the public interests groups.

Many of the political institutions of Mississippi are not particularly adept for policy innovation, which will be necessary for renewable energy in the state. The Mississippi Constitution of 1890 is a complex document that tends to tie the hands of lawmakers, with excessive details in governing law and uncoordinated articles, and make policy innovation difficult. Moreover, the Constitution has always carried an anti-business flair which gives the government powers over corporations that make doing business in the state unattractive and may make renewable energy development unappealing for private entities. Additionally, the Constitution has created a government with a weak governor and strong legislature that has its own implications for renewable energy policymaking. The responsibility of the governor to administer the government is not equal to the power granted, because of the diffusion of power between the publicly elected leaders of the executive branch. The powers of the executive branch are distributed between several elected leaders which limits the governor's powers to influence the operations of government. The legislature suffers a similar dilemma in that it has no central leadership outside of the Lt Governor and the Speaker of the House. Additionally, much authority is invested into the large committee structure further decentralizing power. More often than not, policymaking on major issues in the states becomes a battle between the branches of government. State legislatures are rarely agents of reform and states with strong governors typically have coordinated, rational policymaking; Mississippi has adopted the political system that is least likely to result in policy innovation.

Additionally, there is a variety of state agencies that may find interests in affecting renewable energy policy which only adds to the lack of strong clear leadership on the issue. A renewable energy policy in the state is likely to position certain state agencies in a position to gain political power through control over the growth of new industry. Both elected leaders and state agencies heads stand in a position to influence renewable energy legislation, but not in a position to lead efforts to adopt such legislation. The interests of several state agencies mean that their political agenda will be inserted into the policymaking process which can only add further barriers to adopting a renewable energy policy. Without clear leadership on renewable energy, the policymaking process is likely to devolve into a battle of political agendas between state agencies and government branches. Finally, Mississippi has a rather tumultuous relationship with the federal government. Mississippi has never been a fan of intervention in state affairs by the federal government, unless the intervention is on an issue which is in favor of the state. Therefore, the relationship between the federal and state governments may have mixed implications for renewable energy policy in the state. Essentially, the institutional barriers to renewable policy in Mississippi are a rather elaborate combination of a lack of clear leadership on policymaking and a fickle relationship between branches and levels of government.

Implications of Renewable Energy Reform in Mississippi:

For a renewable energy program to be successful in Mississippi, both a political strategy and public policy must be effectively developed and utilized to address the particular circumstances of the state. A well planned political strategy should draw enough attention from the public, without being to contrary to economic interests, to gain the support of public officials. A comprehensive public policy should adapt successful lessons from other governments while aiming to satisfy the unique short and long-term energy goals of Mississippi.

Renewable energy has the capability of meeting much of Mississippi's energy needs while providing both economic and environmental benefits. Biomass energy by far appears to have the greatest potential success because of both high generation capacity and favorable economics, and therefore should be favored in any renewable policy to achieve the best results. Although wind and solar energy are less attractive options, they should be included in any renewable energy program to ensure both diversification in source and the exploitation of all available resources. Mississippi has many natural resources that should be exploited to better provide for its energy needs. The best strategy to promote renewable development in Mississippi is to formulate and implement a coordinated renewable energy policy. A renewable portfolio standard would produce a strong framework for both renewable goals and development. The renewable portfolio standards should be reinforced with other both financial incentives and state net metering. Financial incentives, including both tax credits and loan or grant programs, would reduce the financial burdens of private development of renewable energy systems, while state net metering would encourage small scale production as well. A single policy instrument is not the answer rather a comprehensive, coordinated renewable energy policy should be developed. A state based renewable energy policy can be the best option in promoting the development of renewable energy generation.

While the politics of renewable energy in Mississippi are not particularly favorable, they do allow for some openings to pursue renewable programs. The political culture may be hostile to challenges of the existing order and ignorant of the wider implications of renewable energy, but a public support campaign focused on the potential of local energy generation and economic benefits should counterbalance both those obstacles. Political interests in the state are varied in their potential to support a renewable program, but if handled correctly they should be able to find benefits within a renewable policy to either garner their support or stifle their opposition. The political institutions in the state are adverse to policy innovation, but strong leadership from public officials coupled with the support of the political interests and public should overcome the obstacles. The political strategy should place emphasis on the local issues related to renewable development over the global issues, while working to best address the concerns of the economic interests in the state and gain the backing of public officials.

CHAPTER 2

CURRENT MISSISSIPPI ENERGY CONDITIONS

In assessing the future of energy in Mississippi, the current energy condition in the state should be taken into account. The assessment will provide a foundation for the analysis of alternative energy programs. The information for the assessment will be drawn from reports by the Energy Information Administration, unless otherwise noted. For simplification, measures of energy will be converted to British thermal units (BTU's), while electricity will be measured in megawatt-hours (mWh), except where noted otherwise, and all prices will be in real (2007) dollars. This chapter will focus on the conditions in Mississippi with regards to the challenges that an alternative energy program will have to address. This chapter will also take into account forecasts for future energy conditions. National forecasts from the Energy Information Administration will be employed for Mississippi, whereby the national cumulative percentage changes will be applied to Mississippi to determine energy conditions for 2010, 2020, and 2030; specific sources will not be included in forecasts because of varying conditions. The overview will cover consumption, production, prices, and environmental impact.

Consumption:

Consumption is the total amount of energy consumed within a state. In 2006, the state of Mississippi consumed 1,216 trillion BTU's of energy.[89] Based on Department of Energy

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[89] US Department of Energy. Energy Information Administration. Consumption, Prices and Expenditures Through 2006 (Washington, DC, November 2008).

forecasts, total energy consumption should grow by -0.1% by 2010, 5.3% by 2020, and 13.26% by 2030; total energy consumption for Mississippi should be 1,214 trillion BTU's in 2010, 1,281 trillion BTU's in 2020, and 1,377 trillion BTU's in 2030.[90] In 2006, Mississippi ranked 12th in the nation for per capita energy consumption, at 419 million BTU's per person. The total energy consumption can be broken down into sources. Petroleum consumption totaled 86,777 thousand barrels, including 40,097 thousand barrels of gasoline.[91] Petroleum consumption was the equivalent of 477.1 trillion BTU's, while gasoline consumption was the equivalent of 209.2 trillion BTU's. Petroleum consumption is mostly from the transportation sector, with less than 10% used for electricity generation. In 2006, Mississippi consumed 307,293 million cu ft of natural gas, or 314.4 trillion BTU's. Natural gas consumption is mostly from electricity generation and home heating. Electricity generation accounts for a little more than 60% of natural gas consumption. Natural gas also supplies energy for 37% of home heating needs. In 2006, the state consumed 190.1 trillion BTU's in coal. Coal is used mostly in electricity generation and the industrial sector. The state consumed 108.7 trillion BTU's in nuclear energy, 62.9 trillion BTU's in renewable energy sources. Nuclear energy is used exclusively for electricity generation, while renewable energy sources are used for a variety of purposes. The consumption total includes 62.6 trillion BTU's in electricity gains from neighboring states; that is electricity transported into the state.[92] (See Table 2.1.)

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[90] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[91] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[92] US Department of Energy. Energy Information Administration. Consumption, Prices and Expenditures Through 2006. (Washington, DC, November 2008).

Table 2.1.

Mississippi Energy Production and Consumption by Source, and Future Estimates (Trillion BTU's)

Fuel Source	Production[93]	Consumption[94]
Natural Gas	78.34	314.4
Coal	36.22	190.1
Nuclear	105.02	108.7
Renewable	60.62	62.9
Petroleum	102.63	477.1
-Gasoline	-	209.2
Total	382.85	1216
2010 Estimate	415.60[95]	1214[96]
2020 Estimate	490.42[97]	1281[98]
2030 Estimate	642.23[99]	1377[100]

By end-use sector, industrial and transportation consumption far out-paced that of other sectors. In 2006, the industrial and transportation sectors consumed 445.6 trillion BTU's and 377.6 trillion BTU's, respectively. Consumption in the industrial sector includes 105.9 trillion BTU's in natural gas, 108.2 trillion BTU's in petroleum, and 115.9 trillion BTU's in electricity losses.[101] Based on Department of Energy forecasts, energy consumption in the

[93] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production (Washington, DC, 2007).

[94] US Department of Energy. Energy Information Administration. Consumption, Prices and Expenditures Through 2006. (Washington, DC, November 2008).

[95] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009 (Washington, DC, 2008).

[96] Ibid.

[97] Ibid.

[98] Ibid.

[99] Ibid.

[100] Ibid.

[101] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

industrial sector should decline by 5.3% by 2010 and 2.4% by 2020, and grow by 3.1% by 2030; industrial energy consumption for Mississippi should therefore be 421.82 trillion BTU's in 2010, 434.78 trillion BTU's in 2020, and 459.14 trillion BTU's in 2030.[102] Consumption in the transportation sector included 355.1 trillion BTU's in petroleum, or in other words petroleum accounts for 94% of transportation needs.[103] Energy consumption in the transportation sector should decline by 2.6% by 2010, and grow by 2.1% by 2020, and 11.5% by 2030; transportation energy consumption for Mississippi should be 367.94 trillion BTU's in 2010, 385.31 trillion BTU's in 2020, and 421.12 trillion BTU's in 2030.[104] The decrease in the next few years is most likely the result of increased federal energy efficiency standards for automobiles and rising gasoline prices. Since more than two-thirds of energy consumption comes from the industrial and transportation sectors. In 2006, the residential sector consumed 229.4 trillion BTU's and the commercial sector consumed 163.1 trillion BTU's.[105] Energy consumption in the residential sector should grow by 5.4% by 2010, 9.1% by 2020, and 15.6% by 2030; residential energy consumption for Mississippi should be 241.85 trillion BTU's in 2010, 250.31 trillion BTU's in 2020, and 265.1 trillion BTU's in 2030.[106] Energy consumption in the commercial sector should grow by 6.9% by 2010, 20.6% by 2020, and 32.3% by 2030; commercial energy consumption for Mississippi should be 174.37 trillion BTU's in 2010, 196.61 trillion BTU's in 2020, and 215.74

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[102] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009 (Washington, DC, 2008).

[103] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

[104] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[105] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

[106] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

trillion BTU's in 2030.[107] The forecasts assert that residential commercial sectors will grow faster than in the industrial and transportation sectors. (See Table 2.2.)

Table 2.2.

Mississippi Energy Consumption by Sector, by Year. (Trillion BTU's)

Sector	2006[108]	2010[109]	2020[110]	2030[111]
Residential	229.4	241.85	250.31	265.1
Commercial	163.1	174.37	196.61	215.74
Industrial	445.6	421.81	434.78	459.14
Transportation	377.6	367.94	385.31	421.12

Electricity generation is a secondary energy production process. According to the Department of Energy, "Mississippi's electric power production is low, and the State imports electricity from neighboring States in order to satisfy consumer demand…Mississippi's residential per capita electricity use is high, due in part to high air-conditioning demand during hot summer months and the widespread use of electricity for home heating during generally mild winter months."[112] Electric power utilities engage in the production, transmission, and distribution of electricity, while the independent producers only produce electricity. Currently, Mississippi Power Company, Entergy Mississippi Inc, and South Mississippi Electric Power

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[107] Ibid.

[108] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

[109] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[110] Ibid.

[111] Ibid.

[112] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

Association are the major electric power utility companies in the state.[113] Electric power produced in the industrial or commercial sectors is electricity produced privately and usually on-site to power operations. In 2007, net electricity generation in the state of Mississippi was 49,880 thousand megawatt-hours.[114] Based on Department of Energy forecasts, net electricity generation should grow by 1.5% by 2010, 11% by 2020, and 23.8% by 2030; net electricity generation for Mississippi should be 50,639 thousand megawatt-hours in 2010, 55,343 thousand megawatt-hours in 2020, and 61,760 thousand megawatt-hours in 2030.[115] Almost of all electricity generation came from the electric power sector with a total of 48,019 thousand mega-watt hours. Electric power utilities generated 36,048 thousand megawatt-hours; independent producers generated 11,971 thousand megawatt-hours.[116] Electric power sector generation should grow by 1.1% by 2010, 9.7% by 2020, and 21.2% by 2030; electricity generation in Mississippi should be 48,534 thousand megawatt-hours in 2010, 52,681 in 2020, and 58,215 in 2030.[117] In 2007, the industrial sector produced 1,849 thousand megawatt-hours; the commercial sector produced 12 thousand mega-watt hours.[118] (See Table 2.3.)

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[113] Ibid.

[114] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[115] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[116] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[117] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[118] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

Table 2.3.

Net Electricity Generation and Electric Power Sector Generation by Year in Mississippi. (Thousand mWh)

Year	Net Electricity Generation	Electric Power Sector
2007[119]	49,880	48,019
2010[120]	50,639	48,534
2020[121]	55,343	52,681
2030[122]	61,760	58,215

In 2007, natural gas, coal, and nuclear energy were the most widely used sources of electricity production. Natural gas generated 21,115 thousand megawatt-hours in electricity.[123] Coal generated 17,451 thousand megawatt-hours in electricity.[124] Nuclear energy generated 9,359 thousand megawatt-hours in electricity.[125] Renewable energy generated 1,497 thousand megawatt-hours in electricity.[126] Mississippi "produces a small amount of electricity from a wood-fired power plant in the eastern part of the State."[127] Petroleum generated 399 thousand

[119] Ibid.

[120] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[121] Ibid.

[122] Ibid

[123] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[124] Ibid.

[125] Ibid.

[126] Ibid.

[127] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi (Washington, DC, December 2008).

megawatt-hours of electricity.[128] Other gases generated 41 thousand megawatt-hours of electricity.[129] Other gases "include blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels."[130] Other energy sources generated 20 thousand megawatt-hours of electricity.[131] Other energy sources include "include non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire -derived fuel, and miscellaneous technologies."[132] Electricity generation is a major element of energy consumption, but is secondary production.

For electricity, natural gas was by far the favorite fuel for consumption. Petroleum consumption from electricity is not overwhelming. In 2007, natural gas consumption from electricity generation was 187,316 million cubic feet. Natural gas accounted for 42.3% of electricity generation. In 2007, coal consumption for electricity generation was 9910 thousand tons. Coal accounted for 35% of electricity generation. In 2007, petroleum consumption for electricity generation was 724 thousand barrels. Petroleum accounted for less than 1% of electricity generation. Energy consumption levels will have to be met by non-conventional sources, such as wind, solar, or biomass, to produce a energy future in Mississippi that is sustainable, environmentally friendly, and affordable.

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[128] US Department of Energy. Energy Information Administration. Electric Power Monthly (Washington, DC, Mach 2008).

[129] Ibid.

[130] Ibid.

[131] Ibid.

[132] Ibid.

Production:

Production is the amount of primary energy produced within a state. Ultimately, Mississippi produced 382.85 trillion BTU's of energy during 2006.[133] Based on Department of Energy forecasts, total energy production should grow by 8.6% by 2010, 18% by 2020, and 31.2% by 2030; total energy production for Mississippi should be 415.60 trillion BTU's in 2010, 490.42 trillion BTU's by 2020, and 642.23 trillion BTU's by 2030.[134] For the year spanning August 2007 to July 2008, Mississippi produced 21,582 thousand barrels of crude oil.[135] In 2005, petroleum products accounted for 102.63 trillion BTU's.[136] The state accounts for about 1.6% of US oil production. Collectively, the state claims 200 million barrels of crude oil in reserve, or enough to sustain the state's oil consumption for just over 6 years. Mississippi currently has approximately 1,555 crude oil wells and 1,836 natural gas wells. The state has three petroleum refining plants located along the Gulf Coast and in Vicksburg, with a refining capacity of 364,000 barrels per day.[137]

In 2006, Mississippi produced 60,531 million cu ft of natural gas.[138] In 2005, natural gas accounted for 78.34 trillion BTU's.[139] Mississippi accounts for about 0.3% of US production.[140]

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[133] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production. (Washington, DC, 2007).

[134] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009 (Washington, DC, 2008).

[135] US Department of Energy. Energy Information Administration. "Mississippi Crude Oil Production (Thousand Barrels): Petroleum Navigator." http://tonto.eia.doe.gov/dnav/pet/hist/mcrfpms1m.htm

[136] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production (Washington, DC, 2007).

[137] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[138] US Department of Energy. Energy Information Administration. "Mississippi Natural Gas Marketed Production (Million Cubic Feet): Natural Gas Navigator." http://tonto.eia.doe.gov/dnav/ng/hist/n9050ms2a.htm

According the Department of Energy, " In recent years, new wells have been completed at the Mariner Field along the Gulf Coast and at the Maben Field in the Black Warrior Basin. Despite new completions, Mississippi's marketed natural gas production has fallen drastically since 2003, when the State's natural gas wells began producing increasing volumes of non-hydrocarbon gases, such as carbon dioxide, helium, hydrogen sulfide, and nitrogen."[141] Natural gas reserves are divided into dry and liquid natural gas forms. Dry natural gas reserves amount to 954 billion cubic feet; natural gas liquid reserves amount to 9 million barrels.[142] In 2007, Mississippi produced 3,545 thousand short tons of coal.[143] In 2005, coal accounted for 36.2 trillion BTU's.[144] According to the Department of Energy, "Mississippi's only coal mine, located in Choctaw County, supplies lignite coal to a 440-megawatt mine-mouth power plant that uses clean-coal technology. Mississippi's other coal-fired power plants are fueled by coal shipped primarily from Colorado." Mississippi coal is not very plentiful or of high quality.[145]

In 2005, nuclear power accounted for around 105.2 trillion BTU's of energy, generated as electricity.[146] Mississippi has a single large nuclear reactor located at the Grand Gulf Nuclear

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[139] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production. (Washington, DC, 2007).

[140] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[141] Ibid.

[142] Ibid.

[143] US Department of Energy. Energy Information Administration. Annual Coal Report. (Washington, DC, 2007).

[144] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production. (Washington, DC, 2007).

[145] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[146] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production. (Washington, DC, 2007).

Power Station near Port Gibson.[147] A second nuclear power station is being considered currently, but development is many years away.[148] In 2005, renewable energy sources accounted for around 60.62 trillion BTU's of energy.[149] Renewable energy includes "wood, black liquor, other wood waste, biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, other biomass, geothermal, solar thermal, photovoltaic energy, and wind."[150] The majority of renewable energy produced in the state is derived from agricultural products.[151] (See 2. 1.) Energy production accounts for the supply side of the energy conditions.

Prices:

As important as any aspect of energy are consumer prices. Energy prices typically vary throughout the year, therefore the average price will be used. Electricity prices tend to peak during the summer months, and sink during the winter months. Typically, the electricity prices in Mississippi are slightly below that of the US. Electricity prices differ by sector and are priced by kilowatt-hours, with residential electricity being the most expensive followed by commercial and industrial being the cheapest. In 2007, the average electricity price for all sectors was 8.08¢ in Mississippi, compared to 8.9¢ as the national average.[152] Based on Department of Energy

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[147] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[148] Matthew Wald. "Mississippi Extends Hospitality to Nuclear Power." New York Times, January 27, 2005.

[149] US Department of Energy. Energy Information Administration. State Energy Data 2005: Production. (Washington, DC, 2007).

[150] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[151] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[152] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

forecasts, average electricity prices should decline by 1.6% by 2010, and grow by 3.2% by 2020, and 14.8% by 2030; average electricity prices in Mississippi should be 7.95¢ per kilowatt-hour in 2010, 8.34¢ per kilowatt-hour in 2020, and 9.27¢ per kilowatt-hour in 2030.[153] Residential electricity averaged 9.4¢ in Mississippi, and 10.64¢ for the national. [154] Electricity prices in the residential sector should decline by 1.4% by 2010, and grow by 4.8% by 2020, and 15.1% by 2030; residential electricity prices in Mississippi should be 9.27¢ per kilowatt-hour in 2010, 9.86¢ per kilowatt-hour in 2020, and 10.82¢ per kilowatt-hour in 2030.[155] Commercial electricity averaged 8.95¢ in Mississippi, and 9.67¢ nationally.[156] Electricity prices in the commercial sector should decline by 3.3% by 2010, and grow by 0.2% by 2020, and 10.8% by 2030; commercial electricity prices in Mississippi should be 8.65¢ per kilowatt-hour in 2010, 8.97¢ per kilowatt-hour in 2020, and 9.92¢ per kilowatt-hour in 2030.[157] Industrial electricity averaged 5.86¢ in Mississippi, and 6.36¢ nationally.[158] Electricity prices in the industrial sector should decline by 0.1% by 2010, and grow by 2.2% by 2020, and 16.3% by 2030; industrial electricity prices in

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[153] "US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[154] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[155] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[156] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[157] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[158] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

Mississippi should be 5.85¢ per kilowatt-hour in 2010, 5.98¢ per kilowatt-hour in 2020, and 6.81¢ per kilowatt-hour in 2030.[159] (See Table 2.4.)

Table 2.4.

Electricity Prices by Sector per Kilowatt-hours, by Year in Mississippi.

Sector	2007[160]	2010[161]	2020[162]	2030[163]
Residential	9.64¢	9.27¢	9.86¢	10.82¢
Commercial	8.95¢	8.65¢	8.97¢	9.92¢
Industrial	5.86¢	5.85¢	5.98¢	6.81¢
Average	8.08¢	7.95¢	8.34¢	9.27¢

Crude oil, and subsequently gasoline prices, reached their all time high during the summer of 2008. Typically, petroleum prices in Mississippi are slightly above that of the national average. Based on the most current energy report from the Energy Information Administration, petroleum and natural gas price ranges will be calculated from the previous 12 months from October 2007 to September 2008. In Mississippi, crude oil ranged from $80.19 per barrel in October to $128.91 in June, averaging $102.60.[164] Gasoline ranged from $2.29 per

[159] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[160] US Department of Energy. Energy Information Administration. Electric Power Monthly. (Washington, DC, March 2008).

[161] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[162] Ibid.

[163] Ibid.

[164] US Department of Energy. Energy Information Administration. "Mississippi Crude Oil Wellhead Acquisition Price by First Purchasers (Dollars per Barrel): Petroleum Navigator." http://tonto.eia.doe.gov/dnav/pet/hist/f003028__3m.htm

gallon in September to $3.49 in July, averaging $2.89.[165] The state gasoline tax rate is 18.4¢ per gallon.[166] Therefore, crude oil averaged $17.75 per million BTU's, while gasoline averaged $21.68 per million BTU's, over the 12 months.

Natural gas is priced at the wellhead, city gate, and for residential consumption by thousand cubic feet. The wellhead price is "the value at the mouth of the well…[it] is considered to be the sales price obtainable from a third party in an arm's length transaction."[167] The city gate price is the value at "a point or measuring station at which a distributing gas utility receives gas from a natural gas pipeline company or transmission system."[168] The residential price is "the price of gas used in private dwellings, including apartments, for heating, cooking, water heating, and other household uses."[169] Natural gas prices are typically below that of the national average. Natural gas at the wellhead averaged $6.84.[170] City gate natural gas ranged from $8.16 in September to $12.72 in June, averaging $10.01.[171] Residential natural gas ranged from $11.55 in January to $20.49 in June, averaging $15.55.[172] Therefore, natural gas average$6.64

[165] US Department of Energy. Energy Information Administration. "Mississippi Regular Gasoline Through Company Outlets Price by All Sectors (Cents per Gallon): Petroleum Navigator." http://tonto.eia.doe.gov/dnav/pet/hist/d120430282m.htm

[166] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[167] US Department of Energy. Energy Information Administration. "Definitions, Sources, and Explanatory Notes: Natural Gas Navigator." http://tonto.eia.doe.gov/dnav/ng/TblDefs/ng_pri_sum_tbldef2.asp

[168] Ibid.

[169] Ibid.

[170] US Department of Energy. Energy Information Administration. "Mississippi Natural Gas Wellhead Price (Dollars per Thousand Cubic Feet)." http://tonto.eia.doe.gov/dnav/ng/hist/na1140_sms_3a.htm

[171] US Department of Energy. Energy Information Administration. "Natural Gas City Gate Price in Mississippi (Dollars per Thousand Cubic Feet)." http://tonto.eia.doe.gov/dnav/ng/hist/n3050ms3m.htm

[172] US Department of Energy. Energy Information Administration. "Mississippi Natural Gas Residential Price (Dollars per Thousand Cubic Feet)." http://tonto.eia.doe.gov/dnav/ng/hist/n3010ms3m.htm

per million BTU's at the wellhead, average $9.81 per million BTU's at city gate, and averaged $15.25 per million BTU's for residential.

In Mississippi, coal is normally above that of the national average. Coal averaged $2.77 in Mississippi, and $2.17 nationally per million BTU's as delivered to the electric power sector. The Energy Information Administration will not disclose more detailed statistics because they are "withheld to avoid disclosure of individual company data."[173] Energy prices will be a major aspect in dictating the success of alternative energy sources. The price ranges per million BTU's produce the price ranges that alternative fuel sources will have to fall into to become economically competitive with conventional fuels. The overview of energy prices should provide a price standard at which non-conventional energy would be economically viable.

Environmental Impact:

The environmental aspects of energy have become more important over the last few years. The major environmental concern, as far as energy is concerned, are greenhouse gas emissions, most importantly carbon dioxide (CO_2). The Kyoto Protocol urges that emissions level be reduced to that of the 1990 level, therefore the most recent emissions level as well as the 1990 level should be compared. In 2005, total carbon dioxide emissions for the state of Mississippi were 63,560,000 metric tons, or just over 1% of total US emissions. In 1990, Mississippi total carbon dioxide emissions were 48,450,000.[174] Based on Department of Energy forecasts, total carbon emissions should decline by 1.5% by 2010 and grow by 1.5% by 2020, and

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[173] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[174] US Environmental Protection Agency. 2008. "CO2 Emissions from Fossil Fuel Combustion – Million Metric Tons CO2 (MMTCO2)."
http://www.epa.gov/climatechange/emissions/downloads/CO2FFC_2005.pdf

8.5% by 2030; emissions for Mississippi should be 62,616,000 metric tons in 64,487,000 metric tons in 2020, and 68,978,000 metric tons in 2030.[175] (See Figure 2.1.)

By sector, electricity power generation and transportation account for more than 80% of emissions in 2005. In 2005, the transportation sector accounted for 25,200,000 metric tons of carbon dioxide; in 1990, transportation accounted for 20,200,000 metric tons.[176] Emissions from the transportation sector are almost exclusively from petroleum. In 2005, electric power generation, from utilities and independent producers only, accounted for 24,590,000 metric tons of carbon dioxide; in 1990, electric power accounted for 13,220,000 metric tons.[177] Emissions for electric power generation come from several sources, see below. In 2005, the industrial sector accounted for 10,620,000 metric tons of carbon dioxide; in 1990, transportation accounted for 11,880,000 metric tons.[178] In 2005, the residential sector accounted for 1,770,000 metric tons of carbon dioxide; in 1990, residents accounted for 1,870,000 metric tons.[179] In 2005, the commercial sector accounted 1,370,000 metric tons of carbon dioxide; in 1990, the commercial sector accounted for 1,280,000 metric tons.[180]

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[175] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[176] US Environmental Protection Agency. 2008. "CO2 Emissions from Fossil Fuel Combustion – Million Metric Tons CO2 (MMTCO2)." http://www.epa.gov/climatechange/emissions/downloads/CO2FFC_2005.pdf

[177] Ibid.

[178] Ibid.

[179] Ibid.

[180] Ibid.

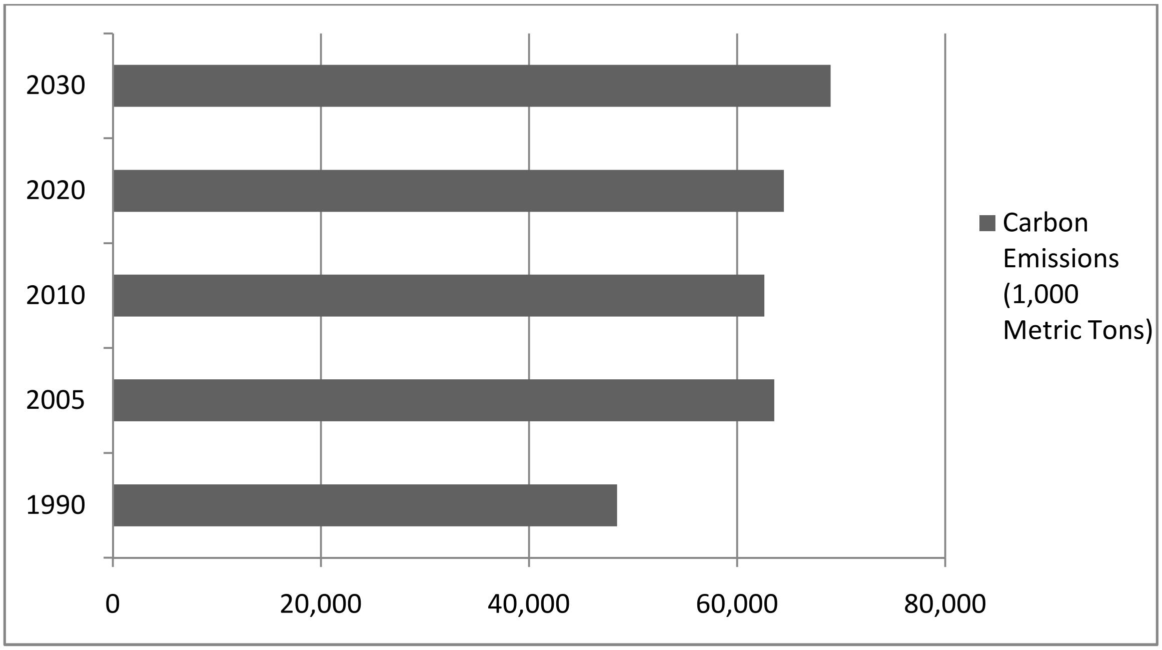

Figure 2.1.

Total Carbon Emissions by Year in Mississippi.[181] [182]

Electricity generation is a major source of carbon dioxide emissions. In 2006, electricity generation from all sectors in Mississippi produced 25,802,259 metric tons of carbon dioxide emissions, or 1% of US emissions from electricity generation.[183] In 1990, Mississippi total carbon dioxide carbon dioxide emissions from electricity generation were 14,640,651 metric tons.[184] Coal and natural gas produce the largest amount of carbon dioxide emissions. In 2006, coal accounted for 17,379,939 metric tons of carbon dioxide; in 1990, coal accounted for 9,168,221

[181] US Environmental Protection Agency. 2008. "CO2 Emissions from Fossil Fuel Combustion – Million Metric Tons CO2 (MMTCO2)." http://www.epa.gov/climatechange/emissions/downloads/CO2FFC_2005.pdf

[182] US Department of Energy. Energy Information Administration. Annual Energy Outlook 2009. (Washington, DC, 2008).

[183] US Department of Energy. Energy Information Administration. Estimated Emissions for US Electric Power Industry by State, 1990-2006 (Washington, DC, 2007).

[184] Ibid.

metric tons.[185] In 2006, natural gas accounted for 8,055,245 metric tons of carbon dioxide; in 1990, natural gas accounted for 4,788,619 metric tons.[186] In 2006, petroleum products accounted for 344,111 metric tons of carbon dioxide; in 1990, petroleum accounted for 683,811 metric tons.[187] In 2006, municipal solid waste produced 22,966 metric tons of carbon dioxide.[188]

There have been some advances in increasing environmentally friendly automobiles in the state. In 2006, there were 5,162 alternative fueled vehicles, or 0.9% of alternative fueled vehicles in the United States.[189] Almost all alternative fueled vehicles were either fueled by liquefied petroleum gas or ethanol. In 2006, there were 3,209 liquefied petroleum gas fueled vehicles and 1,802 ethanol fueled vehicles.[190] To lesser extent, compressed natural gas and electric vehicles are also utilized. In 2006, there were 101 compressed natural gas fueled vehicles and 50 electric vehicles.[191] The environmental impacts from emissions are a significant factor in the success of any renewable energy program. Currently, carbon emissions are in step with the percentage of energy production in the state as compared to the national average.

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[185] Ibid.

[186] Ibid.

[187] Ibid.

[188] Ibid.

[189] US Department of Energy. Energy Information Administration. Alternatives to Traditional Transportation Fuels 2006 (Part II – User and Fuel Data) (Washington, DC, 2007).

[190] Ibid.

[191] Ibid.

CHAPTER 3

RENEWABLE ENERGY POTENTIAL IN MISSISSIPPI

Background:

In assessing the future of an alternative energy program, the viability of renewable energy systems must be analyzed. In this chapter, the potential of generation capacity, costs, development timeline, and environmental impact will be assessed. Generation capacity will be assessed based on GIS modeling. Economics, development, and environmental impact will be assessed based on case studies and meta-analysis of similar projects. The renewable energy sources assessed will be limited to those that will be the most feasible: wind, solar, and biomass. Tidal, wave, hydropower, and geothermal energy systems have less feasibility because of geographic issues.

To determine generation capacity for solar and wind power, GIS modeling of land cover, slope, and other applicable conditions as noted will be taken into account in determining the areas of the total land use potential for each technology. Since the biomass potential is based on more than just the land use, the generation capacity from biomass will be determined by a review of studies on the biomass potential for the state compared to the energy yield of those products, rather than solely on GIS analysis. GIS criterion will be outline for each technology, based on the criterion utilized in: Bravo, Casals, and Pascua (2007), Yue and Wang (2004), and Baban and Parry (2000) for wind and solar energy. The land cover classifications are derived from the National Land Cover Database 2001, and land cover is subsequently defined based on those standards. Areas predetermined to be restricted from use include all state parks, wildlife management areas, national parks, national forests, national wildlife reserves, and Choctaws reservations for environmental concerns. Additionally, any areas contained within the limits of any incorporated city, town, or village will be restricted from use to limit interference with urban sprawl and to facilitate future expansion. The boundaries of such areas were obtained from the Mississippi Automated Resource Information System (MARIS). The restricted areas account for approximately 15% of the total land area. The potential of biomass generation capacity will be based on the net-generation capacity, i.e. the energy generation that is possible from the total product even if the product is transported out of state. In determining economic viability, development timeline, and environmental impact, literature analyzing the aspects for each energy source will be reviewed. Development timeline will be analyzed based on case studies from power stations. Economic viability will be assessed based on cost of energy. Environmental impact will be reviewed based on the environment implications determined from sources. This chapter will provide the information necessary to determine how renewable energy production will affect the state outside of policy and politics.

The renewable energy systems being assessed are wind, solar (both photovoltaic and thermal), and biomass. Wind is essentially a form of indirect solar energy, because "wind results from differences in…the uneven solar heating of the earth's surface."[192] Windmills that produce electricity are termed wind turbines, "in a wind turbine, moving air turns the blades attached to a rotor that drives a generator to produce electricity."[193] The energy output of wind turbines is

[192] Roy Nersesian. Energy for the 21st Century: A Comprehensive Guide to Conventional and Alternative Sources (New York: ME Sharpe, Inc, 2007): 307.

[193] Ibid: 308.

dependent on wind speed, with output increasing exponentially with wind speed.[194] In this study, wind farms with 2 MW wind turbines are being considered. Solar energy directly comes in two forms: photovoltaic (PV) cells, and thermal. Solar energy is affected by a variety of variables including cloud cover, solar radiation, relationship with horizon, and season. A solar PV cell is "…made up of two layers of semiconductor material that can convert sunlight to electricity."[195] Solar PV cells typically produce 1 to 2 watts of power, and are combined to produce larger amounts of energy.[196] On the other hand, solar thermal energy systems utilize the heat from the sun to produce energy. The most common form of solar thermal energy is for water and space heating. Solar troughs and chimneys convert the heat of the sun into electricity. Much like fossil fuel burning plants, the heat from the sun is utilized to produce steam which moves a turbine to generate electricity.[197] In this study, the focus will be on mass production solar energy in the form of solar troughs and chimneys. Biomass can be used in a variety of forms to produce energy. The most applicable biomass uses, for the purposes here, are for electricity production and biofuel for transportation. Biomass crops vary depending on the purpose and the area, but range from sugar cane to corn to certain types of blade grass. Biomass for electricity generation is the burning of biomass crops in a process similar to that of fossil fuel electricity generation. The heat produced from burning biomass produces is transformed into steam which in turn moves a turbine to generate electricity.[198] Biomass for biofuel is usually in the form of ethanol or biodiesel. Both fuels undergo a chemical process

[194] Ibid: 308-309.

[195] Ibid: 318.

[196] Ibid: 318-320.

[197] Ibid: 316-317.

[198] Ibid: 58-60.

which produces a liquid that can be burned in an engine similar to a conventional engine for transportation purposes.[199] In this study, both electricity generation potential and potential biofuel use will be assessed. Wind, solar, and biomass energy should be likely to have the most impact an energy sustainable future.

Wind:

Wind energy generation capacity is directly connected to the available land area. Based on Bravo, Casals, and Pascua (2007), Yue and Wang (2004), and Baban and Parry (2000), GIS criterion was developed to identify areas with potential for wind farms, and potential generation capacity. GIS Criterion is divided into land cover restrictions and location restrictions. The GIS criterion is outlined in Table 3.1. Land cover restrictions outline all areas of land cover that are incompatible for the purposes of wind farms. Land cover restrictions limit acceptable land use areas to open areas without large natural or artificial structures and stable ground, basically. Location restrictions outline the necessary location attributes to support wind farms. Location restrictions add an additional 6% to the area of the restricted areas, for a cumulative 21% of land area limited from use. Based on the outlined criteria, potential acceptable land areas were identified. Estimations of generation capacity for wind turbines by land area were then applied to the total of the land area.

Bravo, Casals, and Pascua (2007) assesses the wind power energy in Spain, based on limitation of terrain, area, and land use. The minimum area for flat terrain was fixed at 8km^2 where the mean slope less than 1% surrounded by 10 km^2 with slope less than 3%, while complex terrain is defined as mean slope greater than 1% and less than 10% with no special

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[199] Ibid: 51-57.

requirements for surroundings but a minimum area of $4km^2$.[200] The land use restrictions were established according to Corine Land Cover 2000 Database nomenclature as: urban fabric; industrial, commercial and transport units; rice fields; forests; beaches, dunes, sand plains; bare rocks; badlands and/or zones with erosion processes; glaciers and perpetual snows; inland wetlands; water courses; lakes and lagoons; coastal lagoons; and estuaries.[201] Wind farm turbines for flat terrain applications were for grassland areas "based on 2.05MWe turbines with 71m in diameter and hub height of 70 m."[202] Wind farm turbines for complex terrain applications were based on "those installed in woodlands or higher superficial roughness with on 0.81MWe turbines with 48m in diameter and hub height of 65 m."[203] Bravo, Casals, and Pascua (2007) does a superior job in defining the types of land uses that should be included in assessing wind power capacity. On the other hand, the differing types of terrain levels used only complicate the assessment for a place like Mississippi that has a fairly uniformed terrain, and the wind turbine placement guidelines are more geared towards many small wind farms in a fairly urban environment unlike Mississippi.

Yue and Wang (2006) uses several factors for assessing wind potential of a small region of southwestern Taiwan.[204] The authors base their criteria for suitable areas "according to recommended guidelines for wind turbine installation" as presented by the Danish Wind

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[200] Javier Dominguez Bravo, Xavier Garcia Casals, and Irene Pinedo Pascua. "GIS Approach to the definition of capacity and generation ceilings of renewable energy technologies." 2007. Energy Policy 35: 4884.

[201] Ibid: 4884.

[202] Ibid: 4883.

[203] Ibid: 4883.

[204] Cheng-Dar Yue and Shi-Shian Wang. "GIS-based Evaluation of Multifarious Local Renewable Energy Sources: A Case Study of the Chigu Area of Southwestern Taiwan." 2004. Energy Policy 34.

Industry Association.[205] The criteria included “a minimum allowable wind speed of 4 m/s; a minimum distance from urban planned districts of 500 m; a minimum distance from villages of 250 m; a minimum distance from wildlife conservation areas of 500 m; a minimum distance from forests of 250 m; and a minimum distance from ecologically sensitive areas of 250 m.”[206] Additionally, both floodplains and roads were not considered for wind turbine installation.[207] Finally, “the distance between wind turbines was set as three times the rotor diameter, calculated using the Vestas V80 wind turbine with a diameter of 80m and a rated capacity of 2MW” and “Annual output was calculated with mean wind speed and roughness class 1.5 by means of the ‘Wind Turbine Power Calculator’ from the Danish Wind Industry Association.”[208] Yue and Wang (2006) provides a good indication of the types of ‘sensitive’ areas to be avoided and the distances to maintain, and a reasonable standard for wind speed requirement; ‘sensitive’ areas are those that are environmentally, politically, or socially off limits for one reason or another and should be avoided. Additionally, the placements of the basis for wind turbine placements and annual output measures seemed to be more in tuned to the wind farm installations in fairly rural areas that would work best in Mississippi. However, land use restrictions are not included.

Baban and Parry (2001) established criteria based on a “based on the literature and the outcome from the questionnaire to comply with the guidelines used nationally and

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[205] Ibid: 732.

[206] Ibid: 732.

[207] Ibid: 732.

[208] Ibid: 732.

internationally." [209] The wind farm location must "avoid summits of large hills , have slope angles less than 10%, have a westerly orientation Wind direction, and have a wind speed greater than 5 m/s Wind speed."[210] Additionally, the following land use restrictions were implemented: "not be located within 500 m of woodland Land use/cover; not be located within 2000 m of large settlements Population Planning; not be located within 500 m of single dwellings Population; not be located further than 10 000 m from roads Access Economic; not be located further than 10 000 m from National Grid Economy; not be located within 400 m of water bodies Hydrology Environmental; not be located within 1000 m of areas of ecological Ecology value/special scientific interest; not be located on or within 1000 m of historic sites Historic/cultural Resource resource; not be located within 1000 m of National Trust property; and avoid taking grade 1 and grade 2 agricultural land."[211] Baban and Parry (2001) provides both additional 'sensitive' areas to avoid along with avoidance distances, as well as more useful criteria for terrain slope that is both applicable and simplified. However, it does not include land use restrictions and is based on a higher wind speed standard.

In developing the criteria here, the aspects most applicable to the study area where combined to form the best criterion for land that is acceptable for wind power generation. First, the land use restrictions from Bravo, Casals, and Pascua (2007) were applied to the land cover definitions of National Land Cover Database to reach the land use restrictions. Second, the 'sensitive' area restrictions from Yue and Wang (2004) and Baban and Parry (2001) were combined and applied to areas of Mississippi that most closely fit the definition, and where

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[209] Serwan Barry and Tim Parry. "Developing and Applying a GIS-assisted Approach to Locating Wind Farms in UK." 2001. Renewable Energy 24: 62.

[210] 63

[211] 63

there were differing standards the more conservative standard was used. Next, the slope restrictions, wind speed requirements, and wind turbine placement and output calculations from Yue and Wang (2004) were incorporated. Finally, the minimum area restrictions from Bravo, Casals, and Pascua (2007) were included. All together, these components of the methodology of the Bravo, Casals, and Pascua (2007), Yue and Wang (2004), and Baban and Parry (2001) form the criterion used for determining applicable land for wind power, as outlined in Table 3.1.

Table 3.1.

Wind Energy Criterion

Land Cover Restrictions:	Location Restrictions:
-Restricted Areas -Developed, High Intensity -Developed, Medium Intensity -Developed, Low Intensity -Developed, Open Space -Pastures/Hay -Cultivated Crops -Deciduous Forests -Evergreen Forests -Mixed Forests -Perennial Ice/Snow -Woody Wetlands -Open Water	-Mean slope ≤ 10% -Minimum area of $4km^2$ -Wind speed ≥ 4 m/s. -Minimum distance from City Limits and Choctaw Reservations of 500 m. -Minimum distance from Wildlife Management Areas and National Wildlife Reserves of 500 m. -Minimum distance from State Parks, National Parks, and National Forests of 250 m. -Westerly oriented wind direction.

The analysis of the wind power potential suggests that there is a total of around 2900 square kilometers of useable land for wind turbine farms. Output was calculated for a 600 kW turbine, with a 50 m hub height. Turbines placement and energy will be determined based on a distance between wind turbines was set as two times the hub height of the turbine and output was calculated by the Danish Wind Industry Association wind energy output calculator.[212] Based on those estimations, wind turbines could generate around 2930 thousand mWh. Wind power would only produce a small part of the electricity necessary for the state of Mississippi.

The development timeline is a significant aspect in getting renewable energy available for the market. Case studies of wind farms show that project timelines are do not push development too far out of reach. A case study of a wind farm project in Iowa states, the development company "initiated development of the project in the summer of 2000…Construction began in May 2001 and was completed in November 2001."[213] The project timeline ran around 18 months for an 80-MW wind farm.[214] A smaller project in Massachusetts presents a similar timeline. Renewable Energy Research Laboratory (2004) is a case study of a smaller 660 kW turbine in a small town. Research on the project began in 1998 and was completed by year's end of 2001. The wind turbine produces a significant amount of energy consumed by the town and just over 24 months to develop.[215] A case study from a wind farm in Greece presents an extended project timeline. According to Polatidis and Haralambopoulos (2007), the development timeline should be around five years. The article outlining a wind farm project in Greece details the timeline for the wind farm.[216] For a wind farm in the United Kingdom, "the duration of the construction period is predictable at about 1 year for a small to

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[212] Danish Wind Industry Association. "Wind Turbine Power Calculator." http://www.windpower.org/en/tour/wres/pow/index.htm.

[213] John R Sweet Company. "Top of Iowa Wind Farm Case Study." http://johnrsweet.com/personal/Wind/PDF/TopofIowaWindFarm.pdf.

[214] Ibid.

[215] University of Massachusetts at Amherst. "Wind Power on the Community Side." Renewable Energy Research Laboratory. 2004. Community Wind Case Study: Hull.

[216] Heracles Polatidis and Dias Haralambopoulos. "Renewable Energy Systems: A Societal and Technological Platform." 2007. Renewable Energy 32: 329-341.

medium farm (< 15 MW) and at 1 to 2 years for a large wind farm. The duration of the development period is less predictable, especially the time required to obtain planning consent which, depending on the mandatory procedures and the number and kind of objections raised, may vary from approximately 6 months to more than 5 years."[217] On the Sioux Indian Reservation in North Dakota, the project began in September 1995 and was completed in March 1997.[218] A New Zealand wind farm project saw "its commencement in November 2003… [and] The Te Apiti project provided first power on 26 July 2004, and was fully commissioned by 25 October 2004."[219] Depending on the size of the wind farm and other construction variables, wind farm development should range from 18 months to 5 years. Wind farms could be producing power within a relatively short time period.

Table 3.2.

Summary of Wind Power Development

Location	Dates	Development Timeline
Iowa	Summer 2000 – Nov 2001	18 months
Massachusetts	1998 – Late 2001	2 ½ - 3 years
Greece	-	Five Years (including planning phases)
United Kingdom	-	1 – 2 years
North Dakota	Sept 1995 – March 1997	1 ½ years
New Zealand	Nov 2003 – Oct 2004	1+ years

[217] Cooper Development Association. "Distribution Generation and Renewables: Wind Farm Case Study." 2007. http://www.copperinfo.co.uk/power-quality/downloads/pqug/851-wind-farm-case-study.pdf.

[218] Project Management Institute. "PMI Case Study: New Zealand Wind Farm." http://www.pmi.org/PDF/Case_New%20Zealand%20Wind%20Farm.pdf.

[219] US Department of Energy. Office of Energy Efficiency and Renewable Energy Division. 2009. "Spirit Lake Sioux Wind Energy Project." http://www.windpoweringamerica.gov/na_sioux.asp.

The generation capacity of wind in Mississippi may not be high enough to serve as a primary energy source, but the economics of wind powered systems does make it competitive with current sources and potentially profitable for land owners. Studies based on the potential of wind energy show that wind energy is more economical than many traditional energy sources. Kobos, Erickson, and Drennen (2006) estimates the costs of wind power based on "three projections…both with and without a tax credit at 3.0 to 4.5 cents/kWh, respectively."[220] The estimations assumed a 20-year system lifetime, a 10% annual rate of discount, capital costs limited to $976 per kW, and 1.1 cents per kWh in operations costs. Based on the three projected models utilized, "energy cost for wind energy reaches a target of 4.5 cents/kWh by 2009, 2007, or 2006."[221] For comparison, Kobos, Erickson, and Drennen (2006) estimates the energy costs of coal at 3.5 to 4 cents/kWh but including health and environmental concerns it is more like 5.5 to 8.3 cents/kWh.[222]

Table 3.3.

Summary of Wind Power Costs

Source	Wind Power Costs	Comparison to Other Sources
Kobos, Erickson, and Drennen (2006)	3.0¢ - 4.5¢/kWh	Coal 3.5¢ - 4¢/kWh 5.5¢ - 8.3¢/kWh (with health and environmental concerns)
Kaygusuz (2004)	3.0¢ - 6.0¢/kWh	Coal 4.8¢ - 5.5¢ Natural Gas 3.9¢ - 4.4¢
Byrne (2007)	-	25% - 50% less than fossil fuel costs on projects of similar size

[220] Peter Kobos, Jon Erickson, and Thomas Drennen. "Technological Learning and Renewable Energy Costs: Implications for US Renewable Energy Policy." 2006. Energy Policy 34: 1654.

[221] Ibid: 1654-1655.

[222] Ibid: 1645-1658.

Kaygusuz (2004) produces a similar cost analysis for wind energy. According to Kaygusuz, "the American Wind Energy Association (AWEA) estimates the levelized cost of wind energy at good sites as ranging from 3.0 to 6.0 cents per kWh, not including the federal production tax credit (PTC)."[223] The tax credit adds 1.5 cents/kWh, but "…applies to the first 10 years that a new wind plant operates, and can reduce the levelized cost of wind by about 0.7 cents/kWh over the plant's 30-year lifetime."[224] For cost comparison, Kaygusuz estimates that the energy costs of coal range from 4.8 to 5.5 cents/kWh and natural gas, from 3.9 to 4.4 cents/kWh.[225] For small scale projects, wind energy is still more economical than diesel for electricity generation. Byrne, et al (2007) estimated the costs of in rural China for projects less than 650 kWh, wind power is in between 25% to 50% of the cost of fossil fuel projects at the same level.[226] Regardless of the level of power generation, wind power is still more economical than fossil fueled systems at the same level. While fossil fuel projects include large capital, operations, and fuel costs, wind projects include only capital and minimal operations costs leading to cheap power production. All three studies illustrate that economically wind power systems can outstrip conventional fuel sources. With a large scale project that would be utilized in Mississippi, the costs would most likely range from 3 to 6 cents/kWh over the lifetime of the power plant, which is well below average electricity costs in the state. By 2010, wind power could be produced 25% to 60% cheaper than the projected average cost of electricity. By 2030, wind power could be produced 35% to 65% cheaper than the projected average cost of

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[223] Kamil Kaygusuz. "Wind Energy: Progress and Potential." 2004. Energy Policy 26: 101.

[224] Ibid.

[225] Ibid.

[226] John Byrne, et al. "Evaluating the Potential of Small-Scale Renewable Energy Options to Meet Rural Livelihoods Needs: A GIS and Lifecycle Cost-Based Assessment of Western China's Options." 2007. Energy Policy 35: 4391-4401.

electricity. Wind power is capable of completing with the conventional fuel sources in use economically at the same scale.

The environmental implications of wind power are imperative a time of growing concern for the environment. According to Kaygusuz (2004), "the environmental benefits of wind power result mainly from reduction in the use of fossil fuels, leading to a reduction in emissions of pollutants created by combustion."[227] Actual environmental emissions from wind power are variable depending on size and energy production. Kaygusuz (2004) estimates that carbon dioxide emissions from the wind power systems being utilized in this assessment should be between 19 and 34 tons/GWh; these emissions occur indirectly through manufacturing processes. Depending on the power generation, carbon emissions should be greatly reduced by wind power. Greenhouse gas emissions have little implication for wind power, but "environmental damage of wind turbines includes visual intrusion, land use, impact on local ecology, noise and effects on radio communications and television reception."[228] These environmental impacts are much less pressing than the damage done by fossil fuels, but "…in most cases they can be alleviated by careful sitting and design of wind plant, and by a policy designed to secure maximum public acceptance of wind energy."[229] Denny and O'Malley (2003) assert similar findings on the environmental impact of wind energy in Ireland. With wind power "considerable CO_2 reductions are seen with increasing levels of installed wind capacity," because of the offsetting of potential emissions from fossil fuel generation.[230] Furthermore, "the

[227] Kamil Kaygusuz. "Wind Energy: Progress and Potential." 2004. Energy Policy 26: 102.

[228] Ibid: 103.

[229] Ibid: 103.

[230] Eleanor Denny and Mark O'Malley. "Wind Generation, Power System Operation, and Emissions Reduction." 2006. IEEE Transactions on Power Systems 21: 347.

relationship between installed wind levels and emission reductions is nontrivial."[231] Denny and O'Malley (2006) maintains that if 11% of fossil fuel generation capacity was replaced with wind power there would be a net reduction of 6.5% to 9% in emissions.[232] Martinez, et al (2009) considers the environmental impact of wind energy in Spain. Based on variables that measure environmental factors including global warming, ozone depletion, and toxicity related to wildlife and humans, the study found dramatic reduction in environment damage. The advantages of wind power were able to reduce the environmental impact in all categories by more than 90%.[233] With concern to wind power incorporation in to the electrical grid, "…it has also been verified that these [environmental] impacts are much smaller than those generated by conventional power plants in operation, with reductions in impact ranging from 89% to 99%."[234] The introduction of wind power would be an improvement for the environment over conventional sources.

Solar:

Solar power generation is directly related to the land area available for exposure to solar radiation. Based on Bravo, Casals, and Pascua (2007), solar photovoltaic cells and solar thermal energy systems will be assessed to determine potential solar energy sites and potential generation capacity. GIS criterion is divided into land cover restrictions and location restrictions as outlined in Table 3.2. Land cover restrictions identify the areas that will be utilized for solar energy. Since solar energy systems can be better incorporated into land areas used for other

[231] Ibid: 344.

[232] Ibid: 345.

[233] Eduardo Martinex, et al. "Life-Cycle Assessment of a 2-MW Rated Power Wind Turbine: CML Method." 2009. International Journal of Life Cycle Assessment 14: 52-63.

[234] Ibid: 62.

purposes, only a certain percentage of the specific land cover areas will be used. Location restrictions identify the slope aspects necessary to support solar energy systems. The estimations made here are to produce an estimation of generation capacity for solar power. Solar power does not have a high potential for generation in Mississippi do to several limiting factors. Based on the outlined criteria, potential acceptable land areas were identified.

Bravo, Casals, and Pascua (2007) assesses the solar power energy in Spain, based on limitation of terrain, area, and land use for both solar photovoltaic and concentrated solar technologies. The slope criteria features for solar photovoltaic cells were set as gradient less than 3% for all aspects, gradient between 3 and 10% for just southeast to southwest aspects.[235] The slope criteria features for concentrated solar power were set as gradient less than 2% surrounded by $4km^2$ with slope gradient less than 3% is suitable for all slope aspects and gradient between 2% and 7% surrounded by $4km^2$ with slope gradient less than 8% is suitable for just southeast to southwest aspects.[236] The land use restrictions for both solar photovoltaic and concentrated solar power were established according to Corine Land Cover 2000 Database nomenclature as, were the percentage indicates the percentage of that type of land suitable for use: discontinuous urban fabric (5%); industrial, commercial and transport units (5%); mine, dump and construction sites (10%); artificial, non-agricultural vegetated areas (10%); pastures (30%); complex cultivation patterns (5%); principally occupied by agriculture (25%); natural grasslands (100%); moorlands and bushes (100%); big formations of dense or moderately dense

[235] Javier Dominguez Bravo, Xavier Garcia Casals, and Irene Pinedo Pascua. "GIS Approach to the definition of capacity and generation ceilings of renewable energy technologies." 2007. Energy Policy 35: 4885-4886.

[236] Ibid: 4885-4887.

bush (25%); scarce bushes (100%); transitional woodland shrub (25%); subdesert Xerosteppe (100%); high altitude spaces with scarce vegetation (100%); burnt areas (100%).[237]

Bravo, Casals, and Pascua (2007) provides the most comprehensive, applicable criteria for solar generation, although some were adapted for use here. First, due to significant similarities between the criterion for solar photovoltaic and concentrated solar, the two sets of criterion were combined to form one set for determining applicable land. Second, the land use restrictions were applied to the land cover definitions of National Land Cover Database to reach the land use restrictions. Third, since the slope restrictions for solar concentrated were stringent, only those were used in defining slope for solar power. Finally, the minimum areas were incorporated into the criterion. The methodology of Bravo, Casals, and Pascua (2007) was adapted to assess the available land for solar power in Mississippi as outlined in Table 3.3.

Estimations of generation capacity for the solar technologies by land area were then applied to the total of the land area. The analysis of the solar power potential suggests that there is a total of around 3700 square kilometers of useable land for solar power stations. According to the National Wildlife Federation, "Mississippi has enough solar resources to produce 4,500 to 5,000 Wh per square meter using photovoltaic systems and 3,500 to 4,500 Wh per square meter using concentrating solar power systems."[238] Based on those estimations, solar photovoltaic systems could generate from 1665 thousand mWh to 1850 thousand mWh per year. However, this estimate does not include rooftop solar photovoltaic cells. The installation of rooftop systems would have to be implemented by individuals; therefore they cannot be guaranteed as a source of energy production. Concentrated solar power systems

[237] Ibid: 4885-4887.

[238] National Wildlife Federation. "Charting a New Path for Mississippi's Electricity Generation and Use." http://www.nwf.org/globalwarming/energypdfs/MISSISSIPPI_10-22-5.pdf.

could generate from 1295 thousand mWh to 1665 thousand mWh per year. Though solar photovoltaic systems have a higher potential generation capacity, the most applicable technology would have to be catered to the land area. Solar power would only produce a small part of the electricity necessary for the state of Mississippi.

Table 3.4.

Solar Energy Criterion

Land Cover Restrictions:	Location Restrictions:
-Restricted Areas (0%) -Developed, High Intensity (5%) -Developed, Medium Intensity (5%) -Developed, Low Intensity (10%) -Developed, Open Space (10%) -Cultivated Crops (10%) -Pastures/Hay (30%) -Grasslands/Herbaceous (100%) -Shrub/Scrub (100%) -Barren Land (100%)	Minimum Area = $4km^2$ Slope: -Less than 2% = all aspects -2% to 8% = only SE and SW aspects

The timeline to energy generation is an important aspect in planning for a renewable energy plan. Looking at three solar photovoltaic farms, an idea of the project timeline can be gained. The projects, two in the US and one in Europe, are medium and large in size. The information is based on case studies obtained from the operating and construction entities associated with the projects. The Alamosa Solar Facility in Alamosa, Colorado has a generation capacity of 8.2 MW from photovoltaic cells produced by SunEdison, North America's largest solar energy services provider. The initial phase of "the project broke ground in April 2007."[239] By August 2007, the solar facility was 44% online with a generation capacity of 3.6MW. Completed in December 2007, "the energy produced by the facility will help…meet provisions of

[239] Sun Edison. "Alamosa Solar Facility Begins Generating 3.6 MW of Renewable Energy." http://www.sunedison.com/uploads/pr/24/091007-alamosa.pdf

Colorado's Renewable Energy Standard."[240] From ground breaking to completion for the medium size plant was around 8 months. The solar largest solar photovoltaic power station in the United States and one of the 10 largest in the world is located at Nellis Air Force Base in Nevada. The Nellis Solar Power System, completed in December 2007, has a 14.2 MW generation capacity and covers a surface area of 140 acres. The total length of construction was 6 months, making the development timeline fairly short for a project of this size.[241] The Serpa Solar Park Project is an 11 MW solar photovoltaic cell farm in Portugal. The project covers approximately 145 acres of olive tree covered hills and includes more than 52,000 solar PV panels. The solar project produced around 102% of the estimated generation capacity for 2007. The project began in June 2006 and was completed by May 2007, leaving a development time of just under a year.[242] Depending on size, the construction timeline for a solar photovoltaic project is between 6 months and 1 year, though the pre-construction phases may add to the project development timeline. A solar photovoltaic power facility could be push into service in a reasonable amount of time.

Table 3.5.

Summary of Solar PV Development

Location	Dates	Development Timeline	Generation Capacity
Colorado	Apr 2007 – Dec 2007	8 months	3.6 MW
Nevada	Summer 2007 – Dec 2007	6 months	14.2 MW
Portugal	June 2006 – May 2007	11 months	11 MW

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[240] Ibid.

[241] Nellis Air Force Base. "Nellis Air Force Base Solar Power System." http://www.nellis.af.mil/shared/media/document/AFD-080117-043.pdf

[242] Sun Power Corporation. "Exceptional Investment Return Expected on Serpa Solar Park Project." http://us.sunpowercorp.com/utility/success-stories/success-story-pdfs/SPWRSerpa_CS_0808.pdf

The economics of solar photovoltaic cells may not be as favorable as other energy sources. The economic outlook for solar photovoltaic cells in the future appears to be strong but currently the prices are not as competitive as would be hoped. According to Bernal-Agustin and Dufo-Lopez, "economical analysis has shown that with the current prices, investment in a grid connected PV systems is generally profitable."[243] The sale price of electricity in Spain is recorded at much higher than that of American prices, yet the authors still assert that solar photovoltaic cells are economically viable at current rates.[244] Van Der Zwaan and Rabl (2003) estimated that depending on the technology and size of the PV system, electricity costs ranged from 9.1¢/kWh to 18.2¢/kWh.[245] Additionally, Van Der Zwaan and Rabl (2003) contends "PV costs are likely to decrease significantly over the coming years, so that a considerable energy supply share from PV world-wide *could* materialize…[and]…damage costs (external costs) due to pollution emitted by conventional power sources are considerable, especially for older fossil-fuelled power plants, and their internalization, e.g. by a pollution tax, would improve the competitiveness of PV."[246] Sterzinger and Svrecek (2005) presents similar price ranges for solar PV cells. For 2004, the study reported costs ranging from 10.5¢/kWh to 18.2¢/kWh, with estimates ranging from 7.4¢/kWh to 13.4¢/kWh in 2010.[247]

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[243] Jose Bernal-Agustin and Rodolfo Dufo-Lopez. "Economical and Environmental Analysis of Grid Connected Photovoltaic Systems in Spain." 2006. Renewable Energy 31: 1126.

[244] Ibid: 1107-1128.

[245] Bob van der Zwaan and Ari Rabl. "The Learning Potential of Photovoltaics: Implications for Energy Policy." 2004. Energy Policy 32: 1547.

[246] Ibid: 1552-1553.

[247] George Sterzinger and Matt Svrcek. "Solar PV Development: Location of Economic Activity." 2005. Center for Renewable Energy and Sustainable Technology. Renewable Energy Policy Project Technical Report: 4.

Table 3.6.

Summary of Solar PV Costs

Source	Solar PV Costs	Future Estimations
Van der Zwaan and Rabl (2004)	9.1¢ - 18.2¢/kWh	Significant decreases
Sterzinger and Svrcek (2005)	7.4¢ - 13.4¢/kWh	3.8¢ - 8.2¢/kWh by 2030 (55% reduction over next 20yrs)
Byrne (2007)	50% - 60% less than fossil fuel costs on projects of similar size	-

Additionally, Sterzinger and Svrecek (2005) estimates that by 2030 the cost of electricity from solar photovoltaic cells will range from 3.8 to 8.2, approximately a 55% reduction over the next 20 years.[248] Furthermore, it is asserted that 187 jobs were created and approximately $153 million in investment were made in the state of Mississippi through 2004 from manufacturing, construction, and installation of solar photovoltaic cells.[249] According to Kolhe, Kolhe, and Joshi (2002), "The economic viability of a stand-alone PV system in comparison to the most likely conventional alternative system, i.e. a diesel-powered system, has been analyzed for energy demand…The analysis shows that PV-powered systems are the lowest cost option …even under unfavorable economic conditions."[250] For small scale projects, solar photovoltaic energy is still more economical than diesel for electricity generation. Byrne, et al (2007) estimates the costs in rural China for projects less than 400 kWh where solar photovoltaic power can be produced for

[248] Ibid: 4.

[249] Ibid: 24.

[250] Mohanlal Kolhe, Sunita Kolhe, and JC Joshi. "Economic Viability of Stand-Alone Solar Photovoltaic System in Comparison with Diesel-Powered System for India." 2002. Energy Economics 24: 165.

50% to 60% of the cost of fossil fuel projects at the same level.[251] The economic prospects for solar photovoltaic cell energy appear to promising in the long run, even if they are not currently economically competitive with conventional fuel sources.

The project development timeline for concentrated solar power plants is slightly longer than that of the solar photovoltaic cell plants but is not outrageous. The Saguaro Solar Power Plant located in Red Rock, Arizona is a 1 MW concentrated solar power plant, utilizing parabolic trough technology. The plant has a moderate generation capacity but was the first "trough-style energy system to have put power on the grid since 1988."[252] In June 2004, site work began and by early 2005 the foundation work was underway. Power plant operation began in late December 2005. The project timeline ran about 18 months.[253] The Nevada Solar One power station located near Boulder City, Nevada is the third largest concentrated solar power facility in the world and the largest in the United States. The power station has a generation capacity of 75 MW, making it the largest concentrated solar power plant built in the US. The total project site is around 400 acres with the solar fields accounting for around 300 acres. Construction began in March 2006 and the power station was completed in June 2007 after 16 months of construction.[254] The Solana Generating Station Project when completed will be "one of the largest solar power plants in world" with a generation capacity of 280 MW.[255] The power plant,

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[251] John Byrne, et al. "Evaluating the Potential of Small-Scale Renewable Energy Options to Meet Rural Livelihoods Needs: A GIS and Lifecycle Cost-Based Assessment of Western China's Options." 2007. Energy Policy 35: 4391-4401.

[252] Scott Canada and Jeff Lee. "Saguaro Solar Power Plant." 2006. Power 150.

[253] Ibid.

[254] Nevada Solar One. "Acciona's Nevada Solar One – Demonstrating the Commercial Competitiveness of Solar Energy." www.nevadasolarone.net/the-plant.

[255] Abengoa Solar Inc. "Solana Generating Station Project." http://www.solanasolar.com/misc/Solana_6-17-2008_letter-size.pdf

utilizing parabolic trough technology, will be located in near Gila Bend, Arizona. According to the proposed timeline, construction will begin in early 2009 and be completed in mid 2011. Additionally, the planning and approval stages began in mid 2008 and ran until early 2009. The total project timeline will be approximately 3 years with half of that dedicated to the actual construction.[256] Actually construction time for concentrated solar power plants is around a year and half, but pre-construction phases may add a considerable amount of time.

Table 3.7.

Summary of Concentrated Solar Development

Location	Dates	Development Timeline	Generation Capacity
Red Rock, AR	June 2004 – Dec 2005	18 months	1 MW
Nevada	Mar 2006 – June 2007	16 months	75 MW
Gila Bend, AR	Mid 2008 – mid 2011	3 yrs	280 MW

The economic assessment of concentrated solar power is similar to that of solar photovoltaic power. Charles, Davis, and Smith (2005) asserts the "cost of electricity for trough plants should be able to drop to approximately 6.5¢/kWh [by 2020], expressed in 2005 dollars from a cost of about 11¢/kWh [in 2005]."[257] Similarly, the "cost of electricity from tower-based plants should be able to drop to approximately 5.7¢/kWh, expressed in 2005 dollars."[258] The results show "initial electricity costs in the range of 11¢ to 15¢/kWh and eventually achieving costs in the range of 5.7¢/kWh to 6.5¢/kWh."[259] Those cost projections are in line with "the

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[256] Ibid.

[257] Robert Charles, Kenneth Davis, and Joseph Smith. "Assessment of Concentrating Solar Power Technology Cost and Performance Forecasts." Presented at Electric Power 2005, April 5-7, 2005: 9.

[258] Ibid: 14.

[259] Ibid: 23.

federal long-term goal to lower the cost of CSP technology to 7¢/kWh from the current cost of 12 to 14¢/kWh."[260] Price, et al (2002) estimates the cost of electricity from concentrated solar power generation should range from 10.1¢/kWh under current systems to 4.9¢/kWh when more advanced systems are put into production.[261] Price, et al (2002) asserts "the value of solar power from these plants should be able to complete directly with conventional fossil-fuel power plants."[262] Additionally, the authors maintain "the technology is poised for rapid deployment should the need emerge for a low-cost solar power option."[263] Quaschning and Blanco (2001) assesses the current state of solar power generation. It was determined the "cost of solar electricity was reduced from 27¢/kWh in the first power plant to about 12¢ to 14¢/kWh in the last installed system" as of 2001. Moreover, the article concludes advancements in production can reduce concentrated solar generation costs significantly below 10¢/kWh.[264] Stoddard, Abiecunas, and O'Connell (2006) assesses the economics of concentrated solar power production in California. Based on the study, concentrated solar power production from parabolic trough plants ranges between 12.5¢ to 14¢/kWh in 2007. Stoddard, Abiecunas, and O'Connell (2006), also, forecasts future costs at between 8.3¢ to 9.3¢/kWh by 2015.[265] However, "the CSP plants are not competitive with the combined cycle plant in the early years,

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[260] Ibid: 20.

[261] Price, et al. "Advances in Parabolic Trough Solar Power Technology." 2002. Journal of Solar Energy Engineering 124.

[262] Ibid: 123.

[263] Ibid: 123.

[264] Volker Quaschning and Manuel Blanco Mureil. "Solar Power – Photovoltaics or Solar Thermal Power Plants?" 2001. VGB Congress Power Plants. Brussels, October 10 -12 2001.

[265] L Stoddard, J Abiecunas, and R O'Connell. "Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California." 2006. National Renewable Energy Laboratory Subcontract Report.

but become more so in the 2015 timeframe."[266] Furthermore, "investment in CSP power plants delivers greater return to California in both economic activity and employment than corresponding investment in natural gas equipment."[267] According to Stoddard, Abiecunas, and O'Connell (2006), "the economic and employment benefits, together with delivered energy price stability and environmental advantages, suggest that the CSP solar alternative would be a beneficial addition to California's energy supply."[268] Though much of the concentrated solar power assessments are based in the Southwest, most of the same economic assessments may hold true for Mississippi, especially the assessments for economic growth and employment growth through investment in new energy systems.

Table 3.8.

Summary of Concentrated Solar Costs

Source	Concentrated Solar Costs	Future Estimations
Charles, Davis, and Smith (2005)	11¢ - 15¢/kWh	5.7¢ - 6.5¢/kWh by 2020
Price, et al (2002)	10.1¢/kWh	4.9¢/kWh (as technology becomes more advanced)
Quaschning and Blanco (2001)	12¢ - 14¢/kWh	Below 10¢/kWh
Stoddard, Abiecunas, and O'Connell (2006)	12.5¢ - 14¢/kWh	8.3¢ - 9.3¢/kWh by 2015

The environmental impacts of solar energy technologies should be taken into account to fully assess the potential for new energy sources. According to Bernal-Agustin and Dufo-Lopez (2006), "During the life of the PV system, substances are not emitted that might be harmful to

[266] Ibid: 6-5.

[267] Ibid: ES-4.

[268] Ibid: ES-5.

the heath or environment. However, a great amount of energy is needed in their production. Furthermore at the end of their useful life, the installation must be disposed of and the residues dealt with."[269] Bernal-Agustin and Dufo-Lopez (2006), also, states that there is a "substantial capacity of these systems in the reduction of contaminating emissions."[270] Tsoutsos, Frantzeskaki, and Gekas (2005) establishes both the negative and positive environmental implications of solar energy technologies. The potential positive implications include: reduction of greenhouse gas emissions, "reclamation of degraded land", "reduction of required transmission lines of the electricity grids."[271] On the other hand, the study argues that solar energy technologies monopolize land, visually impact the landscape, and have the potential to discharge pollutants. Additionally, the manufacturing of solar photovoltaic cells and solar thermal systems have the potential for air, noise, and water pollution as well as the safety hazards associated with the manufacturing industry. The article concludes solar energy technologies "present tremendous environmental benefits when compared to the conventional energy sources… On the other hand, it must be realized that no manmade project can completely avoid some impact to the environment… However, adverse effects are generally small and can be minimized by appropriate mitigation measures, including the use of the best available abatement technologies."[272] Stoddard, Abiecunas, and O'Connell (2006) argues "CSP plants provide environmental benefits by generating power without producing criteria and CO_2 air emissions…While CSP plants may have environmental benefits due to emissions reductions,

[269] Jose Bernal-Agustin and Rodolfo Dufo-Lopez. "Economical and Environmental Analysis of Grid Connected Photovoltaic Systems in Spain." 2006. Renewable Energy 31: 1117.

[270] Ibid: 1126.

[271] Theocharis Tsoutsos, Niki Frantzeskaki, and Vassilis Gekas. "Environmental Impacts from the Solar Energy Technologies." 2005. Energy Policy 33: 289-296.

[272] Ibid: 295.

they do require significant land area. A 100 MW CSP plant is estimated to cover approximately 800 acres (comprised mostly of the solar field) while a 500 MW combined cycle power plant would occupy about 20 acres."[273] For the scenario employed by the study, the authors assert "each CSP plant provides emissions reductions compared to its natural gas counterpart; the 4,000 MW scenario in this study offsets at least 300 tons per year of NO_X emissions, 180 tons of CO emissions per year, and 7,600,000 tons of per year of CO_2."[274] The environmental impact of energy production from solar energy technologies is significantly less than that of conventional sources, but the construction and manufacturing of solar energy systems does have its downsides.

Biomass:

Mississippi has always been an agricultural economy, making it a prime venue for biomass production. Analyzing the potential of biomass production is more complex than simply assessing a few variables, like the analysis for solar and wind power. Mississippi has a wide variety of agricultural products, so to accurately take the entire picture into account a more in-depth study would have to be performed. Biomass potential in Mississippi is, also, a broadly research topic, unlike solar and wind power. There are several studies that take assess at least in part the biomass resources of the state. Therefore, in lieu assessing biomass potential based on GIS criterion, a review of the current literature will be performed.

The biomass resources were determined by a review of Millbrandt (2005), English et al (2007), and Jackson (2007). Millbrandt (2005) analyzes biomass feedstock data "both

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[273] L Stoddard, J Abiecunas, and R O'Connell. "Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California." 2006. National Renewable Energy Laboratory Subcontract Report: 7-1.

[274] Ibid: 8-2.

statistically and graphically using geographic information systems (GIS)."[275] Furthermore, "this study estimates the technical biomass resources available in the United States…[where] estimates are based on numerous assumptions, methodologies adopted from other studies, and factors that relate population to the amount of post-consumer residue generation."[276] Millbrandt (2005) conclusions are "based on the accessible biomass with respect to constraints of land use, and the majority of the quantity depends on assumptions and factors that relate population to the amount of residue generation."[277]

English, et al (2007) assesses biomass potential through a combination "two computer models in order to provide a comprehensive outlook for the agricultural sector and the national/state economic impacts. A computer simulation model, POLYSYS, and an input-output model, IMPLAN, were used for the study."[278] The two computer models were used because "POLYSYS has been used for a number of national agricultural studies that require projections on the impacts on agricultural acreages and production by U.S. Agricultural Statistical Districts as the result of federal farm policy changes. IMPLAN contains state level input-output models that provide an accounting of each state's economy."[279] The authors assert that "the analysis and information generated from the analysis are closely related to the 2006 USDA baseline, so the early years 2006-2010 could be underrepresented (production wise) both nationally and at the

[275] A Milbrandt. "A Geographic Perspective on the Current Biomass Resource Availability in the United States." 2005. National Renewable Energy Laboratory Technical Report: 1.

[276] Ibid: 1.

[277] Ibid: 1.

[278] Burton English, et al. "25% Renewable Energy for the United States by 2025: State Level Agricultural and Economic Impact Tables." 2007. Department of Agricultural Economics University of Tennessee: 1.

[279] Ibid: 1.

state level."[280] Jackson (2007) determines its estimates based on a meta-analysis of several studies on biomass resources.[281] The analysis includes reviews of studies from the US Department of Energy, Mississippi Forestry Association, US Department of Agriculture, National Renewable Energy Laboratory, and Oak Ridge National Laboratory. The review of the reports forms a comprehensive view of current estimates of biomass resources for Mississippi.[282]

Biomass has the greatest potential for energy production in Mississippi. Milbrandt (2005) assesses the potential of biomass resources in the US. According to the study, there is the potential for 2.19 million dry tons of crop residues and 3.83 million tons of forest residues in Mississippi. The study, also, determines there is the potential for 4.5 million tons of primary mill residues in the state. Moreover, the study concludes that there is the potential for 4.88 million tons of switchgrass on reserve lands. According to the report, total biomass resources are about 15.4 million dry tons per year.[283] The Southeastern Sun Grant Initiative (2007) cites similar estimates. According to the report, "it is estimated 3.6 million dry tons of harvesting residues were produced in the state each year and could be made available for energy use…Primary mill residues totaled over 4.5 million dry tons."[284] Furthermore, "it is estimated that the state's agricultural community could produce 2.2 million dry tons of residue biomass annually. Another

[280] Ibid: 1.

[281] Samuel Jackson. "Mississippi Biomass and Bioenergy Overview." 2007. Southeastern Sun Grant Initiative: 1.

[282] Ibid: 3.

[283] A Milbrandt. "A Geographic Perspective on the Current Biomass Resource Availability in the United States." 2005. National Renewable Energy Laboratory Technical Report.

[284] Samuel Jackson. "Mississippi Biomass and Bioenergy Overview." 2007. Southeastern Sun Grant Initiative: 1.

5.3 million dry tons of dedicated energy crops could be produced."[285] Additionally, it is "estimated that on Conservation Reserve Program land alone, 4.9 million dry tons of switchgrass…could be produced each year."[286] The report estimates a total of 15.2 million dry tons of biomass resources per year.[287]

Table 3.9.

Summary of Biomass Resources. (Million dry tons)

Source	Crop Residues	Forest Residues	Primary Mill Residues	Switchgrass	Total
Millbrandt (2005)	2.19	3.83	4.5	4.88	15.4
Jackson (2007)	2.2	3.6	4.5	4.9	15.2
English, et al (2007)	13.6			4.1	17.7

English, et al. (2007) makes slightly higher estimations for biomass resources. According to the 2015 scenario, the report estimates 4.1 million dry tons of energy crops and 13.6 million dry tons of total wood and crop residue resources. According to the study, total biomass resources should be 17.7 million dry tons per year.[288] The total biomass resources, therefore, range 15.2 million dry tons to 17.7 million dry tons a year. Based on Perez-Verdin, et al (2008), a 100-MW generation plant can produce 800,000 MWh a year of electricity with 430,000 tons of

[285] Ibid: 1.

[286] Ibid: 1.

[287] Ibid: 1.

[288] Burton English, et al. "25% Renewable Energy for the United States by 2025: State Level Agricultural and Economic Impact Tables." 2007. Department of Agricultural Economics University of Tennessee.

biomass at 35% efficiency.[289] Therefore, each ton of biomass is capable of producing around 1.85 MWh. The estimation for electricity generation from biomass ranges from 28,120 thousand mWh to 32,745 thousand mWh a year. The energy potential of biomass can have a significant impact on the energy needs of Mississippi. However, these estimations do not include the implications on other uses of biomass including food; this is simply a look at energy potential.

The timeline to energy generation is an important aspect in planning for a renewable energy plan. Looking at a few biomass projects, an idea of the project timeline can be gained. The information is based on case studies obtained from the operating and construction entities associated with the projects. A sizeable biomass power station is located at Hill Air Force Base in Utah. The project began pre-construction phases in April 2003 and construction in February 2004. By the end of 2004, the 1.2 MW power plant was producing power from biomass. The total development timeline lasted around 20 months.[290] In Snowflake, Arizona, a power plant has a generation capacity of 24 MW from biomass produced within the Abitibi recycled newsprint paper mill. The initial preconstruction phase lasted 2 years. By September 2006, construction began on the $55 million project. The project began commercial operations in December 2007. Therefore, construction phases lasted around 16 months plus 2 years for pre-construction phases, totaling around 3 ½ years.[291] The Ely biomass power plant in the United Kingdom saw a similar development timeline. The project, a 38MW burning mostly straw, was

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[289] Gustavo Perez-Verdin. "Economic Impacts of Woody Biomass Utilization for Bioenergy in Mississippi." 2008. Forest Products Journal: 58.

[290] Christopher Abbuehl. "Hill Air Force Base, Utah." 2005. 8th Annual LMOP Conference.

[291] Thomas Suffield. "Biomass Project Development and Financing: 'From Woods to Watts.'" 2008. Renewable Power Project Finance: The Tutorial.

commissioned in December 2000 and was completed in mid-2004. From preconstruction stages to completion, was around 3 ½ years.[292] Depending on size, the construction timeline for a solar photovoltaic project is between 1 ½ years to 3 ½ years, though the pre-construction phases may add to the project development timeline. A solar photovoltaic power facility could be push into service in a reasonable amount of time.

Biomass energy is utilized either as a processed biofuel in a liquid form or as a direct fuel. Biofuels can be used to fuel electricity generation but the most attractive aspect is the potential for a transportation fuel. According to the Worldwatch Institute/Center for American Progress (2006), "ethanol from corn is cost-competitive with gasoline in the United States when the price of oil is above $45 per barrel."[293] Furthermore, "Biodiesel costs vary, depending on factors such as feedstock and production methods, but the IEA estimates that it is competitive with oil at about $65 per barrel."[294] According to Hill, et al (2006), "ethanol net production cost was $0.46 per energy equivalent liter of gasoline, while wholesale gasoline prices averaged $0.44/liter."[295] Additionally, "estimated soybean biodiesel production cost was $0.55 per diesel energy equivalent liter, where as diesel wholesale prices averaged $0.46/liter."[296] The Mississippi Ethanol Feasibility Study assessed the possibility of ethanol production in Mississippi. The study forecasts the price of ethanol in New Orleans-Memphis region to stay between $1.25

[292] Energy Power Resources. "Ely : Detail." http://www.eprl.co.uk/assets/ely/detail.html.

[293] Worldwatch Institute and Center for American Progress. "American Energy: The Renewable Path to Energy Security." 2006. Worldwatch Institute: 23.

[294] Ibid: 23.

[295] Jason Hill, et al. "Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels." 2006. PNAS 103: 11208.

[296] Ibid: 11208.

and $1.31, between 2009 and 2012.[297] A gallon of ethanol has two-thirds the energy content of a gallon gasoline. Therefore, it is competitive with gasoline at $1.96 per gallon, which is in step with other price estimates of ethanol. As long as oil remains fairly expensive, ethanol and biodiesel can be economically viable for use.

Biomass energy is also used as fuel for electricity generation. Since biomass fuels can come in a variety of forms with different energy contents and transportation costs have major price implications, the economics are highly variable. Kumar, Cameron, and Flynn (2003) assessed electricity production costs for a plant in Canada for three biomass fuels: straw, wood, and wood harvest residues. The study asserts “whole forest biomass and straw can generate power for 4.7 to 5.0¢/kWh at their optimum size.”[298] For wood harvest residue the production cost is a little higher at 6.3 ¢/kWh because of the added expense in adapting it into an applicable fuel source.[299] The International Energy Agency Energy Technology Essentials Report is a brief on the issues of biomass energy. According to the report, “because the variety of feedstocks and processes, costs of bio-power vary widely.” The report estimates that if local feedstock is available with low transportation costs, as it is in Mississippi, then electricity costs can be as low as 2¢/kWh. However, “the electricity cost may exceed 3¢-5¢/kWh” when biomass feedstock is obtained at the typical price of $3 to $3.5 per GJ. Due to the high availability of biomass feedstock and low transportation needs, biomass energy in Mississippi should be able to be

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[297] Mississippi State University and Sparks Companies, Inc. “Mississippi Ethanol Feasibility Study.” 2003. Mississippi State University.

[298] Amit Kumar, Jay Cameron, and Peter Flynn. “Biomass Power Cost and Optimum Plant Size in Western Canada.” 2003. Biomass and Bioenergy 24: 461.

[299] Ibid.

produced at a reasonable cost.[300] Curtis, et al (2003) assesses the feasibility of biomass for electricity generation in Georgia. The study indicates that as long as biomass costs are kept low, electricity generation from biomass can range from 6.1¢ to 12.9¢/kWh. These assessments are based on the most effective technologies; though, there have been significant technological advancements in the last few years.[301]

The 25X25 initiative is geared at adopting 25% renewable energy by 2025, for Mississippi it is estimated that the majority of this goal will be met with biomass energy. According to the 25X25 report, the net change in farm income in the state will increase from $2.36 million to $1.04 billion. Furthermore, the estimated agricultural economic impact would increase from $29.7 million to $4.14 billion.[302] Perez-Verdin, et al (2008) estimates the recovery of woody biomass could create a total of 1,712 jobs and $282.5 million in direct, indirect, and related industrial economic impact. Furthermore, a 100-MW biopower plant would create 631 jobs and $103.42 million in economic impact, while a 52-million gallon biofuel plant would create 1,756 jobs and $242.74 million in economic impact.[303] The cost of biomass for electricity generation is highly variable depending on several factors, but because the high availability of fuel and the low transportation costs, generation should be able to be produced at the lower end of the estimation. Biomass energy is not the cheapest form of energy currently available

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[300] International Energy Agency. "IEA Energy Technology Essentials." http://www.iea.org/Textbase/techno/essentials3.pdf.

[301] Wayne Curtis, et al. "The Feasibility of Generating Electricity From Biomass Fuel Sources in Georgia." 2003. University of Georgia.

[302] 25X25 Initiative. "Mississippi's 25x'25 Energy Future: The Economic Impacts and Land Use Changes of Increased Biomass Production." http://www.25x25.org

[303] Gustavo Perez-Verdin, et al. "Economic Impacts of Woody Biomass Utilization for Bioenergy in Mississippi." 2008. Forest Products Journal 58.

but as long as fossil fuel costs remain high, the economic impact of biomass energy in Mississippi could be very favorable.

Table 3.10.

Summary of Biomass Energy Costs

Source	Biofuel Costs	Electricity Costs
Worldwatch Institute/Center for American Progress (2006)	Ethanol – cost competitive with oil over $45 Biodiesel – cost competitive with oil over $65	-
Hill, et al (2006)	Ethanol - 46¢/gasoline energy equivalent liter Biodiesel - 55¢/diesel energy equivalent liter	-
Mississippi Ethanol Feasibility Study (2003)	Ethanol - $1.25 to $1.31/gallon	-
Kumar, Cameron, and Flynn (2003)	-	4.7¢ - 5¢/kWh for forest biomass and straw 6.3¢/kWh for wood harvest residue
IEA (2007)	-	2¢ - 5¢/kWh
Curtis (2003)	-	6.1¢ - 12.9¢/kWh

Biomass energy has numerous environmental benefits, mostly from displacing carbon emissions from fossil fuels. Kaygusuz (2001) argues "Significant environmental benefits can be obtained by using biomass fuels."[304] Furthermore, "Biomass power is one of the most attractive options for addressing CO2 concerns because both growth and conversion involve recycling atmospheric carbon, resulting in no net addition of CO2 into the atmosphere …[though]…woodfuel combustion emits CO2, and when the combustion is incomplete, it also emits CH4, CO, N2O, other HCs, and particulates."[305] However, "If fuelwood is used sustainably,

[304] Kamil Kaygusuz. "Hydropower and Biomass as Renewable Energy Sources in Turkey." 2001. Energy Sources 23: 795.

[305] Ibid.

i.e., tree regrowth is in balance with tree cutting, the emitted CO2 will be recaptured, which results in no net CO2 added to the atmosphere."[306] According to Nersesian (2007), biomass as an energy source has some particularly concerning agricultural impacts; the most notable being the impact on food supplies and the depletion of soil nutrients. Utilizing biomass for energy can place a greater demand on the same crops being utilized for human food supply driving up costs and reducing the available supply. Furthermore, "biomass plantations…[can]…deplete nutrients from the soil, promote aesthetic degradation, and increase the loss of biological diversity."[307] Electricity production from biomass can also produce emissions from combustion, but the emissions are far less than from fossil fuels. On the other hand, "biomass plantations can reduce soil erosion and be managed in a way that minimizes their impact on the landscape and on biological life."[308] Additionally, "there is no reason why biomass plantations cannot make a barren landscape more attractive and encourage biological life."[309] Ciubota-Rosie, Gavrilescu, and Macoveanu (2008) asserts "…biomass energy can be produced and consumed in a sustainable fashion, and there is no net contribution of carbon dioxide to global warming."[310] Furthermore, "such bioenergy crops would have little or no net contribution to atmospheric carbon dioxide as a greenhouse gas."[311] The findings contend that "…if managed carefully, biomass energy can have significant environmental advantages over the use of fossil fuels…an

[306] Ibid.

[307] Roy Nersesian. Energy for the 21st Century: A Comprehensive Guide to Conventional and Alternative Sources (New York: ME Sharpe, Inc, 2007): 58.

[308] Ibid: 59.

[309] Ibid: 59.

[310] Camelia Ciubota-Rosie, Maria Gavrilescu, and Matei Macoveanu. "Biomass – An Important Renewable Source of Energy in Romania." 2008. Environmental Engineering and Management Journal 7 (5): 567.

[311] Ibid.

appropriate level of biomass energy use can have less environmental impacts than our current means of energy production."[312] From the central perspective of energy, biomass is significantly better for the environment than current sources, but agriculturally there may be some negative impacts on economics from products to the effect on the soil. Overall, the positives of biomass most likely outweigh the negatives.

Conclusions:

This chapter has outlined the generation capacity, economics, environmental impact, and project timeline for wind, solar, and biomass energy in Mississippi. The findings are summarized in Table 3.11. Wind power has a meager generation capacity but electricity can be produced rather cheaply and without a dramatic environmental impact. Both solar technologies have the lowest potential for generation capacity. Furthermore, both solar photovoltaic and concentrated solar power are the most expensive of the renewable sources, and both have the most intense environment impact through indirect means. Biomass has the greatest potential for power production, but could have a negative impact on the environment if not managed correctly. Biomass could be produced very cheaply but only under the right circumstances otherwise it quickly becomes too expensive. The highest generation capacity comes from biomass, with wind and solar only capable of generating power to a much lesser extent. Biomass has the potential to be economically viable if transportation costs are kept low, but wind has the most favorable economics for any situation. The solar technology are not as fiscally friendly but as technology and manufacturing techniques advance those technologies should see a great reduction in price. All the renewable sources would be an improvement for the environment over conventional sources, if managed appropriately.

[312] Ibid.

Table 3.11.

Chapter Summary Table.

	Generation Capacity (Thousand MWh)	% of Mississippi Consumption for 2010	Economics (¢/kWh)	Environmental Impact
Wind	2930	5.8%	3-6	Emissions reduction; noise and sight pollution, radio interference
Solar PV	1665 - 1850	3.3% - 3.7%	7-18 (major price reductions by 2030)	Emissions reduction; indirect effects
Solar Concentrated	1295 - 1665	2.6% - 3.3%	5-14	Emissions reduction; indirect effects
Biomass	28,120 – 32,745	55.5% - 64.7%	2-13	Negative impact on agriculture

Based on this assessment, renewable sources do not have the generation capacity to fully sustain the state of Mississippi's energy needs, but they can generate a large portion of it. Wind or solar alone could remove the need for petroleum for electricity generation. Biomass could easily replace coal or natural gas as a generation fuel. (See Chapter 2 for details). A combination of all the renewable sources should be explored, with emphasis placed on biomass over wind and solar. While the potential generation capacity for a mixed source scenario was not included, this type of development would most likely prove to be the most effective. However, a mixed source scenario would have to balance costs, energy production density, and environmental concerns; therefore, there are numerous potential combinations of energy types. Currently, renewable energy is not being fully exploited in the state. The assessment shows that there is the potential for benefits over the conventional sources of energy if a move to renewable sources is made. Over the next quarter century, fossil fuels will become less and less favorable as an energy source, while these renewable sources will only get cheaper and become more of an improvement over the traditional ways of producing power. The assessment of performed here has delineated the major issues surrounding renewable energy production for the state of Mississippi.

CHAPTER 4

RENEWABLE ENERGY POLICY OPTIONS

In assessing the future of an alternative energy program, the policy options for supporting renewable energy must be assessed. In this chapter, the public policy options for promoting renewable energy in the state of Mississippi will be considered. The current policies being utilized by Mississippi as well as those applicable from the US government will first be considered. Additionally, policy initiatives from other states and select countries will be considered to provide other policy options. Information about the domestic policies and programs will be derived from the Energy Efficiency and Renewable Energy unit of the Department of Energy, the Database of State Incentives for Renewables and Efficiency, and academic journals. Information about the success and implications of both domestic and international programs will be obtained from a review of academic journals. The assessment will concentrate on programs that encourage renewable energy, rather than review all energy policy being utilized. The chapter will serve as an overview for the policy tools available for furthering a renewable energy program.

Mississippi:

Mississippi is presently not on the cutting edge of renewable energy policy, but has undertaken certain initiatives. According to Brent Bailey of the 25X25 Initiative, the state of Mississippi has not opposed renewable energy production, but has done very little to support it.[313] The current policies in Mississippi being utilized essentially fit into three categories: state supported financial incentives, power association supported financial incentives, and building codes. The majority of this assessment will focus on the state supported financial incentives, though the other two categories will be covered as well. All energy programs are administered by the Energy Division of the Mississippi Development Authority. The state sponsored financial incentives most closely fit into the type of policies that are necessary to advance an alternative energy agenda, but the push for energy efficiency with other types of policies can help support the general goal of edging out conventional fuel sources. State initiatives supporting renewable energy are thin; Mississippi is not a leader by any means. Federal programs can still be utilized in Mississippi, but those programs will be covered later.

The state supported financial incentive programs are limited to the Energy Investment Loan Program. The Energy Investment Loan Program "offers low-interest loans for renewable energy and energy efficiency projects."[314] Projects are eligible under the requirement that they reduce a facilities energy costs with eligible renewable energy technologies, which include several types of solar technologies, alternative fuels, geothermal, biomass, landfill gas, and hydropower. Loans between $15,000 and $300,000 are issued to commercial and industrial consumers at 3% below the prime mortgage rate at a maximum of seven years. The loans are paid for by $7 million fund financed through federal oil overcharge funds. The loan program is authorized by state law, and became effective in 1989.[315] The loan program is only program

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[313] Brent Bailey, e-mail message to author, February 24, 2009.

[314] Database of State Incentives for Renewables and Efficiency. "Mississippi Incentives for Renewable Energy." North Carolina State University, North Carolina Solar Center, http://www.dsireusa.org/library/includes/map.cfm?State=MS&CurrentPageId=1&RE=1&EE=0.

[315] Ibid.

that truly promotes the adoption of renewable sources as a means of energy. The program is limited in scope and is aimed only at purchasing renewable energy in an individual case.

The power association supported financial incentives and the building codes are also utilized in the overall alternative energy policy in Mississippi. Power association supported financial incentives are incentives offered by the private power associations rather than the state. Currently, seven power associations administer nine programs, mostly aimed at residential homes becoming more energy efficient. The majority of the programs are rebate programs, which provide between $50 and $500 for those who purchase new water heaters, pumps, or more energy efficient appliances for homes under certain guidelines.[316] Three power associations have loan programs in which residential customers can get low interest loans for energy efficient upgrades to their homes through their power provider. The programs are most aimed at making current buildings more energy efficient.[317] Building codes are simply energy efficiency requirements that are required for certain areas of the state.[318] The power association financial incentives and the building codes are aimed at making buildings more energy efficient rather than promoting alternative forms of energy so they are not of particular importance to this assessment. There has been much more of an effort made inside Mississippi to support energy efficiency in construction, than renewable energy sources as a means of production.

[316] Ibid.

[317] Ibid.

[318] Ibid.

Federal:

The federal government has a wide breadth of policy initiatives effecting alternative energy and energy efficiency. The federal government has not specifically been a leader in renewable energy policy but has implemented many programs to promote alternative energy. The current federal programs fit into four categories: industry and business financial incentives, government financial incentive aid programs, personal financial programs, and regulations. All categories include policies that make renewable energy either more affordable or make requirements that further support the growth of alternative energy. All energy related programs for the federal government are administered by the US Department of Energy or for tax credits the US Department of the Treasury, unless noted otherwise. After reviewing the policies in place, a brief assessment of the benefits and faults of these programs for the state of Mississippi will be made. The US government is not a leader internationally or even domestically when certain state governments are taken into account, but there are many programs that work toward the goal of promoting renewable energy.

Several financial incentives for renewable energy exist for business and industry through the federal government. Though not all the programs originated with the 2009 stimulus package, many of the programs were extended or reauthorized by the American Recovery and Reinvestment Act of 2009. There are four tax related programs for corporations and industry available; all four were most recently authorized by the American Recovery and Reinvestment Act. The Qualified Advanced Energy Project Investment Tax Credit "established a new investment tax credit to encourage the development of a US-based renewable energy manufacturing sector."[319] The tax credit is equal to 30% of the qualified investment each year,

[319] Database of State Incentives for Renewables and Efficiency. "Federal Incentives for Renewable Energy." North Carolina State University, North Carolina Solar Center,

with authorized funds limited to $2.3 billion.[320] The Renewable Electricity Production Tax Credit was first created by the Energy Policy Act of 1992 and has since been reauthorized in 2002, 2004, 2005, and 2009. The tax credit applies to electricity produced by renewable sources. The tax credit is worth 2.1¢/kWh for wind, geothermal, and certain types of biomass, and 1¢/kWh for hydroelectric power, municipal solid waste and landfill gas, and certain types of biomass.[321] The Business Energy Investment Tax Credit was first authorized by the Energy Policy Act of 2005, was significantly expanded by Energy Improvement and Extension Act of 2008, and slightly affected by the 2009 stimulus package. The tax credit is equal to 30% of expenditures for solar systems, fuel cells, and small wind turbines, and 10% of expenditures for geothermal systems, wind microturbines, and combined heat and power. Fuel cells, wind microturbines, and small wind turbines installed during the last quarter of 2008 are limited by maximum credits. Eligible taxpayers have the option of the Renewable Electricity Production Tax Credit, the Business Energy Investment Tax Credit, or the Renewable Energy Grants, which cover many of the same elements.

Additionally, the US government has a program designed to reduce losses from renewable energy investments, through tax deductions. The Modified Accelerated Cost-Recovery System, predecessors were put into place in 1986 but were expanded in 2005 by the Energy Policy Act, in 2008 by the Energy Improvement and Extension Act and the Economic Stimulus Act, and in 2009 by the American Recovery and Reinvestment Act. The system allows for investment depreciations to be tax deductable on federal taxes. The property owner, under

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http://www.dsireusa.org/library/includes/SeeAllFederal.cfm?Search=federal&federal=federal&state=federal&currentpageid=1&ee=0&re=1.

[320] Ibid.

[321] Ibid.

certain conditions, can deduct 50% of the depreciated value making investment losses less risky by providing tax relief.[322] There are three loan and grant programs for corporation and industry available. The American Recovery and Reinvestment Act created the Renewable Energy Grants to be administered by the Treasury Department. The grant is an alternative to tax credits to fund renewable energy projects. Grants are available for up to 30% of costs for solar systems, fuels cells, small wind turbines, and other qualifying production facilities which include wind, biomass, geothermal, solid waste, and hydropower.

Additionally, grants are available for up to 10% for geothermal heat pumps, wind microturbines, and combined heat and power.[323] The Department of Energy Loan Programs are low interest loans expected to be repaid within 30 years designed to help industry fund new renewable energy projects. The US Department of Energy Loan Guarantee Program originally authorized by the Energy Policy Act of 2005 was designed to support projects that "avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases; and employ new or significantly improved technologies as compared to commercial technologies in service."[324] The American Recovery and Reinvestment Act authorized an additional Temporary Loan Program for "renewable energy projects that generate electricity or thermal energy and facilities that manufacture related components, electric power transmission systems, and innovative biofuels projects."[325] Under the Food, Conservation, and Energy Act of 2008, the US Department of Agriculture is authorized to provide loans and grants for renewable energy and energy efficiency for the purpose of rural development. The Rural Energy for America Program

[322] Ibid.

[323] Ibid.

[324] Ibid.

[325] Ibid.

works to develop renewable energy by providing grants and loans to promote renewable energy systems.[326] For the business sector, the federal government employs three tax credits, a tax deduction, and loan and grant programs administered by the Departments of Agriculture, Energy, and Treasury to promote renewable energy growth.

The federal government provides funding opportunities for state, local, and tribal governments as well as certain public entities to promote renewable energy. The federal government offers two types of renewable energy programs for government entities: grants and bonds. The Tribal Energy Program Grant administered by the Department of Energy "promotes tribal energy efficiency, economic growth, and employment on tribal lands through the development of renewable energy and energy efficiency technologies."[327] The grants are designed in much the same way that the business grants are but are intended for Tribal Governments.[328] The Rural Energy for America Program, mentioned above, includes grants specifically meant to support renewable energy technologies by public entities. The grants are applied in much the same way as they are for the business sector, but grants are limited to 25% of the total cost of the project or $25 million.[329] Clean Renewable Energy Bond were originally authorized by the Energy Policy Act of 2005, but were extended by the American Recovery and Reinvestment Act. The bonds are meant to aid public entities in financing renewable energy projects. The bonds are much like other bonds but are treated as taxable income for the bondholder. Public power associations, government entities, and electric cooperatives each are

[326] Ibid.

[327] Ibid.

[328] Ibid.

[329] Ibid.

entitled to one-third of the current $2.4 billion appropriation.[330] Qualified Energy Conservation Bonds, authorized by the Energy Improvement and Extension Act of 2008, are specifically meant for state, local, and tribal governments. The bonds are to support certain types of energy projects which include renewable energy technology projects.[331] Both bond programs are designed at a theoretical 0% interest, where the bondholder receives federal tax credits in lieu of bond interest and the borrower pays back only the principle.[332] The federal government provides grant programs from the Departments of Agriculture and Energy, and bonds through the Department of Treasury.

The federal government offers a few programs to promote renewable energy amongst individuals. For individuals, the options are either tax related or mortgages. The Residential Renewable Energy Tax Credit was originally created by the Energy Policy Act of 2005, but the Energy Improvement and Extension Act extended the credit and the American Recovery and Reinvestment Act removed all maximum limits except for fuel cells.[333] The tax credit allows "a taxpayer to claim a credit of 30% of qualified expenditures for a system that serves a dwelling unit located in the United States and used as a residence by the taxpayer."[334] Any system placed before January 1, 2009 is subject to a maximum limit, but systems placed after then are not.[335] The Residential Energy Conservation Subsidy Exclusion is personal tax exemption for direct or

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[330] Ibid.

[331] Ibid.

[332] Ibid.

[333] Ibid.

[334] Ibid.

[335] Ibid.

indirect subsidies for "energy conservation measures" by public utilities.[336] The IRS code allows "installations or modifications primarily designed to reduce consumption of electricity or natural gas, or improve the management of energy demand" to be nontaxable.[337] This tax exemption is applicable to the power association supported financial incentives in Mississippi outlined previously. The federal government, also, provides energy efficient mortgages. The mortgages allow homeowners "to finance a variety of energy efficiency measures, including renewable energy technologies, in a new or existing home."[338] The program is designed so that the "federal government supports these loans by insuring them through Federal Housing Authority (FHA) or Veterans Affairs (VA) programs…[which] allows borrowers who might otherwise be denied loans to pursue energy efficiency improvements, and it secures lenders against loan default."[339] Alternatively, Conventional Energy Star mortgages provide low interest mortgages through Fannie Mae or Freddie Mac to individuals for renewable energy or energy efficient improvements to existing homes.[340] To promote renewable energy for individuals, the federal government has introduced programs that provide tax incentives or low interest mortgages for individuals for renewable energy improvements to their homes.

Though the federal government imposes no standards on energy production from renewable energy, it does set certain goals renewable energy goals for federal agencies and buildings. The Energy Policy Act of 2005 and later the Energy Independence and Security Act of 2007 established and reaffirmed, respectively, energy goals and standards for federal buildings.

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[336] Ibid.

[337] Ibid.

[338] Ibid.

[339] Ibid.

[340] Ibid.

The crux of the legislation is aimed at reducing energy consumption by 30% by 2015, but there is also provisions that encourage renewable energy use. For all new federal buildings or existing buildings going through renovations, a new standard of 30% of all hot water used must come from a solar water heating system is being imposed.[341] Additionally, Executive Order 13423 establishes energy reduction goals for federal agencies. Like the energy goals for federal buildings, the majority of the order are focused on reducing the energy consumption of federal agencies by 30% by 2015, but provisions for renewable energy usage are included.[342] The Executive Order requires agencies "to reduce their fleet's total consumption of petroleum products by 2% annually through 2015, while increasing their consumption of non-petroleum-based fuel by 10% per year."[343] The Energy Policy Act of 2005, also, established green power purchasing goals for the federal government. As long as it is economically feasible and technically possible, the amount of renewable energy consumed from the federal government must meet a certain level. Of the total amount of energy consumed, at least 5% must come from renewable sources between 2010 and 2012, and at least 7.5% after 2013.[344] These provisions will have federal buildings and agencies actually employing and utilizing renewable energy. In this way, the federal government is 'leading by example' by not just encouraging others to employ renewable energy but by utilizing it in federal facilities.

There are both positive and negatives to offering financial incentives to promote renewable energy. Herzog, et al (2001) concludes "the wind power credit, in particular, has proven successful in encouraging strong growth of U.S. wind energy over the last several years—

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[341] Ibid.

[342] Ibid.

[343] Ibid.

[344] Ibid.

with a 30-percent increase in 1998 and a 40-percent increase in 1999."[345] Additionally, "to complement this support of private-sector R&D, tax incentives directed toward those who use the technologies would provide the "demand pull" needed to accelerate the technology transfer process and the rate of market development."[346] Palmer and Burtraw (2005) concludes the renewable production credit can be effective in promoting the growth of renewable energy, though a renewable portfolio standard is a more cost effective approach to achieving the same level of renewable production.[347] The production credit has higher social costs and is less effective in reducing emissions than other policy options. However, the production credit does have "potential value as a policy instrument in supporting new immature technologies."[348] Wohlgemuth and Madlener (2000) concludes "specific incentive mechanisms are necessary but they should be compatible with the introduction of competition in electricity markets. Some of the existing schemes have proved very effective for stimulating the development of renewable sources, but they should evolve to become more compatible with competition."[349] Furthermore "Direct subsidies to investment which has largely been used during the 1980s for increasing renewable production may not be the best solution…In most circumstances, renewables policies should be designed so that subsidy levels are tied to project performance, not capital investment."[350] Wohlgemuth and Madlener (2000) asserts "experience indicates that the need

[345] Antonia Herzog, et al. "Renewable Energy: A Viable Choice." 2001. Environment 43: 10.

[346] Ibid: 10.

[347] Karen Palmer and Dallas Burtraw. "Cost-Effectiveness of Renewable Electricity Policies." 2005. Energy Economics 27: 892-893.

[348] Ibid: 892.

[349] Norbert Wohlgemuth and Reinhard Madlener. "Financial Support of Renewable Energy Systems: Investment vs Operating Cost Subsidies." (presented at the proceedings of the Norwegian Association for Energy Economics Conference, Bergen, Norway, August 31- September 2, 2000.).

[350] Ibid.

for subsidies declines as technologies mature."[351] Ackermann, Andersson, and Soder (2001) argues financial incentives can be "very useful to get a technology off the ground, as the income is secured and, thereby, the risk for the developer is reduced…However, this instrument provides limited incentives to reduce costs below a certain break even level."[352] Ackermann, Andersson, and Soder (2001) references the German experience with financial incentives for renewable energy where Germany "has relatively high feed-in tariffs, the world-wide largest market for wind turbine generators (WTG) has emerged, and the fast up-scaling of wind turbine size is mainly driven by the German market needs" but "WTGs cost seems to be between 15 and 30% higher than in countries where no feed-in tariffs exist."[353]

The federal government has a wide array of policy tools in place to promote renewable energy. For the both the business sector and individuals, there are tax incentives as well as loans and grants to encourage the use of renewable energy. For other public entities, the federal government has made available bonds for funding as well as grants. The US government has, also, imposed renewable energy usage goals onto its own operations. The majority of the incentives put into place by the federal government, though, are either loans and grants or tax incentives. The US government has left many of the alternative energy programs to the states, while attempting to provide some financial incentives.

Other States:

Supreme Court Justice Louis Brandeis asserted 'state legislatures are the laboratories of democracies'. The principle has proven true with alternative energy policy, where it has been

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[351] Ibid.

[352] Thomas Ackermann, Goran Andersson, and Lennart Soder. "Overview of Government and Market Driven Programs for the Promotion of Renewable Power Generation." 2001. Renewable Energy 22: 199.

[353] Ibid: 199.

state government that has led the way in the recent years. State legislatures have taken dramatic strides in assisting the growth of renewable energy in America. Some of the most important legislation to promote renewable energy in United States comes from state governments. The federal government has a wide array of financial incentives all ready in use and the same type of programs utilized by the states do not differ much, so the analysis of state policies here will not focus on the financial incentives, but will provide an overview. Additionally, in reviewing the policies of other states, what may be applicable to Mississippi should be considered foremost. Therefore, this analysis will focus on two of the most important renewable energy policies currently in use: renewable portfolio standards and state net metering. Both programs are specifically designed to promote energy use from renewable sources. Both policy initiatives have found significant support and success across the nation.

Renewable portfolio standards (RPS) are an important part of growing the use of alternative energy in the United States by mandating renewable energy deployment for electricity production. According to the US Department of Energy, "A renewable portfolio standard is a state policy that requires electricity provides to obtain a minimum percentage of their power from renewable energy resources by a certain date."[354] As of April 2009, there are 29 states that have mandatory renewable portfolio standards in place, with several states adding new standards or amending goals already in place within the last year. Additionally, South Dakota, Utah, Vermont, and Virginia have renewable energy goals or objectives in lieu of standards. The essential difference between a renewable standard and goal or objective is that standards make a concrete requirement for renewable energy sources, while goals or objectives

[354] US Department of Energy. Energy Efficiency and Renewable Energy Division, 2009, "States with Renewable Portfolio Standards."
http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.

only require that renewable sources be pursued as long as they are available and cost effective. Table 4.1 shows renewable portfolio standards by state.

Table 4.1.

Renewable Portfolio Standards by State[355]

State	Amount	Year	State	Amount	Year
Arizona	15%	2025	New Jersey	22.5%	2021
California	20%	2010	New Mexico	20%	2020
Colorado	20%	2020	New York	24%	2013
Connecticut	23%	2020	North Carolina	12.5%	2021
Delaware	20%	2019	North Dakota	10%	2015
Hawaii	20%	2020	Ohio	25%	2025
Illinois	25%	2025	Oregon	25%	2025
Iowa	105 MW		Pennsylvania	18%	2020
Maine	10%	2017	Rhode Island	15%	2020
Maryland	9.5%	2022	South Dakota*	10%	2015
Massachusetts	4%	2009	Texas	5880 MW	2015
Michigan	10%	2015	Utah*	20%	2025
Minnesota	25%	2025	Vermont*	20%	2017
Missouri	15%	2021	Virginia*	15%	2025
Montana	15%	2015	Washington	15%	2020
Nevada	20%	2015	Wisconsin	10%	2015
New Hampshire	16%	2025	Mississippi	NONE	NONE

Renewable portfolio standards have found success in many states. Wiser (2008) finds that “In 2007, approximately 76% of all non-hydro renewable capacity additions came from states with active RPS programs.”[356] The author asserts it is “evident that existing state RPS policies have already had a sizeable impact on new renewable resource development.”[357]

[355] Database of State Incentives for Renewables and Efficiency. “Rules, Regulations, and Policies for Renewable Energy.” North Carolina State University, North Carolina Solar Center, http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7&EE=0&RE=1.

[356] Ibid: 12.

[357] Ibid: 13.

Additionally, the report concludes that for most states in2007, RPS programs increased electricity rates by less than 1%. Chen, et al (2003) advocates a standard of 7.5% by 2013.[358] The report estimates that at most the cost of consumer electricity will rise by less than 1%, while a reduction in natural gas prices will completely offset the rate increase. The authors find renewable portfolio standards "could be achieved at little or no cost, and might even reduce electricity costs in the long run."[359]

The major aspect in instituting a RPS policy is proper design and implementation. Wiser, Porter, and Grace (2005) argues "experience in some U.S. states demonstrates that a well-crafted and implemented RPS can effectively provide support for renewable energy."[360] The authors also argue "the verdict on other state RPS policies is more mixed, either because the RPS has not been in place long enough to evaluate results, or because some success has been experienced but that success is still incomplete" while "in still other states, such as Connecticut, Maine and Pennsylvania, experience shows that poorly designed policies will do little to advance renewable markets."[361] The study sets out 7 principles for designing a RPS policy: socially beneficial, cost effective and flexible, predictable, nondiscriminatory, enforceable, consistent with market structure, and compatible with other policies.[362] Langniss and Wiser (2003) asserts "What is becoming clear from the little experience that does exist is that, like any renewable

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[358] Cliff Chen, et al. "The Maryland Renewable Portfolio Standard: An Assessment of Potential Cost Impacts." 2003. Synapse Energy Economics, Inc.

[359]Ibid: 3.

[360] Ryan Wiser, Kevin Porter, and Robert Grace. "Evaluating Experience with Renewable Portfolio Standards in the United States." 2005. Mitigation and Adapation Strategies for Global Change 10: 260.

[361] Ibid: 260.

[362] Ibid: 257-260.

energy policy, an RPS can be designed well or it can be designed poorly." [363] A variety of factors including "inadequate purchase obligations, overly broad renewable energy eligibility guidelines, unclear regulatory rules, insufficient enforcement, and wavering political support" can ultimately sink a RPS policy.[364] The authors conclude "the Texas policy shows that an RPS, if properly designed and carefully implemented, can deliver on its promise of offering a low cost, flexible, and effective support mechanism for renewable energy."[365]

All the variables affecting a RPS policy must be taken into consideration to establish a policy that can tackle all the obstacles. Berry and Jaccard (2001) argues "the selection of the target involves a three-way tradeoff between environmental improvement, long-term technology strategy, and cost." [366] Depending on the political, social, and economic environment the three considerations have to be balanced accordingly to ensure that the high priority policy goals are not pushed to the side in lieu of other goals.[367] Cory and Swezey (2007) asserts that "a successful RPS policy is one that meets a particular state's policy goals. States may enact an RPS with any number of policy goals in mind, such as fuel diversity, economic development, electricity price stability, environmental benefits, and others." [368] Legislators must

[363] Ole Langniss and Ryan Wiser. "The Renewable Portfolio Standards in Texas: An Early Assessment." 2003. Energy Policy 31: 533.

[364] Ibid: 533.

[365] Ibid: 533-534.

[366] Trent Berry and Mark Jaccard. "The Renewable Portfolio Standard: Design Considerations and an Implementation Survey." 2001. Energy Policy 29: 276.

[367] Ibid.

[368] Karlynn Cory and Blair Swezey. "Renewable Portfolio Standards in the States: Balancing Goals and Rules." 2007. The Electricity Journal 20: 30-31.

take into account the availability of resources, the structure of the market, and the existing regulation when designing a new RPS policy.[369]

Some states have found success with RPS programs while others have fallen short. Texas has been particularly successful in its RPS program, while Pennsylvania has not.[370] Texas has implemented two RPS programs, the original in 1999 and an extension in 2006. The original legislation is a "textbook model, establishing a clear and effective REC program, a transparent market transaction process, and an "alternative compliance mechanism" that provides options, albeit costly ones, for electricity suppliers unable to meet standard requirements. The RPS focused on total renewable generation capacity and called for an increase from 1280 megawatts ("MW") in January 2003 to 2880 MW by January 2009."[371] The extension left the mechanisms of the policy in place will raising the capacity level to 5880 MW by January 2015.[372] Texas is seen as one of the more successful cases of RPS programs being enacted, where they have not seen major rate increases or failures to meet the standards.[373] Pennsylvania on the other hand has not seen nearly as much success. Pennsylvania's program is inhibited by the mere complexity where it involves many rules and provisions including a two Tier system for renewable sources.[374] The program is overly complicated leading to much debate on the interpretation of

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[369] Ibid.

[370] Barry Rabe. "Race to the Top: The Expanding Role of US State Renewable Portfolio Standards." 2007. Sustainable Development Law and Policy 7.

[371] Ibid: 11-12.

[372] Ibid: 11-12.

[373] Ole Langniss and Ryan Wiser. "The Renewable Portfolio Standards in Texas: An Early Assessment." 2003. Energy Policy 31.

[374] Barry Rabe. "Race to the Top: The Expanding Role of US State Renewable Portfolio Standards." 2007. Sustainable Development Law and Policy 7.

the rules. The program has not created the economic development the state had hoped, with the policy following short of many of its goals.[375]

Though renewable portfolio standards have been a function of states so far, there has been some debate a utilizing a national RPS program. Nogee, Deyette, and Clemmer (2007) "demonstrates that under a wide range of assumptions, a 20 percent national RPS is achievable, and would save consumers money by reducing natural gas and electricity prices." [376] The findings also "show that a national RPS would diversify the electricity system, promote local economic development, improve the nation's energy security and reliability, and achieve important reductions in global warming emissions."[377] Sovacool and Cooper (2007) concludes that "Federal legislation establishing a clear and uniform national RPS would not only resolve many of the discrepancies that have arisen from the confusing disorder of state-based RPS policies, it would also signal a national commitment to renewable energy generation that is certain to help stimulate a more robust market for renewable energy technologies." [378] Additionally, the authors argue "a national RPS would decrease the cost of electricity and distribute the benefits of renewable generation more justly. Rather than relying on a handful of states to shoulder the burdens of all, a national RPS would expand competition in ways that benefit consumers in all states."[379]

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[375] Ibid: 14.

[376] Alan Nogee, Jeff Deyette, and Steve Clemmer. "The Projected Impacts of a National Renewable Portfolio Standard." 2007. The Electricity Journal 20: 45.

[377] Ibid: 45.

[378] Benjamin Sovacool and Christopher Cooper. "Big Is Beautiful: The Case for Federal Leadership on a National Renewable Portfolio Standard." 2007. The Electricity Journal 20: 59.

[379] Ibid: 59.

State net metering is an important program in encouraging small scale renewable energy production among residents. According to the US Department of Energy, "Net metering enables customers to use their own generation to offset their consumption over a billing period by allowing their electricity meters to turn backwards when they generate electricity in excess of their demand. This offset means that customers receive retail prices for the excess electricity they generate…Net metering is a low-cost, easily administered method of encouraging customer investment in renewable energy technologies."[380] Currently, 44 states have enacted state net metering policies with similar, fairly successful results across the board. The only states not to utilize some kind of state net metering policy are Alabama, Alaska, Kansas, Mississippi, South Dakota, and Tennessee. Most state net metering policies are designed in much the same way, with only minor details differentiating between states.

State net metering works as an incentive for utilizing small renewable energy systems. Ackermann, Andersson, and Soder (2001) asserts "net metering particularly encourages the investment into very small systems for self generating."[381] Additionally, net metering programs also has "benefits for the utilities, as net metering leads to a reduction in distribution losses and an improvement of the voltage profile."[382] Nevertheless, net metering programs "can only be considered an interim solution as they do not necessarily lead to cost reduction."[383] Wan and Green (1998) finds state net metering programs "enhance economic incentives to the owners of

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[380] US Department of Energy. Energy Efficiency and Renewable Energy Division, 2009, "Net Metering Policies." http://apps3.eere.energy.gov/greenpower/markets/netmetering.shtml.

[381] Thomas Ackermann, Goran Andersson, and Lennart Soder. "Overview of Government and Market Driven Programs for the Promotion of Renewable Power Generation." 2001. Renewable Energy 22: 199-200.

[382] Ibid: 199-200.

[383] Ibid: 204.

small renewable energy systems and encourage private investment in renewable energy technologies without requiring public funding."[384] Net metering programs "are easy to implement and require no constant regulatory interaction or supervision after they are in place."[385] Furthermore, "the cost of renewable energy technologies continues to decline, net metering programs will become more effective in facilitating widespread applications of small renewable energy systems."[386] However, "enacted net metering programs for some time, their impact on renewable energy technologies has been small to date" and "costs of small renewable energy systems are also a barrier."[387] Duke, Williams, and Payne (2005) argues "net metering provides an elegant strategy for radically improving the efficiency of pricing incentives."[388] Ultimately, "net metering is generally regarded as a temporary subsidy for helping launch [renewables] in the market…[but] a powerful case can be made that net metering policies should be both more widely adopted and kept in place until efficient energy pricing policies are implemented."[389]

State net metering has mixed benefits for utilities and consumers. Cook and Cross (1997) "findings indicate that net metering, when limited to a small percentage of utility peak capacity, does not unduly disadvantage the utility in the net metered customer's service

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[384] Yih-huei Wan and James Green. "Current Experience with Net Metering Programs." 1998. National Renewable Energy Laboratory: 7.

[385] Ibid.

[386] Ibid.

[387] Ibid.

[388] Richard Duke, Robert Williams, and Adam Payne. "Accelerating Residential PV Expansion: Demand Analysis for Competitive Electricity Markets." 2005. Energy Policy 33: 1918.

[389] Ibid: 1919.

territory."[390] Furthermore, "nearly 50 percent of the value of solar energy produced by the consumer is lost if net metering is not available" while "an increasing percentage put back onto the grid makes net metering more valuable from the customer's perspective."[391] Cook and Cross (1997) concludes "net-metering represents a low-cost, no-regrets way to promote power from renewable energy sources."[392] Gordon, Olson, and Nieto (2006) argues "the customer may be reducing or avoiding purchases of energy from the grid, but the distributor must still maintain the transmission and distribution infrastructure to serve the customer's needs."[393] Furthermore, "the situation is exacerbated by net metering when the customer generator produces more energy than it is concurrently consuming and the meter runs backwards…resulting in a payment from the utility to the customer at full retail price, a payment that is in excess of the costs that the utility avoids as a result of receiving generation from the customer."[394] According to Gordon, Olson, and Nieto, state net metering programs may unduly affect utilities by pushing operating costs onto them while not gaining proceeds from customers, which may lead to higher rate costs for customers not involved in net metering.[395]

Many other states have found success with both renewable portfolio standards and state net metering. Renewable portfolio standards can encourage utilities to develop renewable projects with little consequences for consumers. State net metering can promote

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[390] Christopher Cook and Jonathan Cross. "A Case Study: The Economic Cost of Net Metering in Maryland: Who Bears the Economic Burden." 1997. Maryland Energy Administration: 6.

[391] Ibid: 5-6.

[392] Ibid: 6.

[393] Kenneth Gordon, Wayne Olson, and Amparo Nieto. "Responding to EPAct 2005: Looking at Smart Meters for Electricity, Time-Based Rate Structures, and Net Metering." 2006. Edison Electric Institute:28.

[394] Ibid.

[395] Ibid.

renewable energy projects among individuals without tremendous consequences for industry. The success of both types of programs has had mixed results depending on what state is under review, but for outcomes are generally positive. Mississippi is far behind in adopting policies to promote renewable energy and should learn from other states that face or have faced the same situation.

International Perspectives:

The European Union has tried to implement renewable energy policy, but its member states have also adopted some successful programs. Fouquet and Johansson (2008) indicates "In March 2007, the European Council adopted an overall binding target for Renewable Sources of Energy (RES) at 20% of energy for final consumption by 2020.[396] For the European Union, there "are at present two major different political support mechanisms applied in EU 27 Member States, the feed-in tariff (FiT) systems and the tradable green certificate (TGC) systems.[397] The tradable green certificate systems "are established in Belgium, Italy, Poland, Romania, Sweden and in the United Kingdom… in these systems a defined member of the electricity supply chain, be it consumer, generator or supplier, has to present a fixed minimum quantity of certificates each year, as set by a public authority."[398] In the feed in tariff system "any national generator of renewable electricity (RES) can sell its electricity at a fixed tariff for a specified time period under specific conditions depending on location, technology, etc. The price remains constant for the defined period but for new connections in later years a lower price

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[396] Doerte Fouquet and Thomas Johansson. "European Renewable Energy Policy at Crossroads – Focus on Electricity Support Mechanims." 2008. Energy Policy 36: 4079.

[397] Ibid: 4080.

[398] Ibid: 4080.

level is offered."[399] Nevertheless, "It would well serve the underlying purpose of the RE expansion if targets have the character of minimum levels rather than maximum levels to be achieved."[400]

Several European countries have made strong attempts to promote renewable energy but have had mixed results. Lipp (2007) indicates for the most part renewable energy policy in Europe has been based on two instruments: feed in tariffs and renewable portfolio standards. Denmark and Germany utilize feed in tariffs "and are world leaders in the field of RE development. The FIT in Denmark and Germany has shown that this can be provided by providing different feed-in rates, guaranteeing grid access and enabling a range of societal players to participate in the market."[401] The British renewable portfolio standard "does not provide the same level of certainty, nor does it differentiate between technological learning curves. The result is that development has been limited to a small number of technologies by few participants."[402] Lipp (2007) concludes the evidence from Denmark, Germany, and the United Kingdom suggests the feed in tariff "is more cost effective at getting RE developed…[while] national context is important, but policy choice and design are considered key factors in the slower pace of RE development in the UK."[403] Bechberger and Reiche (2004) finds "Germany is the world leader in installed wind capacity amounting to 13,512 MW in October 2003 (nearly 40 % of the global capacity)"; only Japan has a larger installed PV generation capacity; "Germany is leading in the sale of biodiesel"; and "the German market for

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[399] Ibid: 4080.

[400] Ibid: 4091.

[401] Judith Lipp. "Lessons for Effective Renewable Electricity Policy from Denmark, Germany, and the United Kingdom." 2007. Energy Policy 35: 5494.

[402] Ibid: 5494.

[403] Ibid: 5494.

solar heating systems (solar collectors) is by far the biggest in Europe."[404] Germany has adopted a four pronged strategy for the promotion of renewable energy: investment subsidies, soft loans, tax allowances, and subsidies for operational costs.[405] The German approach has been very successful up to this point with great advances in renewable development. The German policies began with "the 1990 Feed-in Law gave additional and powerful financial incentives to investors in renewables."[406] It was the first step in institutional changes that supported further renewable growth. Jacobbson and Lauber (2006) indicates the promotion of German renewable energy policy was due to "institutional change in the form of a changed energy R&D policy (although only on the margin), the formation of markets (although very small) in the form of protected niches, entry of firms and establishment of some of the elements of an advocacy coalition."[407]

Australia has begun to adopt policies to promote renewable energy but has only had limited success, because of difficulties in coordinating those programs. Watt and Outhred (2001) reveals the Australian government has established the "Sustainable Energy Development Authority (SEDA), with the objective of reducing greenhouse gas emissions by investing in the commercialization and use of sustainable technologies such as renewable energy, energy efficiency and cogeneration; and the 1997 Electricity Act, which includes a requirement for electricity retailers to set greenhouse gas emission targets and implement renewable energy

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[404] Mischa Bechberger and Danyel Reiche. "Renewable Energy Policy in Germany: Pioneering and Exemplary Regulations." 2004. Energy for Sustainable Development 8: 49.

[405] Ibid: 49.

[406] Staffan Jacobbson and Volkmar Lauber. "The Politics and Policy of Energy System Transformation – Explaining the German Diffusion of Renewable Energy Technology." 2006. Energy Policy 34: 272.

[407] Ibid: 271.

strategies."[408] Watt and Outhred (2001) concludes "state governments can provide direct assistance for renewable energy market development through electricity, manufacturing industry and regional development programs" and the "commonwealth government should devise a pro-active industry development policy which should accompany renewable energy targets or other market support mechanisms…also assist the market processes by ensuring consistency in State energy markets."[409] Jones (2009) asserts "the stalling of the development of the renewable energy industry provides evidence of the impact of government policies in the Australian context. Over the 1997–2007 decade the lack of coordination between the federal and state governments resulted in a mixture of renewable energy targets and uneven development of the renewable energy industry."[410] Additionally, the "policy measures introduced by the federal government to increase the percentage of energy supply from renewable sources through a market based mechanism (MRET) provided challenges for state electricity systems to accommodate the improvements that were required."[411] Moreover, "the experience of the renewable energy industry highlights how the political environment shapes the policy measures that determine future development."[412]

South Africa has hesitated on formulating policy to promote renewable energy. Sebitosi and Pillay (2008) finds one of the few government documents addressing renewable energy is a white paper from the South African Department of Minerals and Energy, which states "A

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[408] Muriel Watt and Hugh Outhred. "Australian and International Renewable Energy Policy Initiatives." 2001. Renewable Energy 22: 242.

[409] Ibid: 244.

[410] Stephen Jones. "The Future of Renewable Energy in Australia: A Test for Cooperative Federalism?" 2009. Australian Journal of Public Administration 68: 15-16.

[411] Ibid: 16.

[412] Ibid: 16.

Strategy on Renewable Energy will be developed, which will translate the goals, objectives and deliverables set out herein into a practical implementation plan."[413] However, "no drafting of such a strategy has been undertaken…more than anything else, is the clearest indictment that the government lacks the will or capacity to move forward with [renewable energy]."[414] Nonetheless, Sebitosi and Pillay (2008) indicates South Africa lacks "a framework to deliver reliable and accurate energy data to the policy makers presents a major barrier…Hence there is need for a transformation from an opaque operation that was necessitated by past history to a more transparent one reflecting the new era.[415] Winkler (2005) finds "South Africa has some experience with renewable energy, though largely limited to traditional biomass and off-grid applications."[416] Moreover, the "government is beginning to set targets for renewable energy in the short-to-medium term…more ambitious long-term targets are feasible, aiming at 15% renewable electricity by 2020."[417] However, most objectives for renewable energy are derived from the previously mentioned white paper, but little has been done in policy formation to achieve these objectives, or to develop policy instruments to achieve the renewable energy goals the government is beginning to adopt.[418]

China is beginning to promote renewable energy but is meeting a variety of challenges. Shi (2009) concludes "both renewable energy production enterprises and government

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[413] AB Sebitosi and P Pillay. "Renewable Energy and the Environment in South Africa: A Way Forward." 2008. Energy Policy 36: 3313.

[414] Ibid: 3313.

[415] Ibid: 3315.

[416] Harald Winkler. "Renewable Energy Policy in South Africa: Policy Options for Renewable Energy." 2005. Energy Policy 33: 36.

[417] Ibid: 37.

[418] Ibid: 37.

overstress the role of the government in the development of renewable energy."[419] China's policy has fundamental flaws in that "renewable energy policy is interest-driven, which means that renewable energy development is stimulated by offering subsidies and concessions in prices and taxes...the interest-driven policy is built on the market mechanism. Without a perfect market, these policies will be greatly discounted in their impact."[420] Cherni and Kentish (2007) indicates the "Chinese government has given high priority to renewable energy as part of future sustainable electricity system."[421] The newly enacted "Renewable Energy Promotion Law shows good promise in providing a coherent framework which would act to significantly increase the share of renewable energy within the electricity system and drive development of renewable technologies."[422] China faces challenges in its renewable energy policies though from the institutional and infrastructural framework of the country which is not conducive for developing new energy sources, as well as the high costs of developing new technologies.[423] China faces a much different situation than most Western nations in renewable energy policy because of the general structure of government and the rural nature and size of the nation.

Brazil has had limited success with their renewable energy programs designed, mostly designed to promote biodiesel. Pousa, Santos, and Suarez (2007) indicates the "Brazilian government is very engaged in the biodiesel program, which seems to be an irreversible process. In this sense, the use of biodiesel in Brazil will probably provide financial and

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[419] Dan Shi. "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Circumstances." 2009. China and World Economy 17: 108.

[420] Ibid: 108.

[421] Judith Cherni and Joanna Kentish. "Renewable Energy Policy and Electricity Market Reforms in China." 2007. Energy Policy 35: 3627.

[422] Ibid: 3627.

[423] Ibid: 3620 – 3624.

environmental benefits to the country, specially diminishing our dependence on imported diesel fuel and increasing the agricultural economic segment."[424] Furthermore, "one of the main objectives of the Brazilian biodiesel program is to promote social and regional development in the most economically underdeveloped areas…the government policy trend is to provide social inclusion, by including familiar agriculture as a partner to biodiesel producers."[425] Ruiz, Rodriguez, and Bermann (2007) concludes Brazilian programs have found both success and failures with renewable energy, because of the institutional framework.[426] The programs have been created in such a way that communities and local institutions are fundamental players. Though, "in the first programs, the role of the communities and local institutions was instrumental and subsequently their presence disappeared."[427] Additionally, "the market system that promotes the diversification policies appears to be an obstacle to such purpose because the private sector will participate in these programs only if its profit expectations are satisfied and such profitability cannot be guaranteed by potential electricity consumers in isolated rural areas."[428] The framework of the renewable programs in Brazil has had a particular effect on the success.

The countries of the Middle East have little incentive to develop renewable energy, since they are the center of fossil fuel production for the world, but there have been a few attempts to promote renewable energy in the region. Patlitzianas, Doukas, and Psarras (2006)

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[424] Gabriella Pousa, Andre Santos, and Paulo Suarez. "History and Policy of Biodiesel in Brazil." 2007. Energy Policy 35: 5397.

[425] Ibid: 5397.

[426] BJ Ruiz, V Rodriguez, and C Bermann. "Analysis and Perspectives of the Government Programs to Promote the Renewable Electricity Generation in Brazil." 2007. Energy Policy 35: 2993.

[427] Ibid: 2993.

[428] Ibid: 2993.

finds that among the Arab states very few renewable energy policies have been adopted.[429] Bahrain "is thinking about the increment of the efforts by supporting a number of renewable energy projects regarding PVs, showing its willingness to promote such technologies."[430] Oman has begun a "promotion of renewable energy technologies by establishing a link to international databases and encouraging local colleges and universities to conduct research and development projects."[431] Saudi Arabia has "renewable energy policies for research and development and public awareness…giving extra emphasis on solar-energy education programs."[432] Finally, the United Arab Emirates has begun examining solar energy projects.[433] The Middle East has much less pressure to move towards renewable energy, but the world's leaders in oil and natural gas production adopting renewable energy policies are a sure sign of the importance of the issue.

Internationally, policy to promote renewable energy has faced mixed results. The national context and policy instruments utilized seem to be the most important factors in determining success. Every nation has adopted its own approach to renewable energy, but to be effective the policy has to be adapted to the political and social environment. Lessons to be learned from the international perspective include the impact of coordination between state and federal policies, the overreliance on government as the source for renewable energy promotion, and the effect of the political and institutional barriers on the success of policy. The most important lesson to be learned here is that the policy instruments chosen and the administration of the policy can mean the life or death of renewable energy, therefore any

[429] Konstantinos Patlitzianas, Haris Doukas, and John Psarras. "Enhancing Renewable Energy in the Arab States of the Gulf: Constraints and Efforts." 2006. Energy Policy 34.

[430] Ibid: 3723.

[431] Ibid: 3723.

[432] Ibid: 3724.

[433] Ibid: 3724.

policy implemented in Mississippi or the United States should be carefully considered along the lines of the political and institutional context.

Summary:

Table 4.2 summaries the policy options analyzed in this chapter. Each policy option has its own costs and benefits and should be catered to the individual goals and political environment.

Table 4.2.

Summary of Renewable Policy Options.

Policy Type	Benefits	Drawbacks	Record	RE types
Tax Credits/ Loans/Grants	Reduces production costs	Only effective until technologies mature	Success at federal level, in many states, and other nations	All/Developin g technologies
Net Metering	Allows consumers to produce renewable energy	Pushes distribution/transmissi on costs onto public utilities and other consumers	Success in 44 states, several European nations	Small scale renewable projects
Renewable Portfolio Standards	Mandates renewable energy production	Little success if not properly formulated/implement ed	Success in 34 states, several European nations	Large scale renewable development
Feed-in Tariffs	Provides guaranteed rates for renewable production	Difficult to implement, requires significant institutional reforms	Success in Germany and Netherlands	Large scale renewable development

CHAPTER 5

POLITICS OF RENEWABLE ENERGY IN MISSISSIPPI

Finally in assessing the future of an alternative energy program, the politics that may play a role in influencing renewable energy must be assessed. In this chapter, the political factors that may affect renewable energy in the state of Mississippi will be considered. The chapter will review the political culture, the political interests, and the political institutions that are likely to impact renewable energy policymaking. Information on the political culture, interests, and institutions will be drawn from scholarly works on those topics and related to the potential effects on renewable energy. The assessment will concentrate on the political factors that may affect renewable energy, rather than all political factors. The chapter will serve as an overview for the politics of renewable energy in Mississippi.

Political Culture:

Political culture here is the political relationship between the public and the government. The political culture of Mississippi is rich and interesting, holding to many of the traditionally southern values and stereotypes. To sum it up, the culture is still very much defined by the rural nature, history, and social order of the state, which has remained much the same over much of the 20th and 21st centuries. The assessment will take into account factors of the political cultures that may particularly inhibit or encourage the adoption of renewable energy policies in the state of Mississippi. The political culture will be described and then related to the implications for renewable energy policy.

In assessing the politics of the individual states, Elazar (1984) argues that each state responds to the system of government in their own way. Elazar looks to understanding the political cultural along two lines: "the way in which the states' functioning as political systems influences the operations of the general government; and the way in which the states – still functioning as political systems – adapt national programs to their own needs and interests."[434] Since energy policy is implemented at the federal level but is becoming more and more a function of state government, the measures of political culture can be adapted to understanding renewable energy policy. Elazar (1984) defines political culture as "the particular pattern of orientation to political action in which each political system is embedded."[435] This definition and measures of political culture are particularly applicable in assessing the implication for renewable energy in Mississippi, whereby the role of government has a tremendous effect on the development of new technologies and the culture influences said role. Elazar's categorization of political culture takes into account how the public relates to and influences government operations for both the state government and the relationship between state and federal governments. The political questions of an alternative energy program are the same questions that Elazar has incorporated into his measure of political culture, making it a useful measure here. Elazar' s famous categorization of political cultural identifies Mississippi squarely in the realm of the traditionalistic political culture, as opposed to the individualistic or moralistic cultures.[436] The traditionalistic culture is common across the South, but for most states it is intertwined, at least marginally, with one of the other political cultures. In Mississippi, Elazar

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[434] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984): 109.

[435] Ibid: 109.

[436] Ibid: 124-125.

finds no disbursement of political cultural other than traditionalistic, meaning there is strong homogeneity in the political culture across the state.[437]

Elazar (1984) argues “the traditionalistic political culture is rooted in an ambivalent attitude toward the marketplace coupled with a paternalistic and elitist conception of the commonwealth.”[438] The traditionalistic culture is aptly named, because it can be said to support a system of elitism whereby political authority and political participation are reserved for those of a select portion of society. The culture itself propagates a confinement of “real political power to a relatively small and self-perpetuating group drawn from an established elite who often inherit their right to govern through family ties or social position.”[439] The traditionalistic culture struggles with government innovation, only initiating new programs when they appear to serve the governing elite.[440] The culture “accepts government as an actor with a positive role in the community, but it tries to limit that role to securing the continued maintenance of the existing social order.”[441] Furthermore, “the traditionalistic political culture is found only in a society that retains some of the organic characteristics of the preindustrial social order.”[442] The type of culture Elazar is describing here is a type that resists change and innovation from government and from business more or less; he even uses the term ‘precommercial attitude’.[443] According to Elazar, the culture of Mississippi thus supports the old way of doing things and

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[437] Ibid: 124-125.

[438] Ibid: 118.

[439] Ibid: 119.

[440] Ibid: 120.

[441] Ibid: 118-119.

[442] Ibid: 119.

[443] Ibid: 118-119.

ignores new ideas and innovations. This culture may prove to be particularly devastating in regards to energy policy where new ideas and innovations are popping up every day and change is rapid and necessary.

This assessment of culture could, also, explain why Mississippi has yet to enact any substantial programs regarding renewable energy. Elazar only labels 8 states as wholly traditional: Arkansas, Alabama, Georgia, Louisiana, Mississippi, Tennessee, South Carolina, and Virginia.[444] For the traditional states, only Virginia has implemented renewable energy portfolio, though the standards are only voluntary. For the same states, Mississippi, Tennessee, and Virginia do not have a mandatory state net metering program, though South Carolina has a voluntary program. Of the 17 states that have not implemented renewable portfolio standards, 12 are partial traditional cultures. Of the six that have not implemented state net metering, three are partial traditional cultures. On the other hand, all 9 wholly moralistic states have state net metering and renewable portfolio standards, though North Dakota, Utah, and Vermont are only voluntary or goals. Of the 9 wholly individualistic states, only Indiana and Alaska do not have renewable portfolio standards and only Alaska does not have state net metering.[445]

Moralistic cultures are those where the greater good is held above that of the individual and the government tends to be seen in a positive light. Individualistic cultures encourage a limitation of government intervention into private areas. The traditional culture does not go hand in hand with support of renewable energy policy. As Table 5.1 indicates, state that are categorized as having a dominant traditionalistic political culture are the least likely to have

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[444] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984): 135.

[445] Database of State Incentives for Renewables and Efficiency. "Summary Maps." North Carolina State University, North Carolina Solar Center, http://www.dsireusa.org/library/includes/topic.cfm?TopicCategoryID=6&CurrentPageID=10&EE=0&RE=1.

adopted renewable energy programs such as renewable portfolio standards or state net metering. The traditionalistic political culture is not typically correlated with renewable energy programs on the state level, while individualistic and moralistic cultures are to the degree that there are only a few exceptions

Table 5.1.

Renewable Energy Policy[446] and Political Culture[447] by State.

ST	Cult.	RPS	Net Met	ST	Cult.	RPS	Net Met	ST	Cult.	RPS	Net Met
AL	T			CO	M	X	X	AK	I		x
AR	T		X	ME	M	X	X	DE	I	X	X
GA	T		X	MI	M	X	X	IL	I	X	X
LA	T		X	MN	M	X	X	IN	I		X
MS	T			ND	M	V	X	MD	I	X	X
TN	T			OR	M	X	X	NV	I	X	X
SC	T		V	UT	M	V	X	NJ	I	X	X
VA	T	V		VT	M	V	X	OH	I	X	X
FL	TI		X	WI	M	X	X	PA	I	X	X
KY	TI		X	CA	MI	X	X	HI	IT	X	X
NM	TI	X	X	ID	MI		X	MO	IT	X	X
OK	TI		X	IA	MI	X	X	CT	IM	X	X
TX	TI	X	V	KS	MI			MA	IM	X	X
WV	TI		X	MT	MI	X	X	NE	IM		V
AR	TM	X	X	NH	MI	X	X	NY	IM	X	X
NC	TM	X	X	SD	MI	V	X	RI	IM	X	X
				WA	MI	X	X	WY	IM		X

T = Traditionalistic M = Moralistic X = Mandatory Policy
I = Individualistic V = Voluntary Policy or Goal

The description of traditionalistic political culture provided by Elazar has several implications for potential resistance to an alternative energy program. Renewable energy policy requires government innovation, which may or may not serve the political elite. The Mississippi

[446] Ibid.

[447] Daniel Elazar. American Federalism: A View From the States, 3rd Edition (New York: Harper & Row, Publishers, Inc, 1984): 135-136.

government has a history not embracing innovation or change, when it does not serve the political elite. The obvious examples are: the state is still operating under the 1890 Constitution, which is written following the end of reconstruction; and the decades it took before it was in full compliance with the Voting Rights Act, Krane (1992) finds "in 1985 almost 30% of the state's localities remained in violation."[448] Both of those examples are consistent with the goals of the elite. However, Krane (1992) adds the "elites have cooperated with national policies such as farm support and economic development programs" because they work towards their benefit.[449] When new policies and programs can benefit the elites, innovation can be successful. The section on political interests will address whether renewable energy is a benefit or not to the elite. The two examples of non-innovation, also, go hand-in-hand with maintaining the existing social order. Implementing a renewable energy program has the potential to make changes to the existing order, through the economic impact particularly the replacement of old industries with new (renewable energy replacing oil and natural gas) and potential investments into previously impoverished areas (biomass facilities in the Delta). The political culture supports limiting the role of government to maintaining the status quo, but there is potential for renewable energy to alter that status quo and remake significant portions of the existing order in the state. The still apparent "organic characteristics of the preindustrial social order" again supports the theme of non-innovation and maintaining the status quo. The antiquated social order works in opposition to change and progress, both of which are embodied by the cutting-edge ideas that surround renewable energy. The traditional political culture Elazar describes

[448] Dale Krane. "Mississippi in the Federal Union: An "Approach-Avoidance" Dilemna." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992) 269.

[449] Ibid: 268.

and applies to Mississippi, has strong indications of incompatibility with a renewable energy program essentially because of the resistance to change.

Mississippi is a community based society that does not revel in the connections to the outside world, or even other parts of the state. Krane and Shaffer (1992) argues that Mississippi is a montage of distinct subcultures that function separately, whereby there is a distinct feelings of isolation from the rest of the world for much the state. For the most part, "paved roads directly linking one county seat to neighboring county seats were completed only in the 1950's. Some adults have never traveled outside their home county!"[450] Small communities and towns are still the base for political culture. Accordingly, Mississippi's "scattered and often isolated farm communities exhibit an intimate village lifestyle of shared experiences and traditions."[451] Furthermore, Krane and Shaffer (1992) finds "Mississippi politics are grounded in the grass roots of friendship networks that provide individuals with their identity and their sense of place in the community."[452] The traditional "informal 'good ole boy' and 'good ole girl' networks of these intimate places serve as the principal means for communicating opinions and mobilizing action."[453] The tight knit community atmosphere of Mississippi tends to support a feeling of disconnection from the rest of world, where the rest of the world seems so far away and what happens there seems like it will not have any resonation for Mississippians. In sum, Mississippi has been termed the 'closed society' by many scholars including VO Key and Daniel Elazar, and was even the title of a book by James Silver in the 1960's on political culture.

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[450] Dale Krane and Stephen Shaffer. "Culture and Politics in Mississippi: It's Not Just Black and White." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 16.

[451] Ibid: 18.

[452] Ibid: 22.

[453] Ibid: 21.

The community based culture of Mississippi which supports a disconnection from the rest of the world, effectively nullifies two of the most prominent arguments for renewable energy: sustainability and environmental protection. As long as the people feel separate from the rest of the nation or world, they will also believe that their energy related activities will not have an effect on it. Energy sustainability, energy independence, global warming are all issues that have implication for the entire world so as long as the people of Mississippi feel detached from the world they will feel detached from those issues. As long as they feel detached from these issues, they will have no specific desire to support a program that propagates renewable energy. It is hard to sell a program that is calibrated for a global issue to group of people who have no relevant view or concern about the world outside their own communities. However, renewable energy systems, especially in Mississippi, will be located with a close enough to connection to local communities that they will can become a part of the community. The jobs, economic impact, and the energy produced from these systems will be felt within small communities as well as the urban areas. In Mississippi, the local implications of renewable energy will have a much more significant impact than the global implications. As previously discussed, biomass alone could drastically grow the agricultural industry in the state which would be significantly concentrated to farms in small communities. Therefore, people will have a valid and evident connection to renewable energy though the local economic development, even if the broader issues are ignored.

The lack of information about how government functions and how government programs are designed and implemented can be a barrier to people understanding and accepting them as a means to improve the quality of life. Shaffer and Krane (1992) contends a barrier “to reformers who seek to change the state’s traditionalistic political order consists of public apathy and limited public understanding of complex political issues."[454] Moreover, "in the 1980's, the political awareness of average Mississippians was so low that in one poll fewer than half of the respondents could recall the names of their United States congressman."[455] It was this same lack of information that widely bred demagogues throughout the early 20th century, where politicians played to the fears of the uneducated.[456] Krane and Shaffer (1992) points out "public understanding of the complexities of such issues is hindered by the de-emphasis on the study of government and civics in the elementary and secondary schools…even university students can graduate without completing a required class in government or politics."[457] The people of Mississippi have simply not been socialized into a political system that supports the understanding of government policy, making new initiatives and innovations that much more difficult to sell to the public.

The lack of political education and information regarding energy policy in the United States and Mississippi, however, may not serve as a major barrier to promoting a renewable energy program. As evident by this paper, the issues surrounding renewable energy are not simple and they are not black and white. Nevertheless, Bang et al. (2000) finds that the level of knowledge concerning renewable energy is so low in the general public that it has no effect on support for renewable energy.[458] Additionally, those who support renewable energy are more

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[454] Stephen Shaffer and Dale Krane. "Tradition Versus Modernity in Mississippi Politics." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 286.

[455] Ibid: 286.

[456] Ibid: 271-286.

[457] Ibid: 286.

[458] Hae-Kyong Bang, et al. "Knowledge, Belief, and Attitude toward Renewable Energy: An Application of the Reasoned Action Theory." 2000. Psychology and Marketing 17.

likely to pay a premium for energy produced from renewable sources.[459] The people of Mississippi may be uninformed about renewable energy but it may not have an effect on their support. However, Kuklinski, Metlay, and Kay (1982) finds "unknowledgeable citizens draw on…the cues provided by groups involved" in forming opinions concerning energy.[460] This draws us back to the influence of the political elite and political interests over the general public, as presented by Elazar. If Mississippians are political uneducated and knowledge has no effect on support for renewable energy but the unknowledgeable look to others to help form their opinions, it is safe to say that the political elites and interest groups have the ability to sway the public support. The lack of information is neither a comfort nor a hindrance to renewable energy.

In Mississippi, there is a lack of mass support for the use of public entities to pursue public goods. Mississippi typically ranks at the top of the list for charitable giving by state, but at the bottom of the list for tax burden. The emphasis for creating public goods is not placed on government but rather on private organization and citizens. Shaffer and Krane (1992) indicates the "reluctance to use the public sector for the common good is reinforced by the small-town culture and life-style."[461] The tight knit communities reinforce a reliance on friends and neighbors rather than the government, which makes people averse to government supported programs. Furthermore, members of "local churches often prefer to promote the 'public good' through private religious activities rather than achieving the same end through 'public'

[459] Ibid: 464.

[460] James Kuklinski, Daniel Metlay, and WD Kay. "Citizen Knowledge and Choices on Complex Issue of Nuclear Energy." 1982. American Journal of Political Science 26: 615.

[461] Stephen Shaffer and Dale Krane. "Tradition Versus Modernity in Mississippi Politics." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 283.

government activities necessitating higher taxes…If it were not for federal grants, many Mississippi localities would not have 'public' facilities."[462] Shaffer, Jackreece, and Horne (1999) finds that 46% of the public in Mississippi only trust public officials 'some of the time', while 14% 'rarely' trust them. Many people shy away from government support and look to friends and neighbors, which translates into a political culture that supports a small non-activist government.

The ultimate goals of any renewable energy program are to produce public goods, whether it be economic development, environmental protection, or energy sustainability. The entire lack of support for public entities to promote public goods goes hand-in-hand with the argument to allow the free market to support the development of renewable energy. If the public is more likely to support private means to produce these public goods, then they would look to the market rather than the government for the development of renewable energy. However, the energy market has a history of failing, i.e. the energy crises of the 1970's. Look to the 1970's, when the energy crises occurred and the market was at the mercy of OPEC because they had not developed alternatives to oil to produce energy. Not to overlook the fact that currently the free market puts no premium on the environment, therefore it will continue to suffer because it represents no source of profit. Krueger (1990) argues that market failures are actual government failures.[463] Most renewable energy programs are designed to overcome the market failures by promoting renewable energy to ensure its growth while it is not economically viable compared to conventional sources, either through mandates or subsidies. Even with emphasis on private firms to grow the public good, the government must pursue an active

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[462] Ibid: 283-284.

[463] Anne Krueger. "Government Failures in Development." 1990. Journal of Economic Perspectives 4.

program to support renewable energy or be faced with little growth in the industry. The private sector has done substantial work to develop renewable energy, but the government has to implement policies to promote renewable energy or risk a market failure.

Political Interests:

Political interests here are groups of political actors with similar motivations that may partake in pressure activities to influence the formulation or implementation of a renewable energy policy. The political interests in Mississippi are varied in both pursuit and sway. Interests work to influence the operations of government in conjunction with their overall goals. Many of the political interests have an avid motivation to effect state policy on renewable energy. The assessment will look at the business and industrial interests, environmental interests, and the public interest groups that may choice to influence legislation concerning renewable energy. The interests will be described by how they may choice to shape renewable energy policy.

Political interests are an important element in influencing government operations. Handy (1992) finds the interest groups with the most influence that have implications for renewable energy come from the business or public sectors. The most influential interests were found to be the Mississippi Economic Council, the public utilities, and industry. Mississippi Economic Council "is the state's chamber of commerce… [and] the permanent organization representing most businesses."[464] Public utilities "have a lower profile and are seen as less effective in election campaign activity than in legislative activity."[465] Industry interest groups are

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[464] Thomas Handy. "Mississippi: An Expanding Array of Interests." In Interest Group Politics in the Southern States, eds. Ronald Hrebenar and Clive Thomas (Tuscaloosa, Alabama: University of Alabama Press, 1992): 273-275.

[465] Ibid: 275.

represented by "the Mississippi Manufacturing Association and the oil and gas companies."[466] As well, "most industrial interests are represented by the powerful Mississippi Manufacturing Association, except for the oil and gas groups, which follow independent although coordinated paths in promoting their objectives."[467] State agencies and local governments, additionally, are quite influential in affecting legislation. Known as the 'iron-triangles, they "include those legislator-agency-clientele groupings that consistently succeed in getting most of what they want in the way of new authority and greater financing" which consists of many state agencies including several that would have interests in effect any legislation concerning renewable energy.[468] The Mississippi Association of Supervisors and Mississippi Municipal Association represent local government and have noticeable influence in the state legislature.[469] Handy (1992a) concludes "the tremendous growth in the number and variety of organizations over the last generation has produced a new pattern of interest group politics that influences the course of government."[470]

Lobbyists enjoy a certain amount of influence in Mississippi, because of the lack of professional staffs for legislators and shared interests with state agencies. Lobbyists are the mechanism by which interest groups influence government operations. Handy (1992a) finds lobbyists "have become almost indispensable sources of information for legislators without

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[466] Ibid: 275.

[467] Ibid: 273-274.

[468] Ibid: 276.

[469] Ibid: 276.

[470] Ibid: 274.

personal staffs upon whom to rely for data and assessment."[471] However, "the Mississippi Legislature, virtually without party lines, the information provided by lobbyists is not filtered through the predispositions of party leaders to the legislators… Thus, each legislator is freer to accept or reject interest groups' propositions according to his or her own political philosophy or concern for a constituency or the state."[472] Survey results from Mississippi show "that nearly 60% of both legislators and lobbyists in this state agreed that interest groups are destined to become considerably more important."[473] On the other hand, "it is, of course, in the nature of administrative agencies to work so closely with affected interests that some become coworkers in a common cause."[474] Additionally, "this alliance is even more likely to be formed in Mississippi than in most other states. Instead of an administrative hierarchy of offices and bureaus directed by a few major departments, Mississippi has well over a hundred agencies of varying size and design."[475] Lobbyists have found a special niche in government operations in Mississippi because the institutional arrangements have made it easy for them to exert influence.

The most influential interests in the state come from the business sector as the oil and natural gas companies, the utility companies, and the energy consumers. Browne (1998) indicates "business in America represents itself actively in public policy through both its interest

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[471] Thomas Handy. "Mississippi: An Expanding Array of Interests." In Interest Group Politics in the Southern States, eds. Ronald Hrebenar and Clive Thomas (Tuscaloosa, Alabama: University of Alabama Press, 1992): 294.

[472] Ibid: 294.

[473] Ibid: 294.

[474] Ibid: 275.

[475] Ibid: 275-278.

groups and its own institutional structures."[476] Business interests define their public policy demands "by their own long-lived maintenance needs: keeping firms profitable."[477] The business interests have the financial resources and political influence to have a striking impact on the formulation or implementation of a renewable energy policy. The business interests in the state use their resources to influence both election and legislative activity, but both activities work to the same end, public policy that works in their favor. Any policy that may have an impact on the way a business operates or its profits is going to draw interest, which can potentially be positive or negative depending on the policy instrument and the business interest.

Public utility companies are some of the most influential interests in the state, being mostly active in legislative affairs. Public utilities should be most interested in the renewable energy policy instrument utilized. State net metering encourages individual production cutting into the production by the utilities and renewable portfolio standards limit their ability to control costs by requiring the use of energy systems that may not be as economical as nonrenewable systems. However, production tax credits and other financial incentives would have a positive impact for utility companies. Browne (1998) argues "corporations do far more than just fight government regulation, which often in the face of media and public attention, is a futile act. Businesses have learned reluctantly for years to accept regulation and work to make its inevitable presence as favorable to corporate ledgers as possible."[478] Public utilities may not completely oppose renewable energy promoting policies but they most likely will support

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[476] William Browne. Groups, Interests, and US Public Policy (Washington DC: Georgetown University Press, 1998), 38.

[477] Ibid: 60.

[478] Ibid: 34.

policies that offer financial incentives to them, rather than policies that impose new regulations. Therefore, it is likely that the public utilities would be very involved in any attempts to implement a renewable energy policy that may tremendously affect their business model or profits. Balancing the promotion of renewable energy and appeasing the public utility interests will legislation that works to their favor may prove to be a major challenge.

The oil and natural gas interests in Mississippi are some of the most influential. Although reserves are not as abundant as neighboring Louisiana, fossil fuel production is plentiful in the Southern portion of the state. Furthermore, Mississippi has three oil refineries which account for 2% of all oil refined in the nation.[479] According to the Secretary of State's Office, all three major domestic American oil companies, ExxonMobil, ConocoPhillips, and Chevron, are registered lobbyists clients in the state, meaning they are active in influencing legislation. Additionally, a significant amount of both smaller oil companies, natural gas companies, and fossil fuel services companies are also active in lobbying in the state.[480] With electricity production in the state coming mostly from natural gas, it would most definitely work in favor of the oil and gas interests to oppose a renewable energy policy that may limit their ability to produce or market their most profitable products in the state. However, all three major domestic oil companies have made significant investments into renewable energy technologies and research as both a venture into improving public affairs and entering a future market. Strong opposition would not serve them well in public image, or in encouraging the development of a market they have made significant investments. The fossil fuel industry in

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[479] US Department of Energy. Energy Information Administration. State Energy Profile: Mississippi. (Washington, DC, December 2008).

[480] Mississippi Secretary of State. "Directory of 2009 Registered Lobbyist's Clients." http://www.sos.state.ms.us/elections/Lobbying/Lobbyist_Client_List_Print.asp.

Texas and California are much more formidable political interests and both states have been able to implement renewable portfolio standards and net metering. Therefore, the motivation of oil and natural gas interests to oppose renewable energy policy may not be as strong as one may assume. Oil and natural gas interests at surface level may be opposed to renewable energy but other factors may lead to reservation in opposition to renewable energy.

The industry interests in the state are varied, but all include energy consumers that may have an interest in any policy that has the potential to affect their energy expenses or uses. One of the more important of these interests would be the manufacturers who consume large amounts of energy to produce products and are represented by a major interest group in the Mississippi Manufacturers Association. Nevertheless, almost every industry represented in the state would be affect by a change in energy prices at the end of the day. These industry interests are some of most influential interests in the state, so they may take an active role in influencing legislation that could affect their bottom line. Depending on the policy instrument, industry could be either a friend or foe to renewable energy. Most financial incentives are designed to make renewable energy economically competitive with other sources. Renewable portfolio standards and state net metering are shown to have only slight implications for prices, but do have the potential to greatly affect energy prices. Over the short term this could mean an increase, but over the long term it will probably lead to a decrease if the cost of fossil fuels continues to rise. However, if industry is allowed to participate in state net metering, renewable energy production could prove to be financial windfall by reducing energy bills. Although, not all industry businesses purchase power from the grid so these policies would little or no implications for them. Both policy formulation and implementation have the potential to affect industry. The interests of the non-energy industry in the state are varied which means support will be varied as well depending on how the individual businesses and groups estimate the effects of a renewable energy policy on their operations.

Agricultural interests could play an important role in influencing renewable energy legislation. Though agricultural interests are not among the most influential, they do have a long reach in politics because of the agricultural base of the state's economy. Handy (1992) finds "that if the need arise, practically every legislator in Mississippi can be reached within two or three hours through the network of agricultural interest groups…represented by many important associations, old and new, including those of cotton, dairy, soybean, tree, and catfish farmers."[481] Mississippi has one of the highest potentials for biomass of any state, which if developed properly could bolster the agricultural industry as well as the entire economy. Therefore, the right renewable energy policy could be a windfall for the agricultural interests in the state, if geared to favor biomass or wind in cases where fields were leased out for wind farms. The agricultural interests would definitely want to be involved in the policymaking process when the result could be a huge boost to their industry. However, revamping the state of play for agriculture in Mississippi may have more implications for the industry than just boosting demand. The economic implications stretch farther than just an increase in market demand, and ultimately may or may not be favorable to the agricultural industry overall or for specific segments. Though, the effect of the economic implications will be dependent on the interpretation of those who become politically active on the issue. What's more, the potential of new legislation to make changes to the current way things are done and attempting to enter unchartered territory may be an irritation to many small and medium size farmers. The

[481] Thomas Handy. "Mississippi: An Expanding Array of Interests." In Interest Group Politics in the Southern States, eds. Ronald Hrebenar and Clive Thomas (Tuscaloosa, Alabama: University of Alabama Press, 1992): 273.

agricultural interests are likely to support any renewable energy policy as long as the implications for their industry are favorable.

The environmental interests in Mississippi carry little weight in influencing legislation. As a consequence of the political culture and history, the public in Mississippi has not traditionally been very supportive of environmental concerns resulting in environmental issues not typically being included on the agenda. For the most part, environmental concerns are not even included in the discussions of political interests in the state. Very few environmental organizations are even registered with the Secretary of State's office as being active in lobbying the state.[482] At the surface, it is not expected for the environmental interests to even be germane to the conversation of renewable energy in Mississippi. However, the current environmental interests may be weak but if the state was to begin to seriously considered pursuing a policy to promote renewable energy, the attention of some of the national interest groups that are not currently active in the state may be drawn. Historically, national interests tend to ignore the processes of Mississippi government until they hit the national stage. In 2001, when the issue of Confederate symbols on state flags hit the national spotlight and Mississippi considered a state referendum to change the flag, national media and interests were quick to make their presence known in the state, even though the flag had been in use since 1894.[483] The presence and financial expenditures, and therefore potential legislative influence, are likely to increase once legislation becomes seriously considered by policymakers on an issue of national attention. Nevertheless, the national environmental interests may not deem it

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[482] Mississippi Secretary of State. "Directory of 2009 Registered Lobbyist's Clients." http://www.sos.state.ms.us/elections/Lobbying/Lobbyist_Client_List_Print.asp.

[483] "Mississippi Will Retain Its 107-year-old Flag." CNN. April 18, 2001. http://archives.cnn.com/2001/ALLPOLITICS/04/18/mississippi.flag/index.html

necessary to waste resources in Mississippi. The influence of the environmental interests in effecting legislation is minimal at best but that has the possibility to change for a major piece of renewable energy legislation.

The public interest groups concerned with renewable energy in Mississippi do not wield any particularly significant influence but have been politically active. Groups like the Southern Growth Policies Board and the 25X25 Initiative are continuously involved in policymaking outside the state of Mississippi. Due to the focused nature of the issue, however, they have not been able to garner much influence in Mississippi but continue to be active. In the summer of 2009, both the Mississippi Biomass and Renewable Council and the Southern Growth Policies Board held conferences on renewable energy in an attempt to further understanding of the benefits and gain political capital. The Southern Growth Policies Board annual conference, entitled Southern Energy: Abundant, Affordable, and American, is expected to feature governors from five states speaking on the importance of renewable energy.[484] The 25X25 Initiative and the Mississippi Biomass and Renewable Energy Council produce mass media articles and support academic research on the subject in addition to attempts at lobbying state government.[485] [486] The public interest groups have been working hard in their attempts to gain public favor and further understanding in hopes of influencing legislative activity. However, the public interests groups have yet to gain much political capital.

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[484] Southern Growth Policies Board. "Southern Energy: Abundant, Affordable, and American." http://www.southern.org/conference/conf.shtml.

[485] 25x25 Initiative. "Home." http://www.25x25.org/index.php?option=com_frontpage&Itemid=1

[486] Mississippi Biomass and Renewable Energy Council. "About the Biomass Council." http://www.ms-biomass.org/about.php

Though, Browne (1998) indicates that among the most important political activities interest groups partake in are not simply lobbying the government but lobbying the public and other interests.[487] The public interest groups may be in a position to have an added effect renewable energy policy through lobbying both the public and other interests. By swaying public opinion through media campaigns, public interest groups can bolster public support and interest for renewable energy and therefore effect legislation. Issue based political ads have long been a valuable medium for influencing public opinion.[488] The public interest groups can serve as a uniting entity that can lobby the other interests into supporting a renewable energy policy. As previously indicated, many of the other interests may be on the fence on renewable energy, but these interest groups can pull them onto the support side of the fence. Additionally, the public interest groups can serve a leadership entity to spearhead the lobbying efforts of all the interests that support renewable energy without efforts becoming intertwined with the other issues.[489] The public interests groups have positioned themselves to be leaders in influencing renewable energy legislation, even if individually they lack significant influence.

Political Institutions:

Political institutions here are public organizations and structures that are effected by and effect government action. The political institutions of Mississippi are a reflection of the traditional culture and values that embody the state, having remained in the same position since their inception. Institutions themselves can encourage or inhibit reform and innovation through

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[487] William Browne. Groups, Interests, and US Public Policy (Washington DC: Georgetown University Press, 1998), 84-167.

[488] Ibid: 84-107.

[489] Ibid: 137-167.

the framework and procedures employed. Many of the political institutions have the potential for consequences for renewable energy, in various ways. The assessment will take into account factors of the political institutions that may particularly effect the adoption of renewable energy policies in the state of Mississippi. The political institutions will be described and then relate do the implications for renewable energy policy.

To start with, one of the major institutional barriers for implementing a renewable energy program may be Mississippi's Constitution. The Constitution, written in 1890, has been amended through the years but carries many of the same themes and obstacles it always has. Allen (1992) finds "Mississippi's organic law contains excessive detail, which at times places government in a straitjacket and necessitates frequent amendment to free policymakers to act."[490] Moreover, the "material in certain of the articles is uncoordinated, and some provisions do not relate to the article's main theme…the document still contains material oriented toward 19th century situations."[491] Allen (1992) finds "part of the anti-business flavor of the constitution has been removed by recent amendment and interpretation. Yet some feel it still contains provisions that impair economic growth."[492] Likewise, "section 178 gives the legislature the 'power to alter, amend, or repeal any charter of incorporation' whenever they deem it in the 'public interest'."[493] Shaffer (1992) argues "the constitution's corporations article is at least outdated and, because of its anti-business timbre, may well have hampered the state's

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[490] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 51.

[491] Ibid: 51.

[492] Ibid: 53.

[493] Ibid: 53.

industrial development efforts."[494] Additionally, "the constitution also discourages innovative approaches by local governments by local government to attract industry, because it restricts certain type of monetary or credit assistance to corporations."[495]

The Constitution forms a few distinct barriers for a renewable energy program. First, the complexity makes any reforms difficult, tying the hands of lawmakers. Formulating a renewable energy program may prove to be too daunting of a task for the policymakers, as was implementing a state lottery in the 1980's where the necessary amending to the constitution proved too much a obstacle and the initiative died. Second, the anti-business theme makes any economic development project difficult. Renewable energy development may be supported by government policies, but it is conducted by private business. The constitutional threats to corporations will not be helpful to attracting business to develop renewable energy systems regardless of policy implementation. Finally, the bars to local government innovation will limit the ability of communities to implement renewable energy initiatives on their own. Mississippi's Constitution has long been an obstacle for economic development and policy innovation, both of which are major components to a renewable energy program. The institutional barriers of the constitution may limit the ability to develop or implement an alternative energy program in Mississippi.

The position of governor of Mississippi can best be summed up by William Ethridge, "The governor is given the chief executive power and a mandate to faithfully enforce the laws.

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[494] Stephen Shaffer and Dale Krane. "The Origins and Evolution of a Traditionalistic Society." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 34.

[495] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 53-54.

However, that obligation does not carry with it a corresponding grant of power."[496] Allen (1992) indicates "the governor is a weak chief executive, largely because the constitution provides for the independent popular election of heads of key executive departments."[497] Handy (1992) finds the powers that most governors hold solely are divided among "the heads of eight executive departments and the lieutenant governor [who] are directly elected by voters, and numerous boards and commissions [that] administer public policies independent of any real managing authority by the governor."[498] Furthermore, "although the constitution makes the governor 'chief executive,' much of the bureaucracy is beyond his control."[499] Because the other state executive officers "can work independently of each other and of the governor…the governor cannot require them to support or promote his programs."[500] Handy (1992) concludes "the large number of independent boards and commissions and independently elected executive officials limits his ability to effectively manage the executive branch."[501] Additionally, "it is easy for agency heads to 'go native' and reflect the views of their co-workers and clients

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[496] Thomas Handy. "The 'Weak' Governor." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 132.

[497] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 52.

[498] Thomas Handy. "The 'Weak' Governor." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 132.

[499] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 52.

[500] Ibid: 52.

[501] Thomas Handy. "The 'Weak' Governor." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 152.

rather than those of the chief executive."[502] Disjunction in the executive branch can make promoting any policy difficult, regardless of the support of the governor.

As Feig (1992), points out "Legislative bodies are rarely agents of reform, and the Mississippi legislature is no exception."[503] The state legislature is by far the strongest branch of government in Mississippi, so reform and change have always met obstacles in the state. The state legislature is a large body of citizen legislators with small staffs. Feig (1992) asserts that "with 122 representatives and 52 senators, Mississippi has more legislators per capita than any other southern state."[504] Moreover, "large legislative bodies engage in excessive deliberation and usually require more committees, so their chairmen have greater opportunity to control the policy process."[505] There are "a total of sixty-two committees in the entire legislature – roughly one committee for every three legislators."[506] Furthermore, Mississippi legislators lack personal staffs to assist them in being effective legislators. Even for committees that do have staffs, they are not readily available to assist legislators in doing their jobs.[507] Nevertheless, the "detailed

[502] Ibid: 152.

[503] Douglas Feig. "The State Legislature: Representatives of the People or the Powerful?" In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 131.

[504] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 52.

[505] Ibid: 52.

[506] Douglas Feig. "The State Legislature: Representatives of the People or the Powerful?" In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 117.

[507] Ibid: 118.

procedures work to the advantage of senior members and proponents of the status quo."[508] Additionally, the Mississippi legislature has an "absence of sets of party leaders."[509] Legislative leadership essentially boils down to the Speaker of the House and the Lieutenant Governor.[510] Feig (1992) concludes "the legislature tends to move slowly, its actions tend to be disjointed and its 'policies' incoherent, and local political forces often play a decisive role in influencing legislators' votes."[511] The simple nature and function of the legislature may serve as an obstacle to a renewable energy program.

The governor and the state legislature jointly form a barrier to formulating and implementing a renewable energy policy. The decentralized power of the legislature and the weakness of the governor's position restrict cohesive, coherent policy leadership for reform, which may be a necessary component for a policy arena that is still in the pioneering stages. Krane (1992) indicates "states with strong governors benefit from a rational and coordinated approach to policy development and program management because the strong governor can hold state agency administrators accountable for their performance."[512] The governor has little authority over the heads of executive agencies, confining his ability to guide policy. The governor, also, has the added obstacle of working with the state legislature from a politically

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[508] Tip Allen. "The Enduring Traditions of the State Constitutions." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 52.

[509] Douglas Feig. "The State Legislature: Representatives of the People or the Powerful?" In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 121.

[510] Ibid: 121-122.

[511] Ibid: 130.

[512] Dale Krane. "The Struggle over Public Policy in a Traditionalistic State." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 212.

weak position, further decreasing his influence on policy. However, the governor still has the capability of expressing influence over policy through the power of personality. Handy (1992) finds "a less tangible resource of governors is their interpersonal skills – their ability to persuade legislators to support their programs."[513] Though for this approach to be feasible, the governor has to have strong leadership ability and make renewable energy a priority. The governor is in a difficult position to influence reform and innovation in the state, which are two of the key elements of forming and implementing a renewable energy policy.

The legislature has few institutional based assets or incentives to pursue reform to energy policy in the state. The Speaker and the Lieutenant Governor wield the only real power in the legislator outside the committee chairs, whom they appoint. Feig (1992) finds "if the Speaker and the lieutenant governor exercise their powers with discretion and some respect for the opinions of their legislative colleagues, they are both in a position to have an important say in what happens in their chambers."[514] However, the lieutenant governor may be "preoccupied with promoting [his] own political future"[515] and the Speaker, like other locally elected members of the House, may be preoccupied with his districts issues or retaining his position.[516]

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[513] Thomas Handy. "The 'Weak' Governor." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 147.

[514] Douglas Feig. "The State Legislature: Representatives of the People or the Powerful?" In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 122.

[515] Thomas Handy. "The 'Weak' Governor." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 135.

[516] Douglas Feig. "The State Legislature: Representatives of the People or the Powerful?" In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 120-124.

Traditionally, the legislature has not been a leader in reform and neither the Speaker nor the Lieutenant Governor are particularly inclined to lead such an innovative. The committee chairman "exercise great power… [in their committees that] play a vital role in the passage of new legislation."[517] Still, the Speaker and the Lieutenant Governor have control over committee and chairman appointments which limits the power their power to pursue an independent agenda. The relationship between the governor and state legislature combines to fashion a lack of leadership to pursue new innovate policy, which may form a tremendous barrier to renewable energy.

Along the same theme as a lack of clear government leadership, renewable energy production has the potential to fall under the oversight of several state agencies. The Mississippi Public Service Commission regulates electric utilities and assures "rates and charges for services are just and reasonable, that the service rendered is reasonably adequate, and that any facilities constructed or acquired are required for the convenience and necessity of the public…and has area jurisdiction over all public utilities."[518] The Mississippi Development Authority oversees all the renewable energy and energy efficiency programs in the state.[519] Furthermore, the Department of Agriculture and Commerce regulates all agriculture and petroleum products which could affect biomass and biofuels.[520] Additionally, the Department of Environmental Quality and the Oil and Gas Board are both in a position to weigh in on certain

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[517] Ibid: 119-121.

[518] Mississippi Public Service Commission. "MPSC." http://www.psc.state.ms.us/MPSC/PSC-Home.htm.

[519] Mississippi Development Authority. "Energy." http://www.mississippi.org/index.php?id=4.

[520] Mississippi Department of Agriculture and Commerce. "Laws and Regulations." http://www.mdac.state.ms.us/n_library/agency_info/reg_laws/index_reglaws.html.

issues.[521][522] Of the 5 agencies, the leaders of 3 are elected; only the Directors of the Mississippi Development Authority and Department of Environmental Quality are appointed by the governor. As previously argued, the other elected leaders may not be welcoming of a certain amount of political control being ceded to other agencies. The decentralization of control over renewable energy only adds to the hurdles any policy is going to have to leap over. All of these state agencies have a political agenda that could have various implications for a renewable energy policy. The conflict of government administration and regulation could form a barrier to renewable energy.

The relationship between the federal and the Mississippi governments has long since had a tumultuous relationship. Krane (1992) finds "perhaps no other state in the Union has experienced such a range of conflict and cooperation with the national government as Mississippi."[523] Moreover, "the national government-Mississippi relationship has fluctuated dramatically between periods of 'massive resistance' and 'massive dependence,' Mississippi has experienced an ambivalent, 'approach-avoidance' dilemma with respect to the national government."[524] For issues that the Mississippi government and the public oppose, they tend to be consistently at odds with the national government. However, the strength of federal government has been able to overcome the opposition, consistently, even with the

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[521] Mississippi Department of Environmental Quality. "MDEQ." http://www.deq.state.ms.us/MDEQ.nsf/page/Main_Home?OpenDocument.

[522] Mississippi State Oil and Gas Board. "MSOGB." http://www.ogb.state.ms.us/.

[523] Dale Krane. "Mississippi in the Federal Union: An 'Approach-Avoidance' Dilemma." In Mississippi Government and Politics: Modernizers Versus Traditionalists, eds. Dale Krane and Stephen Shaffer (Lincoln, Nebraska: University of Nebraska Press, 1992), 250

[524] Ibid: 250.

opposition.[525] Federal response to the resistance of school desegregation was to withhold, "funds, school board officials in the nation's poorest state were confronted with the unpalatable choice between continued segregration with its lost of federal dollars and integration…Overall, school desegregation has been a remarkable success story in Mississippi."[526] However, for issues that could provide a serious benefit to the state, Mississippi is overwhelmingly reliant on the national government. Federal funds accounted "for about one-quarter of the total revenues for the state and its local governments and about one-third of state and local government expenditures" in 1988.[527] The role of "federalism compounds the task of governance because policy must be formulated and implemented within a framework of multiple structures and interests."[528] Krane (1992) concludes the greater the challenge to the status quo "posed by national policy, the higher the probability of resistance."[529] The national-state relationship for Mississippi which is defined by conflict and cooperation has mixed implications for a renewable energy program.

The coin to federal-state relationships for Mississippi has two sides. Federalism has implications for renewable energy through the framework that a renewable energy policy has to be implemented. Renewable energy policies effect matters of intrastate and international importance, meaning any policy has to be formulated and implemented with regards to the corresponding policies through other public entities, especially the federal government. The federal agenda can have influence on both the public support and the policy adoption and

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[525] Ibid: 251-256.

[526] Ibid: 255-256.

[527] Ibid: 257.

[528] Ibid: 250.

[529] Ibid: 268.

implementation. Mississippi may welcome or combat support from the federal government, depending on the importance of the issue and the implications for change. There is a strong history of cooperation between the national and state governments for issues that serves the interests of both. The relationship with the federal government can produce support through federal programs or pressure for renewable energy. The federal government has already implemented its own programs to promote renewable energy that can readily be utilized in the state. However, if the federal agenda poses too much of a challenge to the interests of the political elites, the opposition to federal intervention in state matters may serve as a barrier to renewable energy. On the other hand, the federal government has the coercive power to force states to seek certain policies, though we have not reached the stage in renewable energy where the federal government is prepared to force action on the issue. Nonetheless, Mississippi has always been very receptive to federal funding. Therefore support in that form may be well received, though the federal programs that provide financial incentives to renewable energy or make available federal funds for state and local programs. Overall, renewable energy development is in the interest of the state and does not pose a tremendous challenge to the status quo; therefore, there should not be too much opposition to role of the federal government in pursuing a renewable energy program. Ultimately, the relationship with the federal government may serve as a comfort for the adoption of a renewable energy program in Mississippi.

CHAPTER 6

IMPLICATIONS OF RENEWABLE ENERGY REFORM IN MISSISSIPPI

In conclusion, the success of renewable energy development in Mississippi will be highly influenced by the policy and political aspects associated with it. After studying the various components of a renewable energy policy in Mississippi, a few policy recommendations as well as suggestions for dealing with the political obstacles have been developed. If properly cultivated, renewable energy in the state of Mississippi can be successful and produce an array of benefits for the public.

Policy:

For renewable development in Mississippi to be successful, a coordinated, comprehensive public policy on the issue should be developed. Mississippi has no real renewable energy policy to mention. The state has long been lagging behind in the policy area. The federal government has implemented several financial incentives for renewable energy which have gained positive results in promoting renewable energy. The federal financial incentives detract some of the economic pressure involved in developing renewable energy sources. Many other states have found noteworthy success with renewable portfolio standards and state net metering. Renewable portfolio standards have been responsible for much of the growth of renewable energy in the last few years, without any significant impact on energy prices. State net metering has seen success by encouraging small scale renewable projects from individuals. The most important lesson learned from the experience of other states and nations is that policy design and implementation are among the biggest variables in determining success.

The most effective strategy may prove to be a renewable portfolio standard coupled with secondary policy instruments for reinforcements of primary goals. The renewable portfolio standard will be able to provide a framework for energy goals and renewable development in the state from which other programs and policy instruments can stem. The norm for renewable portfolio standards in most states appears to be 1% growth a year for a period of 10 to 20 years, at which point energy goals and needs are reconsidered. Therefore, somewhere between 10% renewable energy production by 2020 or 20% by 2030 would set a reasonable goal for renewable development. The majority of those goals should be met by large scale renewable energy development projects, like wind farms or biomass power plants.

However, the renewable portfolio standard should be developed in correlation with supporting programs. Renewable production tax credits would allow for renewable energy to overcome any economic barriers in the early stages, while loans or grants could overset startup costs associated with large construction projects. As renewable energy projects develop, the economic impact should be able to offset the costs of investment for the public at least in part. Any financial incentives should be created with federal programs in mind, so the greatest advantage can be extracted for the public from the money invested. Financial programs, nevertheless, should be balanced with the other budgetary needs. Additionally, state net metering is a relatively simple program to implement for renewable energy promotion that carries political as well as policy related benefits. While state net metering would encourage only small scale renewable projects, many small projects could result in a substantial amount of production. Furthermore, state net metering allows the public to become active in renewable energy production which could further support for renewable development in the state. Any policy should balance the interests of economic development, environmental protection, and long-term energy outlook.

Policy formulation should be careful not to overemphasize a single source to maintain diversity of supply and best manage the state's natural resources. All avenues of renewable development should be explored to produce the best results. However, biomass has the largest generation capacity and the potential to compete economically with conventional fuels; therefore, it should receive primary development attention to showcase quick success for a politically sensitive program. If only 20% of the potential biomass generation capacity were utilized, the recommended renewable portfolio standard could be met. Additionally, wind power can play a significant role being cost competitive with conventional sources, although it has a lesser generation capacity. If only 20% of the potential wind generation capacity were put to use, 1% of the recommended portfolio standard could be met. Solar power suffers from both low generation capacity and high costs so it may not factor into renewable development in the early stages, but with costs predicted to decrease over the 20 years solar may become a better option in time. Preferably, a combination of wind and biomass power would emerge to meet between 10% and 20% of energy needs of Mississippi supported by tax credits and state net metering, while the renewable portfolio standard functions as an outline for state energy goals.

The goals of any renewable energy policy in Mississippi should balance economic development, long-term energy strategy, and environmental impact in that order. First, economic development is one of the strongest and most important arguments in support of renewable development in Mississippi. Renewable development in Mississippi will require economic investments into the state. Any renewable energy project in Mississippi will have an economic benefit, either direct or indirect, by providing jobs, purchasing materials, and obtaining land. Renewable development will involve multi-million dollar projects that can provide hundreds of short-term construction jobs, and dozens of long-term maintenance and operations jobs. Renewable energy can become a new growth industry in one of the poorest states in the nation.

Second, the long-term energy strategy of Mississippi should focus on the long-term economic impact of renewable energy and future energy needs. Renewable energy will only become cheaper over time as fossil fuels will become more expensive. Renewable development now will serve as an investment into future cheap energy the people of Mississippi. Additionally, diversifying the energy supply can stabilize energy prices. As the price of fossil fuels fluctuations due to national and international economic mechanisms, energy prices of Mississippi will be less affected if fossil fuels play less of a role in the energy mix. For example, if fossil fuels made up 80% of the energy mix, as they do now in the state, a 20% increase in fossil fuel costs would lead to a 16% price increase overall; but if fossil fuels only made up 50% of the energy mix, a 20% increase in fossil fuel costs would lead to only a 6% price increase overall. Stabilizing the price of energy could reduce the economic strain of energy demands on the public, especially at times when fuel costs are increases as the economy is in a downturn. Ultimately, renewable development in Mississippi has many economic gains for the state that is in need of economic growth.

Nevertheless, renewable energy does not have the capacity to fully satisfy all future energy needs alone. Renewable energy should be developed in correlation with other alternative energy sources, such as nuclear, as well as efforts to reduce energy consumption, such as energy efficiency and conservation efforts. Nuclear energy could serve to bridge the gap between energy consumption needs and renewable energy production, further reducing the need for conventional energy sources. Currently, the nuclear power plant located in Port Gibson is a major source of energy production in the state. The experience with the Port Gibson plant indicates that nuclear power can be efficiently and effectively utilized in Mississippi. The expansion of nuclear power could serve as an important counterpart to renewable energy in diversifying Mississippi's energy portfolio as well as nullifying the overwhelming consumption of fossil fuels. There are certain drawbacks to nuclear power, however, which were not explored in this study. Despite those negative elements, nuclear energy should play a role in Mississippi's long-term energy goals along with renewable energy and energy conservation as a means to suppress the need of fossil fuels.

Furthermore, reducing energy consumption can diminish the production-consumption gap as well. Renewable energy can play a tremendous role in the energy future of Mississippi but should be accompanied by other measures to meet energy goals. Energy efficiency and energy conservation programs will ultimately reduce the necessary energy consumption of the state of Mississippi. Reducing energy consumption can be as simple as utilizing new more energy efficient appliances in homes or redesigning manufacturing processes in factories to more efficiently use energy. The Department of Energy, the Tennessee Valley Authority, and several public utilities offer education and services to consumers in an effort to quell energy demand from all sectors. Based on the 2010 forecasts, reducing energy consumption by 20% would increase the state's energy production-consumption ratio from 32% to 42%; placing Mississippi in the top 20 among state for production-consumption ratios. Using less energy would by no means have a negative impact in any way. Along with promotion of alternative energy sources, Mississippi should encourage the use of more energy efficient devices and energy conservation where applicable as a means to restrain energy consumption in the state. Consumption reduction initiatives should be used in parallel to other policies to achieve the long-term goals of more favorable energy conditions within the state of Mississippi.

Third, replacing fossil fuels consumption with that of renewable energy will reduce the environmental impact of Mississippi. Renewable energy systems make no direct carbon emissions, except for biomass which are a significant decrease over those created by fossil fuels. The burning of fossil fuels is one of the largest contributors to global warming. A reduction in these emissions would help stifle this growing environmental disaster. Renewable energy systems require no drilling in ecologically delicate areas. Drilling for fossil fuels causes destruction to huge tracts of land. As reserves become more limited, drilling is aimed at sensitive ecological areas, like the Alaskan Wildlife Refuge. Renewable development would reduce the need to irrevocably damage the environment through drilling. Renewable energy systems do not deplete nonrenewable natural resources. Oil, natural gas, and coal are all limited resources and can quickly and easily be depleted, but wind, sunlight, and if managed correctly agricultural products can produce energy indefinitely. Environmentally, there are numerous benefits of renewable energy over conventional fuels.

Political:

The political strategy for renewable energy reform should be aimed at three goals: gaining public support, placating political interests, and drawing leadership from public officials. Public support can best be garnered by overcoming the obstacles inherit in the political culture. The political culture may be hostile to many of the central elements of a renewable energy program, but a public support campaign focused on the significant benefits should counterbalance those obstacles. First, the local issues related to renewable energy have to be emphasized over the global issues. Rather than focusing on environmental and international relations issues, localized energy production and economic development should be highlighted. Second, public support should increase as they begin to better understand the potential benefits of renewable energy. As people become informed of the potential economic impact, better security of supply, and other factors, the concept of renewable energy will become a more attractive option for the public. Finally, the role of the private sector in renewable development should be stressed, so the obstacle of opposition to the government seeking public goods can be neutralized. The people of Mississippi are not too keen on the government working towards public goods; therefore, the state government should showcase the role of the private sector so the public is not distracted by the role of the government.

The political interests will play an important role in effecting renewable energy policy. The main tasks for dealing with political interests will be gaining their support while limiting their influencing on policy. Political interests in the state are varied in their potential support of a renewable energy program, but if handled correctly they should be able to find benefits within a renewable policy to either garner their support or stifle their opposition. The public utilities should be the most active interest in effecting renewable energy policy because of the impact on their business. Public utilities carry a lot of influence in both legislation and campaign affairs are going to have to be dealt with very diplomatically. Most manufacturing and industrial interests should be pacified as long as state net metering is extended to them. Reducing the cost burden of energy should be enough to gain their support. The oil and natural gas interests are little different story. However, most large oil and natural gas companies are also energy companies, therefore they have a vested interest in both the future of energy and their large investments into renewable technology paying off. The agricultural interests should be easily dealt with as long as biomass production is encouraged within the policy. Providing, the agricultural interests are given a new market to sell their products they should not have any complaints. The environmental interests will be early supporters, but they may not get the strong emphasis on environmental concerns they will want. The environmental interests will probably getting the short-end of the stick when balancing the concerns of all political interests. Finally, the special interests groups have to be encouraged to lobby both other interests and the public. The support of the political interests should be gained without too much of a fight, but their participation in policy formulation may be a much more important factor.

There are several institutional barriers to overcome in the political process of policy reform in Mississippi. Luckily, most of these obstacles can be hurdled with strong leadership from public officials. The reform process in Mississippi is plagues with decentralized power and struggles over political control. If renewable energy reform is championed by strong leadership, the infighting and indecision can be surmounted. From the executive or legislative branch, elected officials can use their influence and political capital to push their agenda through the legislative process. However, as renewable energy reform becomes more popular public officials will come out of the woodwork to gain any or all attention they can, which will only complicate the situation. Nevertheless, as public support for renewable energy grows, there will be greater pressure on public officials to be proactive, which may resolve many of the other obstacles. Ultimately, support from public officials will be necessary for any real renewable energy policy, otherwise there is a strong possibility of the initiative simply being lost in the fold of the political process in Mississippi.

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