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## THROUGH BIOMASS WASTE-TO-ENERGY TECHNOLOGY

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Biomass, fuel cells, hydrogen, nuclear, ocean, solar, waste coal, and wind are on the somewhat crowded list of alternative energies. Waste coal is on the list because the State of Pennsylvania proclaimed this specific waste product to be eligible. The waste coal industry is pushing aggressively to include their proposed waste coal-to-power facilities in the Pennsylvania Renewable Portfolio Standard despite the fact that waste coal is not renewable energy and that waste coal power plants are much dirtier than coal power plants. By much dirtier is meant much higher mercury emissions. Pennsylvania's efforts might be characterized as *Dirty And Desperate Economic Development Through Coal Waste-To-Energy Technology*.



Renewable energy efforts started in 1973 with the onset of the original oil embargo and associated energy crisis. Since that time the US federal government has invested $99.2 billion dollars for energy research and development projects as well as energy efficiency (Source: Congressional Research Service). Somewhat amazingly, the generous spending program has been called a success because it created **technology options** that may also be characterized as **no solutions**. Technology options require government subsidy support whereas true scientific solutions do not. With the alternative energy marketplace generally grasping at efforts to make a government subsidized profit, no single technology, clean or dirty, has yet emerged as a front runner. Oil still remains king of the hill.

Our country's principal effort to develop alternative energies was undertaken by the National Renewable Energy Laboratory (NREL). This laboratory was initially established by the Solar Energy Research

Development and Demonstration Act of 1974. Originally called the Solar Energy Research Institute, NREL began operating in July 1977 and was designated a national laboratory of the U.S. Department of Energy in September 1991.

NREL has existing partnership agreements with approximately 250 industry partners, 70 universities and 80 not-for-profit organizations. Twenty years of research have yielded significant progress in many renewable energy technologies. The cost of wind energy has declined from 40¢ per kilowatt-hour to about 5¢. Photovoltaic systems can now be manufactured for about $2.20 per watt, down from $4.50 per watt in 1980. And ethanol costs have plummeted from $4 per gallon in the early 1980s to $1.22 today. Yet all of these alternative energy technologies still require governmental subsidies for their application in the marketplace. None yet represents a true scientific solution.

The closest NREL has come to a true scientific solution was the *Aquatic Species Program(ASP)* that consisted of the production of a biofuel called **algal biodiesel**. Algal biodiesel is produced through the growing of microalgae for their lipid content. The lipid content is then converted into biodiesel through transesterification in the same manner that soybeans and other vegetable oils are converted. The ASP funding totaled $25.05 million over a 20 year period which began in 1978. Continuation funding was ultimately terminated when it was officially determined that algal biodiesel could not be produced *economically*. Even though every one of the past NREL success stories still requires subsidy support for their marketplace use the ASP program was killed for the same reason. Makes one wonder whether its success had the king worried.

**Biomass energy**, one of the oldest energy sources known to man, uses the energy embodied in organic matter (mainly plants). Biomass-based energy systems utilize wood, agricultural and wood waste, municipal waste, and landfill gas as fuels. Biomass, in all its energy uses, currently supplies more than 3% of total U.S. energy needs and provides almost 10,000 MW of electric generating capacity. Wood fuels provide the bulk of this generation (66%), followed by municipal waste (24%), agricultural waste (5%), and landfill gas (5%). While biomass resources, in one form or another, are present in all 50 states, the development of short-rotation woody crops may significantly expand the future supply of biomass resources.

Wood is the leading biomass energy resource used for power generation, primarily because of its use as a boiler fuel in the lumber and pulp and paper industries. The lumber industry satisfies close to 75% of its energy needs through direct wood combustion, while the pulp and paper industry has achieved a 55% aggregate fuel contribution from wood. Many of these companies use cogeneration systems for power generation. The Edison Electric Institute estimates that

more than 6000 MW of non-utility, wood-fired generating capacity was in place at the end of 1991.

Wood has environmental advantages in terms of emissions of carbon dioxide, a greenhouse gas. Although the burning of a tree releases carbon dioxide, an equal amount of carbon dioxide is removed from the atmosphere when the tree grows. Thus, so long as the trees that are burned are replaced by growing new trees, the net emission of carbon dioxide is zero.

Municipal Solid Wastes (MSW) is the second largest source of biomass power, generating more than 2000 MW of electricity and providing steam for industrial uses. More than 526,060 metric tons (580,000 tons) of municipal waste are generated in the United States each day, with three-quarters or more of this total going to landfills. With landfills nearing capacity, charging higher costs, and adopting stricter regulations, many localities have turned to waste-to-energy (WTE) systems as a disposal alternative-- an estimated 15%-20% of municipal waste is burned for energy. Several industry sources have predicted that from one-third to one-half of the nation's municipal waste could be burned for energy by 2010.

Agricultural waste plants are the third largest biomass generators, producing another 575 MW nationwide. These plants use such diverse feedstocks as bagasse (sugarcane residue), rice hulls, rice straw, nut shells, crop residues, and prunings from orchards and vineyards.

Finally, more than 100 power plants in 31 states burn landfill-generated methane. The high natural gas prices of the 1970s prompted the exploitation of methane, and its development was further spurred by the enactment of PURPA and federal tax incentives for the production of non-conventional fuels. Environmental concerns have also had a positive impact on the landfill methane industry. More than 10% of the nation's 6000 existing landfills are expected to require methane collection systems to comply with federal regulations on hazardous emissions from landfills. Methane is also a potent greenhouse gas, and this may provide greater impetus for landfill methane projects in the future.

Under its *biorefinery* program, NREL does not recognize MSW as a biomass feedstock even though the US Environmental Protection Agency does. Additionally, NREL's biorefinery concept omits a *free fatty acid* platform which would occur under a biogasification process (anaerobic digestion). The United States is the only country in the world that refuses to consider anaerobic digestion in its biofuels alternative energy program. To be absolutely accurate, in its *biopower* program the NREL does indeed recognize anaerobic digestion. In but a single paragraph methane gas is recognized as a product emanating from decaying matter in landfills as well as from biomass through anaerobic digestion. NREL's

general omission of anaerobic digestion is rather unfortunate from an economic development purview as **biogasification has the inherent ability to produce twice as much energy as all thermal gasification technologies.** The production of energy is always directly tied to the profitability of any technology and its prospective need for governmental support subsidies. All thermal gasification technologies are *dry processes* that are always adversely impacted by the biomass moisture content of the biomass. Anaerobic digestion is a biogasification technology and a *wet process* that always requires moisture and thus benefits from the biomass moisture content. This is the fundamental reason why the several hundred but marginally profitable mass burn MSW biomass-to-energy projects throughout the world have the potential to generate at least twice as much power simply by changing their incineration process to anaerobic digestion.

Cities and counties can also achieve economic benefit by using anaerobic digestion technology to convert biomass-to-energy. The cities of Sacramento and Santa Barbara, California and White County, Indiana are just now pursuing biomass-to-energy programs utilizing anaerobic digestion. The town of Reynolds in White County, dubbed BioTown, USA by Indiana's Gov. Mitch Daniels, Lt. Gov. Becky Skillman, and Agricultural Secretary Andy Miller, fully expects an explosion of economic development. There are already some 10,000 anaerobic digesters located at cities and counties throughout the United States. Some 15 years ago some were gradually converted into power production facilities to provide from 1/3 to 1/2 of the sanitary treatment plant's electricity requirements for aeration. Sacramento, Santa Barbara, and White County are simply expanding the use of well established anaerobic digestion from sanitary wastewater to municipal solid wastes. Since municipal solid wastes are well known to produce global warming methane gas at thousands of active and decommissioned landfills through anaerobic digestion, expanding the use of anaerobic digestion technology at the city/county level became a logical technological step for these three communities. The economic development explosion predicted for Biotown, USA can be achieved at every city and county throughout the entire world using the same technology.

One USA based company is already pursuing the economic development of biomass-to-energy technology on a build-own-operate basis that eliminates the need to raise sales or property taxes or sell bonds to pay for the biomass-to-energy technology. The technology is so profitable that electricity and natural gas (methane) will be sold to citizens and businesses at a 20% discount from existing retail while permitting cities and counties to disconnect from the electricity grid thereby becoming energy independent on a fully sustainable basis. The technology also complies 100% with all Kyoto Protocols which, in turn, means that the technology has the ability to reverse the harmful effects of global warming if used

extensively throughout the world.

Economic Development Through Biomass Waste-To-Energy is a win-win technology that creates jobs, lowers the cost of living, achieves energy and fuels independence, reduces global warming, and enables cities/counties to become zero waste-to-landfill communities. The technology also reduces our country's dependence on foreign oil and therefore improves our national security with every additional biomass waste-to-energy project.

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