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启示道路 DaoChi Energy of Arizona

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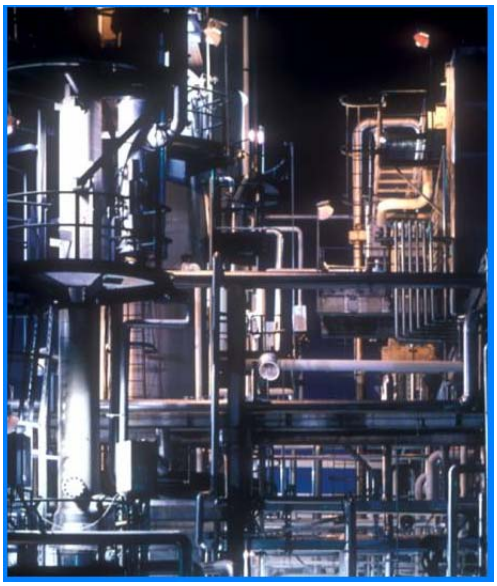


Wastewater processing: A private industry proposal to produce fuels and electricity from "bio-mass"

Generating "green" environmentally friendly gas and liquid fuels as well as electricity from bio-mass renewable energy resources.

SUMMARY:

DaoChi Energy of Arizona has developed a process, based on long established technology from the petroleum industry, that turns sewage sludge into energy. The economic opportunity is tremendous, in part because it is a neglected subject in society. People are squeamish about even discussing sewage. Yet this "product" of modern urbanization is a valuable resource. The problem is that most of it just goes into landfill, further complicating the disposal problem.

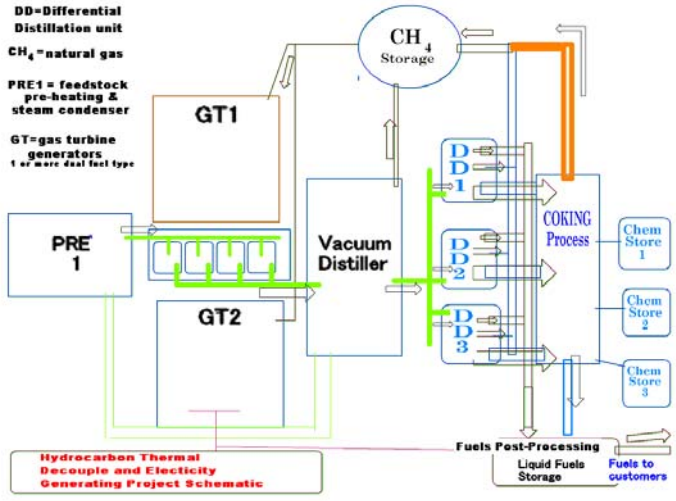
Our processing facilities are, mechanically, substantially the same in most respects as an oil-sands refining establishment, except that this implementation exploits compounding levels of efficiency by also immediately converting some of the output to electricity, while using multiple stages of heat recovery and re-use. The operation re-uses the

generators' 500^0 Centigrade (approx. 932^0 Fahrenheit) exhaust which might otherwise be just "waste" heat. This heat becomes one of the primary sources of heat that enables the chemical transformation of the hydrocarbon content of wastewater (and other bio-mass sources) into the fuel.

In areas where water is a precious resource (and much of North America is in exactly that condition) our process enhances the characteristics of H_2O contributions for groundwater recharge. The steam we create for our production process is eventually cooled to become pure distilled water.

BIO-DIESEL is a term that has come to be more familiar recently to those paying attention to the global energy scene, and to the media coverage of this "green" source of renewable energy. In the USA "bio-diesel" has been given a special definition by the government which is that it is the kind of diesel produced from plant oils by a process of esterification of the fatty acids. This kind of diesel is F.A.M.E., which is short for Fatty Acid Methyl Ester.

Another type of diesel can be made from biomass sources, however, which the government calls, "non-ester renewable diesel." The essence of this biomass diesel production process is that it takes the long-chain molecules of hydrocarbons found in plant materials, and by various means breaks down those long molecules of cellulose and starches found in every form of plant, into shorter chain hydrocarbons substances. Fortunately for us those shorter chains of hydrocarbons form the basis for most of the types of fuels currently in use in the world.



Diesel oil is a light grade of what is usually considered "petroleum" product because as the name "petroleum" implies it comes from "petro" meaning

"rock" and "oleo" meaning "oil". For the purposes of this discussion we will accept the term "petroleum" for fuels which have traditionally been obtained from petroleum and its by-products even though no "rock" is involved. What is different, obviously, in the matter of wastewater is that the organic materials are generally above-ground in origin. That is actually fairly significant in terms of the environmental impact of hydrocarbon fuel use. From the environmental impact point of view all fuels produced in this method would be considered equivalent to "biomass" derived, and generally could be considered "biomass-diesel".

One major consideration of the environmental concerns about both acid rain and global warming is the fact that our combustion processes are adding carbon to the atmosphere. This is quite literally true because the petroleum (rock based) and coal we burn are coming from below-ground sources. Bio-originated fuels are, in large measure, part of the same bio-mass that would be returned to the atmosphere via natural processes of decay, and digestion.

Digestion brings us to our central point about the non-petroleum, in the strict sense, origins of our products. Wastewater's organic component is substantially all some form of long-chain hydrocarbons which were plants or animals when they were ingested by humans as nutrition. Many biofuel production methods involve recently harvested plant material, such as corn, or seed oils. Even the very promising cellulose based ethanol producing processes use fresh (sometimes waste) corn stalks, grasses, trees and sawdust. Unlike corn leaves and stalks the wastewater solids of our sewage are already partly digested, which is to say, the long chains are already partially broken down from the form in which they entered the human food chain.

Our process is one which simply mimics that which happens underground over millions of years as the earth's crust builds up layers of sediment that subject organic materials of pre-historic ages to tremendous temperature and pressures that turns it into "petroleum". These high temperatures and pressures break down the chemical composition of those organic substances. The Hydrocarbon Thermal Decoupling Process (or HCTD for short) does exactly the same thing, except that its time frame is minutes and the conditions are specifically controlled so that the outcome is both predictable and certain.

INNOVATION and IMPROVED EFFICIENCY

Although bio-mass based energy production is still in early stages of development as an industry, we have already taken a step ahead of any existing bio-mass energy project in our innovative combination of purpose. We have taken the basic concept of bio-mass to fuel conversion one extra step further by not only employing the resulting fuels to power the process, but immediately turn a significant portion into electrical energy. This is not the end of the innovation because we also have designed for re-capture and re-use of the heat of the generator exhaust at the electric generation stage as another level of integration that improves overall efficiency. We are fully aware that generators whose exhaust stream is not constrained might produce slightly more electric output. However we are also aware that since the exhaust must in some jurisdictions be "scrubbed" before it is released into the environment, the re-capture and re-use of the heat energy of the exhaust both adds to the overall efficiency but also cools the exhaust gases before the scrubber process. The scrubber process itself is a form of constraint on the free flow of exhaust gases from the generators. This is, however, NOT a departure from conventional wisdom, as it is a policy of the Canadian Government to encourage dual purpose electric power generating plants, albeit in their case they have generally expected the secondary use to be for the production of heat during their demanding winter temperatures.

A Siemens Dual Purpose Plant in Mexico

The Mexican plant illustrated above generates electricity using gas turbines, but then uses "waste" heat for seawater desalination to produce drinking water.

N.I.M.B.Y. (Not In My Back Yard)

There is a reluctance in many communities in North America and elsewhere to accept industrial development in proximity to residential areas. Because of the nature of the materials involved, wastes, sewage and others, political reluctance to having their constituency labeled as a waste dump makes elected officials unreceptive to this, and to some extent, even civic employees feel this pressure. One great advantage of the incorporation of this kind of energy generation facility with wastewater treatment facilities (whether existing or under development) is that issues of odor, safety and the basic needs of the community have already been addressed.

Existing facilities tend to be in industrial zones, or even when they are surrounded by residential infill, they are contained within buffer zones into which residential encroachment has been curtailed either by legislation or social distaste for any greater proximity.

ECONOMICS

The careful integration of multiple re-use of available energy greatly improves the overall efficiency of our process, but there are other economic factors that make DaoChi Energy's strategy financially attractive.

FEEDSTOCK COSTS

Whereas almost every other "green energy" production method has costs associated with acquisition of their feedstock, and in most cases, transportation costs for road or rail as well, DaoChi Energy chooses locations in cooperation with local authorities to minimize transportation costs, if any. Fairly typically the municipality is the "owner" of the sewer sludge, and is only too happy to deliver it to us rather than take it to their own landfill. In other situations, municipal authorities operating waste water processing facilities have to pay "tipping fees" to dispose of their final output in landfills owned or controlled by others (other municipalities, regional authorities, or private industry). Even if they are using their own landfill, avoiding the attributive costs of adding to the landfill has economic value.

The result is that in most cases, sewage sludge is available as our feedstock for free, or in some situations either a cash or exchange credit of a "tipping fee" per ton delivered to us. "Tipping fees" are the amount charged to "dump" waste in a landfill. Even where tipping fee costs are not applied, the cost to the municipality is almost always at minimum equal to the life cycle cost of the landfill operation, and typically, landfill sites are in short supply. So municipalities are willing to pay not to have to place their sewage sludge in their landfill. This is especially true if we are accepting municipal landscaping wastes, or we also offer this service for dairy or CAFO (Concentrated Animal Feeding Operations) manure. Traditionally, manures have gone to fertilize other farm fields. Unfortunately, for these agricultural operations, large dairy and feedlot operators produce far too much manure to meet the needs of local farmers, and distant transportation costs eliminate the economic advantages of manure use for distant agriculture. Since feedlots and large dairies serve urban populations, they may incur smaller disposal transportation costs than even just to distant farm fields. We would also save them additional costs by reducing the unloading time. Instead of having to spread their manure on the broad acreage of fields, it is a simple "dump" to unload at our facility.

REVENUE SOURCES

Fortunately, multiple aspects of the overall process have been intentionally designed to generate revenues, and thus, diversify economic risks, insulating us from market fluctuations in any one field.

Electricity

Electric power generation has several benefits to the overall operation. The actual amount of energy expended to generate electric power for sale is, at present prices for wholesale electricity, difficult to make profitable. However, there are methods to mitigate this. It is actually possible to produce less electric output yet earn more money. This technique is called “peaking”. Electricity costs are so much higher during peak demand times that one can obtain a contract to supply electricity at those times at a rate double and sometimes several times the “base” power rate, if one was to output electricity for sale 24 hours a day. We have not made any specific calculations of these rates in our economic projections, but this technique is available to us because although we would be running the “motor” to generate heat on a 24 hour a day basis, we can engage or disengage the generator at any time. As such, we are available as a “peak period” source on instant notification, or even under direct control of the utility or (electric) transmission entity.

Conversely, although it may appear that generating electricity 24 hours a day is a “money losing” proposition, it is actually an activity that defrays the cost of process heat. As such, the income should be seen as part of the enterprise economics, not taken as a separate economic unit.

However, one should also consider that “green” electricity is becoming more and more valuable, especially as part of existing utility company requirements to meet “renewable portfolio specifications” under state laws. In other jurisdictions regulators or other government offices set energy prices, and typically, they too offer higher rates for “renewable” energy production as compared to fossil fuels (coal, petroleum and gas).

Biomass Diesel

“Biodiesel” has become tremendously popular as an emerging technology to replace fossil fuels. Again, like regulators who have mandated that existing utility companies must produce a certain percentage of renewable energy sources (sources include wind, solar, and geothermal as well as biomass derived energy), several states have already enacted legislation requiring that diesel fuels sold by a certain date MUST contain certain

percentage BLEND of biomass diesel. In general these regulations specify “biodiesel” but since the federal government regulations consider “non-ester renewable diesel” to be equivalent, our production will have a guaranteed demand for many, many years to come.

Our “non-ester renewable diesel” production process is based on proven technology and principles. Almost all of our equipment is “commercial off-the-shelf” in availability. From the grinders and separation equipment that prepares the feedstock, to the evaporators that sanitized and dry it, to the distillation towers and coking devices that do the bulk of the work of the chemical transformation (thermal depolymerization), everything is already in use, most of it proven through many decades of use in the traditional petroleum industry’s refineries.

Our process is simple, but takes advantage of many forms of integration and re-cycling of energy. The fact that we use exhaust heat from generators shows that we have designed for efficiency from the beginning. We recycle heat from the thermo-chemical transformation process to pre-heat and dry the feedstock, while using the same heat exchange process to cool the resulting product stream of fuels. We have multiple forms of “diesel” fuel to sell when we are finished too.

So far as we know, at this time we are one of only 3 companies specifically aiming to produce high quality biomass diesel that is classified as “kerosene”, a particular grade of which is used as aviation fuel (Jet-A, or with certain additives, as JP-8 when used by the U.S. military for both aviation and other vehicles). We also recognize that not all of the output will be of this one type, so we anticipate also producing what we are calling #2 diesel, which is also equivalent to #2 home heating “oil”. This can be used by home owners, or by industrial customers to burn in their boilers. Remember, please, that because these fuels come from biological sources, they are the same “carbon” atoms that would otherwise be re-cycled by normal biological processing (decaying vegetation, animal digestion, etc.) and thus are not contributing to the carbon load in the atmosphere. We know that many airlines are seeking a way to be more “environmentally friendly”. Sir Richard Branson (of Virgin Airlines) has promised to spend $3 Billion on developing cleaner fuels for all his transportation businesses. The U.S. Air Force is under presidential mandates to improve their use of renewable fuels. (The 1992 Energy Policy Act and Presidential Executive Order 13149 from April of 2000 mandated significant improvements in energy efficiencies in the armed forces. The Air Force is significantly behind their quotas at this time.) This is largely because few alternatives are available to them at this time for 3 billion gallons of aviation fuels used annually. Blending our products with conventional fuels, or perhaps even as 100% renewable kerosene will help to change this in the future.

Chemicals

Our products will also include “char”. This is the current politically correct name for what might have otherwise have been called “charcoal”, but most folks in the “green energy” field want to avoid the mistaken impression that some form of fossil fuel ‘coal’ is somehow involved. Public perception is still important to achieving acceptance of these rather fundamental changes in how we treat our planet.

“Char” is simply carbon in a raw form. It can be pressed into blocks or “briquettes” which can be sold for your home barbeque or for restaurants that specialize in the delicious flavor of “charbroiled” foods. Because of the high degree of purity of this char, it is also suitable for activated char filters that remove odors and other impurities from air or industrial processes.

It is expected that we will also be producing other chemicals which could be separated from the particulates extracted during the processing. Which ones might be economically separated from the (comparatively small fraction of) process waste or slag is not know at this time, since this will vary with the exact composition of the feedstock materials we are receiving. “Ash” can be used in building products. Phosphates may be available as a form suitable for inclusion in fertilizer formulations. Some acids will be generated which may or may not have commercial value. It is our intent to try to minimize our “waste” output (which, incidentally will be entirely sterilized), but we expect that we will be producing not more than about 8% waste as a percentage of the feedstock, probably much less, so we will only do so if it appears to be profitable. (We will, of course, meet any required standards regarding elimination of heavy metals or other pollutants if these are present in the feedstock we receive.)

Tipping Fees and Offset Credits

Elimination of undesirable wastes is one of the principal benefits of establishing a DaoChi Energy processing facility. As such, we substitute our useful products for the burden on the public of disposal problems. In general this is viewed in a very positive light. We expect that in many cases (if not all) that municipal, regional and even state governments may be happy to pay “tipping fees” for every pound of feedstock that we accept because it does not have to go into a landfill. In any case, we expect that at minimum local and regional authorities will be willing to grant us “credits” as an offset that eliminates our having to pay tipping fees for disposal of that portion of our feedstock that is not converted to useful products (about 8 – 12 %), because we so substantially reduce the burden on landfill (by 88 to 92% of feedstock weight).

Tax Credits, Carbon Credits, Producer Credits & Investment Tax Credits

Various governments have made such attractive incentives to proceed apace with development of "green energy" that it is almost certain that these things will NOT last the entire life cycle of the plants we build. However, they are not insignificant to the "bottom line" even in the first few years that might otherwise be less profitable as the operations are fine tuned, and improvement to the processes or equipment added. All of the above list of various credits are potentially monetizable sources of income. But all the others pale in comparison to the specific biodiesel incentive in the Federal Tax Code.

The Energy Policy Act of 2006 provides for a **$1.00 per gallon tax credit** , which generally is available to "blenders" of motor fuels. We have calculated that on a 500 Ton/Day of feedstock capacity that we can reasonably expect to produce something **in the range of 4 million gallons per year of high grade kerosene ("blendstock" for JP-8 which is both a vehicle fuel and aviation fuel akin to Jet-A), and an additional 4 million gallons per year of lower grade #2 diesel, both of which qualify under the Environmental Protection Agency ruling as fitting this definition for renewable diesel**. The process also produces a substantial quantity of methane gas which can be burned by our generators (or mixed with natural gas for the same purpose) but we have made our preliminary pro forma financial projections on the assumption that we would use the #2 diesel as the primary heating fuel for our process (as if no exhaust heat were available). On this basis we produce a **net** of only about **300,000 gallons of #2 diesel fuel**. Therefore we foresee that we will be able to "collect" (either directly or as part of the income from sale of the diesel fuel we produce) something between $4.3 and $8 million in tax credits annually.

We have not attempted to calculate: investor tax credit, producer tax credit, nor any monetized value for carbon credits.

INCOME

We calculate income based on the rather modest prices of $2.25/gal for both JP-8 blendstock grade and #2 diesel, and the somewhat pessimistic expectation of just $0.065 per kilowatt hour of electricity produced (on a 24 hour base-load basis) (as mentioned earlier, "peaking" may be more profitable). Our assumption also limited electricity production to the capacity supplying generators with only the methane mixture produced in the early stage of our process, although our income calculations also assume that none of this will be re-cycled into the production process, for which we then calculate that we use the #2 diesel fuel internally as needed for process heat. This amounts to some 2.6 million gallons per year of essentially redundant fuel allowance (and accompanying reduction in projected revenues).

Gross income for a 500 (dried Ton)(approx 2012 wet tons) per day unit then can be expected to be about $10 million from Jet-A, about $500,000 from #2 diesel, and something in the range of $800,000 from electricity sales.

CONCLUSION

The timing is right, rising oil prices worldwide, the need to reduce dependence on foreign sources of energy, the environmental impact of adding carbonaceous content to the atmosphere from the lithosphere, the economic opportunity in a time of rapidly rising expectations that have not yet blossomed, all of these are only the start of the reasons which make our proposal attractive. We are interested in building self-sustaining community assets.

MORE IMPORTANTLY THIS IS A "SOLUTION" to the petroleum dependency that has come to the point of being an economically crippling influence throughout the world. Cheap, local resource re-cycling of organic materials already part of the local environment is a UNIVERSAL, WORLDWIDE solution, not just for the most highly industrialized communities, but everywhere. China, for instance, the fastest growing user of petroleum energy, has the resources in abundance to produce energy without importing virtually all of their fuel as is presently their situation. India too, while not so well endowed with water resources also might be able to use the co-generation for distillation to create desalinated water to solve additional resource problems by using sea water for human consumption and for agriculture.

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