CITIZEN CANE

ESSAYS FOR NEW DAYS IN BIOENERGY

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For Flavia and Isabel

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Preface

Now it is evening and the wind has swung to the northeast and is gathering force. It bangs the palm trees hard, bending them sharply all along the Key, until the coconuts begin to fall, and then we know we are in for it. The sea has turned a dark aquamarine and the whitecaps are rocketing in on a line from Bermuda to the old Cape Florida lighthouse.

When it really blows on Key Biscayne, work stops, and eyes lift to take in the heady winds; you look east for a sign of a break in the cloud line, but this evening there is nothing but the black ink of foul weather coming fast. I look a little farther, and a little farther, to find something, a respite, a calm after peril.

If you could stand high enough maybe you could see the break. Even higher, you could see down the Santaren Channel, down the spine of Haiti, across the Amazon and into the harbor of Rio de Janeiro.

We are ants, too small to see it: gorgeous Sugarloaf rising out of Rio's waters. But on the Key you can hear it, for there are plenty of Brazilians around. Steps away, at one of a dozen establishments, the clink of ice in the caipirinhas, or the cachaça and lime, accompanies the languid lilt of Portuguese.

When the late fall comes, as it comes now, with the northerlies and the early darkness and a heavier surf, it feels a little sad, and it feels good to hear the *fado*, the sad songs

of old Lisbon that are played some times in Rio and Sao Paulo and all the sugar cities of the deep, deep south. My friend Cesar Crespo tells me that '*fado* is Lisbon and Lisbon is *fado*,' but the sweet and the sad of the music fits Brazil like a fine suit of clothes.

Saudade, whispers my wife in her warm, soft Portuguese. *Saudade* — it means something like longing, but a longing perhaps not only for that which was, but that which has not yet come to pass. *Saudade* is the feeling of *fado*, and I think it captures how we feel about the world that we hope will one day come.

It must be true that before we can build a new world, first we must feel a sad, plaintive longing for it.

Saudade - bring on a better world. *Saudade* – let us suffer a little first.

Between the sugar plantations of Sao Paulo state and Mato Grosso and my home on Key Biscayne, lie so many of the lands that personify all that must be suffered and overcome in bringing on the world that could be.

Haiti - a byword for a broken regime. Cuba - a byword for broken development under a string of broken regimes. Venezuela - a byword for the broken north-south dialogue. The Cayman Islands - byword for the broken structures of international finance.

My own little island is a nanocosm of a wider world. We are populated here on Key Biscayne with Argentines, Brazilians, Peruvians, Cubans, French, Scandinavians, Germans and

English – to name a few of the polyglot of nations wherefrom the neighbors hail. Just a few Yankee Doodles like myself. I doubt if 30 percent of our island speaks English at home. Almost no one over 40 who lives here, was born here.

Here on Key Biscayne, ours is an island in motion — always in spirit, sometimes in fact. The waves that are hitting tonight will boil up and move tons of sand, and Key Biscayne will shift just a little tonight. If Hurricane Ida, now developing in the Western Caribbean as I write, develops any further, then another kind of motion will be in evidence: fleeing for the mainland.

But the world itself, and the seemingly intractable problem of energy that has befallen it, is something that is impossible to flee. We are all here on this one island, Earth, longing for something that perhaps never quite was - a world in which we use energy efficiently and justly. *Saudade*.

In the essays that form *Citizen Cane*, I have aimed to explore the terms and conditions, the representations and warranties, by which we can hope to construct a world in which bioenergy drops in, just as the supply of affordable fossil fuels drops out.

Many of these essays are explorations of hard data, some are more lyric. Many have been previously published, some are new. Many address the urgency of a particular topic and time, some take the broader view.

The long-time readers of *Biofuels Digest*, which I founded in July 2007, will recognize much of this material and its

underlying themes of optimism and social justice as they attempt to chart the progress of, and roles for, the makers and users of bioenergy. I have always been a friend of progress.

But as one who lives at the western corner of the Bermuda Triangle, I cheerfully admit no special powers to predict the future. The waters are murky, the charts often muddled, and the way forward is no easier to see now than when Columbus stumbled into the Bahamas, in 1492, thinking he had found China.

The myths are no easier to dispel than when Ponce de Leon landed in 1513, a few hundred yards south of my terrace, in search of the Fountain of Youth. The destination is clear, but the way is spackled with unmarked shoals, and sandbars, and reefs.

Above the murky waters - filled with their tricks and disguises — the evening that is now spreading across the eastern skies is filling with stars. Every living thing on land, with eyes to see, can see them. But only we, we the people, *homo sapiens sapiens*, see the constellations. They are an abstraction — an invention of our restless minds pulling order out of chaos, and cautionary tales out of the void.

Of the 88 constellations, consider the case of Pyxis and Vela. In legend, they were, respectively, the compass and sail of the good ship *Argo*. One tradition holds that Jason and the Argonauts went abroad in search of the Golden Fleece as a monetary adventure — in the old days one caught gold from a stream with a sheep's fleece, which would trap the gold flecks that were shaken out after drying.

Another tradition holds that he was performing a labor to win a throne, wherefrom he would establish justice in the land of his birth.

Chasing money, or a better world — these are more than plausible motivations of the Argonauts — they are the twinned themes of bioenergy — the one hardly distinguishable, at times, from the other.

In our quest for a replacement for fossil fuels — like Jason in the *Argo* — we are sorely in need of a sail and a compass, a Pyxis and Vela. But I have come to believe that, above all, to realize our aspirations we need the deep longing heard in the *fado*. Without direction we are lost, without speed we are lost; but without longing we are utterly lost.

It is the author's usual hope that readers of a collection of work will "enjoy these pages", but more than enjoyment, I hope you they ignite, or inspire, or augment, your own sense of longing— no matter what tribe, goal, or agenda is driving you.

Nothing is worthwhile that comes without a passion; it is the renewable energy behind renewable energy; it is the force that binds all of the arguments and arguers in this industry and quest. It's a good thing.

Saudade.

Citizen Cane

Citizen Cane is based on, and adapted from, remarks titled "Value, or Values?" originally given at the 2009 Platts' Cellulosic Ethanol Conference, held in Chicago. At the conference, there had been a relentless – and understandable – focus on economic sustainability, reflecting pressure from the investor community for cellulosic ethanol to prove that it can compete on price with gasoline.

Since 85 percent of the cost of biofuel is in the feedstock, I felt at the time that the emphasis on cost and yield was understandable, but misplaced. The higher concerns – under what conditions biomass would be affordably available for the production of fuel – inherently led to a consideration of the role of local communities in the great changeover from fossil fuels that must inevitably take place.

"*Let me tell a story 'bout a man named Jed, a poor mountaineer barely kept his fam'ly fed...*" — by now, if you are a devotee of vintage TV or over the age of 40, you may well be humming along to the theme song of *The Beverly Hillbillies*. The song told the story of how these comic hillfolk ended up owning a mansion in a swank part of Los Angeles, because of an oil strike on their land back home. It's the dream of many of poor landowner for a long time now.

But it's not a dream of landowners in Nigeria, according to my friends in Port Harcourt, though many of them are poor and all of them have dreams. You see, in Nigeria, mineral rights belong to the Federal Government, and an oil strike on your property can mean the ruin of your land by a collection of oil derricks, machinery, and the pools and

puddles of oil and gas that will ultimately wreck the soil for some time after the wells have given out.

In places where Nigerian oil is consumed — such as affluent living rooms in the United States where happy families laugh with abandon at the antics of *The Beverly Hillbillies* — we consumers don't much feel the pain or the joy of the oil business, unless we feel the pinch of price rises or joy over a decline.

Cheap fuel! Cheap energy! That's what we want — or have wanted for a long, long time. Cheap fuel, and cheap food, and no questions asked.

So much of our cheap sugar comes from the cane fields of Brazil — for the Brazilians drove down the price with an efficiency that virtually extinguished the US sugarcane business. We don't see the cane worker any more clearly than the Nigerian farmer.

We may tut-tut over reports of slavery in the industry when we see it flash across the Bloomberg Channel, or regret the conditions that every cane worker must experience, wielding a machete at high speed for hours, and days and years. The long years in the hot fields, the high prices in the company stores, the rude shacks used by the cane-workers — we might become agitated if we saw it, but we don't see it, or rather we avert our minds rather than our eyes. It is the same with chicken farms or cattle feedlots — a *60 Minutes* report might arouse our outrage for a day or two, and then we lapse into the old habit of taking the cheap price, and pushing inconvenient thoughts aside.

Belief in the idea of a "global village" appears to be widespread and popular – in fact, the phrase coined by Marshall McLuhan has 2.6 million references in the Google index. But is it a global village – or rather a complex and integrated global market? The market is known to tolerate what would not be allowed to exist in the village, or in the home.

In the village, we see our family and friends and the human equation — in the market we see price, and yield and return on investment. I recall many complaints about the injustice in so many workplaces that my friends and family have served in. Bitching about the job is the American way — and when I was younger, it was the Aussie way. It probably is universal. But how many of those who gossip so much about their own companies, know anything intimate at all about the companies in their mutual fund portfolio? We are happy when the stocks rise, worried or angry when they fall, and for most people, that is all.

It is distance that seems to provide the dulling effect. We hear of suffering or hunger in distant lands but, common sense tells us, most people blot it out of their minds. Oh, there might be a momentary pang or guilt during a television commercial raising money for the poor. But generally, we are consumed by the things around us, yet we consume things made far away.

The painter Max Beckmann said that you could "make the invisible visible through reality," and I have come to believe that the best way to make it real is to experience it at first hand.

In a well-known 2008 essay in the *New York Times Magazine*, Michael Pollan suggested that people could take a small, positive step on climate change by growing some of your own food:

"You begin to see that growing even a little of your own food is, as Wendell Berry pointed out 30 years ago, one of those solutions that, instead of begetting a new set of problems--the way "solutions" like ethanol or nuclear power inevitably do--actually beget other solutions, and not only of the kind that save carbon. Still more valuable are the habits of mind that growing a little of your own food can yield. You quickly learn that you need not be dependent on specialists to provide for yourself--that your body is still good for something and may actually be enlisted in its own support. If the experts are right, if both oil and time are running out, these are skills and habits of mind we're all very soon going to need. We may also need the food. Could gardens provide it? Well, during World War II, victory gardens supplied as much as 40 percent of the produce Americans ate."

It's a simple idea that Pollan presents. I would only wish to extend it to energy as well as food, although in a practical sense I mean energy produced within the community rather than simply in the home.

The problem of energy and food made from Brazilian cane can be remediated by citizen cane. The problem of Nigerian oil can be remediated by citizen oil made from kitchen or municipal waste. All sorts of evil under the sun can be remediated by citizen sun.

Citizen cane can be grown at home, or down the road, just not too far down the road — about ten miles or so. The land in that area — assuming it is fertile — would support a population of 100,000 souls with 34.9 trillion BTUs of bioenergy, (equivalent to 10 million terawatt hours of

power). Solar installations would, in the future, provide even more efficiency. The point is, the land has plenty to give, and needn't require the galactic fossil-fuel inputs with which we juice it. The right combination of feedstock depends on climate and soil, but the principle of "growing your own" is something that is achievable.

Of all the sources of renewable energy — bioenergy, the nexus of food and fuel — has a special reason to embrace the model, because the current focus on yield, scale, ROI is creating a long-term problem for the purveyors of energy from waste or other forms of biomass. In the case of bioenergy, there's a pervasive feeling of a zero-sum game, that one man's energy is inevitably produced from another man's dinner.

Does a given fuel advance us beyond the choice between food or fuel: is it sustainable? That is an important question. But more importantly: whom does it sustain? Whose human dignity does it restore or improve? When the farmer can answer that question, they will have found, and founded, a market based not only in value, but also in values.

It seems to me that, if the debate were purely about value, the cellulosic ethanol industry would be a lot farther along than it is, because the advanced biofuel made from waste has a compelling value proposition on climate, energy security and green jobs.

So does nuclear energy, and this industry is heading for a similar position in the hearts and minds of the public.

The barrier to nuclear energy is fear - fear of catastrophe,

fear of the unknown - and it is the barrier for cellulosic ethanol as well. We are experiencing today the first skirmishes in an all-out war over the replacement of our petroleum and gas resources, the inequitable distribution of fossil reserves, and the fear that the new world will be a worse one, depending on your particular flavor of priorities.

What is the ultimate role of biomass-based fuel in the future? Too early to say. What we can say is that biomass is where it is today - corn in Nebraska, sugarcane in Brazil, because of the demands of the old world, not the new. Logistic systems must consider not only what is in the ground, but what could be in the ground and will be in the ground when all the producers of fuel, food, power, feed, chemicals and plastics must come to renewables to find their feedstocks. All of them will compete for biomass.

In fact, the more that producers succeed in their goal to reduce the yields from waste biomass, the more tempting it will be for the makers of power, chemicals and plastics to come and take those feedstocks away. Everything has higher margins than fuel, excepting perhaps food. Everyone above fuel on the value chain will outbid fuel makers for biomass, and food will outsquawk them.

So does the near-term future of biofuels lie in addressing value? It seems to me it must address values. What, in fact, are our priorities?

Global petroleum demand is 1.3 trillion gallons and natural gas demand is at around 100 trillion cubic feet. The US Renewable Fuel Standard by 2022 replaces about 1 percent of that. At the global level, it will be a long time before

biofuels are considered "critical" in terms of supplying our energy needs, and have first call on feedstocks.

Bioenergy producers will be heard, and respected, but a one percent transformation is not enough to decisively influence any near-term debate on climate change or energy security.

The Grocery Manufacturers Association's "food vs. fuel" campaign against ethanol, the debate over whether biofuels create a carbon-spewing land-use change - these challenges are not the end, or even the beginning of the end. They are the beginning of the beginning.

And do not think for a second that, because cellulosic ethanol looks good on land-use change, that a cellulosic ethanol producer is "safe". The debate will shift to freshwater reserves, or something else. We are all in a proxy war over resource allocation, where 250 quadrillion BTUs of fossil petroleum and natural gas - let alone coal — are disappearing, and titanic forces are at work to influence the corporate and social outcome of this changeover.

But bioenergy can win in the right way for the right reasons on the local level. It can matter to a community or to a county or even a state, and they already do. For those thinking scale, I believe that is the wrong direction. That is value economics and cellulosic ethanol will lose on value economics.

At large-scale, biofuels are just another commodity made in some faraway town and few will care about it in the way farmers want, or need.

Think small. Biofuels may not matter in Manhattan very much, but they matter in Manhattan, Kansas. Why? In the movie "Milk" it was pointed out that, in a 1970s battle over civil liberties for gays, people who knew a gay person were 2-to-1 in favor, while those who did not were solidly opposed.

When your brother-in-law is employed at the ethanol plant, he cares. When your sister teaches children from farms raising energy crops, she cares. When your buddy at the 7-11 depends on the truck drivers delivering biomass for those extra sales of refreshments and snacks, he cares.

Manhattan and Manhattan, Kansas are both governed by a national mandate but have vastly different stakes in the outcome in terms of their local economies. Is Manhattan, Kansas interested in biofuels solely because of cheap or cleaner-burning fuel? Are local economic incentives built around creating the value economics that flow from scale - or is this about a more holistic, yet more local, vision of wealth and opportunity creation?

Within the community are stable supplies of feedstock, stable demand, and the economic case that will sustain bioenergy.

The minute a farmer puts biofuel on a train for California, troubles mount, and overwhelm.

It is the community support that will sustain bioenergy when the food lobby, the chemicals lobby, the feed lobby and others serve up more and more of the "fear, uncertainty and doubt" that is making the biofuel industry's growth difficult and its economic cycles hard to sustain.

Drop In, Tune Out, Turn On: New thinking for new days in bioenergy

This April 2009 essay in the Digest was controversial – I think because some people opined that a suggestion to "tune out" the food vs. fuel debate meant that I thought it was OK for people to starve. It seems to me that saying that the "food vs. fuel" debate of 2008 was a canard, is borne out by the facts: for example, a 60 percent drop in the price of corn in 2008-2009 did not produce even a minor rollback in food prices.

I would like to think that other parts of the essay – such as the emphasis on drop-in fuels – are of use to the industry, and were less pilloried or less noticed. I would probably change one thing – adding emphasis on small-scale distributed production.

"Think for yourself and question authority" - Timothy Leary

It was Timothy Leary, the controversial Harvard professor, who coined the phrase "Turn On, Tune In, Drop Out" in the 1960s, to provide a simple yet evocative way to think about a new set of controversial lifestyle choices that were a product of the social unrest of the 1960s.

In a world where we have a 100-page explanation from the state of California on how they propose to measure greenhouse gas reductions of a single renewable fuel (ethanol) produced from a handful of feedstocks (primarily sugar and corn), we can use some simplicity in bioenergy too.

For too long we have made the dialogue over a handful of renewable fuels more and more complex. If one thing is

assuredly unsustainable in the debate over renewable fuels, it is the way we talk about them.

We need to get past talking about a simple set of alternatives in a complex way, because in the future we will have complex alternatives that we need to organize neatly in our minds.

For the days of making fuel in the manner of what the French describe as a bricolage - that is, an artwork created from the resources at hand - are ending. The time of first-gen fuels is come and gone, though material amounts of fuel made from cane sugar, ethanol and soy will be with us for some time to come and will find an enduring if limited role in the future.

The era of synthetic fuels are upon us, though as Gerald O'Hara said to daughter Scarlett in *Gone With the Wind*, "you may not recognize it now, but there's no getting away from it."

As readers of the *Digest* know, I've filed 7,000 news items on bioenergy over the past two years - hard data - and had more conversations with synthetic biologists and project developers than I can count, that get quickly down to "what do you really got?".

Here's what they got: They have the future of fuel in the maw of their hands.

Based on synthetic biology, we are at the first milepost of the journey to (and on) synthetic fuels, continuously harvested from cellular bioreactors that will be the descendants of

today's feedstock crops.

We need something to express that era that is more relevant than the "made at home, available now" argument that was advanced for corn ethanol, or the "f**k ethanol" argument that has been advanced by critics like Dan Sperling in response.

Here's my alternative: **Drop In, Tune Out, Turn On.**

Drop In: The future does not lie in ethanol and biodiesel, though they may well provide important fractions of the renewable fuel supply for some time to come. The future lies in "drop in" renewable fuels that do not require changes in infrastructure or engine design to accommodate them.

The failure of E85 ethanol to gain meaningful traction has something to do with price, but far more to do with lack of infrastructure and vehicles, and the well-known resistance of the driving public to wholesale changes in the way they buy and use fuels. Not to mention that fuel distribution is increasingly handled as a side business to the sales of snack foods and general merchandise.

To say that retailers (capped at a nickel a gallon in revenue from fuel sales) are loathe to invest $50 grand to add E85 to their station, would give the phrase "Bernard Madoff could have made better investment decisions" a run for its money as understatement of this young century.

But we have alternatives: companies like Amyris Biotechnologies, Sapphire Energy, UOP, Virent and LS9, to name a few, are focused on drop-in fuels that come from

renewable biomass but act like traditional hydrocarbons. Drop in fuels bypass the arguments about conversion timelines and energy density that have plagued first-generation fuels. Synthetic biology is giving us options that do not require re-invention of the 100-year old system of making and distributing fuels, and that's the bigger solution that the broader market requires.

Tune Out: The great debate over land use change, greenhouse gas emissions and the wisdom of the ethanol tariff and alt-fuel subsidies, is a debate about yesterday. The protagonists - such as Friends of the Earth, the Environmental Working Group and the Grocery Manufacturers Association on the one hand, and Growth Energy, the Renewable Fuels Association and the National Biodiesel Board on the other hand - are committing the cardinal sin of a commander in the field, the sin of fighting the last war.

The battle over first-generation biofuels is really over corn and genetic modification of the food supply, more than a debate about fuel. The waving of the red flag of Third World poverty is a canard: far more calories are diverted to fat bellies in the North than are diverted to ethanol distilleries; it's not even a close race. The best thing Westerners can do to provide more food at affordable prices for hungry people in the South is to, borrowing a phrase from the cows at Chick-Fil-A, "Eat more chicken", or even better, eat fewer highly-processed meals altogether.

Not all debates go away if ignored, but the debate over renewable fuel emissions and land use change is an exception. In the future, which is less far away than most

people think, fuels will be generated from waste or cultivated on otherwise useless land or ocean, diverting nary a drop of water from our freshwater aquifers, and will cause less indirect land use change than throwing an unwanted serving of broccoli in the garbage.

Meanwhile, our attention has been diverted from the development and support of advancing and advanced fuels by this Grand Inquisition into the purity of existing alternatives to fossil fuels. The whole process has the theatrical elements of the Salem witch-hunt: it's a continuation of corn politics by other means.

Tune out the debate, and move on.

Turn On: Beyond the advances in fuel technology, there are even more advances in feedstock development that need attention. Turn on to the idea that, like moving from print to digital, we are moving from an era of batch production of feedstock to continuous harvest. We wouldn't have much of a dairy business if we had to kill a cow every time we wanted a glass of milk, yet that is the Stone Age we currently find ourselves in with our most important feedstocks. Better days, like the iceman, cometh.

From corn to soy and over to advanced, high-yield feedstocks like algae, we kill the biomass to harvest the energy. The exceptions are the harvestable large oilseed crops like jatropha and palm, but new continuous harvest options for algae are under development at Iowa State, Ames Lab as well as companies like Naturally Scientific and Catilin.

Assuredly that it the route to yields north of 10.000 gallons

per acre, or even 100,000 gallons per acre given some advances in the underlying science, that will permit us to milk cellular bioreactors producing oils and carbs using a feed of synthetic sugars.

Ultimately, our energy limits from the sun are around 8.5 million BTUs per square meter per year in the mid latitudes, the energy equivalent of 250,000 gallons of gasoline, per acre, per year. That's what rains in from the sun, without tapping the stored energy in carbon and oxygen here on earth.

The limits are in the batch process, which is like print compared to digital - too much energy is expended making cells, especially cells that were designed to survive in the wild and have corresponding allocations of energy to cell walls and other defenses. Continuous production of feedstocks is the wave of the future.

Drop In, Tune Out, Turn On: abandon ye comfortable ways of thinking about the future of liquid fuel. Come together in a discussion of a newer, better fuel supply.

As the Red Hot Chili Peppers advise:

"To readjust you've got to trust
That all the fuss is just a minor thing."

Sugar, Sugar: The transformation of cellulosic ethanol

'Cheap sugar' is a phrase heard over and over in the biofuels industry this year – it is a vital component for a successful bioenergy company making cellulosic ethanol or several other biofuels. This July 2009 essay looked at the latest advances that have cellulose making a comeback as a "hot" feedstock.

"Honey, aw Sugar, Sugar,
You are my candy girl,
And you've got me wanting you."
The Archies, "Sugar, Sugar"

From the 2008-09 "winter of our discontent" to 2009's "Summer of Algae," biofuels have made a remarkable journey in the past six months. But what has become of the former darling of industry dreams — cellulosic ethanol — a fuel and processing technology that one wag said "always was, and always will be five years away"?

While attention this year has been justly diverted to the entry of ExxonMobil into the algae race, not to mention the heady progress towards commercialization at PetroAlgae, Solazyme, Algenol, Sapphire Energy, Aurora and Solix just to name a few, the industry formerly known as "cellulosic ethanol" has been quietly transformed into something that is just as much about cellulose, but not nearly as much about ethanol.

Cellulosic ethanol was promoted as "not your Dad's ethanol," but the leading companies today are not producing "your Dad's cellulosic ethanol" either.

The proposition of cellulosic ethanol began with the observation that, for every four tons or so of corn that was extracted from an acre of farmland, another ton and a half of corn stalks and cobs were left behind. Those stalks and cobs contained cellulose that could be converted into simple sugars, went the theory, if conversion could only be affordably achieved. It was hard science but the added value opportunity made it an easy sell as a topic of investigation.

Later, cellulosic ethanol gained even more urgency when ethanol production for reasons of energy independence and carbon emissions reduction gained substantial traction in the mid-2000s, although it wasn't until Iogen got a pilot running in 2003 that cellulosic ethanol first left the lab.

Even as corn ethanol became everyone's favorite punching bag in 2008 over questions of emissions, concerns over the diversion of the global food supply, and the dearth of cheap feed for the dairy and cattle industries, cellulosic ethanol has remained popular as an idea. Cellulosic ethanol had the promise of providing renewable fuel without tears, and farm income that can help ease rural America out of a long-term stagnation caused by cheap corn.

Cellulosic ethanol will continue to develop as a strong component of the renewable fuels industry, but as a savior of farms and the Jolly Green Giant of carbon-friendly fuels it died with the failure of E85 ethanol. As I write that last sentence I can already hear the indignant jeers of those who

labor so hard to expand the availability of E85. But we have to face facts: in the United States, and in the foreseeable future, E85 is a boutique fuel with an uncertain value proposition except in times of exceedingly high oil prices and affordable corn — a combination of circumstances that is hard to come by.

Ethanol remains an important component of the national energy solution, and affordable cellulosic ethanol is the best kind of ethanol there is, but 36 billion gallons of cellulosic and conventional ethanol by 2022 appears to have become pure fantasy. The modest 100 million gallon target offered by the US government for 2010 included 75 million gallons from Cello Energy, whose projected output is in the 25 Mgy range when the plant is fully operational, an issue in doubt after the developer was slapped with a $10 million judgment in a suit brought by an investor alleging fraud.

But what has risen in its place is far more interesting — the cellulose as a source of cheap simple sugars, and an army of underpaid microbes that convert simple sugars into green gasoline, green diesel — the drop-in fuels — as well as a base for a dizzying array of renewable chemicals. God bless Joe VC, Martha VC, and Uncle Sam who put up the money for the first wave of cellulosic conversion. The second wave has hit the beach, in the guise of ExxonMobil, Dow, BP, and DuPont, and with them comes the heavy artillery that will get the job done.

Here are some trends as cellulosic ethanol gives way to a broader, deeper offering of bio-based fuels and chemicals, made from simple sugars obtained from biomass, that will occupy the headlines of *Biofuels Digest* and many other

publications for some time to come.

It's the cheap sugars, stupid. No matter what anyone describes as the "Holy Grail of Biofuels" or "the mother of all biofuels challenges," they are the same thing. Sugar, sugar. Whether it is tricking algae to convert sunlight and CO2 into sugars that it will later convert to oils, or making fermentable simple sugars from landfill waste or switchgrass, the key to making fuels affordable is the total cost of the simple sugar.

Sustainable, affordable, reliable, available. SARA is the remarkable acronym coined by Tom Murphy of Woodland Natural Resources for what biomass must be if it to be useful as a feedstock for the new fuels and chemicals.

Drop-in fuels. The *Digest* has been drumming this beat for some time, but companies like Amyris, Virent, Sapphire Energy, Synthetic Genomics, PetroAlgae and others who are formulating fuels the drop-in to the fuel supply, have a larger playing field and fewer barriers to scale. It is worth remembering the hoots and hollers when companies like Dynamotive and US Sustainable Energy were touting "biocrude" and drop-in fuels just two years ago. What was a controversial trickle has become a firehose of companies focused on drop-in replacement fuels.

"One word: Plastics". Whatever methanol's or ethanol's shortcomings as a fuel, they are a remarkable platform for chemicals. Upgrading from a base, options like propylene and polyethylene come on to the table, once the simple sugars of biomass have been converted into a simple alcohol. Companies like ZeaChem and LS9 have increasing focus on renewable chemicals, and are finding backers like Dow

Chemical who are looking for sustainable sources far away from the Middle East and other hotspots where manufacturing is based to be close to the feedstocks. Paul Winters of BIO warns:

"The American Clean Energy and Security Act of 2009, which passed the U.S. House by a narrow vote in June, currently does not include biofuels and bio-based products in the system of carbon credits (even though petroleum transportation fuels are capped). Biobased products currently make up 5 to 7 percent of the worldwide market for chemicals and plastics. If incentivized through the carbon market, they have plenty of potential to grow and displace petroleum-based products."

Ethanol extender, bagasse bonanza. Companies like Poet will add value to their considerable holdings in first-generation ethanol by adding cellulosic ethanol capabilities to their existing fleet. Projects like the 25 Mgy Emmitsburg cellulosic ethanol facility are just the start of something that will add up to $100 per acre to farm income, add value and reduce average emissions at ethanol plants, and just about in every way make a solid contribution to a national energy solution.

Look for Petrobras and other companies in Brazil to discover over the long term that converting leftover bagasse to ethanol is a better solution than burning it for power generation. For companies like Coskata and that can transform sugarcane waste into fuel at affordable prices, the future looks mighty bright, although it looks mighty Brazilian and Indian, because that's where the sugar is.

Make haste for waste. The best economics for celluosic conversion are found in waste, where feedstocks are better than free, they come with tipping fees (the money paid by companies to dump trash at landfills). Sandia National

Laboratory has estimated that the US has the resources to sustainable produce 90 billion gallons of renewable fuel per year. Key to this is capturing residues - forest, agricultural, animal and municipal. Of all these, municipal is the kind of trash that comes the cheapest. Companies like InEnTec, BlueFire Ethanol, and Agresti that focus on waste will have a formidable value proposition in a country where the average US resident produces 5-6 pounds of waste per day. That's 300 million tons per year - or 20 billion gallons of fuel at a touch under 70 gallons per ton.

Less is more. Companies like KL Energy - which pioneered the first commercial cellulosic ethanol plant last year — have been saying for some time that the lower yields per ton from cellulose dictate a "small is beautiful" approach to building community-based plants. Lower yields mean a higher transport cost for biomass per mile from field to factory.

Besides, communities of the future like Destiny, Florida are embracing a philosophy of home-grown fuels that are made "of the people, by the people, for the people". Communities that use the fuels they make are more engaged to use them - just look at the concentration of E85 stations in the Midwest in the heart of corn country.

Pilots, start your engines. Paul Winters of BIO reports, "Right now, there are three dozen or so cellulosic ethanol biorefineries in the planning, construction or initial operating stage across the United States, and at least six more in Canada, including Iogen's facility in Ottawa, the world's first operating cellulosic ethanol biorefinery.

Most of these projects are pilot-scale facilities designed to

test and prove a wide variety of technological solutions for turning cellulosic crops and waste streams into fuels, but each producing fewer than 2 million gallons annually."

Beneficial Biofuels. "Beneficial Biofuels—The Food, Energy and Environment Trilemma," will appear in the July 17 issue of Science. David Tilman, a resident fellow of the U of M's Institute on the Environment, said the paper resulted from a year of conversations and debate among some of the nation's leading biofuel experts. The writers include some of the leading lights in cellulosic conversion, and the critique of first-generation fuels. In addition to Tilman, the article contributors include the U of M's Jonathan Foley and Jason Hill; Princeton's Robert Socolow, Eric Larson, Stephen Pacala, Tim Searchinger and Robert Williams; Dartmouth's Lee Lynd; MIT's John Reilly; and the University of California, Berkeley's Chris Somerville.

"The world needs to replace fossil fuels with renewable energy, but recent findings have thrown the emerging biofuels industry into a quandary. We met to seek solutions," said the U of M's David Tilman, a noted ecologist and lead author of the paper. "We found that the next generation of biofuels can be highly beneficial if produced properly."

A release by Science Daily said that "to balance biofuel production, food security and emissions reduction, the authors conclude that the global biofuels industry must focus on five major sources of renewable biomass: Perennial plants grown on degraded lands abandoned from agricultural use; crop residues; sustainably harvested wood and forest residues; double crops and mixed cropping

systems; and municipal and industrial wastes"

To see Chris Somerville and Lee Lynd (the co-founders, respectively, of LS9 and Mascoma) co-authoring with Tim Searchinger and David Tillman, whose work on indirect land use change and biofuels sustainability did so much to cause the biofuels implosion of 2008, is a remarkable thing. Last year, when the benefits of biofuels were touted, they were often derided as "junk science". But now we see some initial signs of a change of outlook by examining the possibilities of unwanted residues. Junk science has been replaced by the science of junk.

It reignites the hope of a peace treaty between the environmental movement and the biofuels industry, and to see the petrochemical industry becoming increasingly committed to the platform, provides the hint of a Grand Alliance that might - just might - bring biofuels into that modest but respected corner of a national energy solution that the molecules deserve.

The B-Train is, perhaps, at long last readying to leave the station. All aboard, next stop a better world.

Routes

A few months ago, Bob Walsh, the CEO of Aurora Biofuels, took me aside at a bioenergy conference and kindly suggested I start publishing a disclaimer, because there was a whispering campaign going on that I had holdings in companies I wrote about, and that my opinion was for sale. After recovering from the shock, I immediately published a disclaimer (I don't own any investments in renewable energy, not do I accept payment for placing favorable articles in the Digest), but perhaps the best answer is the fuller disclosure as to what inspires me, or rather who inspires me, and I hope an entertaining tale for readers. This essay has not been previously published.

I have sometimes been asked how I got into this business of writing about bioenergy, and it is a story best told in one tale of a rich man, one of a poor man; one of the land, and one of the sea.

The yarns are tangled - the lines fouled by time and the limits of memory - and interwoven by family ties.

Ours is a story of restless travel, of passages, of "routes" rather than roots; a sojourn to new lands and new ideas. Energy is the study of forces and momentum, and bioenergy no less so and with the added study of genetics and evolution. Motion and change are the hallmarks of the field, and of the pages of *Biofuels Digest*, and they were well understood by two men out of many whose example inspires me.

Henry Deward Collier is not well known as a seafarer and his obituary in the *New York Times* made no mention of it,

but he loved ships. Great-uncle Harry was best known as the founding chairman of Aramco, today the world's largest oil company, and also chairman of what is known today as Chevron, the fourth-largest US corporation. But he loved the sea, and descended from a long line of Connecticut sea captains who worked the whaling trade and ran schooners between Calcutta, Sydney, Shanghai and the US West Coast in the great days of sail. His father served in the Confederate secret service helping to outfit the rammers, raiders and runners of what would be known to him as the War of Northern Aggression and to you as the Civil War; his grandfather was a sea captain buried under the Oriental Pearl Tower in modern Shanghai.

He started on Washington state's Puget Sound in the 1890s as an engineer on the Flyer, the pride of the "mosquito fleet" that provided transport across and along the Sound in the years before the automobile. Though he joined Standard Oil in the early 1900s, he never lost his love of the sea. A colleague remembered him:

"You could be in his quiet office when he would glance at his desk clock, pick up a pair of binoculars from a drawer and striding to a window high above San Francisco Bay would stand transfixed peering at a graceful tanker, one of his beloved ships, as it passed toward Hunters Point. The sea has always been close to his heart."

He loved how things moved, and received a patent during his career for inventing new ways to change motor vehicle oils.

He was devoted to public service, working hard to ensure that his company supported the Red Cross, the War Chest, international relief and many other charities. He worked

hard to ensure the accession of his friend Dwight Eisenhower to the Presidency. But for him, charity began at home, and he ensured to the best of his ability that his relations had jobs in the darkest days of the Great Depression. Uncle Harry and Aunt May offered to adopt my father as a newborn baby when my grandmother died after childbirth.

He believed very much in tapping the spirit and energy of the soldiers coming back from the Second World War. He developed what he named the Chevron dealership network to offer men an opportunity to work with the Standard Oil Company of California, rather than for it, guessing shrewdly that returning soldiers, after years in the armed forces, would not welcome the stability and remoteness of a major corporation as they had in the jobless 1930s. It was the beginning of the Chevron brand.

After the war, the Chevron logo continued to sport two wings out of the “V”, representing the victory in the war he did so much to support. But he kept a low profile in terms of promoting his own contribution; he coined the popular wartime slogan "Serve in Silence" and strictly observed his own advice.

His strategy of distributing post-war oil through independent Chevron dealerships had two impacts: first, the oil companies today have all divested themselves of their US retail networks; second, the company renamed itself Chevron in 1984.

It was shrewdness, also, that led him to form the partnership of Mobil, Exxon, Texaco and SoCal that became known as

Aramco, and King Faisal of Saudi Arabia was as enthusiastic as he. It assured that there would be sufficient markets for distributing the large quantities of Saudi oil that SoCal had discovered, and that the British would not have a hand in it. Faisal feared British domination.

Strange that only sixty years ago the driving force behind Aramco's formation was the need to develop markets for oil. Today, huge markets are chasing scarce crude oil with the resulting price going to Pluto. Price has become one of the three forces, along with climate change and energy independence, that have driven support for biofuels.

A colleague wrote of SoCal "that its growth never once slackened or faltered because...it was part and parcel of this country's life, progress, and people. That is why it has never failed its employees, its shareholders, its patrons and the myriad of suppliers, big and little". It was easily said of the man as his company in those times. I wonder who would say it now.

He adapted well to change, and it was the facility with which he did so that I think defined his life. His grandfather Henry Ward Collier was a captain in the Orient trade and owned seven sailing ships, but his father William Hoyle Collier became a marine engineer and helped usher in the conversion to steam. Trained as a steam engineer, Harry's first Standard Oil job was working the wharves of Seattle drumming up an oil business in the marine industry. The conversion of the *Athlon*, owned by legendary Seattle banker Joshua Green, was remembered in the *Marine History of the Pacific Northwest*:

"In 1907, *Athlon's* compound engine was replaced with a triple expansion steam engine. About the same time, she was converted to oil fuel, in response to the oil companies launching a push to persuade the steamboat operators to convert from burning cord wood or coal to burning oil. H.D. Collier, a marine engineer, was then Standard Oil's representative in the Puget Sound region. When he approached Joshua Green to consider conversion to oil fuel, Green declined, telling him "Harry, that stuff blows up!" To prove the contrary, Collier rigged up an oil burner under *Athlon's* boiler, then dropped a lighted match in the oil tank. When no explosion ensued, Collier had made his sale."

Harry Collier loved progress, which is what they used to call change. When the company made a massive oil strike in the Middle East, he founded Aramco. Earlier, he moved his focus from steam to oil when the time was right, and I have no doubt he would have embraced bioenergy when it emerged as a viable alternative to fossil energy. For what he loved about SoCal was not so much the fuel as what you could do with it.

He was not a fan of corn ethanol or fond of Henry Ford, its great benefactor and promoter. In fact he financed a series of broadcasts against corn ethanol by CBS commentator H.V. Kaltenborn. But if he did support the argument for corn ethanol in the days of massive, cheap quantities of crude oil, he was not alone. I do not think he would have continued to hold those views with the high prices we see today. He was known to embrace the future with enthusiasm. His summer home in Los Gatos was known as Sun Acres and it was, truly, filled with sun and gardens. He would have understood the concept of energy crops perfectly well and supported their development.

The Sun Acres estate has been broken up but the home still stands, and is owned by John Warnock, the chairman of

Adobe. He often played host to captains, admirals and other men of the sea. Four nieces became the wives of admirals in time, and he took great pleasure in that, as an old sea dog should. But the ship that was named for him, the oil tanker *HD Collier*, was sunk by a Japanese submarine in the war with a great loss of life.

He valued thought before action: thought to him was the guarantor of safety, and Chevron in his day reverberated with the slogan "Think Safety". In the early 1930s, the company hired the San Francisco artist Louis A. Lauck to sculpt a statue of "a careless worker in a gas station who causes accidents". Lauck called the statue "Nodome" and it was a gas station worker with a cap but no head. The image of "Nodome" eventually adorned tokens and other paraphernalia at the company, always exhorting workers to think, and be thoughtful.

My grandfather, who led the SoCal unit known today as Chevron Research, kept a five-inch statue of "Nodome" on his desk throughout his 43-year career at the company. It eventually passed to my father, who worked at Standard stations until he headed for naval officer candidate school; upon my father's retirement earlier in this decade, it passed to me. "Nodome" sits on my desk and is the first thing I see when sitting down to write *Biofuels Digest* each day, exhorting me to think; to use the head I have and he hasn't.

So, Uncle Harry and all his colleagues for all those years have the most direct influence you could imagine. As the *Digest* daily navigates the changes brought by policy, or the markets, or advances in science, I have no more to do than raise my eyes a few inches to spot Nodome, and remember

to think upon the problem clearly, and thoroughly, remembering that brevity is the soul of wit and that getting down to the essence and the truth of things is no less than is what is expected of me, from my father's side of the family.

On my mother's side lies the other side of the coin, the man of the land, who labored in obscurity but left a legacy no less important for one who seeks a model of conduct for coping with change.

Roy William Dugan was a southwestern Iowa man born in the same town and year as the bandleader Glenn Miller. He became a wheat and corn farmer in Wyoming in the 1920s and 1930s; poor wheat harvests, low prices, and near starvation drove the family to Colorado by the winter of 1939-40 where two families and 14 people lived in a 400-square foot house. My mother slept in a dresser drawer that winter. They were, in the fullest sense of the word, dirt poor.

"I sure put in a full week last week," he wrote to my grandmother in February 1930. "We were running the tractor day and nite. Wednesday I worked all day and run the tractor all night. Of course that isn't work. 28 hr without sleep then I got 7 hr of sleep and went 32 hr." He never once mentioned that the average low in February in this area is all of 13 degrees, and that January 21, 1930 it reached 30 degrees below zero.

Ultimately, he would settle in the Yakima Valley in Washington state. According to *Change in the American West*, "the predominant image [of the Yakima Valley] is that of a vast expanse of blowing tumbleweed, rabbit brush, cheatgrass and sage brush." The tumbleweeds in March are

everywhere, even on the main streets of towns.

In the 1930s, it seems like the people were becoming tumbleweeds as well. Driven off family farms by crashing commodity prices, poor yields and dust storms. All the wonder crops and wonder lands seemed to fail all at the same time. All the roots were pulled up by hard times, and a generation was turned into migrant workers.

Roy Dugan found his deep, anchoring taproot in the 1940s working for the Bureau of Reclamation. He began as a wheat and corn farmer, yet found his calling as a ditch rider.

People back east generally don't know much about ditch riders, so a little background will help. A ditch rider monitors the irrigation ditches to ensure that, in the water-starved American west, every farmer uses no more than his allowed water allotment, and ensures that the gates, turnouts and wasteways of the irrigation system are in good order. He is like a policeman of water, the cop on the beat.

Ironically, he wanted to be an energy farmer, for underneath his Wyoming lands were some reserves of oil and gas, and "when the oil comes in" became a regular family refrain to sustain hope through many a long winter when times were hard. He believed so much in the value of the mineral rights that he never sold them, and bade his children to "never sell the mineral rights, no matter what they offer." So, the family continues to hold them, in eastern Wyoming near Teapot Dome, and in years when the price of oil rises, we hear from a number of lawyers and oil companies scrambling for leases.

1930 was the year my grandfather bought his Ford truck,

and his letters from that year are as full of the details of the purchase as of anything else except the construction of his homestead and the proving of his claim to the land under the Homestead Act. The Depression had begun in farming long before the collapse of the markets in 1929 and it wore on him. He applied incessantly for salaried jobs to gain a steady income, but found nothing.

It was hard times that kept them moving, wrestling with low yields and lower prices, with wheat dropping below $1 per bushel in 1930 en route to a low of 49 cents in 1932. Roy's 180 acres of wheat would have yielded $2,800 in 1926 when he was commencing homesteading, but only $1,600 in 1930 and $800 by 1932. Farm relief had commenced with the Agricultural Marketing Act of 1929, but its impact would not be felt in time or in force to meet the crisis of the 1930s.

I cannot recall, with the passage of time, ever hearing Roy complain. He would just get down to the doing of that which had to be done. He accepted his challenges without comment, and never lost his generosity despite an appalling lack of ready cash from year to year. He donated the hymnals to his Methodist church, though I won't pretend to know how he accumulated the money. Birthdays were always highlighted by a little cash from Grandpa. That was his nature, and generosity of spirit and possessions is perhaps the central tie that knots the two threads of family on the maternal and the paternal side.

Collier and Dugan — two men who were shaped by changing times, but it did not warp them, or beat them into some grotesque shape like the tide working a weak part of a rocky shore. Rather, their adventures in agriculture and energy

were made interesting by a consistent force of personality that responded to new times with the curiosity and hope of the American optimist.

They were builders, not critics, men “in the arena” to borrow Roosevelt’s phrase; they believed that science and time would bring along better days, and possibly in the very next town, and it was their job to find themselves a part to play in the far, far country of new lands or new ideas that would become component parts of the American way of life. It was the persistence of hope, and the belief in progress, that made them uncomplaining and inventive and restless and fine.

In their travels Roy and Harry embraced change and opportunity, but it never made them opportunists. Their moral compasses were in good working order: the end never, ever justified the means. They were both descended from *Mayflower* pilgrims, and it seems to me that their Pilgrim forefathers would have taken much pride in the way they conducted themselves under the stress of fast moving or hard-bitten times. There was no tolerance for myth, or foolish thoughtlessness, and there's no better beginning point for a writer on bioenergy than a hardwired thirst for truth.

Wikipedia says that “Groupthink may cause groups to make hasty, irrational decisions, where individual doubts are set aside, for fear of upsetting the group’s balance." Mindless groupthink is so often in evidence, on the far left and far right of the climate and energy debate, that one wonders from time to time how the country devolved. Once there was the practical idealism of rugged individualists; now an

uneasy league of special interests that make up the renewable energy spectrum, who often seem more interested in arguing than finding a common path forward.

If the *Digest* has played a role in blasting out groupthink, and challenging complacency, these two men have established a model for that hard work; they always moved onward when the hard data dictated a small or fearsome diet of change.

There is nothing more encouraging than the stories of adversity successfully managed in the past. The knowledge that good men used truth as a compass, and adaptation as a method, is all the inspiration that one could need to navigate any change that politics or science may yet impose on the future.

Biggie Smalls: Microcrop Industralists go mainstream

Sports writers have long noticed that, the smaller the ball, the better the writing. No one is sure why. In bioenergy, it seems to be true that the smaller the feedstock, the more promise it has. In this August 2009 essay, the fast-emerging opportunities for microcrops (diatoms, plankton, cyanobacteria, algae and flowering microplants) were explored at length, and became a popular topic during what became known in 2009 as "The Summer of Algae".

All microalgae are microcrops, but not all microcrops are microalgae: a larger family of diatoms, cyanobacteria, and tiny aquatic flowering plants such as the lemna family are increasingly in the mix for biofuels commercialization.

As related in the *Digest* in recent months, at least two groups - a team of academics in North Carolina, and the publicly-traded PetroAlgae in Florida, have been reporting progress with microcrops that suggest that the next commercialization breakout in biofuels may be based on tiny organisms that even fans of algae-based biofuels may not yet be familiar with.

Further, a report in ScientificAmerican.com suggested that the mysterious and privately-held Joule Biotechnologies in Massachusetts may be using a modified version of watermeal, the smallest flowering plant, as a base for what it is terming "game-changing" renewable fuel feedstock yielding 20,000 gallons per acre and ready for commercialization as soon as 2010.

What is all the more intriguing about the latest news from Joule and PetroAlgae is that they are reporting that they are competitive on price with crude oil, without subsidies, are capable of conversion into drop-in fuels that require no change in infrastructure, do not require the use of land that is currently used for food production. PetroAlgae is also reporting that its technology to commercialize microcrops is ready for licensing today.

Game changing, indeed. Let's look a little deeper.

New microcrops emerge as candidate feedstocks

The first public hint that new breakthroughs were on the horizon arrived in early April, when a research team at North Carolina State University reported that it has realized up to six times the average corn starch yield by growing duckweed, a microscopic aquatic plant, using hog farm waste water. The researchers concluded that the process cleans up waste water and produces a high-yield biofuel, and the duckweed starch can be converted to ethanol at existing corn ethanol processors.

One of the advantages of the tiny aquatic plants is that so little of their biomass is needed to support their structure, since they float on water instead of standing freely in the air. As little as five percent of some species is fiber - with the rest an attractive mix of proteins, carbs and lipids.

The researchers said at the time that their process will work on any type of nutrient-rich wastewater, including municipal wastewater. However, the team was not far advanced in developing a large-scale system, indicating that they were in

the process of establishing a pilot-scale demonstration of their system for growing, harvesting and drying duckweed.

Later in the spring, PetroAlgae was evolving its message to emphasize "microcrops" over "microalgae", signaling that it was working on several different aquatic plant platforms.

Last week, Joule Biotechnologies made a cryptic announcement of a novel biofuel production system using a modified and otherwise mysterious aquatic, photosynthetic microorganism that, housed in a closed photobioreactor replete with brackish water, would use CO2 and sunlight as sources of reproductive energy. Lipids and fuels would be continuously harvested without destroying the micro-organisms. Wolffia, or watermeal, may be a base for Joule's microorganism, according to a report at ScientificAmerican.com

Joule caught some by surprise because of the unique technical claim; others were simply confused by the jargon with which the announcement was made. As Brendan Borrell remarked at Scientific American.com:

"Basically, all you gotta do is you put your Helioculture™ into your scalable SolarConverter™ and, voila, out comes your SolarFuel™ liquid energy!"

But Borrel also sounded out Rutgers plant ecologist Todd Michael's reaction, and Michael surmised that the aquatic organism that Joule is reluctant to name could well hail from the Wolffia family, a group of microscopic flowering plants popularly known as watermeal.

For those who lack patience to wait for 2011, PetroAlgae's system is available for licensing today. In addition to labs in Melbourne, FL and at the Kennedy Space Center, the company has a 20-acre customer demonstration facility in Fellsmere that the *Digest* first visited back in late January. The change since then is startling - PetroAlgae is really moving down the road.

The customer demonstration facility includes an end-to-end system, from microcrop cultivation to fuel, and in addition to viewing six acres of ponds growing lemna and microalgae, the customer can visit processing where water-soluble proteins are extracted.

The proteins are themselves a high-value product, while the remaining biomass (carbs and lipids) is dewatered with heat assist (potentially recovered from the production process), and produces a mash that can be fed directly to an oil refinery's existing coker unit, which is capable of thermally cracking the mash into drop-in renewable fuels.

Digest readers had a preview of the microalgae cultivation system last January, but the more recent advances at PetroAlgae have included lemna among other microcrops, which are now cultivated in two 1-hectare demonstration ponds, each divided into an 8x24 array of self-contained modules. Each module sports a covering of the microcrop so heavy that the ecosystem when fully developed is retarding natural water evaporation by 70-80 percent.

PetroAlgae is now reporting that, in its 5000-hectare system, it can produce 9-10 metric tons of purified high-value proteins per acre per year, plus 4700-6000 gallons of biofuels

(plus biochar) per acre per year. This pencils out to up to 125,000 tons of protein per year, plus 75 Mgy of renewable fuels, for the full system.

"The future is not years away but here today," noted Executive VP Business development Harold Gubnitsky at the Florida Farm to Fuel Summit last week in Orlando. The PetroAlgae system costs, "several hundred million dollars," according to the company, but has payback within three years, making the investment not for the faint of heart, but potentially lucrative. The company said that the profit imperative is a factor for early adopters, plus the opportunity to be a market leader in climate change.

One fascinating development related to CO2 - PetroAlgae is reporting that adding external CO2 increases per-acre yields by 27 percent.

A feature of both the PetroAlgae and Joule operations are the high yields, and both have emphasized a strong reliance on advanced physics and optics in the development of the systems. As an observer mentioned to the *Digest*, "all the strong algae ventures have top-notch biologists and chemists on board, but have you noticed that a couple of the early breakouts all seem to have someone with a PhD in physics?".

The science of cultivation

PetroAlgae, in addition, has established an extensive system of sensors and controls, which are on display in the customer demonstration facility. The sensors look at wind speed, water temperature, biomass concentration, harvest rate, air temperature, humidity, water levels, and controllers

in the PA system can alter harvest rates and other parameters both on an automated and manual override basis down to individual 20x20 foot cells within a complete 5000 hectare system.

PetroAlgae continues to give guidance that it will commence generation of revenues from at least the first customer installation of the PetroAlgae system during 2009. Customers bring capital, land and water to the project, and optionally CO2 resources if they are seeking yields at the high end of the range. The company has stated that the chemical composition of the proteins has a high enough value that it can nearly cover the cost of the facility investment through the protein side, and fuel sales provide the remainder of the cost coverage plus profit. The company continues to confirm that its system is cost competitive today, with $70 oil.

From R&D to commercialization

The microcrop story continues to move past the R&D phase, and now appears to have moved beyond engineering and into the commercial realm, although the emergence of lemna as the initial breakout feedstock is a surprise. The limiting factors that have been reported in the *Digest* for two years - production rates, "shade walls", oil extraction, CO2 sourcing, dewatering, engineering designs for scale up, appear to have focused down to water, land and capital.

Another way to see it is that it all comes down to capital, to the extent that land is a function of capital and that these systems have sharply limited water usage. That's a daunting, but far less complex challenge than faced the biofuels

industry a few years ago as it moved to revive microcrop R&D when macrocrop economics soured and feedstock limits came into play.

Small is Big, Less is More

The trend: Small is big, less is more, big things may come from small packages; and the period may now be upon us where commercialization is less dependent on R&D as much as the art of the deal. That's a big deal.

As Biggie Smalls put it in his rap anthem "Get Money": *You can be as good as the best of them / but as bad as the worst /so don't test me (get money) /You better move over (get money)."*

Biggie Smalls indeed. A page is turning - keep a sharp eye out. And to commercialize in this space, think "now" not later, But by all means get money, if you are aiming for big things at the small end of the biomass spectrum.

The Slow Burn: Development of the Waste-to-Energy Industry

Even those who dislike bioenergy for using energy crops, like the idea of converting waste to energy. In fact, a whole new idea of waste will come of it. The waste-to-energy industry has had a tough time raising money in the perilous financial markets of 2008-09, but though they are on a "slow burn", they remain a most promising generation of technologies.

"To Carthage then I came
Burning burning burning burning"
T.S. Eliot, The Waste Land

Recently, among the list of countries in which *Biofuels Digest* readers reside, appeared a new addition: the Vatican City. I cannot shake the improbable hope that the Pope has taken an interest in bioenergy and will shortly convert the Popemobile to a drop-in biofuel. He certainly has taken a deep interest in climate change.

"Perhaps reluctantly we come to acknowledge," Pope Benedict wrote last March, "that there are also scars which mark the surface of our earth: erosion, deforestation, the squandering of the world's mineral and ocean resources in order to fuel an insatiable consumption"

Of all the developments in bioenergy, I figure Pope Benedict as a fan of waste-to-energy. What better way to use the modern symbol of western excess — the landfill — than to convert it to fuels that can power everything from African cook stoves to the Pope's own Mercedes M-Class SUV?

For that reason, as well as persuasive economics, I haven't been able lately to get through an entire day without thinking about the promise of companies, such as BlueFire Ethanol and Agresti Biofuels, that are on the verge of a revolution in waste-to-fuel production.

Neither of the two is as well-known as they should be, although BlueFire has probably received more coverage for its Arkenol process for converting municipal solid waste to ethanol, winning a $40 million DOE grant to build a demonstration-scale cellulosic ethanol plant. BlueFire's technology is a sulfuric acid hydrolysis, which converts cellulose to a fermentable sugar without the use of expensive designer enzymes.

Some background on acid hydrolysis

It's based on the acid hydrolysis method first developed in Germany in 1898; by 1932 German researchers had been able to generate up to 50 gallons of ethanol per ton of dry wood biomass using the techniques.

Agresti also uses weak acid hydrolysis, although they have a unique approach. They use a gravity pressure vessel, that draws the biomass down into a 2000-foot deep borehole, using gravity and heat to provide an energy source that, when oxygen is introduced at the bottom burns off the lignin, converts the cellulose to sugars which can be fermented into ethanol, and melts the lignin away.

Sulfur and oxygen - literally the stuff of fire and brimstone. Scientists call it oxidation, but the man in the street calls it

burning, albeit a slow kind that doesn't result in a fire. Burn, baby, burn. That's an answer to last summer's "drill, baby, drill", and to a burning question.

The tale of the tape

Enough science. What is important to know about the process is that it produces up to 50 gallons of ethanol per ton of municipal solid waste in a commercially viable manner.

I can't quite get it out of my head because, in solid waste, we have a large and replenishing source of biomass that no one uses, people pay to get rid of, and for which we already have an aggregation system in place. Around five pounds of garbage per person, per day, aggregated on a city or county-wide basis not by hard-pressed bioenergy producers but by municipal order. No need to harvest switchgrass, corn stover or cobs.

There are more than 180 municipalities with populations of 250,000 or more in the United States - right now, the viability point for these systems, but they hold 75 percent of the US population and presumably three-quarters of the garbage. Actually, since the archives of the Grocers Manufacturing Associations' jihad against biofuels are located in an urban area, the garbage percentage is probably even higher than three-quarters.

That's about 200 million tons of municipal solid waste, or enough to generate 10 billion gallons of ethanol at 50 gallons per ton. The capital cost is around $200 million per 1600 ton per day facility on a 12-18 acre footprint, according

to Agresti, and around $320 million for a 3200 ton per day facility that produces 58 Mgy of ethanol per year.

That's a high capital cost, compared to other advanced biofuels, but the ethanol production cost is well below $1 per gallon and the control over future feedstock price swings is absolute.

According to my back of the envelope calculations, a community that opts for this model will produce ethanol at a retail price of around $1.10, which is equivalent (on a fuel economy basis) to $1.46 gasoline.

That's about a 50-cent discount today to the retail price of gasoline, even at oil prices that are 60 percent down from last summer. Plus, no need for a $1.00 per gallon advanced biofuels subsidy or the ethanol tariff.

That's a total savings to the taxpayer of $1.50 per gallon in today's economics, and much more if the price of oil skyrockets again. It adds up to a $44 million return on 29 million gallons of fuel per $200 million plant, or around a 4-year payback on the cost of building out the biorefinery.

The math looks good to me, and the emissions benefits are excellent, because it would be a hard-hearted biofuels hater who would not see that the direct and indirect land-use impact is practically nil, and waste-to-ethanol presents a strong carbon emissions opportunity compared to crop-based biofuels, or gasoline.

The financing problem

Capital is a problem, but municipalities can help themselves by guaranteeing the project debt or issuing bonds, which shifts the risk from project to the town, reducing the cost of financing and giving buyers of municipal bonds something to crow about.

Even better would be for the United States to guarantee the debt through the Treasury, making it possible to offer investors the safety of US Treasuries combined with the higher yields of commercial paper.

A $70 billion investment would pay back in five years, march us 10 billion gallons towards energy independence or about 6% of US gasoline demand, tariff-free, subsidy-free, with a great emissions story.

Acid hydrolysis is so old a process that it seems too old-fashioned to capture our imagination like the real-time scientific endeavor of making algae into energy. For acid hydrolysis and waste-to-energy, it has been a long time coming; a long, slow burn indeed.

Feel the Burn

Like a burn, it itches, and compels attention, and it should. For what are we burning but the excess slop of a western lifestyle that, were it adopted by the whole of the brotherhood of man, would be utterly unsustainable?

It's garbage worth burning, for it is a vanity, and waste-to-energy is a bonfire of the vanities.

As St. Augustine wrote in the Confessions: "What

innumerable toys...far exceeding all necessary and moderate use and all pious meaning, have men added to tempt their own eyes withal".

I can imagine even the Pope being delighted with a process that, sustainably and economically, converts the refuse from our 'innumerable toys' into useful, clean and affordable energy.

"Feel the burn," say our personal trainers, urging us to fight, and fight more to work off the fat. In waste-to-energy, we have a burn that is worth feeling, and worth fighting for.

Algae Bloom: Companies Struggle To Bring an Industry to Life

This essay, originally published in October 2008, was an early attempt to analyze the rise of the popularity of algal fuel – a popular subject of research in the 1980s and 1990s, which gained new traction after 9/11 and as oil prices began to rise. The National Algae Association protested the article, but in general it was well received by readers, who have shown a deep interest in algae for several years now.

Occasional observers of the algae biofuels movement were stunned last week when Sapphire Energy, a company which has yet to make a pilot-scale product, concluded its new round of financing by topping the $100 million mark, a first for a biofuels venture. Notable among its investors: Cascade Investments, the personal investment vehicle of Bill Gates; and Venrock Partners, an investment partnership for the Rockefeller family.

But it shouldn't have been too surprising, except for the fact that Sapphire is receiving support in lieu of other companies pursuing the technology. For the stakes are huge: replacing petroleum gasoline with an alternative fuel brings a market worth more than $600 billion per year into play; and as much as $2.5 trillion worldwide.

Even in the thin-margin world of fuel production and distribution, the industry can hope to generate annual global profits of between $100 and $150 billion, enough to support a market valuation exceeding one trillion dollars. A dominant player — and who better than famous monopolists

like Bill Gates and the Rockefellers to understand the power of monopoly — could realize a market value at or above a half-trillion dollars. That's what makes $100 million investments look affordable risk.

Why algae? It's possible to make enough of it — unlike first-generation biomass which is unlikely to replace more than 10 and 30 percent of the global fuel supply, and cause price disruption in commodities like corn or sugar cane while doing so (o, at least, prompting fierce debate over its potential to do so).

On paper, algae are not the most promising fuel source. Probably hydrogen is, if we only knew more about how to make it, transport it and store it safely and at affordable cost, and make affordable cars that run on it.

Algae are some of the most efficient organisms on earth in terms of converting sunlight to biomass, at an energy efficiency approaching 5 percent compared to less than one for fast-growing crops like sugarcane. Only cyanobacteria, at around 10 percent, has more efficiency, but the science of producing fuel from cyanobacteria is just not far enough along to establish a timeline and production goals.

We know a lot about making microalgae, courtesy of a nearly twenty-year program at the National Renewable Energy Laboratory that was shut down in 1996 but recently revived when oil prices began to skyrocket.

We don't yet know enough about making it at commercial scale in an economically viable manner. And, we don't know enough about which of the more than 30,000 strains of

microalgae have the right characteristics for biofuel production – among factors such as lipid (oil) content, and resistance to contamination, ease of oil recovery. We don't know nearly enough about harvesting algae oils in a continuous manner at commercial scales and affordable costs. We don't even know if we should target algae oils for biodiesel production or use the whole organism is a gasification process that converts biomass to green gasoline or diesel and avoids the problems of fuel conversion.

So, we have serious questions. Companies like Sapphire, Solazyme, PetroAlgae, PetroSun and Green Star are working hard in the US on answering questions about algae production and recovery. Thoughtful observers like Tyler Krutzfeld, president of MontVista Capital and a board member of the Algal Biomass Organization, theorize that Europe and China may well end up as the leaders in the global algal fuel industry.

Further, companies that can use algae oil or biomass as a feedstock are hungering for the algae producers to scale up capacity. Sustainable Power in Texas has tested its Rivera process using algae as a feedstock. Companies that are synthetic gasoline and diesel from biomass, like LS9 or UOP Honeywell, are watching developments closely. Early-stage algae companies like Bionavitas are rumored to have strong intellectual property collections.

The Defense Advanced Research Projects Administration (DARPA) has a project underway to develop algae fuels for military use. Their interest is serious, going back to certain war game scenarios run earlier in this decade that showed the US military grinding to a halt for lack of fuel, prior to

achieving its military objectives (the same crisis that, happily, saved the Allies in the Battle of the Bulge in World War Two when the Axis forces literally ran out of gas while following up a successful breakthrough in the Ardennes forest).

Right now, production is measured in the tens of thousands of gallons, not the million or billions. The most perplexing problem at the moment is harvest, but all of the challenges mentioned previously are daunting, real, potential game-enders, and will take years not months to resolve.

As of this writing, there are four processes being examined by companies in the space. The traditional method is open pond cultivation, using large ovular "raceways". Most of the NREL work focused on this technology. Contamination is an issue, both from competing organisms and other microalgae. The problem of shade is perplexing too: as algae blooms, sunlight is blocked and limits the growth of the system when it is reflected rather than absorbed.

Photobioreactors are the other popular method. These are closed tubes in which nutrients, CO2, and sunlight are fed in a controlled manner. The issue? The cost per ton of biomass is, at this time, still prohibitive in the trials that have been widely reported.

Solazyme, in California, is pursuing a novel approach. The Solazyme team grows microalgae in giant fermentation tanks based on a diet of sugar, carbon dioxide and nutrients - no sunlight, which they say allows them to achieve the scale of open pond cultivation while retaining the control over contamination that makes photobioreactors attractive.

The fourth method is wild harvest, which Aquaflow is pioneering down in New Zealand, harvesting from rivers; Aquaflow is reportedly in line to become an eventual fuel supplier for Air New Zealand.

Who's in the lead? Hard to say. Solazyme continues to make small batches of algae fuel, and insists that it is limited less by technology than access to capital to scale up its process.

Two organizations have sprung up to serve the fledgling industry. The aviation industry is, by and large, backing the Algal Biomass Organization, based in Seattle. Boeing, the Air Transport Association, IATA, and Air New Zealand are among the sponsors, along with some of the better known scientists in the field, and companies such as Aurora Biofuels, Renewable Energy Group, and UOP Honeywell.

Small entrepreneurs have been flocking in decent numbers to the National Algae Association, founded by investment banker Barry Cohen, based in Houston. The organizations are already bickering, and even managed to schedule their important fall conferences on the same days in different cities.

One organization that has not yet fully joined the "algae bloom" is the Department of Energy, which has limited its activities to a resumption of research at NREL and talk of an RFP to support demonstration-scale algae fuel. DOE officials were notably absent from industry gatherings a year ago, but have been more visible in past months.

What can we say about the timeline and viability of algae.

The technology is promising: no rock stars have yet emerged. The breakthrough that is awaited is in the harvest: algae production and conversion to fuel are parts of the process less fraught with peril. Issues such as carbon capture and offsets are under consideration; though important, not yet on critical path until microalgae reaches scale and carbon sourcing becomes an issue.

Visions of making algae in large section of the sun-drenched western American desert from carbon sequestered from power plants is science fiction. Transporting the fuel out of the desert would require massive changes in infrastructure, not to mention cost. Transporting carbon dioxide and massive quantities of water into some mythical desert location is even less feasible. Diagrams showing endless arrays of algae bioreactors belong in EPCOT, as part of an experimental prototype community of tomorrow we do not yet know how to engineer.

Instead, algae is likely to be made right where it is used, in ever-smaller micro-plants that minimize the carbon expended to move feedstocks and fuels from source to plant to market. A good 10 Mgy technology with a low water usage, continuous harvest, and a process that can be duplicated by college graduates, not just rocket scientists, might just be the ticket.

"Maybe a week, maybe a year, maybe never", said the fictional Dr. David Drumlin in the movie Contact when asked when a vital breakthrough in that film's storyline would occur. It is much the same with microalgae, but for now cautious optimism and a timeline looking at commercial scale by 2015 looks feasible.

Possible, probable, preferred: so goes the futurist division of the world into scenarios. Where's algae? Given the bloom rate of algae, scale up could be rapid, and there is every reason to rate algae as a "possible" to become a major component of the Renewable Fuel Standard by the time the 36 billion gallon target is reached in 2022. Given a breakthrough in continuous harvest, we could well move the status up to "probable".

And for sure, we can already rate it "preferred".

The Gas Chamber: Ethanol Appeals For Mercy In California

This essay originally appeared in Biofuels Digest *in April 2009, at the time that the California Air Resources Board adopted a punitive land use change penalty on most biofuels, with respect to the California Low Carbon Fuel Standard. Biofuels developers were aghast; the occasion offered an opportunity to look at some of the tenets of Indirect Land Use Change and the data that had come in from the 2008 bubble in crop and oil prices.*

In a last-minute flurry of appeal more reminiscent of the battle to save Caryl Chessman or other condemned prisoners from the gas chamber at San Quentin, biofuels supporters, and in particular friends of ethanol, pelted the California Air Resources Board with last-minute appeals to refrain from including Indirect Land Use Change Analysis in the proposed Low Carbon Fuel Standard until the science is more robust.

Critics and supporters of the proposed Indirect Land Use Change analysis have agreed that the science is immature. The question is whether to attribute a penalty to biofuels now, and correct errors in the future, or to delay implementation until a standard model emerges.

Critics of ILUC have charged that a tangled web of relationships between oil companies, environmental organizations, consultants and academics has made it impossible for biofuels to get a fair hearing from CARB. They have pointed out that no other fuel has been subjected to penalty based on the indirect consequences of the fuel's

production.

From Brent Erickson at BIO came one of the most through critiques of Indirect Land Use Change analysis including an analysis of the rapid evolution of the art, and the different results that teams have seen from the use of the GTAP model.

Erickson said in part: "The Board should direct its staff to continue soliciting input from all stakeholders and from the scientific community on appropriate ILUC modeling and reliable data sources, without any fixed commitment to GTAP or the parameters used in GTAP, for a period of up to 2 years…Next time, peer reviews should be completed and posted for public comment before the public comment period on the proposed regulations begins…During the period in which ILUC methodologies are finalized in California, the LCFS regulations should be implemented without ILUC penalties."

BIO also released "Sustainable Biofuels: a commonsense perspective on California's approach to biofuels and global land use," by industry consultant Jack Sheehan, which can be downloaded here. Sheehan wrote:

"The declining land clearing debt estimates in CARB's GTAP analysis relative to the first published estimates by Searchinger in 2008 reflect progress being made in the refinement of the estimates of ILUC impacts, particularly with regard to the types of land affected by the increased demand for biofuels production. The sharply differing estimates between 2008 and 2009 demonstrate how rapidly our understanding the ILUC phenomenon is changing."

Also, the Huffington Post published an article by Andrew Gumbel, in which the LA-based freelancer writes: "A few years ago, CARB caved to pressure from the oil and car industries and gave the green light that enabled GM and the rest of the automotive behemoths to "kill" the electric car. Now it is on the brink of performing another disservice to the future of the planet - this time by considering the adoption of an unproven, brand new method of "carbon scoring" different fuel types that happens to discriminate heavily in favor of old-fashioned fossil fuels like oil and gas and penalize biofuels.

"CARB's decision, which has already been drafted and may or may not be made final on the first day of a two-day board meeting in Sacramento today, will be crucial not just to the fight against global warming in California. The means it chooses to determine the carbon intensity of different fuel types is likely to set the standard nationally, if not also globally. So a great deal is at stake.

"The methodology is not without its complications, but essentially CARB has two choices. The first is to "carbon score" different fuel types based on their chemistry and means of production alone, the so-called "well to wheels" model known by the acronym GREET which has been used and fully peer-reviewed.

"The second choice is to try to throw in considerations of broader economic and geopolitical realities. That's not a bad idea in and of itself. It's hard to assess the total environmental cost of importing oil from the Middle East without considering, say, the fuel burned on the tanker that brings it to the United States, or considering the impact of the continuing U.S. military presence in Iraq. The problem with the model being touted by CARB, though, is that it looks at these indirect factors in the context of biofuels only. It factors in the cost of driving ethanol by truck from Iowa to California, but lets oil and gas off the hook completely for comparable factors.

"A group of more than 100 scientists specializing in energy and the environment have written both to Governor Schwarzenegger and to Mary Nichols, who chairs CARB, to voice their concerns. "We're basically talking about increasing the carbon score of some alternative fuels by 40-200% based on dubious economic modeling that is nowhere near ready for prime time, and then to add insult to injury they are not doing the same economic analysis on other eligible fuels in the program or petroleum," the letter's lead signatory, Blake Simmons of the Sandia National Laboratory, said in a statement. "This is indefensible from either a scientific or public policy perspective and will ultimately fail."

Gumbel also pointed out that CARB member Dan Sperling, whom Gumbel described as leading the charge against biofuels, was intimately involved in the CARB decision to end the electric car mandate in the 1990s at the behest of oil and car companies. The director of the documentary "Who Killed the Electric Car?" described today's hearing as a "cast reunion".

POET CEO Jeff Bruin made a last-minute appeal:

"The ethanol industry supports an accounting of carbon emissions that includes all direct effects from all fuels, including direct land use change. It does not support the selective inclusion of indirect effects as CARB is proposing. Their proposal unfairly penalizes ethanol for indirect effects without considering the indirect effects of any other fuel. POET is not requesting special preference for our products. We are simply requesting the level playing field promised as part of the LCFS and that CARB hold ethanol to the same carbon accounting standard as petroleum, hydrogen, electricity, and all other fuels."

For some time, the phrase "indirect land use change" has been floating around the biofuels industry. It represents a proposition that increased biofuels production in the United States, by causing prices to rise, encourages increased planting of biofuel crops.

By doing so, according to the theorem, other uses are displaced — for example, land for grazing or for growing animal feed — and to replace the supply of feed or grazing land, Amazonian (or other) forest is ultimately displaced. The resulting emissions are charged to biofuels as an indirect emission from a land-use change.

The analysis and debate has been carried out at universities and in academic journals for some time. But now that California has decided to incorporate ILUC impacts in its Low Carbon Fuel Standard, all hell has broken loose.

A large group of scientists have protested the inclusion of ILUCs, saying that in effect that we don't know enough about indirect land-use change modeling to enshrine the analysis in policy. Advocates for ILUC say that the current models are a good start, and good enough, and better than not accounting for indirect emissions at all.

In short, we're arguing about whether the models make for a good forecast. A problem is that we haven't backcast - that is, checked the predictions of the model against known outcomes in the past to see if the predictions were accurate.

Problems with the ILUC world-view

The problem with the ILUC model is that it imagines a unified market in which there are two main actors, growers and users. Higher prices for the grower, goes the analysis, create profit motives. With more profit and revenue to chase from say, corn instead of wheat or cattle, growers are incentivized to change the land-use mix.

But there are two markets and three actors. There is the market between growers and processors, and there is the market between processors and users. The difference between the feedstock price and the refined fuel price is known as the "crush spread". That is the critical dynamic that drives the market for biofuels. When the crush spread is high, biofuel production increases.

When the crush spread collapses, as happened in the commodities bull market of 2008, high feedstock prices did not prompt diversion of land for feedstock production.

Rather, they prompted wholesale bankruptcy of ethanol producers — trapped between falling oil prices and high feedstock costs. Producer after producer has gone to the wall. Production has not gone increased - in fact it has fallen 17-20 percent by most calculations since feedstock prices soared. Land use is changing, perhaps, but not in the predicted direction.

For proof positive, look to lobbying efforts in Washington.

Producers are in Washington right now, but they are not begging to open up more land for corn production. They are requesting mandated increases in ethanol demand and for emergency loans to keep the industry afloat. In short, they are responding on the demand side instead of the supply side.

The National Corn Growers Association is not currently responding to high corn prices with an all-out supply-side effort to convince farmers to plant corn on corn; rather,

their key announcement this week was the formation of a climate change committee to deal with the Low Carbon Fuel Standard and prop up the demand-side.

Biofuel production changes because of crush spreads, not feedstock prices or other opportunities in the land

Biofuels exist in the margin between oil prices and crop prices. Land use change does not require rising feedstock prices, but rising crush spreads. That will happen when feedstock prices are falling faster than falling oil prices, or oil prices are rising faster than rising feedstock prices.

Let's also keep in mind the importance of crop rotation. Planting corn after corn, as any farmer knows, is at best a short term gain with long term pain from soil exhaustion.
The vast majority in variations in planting acreage comes from the need to rest the soil or plant soy after corn, for example, to improve soil nitrogen.

Planting camelina as a biofuel crop is not, necessarily, a response to high prices for camelina oil from biofuels producers. Studies have shown that wheat-camelina-wheat rotations perform better than wheat-fallow-wheat. Planting of energy crops can be a means of responding to opportunities in the food market, not the fuel market.

About mandates

Let's now look at mandates, which attempt to create artificial markets for renewable fuels. The ILUC argument is that the power of mandates disrupts the market and forces a land use conversion to meet the mandated demand.

Corn prices, looking like oil prices more than a steady unbroken streak of ethanol mandate-driven, price-hike inducing sunshine

We are now four years into expanded mandates since the 2005 energy bill, and looking at price and production of ethanol, the curve looks at lot more like the oil price curve than a steady unbroken ray of renewable energy sunshine as envisioned by the mandates.

Ethanol production stalled in sync with the fall in oil prices. According to the ILUC theory, with high demand, prices rise. In fact, with rising demand ensured by mandate, corn and ethanol prices collapsed. The reason? Oil prices.

The crush spread is vital to understand — that is, the relation between the underlying prices of feedstocks and fuel rather than price itself — because crush spreads drive what we can call "producer panic" as biofuels processors scramble to escape imminent doom.

Looking at the data: what happened in 2008 when feedstock prices rose?

The effect is easier to see in biodiesel production. When the crush spread between soy and biodiesel prices collapsed, soy prices were still rising and yet we did not see expanded planting of soy, and more soy biodiesel plants.

Oil drives ethanol prices, which in turn drive the crush spread that may result in land-use changes

A tour of the *Biofuels Digest* database of stories tells the tale. In recent months, we have seen the cosmetic surgeon who converted liposuctioned human fat to biodiesel, we have seen jatropha, algae, camelina, emulsified SVO, straight vegetable oil, waste veggie oil, multi feedstock, tallow, fuel cubes. But since last summer, when soy went to Pluto, we have seen just one (yes, one) soy biodiesel plant, the Blackhawk plant in Illinois. Meanwhile soy biodiesel processors have reduced capacity everywhere.

What drove all that innovation? Had the margins remained wide as a barn door as they were early in the decade, I have no doubt that we would have seen soy, soy, soy, soy, baked beans, soy, soy, soy and soy.

The National Biodiesel Board, characterized by several *Digest* sources as "the soy guys", would have been delighted to oblige.

Falling spreads created innovation as actors sought to reduce costs, the only variable that impacts crush spread they had to some extent in their control.

Rising soy prices do not drive land use change. Rising crush spreads might.

To what extent are biofuels a key driver of land use?

Here is a key question - are biofuels really a major, major driver of land use at all? Actually, no. Energy crops are a marginal use of land, compared to meat. About 70 percent of US corn and soy production is devoted to feed, not food, and not fuel. Feed for animals to provide meat, dairy and

other livestock by-products.

I don't doubt the sincerity of the environmental organizations that are allied with Big Fat to save the world from corn ethanol, but I'm not sure they are looking at all the data and I completely doubt that they are taking into account the unintended consequences of cheap food.

In terms of data, two indirect land-use change model runs are getting huge publicity at the California Air Resources Board. A third, by Purdue economist Wally Tyner, has been completely ignored. The problem - those who have seen the runs say that the indirect land-use change impact is 75 percent lower in Tyner's run than in the others.

In terms of unintended consequences, cheap food has its pitfalls. The price of meat plummeted on a constant-dollar basis relative to earnings between the 1950s and 1990s. What was the result? Easy to see. Look at waistlines.

We are taught in the Sierra Club that, as John Muir once wrote, "if people in general could be got into the woods, even for once, to hear the trees speak for themselves, all difficulties in the way of forest preservation would vanish."

What the heck is the environmental movement doing allied with Big Fat, which does more to keep people off their feet, at the dining tables, off the hiking trails, and out of the forests than any other market sector?

The Blunder Crop: A Special Report on Jatropha Biofuels

This March 2009 essay attracted a fair amount of attention from Digest readers, but was picked up by more environmental sites than almost any other story even run in the Digest. Clearly, because it was a "bad news" story about biofuels – although it was construed, wrongly, that the article was damning jatropha. It damned the way jatropha had been developed.

Kirk Haney tells me there's nothing to worry about with his jatropha biofuels company, SG Biofuels, and I believe him. A successful practicioner of sustainable forestry in Central America via the teak trade, Haney has assembled a top-tier team for SG and is doing the soil testing and the extensive planning — the "hard, dirty work of progress", to borrow Rob Elam's memorable phrase — that will turn jatropha dreams into actual viable industry.

He's joined by a handful of jatropha developers like Mission New Energy and GEM that are getting it done, making it happen.

Elsewhere, things would be going great if they weren't going so badly.

Well-organized efforts are in the minority. More typical: back-of-the-comic book jatropha seed and seedling marketers that prey on the hopes and fears of cash-strapped farmers; the farcical disaster that has developed in Myanmar's national biofuels project; and a number of non-profits (some well-organized, some dreamy) running around in Haiti trying

to save the country from deforestation with projects as small as one designed to provide heat and power to a local bakery.

Jatropha is realizing less than half its projected yields in most projects, and less than a third of optimistic estimates that led jatropha to be labeled "the wonder crop".

The problem? Countries like Myanmar that planned 8 million acres of jatropha and then forgot about harvesting technology, crushers, biodiesel processing or anything approaching a distribution system. The Result? Jatropha seeds rotting in Myanmar's fields. The cure? Getting back to sound planning, extensive soil testing, and excellence in project management.

Here are some updates from the field. It's a fairly shocking portrait of progress inhibited.

Main factors?

1. Hype that cites jatropha's "poor soil" tolerance and high yields without noting that jatropha survives, but hardly thrives, in very poor soil.
2. The lack of mechanical harvesters.
3. The lack of adequate soil testing in the rush to plant.

A world with half as many seedlings and twice the number of harvesters and crushers would a better world be.

Here are some reports from the frontiers:

China

In 2007, China Confidential said that China aimed to have 13 million jatropha hectares planted, with a yield of 0.4 tonnes of oil per hectare on an ongoing basis. As of today, just a handful of plantations in fact exist.

D1 Oils

It started with gigantic promise, and remains jatropha's biggest project developer and biggest hope. However, D1's operations in Africa have proven disappointing, with a regional management shakeup announced last September and an announcement that "the planting position will continue to be kept under review."

Former chairman Lord Oxburgh told National Geographic that initial production would commence in 2007. Former CEO Elliot Mannis later predicted to Reuters in January of 2008 that the first significant harvests of jatropha would be in the second half of 2008, but only 1,000 tonnes of oil were harvested in all. That's roughly enough for 300,000 gallons of biodiesel.

Overall the company is reporting 257,370 hectares under cultivation, the majority in northeast India in a JV with tea giants Williamson Magor. In January 2008, the company told Reuters it had 202,000 hectares under cultivation (which later was trimmed in company stock filings to 192,016 as of March 2008). The company predicted in September 2008 that it would increase its plantations to 300,000 hectares by year end but confirmed in February that total planting had not increased since the September update.

The growth rates suggest it will be some time before the company realizes its overall goal of planting 2.5 million acres (1.01 million hectares), and to this reporter there appears to be persistent difficulties in projecting the timing and volume of production.

Overall, the company appears to be bearing down into the realities of the business, but the numbers do not suggest robust yields are in sight for the near-term. The departure of CEO Mannis and chairman Lord Oxburgh in a boardroom coup late last year was suggestive of troubles at D1, although sources have pointed as much to troubles with the company's UK-based biodiesel processing operations, which were closed.

Variations in yield estimates.

It's understandable that crop yields vary based on inputs, climate and the skill of the farmer. But, even allowing for that, jatropha yields forecasts seem to me as scattered as atoms after a supernova.

Here is a selection.

Frost & Sullivan (2007): 1-5 tonnes of oil per hectare. Baif.org: Cited 8-10 tons of seeds per hectare sourced to "enthusiastic promoters".

Biofuels Revolution: Cited 10 tons of seeds in a report. Here's an article that said that actual yields were one fifth of government estimates - at 1.5 to 2 tons per acre.

Here's another at 10 - 12 tons per hectare of seeds. Here's one that covers all the angles with a stupendously un-useful range of 0.5- 12 tons per hectare.

Here's the winner of the optimist award: The Philippine National Oil Company weighing in with a forecast of a minimum of 15 tons per hectare on the fifth year. A report distributed by (but not from) UNCTAD cites 13 tons per hectare.

Whew! That's 0.5 to 15 in about 10 seconds. Sounds more like an accelerating Jaguar than jatropha yield data. But there you are.

India

In the South Asian heartland of jatropha, Chahattisgarh state takes the absolute cake for predictions of wealth that have not come true. Asia Clean Tech reported in 2007 that the state-owned Indian Oil Co has partnered with Chhattisgarh state to deploy jatropha. 'No less than 500,000 people will get jobs across the state during the next 4-5 years due to these jatropha plantations,' a senior Creda official was quoted in the '07 report. The JV was reported to produce up to 300 tons of biofuel per day within 4-5 years. That's about 33 Mgy of fuel.

How does that employ 500,000 people? That's 66 gallons - or about $150, per worker. At yields of 250 gallons per acre, that's four workers an acre. Even in one of the poorest states in India, that's a poor excuse for economic development and a ruinous, blundering exaggeration that is a standout reason that jatropha has earned the nickname "the wonder blunder

crop".

Myanmar

Moving from comically far-off-predictions to another dimension of hype that would be funny if it were not tragic, let's consider the case of Myanmar.

As reported previously in the *Digest*, the Myanmar government set out in 2006 to cultivate 8 million acres of jatropha, in hopes of making the country more energy self-sufficient and potentially develop an export trade in jatropha oil.

The program was handed down to individual states in the form of a dictat: 500,000 acres or more per state. Individual farmers and even city dwellers were dragged into forced-planting campaigns to meet planting goals. Supervision of planting was handed off to the Army, which detailed numerous young, non-commissioned officers to supervise the work. Planting took place in plantation-style field, in hedges and home gardens.

What was missing? Besides soil testing, uh, just a few things. Like a harvesting plan. According to a Time magazine report, "My friend dutifully tends his jatropha trees and then watches the seeds fall on the ground and die. In his case, the spindly physic-nut shrubs in his garden are supplanting a fragrant frangipani tree or colorful hibiscus bush. But elsewhere in Burma — a nation where UNICEF estimates malnutrition afflicts one-third of children — farmers have had to put aside valuable crop land for a wasted plant."

Haiti

Beyond the tragedy of Myanmar there is the deeper tragedy of Haiti, a land stripped of economic opportunity as well as forest cover.

Kathleen Robbins has been active down in Haiti for quite some time putting together a jatropha cultivation education program, next to the UN Model School. Other NGOs, it appears, have been more focused on planting than educating. According to MargeuriteLaurent.com, at least three-dozen projects are active in Haiti now. One is so small it's aim is to support a single Haitian bakery with power through cultivation of jatropha as an oil source. Would not these incredibly well meaning NGOs do better to band together to achieve some economies of scale?

Voodoo economics

Apparently in Haiti, jatropha is used in voodoo rituals. That seems right, because the cultivation of the plant has been beset, and seems to remain so, with voodoo economics and announcements of yields and harvest potentials that are way ahead of science.

The workers — those actually putting jatropha seedlings in the ground and harvesting the yields, who face the daily disconnect between jatropha reality and jatropha dreams, can use all the practical magic they can get.

Camelina:
An advanced biofuels 'wonder crop'

There has been a succession of wonder crops in bioenergy – corn, switchgrass, jatropha, algae – readers get tired of the hype-the-tripe approach, but camelina is a special case as shown in this August 2008 essay from the Digest. In addition to its appeal as an aviation biofuel, what amazes me is the record farmers have laid down of getting higher wheat yields from a wheat-camelina-wheat rotation compared to wheat-fallow-wheat. It gives hope to those who look for food-and-fuel solutions, not just the dialectic of food-vs.fuel. Since publication, camelina has been successfully flight tested as a jet fuel.

Earlier this week I received a call from Norma Branch, a member of a Kansas farming family. She had seen a report from Susan Candiotti at CNN about jatropha curcus, and was calling to find out more about the wonder tree that produces the dream fuel.

We settled easily into a good conversation about the potential for jatropha (a) anywhere and (b) in Kansas. A lot of smarter people than I are very bullish on (a), but I haven't heard much enthusiasm for (b) and relayed the bad news to new friend Norma.

She took it well, understanding better than most the problems of harvesting from a tree that there isn't a mechanical shaker yet invented for. And it would be a good idea for researchers in controlled trials to find about yields, rather than small farmers who can ill-afford the investment.

But I advised Norma, by all means, to look into camelina.

That's a feedstock a Kansan could and should get enthusiastic about.

Camelina, remember it. Known to some as "gold of pleasure", or wildflax it's a feedstock of interest that I have written about in the *Digest* on several occasions over the past year.

Here's the lowdown on camelina. First, it grows on land unsuitable for food crops. It has yields that are roughly double that of soy. The oil it produces is more cold-resistant than the average biodiesel feedstock. It tolerates cold climates well - it has been grown for years in pockets of Montana. It's supported by research and field trials at a number of land-grant colleges around the country - Oregon State, Montana State, Idaho among them. It grows wild in the US, which is to say it grows here, and grows well, and plays well with other crops. It has a particularly attractive concentration of omega-3 fatty acids that make camelina meal, left over after crushing, a particularly fine livestock feed candidate that is just now gaining recognition in the US and Canada.

All of that is good. But here's what's better. According to Sam Huttenbauer, CEO of Great Plains, The Camelina Company, camelina can be grown in a rotation of wheat crops. Farmers who have followed a wheat-fallow pattern, as is often seen in Washington and Oregon, can switch to a wheat-camelina-wheat pattern, realize up to 100 gallons of camelina oil per acre, and gain up to 15 percent more productivity on the wheat.

So, here's a crop that goes a mile past fuel vs. food, and one

step beyond fuel and food, because it produces fuel and more food. Impressive; even sort of unique.

Dr. Bill Schillinger at Washington State University recently described camelina's business model to Capital Press thus: "At 1,400 pounds per acre at 16 cents a pound, camelina would bring in $224 per acre; 28-bushel white wheat at $8.23 per bushel would garner $230."

Wheat's up since then, but there's a big spread for camelina at 100 gallons per acre when the price of biodiesel exceeds $5 per gallon, and that's not accounting for the potential value of camelina mash. Oil content is in the 35-43 percent range, according to Panter.

I mentioned that camelina is low-rainfall tolerant. It thrives in areas with 10-17 inch rainfall, according to Don Panter, President of Sustainable Oils. In a trial near Lind in eastern Washington state, Schillinger was able to realize a crop of 10 plants per square foot with 2.08 inches of winter precipitation (down from the area average of 5.04 inches).

There are two organizations backing camelina. There's Sustainable Oils, headed by Don Panter, and Great Plains, headed by Sam Huttenbauer. Both are excellent. My impression is that Sustainable Oils has developed a more aggressive network of field trials (among them Texas A&M, Tennessee, Nebraska, Montana State, Oregon State and New Mexico), but that Great Plains has established more relationships with growers. Great Plains has also reached the production stage, while Sustainable is still in grower recruitment and trials.

But it would be hard to find a feedstock better represented than camelina. These two "get it", know what has to be done and are industrious about doing it. Both have a vertically integrated vision. They'll develop the seed, partner with universities for trials, recruit growers, buy back crop, crush, and market both oil and camelina meal. Third-party vendors will provide crushing services for the interim.

The major barrier to camelina is, according to all sources, grower education. Ball one, every grower is accustomed to making shifts in the crops they grow. Ball two, fewer still have the capital base to take the long term view. Ball three, in an era of rising input prices, the high prices for corn and soy are too tempting for most. And ball four, camelina's geography has traditionally been restricted to the dry, cold Inland Empire of the northwest part of the country.

So, four balls, no hits, but camelina has reached first base. What will bring it home? For wheat farmers, it's a natural short crop that can be grown following spring wheat, and adds value to land. For cotton farmers and others with starved soils, it’s a tolerant crop that produces a good, fast yield. A superior meal and rich, virgin oil that performs well in the cold might also prove to be the trick as biodiesel blend percentages become more aggressive in the snowy north. It's a smart, steady play for the grower looking to do better without taking the monstrous risks that are component parts of switchgrass or jatropha plantations.

For my new friend Norma Branch, looking to do better in Kansas, I can't think of anything smarter than looking into camelina. I look forward to reporting more about the crop's progress later in the year. The more you look, the more you

like.

Notes on Coskata and cellulosic yields

There has been a tremendous amount of discussion in the renewables sector and among environmentalists about the amount of biomass that biofuels consume. Is it right to devote so much land to the production of fuel – is it even feasible. This essay looked at the numbers for cellulosic ethanol pioneer Coskata and concluded that the numbers do pencil out.

There has been a lot of discussion of the viability of cellulosic ethanol production models in the scientific literature, but just a few in popular media. Herewith are some notes on how cellulosic yields work out in real-world situations.

The Coskata model presupposes a yield of around 100 gallons per ton of biomass. ZeaChem is seeing up to 160 theoretical gallons per ton and 135 in the real-world in its process tests, and Syntec has been discussing yields in the 100-120 gpt range, so this is consistent (and to some extent conservative) with yields that have been seen elsewhere.

Let's use sugar cane as a target biomass source, since Coskata's first proposed 100 million gallon plant is planned for the sugarcane fields of southern Florida. Sugar cane grows at around 70.9 tonnes per hectare in India, and at 71 in Brazil; in Florida, yields are at 68 tonnes per hectare. 12 percent of that cane is sugar, which yields 1700 gallons of ethanol per acre, or more. The remaining 88 percent is bagasse for a Coskata process, or about 60 tonnes per hectare.

To generate 100 million gallons in this model, Coskata will

need 1 million tons, or 900,000 tonnes of biomass. That will require 15,00 hectares, or 32,500 acres.

That's 51 square miles, or the area within 4 miles of a 100 million gallon refinery. A mighty plantation, but not long hauling distances.

Bottom line? Feasible.

'A Vast Chicken-Wing Conspiracy'

By November 2008 when this essay was published, fuel prices and crop prices had collapsed without any adjustment in food prices, but critics of biofuels were still ranting about the catastrophic impact of bioenergy production on food prices. Many people, including myself, had had enough. This essay, which traces the food vs. fuel debate back to a cabal of companies dependent on cheap grain, was one of the most widely-read in the history of Biofuels Digest.

The food industry responded, generally, by saying that there was a months-long delayed effect in translating lower crop prices into lower food prices – and that was why the collapse of grain prices had not yet produced relief at the supermarket check-out. In the year since publication, corn prices have remained nearly 60 percent below their 2008 high point, and food prices haven't rolled back a nickel. Corn surpluses are at an all-time high, and corn available for export too – on fewer acres than planted two years ago. I can't think of a single prediction of the "food vs. fuel" crowd that came true, but their jihad against biofuels did lasting damage to the industry and the cause of climate change and energy independence.

Since I recall receiving a query or two about the opening, "a vast, right-wing conspiracy" is a phrase used by (then) First Lady Hillary Clinton to describe an array of Bill Clinton's critics at the time of the Monica Lewinsky scandal.

There are vast, right-wing conspiracies and vast, left-wing conspiracies, but what is facing the biofuels industry is a vast, chicken-wing conspiracy.

The conspirators are drawn from groups that Daniel Gross, writing in *Slate*, described as "poverty activists, inflation hawks, efficiency freaks and environmentalists", and are led

by a coalition of processed food, meat and poultry producers.

Meat and poultry producers are defending their business model, and let's give them credit for that. The processed food companies seem attracted to the idea of using the campaign to put through a price increase and blame it on a convenient scapegoat.

I have no idea what my brethren journalists and activist environmentalists are doing caught up in all this. So right on so much for so long, they seem to have lost the plot. Propping up the Big Food regime, still as well-funded and dangerous as they used to think it was, is strange work for environmentalists.

Working under names like Food Before Fuel, the conspirators include the Grocery Manufacturers Association, National Pork Producers, American Meat Institute, National Council of Restaurant Chains, the Environmental Working Group, American Bakers Association, National Restaurant Association, Citizens Against Government Waste, National Chicken Council, and the National Turkey Federation.

Earlier this year, they banded together to call for a waiver of the Renewable Fuel Standard, expressing a belief articulated by Bob Goodlatte, ranking Republican on the House Agricultural Committee:

"There are many factors that have increased the price of corn, but the only factor that we can immediately control is the amount of the corn supply that must be dedicated to meet the RFS...Our livestock producers and the American

consumer have been hit hard in the pocket books...A temporary waiver will offer immediate relief to those affected by the current shortage of the corn supply."

51 members of the House joined Goodlatte in his call. Separately, 24 members of the US Senate led by John McCain of Arizona called for a waiver. Two Republican governors, Jodi Rell of Connecticut and Rick Perry of Texas joined them.

It would be hard to enumerate the covey of environmental writers and bloggers who wrote something against biofuels or the Renewable Fuel Standard, or corn ethanol, but it would measure in the hundreds. From paid consultants shilling for industry in the guise of syndicated articles, to some of the most esteemed writers in the country, opining in well-regarded journals such as *Grist, Scientific American* and *TIME*. The phrase "anti-ethanol" turns up 14,400 web pages in a Google search. There are 42,000 pages with a reference to "food vs. fuel".

"Biofuels Are Bad for Feeding People and Combating Climate Change," one article in *Scientific American* was titled back in February. *TIME* writer Michael Grunwald called it "the clean energy scam" in March.

As many readers know, EPA Administrator Stephen Johnson declined to waive the Standard based on the evidence before him, in a decision handed down in August. Famously, the corn market collapsed in September, and the ethanol market with it, in the market implosion of early fall. No RFS waiver required. Under market forces, corn futures price declined from a high of $7.85 to a level of $3.65 today.

Ethanol fell from the $2.70 range to $1.65 today.

The "immediate relief" that the market provided did not, however, translate into lower food prices.

According to a *Wall Street Journal* article from October 17th: "Grain and soybean prices have fallen by about 50% since their summer highs. But don't expect grocery prices to drop anytime soon. Food companies are typically quick to pass along higher commodity costs on the way up, slower to reduce prices on the way down...By September 30, corn and soybean prices had fallen dramatically, respectively. Yet, during this same month, grocery store prices increased nearly 8 percent."

Here's the bottom line of what this is all about. From Canadian Business: "Kraft said... Input costs are coming down, though they'll still be above historic levels, and pricing is expected to remain in place, which will further pad profit margins."

As Daniel Gross pointed out in *Slate* in July of 2007: "I find much of the anti-ethanol case to be unpersuasive. In each instance, the haters would have us look at ethanol, and the ill effects its greater use would assuredly produce, largely in isolation. Might the production of corn ethanol cause pollution? Of course. Is it worse than the sort of pollution created by other types of energy production—i.e., coal and oil? Probably not."

Does greater use of corn for ethanol help spur price increases for food? Sure, but so do many other factors, like, say, the transformation of China from a subsistence farming

economy into a more modern one. Is ethanol more inefficient, and hence more costly, than gasoline? Yes. But our heavy use of gasoline imposes all sorts of other costs—from pollution to the hundreds of billions of dollars we spend each year in Iraq. Factor those in, and ethanol no longer seems like such an economic loser.

Gross makes an important point. It is important to compare biofuels to the fuel they replace, which is oil. Not just the cost in dollars, but the cost in emissions, security and lives. The tragedy of the Amazonian rainforest deserves attention, but the tragedy of the Nigerian Delta is no less awful.

Here's how the conspirators work. Put up a website, selectively publish only favorable articles. Commissioning them where needed. Paying for advertising to fill gaps. Paying consultants to recruit allies in the environmental movement.

It's a bad model, which some in the biofuels industry are adopting with tit-for-tat sites like Growth Energy, which do not offer a comprehensive and dispassionate view. Biofuels producers and advocates say that tit-for-tat is smart, that you have to throw mud at a mud-slinger. Unconvincing. But it is true that their livelihood is threatened by impressively-organized, cynical efforts such as these, funded by the Grocery Manufacturers Association. "The truth shall set you free" is a less appealing strategy, it appears, then "Shields up, Mr. Spock." Regrettable.

But there is more than grain prices at the heart of this. There is the ongoing "hate debate" over emissions.

The *Wall Street Journal*, whose editorial page writers are among the "efficiency freaks" identified by Gross, recently ran an article by Stephen Power on the subject of indirect land use changes. It detailed efforts by "DuPont, ADM, GM and representatives of the biotechnology industry" to persuade the EPA to "hold off on quantifying the greenhouse-gas impacts of so-called indirect land-use change". The move was opposed by the Clean Air Task Force, the EWG Action Fund, and Friends of the Earth in a letter to EPA Administrator Johnson and republished in the *New York Times* by Green Inc blogger Tom Zeller.

The *Times* opined in an editorial this week that "Environmentalists want an honest accounting, which the public deserves," and notes that "it is the E.P.A.'s duty under the law to give the most unbiased, accurate accounting it can. The issue here is the fate of the planet, not the fate of a particular industry." The argument advanced by numerous distinguished scientists that no generally-accepted model exists for measuring indirect land-use changes is attributed by the *Times* to "the industry".

The controversy is being structured by the *Times* and others as a battle between the biofuels industry, its competitors for grain (including consumers and food producers), and environmentalists. That's as convenient as it is untrue.

The opponents of biofuels are, generally, on an agenda rant and have long since parted company with the facts. The opposition to biofuels is tactical, not strategic: most opponents are upset about some way that the utterly mundane, utterly practical cultivation of energy crops blocks some Nirvana that they seek: usually profits, and other times

a better, more just world written in terms of their choosing.

I have written here and elsewhere that critics of Amazonian deforestation should travel to Brazil and experience the culture and economy of that country before wading into geopolitics from the armchair. Poverty advocates should travel to Africa and Asia-Pacific and actually experience the culture and economies of those regions before wading into the complex issue of global food distribution. Eco-tourism, refugee camp visits, or staying at home and reading about it are not substitutes for real field experience. Go get some.

Here are the hard truths:

We do not have a food supply crisis, according to the hard data. We have a monetary distribution crisis participated in by anyone who has ever accepted higher wages for the same work that an African does. That means you and me.
We do not have a grain supply crisis, according to the hard data. We have a grain distribution crisis caused by rising meat consumption, participated in by anyone who has ever partaken of turkey at Thanksgiving dinner. That means nearly every American, myself included.

We do not have a fuel crisis, according to the hard data. We have a crisis of escalating demand in developing nations that have every right to the same lifestyle that Westerners enjoy, except for the embarrassing fact that there simply isn't enough cheap energy around to provide an affordable Western lifestyle to all.

We do not have a crisis of subsidies and mandates caused by the emergence of ethanol. We live in a state-subsidized and

state-directed economy in almost every corner of importance in the business of the Republic we love and serve. Food, aerospace, defense, banking, environment, oil exploration, drugs, pensions and yes, both farming and renewable energy.

The argument from meat producers that they are subsidy free is a canard. They benefit from the same supports of the grain industry that biofuel producers do.

As *Harper's Magazine* editor Lewis Lapham wrote in his 1990 essay "The Visible Hand" at the time of the S&L bailout:

The national economy depends not only on systematic price-fixing and noncompetitive bidding but also on the guarantee of government intervention. The theory of the free market works at the margins of the economy–among cabdrivers and the owners of pizza parlors, for small businessmen who make the mistake of borrowing $20,000 instead of $20 million–but the central pillars of the American economy rest firmly on the foundation stones of state subsidy...as with the subsidizing of the farms and the defense industry, so also with paying off the bad debt acquired by the savings and loans associations. Except for the taxpayers (who as always, didn't know what was being promised in their name), nobody took the slightest risk. Always and whenever possible, the participants in the swindle adhered to the fundamental American principles of "no money down" and "something for nothing".

We do not have a shortage of solutions to the emissions crisis, according to the hard data. We have a crisis of decreasing interest in paying for solutions to hard problems, preferring to direct our dollars to the purchase of SUVs and larger-screen televisions. The average American home is nearly 50 percent larger than homes built in the 1930s.

Electricity-munching devices are proliferating, including the device I used to write this essay and the one you are using to read it.

We do not have a crisis of emissions and food supply in the Third World caused by biofuel development in the United States. We have a crisis of emissions and food supply caused by a growing population in Africa and Asia that is doing better, and wanting more. The large tracts of land in Africa and Asia that are being "converted" from "valuable carbon sinks" to cropland were, in fact, cropland before. They were abandoned, in some cases because of local farming and water practices, in other cases because Western food aid caused the local market for grains to collapse, creating the same massive migration to cities and cycle of dependency and political unrest that was the undoing of the Roman Empire.

Those lands are not "carbon sinks", except in the calculations of cynical Westerners who conceive of the developing world as a toilet to flush away Western excess. Those lands are no more a "carbon sink" than the land under the home you currently occupy; or the land under mine.

"This Land is Your Land, This Land is My Land" went the Woody Guthrie song. Not "Your Land is My Land".

The critics of biofuels have their points. It is not even close to a perfect industry. It is turbulent, risky, unproven and yet promising. Critics who say that it has had thirty years to prove itself (and that's enough) forget that our primary US transportation system, the railroads, took nearly sixty years

to complete, and were massively subsidized by the US Government. 309 railroads went into receivership or bankruptcy during the period between 1884 and 1894, despite all the help. Yet who denies the importance of rail transport for freight, the very means of distributing cheap grain from the farms to the cities?

The second leg of our transportation system, the interstate highway system, was built entirely with tax dollars, and is 50 years now in construction and still we are spending our public dollars on it. But who disagrees on the vital importance of our highways? Or the military, or airport security? And so on.

The suggestion that a vital national strategic interest — the quest for energy independence, or something closer to it — should be funded entirely by the private sector is the first suggestion of that type since the old Jeffersonian party disintegrated over its opposition to federal funding of canals in the 1830s.

Biofuels are on the verge of a transformation from first- to second-generation. As BlueFire Ethanol CEO Arnold Klann points out, we have finally come to the point where we have more financing issues than technical issues. The era of 100 Mgy cellulosic ethanol plants, such as Coskata proposes in South Florida using sugar cane residues, 20-50 Mgy plants that use municipal waste, and 10-20 Mgy plants that use agricultural waste, is at hand.

The critics of biofuels would be best advised to stand down and let the future happen: a shutdown of biofuels development will affect next-generation fuels far more than

the first-generation fuels such as corn ethanol that they are most concerned with. The future will be fine. Corn ethanol will not rule the world, or even Iowa.

Meanwhile, they would be well advised to revise their direct land use models before proceeding to indirect models.

Most data published from direct models assume a large percentage of farm inputs are coming from fossil fuels: diesel for trucks and equipment, plus petroleum-based fertilizers. This is changing with the growth of biofuel-based fertilizers and the approval of B20 and B100 biodiesel for farm equipment. Once that work is complete, let us indeed take up the question of indirect land use changes, and the true impact of biofuels on land use and food supply.

But let us not have the debate chaired by Kellogg's, Sara Lee, or the National Chicken Council. Good organizations, but hardly disinterested. Their goal is cheap grain to fund their business models in an era where other inputs are rising quickly in price.

Let us also suggest that emissions studies, or indirect land use studies, be comparative in nature. Assessing the indirect land use impact of biofuels, let us compare it something aside from carbon neutrality. Carbon neutrality is a standard that human breathing can't live up to. Let us compare it, instead, to that which it proposes to replace or its competitors in that replacement.

An end-to-end analysis of biofuels should be compared to an end-to-end analysis of oil. For example, is the war in Iraq an "indirect land use change" attributable to rising oil

consumption?

An end-to-end analysis of hybrid cars, and plug-in hybrids, would also be useful. It would be interesting data. What is the social cost of open-mining for nickel and lithium to make batteries? What is the energy cost of the construction of solar PV?

Let's get all the facts on the table, and thereafter form coalitions to compete for the federal purse. If we get this right, we can make progress in our environmental goals and energy security. That is a more important priority than making the world safe for cheap chicken wings.

Seasons of Love

Last spring, it was revealed in House testimony that the EPA staff director responsible for regulating bioenergy, and thereby farm emissions, had never set foot on an American farm. It became a symbol of everything the rural communities thought had gone wrong with the EPA, and eventually the director in question made a symbolic journey to a farm in September 2008, after Senator Charles Grassley of Iowa issued an invitation after hearing about it via this Biofuels Digest *article.*

I have written elsewhere on the need to create a rapprochement between rural and urban communities, and engagement by consumers with the real consequences of their quest for cheap food and fuel. This seemed as good a time as any to take up and extend the discussion on that subject. The theme of personal engagement and community involvement is a recurring 'story arc' in the Digest, as it explores the structure of a real and sustainable model for transportation through its articles and interviews.

"In 525,600 minutes - how do you measure a year in the life?"
— Seasons of Love, from RENT

If my math is right, 21 million minutes have passed since the 1968 arrival of Margo Oge in Lowell, Massachusetts as a 19-year old from Greece, speaking no English, en route to university and the beginnings of a fine career. The story of her rise from humble roots to Director of the EPA's Office of Transportation and Air Quality - in which position she has served 15 years - would be on anyone's short list as a material example of the American Dream.

The fact that she has not set foot on an American farm probably did not matter before now. Her academic

background is in plastics, engineering and government, and in her recent career she has been primarily supervising the emissions coming from industry and cars.

But when the Congress passed the Energy Independence and Security Act in December 2007 and required the EPA to measure both the direct and indirect impacts of biofuels, the task fell to Ms. Oge and her team to propose a model for how Indirect Land Use Change is to be accounted for.

That's when the farm thing became a problem. Because in this case, the EPA is not regulating smokestacks, or industrial odors, or cars, or urban waste - things that any city dweller is all too familiar with. Nor is the EPA regulating lobbyists, or even farmers, or other things or people that can roll on in to Washington complete with charts, and talking points, and campaign contributions.

The EPA is proposing to regulate crops. Crops live on farms, are anchored to the ground, and do not travel to Washington to testify.

Imagine, I asked my wife, who works in the aviation industry, what would happen if it turned out that the person who was responsible for air traffic control in the United States had never visited an airport? She was apoplectic. "That would never happen - it's unthinkable," she opined. But, in agriculture, the unthinkable has come to be.

"How can you be an impartial regulator of an industry," asks Senator Charles Grassley of Iowa, "if you haven't experienced it?"

Look Who's [Not] Talking

40 years in America is a long time without stepping on a farm, but then we live in two Americas, the farm and the city. Though we have increasing means of communication — social networks like Facebook and LinkedIn and Twitter — we seem to be communicating only in tribes. City folk talk to city folk. Farmers talk to farmers. Kids talk to kids. The Beltway talks to the Beltway.

Sen. Charles Grassley of Iowa, on hearing that the director of EPA's ILUC effort had never visited an American farm, said "I'm not surprised," but added, "I'll invite her to mine". "Faceless bureaucrats," said Senator Grassley. "I'm not surprised," he added when asked about the director's lack of familiarity with farms.

"Let me give you some advice," said Rep. Lynn Westmoreland (D-GA), the ranking member of the subcommittee, to Ms. Oge during her testimony, "Get out of Washington. Go spend some time with these farmers."

The tribal nature of the Republic these days would be a social issue well worth discussing over the kitchen table in Clarinda, IA or New York, NY if it were not tied to the 60 day comment period, after which the EPA will cast the Renewable Fuel Standard in stone. From that point forward, we will be stuck with it, or stuck with a long court battle over what is, or what is not, Indirect Land Use Change.

So who does the EPA talk to, and how do they get their bedrock understanding of the real issues? Where do they get their "gut feel", as opposed to the opinions formed from

running dry models that spin around like the wheels of a slot machine in academia and the Federal Reserve. The kind that told us that 9/11 would not happen, that the derivatives market would not need regulation, that the sub-prime mortgage market would hold up, and the levees in New Orleans would never fall down.

Indeed, how do you measure, measure a year? In meetings, in model runs, in cups of coffee with lobbyists? In gallons per acre, parts per million, or bushels for export?

Due Process vs. Don't-Do Process

Let's see how EPA measured their year. Well, actually almost a year and a half by now since EISA was signed by President Bush.

Thousands of model run pages - so many in fact that Ms. Oge confessed she had not herself read them all. Did anyone? Could anyone? Perhaps we will never know. Ms. Oge said she was confident that the process was right. Right before she confessed she had never visited a farm.

But she did say that EPA had sought out and met with many farmers and members of industry. Perhaps it would be fair to say that she met many representatives of industry and farmers, or some kind of Potemkin assembly of token representatives assembled to convey the impression of due process.

Mr. Smith Spams Washington

How many real people from any walk of life really go to

Washington, except in those pepped-up, talking-point infested, lobbyist-designed blitzes where a Million Moms or a Million Men or a Million Manufacturers descend on the Capitol like a locust? Those events involve as much true discourse as a conversation with a telemarketer.

Ms. Oge conveyed to the House Small Business subcommittee that the EPA has consulted widely on indirect land use change. And then every subsequent witness from industry or the farm denied under oath that they had been contacted by the Environmental Protection Agency. Which perhaps would be just an unlucky coincidence if the witness list had not included the American Soybean Association.

Pretty big miss in the outreach process when the number one biodiesel crop is soybeans.

But I don't doubt they tried to do outreach. There is something else amiss here. Something deep. Something important. Something that was supposed to arrive in the bus that brought "change you can believe in", but didn't make it.

"More of the Same" You Can Believe In

We had the changing of the guard, but not, alas, the change of attitude. The attitude that people outside the Beltway or major universities not named Warren Buffett or Boone Pickens are stupid, second-rate, and only worth communicating with when its time to raise money or launch a flood of emails into the White House to simulate the feel of public support.

I can't think of any other compelling reason why the EPA

would embrace NASA satellite data from 2001-04 as a means to calibrate land use change, but then politely rebuff Rep. Aaron Schock's (D-IL) suggestion that actual land use change data from Brazil and the US in the past four years is relevant. The data seems to inconveniently contradict central tenet of ILUC theory.

They must think the Congressman is stupid. The data showed, said Rep. Shock, that higher soy prices in the US and biodiesel production was accompanied by a drop in Brazilian soy acreage, not an increase.

"Let me make it clear," said Ms. Oge to Congressman Schock. "We're looking at 2022, not today. You can't compare what's going on today, with what we're looking [at], which is the 2022 production level."

I can't think of a good argument as to why NASA satellite data from 2001-04 is relevant to indirect land use change, yet 2004-08 actual acreage totals are not. Except that the EPA is looking for data to support a theory, which is inductive reasoning and a dubious path for science or regulation. It looks like they are discounting data that disagrees with the model.

Perhaps there is a better explanation. I hope so. I doubt it.

Can Hubble detect ILUC at the edge of the universe?

Indirect land use change is rooted in an economic theory that price and demand information passes across infinite amounts of space without degrading the signal. No one who depended on a cell phone traveling in rural America would

give two cents for that concept, because everyone knows that the farther you are from a cell tower, the more the risk of a dropped call.

Farmers are sophisticated small business people. It's America's original small business. They know how to find the price of Brazilian soybeans. The faraway can be known and can have an impact, but distance muffles. Local overwhelms. Farmers are more influenced by local markets, local yields, local tax systems, local incentives, local weather, local inventory, local demand, and local costs.

"All politics is local," said Tip O'Neill. Not a bad way to think about farming.

Why did South American soy planting not increase exponentially when US soy prices rose? Ask any farmer - crop rotation, opportunities in ethanol, rising land prices, tax considerations, and low yields.

Take, for example, tax policy. Argentine soy planting increases earlier this decade was prompted not by high prices, but by beef export restrictions designed to create a surplus that would keep beef prices low at home. Farmers switched to soy not for biodiesel but for an export market. Conversion there was. For reasons that were entirely local.

For example, another type of tax policy. In the US, we pay real estate taxes annually. Not so in every other country - in South Africa, for example, there is a transfer tax of around 8 percent. There are few "flippers" in South African real estate - the economics favor the long-term holder, and land conversion is inherently more difficult.

Washington conversion turns out to be mighty difficult too. I thought change had come. I have been mightily encouraged that EPA Administrator Jackson has made, since her confirmation in January, no less than five visits to sites of renewable energy production. Four in Wyoming and one in the Netherlands, as far as a review of the records could reveal.

I was less enthralled when, in her testimony, Ms. Oge offered that "I may not have been to a farm, but I have been to Brazil". I am happy that the EPA overseers of ILUC have an opportunity to visit Brazil. But it does not alter the importance of spending time with that which one hopes to regulate. The SEC should visit Wall Street. The local building department should visit and understand the nature of construction sites. School commissioners should visit and understand schools. The EPA ILUC team should visit and understand farms.

"I will invite her to my farm," boomed Senator Grassley, adding that any of the EPA team members working on ILUC would be welcome at the Grassley farm.

The Senator makes a simple invitation, but, like most Senators who have learned on the stump to use simple words to convey deeper points, there's something to this idea of time on the farm.

The EPA resists the charge that it is out of touch with the American farmer and their grassroots efforts in conservation and environmental protection. The EPA resists it; resists the idea that it doesn't know the country. They think they know the country, though some might say they think they are the

country.

Ms. Oge in her testimony reinforced consistently that the EPA was deeply interested in, and welcomed, input on rulemaking. She was questioned about and spent some time discussing the outreach programs that the EPA has implemented and in which, in many ways, she is responsible for. In 2004, in fact, Ms. Oge was a recipient of the Presidential Distinguished Executive Rank Award for her outstanding leadership on environmental transportation issues. I don't doubt the sincerity of her belief in EPA outreach.

The EPA doesn't see the relevance of first-hand familiarization with what it proposes to protect.
There are 1.4 million square miles of farmland in the Republic. That's the land in every state east of the Mississippi River - nearly twice over. How is it possible to be at EPA all those years and manage to miss that much of our beautiful, precious country?

Ironically, the EPA released a study this week that relates closely to this subject. It's couched in the arcane language that goes over better in the halls of academia and government offices, where scholarly equivocation is more popular than a United States Senator whose speaking style plays better in the countryside where Henry David Thoreau is long forgotten but his maxim "simplify, simplify" lives on.

Change the EPA can believe in

In "Quantifying a Relationship Between Place-based Learning and Environmental Quality: Final Report," Duffin,

Murphy and Johnson conducted a multi-agency evaluation of air quality education programs. They found "programs reporting more place-based learning (PBL) qualities and practices such as service-learning and community partnerships were more likely to report improvements in air quality." They warned that there study was based on a small sample and may not necessarily be generalized to topics such as biofuels or climate change education. But they did find in their study that "the single strongest predictor of air quality improvement was the degree to which the program incorporated an aggregate measure of the principles of place-based learning."

That's why it's important to visit the land. Place-based learning changes you, ask the EPA. They believe in it. They don't believe in it. They drive you crazy arguing one way and then the other.

Common sense rescues the mind. Everyone knows intuitively that direct encounters change you. Inform you. They modify your outlook in ways beyond conversation, more profoundly than a rendition of "Getting to Know You", or perhaps not. That song, from the King and I, reflected the changes coming over a woman who suddenly had become a stranger in a strange land. She went to Thailand, and found unexpected love.

As John Muir said...

As it is with people, so it is with the land. John Muir used to say in the Sierra Club's early days that a person would go up into the mountains as whatever he was before, but he would come down the mountain a conservationist.

We are all of us children of the soil, descended recently or distantly from ancestors who worked a family farm or a village green. Though we have passed by a multitude of routes from the land to our present coordinates, we all share a legacy measured in bushels and pecks and gills.

Today there are just 2 million farms in these United States, and excluding retirees and those whose major occupation is outside the farm, there are just 800,000 working farms today. Many, many people have never met a farmer, and even fewer have tilled a patch of soil bigger than a backyard garden.

We have met the alien, and he is us

Those of us who have left the farm or are descended from those who left before are like members of a second republic that has little in common with the yeoman farmers that Jefferson believed would anchor the Republic forever.

The American farmer is as alien to the average city-dweller now as a Saudi sheik, and the hard lessons of a life based on the soil — what it yields and where and how, and what it will yield not — is as foreign to average urban experience as the means of survival on Mars.

Though we, the people of the 50 states all pledge allegiance to the one flag of the one republic, we are two nations, under [deity of your choosing], frequently divisible.

It seems to me that the national shouting match over farm policy will not be solved by the method Bob Dole once outlined to T. Boone Pickens: "There are 21 farm states, and

that's 42 senators. Those senators want ethanol."

That seems to me to be the road to pork instead of paradise.

Get Back, Jojo

I believe it will be solved by a national conversation that begins with a re-acquaintance with the soil. It's for that reason that I am a strong supporter of Michael Pollan's concept of "Victory gardens", small plots farmed in home gardens and planter boxes that would supplement the food supply and bring us closer to an understanding of the possibilities in the dirt.

But I would go one step farther, and suggest to every state to declare a Farm Day, and on that day that every farmer cooperative and every farming family host family and friends from the city for a day of enjoyment on the farm.

Too often we fall into the trap of thinking of agriculture or ranching, or even agrienergy, only as a "sector" in some intangible thing called "the economy", and we experience only through the highly processed offerings that we still call "food" but that our farmer ancestors would hardly have recognized as such.

Conversely, too often we think of the land as some collection of amber waves of grain suitable for housing prairie dogs and antelope, or as a backdrop fro inspiration-laden framed photos that hang on corporate walls or as some kind of national carbon sink that it suppose to offset the impact of emission-laden lifestyles that take place primarily in American cities.

You've Got a [Farmer] Friend

On an actual farm, speaking with actual farm relatives, I believe that Americans would emerge with a more sophisticated understanding of the challenges and opportunities in our national acreage. From dialogue, better ideas might flow and better ways than shouting would certainly be developed across picnic tables that would foster communication, and perhaps some small revived tincture of a national conversation that has long devolved into negotiations between narrow tribal interests.

It may seem impossible that some percentage of 2 million farmers could, via some summer picnics with their city relations, reach out to the wider America and change the way we talk and think about food, and energy independence, and all the things that flow or may one day flow from the farm.

But LinkedIn tells me that my 4,500 registered friends have 800,000 friends, and that those friends are connected to 13 million people in all. It seems to me that reaching out to a meaningful slice of the population is much easier than it used to be. Everybody knows somebody, and all those somebodys add up to everybody.

Michael Pollan once wrote: "If you are what you eat, and especially if you eat industrial food, as 99 percent of Americans do, what you are is corn." Which is totally cute, but we are the sum of our experiences, not the sum of our meals. Our experiences are based in the who we saw, and where we saw them; the time we spent and where we spent it. If you reach down and touch the grass, the grass will

touch you back.

Stability comes from comity, a social harmony of agreed ideals and a common framework, and not just from a common set of laws or institutions. Renewable energy needs stability, and the deep support that comes from the deep commitment of those who have debated the possibilities and the logical boundaries of agrienergy with their heats as well as their minds.

Perhaps we'll love again

It used to be that the biggest fights over farming were squabbles before the state fair as to who would bring in the biggest watermelon, or which state or county or farm would have the biggest harvests (for the record, let me brag that my beloved home state of Washington leads the nation in corn yields).

We need to get back to that kind of squabble. We were a better nation back then, and will be better again when we get back to some of the old ways we loved, and lost, yet perhaps did not lose everywhere, and perhaps will love again.

Get Back

In the spring and summer of 2009, I wrote with increasing frequency on the divide between the city-dwelling and farm-dwelling tribes in the United States, and elsewhere. Many of the communication problems between farmers and consumers seemed to rest in sheer mutual unfamiliarity. When journalists wrote that field corn was being diverted to ethanol, depriving millions of the food needed for daily life – it really betrayed a wholesale lack of education about the uses of white corn and field corn, the disposition of starches and proteins, that steered an important debate into absurdity.

At the same time, I have a once city-dwelling cousin, Wendy Lane Price, who followed the "back to nature" movement in the 1970s with her future husband Dennis, and I have been the lucky recipient for some time of her poetic spring newsletter on the raising of her gardens and lambs. Her example inspired me to write some thoughts – here published for the first time – on the when and how of getting back to the land.

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that has little in common with the yeoman farmers that Jefferson believed would anchor the Republic forever.

Georgia, Southwest Wisconsin, and Idaho have all lately been described as a "Saudi Arabia of bioenergy", and the description is apt. The American farmer is as alien to the average city-dweller now as a Saudi sheik, and the hard lessons of a life based on the soil — what it yields and where and how, and what it will yield not, — is as alien to average experience as the means of survival in distant Araby.

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But LinkedIn tells me that my 4,500 registered friends have 800,000 friends, and that those friends are connected to 13 million people in all, and just within the 30 million population of LinkedIn.com. Not to mention the 18,000 or so people that read the *Digest*. It seems to me that reaching out to a meaningful slice of the population is much easier than it used to be.

Stability comes from comity, a social harmony of agreed ideals and a common framework, and not just from a common set of laws or institutions. Renewable energy needs stability, and the deep support that comes from the deep commitment of those who have debated the possibilities and the logical boundaries of agrienergy with their heats as well as their minds.

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It's Not Food, It's Not Fuel, It's China

Unlike a lot of people in bioenergy, I am a strong admirer of Lester Brown, and it is depressing to read his anti-bioenergy rhetoric. In this essay, I attempted to update his analysis powering the seminal Who Will Feed China? For my troubles, I received scathing and personal criticism in the People's Daily, which interpreted this essay as an attack on Chinese morals. I didn't receive anything nice from Brown, either, although I remain hopeful. I can't think of anything, looking back, that I am more glad to have written than opining in 2008 that China is all-important in every aspect of the future of bioenergy.

A change in Chinese meat consumption habits since 1995 is diverting eight billion bushels of grain per year to livestock feed and could empty global grain stocks by September 2010, according to a new study from *Biofuels Digest*.

The Study, "Meat vs. Fuel: Grain use in the U.S. and China, 1995-2008" concluded that, even if the U.S. ethanol industry were shut down tomorrow, rising Chinese demand for meat, and the ensuing livestock feed demand, will empty global grain stocks as soon as 2013. The report offers gloomy news for policymakers who have hoped to address global food vs. fuel concerns by restraining U.S. ethanol demand.

The study found that the US produced 349 million tones of corn last year, up from 192 million tones in 1995, but the 157 million tonne increase has not kept pace with rising demand. The US ethanol industry, which has been criticized as the primary cause of grain shortages and rising prices, increased its grain usage by 31 million tonnes during the 12 year period. By contrast, livestock grain demand to supply

Chinese meat consumption increased by 199 million tonnes.

Given that the US population has grown 15 percent in the past 13 years, the 82 percent increase in US corn production left plenty for people, plenty for livestock, and plenty for ethanol.

The bad news is that the grain was Shanghaied, leaving us with a fuel crisis and a food crisis. The good news is that it's easier to find a steak in Beijing.

The report identified that rice, rather than corn or wheat, suffered the largest price increases over the 12-year period, despite the fact that rice is not used for biofuel production. The study also ties falling global grain stocks to corresponding increases in Chinese consumption.

The study determined that China's meat consumption since 1995 has increased by 112 percent per person to 53 kilograms of meat, per person per year.

If the Chinese people had consumed the same amount of meat, per person, in 2007 as in 1995, there would have been enough grain left over to support 927 million hungry people with enough grain for an entire year.

The growth rate is so intense that, even if the US ethanol industry were completely shut down tomorrow, increased Chinese demand would soak up the excess grain by 2011.

The study tracks the meteoric growth in Chinese meat consumption since 1983, a trend spotted early by

Worldwatch Institute founder Lester Brown in his prescient 1994 article "Who Will Feed China?". In 1995, Chinese meat consumption was 25 kilograms per person, and reaching 31 kilograms by 1999, 50 kilograms by 2000, and is 53 kilograms per person today.

Even with all the growth, Chinese meat consumption is still 45 percent less than the average consumption in the U. An additional 277 million tonnes of grain would be needed to support China at parity with the US. That would take 68 million acres to grow. There isn't that kind of arable land available anywhere is the world, whether we grow grains for renewable energy or not.

A Common Sense Theory of Land Use Change

I am no one's idea of a seasoned energy analyst, but I do know something about the Homestead Act because of family ties. In this essay, I proposed that we could look at the Homestead Act as a robust source for data on the theory of Indirect Land Use Change.

Was there a correlation between crop prices and the conversion of virgin prairie to cropland in the United States during the years when the Homestead Act was very much a force in American agricultural expansion? The data indicated that it is unlikely. Not that this argument did much to stem the tide of media reports that increasing use of biofuels in the US would lead to Amazonian deforestation.

Readers of *Biofuels Digest* know that I have been devoting a fair amount of space over the past several months to the discussion of indirect land use change (ILUC). The publication of analysis by a team led by Tim Searchinger, among others, ignited a fearsome debate over the value of biofuels in the battle against climate change. The battle goes on in the halls of government, in academia, and elsewhere.

The theory is straightforward enough, that a rise in US corn prices causes soy farmers to plant more corn, and that the resulting soy shortage is made up by a process of land conversion in, say, Brazil, that ultimately causes rainforest destruction in the Amazon.

Whenever I run an article on ILUC, the reader stats fall through the floor. It appears to be a big yawn. However, the biodiesel industry received a real jolt when soy biodiesel producers were informed that the current draft of the EPA's

ILUC calculation would disallow the use of soy biodiesel as a qualifying fuel under the Renewable Fuel Standard. Corn ethanol has run into real problems qualifying under the California Low Carbon Fuel Standard. ILUC is not just "bad luck" to growers of first-gen feedstocks. If the price of algae, sugarcane, jatropha or camelina rose to a point where modelers could predict an impact on Amazonian rainforest, those feedstocks could find themselves sidelined too.

The state of California and the EPA have attempted to quantify the ILUC effect, with varying degrees of success depending on the person you are talking to. The word "uncertainty" comes up 60 times in the EPA's attempt this past spring, according to the staff of Sen. Charles Grassley of Iowa.

In short, there is no disagreement that there could be an ILUC effect, as predicted by economic modelers, but there has been a firestorm over the provenance and accuracy of the data. For example, there is no current inventory of land use in Brazil that is sufficiently robust - data no later than 2001 has been utilized in some analyses, which takes us back to a time before biofuels were on the rise.

But it occurred to me recently that we have, in historical US data, a decent record of land use conversion and crop prices. We have the data from the US General Land Office, which oversaw sales of virgin prairie and forest from the 1860s through the 1930s when it was merged into today's Bureau of Land Management.

The General Land Office sales between 1869 and 1935 are, actually, a pretty good record of indirect land use change.

For they do not track the changes that farmers made in their planting from season to season, but the change in overall US land that was put under the plough. ILUC, as a theory of carbon, holds that conversion of virgin land releases carbon that offsets any favorable emission gains. Virtually all land conversion went through the General Land Office and was recorded on their books.

So I downloaded the data on crop prices and land use change, and prepared a chart, which is published below. I surely do not hold an advanced degree in this field, but I'll be dad-blamed if I can find any correlation at all. Corn prices (in 2007 dollars) were on the decline for decades while land use conversion soared. When corn prices finally took off after the turn of the century, land conversion slowed to a crawl. The same is true of soy, although the crop price data only dates back to 1913.

National policy had a lot to do with it. Land conversion was

encouraged in the 1800s in the name of "Manifest Destiny" and was discouraged in the 1900s in the name of "conservation".

But I'll advance a theory of my own. Let's call it Lane's Theory of Land Use Change. I don't have modeling software for it and don't plant to invent any, because I believe it is based on the kind of common sense you can obtain from your next-door neighbor. Here it is:

"Land use change does not flow from rises in crop prices, but a fall in land prices."

My grandfather was a homesteader, as a matter of fact, proving his claim near Teapot Dome, Wyoming in 1930. I can assure you that rising crop prices had nothing to do with his conversion of 320 acres. I have 25 or so of his letters from the period. It was cheap land that was on his mind.

Common sense tells us that a farmers, ranchers and timber companies too wary of the topsy-turvy commodities market to convert virgin land to production on the basis of a surge in crop prices. The fall from $8 to $4 in the corn price in a three-month period last summer will tell you why.

When crop prices rise, farmers may well convert from one crop to another to capture a premium - but that in itself is not a land use change of virgin land. I well remember my uncle's decision to pull out his Delicious apple trees and put in Fujis. But no farmer I have ever known has converted land unless the cost of new land is less than the cost of increasing productivity on existing land.

When there is an arbitrage between the cost of productivity increases and the cost of new land, I have no doubt that ILUC can and will occur. But that will generally be the result of falling prices.

Consider the case of Gentleman Smith and Farmer Jones. Gentleman Smith's land is virgin land, untouched for generations while used for scenic value and pasturing a few horses, while Farmer Jones is a corn and soy farmer. One year, crop prices doubled. Farmer Jones took a look at Smith's land, but the land price doubled, and Jones decided instead to put in new equipment on his existing land that would give him a far better result.

The next year, Smith decides to sell but meanwhile corn prices have plummeted. Smith's land value drops with the falling profits, and Jones picks up his land at a significant discount to its long-term value. Jones knows that the corn price will rise at some point; meanwhile he has locked in at a low price. When prices pick up, he puts in new corn on Smith's land and, voila, we have land conversion.

Seems to me that's how it works, and seems to me that the data that we have - as opposed to the data we don't have or assumptions about the future - supports it.

So what's happening down Amazon way? Seems to me that land pirates are converting land illegally, on the whole - at the ultimate falling land price of zero. I doubt they are looking at the timber or crop prices, but rather looking out for the sheriff.

What's happening in Africa? Swathes of land available on

the cheap from national governments desperate for foreign direct investment. Result? Conversion of virgin land.

So, what to make of all this. Option one, call me crazy. Option two, support high land prices and sound enforcement of laws banning illegal seizure of virgin land. High land prices make wealthier citizens out of small landholders all around the world, and give them more resources, borrowing power, and incentive to invest in land improvement.

Of course, high land values flow from long-term improvements in crop prices, and that flows from adding strategies like biofuels into the mix. Biofuels are, as far as I can tell, not a creator of indirect land use change but rather a preventer, insofar as they help support crop prices.

Does a high crop price automatically mean unaffordable food for the world's hungry? No, and again no. High prices will encourage the investment in productivity that will restart the African Green Revolution. 30 bushels of corn per acre is an unacceptable yield in this day and age. A generation before, productivity saved Africa from the threat of starvation. The stagnation in global crop prices did much to cause the very starvation that cheap food was supposed to prevent.

The article "A common sense approach to indirect land use change" that ran last week in Biofuels Digest prompted an elevated amount of response. The most detailed have included an essay by Bill Ray of Ray & Associates and a statistical analysis of data from last week's article by Catchlight Energy exec Dr. Ben Lavie.

Lavie writes: 'Plot the cost of corn vs. the land use change – this is an xy plot which will result in a single line forming if there is a correlation, which one can then use simple least squares analysis to determine the r2 of the correlation – if it is close to 1 you have positive correlation"

After examining the data set in detail, Lavie writes: "Here is the graph I did by plotting the acres in column b by the corn price in column F. No correlation seen for this data set.

Obviously there are other factors besides price of corn which cause farmers to add land. Could be the actual profit (which we don't know), land price, loan interest, wars, consumer confidence, etc. So I am not sure that this proves your point, but certainly doesn't disprove it anyway."

Fat vs. Fuel

I can't think of an issue more than "food vs. fuel" that has inspired so much tomfoolery – but of all the specious claims (on both sides), the one that really galls me is that, somehow, biofuels are an immoral use of crops as long as one person is going hungry.

The same argument could be made against bioelectricity, overeating in the West, the destruction of local Third World farm economies by well-intentioned donation of free food by guilty Westerners, political corruption and the spoiling of good land by nefarious foreign regimes, among other probable causes of hunger.

In this March 2009 essay, I chose to take aim at fat, since it is also intimately tied up in the soaring rates of diabetes and heart disease in the US.

Dr. Alan Bittner was heavily criticized for using liposuctioned human fat to power his car, but perhaps he was a pioneer. In a future US, overeating will consume more and more arable land and divert land from energy production or raising crops for export

According to the FAO and the USDA, US meat consumption has increased 137 pounds per person since the 1950s, with a resulting increase in grain usage of 375 pounds per person (the grain fed to cattle and poultry). Cheese consumption has increased faster than milk's decline, and Americans consume 179 extra pounds of milk, which uses up another 63 pounds of grain.

In short, dietary change in the US has resulted in an

additional 438 pounds of grains per capita, or 8 bushels of corn. That's 2.4 billion bushels of corn, enough for 7.2 billion gallons of ethanol, or 70 percent of the nation's ethanol consumption. Since the 1950s are not remembered as a time of national starvation, let's characterize that 2.4 billion bushels of grain as national overeating.

Or to put it another way, 15 percent of the nation's cropland is devoted to overfeeding Americans. Now, that's a land use change. But who's modeling that?

Well, I can tell you. It's being modeled by the California Air Resources Board but they are charging it to biofuels. How are they doing that? By assuming that any additional use of land anywhere in the world is the result of biofuel production, rather than feed production.

Now that's food vs. fuel, for sure. Or rather, fat vs. fuel.

Governor Arnold Schwarzenegger of California commenced his political career as President Reagan's choice to head the President's Council on Physical Fitness & Sport. Upon election as California Governor, Schwarzenegger pledged to make California "the fitness state".

What the heck is the state of California, of all places, doing making the world safer for overeating on the cheap by discouraging energy crops, instead of adding carbon penalties to the subsidized food onslaught that gets dumped on US markets in the form of cheap burgers, cheap pizza, and cheap cokes?

Exxon has long advised us to "put a tiger in our tanks", but

we have forgotten the old Chinese proverb that "he who rides a tiger is afraid to dismount".

Fat vs. Fuel is not about the fact "The grain it takes to fill an SUV tank with ethanol could feed a person for a year," as critics contend, unless we are discussing vegetarian diets in Burundi. Big Fat needs cheap grain to be able to sell in 2700 calories per day to Americans who should be consuming 2000. The grain that it takes to fill a flex-fuel car with E85 will get you about 23 16-ounce steaks, enough to feed a platoon of troops in Iraq about two thank-you barbecues for all their hard work securing a crude oil supply so that lobbyists can get transport in and out of Sacramento to make sure we keep putting that old Exxon tiger in our tanks each week.

But let me put the proposition put it another way. Last year, we imported, enough oil from Iraq to make 6.6 billion gallons of gasoline. If we had used the land for ethanol production instead of overeating, we wouldn't have needed Iraqi oil. Tell it to the troops.

Now that's a land use change I can get behind. Probably a simplistic argument, but any more simplistic than the argument for indirect land use change, now that we've gone through the data in just a little bit of detail.

I'll give Professor Bruce Dale, Distinguished Professor in Chemical Engineering at Michigan State, the last word, because I called him yesterday to talk about indirect land use change modeling. "It's pure bunk," he said, "and intellectually bankrupt."

Quo Vadis? Whither goes thou, Biofuels? An Easter Message

April 2009, there were so many bankruptcies and troubles in biofuels – particularly in first-generation fuels – that it prompted this call for the industry to propose its own timetable for gradual abolition of subsidies and mandates, and "getting off the dope".

"Whither goest thou, America, in thy shiny car in the night?"
Jack Kerouac, On the Road

Rampant bankruptcy among first-generation biofuel producers, combined with ruthless pressure from environmental and meat industry and food packaging firms to back off on the Renewable Fuel Standard, should cause even the most die-hard biofuels supporters to ask "whither goest thou?"

The crisis is caused by a division of interests that were once united.

First-generation biofuels continue to be a means of grain and oilseed price stabilization, economic development and energy security. The benefits are largely felt in the 21 states that have strong "farm patch" economic dependencies.

In those states and in the first-generation ethanol industry, an attitude of eye-for-an-eye defiance has developed in opposing criticism from well-funded lobbies and passionate environmentalists. It shows in press releases from Growth Energy and the Renewable Fuels Association that state the

appeal of biofuels in hyperbolic terms. Meanwhile, an increasingly troubled support base in the scientific and political communities reminds one of the crumbling support for President Nixon in 1974.

The rear-guard smashmouthness amongst first-generation biofuels advocates and shareholders, that led farm economist Tom Elam to brand a recent RFA release "absolute, total BS," is reminiscent of the Queer Fist demonstrations at the 2004 Republican Convention in New York City.

"We're here! We're queer! We're fabulous! Don't f*** with us!" the protestors chanted. The delegates were suitably appalled, but the enduring value of the campaign was negligible.

The Fat vs. Fuel problem

Meanwhile, the food packaging and meat industries have amped up the dialogue with a well-funded and disingenuous attempt to blame biofuels for rising food prices last summer.

If the controversial CBO report that debunked the theory is not enough for many biofuels critics, it should be enough for the person in the street.

The average voter might not have the available bandwidth to grasp the nuances of macroeconomics, but they see that commodity prices have collapsed and food prices remain high. They can see the campaign by food packagers as an attempt to misdirect attention while a stiff price increase was put through in an attempt to raise profits at the likes of

Kraft. Kudos to the food packagers for sleight of hand worthy of David Copperfield.

The meat and dairy industries have gone through a rough patch in the wake of high commodity prices — but it should be seen as a long-term step in weaning the American public off cheap meat and cheese that has made the nation fatter and less healthy. Corn prices were flat for a generation. The result? 62 percent of Americans are overweight. 24 percent of the US corn supply goes to ethanol, but more than half goes to support US consumption of meats and dairy.

If the US continues to experience the same increase in meat and cheese consumption (per capita) and population growth tracks Census estimates, we will need an additional 8.6 billion bushels of corn to meet our food needs in 2050. At today's corn yields, that would require an additional 56.9 million acres of land for corn. The entire maximum US corn ethanol mandate, at current productivity levels, would require 33 million acres. The crisis is in how much we are eating.

Who among food marketers and cattle and dairymen is advising Congress of that?

On the other hand, biofuels have experienced a crisis in the analysis of emissions tracking. If corn and oilseed prices continue to escalate, goes the theory, it will prompt conversion of land to crop production and release stored carbon into the atmosphere. The analysis is based on an unproven and perhaps improvable theorem that biofuels are causing diversion of land to crop production. But what about the role of overeating and US population growth?

Since the 1950s, average consumption of grain to feed American has risen by billions and billions of bushels. Why are my brothers and sisters in the environmental movement not calling for the closing of McDonalds, Wendy's and Burger King as a necessary, if painful, step on the road to ending deforestation and mitigating global warming? Increased food intake and dietary change is surely what is causing it.

You might call it "fat vs. rainforest".

The inconvenient truth of money

The problem is one that Al Gore called "an inconvenient truth," which is to say that the battle over biofuels in the environmental movement is about money. Biofuels are subsidized, incentivized, mandated, tariff protected, and grant supported. Supporters of solar and wind - which have more substantial environmental gains but do not pencil out in economic feasibility, want more federal, state and local dollars. That is what this is about.

As Deep Throat told Bob Woodward at the height of the Watergate investigation, "follow the money". Then all becomes clear. And the only solution for biofuels is to clearly establish a path to reducing its dependence on subsidies, mandates, grants, tariffs and incentives.

Among the supports afforded biofuels, local economic incentives and research grants are the subject of the least controversy. Bioenergy is an important science and scientific research is important for the US to maintain leadership in.

There's little dispute about that. Local incentives for job creation can be locally controversial, but are not the issue on the main national stage.

The water bomb

Instead, tariffs, subsidies and mandates are the issue. They offend many environmentalists based on their concerns over indirect land use change, and offend economic liberalists who oppose ag policy in general and government market interventions in bioenergy in particular.

The Renewable Fuel Standard would be less controversial if the "fat vs. fuel" issue were better explained, and water consumption in energy crop and biofuels production were limited to rainfall, brackish groundwater or wastewater. A report that biofuels require 2,100 gallons of water for every gallon of fuel (as reported in the April 15th issue of Environmental Science and Technology) is a time bomb with a short fuse.

But the opposition to subsidies and tariffs should be dealt with by a timetable under which they would be swiftly eliminated. The Congress has taken some steps in this direction, but not enough, not near enough. The crisis in the ethanol industry would not have been as severe if the subsidies had been coming down; fewer plants would have been built, and overcapacity would not be an issue.

The agonies of first generation biofuels are making for "unplayable conditions" for advanced biofuels, with too many people tarring all biofuels with the corn and soy brush. Supporters are called "biofools" not "cornfools" or "soyfools".

A breakthrough ignored - the sign of distraction

Last week in *Biofuels Digest*, I was astonished to see an important breakthrough almost completely overlooked by the readership. A team of researchers at the Ames National Lab developed a technique for continuous harvest of oils from algae. Huge stuff.

This breakthrough, which puts us on the brink of the third generation of biofuels, received one tenth the readership it should have. That is because we are distracted.

The importance of continuous harvest is immense. Consider the price of milk if, every time you milked a cow you had to kill her? Vegetables, fruits and grasses have been harvested this way, but not grains or oilseeds. Now, we have the potential of harvesting oil continuously from algae. The potential is discussed by Ames in terms of 10,000 gallons per acre potentials.

But that is today. Another company that will shortly release its research has found a means of producing (currently at bench level) 12 million gallons per acre per year. That's today's US biofuels supply created from 1,000 acres. That's the US energy supply from 15,000 acres, about 40 percent less than the land at Disney World. Walt Disney, who envisioned EPCOT as a sustainable "community of tomorrow" instead of a sort of permanent world's fair, would have been fascinated by the potential. It is early for that technology, and the energy needed for such a system may be fantastically unaffordable, but it reminds us that we are in the early days of all bioenergy technologies.

If all the energy used today on earth could be contained in a box the size of an iPhone, then the total available supply of energy from the sun would occupy a string of iPhones stretching from Earth to Saturn. We are just at the dawn of a new age of energy, scratching with sticks and crude tools: yet, like the apes fighting to the death over carcasses in *2001: A Space Odyssey*, we are fighting over stupidities.

Moving forward with clean hands

The biofuels industry could do its part by proposing a rapid schedule by which subsidies and tariffs will be eliminated.

Then, and only, then, can the industry ask the nation to move onto the real issues with clean hands. So, quo vadis, biofuels: whither goest thou?

Simon Peter first asked the question of Jesus Christ in the days before the crucifixion, and Jesus said "Whither I go, thou canst not follow me now; but thou shalt follow me afterwards." The day for subsidies and tariffs to disappear may not yet have arrived, but some John the Baptist will have to say where and when it shalt follow. If a John is not available, a Barry Goldwater will do: it is time for a Goldwater moment to realign bioenergy for the important role the fuels and their producers will have to play.

If we are to move the conversation beyond the challenges of first generation biofuels and onto the commercialization of second- and third-generation energy, the biofuels industry must now check into a halfway house with a firm schedule for getting off the dope.

Resurrection of a positive national conversation about the future of bioenergy will surely follow.

Biofuels at the Crossroads

This essay appeared at the time of the Digest's first anniversary, and delved into the topic of whether biofuels developers were focused on developing a market, or simply asking for a mandate. I thought then, and think now, that mandates are unsustainable, shaky and cause problems in financing that forestall the very development that mandates were developed to foster. I have never been impressed with how the biofuels industry runs its communications – "all politics are local" said Tip O'Neill, and it seemed to me then and now that grassroots efforts were sorely lacking.

When the *Biofuels Digest* launched in July 2007, the industry was rocking along at high speed. Sure, the Energy Bill was stalled, but everyone thought it would get moving before the end of the year, and biofuels continued to inspire widespread admiration for the potential to improve farm incomes, achieve energy security and reduce greenhouse gas emissions.

Today, biofuels find themselves attacked broadly for creating higher food prices, higher gas prices, doubling greenhouse gas emissions, and contributing almost nothing to energy security.

What happened?

What happened is that prices rose, and the industry and its critics found out that support for biofuels was very, very shallow.

When inflation was under control, not too many souls

troubled themselves to think about building long term support for biofuels. How could you be against it? It was "good for the environment, good for jobs, good for security, good for trade, good for farmers". It was all things to all people. For most people, that was good enough. "Who's afraid of the big, bad wolf?" was the generally giddy attitude, and it served the biofuels industry just as well as it served the first two Little Pigs.

An American Biofuels Council effort last fall to launch grassroots public education seminars and certification courses in consumer biofuels education found itself without major funding support from a single biofuels entity. Instead, it was funded in micro-donations from individual citizens.

The same groups that said no to consumer education last year will shell out millions to the Alliance for Abundant Food and Energy, in a rearguard effort to shore up political support in Washington. They want their subsidies and mandates and are prepared to play plenty to secure them. Now that their straw house and their wood house have blown down, they're prepared to pay for a brick house.

They certainly will pay and they probably will get what they paid for: at the end of the day, every drop of biofuel is a better deal than a drop of imported oil. But then, that was always the case. Major agrienergy companies dropped the ball on education because they understand lobbying far better than consumer marketing. (Sigh) It's the way of things.

They'll find the political support they need in Washington, in all likelihood, although agribusiness is getting a good

fright at the moment from all the negative headlines. Political support has usually been there for biofuels in Washington, and in many state capitals - where energy security is part of the daily work discussion for many officials, the issues are better understood, and the prospect of job creation and pork spending is available.

The average American family and climate change

By contrast, for the average American family - busy working, raising families, preparing for retirement - the debate on biofuels, in the end, is about hard dollars.

If biofuels save money, people are for it.

If it costs money, they are for it ... so long as China pays for it, by buying more US federal debt to fund subsidies and research.

If it means a hit in the pocketbook, they are against it.

All the hoo-hah about the impact of biofuels on climate change won't mean much to most Americans, and to most people around the world...so long as biofuels save people money on energy bills.

After all, the lure of cheap fuel is how gasoline replaced ethanol in the first place, back in the days of the Model T.

All the other stuff - climate change, energy security - is background noise to the average American. In the end, "it's the cost, stupid". Particularly for fuel prices and food prices: they are vivid to us because grocery stores and gas stations

fight for market share based on price.

That's not to say that average Americans are not worried about climate change or energy security. They sure are - just look at the 81,707 registered members of the Pickens Plan online community, or surveys of consumer attitudes about climate change.
But the bottom line is that the average US family knows a lot more about American Idol than climate change, and their thin support for action on climate change will not create support for a tax hike to pay for it, or a cut in basic services to pay for it.

The average citizen is abandoning SUVs not because of concern for the environment, but concern over gas bills.

And that's OK. Prices often help us make good choices.

But hard, difficult, expensive choices are only made by people who have thought through the alternatives. And the American people are not there yet, not by a long shot. Too many are still looking to John McCain or Barack Obama to come up with a "Get Out of Jail Free Card" on climate change, energy security, high prices and international troubles.

In short, they like the idea of an Apollo program or a Manhattan Project, because someone else does the heavy lifting and it comes without added taxes.

Instead, the public will find that, after several regimes have come and gone in Washington, that our problems will not be solved by a "Man on the Moon" program. What is

needed is nearly forgotten, down home, homespun, good old American virtues like thrift, frugality and self-help. The Latest Generation is going have to learn what the Greatest Generation always knew: "Victory begins at home."

Want to do something for the environment, or energy security? Do some work. Make biodiesel, or grow vegetables in a personal "Victory Garden". Don't buy what you don't need, keep the thermostat high and the car use low. Use one instead of two. You get the idea. Big movements are made of little steps by a lot of people.

For now, we need education, on the streets, soon, smartly run, and dedicated to a larger vision than "Biofuels means [fill in the blank] jobs for the community of [fill in the blank]".

Education is important: shallow support is fickle support, and fickle support means uncertainty and instability. That's bad for biofuels, bad for economic development, and bad for the Republic.

That's one of the reasons why the *Digest* was started, to add a daily voice with hard, objective news, and it has become popular because it is free, and easy on the eyes. That's enabled the *Digest* to relay 3400 stories - good and bad - about biofuels to more people than any other source.

What's needed

An objective, non-partisan, non-profit Institute on Renewable Energy that focused on education would be helpful. College degree programs would be helpful. More

certification of community leadership in renewable fuels would be useful.

As it stands, having no way to decide who is balanced and who is on an agenda-rant, the American public either tunes out the biofuels debate until prices rise, or until a fear-monger comes up with a new way to scare them into a blind panic.

Fear, uncertainty and doubt

Biofuels have fallen victim to it, in part because industry leaders were focused on building support for production rather than distribution.

Industry leaders relied on a mandate and subsidies to carry them through to marketing success, instead of building customer belief, and it was never going to be enough. It's far easier to get local support for a plant, comparatively, because communities want growth and jobs. It's harder to build support and understanding at the retail level, and the biofuels industry has been hoping that the need to sell fuel the old-fashioned way, by creating and demonstrating value, door-by-door if necessary, would not be required. Here's the news: it is required, and it always was.

As an official at Archer Daniels Midland said recently when asked to support a grassroots ethanol promotion, "we don't want to associate ourselves with it". Now they'll pay millions to Washington lobbyists to avoid the consequences of that attitude, and rightly so, and it won't nearly be enough.

Creating ethanol-friendly engines that will repair the

perception that ethanol equals bad mileage, that's a start. Spending on grassroots education to repair the perception that biofuels equals famine in Africa will be better. Creating a distribution channel that will provide lower-cost fuel to consumers instead of blending in low-cost ethanol and pocketing the profit - that's the best.

But that's the hard work of retail marketing, and it needs to begin.

Banned in Boston

In August 2009, Massachusetts decided that only biofuels made from waste would qualify under state biofuels mandates. The industry was profoundly shocked. Banning energy crops is one thing – banning algae, cyanobacteria and other high yield feedstocks makes no sense on financial or climate grounds. It was simply and plainly a silly decision, and it has yet to be reversed. This editorial blasted the Massachusetts government for forgetting its own story.

"So they began to think how they might raise as much corn as they could, and obtain a better crop than they had done, that they might not still thus languish in misery" William Bradford, "Of Plimoth Plantation"

The branch of my family that first came to America arrived near Plymouth, MA in November 1620 on the *Mayflower*, fleeing religious persecution and in the hope of finding prosperity and freedom in the New World. 11 of my ancestors made the voyage; more arrived with the Winthrop fleet in 1630 that founded the city of Boston.

The Massachusetts story has been an inspiration to many, none the least myself, for the first writer in the family was William Bradford, who recorded the Pilgrim's story in *Of Plimouth Plantation*. Many an afternoon I have had the pleasure of reading of the trials of the pilgrims, and their discovery of maize and other native crops courtesy of local Indians, and the many uses they made of these crops for food, fuel, and household supplies as well as home remedies. No one who has spent much time with the Pilgrim story ought to be much surprised by the rise of bioenergy and biopharma, for it is but an extension of the furious,

desperate innovations of the Pilgrims themselves, when faced with the trials of living in the New World.

For nearly four centuries, Boston and the state of Massachusetts have been beacons in innovation, learning and forward-thinking, and I am proud to have a connection to the state and delighted by its illustrious contributions in almost every branch of science and learning.

But the recent action of the state government to ban carbon-neutral, non-food, high-yield biofuels is worse than a backwards step; it is an unenlightened step, and an uneducated one. It is the same arrogant desire, to ban things that one doesn't like for decidedly vague reasons, that tempted King James into harassing the Pilgrims.

The result will be the same as with England in the early 1600s. Pilgrims and pioneers will go elsewhere, and use their talents to build a future for other communities. Applying mandates only to biofuels made from waste feedstocks is, of course, good news for those who can meet the standards.

But states like Massachusetts ought to be a haven for even more advanced biofuels made from cyanobacteria, algae, poplar and other materials that can offer far higher yields and emissions gains than waste.

Picking winners and losers goes against the trend of renewable energy legislation, and is bad for jobs, the environment and energy independence. The state promises to revisit the issue as new evidence comes to light. New evidence is appearing every day, and revisiting the issue by lunchtime today is a good idea.

Think Sustainable, Not Renewable

This essay was published in December 2007, and attempted to further the idea that sustainability was going to be a bigger criteria for renewable fuels in 2008 than people thought at the time. In retrospect, I wish only that I had published the essay earlier, made the tone stronger, and was more familiar with the problems that were just emerging in jatropha. Sustainability and indirect land use change were huge for biofuels in 2008 and did much to dim the prospects for the industry.

We have been trained to think about fuels in terms of fossil fuels and renewable fuels. For a long time, fossil fuels were dirty and dirt cheap; renewable fuels were clean, and could clean you out buying them.

A lot of things have changed. Today, biofuels are generally cost-competitive with $100 oil, and will be a lot cheaper than $300 oil.

So why isn't there a stampede to the ethanol pump? Why are there less than 1500 E85 pumps nationwide and yet the entire industry opens pumps slower than Starbucks opens coffee stores?

The answer is that the conversion to biofuels is not a one-night-only event, but a marathon staged like American Idol, and at this point a number of renewable fuels have been "voted off the island".

The public has discovered some things we don't like about renewable fuels, and more and more policy officials are getting behind the concept of sustainable fuels.

These are the fuels that will receive incentives, protection, and consumer support. As an investor, find sustainable fuels that can be made at a commercially viable price and scaled to mass production, and bet on them. They have what it takes to be a long-term winner in the emerging new energy market.

1. Cellulosic ethanol. Cellulosic is popular in the US, where researchers have been seeking commercially viable production costs for the process of converting the woody biomass into sugars before fermenting the sugars into ethanol. Because the process uses waste material, rather than the edible biomass, it does not compete with the food markets and is not only sustainable but has a stable price horizon. R&D companies like Verenium (VRNM) are well worth a look, but Royal Dutch Shell (RDS), Chevron (CVX) and BP (BP) all have a hand in this game.

2. Brazilian ethanol. Of all the processes used to make biofuels on a mass-scale, such as soy- or palm-based biodiesel, or corn-based ethanol, Brazilian ethanol is repeatedly singled out as the most sustainable of biofuels. The market leader among public stocks is Cosan. The risk? Cosan is increasingly beset by competition from the Brazilian state-oil giant Petrobras.

3. Algae-based biodiesel. Of all the biodiesel feedstocks, algae has the most promise in the laboratory for the highest yield. Compared to 400 gallons of fuel per acre for corn, algae can produce 6-10,000 gallons per acre according to some promoters. More, algae requires only sunlight, CO2 and some nutrients to bloom at high speed. Small

companies are active in this market. Green Star Products (GSPI) is one of those closest to a commercial solution. The Risk? A viable process for extracting oil will not be found soon.

4. Jatropha-based biodiesel. Jatropha doesn't have the yield potential of algae, but it has more immediate viability, for the plant has been a proven high-yield oilseed source for a long time. Yields of 600 gallons to 1000 gallons per acre are talked about by promoters. Jatropha flourishes in marginal land, and is considered a "feedstock of interest" for that reason. BP and D1 Oil are among the public stocks most heavily invested in jatropha. The risk? Jatropha must be hand-harvested, and there's a risk that a viable way to produce oil on a mass scale will not be found until harvest can be mechanized.

Chasing Down 36 Billion Gallons of Biofuel

The Digest is generally not a cheerleader for the bioenergy industry, but this essay goes the other way, with more enthusiasm and exhortation than are generally appropriate in a news publication. It is clear that the debate over the Renewable Fuel Standard did not end in 2007, but simply changed in character. But it did correctly identify the E10 ethanol "blend wall" and the lack of E85 infrastructure as critical missing pieces in building a market, and these issues have become even more important in the two years since this was published in December 2007.

Now that the Energy Bill has become the Energy Independence Act of 2007, let's not forget that there are a lot of people — friends, neighbors, competitors, adversaries — who think that 36 billion gallons is an awful lot of ethanol. It's right for them to feel troubled and worried about the journey we have set for ourselves. Where, exactly, are the technologies going to come from that allow us to attain these lofty goals?

The American way, for as long as anyone can remember, has been to set off on impossible journeys to far-flung destinations, and reach new worlds of possibility that other nations and peoples have been known to wonder at.

"How did the Americans get a hold of America?" goes the whisper. "They don't deserve it!"

The Pilgrims knew. Lincoln knew. The doughboys of World War I and the GI Joes of World War Two knew. Lindbergh knew. NASA knew.

Or rather, they didn't know anything, except that they had a destination to reach and, somehow, using good old American know-how, they were going to get there.

The American system, for all its failures and weaknesses, is built by, built on, and built for impossible journeys.

So, the debate over the Renewable Fuel Standard has ended. Now, as Pilgrims, we set out on "an impossible journey" to produce 36 billion gallons of renewable fuel in a safe, viable, and sustainable manner, and we have 15 years to get there.

The Renewable Fuel Standard is a lousy name, if you ask me, because there's nothing in that term that implies how long, tough, and perilous the pilgrimage ahead of us will be.

But I don't doubt for a second that we will reach our goal, and with time to spare.

But if the Standard has a terrible name, it is a beautiful thing. The Standard is good because it gets us focused on the future without dictating any more than absolutely necessary about how we will get there. The Standard is a goal-line that we have to reach, but like all great football games, the players and plays are up to the individual teams to decide.

Along the way to this decision, some of our fellow Americans opposed the Standard, and some of our friends in the renewable industry did not realize, this time around, a long-cherished Renewable Power Standard.

Not everyone, as a result, is in love with the bill. That's

understandable: it's a compromise.

Historian Shelby Foote, in the Ken Burns documentary The Civil War, reflecting on the origin of the war, said: "We failed to do the thing we have a true genius for, compromise. Americans like to think of themselves as uncompromising, but it's the basis of our democracy. Our government is founded on it; it failed."

So we have done the thing that we do: we have compromised, set our goals, and now we set out on the journey to reach a shining city on a hill, whose light we have set ourselves to make in a sustainable manner from renewable resources.

What better way to make our beloved Republic permanent than to light it, heat it, and fuel it from sources that are renewable, and under our control?

The Renewable Fuel Standard is simply a beginning, for it does not address the means but rather the end. Like a market-maker in the stock markets, it provides a necessary base of assurance, but it is one moving part among many.

Without the Standard, how could the car makers invest in flex-fuel technologies without knowing if ethanol had a future? How could pipeline manufacturers invest $1 million per mile to build infrastructure? How could gas station owners take the plunge on pump conversion?

Without the Standard, there was too great a risk of too many trapped investments in too many industries.

So with the signing of the Act and the establishment of the Standard, much is accomplished, but much remains.

We need to move past the E10 "blend wall". We aren't going to use more than 14-15 billion gallons putting E10 in everyone's car, and few people are really ready for E85. The Brazilians do it right in mandating an E22 minimum blend. That would use up 31 billion gallons right there, even if not one drop of E85 was sold.

We need a guaranteed loan program or grant program, for E85 pump installations. Gas stations make money on snacks and soda, not gasoline, and station owners have neither the capital, borrowing power, or compelling interest to make the conversion. We're going to be mightily exposed if we have to sell 5-20 billion gallons of E85 and consumers have nowhere to get it.

We need to repeal the ethanol tariff and subsidies. The US biofuels industry is not going to succeed until it can compete head-to-head with Brazilian ethanol. We may as well get started now. It will require a hatful of technology breakthroughs, but so did walking on the moon. I have no doubt that we will get there, but we cannot simply lock in the profits for existing ethanol technologies and expect an economic miracle. That's the Soviet way: it will take us all down the same path as the Soviets took, and to the same end.

What we need is not a Soviet end, but an American beginning. We have set the goal, now let us hitch ourselves to any wagon that will take us across the prairies of our dreams. Let us work cooperatively with all nations, our

fellow pioneers, remembering that the best way to win a friend is to be a friend.

By all means, let us stop the squabbling about the suitability of ethanol. Quibbling about the wagon is no way to cross the frontier. Let us make the best of what we have, and get down to the work of finding the means, against all odds, to reach our destination.

Finding the means to reach impossible destinations against impossible odds is, after all, what we are good at. It is the very reason our forefathers made it here in the first place, and bequeathed this beautiful land to our care.

As Al Gore said "The way ahead is difficult. The outer boundary of what we currently believe is feasible is still far short of what we actually must do. Moreover, between here and there, across the unknown, falls the shadow. That is just another way of saying that we have to expand the boundaries of what is possible. In the words of the Spanish poet, Antonio Machado, "Pathwalker, there is no path. You must make the path as you walk."It is time for us to get moving, to cease the talking of the talk, and to begin the walking of the walk.

We've talked enough about America's leadership role.

Now it is time to saddle up, pilgrims, and remind the world how we came to be in America in the first place.

We say that we're the most stubborn, inventive, tough, competitive, sunny, die-hard, optimistic, inexplicable nation the world has ever known.

Let's prove it.

The Lowdown on Biofuels Subsidies and Mandates

Like a few other essays in this collection, this was for publication at UseCorn.com, a site covering bioenergy stocks and investment, and was published in November 2007The Digest has not editorially been a strong supporter of subsidies, mandates and tariffs, being more fond of refundable or transferable tax credits as a means of assisting young energy companies to grow. But mandates and subsidies are a daily fact of life, and this essay looks at the emerging level of risk in pure-play ethanol stocks. I can't say I foresaw the bankruptcies that befell most of them in 2008-09, but some of the underlying causes were clear even at the time.

Since the biofuel industry is young and capital-intensive, subsidies and mandates have been put into place to reduce the risk for investors, and increase the availability of capital for the rapid expansion of the industry.

The good news? Ethanol and biodiesel production has boomed in the United States. Ethanol production will reach 5.6 billion gallons this year - not a gigantic dent in the overall national fuel demand of 140 million gallons - but an impressive start.

The bad news? Ethanol pure-plays like Pacific Ethanol are not exactly swimming in profits. In fact, their gross margins are down alarmingly thanks to the increased cost of corn and the reduced price of ethanol on spot markets as more production comes online. That's one of the reasons why pure-plays have "risk" written all over the reports from analysts who follow their stocks.

Pavel Molchanov, biofuels analyst for Raymond James, says "At current ethanol and corn prices, we estimate that a typical U.S. ethanol producer is generating negative EBITDA of about $0.06/gallon....We are still not ready to call a bottom in the crush spread (currently $0.41/gallon, down from a 52-week peak of over $1.10/gallon in May), but we believe that the bottom is not far off."

The drop in ethanol demand has the infant ethanol industry crying for more mandates, and holding desperately onto their incentives for dear life.

Subsidies and mandates are powerful forces on the balance sheet and income statements of young companies in a young industry. So, investors have the difficult job of not only understanding the profit potential of the company: they have the second duty of figuring out what level of incentives and mandates will be continued and to what extent that will alter the profit outlook.

Subsidies and mandates always good for the bottom line? Not so! Incentives are good for industries, but they can produce disastrous overcapacity and competition for some companies that find themselves in the wrong place at the wrong time.

Good subsidy and mandate structure encourages the industry without creating investor exuberance and without rewarding bad companies.

Let's see where we are, where we are likely to head, and what that means for the biofuels investor/

Where we are

In the United States, we have a Renewable Fuel Standard (RFS) that mandates the sale of 7.5 billion gallons of alternative fuels by 2012. This translates to about four percent of the market. We also have a 51-cent per gallon blender credit that goes to fuel distributors who blend ethanol with gasoline, and a $1 per gallon blender credit for biodiesel. Many individual states have even stronger biofuels mandates in place, and some states offer additional subsidies.

Where we are going

The US House passed a 2007 Energy Bill that kept the ethanol and biodiesel subsidies while reducing the ethanol subsidy by a nickel a gallon, but did not propose a new RFS.

The feeling in the House was that the biofuels industry should have subsidies, but no longer needed mandates.

The US Senate passed a version of the Energy Bill that continued the subsidies and set a new RFS of 36 million gallons of renewable fuels by 2015.

The House and the Senate conference to resolve differences in the bills collapsed in confusion. The House ultimately passed a new 25 x 25 mandate that 25 percent of all fuel should come from renewable sources by 2025; meanwhile, the Senators Obama and Harkin introduced a new Senate bill with an RFS of 18 million gallons by 2016.

What it means for the biofuel investor

Subsidies are good for producer stocks because they make US producers more competitive. Right now, the betting is that the subsidy on ethanol will be reduced; so, if not, think about large-scale, pure-play ethanol stocks like PEIX, AVR or VSE that will be suddenly undervalued.

If subsidies are dropped on ethanol, that will make biodiesel perhaps a stronger component in the overall drive towards renewable fuels. If so, look to see upside for companies like BBDS.OB and NBF that are pure-plays on the biodiesel side.

If a 16 million gallon mandate for 2016 goes through, that means corn ethanol will have to carry a lot of the weight because second-generation cellulosic ethanol technologies and diesel engine improvements will not have had time to gain market traction.

In mandates are set with a longer time horizon, then the oil companies look better, and diversified companies like ADM which have hedged their bets in second-generation biofuels projects will look more attractive.

Whatever you feel will happen, it is important to always grasp that no matter what happens to incentives or subsidies — expanded, renewed, or dropped — they matter enormously in the investment decision, and understanding what is about to happen in Washington is one of the best ways to make money investing in biofuels for the next several years.

Your Friend, the Federal Government

This article was written in December 2007 for publication at UseCorn.com, a site covering bioenergy stocks and investment. Financial markets generally are less than fond of government intervention, and at the time of the article there was increasing criticism of the government's intervention in crop and energy markets. When I wrote that Government intervention is queer, but it's here, and you're gonna see a lot more of it," I did not foresee the global financial crisis of 2008, else I would have made these points even more forcefully.

Government intervention is queer, but it's here, and you're gonna see a lot more of it.

When it comes to commodities such as soybeans, corn, sugar, wheat and crude palm oil, there's a new sheriff in town. That sheriff is named Government Intervention.

Governments are no longer intervening in traditional commodities markets to make them more efficient or stable, or to offer price supports or production quotas as they have in the past. They want to turn these commodities — which are usually used for food and feed — into fuels.

Whether you think of it as climate control, energy security, or export promotion, it's queer, but it's here. And there's going to be a lot more of it, for a long time to come.

These governments are going to get their biofuels whether you like it or not. They are going to incentivize it with grants, subsidize it if they have to, and mandate its usage if they must.

Incentives, subsidies and mandates are getting pretty popular. The EU, United States, Japan, China, Australia, South Korea, and Brazil, all have them, and they are going to make them more robust as time goes on.

We have to internationalize our thinking, because the US is less of a player in this market than we are accustomed to. For example, over half of global R&D is spent in the US, but with only 5 percent of the world's population, when it comes to foods and fuels, the US is increasingly just one player among many.

So, the complexity of commodities is increasing. When it comes to corn, we not only have to think about feed and food, we have to think about fuel and carbon footprint. These are real calculation inputs that have to be factored into commodities buying, and it is making trading much more complex than before.

How complex? Well, take for instance the projection by respected analysts at TransGraph that crude palm oil prices would fall 4.7 percent in October, to $723, due to increased production in India. Many people might have gone short on palm oil because of that report. What happened? Palm has skyrocketed to $901 per ton as of November 8, 2007.

When markets become complex, opportunities can become highly interesting to the investor who carefully assembles his data. Information is at a premium.

What happened to soybean oil and corn prices? Corn is trading at $3.89 a bushel as of November 9 for the

December contract and soy is over $9 a bushel. Those are both more than 50 percent increases over last year. Will they stay at these levels?

The answer does not lie in studying traditional supply and demand, but studying interventions and mandates, and also studying substitutions. Consider, for example, that China ordered a halt this past month to all corn ethanol plant construction in the country because of the poor corn harvests this year would otherwise have forced China to buy corn on the spot market and import. That's a massive substitution that will have an effect on the corn market as well as the Asian ethanol market.

Consider the fact that India has mandated that 5 percent of fuel sold this year must come from renewable sources. Did they do this to help save the environment? Partly. The major reason was a sugar glut after record harvests, and India has decided to turn the excess sugar into ethanol fuel rather than suffer through the effects of a collapse in the sugar price if 12 million tones of sugar were dumped on the market.

The EU is considering a 10 percent mandated usage of renewable fuels in the near future. The US Senate has passed an energy bill mandating the use of 36 billion gallons of ethanol per year by 2022, of which 15 billion are to come from corn ethanol, compared to 6 billion gallons used today. India is scheduled to move to a 10 percent mandate next October.

But when it comes to charting commodity demand, it is not as simple as charting out the progressive imposition of a

mandate. For ethanol can be produced from 22 different feedstocks — including corn, rice, sweet sorghum, sugar cane, sugar beet, cassava, wheat and switchgrass.

Projecting supply and demand of a given feedstock means taking into account the geographic distribution of feedstocks. Europe uses primarily rapeseed and wheat for biofuels, the US uses primarily corn and soy oil; while Australia uses primarily beef tallow.

But we also have to look at government intervention in the form of subsidies. For example, a $1 per gallon biodiesel blending incentive given in the US has, through a loophole, allowed Malaysian palm oil biodiesel producers to bring their B100 to the US, blend 0.1 percent petroleum diesel in it, and export to Europe as low-cost B99.9.

So, when looking at commodities that can be turned into biofuels, look beyond traditional metrics such as harvest forecasts. Chart the impact of government intervention, and your investment opportunities just became a whole lot more simple.

Benjamins for Biofuels: Who's Getting Money Now, and How

No series of Digest essays ever attracted so much feedback – not by a long shot – as the "Benjamins for Biofuels" articles published in October 2009. Readers had been tipping me off for weeks that the Department of Energy programs for the commercialization of biofuels were not working as planned. Complaints from investors, investment bankers, attorney and project developers reached a critical mass, and finally I set down to write the story. In the end, so many readers came forward that the story practically wrote itself. Aside from making me an unpopular figure in the DOE press office, I am not sure the articles have had much impact, but they certainly have been as widely cited as anything else the Digest has published. I would have traded all the visibility for an ounce of true change, but it is simply too early to tell.

Part I: Who's Getting Money Now, How

1. Cheap sugar, baby.

Many strategies have been mooted, but one perennial is still popular. Have the cheapest way to make a load of sugar. Simple sugars are the new gold: if you can make it fast enough and cheap enough, customers and their own financing backers will beat a path to your door.

Sometimes, though, you can just be the biggest, baddest sugar project in a local market, even if your technology is not quite ready for the 22nd century. This Philippine project went down just such a road, obtaining $30 million in equity from Itochu and others.

In the Philippines, the Japanese firm Itochu is joining local investors in funding Green Future Innovations, which has proposed a $100 million, 14 Mgy sugarcane ethanol plant in San Mariano, Isabela. The investors will put up $30 million in equity, and the remainder will be project debt finance. The project will supply ethanol to the local market, which is moving from an E5 mandate today to an E10 mandate in 2011. The facility will utilize sugarcane from an 11,000 hectare plantation, which will also supply bagasse for a 19 MW power project associated with the development - 13 MW will go to the grid while the remainder will support farming and distilling operations.

2. The Baby Bloomers

Nothing is getting funded in bioenergy this year quite as fast and furiously as algae-related ventures. These young companies, the baby bloomers, have been landing scads of VC and public funding, leaving their brethren in advanced bioenergy scratching their heads in wonder, disbelief, and occasionally a bit of spite.

This government-funded project landed $70.5 million based on stimulating green jobs in a depressed region, and as a carbon strategy. Not to mention the promise of fuel, and biochar that can be converted into energy at a higher clip than simply burning biomass.

In Arizona, the U.S. Department of Energy announced that Arizona Public Service has been awarded $70.5 million from the American Recovery and Reinvestment Act (ARRA) to expand its ongoing algae-based carbon mitigation project. The project will now be tested with a coal-based gasification

system that aims to minimize production of carbon dioxide when gasifying coal. The host facility for this project is the Cholla Power Plant located in Holbrook. Funding for the project expansion falls under the ARRA's $1.52 billion funding for carbon capture and storage from industrial sources.

Arizona Public Service will scale up a concept for co production of electricity and substitute natural gas via coal gasification, while scaling up an innovative reutilization technology where power plant CO2 emissions are biologically captured by algae and processed into liquid transportation fuels.

The project is also expected to provide stimulus to a region that has experienced 13 percent unemployment. The funding will be provided in increments, with the first phase released to fund a feasibility study. In the project, APS will seek to grow algae fast enough to absorb carbon dioxide released from burning biochar to make electricity - the biochar in turn will be created from syngas from coal.

3. Swing Your Partner

Public-private partnerships have been a hallmark of bioenergy projects for quite a while. But never more importantly than now, when local authorities despair over rising costs of landfills, and bioenergy developers are hard-pressed to raise the benjamins for their projects. A Canadian partnership between the city of Edmonton, the province of Alberta (home province of Canadian prime minister Stephen Harper) and Enerkem shows how it can get done - not only for a waste-to-energy project, but an R&D center to

boot.

In Canada, Enerkem, the City of Edmonton and the Government of Alberta commenced construction of a joint advanced energy research facility. The research facility, a collaborative effort between Enerkem, the City of Edmonton and the Alberta Energy Research Institute (AERI), will focus on the conversion of various types of waste from industrial sectors and from the municipal sector, to produce green transportation fuels and chemicals. It will be adjacent to the commercial waste-to-biofuels production facility, which will soon begin construction and will produce 10 Mgy of ethanol. Construction completion is scheduled for the first quarter of 2010. Funding for the $10 million center comes from the Government of Alberta through AERI.

4. Drop Right In

Earlier this year, the *Digest* published a controversial essay, "Drop In, Tune Out, Turn On," saying that drop-in fuels were the future, and that food-vs.-fuel would fade as an issue. While ethanol and biodiesel projects continue to surface with amazing technologies and smart management, drop-in fuels such as renewable diesel have been receiving more and more attention from investors.

In this financing round, Amyris raised $24.7 million - less than it had hoped, but one of the big winners for the summer of 2009 - for its renewable diesel ventures.

In California, Amyris Biotechnologies said in an SEC filing that it has raised $24.7 million in Series C financing after

offering $62 million in shares last July to investors. The $24.7 million represented the first closing in the Series C round, and included existing investors Khosla Ventures, Kleiner Perkins Caufield & Byers, TPG Biotech and Votorantim Novos Negocios. Amyris was ranked #3 in the 2008-09 50 Hottest Companies in Bioenergy.

The company had previously raised $70 million in its Series B round in September 2007 from investors including DAG Ventures, Khosla Ventures, Kleiner Perkins Caufield & Byers and TPG Ventures, and a total of $120 million, according to Amyris spokeswoman Annika Jensen.

5. One Man's Meat is Another Man's Feedstock

Mascoma has found an interesting way to advance its business operation: take lignin, a by-product of its cellulosic ethanol technology, and use it as a catalyst for a partnership with Chevron, which has developed a set of lignin-to-transportation fuel technologies on its own.

In New Hampshire, Mascoma announced that it has entered into a feedstock processing and lignin supply agreement with Chevron Technology Ventures. Under terms of the agreement, CTV will provide various sources of lignocellulosic feedstock to Mascoma. Mascoma will then convert the feedstock to cellulosic ethanol through its proprietary process, which produces lignin as a by-product. Mascoma will provide this lignin to CTV for evaluation.

“This is an important moment for us at Mascoma,” said Dr. Jim Flatt, President of Mascoma. “The upgrading of our byproduct lignin to high value transportation fuels is an

important step in our effort to prove the effectiveness of integrated biorefineries. It has been our goal all along to make our process as integrated and sustainable as possible." Lignin is a complex chemical compound derived from woody biomass.

After biomass has been converted through Mascoma's proprietary Consolidated Bio Processing method, which breaks down the sugars in the cellulose and turns it into ethanol, energy-rich lignin is left over.

6. It's Been So Long, Darling

Several companies that have long been rumored to be contemplating a bigger role in bioenergy have included Darling, the international rendering giant; Bayer, Total, and ExxonMobil. This summer both Exxon and Darling entered the field via bioenergy partnerships.

Both come with caveats: Exxon's algae partnership with Synthetic Genomics is conditioned on an undisclosed set of milestones; Darling's waste-to-fuels partnership with Valero is very publicly conditioned on additional financing from DOE. Not that Darling and Valero are playing hardball with Washington…

In Louisiana, a report published in a recent edition of the *Digest*, suggesting that Valero was prepared to enter the biodiesel business, was confirmed when Darling International and a Valero subsidiary announced that they intend to form a joint venture to produce 135 Mgy of renewable diesel from animal fat at a plant near Norco. The companies said that the proposed plant would be located

next to the existing St. Charles refinery, and that JV would seek DOE loan guarantees to assist with the financing of the facility. The companies said that DOE funding is a must-have in order to go forward with the project.

7. Government is Your Friend

In so many ways, all financing projects are getting through based on some government assistance - grants, tariffs, subsidies, incentives, mandates or other support. But Canada's quarterly hand-out of $550 million in grants for bioenergy commercialization has been a lifeline in keeping Canada moving forward in developing new products for its beleaguered forest products industry, as well as maintaining forward momentum on climate change.

Companies like Nexterra have received up to $77 million for biomass gasification and other technologies - more than any US project, where the DOE has been more content to make small bets. One note: none of the "small bets" in cellulosic ethanol funded by the DOE in 2008 have been built, while Canadian projects are moving forward. Hint, hint.

In Canada, Sustainable Development Technology Canada said that it will award up to $550 million in its next cleantech funding round. SDTC is a not-for-profit corporation created by the Government of Canada to finance and support the late-stage development and pre-commercial demonstration of clean technologies. SDTC helps companies through the critical juncture when capital and scaling costs become formidable challenges and the risk profile deters many other investors. To date, SDTC has allocated $ 376 million to 154 clean technology projects. An

additional $905M million has been leveraged from project consortia members, for a total portfolio value of $1.3 billion. SDTC is accepting applications until October 21, 2009.

8. The Old Switcheroo

When in doubt, turn about. I think a sailor said it first, but US Ethanol managed the same feat when it moved its target from ethanol to power generation, using biomass. Getting it done, making it happen sometimes means changing your whole focus, as when PetroAlgae got going with lemna instead of algae, and here US Ethanol proceeded with...well, not ethanol. Recognizing that ethanol is a great intermediate has also been a hallmark of ventures like ZeaChem that are also getting traction.

In Washington state, US Ethanol has announced that a planned $100 million Northwest Ethanol project will convert now to power generation, and will produce 24 MW from wood-waste, including wood chips and hog fuel.

The original project concept was to produce corn-based ethanol, but the new project will save $27.,5 million in capital costs and makes the project easier to qualify for federal economic stimulus money and other funding sources for biomass projects. The project, which will be built in Longview, will still ultimately include celluosic ethanol in its development, but as a later stage. The company said in documents that it will issue of the Washington Economic Development Finance Authority tax-exempt economic development revenue bonds to finance the project.

9. Jumping Jack Flash it's a Gas, Gas, Gas

One of the hot products still getting funded is gasification. Whether it is Coskata for its technology for producing ethanol, or S4's plasma gasification technology, or the biogas project by the Tulalip Tribes described below - gas is, as they say, expanding. An additional tip: both Tulalip and the Southern Ute tribes have been financing bioenergy, which is considered to be an excellent long-term use of earnings from tribal gaming businesses.

Earlier this year, the Tulalip Tribes and local dairy farmers, with a grant from DOE and USDA, have established a biogas project to remediate dairy waste streams and provide electricity to Puget Sound Energy and the grid. The federal agencies providing funding for the initial feasibility study, and state funds helped with the search for an anaerobic *Digest*er. The resulting partnership between Tulalip Tribes, the Sno/Sky Agricultural Alliance, Northwest Chinook Recovery and Washington State Dairy Federation uses 30,000 of waste per day to generate heat and 2 MW of power.

According to the DOE, US Tribal lands have the potential to meet more than 14 percent of America's energy needs with wind power, and by using solar resources and bioenergy, could meet all of America's energy needs. 5 percent of US land and 10 percent of energy resources (conventional and renewable) are on US Tribal land.

10. Venture capital: "We're not dead yet."

It has become the conventional wisdom to write obits for the

VC industry, citing the rising cost of projects and the lack of an IPO market for exits. However, as has happened many times before, Khosla Ventures demonstrates that it is called "contrarian" not only by its critics, but its admirers who have poured in $1 billion into the company's new fund because, like another famous Silicon Valley institution, it can "think different."

In California, Khosla Ventures has announced two new cleantech investment funds with a combined $1 billion in fresh capital. The first fund, $250 million in size, will fund new startups, while the larger $750 million fund will provide fresh capital to companies that are seeking funds for scale up and commercialization.

The second fund is an example of an approach to solve the "valley of death" problem that befalls companies as they transition from small early-stage companies and find themselves too big for traditional VC investments but too early to attract project finance interest.

According to a report in Forbes, Khosla will set up a "conflicts committee" for the new funds that will oversee and limit re-investment in old companies that have not succeeded. Bnet.com is reporting, "Talk is growing of a spate of cleantech IPOs down the road." Khosla invested in Coskata, Amyris, LS9, RangeFuels, LanzaTech, Gevo and KiOR, as well as an interest in Cello Energy, which recently attracted interest when the company was assessed $10 million in liability to an earlier round investor. Among other Silicon Valley giants, Burrill & Company has also commenced development of a new cleantech fund.

11. I want to say one word to you. Just one word. Are you listening? Plastics.

To survive, diversify. That's the theme of companies like Solazyme, ZeaChem and Glycos Bio that are targeting feed, chemicals and nutraceuticals with technologies originally developed for the fuel market. Whether it is ingredients like algal oils for food products, or intermediates like propanediol, companies that focus on a wide-range of higher-value products are getting more funding traction.

Having said that - diversify but do not entirely divert. Markets that look promising today might collapse from oversupply, just as the ethanol market did — the true markets for renewables will remain power and fuel, because they have the size to absorb the capacity that new companies are capable of generating.

In Massachusetts, Novomer announced that it has completed a Series B funding round of $14 million, led by OVP Venture Partners. The company makes low-cost plastics, polymers and other chemicals from renewable feedstocks including CO2 and carbon monoxide. The company has raised $21 million to date, to exploit the potential of catalysts developed by Geoff Coates at Cornell.

Investors also participating in the round included Physic Venture Partners, Flagship Ventures and DSM Venturing. The company's first product, a polypropylene carbonate sacrificial binder, was released last year.

12. Only Nixon (and Bioenergy projects) could go to China

In #9, I mentioned the Indian tribes, first encountered by Columbus as he sought out a faster way to get to China. There days, no one is finding a faster path to China than bioenergy project developers. If you haven't had your passport stamped in Shanghai, Beijing, or Shenyang, time to hit the road and explore options. China's capital accumulations, growth rate, and growing carbon problems (in this decade it became the world's #1 CO2 emitter) make it a ripe target for hot technologies.

Part II

All Jim Pittman of Alabama wants to do is get financing. Whether his cellulosic ethanol technology will see the light of day - or should - is a topic for another time and place, and for evaluators of technologies more skilled than myself.

But this is America, where everyone is supposed to get a fair shake. This is the land of Teddy Roosevelt and the Square Deal, Harry Truman and the Fair Deal, Franklin Roosevelt and the New Deal.

But small business entrepreneur Jim Pittman has been getting Barack Obama and the No Deal. Or rather, the same old Washington shuffle, money for the boys. Not what was expected from the folk who campaigned on "Change You Can Believe In."

Instead, what we have is a heartbreaking saga that seems to have stepped right out of the same roots as "United Breaks Guitars".

The stimulus was intended to be all about reviving "business as usual" by, for a little while, doing "business as unusual". But what turned out to be unusual is how "business as usual" things are working in Washington. At a time when there is real distress in the country.

Jim Pittman's cautionary tale

Let me let Jim tell the tale, and then I'll come back with some metrics on DOE and where all the stimulus dollars are going - and not going.

"I have been working with the DOE & USDA for about 4 years now," says Jim. "More than a year ago, I received a Fact Sheet from the USDA titled 2008 Farm Bill Renewable Energy Provisions. This Fact Sheet came from the USDA Headquarters in Washington, DC. I was told to contact the USDA office in Montgomery, Alabama for additional help with applying for funding.

"The man I spoke with at the USDA office in Montgomery, Alabama was Quinton Harris and I seemed to know more than he did," Jim added. " I had to give him the copy of the Fact Sheet and forward the email to him. All Mr. Harris provided me with was an out of date list of banks who would provide loans under the USDA program and a referral to another USDA office down the hall who told me I could apply for as much as $200,000 in grant funds to purchase land to grow crops on.

“I asked what did I need to do to apply for this funding and the men in the office told me I could not apply for the funds. I asked for a clarification and was told the USDA offered up to $200,000 to purchase land to grow crops on, however no one could apply for the funds. I went back down the hall and told Mr. Harris what I had been told.

"He said I must have misunderstood. Mr. Harris went up the hall and came back in a few minutes saying he was told the same thing. A few weeks later, Mr. Harris called to tell me I needed to apply for a USDA guaranteed Business Loan with a maximum of $250 million.

“This was incorrect. I should have applied for a USDA guaranteed Biorefinery Loan with a maximum of $250 million. A USDA guaranteed Business Loan only has a maximum of $25 million. The only other problem was that neither Congress nor the USDA had notified the banks of the change. The banks were only willing to loan about $2.5 million which I am told was the old number.

"I received a huge amount of incorrect information & misinformation, including a list of 39 banks which is supposed to be willing to make loans under this program. Most of the banks said they had not made this kind of loan in the past 5 years, with the rest saying they had stopped supporting this kind of loan more than 10 years ago. When I did find a

bank willing to work with me on this kind of loan, the USDA refused to communicate with them at all."
But the horrors didn't stop with the funding requirements run-around. Then there was the notification system.

"I was supposed to be on an email list to receive regular updates from the USDA about funding. I received a notification on April 30, 2009 saying that loan guarantees for all of 2009 was closing on April 30, 2009. Some updates, right?

It took until May 10, 2009, for someone to respond as to why I was not receiving regular updates from them. Have not heard from them since, so I guess I am not on an email update list. I had to email the White House to get anything done about this as I never heard from the Secretary of Agriculture. Then, I was told it would be after October 2009 before the USDA would be accepting any new application and those would be for 2010."

But all that - well, that's the good part. Now for the bad news.

"I will be attending another Webinar tomorrow with the DOE on funding, however each time I attend one of these it is like they want to push the funding date off just a little bit more. First, funding was May 2009. Then, July 2009. Then, September 2010. Now, it is December 2011. Yet, all of the Recovery Act 2009 funds are supposed to be spent by September 2010. Figure that. I have heard rumors from DOE that some of the TARP funds might be used for Renewable Energy, however I have seen nothing on this yet. The Webinar tomorrow is supposed to be about NEPA paperwork. The last Webinar crashed midway through and ended up running over."

Hi, we're the Government, we're here to help

So, Jim did what Small Business people are supposed to do.

He contacted the Small Business Administration.

"I contacted the SBA about help with writing a business plan. They gave me the usual information to help with writing a business plan and told me to bring one in. I was working on some technical papers at the time and made a mistake when I took them the plan. I gave them the coversheet for the business plan on top of a technical paper. I realized it after I got home. I tried to call the man I had given the plan to, however he was out of the office. I left a message for him to call me, but I did not tell him why. He did not call me back that day or the next."

If you are like me, you would think that at this stage the SBA would call back, realize the mistake, and work with Jim to rectify matters. Of course, like me, you would be dead wrong.

"When he did call me back, it was to set up an appointment for me to meet with him the next day. When I sat down with him, he told me it was a good business plan. He told me for me to be able to get a loan, I would need to have a great business plan. To have a great business plan, I would need to hire a special business plan writer and pay him a fee in advance ($5,000). He was very surprised when I told him that I knew he had not read my business plan. I told him to look at the second page and he then realized why I had called him back the very first day."

DOE's Spending Spree

These horror stories are just grist for the mill in Washington, but this was supposed to be the year when

things were different. Meanwhile, I did some checking on DOE funding to date. You can download my compiled spreadsheet, here, of every funding announcement I could find made by the DOE since the Inauguration.

$32.9 billion in total funding announced, including grants and loan guarantees. Impressive!

But just $17.44 billion for the private sector, the street - nearly half of that in loan guarantees rather than outright funding.

The rest of it went to government (although, some went in state block grants that may, in turn, have some portion that finds its way to the street; and some of that went to the utility sector, in which there are private companies). Seems to me that government announcing a grant to government is double-counting. Call me stupid - isn't that just an allocation?

Pennies for biofuels

Of the $32 billion, $792 million has gone directly to biofuels or biomass — 2.4 percent. That's 29 percent less than went to coal - which I thought was the energy we were supposed to be transitioning away from, rather than investing in.

Electric and "clean" vehicle technology received $2.9 billion — that's $500 million more than the entire support for the solar, biofuels, wind, hydro, and geothermal investments which are supposed to provide the renewable molecules and electrons to power said vehicles.

Now, looking at the $792 million for biofuels, let's ask how much of that is on the street right now. The DOE sent around an announcement yesterday, and some money for biofuels did in fact just hit the street. For the BioFuel Oasis Cooperative in Berkeley, California, an award in lieu of tax credit in the amount of $16,858.

That's 5 one-hundred-thousandths of one percent (0.00005%) of the total announced funding. I had to get out a scientific calculator to handle all the zeroes. Here we are debating in the Congress whether to continue to stimulus - heck, the first wave of investment isn't even on the street yet.

Is this some kind of bizarre black-ops study of the effect of government stimulus, in which the biofuels industry received the placebo?

The Golden Fleece Award

My favorite grant was $85 million announced in July, "to support at least 50 early career researchers for five years at US academic institutions and DOE national laboratories."

Let me do the math there, that's $1,700,000 per researcher, or $340,000 per person per year. But it gets better. The university positions are for "summer salary and expenses" only. Only some of these positions — for DOE National Labs — are full time. Full-timers get $500,000 in funding, per person per year.

Now, according to salary.com, the average salary for an assistant professor in the United States is $62,654. Leaving

$438,346 for DOE national lab "expenses". Where is William Proxmire's Golden Fleece Award when you need it?

Let's put this in perspective. This 50-person program received more than nuclear energy R&D, so far this year, or hydroelectric power development, or fuel cell research.

What is wrong with these people?

Part III

A flood of response came in yesterday to part II of the "Benjamins for Biofuels" series on the state of bioenergy finance.

Response came in from all over the US and as far away as Poland to "Are biofuels receiving a stimulus, or a placebo?". Producers, attorneys, and investment bankers confirmed that there is something seriously awry with current efforts to restore liquidity to bioenergy project financing. I even heard from a solar producer who confirmed that the problems are not limited to bioenergy. All agree that goals are sound, but structure and execution have been found wanting.

"God is in the details," wrote Gustave Flaubert. If the Supreme Being is, in fact, currently residing in the details of how biomass and alternative energy are being financed, a severe working capital shortage is sure to be coming up in the Hereafter.

When I contacted the USDA and Department of Energy for comment on problems raised by producers in yesterday's story, stony silence emanated from USDA. The DOE press office informed me when I called that" we're in a staff meeting right now, can you put it in an email." I could have been calling to relay the news that the Middle East had gone up in flames. Email duly sent, no response duly received.

Stonewalling the *Digest* appears to be a criteria for mid-career advancement in the federal Government, but as several officials at EPA discovered this summer, when the *Digest* speaks it is not with the editorial department's voice that needs to be heard. It is your voice. You will be heard, in the

end, not because you have a beef, but because you have a point.

Not everyone in Washington was so unresponsive. The office of Senator Blanche Lincoln of Arkansas, the newly appointed chairman of the Senate Agricultural Committee, called right back and is taking a look at an intriguing proposal by industry investment banker Tyler Krutzfeld that I will relate a little more about in a moment. What more can anyone ask?

Today, I'll be contacting Cathy Zoi, the assistant secretary of Energy for EERE, and we'll see what her office has to say about all of this. I'll report back tomorrow as we move up the chain of command in DC until someone takes the time to respond.

You have a point about bioenergy finance. It's time to think through the problems raised by the bioenergy industry with respect to the financing of the nation's goals in clean energy. The process is crippled. LS9's success yesterday in raising $25 million from Chevron and other investors will be meaningless if a financing structure for sustainable biofuels is not in place. Giovanni Bisignani, the CEO of IATA, said so this week in Washington, and he is right.

President Obama said to the United Nations yesterday: "We understand the gravity of the climate threat. We are determined to act. And we will meet our responsibility to future generations."

Note to the Obama Administration: It is time to match rhetoric with deeds. Pick up the phone.

A few selections from the in-box at *Biofuels Digest*.

From Mike Carpenter, managing director of Energy Recovery Group in Oregon: "My USDA Oregon rep sent me the contact information of 30 banks, all apparently designated USDA 90% guaranty, $10M – 3 of thirty responded.

"One of the three followed up – we had a deal – all I have to do is: Show 30% cash, 27 different documents, private and personal, and the killer, a separate, exclusive method or vehicle to pay for the project, not related to the project. As a solar project, I need to show a 5-year payoff. I called the other 27 banks just to check – the FDIC answered twice, we aren't lending any money, we don't have anyone smart enough to analyze a solar deal, on and on."

From noted industry attorney Todd Taylor, partner at Fredrickson & Byron: "This is why I always tell people to be careful about having so much Gov't activity in the space. Not only does Government make bad bets (look at cellulosic ethanol and how renewable fuels and feedstocks are defined in RFS II…lunacy) and should not be picking winners, but it stifles innovation, puts undue restrictions on projects.

"But worst of all are stories like Jim Pittman's. It would be far better for Gov't to create an environment where innovation can succeed, entrepreneurs and financing sources have certainty and let the private sector do what it does best."

From Martin Mizera, CEO of Unicorn Chemical: "At this

point we have 3 ethanol and one biodiesel projects going on in Poland. Regarding Jim Pittman's saga - Poland is a recipient of an ungodly amount of EU development funding of all kinds, $95 billion by the latest count. The government is hard pressed to give it all away. It is also a country with ca 7.5 million tons of surplus grain this year and local production is not subject to EU duties. All kinds of banks are competing for the business of biofuel developers. We'd like to bring it to your and your readers' attention that they are all (Jim Pittman included) welcome to come here with their projects. Unicorn Chemical would be more than happy to intermediate on their behalf, get them loans, get them industrial grants (non-repayable - ever!) and in general hold their hand before they can run.

“The EU grants are between 50-85% of the project value, research, technology and brick and mortar included. I have gone to Poland from Michigan, so can everyone else."

Another reader wrote on the general subject of governmental craziness, stating that it took the EPA 30 years to decide to test vehicle fuel economy with the air-conditioning running. Apparently too late to add value to a patent on a technology that improved fuel economy while air-conditioning is running by up to four percent. By the time EPA added air-conditioning to the test, says the reader, the patent expired.

From Jim Pittman himself, the antihero of yesterday's saga: "At the beginning of the DOE Webinar today, we were told if the same thing happened as before [Webinar system crash] to just stay online or on the phone. It makes no sense to be on the phone and the web both as to ask a question, you

have to enter it on your computer. They have not yet made a way for you to just access the Webinar by phone as they originally said they were going to do. Well, it crashed again. I was connected by phone and suddenly I had a busy signal. "Also, I was unable to connect by the computer, so I missed out on the last 30 minutes or more. First, I was told the speaker would be talking for 1 hour and then Q&A would be 30 minutes. The speaker could not pronounce most of the words in his presentation. It only took 30 minutes for his presentation. So, they started Q&A immediately. Before we were able to see questions as they were typed in. This did not happen this time, so that should have told them something right there. We were told the slides would be available either today or by the end of the week.

The really strange statement was that the DOE hoped to one day have a loan process, which would only take 15 months! They said there were more than 500 people in attendance for this Webinar and most of the people represented small businesses, however DOE still has not worked out a plan/loan for small businesses. Why did we need this information then?"

From industry investment banker Tyler Krutzfeld of MontVista Capital - that rara avis of energy financing, a solution: "Our banks are crippled, failing, or readjusting to higher capital needs- and the USDA is not staffed up to do their homework ahead of the banks – thus credit is not flowing to good projects. This reality, combined with distressed assets in a range of sectors, spells a credit freeze. A suggestion for you to your readers (to their Senators) which may actually help our banks shake off this historic hangover:

"Dear Secretary: Please change your underwriting process, train staff, and if necessary hire staff - to offer a loan guarantee prior to a bank offering a loan commitment, not contingent to a loan commitment. Allow the USDA to be a part of the solution to this credit cycle, not a neutral party. This requires a minor adjustment of existing resources in DC to the state level."

It was Tyler's solution that in part, prompted me to contact USDA, and such a disappointment that the Secretary's staff were disinclined to respond with even so much as a "buzz off". It appears to be a sensible idea proposed by an investment banker perfectly positioned to see the problem and the fix.

Now that Senator Lincoln is on the case — in her role as chairman of the Senate Agricultural Committee, and gatekeeper of the USDA's budgeting process — let's see if the response rate changes a little.

Part IV

The US Government offered $529 million loan to an Al Gore-backed company making an $89,000 all-electric sports car in Finland, while US projects for US jobs go unfunded.

The move follows a $465 million loan to Tesla Motors for another all electric sports car. Employees of Fisker's top investor, KPC&B, donated more than $2 million to the Obama presidential campaign, and customers who have pre-ordered the Fisker include Al Gore. Gore is a partner in KPC&B.

The DOE denied that politics played a role in the decision, saying that a "detailed technical review" took place, and that the bulk of loan proceeds for the Silicon Valley-based Fisker will go towards development of a $40,000 family sedan that will be built in the US.

There's only one catch. According to the Journal, the family sedan has not yet been designed.
Meanwhile, response continues to pour in to the *Digest* regarding delays, confusion and unhappiness over government-related funding of bioenergy, as reported this week in the *Digest*'s "Benjamins for Biofuels" series on bioenergy financing. I asked for success stories and horror stories, and received none of the former, plenty of the latter. Successful ventures, of course, have less of a motivation to write.

But zero is zero. Unless you count the millions for Finland.

At the National Science Foundation, a bioenergy research

project was declined by NSF, in part, because of a "very poor" grade given by a reviewer who wrote: "To base the proposal on the theory that there will be a variety of low-value feed stocks available is, in the opinion of this reviewer and many other industry observers, a faulty premise. Biomass is cheap right now because no one wants it. However, as demand increases, it will become more expensive. Further the laws of supply and demand mean that replacing a significant amount of gasoline with biofuels would drastically lower the demand for gas. This would, in turn, cause the price of gas to plunge, making biofuels less competitive."

The same argument could be made to reject solar and wind energy research — or any alternative energy — by making the case that massive adoption of solar or wind would cause the price of coal to plunge, making solar and wind less competitive. The same argument could be made, in fact, about guns and butter. Or the impact of the automobile on the price of horses. Or the impact that the invention of the wheel on piggyback service providers.
From the same review of this technology, I quote:
Reviewer #1: "This is a well thought out proposal supported by a well qualified team."
Reviewer#2: "This is a well written proposal with good technical foundation to carry out the project. Project team collectively has good qualification and sound experience to advance the scientific work in a professional manner."
Reviewer #3: "The company has a very poor intellectual property position. The company does not appear to have a sound business plan."
Reviewer #4: "The proposed team has no relevant experience in commercialization or business development experience."

Reviewer #5: "The proposed plan is sound and improved results are likely with further research."

A reader writes: "We met with Patrick Davis, program manager of vehicle technologies at DOE/EERE and one of his assistants. Joining us at the meeting were two senior research officials from DOT/Federal Railroad Administration (FRA) who told Davis that it is their belief that the AHL-TECH technology is worth considering for next generation "high speed rail" (HSR) passenger service which is a cornerstone of Obama administration transportation, clean air, and energy policies. Davis advised that "vehicle technologies" do not include anything related to railroads but are focused on cars, trucks, engines, hybrids, batteries, etc. He added:

1. DOE can't do anything because "we don't have any money;"
2. We won't have any money for new programs until the FY11 budget cycle;
3. Congress will decide what to do (meaning DOE has no control over or input into the process); and
4. We may have some new direction(s) that could include rail in six months or so.

A reader writes: "On April 11, 2009 DOE announced a whopping $38.5B in loan guarantees to “encourages the development of new energy technologies and is an important step in paving the way for clean energy projects.” All a start-up company has to do is fill out reams of paperwork and submit it along with their justification of why they need the money and there $75,000 non-refundable application fee. ”

"David Frantz, Director of DOE's Loan Guarantee Office, said, "We intend to move forward quickly and deliberately to issue solicitations, conduct a thorough financial and technical review and support these truly innovative technologies that hold great promise for our nation's energy security." So for a meager $75,000 application fee, a small company that only needs a couple of million dollars to get started, can put life on hold for 15 months or more (if DOE gets the process streamlined down to 15 months) while they wait to hear if DOE will guarantee a loan that the banks won't make.

"In the meantime, $38.5B is held in limbo because it is "budgeted" for loan guarantees that are never made, or if made, go only to huge corporations that can afford to pay $75,000 and keep operating while they wait to see if the loan guarantee goes through. So much for "accelerating commercialization."

A reader writes: "If I have been working on a project for several years, and have interest from customers, I can always go to the DOE for a $150k SBIR grant. First, just make sure your "innovative" technology has already been thought of so the government already has put in a cubbyhole for funding ("Yes Mr. Inventor, it does appear you have an engine that will run on water, but we cannot give you the $150k grant to research it because there is no Water Engine category in our SBIR solicitations for this year. Perhaps next year...") Then all I have to do is go back to the drawing board, spend the next six months to a year to have someone else tell the DOE that the project I have already spent time and money on to develop and that customers want to buy is worth looking at,

because this phase is only a “Feasibility Study” (“Yes, Mr. Inventor, here is $150k to confirm that the product you have designed and shown can work and that customers want to test is actually feasible.”)

“Then once I have put my project on hold for almost a year, and spent $150k of the government’s money, I can then put in for another grant for up to $750k for R&D on something I have already developed! After a meager three to four years I am ready to commercialize the product that was ready to go when the entire process started. But if you do not go through Phase I, showing the feasibility (again) of what you have already developed and are ready to build, you cannot request the $750k in R&D money. That is what the “guaranteed loan” programs are for."

Part V

Over the past week, we have reviewed who is getting the benjamins (i.e. money) in bioenergy now, horror stories regarding delays at DOE and USDA, the possibility of shenanigans in the financing provided to Fisker Automotive by the Department of Energy, and all kinds of feedback from readers near and far.

In today's concluding report we have selected two reader notes received on Friday that add some color to the problems already highlighted and, in hopes of fighting a problem with a solution, we propose what we believe to be a sounder structure for bioenergy finance going forward.

From a reader: "Back in August 2009, I was trying to filling out the load of paperwork for a SBIR/STTR (Small Business Innovative Research/Small Business Technology Transfer) grant. I had question. I called the phone number I had been given for the help desk. The number was not an active, working number. I had to email a man who has been able to provide phone numbers or email addresses in the past and no other help.

"He gave me the correct phone number for the help desk. When I called the help desk, I was told they could not help me or answer my question. The help desk is an outside contractor who must direct you to the email address of the project leaders as none of them are taking any phone calls about any opportunity offered by the DOE! Really helpful, right? I still do not have any sort of receipt that the DOE accepted my grant application at all. First, you have to apply at www.grants.gov, then at www.fedconnect.net, and then

you are told you have to go through a long access process to IIPS to apply. Then, you are not able to get anyone to help you get back to IIPS. We're here to help you (get lost), right?"

From a reader: "Peer review is a great system for apportioning research support, but it does have one fault. Because a favorable funding score depends so strongly on a consensus of reviewers' comments, it is very poor at evaluating unorthodox research proposals. The NIH is very aware of this, and tries to set aside a small pool of its total funds to be used for funding unorthodox proposals (or alternatively, proposals by new or inexperienced investigators). So far as I know, NSF does not have a similar program.

“Perhaps the greatest case in which an unorthodox scientist went unfunded for many years because his discoveries fell so far beyond the pale was Carl Woese at Illinois, the discoverer of the archaebacteria. No one would believe that there was a third kingdom of living organisms that had remained undiscovered for more than 100 years. It turns out that these are not only the most abundant bacteria on earth (because of their abundance in the ocean), but also that they are probably responsible for the formation of most of our petroleum deposits. This is an important discovery for anyone interested in biofuels."

Notes toward a solution:

Readers have been consistent in noting that, for a variety of reasons, capital is tight. Both debt and equity are historically difficult to obtain just when the nation is embarking on a schedule leading towards 36 billion gallons of biofuels

production by 2022.

What the nation appears to require is a larger investor pool, yet investors are shying from biofuels because of project risk, technology risk, timing risk - the perceived risk is high, even if the rewards are substantial, and the numbers are well beyond the resources of those, like venture funds, who thrive on risk. It is one thing to ask a company to invest when it stands to make a 10-100X return on investment. Banks, who deploy huge amounts of project finance for pennies of interest on the dollar, are another matter.

To increase the investor pool, we must de-risk the investments and simply the investment process — not every investor has a back office filled with bright talent to perform due diligence.

How? Asset-based securities, sold to global investors.

In an asset-backed security schematic, "Renewable energy project A" receives a loan from "Bank B". "Bank B", in turn sells the loan to a quasi-private corporation, a Renewable Energy Finance Corporation. The corporation issues tax-exempt bonds, backed by government guarantee, and sold in pools of loans as an asset-backed security to global investors.

The investors thereby participate in renewable energy finance without having to choose projects, or assume the geographic or technology risk of a single development.

Meanwhile, project developers and participating banks contribute funds to an oversight organization - like the Federal Deposit Insurance Corporation — that provides

insurance to the government when projects fail. This Federal Energy Insurance Corporation also has the power to regulate loans, and seize troubled assets. What is the result?

1. Global investors provide liquidity, protected from risk by pooling of loans and by government guarantee, rewarded with tax-exempt interest payments,

2. Government provides a secondary market for loans to participating banks, itself protected from excessive risk by the funds and oversight provided by the FEIC oversight organization; rewarded with accelerated progress in its renewable energy goals.

3. Banks, having a new secondary market to sell its portfolio of renewable energy loans into, are able to originate loans, dispose of them into the secondary market, and apply the replaced capital to increase the volume of project finance. They are protected from excessive risk by selling loans into the secondary market, and rewarded via a faster rate of landing.

4. Projects have the opportunity to access more funds, cutting project timelines and reducing the cost of capital. Good, feasible projects are protected from the risk of going unfunded, and in turn through FEIC fees are reducing risk to lenders and the secondary markets.

5. The Renewable Energy Finance Corporation can be capitalized and managed as a public entity or, alternatively, be opened up to investors, who will participate in income derived from the spread between the interest rates paid by projects, and interest paid on tax-exempt, de-risked bonds

backed by the project assets.

While asset pools can be created in the private market, thereby collating and de-risking individual "bets" on bioenergy projects, but the public sector is the owner of the public good created - cleaner air and energy security.

Why de-risk? The risks associated with bioenergy have proven acceptable to early-stage capital who have a big upside, but anathema to lenders who provide as much as 80% of the capital for the pennies in project interest.

The lessons derived from Fannie Mae, Sallie Mae, and Freddie Mac could pay dividends in a stronger public structure for renewable energy — in its own way, a national priority equal to the importance of home mortgages and tertiary education for which other public financing corporations were founded.

How Castro Biofooled The World

This essay was the first published in the Digest on the origins of the "food vs. fuel" debate, and appeared in February 2008. It also charted the close connection between policy and economics in "food vs. fuel" considerations. Living in Miami as I do most of the time, it seemed a natural to focus on Fidel Castro, a decidedly unpopular figure here in the Magic City.

"'Change, change, change!'" Fidel Castro wrote, regarding the US Presidential campaign, in a column published this morning in Havana. "I agree, 'change!' but in the United States," he continued. "I enjoyed seeing the embarrassing position of all the U.S. presidential candidates."

However, change appears to be coming more quickly for Cuba's biofuels policy than for Castro's US targets. And some level of embarrassment may follow.

It is becoming increasingly clear that Castro's opposition to food-based biofuels is based in his policy of opposing the US. Castro was quoted in Znet's "Maize of deception: How corn-based ethanol can lead to starvation and environmental disaster", stating that "using corn, or any other food source, could result in the premature death of upwards of three billion people."

In fact, Castro has been building up a food-based biofuel empire, striking quiet distribution deals with Nigeria and Venezuela. Further, the potential for Cuba to produce between 2 billion and 3.2 billion gallons per year of sugar cane ethanol has been projected by industry analysts.

Ironically, Castro's Marxist formulation of a zero-sum struggle between the forces of "food" and "fuel" has found a welcoming home in US-based NGOs and media outlets.

Even more ironic that it is the conservative forces supporting conventional oil & gas interests who have most enthusiastically adopted the Marxist outlook, not excluding usually reliable anti-communist media such as the Wall Street Journal.

Finally, Comrade Castro has found common ground among US conservatives! These writers and policy wonks have been so determined to spread his message of "food vs. fuel" in their own name that virtually no one remembers that it was Castro's idea in the first place. How ironic that conservative forces have propelled the Marxist dialectic into which the global dialogue over biofuels has fallen.

Castro's, and Cuba's, expansion into ethanol began as the result of a failed policy of sugar cane expansion, which was predicated on the sale of sugar to the Soviet Union, in return for oil and manufactured goods. In the 1970s and 1980s, Castro's policies increased Cuban sugar production from an infamous initial target of "Ten Million Tonnes", which required almost every able man on the island to work in the sugar industry, to more than 80 million tonnes of sugar cane production by late 1989. Cuba exported more than 10 million tonnes of sugar by the 1980s, making it the largest exporter of sugar in the world.

With the collapse of the Soviet Union came the collapse of the Cuban sugar trade with the Eastern bloc, and production tumbled to as low as 1.5 million tonnes of sugar

by 2006, with only 1 million tonnes exported. And, by 2007, record sugar cane harvests in Brazil and India were threatening the collapse of global sugar prices. India pressed forward with an emergency introduction of an E5 mandate in October 2007 to soak up excess production, and is prepared to go to E10 in October 2008 despite widespread chaos in implementation.

By 2006, Cuba has shuttered 40 percent of its more than 150 sugar cane processing plants, and with rising international oil prices, the island has naturally turned to sugar cane ethanol as an export product. The country has constructed 17 ethanol production plants to date.

Castro may not have regretted a decision to block ethanol development in Cuba by Archer Daniels Midland in the 1990s, but Cuba has faced severe capital shortages in modernizing its 17 ethanol plants, and questions about potential export markets. The US has remained implacably opposed to Cuban imports, and the EU has become a less attractive market for ethanol in light of rising opposition to biofuels among the European intelligentsia, and an increase in European sugar beet ethanol production capacity.

When Castro struck out against biofuels, it was not only in articles in party-controlled newspapers on the island of Cuba. Cuba, Bolivia and Venezuela supported a draft report to the UN General Assembly calling for a five-year moratorium on ethanol production produced from sugar cane. The author of the report, UN Special Rapporteur on the Right to Food, Jean Ziegler, said that "transformation of agricultural land for the production of bio-fuels in America" is a "huge problem. This had resulted in the rise of the price

of corn, especially in Mexico. This would lead to massive hunger in the world."

Ziegler spoke also about the situation in Brazil, stating that "the scale of sugar cane plantations was spreading to the detriment of domestic agriculture in Brazil. The landless peasants in Brazil had campaigned against bio-fuels — all 6 million of them."

Castro received strong initial support from close ally Hugo Chavez of Venezuela as well as continuing support from Bolivia, but Chavez subsequently introduced an E7 national ethanol target. Chavez said that his government is no longer opposed to the use of ethanol or the use of foodstocks to produce it, but opposes the use of corn for ethanol production.

Chavez said that for each acre planted to grow sugarcane for biofuels, his government would plant two acres for food production, which would require 36 million acres of land to be converted to food production, based on 780,000 barrels a day of oil consumption as reported in the New York Times.

This is equivalent to an area the size of the state of Iowa.

Land conversions that have resulted in 6.5 billion gallons of ethanol production, or 15 million acres of land-use conversion, were the subject of articles in Science magazine and have prompted anti biofuels articles in more than 30 major US print and online media. Not a single commentator, among an ocean of opinion about the greenhouse gas consequences of devoting 15 million acres to corn ethanol, mentioned Venezuela's policy.

It was an editorial by David Ridenour of the National Center for Public Policy Research, that first linked biofuels to higher retail food prices in the US, and "chronic hunger, malnutrition and starvation" in the poverty-stricken nations of Africa and Southeast Asia, and was widely syndicated in the United States.

For Cuba, the attractions of tweaking the United States in foreign capitals, or saving three billion people from premature death, has proven less appealing than paying for the country's 1.5 billion gallons of oil imports, which will cost Cuba 3.65 billion based on the current world oil price of $100 per barrel. The country currently meets only 33 percent of its consumption needs through production. Export of 3 billion gallons of ethanol would provide roughly $7 billion in export income, more than enough to pay for Cuba's oil needs.

As the strident calls for a moratorium on biofuels over the issue of food shortages have fallen to a whisper in Caracas and Havana, the din has been replaced by the racket of the keyboards of the Wall Street Journal editorial board, who have lately discovered a sympathy for the plight of the world's poor.

Meanwhile, the African and Asian small farmer continues to look at the potential for a rising income, and some food security for their villages, from much maligned biofuels. They would point out that, despite the best efforts of many to link their plight to the escalating cost of grain, food and grain are not the same thing. Energy inputs are required to turn grains and plants into food.

Just ask the 27 children who died in the Philippines in 2005 from eating undercooked cassava. The world's fifth most important staple food, cassava is a deadly poison if eaten raw, and requires energy inputs to make it edible. In fact, 80 percent of the cost of food is not the grain or biomass it is made from; it is the cost of energy to plant it, harvest it, process it, transport it and package it.

It has never been a case of "food vs. fuel" since time out of mind when humankind discovered fire and the preservative powers of baking bread and roasting meat.

Biomass + fuel = food.

Expensive fuel, or expensive food, is an inconvenience in the West. In developing nations, the lack of access to affordable fuel will kill more children than anything else. The West has been donating food and grains for years, and will continue to do so. Who has ever donated a drop of fuel, among all the world's oil-rich powers?

Who will give a drop of oil to help a mother cook the cassava long enough to remove the cyanide? Or bake the bread? Or cook the vegetables to soften them for babies' teeth? They don't donate, they sell it. At inflated prices, happy to remind the West of their obligation to provide low-cost grain to the world's poor, so that the poor can afford the East's high-price fuel to turn grain into food.

Unaffordable fuel forces mother to put out the cooking fire as quickly as possible, raising the specter of bacterial poisoning. It forces children into the forest to search for firewood, and anyone who thinks that the world's

deforestation crisis is happening in the soy farms of the Amazon hasn't been to Africa, or seen the devastation of Haiti.

Kerosene is no longer affordable and people are turning back to the stone age of the three-stone fire pit fueled by firewood and charcoal. Put that in your land-use conversion model and see where it gets you. Doubt it? Visit a village in Africa or India, and see for yourself, and leave the Amazon to rich ecotourists who care nothing about the root causes of poverty, or alleviating real suffering. Who are, in fact, Castro's and Chavez's greatest allies in a war of deception over agricultural nationalism.

The battle is not between the world's consumers of food, and the world's consumers of fuel, although it has been convenient to frame it this way, because the prospect of starving the world's children by driving an SUV filled with E85 is upsetting to soccer moms. People who like to exploit soccer moms for donations, votes, and page views like to frame the issue in this way. Most soccer moms, they know, have never been on a farm, and can be emotionally manipulated by images of starving Mexican children, whom they are told cannot afford tortillas because biofuels have taken their corn away.

People who exploit soccer moms, know that few of them have ever eaten a tortilla in Mexico, and don't know that the white corn used to make them is grown almost exclusively in Mexico and has never been used to make a single drop of ethanol. Mexicans have increased their population by 19 percent since 1994, but corn consumption is up 57 percent.

The CEO of Nestle this morning was, refreshingly, honest about the issue. Peter Brabeck told the Financial Times that the "food industry will remain in competition with the biofuels industry for land as rapid global economic development increases demand for food...the consumption habit changes in emerging markets will not revert."

But small farmers know that, from Nigeria to Iowa, just as they know that biomass + fuel = food. Which begs the question, how many of the people who have spoken about the prospect of a worldwide food shortage have actually, with their own hands, ever cultivated a single straw of that which they speak?

Biofuels and Veterans

This essay did not appear in the Digest – it was originally written in support of a veterans' recognition tour which ultimately was cancelled – and has not previously been published. It not only thanks the troops, but goes through some of the basic criticisms of biofuels that usually are not addressed in an industry publication where basic issues are already understood.

After the fall of the Soviet Union in the early 1990s, Winston cigarettes celebrated the new availability of Eastern European markets with an outdoor advertising campaign that offered Winston as "The Taste of Freedom".

But today, the taste of freedom is better described as (drinkable, but not recommended for consumption) biofuels. 70 percent of US oil - or more than 140 billion gallons per year just for gasoline and diesel - is imported from overseas to fuel our cars and trucks, sometimes from friends but in many cases from nefarious regimes such as Iran and Venezuela, and even in friendly countries many petrodollars provide the wellspring of funding for organizations such as Al-Queda.

Veterans know the price that has been paid to secure foreign oil for consumption at home, and generals know that our dependence on foreign oil extends not only to our personal cars and trucks but to military vehicles serving both in support and front-line roles.

Biofuels are not a perfect fuel - what is? But they are home grown, affordable, and available now. Made today from

excess stocks of crops such as corn and soybeans today, and tomorrow from grasses, algae and landfill materials, biofuels are expected to provide up to 30 percent of US transportation fuels by 2022, while providing a minimum of 20 percent reduction in greenhouse gases compared to conventional fuels.

Opponents of biofuels say they are supported by subsidies, but what they really receive is an exemption from taxes while the industry grows toward critical mass. That's the American way - young families pay lower taxes, too, when they are just starting out, and receive tax deductions for housing and a lower tax rate overall. Later, when they have built strong careers and earnings, they pay a higher rate. It's the same with biofuels.

Opponents of biofuels also say that they burn food that is needed to feed hungry people. But hunger is not a food production problem, it is a money distribution problem. Biofuels that are grown in Africa, Asia and Latin America help create jobs and national income that helps countries to afford proper nutrition. Besides, the corn that is used to feed people is not used for biofuels.

Opponents of biofuels say that biofuels are bad for the environment because they cause Amazonian deforestation. Don't believe it. No biofuels are grown in the Amazon. Amazonian deforestation is caused by expansion of the cattle and timber industries. Don't believe it? Use Google Earth to fly over the Amazon - you'll see.

Actually, the opponents of biofuels are well organized - like Al'Queda. Except, in this case, they are domestic opponents.

Primarily in the cattle and poultry industries, as well as supporters of solar power and wind. You probably remember that last summer there was a lot of talk by food manufacturers about how the rising price of corn forced them to raise food prices. No?

Well, corn prices have dropped by 60 percent since last summer - food bills haven't dropped a penny. But you don't hear much about that from the makers of corn flakes, who knew all the time that there's only a nickel of corn in a $4.00 box of corn flakes.

An old World War Two phrase, like "loose lips sink ships", was "Serve in Silence", and biofuels serve in silence, for sure. By offering you affordable, homegrown fuels, they allow our country to keep our dollars at home, and our troops at home, defending American borders instead of the borders of foreign oil fields. The technology for making and distributing them is far from perfect - but think how fast other technologies like computers and home electronics have advanced because of good old American know-how. The advances in biofuels have brought down the cost of making biofuels from, for example, algae, by more than 80 percent in the past five years.

What was once a flight of fancy is becoming a reality - imagine flying on biofuels?! Continental Airlines in January successfully demonstrated that biofuels can safely power an aircraft in a tough series of flight tests. Plus, they are less explosive in the case of leaks or accidents than traditional jet fuel, and are more economical in terms of miles per gallon.

Algae is such a potent feedstock that, even today in the

infancy of the industry, commercial companies are growing 6000 gallons of fuel per acre - that's enough to replace our entire imported fuel supply with fuel grown on barren ground less than the size of Nevada. That's good for Nevada, and good for our troops, who can be deployed in more effective tasks than making the world safe for imported fuel.

The 10 Most Bizarre Stories of 2008-09

The second annual appearance of the 10 Most Bizarre Stories produced some real chestnuts – the mad plastic surgeon using liposuction fat to fuel his cars; the development of biofuels on Mars, and more. I don't think there is any single feature I enjoy putting together more than this one.

1. Liposuction biofuels. In California, the controversial Beverly Hills Liposculpture announced that it would close, after disclosures (that may be unrelated to the shut-down) that its chief, Dr. Alan Bittner, has been converting liposuctioned fat into biodiesel to power two SUVs belonging to himself and a girlfriend. The company served more than 7000 liposuction patients over a 10-year period. Yecch.

2. Police sergeant nabbed in grease theft operation. In California, police sergeant John Landahl of Folsom was arrested last October on a charge of stealing used cooking oil from the Sacramento Rendering Company. The theft of approximately 1000 pounds of grease led to the charge. Numerous victims of grease theft across the country have noted a slow response by police, who have been reluctant to chase down pilferers of waste materials.

The sergeant is a 22-year veteran of the department, and went on administrative leave pending trial. Meanwhile, grease thieves are stealing 600,000 pounds per year in northern California. Grease theft has spread to Oregon Kentucky, Taxes, Florida, Missouri, Alabama, Washington, and North Carolina

3. Veggie Vroom. The World First Racing team in Britain announced the construction of a Formula Three car that runs on vegetable oil and waste chocolate, with a steering wheel made from carrots and other root vegetables, a seat made from flax fiber and soybean oil, and bodywork made from potato starch.

4. Biofuels on Mars. Researchers at Flometrics have reported the possibility of growing oilseed crops on Mars for rocket fuel, after a test of B100 biodiesel in a Rocketdyne LR-101 engine showed comparable burn characteristic to RP-1 kerosene. The test was carried out in a General Dynamics/Convair Atlas missile based on a six-second burn, and B100 developed an 820 lb thrust compared to 840 for RP-1.

5. Sewage in an ocean-floating baggie as an algae bioreactor? Officials at NASA have proposed an algae-based solution for the production of biofuels in closed plastic bags that would be filled with sewage that the algae would utilize as a feedstock, and produce algal oil. NASA said that the proposal addressed a major limitation of closed bioreactor systems on land, which is water-storage and temperature control in addition to land acquisition. The semi-permeable membranes "allow fresh water to flow out into the ocean, while retaining the algae and nutrients," using a technology that NASA is testing for use in long-duration space flight.

6. Biobutanol, other biofuels envisioned for Virgin Galactic spaceflight. In New Mexico, construction commenced last month on the $198 million Spaceport America, a vertical launching pad and runway facility in Truth or Consequences that will be home to the Virgin

Galactic spacecraft offering commercial space tourism flights for $200,000. Sir Richard Branson's Virgin Fuels is developing biofuels that can be used to power both the mothership Eve that will launch the spacecraft from the stratosphere, while the SpaceShipTwo spacecraft will itself be designed to run on biobutanol. Branson is an investor in Gevo, a development-stage company making butanol from cellulosic feedstocks.

7. Arctic Technology Centre to convert shark waste to biodiesel in Greenland. The village of Uummannaq finds itself with an abundance of sharks - so much so that there is a bounty of $38 for a shark heart. What to do with all the carcasses? Make biodiesel, says the Arctic Technology Centre in Sisimiut. A pilot project in will provide up to 13 percent of the energy for the village's 2450 inhabitants, using a combined heat and power process from sharks and other fish waste oils. Eew.

8. Prince Charles converts Royal Train to biodiesel. The Prince is at it again, God bless him. The eco-friendly monarch-in-waiting last year started fueling his Aston Martin D86 with ethanol made from wine, and his collection of Jaguar and his Land Rover vehicles to used cooking oil-based biodiesel. Now, staff said that plans are underway to convert the royal train to biodiesel. Cutting back on the number of transportation options has not yet been announced by the Palace.

9. Coconut-powered bamboo taxis. In the Philippines, "Bamboo taxis" made of 90 percent bamboo and powered by coconut biodiesel have emerged as a replacement for dangerously crowded motorcycles used to carry up to six

passengers in town traffic.

10. Look before you speak department. Bill Reinert, Toyota Motor Sales national manager for the advanced technology group told a conference audience that “Using ethanol for fuel is like electing the dumbest kid in school as class president." Apparently Toyota's investment in the development of cellulosic ethanol, in partnership with Nippon Oil and Mitsubishi, escaped the attention of Toyota Motor Sales.

The 10 Most Bizarre Stories of 2007-08

A favorite annual chore for me are the annual 10 Most Bizarre Stories of the Year, which appear in the anniversary issue, on or around July 27th. The first year the 10 Most Bizarre first appeared in July 2008, and the stories from that year – turning dope into moonshine, and organized crime moving into theft of kitchen grease, were classics that will be hard to top for years to come.

#1. A favorite story this year was the vote by the Vermont State Senate to approve hemp cultivation for the production of ethanol. That is ethanol, a/k/a/ "moonshine whiskey" and hemp a/k/a "marijuana". The *Digest* "moonshine from marijuana" story took a look at Henry Ford Sr's love affair with hemp, including sponsoring the construction of a hemp fiber car powered by hemp ethanol and known as the Hempmobile. The story includes links to footage from the Depression era of the Hempmobile in motion.

#2. A Brazilian ethanol plant with an allegedly deplorable record in abusive worker conditions reveals that among its investors are...wait for it...Bill and Hillary Clinton. The story did not back up too much on Hillary during the campaign, but was a distraction to say the least when the story surfaced in March.

#3. When in doubt, try coffee. A process called torrefaction used for roasting coffee beans was tested successfully as a means of reducing the cost of transporting biomass for cellulosic ethanol feedstock. Starbucks has not subsequently announced an entry into the ethanol field.

#4. Organized crime moves into....grease theft! A 250 percent rise in grease pilfering is attributed to organized criminal activity as the rising cost of feedstock creates an arbitrage opportunity for enterprising mafioso. In this story, crime had spread into more than 10 states but police were too busy laughing to do much crime prevention. Victims of the thefts are not quite sure why police think that this type of crime is beneath their dignity to investigate.

#5. The funniest climate change ad ever comes from Australia, in which the Get Up Australia! creates a fake organization called Fuel Watch that determines that fuel is f***ing expensive.

#6. In this story, enterprising Europeans convert unsold wine into ethanol, creating new uses for the "wine lakes" that have long been the butt of European jokes and a headache for European officials eager to protect the wine industry. Later in the year, it was revealed that Prince of Wales also is using biofuel made from undrinkable wines.

#7. An enterprising group of anti-biofuels demonstrators invaded a British biofuels conference and managed to land a pie in the face of the CEO of BP Fuels.

#8. Nigeria decides to ban ethanol because the oil-rich country cannot afford equipment to test imported gasoline for ethanol content, resulting in an embarrassment when E22 is imported from (presumably) Brazil and ruins the hoses and engines of thousands of cars that have an E10 limit. Why is Nigeria importing fuel, anyway?

#9. Myanmar wins international support for its plan to

cultivate 7,000,000 acres of jatropha, despite rumors of heavy-handed army supervision of a forced conversion from food to fuel production. It all seemed great, that is, until someone realized that the country had disastrously miscalculated the acreage and a famine broke out in the formerly rice-rich country due, observers said, to the jatropha program. How drought-tolerant jatropha was cultivated in former rice paddies is something the foreign observers did not feel compelled to explain.

#10. The always-quotable Bob Lutz, vice-chairman and hybrids chief of General Motors, provided a lulu when he called global warming a "crock of s**t".

The 10 Most Overlooked Stories of 2008-09

Each July 27th, on the Digest's anniversary, a list of the 10 Most Overlooked Stories of the Year is published, in addition to the 10 Most Bizarre and the 10 Most Popular. It is often a surprise, looking over the statistics that come with web publishing, to see which stories unexpectedly gained traction, and which stories did not despite the best hopes. A select group are stories that are overlooked at the time – but come back to haunt developers, investors, enthusiasts and more.

A classic case was the almost completely overlooked original report of the theory of indirect land use change, which originally was cited in the Digest in 2007 but did not gain traction in the readers' minds until 2008. Here below are picks for the most overlooked stories of 2008-09.

1. E15 ethanol and the EPA waiver. The National Cattlemen's Beef Association said that, since January of 2008, cattle feeders have lost a record $5.2 billion in equity due to high feed costs and economic factors that negatively affected beef demand. Meanwhile the Growth Energy waiver request for E15 has now ended its comment period and moves to EPA review.

The American Coalition for Ethanol (ACE), the nation's largest ethanol advocacy association, filed comments with EPA Administrator Lisa Jackson on behalf of nearly 1500 grassroots members nationwide and submitted a petition signed by 7000 individuals in support of the approval of E15. Meanwhile, 46 organizations signed a letter to EPA Administrator Lisa Jackson opposing the waiver permitting E15 blending.

Digest readers showed more interest in advanced biofuels than the ethanol debates, but the Renewable Fuel Standard locks both first and second-generation fuels together under one mandate.

2. The reorganization of oil's interests in bioenergy. Signs have been popping up all year that the oil industry was rethinking bioenergy. BP unwound its partnership with D1 in jatropha, and accelerated on butanol in partnership with Dupont; Valero and Sunoco picked up ethanol plants on the cheap. Total invested in Gevo. Shell advanced with Codexis.

The industry fell over with shock when ExxonMobil announced a $600 million investment in algae R&D, but a little-read item from last December presaged a big year for Big Oil and biofuels. The move by BP Solar's CEO to head up Virent might have been seen as a sign that both Shell and BP were getting out of other renewables and placing their bets on biofuels.

3. Bioenergy fires. When the "Complete Training Guide for Ethanol Emergency Response" was released by the Ethanol Emergency Response Coalition this month, it was a popular read. Less so were reports throughout the year on biofuel fires. Reports on a 114-car ethanol train derailment in Illinois and a 50,000 gallon ethanol tank exploding in Florida remind us that ethanol fires are unique, and uniquely dangerous.

4. Indirect Land Use Change. The *Digest* had one sure way to drive down reader interest in 2008-09: write about indirect land use change and the ongoing efforts to define it

and penalize the biofuels industry for creating it.

The industry woke up on the issue after the California Air Resources Board virtually banned corn ethanol from the state after applying ILUC penalties, and after biodiesel nearly found itself thrown out of the Renewable Fuel Standard after the EPA applied it in its RFS2 draft. "A common sense theory of indirect land use change" got some attention for applying historical data to the story. News that Greenpeace says biodiesel demand not a significant driver of Amazon deforestation was generally overlooked.

News that some of the leading lights in ILUC and among biofuels academics had co-authored a definition of "Beneficial Biofuels" did not get much attention. Only 15 readers clicked through to see it – compared to more than 10,000 who clicked through on the top individual stories of the year. A story on the impact of rising caloric and grain consumption in the US and falling rates of Amazon deforestation did not attract much attention either.

One article that nearly made the top 10: TIME magazine's "hate journalism" piece, charging that Congress intends to encourage planetary peril with biofuels policy, and adding that EPA's proposal on indirect land use change was rigged . Good news that salt-friendly crops could be key to 63 billion gallons in ethanol from non-foodstock land, didn't get much attention either.

5. India. *Biofuels Digest* special correspondent Joelle Brink has been doing an outstanding job all year of covering India's triumphs and challenges in bioenergy. None of her stories have quite made the top 10, but they are all well

worth a read. Here's a favorite: A Tale of Two Biofuels Models: US and India.

6. Godware. The Defense Advanced Research Projects Administration (DARPA) is seeking research proposals for "Physical Intelligence" or "godware", biochemical systems that can "self-organize" into organic fuel cells, or hydrocarbons from atmosphere, sunlight and water. That's interesting. Where will it lead?

7. Destiny, FL. The first master planned sustainable city in the US, will be base for pyrolysis, gasification as well as bioenergy crop cultivation. It's a fascinating concept that is ahead of its time and deserves a look.

8. Water or lack thereof. Articles about the water footprint of biofuels, pressure on aquifer systems, and both good news and bad news in water usage are generally not big "reads" in the *Digest*. Watch out – water is the new gold.

9. Aviation biofuels. Jet biofuels headed for flight certification in 2010, says Boeing in a June report. Aviation stories have been popular in the *Digest* – but stories on the fast approach of certified aviation biofuels are worth another look.

10. Advanced engines. When Ford Motor said it could add 40 percent efficiency to its EcoBoost engine using ethanol, it raised some interest from readers. Ethanol injection systems are a subject one can't know enough about – especially those who find themselves defending ethanol against the charge that it reduces fuel economy. The new technology uses a separate ethanol tank to inject small amounts of ethanol,

which boost power through ethanol's higher octane and provide more oxygen for the complete burning of fuel.

The Magic Beans of Freedonia

This was originally published in October 2009 in the Digest, as a Hallowe'en offering. As illustrated fiction, it was a departure from the norm. In this story, a group of Freedonian farmers discover that their plan to buy low-cost fuel from a wily group of Trolls from the East...has unintended consequences. Is it a complete fiction, or an allegory for modern times? Well, you be the judge.

Once there was a land of plenty called Freedonia, and in a valley by a hill lived a hard-working people who grew Freedonia beans. They kept some for themselves to make food, shelter, and clothing, and sold some to the people in the next valley, the Nefarians, for cash. A little that remained they sold to Alan Kahal, who converted it into fuel for their tractors and trucks.

One day, Alan came to buy his annual supply, and the Freedonians told him that they had sold the whole crop to the Trolls from the East. "Why?" asked Alan. "They had a better price," said the Freedonians. "What will you do for fuel?" asked Alan. "The Trolls sold us

some of theirs, for half what we used to pay you."
"But what about the Nefarians?" Alan asked. "We don't know," said the Freedonians. "Maybe they'll get something from the Trolls. It's none of our business, we just sell beans."

"Well, I can't argue with that," said Alan, and he went away to think.

The Trolls sold the food to the Nefarians, and the Freedonians drove around on Troll fuel, which pumped a great deal of brown smoke into the air.

One day, Alan met a peddler, who told him, "What you need is a Magic Bean Machine. It will make fuel ten times faster, and you can match the Trolls' low price."

So Alan bought a Machine, and it made fuel ten times faster. He told the Freedonians he would be able to sell fuel for half the price of the Trolls, and they were very happy. He owed the peddler a great deal of money, but he was sure to earn it back with the next harvest.

At harvest time, the Freedonians told Alan that once again they had sold the whole crop to the Trolls. "Why?" asked Alan. "When we told them about your Machine, they sold us fuel at half of your new price."

"But what about the Nefarians?" Alan asked. "We don't know," said the Freedonians. "Maybe they'll get something

from the Trolls. It's none of our business, we just sell beans."

"Well, I can't argue with that," said Alan, and he went away to think.

The Trolls sold the food to the Nefarians. And the Freedonians drove around some more on Troll fuel, which filled the air with a tremendous amount of brown smoke that filled the sky.

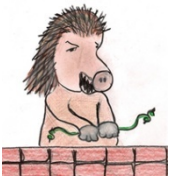
One day, the peddler came by to collect his money, and Alan told him what had happened. The peddler said, "What you need are Magic Beans. That way, you won't need beans from the Freedonians at all. You will grow ten times more, and you can match the Trolls' low price." So Alan bought and planted Magic Beans, which grew a mile high. He told the Freedonians he would be able to sell fuel for half the price of the Trolls, and they were very happy.

He owed the peddler a colossal amount of money, but he was sure to earn it back with the next harvest.

At harvest time, Alan came to sell his fuel, and the Freedonians told him that they couldn't use any of it. "Why?" asked Alan. "Last year, with all the money we saved, we bought new trucks and tractors from the Trolls. They can't run on your fuel – only Troll fuel."

And there was nothing left for Alan to do but see the

peddler and tell him what had happened. The peddler was very angry and took the magic beans and the Magic Bean Machine away from him. The peddler did not know what else to do, so he offered to sell the Machine and the magic beans to the Trolls.



"We don't need a Magic Bean Machine," said the King of the Trolls, "but to help you out, we'll take it off your hands for nothing." The peddler could not use the Machine himself, so he agreed.

The next harvest, the Trolls came to see the Freedonians, who had their bean crop all bundled up and ready for trade. "We are low on Troll fuel," said the Trolls. "We will sell you Kahal fuel blended with Troll fuel, only the price is ten times as high as before."

"But we can't run the fuel in our tractors," said the Freedonians. "That's OK," said the Trolls, "we'll sell you new tractors and trucks, only the price is ten times as high as before."

The Freedonians refused and tried to sell their crop to the Nefarians. But the Trolls had given the Nefarians food made from magic beans, which made them eat and eat and eat — they were insatiable, but only wanted magic beans.

The Freedonians went to the peddler who said, "I can't buy

your crop — I sold the Machine to the Trolls." The Freedonians searched for Alan Kahal, but he had left the business and moved far away.

So they went back to the Trolls and sold them their crop, for one-tenth the old price, and all their savings were spent on new tractors and trucks, and they went bankrupt trying to raise money to buy fuel. And the Trolls made slaves of the Freedonians, and put them to work in the valley every day growing magic beans. The Nefarians were sent to work beating Freedonians to make them work faster.

And the Trolls grew very rich and the skies grew thick with brown smoke. And the Freedonians sometimes thought about how smart they had been, buying fuel at half price and selling crops for top dollar. They knew that they had been the victims of very bad luck.

But they couldn't think about it often, for they were usually too tired and sore from the work and the beatings, and sick from the smoke.

About the Author

James M. Lane is editor and publisher of *Biofuels Digest* and other newsletters on renewable energy, biotechnology and sustainable living.

He has authored eight other books on a variety of subjects, including *Anchoring America: the Changing Face of Network News* (with Jeff Alan), *Living Abroad in Australia*, and *The Complete Golfer's Almanac*.

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