

A Case Study Journey in Cultivating Advanced Biofuel Projects

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Iowa has two cellulosic ethanol plants that have been under construction and I have been observing their development as the Director of the Community Vitality Center at Iowa State University and as an Extension Ag Economist who has a dual interest in Ag Policy & Economic Development.

I have also been involved in facilitating formation of two advanced biofuel company startups and I am interested in learning about others so I can share ideas and best practices in my extension role.

My interest in biofuels and my story started more than 3 decades ago. I toyed with an idea for a title: "The PCs in Project Development...but Not Computers --- the Ps and Cs being....

Credibility, Capital, Pathway (Permitting), and Profits

This would be reasonable title, because most of the episodes in the journey started by sitting on the couch and contemplating the opportunity gap and how to put together a project on the back of an envelope to solve a problem.

At each stage the question has always been,

- What is the next best step to enhance project credibility?
- How can capital be raised to get to first base and the next?
- What development pathways are expected by industry & regulators?

- How do you get to credible cost estimates for construction and operations in order to generate the investment grade returns and payback projections for attracting accredited investors?
- And then, how do you put the plan into action to generate the actual returns so the project and projections become reality with multiples?

As an Extension Economist I was initiated in the profession during the Farm Finance Crisis in South Dakota. I had the fortunate opportunity to serve as an Advisory Member of the Land O' Lakes Board and observed how a Fortune 500 Food Company and Regional Farm Cooperative could go from a \$30 million bottom line to negative and back over the course of five years.

During the 1990s, I was elected to City Council and learned how community leaders used economic development tools like Tax Increment Financing to foster new companies and create jobs.

Up until the mid-1990s, most universities didn't have a course in entrepreneurship or project development because the preferred pathway was called the "brain drain" from rural areas to universities to high-paying jobs in metro areas. Most universities now have courses in entrepreneurship and business development centers. So universities do make changes, but sometimes the wheels turn slowly.

In the 2000s, I worked with rural community leaders to form the Community Vitality Center at ISU. The mission was to foster community entrepreneurship programs. Prior to the 2002 farm bill, we were discussing ideas with Senator Harkin and Senator Grassley's staff for unlocking farmland asset values to invest in new rural ventures and value added agriculture. Some tools became very relevant such as USDA Producer Value Added Grants, federal New Market Tax Credits, and Small Producer Alcohol Fuels Tax Credits.

As it turned out, biofuels was poised to take off and become the biggest economic development wave of our generation for rural America. Iowa built 41 ethanol plants and 12 biodiesel plants. Agriculture became an industry that not only produced food and fiber -- but began producing for a whole new energy sector to reduce our addiction to oil imports -- then at 60% of domestic fuel consumption.

I was interested in the idea that 500 to 1000 farm and rural investors could raise sufficient capital to build an ethanol plant with regional impacts that according to the prospectus would generate projected returns greater than 20% with a 5 year payback. Capitalism at its finest hour. So as long as the industry remained healthy, the local retail capital raise could result in higher economic multipliers for rural communities than would otherwise be the case.

Being a consummate extension economist, I wanted to explore whether the adoption of that rural development model could be facilitated at another location. So I co-facilitated a group of 26 investors in my hometown to raise a million plus in seed funds to plan an ethanol project and select a site. We looked at a dozen sites, but before we found the site that met industry criteria and one that the RRs would approve, two other groups formed in the region where only one plant could be built and survive. So we sold our Letter of Intent (LOI) for units in an ethanol company that wanting to build a plant in Iowa. That is how I ended up on the Amazing Energy Board. Within six months the markets fell, our LOI was worth half what we sold it for, and no plant was ever built in my home area. Those who backed the other projects lost all their investment, while our project received a multiple payback after the Amazing Energy plant was sold to the Andersons in 2012.

About five years after the fact, the economic benefits were assessed in a report on the Economic Impacts of the Ethanol Industry in Iowa and the U.S. sponsored by the Community Vitality Center last year. Table 1 shows the Iowa Department of Revenue ownership data for 28 biofuel plants organized as LLCs. The average number of investors was 367. The median number of investors was 167, which implies that a small number of facilities have a large number of investors. The company with the largest number of shareholders has 1,533 underlying owners. The report indicated that most shareholders are Iowans, including individuals and corporations, and Iowans also owned the majority of the companies. On average, Iowa resident shareholders owned 89 percent of the companies.

Investors in the sample of biofuel plants were likely to live within a 100 mile radius of the plant. The geographic distribution of investors

with and without farm income was indistinguishable as both types of investors were clustered around the plant. Of course ownership patterns can change over time as some plants are sold or otherwise transferred, and the capital raise strategies for next generation biofuels potentially will be different than first generation.

Table 1. Ownership Statistics for Iowa Biofuel Plants organized as Limited Liability Companies, 2005-2008.

	Average	Median	Minimum	Maximum
Number of Owners	367	167	3	1,533
Percent Owned by Iowa Owners	89	99	01	100
Number of Individual Owners	346	161	3	1,533
Percent Owned by Individuals	81	91	01	100
Number of Iowa Farm Owners	168	75	0	745
Percent Owned by Iowa Farmers	31	38	0	62

Source: Iowa Department of Revenue

In terms of economic impact, the CVC Report highlighted one case study 100 mgy ethanol plant that provided \$54.6 million of dividend income to investors over a 5 year study period— which included 2 years with no payouts. The Economic impact of owner payouts for this single plant resulted in additional induced effects in the economy of an estimated \$14.7 million of new income, equivalent of 431 jobs, and \$46 million of new sales, primarily in retail trade and services.

Anyway while serving on the AEHC Board, I was asked to serve as a Co-Chair of the R&D Committee. The Committee was to monitor strategic technologies for the industry and to identify new incremental technologies that could add value and margin to the plant and region. Top priority was for incremental technologies that didn't cost much and that would have a 2-year or less payback. Our plant had invested in a new corn oil process and subsequently we were one of a few dozen firms named in the infamous multi-million dollar "Greenshift" patent infringement lawsuit. We were able to identify and install a "wrap-around technology" to improved oil production performance. This helped to avoid most of the legal exposure faced by the other plants, but a hefty legal expense for patent attorneys was paid to settle the claim.

The Amazing Energy Board and R&D Committee members were encouraged to attend seminars and Trade Association Meetings to

stay on top of the latest policy, market, and technology developments. At one of the national trade shows, an R&D Committee member bought a book from a speaker who was President of a young R&D firm that had just applied for a Patent in July 2008. The patent was for a novel thermal catalytic technology for producing butanol. He was looking for an ethanol industry partner to help develop the technology. So we invited him out to make a Presentation. The Board approved an R&D collaboration project, but at that time there were no margins for an R&D budget.

State and Federal Programs: Discovering the Nature of Change.

At that time, the U.S. DOE announced a new biorefinery grant program for doing \$15 million pilot projects requiring a 20 percent match and \$45 million commercial demonstration projects requiring a 50 percent match. In Iowa, state government had created a \$100 million fund in 2007 called the **Iowa Power Fund** that could be used as match to leverage federal funds like DOE and private investment into Advanced Biofuels, Wind Power, Solar Power, other early stage research to commercialization and education projects. Texas had a \$200 million technology fund for similar purposes.

The Iowa Power Fund approved 50 projects between 2007-2010 and allocated \$71 million that would potentially leverage \$604 million in investment. In the list of 50 approved projects, 11 were advanced biofuels and biomass projects:

Table 2. Iowa Power Fund Advanced Biofuel & Biomass Projects

1. Poet Project Liberty --\$14.750 million with a \$231.4 million match for the first-of-a-kind 30mgy cellulosic ethanol plant at Emmetsburg, Iowa. That is \$7.71 per gallon capacity for the pioneer plant.
2. Dupont Danesco--\$9 million with a \$226.1 million match for a 30 mgy cellulosic ethanol plan at Nevada, Iowa--\$7.54/ gallon capacity.
3. Bioprocess Algae & Green Plains Renewable Energy—\$4.168 million with \$4.738 million match to develop algae advanced biofuel production at Shenandoah, Iowa
4. Quad County Corn Processors--\$1.450 million with \$7.702 million

match to develop an incremental build-on cellulosic ethanol process using distillers grain at an Galva, Iowa.
5. Avello Bioenergy -- \$2.5 million with \$4.644 million match to develop pyrolysis technology at ISU for converting biomass to asphalt pavement, roofing shingles, fuels and chemicals, Boone, Iowa.
6. AmbroZea --\$1.5 million with \$14.5 million match to develop multi-tasking yeast in an ISU and U of I collaboration for commercial use in the ethanol industry, Ames, Iowa.
7. Growth Design Energy Mt Valley \$1.5 million with \$7.805 million match to develop a 3mgy biodiesel refinery using second generation technologies located near Forest City, Iowa.
8. Amana Renewable Energy Project --\$1.082 million with \$4.077 million match to construct anaerobic digester, methane engine, and generator for baseload power generation from animal feedlot manure and organic industrial wastes, Amana, Iowa.
9. PL Energy--\$2 million with \$3 million match to construct demonstration scale on-farm gasification project to convert poultry litter to power, Webster City, Iowa.
10. Renew Energy Systems --\$250,000 with \$627,000 match for a mobile solid biomass briquette plant at Osage, Iowa.
11. SynGest Menlo LLC--\$2.5 million with 3.5 million match for FEED stage Engineering of Bio-Ammonia fertilizer production from biomass.

By 2010, \$38 million -- about half of the approved total -- had been invested in 31 projects. The invested amount was leveraged about 10 to 1 when compared to the combined construction budget total.

Amazing Energy's butanol project that was initially approved by the Iowa Power Fund for a \$2 million grant, contingent on federal approval of an \$8 million DOE biorefinery grant.

In the DOE “dink” letter, the reviewers said the proposed technology was indeed novel, innovative, and interesting, but the application was turned down citing that other objectives were poorly written. Even though the technology works just as well with sugar, cellulosic, or algae ethanol, subsequently we were told the real issue was that the project planned to use corn-ethanol as one of the inputs. It seems that Congress and DOE had passed criteria for biorefinery grants to exclude any consideration of the use of corn ethanol as a result of the “food versus fuel” debate. So what may otherwise be a competitive technology today for reaching national 36 bgy RFS goals by 2022 -- without using any more corn -- sat on the shelf for the last four years.

After 3 runs at federal funding with multiple agencies, a decision was made to pursue private capital and strategic partners. With the Great Recession, private capital all but dried up until recently. And even then, it is primarily available only for projects with well developed markets and commercially proven technologies, except in rare cases.

Early this year in 2013, the IP holder finally received his U.S. patent—4.5 years after initial application. So that has been another regulatory barrier that we could talk about. However with his patent in place, there is renewed hope for investor and strategic partner interest in this collaborative R&D venture.

Meanwhile in Iowa, there was a changing of the guard in the Iowa Executive Branch in 2010 and the Iowa Power Fund is no more. Today, the prime focus is on creation of 200,000 new jobs and a new public-private partnership designed to bring both public and private sector resources to bear in providing a wide range of economic development incentives and entrepreneurial information resources statewide. The Iowa Economic Development Authority is the name of the newly reconfigured department and its private sector partner called the Iowa Innovation Corporation.

Iowa now has a series of Innovation Programs supported by a state Demonstration Fund. Between 2007 and 2012, the Demonstration Fund awarded \$13 million to 101 companies—so the \$140,000 average amount divvied out per project was much less than the Iowa Power Fund. However, a third-party Economic Impact Analysis done on 79 of these firms receiving \$8.7 million estimated the total annual

economic impact for the state was \$150 million, and supported about 1,100 total jobs, \$49 million in annual earnings, and \$2.1 million in annual tax revenue--for a state revenue payback of less than 5 years.

The Iowa Innovation Corporation is in the process of creating a complementary private sector Innovation Investment fund for 2nd and 3rd stage capital. Iowa also still has investment tax credits for job creation, and 20% tax credits for angel investors and community seed capital funds for those who are eligible and apply.

That brings me to a discussion of the second Advanced Biofuels Project that I am collaborating with because the accredited investors participating in that project wish to access the angel tax credits. This project is traced to November 9, 2011 when the Community Vitality Center and 30 other groups organized a rural Young Entrepreneur Summit (YES) on campus. We attracted 160 participants. During the discussion period, there was a obnoxious 70 year old who stood up and said that he had been to all sorts of agencies and firms asking for help to no avail. I initially thought he was a little crazy and told him that I would visit with him after the Summit.

As it turns out, he was a Ph.D. level chemical engineer who had retired after 40 years of oil and chemical industry experience. He had received 3 patents for converting CO₂ and other carbonaceous inputs into syngas and had demonstrated his technology at a 12.5 ton per day scale. The more we listened, the more we became convinced that he may have a strategic technology. CO₂ is a regulated GHG and CO₂ off of ethanol plant fermenters is about 97 percent pure.

So another AE board member and I worked to create credibility for his project and to get him in front of strategic investors and partners who could take him to the next step. During March 2013, we raised over \$250,000 from more than an dozen accredited investors for a Pre-FEED (Front End Engineering Design) feasibility study to get a 3rd party to verify the potential performance and economics of his technology.

If his technology does what he says, there is potential to double the biofuel production from an existing ethanol plant without using any additional corn at competitive breakeven costs without subsidies.

The investor group comes from three ethanol networks and represents prominent farmers, bankers, farm credit director, corn grower director, REC director, manufacturing sales, attorney, accountant, and 8 ethanol company directors. This composition was designed to generate confidence and credibility in the biofuels industry. The Pre-FEED study is being done by a global engineering firm with a solid reputation and expertise related to the technology. The firm is also well known in the oil and gas industry and has projects in 40 countries.

If the Phase 1 study is a go, then we move on to Phase 2, and Phase 3 which gets us to investment grade numbers for actually raising capital for construction of a commercial demonstration plant.

However, the factor creating the most uncertainty at the present time is the POLICY UNCERTAINTY emanating from WASHINGTON.

This includes,

- Budget Uncertainty that is generating uncertainty in the General Economy for economic growth rates and another recession.
- Farm Bill Uncertainty affects our project as our preferred investors who have enjoyed record incomes are impacted by failure to pass a farm bill.
- Program Uncertainty for USDA Rural Development, Treasury's New Market Tax Credits, and federal Loan Guarantees
- RFS Uncertainty from the Big Oil and Corn Ethanol fight which is creating a lot of uncertainty for the cellulosic and advanced biofuels sectors.
 - RFS be Repealed? Will it be modified? Or, Will it be frozen as suggested by my panel colleague? That could stifle commercialization for those who have invested in advanced biofuels just as the 20 bgy portion of promised RFS mandated growth is ready to become effective.
 - In our CO2 technology case, we don't know which EPA pathway to plan for in producing biofuel RINs, because of

the uncertainty. What if our technology could produce green gasoline for half the cost of petroleum-based gasoline—it may never get developed.

- So should we use biomass, coal, or natural gas as the complementary inputs based on the uncertainty with the RIN policy and regulatory incentives?
- In the absence of regulation, using natural gas in combination with the waste CO₂ makes competitive sense and could provide a more efficient mechanism for getting cheap natural gas into the transportation fuel sector.
- But we still also have to seek or hire technical assistance with EPA regulatory expertise to figure out the optimum regulatory pathway and submit an application.
- If we use CO₂ from Corn-ethanol plants, we need to know whether the GHG emissions can be reduced by the 50% compared to gasoline in order to qualify for advanced biofuels regulatory treatment.
- These are all extra regulatory questions and costs that must answered before a domestic project proceeds.
- We are in a different entrepreneurship environment than the form of capitalism & free enterprise faced by our ancestors.
- The Global Competitiveness questions are enough to make project leaders ponder whether it would be cheaper and less risky to develop the new technology in Brazil first before deploying it in the U.S.
- That is somewhat ironic, because the reason I got into this adventure to begin with was that we wanted to identify and preserve access to strategic technologies that could sustain the biofuel industry competitiveness in Iowa consistent with a land grant university extension mission.

As a result, the bottom line in our Pre-FEED studies, our success criteria is based on evaluating the feasibility of the technology without any government subsidies. But despite the best efforts, uncertainty hangs over the nation like a cloud over the investor community.

What Must Project Developers Do to Succeed?

In a nutshell, Project Developers must manage the risks that financial markets want addressed for successful project funding. Financial markets don't like surprises, and pioneer commercial plants using new technologies rarely go as planned without surprises. Two speakers at the International BioMass Conference in Minneapolis highlighted the following useful framework for de-risking projects:

1. Off-take Agreements: Assurance that products will be sold at terms that generate margin
2. Feedstock Agreements: Assurance that inputs will be available at terms that generate margin
3. Technology Demonstrated: Assurance new technology physically performs as expected to generate margins
4. Efficient Engineering Design & Construction Warranty: Assurance that plant will be permitted, cost, and perform as expected.
5. Operations and Maintenance Experience: Assurance that plant can be managed and sustained at performance level projected
6. Financial Projections based on solid engineering, market assessments, and investment banking standards: Assurance that capital and operating costs are accurate, and market margins will provide payback returns in manner projected

Source: "Biofuel Project Financing Considerations." Presentation by John May, Managing Director, Stern Brothers & Co. (Saint Louis investment banking firm) "Making the Deal: Bioenergy Finance Investment Trends." Presentation by James Schmidt, Audit and Assurance Services Partner, Eide Bailly LLP (St Paul.) at

International Biomass Conference, Minneapolis Convention Center
April 8-10, 2013.

What can Universities do to assist in Project Development for small companies with strategic technologies?

First, recognize that all three sources of new technology innovations and intellectual property exist, and then configure outreach and technical assistance programs accordingly. The first approach often used is to set up an Intellectual Property Office. The primary function of Intellectual Property Offices is to foster patents and intellectual property for licensing on behalf of faculty, staff, and students. Admirably many Research Foundations split and share the royalties among the inventors, college, and foundation.

The second approach often used by universities involves building partnerships with large companies with R&D budgets to support university research positions and programs looking for discoveries in the areas of research interest so that some benefits might accrue back to the supporting company or industry. But if that is all the Land Grant University does, then it is not maximizing its Extension mission of enhancing economic growth for its state and stakeholders.

At last year's ISU Extension Annual Conference, Professor Richard Lester, Director of MIT's Industrial Performance Center stated that only 3 percent of the patents come from academia and that 97 percent of U.S. Patents come from outside academia. Not all 97 percent come from corporate R&D programs.

What about the case of a retired Ph.D. level chemical engineer or the small startup R&D company living off of government SBIR research contracts? In both of these cases, the small company entrepreneurs did not need research expertise nor did they want to necessarily bring their intellectual property on campus. In both cases, their priority gaps were project development expertise and access to patient capital rather than research science talent.

Remember, the ethanol industry grew--not only from several wet-milling companies like Cargill and ADM--but also from a half dozen dry-milling entrepreneurs and family-owned businesses located in

eastern South Dakota, western Minnesota, and northwest Iowa. While the next generation of biofuels will have involvement from “Big Oil” and “Big Ag,” this may not mean that we can afford to bypass strategic discoveries from small firms. They may just provide the next game changing technology.

So what can universities do to close the gap?

1. Develop and organize incentives and institutional capacity for supporting Project Development Skills, Expertise, and Technical Assistance. Approaches may involve teams of specialists or individual coaches with unique experience in the biofuels industry or related development projects.
2. Organize programs to address gaps in capital and facilitate capital assistance underwriting targeted to Small Firms with strategic technologies that are in the public interest.

Ag Ventures Alliance based in Mason City, Iowa is a model for doing both. Don Hofstrand, an Extension Farm Management Economist and a group of farm and agribusiness leaders founded Ag Ventures Alliance as an Agribusiness Development Cooperative in 1998 when he asked and was asked to help form an entity to develop value-added agriculture enterprises. AgVA has grown to over 1,200 accredited investor members across multiple states and has business development staff that assist in project development and raising capital nationally. They are currently raising funds for several ventures.

They start with a portfolio approach so they look for a diversified set of projects and commercial returns with paybacks and they have the flexibility to conduct private placement meetings and multiple locations across their membership base. As a result, some of the AgVA capital may be considered to be patient capital.

Ag Ventures also created **Rural Development Partners** in 2004 which is a nonprofit subsidiary that allocates New

Market Tax Credits to eligible projects in economically distressed rural census tracts nationally.

University and Community Foundations

Alternatively, I have always wondered why we couldn't unlock the power and expertise of **University and Community Foundations**. Certainly the Foundations are to be commended for increasing scholarship support to reduce student debt loads and endowed chairs to attract and retain top researchers and faculty talent. But what about endowments for beefing-up entrepreneurial project development programs and patient early capital for partnerships with small companies that hold strategic technologies in the public interest?

I could see a fund for supporting strategic ventures as capturing the interest of alumni and community stakeholders, if benefits are dispersed to companies and business parks in hometowns distributed throughout the state. Perhaps a defined portion of pension funds should be targeted to small companies with strategic technologies as a means of reinvestment in communities that send their kids off to college. I'm sure my campus bound colleagues might have a little heartburn on that recommendation. But if done with proper underwriting standards and presented as one of many options, there should be no issue.

Reward Faculty & Staff to work and build entrepreneurial communities and partnership networks with strategic technology small companies. If we want university faculty and staff to be successful in creating companies, perhaps the incentives for creating successful companies should be as great or greater than the rewards for attracting grants or publishing in peer reviewed academic journals.

In a nutshell, the Extension Mission of the Land Grant University may need some strategic re-enforcement. It is more than simply teaching the basics. Economic Development has evolved to strategic doing. Strategic doing is something that cannot be accomplished without

getting off campus and building real world partnerships with people and companies where they live and operate. Participation often requires having “skin in the game in order to sit at the table” for involvement in board level decision-making and coaching opportunities. This requires a level of empowerment that risk adverse administrators are often not willing to provide. Project Development partnerships are developed as trusting relationships with clients--one company and one industry network at a time.

Finally, we might ask:

What can the Private Sector Do to Assist in Developing new Technology Projects?

Over the past 5 years I have probably spoken with 2-3 dozen companies that I thought might make good strategic partners.

However more often than not, their response statements were....
“We are an operating company--Not an R&D company.”

Some were billion dollar companies. Many companies have survived because of this strategy and success certainly speaks for itself. However, it is also true that the “horse and buggy” manufacturers that followed this philosophy went by the way side a hundred years ago.

Media reports have said there are billions of dollars in large corporations sitting on the sidelines waiting for the right opportunities. The best opportunity for investment returns is not necessarily preordained in the expansion of existing enterprises, but in strategic partnerships with the potential for mutually improving returns for both companies. Our nation was built on an entrepreneurial spirit and a capitalistic system that rewards those who invest and manage the risks of innovative solutions that address market opportunities.

The U.S. government will invest less than \$2 billion in agricultural research in 2013. The U.S. total when we add the private sector agricultural research is about \$5 billion. According to press reports, China plans to invest about \$45 billion—or 9 times more than the U.S. So is our investment level sufficient for sustaining our present living standard and that future for future generations?

In the final analysis,

As a nation, the U.S. has enjoyed the benefits of being an engine for global innovation and economic growth for the past 150 years. We recently celebrated the 150th birthday of USDA, and the 100th birthday of Extension.

The world's standard of living rose as the result of U.S. innovation and agricultural development. And being the global agricultural innovation leader has enhanced our own standard of living more than anywhere else in the world.

The unanswered question, "Will the investments required to retain that global status for the benefit of our future generations be made?"

Not only must we figure out how to feed a world with 9 billion people. But those same people will want access to energy for quality of life and advanced biofuels holds one of the keys to energy for unlocking mankind's global opportunities.

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