Is the conversion of municipal solid waste to biofuels and bio-products a truly sustainable and economic business model in the USA?

An analysis of the USA market and the state of play for MSW to biofuels and bio-products projects
The conversion of source separated Municipal Solid Waste (MSW) into useful products (energy, fuels, chemicals and gases) is not a new concept in the either the global or domestic US market. To date the only widespread technology that has mass market acceptance is incineration (or mass burn); using waste as a fuel source to drive electricity generating turbines.

However, there are several industry and macroeconomic drivers which have meant conversion of MSW in its various forms is increasingly appealing. With Connecticut, Vermont, California, Massachusetts and several other US states passing legislation to drive organic waste diversion, there is the emergence (albeit slow) of regulatory pressure to adopt other conversion technologies. In addition, demand for petroleum based products (be that fuel, plastics or chemicals) continues to rise and costs for conventional production show no sign of coming down.

Furthermore, with sustainability seen as the zeitgeist for many of the nation’s top corporations, they and waste management companies are taking steps to bring their operations into line.

These drivers, whilst providing an opportunity for waste conversion, are not in themselves reasons to label the waste conversion market sustainable or economically viable. One of the fundamental reasons for this is that waste conversion technology is a broad term for what amounts to several quite different technologies. A review of some of America’s leading waste conversion technologies offers little in terms of consistency. Business models vary and crucially the location of a project can have massive implications for its performance.

In this debate piece, we will endeavor to take a very specific look at the business case for the production of biofuels and bio-products from waste, deal with common arguments for and against, and also investigate where this particular waste conversion route sits relative to others including Anaerobic Digestion, Mass Burn and landfill gas to energy.

The MSW to Biofuels and Bio-products debate: setting the scene

The business case for Waste to Biofuels and bio-products is at first glance, simple. Take a waste product at zero value and turn it into a fuel or chemical worth considerably more and in so doing reduce emissions (since biofuels are cleaner than unblended diesel and petrol) whilst diverting MSW away from landfill sites. In revenue terms, there are two potential revenue streams: firstly the tipping fees from taking the waste; and secondly the revenues from selling the biofuels. This process would seem to be a win-win situation, achieving environmental objectives in a sustainable way, whilst turning a profit.

However, there are several factors which complicate the basic premise and commercial opportunity in waste to fuels and chemicals. Startup
costs for a facility that can operate at sufficient economies of scale are significant at a time when private investment is slow and government subsidies are modest. Furthermore, demand for biofuels varies nationwide and securing a long term agreement to supply biofuels can be challenging. In addition, tipping fees vary enormously by state and geography. Where tipping fees are low, the production of biofuels from waste is simply not cost competitive with landfill.

Having set the scene, let's examine some of the commonly debated areas and issues arising from the production of biofuels and bio-products from municipal solid waste.

Here's the debate with points for and against the production of biofuels and bio-products from waste:

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<td>Waste to biofuels is unproven at commercial scale.</td>
<td>Certainly it is true to say that waste to biofuels is not a widespread or easily adoptable process. These second generation biofuels are relatively recent and in the US market there is no long term success story standing as evidence of a scalable, repeatable business model.</td>
<td>Companies such as Ineos Bio are already operating at commercial scale; the company’s Vero beach facility began operating at a commercial capacity in the summer of 2013 using both wood and vegetative wastes. The plant began incorporating municipal solid waste during 2014.</td>
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<td>In addition, the market failures such as Terrabon (who filed for bankruptcy in 2012) to the Lake county saga involving Powers Energy of America are a stark reminder of the difficulty in moving a waste to biofuels project from idea to commercially successful business.</td>
<td>Furthermore, the construction of several other commercial scale facilities is either well on the way or nearing completion. Enerkem and Fulcrum are two companies with large scale facilities in construction, having already successfully passed the demonstration phase.</td>
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The expert view:

“Scalable proof of concepts is very important and sharing the data amongst several technology developers is a good idea. [There is a] Serious challenge to perform due diligence without good quality, public, validated information. There is old and obsolete government information which is of a very poor quality. Where do people go to have a reference base and the figures to lean on? Without high quality, robust data from functioning operations, the justification for large capital injections can still be a barrier.”
Having set the scene, let’s examine some of the commonly debated areas and issues arising from the production and securing a long-term agreement to supply biofuels. In addition, tipping fees vary costs for a facility that can operate at sufficient economies of scale are significant at a time when private biofuels and bio-products a truly sustainable

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The impact bio-renewable chemicals and bio-products could have on the market is negligible.

Understanding and finance form major barriers for the uptake of the renewable chemicals market. Whilst it is acknowledged that there are proven pathways for converting biomass-based feedstocks to chemicals, this is still an industry in its infancy and the adoption of renewable chemicals is far from being a given.

Chemistry World magazine makes the valid point about feedstocks; “Biomass derivatives rarely have the purity and homogeneity that fossil feedstocks offer, and purification processes for bio-derived streams are particularly expensive as they involve distillation. Studying a transformation in a lab with a feedstock that is 99.9% pure may give some neat results and net you a prestigious paper, but impurities and mixtures are unavoidable in biomass processing and ignoring them ignores the point of the research.”

So whilst the impact could be significant and the market has enormous potential, this has not happened yet and undoing a century of reliance on traditional petrochemicals will be far from an overnight change.

The impact of bio-renewable chemicals is anticipated to be $2.4 Billion for bulk chemicals alone with considerably more for other chemical types. This hardly represents a negligible impact.

Furthermore, the entire renewable chemicals market is estimated to reach $84.8 billion by 2018 with a CAGR of 7.7%. While alcohols currently form the largest segment of the renewable chemicals market, the polymers segment holds the maximum growth potential at an expected CAGR of 13% from 2013 to 2018. This clearly demonstrates a strong and growing market demand and certainly opens the door for renewable feedstocks to make a massive impact.

Industry analysts suggest 2014 may see a resurgence of private investment in renewable chemicals as traditional chemical companies including DSM, BASF, DuPont, Braskem, Dow, and more turn toward investment in several commercially-viable bio-based chemicals. Recent financing announcements from Amyris, Calysta Energy, Global Bioenergies, Saudi Aramco Energy Ventures, and more support this assertion.

The expert view:

“There is a lot of creativity at work. The chemical marketplace seems to be very interested in alternate suppliers who can meet the qualification requirements and are willing to aggressively price their products. The petro based incumbents who use natural gas derivations are at the end of their learning curve while this emerging group is at the start of theirs.”
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Waste to biofuels doesn’t compare favorably with other waste conversion technologies or current methods of disposal.

To draw a proper comparison, it is necessary to look at factors such as return on investment, environmental benefits and technology effectiveness.

On all these counts MSW to Biofuels could be said to have dubious values as a process. Anaerobic Digestion (AD) facilities are generally cheaper to design and build, plus they are significantly better proven. In terms of investment, the cost to successfully develop Harvest Power’s Anaerobic Digester at Palo Alto was in the region of $97 Million. AD technology is widely and globally proven. Furthermore, AD’s flexibility as a process allows for biogas to be used to generate electricity, it can be sent to a pipeline as gas, it can create fertilizer and power can also be adapted to provide combined heat and power. In terms of environmental benefits, AD has a considerably lower carbon footprint.

If one also takes incineration (mass burn) as a benchmark (a technology that is both proven and effective at disposal and energy creation), then waste to biofuels falters.

Over 28 Million tons of waste per year is burnt annually to create an annual electricity output of 2,720 megawatts. Comparison of waste to biofuels with other waste conversion technologies is at this point very difficult given that the data from working waste to biofuels facilities is in short supply. So, one could argue that it is much more valid to consider waste to biofuels over a longer term lifecycle and also in the context of future expectations than just by looking at the historical financial data of a business case in isolation now.

Moreover, seeing waste to biofuels as an isolated process in competition with other waste conversion methods is misguided. The creation of biofuels may well be completed alongside sustainable chemical production, or may well be an accompaniment to power generation. This is particularly relevant at Ineos Bio’s Vero beach site for example where power and fuel are created together.

Enerkem’s facility in Edmonton creates fuel from non-recyclable and non-compostable MSW; so it works in partnership with other sustainable waste technologies, not against them. Therefore one must examine the whole process from curbside to end product in order to fully evaluate the effectiveness of waste to biofuels, not on simply the biofuel creation.

The cost of petroleum based fuels has been rising considerably over the past 30 years and there is no indication this will change. In that context, a viable substitute to petroleum fuels such as waste derived biofuel will increase in value, enhancing the business proposition.
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On the regulatory front, the trend on environmental regulation in the USA is changing markedly. There is more environmental legislation than ever before with more planned over the next two years. In addition, many business gurus (Michael Porter amongst them) have commented that the environmental vs. competitiveness debate is incorrectly framed and that environmental innovation actually provides net benefits to private companies. As this wisdom becomes more accepted the viewpoint on sustainably produced biofuels will shift accordingly.

Waste to biofuels doesn’t compare favorably with other waste conversion technologies or current methods of disposal.

The expert view:

“The growth and efficiency improvements in digestion are stimulating a lot of investment in synergistic processes which go to fuels. One cannot deny that the availability of the digester outputs stimulates a hard look at the opportunities. Relationship building and maintenance with digester operators including municipalities is sometimes challenging but the pathway to fuels is illuminated. I am a great fan of gasification. This is process sector that has a lot of small players and a lot of ambition. Recently I have seen non-fuel players take stakes in gasification chasing fuels. This is a noteworthy shift. Sadly the US government has failed to assist the evolution of this sector in recent years while we see foreign governments push hard in the area. There are transformational changes occurring in both the enabling technology and the expansion of end product sector applicability. This will be a very active growth area with real promise to challenge the petro-incumbents.

Overall waste conversion is becoming far more viable because the supportive technologies have matured and become more viable. It is more viable because the toolset has evolved. This amplifies the capital proposition and increased leverage improves the ability to attract funding and convince investors.”
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The biofuels market is heavily reliant on subsidies and government support; making them unsustainable in the long term.

The biofuels market is unquestionably supported by the US government in the form of subsidies. $45 billion was given out by the US government between 1980 and 2011 alone.

In terms of regulatory support, the renewable fuels standard is put in place to artificially skew the market in favor of biofuels. Some argue that the reality however is that this does more harm to the consumer at the pump than it does to the oil producing and importing companies for whom the standard was meant.

The US Navy and Air Force’s spending on biofuels came in for huge criticism when it was found that they were paying $150 per gallon for biofuels when a $3 per gallon alternative was available. Meanwhile the Navy spent $12 million in just one day to demonstrate its so-called Great Green Fleet during the Rim of the Pacific multinational naval exercise. It was alleged that such an investment reflected political point scoring rather than a genuine effort to create a sustainable fuel source for the Navy or Air Force. Either way, the amounts invested show biofuels are still totally reliant on government to compete with other fuels.

Yes, the biofuels market is reliant on subsidies, tax breaks and regulation but this is no different to the majority of clean energy; wind, solar and electric cars are all government supported either at state or federal level. Many socially responsible markets require government investment to function (at least initially) and this does not necessarily constitute a weakness, rather it indicates a popular will to adjust the market.

One could also make the argument that the majority of subsidies paid out for biofuels have been paid to support farmers creating 1st generation biofuels from corn and soy beans rather than 2nd generation biofuels from waste products. Waste to biofuels and bio-products projects are attracting interest and investment without the need for a market based heavily on subsidy.

Moreover, the argument for more waste to biofuels support is a more cogent one because both fuel production issues and waste disposal issues are being addressed.

The expert view:

"Agri business based fuels have always been reliant on subsidies. But there is a future for agri business without them.... I’ve seen the successes when it is completely non-related to government action and inaction.

Of course the waste based biofuels have never enjoyed the same level of government support the agri-fuel giants were able to lobby for thus the playing field is still not level."
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Waste to biofuels and bio-chemicals projects struggle to attract funding

Primary, qualitative research with bio-tech startups frequently reveals that they see funding as a serious issue. The cost to ‘prove’ technology at scale, with a heterogeneous waste stream is a massive hurdle. Indeed, several high profile strategic investors have either pulled out of the market or reduced their presence; Waste Management Inc. amongst them. Over the past 3 years, high profile MSW to biofuels companies Enerkem and Fulcrum withdrew from issuing IPOs on the basis that market conditions were poor. Investors are often spooked by the reports coming back from the market; Syntroleum fuels and Dynamic fuels are reportedly losing in excess of $2 million per month as their joint $150 million facility stands idle. Meanwhile in Colorado, Gevo lost $12 million in Q1 despite raising further capital. These instances, whilst to be expected as the industry begins to mature, create anxiety amongst investors as they look for surer bets in the energy and fuels markets.

Funding may well be a challenge in the MSW to biofuels and Bio-products arena but the list of companies that have received significant investment is encouraging. Solazyme, Amyris, Genomatica and Lanzatech, plus a whole host of others have received investments from $40 million to in excess of $100 million. This does not indicate a lack of willingness for investment. Perhaps more encouraging are the diverse sources of investment; Siemens, Mitsui, Boeing, Embraer, DuPont and Braskem are just some of the large multinational corporations putting large sums into waste derived biofuels and bio-products. So, whilst achieving a sufficient level of investment is difficult, it is far from impossible.

The expert view:

"The financial community uses due diligence methodology to ensure that the quantifications in a cost benefit analysis are adequately supported. The promise of a return in biofuels investments has changed due to changes in legislative and regulatory requirements for proportional use of non-petroleum constituents in transportation fuel. We have seen the biodiesel from soybean challenges. So the financial community will apply a rigorous risk assessment to these value propositions. Recent enterprise failures do not help confidence. A key point of optimism is the core proposition that the applicable waste feedstocks are still available and economically accessible. I would say the question of process efficiency is now front and center. While there are a lot of demos and pilots out there – who will scale up to material quantities? This is a provocative and exciting question.

But is there money out there for new projects...Absolutely. There is a lot of money looking for a home. People who are asking for the money need to learn how to put themselves in the position of the people who have the money. Don’t teach the finance guys about the technology. They want the tools to be unquestionable – they want you to quantify the benefits."
The US biofuels market in the USA faces uncertainty and structural flaws.

The EPA has already made clear that the E-10 blend wall (the point at which the E-10 fuel wall is saturated by ethanol) has been reached. Figures for 2013 clearly show that gasoline consumption at large has been reduced. In addition, targets set by the EPA for second generation biofuels have been retrospectively reduced. So there is more than a hint of uncertainty for biofuels producers as they look to protect their share of the motor fuel market.

The emergence and growth of the US natural gas vehicle market is also an area of concern for biofuels producers. With compressed natural gas (CNG) at a national average price of $2.09 vs. in excess of $3 for both gasoline and E-85, the economic case for biofuels loses further ground.

It is important to consider that whilst there have been changes to the anticipated output resulting from the renewable fuels standard and the accompanying RINs; the standard is still very much in place.

"It’s important for people to understand that this is a one-time adjustment. Going forward, the agency will continue to base targets on expected volumes in forthcoming years, which is the only way to grow the advanced biofuels industry," said Brooke Coleman of the Advanced Ethanol Council.

Natural gas has largely only been commercialized in the US for medium to heavy duty logistics fleets rather than regular use cars. Whilst natural gas represents significant costs savings and emissions profiles, the infrastructure is not yet widespread.

The expert view:

“There is an overwhelmingly promising future in biofuels ahead as America leaves behind its blind allegiance to the petro-paradigms. Backing creative insights and unrestrained technical aggressiveness is a good bet.

However, there is enormous difficulty projecting due diligence. There’s not a lot of actuarial data as these are new industries and therefore it is difficult to make serious financial decisions. You must dive deeper in to the people, the technology and the scenarios. You must think about the market acceptance.”
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Conclusions from the debate

As with all debates, there is seldom a conclusive and definitive answer. However there are some clear conclusions that we can take away from the debate:

1. Waste derived biofuels and bio-products clearly have a future in the US and international markets. The trends for cleaner fuels, supportive regulations and the development or better proven technology mean both the biofuels and bio-products markets are ripe for the shift towards sustainable alternatives.

2. Finance and funding are clear areas of concern and remain barriers to successful commercialization. The emphasis has shifted away from proving a concept and towards proving a commercially viable business proposition that produces at scale.

3. The biofuels market has been prone to turbulence, national disagreement and changeable policy. However, even with the upheavals, advanced biofuels derived from waste have a massive opportunity because they solve the dual problems of sustainable disposal and clean alternative fuels. Unlike traditional biofuels, they are driven by a non-controversial feedstock that is not subsidy dependent.

4. It’s all about scale. The biggest conclusion that can be taken from this debate is that the pursuit of verifiable data from a working commercial project at scale is the most important outcome for the industry. Once projects can prove their results and demonstrate worthy returns then the growth of the industry can begin in earnest.

If you are looking to progress with an MSW to Biofuels or Bio-products project in 2014, get ahead by attending the MSW to Biofuels and Bio-products Conference and Expo this October 6+7 in Orlando (Hyatt Regency Hotel).

This event will help you secure investment, build new partnerships, navigate your way to a commercially viable project.

You’ll meet municipalities, private waste management companies, financial advisors, EPCs, developers and tech providers – this is an event not to be missed!

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