Science AMA Series: I'm Professor David Glasser, winner of the inaugural Harry Oppenheimer Gold Medal and director of Materials and Process Synthesis at UNISA. I'm here with Professor Diane Hildebrandt to talk about waste to energy conversion. AMA!

Waste$_t o_E nergy$[1]$andr/ScienceAMAs$[1]

[1]Affiliation not available

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the WINNOWER

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Hello, and thank you for lending Reddit some of your time and expertise.

My question is this: with climate change looming in the not-so-distant future and carbon emissions in the hot seat, do you expect this technology to be a help or a hindrance in the battle to prevent catastrophic warming? Producing hydrocarbon fuels from currently solid waste would not be carbon-neutral, I think, but do you expect this tech to gain widespread adoption such that it could have a slowing effect on the transition from fossil fuel to renewable energy sources?

oz6702

Complex questions to address, but I will attempt to balance brevity and clarity in reply.
The overall effect of this technology depends on what energy sources it ends up displacing and upon what feedstock it utilizes. Biomass is the preferred feed-stock because biomass will be a permanent fixture on the planet whereas the over-abundance of plastic is, hopefully, a temporary problem. While converting plastic and then burning the products is carbon-positive, if it is displacing fossil fuel consumption then it has a similar carbon footprint to what it is displacing, while also removing persistent pollutants from the environment. If energy from converting plastic displaces renewable sources then, as you say, it releases excess CO_2. After all, plastic is a carbon sink, albeit a dirty one. I think, however, that mankind must inevitably deal with all of our plastic and I think sooner is better than later.
When waste biomass is the feedstock, the benefits are much clearer; converting it and using the products prevents the breakdown of biomass into methane, which is a far more potent greenhouse gas than CO_2. Moreover, biomass is itself a renewable resource. All of the carbon in biomass comes from CO_2 in the atmosphere originally, so the overall process starts with CO_2 and ends with CO_2, extracting solar energy in the process.

Can waste to energy conversion work efficiently on my house soon?

Would this create an incentive to waste food and products?

Moral_Gutpunch

I hope so and I hope not, respectively.

We (and by we, I mean my wife) recycle all our plastic, paper and glass waste. I often wonder though, we have to drive to the recycling bins in our area (5 minute drive). Then the collection lorry has to come and pick it up and take it to a recycling depot, where presumably its sorted and recycled in some way. How much energy in involved in this process and does it conserve more energy than simply making a new product or taking the waste to land fill? In other words is recycling better for the environment than disposal and replacement?

colinsteadman

Once it gets out into the environment at large, plastic becomes a permanent problem. It doesn't bio-degrade on any relevant timescale and it can get into places where collecting it again is close to impossible, even when it's dumped in a supposedly safe landfill. Whether it's worthwhile to use a bit of extra energy to deal with it might seem like a close call when you look at the short-term consequences but with a more long-term view in mind, continuously dumping plastic is unconscionable.

Can you provide us with more details on the conversion unit: does it work with any kind of plastic, and does it require external energy?

Dastardlyrebel

In principle any kind of plastic can be converted, currently we are staying away from chlorine containing plastics (like PVC) due to the formation of HCl that becomes problematic downstream when/if it condenses. Its a technical issues that can be overcome though.

The gasification itself does not require and external energy source. The energy comes from partial oxidation and combustion of part of the plastic. The ideal situation would be to run close to adiabatic conditions, in reality we run somewhat overall exothermic.

How economic is this form of energy conversion? Is there any downside to this? Any catch? What kind of hurdles might one expect when trying to implement this on a larger scale? P.S. I know too many questions, beg your pardon.

thediabolicalkid

The gasification part of the process is amazingly robust, it can handle basically any organic matter that's thrown at it. The FT portion of the process is more sensitive, however. The catalyst is quite easily poisoned so there's a need for a gas cleanup step, which is generally designed for the specifics of the feedstock. If the feedstock has anything that the gas cleanup is not geared for, that can mean a nasty (and expensive) surprise for the catalyst. So one big hurdle is making sure that the feedstock compositions are well-known and predictable.

What could we do with this technology in South Africa? What do you recommend I do if I want to go into a similar field of research after I graduate from Highschool.

500mmrscrub

South Africa is in a unique position when it comes to sustainability. We have a wonderful environment and a multitude of ecosystems, all worth protecting but all threatened by a growing, energy-hungry economy. We are on the front lines of green technology, if you will, with a tremendous need for economic growth and job creation but also a tremendous to ensure that they don't come with a steep environmental cost.

As for how to pursue similar lines of research, I may be biased but I believe Chemical Engineering is by far the best field of study for pursuing sustainability.

I think a more marketable process would be a small scale unit marketed to individuals. Is the technology in existence for a tabletop unit? Something that could convert grocery bags and other household plastic waste into small quantities of home heating oil, gasoline and methane for the everyday consumer. Something similar to what is purported to be done by the small batch unit shown here: http://www.blest.co.jp/eng/service/#pamphlet If not, what technological hurdles need to be overcome to make it feasible?

AJLEB

Economies of scale do apply to the capital cost, so smaller units tend to have a long payback period. The smaller size also results in more heat loss and therefore lower overall thermal efficiency.
That said, it is quite possible to go down to quite a small scale. We've got a unit designed to handle 350kg/day of waste and it can be carried around in the back of a small truck if need be. There aren't any real technological hurdles to scaling down, just economic ones.

Does this make sense? I mean the biggest issue is the plastics that escape the system, that people can displose of responsibly but don't, and end up in the oceans not degrading and clogging animal stomachs.

How could it be cost efficient to use the energy to go out and recover all of the drifting material?

Wouldn't a better focus be to stop the current production collection destruction cycle and just go at the direct issue, the stubborness and toxicity of the plastics themselves. Anything else seems like pouring in water without putting the plug in first.

boringmichael

Well, put it this way; if you told people that they had to dig ore out of the ground at great expense for the benefit of the environment, no-one would be doing it. Tell them, instead, that the ore has gold in it, and people are falling over themselves for the right.
A financial incentive makes all the difference.

Not an expert on the topic of waste gasification, but I am familiar with high temperature gasification of biomass to form syngas, using noble metal catalysts on ceramic membranes/supports. Such systems can be rearranged to co-electrolyse methane and CO2, although this is still at TRL 1. Such solutions are limited by the efficiency and conversion rates of the catalysts, the fast catalytic activity drop with operation time, and the high-temperature required for operation. What are the specific advantages and limitations of your solution compared to these?

whatevs

Our system doesn't require a catalyst for most feedstocks, which makes it fairly robust and easy to

operate and maintain. That ease of use is a key part of our plan for rolling it out on a wide scale; we intend for it to be used in remote areas without needing experts on the technology to operate the units.

What exactly does your equipment will process into what kind of fuel? I mean, there are different compositions of plastic, different trace materials in it. Or is it like "Back to the future", where I can throw anything that kinda plastical?

Overjay

There are very few fundamental restrictions on the process. The gasification in particular can handle just about anything that gets chucked in. The catalyst for the Fischer Tropsch section is quite sensitive, however, so the gas cleanup step has to be able whatever impurities happen to show up. It is possible to design a highly robust gas cleanup, but it's more economic to design for a specific feedstock.

Since the plastic is converted into fuel, what are the climate change and global warming implications ?

We are nowadays talking about capturing atmospheric CO2 on one hand and if successful, the process of converting massive landfills to fuel will release all the trapped CO2.

rick29de

If energy made from plastic waste replaces energy made directly from fossil fuels, the effective carbon footprint stays the same, minus whatever emissions might otherwise arise from the waste. It also prevents that plastic from finding its way into the environment, which is a major issue that needs tackling.

Converting biomass is a carbon-neutral process because the Carbon content derives from plants, which use CO2 from the atmosphere. Each carbon atom that gets combusted in the process to result in CO2, was originally extracted from atmospheric CO2 so the net effect is neutral.

What do you think about thermal depolymerisation? Has it just not been economical enough to take off?

mdhe

The oil from this is quite complex and does not fit that easily into the current oil infrastructure as a high value product

How volatile is the process itself and will it be viable from a maintenance and operational standpoint to install these at recycling facilities and/or landfills?

alpha_phenol

The process is quite stable and safe. Our units are packaged inside cargo containers and are essentially turn-key processes that can be operated on-site by one or two technicians with a modest amount of training.

Any thoughts on computational material design to uncover materials better suited to our needs?

lance_vance_

None as yet.

Hi- 6th grade science teacher asking on behalf of students regarding our performance expectation of "apply scientific principles to design a method for monitoring and minimizing human impact on the environment." *Questions edited for clarity- removing: um, like, things*

How long did it take your team to build the unit to its current state? And at what point did you decide it was efficient enough?

Humans have options for better waste management now - since they don't use them, what makes you believe people will use your processor?

What can the fuel be used for since we already have so many things that run on fossil fuels? Or, how far into the future will these by-products be regularly usable?

Can we get one at our school?

Kimbateaches

Hi Guys – great to hear from you and we are so glad that you are interested in science.

Getting such a technology to work requires lots of different skills and knowledge. We are a team of around 50 engineers and scientists and we have specialists in catalysis, reactors, design, gasification, water clean up and so on. We all have to work together to make this idea a reality. Some us, like David Glasser and Diane Hildebrandt, have been working for more than 20 years in areas related to this work, while some of the other engineers have just joined the team and are doing their PhD's in an area that we need to understand to make the technology work better.

As engineers and scientists we are always wanting to make things better and more efficient and it is hard to stop and say "what we have is good enough". However about 5 years ago we decided that, while there's always room for improvement, we were in a position where we could prioritize commercialization. We had tested all the individual parts of the process and had built a small scale plant that converted biomass (wood chips) into fuel. We are of course still improving and changing things to make things better and better. Our newest demo plant has been improved by what we learnt on our first small scale plant.

I think that there will be different drivers in different communities to use this technology. In Africa the municipal garbage is often not collected and plastic bags are known as "the flowers of Africa" as the bags blow around and get stuck on the barbed wire fences and flap in the wind, rather like flowers. We also have people who do not have jobs or money. We hope that if we give value to waste, this will be an opportunity for people to collect waste and take it to the waste plants where they will get paid for the waste they collect, thereby cleaning up the environment and creating wealth for people. In more developed countries, such as America, I think that converting waste to useful products will be also driven by economics and perhaps this will change people behavior or allow new business to grow that make a living by collecting waste and selling it.

The technology we use uses the Fischer Trospch reaction to make a synthetic crude oil. This fuel is made from coal in South Africa and our cars and trucks in the Johannesburg area of SA use this fuel. Thus we can replace some of the fossil fuels we currently use with a fuel that is made from garbage of biomass and these fuels have the advantage that they fit fairly easily into the current fuel systems.

You will need to see what waste you have available from your school and how much there is. Also you will need to see if there are any bylaws that prevent you using your garbage on site! In SA we find it quite hard to use garbage as a feed as it "belongs" to the municipality and is covered by many laws

which means that we have to work with the municipality to get such technology implemented.

Hope the answered helped and good luck with your studies.

Have you considered as a marketing/ public education idea to make a smaller unit into a van, and drive it around and have people throw food waste into it. You would paint it like back to the future and drop banana peels into it and ideally it would be powered by the conversion.

derphurr

As engineers we have a built-in tendency to focus on engaging directly with industry rather than on marketing to the general public. We're working on shifting to a broader focus (by doing an AMA, for instance) and a mobile test unit would definitely help with that. Thanks for the idea!

How does it feel to know that most Americans completely and utterly reject science?

bobojcd

I would suggest that it's more accurate that most Americans reject certain aspects of science, particularly evolution, while still being perfectly content to make use of the products of science that are all around us. So certain elements of science are rejected, rather than science in its entirety.

The growing sentiment of anti-intellectualism is certainly concerning but it's good to remember that scientists have endured far worse in the past and yet progress marched on regardless

Is the gasification process at a very basic level, just a high-pressure incinerator? Or a process similar to how wood is made into charcoal?

doubledundercoder

Gasification does not have to run under high pressure. Conceptually you could picture it as a hybrid between incineration (excess air) and pyrolysis (no air).

Gasification uses a limited amount of air (the "limiting" reagent) to break down the plastic into (mostly) CO and H2. This can then be used to produce a wide array of useful (and valuable) chemicals.

In the case of waste -> liquid fuel conversion, what is the process efficiency? < 25% ?

doubledundercoder

It's quite possible to get over 70% overall thermal efficiency but in practice in the field, 50% to 70% is more typical. It's highly dependent on the specifics of the feedstock.

Great work you're doing! I have a few questions.

What do you foresee as the main energy input for the gasification process? Will it use fossil fuels?

And also, what are your thoughts on converting carbon dioxide to syngas for liquid fuel synthesis?

Aizero

The product distribution and overall energy balance of gasification can be tuned by manipulating the amounts of oxygen and water fed to the process. It is common practice to make the process adiabatic (zero energy input) or slightly exothermic, to avoid the necessity of using fuel.

As for chemically converting available CO2, its viability is dependent on an abundance of cheap energy. The conversion process itself has inefficiencies so the energy input required will exceed the energy content of the resulting fuel and then there is the separation work required to obtain pure CO2. Overall, it won't be feasible from an economic or energy standpoint unless there's a massive push toward solar or nuclear energy.

What can the average person do to curb wastefulness?

GenevieveLeah

The short answer is: waste less stuff. The big principles of reduce, reuse, recycle are quite well-known at this point so going forward, what's needed on a personal basis is maybe a bit more discipline on a personal level when it comes to cutting consumption, and definitely more education about efficiency and sustainability.

Approximately how much energy can you produce from, say, 1000 tons of municipal solid waste?

questionto42

A rough rule of thumb is that one ton of waste yields one barrel of fuel; so 1000 tons would make around 1000 barrels of fuel.

Do you ever see this being able to be scaled down to a residential scale so that people will be able to one in their homes?

High5Jive

The smallest units currently in operation are designed for about 10kg/hour of biomass, more than a household produces. It's more likely that we'll see units sized to serve a block or an apartment complex as opposed to a single household.

How economically viable is to develop this in a large scale? Can it actually compete with coal from a cost perspective?

Notnotfakeaccount

Economies of scale apply so the larger the operation the cheaper it ends up being. From a cost perspective it will be much cheaper than coal if adequately scaled up, because coal is expensive whereas waste is free.

In practice, what kind of economies-of-scale and site infrastructure would be necessary for organic waste to be considered as a serious viable alternative or suppliment to coal or natural gas feed stocks?

typical_neckbeard231

Organic waste is a long way from becoming an alternative to fossil fuels. While managing organic waste is becoming a real problem, there is still not enough of it.

If enough of these smaller scale units were implemented, and other organic wastes were included (such as agricultural and forestry waste), it may become possible to offer this as a serious alternative but the current goal is to supplement.

Thank you for taking the time to come here and discuss your technology with us. My question I would like to ask is, how far away are we from having power plants like the one on the deLorean in Back to the Future 2?

Liveonafarm

That was nuclear fusion, I'm afraid. We're just doing chemical conversion.

How does your process compare to pyrolysis, which has been demonstrated by companies such as Next Generation Recycling and what advantages/tradeoffs does it offer?

szepaine

Pyrolysis and gasification are essentially just different points on a continuous spectrum, where operating temperature and amount of oxygen fed dictate the balance between the two. The balance that suits a particular application will always depend on the specific circumstances. Gasification allows us to produce cleaner fuel and higher value commodities, so that's where we tend to focus.

Hello,and thanks for doing the AMA. Ignoring any economies of scale, do you believe may be a solution to problems such as the Great Pacific Garbage Patch? On the other side of the spectrum do you think this process would be a viable power source to some villages in remote places whose only major source of waste would be some kind of crop or wild plant and less plastic based.

sterlingheart

The Great Pacific garbage patch is incredibly problematic, not just because of its location but also because it's actually highly dilute. Consequently, expensive separation is necessary for getting at the plastic. Being able to convert it into valuable fuel might be just the financial incentive needed to get someone on that.
Plant-based processes are also a great option; the process is well-suited to using them and the resulting process is carbon-neutral overall.

First, thank you so much for your work in this field and secondly, for doing this AMA!

I have two questions about your plan for the products of your reaction, going forward: 1) Production of fuel from the FT process is notoriously costly, who will buy this fuel, is it economically competitive in your target area? 2) Will your fuel be produced in a form easily used by consumers?What products is the process optimized to make methanol/ethanol/gasoline/diesel?

Logorg

FT fuel is economically viable in a South African context. We actually already buy it every day. It has the same price as conventional fuel. This technology can be economically viable if the business case is carefully designed.

At smaller scales, we target a diesel blend and wax rather than gasoline. Methanol and Ethanol are products of a different process which we have currently not targeted.

In quite a few places they burn trash to create heat and then of course electricity. It creates greenhouse gasses, but displaces fossil fuels used to make electricity. I would think that conversion to other products would be too inefficient by comparison. How true is that?

oldmedman

The gasification --> Fischer Tropsch process can be used to produce electricity on the spot using something very similar to an Integrated Gasification Combined Cycle generator. The thermal efficiency of this type of generator is generally a lot higher than you can get from just burning trash in a furnace, and it burns more cleanly. So if there's a demand for electricity, this technology is very well-suited to that application.

One issue with electricity is storage. Batteries have far lower energy density than liquid fuels, and their energy dissipates over time. You use it or lose it. Other products, like liquid fuels can be stored for later use. In most instances, liquid fuels wind up being the most desirable product, so that's where our focus lies.

what kind of a role do you see nanomaterials making in the clean energy revolution of the future? by my understanding, metamaterials such as fullerenes, graphene, CNTs present unique frameworks for reimagining systems on a nanoscale for more efficient potentials

CaptnWillie

Nano-materials could potentially provide better catalysts but it's not an area we're exploring at the moment.

In the US, a lot of effort goes into collecting grass clippings and leaves, by home owners and municipalities. Would this be suited as a way to deal with this biomass? Would a source like this be better treated naturally and turned into compost?

derphurr

From a greenhouse gas perspective, composting is problematic because it releases methane, a far more potent GHG than CO2. If soil improvement is a priority, it's possible to tune the gasification process to produce some amount of biochar as a by-product, and it's an excellent fertilizer / soil improver.

What practical steps can every day people take in light of the environmental disaster likely following the U.S. election to help limit the damage to the environment?

DrNO811

The United States has 300 million people and only one president; the results of the election matter far less than the actions of everyday people.

Hello! Thank you so much for taking the time off to answer our questions.

I am a chemistry undergrad and have been researching on carbon dioxide reduction; the current problems with this technology lie in the poor selectivities of electrocatalysts and high overpotentials of the reactions. Do you expect that these problems can be solved in the near future, and if so, how?

Bloo14

These problems have been solved quite well by Nature (the abstract concept, not the journal); plants are highly efficient at using solar energy for carbon reduction. Humankind currently produces 140 billion tons per year of waste biomass, so there is already more than enough solar energy being used for this purpose. The trouble is that for the moment, it goes to waste.

Have you read into the logistical challenges of sorting and transporting plastic waste recouped from solid-screen captures in the Pacific Ocean?

more here

metalliska

It's quite possible to mount a gasification and Fischer Tropsch unit in a boat and convert the plastic on-site in the Pacific, bringing back liquid fuel. This would at the very least cut down on the cost of transporting the plastic back to dry land.

What are the bottlenecks to this process, both in terms of conversion rate and economic feasability?

theworm1244

Getting new technologies out there is always very difficult. The bottlenecks initially are gaining market acceptance both for the technology as well as the products. As more and more plants are sold (and therefore manufactured), one can rely on economies of scale to bring the prices down and also for the market to grow to accept the products. On the technical side, a major innovation has been to develop a FT catalyst and reactor system that is cheap, robust and has a long life.

Thank you for your time! My question is: how 'clean' does your process need to be? In the US our waste is primarily food containers/chemical containers. Does the food and chemical residue offer significant challenges to the technology, and if so, what is the solution to make it as easy as possible. In my experience, the less steps the consumer (whether it is the individual or the city/county/state/country level) has to take, the more likely they will start using a new service. Also are there programs in place to get one of these containers as a demonstration? How would one go about doing so? Thank you!

BringFiretothePeople

The food residue and other organic residues in the containers are not a problem. We currently have a demonstration pilot plant under construction. We hope to get demonstration plants out in the field for testing and have applied for funding for field testing the very small scale plants.

I have two questions. 1. How is this more efficient, or superior, to the larger scale waste-to-energy plants that were built previously? No new municipal plants have been built in many years, but many of the older ones reduce the volume of municipal waste by 80%-90% while providing electricity at a 30%-

35% efficiency. 2. Why not directly recycle the recyclable plastics. We found in the municipal systems that, while plastics have excellent BTU content, they could be recycled and other items like yard waste, food waste and tires burned.

unrulywind

To my knowledge, those older plants were all just incinerators, which tend to be quite inefficient at electricity production. Gasification offers higher thermal efficiency, along with the option of producing higher-value products so it's a technology that has far more applications.
That said, in very cold climates low-grade heat is reasonably valuable, so incinerators are an economic solution. Sweden, for instance, actively imports garbage because they don't produce enough for their burners.

What's the real viability of plasma arc disposal? Can it decompose enough of the fuel to make it safe to handle reasonably after? How do you trap or extract the many toxic base materials? Can the solids trap toxic particles enough to really use it as fill or aggregate? What are the top toxic materials Plasma disposal is addressing?

Why hasn't it caught on?

Thanks!

btao

The biggest issue with plasma arc disposal is energy-inefficiency so it's generally only used when very high temperatures are needed to decompose particularly problematic materials.

Are there any viable solutions proposed that would include converting landfill waste into energy? to cut down on the mass pollution landfills are responsible for, this isn't this is a major concern for people in your field? I appreciate a response, thank you for your time.

KVG7750

If we're able to convert and use the carbon-containing, there will be far less need for landfills. Our focus for the moment is on reducing the rate at which material goes into landfills. Dealing with existing landfills must come after that, because they're much more difficult to deal with because they're rife with contaminants of all sorts.

I'm currently writing a research report on the impending energy crisis, and I would like to compare the efficiency of different systems. I'm finding it very difficult to find raw data about alternative ("green") systems of energy production. Is there anywhere in particular I may be able to access this data ?

TheAetherkings

That kind of data is generally proprietary so it's difficult to get hold of. For older technologies, such as ethanol, there will be data in literature but for newer technologies, it will be tough to pin anyone down on an exact figure.

How long does it take to process 1000 kg of waste?

monkeydave

Depends on the size of the facility. As stated earlier: we have mainly designed for 5 tons per day, for economy of scale reasons. 1000 kg would thus take 5 hours.

How modular can this technology be? I was going to ask how you deal with excess methane, but you already answered that. Any chance that your processes can be incorporated to a sewage treatment facility?

Thanks in advance.

godlameroso

We aim to make the process modular enough to be used by just about anyone. Our goal is to make units that are no more complicated to operate than a car, and no more expensive.
Sewage is a viable feedstock but it does contain a bit more water than the process can tolerate so it would necessitate a drying stage. It's often more economical to just use it as a fertilizer, if appropriately sterilized.

What do you think about Donald Trumps energy policies?

SteeleNoose

That depends on what Donald Trump's energy policies actually turn out to be.

Hi! I think your work is absolutely fascinating. I'm currently in matric and still not quite sure what field I want to get into. What courses have to do with what your field?

phandelion

I might be biased, but Chemical Engineering is your best bet.

I know i probably too late, and maybe answered but needed to ask before you left. With waste to energy conversion there will always be contaminates/heavy metals produced, no matter the regualtion some will always be realeased, so my questions are.. Do you think we will ever reach a point where waste to energy conversion can be truely 100% pollutant free/safe for the envriomentand the people living near to these incinerators? AND , is there currently anyway to protect people/property/enviroment from the effects of these harmful air born pollutants?. (Anyway to deal with the smell? That to would be nice too) Thank you for your time . any links for further reading would be great also. All the best.

Alsmoo420

We're predominantly using biomass so the metals present in the feedstock are generally metals that plants require. The solid waste from the process can then be used as fertilizer so the metals essentially circulate through the eco-system.
In the case of heavy metal contamination, this process can actually serve as a means of clearing heavy metals out of an eco-system; these contaminants are easier to separate and handle in the gas phase than to extract from living plant matter.

As for smell: gasification is itself a solution; it uses a much higher temperature than furnaces and incinerators so it achieves almost entirely complete chemical conversion, eliminating the volatiles that might otherwise cause a smell.

How viable is pine beetle kill as ecologically sound biomass for the production of biofuels?

awellsab12

Dead wood is an excellent feedstock for the process. I don't see any issues with Pine Beetle Kill; the high-temperature gasification step effectively sterilizes everything it processes so the beetles themselves would just be a little bit of extra biomass. Being able to turn waste biomass into valuable products also improves the economics of removing waste biomass such as beetle kill or even invasive tree species, possibly adding a financial incentive for ecological remediation.

The cannabis industry produces an enormous amount of waste biomass and turning it into fuel has been on my mind for 6 years now. Is there a requirement for the biomass? I use Carbon Dioxide alongside LHC's and other solvents to process dry biomass and then we mix 50/50 v/v and send to Waste Management. If we could utilize that on site as fuel for generators or heat that could be a not insignificant cost savings.

ReverendSin

The process is quite flexible and robust; it can handle virtually any source of biomass.

My question may seem odd, but here goes. Since we know that garbage placed into landfills doesn't biodegrade very quickly, especially if it's in a plastic garbage bag, wouldn't it be better for the environment to leave biodegradable trash on the side of the road where it could deteriorate much more rapidly? Isn't it more harmful to put it in a landfill inside a plastic bag? I'm only talking about the trash that biodegrades fairly quickly like paper, wood, etc. I realize our roadsides might not look as nice and that the best option is to not litter in the first place.

Lkbbrasil

You're absolutely right; organic matter is wasted in a landfill, where it's not available for any sort of utilization. Buried in a garden, it serves as compost.

Is there any way to compost dog poop safely?

andrelo22

In small quantities it can just be buried and it acts as a reasonable fertilizer.

If we use the fuel for generating electricity; what average percentage of the planet's current electricity supply could we generate this way? (I ask because if the fuel is stored, it might be used to fill in for variable sources like wind and solar when they aren't generating).

wolfkeeper

A total of 140 billions of biomass per year are produced worldwide, which could amount to as much roughly 140 billion barrels of synthetic crude oil per year, more than double the world's total demand for liquid fuel. So if all the available resources are utilized, this process could theoretically supply all of the liquid fuel as well as all of the electricity. However, reaching even a sizable fraction of that full capacity

is probably a pipe dream at this stage. We envisage the process principally supplying automotive fuel, but perhaps with a bit of electricity generation thrown into the mix.

Has any work been done on finding safe, economical ways to harvest the low-level heat generated by spent nuclear fuel?

DrColdReality

Something quite similar to a steam engine, but using low-boiling hydrocarbons instead of water, has been developed and is commercially available. The overall efficiency is quite constrained by thermodynamics (Carnot efficiency), however.

Is the conversion of food wastes to energy a 'better' solution than feeding them to pigs as used to happen before various health scares?

AllanfromWales

Food waste is just a small portion of agricultural waste, and there are things that even pigs can't eat. That said, different circumstances call for different solutions so there will be some contexts where pig-farming is the best bet but others in which fuel production is favoured.

I like that you started with "animals we share the planet with" - share being the key word!

Although I completely agree with the process of recycling (or figuring out how to recycle) 100% of our waste, what is the Economic Gap to get there?

By this I mean, say it costs 100% to baseline get copper from the ground, but it costs 125% to recapture from waste. So the premium for recycling this particular material is 25%. From an environmental standpoint, recycling is always better, but from an economic scale, it can be hit or miss.

Would newer process driven factories help reduce the costs? Are we already there? If not, how far are we to Economic break even?

Thanks again!

Tito_Mojito

If we're able to produce enough units for economies of scale to take effect and we're able to get those units close to the source to avoid unnecessarily transporting waste over large distances, then we expect to become cheaper than fossil fuels because our raw materials are waste, whereas theirs are a valuable commodity.
As an aside, we're working with a commercial operation on recovering metals from electronic waste and what we've found is that the process is economically quite viable, with the added benefit of working against the dire environmental threat posed by rare earth metals.

Will be 2D crystals a new way for optical storage or will DNA hard disks come before? Are the servers running in the world a concern for energy expenditure or not?

Pella86

We have no expertise on the topic of data storage so I'm afraid I can't really answer your first question.

As for the second, the energy consumption of data storage and transmission is very small compared to that of other sectors such as transportation.

What percentage of US energy (or liquid fuel) requirements could be met by this technology?

Zappity_EVE

If all available agricultural waste were used, we estimate that the total output would roughly match the US's demand for liquid fuels.

What is the efficiency of this process? How much energy is expended to get what amount of energy back?

HexesNHoes

Overall thermal efficiency in the field comes to about 50% for the smaller units.

OP is not delivering. Kry jou huis in orde!

-NiceToWatch-

It's nice to see some Afrikaans on reddit! I'm just trying to get some more of our team on a skype conference call and then we'll start tackling questions.

What are the carbon footprint comparisons between leaving the waste "as-is" versus working towards converting it to usable material?

Thanks for being here!

tsunami845

In the case of biomass, the carbon footprint is very similar. If left alone, biomass rots to release CO2 and methane. In the case of plastic, however, gasifying and converting it results in higher overall CO2 emissions. Plastic, because it isn't biodegradable, actually serves as a carbon sink overall. It is very damaging in other ways over long periods of time, however, so processing it is crucial to minimizing environmental damage.

Are there any byproducts created in the process that could be harmful (to health, the environment, etc.) ? Specifically, what kind of waste is being converted?

koddish

We can convert any carbon containing waste that has energy locked in it. Thus we can convert plastic, biomass, waste food, municipal waste etc. We emit CO2 as we utilize some of the feed to supply energy to the process. The other wastes depend on the type of feed. A feed of plastic feed does not emit water while biomass would produce a waste water stream which we clean up before emitting it. There will also be ash from biomass which one could return to the land as it contains the trace minerals that were in the biomass and thus one would close this loop on recycling nutrients. Other wastes are deactivated catalysts (we typically use iron and so this is not too problematic) and the absorbents that clean up the gas leaving the gasifier (this would mainly contain sulpher).

Do you think it would be better to use gasification to mitigate our waste problems, should we try and move towards generating less waste as a society, or a combination of both?

tomsaywhaa

Definitely both. Even if we manage to handle all of our waste, as a society we still need to bring our energy consumption down to what we can sustainably supply. At the same time, just trying to minimize waste is no substitute for actually eliminating it.

Practicalities dictate that different solutions will suit different circumstances. As a society we're facing a monumental task and we'll need a mix of solutions to tackle it.

What is the percentage of waste can you convert to energy during gasification, and what do you do with the byproducts (if any) after?

tomsaywhaa

Depends on the waste being converted. On a mass basis you can get a conversion up to 50% for plastics. Lower quality wastes (like food waste) can see lower mass conversion, some 15%. On an energy basis the conversions are a bit higher.

The biggest byproducts are CO2, H2O and ash. The CO2 and H2O are less than what is made from fossil fuels. The ash is problematic but it has a significantly smaller volume than the unconverted waste. Its not perfect in terms of emissions but signifies a significant volume reduction.

What exactly are the commodities produced? Are these commodities in enough demand for a reasonable payback period?

CatchingRays

We tend to focus on producing diesel because it's easy to find a market for. We can also produce short-chain hydrocarbons suitable for gas-fired power production on-site. Longer-chain products like waxes are also possible and have higher value, but they're more difficult to find a market for.

if we assume the environmentally best possible scenario given the current situation and available technology, do you think it would be possible for human beings to survive indefinitely on this planet? I'll rephrase it better: if from now on we follow every possible strategy to reduce waste production and optimize waste conversion, do you think our planet could sustain indefinite population growth in the long term, or we will need something more (like meticulous population planning and/or space colonization)?

erik-01

If we remain dependent on resources that will eventually run out then no, we cannot continue indefinitely. However, we produce 140 billion tons of waste biomass annually; more than enough to supply all of our fuel needs if converted using waste-to-energy technology. Meanwhile, our electricity needs could potentially be supplied by solar energy so in principle, it is possible for us to completely transition to sustainable technology, provided our population doesn't increase too dramatically.

How much energy goes into conversion? As in what's the efficiency of such a process to convert to hydrocarbons?

avatharam

All of the energy for the process comes from the feedstock, at a thermal efficiency of about 50% in field conditions.