WHAT TO DO WITH URBAN BIOMASS? ENERGY, OF COURSE!

While energy supply is becoming a major issue for global economy, new sources of energy are emerging or developing. The production of energy through waste recovery and recycling is part of this tendency. This process offers two benefits: it reduces our environmental footprint and increases the proportion of renewable energies in our energy mix. What techniques exactly are used, what is available potential, which fields are most innovative? Jean-François Nogrette, CEO of SARP Industries – a subsidiary company of Veolia specialized in special waste processing – has accepted to meet ParisTech Review and provide us with new information on this matter.

While the world suffers from energy shortages, there is still one resource that we are able to produce up to 1300 million tons a year on the global scale – in other terms, 1.2 kg per day and per city dweller. The production of this resource has doubled in ten years and should increase according to the same rates during the next decade.

This resource has nothing magical. It doesn't come from a secret underground deposit, or from a mysterious micro-alga of a new kind. It comes directly from our garbage cans. The figures above are provided by a report published in 2013 by the World Bank, titled *What a Waste: A Global Review of Solid Waste Management*. This report only examines municipal waste.

The production of industrial and agricultural waste is much more difficult to assess, as there is no standardized data on the subject. A ~~study published in 2009~~, titled *From Waste to Resource – An Abstract of World Waste Survey*, estimated that the global yearly production of industrial waste (leaving out the construction and mining sector) reached 1.7 to 2.1 billion tons. According to Eurostat, in the EU alone, the overall domestic, agricultural and industrial waste (leaving out the construction and mining sector) reaches approximately 900 million tons per year, in other terms, a yearly production of over 1800 kg per inhabitant.

What can we do with all this waste? The increasing importance of ecological issues has led to search for ways to reduce their production. But another method is to consider

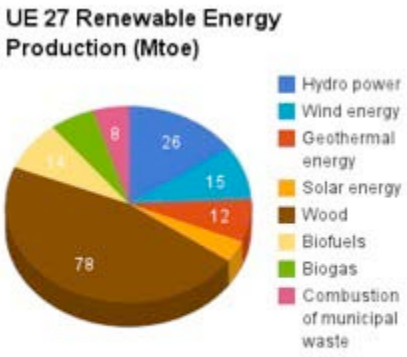
them as a valuable resource. Their transformation into energy responds to this challenge. What volumes are we talking about? What are the techniques that are used?

Energy can be produced by the recovery of waste. There are two main approaches that are adapted to domestic waste and industrial waste. The first is incineration and the second is anaerobic digestion.

The future of incineration

Used for decades, especially to fuel district heating plants, incineration doesn't have a very good reputation. It does indeed eliminate a good part of waste and seems difficult to replace today: in OECD countries, 39% of domestic waste is processed this way (stats from 2011) . But pollution is the main problem of this technique. In modern plants, the emission of dioxins and dust has been significantly reduced, but the remaining bottom ashes are still very toxic.

As reminded by Jean-François Nogrette, "incinerators of domestic waste » produce a significant amount of energy". To take the EU, this production covers 8% of the overall renewable energies, a proportion that can be compared to solar energy.



Source European Union

The performances are still modest: to generate the same amount of energy as 1 ton of fuel oil, it is considered that you need 5 to 7 tons of waste. The modernization of the plants could still increase the output. Denmark is the European leader of power and heat production per inhabitant: the kingdom's thirty plants consume 3.5 million tons of waste per year and cover 5% of the domestic demand of electricity and 20% of heat.

Africa is also beginning to produce electricity from household waste. In 2010, the first African production unit of electric power from domestic waste was launched in Ifrane, Marocco.

Developing biogas

As an alternative to incineration, anaerobic digestion is today a promising way to recover the biomass while mitigating the negative impacts on the environment, by letting nature do part of the work. Many countries have adopted this method that enables them to process a wide range of waste: wastewaters, sludge from wastewater treatment plants, household waste, animal manure, as well as the waste from the food industry...

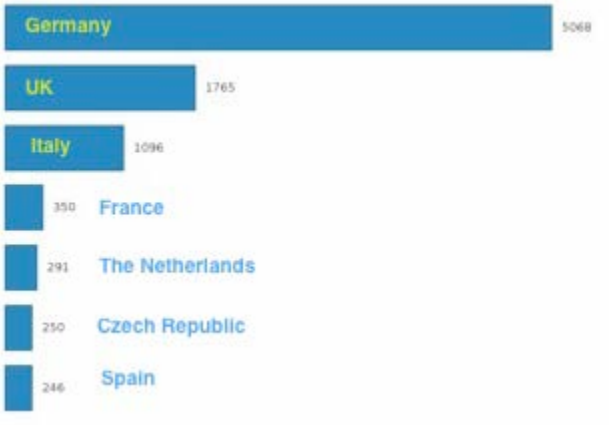
Biogas (a mix of methane and CO2) is produced through fermentation, either by a “digestion” process in an appropriate facility, or else by burying waste in special landfills that produce gas during roughly 12 years. This solution was chosen in the UK.

Gas is generally used to produce electricity. It can also feed cogeneration units that produce both electricity and heat. This solution is widely used in Germany where farms have also anaerobic digestion facilities that produce organic manure for spreading. Part of the biogas (15% to 25%) is used to heat the “digesters” or to power the site.

Not all kinds of waste have the same energy value. In treatment plants, only highly energy matter is used to produce biogas: sugars, fats, and proteins. The productivity of methane can reach from 3 to 18 m3 per ton. For household waste, organic matter is more or less mixed with other kinds of waste and productivity can vary a lot, although it is generally much higher: between 50 to 90 m3 per ton.

Across all facilities, the production of biogas represents today about 6% of the primary production of renewable energy in Europe. A crucial lever for the development of this sector is the feed-in tariff (FIT) of the electricity produced from biogas. In the US, the price is set according to the energy policy. Germany, with its proactive policy, remains undoubtedly the European leader in this field, although FITs were significantly reduced in the recent years.

EU: the biggest biogas producers (in ktoe)



Source: EurObservers

Biofuels from recycling

Recovery procedures aren't the only way to transform waste into energy. Other activities are being developed around recycling. Unlike the recovery procedures mentioned above, they recover used material and process it so that it can be re-used.

Fuel can be produced by recycling specific kinds of waste oil. For instance: engine lubricants, residues recovered from hydrocarbon separators or from industrial vats. These contaminated petroleum products are re-distilled and can be used in industrial boilers. According to Jean-François Nogrette, "the challenge is that this recovery is very disseminated." Obviously, this highly polluting waste is the main target of public authorities, which can finance their recovery or even make it compulsory. A French law from December 2006 imposes the implementation of hydrocarbon separators in service stations and in parking facilities that are exposed to significant amount of hydrocarbons. However, the overall volume of collected hydrocarbons will certainly not lead to the rise of a new sector: the aim is rather to mitigate pollution.

Agricultural waste provides another resource that is beginning to be re-used: bioethanol, produced from cellulose and lignin. Sometimes, vegetal waste, such as straw is even used. In 2009, Abengoa Bioenergy, a world producer of bioethanol, launched a production unit of lignocellulose-based bioethanol with a production capacity of 5 million liters, in Babilafuente, in Spain. The bioethanol sector has also been developed in some emergent countries (China, Brazil, South Africa) from manioc, sugar plants and cereals.

In the North, other more plentiful resources, easier to collect than oil, are being tapped. Since 2009, SARP Industries, in its Limay plant, produces 40 000 tons a year of biodiesel from fatty waste, mainly food oils. This feeds each year 300 trucks in B30, a fuel that contains 30% of biodiesel.

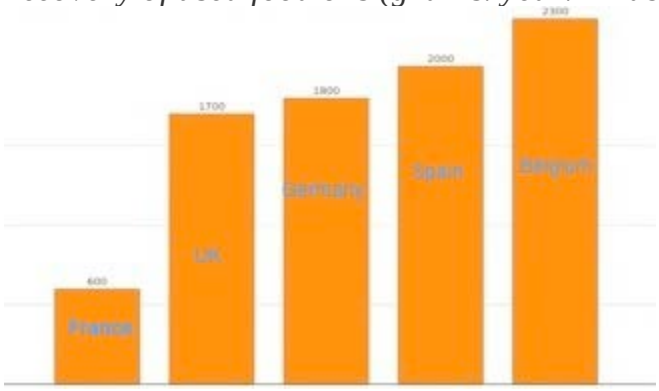
This is “second generation” biodiesel, as opposed to the first generation developed from oil plants (colza, soya, palm). The main benefit of the second generation is that is doesn’t use any cropland.

However, the produced volumes are very modest: used frying oil is certainly not an infinite resource! By contrast, the European leader of first generation biodiesel, Diester Industrie, has produced 2.1 million tons of biodiesel in 2011 in 13 European facilities, for an overall production capacity of 2 million tons, according to 2012 data from the European observatory of biofuels, EurObserv’ER. http://www.eurobserv-er.org/pdf/baro210.pdf

To proper, the recycled fuel sector needs to rely on an effective collection system, that isn’t always easy to implement. “Some fatty waste recycled for non-energetic uses, such as recycled lubricating oil, are collected in Europe thanks to the virtuous systems that have been implemented for many years”, says Jean-François Nogrette. “But for frying oil, it’s more difficult: restaurants aren’t necessarily very enthusiastic to keep used oil in cans where it could solidify, etc.”

The situation varies a lot from one country to another, even between neighbor countries. In France, despite the theoretic ban to reject used food oil through the public wastewater treatment network, or to through in landfills, the estimated collection rate is only 20%, whereas it reaches 50% in Belgium. The volume collected per year and per inhabitant is also an interesting fact that enables to get a clearer picture of the disparities: 600 grams in France versus 2300 grams in Belgium.

Recovery of used food oils (grams/year/inhabitant)



“The production of second generation biodiesel from waste is minute compared with conventional petroleum diesel, and things will stay as they are”, according to Jean-François Nogrette. “For instance, at this day, the French law provides an incorporation rate of 7% of biofuel in service stations. In the specific case of diesel, second generation biodiesel is only a 0,35% share of these 7%.”

The benefit of biodiesel produced with used oils is elsewhere. First of all, there is a dual impact on the environment: the recovery of polluting waste on one hand and the reduction of greenhouse gas emissions thanks to the replacement of traditional diesel, on the other hand. This double benefit has an economic value and can serve as a basis for business models.

The economics of waste

In Europe, the guidelines implemented by the European Commission promote the use of biofuel produced from waste and residues. These count as double in the 20% of renewable energies in public transports by 2020. More generally, in developed countries, compulsory regulations encourage increasingly recycling and the treatment of the most polluting waste. Treatment has a cost that can be charged to the waste producers. The sector will then combine service (waste treatment) and production that separately will not be beneficial but will integrate in a more complex value chain. Today, waste treatment specialists are learning today to work on both sides of the fence, by producing energy or raw materials without abandoning their original treatment activities.

Within the new models that are being implemented, the production of fuel or energy plays sometimes a complementary role. For wastewater treatment, for instance, the recovery of biogas aims simply at achieving energy self-sufficiency of treatment plants,

by feeding electric turbines with the produced gas. Today, the Braunschweig and Budapest plants cover almost all of their needs by methanizing their sludge with co-products, such as expired goods from supermarkets. Methane can also be used locally in gas networks or as fuel, but these are limited uses.

Jean-François Nogrette highlights a key issue for the development of the recycling sector: trust. “Historically, recycled products are seen as second category products: recycled paper was bought to help make the world a little greener, knowing that recycled paper is clearly less attractive... For fuel, or engine oil, this becomes a real issue because consumers don’t want a lower quality product for this kind of use.”

To mitigate this image problem, Veolia has set up a partnership with Total for its recycling plant of engine lubricant oil, Osilub, that has recently opened in Normandy: recycled products are sold under a brand, Total, that is acknowledged by the consumers as a producer of “mainstream” products. “From a technical point of view, we have to offer the same quality as if the product were, so to speak, new”, adds Jean-François Nogrette.

Apart from the trust of consumers, the growth of these activities relies on political commitment and regulation. Proactive public policies can help structure this sector and make it grow. It is already the case in Europe where, apart from quotas and objectives established by environmental policies, member states assign lower taxes for recycled fuel than for conventional petroleum products.

However, this political support also produces some negative effects. “As happened for other products, speculation on raw material, specifically waste, is beginning to appear”, according to Jean-François Nogrette. “Today, many American frying oils are exported to Germany, because of the tax benefits...”. This is certainly a paradox for a sector that claims to be virtuous in terms of environmental impact... As noted by Jean-François Nogrette, “there’s an economy of waste, with everything the word “economy” involves”.

For investors, this is a sector with a huge potential because, as explained by Jean-François Nogrette, “the waste industry is increasingly evolving towards a transformation industry. For example, ten years ago, product sales were 1% of the turnover of SARP Industries, the subsidiary of Veolia specialized in special waste. Today, this proportion has reached 25%. The company has now become a producer of raw materials.”

Companies of this sector show a growing tendency of moving from the sorting of waste to the regeneration of raw materials and are getting involved in new business models. As consequence of the transformation of the sector, the entire value chain is growing and some activities that didn't even exist 15 years ago are booming today, offering new opportunities.

Research and development can play a crucial role to identify these opportunities and design solutions. In close collaboration with researchers, Veolia and its American competitors are working on the liquefaction of polymers to produce liquid fuel – a source of energy that can be stored, unlike electricity. Beyond waste, many other organic resources can be recycled. An evolution that will be most interesting to follow.

Source : http://www.paristechreview.com/2013/09/04/urban-biomass-energy/