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Editorial

NEW PRIORITIES IN WASTE MANAGEMENT: ENERGY PRODUCTION, CLIMATE PROTECTION AND ENVIRONMENTAL SUSTAINABILITY

The current situation

We live in difficult times characterised by epidemics, extreme weather conditions, continuously rising CO_2 emissions, extensive deforestation, desertification, global pollution and loss of biodiversity. Moreover, an enormous burden of human tragedies is produced by a series of wars, resulting also in massive energy and environmental destruction.

To address these disasters, people from all fields, including the waste management (WM) sector must do their part. We should view this as an obligation to be more proactive in the field with regard to waste prevention and increasing product and material reuse with residual waste minimisation (Stegmann, 2021). Emissions and emission potentials from landfills should be further reduced and products (e.g., compost, manure) further detoxified.

The WM sector should also address the issue of energy shortages, particularly in Europe, and insufficient renewable energy production worldwide, and attempt to gain independence from external energy supplies. Consequently, all private or communal WM collection and treatment companies and entities should become energy self-sufficient. The latter should be achieved by on-site measures rather than by means of emission trading and other $CO_{2eq.}$ avoidance compensation measures e.g., – laxly formulated – planting trees in Africa. In my view, the latter represents a form of greenwashing to avoid becoming energy efficient by independently established measures. The climate makes no distinction as to the origin of $CO_{2eq.}$. A drastic reduction of $CO_{2eq.}$ would be required in climate gas emissions in order to reduce the atmospheric temperature. I indeed am of the opinion that $CO_{2eq.}$ originating from the biological degradation of organics should not be viewed as CO_2 neutral or be exempted in CO_2 balance calculations. In my view, this also constitutes a form of greenwashing, opening doors onto all kinds of manipulative calculations. The ultimate goal is to reduce CO_2 emissions as much as is feasible/possible, without distinguishing over the origin of the emissions.

How can the waste management sector become energy self-sufficient?

As an initial step, the waste management company should prepare an energy balance for company activities including waste collection, infrastructure and treatment facilities. Based on the results, the company should subsequently determine areas in which energy losses can be reduced and additional energy produced through facility and process optimisation. For example, all separately collected kitchen and yard waste should be anaerobically treated in solid state reactors with subsequent composting in naturally aerated windrows; existing artificially aerated composting plants should be substituted by the above - mentioned treatment process. Higher energy gains may be achieved by increasing the energy efficiency of combined Heat and Power (CHP) engines (electric efficiency up to 40%) and by all year-round heat utilisation of their cooling water (90-70°C). Energy is moreover frequently used to air cool the cooling water, a model which, in my view, should be discontinued. In addition, using the same infrastructure and facilities, additional substrates (possibly even in separate AD reactors) should be anaerobically treated as manure, sewage sludge, residues from food production, canteens, etc.

Biogas production may be increased by injecting biologically produced hydrogen into an AD reactor. Of course, use of the separately produced H_2 in fuel cells may represent an alternative option (Rechtenbach, et al. 2009). Biogas production and final substrate quality may also be improved by adequate substrate pre-treatment (better sorting, shredding to optimum particle size, etc.). If landfills are located at a WM site, the produced biogas can be used in existing energy production facilities. Power crops may be grown on closed landfills for fermentation in AD reactors.

To relieve the burden on the infrastructure, electricity should be used as a priority in an on-site network for pumps, blowers (e.g., in-situ aeration of landfills), loading electric powered waste collection trucks and cars, etc. The use of low temperature heat (90-70°C) is particularly problematic due to a frequent lack of users during the summer months. On-site heating AD plants, producing warmwater for the infrastructure are all year-round users. For excess heat, the introduction of a district heating system that also supplies external users living in the neighbourhood may be an option. This network should be powered solely by the WM facility. For economic reasons, excess heat may also be uploaded to the public district heating networks, if available. As often discussed, large heat consumers may be located on site (greenhouses, material drying facilities.).

As a general rule, solid waste incinerators produce si-

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gnificant amounts of heat and electricity with the potential for further reducing energy losses by up to 30% (Chang, et al, 2001). Supplying turbines with a higher temperature steam may be an option for increasing electric efficiency once the problem of high temperature corrosion has been solved. Another source of significant energy losses is represented by off-gases from the stack. If peripheral WM plants are adjacent to an incinerator, they should be part of the energy management so allow the entire WM location becomes energy self - sufficient.

Additional options may be available for energy production on WM sites: the use of low temperature heat from landfills or compost plants for heat production in heat pumps, whilst off-gas heat from CHP and flares may be used by the ORC process to produce electricity.

This however is only one side of the story; the other lies in the production and use of energy produced by “external energies” such as wind and photovoltaic.

WM sites may constitute ideal locations for wind power plants, available in a range of sizes between 1 $kW_{el\ p}$ and 7 $MW_{el\ p}$. Optimum conditions for wind power plants are present at the top of closed landfill mounds. It may prove easier to obtain planning permission when the wind turbines are located on the WM site owned by the WM company.

Landfills also represent ideal locations for the installation of photovoltaic panels, a practice frequently observed in Germany. These panels can be mounted about 1.5 to 2 m above the landfill surface to allow for underlying plant growth. The roofs of the buildings on waste management sites may be equipped with photovoltaic panels, whilst large buildings such as incinerators may also have the facades covered with panels. A wide range of options is available for the aesthetic locating of panels on the facades.

These options are readily achievable at the majority of WM sites and should be adopted to reach energy self-sufficiency, with the added potential of even the exportation of energy.

A similar approach is adopted by energy villages in Germany, Denmark, Austria and possibly other countries that are self-sufficient for the production of heat and electricity; more than one hundred villages have already been formed, with many more in the planning stage. To produce energy, photovoltaic panels, wind power, biogas from AD plants, heat pumps, woodchips incinerators and others are used. In addition to internal electricity networks, several villages have also built their own district heating systems. Residents are frequently also financial partners in this venture. (Anonymous, 2020).

The question however is how can the necessary investments be funded? As in the case of energy villages in Germany, cheap loans should be available. Other financing options may include: self - financing using waste collection fees (I see energy management as an integral part of WM), external credits with low interest rates (possibly subsidised by regional or federal governments), external investors (including private utility companies and waste management companies), crowdfunding, participation of resident citizens, and others besides. Mixed forms of financing should also be envisaged. However, not only should the costs for necessary investments be considered, but also revenues that increase in line with rising high energy costs on the market. Indeed, in view of the fact that the costs of purchasing electricity may be approx. double the revenue gained when selling the produced energy to a utility company, significant sums can be saved by making independent use of the self- produced energy.

The production and utilisation of energy on WM sites, particularly landfills, is implemented on a regular basis. I strongly advocate an increasingly consequential approach based on energy self-sufficiency becomes the norm. Should this be the case, a win-win situation will ensue for the following:

- WM companies that take action to promote a sustainable environment may also improve their image and company value and make financial savings in the long run;
- WM companies may potentially be financially supported by governments and/or politically obliged to become energy self-sufficient in the future;
- The climate through the reduction of $CO_{2eq.}$ emissions by producing renewable energy substituting externally produced electricity and further reduction of emissions.

There will however also be the inevitable losers:

- The environment, with the production of photovoltaic and wind power plants and other facilities and devices aimed at increasing energy production, all necessitating the use of significant amounts of materials and energy.

A situation therefore of Yin and Yang – in this case, of positive and negative effects. It is undeniable however that the positive effects gained will far outweigh the negative outcomes. Ultimately, this is the only chance we have to reduce CO_2eq. emissions for the purpose of protecting the climate and our living environment.

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