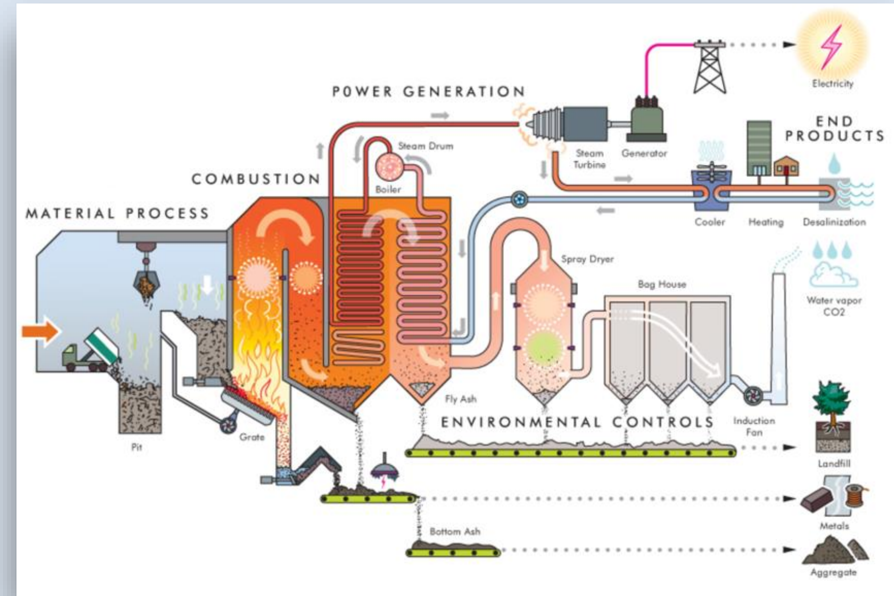
A GUIDE TO ASSESS WASTE-TO-ENERGY PROJECTS OR PROPOSALS

FOR THE BENEFIT OF PUBLIC AUTHORITIES, JOURNALISTS AND CONCERNED CITIZENS



Source: U.S. Energy Information Administration, 2022

Written by **Pierre Guerber**, Ecosoum's Director, based on **GAIA** contents.
Validated by **Narantuya Gursed**, Ecosoum's President.

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INTRODUCTION

Over the past years, many cities in developing countries – especially in Asia – have been approached by companies selling waste incinerators. Many of these incinerators are marketed as "waste-to-energy" facilities, which can supposedly generate electricity by processing waste.

Although, historically, "waste-to-energy" (WTE) has been mainly referring to mass-burn plants (facilities where waste is directly burnt), variants have emerged under many names – such as "gasification", "plasma arc" and "pyrolysis" – over the past decades. Often, the incineration industry claims that such technologies are not incinerators because they may not use oxygen to combust the waste stream. However, these claims are misleading because processed waste is still thermally converted into a gas – often known as "syngas" – which is then burnt to make energy. In fact, gasification, plasma arc and pyrolysis are all classified as incineration in European legislation.[1]

The overall failure and negative impacts of WTE have clearly been demonstrated, so much so that many countries and organizations – starting with the European Union – have been moving away from it over the last decade.[2] Yet, proponents of these plants keep claiming that WTE remains the best option to solve the waste crisis and enable proper waste management in cities and municipalities. Despite being repeatedly proven wrong by scientific analyses, incinerator bankruptcies and new health scandals, WTE promoters still promise that their facilities can operate without polluting the environment and endangering human health, while offering big returns in electricity sales.

Facing new WTE project proposals, public authorities need to be able to assess these proposals with critical thinking and sufficient information to make an informed decision. This guide aims to provide all involved stakeholders a brief introduction about waste-to-energy, technical basics about main existing technologies, and a list of questions to systematically ask WTE project proponents.

Actually, incineration is too important an issue to be left alone to experts and decision-makers. Citizens and communities have the right to know if a waste-to-energy facility is going to be built in their neighborhood – or more broadly in their country. Risks of negative impacts on their lives and environment are too high for waste-to-energy projects to be decided without their informed consent. Therefore, this guide is also directly intended to all concerned citizens and journalists willing to cover this issue, so they can better understand what is at stake and how to assess WTE projects.

The content of this guide essentially comes from documents produced by the Global Alliance for Incinerator Alternatives (GAIA).[3] To fully understand the problems waste-to-energy has created all around the world and the relevant alternatives that are already available, we also recommend reading Ecosoum's report entitled *Should we introduce waste-to-energy in Mongolia?* (2023).

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[1] Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste (Article 3).

[2] See Ecosoum, *Should we introduce waste-to-energy in Mongolia?* (2023).

[3] This report is mostly based on two reports by GAIA, respectively entitled *A guide for cities and municipalities faced with "waste-to-energy" incinerator proposals* (2017) and *Questions to ask when evaluating a "waste-to-energy" incinerator project or proposal* (2016). Additional sources and references are available in these reports.

WHAT IS WASTE-TO-ENERGY?

BIOLOGICAL VS. THERMAL WASTE-TO-ENERGY

Waste-to-energy facilities are plants that process waste (discards people throw away) into energy in the form of heat or electricity. There are two types of waste-to-energy processes:

1. **Biological waste-to-energy** systems use biological processes to generate energy. These include biodigesters and other anaerobic digesters which are used for biogas production. Biological WTE systems are used for organic matter and rely on the decomposition process of organics to generate biogas.
2. **Thermal waste-to-energy** systems are processes that involve incineration (burning of the waste material) one way or another – which is why they can be called "WTE incinerators". Such thermal WTE relies on materials with high calorific value (meaning materials that burn well such as plastics and paper), rather than organics (which contain a lot of water and thus do not burn well). Conventional thermal WTE is called "mass burn" (when waste is directly burnt in a furnace), but other technologies such as "gasification", "pyrolysis" or "plasma arc" are also thermal WTE.

Question to ask the WTE proponent:

Is the facility a biological or thermal waste-to-energy facility?

Cities and municipalities need to be wary if the proposed facility is a thermal waste-to-energy facility, not only because such WTE incinerators are bad for the environment and human health but also because they destroy resources and they are a very expensive way to manage waste and to generate electricity.[4] There are better and more sustainable waste management options available for cities and municipalities, which follow the sustainable waste hierarchy (3R principle) that prioritize reduction, reuse and recycling.

In the rest of this document, we focus exclusively on thermal waste-to-energy. Therefore, we use the words "WTE incinerators" or "WTE facilities" as synonyms, which include all thermal WTE technologies (mainly mass-burn, gasification, pyrolysis and plasma) but exclude biological WTE.[5]

INTRODUCTION TO THERMAL WASTE-TO-ENERGY

An incinerator is any stationary or mobile structure or equipment used for the thermal treatment of waste. There are different types of incinerators, which may be classified according to the kind of thermal process used for burning (mass burn, gasification, plasma arc, pyrolysis, etc.), the furnace or reactor design, or the kind of waste they burn (industrial, medical, or municipal solid waste). All in all, the most important features to consider with WTE incinerators are the way they burn waste and the systems they use to control pollution.

[4] For more information and references about negative impacts of WTE, please refer to above-mentioned *Should we introduce waste-to-energy in Mongolia?* report and to Ecosoum's *Plastic Solutions Review* report (2022).

[5] It is worth noticing that when people talk about "waste-to-energy" without additional specification, they usually tend to refer to *mass-burn* specifically, not other technologies (which are sometimes referred to as "plastic-to-fuel" – like in Ecosoum's *Plastic Solutions Review* report). Therefore, when addressing the WTE issue of in detail, it is important to clarify precisely what we are talking about to avoid misunderstandings.

Pollution control systems are particularly important because regardless of how they burn waste, WTE Incinerators always create pollution (not only through toxic gas and particulate emissions in the air, but also through production of hazardous solid and liquid residues). The emissions from incinerators include very hazardous substances such as dioxins, furans, particulate matter, carbon monoxide, nitrogen oxides and other acidic gases (SOx, HCl), metals (cadmium, lead, mercury, arsenic, and chromium), polychlorinated biphenyls (PCBs), and brominated polyaromatic hydrocarbons (PAHS). These toxic pollutants can cause a wide range of severe health impacts such as preterm births, lymphoma, various types of cancers (which can all lead to death).[6]

Because of the toxic pollution they produce, WTE incinerators have become increasingly complicated as the industry tries to build more and more models that are "safer" than previous ones. A considerable part (and cost) of large WTE facilities (more than half of the total construction cost, as well as recurring operating costs) are actually pollution control structures and systems. As a consequence, the latest WTE incinerator in developed countries are major infrastructure projects that can cost upwards hundreds of millions of US dollars.[7]

There are notable process differences between conventional mass burn incinerators and other types of incinerators such as gasification, pyrolysis and plasma arc facilities. In basic terms, while mass burn incinerators directly combust waste in one single chamber in an oxygenated environment, gasification, pyrolysis and plasma incinerators start heating waste materials in a first chamber with limited oxygen and then burn the released waste gases (as well as char and other solid byproducts in some cases) in a second chamber.

Gasification, pyrolysis and plasma arc incinerators typically utilize either a steam or a gas turbine to generate electricity (waste gases are burnt to create heat, which is used to create steam, which is used to power a turbine and produce electricity). In addition to these processes, some companies claim that they can use waste gases and oils to create liquid fuels to be combusted in vehicles or industrial facilities off-site.

MAIN TYPES OF THERMAL WASTE-TO-ENERGY TECHNOLOGIES

The major variations between gasification, pyrolysis and plasma arc technologies have to do with the different temperature levels used in the processes and the amount of air or oxygen present. Precise definitions of these technologies are not clearly established and there is a lack of consistency across the industry in the use of each term. The sections below present each main type of WTE incinerator according to thermal process used.[8]

COMBUSTION

Combustion is a high-temperature exothermic redox chemical reaction between a fuel (in this case: waste) and an oxidant (typically: oxygen in the air). Simply put, combustion means burning.

[6] CIEL, *Plastic & Health: The Hidden Costs of a Plastic Planet* (2019).

[7] GAIA, *The High Cost of Waste Incineration* (2021).

[8] The brief presentation of each WTE incineration technology is mainly based on two GAIA reports: *An Industry Blowing in Smoke* (2009) and *Resources up in Flames: The Economic Pitfalls of Incineration versus a Zero Waste Approach in the Global South* (2004).

The ash produced by combustion is a combination of materials incompletely burnt and new solids formed during the oxidation process.

The two most common combustion technologies for solid waste are:

1. **Mass burn**, in which waste is directly burned. Often the heat produced during the burning is used to convert water to steam to drive a turbine connected to an electricity generator.

2. **Refuse-derived fuel (RDF)**, in which mixed waste is initially processed prior to direct combustion. The level of processing varies among facilities, but usually involves shredding and removal of metals and other materials with low heat potential. The processed materials (which can take the form of relatively homogeneous pellets or briquettes) are then used as fuel either in the same manner as in mass burn plants or to fuel other existing facilities such as cement kilns.

PYROLYSIS

Pyrolysis is the thermal degradation of materials by heat in the absence of (or with a very limited supply of) oxygen. In a pyrolysis unit, materials are heated to a temperature between 1,000 to 8,000 degrees Celsius (in municipal, industrial and medical waste incinerators). The lack of oxygen aims to prevent combustion. However, eliminating all oxygen is virtually impossible (there is always oxygen present, whether trapped among the waste material or in the chemical composition of waste); therefore, some oxidation occurs and results in the formation of dioxins and other hazardous compounds.

Pyrolysis reactions are endothermic, which means they require the addition of energy. The types of pyrolysis are based on the energy source, which can be: natural gas, syngas, and/or fuel oil combustion; resistance heating; induction heating; and plasma pyrolysis (ionized gases that release energy when current is passed through).

Aside from the release of harmful gas and particulate emissions, the process results in a solid residue called “char” or “slag” (which is likely to contain toxic substances like heavy metals).

GASIFICATION

Gasification is also an endothermic process. It is similar to pyrolysis except that the thermal transformation of solid waste takes place in the presence of a limited amount of air or oxygen, producing a combustible synthesis gas (“syngas”). This gas can then be used in either boilers or combustion turbine/generators.

Gasification plants typically operate up to 1,600 degrees Celsius for municipal solid waste. The gases produced are non-condensable. When operated with limited amounts of air, it produces what is known as ‘producer gas’, which has 25% the calorific value of natural gas. When the process involved limited amounts of oxygen, ‘syngas’ is formed, which has 25-40% the calorific value of natural gas. This process generates solid and liquid byproducts, which may contain high levels of toxic contaminants. The solid residues are char and ash.

PLASMA ARC

Plasma arc processes are usually described as being part of a gasification system. This process enables the rapid thermal decomposition of material by partial oxidation through the addition of limited amounts of air or oxygen. It uses electrical energy and high heat with temperatures ranging approximately from 1000–4500 °C.

Question to ask the WTE proponent:

What kind of WTE incinerator is it?

Proponents will say that gasification, pyrolysis and plasma arc facilities are not incinerators. As we've explained, this is technically not true: gasification, pyrolysis and plasma arc also rely on combustion processes and are usually classified and regulated as incinerators (like in the European Union, for example).

FREQUENT MISTAKES ABOUT WASTE-TO-ENERGY

DO INCINERATORS MAKE LANDFILLS UNNECESSARY?

Incinerators are not waste disposal facilities, but rather waste treatment facilities. The waste is not disposed of but merely transformed into other forms of waste, which also need further disposal. These waste by-products include polluting air emissions (cancer causing dioxins and furans, particulate matter, etc.), fly ash (the fine particles of ash that are captured by the facility's filter systems), bottom ash or clinker (residue from the facility's furnace), and liquid releases from water used during operations.

Because most of the materials burned by incinerators have toxic content and because the incineration process itself also creates toxic chemicals, the waste by-products of incineration end up more toxic than the original waste processed. In the end, although incineration can reduce the volume of waste (while increasing its toxicity), all cities or municipality which rely on WTE incinerators still need specially designed hazardous waste landfills.

Because the byproduct includes fine ash (including particulate matter), incineration ashes need to be packed and secured before being dumped in a landfill. Otherwise, there is a very high risk ash will be scattered by the wind. Transporting the ash from the WTE facility to the hazardous waste landfill also needs to be conducted with specialized trucks as the ash cannot be handled safely with ordinary hauling or garbage trucks.

Question to ask the WTE proponent:

How will ash and other incineration by-products be managed and disposed of?

In incineration, the "cleaner" the air emissions, the more toxic and hazardous the ash: what is removed from the air emissions thanks to pollution control filters is trapped in the ashes and other byproducts. Since incinerator ash is classified as hazardous waste, companies need to follow proper protocols in transporting and disposing such by-products. They also need to be transparent in stating where they will locate the ash landfill as this will be harmful to communities.

DO INCINERATORS MAKE WASTE SORTING UNNECESSARY?

No. Waste experts around the world recognize that a sound approach to waste management begins with waste segregation, which is essential to ensure that materials can be reused and recycled. Incinerator companies who say that WTE facilities eliminate the need for waste sorting are misleading or not properly informed of the latest practical science of waste management. Cities and municipalities need to be wary of these claims.

In any case, even without taking into account the paramount importance of reducing, reusing and recycling, at-source waste sorting is still necessary for WTE incinerators to function properly. In fact, incinerators cannot work efficiently if the waste is mixed, because unsorted waste is too heterogeneous and contains too much hard-to-burn waste (starting with wet organic waste). And even in countries where waste segregation is mandatory, many gasification plants have closed because they need very homogeneous inputs and cannot handle heterogenous waste such as municipal waste.

About this issue, Hakan Rylander, former President of the International Solid Waste Association (ISWA) and CEO of South Scania Waste Company (a conventional waste incineration company in Sweden), said:

> "*A number of [gasification] plants were built in Europe and a number of efforts were done to successfully scale up the technology. However, it didn't work anywhere unless you had a very very homogenous input of fuel to the reactors. Waste is not a homogenous fuel. It has so far turned out to be too heterogenous to be able to treat in a gasification or pyrolysis process, irrespective of how you pre-treat the waste. It is absolutely not applicable for mixed MSW with today's technology. Another very negative factor is that the energy balance very often has turned out to be negative.*" [9]

CAN WASTE-TO-ENERGY REALLY SOLVE THE WASTE CRISIS WHILE PRODUCING A SIGNIFICANT AMOUNT OF ENERGY?

Clearly not. Most policymakers, city planners and waste experts agree that there's no such thing as a one-shot solution to waste issues. Waste is a complex problem that cannot be solved by the construction of a single facility. In fact, serious organizations that usually don't even oppose waste-to-energy emphasize that public decision-makers should be wary of companies that present WTE as an ideal solution to solve all waste management problems while generating energy. For example, in 2017, GIZ published a guidebook in which they clearly warned governments:

> "*Decision makers at national and local level in developing and emerging countries may be tempted by technology providers who promise that WTE plants will solve their waste disposal problems, create a lucrative business opportunity and contribute positively to energy supply. As such, waste seems to be an ideal feedstock for energy recovery. So far, however, only a limited number of projects built in developing and emerging countries have operated successfully in the long term.*"[10]

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[9] *http://mavropoulos.blogspot.com.au/2012/04/lets-speak-about-waste-to-energy.html*

[10] GIZ, *Waste to Energy Options in Municipal Solid Waste Management* (2017).

The same GIZ report devotes a chapter to myths that WTE companies propagate and which state and municipality officials need to be wary about:

> *"It is important to be aware of several common myths that persist around Waste-to-Energy and may be pushed by inexperienced companies looking to take advantage of municipalities:*
>
> ***Myth 1 – "WTE is an easy-going solution to get rid of all the waste problems in a city"**: The situation is much more complex and WTE needs professional planning, construction and operation. Unfortunately, there are several companies on the market which are inexperienced with the conditions in developing and emerging countries. Decision makers need to be aware that their objective is first and foremost to "sell" their product and not to solve the local problem.*
>
> ***Myth 2 – "A WTE plant can finance its costs exclusively through the sale of recovered energy"**: In Europe where calorific values of waste and energy prices are higher, the revenue from non-subsidized sale of energy (in form of heat and power) might cover operating costs but never the entire investment and capital costs.*
>
> ***Myth 3 – "With a WTE plant in operation, a big fraction of the energy demand of a city can be covered"**: In reality, energy from household waste will only be able to contribute a small fraction to the overall electricity demand of a city (~ 5%). Utilization of heat is the most efficient application in Europe, but hardly used in developing countries.*
>
> ***Myth 4 – "You can make gold from garbage; even unsorted waste can be sold with profit to be used for further energy and material recovery"**: In reality, WTE is not a business model that generates cost covering incomes. Revenues from energy sales help to cover part of the overall costs of thermal treatment but additional gate fees or other forms of revenues are required to cover full costs. In all countries, waste management as a whole has costs and cannot be considered as a profitable business that could depend exclusively on the sale of energy, Refuse-Derived Fuel (RDF) and recycling materials at current prices for these products.*
>
> ***Myth 5 – "Qualified and experienced international companies are queuing up to invest and operate large WTE plants in developing and emerging countries at their own risk"**: This is only partly correct as experienced international companies are presently reluctant to invest in WTE in developing and emerging countries. The legal, financial and reputational risks are high and any project of the private sector has to be bankable."*

Simply put: if the WTE projects look too good to be true, it certainly is because they are not true.

ARE GASIFICATION, PYROLYSIS AND PLASMA POLLUTION-FREE?

No: all incinerators produce pollution, regardless of type or process used. Companies using or promoting technologies like gasification, pyrolysis or plasma claim that these are not incinerators, ignoring the fact that the toxic gases created by heating the waste are in fact combusted. The most notable pollutant emitted by all plants is cancer-causing dioxins. Studies show a significant risk of dying from cancer in areas near incinerators. Aside from dioxins, the same toxic by-products can be released from these WTE facilities as from other incinerators, including furans, mercury and other heavy metals, particulate matter, carbon monoxide, hydrogen chloride, sulfur dioxide and more – as well as toxic contaminants in the char or ash residues and contaminated waste water. Many of these pollutants are carcinogenic and threaten public health even at very low levels.

Some companies claim that these technologies are "pollution free" or have "zero emissions," but these claims have been shown repeatedly to be untrue. Recent tests from municipal solid waste in a test pyrolysis facility in southern California found more dioxin, volatile organic compounds (VOCs), nitrous oxides (NOx), and particulate emissions than in existing mass burn incinerators. Over the past 20 years, numerous proposals for waste treatment facilities hoping to use plasma arc, pyrolysis, or gasification technologies failed to receive final approval to operate when claims of the companies did not withstand public and governmental scrutiny.

Carcinogenic dioxins, as a by-product of thermal treatment, are the biggest problems with incinerators. The production of dioxin is not continuous. The majority of dioxins are usually produced in short-term emissions peaks during start-up or shutdown, or under "upset" conditions (conditions in which the incinerator is operating outside specified parameters). Many facilities only test for dioxins during peak operation and not during start-up, shutdown or upset conditions, thus skewing actual data. Even gasification, pyrolysis and plasma arc facilities produce dioxins.

Today, the accepted way to measure dioxins is continuous dioxin monitoring throughout operations. Unfortunately, this kind of dioxin monitoring is not required in many developing countries. In some countries there is only one dioxin lab (as in the Philippines), or none at all. This means that the dioxin sample will take weeks or months to study, after the dioxins have already been spread in the environment and inhaled by nearby communities.

Questions to ask the incinerator proponent:

Can the company provide details of all stack emissions, their chemical profiles and their effects to health and the environment?

How does the technology treat/filter air emissions? What exact pollution control equipment/devices will be used?

What exact methodology will the proponent use to measure dioxin emissions and how often will it be done?

How will the technology filter nano- or ultra-fine particulate emissions?

Will the company monitor and measure emissions continually, not only during optimum conditions, but also during upset conditions or malfunctions, and during start-up or shut-down?

What regulatory standards for health and environment will apply to dioxin emissions?

It is important to ask as many questions as possible regarding the pollution from the facility, and to double check answers against data not provided by the company. You can also ask for the details of the pollution control system. As a general rule, at least half of the price of a WTE facility with a working pollution control is the pollution control system itself. Many companies who sell facilities to countries with limited financial resources lower the price of the facility by cutting corners on pollution control.

ARE GASIFICATION, PYROLYSIS AND PLASMA ARC PROVEN TECHNOLOGIES FOR TREATING MUNICIPAL SOLID WASTE?

No. Gasification, pyrolysis and plasma arc are not proven systems for the treatment of municipal solid waste. To this day, no commercial application of gasification, pyrolysis or plasma arc facilities has succeeded anywhere in the world. The above-mentioned GIZ report from 2017 confirmed that no large-scale gasification facilities were in operation:

> *"At present, no plant for the treatment of MSW is in operation on a larger scale in Europe, Africa or Latin America and the few plants in Asia (mainly Japan) and the USA are operating as an integrated element of a more complex MSWM system or for specific waste streams only. The advanced technology and operating requirements, highly specific waste input needs and high upfront capital costs make this technology difficult to apply at scale. [...] Some of these developments met technical and economic problems when they were scaled-up to commercial sizes, and are therefore no longer pursued. Some are used on a commercial basis (e.g. in Japan) and others are being tested in demonstration plants throughout Europe, but still have only a small share of the overall treatment capacity when compared to incineration and are applied for selected waste only. There are no successful experiences with the treatment of bigger volumes of mixed MSW due to its heterogeneous composition."*

Question to ask the incinerator proponent:

What are some examples of previous similar facilities for MSW which you built and which are operating successfully?

Chances are, the incinerator proponent will not be able to give an example because no commercial WTE gasification plant is currently operating in the world. If the proponent does give an example, it is easy to do a quick check in the internet to verify the claim.

IS A WASTE-TO-ENERGY FACILITY A GOOD INVESTMENT?

Incinerators are the most expensive method to generate energy and to handle waste, while also creating a significant economic burden for host cities and their taxpayers. WTE incinerators, particularly gasification, pyrolysis and plasma arc facilities, are the most expensive options to manage waste, both in terms of construction costs and operational expenses.

Many WTE incinerator plants have failed because of financial non-viability. Gasification, pyrolysis and plasma arc facilities are the most expensive ways for both dealing with waste and producing electricity. According to the US Energy Information Administration, the projected capital cost of new waste incinerator facilities is twice the cost of coal-fired power plants and 60% more than the cost nuclear energy facilities. Waste incinerator operations and maintenance costs are also 10 times the cost for coal plants and four times the cost of nuclear plants.[11]

Additional costs for repairs (WTE facilities are high maintenance plants), pre-treatment of waste (necessary for municipal solid waste), and replacement of parts, filters, etc., also need to be factored in. At the same time, revenues are uncertain, a lot lower than expenses, and the energy produced is not sufficient to cover capital and operational costs.

WTE facilities – including gasification, pyrolysis and plasma arc – produce very little electricity and frequently consume more energy than the amount they generate. Because of the unreliability of energy generation, the income from electricity sales is also unreliable.

[11] U.S. Energy Information Administration, *Updated Capital Cost Estimates for Electricity Generation Plants* (2013).

Waste is a highly inefficient fuel, due to its relatively low calorific value. Municipal solid waste comprises a lot of organic waste, which contains a lot of water. This means that incinerators need to input additional energy to process the waste first to make it suitable for combustion, and they take this energy from other fossil sources. Even in developed countries, with higher calorific value waste streams (less organic waste in the overall mix), gasification plants are challenged to meet projected energy production targets.[12] GIZ also acknowledges in its above-mentioned report that a WTE plant is not capable of financing its costs through the sale of electricity.

Municipalities which are counting on revenues from electricity sales need to be wary about the promises of WTE companies that they can profit from electricity sales.

Question to ask the incinerator proponent:

Does the total cost of the facility include:

- ***Operations and maintenance? (How much will it cost annually?)***
- ***Cost of pollution control systems and their parts and replacement filters?***
- ***Costs for the proper disposal of the ash and slag?***
- ***Baseline soil, air and groundwater monitoring?***
- ***Baseline human health monitoring for host communities?***

What is the nature of the waste service contract? Is it a put-or-pay[13] contract? How many years is the lock-in?

The usual contracts for incinerator facilities are long-term (up to 30 years) put-or-pay contracts. This means that the state or municipality will promise to deliver a minimum quantity of waste and pay the company tipping fees for this quantity, even when the waste the state or municipality produces is less than the minimum agreed.

Tipping fees for incinerators are drastically more expensive than tipping fees for landfills, particularly in developing countries, so the amount is usually considerable. Many industry documents by incinerator companies confirm that these facilities actually earn money through tipping fee and not through energy production. In most cases, these facilities rely on government energy subsidies to ensure better profit margins.

IS ELECTRICITY FROM WASTE-TO-ENERGY A RENEWABLE ENERGY?

Renewable energy is defined as energy created from natural processes that do not get depleted, such as wind, wave or solar energy. Therefore, energy from burning waste can absolutely not be considered as renewable energy. Municipal waste is non-renewable, consisting of discarded

[12] GAIA, *Waste gasification and Pyrolysis: High risk, low yield processes for waste management* (2017).

[13] A "put-or-pay" contract is a long-term contract, usually 10-30 years, between a waste generator (often a municipality or city) and the incinerator company, whereby the generator is required to deliver a given minimum quantity of waste and pay a given tipping fee for the duration of the contract. Under this type of contract, if the host city or municipality does not produce enough waste to feed the incinerator, it may be forced to import waste from other cities or countries to meet the waste requirement, or pay the difference. The reason incineration companies want public authorities to sign put-or-pay contracts is that incinerators need a constant supply of waste and public money to operate properly and generate revenue. Many incinerators have driven their host city or municipality to bankruptcy because of heavy subsidies (see GAIA, *Waste Incineration: A Dying Technology*, 2003).

materials such as paper, plastic and glass that are derived from finite natural resources such as forests that are being cut down at unsustainable rates. Plastic also comes from fossil fuels which is not renewable.

Question to ask the incinerator proponent:

Will the proponent receive any government subsidies or tax breaks for renewable energy or climate change mitigation?

Such subsidies or tax breaks are not acceptable since WTE is not renewable and actually contributes to climate change.

HAS WASTE-TO-ENERGY SOLVED THE WASTE PROBLEM IN EUROPE?

WTE incineration has not solved the problem of waste in Europe. Over the past years, some EU countries have systematically over-invested in WTE facilities while under-investing in recycling. As a result, they are now locked into expensive long-term contracts (40-50 years) with incineration plants that need a constant flow of waste on a 24-hour basis to keep operating.

In some EU states such as Germany, Denmark, Sweden or Holland, there is already more incineration capacity than generated non-recyclable waste. Plans to increase incineration capacity pose an environmental and an economic threat. Many of these countries, especially Sweden, even import massive amounts of waste from abroad to keep feeding the needs of their facilities.

Fortunately, over the past five years, the European Union has been progressively moving away from waste-to-energy. Through a series of policies and directives, the EU removed WTE from its list of sustainable finance activities and decided to stop investing in WTE facilities.[14]

QUESTIONS TO ASSESS A WASTE-TO-ENERGY PROJECT

QUESTIONS TO ASK WASTE-TO-ENERGY PROPONENTS

As WTE projects and proposals are rarely presented with much transparency, it is crucial to ask as many questions as possible to the company offering to build and/or operate a waste-to-energy facility. In addition to the few questions introduced in the previous sections, this chapter provides an extensive list of relevant questions to ask WTE proponents.

COMPANY HISTORY

1. Is this company based in Mongolia? If not, where?
2. Has this company been assessed as a *bona fide* and legal entity by government authorities? Does it have the necessary permits to operate legally in Mongolia?

[14] Zero Waste Europe, *Waste-to-Energy is not Sustainable Business, the EU says* (2019). See Ecosoum's *Should we introduce waste-to-energy in Mongolia?* 2023) for more details about EU policies and institutions moving away from WTE.

3. Is the company claiming to be a subsidiary of or recognized by a bigger international/parent/multinational company or corporation? Please provide proof.
4. What is the operational, safety, health, environmental and financial track record of the company?
4. What is the company's track record? Is it a newly-established company, or has it been operating in Mongolia or in other places for many years?
5. Does the company have any experience in providing other waste services?
   - If yes, what kind of services? How long has the company been offering these services?
   - If no, what assurance is there that the company has real capacity to successfully deliver waste services to the municipality and operate a complex and expensive waste treatment facility?
6. Who are the owners of the company?
7. Who will manage the daily operations of the facility?
8. Is there an existing and operational facility owned/managed/run by the company in Mongolia or anywhere else in the world?
9. What is the company's labor, health, safety, financial and environmental record?
10. Does the company have real financial capability and insurance to establish/operate/maintain a multi-million-dollar waste treatment facility?
11. If the project is a partnership between a locally-registered company and a foreign entity, can the local partner sustain operations in the event that the foreign company pulls out or folds up for any reason?
12. Does the company receive subsidies, tax breaks or other financial incentives from the Mongolian government or another government to establish and operate in Mongolia?
13. If this project is part of an aid package or a loan, has a verified commercial case been provided to justify the technology ahead of local, community-owned and operated investment models?
14. How will the proponent demonstrate support for worker safety, recycling and composting?
15. Who will be responsible for any failure of the technology to meet Mongolia's labor, financial, health and environmental regulations?

TECHNOLOGY

1. What kind of technology will be used?
2. Is this an experimental technology?[15]
3. How will the company collect waste from the municipality?
4. What kind of waste will be processed by the technology?
5. Will the facility treat hazardous and medical waste? Will the facility burn tires?
6. Will the company collect and process mixed waste? Are there local laws prohibiting the collection, transport and processing of mixed waste?[16]

[15] If this is a pilot project, Mongolia should not agree to be a test case.
[16] Remember that source-separation and separated collection is extremely important in ensuring higher recovery of recyclables and clean, uncontaminated organics for composting.

7. If the waste is heterogeneous, how and where will it be separated?
8. Is this technology operating elsewhere in the world? If so, where? Is it run by the same company?
9. Has the technology failed in any other location? If yes, how?
10. Can the proponent demonstrate compliance with health and environmental protection laws and standards in other jurisdictions?
11. Has this technology/company been involved in a prosecution for a breach of regulation anywhere in the world? If yes, ask them to provide details.
12. What kind of emissions will be released and at what concentrations?[17]
13. Can the proponent provide details of all stack emissions, their chemical profiles and their effects to health and the environment?
14. How does the technology treat/filter air emissions? What exact pollution control equipment/devices will be used?
15. What exact methodology will the proponent use to measure dioxin emissions and how often will it be done?
16. How will the technology filter nano or ultra-fine particulate emissions?
17. Does the incinerator have a vent stack or bypass vent stack to be used during emergencies when the air pollution control system needs to be bypassed?
18. What are the potential upset conditions and malfunctions that can happen in the facility?
19. What kinds of emissions will be produced during upset conditions or malfunctions?
20. Will the company monitor and measure emissions not only during optimum conditions, but also during upset conditions or malfunctions, and during start-up or shut-down?[18]
21. What regulatory standards for health and environment will apply to dioxin emissions?
22. What kind of solid and liquid waste will be generated by the technology?
23. Does the technology produce bottom and/or fly ash? If yes, provide details of quantity and type.[19]
24. How will the ash be treated or disposed?
25. Where will this ash waste be dumped?[20]
26. What will happen to the materials that are not incinerated?
27. Does the technology produce syngas, biochar or any other byproduct?
28. Where will these byproducts be used? Is there a commercial market for them?
29. Are there local laws prohibiting the commercial use of byproducts from incineration?
30. What other facilities (building/equipment) will be built or used to support or complement the technology?

[17] Remember that there is no technology in the world that has zero emission.
[18] Remember that the production of dioxin is not continuous. The majority of dioxins are usually produced in short-term emissions peaks during start-up or shutdown, or under “upset” conditions.
[19] Remember that incinerators are waste treatment facilities that generate even more toxic waste in the form of ash, slag, sludge, etc. that must be carefully contained and disposed.
[20] Remember that in incineration, the cleaner the air emissions, the more toxic and hazardous the ash. What is removed from the air emissions is trapped in the ash.

ECONOMICS

1. What is the total cost for the establishment of the technology?
2. Do these costs include baseline soil, air and groundwater monitoring?
3. Do these costs include baseline human health monitoring for the host community?
4. What will be the total costs for the ongoing operation and maintenance of the plant?
5. What is the cost of the pollution control equipment? How much do the replacement filters or associated parts cost?
6. How much will it cost to keep the pollution control equipment clean and effective for the duration of the life of the plant?
7. Who will pay for the technology?
8. Describe the nature of the waste/service contracts the company has or will enter into. Is the contract put-or-pay?
9. Will a copy of the contract be provided to the host community? Scrutinize what the contract says:
   - How many years is (are) the contract(s) valid?
   - What are the responsibilities of the company under the contract?
   - What are the responsibilities of the state or municipality under the contract?
   - What rights (financial/others) does the liability clause give the state or municipality in the event of the management's failure to run the plant?
10. Has a full cost benefit analysis been undertaken by the proponent to justify this technology ahead of Zero Waste solutions such as composting, recycling and reuse?

ENERGY RECOVERY

1. Is the project being described as a waste-to-energy technology?
2. Will the proponent receive any government subsidies or tax breaks for renewable energy or climate change mitigation?
3. Does the technology meet the European Union's Waste Incinerator Directive for Energy Efficiency? If no, why not?
4. How much carbon dioxide and other greenhouse gases will the technology emit to the atmosphere annually?
5. What is the energy balance of the technology (energy that is produced versus energy that is used to process waste)?
6. Will the technology use auxiliary fuel? If yes, what kind of fuel will be used? Also, this must be computed as part of the energy balance.
7. Can the company provide details of the amount of embedded energy lost compared to the calorific energy created based on the annual throughput? If no, why not?
8. Can the company demonstrate that the technology will be able to generate enough electricity to sell to the grid or be used by the host community?
9. Will the technology produce any waste derived fuels (for example, syngas, ethanol, etc.)? How or where will this fuel be used?

10. Is waste generated in the municipality sufficient to produce enough Btu (British thermal unit) value to sustain incineration even after all the recyclables and compostables have been removed?[21]

HEALTH

1. Has the company prepared a full-scale monitoring program and established baseline data?[22]
2. Are there discharges to the air, water or soil that can harm human health?
3. How will the proponent and the government monitor and measure these discharges for human health protection?
4. What standards or criteria will be used to assess human health protection?
5. Are these standards legally enforceable? Who will enforce them?
6. How will the proponent prevent adverse human health impacts?
7. How will the company act on and respond to possible health concerns/complaints by residents?
8. Will there be a complaints register for the host community? Will this be provided to authorities?
9. Will there be a complaints resolution process?
10. Will there be a health surveillance system for the duration of the plants operation? Who will monitor and assess this?

ENVIRONMENT

1. Is the project going to be located in or near ecologically-important areas such as protected landscapes, biodiversity conservation areas, watersheds, etc.?
2. Are there any sensitive receptors close to the proposed land such as rivers, streams, schools, residential dwellings, hospitals, etc.?
3. Are there any sensitive land uses such as fishing, farming and agriculture that may be affected?
4. How much land space will be used by the facility?
5. Will land be sourced from private landholders or other land users?
6. Are there land use issues in the municipality?
7. Is the project detrimental to farming/residential land use?
8. What buffer zone distances does the proponent propose to be used for the protection of human health and the environment?[23]

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[21] Remember that waste in most developing countries is composed mostly of biodegradable materials that have high moisture content and are inappropriate to incinerate.

[22] At least a full year before the project starts, there must be soil/water/air sampling and body burden tests for a sample population of the host community. Hair, nail and blood samplings must be taken so that these may be used as baseline for comparison later on for heavy metals and other emissions in case the project pushes through. Monitoring and body burden tests must be done regularly (for example, every 6 months). All of these tests must be shouldered by the company.

[23] Remember that pollution and toxic emissions from incinerators travel long distances and persist in the environment for long periods. There is no safe buffer between an incinerator and a community.

9. How much water will be used by the technology?
10. Are there any issues about water supply and access in the municipality?
11. How is water sustainability in the community addressed with regards to dwindling water supplies caused by climate change?
12. What will happen to the waste water coming out of the facility?[24]
13. How will the proponent prevent environmental harm?
14. What standards or criteria will be used to assess environmental protection? Are these legally enforceable?
15. What discharges to air, water and soil will there be during the lifetime of the plant?
16. How will the proponent monitor and measure these discharges for environmental protection?
17. What emergency procedures are in place in the event of an explosion, accident, fire or uncontrolled environmental discharge?
18. Will the proponent be required to submit an Environmental Management Plan to authorities for approval?
19. Has the company prepared an Environmental Impact Assessments for the WTE facility and the final storage site of the slag/ash?
20. Will these plans be available to the community? If no, why not? Will this plan be legally enforceable?

SOCIAL/CULTURAL

1. Is the project going to be located in a culturally-important area such as indigenous and ancestral domains, heritage areas, national monuments, etc.? Are there any places of spiritual, religious or cultural significance nearby that may be affected?
2. Has the proponent undertaken community engagement in the host community? What was the outcome of this community engagement?
3. Will the proponent establish a community stakeholder engagement committee for the lifetime of the project?[25]
4. How many local jobs will be created during the establishment of the project? Will the company employ people from the host community?
5. How many local jobs will be created for the ongoing operation of the facility?
6. Comparatively, how many jobs will be lost in the current waste management program/service/ system? Will there be any loss of jobs in the recycling and composting sectors as a result of this project?
7. Will the project affect the host community's current and future land uses, amenity, cultural, religious or spiritual practices in any way? If yes, how will the proponent address this?
8. What are the hours of operation?
9. How many trucks will be entering and leaving the facility on a daily basis?

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[24] Remember that there is no waste treatment facility that does not produce or discharge waste water.

[25] Community members must be part of the monitoring team that will inspect and evaluate the facility's compliance and performance during its lifetime.

10. What noise and odor pollution impacts can be expected from the operation of the facility and truck movements?
11. How will noise and odor pollution be managed?
12. Will the facility build a new access road or use existing community roads?
13. If a new access road will be built, where will it be located?
14. What plans are in place to manage the possibility of increased traffic and noise in the community?
15. What lighting impacts can be expected from the operation of the facility? How will these impacts be managed?

REGULATION

1. What regulatory standards for health and environmental protection will apply? Do they meet international standards such as those under the European Union Waste Incinerator Directive?
2. What system will the company use to determine continuous sampling and analysis of dioxins in real-time or near-real-time basis?
3. How much of the facility's daily operational and monitoring data will be made available to the community and to regulatory agencies?
4. Can this data be made available online, so that the community can track emissions from the facility on a regular basis?
5. How often will a license-to-operate be reviewed or renewed?
6. Will the permit require the video monitoring of the smokestack(s) so that major upsets or problems are taped and monitored?
7. Who will enforce the license or permit?
8. What laws or penalties will apply should the proponent breach the license?
9. Who in the company will be responsible for the regulatory compliance of this technology?
10. Will civil society have input into the regulation of this proposal/project?

QUESTIONS TO ASK PUBLIC AUTHORITIES

As previously mentioned, impacted communities and other citizens have the right to know about WTE projects that may have an impact on their lives. Likewise, it is journalists' duty to properly inform the general public about such matters. In addition to the previous list of questions intended for project proponents, the following questions should be addressed directly to public authorities.

BETTER SOLUTIONS

1. Why does the municipality need or want to build an incinerator?
2. What are the main factors motivating the proposal to build an incinerator?
3. What are the expected benefits of the project and who will benefit the most from the project?
4. Is there real or actual data to back up these claims? Please provide the commercial case for the project?

5. Have other solutions been developed/explored/implemented to solve these concerns?
6. Is proper waste management thoroughly implemented in the area?
   - What investments have been made to promote waste avoidance and reduction, source separation, reuse, recycling and composting?
   - Are there policies or regulations in place to promote waste avoidance, source separation, reuse, recycling and composting? Are they being implemented properly?
   - Does the state or municipality support the waste hierarchy that promotes waste reduction, recycling and composting ahead of waste disposal or energy recovery?
   - What infrastructure does the state or municipality provide the community to recycle and compost?
   - Has the state or municipality implemented information and education activities to increase residents' awareness on waste management, recycling and composting?
7. If there is no waste management program, what is the current waste management scenario in the municipality?
8. How much waste is created by the municipality? In comparison, how much waste will the company/technology treat?
9. Will the project encourage the creation of more waste? Won't the project go against local laws mandating waste reduction and diversion targets?
10. Is the state or municipality willing to be locked into a long-term waste contract?
11. If the municipality does not produce enough waste, is it willing to import waste from other municipalities/cities/countries to meet the requirements of the company?
12. Did the municipality undertake a waste composition and analysis study? What are the results of the study? Does the waste composition and analysis study justify the need to build an incinerator?
13. Will the technology be used primarily to treat residual waste?
14. If waste reduction, source separation, recycling and composting is improved or strengthened, the residual waste fraction will be reduced over time. Won't this make the incinerator useless?
15. Is the state or municipality willing to invest in long-term solutions to address residual waste such as instituting better packaging/design laws, promoting local/ecological products and packaging, etc., that are more cost-effective and sustainable than expensive high-risk technologies?
16. How does this project move the community toward real and sustainable solutions such as Zero Waste?

ENVIRONMENTAL

1. Are the residents aware of all the arguments for and against the project/technology?
2. Is the state or municipality fully aware of an incinerator's effects to the environment?
3. Does the host community practice sustainable/ecological waste management?
4. How will the project affect local initiatives to reclaim/recycle/reuse/compost wastes generated locally?
5. Is the host community located in an environmentally-critical area?

6. Are there any sensitive land uses in the host community that could be affected by this proposal?

HEALTH

1. Is the state or municipality fully aware of an incinerator's health effects?
2. How will the state or municipality ensure that the proponent will monitor and measure discharges for human health protection?
3. What standards or criteria will the state or municipality use to assess human health protection? Are these legally enforceable?
4. What role will the state or municipality have in preventing adverse human health impacts from this proposal?
5. Will the state or municipality support a health surveillance register for the community?

SOCIAL

1. How was the host community chosen?
2. Did the state or municipality undertake community engagement about the project? What was the outcome of this community engagement?
3. In case of resistance from the community, will the local government respect the objection of the residents?
4. Will the state or municipality support a community stakeholder engagement committee/monitoring and evaluation team for the lifetime of the project?
5. Will the project affect the host communities current and future land uses, amenity, cultural, religious or spiritual practices in any way? If yes, how will the state or municipality address these?

REGULATION

1. What specific role will the municipality have in the regulation of this proposal/project?
2. How will the =municipality support civil society to have input into the regulation of this proposal?
3. Will there be a municipality complaints-register for the host community?
4. Will there be a municipality complaints-resolution process?
5. How will the municipality support their community to have a voice and a role in the regulation and management of this proposal?
6. What government agencies will be responsible for ensuring regulatory compliance?
7. Do concerned government agencies have real capacity to regularly monitor and enforce safety and regulatory compliance?
8. How will authorities monitor, audit and ensure compliance of this regulation?

JOBS/ECONOMICS

1. Was there a feasibility study conducted that proves that the project is the best waste management option for the municipality?
2. How will the project affect the waste workers in the municipality? How will the project affect the recycling sector?
3. How does the municipality plan to support waste workers who may be displaced by the project?
4. What is expected from the municipality in terms of financing (tax breaks, free land use, waived permits, tipping fees, other subsidies, etc.)?
5. Is the municipality aware that there are documented cases of incinerator companies driving host cities to bankruptcy?[26]
6. Will the project become a debt that will be shouldered by the municipality in case of bankruptcy?
7. Is the municipality fully aware of its responsibilities under the contract?

CONCLUSION

States and municipalities faced with mounting waste problems can be tempted to resort to thermal waste-to-energy as a "silver bullet" that may seem to solve the problem once a facility is built. In fact, in recent years, this is how many companies have peddled WTE facilities to local governments. However, decision-makers need to be wary and assess waste-to-energy projects with critical spirit.

Waste incineration has been known to cause more problems than it purports to solve. It endangers human health and the environment, and has led many municipalities into debt due to staggering costs for both construction and maintenance, as well exorbitant tipping fees. In addition, municipalities cannot rely on returns from energy generation as the output is very minimal when compared against investment costs and energy inputs. There are many cases around the world where cities and municipalities have lost money invested in such facilities, and have ended up with stranded assets that can't be used.

Waste is a complex issue that can't be solved by the mere construction of a waste burning facility. It requires an integrated approach that values what we call waste as potential resources, and recognizes the toxic burden that waste incineration imposes on people and the environment. Safer, simpler and more effective solutions – broadly referred to as "Zero Waste" – are already available. By implementing measures that are much higher up the waste hierarchy (reduction, reuse, recycling and composting), cities and municipalities can drastically reduce the amount of residual waste they produce.

Such Zero Waste solutions are proven waste management options that are better for our environment, create more jobs, do not pollute our air and water and are not as expensive to establish. There are Zero-Waste-compatible technologies such as anaerobic digestion that create organic compost and energy without leaving a toxic ash. The key is to institutionalize programs

[26] Remember that incinerator contracts and subsidies have caused bankruptcy in other cities.

that encourage the creation of clean waste streams that support maximum resource recovery, composting, reuse and recycling of our waste.

Zero Waste solutions are an important part of a sustainable society and circular economy where virgin materials are reused and recycled over and over. Benefits derived from recycling and composting activities are superior to incineration (which always turns out counter-productive as it disincentivizes waste reduction, reusing and recycling). For example, we can save 26.4 times more energy by recycling PET plastic water bottles than by "processing" them in a WTE incinerator.[27]

The incineration industry promotes waste-to-energy technologies as "green energy" and "climate solutions", but in fact incinerators are the dirtiest way to make electricity. To make the same amount of energy as a coal power plant, waste incinerators release 28 times as much dioxin, 2.5 times as much carbon dioxide (CO_2), twice as much carbon monoxide, three times as much nitrogen oxides (NOx), 6-14 times as much mercury, nearly six times as much lead and 70% more sulfur dioxides.[28]

In the end, Ecosoum strongly recommends national and municipal authorities to:

1. Reject all thermal waste-to-energy proposals as these will create more problems that they purport to solve.
2. Officially adopt a Zero Waste approach with clear targets and deadlines for reducing waste generation and increasing reusing and recycling rates;
3. Design and implement a solid waste management plan that prioritizes actions higher up the waste hierarchy (reduction, reuse, recycling and composting) as these are recognized to be the preferred and sustainable actions for waste management.

[27] ICF Consulting, *"Incineration of Municipal Solid Waste: A Reasonable Energy Option?" Fact Sheet #3* (2005).
[28] Energy Justice Network, *Trash Incineration More Polluting than Coal* (2018).