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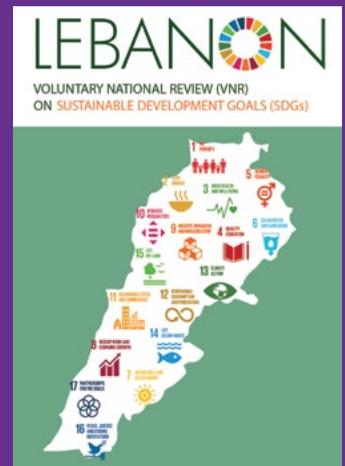
Incinerators are Not a Suitable Solution for Lebanon



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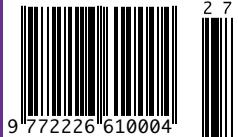
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Incinerators are Not a Suitable Solution for Lebanon

The incinerator industry often promotes incinerators as having “zero emissions” or as being “safe for community health”. The truth, however, is that all incinerators contaminate people and the environment with toxic and cancer-causing emissions.



Incinerators are Not an Option for Solid Waste Management in Lebanon

By Dr. Najat A. Saliba*, Foreword by Responsible Business - Beirut

Lebanon has been in the midst of serious discussions around building waste-incineration facilities to generate energy. At first glance, it seems like a win-win solution for Lebanon's garbage problem: on one hand, we can get rid of "garbage" and then on the other, acquire a new energy source with fuel that's relatively free. But in fact, it's a problematic solution and a complicated issue.

The practice is especially popular in the European Union, where some countries import waste to fuel their generators. But the difference is that across Europe, there is no such thing as "garbage" – but rather, waste! It is no longer contentious to mention that the best ways to deal with waste are to reduce reuse and recycle.

In effect, burning waste may seem easier and less expensive than sorting, diverting, and recycling. But once it's burned, it can never be used for anything else. Incinerating waste also comes with major environmental problems. Although modern technologies reduce many air pollutants once associated with the process, burning plastics and other materials still creates emissions that can contain toxins such as mercury, dioxins, and furans. As with burning fossil fuels, burning waste - much of which is plastics derived from fossil fuels - also produces carbon dioxide and nitrous oxide emissions that contribute to climate change.

Burning waste doesn't make it disappear, either. Beyond the fly ash and pollutants released into the atmosphere, a great deal of toxic "bottom ash" is left over. That ash will usually be disposed of in landfills. But research has found high levels of the carcinogenic heavy metal cadmium in bottom ash, sometimes twice the limit allowed

for landfills. High lead levels have also been reported. Incineration is also expensive and inefficient. Once we start the practice, we come to rely on waste as a fuel commodity, and it's tough to go back to more environmentally sound methods of dealing with it.

Currently in Europe, waste-to-energy is acknowledged to be a necessary tool to move towards a more sustainable circular economy as it helps to avoid the prospect of landfills and generates energy. However, local governments ask to strictly respect the waste hierarchy, putting waste prevention first. Members are in favor of creating stable markets for products and materials based on secondary raw materials and of making every effort to reduce landfilling.

Despite being an attractive technological option for waste management, incinerators remain a subject of intense debate around the world. In the absence of effective controls, harmful pollutants will be emitted into the air, land and water which will influence human health and environment. Although incineration of municipal waste coupled with energy recovery can form an essential part of an integrated waste management system, yet strict controls are required to prevent its negative impacts on human health and environment.

Does Lebanon have the capacity to instill a highly regulated waste management system when it has failed to fund a local sorting and diverting mechanism since the garbage crisis began over four years ago?

Diversion and recycling can lessen the need to extract new resources and disrupt the environment while creating more value and jobs. That's a win all around!

Waste to energy (WtE) technologies from gasification, to pyrolysis, and plasma arc are all based on similar principles. Practices include burning waste, and like other combustion processes, they are a source of climate and toxic pollution. Their air emissions are toxic, the residual ashes are toxic and significant, WtE technologies are not climate-friendly, and they are a major deterrent to recycling and composting. In addition, WtEs are a waste of energy, and money. WtE technologies are not risk free as they are shown in the case studies, they are NOT suitable for Lebanon, and present a major environmental injustice. Most importantly WtE will cause the death of innovation and young minds. Below are the ten reasons why incineration is NOT an option for solid waste management in Lebanon.

1. Air emissions are toxic

Plastic and other waste releases dangerous substances such as particulate matter, volatile organic compounds (VOCs), heavy metals, dioxins¹, sulfur dioxide (SO₂), carbon monoxide (CO), nitrogen dioxide (NO₂), mercury, carbon dioxide (CO₂), polycyclic aromatic hydrocarbons (PAHs), dioxins, and furans. Both dioxins and furans are characterized as persistent organic pollutants (POPs). As their name indicates, POPs are persistent and resistant to degradation and as such they are bio accumulative (build up in the tissues of living organisms) and toxic. These properties make them arguably the most problematic chemicals to human health and the environment. When entering the body, they accumulate in the fatty tissue. Men store them in their body while women get rid of them by transfer-

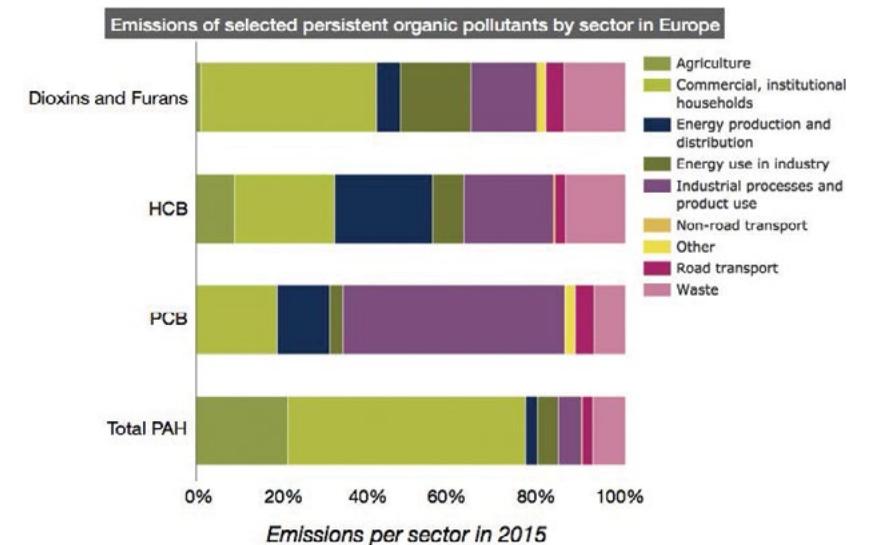


Chart 1. The emissions of POPs by sector in Europe in 2015. Waste in pink constitutes more than 20% of POPs dioxin and furan emissions.

ring them to their babies through their womb. All these pollutants contribute to the development of asthma, cancer, endocrine disruption, and the global burden of disease. With all the claims that newer WtE technology are free from toxic emissions, POPs' emission inventory by sector in Europe still shows that waste is considered a major source of POPs (see Chart 1). Furthermore, burning toxic products such as electronics can also emit ultrafine particles and nanoparticles that are not captured through air pollution control measures and as such they will be emitted into the air only to cause more deaths and diseases.

2. Fly and bottom ash are toxic and significant

WtE facilities erroneously report that they reduce incoming waste down to only 10%. The U.S. Environmental Protection Agency (EPA) states that ash constitutes up to 25% of processed waste by weight. This

means incinerators cannot eliminate or replace landfills because a sizeable quantity of toxic ash will still need to be buried.

There are two types of ash: fly ash and bottom ash. Fly ash is extremely dangerous waste that comes out of a chimney. It includes the fine particles that are removed from the flue gas and residue from other air pollution control scrubbers as presented above. Bottom ash is the remaining unburned materials much like the ash in a fireplace.

3. Not climate-friendly

When compared to other electricity-producing technologies, incineration contributes the greatest amount of greenhouse gas emissions (see Chart 2).

4. Deterrent to recycling and composting

Much of the waste in developing

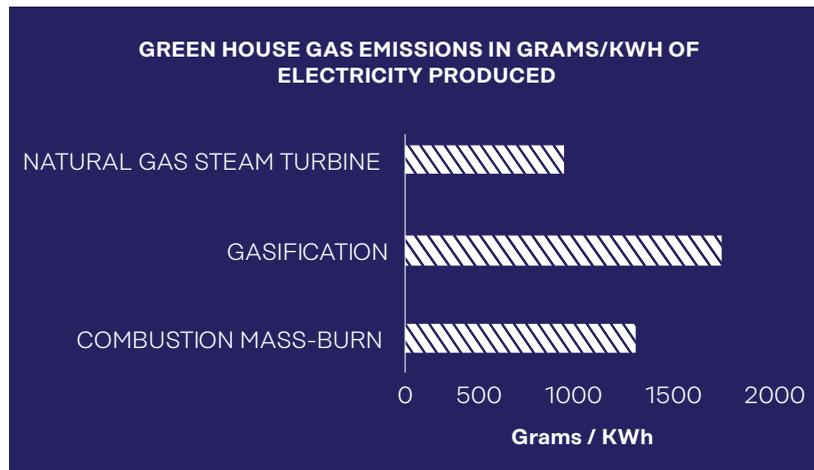


Chart 2. Greenhouse gas emissions in grams/KWH of electricity produced. The data is taken from energy production facilities in Ontario, Canada

countries is formed of organic materials (around 50% in Lebanon). As such, its calorific value is low, meaning that one needs to add a lot more fuel and other burning waste to have the burner reach the optimal temperature of 850°C³. This temperature is optimal because at $T < 850^{\circ}\text{C}$, the energy produced cannot generate electricity. Instead, incomplete combustion of waste will produce larger quantities of the toxic gases already mentioned. Therefore, WtE facilities need to burn energy-rich materials like paper and plastic to reach optimal temperatures, which means facilities will select these types of waste to feed the furnace and not water-rich food scraps or non-combustible glass. By doing so, WtE facilities will be directly competing with recycling markets for these valuable paper and plastic materials. When enough paper and plastic are not available, WtE facilities add fuel to reach the proper calorific value to produce electricity (more on this point later). The only material that WtE facilities are claiming to re-

cycle is metal, not because of their commitment to recycling but rather because metals do not burn and are a contaminant in the furnace⁴.

5. Waste of Energy

WtE is the most expensive method of generating electricity. In 2018, the U.S. Energy Information Administration (EIA) published a report⁵ showing that trash incinerators were more expensive to build and operate than nearly all other energy sources including wind, solar, and natural gas (see Table 1). It is evident in the case of Lebanon that the government needs to put more efforts in upgrading and maintaining current power plants to generate electricity rather than investing in the most expensive technology in the world to generate much less electricity than what is being advertised. More on the existing status of power generator emissions in Zouk in (8) below.

6. Waste of Money

It requires a minimum of 7000 Kj/Kg for the furnace to burn at 850°C

and 8400 Kj/Kg to produce electricity⁶. If we assume that the average organic waste in Lebanon is 52%, this means that the maximum calorific value that can be reached with this waste is 6500 Kj/Kg. The deficit calorific value necessary to produce electricity is then around 2000 Kj/Kg. This deficit will be compensated by adding, for example, diesel fuel that produces 40,000 Kj/Kg.

Taking Beirut as an example, the 292,000,000 Kg of waste per year would need 17,600,000 liters of diesel at a cost of \$11.7 million per year.

Added to this high cost are the billions of dollars per year required to operate incinerators built to European standards of health and safety⁷, which still allow the release of dangerous waste pollutants and ash residues. All over the developed world, more than half the investment is put in control systems and pollution control equipment to reduce toxic emissions. Examples are the ammonia injectors needed to remove nitrogen dioxide, activated carbon to remove mercury, lime injected onto dry scrubbers to remove acid gases, and electrostatic precipitators to remove particulates and toxins^{8,9}. Most importantly, the cost of a special landfill for fly ash disposal is almost ten times costlier than a municipal landfill with an even higher annual cost for operation and maintenance¹⁰.

7. WtE is not risk free as shown in the following case studies

Incineration facilities, while claiming the safety of their practices, are

Table 1. Capital energy technology and fixed operation and maintenance (O&M) cost

Technology	Capital Cost (US dollars)	Incineration higher by	Fixed O&M	Incineration higher by
Trash Incineration	8,170		417	
Photovoltaic	2,004	308%	22	1795%
Wind	1,548	428%	47	787%
Conventional natural gas	935	774%	11	3690%

frequently cited for pollution violations and have been shut down in many places. Following, we review some case studies from around the world ((a-d)¹¹(e)¹²):

a. In 2011, the state of Connecticut sued its WtE plant for repeated excessive dioxin emissions.

b. The Thermoselect Karlsruhe facility in Baden-Württemberg, Germany was a gasification incinerator, designed to process 225,000 tons of municipal waste per year. Thermoselect falsely claimed that its technology completely destroys dioxins and furans. Recurring operational problems prevented the facility from reaching full operating capacity. It was closed in 2004 after losing approximately \$500 million on municipal solid waste (MSW) gasification.

c. Brightstar Environmental gasification technology also called the Solid Waste & Energy Recycling Facility (SWERF) was promoted in many countries but was only constructed in Wollongong, New South Wales, Australia. The facility operated in test phase from 2000 to

2004. It closed thereafter after losing US\$134 million. Brightstar's website admitted to emissions of toxicants.

d. In 2002, the Malaysian government planned to install a gasification incinerator to treat an average of 5,000 tons of waste per day. The incinerator was originally planned to be installed in Kuala Lumpur but then moved to Broga in the state of Selangor under the community's pressure and refusal. An environmental impact assessment for the proposed Broga facility noted concern for public health and safety and raised the possibility that dioxin emissions and accidents could cause cancer. The Japanese corporation "Ebara" that commissioned the project lost over \$300 million (US) in plant repairs caused by contaminant leakage. To date, the Broga facility is still in the planning stage.

e. The Environmental Council of Zambia (ECZ) has reported recurring problems with incinerators due to malfunctioning equipment, improper operation, and poor communication between operators and

maintenance personnel. The described scenario feels closer to home as inferred by current practices here in Lebanon.

8. Incinerators are NOT Suitable for Lebanon

According to a report published by the National Academy of Science, the incineration process requires extensive and continuous monitoring of the waste feed, handling of the ashes, the fugitive (air emissions before and after combustion and during the loading and discharging of the waste and the residue) and air emissions, water discharge, combustion temperature, and feed cut-off and restart when needed. Our experience over the past 20 years has shown the inability and the unwillingness of local public institutions to complete such serious tasks. Examples include:

a. Power plants: Emissions from ill-maintained power plants have shown that the amount of carcinogens in the air around the Zouk power plant is 300% higher than other sites that are experiencing heavy traffic and in-

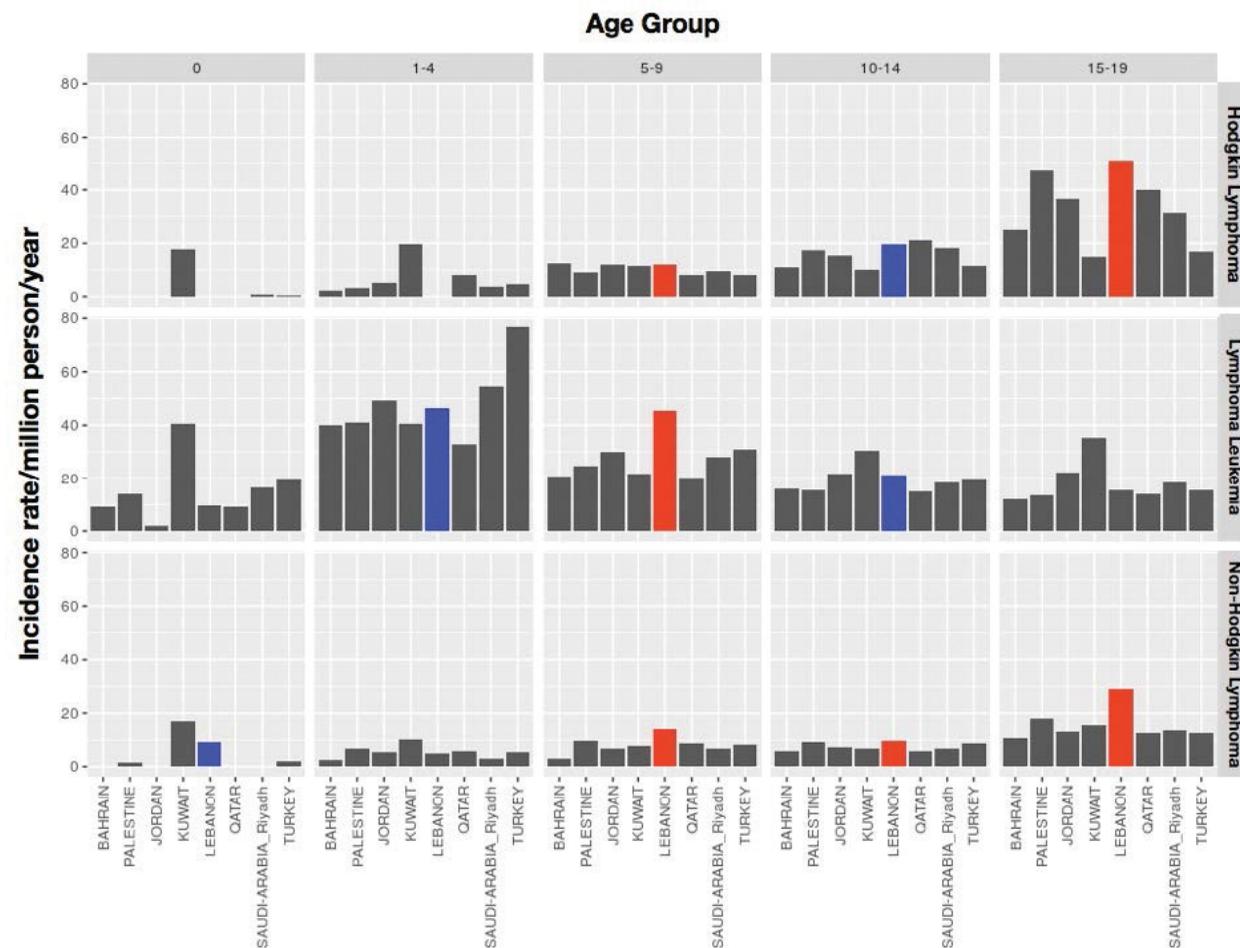


Chart 3. The prevalence of cancer among different age groups in Lebanon and some of the neighboring countries. The red bars indicate where Lebanon is ranked first, and the blue bars show when Lebanon is ranked the second highest.

dustrial activities¹³. Still, no filters or scrubbers have been put in place even after data was published and public officials were informed of the disastrous situation.

b. Old traffic fleet: Our data also showed that emissions from cars on the streets leading to Beirut are seven times more toxic than traffic in Los Angeles¹⁴. This is not due to the higher number of cars but to

the number of old and high emitting cars. Yet, no plan to remedy the situation is ready for implementation. **c. Diesel generators:** Our studies show that the number of carcinogens emitted from diesel generators in Hamra increase by 38% when the generators are on¹⁵. It is important to note that this number is associated with three-hour outages and not six and twelve hours as is the case in most

cities and villages in Lebanon.

d. Occupational health and safety workers at waste sorting facilities: Based on several visits conducted to waste sorting and treatment facilities, we witnessed workers doing their jobs without any protection and smelled the odor of waste fermentation from a distance. This indicates that care in handling waste has not been taking serious-



ly by contractors or the supervising governmental bodies. Studies of incineration facilities workers found increased death rates from cancer and heart disease¹⁶.

e. Law 174: Despite the issuance of law 174 that bans smoking indoors in restaurants and public spaces, the law is not enforced even in the ministry and municipality offices. This includes those offices that are claiming they will enforce the regulations for the incinerators, indicating that incinerator regulations may not be taken seriously.

As a result of this carelessness, the ambient air pollution level in Beirut has reached 3.2x higher than what is recommended by the World Health Organization (WHO) and has caused many diseases and deaths. It is important to note that according to the recent report of the International Agency for Research on Cancer, the incidence of lymphoma in Lebanon is the highest among children (5-9 years old) and adolescents (15-19 years old) (see Chart 3) when compared to

other neighboring countries.

9. Incinerators present major environmental injustice

Certain areas in the suburb of Beirut have suffered from environmental injustice. Added to the poor status of most of the population, these areas have carried the disproportionate burden of air and water pollution due to waste, sewage, and untreated industrial discharges. Discriminatorily enough, the same areas are being suggested as ideal sites to host the new incinerators if implemented. Several studies have demonstrated a correlation between people living near pollution sources and increased rates of death from cancer¹⁷.

Recently, research has shown that air pollution may play a major role in causing fetal/newborn malformations. It can even inappropriately alter the function of some genes changing when or what they instruct cells to do¹⁸. This can only imply that this population will be condemned for future generations.

10. Most importantly WtE will cause the death of innovation and young minds

Most developing countries are looking to “research and evaluate new and emerging non-combustion thermal, chemical, and biological technologies”. They are convinced that there is a great need to adopt alternative and cleaner methods for the disposal of municipal garbage. It is a shame to see that our country officials do not have faith in our young minds. Many studies conducted at their ministries and public offices are completed by foreign consultants who are eager to fulfill their agenda before looking at local needs and benefits.

The option of incineration might suit several consultants, contractors and narrow-minded people who are keen on cashing-in by burning the problem as quickly as possible. Hopefully, they realize they are burning resources and creating an even more toxic and dangerous problem that will still need a much costlier landfill. Moreover, this approach



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will burn not only waste but also our health and all the hopes of creating new industries and new innovative alternatives based on local research as well.

Moving beyond trash into a circular economy requires collective commitment, dedication, and hard work, qualities that are not foreign to Leb-

anese youth, entrepreneurs, and researchers. Building an infrastructure and technologies that keep systems circulating endlessly will make us global leaders in technological, regulatory, social, and business-model innovation. You and I both know very well that this is not a dream because all of us doctors, engineers, philanthropists, artists, teachers, media experts, farmers, and craft-

ers have proven to be leaders in our fields and innovators in the international arena. We shall have, and continue to strive to excel even in municipal waste management.

Dr. Najat A. Saliba is the Director of the Nature Conservation Center (NCC) and Professor of Chemistry at the American University of Beirut.

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