

# **Digester to SDG 2.1**

## **Digester - MBGC toward SDGs/UN 2.1**

(Target 2.1: By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round).

## Summary

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## Digester to SDG 2.1

### Hunger Crisis:

Hunger is invasive, yet entirely preventable, global crisis that persists in the 21st century, affecting millions of people across the world. Despite remarkable advancements in technology, science, and the global economy, one of the most basic human needs that is access to nutritious food, remains out of reach for far too many. This enduring issue raises profound questions about social justice, equity, and the state of humanity's moral compass. In a world with abundant resources, it is disheartening that anyone should go to bed hungry or suffer from the devastating consequences of malnutrition.

As of the latest available data in 2022, hunger is an urgent problem. The United Nations Food and Agriculture

Organization (FAO) estimated that around 9.2% of the world's population, nearly 690 million people suffered from chronic undernourishment. To put it into perspective, that is roughly one in eleven people globally, living in a state of perpetual hunger. While these numbers may seem overwhelming, the battle against hunger has seen some progress over the years, primarily through the concerted efforts of international organizations, governments, and grassroots initiatives. However, challenges and inequalities persist, exacerbated by numerous factors, including conflict, climate change, economic disparities, and political instability.

To fully understand the magnitude of the problem of hunger, we must begin by acknowledging the harsh reality faced by millions of people around the world. Hunger does not define age, gender or nationality. It penetrates the lives of children, adults and the elderly in urban and rural areas. From the busy streets of big cities to the remote corners of developing countries, the pain of hunger takes over. It

affects people on all continents regardless of their country's economic development.

For countless individuals, hunger is not an occasional problem but a relentless, constant struggle. Malnutrition leads to chronic malnutrition, stunted growth, weakened immune systems, and reduced overall quality of life. Children are particularly vulnerable to the risks of famine, because poor nutrition in early childhood can lead to irreversible mental and physical illness.

Hunger is a serious and widespread issue in many low-income countries, particularly in sub-Saharan Africa and South Asia. However, it is important to recognize that hunger is not limited to poor areas. Even in high-income countries, individuals experience food insecurity, often hidden from the public eye. This highlights the multifaceted nature of the problem and the need for effective global management.

To tackle global hunger correctly, it's vital to understand its underlying causes. Hunger is a complex problem with

interconnected factors contributing to its staying power. Some of the key drivers consist of:

- **Poverty:** Poverty and hunger are intertwined in a vicious cycle. Families living in poverty often lack the resources to get entry to good enough food, healthcare, and training. In flip, undernutrition can trap individuals within the cycle of poverty through impairing their bodily and cognitive improvement, limiting their monetary possibilities.
- **Conflict and Displacement:** Armed conflicts, each internal and international, have dire results for food protection. Displaced populations, whether as refugees or internally displaced persons, regularly lose their livelihoods and face meals shortages because of the disruption of agricultural activities and get admission to to markets.
- **Climate Change:** The impacts of weather exchange are more and more glaring, with growing temperatures, intense weather events, and converting rainfall patterns affecting crop yields and food production. Vulnerable

communities, specifically those reliant on agriculture, are left exposed to food insecurity.

- **Inequality:** Socioeconomic inequalities can exacerbate food lack of confidence. Disparities in profits, land ownership, and get admission to to assets can restrict people' ability to stable adequate vitamins.
- **Economic Shocks:** Economic crises, along with those as a result of worldwide monetary downturns or localized economic disturbances, can power up meals prices and decrease human beings's buying strength, making it challenging for them to have enough money important nutrients.
- **Poor Infrastructure and Distribution:** Inefficient transportation and distribution systems can lead to food losses, limiting the availability of food in areas that need it the most.
- **Inadequate Education:** A lack of education and awareness about the importance of nutrition, hygiene, and sustainable farming practices can perpetuate the cycle of hunger in many regions.



These are but a few of the myriad factors contributing to global hunger. Addressing this issue comprehensively requires a multifaceted approach that considers the specific challenges faced by different regions and communities. Additionally, it calls for international collaboration, targeted policies, and sustainable development initiatives to alleviate the suffering caused by hunger.

## **Sustainable Developmental Goal 2.1 (SDG 2.1):**

The United Nations Sustainable Development Goal (SDG) 2, often referred to as "Zero Hunger," represents a powerful global commitment to eliminate hunger and ensure food security by 2030. As the cornerstone of a more equitable and sustainable future, SDG 2.1 encapsulates not just the alleviation of physical hunger but also the fulfillment of fundamental human rights and the achievement of ecological balance. In a world rich in resources, yet plagued by disparities, the journey toward achieving SDG 2.1 calls for comprehensive strategies, international cooperation, and a deep understanding of the intricate challenges that hunger poses.

As the bedrock of global efforts to combat hunger, SDG 2.1 is an ambitious commitment to ensuring food security and improved nutrition while promoting sustainable agriculture. This goal is an integral part of the broader 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015. With its

commitment to "leave no one behind," the 2030 Agenda envisions a world of peace, prosperity, and sustainability.

SDG 2.1 stands as a symbol of global unity to address hunger, which impacts nearly every facet of human existence, from health to education, social equity to economic development. It not only seeks to address the issue of hunger directly but also aims to create a more resilient global food system that can withstand the challenges of a rapidly changing world.

These root causes of persistent hunger around the world are interconnected, and they demand comprehensive, tailored solutions that address the specific challenges faced by different communities and regions. They require the collaboration of governments, international organizations, and civil society to develop and implement strategies that confront these challenges head-on.

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The significance of SDG 2.1 knows no borders, it is a pivotal step in the pursuit of a more equitable, just and sustainable world. Let's shed some light on the importance of SDG 2.1 and global efforts required to make it a reality.

- 1. Ensuring a Basic Human Right:** It is undeniably a fundamental human right to have access to sufficient, safe and nutritious food. SDG 2.1 emphasizes on this basic

ideology, asserting that every individual, regardless of their background or circumstances, should be able to enjoy this essential human necessity. However, the persistence of hunger across the globe starkly demonstrates that this fundamental right remains unfulfilled for a significant portion of the world's population. Adequate nutrition is the cornerstone of human well-being. It not only sustains life but also empowers individuals to lead healthy and fulfilling lives. When we speak of food security, we are not merely addressing the provision of calories but ensuring that every morsel is safe, nutritious, and culturally appropriate. The core principle of this aspect of SDG 2.1 is to guarantee that every individual has the opportunity to lead a dignified life, where hunger and malnutrition are consigned to history.

- 2. Breaking the Cycle of Poverty:** Poverty and hunger are deeply entwined, engaged in a symbiotic relationship that perpetuates the suffering of countless individuals. SDG 2.1 recognizes that to end hunger, we must tackle its root causes, and one of the primary culprits is poverty. Poverty

deprives individuals of the resources and means to access nutritious food, quality healthcare, and education. Concurrently, undernutrition traps individuals in a cycle of poverty by inhibiting their physical and cognitive development, limiting their economic prospects, and perpetuating disparities between the impoverished and the more fortunate. Breaking the cycle of poverty requires multifaceted efforts, ranging from economic empowerment and access to education to social safety nets and healthcare services. SDG 2.1 underscores the significance of addressing the multifaceted aspects of poverty as a means to eradicate hunger. It is an exhibition to the understanding that food security and poverty reduction are intrinsically linked, and the pursuit of one significantly contributes to the realization of the other.

- 3. Fostering Sustainability:** SDG 2.1 places sustainability at its core, emphasizing the imperative need for agricultural and food systems that are environmentally friendly, resilient, and capable of withstanding the diverse challenges posed by climate change. The sustainability

aspect of this goal is essential, not just for ensuring that present generations have access to nutritious food but for safeguarding the food security of future generations as well. Agriculture, as a source of sustenance, income, and employment for billions of people worldwide, is undeniably linked to broader ecological and environmental concerns. Unsustainable farming practices, deforestation, overuse of chemical fertilizers, and over-exploitation of water resources all contribute to environmental degradation. Such practices exacerbate soil erosion, biodiversity loss, and the release of greenhouse gases, amplifying the challenges of climate change. By fostering sustainability in agriculture, we align the interests of food security with those of ecological preservation. Sustainable agricultural practices, such as crop diversification, organic farming, efficient resource management, and agroforestry, not only promote food security but also mitigate the environmental impact of food production. By embracing sustainability, we reduce our carbon footprint, preserve biodiversity, and ensure that the ecosystems that sustain us

remain resilient in the face of changing climatic conditions.

- 4. Supporting Global Health:** Adequate nutrition is the foundation of good health. Thus, addressing hunger and malnutrition significantly contributes to improving global health outcomes. SDG 2.1 recognizes the intrinsic link between nutrition and health, emphasizing that ensuring access to nutritious food is not merely a means of averting physical hunger but of promoting well-being at the broadest level. Malnutrition can have profound health implications. Undernutrition in children can lead to stunted growth and developmental delays, while in adults; it can result in increased susceptibility to diseases and infections. On the flip side, overnutrition or diets high in unhealthy foods can lead to obesity and diet-related diseases, such as diabetes and cardiovascular disorders. The goal of ensuring access to sufficient and nutritious food is, therefore, intrinsically tied to broader healthcare objectives. It is a fundamental step in reducing the burden of preventable diseases and ensuring the well-being of



populations. It reinforces the message that food is not merely sustenance but a cornerstone of good health for individuals and societies alike.

**5. Promoting Social Equity:** Hunger is not an indiscriminate force; it disproportionately affects vulnerable populations, including women, children, and marginalized communities. SDG 2.1 acknowledges these disparities and underscores the need to reduce them significantly. It seeks to ensure that the benefits of food security reach those who need them most and that the most marginalized are not left behind. Gender equity, in particular, is a critical dimension of this aspect of SDG 2.1. Women often play central roles in food production and family nutrition. Therefore, empowering women and ensuring their equal access to resources and opportunities in agriculture is essential for addressing hunger effectively. Empowered women are better positioned to make decisions about food production, family nutrition, and income generation, contributing to enhanced food security. This goal also emphasizes the need to address the

unique vulnerabilities of children. Childhood malnutrition not only hampers physical and cognitive development but also perpetuates cycles of poverty and health disparities. Therefore, interventions aimed at reducing child malnutrition play a vital role in achieving SDG 2.1.

- 6. Addressing Climate Change:** The sustainability component of SDG 2.1 recognizes that agriculture and food systems play a critical role in mitigating climate change. The impact of climate change, from rising temperatures to erratic weather patterns, poses a significant threat to crop yields and food production. Vulnerable communities, particularly those dependent on agriculture, are exposed to heightened food insecurity as a result of these changes. Sustainable agriculture practices, such as the cultivation of climate-resilient crops, efficient water use, and agroforestry, not only enhance food security but also reduce the environmental impact of food production. They contribute to mitigating climate change by sequestering carbon, preserving biodiversity, and reducing the emission of greenhouse gases. Moreover, the

need to adapt to climate change is a crucial aspect of achieving SDG 2.1. Communities in climate-vulnerable regions must develop strategies to safeguard their agricultural practices and food supplies in the face of changing conditions. These adaptation strategies, ranging from improved water management to crop diversification, are essential components of the goal's broader climate-resilience agenda.

- 7. Encouraging Responsible Consumption:** Achieving SDG 2.1 goes beyond food production; it extends to responsible consumption. The goal emphasizes the need to reduce food waste and minimize the strain on natural resources. Responsible consumption patterns can significantly contribute to reducing the environmental impact of food production. Food waste is a critical issue in the fight against hunger. Roughly one-third of the food produced globally is lost or wasted, amounting to approximately 1.3 billion tons of food each year. This waste represents not only a squandering of precious resources but also a missed opportunity to feed the hungry.

SDG 2.1 acknowledges the urgency of reducing food waste through efficient production, distribution, and consumption practices. Furthermore, responsible consumption aligns with broader sustainability goals, reducing the demand for resources and minimizing the ecological footprint of food systems. Sustainable food choices, such as reducing meat consumption and favoring plant-based diets, play a pivotal role in minimizing the environmental impact of food production.

SDG 2.1, as part of the broader SDG 2 - Zero Hunger, represents a rallying cry for a hunger-free, equitable, just, and sustainable world. It is a multifaceted goal with far-reaching implications, encompassing the assertion of basic human rights, poverty eradication, sustainability, global health support, social equity promotion, climate change mitigation and adaptation, and responsible consumption.

This goal is not a solitary endeavor but a collective global commitment to a more equitable, just, and sustainable world. It underscores the importance of international cooperation, emphasizing that hunger knows no borders.

The international community, through organizations like the United Nations and various non-governmental organizations, plays a pivotal role in coordinating efforts, mobilizing resources, and providing assistance to countries facing food security challenges.

As we navigate the complexities of the 21st century, we are confronted with the paradox of hunger; an issue that continues to persist despite remarkable advancements in various domains. SDG 2.1 is a call to action, urging nations, organizations, and individuals to rise to the challenge and eliminate hunger by 2030. It is a roadmap for a brighter future, where food is a source of nourishment and not a cause of suffering. In our pursuit of Zero Hunger, we find a path that leads us not just to full stomachs but to a more just and sustainable world for all.

## **Mini Bio Gas Continuous (MBGC) “Digester”:**

In a world where millions still suffer from undernourishment and food insecurity, MBGC (Mini Bio Gas Continuous) also known as the “Digester” stands firm as a beacon of hope in our collective pursuit of Sustainable Development Goal 2.1 which seeks to end hunger, enhance food security and foster sustainable agriculture. This innovative technology not only embodies the spirit of progress but also shines brightly as a symbol of a more equitable, just and sustainable world.

The Digester uses anaerobic digestion as the core of its mechanism. Anaerobic digestion is the fundamental process underlying the production of so-called biogas. It involves the degradation of organic material by microorganisms in anaerobic conditions, i.e., in total absence of oxygen. It is a process similar to composting, which, however, occurs aerobically, in the presence of oxygen. The biogas production cycle represents an integrated system of renewable energy production,

resource utilization, organic waste treatment, and nutrient recycling and redistribution. It inherently generates agricultural and environmental benefits, as listed below:

- Production of renewable energy.
- Inexpensive and environmentally friendly waste recycling.
- Reduced greenhouse gas emissions.
- Pathogen reduction through sanitation services.

From a microbiological perspective, the anaerobic degradation of organic matter into methane and certain by-products is a complex, multistage process of metabolic interactions performed by well-organized microbial communities. Consequently, various microorganisms coexist in anaerobic digesters. Even when a single type of substrate is used, their concentrated activity is necessary for the proper conversion of matter. The anaerobic digestion process causes a series of transformations in the organic material, resulting in processed material and a

variety of gases, namely, the digestate and biogas, respectively.

The anaerobic digestion is a complex process which includes four phases, each playing a significant role to make this process sustainable and effective.

- 1. Hydrolytic Phase:** This is the initial phase of the process, marked by the action of water on organic matter through hydration. During this phase, complex organic compounds are broken down into simpler molecules, making them more accessible for subsequent microbial activities.
- 2. Acidogenesis and Acetogenesis Phases:** These phases involve the activities of specific bacteria to further break down organic materials. Acidogenesis focuses on the conversion of complex organic molecules into simpler acids. The acetogenesis phase builds on this by producing acetate and other compounds.
- 3. Methanogenesis Phase:** This is a pivotal stage in anaerobic digestion. Specific bacteria drive the conversion of organic acids and compounds from the previous phases



into methane gas ( $\text{CH}_4$ ). Simultaneously, there's a gravimetric separation process, dividing the components into a lighter, mainly oleic phase and a heavier, predominantly protein phase.

- 4. Gravimetric Separation of NPK Salts:** Although not explicitly named as a phase, this step is a vital part of the overall process. It involves the separation of NPK salts, including nitrogen, phosphorus, and potassium salts, of varying concentrations using a gravimetric method. Different titres of these salts are efficiently collected.

These four phases collectively contribute to the efficient decomposition of organic matrices while extracting valuable resources like methane, NPK salts, and clarified water. The MBGC digester's ability to manage these phases optimally makes it a beacon of hope in the context of sustainable agriculture and addressing hunger, in line with SDG 2.1.

Several case studies have been done where anaerobic digestion was used to provide an underserved community

with resources that increases their agricultural yield and helped them to break out of the vicious cycle of the poverty and hunger.

In several rural areas of India, small-scale biogas digesters have been deployed to process cattle manure and crop residues. The biogas produced is used for cooking and lighting in households that lacked access to clean energy sources. The nutrient-rich slurry left after digestion is used to fertilize crop fields. This not only enhances cooking conditions and reduces indoor air pollution but also increases agricultural productivity, leading to improved food security for these communities.

In the informal settlement of Kibera, a community-based organization established a biogas plant to process organic waste from households. The biogas generated is used for cooking in homes, and the nutrient-rich digestate serves as organic fertilizer for community gardens. This sustainable approach has improved food production within the urban

setting, helping residents access fresh produce and contributing to food security.

Various rural communities in Senegal have adopted small-scale biogas systems to manage organic waste from agriculture and livestock. Biogas is utilized for cooking and lighting in households, reducing the reliance on firewood and increasing energy access. Additionally, the nutrient-rich effluent from the biogas digesters is used as organic fertilizer, improving soil fertility and crop production. This sustainable model enhances food security in these communities.

These case studies demonstrate that anaerobic digestion, particularly in underserved areas, plays a critical role in promoting sustainable agriculture, improving food security, and advancing SDG 2.1. By converting organic waste into clean energy and nutrient-rich fertilizers, these communities achieve greater self-sufficiency, reduced environmental impact, and increased agricultural

productivity, ultimately addressing hunger and malnutrition challenges.

The Digester consists of an insulated, box shaped container divided into three distinct large volumes inside its lower part. These volumes determine the path of the liquid phase. Two partitions are used to organize the three large volumes; these two partitions have a height equal to two-third of the total height. A vertical gap of only a few tens of centimeters wide is left between these two partitions as one extends almost the entire length of the structure and the second partition covers the entire length of the box, the gap allows the sludge to pass through it; a natural passage for the sludge from the first two volumes. To connect the second and third volumes, a perforated pipe of appropriate diameter is used, with the end closed, such that the sum of the areas of the various holes equals the section's area. The third volume is further divided into three parts by two new partitions perpendicular to the previous ones, covering the entire width of the third volume. These partitions are spaced at an appropriate

distance, allowing different types of salts to deposit in three different stages. These salts will then be pumped away from the corners, where salt accumulation is expected to be higher.

In several parts of the structure, during the recycling phase at the end of the second volume and throughout the duration of the third volume, gravitational separation of the fluid is employed. At the end of the second volume, it is used to separate the oleic and proteinaceous parts from the one ideal for continuing the cycle, allowing for their recycling. In the third volume, through two partitions, gravitational separation is used to divide the fluid into three different types of NPK salts.

The MBGC (Mini Biogas Continuous) system consists of a relatively small number of components: a purpose-built prefabricated structure divided into three volumes, a series of honeycombs to be placed in appropriate areas, a limited number of pumps, and a limited number of pipelines. Furthermore, the compact dimensions of the enclosure,

approximately 10 meters in length and two meters in width, make the transportation of the structure relatively straightforward. Additionally, the use of vibrated concrete as the primary building material keeps the costs of the structure reasonable.

The Microbial Biogas Complex (MBGC) offers several advantages for achieving Sustainable Development Goal (SDG) 2.1, which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. Here are the key advantages of MBGC in the context of SDG 2.1:

- 1. Enhanced Food Security:** MBGC contributes to food security by providing a sustainable source of energy for cooking, which is particularly valuable in areas with limited access to electricity or clean cooking fuels. This reduces the time and effort required for cooking, allowing households to allocate more resources to food production and nutrition.

- 2. Nutrient Recovery:** The digester's gravimetric separation process enables the recovery of NPK salts (nitrogen, phosphorus, and potassium salts) from organic waste. These nutrient-rich salts can be used as fertilizers in agriculture, improving soil fertility and crop yields. This, in turn, enhances food production and the availability of nutritious food.
- 3. Waste Recycling:** MBGC effectively recycles organic waste into valuable resources. By converting organic matter into methane (biogas) and nutrient-rich salts while minimizing waste, it reduces the environmental impact of waste disposal and contributes to a more sustainable and circular approach to waste management.
- 4. Clean Energy Production:** The methane (biogas) produced in the MBGC digester can serve as a clean and renewable energy source. This has multiple benefits, including reducing greenhouse gas emissions and improving air quality by substituting traditional, polluting cooking fuels with biogas.

- 5. Rural Development:** MBGC is well-suited for rural areas, where many people depend on agriculture for their livelihoods. By providing a renewable source of energy and nutrient-rich fertilizers, it supports rural development, increases agricultural productivity, and reduces the vulnerability of rural communities to food insecurity.
- 6. Climate Mitigation:** By capturing methane, a potent greenhouse gas, and converting it into biogas, MBGC helps mitigate climate change. This aligns with SDG 13 (Climate Action) and contributes to global efforts to reduce greenhouse gas emissions.
- 7. Biodiversity and Ecosystem Benefits:** Implementing MBGC can reduce the pressure on natural ecosystems as it promotes sustainable agriculture and nutrient recycling. This indirectly contributes to biodiversity conservation and ecosystem health, aligning with SDG 15 (Life on Land).
- 8. Gender Equality:** MBGC can have a positive impact on gender equality, as women often bear the responsibility for



cooking in many households. Access to cleaner cooking fuel reduces the health risks and time burdens associated with traditional cooking methods, which disproportionately affect women and children.

**9. Community Engagement:** The implementation of MBGC often involves local communities in its operation and maintenance. This fosters community engagement, empowerment, and ownership of the technology, contributing to the sustainability of the project.

**10. Adaptability:** MBGC can be tailored to local conditions, making it adaptable to various regions and contexts. Its scalability allows for the expansion of biogas systems to meet the specific energy and agricultural needs of communities.

The Digester offers a multifaceted approach to addressing the objectives of SDG 2.1. By improving food security, recycling waste, and producing clean energy and nutrient-rich fertilizers, MBGC plays a crucial role in promoting

sustainable agriculture, enhancing nutrition, and ultimately contributing to the goal of ending hunger.

### **Advantages of the MBGC:**

1. Low operating costs and a relatively low daily biomass requirement.
2. The incoming biomass can have a variable wet index (WET) due to initial mixing.
3. Compact size allows for stable and easily controllable biological processes, leading to lower management costs.
4. The compact design and low material requirements make the MBGC adaptable to various settings.
5. Continuous processing eliminates loading pauses found in conventional biogas plants.

6. The MBGC's unique feature lies in its ability to obtain three different types of NPK salts and clarified water through the gravitational separation of the final volume, which can be reused in the cycle or extracted for other purposes.

In a world grappling with complex and interconnected challenges, the pursuit of Sustainable Development Goal 2.1 (SDG 2.1) stands as an urgent and noble endeavor. SDG 2.1, which seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture, serves as a cornerstone for global development and well-being. Within this framework, anaerobic digesters emerge as transformative tools, offering innovative solutions to the multifaceted problem of global hunger.

## **Conclusion:**

Hunger is far from a simple challenge. It is entangled with issues of poverty, inequality, climate change, and unsustainable agricultural practices. Achieving SDG 2.1 requires a comprehensive approach that tackles the intricate web of factors driving hunger. Anaerobic digesters prove to be an invaluable ally in this endeavor, addressing multiple facets of the hunger issue.

The Digester holds the potential to break the poverty-hunger cycle. By promoting sustainable agriculture and transforming organic waste into valuable resources like biogas and nutrient-rich digestate, these systems empower communities with income-generating opportunities. This economic empowerment, in turn, contributes to food security and a pathway out of poverty. Climate change

presents a significant threat to global food security. Anaerobic digesters emphasize sustainability and reduced greenhouse gas emissions, aligning with the goal of climate-resilient agriculture. By mitigating climate change and fortifying the resilience of food systems, digesters become vital instruments for ensuring the world's food supply.

By optimizing the utilization of resources by converting organic waste into biogas, a clean and renewable energy source. This not only mitigates the environmental impact of waste disposal but also contributes to sustainable energy access, a crucial element of food security. The digestate produced as a byproduct of anaerobic digestion enriches soil with essential nutrients, supporting higher crop yields and diminishing the need for chemical fertilizers. By endorsing sustainable agriculture practices that improve soil health, anaerobic digesters ensure long-term food security.

Reduction of food waste and improve nutrient cycling. By encouraging responsible consumption patterns and diverting organic waste from landfills, anaerobic digesters ensure that more food reaches those who need it most, addressing malnutrition and food quality issues. A fundamental aspect of SDG 2.1 is its recognition of access to sufficient, safe, and nutritious food as a basic human right. Anaerobic digesters align harmoniously with this commitment, as they actively contribute to the fulfillment of this global goal. Digester is instrumental in realizing the right to food by diverting organic waste from landfills, where it would otherwise go to waste. Instead, this waste is transformed into valuable assets like biogas and nutrient-rich digestate, which benefit local communities and the environment alike. Hunger disproportionately affects vulnerable populations, including women and children. Digester serve to level the playing field by advancing sustainable agriculture and ensuring food security reaches those who need it most. By increasing the productivity of small-scale farmers and empowering

marginalized communities, digesters promote social equity.

In the context of SDG 2.1, the Digester emerges as beacons of hope for several compelling reasons. It embodies principles of sustainability and resilience. They reduce greenhouse gas emissions, advocate sustainable agricultural practices, and contribute to a circular economy. These aspects are pivotal for addressing the fundamental causes of hunger, including climate change and resource scarcity. It maximizes the use of organic waste by converting it into valuable resources such as biogas and nutrient-rich fertilizers. By harnessing the power of waste-to-resource conversion, these systems combat hunger while minimizing waste and environmental degradation. Digester exhibits adaptability and versatility. They can be implemented across diverse settings, from rural farming communities to urban food waste facilities. This versatility positions them to address hunger and food security issues on a global scale. Digester can empower communities by creating local, renewable energy sources

and income-generating opportunities. As they reduce energy costs, promote economic growth, and enhance soil fertility, digesters strengthen communities and enhance their capacity to combat hunger. It represents an innovative intersection of technology, biology, and sustainability. They leverage cutting-edge solutions to address age-old challenges, underscoring the potential of technology to advance global goals.

The journey toward achieving SDG 2.1 is a shared global mission. The Digester, by addressing food security, sustainability, resilience, and social equity, play a pivotal role in transforming this vision into a tangible reality. This device offers a practical and scalable solution for ending hunger, breaking the cycle of poverty, and ushering in a sustainable future for all. As the world faces the dual challenges of increasing food demand and a changing climate, the Digester represent a spark of hope, illuminating the path toward a more equitable, just, and food-secure world where no one goes to bed hungry. The synergy between SDG 2.1 and the Digester is a testament



to the power of innovation, technology, and global collaboration in confronting humanity's most pressing challenges. It is an alliance that holds the promise of a brighter future for generations to come.





**J W T**

[joules water team](https://www.jwt-jwt.it/joules_water_team)  
<https://www.jwt-jwt.it/>

**Subject to the NDA, consultancy and appropriate industrial property rights are available;**

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**JWTeam**

[http://www.expotv1.com/ESCP\\_NUT\\_Team.pdf](http://www.expotv1.com/ESCP_NUT_Team.pdf)

*Offers extensive support on **Energy** and **Water Cycle**,  
verse [IP S DGs /UN](#)*

## **Bibliography/Conclusion**

Any reference to people and things is purely coincidental, as well as creative/imaginative and aimed at the common good (both in fiction and non-fiction/disclosable texts).

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### **Digester from MBGC (source) :**

Patent:

[MBGC](#) , <https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2016092582> (organic waste to biogas, for urban and periurban); [view1](#), [MBGC Plan](#), [Hello](#);

Italy: GRANT

[http://www.expotv1.com/LIC/MISE\\_0001427413\\_MBGC.pdf](http://www.expotv1.com/LIC/MISE_0001427413_MBGC.pdf), ...mean "INDUSTRY (useful), NEW (no make before), INVENTIVE (teach some things)"

**Abstract/Description - Patent:**

**MBGC** , <https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2016092582>

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## Summary – Applications (to SDGs)

**MBGC**

<https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2016092582>

**Biogas** - generate **high purity raw materials from organic matrices**. **MBGC** is dedicated to the disposal and reconversion of organic waste , both from excrement (human and animal) and from manufacturing processes (agri-food industry), as well as in many agro-zootechnical activities. Very compact system that uses only renewable energy, with high energy recovery indices and production of high quality by-products (CH<sub>4</sub>, CO<sub>2</sub>, NPK<sub>x</sub> , H<sub>2</sub>O). Excellent solution for urban areas for contrast to the disposal of wastewater and containment of interventions on its infrastructures ( sewerage transport networks and purifiers ), acting in a distributive /pervasive manner where the problem arises. It offers significant contrast to the load Organic contributing to the performance on " **Water cycle** ".

**Project:** MBGC – Mini Bio Gas Continuous

**Objective :** Launch a pre- assembly and testing site (procedures and manuals) for the production of MBGC tanks

**Target:** Prefabricated (CLS) companies, hydromechanics , financial investors, operators in the BioGas / BioMethane sector

The project aims to activate a production site, from design to assembly (pro delivery and rapid assembly), with the development of production-oriented procedures agreed with the client (based on the products available for supply) and destinations of the outputs produced. The solutions rely on standard products from the water management and prefabricated market, assembled and tested with a view to optimize linear anaerobic digestion, with selective and corrective extraction. In collaboration with internal and external laboratories, it will act as remote support for the installations in charge (EPC - Engineering , Procurement and Construction ).

**Summary:** This is a method for anaerobic digestion and a device for its implementation. Anaerobic digestion is a biological process that breaks down organic matter in the absence of oxygen, producing biogas, fertilizer and water. Biogas is a mixture of methane, carbon dioxide and other gases that can be used as a renewable energy source. The fertilizer is composed of nitrogen, phosphorus and



potassium salts ( NPKx salts ) which can be used to enrich the soil or supplement supplies from specific industries. Water is the liquid fraction that can be reused or discharged after treatment.

A device to implement this method consists of a tank divided into different areas, where different phases of anaerobic digestion take place. The tank is equipped with bulkheads, pipes, pumps, heating means and gas separation means. The organic matter enters the tank through a vertical inlet pipe ( in homogeneous diffusion mode) and undergoes the following phases:

- 1) Hydrolysis: organic matter is divided into smaller molecules by means of water and enzymes;
- 2) Acidogenesis : the hydrolyzed products are transformed into volatile fatty acids and other compounds by acidogenic bacteria .;
- 3) Acetogenesis : volatile fatty acids and other compounds are further transformed into acetic acid, hydrogen and carbon dioxide by acetogenic bacteria;
- 4) Methanogenesis : acetic acid, hydrogen and carbon dioxide are transformed into methane and carbon dioxide by methane genic bacteria;

The liquid mixture flows through the tank from one area to another, following a path defined by the bulkheads and pipes. Along the way, some pumps recycle some of the liquid mixture to optimize the process. In the last zone, the liquid mixture separates into different components by gravity:

a) Oleic phase: the lighter fraction which mainly contains fats and oils , is drained and brought back to the beginning;

b) Protein phase: the heavier fraction which mainly contains proteins and amino acids, not yet treated, is taken and brought to the beginning;

c) NPK salts: the solid fraction that precipitates at different levels according to their solubility and specific weight;

d) Clarified water: the clear fraction that remains after the separation of the other components is expelled by gravity and thermally pre-treated in the last part of the tank at half level;

The gases produced during the process (methane and carbon dioxide) rise towards the top of the tank, where

they separate by density and start non-specific functions. Carbon dioxide, being heavier, remains in the lower part of the space above the liquid surface, while methane, being lighter, moves towards the upper part of the space. Gases are extracted through pipes with holes that are connected to gas storage or utilization systems. The device also includes a lighting and cooling system to prevent the formation of hydrogen sulfide, a toxic gas that can result in anaerobic digestion, damaging it. Lighting stimulates photosynthesis in some bacteria that consume hydrogen sulfide in the absence of oxygen. Cooling condenses water vapor in the gas phase and returns it to the liquid phase .

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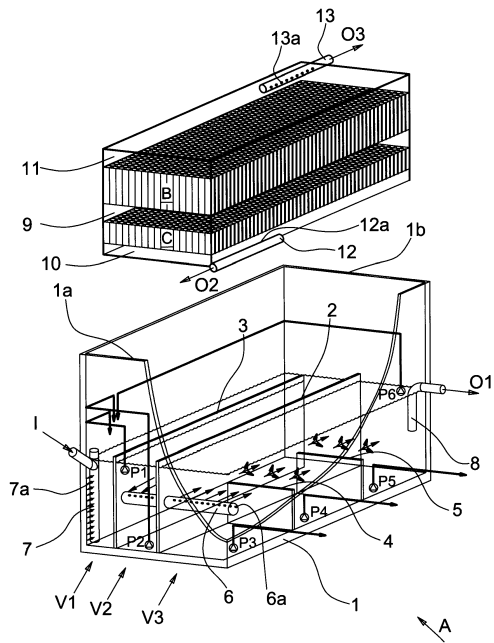


Fig. 1

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(54) Title (EN): METHOD FOR ANAEROBIC DIGESTION AND DEVICE FOR IMPLEMENTING SAID METHOD

(54) Title (FR): PROCÉDÉ DE DIGESTION ANAÉROBIE ET DISPOSITIF POUR LA MISE EN ŒUVRE DUDIT PROCÉDÉ

(57) Abstract:

(EN): This invention relates to a method and to a device for the implementation of said method, to decompose and to selectively extract methane, carbon dioxide, NPK salts (nitrogen, phosphorus and potassium salts) of various titre and clarified water, from an organic matrix; said components will be the raw material for further industrial processes. The method is characterized in that it includes the following phases: • implementation of a hydrolytic phase, constituted by the fission action by means of the water, by hydration; • implementation of an acidogenesis phase generated by means of specific bacteria; •

implementation of a acetogenesis phase generated by means of specific bacteria; • implementation of a methanogenesis phase by means of specific bacteria, with a simultaneous gravimetric separation of a mainly oleic phase, lighter and of a predominantly protein phase, heavier; • gravimetric separation of solutions of said NPK salts of different titres • taking of clarified water. The device is characterized in that it comprises a basin (1) divided into various zones (V1), (V2), (V3), in each of which biological reactions occur, in accordance with the claimed method, said zones being all communicating and identified by suitable separation baffles, in particular: • a first baffle (2) extended from a first end (1a) of the basin to a second end (1b) of said basin (1), dividing it into two parts; • a second baffle (3), of height equal to said first baffle that divides one of said parts in a first zone (V1) and in a second zone (V2) extending from said first end (1a) of the basin (1) until it reaches the vicinity of said second end of the basin (1), so that said two zones (V1) and (V2) are communicating through an opening, of substantially vertical development, between the end of said second baffle (3) and the second end (1b) of the basin (1); • a plurality of baffles (4) and (5) transversely arranged to said first baffle (2) and inside a third zone (V3), delimited by said first baffle (2), said third zone (V3) being placed in communication with said second zone (V2) through a



transfer pipe (6), positioned at about half height of said first baffle (2); • two blocks (B) and (C), placed in the upper part of said basin (1) and provided by taking means (12, 12a, 13, 13a), each of said blocks (B) and (C) including a plurality of vertical pipes and being fitted to carry out a gravimetric separation of the gases that are generated during the treatment of said mixture; said baffles (2) and (3) and said transfer pipe (6), by identifying a path crossed by the liquid mixture to be treated, that runs into the beginning of said first zone (1) where it is placed an inlet pipe (7) of the liquid mixture to be treated and comes out from various points of said third zone (V3).

(FR): La présente invention concerne un procédé et un dispositif pour la mise en œuvre dudit procédé, pour décomposer et extraire sélectivement du méthane, du dioxyde de carbone, des sels de NPK (sels d'azote, de phosphore et de potassium) de titres divers et de l'eau clarifiée, à partir d'une matrice organique; lesdits composants constituant la matière première pour d'autres procédés industriels. Le procédé est caractérisé en ce qu'il comprend les phases suivantes : mise en œuvre d'une phase hydrolytique, constituée par l'action de fission au moyen de l'eau, par hydratation; mise en œuvre d'une phase d'acidogénèse au moyen de bactéries spécifiques; mise en œuvre d'une phase d'acétogénèse au moyen de

bactéries spécifiques; mise en œuvre d'une phase de méthanogénèse, au moyen de bactéries spécifiques, avec séparation gravimétrique simultanée d'une phase principalement oléique, plus légère, et d'une phase principalement protéique, plus lourde; séparation gravimétrique de solutions desdits sels de NPK de titres différents; prélèvement de l'eau clarifiée. Le dispositif se caractérise en ce qu'il comprend un bassin (1) divisé en différentes zones (V1) (V2), (V3), dans chacune desquelles ont lieu des réactions biologiques, conformément au procédé de l'invention, lesdites zones étant toutes communicantes et identifiées par des chicanes de séparation appropriées, en particulier : une première chicane (2) s'étendant d'une première extrémité (1a) du bassin jusqu'à une deuxième extrémité (1b) dudit bassin (1), le divisant en deux parties; une deuxième chicane (3), de hauteur égale à celles de ladite première chicane qui divise l'une desdites parties en une première zone (V1) et en une deuxième zone (V2) s'étendant entre ladite première extrémité (1a) du bassin (1) et le voisinage de ladite seconde extrémité du bassin (1), de sorte que lesdites deux zones (V1) et (V2) communiquent par une ouverture, de développement sensiblement vertical, entre l'extrémité de ladite deuxième chicane (3) et la seconde extrémité (1b) du bassin (1); une pluralité de chicanes (4) et (5) placées transversalement par rapport à ladite

première chicane (2) et à l'intérieur d'une troisième zone (V3), délimitée par ladite première chicane (2), ladite troisième zone (V3) étant mise en communication avec ladite deuxième zone (V2) par un tuyau de transfert (6), placé à environ la moitié de la hauteur de ladite première chicane (2); deux blocs (B) et (C), placés dans la partie supérieure dudit bassin (1) et munis de moyens de prélèvement (12, 12a, 13, 13a), chacun desdits blocs (B) et (C) comprenant une pluralité de tuyaux verticaux et étant conçu pour effectuer une séparation gravimétrique des gaz qui se dégagent pendant le traitement dudit mélange; lesdites chicanes (2) et (3) et ledit tuyau de transfert (6) délimitant un trajet emprunté par le mélange liquide à traiter, qui s'étend du début de ladite première zone (1) dans laquelle est placé un tuyau d'entrée (7) du mélange liquide à traiter et sort par différents points de ladite troisième zone (V3).

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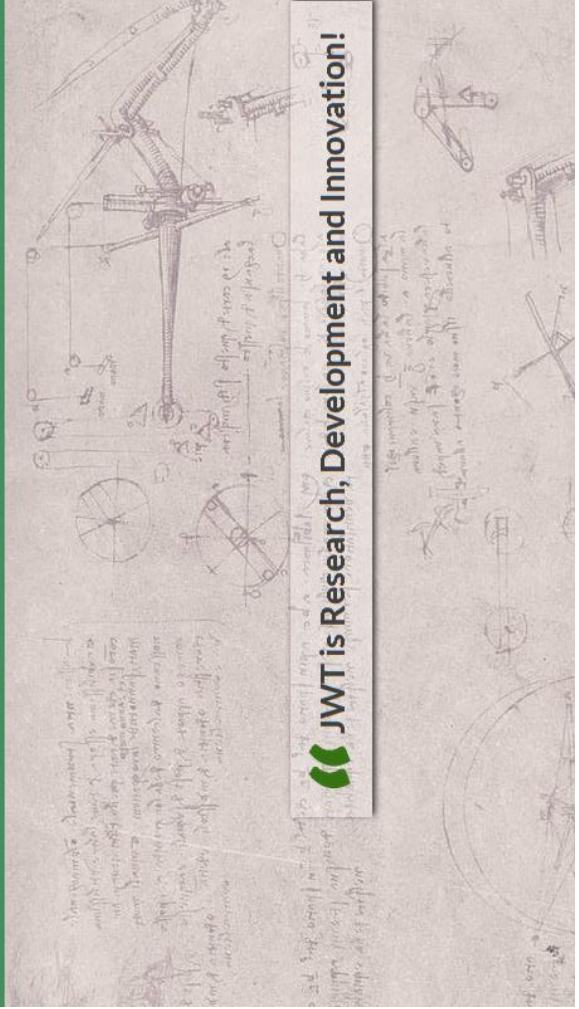
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Declaration made as applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51bis.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate

Declaration of inventorship (Rules 4.17(iv) and 51bis.1(a)(iv)) for the purposes of the designation of the United States of America



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