

# Concept Note

Project/Programme Title: Waste to Energy Promotion in Campuses and Small Cities

Country(ies): Thailand

National Designated Authority(ies) (NDA): Ministry of Natural Resources and Environment

Accredited Entity(ies) (AE): \_\_\_\_\_ - \_\_\_\_\_

Date of first submission/  
version number: [2024-06-28] [V.1]

Date of current submission/  
version number: [2024-06-28] [V.1]



**GREEN  
CLIMATE  
FUND**

## Notes

- The maximum number of pages should **not exceed 12 pages**, excluding annexes. Proposals exceeding the prescribed length will not be assessed within the indicative service standard time of 30 days.
- As per the Information Disclosure Policy, the concept note, and additional documents provided to the Secretariat can be disclosed unless marked by the Accredited Entity(ies) (or NDAs) as confidential.
- The relevant National Designated Authority(ies) will be informed by the Secretariat of the concept note upon receipt.
- NDA can also submit the concept note directly with or without an identified accredited entity at this stage. In this case, they can leave blank the section related to the accredited entity. The Secretariat will inform the accredited entity(ies) nominated by the NDA, if any.
- Accredited Entities and/or NDAs are encouraged to submit a Concept Note before making a request for project preparation support from the Project Preparation Facility (PPF).
- Further information on GCF concept note preparation can be found on GCF website [Funding Projects Fine Print](#).

<b>A. Project/Programme Summary (max. 1 page)</b>			
<b>A.1. Project or programme</b>	<input checked="" type="checkbox"/> Project <input type="checkbox"/> Programme	<b>A.2. Public or private sector</b>	<input checked="" type="checkbox"/> Public sector <input type="checkbox"/> Private sector
<b>A.3. Is the CN submitted in response to an RFP?</b>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, specify the RFP: _____	<b>A.4. Confidentiality<sup>1</sup></b>	<input checked="" type="checkbox"/> Confidential <input type="checkbox"/> Not confidential
<b>A.5. Indicate the result areas for the project/programme</b>	<p><u>Mitigation</u>: Reduced emissions from:</p> <input checked="" type="checkbox"/> Energy access and power generation <input type="checkbox"/> Low emission transport <input type="checkbox"/> Buildings, cities and industries and appliances <input type="checkbox"/> Forestry and land use <p><u>Adaptation</u>: Increased resilience of:</p> <input type="checkbox"/> Most vulnerable people and communities <input type="checkbox"/> Health and well-being, and food and water security <input type="checkbox"/> Infrastructure and built environment <input type="checkbox"/> Ecosystem and ecosystem services		
<b>A.6. Estimated mitigation impact (tCO<sub>2</sub>eq over lifespan)</b>	4.87 – 9.75 Million tCO <sub>2</sub> eq	<b>A.7. Estimated adaptation impact (number of direct beneficiaries and % of population)</b>	
<b>A.8. Indicative total project cost (GCF + co-finance)</b>	Amount: USD 28,500,000	<b>A.9. Indicative GCF funding requested</b>	Amount: USD 28,500,000
<b>A.10. Mark the type of financial instrument requested for the GCF funding</b>	<input checked="" type="checkbox"/> Grant <input type="checkbox"/> Reimbursable grant <input type="checkbox"/> Guarantees <input type="checkbox"/> Equity <input type="checkbox"/> Subordinated loan <input type="checkbox"/> Senior Loan <input type="checkbox"/> Other: specify _____		
<b>A.11. Estimated duration of project/ programme:</b>	4 years	<b>A.12. Estimated project/ Programme lifespan</b>	20 years
<b>A.13. Is funding from the Project Preparation Facility requested?<sup>2</sup></b>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Other support received <input type="checkbox"/> If so, by who: _____	<b>A.14. ESS category<sup>3</sup></b>	<input type="checkbox"/> A or I-1 <input type="checkbox"/> B or I-2 <input checked="" type="checkbox"/> C or I-3
<b>A.15. Is the CN aligned with your accreditation standard?</b>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	<b>A.16. Has the CN been shared with the NDA?</b>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
<b>A.17. AMA signed (if submitted by AE)</b>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If no, specify the status of AMA negotiations and expected date of signing: _____	<b>A.18. Is the CN included in the Entity Work Programme?</b>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<b>A.19. Project/Programme rationale, objectives and approach of programme/project (max 100 words)</b>	<p>Brief summary of the problem statement and climate rationale, objective and selected implementation approach, including the executing entity(ies) and other implementing partners.</p> <p>Organic waste comprises 64% of Thailand's total waste, with a significant portion left unutilized, resulting in greenhouse gas emissions from landfills. To align with Thailand's Bio-Circular-Green policy and mitigate emissions, this project aims to construct 10 biogas systems, each capable of processing 30 tons/day of organic waste. These systems will</p>		

<sup>1</sup> Concept notes (or sections of) not marked as confidential may be published in accordance with the Information Disclosure Policy ([Decision B.12/35](#)) and the Review of the Initial Proposal Approval Process ([Decision B.17/18](#)).

<sup>2</sup> See [here](#) for access to project preparation support request template and guidelines

<sup>3</sup> Refer to the Fund's environmental and social safeguards ([Decision B.07/02](#))

	<p>be implemented in universities and small cities, providing a suitable solution for waste management.</p> <p>The biogas produced will be utilized to generate electricity and can be further upgraded to hydrogen for local transportation needs. This initiative will involve the construction of organic waste management facilities on large-scale university campuses or in small cities with populations ranging from 30,000 to 50,000 residents.</p> <p>Key executing entities include universities, local waste management authorities and renewable energy companies, with support from government agencies.</p>
--	--

## B. Project/Programme Information (max. 8 pages)

### B.1. Context and baseline (max. 2 pages)

*Describe the climate vulnerabilities and impacts, GHG emissions profile, and mitigation and adaptation needs that the prospective intervention is envisaged to address.*

*Please indicate how the project fits in with the country's national priorities and its full ownership of the concept. Is the project/programme directly contributing to the country's INDC/NDC or national climate strategies or other plans such as NAMAs, NAPs or equivalent? If so, please describe which priorities identified in these documents the proposed project is aiming to address and/or improve.*

Thailand is highly vulnerable to the impacts of climate change, facing increased risks such as increased flooding, droughts, sea level rise, and extreme weather events. Key sectors at risk include agriculture, water resources, tourism, public health, and human settlements. Thailand's first National Adaptation Plan (NAP) aims to build resilience in these priority sectors.

In 2019, Thailand emitted 372.72 MtCO<sub>2</sub>eq of greenhouse gases (GHG, excluding LULUCF). The energy and transport sectors are the main contributors to these emissions. Thailand's updated Nationally Determined Contribution (NDC) under the Paris Agreement commits to reducing GHG emissions by 30% from the projected business-as-usual (BAU) level by 2030, with a conditional target of 40% reduction contingent upon international support.

The proposed biogas project, which will process organic waste into biogas and hydrogen, directly contributes to Thailand's NDC mitigation targets. Organic waste is a significant source of methane, a potent GHG. By capturing and utilizing methane from organic waste, the project will help reduce Thailand's emissions. An exemplary model is the integrated waste management center at Chiang Mai University (CMU). As part of its commitment to sustainable waste management and zero waste goals, CMU has implemented a comprehensive system that addresses waste from source to end-product. This includes a six-category waste separation system and a mechanical sorting system. Organic waste is fermented to produce 900 cubic meters of biogas per day, generating 5,200 kWh of electricity annually, and producing 18,000 kg of compressed biomethane gas (CBG) per year to fuel the university's transportation shuttles. This system has significantly reduced waste, converting various waste fractions into useful products such as refuse-derived fuel (RDF), asphalt, bricks, and biochar. CMU also collaborates with nearby municipalities to process organic waste from restaurants and hotels, demonstrating effective collaboration.

The biogas project aligns with and directly contributes to Thailand's key national climate and development strategies. The Climate Change Master Plan 2015-2050 aims to facilitate GHG reductions and promote low-carbon development, and the biogas project supports these goals. Under the NDC Roadmap on Mitigation 2021-2030, biogas is one of the renewable energy options, highlighting its importance in the country's mitigation efforts. The Draft National Energy Plan 2024 aims to increase the share of renewable energy to over 50% by 2037 in the PDP 2018 ver.1. The biogas project contributes to this renewable energy goal, with a requirement of 936 MW of new biogas power. The plan also includes hydrogen as a future energy source, further aligning with the project's objectives. Additionally, the project advances Thailand's Bio-Circular-Green (BCG) Economic Model, which promotes a balanced, sustainable, and inclusive economy aligned with the UN Sustainable Development Goals (SDGs).

The project also supports the Net Zero Campus initiative launched in March 2024 by NXPO, TSRI, CUPT, and DCCE. This initiative aims to accelerate carbon reduction in higher education, involving 170 universities nationwide. By partnering with universities, the biogas project can contribute significantly to the Net Zero Campus initiative.

*Describe the main root causes and barriers (social, gender, fiscal, regulatory, technological, financial, ecological, institutional, etc.) that need to be addressed.*

To successfully scale up biogas as a climate solution in Thailand, the project addresses several key barriers. The proposed biogas project is designed to help overcome the following critical technological, financial, institutional, and social barriers. Technologically, there is limited access to advanced biogas technology and local capacity. The project aims to increase access to biogas systems and build technical capacity for their operation and maintenance, demonstrating biogas upgrading to hydrogen for the transportation sector. Financially, high upfront investment costs and perceived risks can under financing. By implementing 10 financially viable systems, the project will demonstrate a replicable business model, attracting additional public and private investment for scale-up.

Institutional capacity and experience with biogas within local governments and universities are limited. The project will build institutional capacity to deploy and operate biogas systems, enabling partners to become long-term biogas champions. Hands-on experience through the project will foster this capacity, and collaboration with the Net Zero Campus project will further strengthen institutional alignment with national priorities. Socially, there is a lack of public awareness about organic waste recycling and the benefits of biogas and hydrogen. The project's university and municipal partnerships provide a platform to raise public awareness, increase knowledge, and generate public support for organic waste-to-biogas initiatives. Integration with the Net Zero Campus project can amplify public outreach and engagement efforts.

In conclusion, the proposed biogas project is well-positioned to address Thailand's climate vulnerabilities, contribute to its NDC targets and national climate strategies, and help overcome key barriers to scaling up this promising solution. By demonstrating a replicable and locally-owned model for converting organic waste to biogas and hydrogen, the project can catalyze wider adoption of this approach across Thailand. Alignment with the Net Zero Campus project further strengthens the project's institutional partnerships and public engagement potential. Successful implementation will yield climate mitigation, energy security, and sustainable development co-benefits for the country.

## B.2. Project/Programme description (max. 3 pages)

*Describe the expected set of components/outputs and subcomponents/activities to address the above barriers identified that will lead to the expected outcomes.*

The proposed project aims to address the key barriers to scaling up organic waste-to-biogas systems in Thailand through the following main components and activities:

### **Component 1: Demonstration of Viable Organic waste-to-Biogas Model**

The project will improve the process of Chiang Mai University's (CMU) integrated waste management center by enhancing existing waste separation, mechanical sorting, biogas production, and resource recovery processes. A small-scale Steam Methane Reforming (SMR) system will be installed to convert biogas from organic waste into hydrogen (H<sub>2</sub>) for use as a clean vehicle fuel. This component will demonstrate the potential for a circular economy approach to waste management, developing a standard design based on the CMU model to facilitate replication in other universities and municipalities across Thailand. The project aims to contribute to national goals of reducing greenhouse gas emissions, promoting renewable energy, and transitioning towards a Bio-Circular-Green (BCG) economy. CMU will serve as a living laboratory for research, innovation, and education in sustainable waste management, engaging students, faculty, and the wider community in the transition towards a zero-waste society.

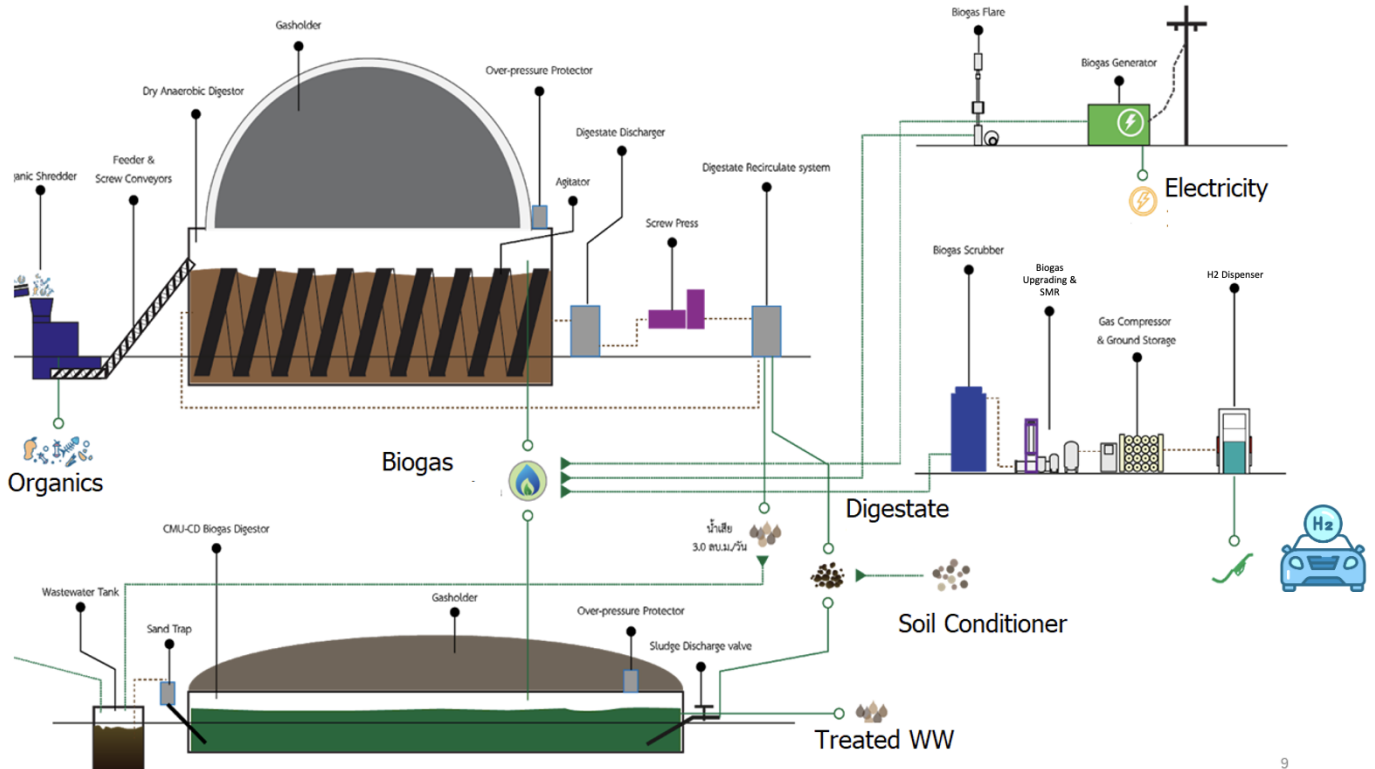
The concept of waste to energy in campuses and small cities in Thailand is presented in Fig.1.

### **Component 2: Expansion of the System to make 10 Systems in Different Regions**

This component involves the construction of 10 biogas systems, each processing 30 tons/day of organic waste, at strategic locations such as universities and municipalities. The systems will incorporate advanced pre-treatment, digestion, biogas upgrading, and digestate utilization technologies. The development of viable business models for each system will demonstrate waste disposal cost savings, energy sales, and co-product revenues, ensuring financial sustainability and encouraging broader adoption of the technology.

### **Component 3: Enabling Sustainable Management**

To ensure sustainable management, the project will provide technical training for local government and university partners on biogas system operation and maintenance. Public awareness campaigns on organic waste separation, recycling, and the benefits of biogas will be conducted. The project will establish multi-stakeholder networks to share knowledge and scale up organic waste-to-biogas initiatives. Collaboration with the government will aim to strengthen policies and targets for organic waste separation, collection, and recycling. Additionally, the development of technical standards and certification schemes for biogas and digestate quality, along with results-based financing mechanisms, will incentivize wider adoption of organic waste-to-biogas systems.



<Figure 1> The Concept of Waste to Energy in Campuses and Small Cities in Thailand

9

*In terms of rationale, please describe the theory of change and provide information on how it serves to shift the development pathway toward a more low-emissions and/or climate resilient direction, in line with the Fund's goals and objectives.*

By demonstrating technically and financially viable organic waste-to-biogas models, building local capacities, and strengthening the enabling environment, the project aims to catalyze a transformational shift towards a circular economy approach to organic waste management and renewable energy production in Thailand. The key assumptions underlying the theory of change include the successful demonstration of viable business models generating market demand and investment in organic waste-to-biogas systems. Local partners will gain the necessary technical, operational, and financial capacities to sustain and replicate biogas projects. Government policies and incentives will effectively drive organic waste separation, collection, and delivery to biogas systems. Awareness campaigns and stakeholder networks will generate public support and participation in organic waste-to-biogas initiatives.

By diverting organic waste from landfills and displacing fossil fuels, the project contributes to Thailand's low-emission development pathway in line with its NDC targets and Long-Term Low GHG Emission Development Strategy. The project also increases climate resilience by turning organic waste into a valuable resource for clean energy and organic fertilizer production.

*Describe how activities in the proposal are consistent with national regulatory and legal framework, if applicable.*

The project is well-aligned with and directly contributes to the implementation of several key national policies and plans in Thailand. The Alternative Energy Development Plan (AEDP) identifies biogas as a priority renewable energy source for achieving the AEDP target of 30% renewable energy in total energy consumption by 2037. The project will help meet the AEDP biogas target of 3,600 MW by 2037. The project supports the Nationally Determined Contribution (NDC) targets of 30-40% reduction in GHG emissions from the projected BAU level by 2030 by reducing methane emissions from diverted organic waste. The National Energy Plan (NEP) 2023 focuses on promoting renewable energy, waste-to-energy, and the BCG economic model for sustainable development, with biogas playing a key role in integrated energy planning. The Net Zero Campus Project, led by NXPO, TSRI, CUPT, and DCCE, aims to accelerate carbon reduction in higher education institutions. By partnering with universities to install biogas systems, the project will contribute to achieving their net zero goals.

*Describe in what way the Accredited Entity(ies) is well placed to undertake the planned activities and what will be the implementation arrangements with the executing entity(ies) and implementing partners.*

The project will work closely with relevant government agencies such as the Department of Alternative Energy Development and Efficiency, Pollution Control Department, and Office of Natural Resources and Environmental Policy and Planning to ensure compliance with all relevant regulations and standards related to waste management, renewable energy, and environmental protection. Other key implementation partners include technology providers for waste pre-treatment, digestion, biogas upgrading, and utilization equipment. Local community organizations for public awareness and waste separation campaigns, while financial institutions for providing co-financing and developing sustainable biogas business models. Research institutions for technology performance monitoring, impact assessment, and knowledge sharing.

*Please provide a brief overview of the key financial and operational risks and any mitigation measures identified at this stage.*

#### Key Financial and Operational Risks and Mitigation Measures

##### **Financial Risks:**

High upfront capital costs of biogas systems lead to difficulty in securing financing. To mitigate this, the project will develop strong business models demonstrating returns from waste disposal savings, energy sales, and co-product revenues. Collaboration with financial institutions will establish dedicated financing mechanisms and credit lines for biogas projects. Uncertainty in long-term revenues from energy sales due to changing tariff regimes will be addressed by working with the government to establish stable, long-term feed-in tariffs or other incentives for biogas energy. Diversifying revenue streams through the sale of biogas, electricity, heat, and co-products like organic fertilizer will also be pursued.

##### **Operational Risks:**

Inadequate quantity or quality of organic waste feedstock may impact biogas yield and system performance. This will be mitigated by partnering with local governments and waste generators to secure long-term organic waste supply contracts, providing training and incentives for proper waste separation at source, and installing waste pre-treatment and storage facilities to ensure consistent feedstock quality. The lack of local technical capacity to operate and maintain biogas systems will be addressed by providing hands-on training and capacity building to local O&M teams. Establish standard operating procedures and regular maintenance schedules. Partner with technology providers for remote monitoring and troubleshooting support.

##### **Social Risks:**

Public opposition to organic waste collection and biogas facilities due to odor, traffic, or other nuisance concerns will be mitigated by conducting extensive stakeholder consultations and incorporating community feedback into project design. Implementing best practices for odor and traffic control and raising awareness about the environmental and social benefits of organic waste-to-biogas projects will also help. Ensuring equitable distribution of project benefits and avoiding potential exclusion of marginalized groups will involve conducting a detailed social impact assessment and developing a benefit-sharing plan. Engaging women's groups, low-income communities and other vulnerable populations in project design and implementation will ensure inclusivity.

##### **Environmental Risks:**

Potential for effluent discharge, air emissions or solid waste from biogas systems causing pollution will be mitigated by designing and operating biogas systems in compliance with all relevant environmental regulations and standards. Implementing best practices for effluent treatment, emission control, and solid waste management, regularly monitoring environmental performance, and reporting to relevant authorities will ensure compliance. Climate risks such as floods or droughts impacting organic waste supply and biogas system operations will be addressed by conducting a climate risk assessment and incorporating adaptation measures into project design. Developing contingency plans for alternative waste supply and biogas system operation during extreme weather events and exploring climate insurance options will further mitigate these risks.

#### **B.3. Expected project results aligned with the GCF investment criteria (max. 3 pages)**

*The GCF is directed to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change, and promoting the paradigm shift towards low-emission and climate-resilient development pathways by limiting or reducing greenhouse gas emissions and adapting to the impacts of climate change.*

*Provide an estimate of the expected impacts aligned with the GCF investment criteria: impact potential, paradigm shift, sustainable development, needs of recipients, country ownership, and efficiency and effectiveness.*

### 1. Impact Potential

The project is expected to reduce 939,727 tCO<sub>2</sub>eq over its 15-year lifetime by diverting organic waste from landfills and displacing fossil fuels, contributing significantly to Thailand's NDC target of a 30-40% reduction in GHG emissions from the projected BAU level by 2030. Additionally, the 10 biogas systems will generate 14.85 million kWh of clean electricity per year, supporting Thailand's AEDP target of 30% renewable energy in total energy consumption by 2037. By converting organic waste into biogas and organic fertilizer, the project enhances climate resilience, reducing the vulnerability of local communities to climate impacts such as floods and droughts that can disrupt waste management and energy systems.

### 2. Paradigm Shift Potential

The project will showcase viable circular economy models for organic waste-to-biogas systems that can be replicated and scaled up across Thailand and the region, promoting a shift from linear to circular approaches in waste and energy management. Through capacity building and knowledge sharing, local technical, operational, and financial capacities for biogas project development and implementation will be strengthened. Lessons learned will be disseminated through stakeholder networks and knowledge platforms to catalyze further adoption of organic waste-to-biogas solutions. The project will also work with the government to strengthen policies, regulations, and incentives for organic waste recycling and biogas production, creating a conducive environment for private sector investment and market development in the biogas sector.

### 3. Sustainable Development Potential

The project is set to create at least 200 permanent green jobs in biogas system operation and maintenance, generating \$5 million per year in revenues for local governments and universities from waste disposal savings, energy sales, and organic fertilizer production. Improved waste management services will benefit 300,000-500,000 people, reducing odors, pests, and public health risks associated with organic waste while providing clean energy access and improved agricultural productivity through organic fertilizer use. Environmentally, the project will not only reduce GHG emissions but also decrease air and water pollution from organic waste decomposition in landfills, promoting sustainable land management and soil health through nutrient-rich digestate application as organic fertilizer.

### 4. Needs of Recipients

Thailand is highly vulnerable to the impacts of climate change, particularly in the agriculture, water, and public health sectors. The project addresses these vulnerabilities by providing clean energy, improving waste management, and enhancing soil resilience. Thailand faces significant challenges in managing its growing organic waste generation, expected to reach 20 million tons per year by 2030. This project demonstrates scalable solutions for diverting organic waste from landfills and creating value from this underutilized resource.

### 5. Country Ownership

The project is fully aligned with Thailand's NDC, AEDP, NEP, and other national policies and plans for climate change mitigation, renewable energy development, and sustainable waste management. It is endorsed by key government agencies such as the Department of Alternative Energy Development and Efficiency, Pollution Control Department, and Office of Natural Resources and Environmental Policy and Planning. Implementation by local government and university partners ensures strong country ownership and capacity building for long-term sustainability.

### 6. Efficiency and Effectiveness

Leveraging \$10 million in co-financing from government, private sector, and other sources, the project demonstrates its ability to catalyze additional investment in organic waste-to-biogas systems. The expected GHG emissions reduction of 935,000 tCO<sub>2</sub>eq over 15 years translates to a cost-effectiveness of \$20/tCO<sub>2</sub>eq, comparing favorably with other waste-to-energy and renewable energy projects. The integrated approach to addressing organic waste, energy, and climate challenges through a single intervention enhances the overall efficiency and effectiveness in achieving multiple sustainable development goals.

By delivering significant impacts across these key GCF investment criteria, the proposed organic waste-to-biogas project in Thailand has the potential to make a substantial contribution to the global efforts towards attaining the goals set by the international community to combat climate change and promote the paradigm shift towards low-emission and climate-resilient development pathways.

### B.4. Engagement among the NDA, AE, and/or other relevant stakeholders in the country (max ½ page)

*Please describe how engagement among the NDA, AE and/or other relevant stakeholders in the country has taken place and what further engagement will be undertaken as the concept is developed into a funding proposal.*

The National Designated Authority (NDA) for this project is the Ministry of Natural Resources and Environment (MNRE) of Thailand. MNRE is actively working with the National Designated Entity (NDE), the Office of National Higher Education Science Research and Innovation Policy Council (NXPO) to encourage national institutions, especially private and financial institutions, to gain direct access to the GCF. Chiang Mai University (CMU), a key partner in the proposed project, has been collaborating with nearby municipalities to bring organic waste from restaurants and hotels to its integrated waste management plant. This demonstrates existing partnerships between academia and local governments.

The project aligns with the Net Zero Campus initiative launched in March 2024 by NXPO, Thailand Science Research and Innovation (TSRI), the Council of University Presidents of Thailand (CUPT), and DCCE. This multi-stakeholder initiative aims to accelerate carbon reduction in higher education institutions, showcasing engagement and coordination among relevant government agencies and universities.

As the concept develops into a funding proposal, further engagement will be conducted through stakeholder consultations and participatory workshops. These will involve local governments, universities, waste generators, technology providers, financial institutions, and community organizations to validate the project design, assess needs and priorities, and build consensus on the proposed interventions. Additionally, a Project Steering Committee or Board will be established with representatives from MNRE, NXPO, DCCE, and other relevant partners to provide strategic guidance and oversight during project development and implementation.

### C. Indicative Financing/Cost Information (max. 3 pages)

#### C.1. Financing by components (max ½ page)

*Please provide an estimate of the total cost per component/output and disaggregate by source of financing.*

Component/Output	Indicative cost (USD)	GCF financing		Co-financing		
		Amount (USD)	Financial Instrument	Amount (USD)	Financial Instrument	Name of Institutions
10 Waste to Energy Systems	28,500,000	28,500,000	Grant			
<b>Indicative total cost (USD)</b>	28,500,000	28,500,000				

*For private sector proposal, provide an overview (diagram) of the proposed financing structure.*

#### C.2. Justification of GCF funding request (max. 1 page)

*Explain why the Project/ Programme requires GCF funding, i.e. explaining why this is not financed by the public and/ or private sector(s) of the country.*

The proposed organic waste-to-biogas project in Thailand requires GCF funding due to several barriers that hinder public and private sector financing for such projects:

**1. High upfront capital costs:** Biogas systems require significant initial investments in waste collection, pre-treatment, digestion, and energy generation equipment. These high capital costs can deter local governments and universities with limited budgets from investing in biogas projects. GCF funding can help overcome this barrier by providing the necessary upfront capital to demonstrate viable biogas models.

**2. Perceived technology and performance risks:** Biogas technology is still relatively new and unproven in Thailand, especially at the scale proposed for this project (30 tons/day of organic waste per system). This leads to perceived risks around the reliability, efficiency, and long-term performance of biogas systems. GCF funding can help mitigate these risks by supporting the demonstration of best-in-class technologies and building local capacities for operation and maintenance.

**3. Limited access to commercial financing:** The lack of a proven track record for large-scale organic waste-to-biogas projects in Thailand means that commercial banks and investors are often unwilling to provide financing due to the perceived risks. Even when financing is available, the terms (e.g. interest rates, collateral requirements) may not be viable for project developers. GCF funding can help bridge this financing gap and crowd in additional public and private investment by demonstrating the bankability of biogas projects.

**4. Inadequate policy and regulatory support:** While Thailand has several policies and targets supporting renewable energy and waste management, there are still gaps in terms of specific incentives and regulations for organic waste-to-biogas projects. For example, there is no dedicated feed-in tariff or tax incentive for biogas electricity, and regulations around organic waste separation and collection are not consistently enforced. This creates uncertainty around the long-term revenues and viability of biogas projects. GCF funding can help address these policy and regulatory barriers by supporting the development of an enabling environment for biogas scale-up.

*Describe alternative funding options for the same activities being proposed in the Concept Note, including an analysis of the barriers for the potential beneficiaries to access to finance and the constraints of public and private sources of funding.*

Alternative funding options for the proposed project activities include:

**1. Government budget allocations:** The Thai government could allocate funds from its national or local budgets to support the development of organic waste-to-biogas projects. However, competing priorities and limited fiscal space mean that government budgets are often insufficient to cover the full costs of such projects.

**2. Private sector investment:** Private companies, such as waste management firms or renewable energy developers, could invest in organic waste-to-biogas projects as a business opportunity. However, the perceived risks and lack of a proven business model mean that private-sector investment is likely to be limited without some form of public-sector support or risk-sharing.

**3. Development bank loans:** Multilateral or bilateral development banks could provide loans for organic waste-to-biogas projects as part of their climate change or sustainable development portfolios. However, these loans would likely be at or near market rates, which may not be viable for all project developers. Additionally, accessing development bank loans can be a lengthy and complex process.

The proposed GCF funding for this project is in the form of a grant, which is justified given the significant barriers and risks outlined above. A grant instrument will enable the project to demonstrate the technical, financial, and environmental viability of organic waste-to-biogas systems without placing an undue debt burden on the implementing partners. The grant funding will be used to cover the incremental costs of the biogas systems, such as the additional equipment and infrastructure needed to collect, pre-treat, and digest organic waste, as well as the costs of capacity building, awareness raising, and policy development activities.

*Justify the rationale and level of concessionality of the GCF financial instrument(s) as well as how this will be passed on to the end-users and beneficiaries. Justify why this is the minimum required to make the investment viable and most efficient considering the incremental cost or risk premium of the Project/ Programme (refer to Decisions B.12/17; B.10/03; and B.09/04 for more details). The justification for grants and reimbursable grants is mandatory.*

The level of concessionality provided by the GCF grant is justified based on several key factors. Firstly, the project is aligned with Thailand's NDC and national climate change priorities, as well as the GCF's investment criteria and results areas. It will deliver significant climate mitigation and adaptation benefits, alongside a range of economic, social, and environmental co-benefits. Secondly, the project targets a new and underserved market segment—organic waste-to-biogas—with substantial potential for scale-up and replication. The demonstration effect of the project will help catalyze additional public and private investment in the sector. Thirdly, the project will generate valuable knowledge and lessons learned that can be shared with other developing countries facing similar challenges in managing organic waste and reducing GHG emissions.

The GCF grant funding will be passed on to the end-users and beneficiaries in the form of reduced waste disposal costs, increased access to clean energy, and improved environmental and social conditions. The project will work with local governments and universities to develop sustainable business models that ensure the long-term viability of the biogas

systems beyond the initial grant funding period. This may include revenue streams from the sale of biogas, electricity, and organic fertilizer, as well as cost savings from reduced waste transportation and disposal.

In summary, GCF funding is critical to overcoming the barriers to public and private investment in organic waste-to-biogas projects in Thailand. The proposed grant instrument is the minimum required to demonstrate the viability of this innovative solution and catalyze a paradigm shift towards sustainable waste and energy management practices in the country.

### C.3. Sustainability and replicability of the project (exit strategy) (max. 1 page)

*Please explain how the project/programme sustainability will be ensured in the long run and how this will be monitored, after the project/programme is implemented with support from the GCF and other sources.*

The long-term sustainability of the proposed organic waste-to-biogas project in Thailand will be ensured through the following key measures:

**1. Viable Business Models:** Each of the 10 biogas systems will be designed and operated based on a sustainable business model that generates sufficient revenues to cover ongoing costs. This will be achieved through a combination of waste disposal fees, energy sales (biogas, electricity, heat), and sales of co-products like organic fertilizer. The project will collaborate with local governments, universities, and private sector partners to develop and implement these business models, ensuring that they are tailored to the specific context and needs of each site.

**2. Capacity Building:** The project will invest significantly in building the technical, operational, and financial capacities of local stakeholders to effectively manage and maintain the biogas systems over the long term. This will include training programs for system operators, university staff, and government officials, as well as the development of standard operating procedures, maintenance manuals, and other knowledge resources. By building local capacities, the project aims to create a cadre of biogas champions who can sustain and replicate the systems beyond the initial project period.

**3. Enabling Policy Environment:** The project will work closely with national and local government agencies to strengthen the policy and regulatory environment for organic waste management and biogas production. This may include advocating for waste separation and recycling mandates, feed-in-tariffs or other incentives for biogas energy, and quality standards for biogas and organic fertilizer. By creating a more enabling policy environment, the project aims to provide long-term support and incentives for the sustainable operation of the biogas systems.

**4. Stakeholder Ownership:** The project will prioritize local ownership and participation in the design, implementation, and management of the biogas systems. This will include involving local communities, waste generators, and end-users in the planning and decision-making processes, as well as creating opportunities for them to benefit from the project outcomes (e.g. through access to clean energy, improved waste services, job creation). By fostering strong stakeholder ownership, the project aims to create a sense of shared responsibility and motivation for sustaining the systems over the long term.

**5. Monitoring and Evaluation:** The project will establish a robust monitoring and evaluation (M&E) system to track its performance and sustainability over time. This will include regular monitoring of key technical, financial, and social indicators (e.g. waste processed, biogas produced, revenues generated, jobs created), as well as periodic evaluations and audits by independent third parties. The M&E system will provide valuable data and insights for adaptive management and continuous improvement of the biogas systems, as well as for reporting to funders, regulators, and other stakeholders.

By implementing these measures and monitoring mechanisms, the project aims to ensure its long-term sustainability and to create a replicable model for organic waste-to-biogas systems in Thailand and beyond. The ultimate goal is to catalyze a paradigm shift towards a more circular and low-carbon economy, in which organic waste is seen as a valuable resource for generating clean energy and supporting sustainable development.

### D. Supporting documents submitted (OPTIONAL)

- Map indicating the location of the project/programme
- Diagram of the theory of change
- Economic and financial model with key assumptions and potential stressed scenarios
- Pre-feasibility study

- |   |
|---|
| <input type="checkbox"/> Evaluation report of previous project              |
| <input type="checkbox"/> Results of environmental and social risk screening |

**Self-awareness check boxes**

Are you aware that the full Funding Proposal and Annexes will require these documents? Yes  No

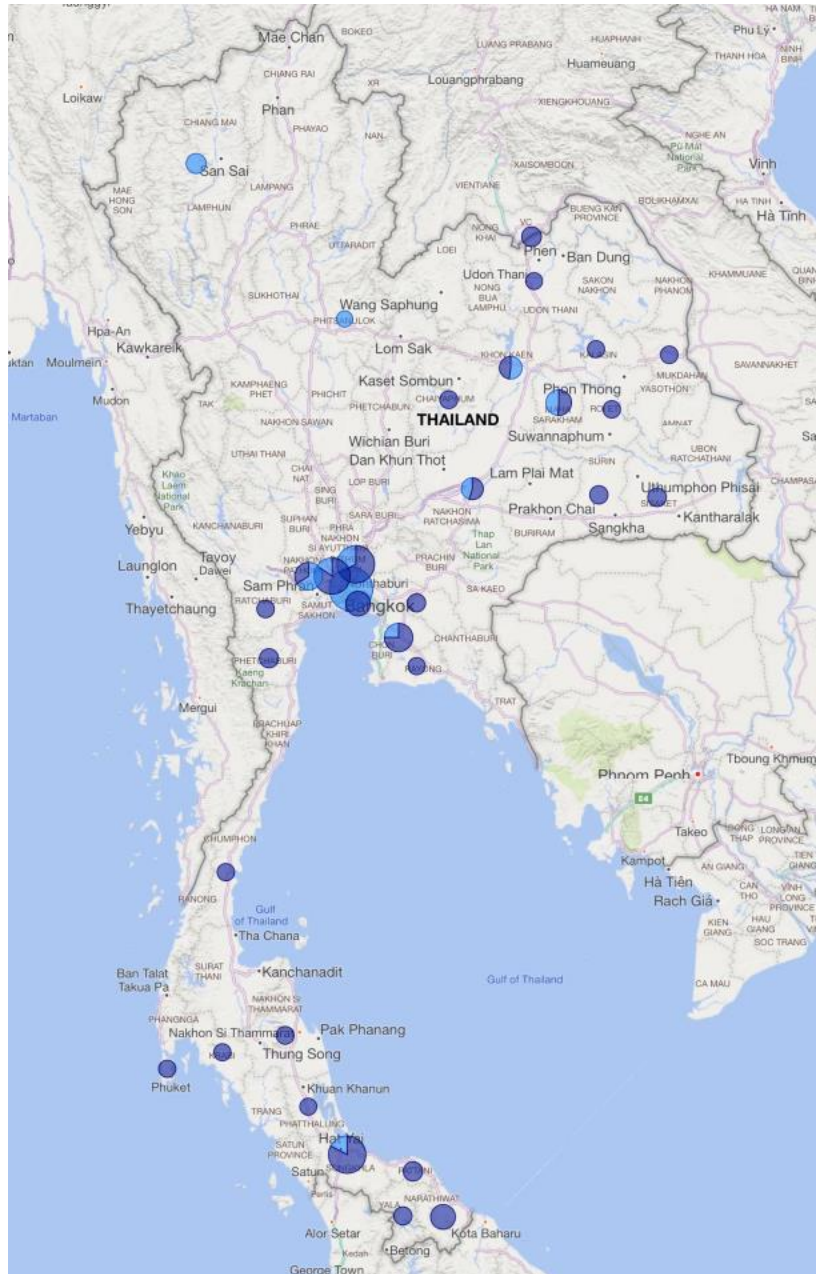
- Feasibility Study
- Environmental and social impact assessment or environmental and social management framework
- Stakeholder consultations at national and project level implementation including with Indigenous people if relevant
- Gender assessment and action plan
- Operations and maintenance plan if relevant
- Loan or grant operation manual as appropriate
- Co-financing commitment letters

Are you aware that a funding proposal from an accredited entity without a signed AMA will be reviewed but not sent to the Board for consideration? Yes  No

Supplementary Data

I) The potential campuses and local authorities which might participate in the project.

**Classification** ● Campus ● Local Authorities



<Figure 1> The Concept of Waste to Energy in Campuses and Small Cities in Thailand

[Table 2] The names of small cities and campuses with their number of residents

Number	Province	Local Authorities	Population
1	Nonthaburi	Tessaban Mueang Bang Rak Phatthana	46,982
2	Chonburi	Tessaban Mueang Saen Suk	46,370
3	Songkhla	Tessaban Mueang Kho Hong	45,964
4	Nong Khai	Tessaban Mueang Nong Khai	45,742
5	Maha Sarakham	Tessaban Mueang Maha Sarakham	44,572
6	Nonthaburi	Tessaban Mueang Bang Kruai	44,486
7	Pattani	Tessaban Mueang Pattani	43,915
8	Songkhla	Tessaban Mueang Khlong Hae	44,134
9	Songkhla	Tessaban Mueang Khao Rup Chang	43,115
10	Pathum Thani	Tessaban Mueang Khu Khot	42,249
11	Phetchaburi	Tessaban Mueang Cha-am	41,956
12	Nonthaburi	Tessaban Mueang Bang Khu Rat	40,864
13	Narathiwat	Tessaban Mueang Narathiwat	40,309
14	Narathiwat	Tessaban Mueang Su-ngai Kolok	39,984
15	Songkhla	Tessaban Mueang Singhanakhon	40,045
16	Samut Prakan	Tessaban Mueang Pak Nam Samut Prakan	39,937
17	Sisaket	Tessaban Mueang Sisaket	39,131
18	Samut Prakan	Tessaban Mueang Phra Pradaeng	38,492
19	Surin	Tessaban Mueang Surin	37,304
20	Chonburi	Tessaban Mueang Ang Sila	37,217
21	Yala	Tessaban Mueang Sateng Nok	37,199
22	Chachoengsao	Tessaban Mueang Chachoengsao	36,948
23	Nakhon Pathom	Tessaban Mueang Rai Khing	35,711
24	Chaiyaphum	Tessaban Mueang Chaiyaphum	35,301
25	Nakhon Si Thammarat	Tessaban Mueang Pak Phun	34,624
26	Pathum Thani	Tessaban Mueang Bueng Yitho	34,197
27	Ratchaburi	Tessaban Mueang Ratchaburi	33,278
28	Nonthaburi	Tessaban Mueang Bang Si Mueang	33,159
29	Mukdahan	Tessaban Mueang Mukdahan	33,057
30	Roi Et	Tessaban Mueang Roi Et	33,045
31	Pathum Thani	Tessaban Mueang Sanan Rak	32,969
32	Chumphon	Tessaban Mueang Chumphon	32,593
33	Nakhon Ratchasima	Tessaban Mueang Pak Chong	32,381
34	Pathum Thani	Tessaban Mueang Bang Khu Wat	32,268
35	Phuket	Tessaban Mueang Kathu	31,793
36	Rayong	Tessaban Mueang Ban Chang	31,716
37	Kalasin	Tessaban Mueang Kalasin	31,383
38	Krabi	Tessaban Mueang Krabi	31,227
39	Khon Kaen	Tessaban Mueang Chum Phae	30,751
40	Phatthalung	Tessaban Mueang Phatthalung	30,626
41	Udon Thani	Tessaban Mueang Nong Samrong	30,162

II. Preliminary Feasibility for the Waste to Energy Plant in the project

[Table 3] Preliminary feasibility results

Total Waste Capacity per Plant	50	tons/d
Organic Waste Quantity	25	tons/d
Biogas Yield From Organic Wastes	100	Nm <sup>3</sup> /ton
Biogas Production	2,500	m <sup>3</sup> /d
Biogas Production	825,000	m <sup>3</sup> biogas /year
Electricity Generation	1,650,000	kWh/year
RE Revenue	7,425,000	THB/year
RDF Product	23	tons/d
RDF Revenue	5,940,000	tons/d
RDF Transportation Cost	8,000	THB/trip
RDF Net Revenue	3,300,000	THB/year
Tipping Fee	700	THB/ton
Tipping Fee	11,550,000	THB/year
Total Revenue	18,975,000	THB/year
Plant O&M	5,000,000	THB/year
Plant CAPEX	100,000,000	THB
Payback	7.16	year
Ton CO <sub>2</sub> eq Reduction	62,648.44	tons/year
Total GHG Reduction @ 15 years in the project	939,727	tons
GCF Budget/tonCO <sub>2</sub> eq	29.56	USD/tons