USAID Vietnam Urban Energy Security

Scope of Work

Demonstrating the Recovery of Oil from Plastic Waste Through Pyrolysis

BACKGROUND

As Vietnam experiences steep increases in energy demand and rising air pollution challenges, there is growing recognition that cleaner, more reliable sources of energy are needed and greater capital investment is necessary. USAID Vietnam Urban Energy Security (the Project) works closely with target cities (*Danang and Ho Chi Minh City - HCMC*) to improve enabling frameworks, mobilize investment, and increase the adoption of innovative solutions for advanced, distributed energy.

The overall goal of the Project is "advanced, distributed energy solutions deployed to improve urban energy resilience and energy security" in Vietnam. At its completion, the Project expects to achieve the following high-level results:

1. At least 400 megawatts (*MW*) of advanced, distributed energy systems deployed in the selected cities.
2. At least $600 million in public and private investment mobilized for advanced, distributed urban energy systems.
3. At least 20 innovative solutions to address urban energy and environment issues demonstrated and/or commercialized.

To achieve the third high-level expected result, the Project is implementing a range of activities: innovative pilots/ demonstrations are being funded through a competitive Innovation Challenge Fund (ICF); innovative solutions are being identified and piloted/ demonstrated outside the ICF process through discussions with city-level private and government stakeholders and research by the Project's technical team; and selected innovators will receive tailored support to scale and/ or commercialize.

Innovators registered in Vietnam with solutions in the form of new technologies, practices, and business or financing models are being supported through the above activities. Solutions fall within the following categories: transportation, building efficiency, electricity generation, electricity delivery and management, and water efficiency. They must be piloted/ demonstrated in Danang and/ or HCMC.

PLASTIC WASTE PYROLYSIS - THE POTENTIAL

The increase of the human population, rapid economic growth, continuous urbanization, and changes in lifestyle are resulting in plastic waste production and consumption increasing at an alarming rate. Statistics of the World Bank show that Vietnam has become one of the major sources of plastic waste in the world. An estimated 3.1 million tons of plastic waste is dumped on land each year, and the amount

of waste dumped into the oceans is between 0.28 and 0.73 million tons[1]. Vietnam is one of the top five plastic polluters of the world's oceans[2].

Plastics are made of petrochemical hydrocarbons and difficult to decomposition. Plastic waste recycling is carried out in different ways, but in most developing countries, open or landfill disposal is a common practice for plastic waste treatment. The disposal of plastic waste in landfills provide habitat for insects and rodents, that may cause different types of diseases. In addition, due to rapid urbanization, the land available for landfills, especially in cities, is reducing.

Vietnam's 2020 Environmental Protection Law, which came into effect on 1 January 2022, introduced the Extended Producer Responsibility (EPR) concept which specifies the responsibilities of producers and importers with regard to the recycling and treatment of discarded products and packages. On 10 January 2022, the Government issued Decree 08/2022/ND-CP to guide the implementation of various provisions of the Law and provide regulations on EPR-related matters.

As per Decree 08, manufacturers and importers of certain products (e.g. tires/tubes, batteries, machine oils, electrical/electronic equipment and means of transportation) and certain packages (e.g. **plastic packaging including PET bottle, EPS, PSP, PVC, plastic container tray, and film**) to be sold in Vietnam are responsible for recycling such products and packages. The compulsory recycling rates vary from 0.5% to 22% depending on the type of products/ packages and will be increased every three years.

Producers and importers can choose to self-recycle (subject to certain conditions) or make a monetary contribution to the Vietnam Environment Protection Fund ("VEPF") to support recycling activities. Those who choose self-recycling must register annual recycling plans and submit an annual report on the recycling results to the Ministry of Natural Resources and Environment (MONRE).

Although Decree 08 came into effect on its signing date, the application of the recycling obligation is scheduled to begin from 2024, 2025 or 2027 depending on the type of product/package.

With the introduction of the EPR concept, converting waste plastics to Fuel Oil by Pyrolysis offers a potential solution for Vietnamese waste treatment plants. Pyrolysis is a common technique used to convert plastic waste into energy, in the form of solid, liquid and gaseous fuels. It is however a new technology to Vietnam.

PLASTIC WASTE PYROLYSIS – THE TECHNOLOGY

Plastic is created from crude oil and can therefore be transformed back into its original components. To achieve the transformation however, plastic waste must be heated to between 400°C – 700◦C under moderate pressure to disrupt the long-chain molecules. Pyrolysis of waste plastics produces varying proportions of solid, liquid and gas products under different conditions.

The resulting gas from pyrolysis is usually a fuel with a medium-to-low heating value (CO: 15-30%, H_2 10-20%, CH_4 2–4%). The gas consists of flammable hydrocarbons that can be burned, providing heat for pyrolysis. Flue gas further treatment to meets regulations before it can be discharged into the atmosphere.

[1] https://changevn.org/en/vietnam-releases-3-1-million-tons-of-plastic-waste-into-the-environment-every-year/

[2] https://www.worldbank.org/en/country/vietnam/publication/towards-a-national-single-use-plastics-roadmap-in-vietnam-strategies-and-options-for-reducing-priority-single-use-plasti#:~:text=An%20estimated%203.1%20million%20metric,polluters%20of%20the%20world's%20oceans.

The pyrolysis oil contains 16–25% olefins, 62–80% aromatics, and 3–14.5% paraffins and naphthalene. The higher heating value (HHV) of pyrolysis oils is high (40–43 MJ/kg) and close to those of liquid fossil fuels (diesel 45 MJ/kg and heavy fuel oil 42–43 MJ/kg). Solid products from pyrolysis are between 5-6% and can be used as a solid fuel for combustion or for landfill.

The disposal of plastic in landfill emits 71 kg CO_2 however the conversion of plastic waste into oil fuel through pyrolysis has a net emission of 160kg CO_2 which a result of the emissions savings from fossil oil displacement. Chlorine might present in the plastic feedstock because of the presence of PVC as a minor component. During the conversion of the plastic to oil products, this produces the acidic gas hydrogen chloride. This can be tolerated by the use of a neutralizing agent such as calcium carbonate. It is suggested that PVC is unlikely to be a significant problem as it constitutes 0.5% or less.

OBJECTIVES

The Project seeks an offeror to invest in, install and demonstrate a plastic waste pyrolysis system at a suitable location in Danang or HCMC. Offerors are likely to include waste treatment plants.

The demonstration will be of interest to multiple stakeholders including local government and the private sector e.g. MONRE, Department of Industry and Trade in HCMC and Danang, waste treatment plants, energy-intensive industries etc. The demonstration of the solution aims to:

- demonstrate that pyrolysis system can produce oil.
- demonstrate that pyrolysis system is an appropriate technology in support of the new EPR.
- demonstrate that the pyrolysis system represents a good investment.

Performance of the pyrolysis system will be tested. The implementation process, lessons, achievements, and challenges will be documented. The findings will be shared with appropriate stakeholders, including local authorities and potential customers. If the innovation is deemed to be appropriate for scaling and commercialization, then the Project will support this through a separate process.

ANTICIPATED ACTIVITIES

The selected offeror is expected to carry out the following activities:

- Select the most appropriate demonstration site and develop a technical proposal.
- Agree terms and conditions with the site owner.
- Manage the process of purchasing and/or manufacturing pyrolysis equipment.
- Install and commission the pyrolysis system.
- Collect data, monitor and report against a set of key performance indicators e.g. related to costs, value and quality of outputs, performance of the equipment etc. The indicators will be agreed with the Project and will be reflected in a Monitoring & Evaluation plan.
- Document lessons and results, including successes and challenges.
- Support the Project's independent MEL firm[3] and share information with the Project to document the implementation process, lessons, achievements, and challenges. Prepare progress and final reports.
- Support the Project to share the findings of the demonstration with relevant stakeholders e.g. by featuring in promotional materials and attending a limited number of workshops and exchange visits. Stakeholders at workshops are likely to include USAID, GVN, MOIT, DOITs, and potential customers of the technology from HCMC and Danang.

[3] 1) an independent Monitoring, Evaluation and Learning service provider

- On an as-needed basis, provide inputs to the preparation of communications materials developed by the Project team, and organize site visits for high-level stakeholders and at the request of the Project.

TARGET BENEFICIARIES

The demonstration aims to benefit the following stakeholders:

- Waste treatment plants.
- Cement factories, and other industries reliant on large volumes of fuel that may be interested in the recycled fuel.
- Businesses involved in the production and/ or importation of plastic packaging including PET bottle, EPS, PSP, PVC, plastic container tray, and film.
- Technology providers interested in marketing pyrolysis technology.
- MONRE – responsible for overseeing companies' recycling plans and contributions to VEPF.
- MOIT - responsible for the governance and regulation (in addition to advancement, promotion, management and growth) of industry and trade.
- Department of Industry and Trade – mandated with supporting industry and economic growth.

EXPECTED TIMELINE AND DELIVERABLES

Implementation is expected to start in May 2023, for a maximum period of up to nine (9) months subject to the Project extension by USAID. The offeror should propose a timeline and sequence of activities that aligns with their proposed technical approach. Deliverables will include:

- A report documenting the results/ analysis of survey findings related to identification of the potential demonstration site.
- A technical proposal that includes an executive summary, a need statement, i.e. what is the issue being addressed and why it matters, activities, methodology and expected outcomes i.e. financial (IRR, NPV over 5 years), evaluation plan; and budget.
- A clear agreement detailing the terms and conditions with the site owner of the demonstration site (including but not limited to a description of the demonstration, the demonstration activities with tentative implementation timeline).
- A report detailing the installation and commissioning at one appropriate location.
- Bi-monthly progress narrative and financial progress reports as per an agreed template (number and timing of reports to be agreed with the Project).
- A completion report documenting activities, successes, lessons as per an agreed template.
- Guideline/ manual (in English and Vietnamese) for suppliers (and their agents) to promote and scale the technology in the future. This manual will detail the steps involved, the challenges and ways to resolve these challenges (based on experience with the demonstration).

All documents will be in English except for the guideline/manual which will be in both English and Vietnamese. If the agreement with the owners (and city authority, if any) of the demonstration site is in Vietnamese, the main body of the agreement must be translated into English.