



USAID Vietnam Urban Energy Security

Scope of Work

Demonstrating the Recovery of Oil and Carbon Black from Used Tires 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.

RUBBER PYROLYSIS - THE POTENTIAL

The 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. those for containing foodstuff) 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, rubber pyrolysis offers a potential solution for Vietnamese rubber producers and waste disposal plants. Pyrolysis allows manufacturers to safely recycle used tires, the outputs of which include fuel oil (up to 50%), carbon black (up to 30%), steel wire (up to 12%) and gas (up to 10%), all of which can be sold. Oil gas generated from the process can also be used by the factory as a fuel.

RUBBER PYROLYSIS – THE TECHNOLOGY

Pyrolysis is an alternative to scrap tire disposal and results in the recovery of valuable products such as fuel oil and black carbon. It involves the decomposition of the rubber tire at high temperatures (400-500°C) in an oxygen-free atmosphere. The raw material – rubber or rubber by-products – is heated in a reactor, generating oil gas, which when passed through a condenser turns into liquid oil. Oil gas that cannot be condensed is recycled by being fed into the pyrolysis burner to heat the reactor, making the pyrolysis process energy efficient.

The final product of the pyrolysis process is mainly fuel oil (that can be further refined into diesel), carbon black, synthesis gas, and steel wire. The obtained oil (Fuel oil – recycled [FO-R]) has the same calorific value as fuel oil (FO-TCVN 6239:2019) and has approximately the same sulfur content as FO N°1A oil (0.5-2% S). FO-R is a good heating fuel that can be used in many industries e.g. steel and cement production. There is no need to modify equipment in the combustion system when switching from conventional oil into fuel oil that has been recycled from rubber. Carbon black can be used for burning and heating, like coal, in industries such as cement plants and power plants.

During the pyrolysis process, the gas consists of flammable hydrocarbons with a calorific value of approximately 38-41 MJ/m³ and a concentration of Hydrogen Sulfide (H₂S) of about 3mg/m³. When burning and providing heat for pyrolysis, H₂S will convert into Sulfur Dioxide (SO₂) gas in the flue gas. SO₂ gas will be treated by the absorption method with an alkaline solution so that the flue gas meets QCVN¹ 19:2008/BTNMT before being discharged into the environment.

FO-R has a calorific value of approximately 40-42 MJ/kg which is equivalent to FO and FO-R has a Sulphur (S) content of about 1-1.5%. FO-R can be used in the industrial sector and has lower SO₂ emissions in comparison to FO N°2B and N°3B.

The calorific value of carbon black is in the range of 28-30 MJ/kg and has 3% sulfur and 16% ash content. Carbon black has a higher calorific value than anthracite coal 4A Quang Ninh. The fact is that all the coal combustion incinerators in industry are always integrated with SO₂ exhaust gas treatment systems, therefore the use of carbon black is promising for application in the energy sector.

¹ Quy chuẩn kỹ thuật (QCVN) = Vietnamese National Standards (TCVN)

A vast quantities of waste rubber produced each year², however with the introduction of the new EPR, the pyrolysis solution requires closer attention. The belief is that this innovative solution can help with the achievement of the EPR whilst also reducing rubber waste, but scaling has been slow because:

- there is a need to demonstrate the solution to assess its performance.
- there is a need to further document evidence of the solution's costs and benefits.
- there is a need to showcase/ demonstrate and promote the solution for potential users.

To support HCMC and Danang achieve the enforcement of the EPR, and achieve energy savings and emission reduction targets, the Project seeks an offeror to demonstrate this innovative solution in Danang or HCMC.

OBJECTIVES

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

- Recycling plants with an interest in recycling rubber tires and/ or rubber by-products.
- Rubber factories producing rubber tires/ tubes/other rubber products that must self-recycle or make a monetary contribution to the Vietnam Environment Protection Fund as per the regulations in Decree 08.

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, recycling plants, energy-intensive industries etc. The demonstration of the solution aims to:

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

Performance of the rubber 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 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 by-products and 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.

² Estimated at 400,000 tons of waste each year (equivalent to 30,000 tons/month).
<https://www.monre.gov.vn/English/Pages/Vietnam-has-the-first-automobile-waste-tires-recycling-factory.aspx>

- Support the Project's independent MEL firm³ 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.
- 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:

- Rubber factories that must comply with the new EPR.
- Waste tire and rubber recycling plants.
- Producers and importers impacted by Vietnam's new EPR.
- 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).

³ |) an independent Monitoring, Evaluation and Learning service provider



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.