

SITURN Innovation Challenge – Webinar Summary and Key Actions



Purpose and context of the challenge

SITURN is a collaboration between NAM, Arcadis and WellGear established to decommission former onshore gas production systems in the Netherlands. The programme covers approximately 800 production wells, 350 locations and 1,750 kilometres of pipeline. WellGear is responsible for the subsurface scope, while Arcadis focuses on the above-ground cleaning, dismantling and removal activities.

During natural gas production, other substances from the deep subsurface are produced along with the gas, including mercury. Because these substances were separated from the natural gas for decades using gas treatment systems, the steel from these installations has become contaminated with mercury. After production has stopped, the treatment installations are thoroughly cleaned. However, for installation components containing mercury-contaminated steel, an additional approach is required. As a result, finding a new destination for reuse or processing by smelters is more complex than for regular steel scrap. NAM and Arcadis currently have a technically workable route for handling this steel through intensive cleaning. This route is feasible, but costly, and leads to additional secondary streams and transport movements..

The challenge

How can mercury-contaminated steel from above-ground gas treatment installations be treated and reused in a circular, responsible and scalable way, while preserving as much material value as possible?

The primary driver confirmed during the webinar is cost reduction. SITURN is not primarily working against a fixed time deadline, although reducing on-site cleaning time and overall lead times would be valuable. Any proposed solution must remain technically and legally acceptable and must provide a responsible end-to-end route for the material. SITURN does not want contaminated steel to be exported or reused in a destination where there is insufficient control over its eventual treatment or end-of-life.





Current situation and technical process

The current approach consists of both on-site and off-site cleaning.

On-site cleaning

The facilities are first drained and sediments are removed. Pure mercury is recovered where present, followed by flushing with hot water and chemicals and, if required, high-pressure cleaning. The webinar indicated that substantial quantities of elemental mercury can be recovered from individual facilities.

The current process also needs to account for other potential contaminants, including condensate, low levels of radioactive material, asbestos in some seals and gaskets, and, in some cases, chromium-related contamination. These are not the primary focus of this innovation challenge since sufficient technical solutions are in place.

Off-site deep cleaning

The most difficult components are generally heat exchangers, particularly shell-and-tube heat exchangers and their internal components. Some other components, pipelines or vessels may also require off-site treatment depending on the outcome of the on-site cleaning.

The current off-site process can involve:

- scaling and removal of contaminated material;
- high-pressure water treatment;
- cutting equipment into smaller pieces where necessary to improve access;
- treatment with strong acid;
- repeated cleaning cycles where required.

A typical heat exchanger discussed during the webinar weighs approximately 22 tonnes. The current processing time for cleaning a heat exchanger is approximately three weeks per unit. A larger batch of around ten comparable heat exchangers was indicated to take approximately 30 weeks. Overall for a large facility location: mobilisation, cleaning, demolition and demobilisation currently takes approximately three to four months.

The challenge is particularly difficult because the geometry and design of some parts of the processing equipment prevent effective access to the contaminated internal surfaces. Cutting the equipment into sections can improve access and enable additional cleaning cycles.

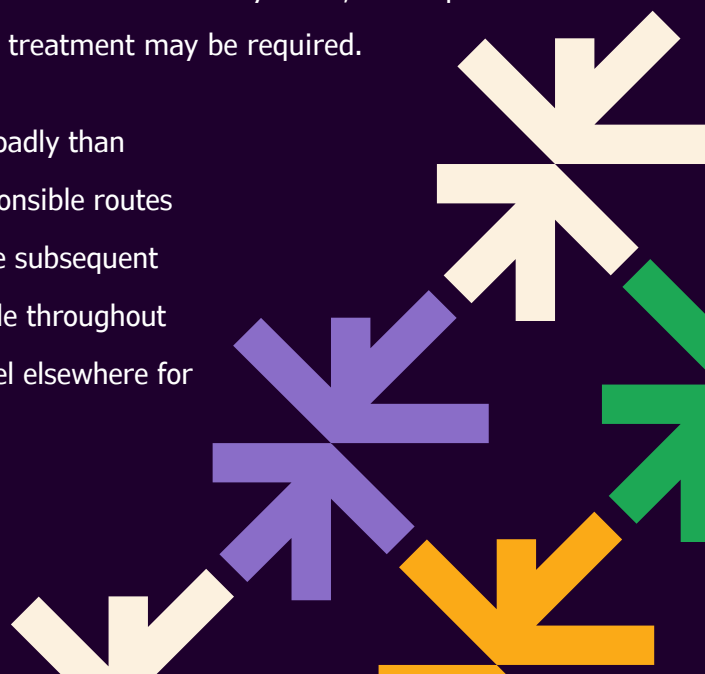
Mercury measurement and the 1 mg per kg target

The current acceptance target discussed in the webinar is 1 mg of mercury per kilogram of steel (1 ppm). SITURN uses XRF as a process-control instrument. The XRF equipment needs to be appropriately calibrated for the relevant measurement range. During the cleaning and demolition process, XRF measurements are used to identify whether material appears to be sufficiently clean and whether additional investigation or treatment is required.

Laboratory analysis provides the verification of the final mercury concentration. Samples are taken from the steel and analysed in a laboratory to determine the actual mercury concentration. The laboratory result is used as the verification basis for release of the material.

The webinar clarified that XRF is therefore considered a process instrument, while laboratory analysis functions as the verification/validation method. Measurements are also taken during demolition and before material leaves the site. Where material is sufficiently clean, it can proceed as clean scrap. Where contamination remains, additional treatment may be required.

The challenge document frames the opportunity more broadly than simply reaching 1 ppm: SITURN is also interested in responsible routes for steel containing more than 1 mg/kg, provided that the subsequent processing route is controlled, transparent and responsible throughout the material's lifecycle. Simply sending contaminated steel elsewhere for reuse is not considered sufficient.





Current outlets and the broader processing challenge

At present, SITURN has not identified an end processor or smelter that is willing to accept the mercury-contaminated steel.

The webinar clarified that the cleaned steel is not specifically being sent to a specific end processor. Instead, material meeting the applicable requirements enters the market as clean scrap.

A previous Dutch option was a company in the North of the Netherlands, which had developed a smelting solution for the mercury-contaminated steel, but this company is currently not operational at the time of the webinar.

SITURN has also investigated potential other European outlets. Exporting contaminated steel can, however, create permitting and cross-border regulatory issues. The webinar specifically mentioned that an option in Germany had been legally investigated but could not currently be used because the relevant Dutch and German regulatory frameworks did not align. The official challenge documentation likewise identifies cross-border processing as an area requiring careful legal and permitting substantiation.

Importantly, SITURN stated that the challenge should not be interpreted as a cleaning-only challenge. A solution involving an end processor or smelter could also be relevant, provided that the facility can responsibly manage mercury released during processing. The official challenge information similarly highlights the possibility of circular processing while maintaining control over the complete chain.

What has already been tried

SITURN has already investigated a range of potential approaches, including:

- chemical cleaning;
- laser-based cleaning experiments;
- ultrasound cleaning;
- mercury-solvent approaches;
- chemical cleaning using stabilised acids;
- temporary storage to create additional time for optimisation;
- different off-site cleaning techniques;
- heat-based cleaning/thermal approaches;
- discussions with potential end processors in Europe.

Some chemical trials did not deliver the required result. Heat cleaning was also investigated, but at the time the cost was considered too high to proceed. SITURN is nevertheless open to proposals that improve the current process or combine several approaches into a better overall solution.

This means that applicants do not necessarily need to propose a completely new end-to-end technology. SITURN explicitly indicated that a partial solution can be valuable if it can be combined with other technologies or partners to create a better overall route.

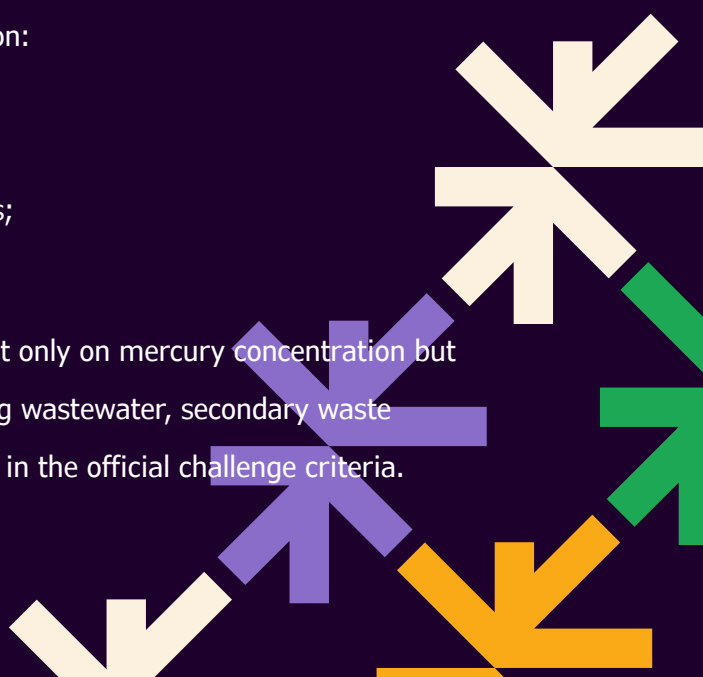
Waste and secondary streams

Reducing the waste footprint is considered relevant to the challenge. The current process produces significant quantities of wastewater and other contaminated waste streams. The webinar indicated that approximately 1,500 tonnes of flushing water per location can be sent for treatment, although the exact breakdown of all waste streams was not yet available during the session.

The SITURN team agreed to provide further information on:

- the detailed waste breakdown;
- the quantities of different waste streams;
- the acceptance criteria for mercury-containing liquids;
- the associated treatment costs.

The current treatment price for wastewater depends not only on mercury concentration but also on other compounds present in the waste. Reducing wastewater, secondary waste streams and transport movements is explicitly included in the official challenge criteria.



Applicant Questions and SITURN Responses

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Question: What treatment times are currently achieved per tonne, and how much does processing time contribute to the overall cost?

- **SITURN response:** Treatment times vary depending on the equipment and contamination level. For heat exchangers, the current off-site cleaning process can take approximately three weeks per unit. SITURN acknowledged that treatment and processing time is an important cost driver, but confirmed that the primary driver is overall cost reduction, rather than meeting a fixed project schedule. SITURN is nevertheless interested in solutions that reduce on-site and off-site cleaning time.

Question: Where does the steel currently go after cleaning? Is it sent to Tata Steel, and is 1 ppm the relevant acceptance level?

- **SITURN response:** Steel that meets the applicable requirements can enter the clean-scrap route. Tata Steel was mentioned as an important scrap processor in the Netherlands, but it currently does not accept SITURN's relevant contaminated scrap. SITURN has investigated other potential end processors, but has not yet found an operational processor that can accept the material at a higher mercury concentration. The 1 mg/kg (1 ppm) level is an important reference point for the current cleaning route.

Question: How is the mercury concentration measured? Is XRF used on site?

- **SITURN response:** XRF is used as a process-control instrument during cleaning. After cleaning, samples are sent to a laboratory to determine the actual remaining mercury concentration. The laboratory result is used as the verification basis for releasing the scrap.

Question: Is SITURN interested in solutions that reduce the overall waste footprint, including spent chemicals and mercury-contaminated waste?

- **SITURN response:** Yes. SITURN is interested in an end-to-end solution and would consider a technology that addresses only one part of the process if it contributes to a better overall route. Reducing secondary waste streams is consistent with the broader challenge objectives.

Applicant Questions and SITURN Responses

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Question: What volumes of wastewater and other contaminated waste are currently generated?

- **SITURN response:** Approximately 1,500 tonnes of flushing water per location are currently sent for treatment. SITURN did not have a complete breakdown of all waste quantities available during the webinar, but agreed to provide further figures.

Question: What are the acceptance criteria for mercury in the wastewater sent for treatment?

- **SITURN response:** The exact acceptance criteria were not available during the webinar. SITURN explained that the treatment company samples the wastewater received from the tankers and determines the treatment price based on the contamination level. Mercury is one factor, but other compounds can also significantly affect the treatment cost. SITURN agreed to check and provide the relevant information.

Question: What is the cost split between on-site cleaning, waste processing, off-site cleaning and other activities?

- **SITURN response:** SITURN did not have the figures available during the webinar but confirmed that it can provide a percentage breakdown of the different cost categories. This information is considered useful for applicants to identify where the largest potential improvements can be made.

Question: Which of the cleaning methods already tested have been successful or unsuccessful, and where does SITURN see the greatest potential for improvement?

- **SITURN response:** SITURN has already tried a range of approaches and is specifically interested in solutions that introduce a new or significantly improved approach.

Applicant Questions and SITURN Responses

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Question: Is SITURN looking specifically for a cleaning technology, or could an end processor/smelter also be part of the solution?

- **SITURN response:** The challenge is not limited to cleaning. SITURN is explicitly open to solutions involving an end processor or smelter. A facility capable of processing mercury-contaminated steel while controlling mercury emissions could potentially form part of the solution, provided the route is legally and technically acceptable and the material remains responsibly managed.

Question: Would SITURN consider investing in or taking ownership of a future recycling or processing facility?

- **SITURN response:** SITURN would be willing to explore financial engineering or other mechanisms that could support investment in a new processing facility. However, SITURN does not intend to take ownership of or an active operating role in such a company.

Question: Is there interest in a commercial solution even if it is only a partial solution rather than an end-to-end technology?

- **SITURN response:** Yes. SITURN has no predefined preference for a specific technology or commercial model. A partial solution can be valuable if it can be combined with other technologies or partners to create a better end-to-end route.

Question: Does SITURN want to acquire the intellectual property of applicants?

- **SITURN response:** No. SITURN's objective is to establish partnerships and explore collaboration, purchasing, selling or joint development. The official challenge documentation confirms that submitted IP remains with the submitting party unless otherwise agreed in a separate agreement.

Applicant Questions and SITURN Responses

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Question: Could a European processing route be used, for example in Germany?

- **SITURN response:** SITURN has investigated European processing options, but cross-border transport of mercury-contaminated steel creates legal, classification and permitting challenges.

Question: Is there currently an end processor or smelter in Europe that can accept the contaminated steel?

- **SITURN response:** At the time of the webinar, SITURN had not identified an operational end processor or smelter able to accept the relevant contaminated steel. SITURN had approached companies to explore whether they would be willing to accept the material. Developing such an end-processing route would be considered a valid part of the challenge.

Question: Has SITURN discussed government support for developing domestic processing capacity or keeping the material within the Netherlands?

- **SITURN response:** The SITURN representative indicated that, to his knowledge, no such discussions with the government had taken place at that point.

Key takeaway from the Q&A

The Q&A made one point particularly clear: SITURN is not looking for a single predefined cleaning technology. The organisation is open to improvements anywhere in the chain—from cleaning and waste reduction through to processing, recycling or smelting. A partial solution can therefore be relevant, provided it contributes to a demonstrably better end-to-end route.

The webinar resulted in several concrete follow-up points that SITURN provides:

- Detailed percentage breakdown of current costs:
 - on-site cleaning 28%
 - off-site cleaning 30%
 - waste processing 16%
 - other relevant costs 26%
- More detailed information on current waste volumes and waste streams. Some indicative figures per facility (type: king size cluster):
 - Pure mercury: between 700 - 3,000 kg
 - At start cleaning available: 1,800 mercury contaminated scrap
 - Mercury contaminated sludges: 10,000 - 25,000 kg
- After first cleaning:
 - off site cleaning E2's & other scrap, vessels, etc: 700 tons (mostly liquids)
- Industrial cleaning water: 1,500 - 1,750 m³ (total)
- Quantification of contaminated waste associated with specific equipment such as heat exchangers.
 - This varies during the cleaning process; Main issues Mercury & COD for waste processing; Main issues Flash point & mercury concentrations for acceptance by waste processors.
- Acceptance criteria for mercury and other parameters in wastewater sent for treatment.
 - This varies per waste processor (acceptance criteria). Critical for acceptance: COD and Flash point; Critical for processing (costs): mercury and COD.

The SITURN team explicitly stated that cost figures could be provided as percentages across the different cost categories. Exact figures will be shared after signing a NDA.

Application and next steps

The webinar confirmed an application deadline of **18 September 2026**. Applications will be collected and reviewed by SITURN together with ChallengeBase. Approximately five promising applicants may be invited to the next stage, depending on the number and quality of submissions.

The planned process is:

1. Application: submit an initial solution proposal.
2. Selection: SITURN reviews the proposals and selects the most promising candidates: 24 September 2026.
3. Introductory meetings: planned online for 6 October 2026.
4. Site visit: for candidates where there is continued mutual interest.
5. Deep dive: further discussion of the technical solution, collaboration model, potential barriers, IP and implementation.
6. Match event: if a collaboration is agreed, the intention to collaborate can be formally celebrated.
7. Development and pilot phase: testing, contracting, piloting and, where successful, scaling.

Applicants were encouraged not to over-engineer the initial submission. The first proposal should provide a clear overall view of the solution and create a basis for discussion; it does not need to contain every technical and financial detail at the application stage.

Disclaimer

This challenge is a non-binding invitation to submit solutions and does not qualify as a procurement procedure. Participation does not create any entitlement to award, compensation or further collaboration. SITURN reserves the right to amend, suspend or terminate the challenge.

All intellectual property rights relating to submitted proposals remain with the submitting party, unless agreed otherwise in a separate agreement.