Market consultation

for: Modular Electrolysis Pilot Design and Construction

Contracting authority:
The Netherlands Organisation for Applied Scientific Research TNO

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Contents

1. Introduction

This document describes the organisation TNO, and the content, objective, schedule, preconditions and procedural matters of the market consultation.

TNO intends to build an Modular Electrolysis Pilot for carbon dioxide conversion. The objective is to design and construct a highly flexible electrolysis pilot for the direct electrochemical conversion of CO_2 to formate/formic acid and other products using renewable energy. This pilot needs to be developed in the framework of an Interreg 2 Seas project, called Electrons to High Value Chemicals (E2C, see https://www.voltachem.com/e2c). TNO would like to work together with a commercial partner to design and construct this pilot installation. Therefore, TNO would like to gain more information from the market by conducting this market consultation. The gained information might be used as input for the a possible formal tender process. Therefore, any party which is able to develop and build such pilot demonstrator for the purposes described in section 3 is invited to contact TNO to present the answers on the questions posed in section 4 and other relevant information they would like to share with TNO.

After this market consultation TNO will decide which Tender procedure is the most appropriate choice for designing and building the Modular Electrolysis Pilot.

1.1 TNO

The Netherlands Organisation for Applied Scientific Research, hereafter 'TNO', is a modern, industry driven Research & Knowledge organisation. It was established in 1930 by Act of Parliament with the intention of maximizing the practical relevance of scientific research to the public sector, industry and society at large. The government of the day believed that this would enhance the innovative strength of the Netherlands and contribute to long-term economic growth. TNO is an independent not-for-profit research organisation. We believe in the joint creation of economic and social value.

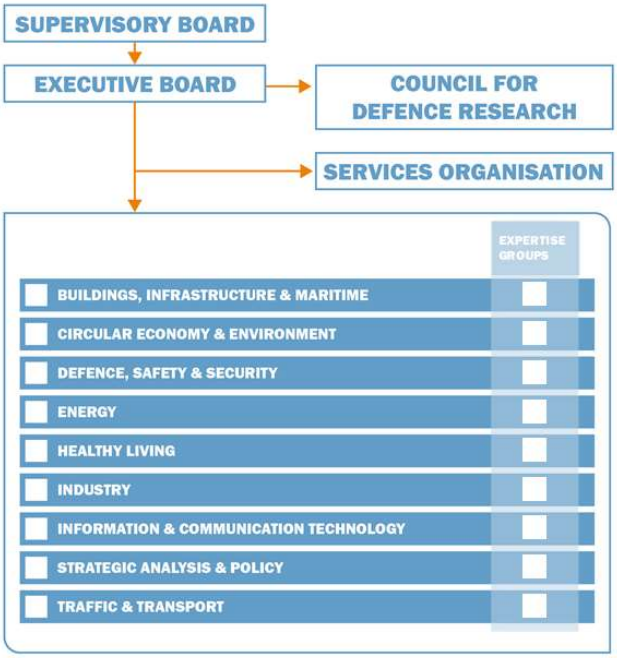
TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the wellbeing of society in a sustainable way. This is our mission and it is what drives us, the over 2,600 professionals at TNO, in our work every day.

Effective innovation is what TNO stands for. We do not do that alone but with companies, governments and a whole range of organisations. Through collaboration we create innovations that sustainably strengthen the competitiveness of companies and the wellbeing of society. We develop knowledge not for its own sake but for real applications. We work on issues that concern our environment, safety and security, the energy transition, innovations in industry and how to keep the ageing population actively engaged. These are the challenges that TNO researchers take up every day in their drive to produce impactful innovations.

1.2 Organisational structure

TNO's high level of ambition demands an appropriate organisational structure and corporate culture. Staff must be given every support as they pursue innovation and productive cooperation. The current organisational structure is shown below:

TNO STRUCTURE



We focus on transitions or changes in nine societal themes:

- Buildings, Infrastructure & Maritime: 'Robust constructions, sustainable use'
- Circular Economy and the Environment: 'Directing and accelerating sustainability'
- Defence, Safety and Security: 'We're putting our knowledge and technology to work for safety and security'
- Energy: 'Faster towards a sustainable energy supply'
- Healthy living: 'Focussing on participation, not on the disease'
- Industry: 'Innovating for employment, welfare and well-being'
- Information & Communication Technology: 'Interpreting and accelerating digital transformation'
- Strategic Analysis & Policy: 'Turning complex issues into concrete innovations'
- Traffic and Transport: 'Helping to create liveable, sustainable cities'

Innovation with purpose is what TNO stands for. We develop knowledge not for its own sake, but for practical application. For further information, see: *https://www.tno.nl/en*

1.3 Procurement

The TNO Procurement Department is involved in the purchasing, procurement and tendering procedures on behalf of TNO. For the Modular Electrolysis Pilot this is done in close cooperation with the department Sustainable Process & Energy Systems which is part of the unit Energy / ECN part of TNO. As part of the Finance, Procurement & Legal division, the Procurement Department is responsible for organizing and implementing all procurement processes in line with the corporate objectives of the organisation.

1.4 Purpose

Before proceeding with the preparation of a tender, TNO would like to consult the market on how this tender (in broad lines) can be structured. Within the scope of the market consultation, advice is sought to gain insight into the potential market for the development and building of the Modular Electrolysis Pilot for TNO. The market consultation is open to all players in the market.

The market consultation generates benefits for all parties involved. TNO observes what is possible and what the perception is of the market. So as to provide a more effective and coordinated response in how, for example, preferences and requirements can be formulated in the tender.

For interested players in the market an added advantage is that they get an early view of TNO and the tender which might follow. In addition, the market can affect requirements which will come back in the tender. This allows participants to contribute to the success of the tender.

The purpose of the market consultation is covering the following aspects:

- To gain more insights in discriminating factors for different configurations of the Modular Electrolysis Pilot.
- To gain more insight into the current possibilities and the choice on the market.
- To get a clear understanding of the visions, ideas and suggestions of market participants.
- To gauge market interest for this possible tender.
- To decide which procurement strategy is best suited to our functional requirements in the current market.

The results of the market consultation may be processed in the possible tender documents, without traceability of participants of this market consultation.

1.5 Schedule

There are no follow up sessions planned for this market consultation, although after the market consultation TNO may wish to contact subscribers for an explanatory interview on their reply.

The schedule of the market consultation is shown in the table below.

Date	Deliverable / activity	Who?
4th of June 2019	Market Consultation document published by TNO	TNO
24th of June 2019, 15:00h	Deadline for submitting your input	Subscriber
After 24th of June 2019	Possibility of Explanatory interview	TNO and Subscriber
Date of tender publication	TNO summary of market consultation results	TNO

1.6 Explanatory interview

Based on the answers of the Questionnaire of section 4, TNO may wish to invite or visit parties for an explanatory interview. TNO will assess the received answers on content and relevance for an explanatory interview for TNO, as well as the need for (further) explanation. The location for the interview will be Leeghwaterstraat 44, Delft or the location of Subscriber.

2. Basic principles and preconditions

The basic principles and preconditions mentioned below apply to this market consultation:

- TNO observes the principles on non-discrimination and transparency when carrying out this market consultation;
- This document is solely intended for market consultation purposes;
- Market parties who do not join this market consultation are thus not excluded of participating the possible tender. Neither are market players who join this market consultation in any way excluded, or privileged in, the possible participation of the tender;
- If market parties are not joining this market consultation, although they are able to deliver such system, they are kindly requested to forward this information to the TNO contact person named in section 2.1.
- This market consultation is without any obligation, both for participants and for TNO;
- Parties who are participating or not in this market consultation cannot derive any mutual obligations or rights towards TNO;
- Participating to this market consultation does not confer an entitlement at obtaining a contract award;
- TNO shall not reimburse any eventual costs in participating to this market consultation;
- Participating market parties agree that the information provided by them can be processed anonymized in the further elaborating program of requirements;
- In the context of the market consultation, provided information may differ from the information that will be provided in the tender procedure;
- The contribution of participating Parties will be handled as much as possible with confidentiality and in any case TNO will

take into account the legitimate interests of the parties;
- The official language during this market consultation is English;
- TNO is not bound in any way by the outcome of the market consultation or obliged in realisation and/or tendering of the project upon which the market consultation is linked;
- No claim will be honoured for the use of information, confidentiality, or request for compensation herewith;
- All documents submitted by the participating Parties are considered public documents and shall be copy-right free unless otherwise marked by participating Parties. If copyrights are applicable, TNO is protected by the participating Parties;
- TNO reserves the right:
    - To perform the proposed procurement process in a different way, in terms of content and style, than the process that may have been communicated;
    - To cease publication of the market consultation temporarily or permanently;
- Participating in this market consultation, constitutes the Parties unconditional approval of the procedure as stated in this document.

2.1 Form and content

The consultation is set up as follows:

Written responses

Any interested market party who believes that they can contribute to the market consultation, should respond to TNO via the TenderNed procedure. Responses should be received by TNO no later than 24th of June 2019, 15:00h. Responses can be sent to:

Name : Mrs. M. Mastop
Position : Procurement Officer
Department : Procurement
E-mail : aanbesteden@tno.nl

In the heading of your e-mail and in all future correspondence relating to this market consultation should be clearly mentioned ‘Marketconsultation 2019 FPL-INK 076’.

2.2 Intellectual property rights

Except where expressly permitted under Copyright Law or where necessary for the successful preparation of a Market Consultation document, no part of the market consultation documents may be reproduced in any form, by print, photocopy, DVD, CD-ROM, microfilm or other means, without the prior written permission of TNO. Market consultation documents and all accompanying documents submitted further to the Market Consultation Procedure become the property of TNO upon receipt.

2.3 Use of TNO logo

It is not permitted to copy, modify or otherwise use the TNO logo on any documents submitted by the Market Party further to the Market Consultation Procedure.

3. Background of the demand

TNO intends to design and construct a Modular Electrolysis Pilot which is dedicated to the electrochemical conversion of carbon dioxide to formate/ formic acid and other products. The electrolysis pilot is developed into the framework of the Interreg 2 Seas E2C project E2C (https://www.voltachem.com/e2c). It will be part of the TNO Electrolysis Field lab initially placed at an industrial location in the region of Rotterdam. Additionally, it is foreseen that the pilot will be moved to- and placed at other sites in the EU 2-seas region (UK, France, Belgium, Netherlands). Thus it should be transportable by road and it could be installed at different industrial locations.

The Modular Electrolysis Pilot described in the present document is referred to with the acronym "ZEUS". ZEUS is built in a modular way in order to offer maximum flexibility for the testing of different electrolyzers producing various gasesous and liquid products which result from the direct electrolysis of carbon dioxide. The pilot needs to fulfil a set of typical requirements for such equipmentwhich are grouped into the following categories:

- **FUN**ctional: Operational pressure, temperature, etc.
- **CON**figurational
- **INT**erfaces
- **PHY**sical characteristics
- **QUA**lity factors

The requirements will be further given in section **Fout! Verwijzingsbron niet gevonden.**. For a better understanding of the system that needs to be designed, developed and build, a system breakdown is given in section 3.1.

3.1 The System Breakdown (SBD) of ZEUS, the Modular Electrolysis Pilot

The System breakdown of ZEUS is given in Figure 1 where the different levels of the system are depicted. The subject of the current market consultation is the entire ZEUS system with the exception of the electrochemical reactors depicted at Level 3, namely Electrochemical reactor systems for both of the modules: A-ERS and B-ERS. Thus the electrochemical reactors itself are out of scope of this market consultation and are developed separately form ZEUS. However, ZEUS must be designed in a flexible way such that a large range of different electrolyzers from different companies can be tested.

At the heart of the entire ZEUS are the electrochemical reactors (electrolyzers). The rest of the setup is developed and built in a way that allows the safe, continuous and autonomous operation of the electrolyzers.
Module A will be primarily developed for the production of liquid products in general and formic acid in particular.
Module B will be primarily developed for the production of both liquid and gaseosus products in general and formate and carbon monoxide in particular.

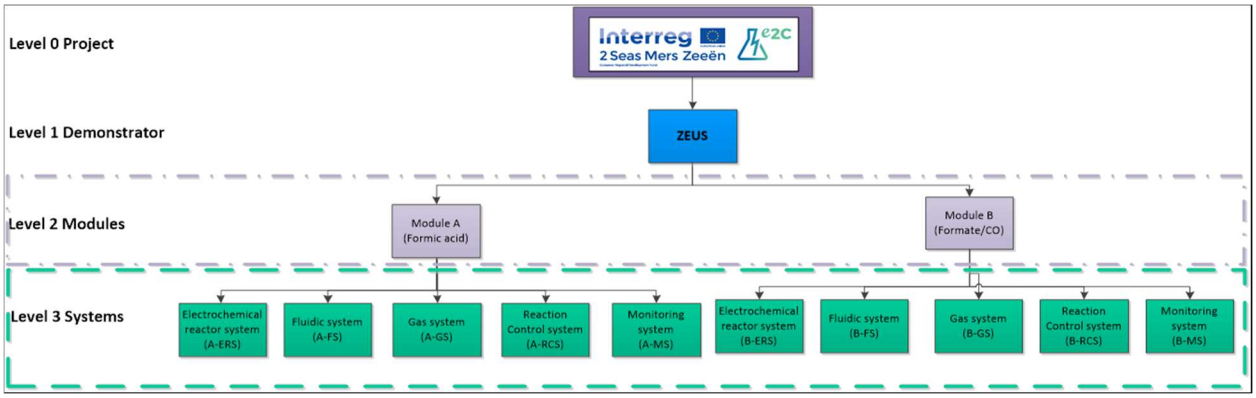


*Figure 1. System breakdown (SBD) of ZEUS, the Modular Electrolysis **Pilot**.*

3.2 First sketches

It is envisaged that ZEUS will be placed into a confined enclosure. A schematic of a configuration is representated in Figure 2.

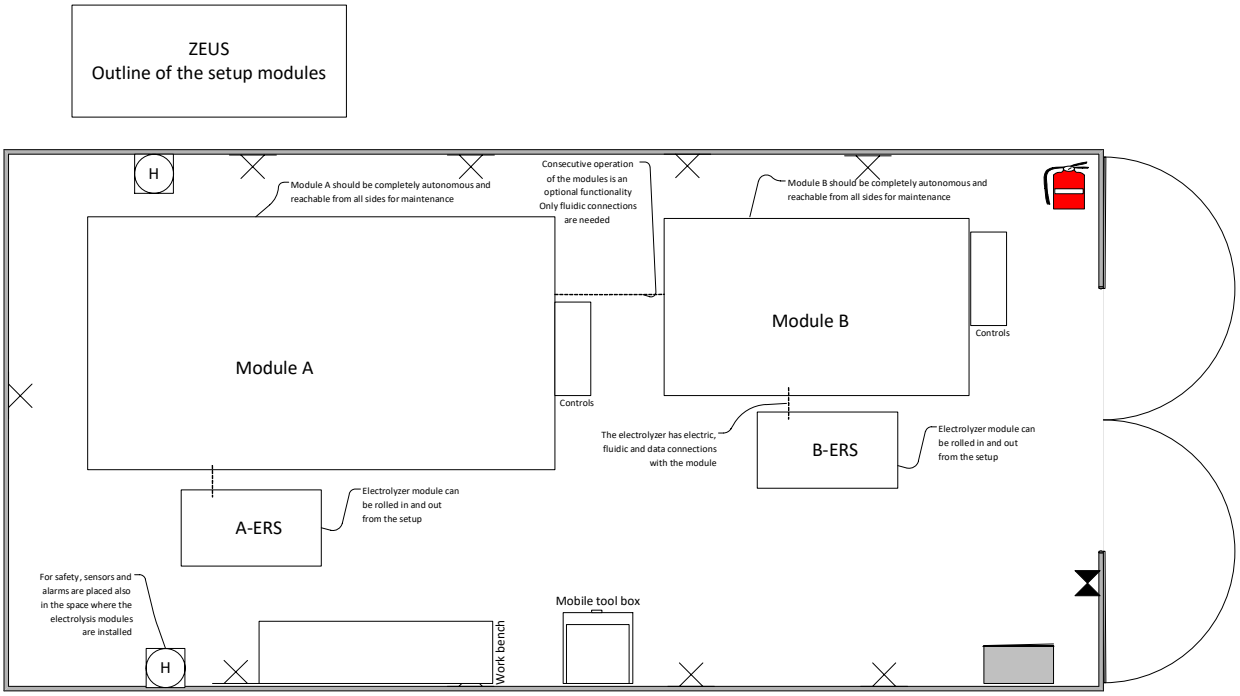


Figure 2. Schematic representation of the envisaged outline of ZEUS when placed in a shipping container sized confinement. NOT TO SCALE

4. Questionnaire

Subscribers are not obliged to answer all questions of the market consultancy.
Subscribers can be asked for additional explanation in a second round.
Subscribers are requested to limit their response with a maximum of 8 pages of A4.

	Questions on interest
A1	Do you consider, based on the limited information of this document, to apply to the tender? If yes, why, if not, why not?
A2	If you consider to apply as a combination of parties, which subcontractors would they be and why would you choose for these parties?
	Questions on the content
B1	Are you capable of making an engineering design of an Electrolysis pilot system based on a conceptual design?
B2	Are you capable of designing pressurized electrolysis setups?
B3	Are you capable of designing an autonomous electrolysis setup?
B4	Are you capable of building an electrolysis pilot system?
B5	Are you capable of building an autonomous electrolysis setup?
B6	Do you have experience with building metal free pressurized systems (1-20 bar)?
B7	Are you familiar with applying HAZOP methodology for the designing and building of chemical reactors?
B8	Do you have ideas on how to make the setup mobile in such a way it can be used at different locations? What critical issues do you see for using a standard sized container housing as the placement of the electrolyzer pilot? How would you address these issues?
B9	Have you deisgned or built electrolysis setups before?
B10	What would be the standard temperature range during operation and non-operation?
B11	What are the minimum and maximum operational and non-operational temperatures?
B12	What kind of thermal measures can be offered (insulation, local heaters, etc) in order to stay within the operational temperature ranges of the Modular Electrolysis Pilot if the electrolyzer is at different temperature?
B13	Can you implement a backpressure regulating system over multiple electrolyte feeding vessels?
B14	Can you design and implement an automatic inline (or semi-inline) sampling system for liquids?
B15	Can you design and implement an automatic inline (or semi-inline) sampling system for gases?
B16	Can you deliver a software application with a graphical user interface for the automatic operation of the Modular Electrolysis Pilot?
B17	Can you design the software application to interface and extract data from external inline analysis setups such as gas chromatographs?
B18	Can you use the input from inline analysis setups such as pH meters
B19	Can you implement an alarm system in the software application and the setup?
B20	Do you have specific innovative solutions that can be used for the Modular Electrolysis Pilot?
	Question regarding the tender
C1	What is the track-record of your company in engineering / procurement / commissioning of novel electrolysis pilots?
C2	We consider the development of the Modular Electrolysis Pilot (ZEUS): design, engineering, manufacturing, system integration, testing, commissioning. Which phases will be performed by yourself, which will be outsourced to third parties?
C3	Interfaces of the Modular Electrolysis Pilot (ZEUS) with other parts (the electrolyzer, the gas supply, the ventilation) will probably not be clear at contract signing. What kind of flexibility can be offered regarding late definition of interface definitions?

C4	What are your strongest added values?
C5	Is your organisation able to estimate the price-impact of still TBD requirements, and can you provide estimation per each TBD item if applicable?
C6	Which ones are the price-driving parameters in the execution of the project?
C7	Which important costs can be reduced using a well-chosen approach during contract?
C8	Is your company and possible subcontractors ISO9001 certified?
C9	What is your indication of price per size of the system?
	Questions regarding planning
D1	How much time do you need to make a sufficient proposal during the tender?
D2	What would be the lead time from contract award to Preliminary Design Review?
D3	When would it be possible to perform the Factory Acceptance Test at your premises?
D4	When would it be possible to perform the Site Acceptance Test at TNO in Delft or at the field lab location in the Rotterdam area?
D5	What is the expected maintenance interval?
D6	What do you consider as the greatest risk(s) of the development of the Modular Electrochemical Pilot?
	Finally
E1	Are you prepared to explain your answers to the questionnaire orally by invitation?
E2	Do you have other ideas, suggestions, or comments?