

**EXPRESSION OF INTEREST (EoI)  
FOR**

Transfer of Technology  
on

**Hydrogen Storage and Delivery using Catalytic  
System (HyStoCat)**

**A Liquid Organic Hydride based Technology**



**CSIR-National Environmental Engineering Research Institute (NEERI), Nehru  
Marg, Nagpur - 440 020 Maharashtra**

**September 2023**

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## Introduction

CSIR-NEERI has developed a technology on, “Hydrogen Storage and Delivery using Catalytic System (HyStoCat)”. The technology is based on a paired reactions of hydrogenation of aromatics to cycloalkanes and dehydrogenation of cycloalkanes to aromatics. The heart of the technology is catalytic dehydrogenation wherein process and catalysts are patented by of CSIR-NEERI The process has been patented nationally (IN 288846) and internationally (US 9005571 and EP 2620410). The technology is very effective for long term and short period storage of hydrogen. It provides an efficient route with relatively higher gravimetric and volumetric capacities of hydrogen storage. CSIR-NEERI intends to transfer its know-how to MSMEs/ industries/ Government Organizations etc. with Engineering and Scientific knowledge, good financial background and adequate experience of renewable energy systems in general and hydrogen energy in particular. CSIR-NEERI has decided to issue a **non-exclusive license** for a period of **Five years** for practicing the technology commercially in India. For implementation outside India a separate TT agreement with separate conditions will be required.

### 1. About CSIR-NEERI

CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur is one of the premium institutes of CSIR under the Ministry of Science and Technology, Govt of India. The institute is dedicated to research and innovations in environmental science and engineering, besides providing solutions to industry, government, and society. Over the years, the institute has developed excellence and expertise and global recognition in emerging areas of environmental science and engineering.

### 2. HyStoCat Technology details

The technology is based on a paired reactions of hydrogenation of aromatics to cycloalkanes and dehydrogenation of cycloalkanes to aromatics as explained in the figure 1 for a particular application of providing hydrogen to fuelling stations. Hydrogen is picked from hydrogen production facility by hydrogenation of aromatics to cycloalkanes and subsequently, delivered at required location via dehydrogenation of cycloalkanes to

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aromatics. Aromatics can be transport back to pick up hydrogen in next cycle. The other applications for the technology for hydrogen storage and transportations are possible. Carrying hydrogen in chemically bounded form as cycloalkanes at ambient temperature and pressure and recovery of hydrogen via a subsequent dehydrogenation reaction is a potential option for hydrogen delivery and delivery. The candidate cycloalkanes including cyclohexane, methylcyclohexane, decalin etc. contains 5.5 to 8 wt% hydrogen with volume basis capacity of hydrogen storage of 40-60 kg/m<sup>3</sup>. In view of several advantages of the system such as transportation by present infrastructure of lorries, no specific temperature pressure requirement and recyclable reactants/products, the LOH definitely pose for a potential technology for hydrogen delivery. Due to high boiling points of cycloalkanes, the present infrastructure such as oil tankers and tank lorries can be used for the long-term storage and long distance transportation of hydrogen in the form of LOH

A considerable development is reported in this field regarding various aspects of the catalytic dehydrogenation of the cycloalkanes for activity, selectivity and stability. The process can facilitate a saving of carbon dioxide emissions by replacing fossil fuels with hydrogen for transportation and other applications. There is a large techno-economic potential for the process.

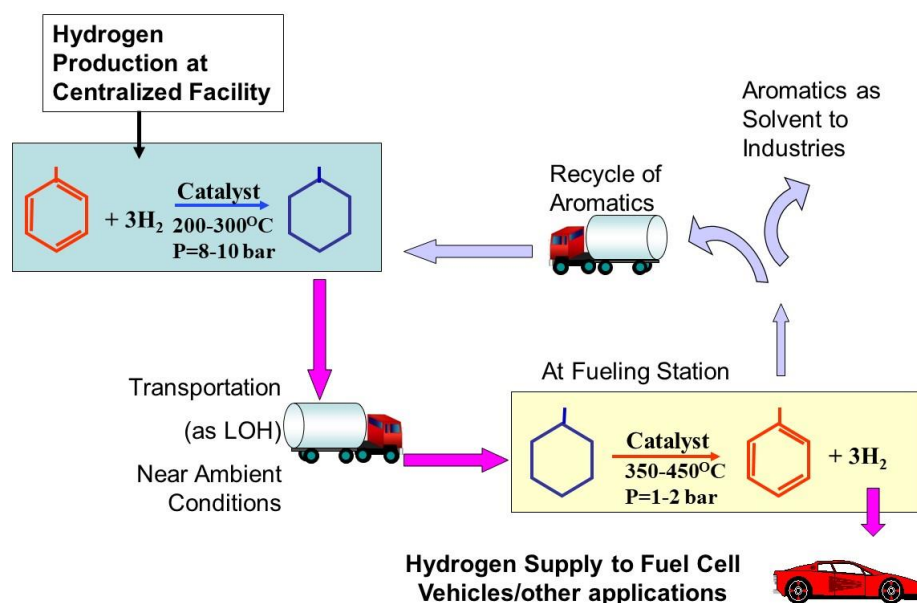


Figure 1. Concept of Hydrogen Storage and Delivery using LOH

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The HyStoCat technology is related to pickup of hydrogen using LOH hydrogenation method and delivery at the delivery point via a catalytic dehydrogenation process. The transportation between pick-up and delivery location may be carried out at ambient temperature and pressure. The transportation method may be selected and design appropriately as per the need, safety norms etc. HyStoCat is independent of transportation systems used for transporting LOH.

**Technology Status:**

**IPR Status:** The Technology is developed through wholly in-house projects funded by Ministry of New and Renewable Energy (MNRE). The heart of technology consisting of dehydrogenation process and catalysts thereof have been patented nationally (IN 288846) and internationally (US 9005571 and EP 2620410).

**Technology Readiness Level:** The Technology is currently at TRL 5 wherein development of catalytic reactor system for dehydrogenation and its integration with commercially available PEM fuel cell is validated. The same reactor is used for hydrogenation reaction. Further prototype of capacity of delivering 1 Nm<sup>3</sup>/h of hydrogen is developed. Further development required for TRL 7 to 9 is expected to be carried out during implementation for various applications jointly with licensee.

**Technology Value Proposition:**

- The Technology offers the solutions which will impact Industries:
  - The technology provides improved process for storage and delivery of hydrogen by dehydrogenation of hydrogenated liquid organic and cyclic pick up through a hydrogenation reaction.
  - Relatively high capacity for hydrogen storage both volumetric and gravimetric as 40 kg/m<sup>3</sup> and 5.5 wt.% respectively.
  - The technology is based on a paired catalytic reaction of hydrogenation of aromatics to cycloalkanes and dehydrogenation of cycloalkanes to aromatics.
- The Technology offers following advantages over existing technologies:
  - Higher activity of novel catalysts.
  - Relatively high hydrogen storage capacity.
  - Hydrogen purity of 99.95%
  - Hydrogen free of CO<sub>x</sub>.

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- Handling of LOH at ambient temperature and pressure, no need of cryogenic conditions or high-pressure storage during transportation.
  - Technology considerations:
    - Minimum use of noble metal in the catalyst leading to cost-effective catalyst.
    - Complete process integration and automation
    - Novel reactors for higher efficiencies
  - Benefits/value offered by solution:
    - Cost effective approach due to reversible catalytic reactions.
    - No heavy infrastructure costs as existing lorries systems gasoline and diesel are useful.
    - Effective long-term storage and long-distance transportation of hydrogen in the form of liquid organic hydrides.

### 3. Technology Transfer Package

The Transfer of Technology (ToT) package contains the following:

- General system design and installation document
- Catalyst preparation method and characterization details
- Operation and maintenance instructions
- Feed and product quality specification document
- Technical Support for joint development for applications. Technical Support for design, installation, demonstration and troubleshooting for a period of 2 years. Technical support and any additional feature or development required will be provided on charged basis.

### 4. Technology License Fee and conditions

The major terms and conditions of the technology transfer are as following. The detailed terms and conditions will be covered in technology transfer agreement;

- Technology License Fee:
  - Rupees 3.00 Crore (Rupees Three Crore only) + GST (as applicable) at the time of TT as lumpsum (Relaxation for payment period for lumpsum license fee for MSME/Startups will be considered case to case basis)
  - Plus recurring royalty will be decided based on the market plan, application plan by potential technology buyer

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- The technology will be transferred on Non-Exclusive basis
  - The performance of licensee will be evaluated every Five years for continuation of license without any additional fee.
  - Cost of development projects for various applications, such as towards demonstrations/pilots and any certifications etc., will be borne by licensee

## 5. Who can apply?

- a) Industries with background/interest in processing storage and supply of Hydrogen.
- b) Having good financial background evident from turnover for past three years.

## 6. How to Apply?

- The EOI shall be submitted in one single envelope in hard copy and should reach to CSIR-NEERI on or before the specified due date in this EOI
- The interested firm should submit **Application** in the format enclosed in **Annexure-I**
- The firms shall submit their EOI addressing to Director, CSIR-NEERI, Nehru Marg, Nagpur- 440 020. Address for submission of EOI is given below:  
To  
Scientist & Head  
Business Development & Project Monitoring and Planning Division (BDPMPD),  
CSIR-NEERI, Nehru Marg, Nagpur 440020
- Any query may be written to Scientist & Head, BDPMPD at Email: [pmpddivision@neeri.res.in](mailto:pmpddivision@neeri.res.in);
- All the documents submitted by the selected firms should be signed and numbered.
- Applications that are incomplete in any respect or those that are not consistent with the requirements as specified in this document or those that do not adhere to formats, wherever specified may be considered non-responsive and may be liable for rejection and no further correspondences shall be entertained with such applicants.
- Canvassing in any form would disqualify the applicant.

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## 7. Availability of EOI documents:

Applicants should download the complete set of EOI documents which is available in our website [www.neeri.res.in](http://www.neeri.res.in) . Applicants are requested to visit the website regularly for corrigendum towards any modification/ addition/ due date extension etc. for this EOI, since the same shall not be published in newspapers.

## 8. Qualification Criteria:

- i. The applicant organization must be a reputed firm/company/MSME.
- ii. It is desirable that the firm should have experience of renewable energy projects in general and hydrogen related renewable energy experience in particular.
- iii. Having good financial background with turnover of minimum 10 crore for past three years to implement technology. This criterion may be relaxed for MSMEs as per GOI rules.
- iv. The firm should have engineering capabilities for utilization of the technology and develop various applications in the field. Past experience of engineering project implementation, operation & Maintenance. Supporting documents for past experience to be provided.

**The details about points (i) to (iii) should be provided for past 3 years in Application (Annexure I), Annexure 1.1, Point No. 14 and Annexure 1.3 of EOI by enclosing copies of work orders, completion certificates etc.**

- v. A detailed proposed business plan should also be provided in **Application (Annexure I), Business Plan (Annexure 1.4)** of EOI.
- vi. The firms must agree to pay the technology license fee and royalty to CSIR-NEERI as defined in section 4 of EOI.

## 9. Process for Selection of Firm

- a) Technically qualified firms as per above section 8, points (i) to (vi) will be called for discussion and presentation before Technology Transfer Committee of CSIR-NEERI before final acceptance as per CSIR-NEERI's approved procedure. The

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firms will be shortlisted based on the presentation, discussion and documents supporting experience of firm.

- b) All shortlisted firms will be offered Transfer of Knowhow on Non-exclusive basis.
- c) The transfer of knowhow shall be executed through Licensing Agreement with standard terms and conditions.

#### **10. Other conditions**

- i. CSIR-NEERI reserves the right to withdraw/cancel this EoI or this request for EOI without assigning/notifying any reason and/or invite afresh with or without amendments, without liability or any obligation for such request for EOI. Information provided at this stage is indicative and CSIR-NEERI reserves the right to amend/add further details at final stage of selection.
- ii. The decision of the Director, CSIR-NEERI, Nagpur shall be final and shall be binding.
- iii. CSIR-NEERI shall not be responsible for any expenditure incurred by the applicants in connection with the preparation and delivery of their applications or any other expenses incurred as regards the subject EoI.
- iv. Telefax/ E-mail/ CD shall not be accepted if not accompanied with a formal signed document. CSIR-NEERI takes no responsibility for any delay/ loss during posting for non-receipt of document sent by Post/ Courier within the due date.
- v. Mere submission of the proposal/ application does not entitle automatic qualification.
- vi. Proposals found suitable shall be shortlisted for detailed discussion/ presentation by the Technology Transfer Committee (TTC) before final acceptance as per CSIR-NEERI's approved procedure.
- vii. Any clarification against this EoI can be sought from the designated official(s) only in writing or through e-mail, which shall be clarified by the designated official only through e-mail. CSIR-NEERI may at its discretion extend this deadline for the submission of EOI.
- viii. To assist in the examination, evaluation and comparison of EOI, CSIR-NEERI at

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its discretion can ask the applicant for the clarification or submission of additional information/documents. However, post submission of clarification at the initiative of the applicant shall not be entertained. Authority reserves the right to visit the facilities of the applicants if required.

- ix. At any time before the submission of the applications against the EOI, the CSIR-NEERI may carry out amendments(s) to this EOI document and/ or the schedule. The amendment shall be made available on the website [www.neeri.res.in](http://www.neeri.res.in) and will be binding on them.
- x. The Authority reserves the right to accept or reject any application without assigning any reason thereof.

### 11. Contact Person for technical enquiries

Dr Rajesh B Biniwale  
Chief Scientist & Head  
Cleaner Technology and Modelling Division  
CSIR-National Environmental Engineering  
Research Institute  
Nehru Marg, Nagpur-20  
Tel: +91-9822745768  
Email: [rb\\_biniwale@neeri.res.in](mailto:rb_biniwale@neeri.res.in)

### 12. Submission of EOI

The EOI proposal should be submitted with all supporting documents as required in section 8. The Technical information may specify details and strength of the applicant as specified in **Annexure –I**. The last date for submission of EOI in hard copy is **October 16, 2023 till 5:00 PM**

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## Envelope A

# Application

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**COVERING LETTER**

(On Company/ Institute letterhead)

Date:

**To,****DIRECTOR**

CSIR-National Environmental Engineering Research Institute  
Nehru Marg, Nagpur-440 020  
Maharashtra, INDIA

**Subject : Submission of Expression of interest (EOI) for Transfer Technology,  
“Hydrogen Storage and Delivery using Catalytic System (HyStoCat)”**

**Dear Sir,**

Having examined the Expression of Interest (Eoi) the undersigned, on behalf of our company intend to participate in EOI for Transfer of Technology, **“Hydrogen Storage and Delivery using Catalytic System (HyStoCat)”** and submit the Qualification requirements proposal in response to the Expression of Interest (Eoi) for the said EOI. We attach here with the response, as required by the Eoi, which constitutes our proposal.

I/We confirm that the information contained in this response or any part thereof, including its exhibits and other documents is true, accurate, verifiable and complete. I/We fully understand and agree to comply that on verification, incorrect information, if found to have been furnished the application is liable for rejection at any stage of evaluation. Our Firm/Company agrees for acceptance of all the terms and conditions set out in the EOI documents. It is hereby confirmed that following authorised person is entitled to act on behalf of our company/ corporation/ firm/ organization and empowered to sign this document as well as such other documents, which may be required in this connection.

Our Authorised contacts for our company are:

Name:

Designation:

Address:

Phone No: &amp; Mobile No:

Fax:/ E Mail:

(Signature and Seal of Company)

(In the capacity of Director/CEO)

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## DETAILS OF THE COMPANY

	Item	Details (Attached True copy)
1.	Name of the party/legal entity With Year of establishment	
2.	Name of the Owner/ Founder contact details	
3.	Details of Directors	
4.	Details of Registration as an industry/legal entity (copy of certificate to be enclosed)	
5.	Address of works & Registered office premises	
6.	Certificate of Incorporation	
7.	PAN Number	
8.	GST Number	
9.	Udyog Aadhar	
10.	Details of office Premised/ branches/ industry etc.	
11.	Details of CEO/MD/GM	
12.	List of regular employees with qualifications, experience should be provided	
13.	Total Staff of Company	
14.	Details of work done in past 3 years. Copies of work orders, completion certificates etc.	

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**FINANCIAL DETAILS OF COMPANY**

	<b>FY 2019-20</b>	<b>FY 2020-21</b>	<b>FY 2021-22</b>
Annual turnover			
Net Profit			
Net Worth			
Debt/Equity ratio			

**Note- Please submit Audited Annual Reports containing audited balance sheets and profit loss accounts statements for preceding 3 financial years**

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**EXPERIENCE CRITERIA&PROVEN TRACK RECORD**

**List top five projects ongoing/ completed, if any (Last 3 years) in  
Hydrogen/Renewable Energy sector**

Name of the Project	Sponsoring Agency	Amount sanctioned (Rs Lakhs)	Amount released (Rs Lakhs)	Duration (in years) From- To	Awards (If any)

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**BUSINNESS PLAN**

[Details Business Plan for implementation of technology, plan shall have details on the facts and figures]

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**AFFIDAVIT**  
(On 100 rupees' stamp paper)

I, \_\_\_\_\_ Son of \_\_\_\_\_  
Aged about \_\_\_\_\_ years, resident of \_\_\_\_\_  
\_\_\_\_\_ and \_\_\_\_\_  
\_\_\_\_\_ (Director/Partner/Proprietor) of \_\_\_\_\_  
\_\_\_\_\_ having its Registered office at \_\_\_\_\_,  
\_\_\_\_\_ do hereby solemnly affirm and

declare as under:

We are not debarred or black listed by any of the Government Authorities / Government Organization / Public Sector Undertakings / Private Organizations for carrying out any of the assignments, tasks, works, projects etc.

1. We have not defaulted in repayment of any of the undisputed dues raised / taken by us from financial institution / Non-Banking Financial Company (NBFC's) and banking companies.
2. No case of the fraud has been lodged against us by any of the stakeholders including Government departments, banks and financial institutions or any other Person / Organization.
3. We have complied with all regulatory and statutory requirements applicable to our organization till \_\_\_\_\_
4. We will abide by all the rules, regulations and directions given by CSIR-NEERI or any of the departments in relation to the projects for which such license is being allotted.

That the contents of this affidavit are true to the best of my knowledge and belief, and nothing in material has been concealed in.

I also acknowledge that CSIR-NEERI has right to cancel all the licenses granted in relation to which this affidavit is executed, if any of the information, explanation provided to CSIR-NEERI seems untrue.

Date: -

Place: -

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**UNDERTAKING WITH REGARD TO NON-LITIGATION**

(To be submitted on Company's Letter Head)

**To**

**DIRECTOR**

CSIR-National Environmental Engineering Research Institute  
Nehru Marg, Nagpur-440 020  
Maharashtra, INDIA

**Subject: Undertaking regarding Litigation**

Dear Sir,

It is hereby confirmed and declared that M/s -----, does not have any litigation / arbitration history with any Government department/ Public Sector Undertaking/ / or any other public authority with which any MoU was / has been executed / undertaken.

Yours faithfully,

(Signature of the Authorised signatory)

Name:  
Designation:  
Seal:  
Date:  
Place:

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