

# National Institute of Chemistry

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## 1. Company Overview

National Institute of Chemistry, Center for Demonstration of Carbon Free Technologie, Loke pri Zagorju 14b, 1412 Kisovec, Slovenia

- Established: 1946 (Institute) / 2024 (Demonstration Centre)
- Public research institute
- Large research organisation (250+ employees)
- Member of TECES partnerships

The National Institute of Chemistry (NIC) is an internationally recognised Slovenian public research institution with long-standing cooperation with industry. The Center for Demonstration of Carbon Free Technologies focuses on applied research, pilot development and demonstration of hydrogen, carbon capture and circular energy technologies.

The Centre bridges laboratory research and industrial-scale deployment, supporting decarbonisation, energy resilience and modular carbon-free solutions suitable for civil and defence applications.

## 2. Core Capabilities & Technologies

NIC develops and validates advanced energy and carbon-neutral technologies.

### ***Key Technological Strengths:***

- Hydrogen production (water electrolysis, hybrid and wastewater electrolysis)
- Biomethane and biogas reforming to syngas and hydrogen
- CO<sub>2</sub> capture (air capture, exhaust treatment, gas polishing)
- CO<sub>2</sub> conversion to methanol and methane
- Ammonia production and cracking technologies
- Waste-to-energy and circular feedstock processing
- Magnetically and induction-heated catalytic processes
- Solar and light-driven catalysis
- Bio-based materials and sorbent development

- Digital twin and circular process optimisation approaches

***In-house Infrastructure:***

- Electrolyser prototyping (up to kW nominal power)
- PEM and AEM testing platforms (10 cm<sup>2</sup> to 0.5 m<sup>2</sup> active area)
- Membrane welding and material deposition capabilities
- Catalyst and sorbent performance testing
- ATEX-certified reactor testing setups
- Nanomaterial characterisation and design facilities

### **3. Product Portfolio Relevant for the Philippines**

NIC offers modular low-carbon process development and demonstration support.

#### **Development of Bio-Based Sorbents from Residual Biomass: *Technology readiness level: TRL***

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- Production of bio-based sorbents from contaminated residual biomass
- Removal of CO<sub>2</sub>, ammonia, VOCs and sulphurous compounds
- Thermochemical recovery of polluted biomass
- Sorbent regeneration cycle development
- Advanced characterisation (morphology, structure, composition, heavy metals)

***Applications:***

- Flue gas mitigation
- Industrial air purification
- Steelmaking feedstock improvement
- Environmental remediation at degraded sites

#### **Magnetically Heated Production of Methane, Methanol and Ammonia: *Technology readiness level: TRL 3–7 depending on product***

- Rapid high-temperature generation via alternating magnetic fields
- Catalyst-integrated magnetic heating
- Faster start-up and precise temperature control
- Reduced thermal losses compared to conventional reactors

- Modular, mobile and grid-independent operation
- Suitable for integration with intermittent renewable energy

**Applications:**

- Power-to-X systems
- Green fuel and chemical production
- On-site ammonia generation
- Renewable-based methanol production
- Decentralised chemical production facilities

**4. Target Sectors in the Philippines**

- Department of Energy
- Renewable energy developers
- Industrial decarbonisation projects
- Petrochemical and fertiliser industry
- Waste management operators
- Defence energy resilience initiatives
- Water and wastewater infrastructure operators

**5. Use Cases Relevant to the Philippines****Hydrogen & Energy Security**

- Local hydrogen production using renewable electricity
- Biomethane reforming for distributed hydrogen supply
- Hydrogen generation integrated with wastewater treatment

**Carbon Capture & Utilisation**

- CO<sub>2</sub> capture from industrial exhaust
- Conversion of captured CO<sub>2</sub> to methanol or methane
- Power-to-X integration with solar and wind

**Ammonia & Energy Storage**

- Green ammonia production for storage and transport
- Ammonia cracking for hydrogen recovery

- Modular fuel solutions for remote or island systems

## Circular Waste & Biomass Valorisation

- Conversion of contaminated biomass into sorbents
- Industrial gas purification
- Sustainable feedstock recovery

## 6. Competitive Advantages

- 75+ years of scientific excellence
- Strong industry collaboration experience
- TRL 3–6 demonstration infrastructure
- Integrated materials, catalyst and reactor development
- Experience in defence and dual-use programmes
- Modular and mobile process concepts
- Integration with renewable energy systems

## 7. Reference Projects

- Portable Energetically Self-sustained Devices for Military Purposes (NATO SPS)
- IAPUNIT and IAPUNIT II: PEMFC auxiliary power units
- Solid Oxide Fuel Cell project (Slovenian Ministry of Defence)
- ReWater: Modular wastewater treatment and hydrogen production
- MICRO ESA RPA: Magnetically heated methanation
- E-CODUCT: Electrically heated catalytic CO<sub>2</sub> reduction
- HYSTRAM: Hydrogen storage and transport via ammonia
- Alps4GreenC: Sustainable green carbon production

## 8. Deployment & Cooperation Models

NIC seeks cooperation in the Philippines through:

- Joint R&D and pilot demonstration projects
- Technology screening and commercial material validation
- Process optimisation and pilot upscaling



- Integration with local renewable energy developers
- Collaboration with industrial chemical producers
- Support in modular hydrogen and CCU deployment

*Cooperation focus:*

- Hydrogen economy development
- Carbon-neutral fuels and chemicals
- Renewable-based industrial decarbonisation
- Technology transfer and pilot validation

## **9. Primary Contact**

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