

[The NUS Environmental Research Institute \(NERI\)](#) is a university-level research institute that focuses on the development of integrated sustainability solutions for the environment. It collaborates with government agencies, industry, non-government organisations and leading academic institutions to ensure that its research consistently addresses real-world issues.

NERI also serves as the NUS Point-of-Contact for environment and water research. The Institute plays a pivotal role in engaging government agencies, industry and institutions to understand their research needs and bringing together researchers and expertise across NUS to propose possible research initiatives and solutions to address these needs.

The current key research focus and programmes include:

- [Environmental Surveillance and Treatment](#)
- [Environmental and Human Health](#)
- [Green Chemistry and Sustainable Energy](#)
- [Impact of Climate Change on the Environment](#)
- [Food, Energy and Water Nexus](#)

Strategic Programmes

- [Energy and Environmental Sustainability Solutions for Megacities - E2S2](#)
- [Integrated Tropical Peatlands Research Programme](#)

Selected research highlights in the key research focus

[Safeguarding Water Quality through Detection, Surveillance & Modeling of Emerging Contaminants in the Urban Water Cycle](#)

Chemical and microbiological emerging contaminants (ECs) threaten human and ecosystem health. The E2S2 Programme hosted at NERI links interdisciplinary research themes through establishing methodologies and developing diagnostic tools for extensive surveillance of ECs in water compartments, uncovering fate and transport through environmental models, and developing risk assessments and ecotoxicology studies providing solutions to mitigate EC risks.

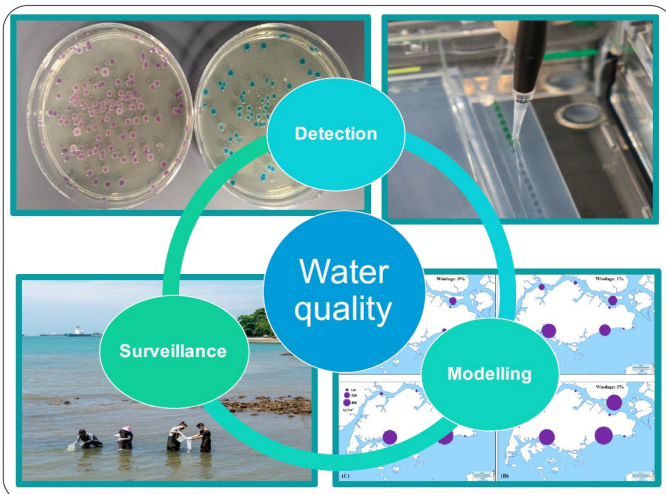


Smart Water & Adaptive technology for data collection from surface water body.

[Smart Water and Adaptive Technology – Big-Data Collection from the Environment](#)

Slow sensor speed and high cost remained as major challenges when incorporating robotics and IoT for environmental studies.

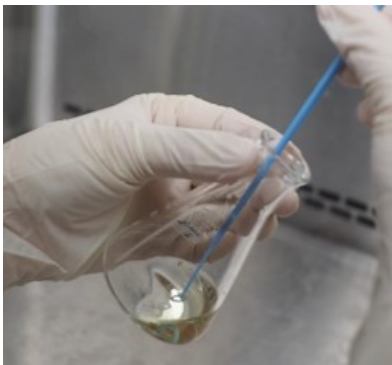
The Tropical Marine Science Institute (TMSI) and NERI are developing multi-robot informative-path-planning algorithms to improve measurement speed and accuracy. The researchers are also developing novel low-cost smart sensor for mass deployment to enable big-data collection from the environment.



Control of Antibiotic Resistance in Drinking Water

Antibiotic resistant bacteria/genes in drinking water pose a serious risk to public health.

NERI researchers are studying the development and persistence of antibiotic resistance during drinking water treatment and distribution. The disinfection with advanced UV technology is applied to control the dissemination of antibiotic resistance in drinking water.



Inoculation of antibiotic resistant bacteria.

Sustainable Climate Resilience Seawater Desalination with Low-Chemical-Energy Pre-treatment Processes

NERI has embarked on projects to develop low-chemical-energy pre-treatment processes for seawater desalination.

Innovations of these technologies involve the development of a robust, integrated and cost-effective electrocoagulation (EC) pre-treatment platform and process optimisation of ceramic ultrafiltration (UF) membrane for foulants removal prior to the reverse osmosis (RO) process in seawater desalination.

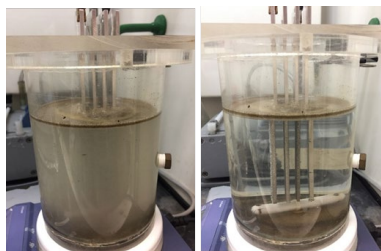


Purifying hard-to-treat industrial wastewater by electrochemical advanced oxidation process.

Dealing with Hard-to-Treat Industrial Wastewater

In Singapore, more than 50% of the water demand is used by the industry and this proportion is expected to reach 70% by 2060.

Specific electrochemical advanced oxidation technologies are being developed to deal with this specific kind of wastewater characterised by high organic load and toxicity.



Before (left) and after 3 mins of electrocoagulation treatment (right).

Development of Bio-inspired Artificial Channels for Water Purification

A NUS team has designed novel synthetic oligourea foldamers with channel activities that form self-assembled nanostructures similar to proteins.

Their higher resistance to microbial degradation allows the opportunities to develop artificial water/ion channels mimicking naturally occurring channel proteins. These foldamers can be used to develop cost-effective, highly efficient devices for water purification.



Preparation of fluorescence dye-encapsulated liposomes for functional studies of synthetic water channels (foldamers).





Food Waste to Resources

Increasing amounts of disposed food waste are posing environmental problems in megacities. Food waste accounts for nearly 25% of solid waste disposed in Singapore.

This project aims to provide sustainable alternative to managing food waste in Singapore. Reducing the load of wastes being disposed, decentralised model of this treatment system eliminates the need for tipping fee and also generates renewable energy and resources for use within the community.

Participation of the public through this project will also raise environmental awareness of citizens and therefore promote sustainable practices and standards in Singapore.



A 1,000 L anaerobic digester for pilot-scale testing.

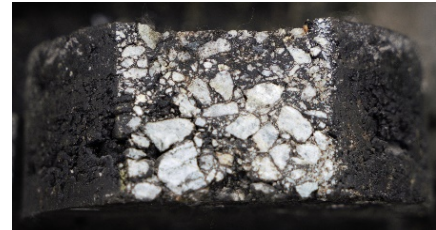
Waste Plastics on Roads: Building a Circular Economy

Use of waste plastics on roads today is highly localised and many urban cities have yet to fully embrace this concept.

NERI together with Department of Civil and Environmental Engineering at NUS have initiated research on waste plastics on roads and looking into solutions to overcome challenges for its implementing in urban cities. The result of this research would mitigate the adverse environmental impacts of plastic waste and would create a sustainable circular economy for plastic.



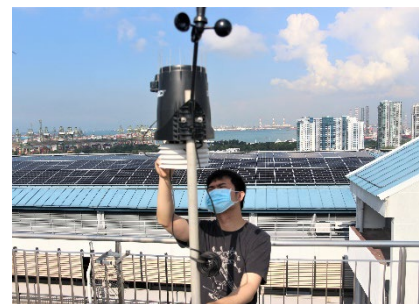
Performing wet mixing of waste plastics on bitumen at the laboratory.



Asphalt sample with waste plastics wet-mixed into bitumen.

Studying Dynamic Atmospheric Processes in Tropical Urban Environment

Air quality sciences have been major research foci of NERI. Following strong conviction of protecting our urban atmospheric environment in the tropics, NERI has been nurturing young scientists and engineers to harvest in-depth understandings of sources, transport and evolution of ambient pollutants to support national policy/services, facilitate regional collaboration and adapt to changing global atmosphere in the 21st century.



Adjusting atmospheric environment monitoring system





Value-added Vegetables

Establishment of sustainable urban farming plays a pivotal role in ensuring nutritional security for the nation.

NERI is equipped with sophisticated equipment and possesses in-house expertise for growth assessment, nutritional and nutraceutical profiling of vegetables. Information generated would be useful for the consumers to make informed decisions on the food crop selection.

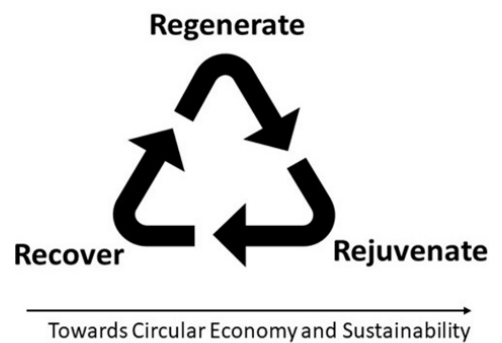
Future of Farming – Microbiome Solutions for Green Environment

NERI adopts a holistic nature-based framework incorporating elements from food-energy-water nexus for sustainable farming practices.

Blending concepts from microbial ecology, environmental and life sciences supported by robust data and AI platforms, NERI researchers are developing microbial consortia to (i) enhance nutritional and nutraceutical quality of crops; (ii) boost plant health and defense mechanisms against emerging pests and diseases; and (iii) increase crop yield and production.

The integrated approach promotes co-benefits and trade-offs to develop cost-effective integrated farming solutions for diverse stakeholders. The research directions are aligned with the national as well as international goals for resilient food systems and sustainable farming practices.

Microbiomes for Future Farming



Microbiomes-based solutions to enhance soil fertility, plant health and environment protection

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