



Sharif Energy, Water and Environment Institute (SEWEI)

Introduction

Encompassing vast oil and gas resources, Iran has consistently been recognized as one of the primary energy players in the region and the world. The obligations of sustainable development and adaptation strategies to climate change have posed a serious quest for expanding investment in renewable energies to protect the environment from further adverse impacts of utilizing fossil fuels. In addition, the imbalance between water resources and consumption due to the excessive development of agricultural activities, together with the lack of proper management of urban and industrial effluents, has brought about a critical quantitative and qualitative condition of these resources in many parts of the country. Given the necessity of integrated management of water, energy, food, and environment, as well as considering the mission and roadmap of the Sharif University of Technology (SUT) for the sustainable development of the country, the Sharif Energy, Water and Environmental Institute (SEWEI) was established in 2019 by merging the Sharif Energy Research Institute, the Institute of Water and Energy, and the Research Institute of Biotechnology and Environment. Approved by the SUT's Board of Trustees, SEWEI is currently governed by an independent Article of Association.

Objectives

- 1) Identifying the country's research needs in the fields of water, energy, and environment and developing research plans to meet these needs;
- 2) Conducting fundamental, applied, and developmental research in the field of energy, water, and environment;
- 3) Identifying new technologies, developing technology, and deepening technical knowledge in the fields of activity;
- 4) Localizing technologies and improving Iran's world ranking in the relevant fields of activity;
- 5) Commercialization of the research and technological achievements of SEWEI in compliance with the relevant rules and regulations;
- 6) Establishing effective communication between the university and various economic and social sectors of the country in the fields of activity;
- 7) Optimum use of all software and hardware facilities and the potential of human resources in the university to carry out research projects in the field of activity;
- 8) Establishing active and constructive cooperation with other scientific and research institutions inside and outside the country to implement joint research projects in the relevant fields of activity;
- 9) Establishing cooperation and scientific exchanges with related scientific and research centers on the national and global scale;
- 10) Facilitating the recruitment of elite scientists and promoting human resources capabilities in the fields of activity;



11) Organizing educational workshops, scientific conferences, and presenting research and technological achievements in compliance with the relevant rules and regulations.

History

Sharif Energy Research Institute (SERI) constitutes the first core of SEWEI. In 1992, the Energy Study Group was initially established upon a contract between SUT and the Planning and Budget Organization of Iran (PBOI) for the implementation of the "Comprehensive National Energy Plan" project. In 1995, a mobile energy-saving laboratory was launched with the support of PBOI and JICA-Japan. In 1997, the Energy Study Group delivered the project of re-allocating energy subsidies for Iran's Ministry of Petroleum, which led to the promotion of this group to a research center, the establishment of the Energy Systems Engineering Department at the master's level, and finally the establishment of SERI in 2004 with the support of the Ministry of Petroleum. Also, within the Memorandum of Cooperation between the National Iranian Oil Company and SUT, SERI became responsible for organizing a research group in the field of energy modeling, and the National Iranian Oil Company was recognized as a member of the steering committee at SERI.

Institute of Water and Energy, as the second core of SEWEI, was established in 1967 with the aim of producing, developing, and improving water desalination technology along with the training of expert staff and providing technical and engineering services. The activities of this center started with the implementation of the solar desalination project on Hangam Island and continued with the design and construction of solar water desalination, evaporation, and reverse osmosis pilots, as well as solar water heaters. By equipping the laboratory required for developing water desalination systems with a capacity of 500 cubic meters per day, promotion to an industrial scale also became feasible, and the implementation of numerous industrial projects was targeted by the agenda. These efforts led to the design, construction, installation, operation, and maintenance of water desalination plants in ports and islands in the south of the country between 1973 and 1989. In addition to the activities related to water desalination, due to the industrial growth of the country and the emergence and aggravation of environmental problems, the institute has focused on simple and inexpensive industrial wastewater anaerobic treatment systems since 1989. These activities led to the localization of the design, construction, and operation technology of industrial refineries for various industries such as slaughterhouses, sugar factories, alcohol factories, and milk industries.

During several decades of activity in the field of water and wastewater, Institute of Water and Energy received the certificate of the accredited laboratory from Iran's Department of Environment in 2002. In addition to the activities in the field of water and wastewater, due to the emergence of air pollution issues in the country, the pilot research activities on the use of atmospheric pollutant purification technologies for industries were also started since 1991. Design and development of sensors and precise instruments for measuring environmental pollutants were also accomplished in 1989. Designing and manufacturing photovoltaic solar cells from silicon and gallium arsenide sublayers has been one of the activities carried out by the institute. By initiating the water, drought, erosion, and environment working group in the



Presidential Office of Science and Technology, a bilateral Letter of Agreement was signed with SUT, which led to the establishment of this working group in the institute. Due to climate change and the occurrence of persistent drought in the country, part of the activities of this collaboration was directed towards the drafting of a strategic document for the development of water, drought, erosion, and environmental technologies. In the process of compiling this document, a document was first prepared for technologies addressing drought challenges. Accordingly, the methodology for compiling the strategic water technologies document was prepared and approved by the water steering committee in 2013.

The Biotechnology and Environmental Research Institute, as the third core of SEWEI, was established in 2011 to help improve environmental research in SUT, to create a suitable platform for the implementation of practical projects, to train researchers and transfer technical knowledge, and to conduct research in all fields related to the environment based on the essential needs of the country, and to communicate with Iran's Department of Environment and related ministries to help recognize and solve environmental issues.

Organizational chart and research groups

Board of Trustees

- President
 - Research Council
 - Vice President of Research
 - ✓ Energy research group
 - ✓ Water research group
 - ✓ Environment research group

Laboratories

(1) Water, wastewater, and microbiology laboratory

Hosting several calibrated instruments, the water and wastewater laboratory has a longstanding history of providing services for chemical tests of water and wastewater since 1999. The laboratory succeeded in obtaining the certificate of the accredited laboratory from the Iran Department of Environment in 2002 (certificate available at www.doe.ir), as well as obtaining ISO 17025 certificate in testing drinking water parameters since 2014. The laboratory is committed to strictly implementing water quality control and assurance rules and using the standard sampling and analysis methods. The water microbiology laboratory started its activity in 2002 in the microbial testing of drinking water, surface water, and groundwater used in industries and agriculture. This laboratory is also accredited by the Iran Department of Environment for testing the microbial parameters of drinking water. The most important instruments in the two laboratories are listed below. Further detail on the laboratory services, instruments, and tests is accessible at www.ewe.sharif.edu.

- ✓ Spectrophotometer 2010 DR
- ✓ Spectrophotometer 4000 DR



- ✓ Conductivity meter (EC meter) (Metrohm model)
- ✓ PH meter (Metrohm model)
- ✓ Laboratory oven
- ✓ Atomic absorption spectrometer (VARIAN model)
- ✓ Incubator
- ✓ Olympus microscope
- ✓ Refrigerated incubator
- ✓ Laminar hood
- ✓ Autoclave
- ✓ UV-VIS visible spectroscopy

(2) Thermal analysis laboratory

The thermal analysis laboratory was established in 2010 and is equipped with a TGA/DSC device capable of thermogravimetric analysis and differential scanning calorimetry. This laboratory provides analysis services to research communities and industries related to mineral industries, polymer industries, pharmaceutical industries, cosmetics industries, food industries, electronics industries, and nanotechnology. Further detail on the laboratory services, instruments, and tests is accessible at www.ewe.sharif.edu.

(3) Energy audit laboratory

The energy audit laboratory was established in the early 2000s as part of the first national action to optimize energy consumption in cooperation with the Japan Scientific Cooperation Organization (JICA). This laboratory has played a key role in the formation of energy audit projects in the country, and many of the country's energy-intensive industries were subjected to a detailed audit for the first time by the professional team of this laboratory. These projects include but are not limited to, the energy audit of Mobarake Siman Steel Complex, Faraz Firouzkoh, gas pressure boosting stations, oil and oil product transmission line pump houses, Isfahan Steel Company, oil production units in the National Iranian South Oil Company, the oil extraction and production unit of Siri Island, the residential complexes of the National Iranian South Oil Company, and Sarcheshme Copper Mine. During the 30 years of activity, this laboratory has always emphasized upgrading and updating the equipment and methods needed to perform energy audits. The most important laboratory instruments are listed below. Further detail on the laboratory services, instruments, and tests is accessible at www.ewe.sharif.edu.

- ✓ Thermal camera (TESTO 881)
- ✓ Calorimeter (IKA 2000C)
- ✓ Gas chromatography (GC) (Agilent 6890)
- ✓ UV-VIS visible spectroscopy
- ✓ Portable combustion test kit (Testo330)
- ✓ Portable combustion test kit (Testo310)
- ✓ Portable power analyzer (516 IKOIH)
- ✓ Portable dust meter (Sick - FWSE101)



- ✓ Portable liquid flow meter (FLUXUS ADM 6725)
- ✓ Portable gas and liquid flow meter (FLUXUS G601, Transducer: GLG)
- ✓ Mashhad Tadbir portable power analyzer (W106)
- ✓ Furnace (Pars Azma)
- ✓ Laboratory oven (Pars Azma)
- ✓ Portable device for measuring dissolved oxygen (Hach Sension6)
- ✓ Portable water hardness meter or a TDS meter (YOKOGOWASC82)
- ✓ Portable pH meter (YOKOGOWAPH81)
- ✓ Portable radiation thermometer (Radiation temperature)
- ✓ Power meter (YOKOGOWA, HIOKI)
- ✓ Surface temperature portable thermometer (-50 °C ~600 °C)

(4) Research laboratories

These laboratories are established by faculty members to promote and develop research activities on specific topics. Currently, SEWEI hosts the Internet energy research laboratory, decentralized distributed data systems research laboratory, and the laboratory for waste and biomass conversion into energy and fuel.

(5) General research laboratory

The general research laboratory has specific research objectives, and all the faculty members of SEWEI can use the space or equipment of this laboratory to carry out their research projects. The equipment of this laboratory has been provided by either SEWEI or from the grants of faculty members. Other faculty members in SUT are also welcome to use the facilities of this laboratory to carry out their scientific and research activities. At present, the main activities of this laboratory are in the field of construction and application of new technologies in the extraction of all kinds of metals and chemicals from all kinds of industrial and mineral wastes, as well as the construction and application of new technologies in water and wastewater treatment based on the advanced methods of oxidation, such as the catalytic, photocatalytic, electrophotocatalytic, and electrooxidation methods. The laboratory is also active in the field of energy storage systems, such as supercapacitors and lithium-ion batteries.

Laboratory service request

Applicants can submit their requests through the customer portal of Sharif Laboratory Information Management System (<http://portal.c-labs.sharif.ir>). This system facilitates online registration and tracking of intended tests.

Workshop services

(1) Electric workshop services

- ✓ Consulting services for the design of all types of electronic and electrical equipment and circuits;
- ✓ Making all kinds of electronic and electrical equipment and circuits based on the designed plan;



- ✓ Repairing control and electronic boards;
- ✓ Repairing UPS, linear, and switching power supplies;
- ✓ Repairing electrical laboratory equipment, such as oscilloscope, signal generator, multimeter, spectroanalyzer, etc.;
- ✓ Repairing all kinds of analyzers, testers of all kinds of flowmeters, and digital valve controls;
- ✓ Repairing new energy laboratory equipment;
- ✓ Single-phase and three-phase wiring of electrical panels.

(2) Mechanics and facilities workshop services

- ✓ Conducting 5-layer piping
- ✓ PVC piping
- ✓ Drilling
- ✓ Welding and turning
- ✓ Sheet bending and cutting
- ✓ Chassis construction
- ✓ Metal piping

(3) Heavy workshop services

- ✓ Standing drill
- ✓ Lathe machine
- ✓ Milling machine

Selected applied research projects between 2016 and 2021

- ✓ Optimization of energy and environment in buildings;
- ✓ Preparation of environmental management plan for industrial units under Isfahan Oil Refining Company according to MAPSA;
- ✓ Part of the road map project for the development of the national infrastructure for the dissemination of weather data;
- ✓ Development of a predictive maintenance and repair software system for rotating equipment based on the Internet of Objects with the aim of creating a platform for creating digital twins of equipment and processes;
- ✓ Consulting on strategic planning for handing over the management and operation of fuel supply stations to branded companies;
- ✓ Evaluating the opportunities and challenges of developing the country's bottled water industry and its value in managing the supply and demand of quality drinking water;
- ✓ Comparison of MTP-MTO technology and economic comparison and feasibility of its development in Iran;
- ✓ Preparation of location maps of power plants, a general review of the current status of groundwater resources, and a general review of the current status of surface water resources;



- ✓ Completing the construction of a semi-industrial pilot of a new water desalination method using low-temperature remote heat sources;
- ✓ Development of technical knowledge for designing industrial air separation units by cryogenic method;
- ✓ Development of a plan to reduce the pollution of the Jajroud River, upstream of the Letyan Dam;
- ✓ Designing and carrying out the test of the self-stated characteristics of the company in order to submit it to the standards department of Tehran province to check the discretion of taking the COP product quality certificate on the product;
- ✓ Evaluation and validation of the power upgrade of Tida mechanical drive gas turbine compared to Centar solar turbine from model 4000 to 4500;
- ✓ Providing technical and engineering services and designing the smartening plan of CNG stations;
- ✓ Cooperation program with Iranian entrepreneurs and experts abroad;
- ✓ Increasing the level of public awareness in the field of energy and environment optimization in the building sector;
- ✓ Developing the technical knowledge and localizing the carbon dioxide gas separation unit with the aid of a solvent from the waste gases coming out of the reformer;
- ✓ Sampling and analysis of physical, chemical, and microbial parameters;
- ✓ Hydrometallurgy of sulfur and low-grade oxidized antimony minerals in acidic and alkaline phases;
- ✓ Revisiting the comprehensive plan to reduce air pollution in Arak city;
- ✓ Measurement of heavy metals in drinking water sources and reservoirs in Mazandaran province;
- ✓ Investigating solutions to increase the resilience of the distribution network hosted by the Mazandaran Power Distribution Company during storms;
- ✓ Holding specialized workshops on energy management and optimization in energy industries;
- ✓ Environmental monitoring of Babak Copper Complex (second phase);
- ✓ Identification of localization, investigation of production sources of polysilicon, solar silicon, and transfer of production technology of cells and solar panels;
- ✓ Research in the field of zoning priorities of seawater desalination facilities in the Persian Gulf and Oman Sea coastlines (Khuzestan and Sistan and Baluchistan provinces);
- ✓ Design and fabrication of a micro-scale cogeneration system for heating and electricity (MMCHP);
- ✓ Development of optimization methods for energy hub systems under various uncertainties. Iran-Turkey joint project (MSRT-TUBITAK).