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**Project Title:** Strategic Document and Roadmap of Chemistry and Process Research Department

<b>Department:</b>	Chemistry & Process	<b>Employer:</b>	Niroo Research Institute
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<b>Project Financial Code:</b>	210008	<b>Project Quality Code:</b>	PPCPN36
<b>Type of Project:</b>	Future study	<b>Assistant:</b>	Research affairs

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**Keywords:** Roadmap, Chemistry, Process engineering, Water treatment, Electrochemistry, Transformer oil, Power industry.

**Project Necessity:**

The power plant industry, as an infrastructure industry, is one of the most important industries in the economy, which directly and indirectly plays a role in creating added value and the path of economic growth.

Technology roadmaps are becoming popular as tools to manage the future of technology. They have been developed to different kinds of publics and matters, being characterized for forecasting what is possible or likely to happen, and also for planning its follow up.

Roadmap of chemistry and process research department is intended to provide an evidence-based foundation for the chemistry and process researches and activities upon which future policy can be implemented and actions delivered.

**Project Goals:**

Here are all the benefits that roadmap of chemistry and process research department will provide:

- Define the strategy and guide execution process
- Support internal and external communication and scenario planning
- Prioritize time and resources investments
- Long- term actions, between 2021 and 2026, have been proposed for the barriers identified for each mentioned divisions
- Detailed Action Plan – realistic timescales for targets to be met and who can act to achieve these target

- Identified opportunities, barriers and risks, including political and social barriers and how they can be addressed

### **Abstract:**

The technology road mapping method assists structuring the planning process, allowing the visualization of gaps in the strategic planning, by aligning future goals and the activities present in the organization. This allows to identify and prioritize a sustainable competitive advantage and to correctly allocate the organization technological and human resources.

The roadmap of Chemistry and Process research department included five sections which listed in below:

- 1- Identify power industry research priorities in the field of chemistry and chemical processes, integrate and direct research
- 2- Promoting the role of the Chemistry and Process Research department in policy research and decision-making in the field of chemistry and process in the power industry
- 3- Identify the challenges of the power industry in the field of chemistry and chemical processes and provide practical and effective solutions in the short and long term
- 4- Establishing a network of specialists and communicating with national and international research and industrial centers
- 5- Achieving value-added products, commercializing designed products, improving current products and developing new products, job creation

### **Steps and Methodologies:**

The overall steps of roadmap of chemistry and process research department are:

- Investigating the dimensions of the subject and the scope of studies
- Explaining the position of Chemistry and Process Research Group in Niroo Research Institute
- Providing a vision and explaining the long-term plan of the chemistry and process research department
- Developing a roadmap for the Chemistry and Process Department research activities
- Investigating the potential of chemical materials and processes in power industry

This project includes detailed information on the drive for materials and chemical process, as well as the opportunities and barriers to increasing the share of chemicals and related process regarding below research tracks:

- 1- Chemicals in the power industry
  - Technical and economic feasibility study of recycling materials and compounds from powerplant wastes
  - Future study of ion exchange resins used in the power industry
  - Strategic document and roadmap for localization, production of necessary chemicals in power plant industry
  - Future study of the synthesis of polymer membranes used in the reverse osmosis process

- Development of method for measuring metal ions of fuel samples
- Developing a research laboratory for manufacturing and analyzing chemical compound
- Technical and feasibility study and synthesis of polymeric nanocomposite adsorbent for removal of anions from water

## 2- Chemical process engineering

- Development of the method for measuring metal ions of fuel samples
- Technical feasibility study and synthesis of polymeric nanocomposite adsorbent for removal of anions from water
- Design of research laboratory for manufacturing and analyzing chemical compounds
- Synthesis and evaluation of new catalysts and optimization of existing reactor system to convert CO<sub>2</sub> into value-added materials
- Technical-economic study to select the optimal desulfurization process for diesel fuel in power plants
- Investigation of applied processes in order to achieve optimal methods of producing value-added products from the flue gas of power plants

## 3- Innovative chemical technology

- Synthesis of organic solar cells by non-evaporative method
- Technical and economic feasibility study of an operational plan for the manufacture of phosphorescent and fluorescent organic compounds used for the light emitting layer in OLED
- Development and synthesis of a new electro-photo system to reduce nitrogen oxides from the flue gas of power plants
- Improving the performance of thermal energy storages using nanotechnology
- Design of a research laboratory for the innovative chemical technology

## 4- Fuel and oil

- Technical and economic study of using natural and synthetic ester oil in power transformers
- Technical-economic studies in order to determination of the optimal small-scale process for dispersed hydrogen production in Iran
- Technical and economic study of synthesis of DME from power plant flue gas as an alternative liquid fuel
- Study, feasibility and laboratory synthesis of water-fuel nanoemulsion to increase combustion efficiency in thermal power plants
- Synthesis and evaluation of new photocatalysts and optimization of existing photoreactor system to convert CO<sub>2</sub> into value-added materials

#### 5- Water treatment

- Future study on the properties and applications of polymer adsorbents in the water treatment industry
- Study and evaluation on application of new adsorbents for water and wastewater treatment
- Investigation on performance of the novel chemicals used in chemical control of boilers
- Synthesis of polyamide-based nanocomposite membranes for application of active layer in reverse osmosis membranes
- Future study of the synthesis of polymer membranes used in the reverse osmosis process
- Development of water and steam laboratory

#### 6- Electrochemistry

- Feasibility study of synthesis and development of solid state supercapacitors based on nanomaterials
- Study and investigation of electrochemical methods of corrosion monitoring at the contact of metal with water and metal with flame in the thermal power plants
- Technical and economical feasibility study of synthesis organic and hybrid nanocoatings as a corrosion inhibitor
- Feasibility study of synthesis of ultra-battery laboratory cell (advanced lead-acid battery)

#### 7- Energy storage devices

- Future study of comprehensive tests of used electrochemical storage in the country (within 10 years)
- Future study of extraction and recovery of lithium metal in order to produce value-added products in the power and energy industry
- Review of the document on the development of energy storage technologies used in the electricity and electric vehicles industry
- Synthesis and application of thermal-energy storage systems based on chemical processes
- Acquisition and compilation of technical knowledge for designing and manufacturing negative electrodes of advanced (ultra-battery) lead-acid batteries used in storage devices
- Fabrication of flow cell laboratory cell samples with energy storage applications in power generation, distribution and transmission

#### **Main Results (technical outputs, patents, papers, books, reports, etc.):**

Final report "Strategic Document and Road Map of Chemistry and process Group "; Chemistry and Process Group, Niroo Research Institute, September 2021.