



TECHNOLOGY AREAS FOR NSTIP PROGRAMS

Water:

Key technologies include the following:

Water Desalination:

- Thermal Desalination.
- Membrane Desalination.
- Hybrid Desalination.

Drinking Water Treatment:

- Membrane Treatment.
- Chemical Treatment.
- Ionic Exchange.
- Decontamination.
- Filtration.

Wastewater Treatment:

- Biological Treatment.
- Biological Membrane Treatment.
- Chemophysical Treatment.
- Advanced Treatment.

Water Resources Management:

- Water Conservation.
- Water Reuse and Recycling.
- Groundwater Recharge.
- Rain Harvest.
- Cloud Seeding.

Oil and Gas:

The following eight technology target areas and more focused secondary technology areas are listed below:

An advanced and integrated database with high end visualization and communication tools for oil and gas information:

- Development of data storage, compression, and monitoring capabilities.
- Capabilities in data format upgrade and adaptation to our needs.
- Development of analysis, visualization, and integration tools.
- Improved data accessibility through better communication and structure.
- Advancements in data openness and sharing systems.

Completion of the petroleum geological information:

- Mapping, modeling, and describing the sedimentary basin.
- Better understanding and characterization of the petroleum systems including the source rock.
- Improved description of important and complicated formations including the Onaiya formation.
- Improved fault and fracture description and direction in carbonate formations.
- Completion of the geological maps and their integration and coherency.

Enhanced oil recovery (EOR):

- Improved injection and production systems in carbonate reservoir.
- Determine the proper enhance recovery methods for existing reservoirs.
- Reduce water-oil ratio.

Reservoir modeling, monitoring and management:

- Improved reservoir modeling and simulation, modeling and simulation tools.
- Enhanced reservoir monitoring and attributes extraction.
- Enhancements in real-time and remote monitoring of changes in giant reservoirs.
- Improved information and attribute integration for reservoir simulation.
- Fracture and fault detection and mapping in carbonate reservoir.

Improved oil and gas exploration success rates especially in the Rubaii Alkhali and the Red Sea:

- Improved efficiency and quality of land acquisition.
- Solving near surface seismic problems.
- Solving seismic multiple related problems.
- Improved seismic imaging.
- Development of unconventional methods for exploration and data integration.

Oil and natural gas production:

- Solving the problem of gas condensate in producing wells.
- Oil and gas reservoir stimulation.
- Production free of pollutants.

Improved drilling operations (quality and efficiency):

- Reduce drilling cost and drilling completion through developing efficient drilling systems.
- Complete drilling and consequences monitoring systems.
- Improved drilling in deep water and through formations in old and hard layers.
- Improved drilling in high temperature, high pressure and high productivity formations.

Protecting the environment:

- Improved monitoring systems and methods for emission from wells.
- Enhanced production standards to avoid emission.
- Improved carbon dioxide capture, and sequestration.
- Production and injection related hazard assessment.

Petrochemicals Technology:

Oil Processing

- Gas.
- Hydro-treatment.
- Clean fuel.
- Cracking
- Isomerization
- Dehydrogenation
- Polymerization
- Alkylation

Petrochemicals Synthesis

- Light paraffin activation
- Polymers

Nanotechnology:

Key technology areas for the program are:

Quantum Structure & Nanodevices:

- MEMS.
- Nano-Bio.
- Nano photonics.
- Nano electronics.
- Quantum structure.

Material & Synthesis:

- Nanocatalyst.
- Fuel additives.
- Fuel extraction.
- Thin films and coatings.
- Nanofiltration.
- Composite material.
- Thermal insulation.
- Nanotubes (NTs) and nanowires (NWs).
- Material enhancement using nanoparticles, NWs or NTs.
- Nanoparticles and quantum dots.
- Textile: fire/water resistant.
- Adhesives.
- Energy harvesting.
- Energy storage.
- Lubrication.
- Water purification, desalination, and decontamination.
- Water quality monitoring.

Biotechnology:

Medical research:

- Chronic diseases.
- Growth and old diseases.
- Infectious diseases.
- Cancer.
- Cardiovascular and vascular diseases.
- Diabetes and its complications and cables causes and treatment.

Agricultural research:

- Plant breeding.
- Animal breeding.
- Bioproduct production.
- Plant protection.

Environmental research:

- Microbial biodiversity.
- Bioremediation.
- Microbial enhancement.
- Biopolymers.
- Biosensors.
- Fermentation and bioreactors.
- Biorecycling.

Information Technology:

Speech and Language

- Speech.
- Text.
- Special needs applications.
- Arabic document processing and optical character recognition (OCR).

Scientific Computing

- Supercomputing applications.
- Computer simulation.
- Computer modeling.

Computer Systems and Networks

- Computer networks.
- IT security and privacy.
- Database systems.
- Operating systems.

Software Engineering and Innovated Systems

- Local Applications/Localization.
- Open source software (OSS) engineering.
- System analysis and design.

Electronics, Communication and Photonics {ECP}:

Recommended Initiatives:

Wireless Communications and Wireless Sensor Networks:

- RFID.
- Body sensor networks.
- Oil & gas pipeline monitoring.
- Condition-based maintenance.
- Software defined radio.
- Cognitive wireless networks.
- UWB (ultra wide band).

Information Security:

- Quantum cryptography.
- Quantum computing.
- Cryptography.
- Emission control and shielding.

Lasers and their Applications:

- Optical memories.
- Surveillance.
- LIDARs (Laser Radars).

Advanced MEMS Sensors & Actuators:

- Optical MEMS.
- High performance actuators.
- Micro fluidics.
- Inertial sensors.

Recommended technologies:

- Integrated circuits (ICs).
- Microwave systems.
- Reconfigurable computing.
- Printed circuit boards (PCB).
- Electro-optics.
- Digital signal processing (DSP).

Space and Aeronautics:

The major thrusts of the Space and Aeronautics Program are:

Space:

- Earth Observation.
- Navigation.
- Telecommunications.
- Science.
- Launch Services.

Aeronautical and Aviation:

- Very light aircraft.
- Unmanned Aerial Vehicles.

Energy Technology:

The priority technology areas that have been identified to be important to Kingdom are:

Renewable Energy Generation:

- Solar energy.
- Wind energy.

Conventional Energy Generation:

- Steam and gas turbines.
- Micro-turbines.
- Waste Heat Extraction Processes.
- Multi-generation.
- Combined cycle.

Electricity Distribution and Transmission:

- Electrical transformers.
- Electrical cables.
- Electrical networks.
- Electrical Circuit Breakers; CB.

Energy Conservation and Management:

- Air conditioning and refrigeration.
- Lighting system.
- Building envelope.
- Boiler / Furnace Efficiency.
- Electric motors.
- Heat exchangers.

Energy Storage:

- Super capacitors.
- High-speed flywheels.
- Superconducting magnetic.
- Advanced batteries.
- Thermal energy storage.
- Pumped storage.

Fuel Cell and Hydrogen:

- Hydrogen production from hydrocarbon fuels.
- Hydrogen storage.
- Proton exchange fuel cell.
- Solid oxide fuel cell.
- Direct methanol fuel cell.
- Stack fabrication and testing.
- Fuel cell electrodes.
- Fuel cell membrane.
- Fuel cell catalyst.

Combustion:

- Automotive combustion.
- Direct Injection.

- Auto-Ignition/ Homogenous charge compression ignition.
- Industrial combustion.
- Efficiency enhancement.
- Emission reduction.
- Combustion modeling.
- Laser application.
- Fuel technologies.

Environmental Technology:

Waste

- Municipal waste water*.
- Municipal solid waste.
- Industrial waste water*.
- Hazardous medical waste.
- Hazardous waste. (* Addressed by Water Technology Program)
- Industrial solid waste.
- Agricultural waste.

Pollution

- Food contamination.
- Oil contamination.
- Radioactive contamination.
- Thermal pollution.
- Noise Pollution.

Air Quality

- Ambient air quality.
- Greenhouse gases.

Degradation of Natural Resources

- Desertification.
- Degradation of coastal areas.
- Biodiversity.
- Degradation of water resources.

Advanced Materials:

Membranes

- Advanced function membranes
- Filtration membranes

Composite and Hybrid Materials

- Corrosion-resistant materials
- Composites are needed for construction, pipelines, optical fibers, and water services
- Non-destructive testing (NDT) technologies,
- Welding technologies

Polymers and Polymer Processing

- Advanced polymer technologies have broad industrial uses including oil and natural gas drilling, pipeline and storage tanks, electronics, textiles, agriculture, water, dentistry, and drug delivery.
- New classes of polymers and polymer processes including resin systems and high temperature ablative resins, nanostructured polymers, water soluble and biodegradable polymers, flame retardants, UV light stabilizers, and nanoparticles for polymer reinforcement.

Metals and Alloys

- Advanced functions include duplex and ferritic steels for thermal plants, materials for desalination plants, materials to reduce high temperature stress corrosion cracking, and materials for specialized uses in medical applications.
- Specialized alloys include corrosion and erosion resistant and high temperature and strength alloys for use in water treatment, construction, and oil and gas industries.

Ceramics

- Development of specialized ceramics such as aluminum oxide, tungsten carbides, and refractory oxide. Summary of Strategic Technology Programs dispersion strengthened alloys for use in insulation, medical implants, and building materials.

Smart Materials

- Advanced functional materials include photo-, thermo-, piezo-, tribo-, and electrochromatic materials, and smart glass for use in construction. Other smart materials include multifunctional materials and switchable systems for use in textiles, food packaging, and solar applications.
- Silicon-based materials, including semiconductor materials, silicon nanoparticles, and silicon oxide nano-particles, for applications in electronics and other industries.
- Heat transfer materials, to both aid and reduce heat flow, with applications in many industries.

Coating

- Corrosion resistant, self-cleaning, and healing coatings; light, heat, and pressure switchable coatings for various industrial applications.
- Development of UV light resistant coatings and metallic and thermal barrier coatings also for use in textiles, food packaging, and oil and gas drilling and transport.

Mathematics and Physics:

Nuclear and High Energy Physics

Quantum Information

Condensed Matter

- Optical, magnetic physics.
- Codes to predict property of nanomaterials.
- Physics of solids at the nanoscale.
- Electronic state and transport at quantum size limit.

- Material properties, fluids, and magnetism.
- Physics of free radical systems.
- Spintronics.
- Synthesis of materials.

Medical Physics

Accelerator Physics

Numerical Analysis

Optimization

Applied Mathematics

- Cryptography.
- Epidemiology.
- Statistics.
- Econometrics/financial mathematics.
- Risk analysis for insurance.

Medical and Health:

Non-Communicable Diseases

- Cardiovascular Diseases
- Diabetes
- Cancer
- Allergy and Asthma
- Neurodegenerative Diseases

Communicable Diseases

Genetics

Cell Therapy

Disability

Agriculture Technology:

Production

- Plant Production
- Animal Production
- Aquaculture

Manufacturing

- Food
- Non-food
- Aquaculture

Natural Resources

- Pastures and Forests
- Genetic Origins

Building and Construction:

Building and Construction Materials, Architectural

- Structural
- Geotechnical (Grid and backfill materials)
- Electrical.
- Mechanical.
- Sanitary.
- Insulation.
- Advance/ composite.
- Other materials.

Building and Construction Systems

- Concrete.
- Masonry.
- Steel.
- Composite.
- Other Systems.

Building Design, Performance and Quality Assurance

- Buildings safety, serviceability and durability.
- Structural Dynamics and earthquake engineering.
- Geotechnical aspects (foundation – soil interaction)
- Hydrothermal analysis and properties of materials, components and buildings.
- Air quality, ventilation and moisture problems in buildings.
- Building climatology and thermal analysis of buildings and of urban areas.
- Passive thermal control systems and means.
- Acoustic performance of components and spaces.
- Effect of environmental noise on buildings;
- Fire safety, building services, intelligent buildings, etc.
- Development of criteria, evaluation methodologies and monitoring overall performance of buildings.
- Development of test methods.
- Building systems and components.
- Building envelope testing.
- Energy and water conservation systems.
- Ecologically sustainable development (ESD).

Building Assembly systems

- Electrical;
- Mechanical.
- Electro-mechanical.
- Sanitary.
- Safety, Security and monitoring.
- Other Systems.