

CANADA'S OIL & GAS INNOVATION FOCUS AREAS 2021

Our Vision: Canada is the global leader in clean hydrocarbons from source to end use.

Through the Clean Resource Innovation Network (CRIN), focus areas have been defined to guide the development of technology to address priority environmental and economic challenges of the oil and gas sector. Key to this work is the input of industry through CRIN's seven technology theme areas. Visit www.cleanresourceinnovation.com for more information about the theme areas and 'industry pull' as an important factor in accelerating commercialization and wide-spread adoption of innovative technologies.

Note the following lists are not exhaustive and, in some areas, technology development may include both new developments and retrofit opportunities for existing operations.

Digital Oil and Gas – Focus Areas

- **Environmental Monitoring:** Including monitoring of environmental impacts on land, air, and/or water at any stage of project development – evaluation, assessment, construction and operations, and closures.
- **Operational Excellence and Efficiency:** Projects in this area will enhance excellence and efficiency in operations which could be applied through the entire organization to improve accuracy, quality and productivity and reduce costs in the delivery of services and products.
- **Capital Project Execution:** Solutions could be directed at any project stage – greenfield, construction, turnaround, and brownfield; Digital solutions can be applied to enhance effectiveness and efficiencies in planning, contracting and procurement, project execution, construction, drilling, commissioning, maintenance, and project governance.
- **Health and Safety:** The broad scope of health and safety in the oil and gas industry includes identifying, preventing, controlling, and eliminating exposure to risks, hazards and dangerous conditions, by ensuring all employees have the training and competency to work safely, whether onshore or offshore.

Land and Wellsite Remediation – Focus Areas

Solutions for land management and retirement of inactive oil and gas assets that involve accelerating timelines to closure, reducing costs, and ensuring sustainability in the methods selected for environmental management. Example technologies and best practices include but are not limited to:

- Developing fit-for-purpose technologies and novel approaches.
- Solutions that support liability management and strategic planning of closure activities.
- Onsite or offsite remediation solutions.
- Advanced data gathering and analytical techniques.
- Digital technologies that underpin the objectives of this technology focus area.

Methane Emissions, Monitoring, Quantification, and Abatement – Focus Areas

Cost effective methane emissions detection, quantification, monitoring, reporting and mitigation technologies from upstream, midstream, downstream, and transportation of oil and gas to help industry meet its 45% methane emissions reduction target, including but not limited to:

- Methane mitigation from oil and condensate tanks, pneumatic devices, compressor seals, dehydrators, chemical pumps, and wells surface casing vent flow.
- Cost effective and accurate methods incorporating sensors combined with digital platforms to help in methane detection, quantification, monitoring and reporting.

Novel Hydrocarbon Extraction – Focus Areas

Novel solutions for accessing and producing hydrocarbons with less environmental footprint, including but not limited to:

- Thermal, solvent, chemical or CO₂ enhanced oil recovery (EOR) projects in heavy oil reservoirs.
- Gas, CO₂, cyclic injection, or other floods that minimize decline or minimize re-fracturing or down-spacing in light/tight reservoirs.
- Solvent processes or subsurface heat generation in in situ oil sands.
- Material handling, aqueous and non-aqueous extraction or other technologies in mined oil sands reservoirs.
- Downhole treatments that can be applied to restart/reinvigorate shut-in wells.
- Production processing infrastructure, well architectures/completions, and artificial lift in all reservoirs.

Water Technology Development – Focus Areas

- Water treatment technologies addressing input water quality aspects such as total dissolved solids (TDS), organics, total suspended solids (TSS), turbidity, grease, oil, silica, etc.
- Operational excellence solutions such as novel instrumentation, process control, online analyzers, surface leak prevention, asset integrity assurance, tank inspection and cleaning technologies, feedwater production efficiency improvements, and incorporation of artificial intelligence, machine learning, augmented/virtual reality, and other novel digital solutions.
- Alternative steam generation technologies such as steam from alternative and recycled feedwaters.
- Technologies to improve the quality and increase reuse of disposal process streams, including reducing oil and grease, TSS, organics, etc., minimizing impacts to groundwater quantity and quality.

Low Emission Fuels and Products – Focus Areas

These technology development focus areas represent the combined CRIN technology theme areas of

- **Cleaner Fuels – Reducing Carbon Intensity** technology theme area
- **Low Emissions Value-Added Products** technology theme area
 - **Innovative Products from Hydrocarbons:** Technologies included in this focus area produce carbon based non-combustion products, such as activated carbon, carbon fibre, asphalt binder from petroleum and natural gas. Other examples of technologies included are new recovery techniques for elements like lithium, vanadium, titanium, or nickel recovered from co-produced hydrocarbons.
 - **Carbon Capture and Utilization:** Technologies included in this focus area reduce greenhouse gas emissions by capturing, utilizing and/or converting carbon dioxide.
 - **Hydrogen and Geothermal:** Technologies included in this focus area develop clean energy opportunities from hydrocarbon-derived hydrogen and recovery of geothermal energy to optimize the utility of the oil and gas industry.
 - **Low Carbon intensity Alternatives and New Fuels:** Technologies included in this focus area develop products and processes that reduce fuels' carbon intensity. Examples include innovative fuels and production of fuels from biogenic feedstocks within existing infrastructure potentially including waste products, bitumen partial upgrading, or other novel processes.