GTI has extensive and specialized technical expertise in the natural gas E&P, pipeline and distribution industry that can be used by producers and operators to complement or supplement internal expertise. GTI can develop company-specific models, provide independent audits, manage pilot projects, assist in establishing best practices, and develop company specific programs for integrity management, environmental engineering and technology implementation. GTI's proprietary databases, models and unique industry access, combined with seven decades of research experience, can be leveraged to provide distinctive expertise.

Distribution Integrity Management
- Threat identification including potential threats
- Relative risk ranking and modeling
- Probability of failure using advanced modeling techniques for specific material threats such as vintage plastic and cast iron graphitic corrosion
- Consequence modeling

Pipeline Integrity Management
- Threat interaction modeling
- ILI and Direct Assessment technology selection
- Probability of failure using advanced modeling techniques for specific threats
- Consequence modeling including leak rupture boundary determination

Environmental Engineering
- Life cycle analysis and modeling for sustainable water and waste management
- Produced water treatment, water reuse, and brine disposal
- Characterization and deployment of advanced soil, sediment and water treatment systems
- Environmentally acceptable endpoints for the management of contaminated soils and sediments
- Community waste and biomass to methane options for green energy planning
- Techno-economic assessments

Exploration and Production
- Design and quality control of hydraulic fracturing
- Field studies of tight sands, shale gas, and coalbed methane
- Development of project plans for drilling and completion of unconventional plays
- Study of changes in seismic attributes resulting from saturation changes

Pipe Rehabilitation
- Trenchless rehabilitation technology feasibility analysis
- Composite rehabilitation technology selection
- Integrity management programs for pipe segments rehabilitated with composites
- Material testing
- Regulatory acceptance support

Excavation Damage Prevention
- Contract locator audits
- Training program reviews and enhancements
- Locating technology assessment and enhancements
- Policy and procedure assessment
- Continuous monitoring technology assessments and recommendations

Corrosion Management
- Corrosion growth rate modeling
- Internal corrosion from traditional and renewable gas assessments
- MIC identification and quantification

GIS and Field Data Collection
- Data integration and modeling
- Extending GIS access to the field
- GIS-based data collection on mobile devices
- Smart phone application development for ESRI and Google platforms
- Hardware recommendations including smart phone and tablet computers for mobile data collection
- GPS data collection technology recommendations and field procedures
- GIS accuracy improvements and conflation
- Interoperability and communications capabilities and strategies
- Pilot projects and technology assessments

Asset Lifecycle Tracking
- Implementation of ASTM F2897-11 for asset tracking and traceability
- Barcode and smart tag technology implementation

Independent Third Party Audits
- Mock DIMP audit
- Quality assurance and quality control
- Damage prevention program
- Leak management program

Technology Business Case
- Formal business case assessment for new technology implementation
- NPV, IRR and payback period analysis
**Laboratory Capabilities**

**Infrastructure Labs**

**Materials Analysis and Characterization Laboratory (MACL)**
This lab focuses on the fundamental properties and characteristics of materials. Forensic analysis of polymers, metals, and composites gives the ability to better understand failures before they become much larger problems. Standard and customized tests are conducted to determine density, thermal properties, tensile strength, compression, mechanical properties, and other characteristics. Advanced equipment such as scanning electron microscopy (SEM) is used for microstructural examinations and chemical composition determination. A temperature- and humidity-controlled room conditions specimens to ASTM specifications prior to testing. This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) in compliance with ISO/IEC 17025 on certificate 2139-01.

**Analytical Chemistry Laboratory**
GTI’s Analytical Chemistry Laboratory gives the energy industry a depth of customized support unavailable in typical commercial laboratories. It provides complete laboratory services for natural gas, biogenically derived gas, coal, liquid fuels, and other materials for the natural gas and power generation industries, as well as for numerous municipalities and utilities. Our capabilities incorporate modern instrumental techniques and traditional referee methods providing highly accurate determinations. Advanced analytical capabilities include gas chromatography coupled with atomic emission and mass spectral detectors. This laboratory is accredited by A2LA in compliance with ISO/IEC 17025 on certificate 2139-04.

**Environmental and Microbiology Laboratory**
State-of-the-art microbiological research and testing services provided in this lab integrate molecular genetics techniques to areas such as pipeline microbial corrosion prevention and treatment, microbial characterization, molecular biology, and anaerobic digestion studies. Our microbial corrosion testing service uses quantitative polymerase chain reaction (qPCR) testing to directly detect and quantify (without prior growth) corrosion-causing microorganisms typically found in pipes, production wells, and other equipment. This technique can be applied in the natural gas, petroleum, chemical, water, produced water and wastewater industries. Additional environmental capabilities are forensic chemical fingerprinting studies, including gas chromatography/isotopic ratio mass spectrometry (GC/IRMS), which measures stable isotope ratios of carbon to discriminate between different sources of carbon-containing contaminants.

**Outdoor Infrastructure Testing Facility**
Multi-acre, controlled soil bed (sand, clay, rock, etc.) provide unique capabilities to evaluate all buried infrastructure systems. Research and evaluations include: pipe locating, leak detection, pinpointing, migration, and greenhouse gas emissions. Systems can be tested for corrosion resistance and coating performance. This outdoor facility has been used for: keyholing, lining, splitting, locating, low- and high-pressure testing, and other technologies.

**Indoor Infrastructure Testing Facility**
A series of environmentally controlled large-bay (25' high) labs with 5-ton overhead cranes provide the capability to fully evaluate metallic, polymer, and composite piping systems. This includes full-scale burst, hydrostatic, cyclic, and accelerated testing period. The same testing can be applied to evaluate all applicable joining systems and appurtenances.

**GTI Fabrication Facility**
The GTI Fabrication Facility has the capabilities you need to turn your ideas into working prototypes. We have CNC machining, MIG and TIG Welding, Plasma Cutting, PLC Programming and CAD/CAM support software.

**Soil & Pavement Facility**
This facility provides a wide range of services and capabilities for utilities infrastructure and pavement restoration research. It allows for performance evaluation, development, and cost-analysis studies of new materials and technologies related to utility installations and pavement restoration practices. It includes both indoor and outdoor test sites and contains various types and sizes of buried gas pipes, backfill materials, and pavement sections.

**Sensors and Automation Laboratory**
Key activities here focus on sensors/technologies for a smart energy infrastructure, with an emphasis on operational needs. Major areas of expertise include automation, remote monitoring, and controls. Capabilities include tools and equipment for embedded system
development, automation, sensor and signal conditioning; data acquisition technologies and digital signal processing; and data communication systems and wireless communication technology. We also have the ability to construct electronic prototypes.

Advanced Modeling and Analysis Facility
GTI has the capability to develop predictive models that describe the behavior of systems with complex interactions and estimate the underlying event probabilities for these models. We accomplish this using a variety of probabilistic methods and other appropriate techniques integrating our full slate of state-of-the-art analyses and Finite Element Method (FEM) software.

Our knowledge of these software tools—along with detailed material science, chemical and physics expertise—enable the simulation of stress, heat transfer, fluid dynamics, microfluidics, porous flow, chemical kinetics, electromagnetics, acoustics, geo-mechanics, seismic and many other physical phenomena for comprehensive sensitivity analyses. GTI has extensive leading-edge software, laboratories, databases, and data visualization tools that are useful in calibrating constitutive models, validating simulation results, and analyzing and viewing data in the correct context.

GIS/GPS Mobile Application Lab
Realizing the gas industry's developing requirement to capture and record precise location data and accurate gas network attribute data, GTI has created the GIS/GPS Mobile Application Lab. Utilizing the latest real-time, high-accuracy GPS receivers paired with readily available smart phones and tablet computers, GTI develops mobile applications based on industry-leading GIS technology to efficiently and effectively capture infrastructure data, build functional geometric networks and integrate GIS data in real-time web-based applications.

Energy Conversion Labs

Pilot-Scale Gasification Campus
These highly instrumented facilities, offering innovative sampling and analytical systems and comprehensive diagnostic capabilities to support parametric testing, assure that we and our clients have fully developed operating procedures and performance characteristics for commercial plants. Their flexibility provides independent or integrated systems testing. They are also available to outside users for pilot scale process testing.

- **Flex Fuel Test Facility**
  The Henry R. Linden Flex-Fuel Test Facility (FFTF) evaluates gasification processes integrated with downstream syngas clean-up at nominally 1 ton/hr of coal or biomass feed rate to facilitate the commercialization of advanced technologies.

- **Advanced Gasification Test Facility**
  A five-story facility integrated with process equipment in the FFTF houses advanced gasifier, gas processing, and syngas conversion systems to allow feed-to-product process development testing.

- **Acid Gas Treating Pilot Plant (AGTPP)**
  The AGTPP is used for acid gas cleaning via solvents in a standalone mode for sour natural gas evaluations or integrated with the pilot-scale gasification test platforms at GTI for syngas treatment. The system can be used with many different chemical and physical solvents to treat up to 1.25 MMscfd.
**Thermochemical Conversion Laboratory**

Within this laboratory, GTI develops and evaluates, on a pre-pilot scale, thermal and catalytic processes for converting coal and biomass feedstocks into liquids and gases.

**IH² Technology Pilot-Scale Plant**

GTI’s IH² Pilot-Scale Plant operates extended test campaigns to characterize and optimize process conditions to produce a range of distillate fuels (gasoline, diesel and jet fuel) from a variety of biomass resources, including wood, agricultural residues, algae, aquatic plants, and municipal waste.

**Gas Processing Laboratory**

This lab houses several unique setups to assess materials properties (e.g., membranes, solvents, catalysts, and adsorbents) and their efficacy in process configurations to separate and capture components such as H₂S, CO₂, and trace contaminants from gas streams.

**Hot Gas Cleanup Laboratory**

The lab aids researchers and clients in the evaluation of a broad range of materials to remove reduced sulfur compounds, hydrogen chloride, and trace metals; to decompose ammonia; to hydrolyze hydrogen cyanide; and to design gas cleanup systems. This is GTI’s primary laboratory for evaluating sorbents for potential use in cleaning up the hot gas produced by a gasifier.

**End Use Labs**

**Residential/Commercial Appliance and Equipment Laboratory**

This facility is designed to foster the development and advancement of natural gas appliances and equipment, including improvements in efficiency, safety, performance, cost, and emissions. We have specialized expertise in residential space conditioning and water heating, with a focus on traditional equipment such as furnaces, boilers and HVAC systems; water heaters (advanced tank and tankless products); and cooking equipment for both residential and commercial food service applications.

**Combustion Laboratory**

Within this facility, researchers develop and evaluate advanced steam and power technologies for industrial and large commercial application and combustion systems for use industrial process heating products and systems.

**CHP and Renewable Energy Laboratory**

GTI’s CHP and Renewable Energy laboratory contains multiple types of low- to medium-temperature solar thermal technologies and associated end use equipment such as tank and tankless natural gas water heaters, boilers, space conditioning equipment and other technologies that can enable investigation of integrated or hybrid energy systems using solar thermal.

**Transportation Laboratory**

The lab provides technology solutions to the natural gas vehicle (NGV), hydrogen, and other alternative fueled transportation system sectors, with an emphasis on vehicles, fueling infrastructure, and safety. GTI has extensive capabilities and facilities for working with high-pressure and cryogenic natural gas and hydrogen, plus other novel combustible energy sources.

**Reciprocating Engine Test Center**

The test center is used for laboratory-scale development and evaluation of advanced combustion technologies for reciprocating engines, including waste heat recovery, recycling and novel cycles.

**Energy Materials Lab**

Laboratories and test facilities for several areas of fuel cell research and development, hydrogen storage material development, water treatment devices, heat pumps, alcohol separation, and gas purifications with a particular focus on high-performance and low-cost materials.

GTI performs research on high-temperature and (molten carbonate and solid oxide) fuel cells as well as low temperature proton exchange membrane (PEM), direct methanol, and alkaline fuel cell power systems.

GTI has equipment and expertise to develop a variety of membranes, such as organic polymer membranes, zeolite membranes, metal alloy membranes, high temperature ceramic membranes, and combination membranes.

GTI is a leading research, development, and training organization that have been addressing the nation’s energy and environmental challenges by developing technology-based solutions for consumers, industry, and government for more than 70 years. Our research initiatives address issues impacting the natural gas and energy markets across the industry’s value chain—supply, delivery, and end use.

GTI provides services at every phase of the technology development cycle—from concept to commercialization. We offer research and development, program management, technical services, analytical services, consulting, commercialization, and training.