2011 Technology Innovation Program

Forging New Paths for the Electricity Future
Overview
The Electric Power Research Institute’s Technology Innovation Program (TI) conducts research and development (R&D) to drive innovation in pivotal areas—enabling advanced fossil, nuclear, and renewable generation and coal plants with near-zero emissions; supporting sustainable water resource management and long-term operation of the existing nuclear fleet; and promoting the smart grid, end-use efficiency, and electrification.

TI is leading technology development for carbon capture, energy storage, nondestructive evaluation, power electronics, emission control, and other critical applications. Strategic work in rapidly emerging scientific disciplines is helping to create nanoengineered coatings, self-healing cables, mobile “apps” for equipment diagnostics, and robotics and sensors for real-time monitoring and control. Potentially game-changing innovations are being pursued in areas such as radioactive waste management, powder metallurgy fabrication, biomass fuel treatment, transformer monitoring, and coal gasification. Across an application horizon extending 5 to 20 years ahead, the knowledge and technologies developed through TI help guide strategic planning, address economic and environmental challenges, and create business opportunities.

Approach
The TI portfolio includes four components that draw on expertise across EPRI, its members, and the research community to transform new ideas and advanced concepts into practical innovations:

- **Thought Leadership** informs strategic decision-making.
- **Strategic Programs** advance long-term science and technology.
- **Breakthrough Technologies** accelerate progress in high-impact areas.
- **Polaris Initiative** incubates promising ideas.

Strategic intelligence and new knowledge are communicated directly to industry stakeholders. Pre-commercial technologies are transferred to EPRI’s Generation, Nuclear, Power Delivery and Utilization, and Environment sectors for further development and real-world application.

**The TI R&D portfolio’s four complementary components address strategic needs by serving as front-end incubators that feed advanced knowledge and technology to EPRI’s sectors for solution-oriented development, demonstration, and commercialization.**

New for 2011
The 2011 TI portfolio brings a sharpened focus to applied innovation. Nine new strategic programs are under way to expand coverage of critical industry issues. Across all 18 programs, innovation scouts are monitoring government and university research—as well as work funded by venture capitalists—to identify and pursue high-value opportunities through high-leverage collaborations. Technology readiness levels (TRLs) define the status of individual innovations and outline how they will be advanced and ultimately transitioned into EPRI’s sector programs. In addition, a stage-gate process provides milestones for motivating progress on targeted breakthroughs. Together, TI’s big-picture perspective and line-of-sight approach are designed to maximize return on strategic R&D investments.

**TRLs are used to balance and monitor the TI R&D portfolio, with some strategic work at TRL1-2 and the majority spanning TRL3-6. This ensures both a steady flow and smooth transition of innovations into EPRI’s sector programs and the electricity industry.**

**Thought Leadership**
TI applies outside-the-box thinking and cross-cutting expertise to anticipate and exploit scientific and technological progress. **University outreach** brings fresh perspectives and new ideas to bear on pivotal policy, technology, and market issues. **Multidisciplinary experts** quantify the potential of advanced technologies, including the possibility for disruptive innovation. **High-level collaborations** lead the industry in new directions, such as cyber security for the smart grid and multi-factor frameworks for siting new generation plants. Strategic insights, opportunities, and priorities inform industry and government decision-making and guide R&D planning throughout EPRI.
Strategic Programs

Forming the core of TI, these cross-disciplinary, highly structured programs focus applied innovation on key technology areas. New programs for 2011 are identified with an asterisk:

**Biotechnology:** Pursue wastewater treatment, energy production, and other applications for biologically mediated processes and transgenic species.

**Carbon Capture:** Establish basic knowledge of capture mechanisms and accelerate development of technologies offering much lower energy penalties and costs.

**Concrete**: Develop inspection and condition assessment capabilities for new and aging structures at nuclear plants, substations, and other facilities.

**Emissions, Health, and Environment:** Determine potential impacts of emerging generation, carbon capture, and pollutant control systems to inform technology development and policymaking.

**Energy Efficiency**: Develop home/commercial building envelope materials and end-use technologies offering increased efficiency and improved demand-response capabilities.

**Energy Storage**: Advance thermal storage for bulk power applications and battery designs, electrodes, and manufacturing technologies for stationary and transportation applications.

**Environmental, Health, and Safety Impacts of Smart Grid**: Evaluate potential magnetic field exposures for new communications infrastructure and the lifecycle environmental impacts of renewable technologies.

**Grid Transformation**: Develop communications, operations, planning, and cyber security technologies to facilitate demand response, integrate renewables, and deliver smart grid functionalities.

**Low-Dose Radiation**: Assess the risks of low doses and dose rates associated with nuclear plant operations to inform future exposure standards.

**Materials – Fossil and Nuclear Generation:** Develop improved materials and new understanding of damage mechanisms for advanced coal plants and existing nuclear assets.

**Materials – Grid Transformation:** Apply nanotechnologies and new materials to increase power transfer, enhance grid reliability, and reduce greenhouse gas emissions.

**Near-Zero Emissions:** Develop advanced technologies to control pollutant emissions and help maintain coal as an economically viable and environmentally acceptable supply option.

**Nondestructive Evaluation:** Advance inspection and condition assessment capabilities to reduce maintenance costs and improve asset management at nuclear and fossil plants.

**Nuclear Fuel Cycles**: Model fuel cycle scenarios to evaluate power generation and fuel processing options and optimize for resource utilization, cost, security, and waste production.

**Power Electronics**: Design solid-state devices based on advanced semiconductors offering higher carrying capacity, increased efficiency, faster response, and reduced size and costs.

**Renewables:** Develop advanced technologies to enable widespread deployment of renewable generation options in central-station and distributed applications.

**Sensors and Operations:** Design and test sensor systems for real-time monitoring and control to increase the availability and reliability of electricity infrastructure.

**Water Use and Availability**: Develop cooling, conservation, and treatment technologies to minimize water use, reduce operational and environmental impacts, and facilitate siting of new capacity.

**Breakthrough Technologies**

In focused multi-year projects, TI accelerates progress on innovations promising significant—and potentially revolutionary—impacts:

- Handheld, Real-Time, 3-D Imaging for Component Inspection
- Transmission Line Robotics for Condition-Based Maintenance
- On-Site Carbon Activation for Low-Cost Multi-Pollutant Control
- Sequestration Resins for Contaminant Removal in Nuclear Plant Coolants
- Functionally-Graded Compositional Control Methods for Erosion Protection

**Polaris Initiative**

TI reserves a pool of funding to pursue new ideas and potential breakthroughs as they are identified. In 2009-10, 35 Polaris projects enabled EPRI experts to conduct feasibility studies and basic research on topics such as single-well geothermal power generation, nanotube-based filtration, diffusion coatings for boiler tubes, frost inhibition for air conditioners, transient-based condition monitoring, and control of high-resistivity fly ash.
Resources

EPRI members have access to all TI activities and results. Results are communicated through technical reports and other vehicles. Visit [www.epri.com](http://www.epri.com) for more information.

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**The Electric Power Research Institute, Inc.** [EPRI, www.epri.com] conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI’s members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI’s principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together… Shaping the Future of Electricity