

Electric Transmission and Distribution

Electric Transmission and Distribution

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Energy Supply
Office of Electric Transmission and Distribution

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply (OETD)					
Electric Transmission and Distribution.....	88,384 ^{ab}	82,377	-1,559 ^{cd}	80,818	90,880
Subtotal, Energy Supply (OETD).....	88,384	82,377	-1,559	80,818	90,880
General Reduction.....	0	-1,080	+1,080	0	0
Total, Energy Supply (OETD)....	88,384	81,297	-479	80,818	90,880

Preface

As the Nation moves forward seeking new energy technologies and methodologies, and transferring those technologies and methodologies to the private sector, the Department of Energy leads this critical endeavor which breaks the Nation’s reliance on imported energy sources. Within the Energy Supply appropriation, the Office of Electric Transmission and Distribution (OETD) is at the forefront of this effort to modernize and expand the Nation’s electricity delivery system. These endeavors will ensure a more reliable and robust national electricity supply.

Within the Energy Supply appropriation, OETD comprises one program, Electric Transmission and Distribution, with four subprograms: Research and Development, Electricity Restructuring, Energy Reliability and Efficiency Laboratory, and Program Direction.

This Overview will describe the Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goal. These items together put the appropriation in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the goals will be achieved and how performance will be measured. Finally, this Overview will address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

^a Reflects the spread of \$2,082,000 reduction in prior year balances.

^b Reflects the spread of \$1,447,000 for SBIR/STTR

^c Reflects the distribution of the 0.59% rescission (\$479,000) from the Consolidated (Omnibus) Appropriations Bill for FY 2004

^d Reflects OETD’s share of the \$10,000,000 Energy Supply general reduction (\$1,080,000)

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA^a unit" concept. Within DOE, a GPRA Unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA Unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA unit. A numbering scheme has been established for tracking performance and reporting.^b

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Mission

The mission of the newly created Office of Electric Transmission and Distribution (OETD) is to lead a national effort to modernize and expand America's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security. This effort is accomplished through research, development, demonstration, technology transfer, and education and outreach activities in partnership with industries, businesses, utilities, States, and other Federal programs and agencies, universities, national laboratories, and other stakeholders.

Benefits

The Office's research and development (R&D) in high temperature superconductivity, transmission reliability, distributive technologies, energy storage, GridWise and GridWorks fosters a diverse supply of affordable and environmentally sound energy, provides for reliable delivery of energy, helps guard against energy emergencies, and improves energy efficiency. This leads to primary energy savings and environmental emissions reduction, as well as energy reliability and cost savings. The Office's electricity restructuring and analysis work supports States and regions in developing policies, market mechanisms and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (i.e. demand response programs that are easy to understand and use) electric markets.

^a Government Performance and Results Act of 1993

^b The numbering scheme uses the following numbering convention: First 2 digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

Strategic Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission plus seven general goals that tie to the strategic goals). The Energy Supply Appropriation supports the following goal:

Energy Strategic Goal: To protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Subprograms funded within the Energy Supply Appropriation have one Program Goal that contributes to the General Goals in the "goal cascade." This Program Goal is 04.12.00.00.

Program Goal 04.12.00.00 Electric Transmission and Distribution: OETD will lead a national effort to modernize and expand the Nation's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security.

Contribution to General Goal

Within the Office of Electric Transmission and Distribution, the Research and Development Program and the Electricity Restructuring Program contribute to General Goal 4 as follows:

The High Temperature Superconductivity (HTS) R&D Program Activity contributes to this goal by improving the reliability and security of the Nation's electric power system. To achieve these benefits, HTS pursues its long-term performance goal, which is as follows: By 2012, develop to the 100 percent operational capability level, wire and four types of high-temperature superconducting electric power prototypes with typically half the energy losses and half the size compared to conventional equipment of the same power rating. Annual targets — that track achievements toward this Program Activity goal — are detailed in the chart which follows, entitled "Targets for High Temperature Superconducting Electric Power Equipment Prototypes."

The Transmission Reliability R&D Program Activity contributes to this goal by developing real-time information and control technologies and systems that increase transmission capability, economic and efficient electricity markets, and grid reliability. This Program Activity tracks its progress by measuring the amount of cumulative savings.

The Electric Distribution Transformation R&D Program Activity contributes to this goal by developing distributed sensing, intelligence and control technologies that improve the electric infrastructure's security, reliability, and resiliency. This Program Activity tracks its progress by measuring peak load reduction.

The Energy Storage R&D Program Activity contributes to this goal by developing storage technologies that reduce power quality disturbances and peak electricity demand, and improve system flexibility to

reduce adverse effects to users. This Program Activity tracks its progress by measuring reductions in cost per kilowatt and per kilowatt-hour for three storage technologies.

The GridWise Program Activity contributes to this goal by continuing development of communication and control systems to support adaptive intelligent grid operations, integrating distributed energy devices and enhancing customer electric service, thereby allowing the use of real-time information to improve reliability and system efficiency and allowing the electric system to be more resilient.

The GridWorks Program Activity contributes to this goal by providing seed support to accelerate development and demonstration of an integrated portfolio of advanced technologies that bridge the gap between laboratory prototypes of the base Program Activities and the application needs of the electric industry. This will help provide reliable delivery of energy, improve energy efficiency, and guard against energy emergencies.

The long-term performance goal for both GridWise and GridWorks is to implement an advanced technologies and integrated-information management system for the Nation's electric system that will overcome today's limitations and afford a decrease of 25 percent in regional blackouts by 2015 as compared to 2003. Reliability events consist of roughly 80 percent distribution (localized) events and 20 percent transmission (multi-region) events.

The Electricity Restructuring Program contributes to this goal by providing technical assistance and analysis that supports States and regions for developing policies, market mechanisms, and programs that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (with demand response programs that are easy to understand and use) wholesale and retail electric markets. This Program tracks its progress by measuring the increase in impact upon regional transmission organizations.

The Import/Export Authorization (IEA) activity – within Program Direction – contributes to this goal by managing the regulatory review of exports of electricity and the construction and operation of electric transmission lines which cross U.S. international borders. These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping ensure availability of competitively priced electricity supplies in a competitive and environmentally-sound manner. The activity also ensures that exports of electric energy and the construction of new international electric transmission lines do not adversely impact the reliability of the U.S. electric power supply system and that electricity trade occurs in the freest possible marketplace. IEA's activities help deregulate energy markets and reduce international trade barriers, as well as create an integrated North American energy market. IEA encourages greater exchange of technical and regulatory information among our trading partners. Through its publications, IEA increases public awareness of energy issues and the advantages of competition in the marketplace.

The High Temperature Superconductivity R&D targets below assume a continuation of recent funding patterns and that the Program Activity managers will pursue these targets as opposed to pursuing more basic R&D. These targets also represent the lowest performance values (in terms of voltage and power) that must be demonstrated to establish the technical capability to develop future commercial versions that address all, or a majority, of possible usage on the grid.

Targets for High Temperature Superconducting Electric Power Equipment Prototypes

Metric	HTS Wire	HTS Motors		HTS Generators		HTS Transformers		HTS Power Cables		
	Cost	Voltage	Power	Voltage	Power	Voltage	Power	Voltage	Power	Length
Current Status	\$200/ kA-M	4kV	1.2 MW (2001)	4.16 kV	1.8 MW testing	13.8 kV	1.7 MW (2001)	12.5kV	25 MW	0.02 mile (2000)
2004						24.9 kV	10 MW			
2005	\$150/ kA-M			13.8 kV	100 MW			13.8 kV	40 MW	0.2 mile
2006	\$100/ kA-M							34.5 kV	30 MW	0.2 mile
2007	\$75/ kA-M	4 kV	5 MW					138 kV	600 MW	0.5 mile
2008	\$50/ kA-M			13.8 kV	340 MW	138 kV	50 MW			
2009	\$30/ kA-M									
2010	\$25/ kA-M							138 kV	600 MW	2 miles
2012	\$20/ kA-M	6kV	5 MW	13.8kV	850 MW	345kV	340 MW			
2017	\$10/ kA-M									

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
General Goal 4, Energy Security	88,384	80,818	90,880	+10,062	+12.5%
Program Goal 04.12.00.00,					
Electric Transmission and Distribution	88,384	80,818	90,880	+10,062	+12.5%
Total, General Goal 4 (Energy Supply (OETD)).....	88,834	80,818	90,880	+10,062	+12.5%

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Electric Transmission and Distribution					
Installed first industrial HTS electrical transmission cables at Southwire Plant in Carrollton, Georgia and began testing system reliability. (MET GOAL)	Document 6,000 hours (100 percent load) operation of the first successful HTS power delivery system to power an industrial use. (MET GOAL)	Complete initial testing of Detroit superconducting transmission cable and document operational costs and reliability. (NOT MET)		Complete testing of 10 MVA superconducting transformer in operation on the Wisconsin Electric Power Company grid.	Complete testing of a 13.8 kV, 100MW HTS generator.
	Install first-of-a-kind superconducting electrical transmission cables to replace existing delivery to an urban substation serving 14,000 customers in Detroit, Michigan and begin testing operation and reliability. (MET GOAL)		Increase the capability to reproducibly fabricate a 10-meter length of Second Generation HTS wire to carry 50 amps of electricity and 1-meter lengths that carry 100 amps from a 40-amp base.	Install and operate a prototype wide area measurement system in the Nation's Eastern Interconnect with 12 time-synchronized and monitoring instruments that feed data into two data archiving and analysis locations	Install and operate a prototype wide area measurement system in the Nation's Eastern Interconnect that includes 50 time-synchronized monitoring instruments that feed data into six data archiving and analysis locations.
			Support the field test of a 100kW lithium battery system for 700 hrs at a utility site.	Test and evaluate the performance of a 500kW/750kWh sodium sulfur battery (first in U.S) installed at an American Electric Power site for six months to determine technical and economic performance.	Complete testing and report on a sodium sulfur battery system in both peak shaving and power quality modes at American Electric Power.
					Reduce by 10% the total time required by OETD to complete its FY 2006 CFO, OMB and Congressional budget submissions as compared to its comparable FY 2005 budget submissions.

Means and Strategies

The OETD Program will use various means and strategies to achieve its Program goals. However, various external factors may impact the ability to achieve these goals. The Program also performs collaborative activities to help meet its goals.

With regards to means, as OETD reaches full operating capacity in human and information technology resources, greater focus will be placed on expanding staff skills with training in information technology and cross-training in electric transmission and related technologies outside of the specialty of a given staff member. The training will further the integration of OETD's knowledge base and efforts to oversee fuller integration of electric transmission R&D technologies.

Information Technology will provide more efficient tracking of, and access to, essential program management-related information and office support functions, and allow for more productive and efficient use of staff time in pursuit of OETD's technology goals.

Among OETD's strategies, increasing market penetration of electric transmission and distribution systems is achieved through 1) advances in technology cost and performance, and 2) the implementation of national standards for interconnecting power with the grid. Technology advances include development of first generation superconducting wire, development of real-time monitoring and control software tools, and development of system operating models to improve grid reliability and efficiency. Modernization and expansion of the electricity infrastructure is achieved by improving the reliability, efficiency and cost-effectiveness of the system with the following achievements: 1) improving the efficiency and production of high temperature superconducting wires and power equipment; 2) developing real-time information and control technologies and systems; 3) developing distributed intelligence sensing and control technologies; 4) reducing the cost and increasing the energy density of energy storage systems; 5) providing technical assistance and analysis that supports state and regional wholesale and electric market improvements; and 6) developing an integrated portfolio of these advanced technologies that achieves commercial viability and addresses the crucial needs of the entire electric system.

These strategies will result in significant improvements in the reliability, efficiency, and costs of the Nation's electric transmission and distribution infrastructure.

The following external factors could affect OETD's ability to achieve its strategic goal:

- Congressionally-directed projects that do not contribute to the program's goals;
- Funding that is below the requested levels;
- Partners, including industry and governmental, who discontinue key transmission and distribution technology R&D and cost sharing with OETD;
- The low level of investment in transmission-and-distribution deployable hardware;
- Policies that fail to adequately address underlying transmission and distribution infrastructure and systemic problems.

In carrying out OETD's program mission, the subprograms perform the following collaborative activities:

- Planning, reviewing, partnering and cost sharing with leading U.S. companies pursuing R&D and related work on electric transmission technologies;
- Consulting with utilities, Regional Transmission Organizations and Independent System Operators on regional policies, market assessments, planning, and regulations;
- Collaborating with other DOE offices and related entities — including the Office of Energy Assurance, Fossil Energy and Energy Efficiency and Renewable Energy — on how to best ensure energy security (per DOE's General Goal 4) with a diverse supply of reliable, affordable, and environmentally sound energy; the Energy Information Agency on market analysis; the Power Marketing Administrations and the Tennessee Valley Authority (TVA) on evaluating transmission-related technologies that enhance reliability and lower costs to consumers; and DOE laboratories on planning, managing, reviewing and completing R&D technical work with industry;
- Working with other Federal agencies, such as the Federal Energy Regulatory Commission (FERC) to develop policies, market mechanisms, regulations, laws and programs that facilitate modernizing and expanding the Nation's grid and the Department of Defense to develop and test technologies;
- Collaborating with non-governmental organizations, such as the North American Electric Reliability Council (NERC) and the Electric Power Research Institute (EPRI) to analyze market mechanisms and develop improved approaches to grid modernization and expansion;
- Working with States and regional entities, such as regional governors' associations and the National Association of Regulatory Utility Commissioners (NARUC) to develop policies, market mechanisms, regulations, state laws, and programs to improve the electric grid at the local, State and regional levels;
- Partnering with universities to develop plans and reviews, and to further R&D.

Validation and Verification

To validate and verify OETD's performance, the office conducts various internal and external reviews and audits. OETD's programmatic activities are subject to continuing review by OMB and the Congress, the General Accounting Office, and the Department's Inspector General. Senior management invites external reviews of office-wide planning, design, management and programmatic results in order to improve office effectiveness. Each Program Activity manager conducts annual peer reviews — comprised of independent, subject-area experts — to review the management and technical achievements of both programs and projects. Program Activity managers maintain long-term goals, annual targets and milestones, which are tracked by OMB and DOE's program management reporting system. Program Activity managers also maintain monthly accounts of project status to ensure that all projects are on-track and within budget. Senior management and budget personnel ensure that expenditures are within financial plans and in accord with budget requests. Senior management tracks the progress of each Program Activity on at least a quarterly basis, and makes adjustments necessary to achieve annual targets and long-term goals.

R&D Investment Criteria

The President's Management Agenda identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is measured involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop highly analytical justifications for applied research portfolios in future budgets. This will require the development and application of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

The Scoring Criteria for Applied R&D Investments, along with Program Assessment Rating Tool (PART), has helped OETD focus on developing long-term program/subprogram goals, performance indicators, annual targets, and benefits analysis that more clearly identify OETD's direction and help redefine strategies for meeting long-term goals.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2005 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The refocusing of the High Temperature Superconductivity R&D (HTS) Program Activity was supported by the results of the PART review. In arriving at a summary score of 70, OMB gave the OETD a score of 88 on Program Management. This score is attributed to OETD's use of near-term and long-term tracking systems to measure progress toward annual targets and long-term performance goals, use of independent peer reviews, spend plans, and site visit reviews.

Scores on Program Purpose and Design (80), Strategic Planning (70) and Program Results (59), primarily reflected OMB's findings that: the Program Activity did not demonstrate how factors of risk, years to commercialization, public benefits, and total Federal costs have impact upon — and are used to prioritize — its investments on R&D; the Program Activity lacked complete and transparent linkage between annual and long-term performance goals and resource needs; the Program Activity lacked a cost-effectiveness measure; and the Program Activity demonstrated only to a "small extent" progress in achieving its long-term performance goal.

To address these findings, this budget contains a more complete and transparent presentation of resource needs in terms of annual targets and long-term performance goals. A cost-effectiveness measure is included in the budget as well, and the HTS Program Activity plans to devote more of its resources to its long-term performance goal. The HTS Program Activity has developed "bubble charts" showing risk, years to commercialization, public benefits and Federal costs, which will be used in the future to make decisions on R&D investments, including prioritization of work.

Significant Program Shifts

DOE established the Office of Electric Transmission and Distribution (OETD) during FY 2003 to satisfy the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS) recommendations. The funding was shifted in its entirety from the Electricity Reliability Program of the Office of Energy Efficiency and Renewable Energy to the new office. OETD will have four Subprogram line items: 1) Research and Development, 2) Electricity Restructuring 3) Program Direction, and 4) Energy Reliability and Efficiency Laboratory (EREL). Research and Development has six Program Activities: 1) High Temperature Superconductivity R&D, 2) Transmission Reliability R&D, 3) Electric Distribution Transformation R&D, 4) Energy Storage R&D, 5) GridWise, and 6) GridWorks.

Beginning in FY2005, the Import/Export Authorization function will be transferred from Fossil Energy in the Interior and Related Agencies Appropriation to OETD in the Energy Supply Appropriation because this function matches the mission of OETD.

Energy Supply
Office of Electric Transmission and Distribution

Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
NNSA Service Center					
Lawrence Berkeley National Laboratory	2,743	5,853	7,010	+1,157	+ 19.8%
Total, NNSA Service Center	2,743	5,853	7,010	+1,157	+ 19.8%
Chicago Operations Office					
Argonne National Laboratory	3,198	1,165	3,031	+1,866	+ 160.2%
Brookhaven National Laboratory	480	424	505	+81	+ 19.1%
Chicago Operations Office					
Research and Development	4,557	13,928	3,509	-10,419	- 74.8%
Program Direction	369	0	0	0	0.0%
Total, Chicago Operations Office	4,926	13,928	3,509	-10,419	- 74.8%
National Renewable Energy Laboratory	15,551	8,977	4,847	-4,130	- 46.0%
Total, Chicago Operations Office	24,155	24,494	11,892	-12,602	- 51.4%
Golden Field Office					
Golden Field Office	15,166	14,165	16,169	+2,004	+ 14.1%
Idaho Operations Office					
Idaho Operations Office					
Research and Development	12,061	583	2,021	+1,438	+ 246.7%
Program Direction	189	0	0	0	0.0%
Total, Idaho Operations Office	12,250	583	2,021	+1,438	+ 246.7%
Idaho National Engineering and Environmental Laboratory	72	0	0	0	0.0%
Total, Idaho Operations Office	12,322	583	2,021	+1,438	+ 246.7%
Los Alamos Site Office					
Los Alamos National Laboratory	7,202	6,091	8,084	+1,993	+ 32.7%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Oak Ridge Operations Office					
Oak Ridge Operations Office	454	0	1,010	+1,010	+ 100.0%
Oak Ridge National Laboratory					
Research and Development	12,320	13,507	18,187	+4,680	+ 34.6%
EREL	0	736	0	-736	- 100.0%
Total, Oak Ridge National Laboratory	12,320	14,243	18,187	+3,944	+ 27.7%
Total, Oak Ridge Operations Office.....	12,774	14,243	19,197	+4,954	+ 34.8%
Richland Operations Office					
Pacific Northwest National Laboratory	1,042	2,326	7,865	+5,539	+ 238.1%
Sandia Site Office					
Sandia National Laboratories	5,338	7,298	5,638	-1,660	- 22.7%
National Energy Technology Laboratory	0	257	208	-49	- 19.1%
Washington Headquarters					
Office of Scientific and Technical Information.....	26	0	33	+33	+ 100.0%
Research and Development.....	4,487	1,818	2,562	+744	+ 40.9%
Program Direction.....	3,129	3,690	10,201	+6,511	+ 176.4%
Total, Washington Headquarters.....	7,642	5,508	12,796	+7,288	+ 132.3%
Total, Energy Supply (OETD).....	88,384	80,818	90,880	+10,062	+12.5%

Site Description

NNSA Service Center

Lawrence Berkeley National Laboratory (LBNL)

LBNL has the lead for a national laboratory/industry/university consortium that was formed to support research in Transmission Reliability R&D. This consortium is assisting in implementing the DOE Transmission Reliability R&D Program Activity. In support of the Electricity Restructuring Program Activity, LBNL provides DOE with nationally recognized expert technical assistance to individual State public utility commissions and energy offices, regional transmission organizations/independent system operators and regional State groups as well as transmission policy analysis support. In conjunction with SNL, the National Science Foundation and the California Energy Commission, LBNL is involved in the design, demonstration, and analysis of the Microgrid concept. As currently envisioned, a microgrid includes a cluster of loads and microsources connected at one controllable point within the distribution system. In FY 2004, LBNL is providing support on the 2003 Summer Blackout Investigation.

Chicago Operations Office

Argonne National Laboratory (ANL)

Argonne National Laboratory performs research and development for the High Temperature Superconductivity R&D (HTS) Program Activity. Argonne utilizes unique expertise in ceramics and materials science to improve conductor performance and to investigate deposition processes, such as metal-organic chemical vapor deposition (MOCVD), which are potentially scalable by industry for a second generation of HTS conductors. Unique facilities such as the Intense Pulsed Neutron Source (IPNS) and the Advanced Photon Source are used for measurement and characterization in ANL's research. Argonne also performs research on superconducting electric motors, transmission cables, and flywheel electricity systems.

Brookhaven National Laboratory (BNL)

BNL supports the High Temperature Superconductivity R&D Program Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire processing and application issues.

Chicago Operations Office (COO)

The Chicago Operations Office commissioned the solicitation for "Cooperative Research and Development for Advanced Communication and Control" and has been providing project management support to the five financial assistance subcontracts awarded through the solicitation. The COO also administers all contracts for the composite conductor network. Beginning in FY 2004, COO is used to issue grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions.

National Renewable Energy Laboratory (NREL)

NREL works with industry to develop a uniform national standard for interconnection of distributed power resources with the electric grid and performs research to develop related test and certification procedures. NREL performs analysis addressing regulatory and institutional barriers to distributed power and provides technical assistance to State agencies and others on these issues. NREL commissioned two rounds of solicitations and has been providing project management support to 14 R&D subcontracts. NREL administers Congressionally-directed funds for the Dine' Power Authority Navajo Transmission Project. NREL also supports the High Temperature Superconductivity R&D

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Program Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire processing and application issues.

Golden Field Office

Golden Field Office (GFO)

GFO administers the Superconductivity Partnership with Industry (SPI) for the High Temperature Superconductivity R&D Program Activity. The SPI is 50 percent cost-shared with industry and consists of 11 projects to develop first-of-a-kind designs for more efficient power cables, transformers, industrial motors and flywheel energy systems.

Idaho Operations Office

Idaho Operations Office (IDO)

The Idaho Operations Office administers all financial assistance agreements for Congressionally directed funds for Alaska transmission construction projects. IDO also administers the University Cooperative Projects for the High Temperature Superconductivity R&D Program Activity. The University projects are in cooperation with the National Laboratories and consist of seven projects to transfer new technologies developed at the universities to individual National Laboratories that would benefit from these new technologies.

Idaho National Engineering and Environmental Laboratory (INEEL)

INEEL assists NREL in developing a uniform national standard for interconnection of distributed resources with the electric grid.

Los Alamos Site Office

Los Alamos National Laboratory (LANL)

LANL works with industry to develop second generation HTS wires based on the ion beam assisted deposition (IBAD) process pioneered by LANL. LANL's expertise in film deposition processes and materials science is used to improve the performance of IBAD wires. Commercial versions are expected to be able to carry 1,000 amperes of current through a centimeter wide metal strip coated with a film the thickness of only a few human hairs - a revolutionary change. LANL is also developing superconducting transmission cables and superconducting fault current limiters (a device that protects the electrical system against lightning strikes and other accidents).

Oak Ridge Operations Office

Oak Ridge Operations Office

The Oak Ridge Operations Office administers the Interagency Agreement with the Department of Defense for the Title III procurement of industry pilot plants to produce Second Generation Superconducting Wire. Through extensive interaction with the Department of Defense, the industry projects will accelerate the commercial availability of Second Generation Wire by three to five years.

Oak Ridge National Laboratory (ORNL)

ORNL is part of a national laboratory/industry/university consortium that was formed to support research in Transmission Reliability R&D. ORNL operates the National Transmission Technology Research Center for testing transmission technologies. The Energy Reliability and Efficiency Laboratory (EREL) is planned to accommodate larger and more advanced testing capabilities. ORNL

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Funding by Site**

FY 2005 Congressional Budget

also develops second generation HTS wires based on the rolling-assisted biaxially textured substrate process (RABiTS) patented by ORNL. ORNL is applying its expertise in cryogenic systems and power system technology in projects to develop superconducting transformers and transmission cables. ORNL also participates in strategic planning for the next generation control architecture for the distribution system. In FY 2004, ORNL is providing support on the 2003 Summer Blackout Investigation.

Richland Operations Office

Pacific Northwest National Laboratory (PNNL)

PNNL is supporting development of communication and control architectures and technologies, as well as the integration of multi-vendor distributed energy resources into the distribution system. PNNL supports development of technologies for improved load/demand management while responding to market prices and electricity supply/demand conditions. PNNL is involved in the GridWise Alliance and Industrial Consortium. PNNL is part of a national laboratory/industry/university consortium that was formed to support research on Transmission Reliability R&D. PNNL conducts evaluations of the technological and institutional aspects of recent reliability events on the Nation's electric power system, and is the lead for research activities in real-time monitoring and control for the power grid. In FY 2004, PNNL is providing support on the 2003 Summer Blackout Investigation.

Sandia Site Office

Sandia National Laboratories (SNL)

In conjunction with Lawrence Berkeley National Laboratory, the National Science Foundation, and the California Energy Commission, SNL is involved in the design, demonstration, and analysis of the Microgrid concept. SNL is part of a national laboratory/industry/university consortium that was formed to support research on Transmission Reliability R&D. SNL also works to develop advanced superconductors based on the sol-gel chemical deposition process. For energy storage, SNL develops improved energy storage system components including power conversion electronics and modular multi-functional energy storage systems.

National Energy Technology Laboratory (NETL)

NETL will provide strategic planning and technical support to the Electric Distribution Transformation Program Activity as well as intra- and inter-departmental coordination support with other Federal Programs.

Washington Headquarters

Office of Scientific and Technology Information (OSTI)

The OSTI publishes and maintains on-line, full-text electronic current awareness publications and produces CD-ROM disks containing the High Temperature Superconductivity R&D Program Activity annual Peer Reviews.

Washington Headquarters

In conjunction with LBNL, SNL and the California Energy Commission, the National Science Foundation, through a Headquarters grant, is involved in the design, demonstration, and analysis of the Microgrid concept. DOE Headquarters is also used to issue grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions. Other activities include SBIR/STTR, I-Manage and communications.

**Energy Supply/
Electric Transmission and Distribution
Funding by Site**

FY 2005 Congressional Budget

Electric Transmission and Distribution

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Electric Transmission and Distribution					
Research and Development .	80,439	70,807	-1,340	69,467	75,679
Electricity Restructuring	4,816	7,059	-134	6,925	5,000
Energy Reliability and Efficiency Laboratory.....	0	750	-14	736	0
Program Direction	3,129	3,761	-71	3,690	10,201
Subtotal, Electric Transmission and Distribution	88,384	82,377	-1,559	80,818	90,880
General Reduction	0	-1,080	+1,080	0	0
Total, Electric Transmission and Distribution	88,384 ^{ab}	81,297	-479 ^{cd}	80,818	90,880

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act of 1978"
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-697 "Superconductivity and Competitiveness Act of 1988"
P.L. 102-486 Energy Policy Act of 1992 (EPACT)

Mission

The mission of the newly created Office of Electric Transmission and Distribution (OETD) is to lead a national effort to modernize and expand America's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security. This effort is accomplished through research, development, demonstration, technology transfer, and education and outreach activities in partnership with industries, businesses, utilities, States, other Federal programs and agencies, universities, national laboratories, and other stakeholders.

^a Reflects the spread of \$2,082,000 reduction in prior year balances

^b Reflects the spread of \$1,447,000 for SBIR/STTR

^c Reflects the distribution of the 0.59% rescission (\$479,000) from the Consolidated (Omnibus) Appropriations Bill for FY 2004

^d Reflects OETD's share of the \$10,000,000 Energy Supply general reduction (\$1,080,000)

Benefits

The President's National Energy Policy (NEP) contains more than 20 recommendations pertaining to the development of electricity reliability and distributed energy technologies and programs. Among these recommendations, DOE should expand research and development on transmission reliability and superconductivity, as well as conduct a study to examine the benefits of establishing a national electricity transmission grid and to identify transmission bottlenecks and measures to address them.

To satisfy these recommendations, DOE: (1) conducted an independent analysis of U.S. electricity markets and identifying transmission system bottlenecks; (2) led an extensive, open, public input process; and (3) commissioned a series of six issue papers from teams of nationally recognized experts to provide a comprehensive survey of the Nation's electric infrastructure.

These six issue papers combined to form the National Transmission Grid Study, which contains 51 recommendations for improving the reliability of the Nation's electric transmission system. Among the recommendations, DOE should create an Office of Electric Transmission and Distribution in order to adequately address the Nation's vital electricity needs. The study further recommended accelerated development and demonstration of high-temperature superconductivity, advanced conductors, energy storage, real-time system monitoring and control, voluntary load reduction technologies and program, and interconnection and integration of distributed energy resources.

In Secretary of Energy Spencer Abraham's May 2002 letter to the President as a response to the NEP recommendation, he wrote, "This report makes clear that our Nation's transmission system over the next decade will fall short of the reliability standards our economy requires and will result in additional bottlenecks and higher cost to consumers." It is essential that we begin immediately to implement the improvements that are needed to ensure continued growth and prosperity.

On August 14, 2003, a multi-regional electric power blackout affected an area with an estimated 50 million people and 61,800 megawatts of electric load in the States of Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut and New Jersey, and the Canadian Province of Ontario. In the aftermath of the blackout, OETD is co-founding, with their Canadian counterparts, the U.S.-Canada Power System Outage Task Force, which is investigating the causes of the major event and developing recommendations to reduce the possibilities of future outages and limiting the scope of any that occur. This event underscores the urgency of advancing OETD's research and development and electricity restructuring activities.

The Office of Electric Transmission and Distribution supports the Energy Supply Appropriation and DOE's Mission by providing for reliable delivery of energy, improving energy efficiency, exploring advanced technologies that make a fundamental change in our mix of energy options, and guarding against energy emergencies.

Research and Development

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Research and Development					
High Temperature Superconductivity R&D.....	38,801	34,129	45,000	+ 10,871	+ 31.9%
Transmission Reliability R&D	21,576	11,760	10,720	- 1,040	- 8.8%
Electric Distribution Transformation R&D.....	11,072	14,563	5,459	- 9,104	- 62.5%
Energy Storage R&D.....	8,990	9,015	4,000	- 5,015	- 55.6%
GridWise.....	0	0	5,000	+ 5,000	+ 100.0%
GridWorks.....	0	0	5,500	+ 5,500	+ 100.0%
Total, Research and Development.....	80,439	69,467	75,679	+ 6,212	+ 8.9%

Mission

The mission of the Research and Development program is to advance the technologies which will allow OETD to lead a national effort to modernize and expand America's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security, that in turn support the Department of Energy's mission for protecting national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

Benefits

This program provides for the research and development that will advance high temperature superconducting, transmission reliability, electric distribution and storage technologies. Together, these technologies provide a backbone for modernizing and expanding the Nation's grid.

Activity Focus

The program works through six main Program Activities. The High Temperature Superconductivity R&D Program Activity works to bring the unique efficiency and capacity advantages of superconductivity to electric power applications. The Transmission Reliability R&D Program Activity supports modernization of the Nation's transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition. The Electric Distribution Transformation R&D Program Activity transforms today's electric distribution infrastructure for increased affordability, security, resiliency, and reliability. The Energy Storage R&D Program Activity includes research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines. The GridWise Program

Activity focuses on developing distributed intelligent agents to diagnose local faults and coordinate with power electronics and other existing, conventional protection schemes that will provide autonomous control and protection at the local level. The GridWorks Program Activity accelerates the development of a robust portfolio of technologies for modernizing and expanding the electric grid, thereby reducing the likelihood and impact of reliability events, including blackouts.

High Temperature Superconductivity R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
High Temperature Superconductivity R&D					
Superconductivity Partnerships	15,776	13,580	17,838	+ 4,258	+ 31.4%
Second Generation Wire Development	17,839	12,819	17,162	+ 4,343	+ 33.9%
Strategic Research	5,186	6,749	10,000	+ 3,251	+ 48.2%
Congressionally Directed Activities	0	981	0	- 981	- 100.0%
Total, High Temperature Superconductivity R&D.....	38,801	34,129	45,000	+ 10,871	+ 31.9%

Description

The High Temperature Superconductivity (HTS) R&D Program Activity will support OETD's mission by bringing the unique efficiency and capacity advantages of superconductivity to electric power applications.

Benefits

The High Temperature Superconductivity (HTS) R&D Program Activity provides the unique efficiency and capacity advantages of superconductivity to the national effort to modernize and expand America's electricity delivery system. Fully operational, pre-commercial prototypes of electric power equipment, incorporating HTS wires, are being developed to have only half the energy losses and to be half the size of conventional power units. This Program Activity is developing more reliable and robust HTS distribution and transmission cables that have three to five times the capacity of conventional copper cables and higher efficiency, which is especially useful in congested urban areas.

Activity Focus

This Program Activity seeks to develop fully operational, pre-commercial prototypes of energy intensive power equipment that, by incorporating HTS wires, will have only half the energy losses and are half the size of conventional units. The mission will be supported by developing HTS distribution and transmission cables that have three to five times the capacity of conventional copper cables and higher efficiency for use in congested urban areas.

The High Temperature Superconductivity (HTS) R&D Program Activity utilizes the property of certain crystalline materials that become free of electrical resistance at, and below, the temperature of liquid nitrogen. The absence of electrical resistance makes possible super-efficient electrical power

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components that have only half the energy losses and are half the size of conventional technology of the same power rating. In the long term, HTS electrical wires will someday be able to carry 100 times the amount of electricity compared to the same size conventional copper wires. In the near-term, superconductive transmission cables that carry three to five times more power than present technology will enable direct replacement of existing underground power cables by urban utilities to meet demand growth without costly and disruptive construction.

Statutory mandates for this Program Activity include the Superconductivity and Competitiveness Act of 1988, Public Law 100-697 and the Energy Policy Act of 1992, Public Law 102-486. The public benefits result primarily from the increase in the efficiency and capacity of a wide range of electric power equipment using HTS wires.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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High Temperature Superconductivity R&D

Complete initial performance testing of a prototype, high-efficiency HTS generator being developed with General Electric to increase stability and decrease losses. Test the open-geometry, low power, Magnetic Resonance Imaging (MRI) system being developed with Oxford Superconducting Technologies; this will be smaller and more affordable than currently available.

- **Superconductivity Partnerships** **15,776** **13,580** **17,838**

Complete initial performance testing of a prototype, high-efficiency HTS generator being developed with General Electric to increase stability and decrease losses. Test the open-geometry, low power, Magnetic Resonance Imaging (MRI) system being developed with Oxford Superconducting Technologies, which will be smaller and more affordable than currently available.

- **Second Generation Wire Development** **17,839** **12,819** **17,162**

The coordinated industry-national laboratory-university effort to establish manufacturing capability at one or more private companies will conduct research that will result in the availability of long (100 meter to 1 kilometer) lengths of high performance “second generation” wire. Research will focus on the most promising deposition processes (from the six or more actively examined in FY 2003) to reliably protect against over currents, build in mechanical properties of flexibility and ruggedness, reduce alternating current losses, and accelerate processing times to reduce costs.

- **Strategic Research.....** **5,186** **6,749** **10,000**

The cause of alternating current energy losses in HTS wires will be understood, resulting in more efficient HTS wires (while resistance losses are eliminated by high temperature superconductivity, there remain alternating current losses which can be reduced). Prototypes of more efficient, compact, cryogenic systems will be developed that are suitable for use in a wide variety of applications. Wire research will focus on gaining understanding of ways to reduce processing times as well as to improve the mechanical properties (flexibility and strength) of second generation wires.

- Congressionally Directed Activities.....** **0** **981** **0**

A joint research program between Wright State University and the University of Albany, in collaboration with Wright Patterson Air Force Base, to enhance the performance of second generation, high-temperature coated superconductors.

- Total, High Temperature Superconductivity R&D** **38,801** **34,129** **45,000**

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

High Temperature Superconductivity R&D

- **Superconductivity Partnerships**

Funding is increased to restore the more rapid development and testing of prototype superconducting power cables in three different electric grid applications and a superconducting 100 MW generator as the projects move from the design phase to the construction phase..... +4,258

- **Second Generation Wire Development**

Funding is increased to restore the experimental fabrication of greater length and more uniform Second Generation Wire. Industry and national laboratory researchers are moving from fabrication of 10 meter lengths to 100 meter lengths of wire and higher current capacity through greater wire uniformity..... +4,343

- **Strategic Research**

Funding is increased for cooperative Strategic Research between national laboratories and industry to restore development and testing of designs for a new generation of more efficient cryogenic refrigeration systems to cool future superconducting equipment +3,251

Congressionally Directed Activities

Reflects research on second generation high temperature coated superconductor research -981

Total Funding Change, High Temperature Superconductivity R&D	+10,871
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Transmission Reliability R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Transmission Reliability R&D					
Real Time Grid Reliability Management.....	2,946	3,034	6,000	+ 2,966	+ 97.8%
Reliability and Markets	2,164	1,467	4,720	+ 3,253	+ 221.7%
Congressionally Directed Activities	16,466	7,259	0	- 7,259	- 100.0%
Total, Transmission Reliability R&D	21,576	11,760	10,720	- 1,040	- 8.8%

Description

The Transmission Reliability R&D Program Activity supports modernization of the Nation's transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition. A real-time information platform will monitor, track, predict and react to grid, market, and security operational trends to provide grid operators with the means to extract full capability from the transmission infrastructure while maintaining high-quality, low-cost, secure electricity delivery services. This includes developing real-time monitoring and control software tools and system operating models for grid operators, and market design research, including demand response integration, to support restructured markets development.

Benefits

The Transmission Reliability R&D Program Activity supports the mission of the OETD program to modernize and expand the Nation's electricity delivery system to ensure a more reliable and robust electricity supply by developing information management, real time measurement, and reliability compliance systems that enable reliable power system operation and efficient electricity delivery through fair, competitive markets. This Program Activity also supports the integration of monitoring and control systems into the national grid, and the design and testing of competitive electricity markets through electricity industry partnerships, and OETD's goal of developing enhanced economic security through efficient electricity markets.

Activity Focus

The Transmission Reliability R&D Program Activity is developing information management, wide area measurement, disturbance recognition, and reliability compliance monitoring systems to enable reliable system operation, efficient electricity markets, and compliance with electric reliability and security standards. This Program Activity collaborates with transmission system operators and other electricity industry stakeholders through peer reviews to identify electric transmission technology research needs. Transmission Reliability R&D supports the integration of advanced transmission monitoring and control systems, in addition to composite conductors, into the national grid through industry partnerships. It

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also provides technical and analytical support to allow customers to control their own loads and participate in competitive electricity markets, performs market monitoring and design analysis to identify market participant behavior and impacts, and conducts unbiased, third-party analysis on technically-based policy options for efficient, fair competitive markets.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Transmission Reliability R&D

The Transmission Reliability R&D Program Activity supports modernization of the Nation’s transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition.

- **Real Time Grid Reliability Management**..... **2,946** **3,034** **6,000**

Supports recommendations in the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS). The NEP calls for the Department to extend transmission reliability R&D and to conduct the NTGS. The NTGS contains 17 specific recommendations that call for technical support related to this activity, and specifically recommends accelerating development and demonstration of real time system monitoring and control technologies. Increase support development of real time grid monitoring sensors, software and system deployment.

- **Reliability and Markets** **2,164** **1,467** **4,720**

Supports recommendations in the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS). The NTGS recommends that DOE research and identify reliability data and performance metrics, and evaluate performance-based regulations, in addition to accelerating development and demonstration of voluntary load reduction technologies and activities.

Congressionally Directed Activities..... **16,466** **7,259** **0**

- Field testing of aluminum ceramic fiber composite conductors 2,838 3,924 0
- Swan Lake – Lake Tyree electrical intertie pursuant to the Southeast Alaska 4,732 0 0
- Upper Lynn Canal Power Supply Project 4,732 0 0
- Tok-to-Christochina Transmission Project 1,893 0 0
- Power Grid Project, New Jersey and Pennsylvania, Drexel University 1,893 1,962 0
- Indian Point Energy Center Study in New York..... 0 981 0
- Dine’ Power Authority in New Mexico to continue development of the Navajo Transmission Project 378 392 0

Total, Transmission Reliability R&D..... **21,576** **11,760** **10,720**

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Transmission Reliability R&D

- **Real Time Grid Reliability Management**

Increase to accelerate development and deployment of real time grid monitoring systems in the Eastern United States to avoid reoccurrence of the August 14, 2003 blackout.....	+2,966
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- **Reliability and Markets**

Increase accelerates research and development in market design and evaluation, and in demonstration of demand responsive load as spinning reserve capacity.....	+3,253
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Congressionally Directed Activities

Includes research on aluminum matrix composite conductors, PowerGrid simulator at Drexel University and the New Jersey Institute of Technology, Dine Power Authority project, and Indian Point Energy Center Study in New York.....	-7,259
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Total Funding Changes, Transmission Reliability R&D	-1,040
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Electric Distribution Transformation R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Electric Distribution Transformation R&D					
Peak Load Reduction	3,615	3,208	5,459	+2,251	+ 70.2%
GridWise	1,212	711	0	-711	- 100.0%
Congressionally Directed Activities	6,245	10,644	0	-10,644	- 100.0%
Total, Electric Distribution Transformation R&D	11,072	14,563	5,459	-9,104	- 62.5%

Description

The Electric Distribution Transformation R&D (EDT) Program Activity transforms today's electric distribution infrastructure for increased affordability, security, resiliency, and reliability. The existing grid system, primarily employing a design from the 1950's, has low asset utilization and does not engage distributed resources to collaboratively manage peak loads. It is deficient in its ability to tailor the level of power quality and reliability to specific customer needs, and in offering customer choice in power generation and use. Through integration of advanced communications, information, sensor and control infrastructure, and distributed energy resources, EDT will transform this aging distribution system into an information rich, intelligent power network that will address current deficiencies and lay the foundation for the next-generation distribution infrastructure. The new infrastructure will be secure from, and resilient to natural and man-made incidents, as well as reliable and responsive to customer needs.

Benefits

The Electric Distribution Transformation R&D Program Activity supports R&D that will enable "plug-and-play" of distributed resources, including load, through the development and testing of advanced interconnection technologies and standards. This "plug-and-play" technology will allow the full integration of distributed resources into distribution operations. This integration will lead to increased asset utilization and enhanced system reliability for the entire national electric system. The R&D conducted within EDT supports the mission of OETD by ensuring greater system reliability and by increasing technology choices for expanding America's electricity delivery system.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Electric Distribution Transformation R&D

The Electric Distribution Transformation (EDT) R&D Program Activity conducts research and development to advance efficient, reliable and secure electric power distribution systems of the future, from the substation through the interconnection system of distributed energy resources (DER) to demand/load management at end-use facilities.

- **Peak Load Reduction**.....
3,615
3,208
5,459

Continue level of effort to support completion of demonstrating distributed energy resources aggregation, at >1 MW, for integration with grid operations – in support of a major research and development/demonstration/deployment priority identified through industry-led, Federal-facilitated technology roadmap workshops. Continue and/or complete projects supporting interconnection technology development and standards development as recommended by the National Transmission Grid Study.

In the area of interconnection standards and activities, OETD will develop IEEE P1547 “Draft Standard for Interconnecting Distributed Resources with the Electric Power System” series of standards and advanced modular plug-and-play technologies for seamlessly integrating DER with electric power system and local needs.

In the area of test-bed and field demonstration, OETD will conduct a phased demonstration of DER system integration, progressing from the packaged system to facility, utility and smart utility levels.

In the area of distribution system simulation and analysis, OETD will develop advanced simulation and analysis tools to provide high-fidelity predictions for technology applications, system reliability, and economic decision-making, as well as model verification data from field tests and demonstrations.

In the area of stakeholder and institutional adoption, OETD will promote acceptance of new distribution infrastructure, standards, and practices and support removal of institutional/regulatory barriers and constraints.

- **GridWise**
1,212
711
0

Activity moved to GridWise Program Activity.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities	6,245	10,644	0
▪ Automated energy distribution and reliability systems in Indiana.....	2,838	981	0
▪ Micro-distributed generation prototype in Vermont...	331	245	0
▪ Natural Energy Laboratory in Hawaii to continue development and deployment of distributed energy systems.....	473	491	0
▪ Distributed energy systems integration, demonstration, and technology transition program in Pennsylvania.....	1,893	0	0
▪ Electric Infrastructure Technology, Training and Assessment Program in Pennsylvania.....	0	2,943	0
▪ Center for Distributed Generation and Thermal Distribution at Washington State University.....	0	491	0
▪ Navajo electrification demonstration project.....	0	2,943	0
▪ Research on advanced ceramic engines and materials for energy applications.....	0	294	0
▪ Research at the Georgia Institute of Technology on the use of recycled carpet as fuel for kilns.....	0	294	0
▪ The Connecticut Power Technologies Project.....	0	1,962	0
▪ Co-OP Plus, in Western Massachusetts, for installing and servicing fuel cells and distributing green electricity.....	710	0	0
Total, Electric Distribution Transformation R&D	11,072	14,563	5,459

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Electric Distribution Transformation R&D

- **Peak Load Reduction**

Increase supports the initiation of new projects to evaluate the impact of DER and interconnections with the grid; new demonstration projects in DER system integration; provide increased support for State and local reforms to remove barriers to distributed energy resources; solicit new projects in distributed sensing, intelligence and control technologies.....

+2,251

- **GridWise**

Activity moved to GridWise Program Activity for FY 2005

-711

Congressionally Directed Activities

Reflects research on automated energy distribution and reliability systems, a micro distribution generation prototype, the development and deployment of distributed energy systems in Hawaii, a distributed energy systems integration, demonstration, and technology transition program, the Electric Infrastructure Technology, Training and Assessment Program, the Center for Distributed Generation and Thermal Distribution, Navajo electrification demonstration project, research on advanced ceramic engines and materials, and the use of recycled carpet as fuel for kilns, and the Connecticut Power Technologies project.

-10,644

Total Funding Change, Electric Distribution Transformation R&D

-9,104

Energy Storage R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Energy Storage R&D					
Energy Storage R&D.....	5,678	2,148	4,000	+1,852	+ 86.2%
Congressionally Directed Activities	3,312	6,867	0	- 6,867	- 100.0%
Total, Energy Storage R&D	8,990	9,015	4,000	- 5,015	- 55.6%

Description

Energy Storage R&D Program Activity includes research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines. Energy storage mediates between variable sources and variable loads. Some of the variations are the normal, cyclical variations produced by loads coming on and off, such as the day-night cycle. Some of these variations are abnormal, but expected as a result of equipment failures, rapid load changes or storms. In the case of security issues, these variations could be the result of malevolent actions. Whatever the cause, energy storage provides network operators with the opportunity to respond in a coordinated, planned manner.

Benefits

The Energy Storage R&D Program Activity develops advanced electricity storage technologies, which supports OETD's goal of modernizing America's electric delivery system to provide a reliable and robust electricity supply. This is done with industry partnership, which plays a significant role in modernizing and expanding the electric delivery system. Energy storage technologies will improve the quality, reliability, flexibility and cost effectiveness of the existing system during normal operation. The National Transmission Grid Study recognizes that "distributed generation and storage allows customers to reduce reliance on the transmission system by "distributing" or placing generation sources and energy storage closer to locations at which electricity is used." Improved energy storage technologies will allow for increased equipment utilization, and reduce the number and severity of transmission congestion events.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Energy Storage R&D

Energy Storage R&D Program Activity include research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines.

▪ Energy Storage R&D	5,678	2,148	4,000
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Large scale, megawatt-level energy storage systems can significantly reduce transmission system congestion, help manage peak loads, and increase the reliability of the overall electric grid. Energy storage can also benefit transmission system stability by injecting power to damp out system disturbances. Such disturbances have led to grid collapse and widespread costly blackouts. Storage will help relieve transmission bottlenecks through better operations, a goal identified in the National Transmission Grid Study. These activities also support Chapter 7 of the National Energy Policy recommendations to develop a comprehensive energy delivery system.

Together with distributed energy resource technologies, energy storage technologies provide the high reliability required by the digital economy, telecommunication, and high technology manufacturing. While today’s grid can at best give three “nines” of reliability (i.e., 99.9 percent reliability), energy storage provides seamless power during micro outages, voltage sags, and frequency disturbances yielding the equivalent of seven to nine “nines” of reliability (i.e. 99.99999 percent to 99.9999999 percent). Industry estimates that disturbances cost U.S. industry up to \$25 billion per year. Energy storage systems, backed up by distributed generation, are the cost effective way to provide required reliability for the consumer.

The Program Activity funds the design of systems with integrated power electronics and controls, contributes to research on advanced storage components, and performs strategic research analysis by developing economic and performance models to effectively guide future research. Technologies involved in the Energy Storage R&D Program Activity include advanced battery systems, flywheels, supercapacitors, and thermal storage.

In FY 2005, collaborative demonstration projects with the California Energy Commission will be operational. Data collection, both economic and technical, will begin with periodic reports on the systems performance. Testing of the sodium sulfur battery system in both peak shaving and power quality modes at American Electric Power (AEP) will be completed and the final report issued. Power electronics activities will include full power testing of an Emitter Turn-Off (ETO) based inverter in collaboration with the Navy and the refining of a cascade inverter concept and electro-optic sensing being developed under a SBIR contract.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities	3,312	6,867	0
▪ Electricity transmission research at the University of Missouri-Rolla	0	981	0
▪ Research into lead carbon acid asymmetric supercapacitors	0	2,943	0
▪ Continue development of bipolar nickel metal hydride battery storage system.....	946	981	0
▪ Research, development and demonstration of advanced thermal energy storage technology integrated with renewable thermal energy technology	2,366	1,962	0
Total, Energy Storage R&D	8,990	9,015	4,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Energy Storage R&D

- **Energy Storage R&D**

Increase will accelerate development of advanced storage technologies to mitigate grid congestion and increase grid stability to avoid reoccurrence of the 2003 blackouts..... +1,852

Congressionally Directed Activities

Reflects research into electric transmission, lead carbon acid asymmetric supercapacitors, development of a bipolar nickel metal hydride battery storage system, and advanced thermal energy storage technology integrated with renewable thermal energy technology

-6,867

Total Funding Change, Energy Storage R&D

-5,015

GridWise

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
GridWise					
GridWise R&D	0	0	5,000	+ 5,000	+ 100.0%
Total, GridWise	0	0	5,000	+ 5,000	+ 100.0%

Description

GridWise denotes a modernized electric infrastructure framework where open, but secure, communication and information technologies, and associated standards, are used throughout the electric grid to enhance reliability and robustness, promote economic efficiencies, and provide value and choices to electricity consumers. In contrast to the GridWorks Program Activity, which focuses on advanced equipment applications, the GridWise Program Activity (software-centric) comprises the intelligence — or brains — behind a modern electric grid that incorporates GridWorks (hardware-centric) technology. Leading the electric system into the high-tech information age with GridWise will allow the Nation to realize the benefits achieved by cutting-edge industries that use essential real-time information to maximize reliability and system efficiency. GridWise also creates a more resilient electric system by incorporating autonomic system reconfiguration (“self-healing”) in response to disruptions.

Benefits

GridWise will enable a higher level of end-to-end productivity, security and reliability within the energy system. Utilizing new and existing technologies, GridWise will deliver real-time information via an integrated network that functions much like a nervous system in a living organism. Access to this continuous information stream enables instant detection and reaction to pressures on the energy system, allows for a more informed decision-making process and empowers customers — all of which leads to increased electricity security and reliability for individuals, organizations and the country as a whole, in accordance with the mission of OETD.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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GridWise

GridWise denotes a modernized electric infrastructure framework where open, but secure, communication and information technologies, and associated standards, are used throughout the electric grid to enhance reliability and robustness, promote economic efficiencies, and provide value and choices to electricity consumers.

▪ GridWise R&D	0	0	5,000
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Gridwise R&D focuses on developing distributed intelligent agents to diagnose local faults and coordinate with power electronics and other existing, conventional protection schemes that will provide autonomous control and protection at the local level. This hierarchy will enable isolation and mitigation of faults before they cascade through the system. The work will also help users and electric power system operators achieve optimized control of a large, complex network of DER systems, and will provide remote detection, protection, control, and contingency measures for the electric system.

Funding will allow continued development of communication and control systems to support adaptive intelligent grid operations, integrate distributed energy devices and enhance customer electric service.

This work will initiate the integration of information technologies into transmission and distribution networks that eventually will help develop autonomous control and protection at the local level, and thereby reduce the risk of cascading power outages and improve reliability of the electric system. The impact of not funding this work is a higher vulnerability to faults cascading into larger regions of the country, which may result in multi-region blackouts.

The system architecture and standards work will guide development of the electric system from transmission to end-use. At present, there is no common architectural construct or standards for integrating information and control technologies into the electric delivery system. Their existence would enable cooperative, real-time optimization of the system across all levels. This work begins the necessary coordination to develop a system architecture and associated standards for the electric system.

The Program Activity’s education and training work aims at assisting grid operators to perform their jobs more effectively in the face of growing electric system complexity. Eventually, there may be intelligent agents to take action before disturbances propagate through the system. However, grid reliability will depend on an operator’s ability to analyze the data and respond appropriately. This will require training (including electric grid simulators).

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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This work launches an education and training development program for operators, including university centers of excellence. Graduates of these programs will have the skills needed to properly analyze and manage electric grid operations, and more effectively prevent disturbances, including blackouts.

Total, GridWise	0	0	5,000
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Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

GridWise

▪ **GridWise R&D**

Increases sensing, intelligence & control technologies; systems architecture and standards; and education and training activities and allows for electric system integration of communication and control technologies for adaptive grid operations (not just on the distribution system). Activity was moved from Electric Distribution Transformation (formerly Distribution and Interconnection R&D) in order to focus more on the integration across the entire electric system, not just the distribution system

+5,000

Total Funding Change, GridWise	+5,000
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GridWorks

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
GridWorks					
GridWorks R&D	0	0	5,500	+ 5,500	+ 100.0%
Total, GridWorks	0	0	5,500	+ 5,500	+ 100.0%

Description

GridWorks accelerates the development of a robust portfolio of technologies for modernizing and expanding the electric grid, thereby reducing the likelihood and impact of reliability events, including blackouts. GridWorks bridges the gap between the laboratory prototypes of the base programs and the application needs of the electric industry. It is focused on achieving the commercial viability of these technologies — taking an integrated perspective of the entire electric system — by: 1) working with industry to identify needs; 2) mobilizing manufacturers to respond with product; and, 3) utilizing demonstrations to ensure functionality (e.g. durability). GridWorks is organized to encourage increased collaboration among the base programs, and to create a cohesive, comprehensive portfolio of systems and equipment that will be introduced into the electric system in a manner that will ensure safe, reliable, and efficient operation.

Benefits

The increasing demand for electricity to drive our economy and meet our modern way of life has placed strains on our antiquated infrastructure. By accelerating the development of a robust portfolio of technologies for modernizing and expanding the electric grid, GridWorks reduces the likelihood and impact of reliability events, including blackouts. GridWorks uses the facilities at our National Laboratories to accelerate development and testing of advanced conductors, increasing much-needed transmission line capacity. GridWorks complements the architectural software development of GridWise by developing and demonstrating associated hardware. For example, GridWorks significantly expands the deployment of sensors needed for a real-time monitoring system that provides the electric system operator with the ability to quickly see and respond to system disturbances and failures. In addition, GridWorks provides faster protection by pursuing technological breakthroughs in the development of advanced power electronics so that unintentional problems can be curtailed before they can propagate through the electric system.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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GridWorks

GridWorks accelerates the development of a robust portfolio of technologies for modernizing and expanding the electric grid, thereby reducing the likelihood and impact of reliability events, including blackouts.

▪ GridWorks R&D.....	0	0	5,500
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GridWorks crosscuts the electric system, funding effort in four major areas: cables and conductors; operator-based control and monitoring; substation and auxiliary equipment; and power electronics.

For cables and conductors, the transmission of electricity over long distances and at higher voltages has become an important component of a future modernized electric system. There is a national need to increase transmission and distribution capacity, not only to relieve congestion costs, but also to ensure the reliable and efficient operation of the electric grid. However, siting new transmission lines is time-consuming and costly, and often meets with public resistance. An alternative is to expand transmission capacity by increasing the utilization of existing rights-of-way. In FY 2005, this Program Activity will accelerate the development and testing of advanced composite conductors. This supports the recommendation in the National Transmission Grid Study to accelerate development and demonstration of grid-related technologies, and to evaluate them at a national test center.

A modernized electric infrastructure will need a control and monitoring system to ensure reliable and secure operation of the grid. GridWorks complements the architectural development of GridWise by developing and demonstrating associated hardware. For example, a real-time monitoring system requires widespread deployment of sensors to provide appropriate information to the operators and/or distributed intelligent agents. In FY 2005, this Program Activity will accelerate the development and deployment of low-cost, reliable and robust sensors that can monitor current flow, voltage, and phase angle throughout the electric system. These sensors are a core component of the real-time monitoring system that provides the operator with the ability to see in real-time what is happening on the electric grid and also provides a method of archiving time-synchronized grid information for further analysis. The goal is to significantly expand deployment of these technologies in the Eastern Interconnection (where the 2003 blackout occurred) and ultimately throughout the Nation.

Substations are located at both ends of the transmission line. A transmission substation, located near the power plant, uses large transformers to increase the generated voltage to extremely high voltages (tens or hundreds of thousands of volts) for long-distance transmission on the grid. At the other end of the transmission line, a distribution substation uses transformers to step transmission voltages down to distribution voltages (typically less than 35,000 volts). In addition,

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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a distribution substation has circuit breakers, switches, and other protective devices so that distribution lines can be disconnected when necessary. There is a need to develop smaller, lighter, more efficient, lower cost transformers and fault protection equipment.

Presently, faults and instability in an electrical grid are detected by protective relaying, and cleared by operation of circuit breakers or fuses. It is desirable in the future for stability protection to act much faster and for fault currents to be cleared quicker. The response rate of static interruption devices (i.e. power electronics) shows potential for reducing system faults. The problem is that most commercial power electronics devices are silicon-based, and their performance in power applications is limited by the material properties of silicon. There is a need for further development of advanced high voltage, high current, high frequency power switches and for technical analysis and research in the area of Diamond and SiC (silicon carbon)-based power electronics, to improve the mechanical robustness and increase the service lifetime of power electronic devices for electric system applications, including protective, switching control for two-way power flow.

Total, GridWorks.....	0	0	5,500
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Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

GridWorks

- **GridWorks R&D**

Funding will provide for conducting research on advanced composite conductors, control and monitoring, substation and auxiliary equipment, and power electronics. +5,500

Total Funding Change, GridWorks **+5,500**

Electricity Restructuring

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Electricity Restructuring					
Electricity Restructuring.....	4,816	6,925	5,000	-1,925	-27.8%
Total, Electricity Restructuring.....	4,816	6,925	5,000	-1,925	- 27.8%

Mission

The mission of the Electricity Restructuring Program Activity is to provide technical assistance and analytical support to States and regions for policies, market mechanisms, and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly wholesale and retail electric markets, as well as to conduct investigations into reliability events — including the use of modeling and analysis — to understand the causes and to develop recommendations for avoiding such future events.

Benefits

The Electricity Restructuring Program Activity helps States, regional electric grid operators, and Federal agencies develop policies, market mechanisms, regulations, state laws, and programs that facilitate the Office of Electric Transmission and Distribution’s mission to modernize and expand America’s electric grid to ensure a more reliable and robust electric supply.

The Subprogram helps to prevent future reliability events by conducting investigations of previous regional blackouts and more local outages, analyzing these events, and making recommendations to avoid future occurrences.

The Subprogram supports the Energy Supply Appropriation and DOE’s mission by providing for a more reliable delivery of energy, improving energy efficiency, exploring advanced technologies that make a fundamental change in our mix of energy options, and guarding against energy emergencies.

Electricity Restructuring

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Electricity Restructuring					
Electric Markets Technical Assistance	871	2,020	5,000	+ 2,980	+ 147.5%
Blackout Investigation.....	0	4,905	0	- 4,905	- 100.0%
Congressionally Directed Activities	3,945	0	0	0	0%
Total, Electricity Restructuring.....	4,816	6,925	5,000	- 1,925	- 27.8%

Description

The mission of the Electricity Restructuring Program Activity is to provide technical assistance and analytical support to States and regions for policies, market mechanisms, and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly wholesale and retail electric markets.

Benefits

Using education and outreach, the Electricity Restructuring Program Activity helps States, regional electric grid operators, and Federal agencies develop policies, market mechanisms, regulations, state laws, and programs that facilitate the Office of Electric Transmission and Distribution's mission to modernize and expand America's electric grid to ensure a more reliable and robust electric supply.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Electricity Restructuring

Provides technical assistance and analytical support to states/regions on policies, market mechanisms and programs that facilitate competitive, reliable, environmentally sensitive, customer-friendly electricity markets and conducts investigations and analysis of reliability events.

- **Electric Markets Technical Assistance** **871** **2,020** **5,000**

Expert technical assistance is given on an as-requested basis to state public utility commissions, state legislatures, regional State associations, regional transmission organizations/independent system operators, Federal officials and Governors’ offices. This includes technical assistance to States with substantial State public purpose (“system benefit”) funds that are members of the Clean Energy Funds Network. Technical assistance to these States focuses on best management practices. Topics of technical assistance, or supporting technical analysis, are the reliable and efficient supply and delivery of retail electric service and portfolio management, which includes demand response (peak load response) and other policy and market mechanisms for energy efficiency and renewable energy technologies in electricity markets (e.g. renewable portfolio standards, public benefit funds). Improvements in transmission policy, such as better state-based practices for siting of transmission lines, and improved coordination among states in the review of siting proposals, are also supported. Electric Markets Technical Assistance provides technical assistance in these same subjects to existing and emerging regional electricity organizations that are responsible for wholesale power system operations or coordination among state regulators.

A substantial effort is placed on quickly and efficiently disseminating findings of sponsored technical analyses, accomplished in partnership with State, regional, and national organizations that have roles in electric markets and regulation. Electric Markets Technical Assistance does not advocate, but serves as a clearinghouse to assist and inform State- and regionally-based policymakers on electricity market policies and programs. This Program Activity respects State and regional differences and avoids instructing about or directing their actions.

Also to be undertaken is analysis and implementation of policy-related recommendations that would improve reliability and enhance the electric transmission system contained in the National Transmission Grid Study, the August 2003 Blackout Investigation Final Report, or Congressionally-directed in pending energy legislation.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Electric Markets Technical Assistance will implement the National Transmission Grid Study recommendation to identify transmission bottlenecks (chokepoints) that are especially significant as threats to system reliability or barriers to economic efficiency. These bottlenecks, called “National Interest Transmission Bottlenecks,” will be identified through a two-year open and public process using input from industry, States, independent experts, and other stakeholders. Public identification by DOE of these National Interest Transmission Bottlenecks is needed every two years to focus appropriate actions by the Federal Energy Regulatory Commission (FERC), electric grid regional organizations, States, and private sector firms to ease such bottlenecks by means of timely investments drawing on the full range of appropriate technologies. After identifying bottlenecks, DOE will work pragmatically with affected parties to identify appropriate investments and remove obstacles to their realization.

Additional areas of possible transmission and reliability policy analyses include: review of the adequacy of Federal reliability and transmission data collection; development of objective standards for performance evaluation of Regional Transmission Organizations (RTOs); exploring how to encourage electric infrastructure investments, including newer more efficient yet riskier technologies; investigation of benefits from bulk power “superhighways” and other alternative electric grid architectures; and analytical support for improvements to grid reliability standards and regulation.

▪ Blackout Investigation	0	4,905	0
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These funds shall be used to conduct an extensive investigation, to include modeling and analysis, of the various electrical and System Control and Data Analysis (SCADA) systems, the reliability rules, systems operations and other factors, such as cyber situations and disturbances that might have caused or contributed to the August 14, 2003 blackout. This activity should be completed by the end of FY 2004.

Congressionally Directed Activities	3,945	0	0
▪ National Alliance of Clean Energy Incubators	789	0	0
▪ National Renewable Energy Laboratory virtual site office in Nevada to develop renewable energy resources	3,156	0	0
Total, Electricity Restructuring	4,816	6,925	5,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Electricity Restructuring

- **Electric Markets Technical Assistance**

Implements National Transmission Grid Study recommendation to identify National Interest Transmission Bottlenecks using a biannual public process; take appropriate actions to mitigate these bottlenecks. Assesses economics of major technological alternatives for increasing grid carrying capacity +2,980

- **Blackout Investigation**

The reduction in funding is due to the termination of the investigation into the causes of the August 14, 2003, blackout. These activities should be completed by the end of FY 2004. -4,905

Total Funding Change, Electricity Restructuring **-1,925**

Energy Reliability and Efficiency Laboratory

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Energy Reliability and Efficiency Laboratory					
Energy Reliability and Efficiency Laboratory.....	0	736	0	- 736	- 100.0%
Total, Energy Reliability and Efficiency Laboratory	0	736	0	- 736	- 100.0%

Mission

The mission of the Energy Reliability and Efficiency Laboratory (EREL) is to research and develop electricity transmission and distribution technologies, distributed energy resources and demand-responsive building systems in order to create an electric grid that is secure, flexible, reliable, efficient, expandable, and affordable.

Benefits

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation's growing needs for increased transmission capacity and power quality, at an affordable cost.

The EREL facility will provide R&D resources needed to successfully develop and introduce high temperature superconducting (HTS) cables, advanced overhead conductors, power electronics, and sensors and controls that can help expand and modernize the grid, relieve transmission constraints and improve system reliability.

Energy Reliability and Efficiency Laboratory

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Energy Reliability and Efficiency Laboratory					
Project Engineering & Design ...	0	736	0	- 736	- 100.0%
Construction	0	0	0	0	0%
Total, Energy Reliability and Efficiency Laboratory	0	736	0	- 736	- 100.0%

Description

The mission of the Energy Reliability and Efficiency Laboratory (EREL) is to research and develop electricity transmission and distribution technologies, distributed energy resources and demand-responsive building systems in order to create an electric grid that is secure, flexible, reliable, efficient, expandable, and affordable.

Benefits

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation's growing needs for increased transmission capacity and power quality, at an affordable cost.

The EREL facility will provide R&D resources needed to successfully develop and introduce high temperature superconducting (HTS) cables, advanced overhead conductors, power electronics, and sensors and controls that can help expand and modernize the grid, relieve transmission constraints and improve system reliability. It will develop integrated energy systems that optimize and integrate end-use generation and combined heat and power to achieve greater energy efficiency, high power quality, and reliability. Finally, the EREL facility will develop and verify the performance of advanced building systems that integrate heating and cooling equipment, appliances and building materials, with the communications, sensors and controls required for price-responsive demand.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Energy Reliability and Efficiency Laboratory

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation’s growing needs for increased transmission capacity and power quality, at an affordable cost.

- **Project Engineering & Design.....** **0** **736** **0**

In FY 2004, Oak Ridge National Laboratory (ORNL) will provide project management and will award an Architect-Engineer (AE) contract for the project design. The preliminary design will be completed and the Critical Decision 2 (CD2) — DOE’s approval of the performance baseline — also will be completed during FY 2004.

A life cycle cost analysis was conducted to examine two alternatives to new construction: (1) renovation of existing laboratories and offices at ORNL, and (2) lease space from the private sector. For the renovation alternative, adequate space at various locations throughout the complex would be upgrade to meet the needs, goals and objectives of the DOE/OETD R&D program initiatives. Leasing space from the private sector includes modifying the space from the private sector includes modifying the space to meet the needs of the EREL and returning the facility to its original condition upon completion of the research program. The results indicate that construction of the new facility as proposed has the lowest present value life cycle cost.

All DOE facilities, including EREL, are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, “Federal Compliance with Pollution Control Standards”; section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR 101-19.6. This project will be located in an area not subject to flooding determined in accordance with the Executive Order 11988. DOE has reviewed the U.S. General Services Administration (GSA) inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

- **Construction** **0** **0** **0**

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Physical construction will begin late in the second quarter of FY 2006 and should be completed in FY 2009.

Approximately 80 percent of the 52,000 square foot multistory building will be laboratory space, including a large high bay area serviced by two 2-ton cranes for handling large equipment and integrated energy systems. These laboratories are critical to achieving DOE/OETD program goals such as improving the cost-performance ratio of HTS wires by at least a factor of four by 2012 and enabling T&D systems to flexibly respond in real time to local power reliability conditions. The facility's unique capabilities will include:

- A full spectrum of equipment for continuous processing and characterization of 2nd generation HTS tape;
- An isolated power line for electricity T&D research including impulse testing to 500KV to determine breakdown properties; and
- Facilities for optimizing the integration of distributed generation and thermally-activated equipment, along with advanced power electronics, communications, sensors, and controls.

The remainder of the space will contain offices for approximately 40 occupants, and conference and meeting rooms. Some of the office space will be for visiting scientists from energy companies, technology manufacturers, energy-intensive industries, universities, and other national laboratories to collaborate with ORNL staff on cost-shared R&D. Through designation as a National User Center, and with the support of advanced information technologies, researchers from across the nation will have access to EREL's unique collection of research equipment without having to travel to East Tennessee. Strong R&D partnerships are essential to achieving OETD's goals. Such R&D alliances leverage public and private resources and foster innovation. By providing university scientists access to unique facilities and equipment and by arranging technical personnel exchanges, the EREL will generate advances in fundamental science. By developing new technologies and the equipment needed to characterize and test them, the EREL will allow industry to address scale-up and user requirements.

The EREL will be located at the north entrance of ORNL, where it will be a highly visible showcase for sustainable energy technologies and design practices. The building structure will be steel and will be clad with an aesthetic low-maintenance exterior. An advanced heating, ventilating, and air-conditioning (HVAC) system will provide cost-effective, energy-conserving space conditioning utilizing the waste heat from on-site power generation. Land improvements will include service drives, walkways, drainage, and landscaping. Utilities will be extended from the existing distribution systems adjacent to the site and upgraded as required. The EREL will be designed and engineered to achieve a silver rating based on the Leadership in Energy & Environmental Design (LEEDTM) rating system developed by the U.S. Green Building Council. Energy Star certification will be sought for applicable portions of the building.

Total, Energy Reliability and Efficiency Laboratory...

0

736

0

Energy Supply/
Electric Transmission and Distribution/
Energy Reliability and Efficiency Laboratory

FY 2005 Congressional Budget

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Energy Efficiency and Reliability Laboratory

- **Project Engineering & Design (PED)**

Project engineering and design is delayed in FY 2005 to allow OETD to focus on higher level priority activities. PED will resume in FY 2006.

- 736

Total Funding Change, Energy Efficiency and Reliability Laboratory

-736

Capital Operating Expenses and Construction Summary

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2003	FY 2004	FY 2005	Unappro- priated Balance
EREL.....	19,500	0	0	736	0	18,764
Total, Construction....	19,500	0	0	736	0	18,764

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Chicago Operations Office					
Argonne National Laboratory					
Salaries and Benefits.....	0	0	0	0	0
Travel.....	0	0	0	0	0
Support Services	0	0	200	+200	+ 100.0%
Other Related Expenses	0	0	0	0	0
Total, Argonne National Lab...	0	0	200	+200	+ 100.0%
Full Time Equivalents.....	0	0	0	0	0
Chicago Field Office					
Salaries and Benefits.....	300	300	430	+ 130	+ 43.3%
Travel.....	36	25	60	+ 35	+ 140.0%
Support Services	36	17	40	+ 23	+ 135.3%
Other Related Expenses	45	25	80	+ 55	+ 220.0%
Total, Chicago Field Office	417	367	610	+ 243	+ 66.2%
Full Time Equivalents	2	2	3	+1	+ 50.0%
Total, Chicago Operations Office.....	417	367	810	+443	+ 120.7%
Idaho Operations Office					
Salaries and Benefits.....	140	96	0	-96	- 100.0%
Travel.....	15	2	0	- 2	- 100.0%
Support Services	0	0	0	0	0%
Other Related Expenses	27	2	0	- 2	- 100.0%
Total, Idaho Operations Office.....	182	100	0	- 100	- 100.0%
Full Time Equivalents	1	1	0	-1	- 100.0%

Headquarters					
Salaries and Benefits.....	2,080	2,314	4,778	+ 2,464	+ 106.5%
Travel.....	90	73	330	+ 257	+ 352.1%
Support Services	90	331	1,820	+ 1,489	+ 449.8%
Other Related Expenses	270	505	2,463	+ 1,958	+ 387.8%
Total, Headquarters	2,530	3,223	9,391	+ 6,168	+ 191.4%
Full Time Equivalents	16	16	34	+18	+ 112.5%
Total Program Direction					
Salaries and Benefits.....	2,520	2,710	5,208	+ 2,498	+ 92.2%
Travel.....	141	100	390	+ 290	+ 290.0%
Support Services	126	348	2,060	+ 1,712	+ 492.0%
Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%
Total, Program Direction.....	3,129	3,690	10,201	+ 6,511	+ 176.4%
Total, Full Time Equivalents	19	19	37	+18	+94.7%

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Electric Transmission and Distribution. It also includes associated properties, equipment, supplies and materials required for supporting the responsive management and oversight of programs. Activities also include necessary funds for support service contractors, equipment, and travel.

DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from staff offices that support the programs in carrying out the mission. DOE's staff offices perform critical functions necessary for success in achieving the Department's goals which include, but are not limited to, managing information technology, ensuring sound legal advice and fiscal stewardship, developing and implementing uniform program policy and procedures, maintaining and supporting our workforce, safeguarding our work spaces, and providing Congressional and public liaison.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. The Office of Electric Transmission and Distribution performs critical functions which directly support the mission of the Department. These functions include providing for reliable delivery of energy, improving energy efficiency, exploring advanced technologies that make a fundamental change in our mix of energy options, and guarding against energy emergencies.

In FY 2005, the Import/Export Authorization (IEA) activity was transferred from Fossil Energy under the Interior and Related Agencies Appropriation to OETD under the Energy Supply Appropriation because its activities meet the mission of OETD.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Salaries and Benefits..... **2,520** **2,710** **5,208**

Funds a total of 37 FTEs that will provide the executive management, program oversight, analysis, and information required for the effective implementation of the OETD programs.

The DOE Headquarters component has 28 FTEs in FY 2005 who are responsible for the development of policies, strategic plans and related guidance to program offices; evaluation of program performance; formulation, defense and execution of budgets; as well as communications with the public and stakeholders regarding polices, funding, program performance and related issues.

With a Congressionally approved transfer from the Interior Budget, headquarters salaries and benefits also includes \$726K for 6 FTEs that are responsible for performing the congressionally mandated functions of the Import/Export Authorization (IEA) activity, which grants and/or modifies Presidential permits for the construction, operation, maintenance and connection of electric transmission facilities at the U.S. international borders. IEA manages the regulatory review of exports of electricity and the construction and operation of electric transmission lines which cross U.S. international borders.

These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping to ensure availability of competitively priced electricity supplies in a competitive and environmentally sound manner. The activity also ensures that exports of electric energy and the construction of new international electric transmission lines do no adversely impact on the reliability of the U.S. electric power supply system and that electricity trade occurs in the freest possible marketplace. IEA’s activities help deregulate energy markets and reduce international trade barriers, and create an integrated North American energy market. IEA encourages greater exchange of technical and regulatory information among our trading partners. Through its publications, IEA increases public awareness of energy issues and the advantages of competition in the marketplace.

OETD Program Direction also supports three Chicago Field Office personnel who are accountable for contract acquisition and management, as well as direct R&D project direction and monitoring.

Travel..... **141** **100** **390**

Travel will allow OETD to effectively manage R&D programs and provide technical outreach to regional, State and local organizations. Of the amount requested in 2005, \$16K would be used by staff performing IEA activities.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
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Support Services..... **126** **348** **2,060**

Includes funding for support service contractors, equipment, and general OETD initiatives that support all energy resources programs. Provides support services needed for energy technology specific advisement on critical science, engineering, environmental, economic, and legal issues; safety and health support; facility safeguards and security; computer systems development along with subsequent hardware and software installation, configuration and maintenance activities. A critical level of contracted skills and abilities is necessary to help assess and exploit the potential of energy technologies, as well as implement the President's Management Agenda to the fullest extent possible.

Of the amount requested in 2005, \$335K will be used to provide for contractor support to execute IEA activities.

Other Related Expenses..... **342** **532** **2,543**

This includes working capital fund expenses such as rent, supplies, copying, graphics, mail services, printing and telephones. Also, \$124K will be used in FY 2005 to provide training, supplies and working capital fund costs for the six IEA program staff.

Total, Program Direction **3,129** **3,690** **10,201**

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Salaries and Benefits

- Reflects 18 additional full time equivalent employees (FTEs) that will support the expanding roles of the Office of Electric Transmission and Distribution. The additional FTEs will allow the OETD to effectively manage its R&D programs. The increase also reflects general pay increases, promotions, and other within-grade increases
 +2,498

Travel

- Additional travel to support the increase in FTEs. Travel will allow OETD to effectively manage R&D programs and provide technical outreach to regional, state and local organizations.
 +290

Support Services

- Reflects market analysis, scenario planning, operations planning, technical reviews, workforce analysis, and general support
 +1,712

Other Related Expenses

- Includes development of information technology infrastructure (including eXCITE support), systems (including websites and intranet), program management and capital planning, as well as telecommunications
 +2,011

Total Funding Change, Program Direction	+6,511
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Support Services by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Technical Support					
Energy Technology Advisement on Critical Issues.....	82	263	460	+ 197	+ 74.9%
Total, Technical Support.....	82	263	460	+ 197	+ 74.9%
Management Support					
Computer Systems Development, Installation, Configuration and Maintenance.....	0	37	1,470	+ 1,433	+ 3,873.0%
Preparation of Program Plans.....	24	28	56	+ 28	+ 100.0%
Training and Education	20	20	74	+ 54	+ 270.0%
Total, Management Support	44	85	1,600	+1,515	+ 1,782.4%
Subtotal, Support Services	126	348	2,060	+1,712	+ 492.0%
Use of Prior-Year Balances.....	0	0	0	0	0
Total, Management Support	126	348	2,060	+1,712	+ 492.0%

Other Related Expenses by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Other Related Expenses					
Equipment	163	50	240	+ 190	+ 380.0%
Working Capital Fund	179	482	2,303	+ 1,821	+ 377.8%
Subtotal, Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%
Use of Prior-Year Balances.....	0	0	0	0	0
Total, Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%

