

NIST Advanced Technology Program

Focused Programs

Catalysis & Biocatalysis
Technologies

Selective-Membrane
Platforms

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What NIST is...



NIST's primary mission is to promote economic growth by working with industry to develop and apply technology, measurements and standards.

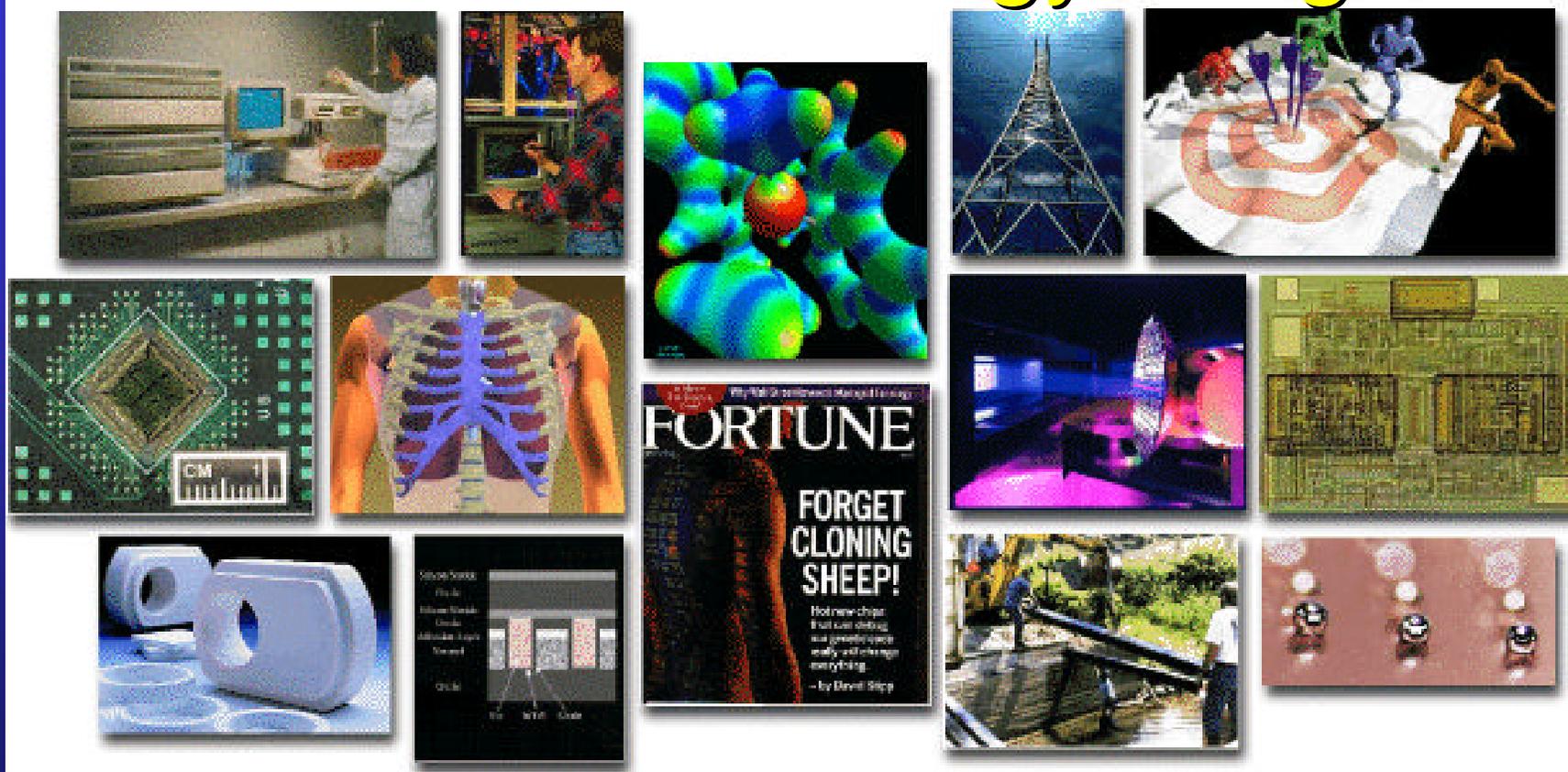
Measurements and Standards Program

Advanced Technology Program

Manufacturing Extension Partnership

National Quality Program

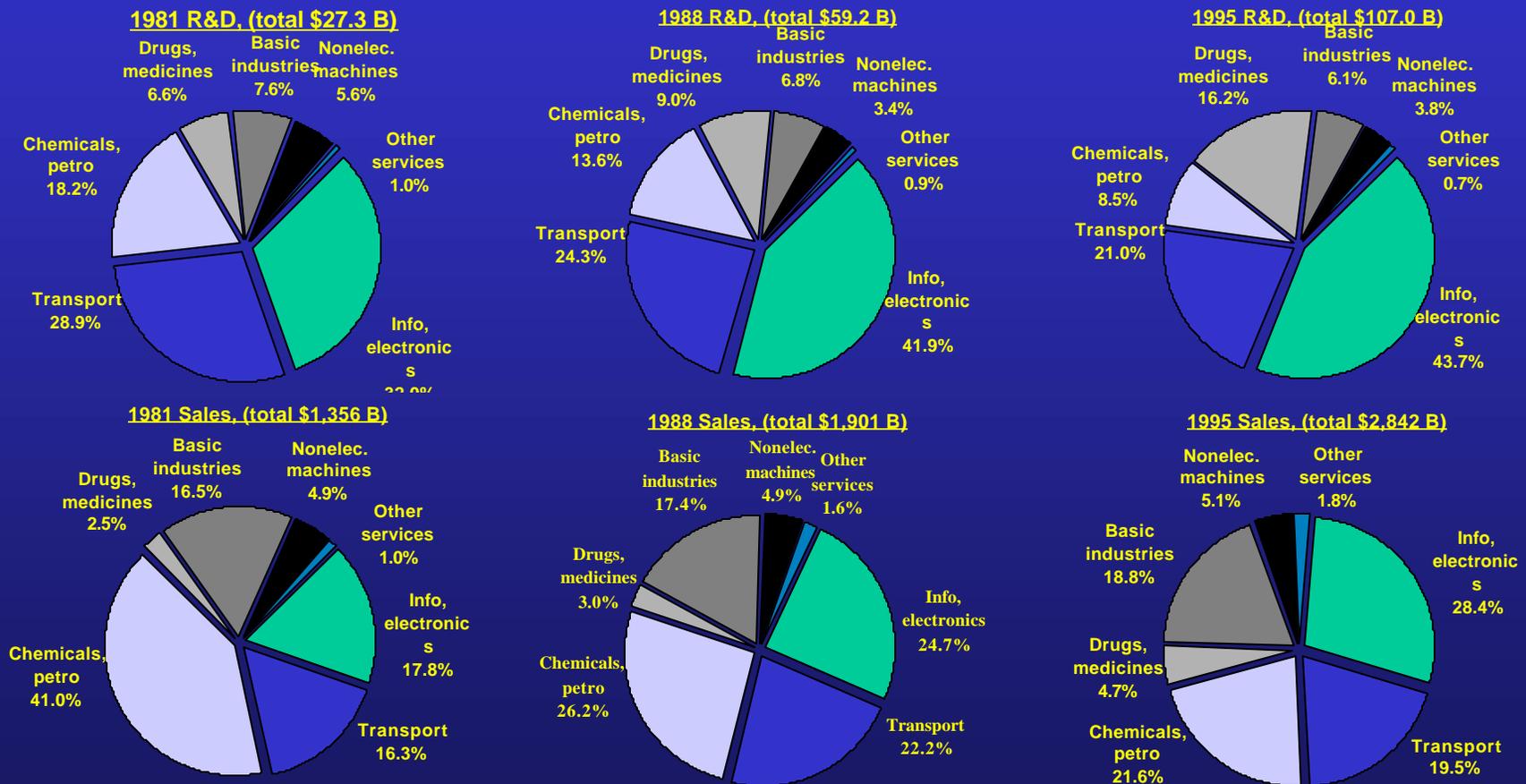
Advanced Technology Program



*Bridging the Gap Between the Laboratory
and the Marketplace*

Sectors' Percentage Shares of Total Industry R&D Spending and Net Sales, 1981, 1988 & 1995*

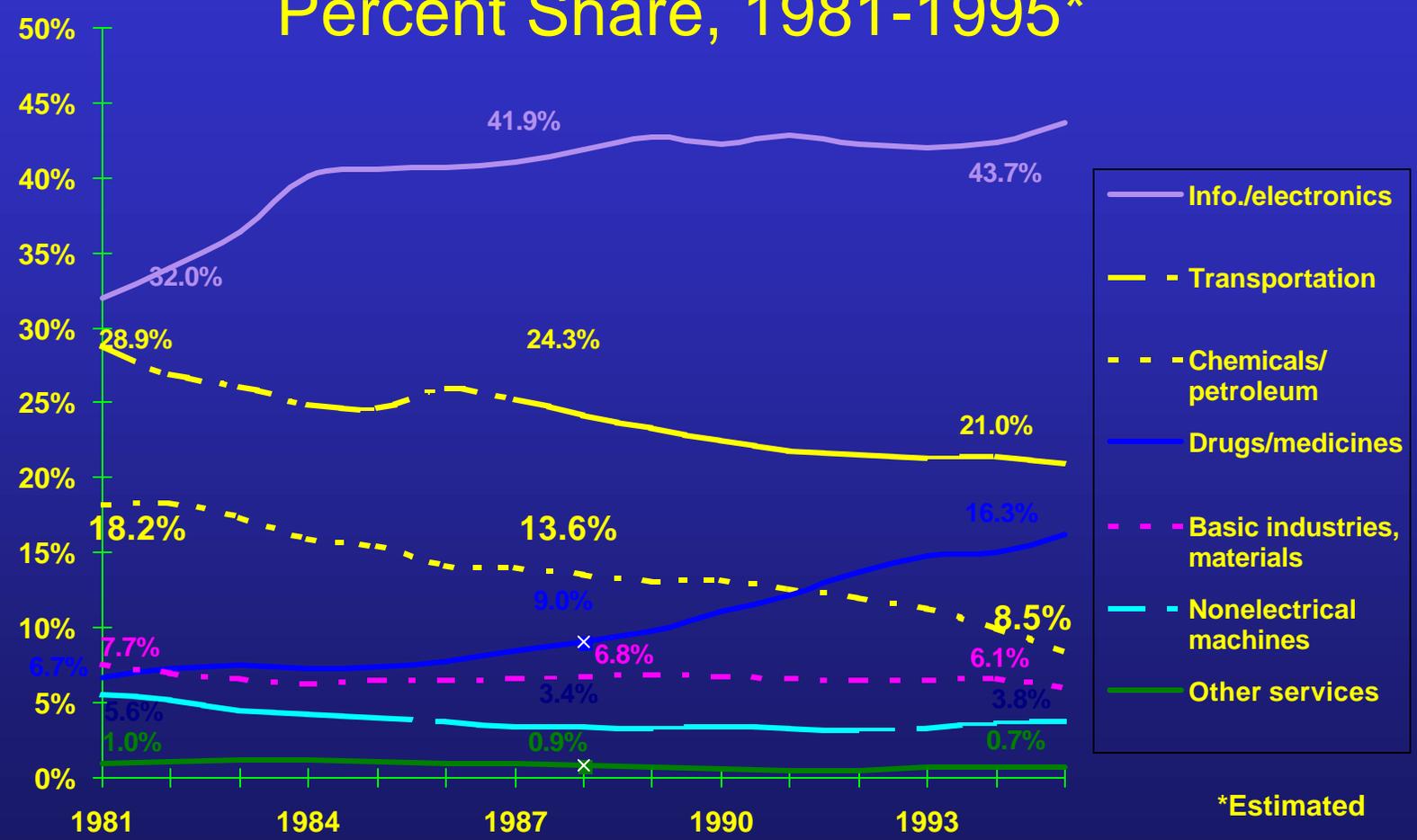
Publicly-Traded R&D-Conducting Firms, Billions of Current Dollars



*1995 is estimated. Data Source: Standard & Poor's Compustat, Oct. 1996. All listed U.S. publicly-traded companies that conduct at least \$1,000 R&D.

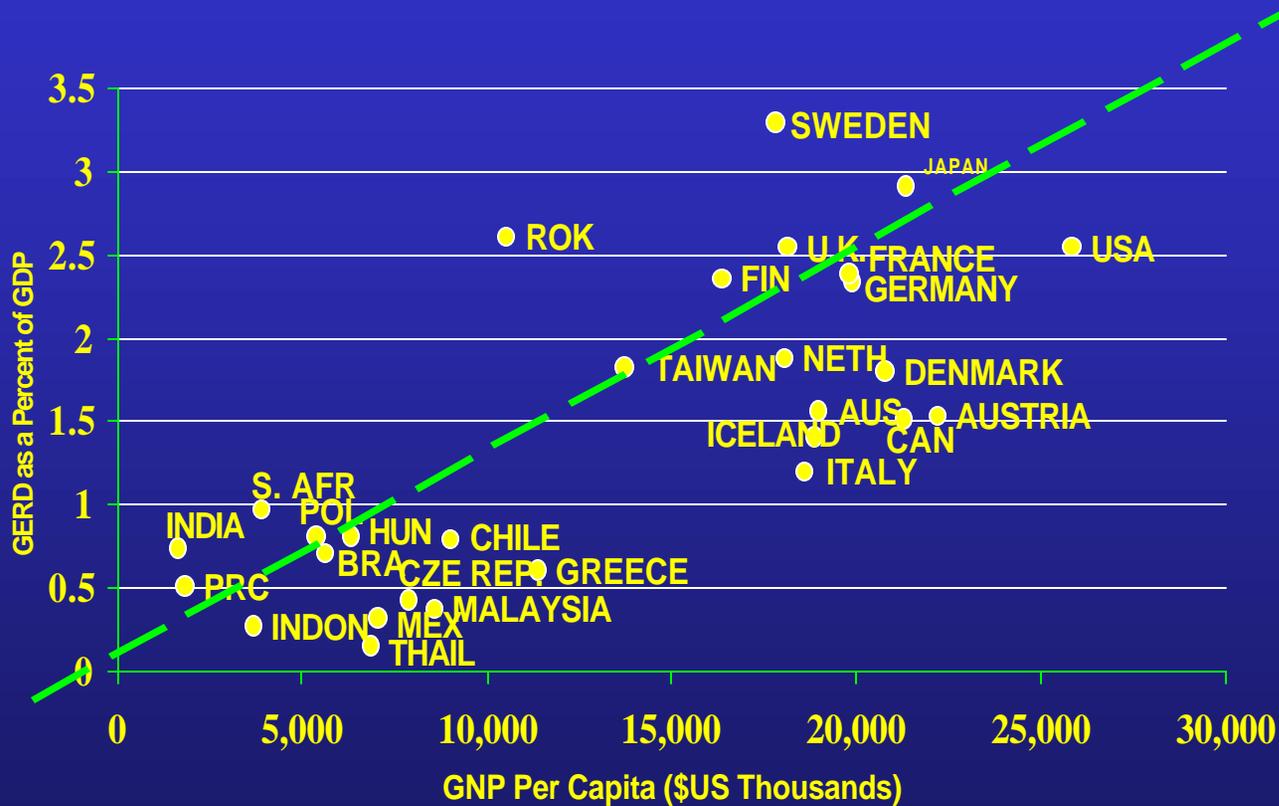
Total Industry R&D Expenditures

Percent Share, 1981-1995*



Total National R&D Spending

Percent of GDP Compared to GNP per Capita (1994)



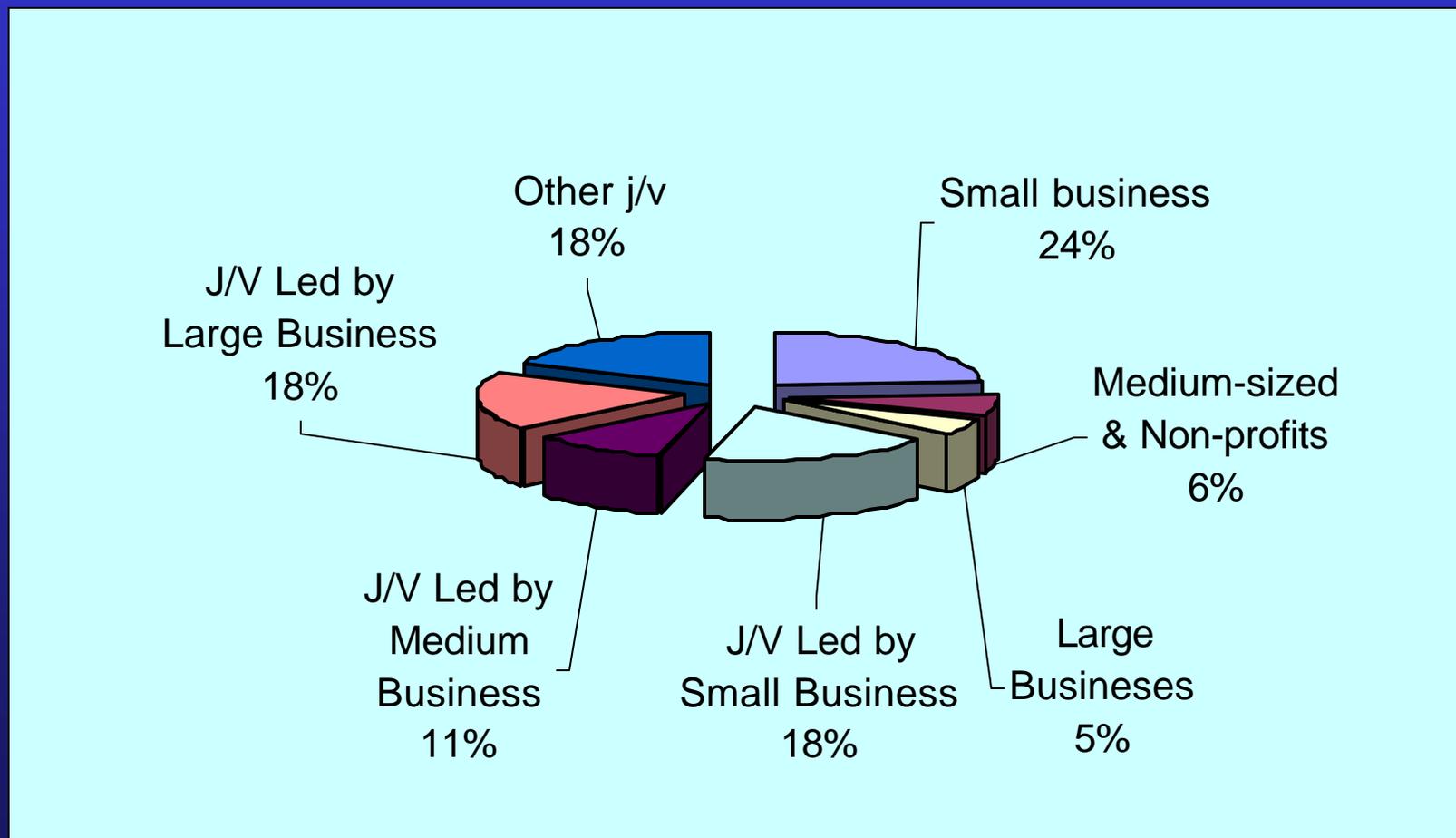
Source: The Global Competitiveness Report, 1996, World Economic Forum, Geneva, Switzerland
 WORLD BANK, From Plan to Market: World Development Report 1996, NSF, Science and Engineering Indicators, 1996

The Competitive Environment

- Advances in technology account for more than 50 % of U.S. economic growth
- Global competition has forced a focus on short-term return on investment and increased R&D efficiency
- Now more than ever, our nation's economic well-being depends on rapid development and commercialization of technology



Distribution of \$1,386 M to 431 ATP Awards 1990 - 1998



ATP FOCUSED PROGRAMS

Selective-Membrane Platforms

Active or completed projects: 16

Estimated ATP funding: \$ 31.3 M

Industry cost-share funding: \$ 39.8 M

ATP FOCUSED PROGRAMS

Selective-Membrane Platforms

Technology Challenges:

- **Stable Liquid Membranes: agricultural & biotechnology products**
- **Hydrogen-selective, composite Membranes for H₂ production**
- **Solvent & Temp Stable Polymers: seed oils, pharmaceuticals**
- **Facilitated Surface Transport: industrial gases**
- **10-50 nm Monodisperse PSDs: viral filtering, dialysis**

ATP FOCUSED PROGRAMS

Selective-Membrane Platforms

- Praxair** Facilitated Transport Membrane Platforms
[2 yrs ATP Funds- \$2,000 K Proj. Funds- \$2,480K]
- Baxter** TIPS Ultrafiltration Membranes for Biological Separations
[3 yrs ATP Funds- \$975 K Proj. Funds- \$2,610 K]
- Cargill** Development of Solvent Compatible Polymeric Membr.
[5 yrs ATP Funds- \$3,752 K Proj. Funds- \$8,338 K]
- Praxair/WJA** High-Temp. Hydrogen Selective Membrane Platforms
[4 yrs ATP Funds- \$1,515 K Proj. Funds- \$3,066 K]
- Facilichem** Stable Liquid Membranes
[2 yrs ATP Funds- \$2,000 K Proj. Funds- \$2,480 K]

ATP FOCUSED PROGRAMS

Selective-Membrane Platforms

Amoco	Facilitated Transport . . For Low-Cost Olefin-Paraffin Separations
IBC	Novel Anion-Selective Separations Using Molecular Recognition
Air Products	Energy-Efficient Oxygen Production . . Ion-Transport Membranes
GelTex Pharm	Molecular Recognition Polymers as Anti-Infectives
CuraGen	Molecular Recognition . . Design of Protein-Specific Drugs
Praxair	Advanced Sorbents for Reducing the Cost of Oxygen
Ceramatec	Development of a High-Pressure Oxygen Generator Using a Solid Electrolyte Oxygen Separation Technology
BP/Praxair	Dual Purpose Ceramic Membranes
IBC	Non-Chromatographic Enantiomer Separation and Purification
Aphios	Marine Microorganisms and Saline Fermentation . .
Mycogen	Oleaginous Yeast Fermentation . . Production of Squalene . .

ATP FOCUSED PROGRAMS

Catalysis and Biocatalysis Technologies

Active or completed projects: 18

Estimated ATP funding: \$ 68.29 M

Industry cost-share funding: \$ 73.13 M

ATP FOCUSED PROGRAMS

Catalysis and Biocatalysis Technologies

Technology Challenges:

- New catalysts and bio-catalysts, catalytic processes
- Increased manufacturing reliability
- Reducing mfg. cost and environmental impacts
- Reactor modeling & design
- Reduced development time and costs
- Improved understanding of catalyst structure and function
- Availability of computational tools

ATP FOCUSED PROGRAMS

Catalysis and Biocatalysis Technologies

1995 (95-05)

The Dow Chemical Co.	Breakthrough Process....Propylene to Propylene Oxide
Genencor International, Inc.	Continuous Biocatalytic Systems.... Renewable Resources
Phillips Petroleum Co.	Computational Methods for Catalyst Design
General Electric Company	Biosynthesis of Monomers
ABB Lummus Global*	Thin-Film Solid Acid Catalyst for Refinery Alkylation
B.F. Goodrich/3M Co.	Tailored Optical Polymers Through a Novel Catalyst System
Amoco Corporation	Elastomeric Polypropylene and Elastic Non-wovens Venture
W.R. Grace/Cryovac*	Polar-Tolerant Organometallic Catalytic Technology...

1998 (98-05)

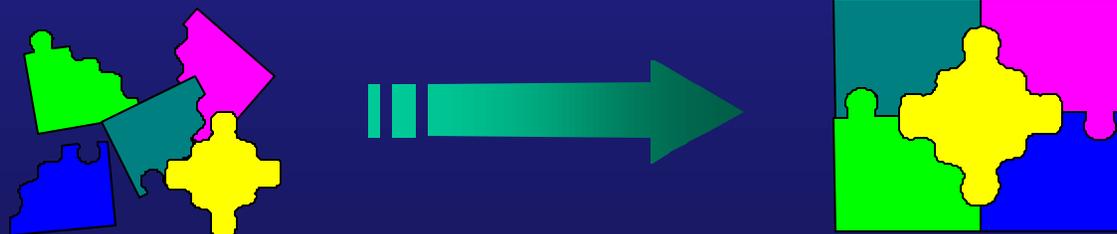
Maxygen, Inc.	Whole Genome Shuffling....
Thermatrix, Inc.	Integrated Four-Way Converter for Diesel Emission Control
Henkel/GE	Biosynthesis of Chemical Intermediates
Dyax Corp.	A Phage-Display-Based Platform Technology..

Our Targets: Where Market Needs and Emerging Technologies Converge

- Markets demand higher performance/price ratios
- Globalization of markets increases *pace* of change

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- Convergence of hardware and software technologies
- Lower cost, generic solutions increase availability



An ATP Program Starting FY 1999

Combinatorial Discovery of Chemicals and Materials

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Benefits of Combinatorial Methods to U.S. Industry

- Reduced innovation cycle times across organization
 - ★ Discovery
 - ★ Process development
 - ★ Customer service and flexible manufacturing
- More efficient use of capital for R&D and manufacturing
 - ★ Time-to-market and ROI of R&D \$'s
- New products/new technologies
 - ★ New markets/new competitive positions
- Reduces competitive threat of reverse engineering IP
- Allows for “out-of-box” experimentation
 - ★ Broadens spectrum of materials in development

Impact on Catalyst Innovation

- Increase return on investment
 - ★ Capital cost
 - ★ Product quality
 - ★ Yields
 - ★ Manufacturability
 - ★ On-stream factor
 - ★ Energy consumption
 - ★ Asset management
- Meet changing market demands faster
- Permit feedstock flexibility
- Increase focus on environmental stewardship
- Huge leverage toward social benefits

Catalyst Discovery/Process Issues

- Discovery
 - ★ Deposition, Surfaces and Substrates, Temp/Pressure
- Preparation
 - ★ Oxidation, Reduction, Calcination
- Product and Process Development
 - ★ Characterization, Robustness, Lifetime, Scalability

Technology Needs: Catalysis HTS

Design of the Library

- What is a catalyst ?
- Computational/Modeling
 - ★ Structure-Property
- Statistics/expert systems

Screening (HTS)

- MEMS Sensors
- Process control
 - ★ Temperature/pressure
- Scalability Predictions
 - ★ Micro- vs. bulk properties

Synthesis and Processing

- Automation: 10^3 - 10^6 samples
- Reproducible results: quality
- Order chaos (reduce unknowns)

Informatics

- Registration
- Data integration/analysis
- Hardware control
- Quality

Technical Issues: Why ATP Support ?

- Miniaturization of reaction, processing, and testing apparatus
- Clear understanding of “scalability”
- Generically useful high throughput synthetic or fabrication methods
- Generically useful high throughput measurement and screening technology

ATP '99 National Meeting



**Today's
Innovators**

**ACCELERATING
TOMORROW'S
TECHNOLOGY**

November 15-17, 1999

**DoubleTree Hotel
San Jose, California**

For all the latest information, visit our National Meeting website at:

<http://www.atp.nist.gov/nationalmeeting>