



TECHNOLOGY LED GROWTH IN PERFORMANCE CHEMICALS: EMERGING OPPORTUNITIES



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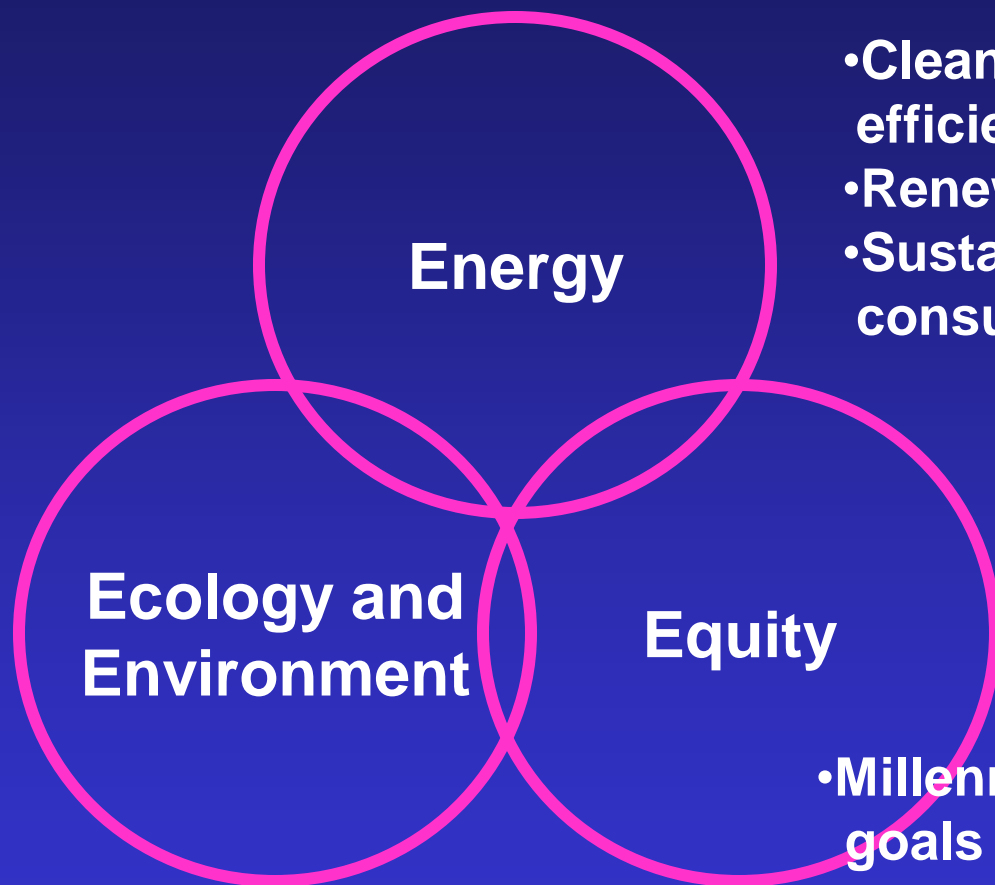
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**Frost & Sullivan's Executive
Summit on
Accelerating Growth in
Chemicals, Materials and Foods:
A Frost & Sullivan Executive
MindXchange,
Mumbai**

June 25, 2008

CHEMICAL INDUSTRY AT HISTORIC CROSSROADS

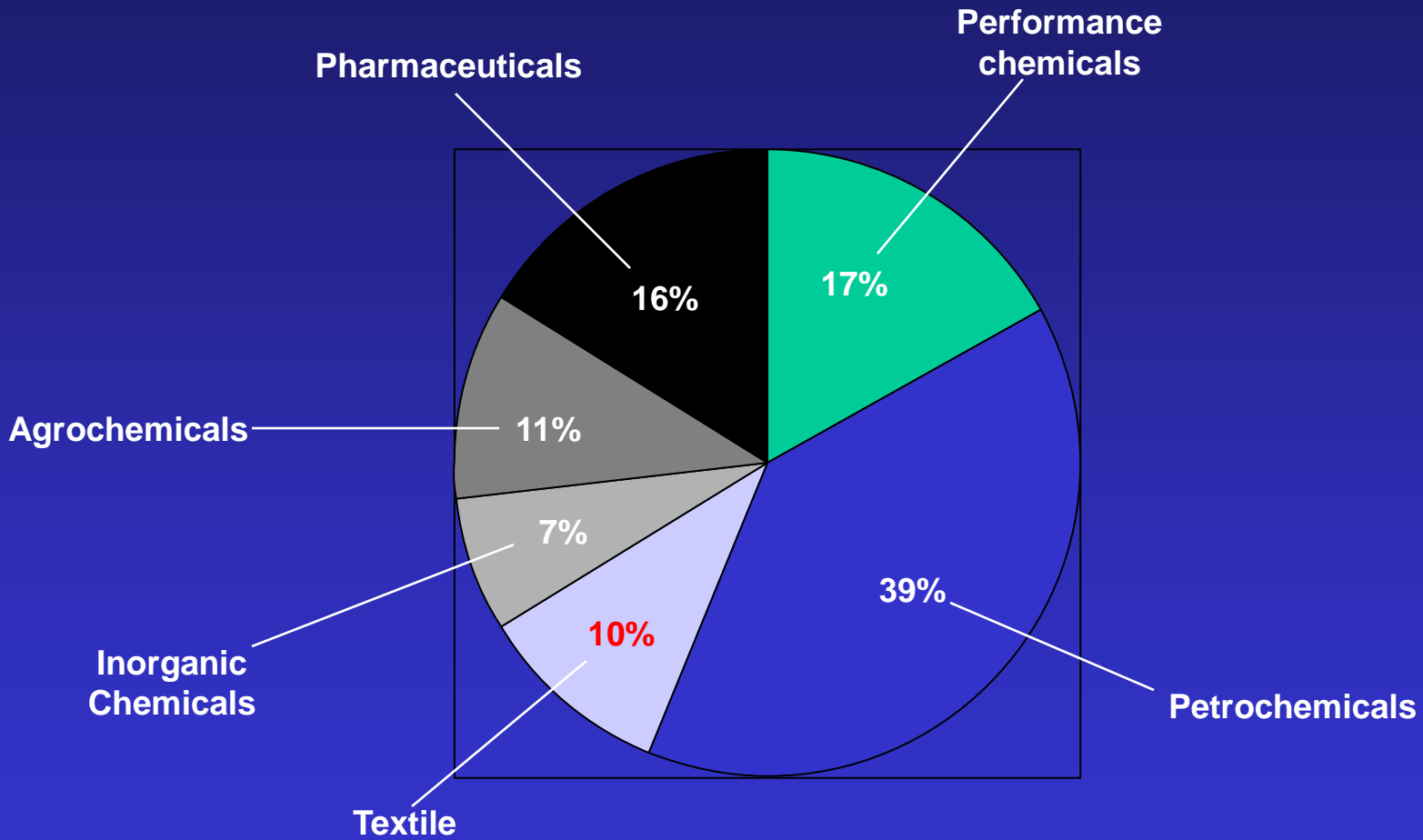


- Clean energy / energy efficiency
- Renewable energy
- Sustainable consumption

- Millennium development goals
- Access and entitlement
- Equitable distribution
- Climbing the economic ladder

- Sustainable development
- Materials from biomass/Degradable materials
- Decarbonization

WORLD CHEMICALS MARKET



- Additives for polymers
- Catalysts
- Construction chemicals
- Oil field chemicals
- Water treatment chemicals
- Paper chemicals
- Leather chemicals
- Paints and surface coatings
- Adhesives
- Textile chemicals
- Cosmetic/personal/household/baby care
- Electronic chemicals

- Flavors and fragrances
- Foundry chemicals
- Lube additives
- Rubber chemicals
- Photographic/reprographic chemicals
- Printing inks
- Detergents and surfactants
- Cleaning chemicals

Low volumes (<5000 TPA) niche applications, high price (>10 \$/kg), sold on specifications or performance, either as pure chemical substrates or as mixtures or as formulated products

CHANGING TOPOGRAPHY OF PERFORMANCE CHEMICAL BUSINESS

- **Globalization of business**
- **Shifting manufacturing geographies**
- **Growing concerns for sustainability**
- **Changing customer expectations driven by new demographics**
- **Changing work force requirements**
- **Impact of ICT**
- **Industry consolidation**

*J. Mack, Speciality Chemicals :
Competitiveness in Global Markets,
American Chemistry Council,
Leadership Conference, Houston, USA
October 2001*

FORCES OF CHANGE IN THE SPECIALITY CHEMICAL INDUSTRY

- Unprecedented rise in fuel and raw material costs
- High cost of new product introductions; difficulties in identifying new growth platforms
- Increasing regulatory (environment, health and safety) frameworks
- Faster technology diffusion / commoditization of products leading to quicker price / margin erosion
- Supply chain is taxed by breadth of markets, products and geography
- Increased global segmentation in terms of technology providers , low cost producers and large domestic markets

Merely building capacities or growth via acquisition without a specific game plan is no longer sufficient for survival

NEW BUSINESS MODELS FOR GROWTH

- **Lowest cost producer in the industry (operators)**
- **Company that achieves higher margins by differentiating its offerings through technology or service to customers (solution provider)**

(Accenture)

- **New product developer**
- **Application developer**
- **Systems solution provider**
- **Process technologist**
- **Value chain integrator**
- **Low cost producer**

(McKinsey)

***F.G. Budde et al.,
Value Creation : Strategies for the
Chemical Industry
Weinheim, Germany, Wiley-VCH 2001***

INNOVATION DILEMMA

Dilemma	Strategies
<ul style="list-style-type: none"> • Competing solely on price, pushes operating margins progressively down • High margin business leads to poor share holder value 	<ul style="list-style-type: none"> • Manufacturing efficiency • R&D / Innovation efficiency • Flexible R&D strategy • Embracing uncertainty

Challenge : Implement a hybrid strategy; successfully manage a commodity like business while simultaneously developing and seeking new business models

Ability to deal with uncertainty will become an increasingly key competitive differentiator

RETURN ON INNOVATION INVESTMENT

- **Product R&D**

5-10% of sales derived from product introduced in the past five years for every 1% of sales invested in product R&D

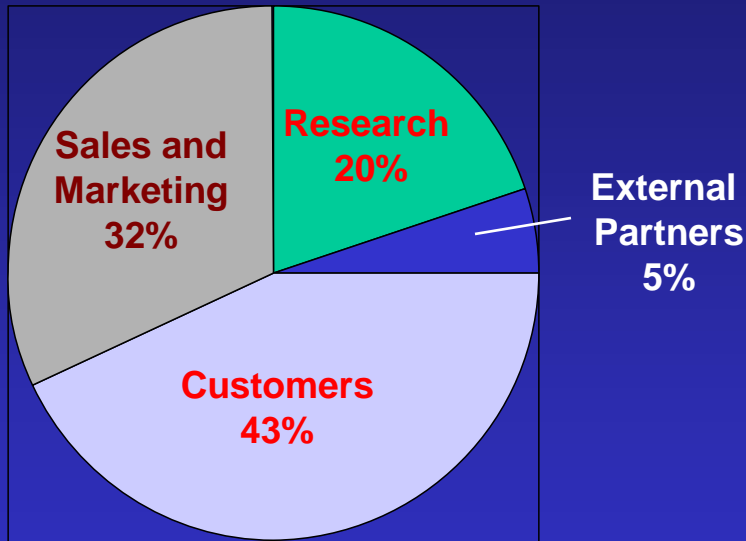
- **Process R&D**

2-5% reduction in total production cost for every 1% of sales invested in process R & D

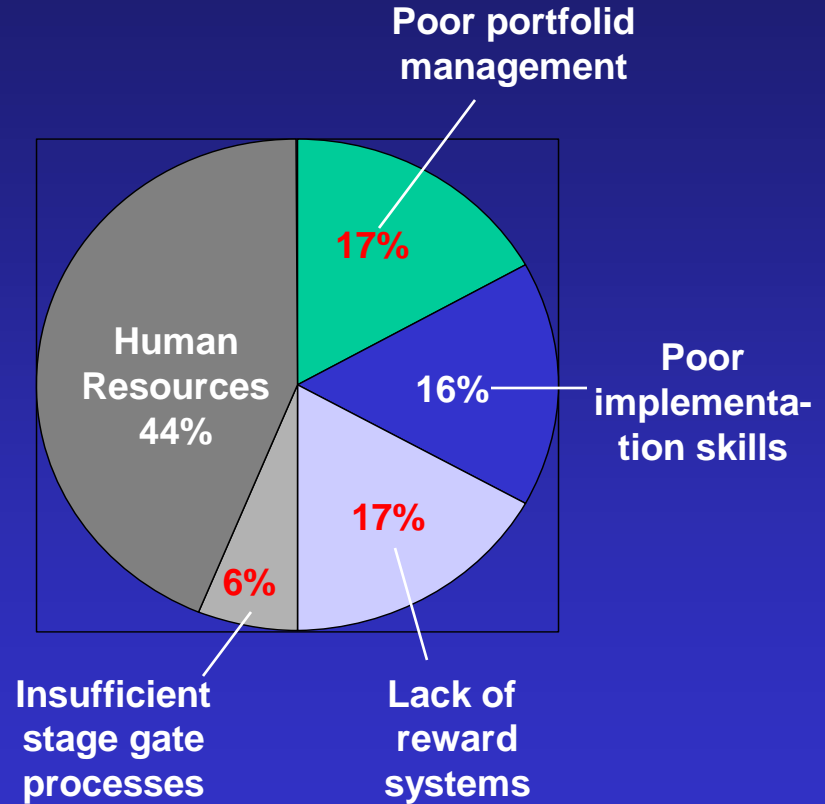
Measured as above only 20% of chemical companies (sample size: 27) achieved substantial returns on their R&D. More than 60% reported negative returns. Typically performance chemical industry invested 3-6% of their sales on R&D

SOURCES / BARRIERS FOR INNOVATION : AN EUROPEAN PERSPECTIVE

SOURCES



BARRIERS



TECHNOLOGY PLATFORMS FOR PERFORMANCE CHEMICALS

- **Clean Technology**
 - Solid catalysts
 - High specificity / atom economy
 - Green solvents

- **Chemistry in Unusual Media**
 - Supercritical CO₂ and water
 - Aqueous media
 - Ionic liquids
 - Reaction in dispersions, suspensions and emulsions
 - Solid state reactions

- **Industrial (white) Biotechnology**
 - Bio-catalysis and bio-transformations
 - Bio-based building blocks for performance chemicals
 - Fermentation processes

Contd....

TECHNOLOGY PLATFORMS FOR PERFORMANCE CHEMICALS

- **Chemistry Toolboxes**
 - Chiral switches / single enantiomers
 - Microencapsulation
 - Synthetic chemistry tool boxes (e.g. Suzuki coupling, catalytic hydrogenation, metathesis, click chemistry etc.)
 - Crystal engineering and polymorphism

- **Unusual Reaction Conditions**
 - Photochemistry / photocatalysis
 - Electrochemistry
 - Microwave
 - Sonochemistry
 - Plasma

TECHNOLOGY PLATFORMS FOR PERFORMANCE CHEMICALS

- **New Processes / Product Strategies**
 - **Chemical product engineering**
 - **Process intensification**
 - **Micro-reaction engineering**
 - **Novel reactor and mixer designs**
 - **Novel separation processes especially membrane based processes**
 - **Computational modeling, simulation and visualization**

THE INDIAN FINE CHEMICAL INDUSTRY

- **Fragmented and low capacity**
- **Low capital/technology intensity**
- **Relative unfamiliarity with catalytic processes involving reactor types other than batch stirred tank reactors**
- **Threat of horizontal transfer of technology**
- **Limited in house technology development strength**
- **Inadequate attention towards quality and consistency**
- **Lack of deep pockets to sustain business cycles**
- **Poor product marketing skills, especially in global markets**

PROCESS CHEMISTRY AND TECHNOLOGY AT NCL

- **Strong process chemistry / process design and engineering skills**
- **High degree of competence in homogeneous and heterogeneous catalysis**
- **Excellent analytical support facilities**
- **Ability to experiment with several reactors (batch, CSTR, fixed bed , trickle and fluid bed) at high temperatures and pressures**
- **Strong domain knowledge in process modeling, simulation, advanced process control strategies and flow modeling**
- **Over three decades of close association with Indian Chemical Industry**
- **NCL is recognized as a credible partner, especially, for new technologies knowledge, skills and facilities**



EFFICIENCY GOALS FOR PERFORMANCE CHEMICAL INDUSTRY : 2020

- **Reduce feed stocks losses to waste / byproducts by 90%**
- **Reduce energy intensity by 30%**
- **Reduce emissions including CO₂ and effluents by 30%**
- **Increase use of CI building blocks and use of renewables by 13%**
- **Reduce time to market through use of new R&D tools by 30%**
- **Increase the number of new products and applications annually by 15%**
- **Reduction production costs by 25%**

***New Process Chemistry Roadmap : Vision 2020
(The American Chemical Society)***

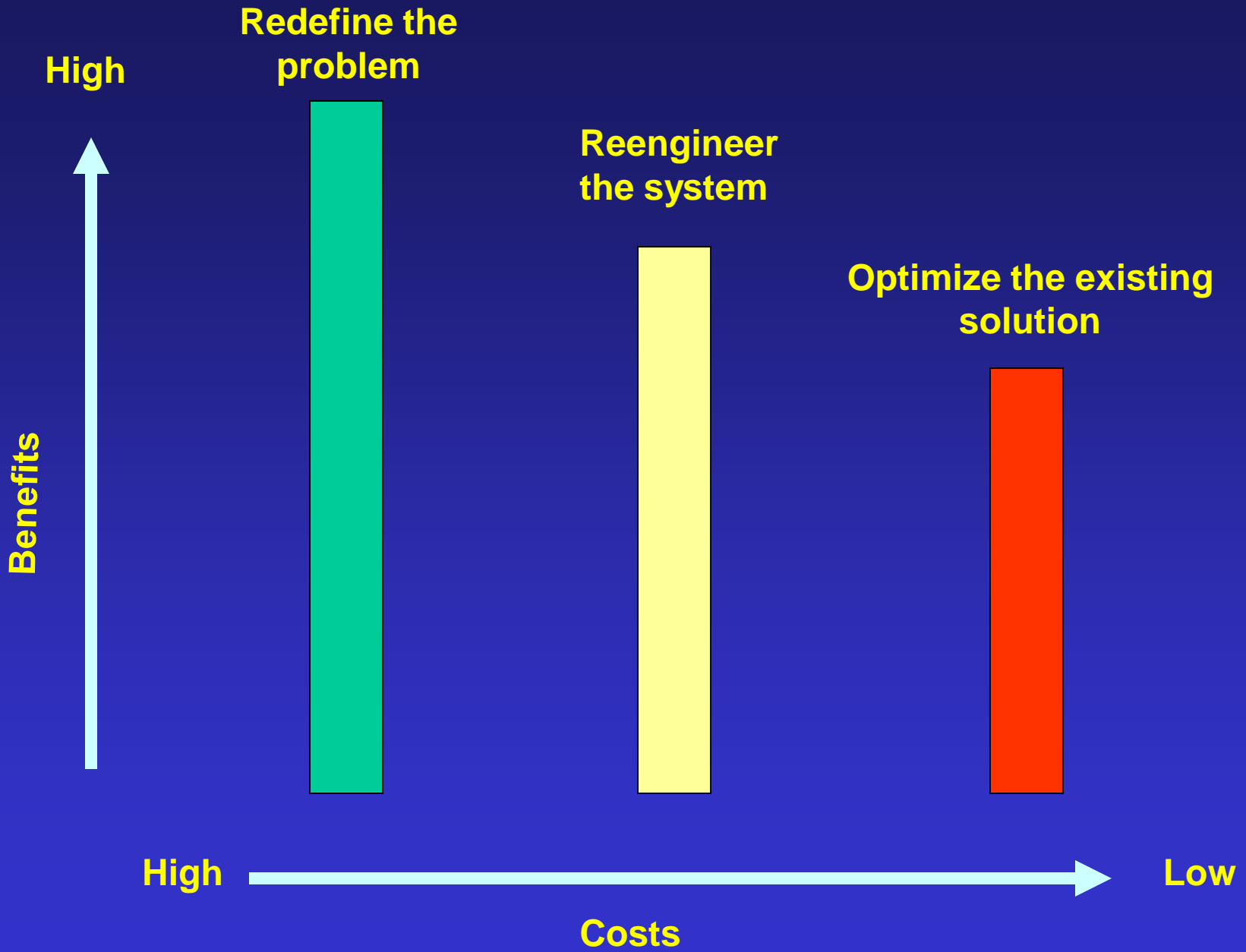
CHEMICAL PRODUCT ENGINEERING : AN EMERGING PARADIGM

- Traditionally chemical engineering has focused on the synthesis, design, optimization, operation and control of chemical processes that result in the transformation of raw materials to useful products.
- However, to meet the future needs, chemical engineering must not only address process needs, but also product design and engineering. The design of a product involves combination of process, property and applications, to deliver the desired functionality to customers.
- Typical products, include, bulk solids, powders, foams, composites, paste, creams, emulsions, dispersions, aerosol, also termed as structured products, engineered products, formulated products or dispersed systems


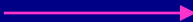


*R. Costa et al.,
AIChEJ June 2006*

PERFORMANCE CHEMICALS : SOME THOUGHTS

- **Identify multiple product capabilities from the same set of facilities**
- **Examine chemicals which are single vendor item in the global market**
- **Look for chemicals that can be manufactured in existing facilities with incremental capex**
- **Identify chemicals of strategic nature which are under technology embargoes**
- **Look for opportunities where improved purities of currently produced chemicals can open up new market opportunities**
- **Focus on formulated products**
- **Identify chemicals where India has unique raw material advantages**



STRATEGIES FOR COMPETITIVENESS

- **Volume**  **Value**
- **Specifications**  **Functions**
- **Composition**  **Provide solutions**
- **Products**  **Services**

THANK YOU

