



**Advancing the Promise of
Chemical Industry Towards a
Sustainable Planet:
*New Wealth Creation Equations?***

Partha S. Ghosh

***P. C. Ray Memorial Lecture
ICMA***

Synopsis

As we move into knowledge intensive era, characterized by the development of nano, opto, bio technologies, and as the forces of globalization, digitization and innovation shape corporate responses there is no doubt the future business models will be different; In view of the possibilities ahead it is my strong conviction that *Chemical Industry stands to benefit the most as well as perhaps have the most influence on shape of things to come. World wide and India particularly the industry must rise to the challenge.*

On the other hand it is equally true that the current economic and business models will soon hit their limits in terms of their influence on socio economic advance as concerns related to Global Energy, Ecology and Equity increase and could endanger the sustainability current habits of consumption, current methods of production and current methods of wealth creation. *New thinking with repurposed mindset is essential.*

Indian Chemical Industry must now celebrate the enterprising spirit of pioneers like P C Ray and Jamestji to recreate the new chemical industry paradigm which is agro based, ecology friendly and most importantly solutions oriented which are on one hand holistic and global, on other hand sensitive to the locale recourses, ecology and development issues; I personally belief India industry has come at cross roads when it will need to structure and make difficult choices on how *not to get trapped existing well proven models (although unsustainable) while take advantage of the nascent stage of development the industry is in to define the new path*

Uncovering Game Changing Moves will require enlightened vision, vigor and values which are practical and yet transformational. *Let thousands of innovative experiments bloom.*

Agenda

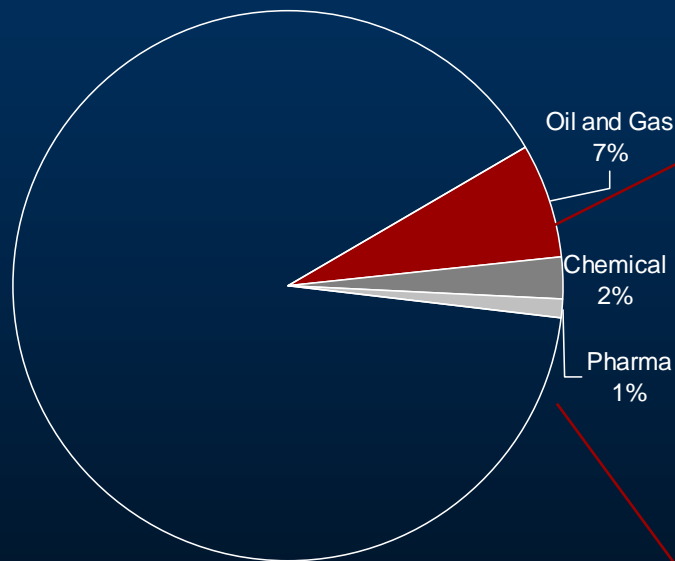
- 1. Strategic Possibilities in the Knowledge Intensive Economic Era?**
- 2. Limits of the current model? Need for *Game Changing Moves*?**
- 3. How to Uncover Game Changing Moves?**

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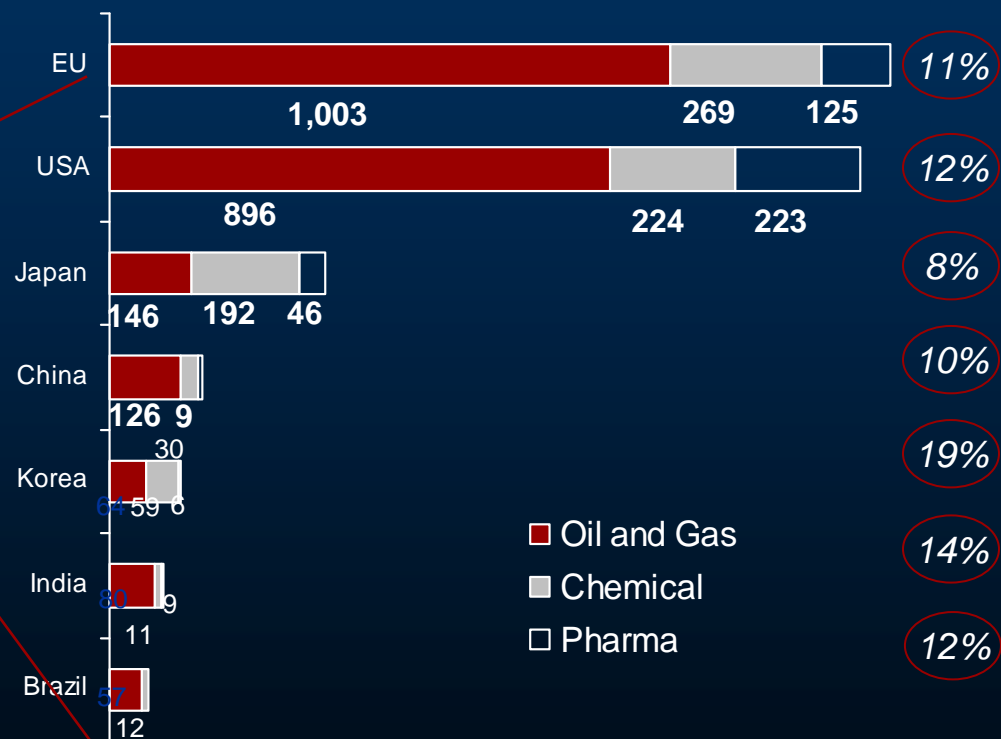
Oil and Gas, Chemical and Pharmaceutical sectors contributed 10% to global GDP in the year 2004

Global GDP: 2004¹



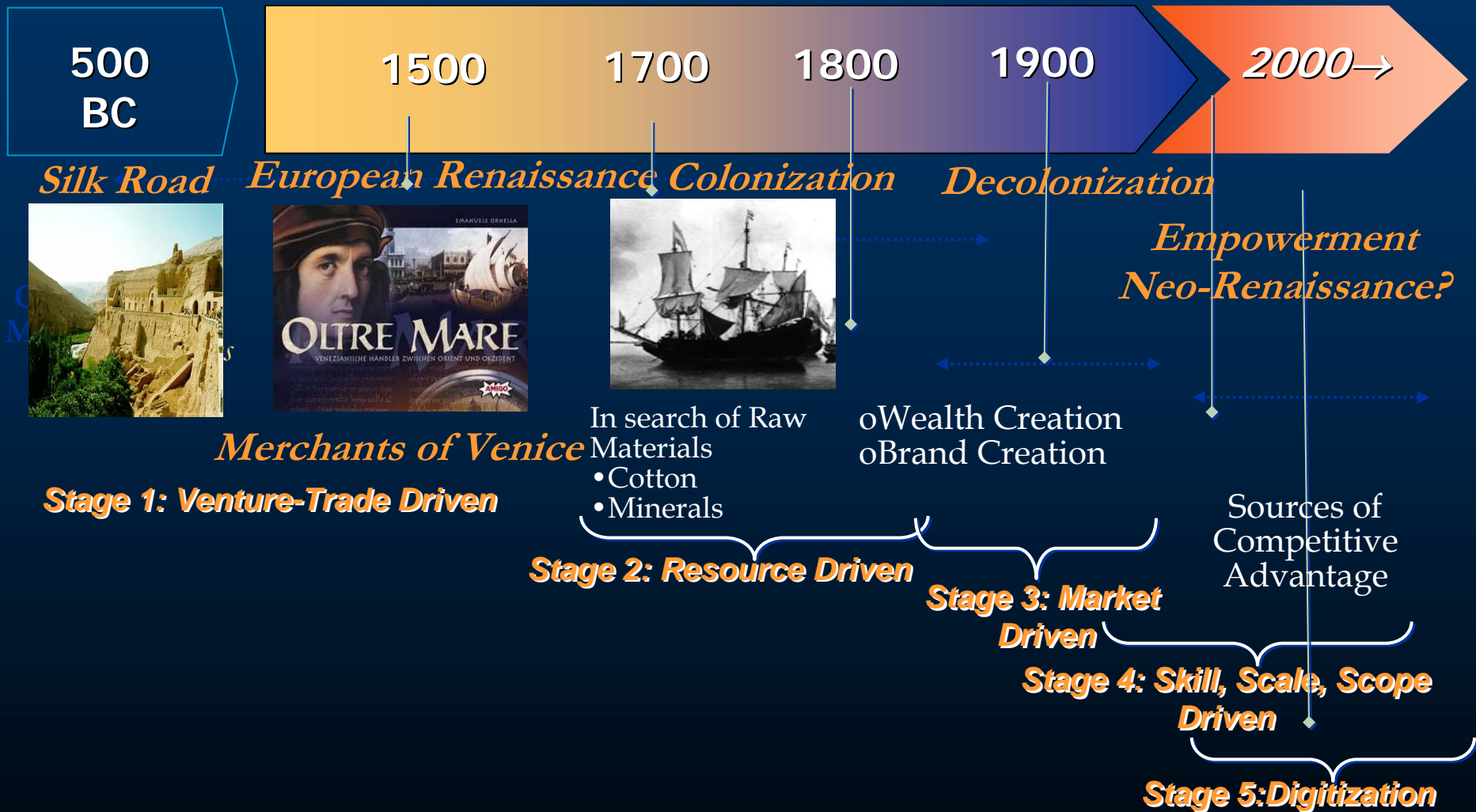
100% = US\$ 40,888 Billion

GDP by Different Sectors : 2004² (US\$ B)

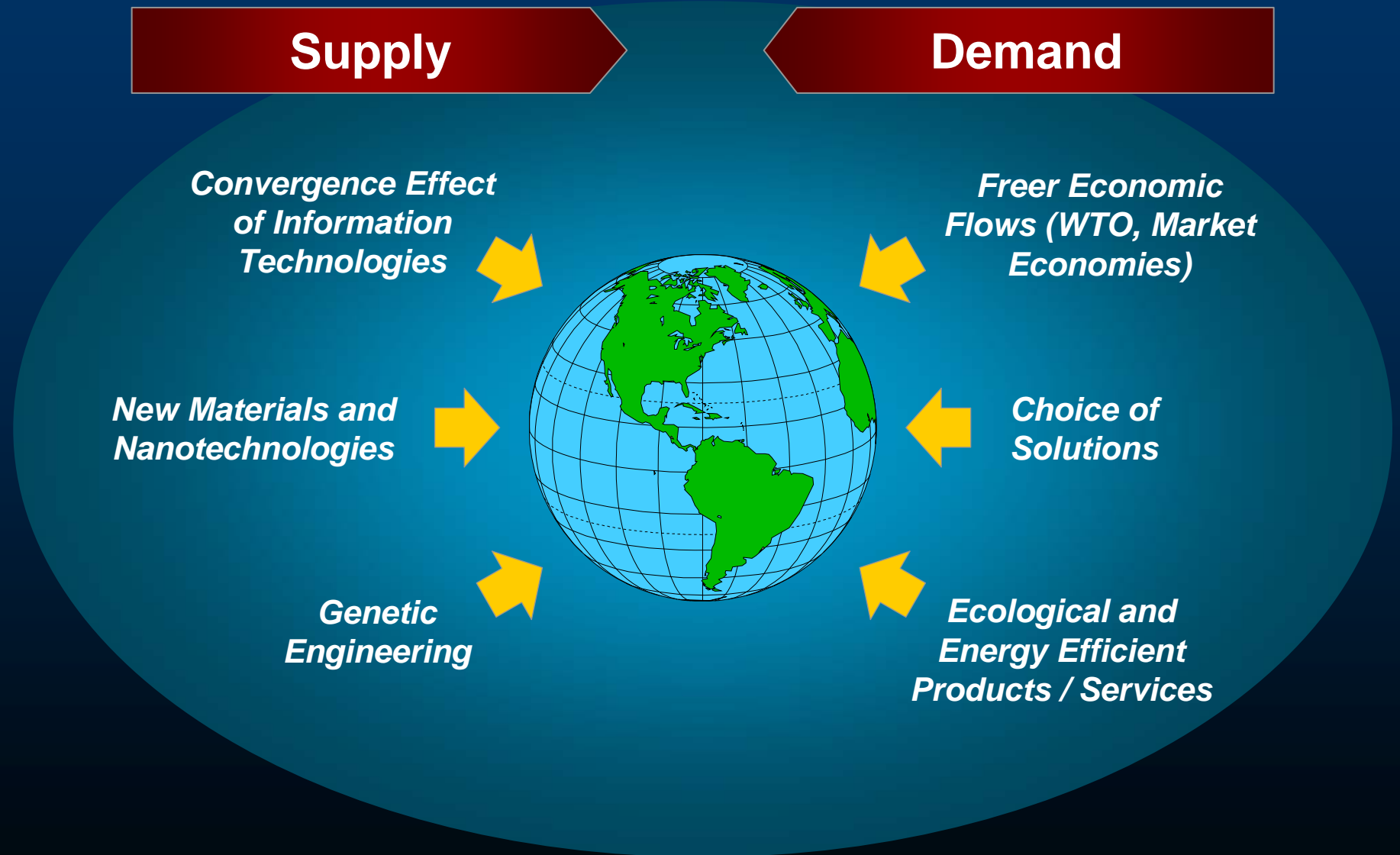


Boston Analytics Research
 1. "Total GDP 2004", The World Bank, July 2005
 2. Thomson One Banker

Globalization led by Chemical Industry: 2500 Years in Perspective

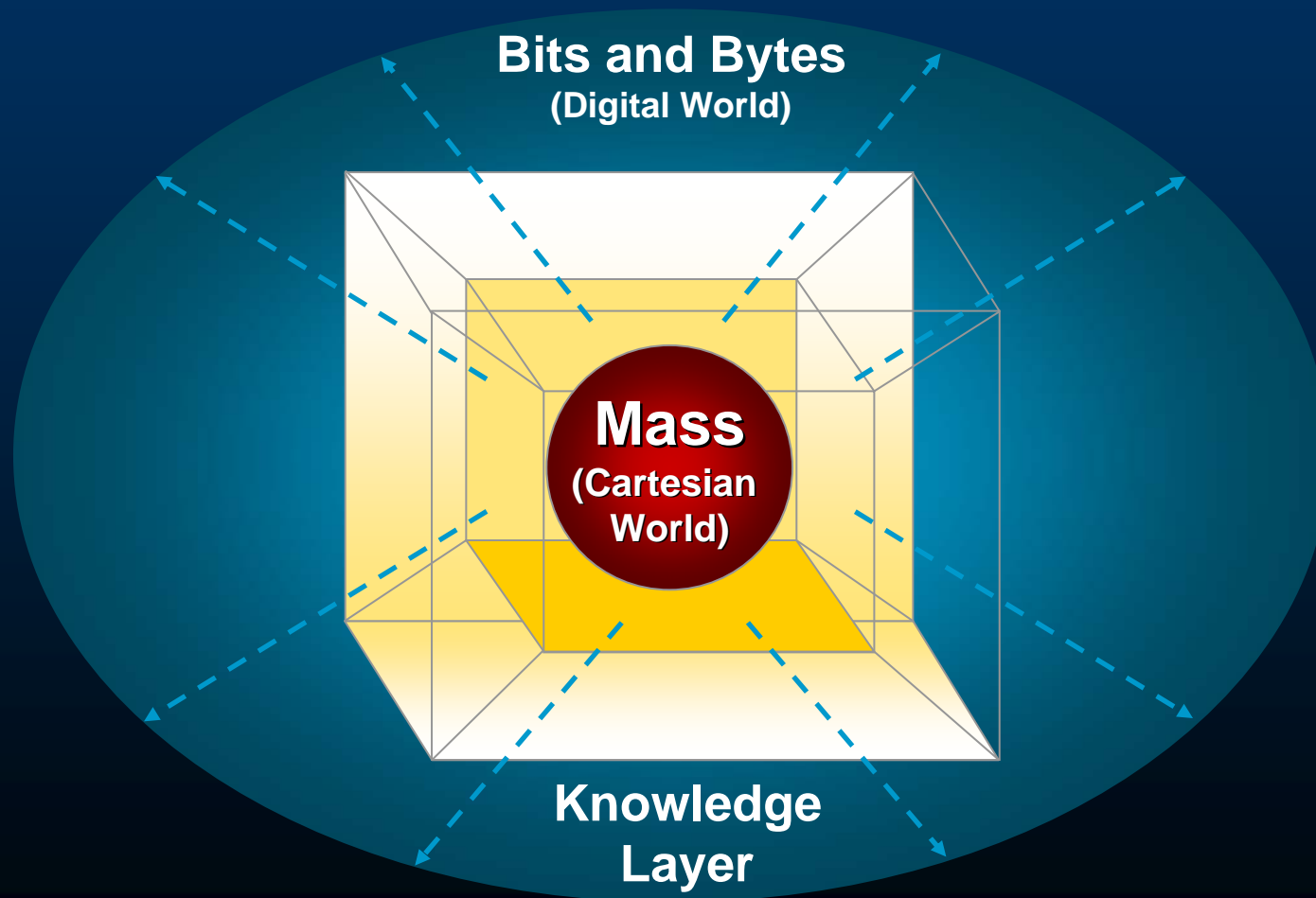


The Emerging Economic Environment — The Big Picture



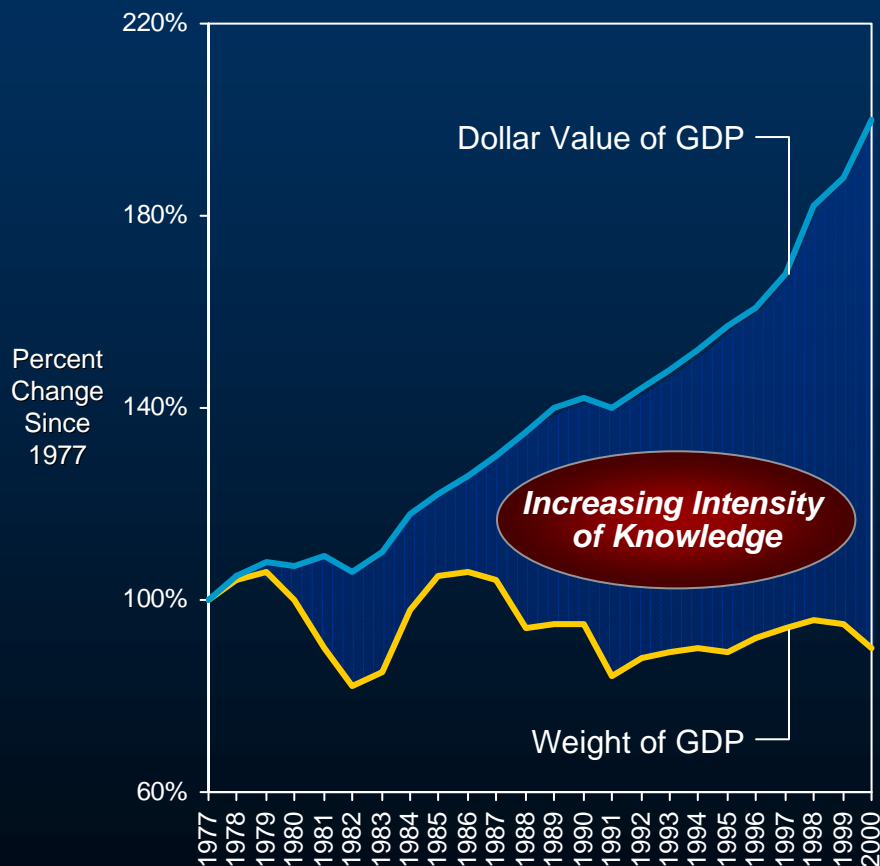
Vision of the New Breed of Industries

“Value Creation through Integration of Bits and Bytes with Atoms and Molecules”

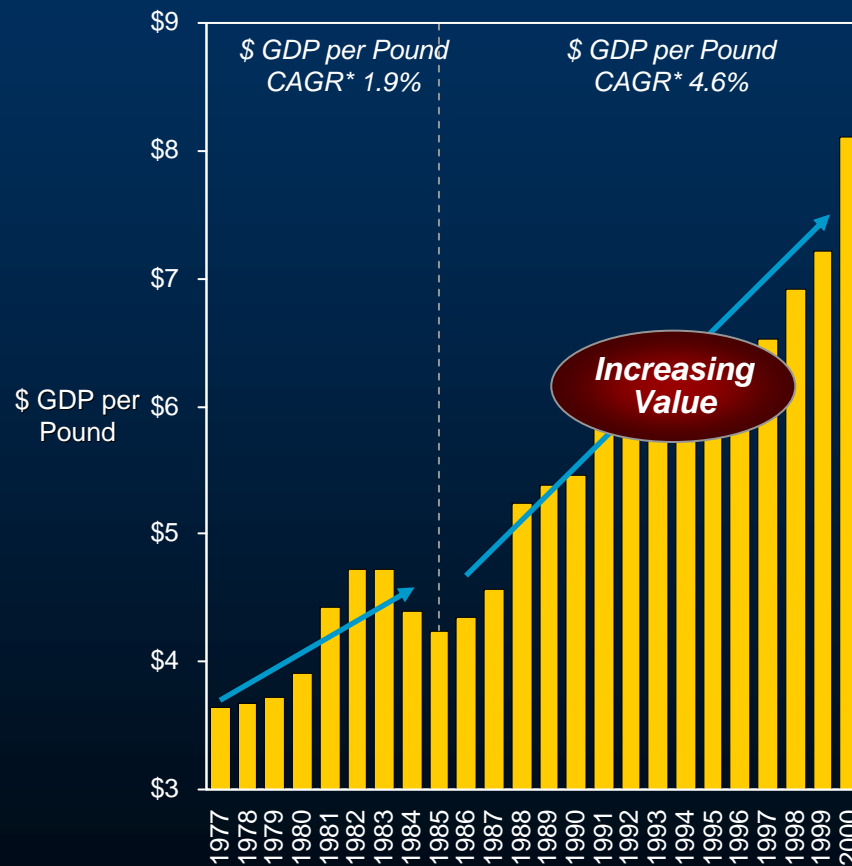


Towards Lighter and More Intelligent Economy = *More Intelligent Molecules/smarter properties of materials*

Change of \$ Value of GDP vs.
Change of Weight of GDP (1977
Index = 100)



Increasing Value-Added
(\$ per Pound)



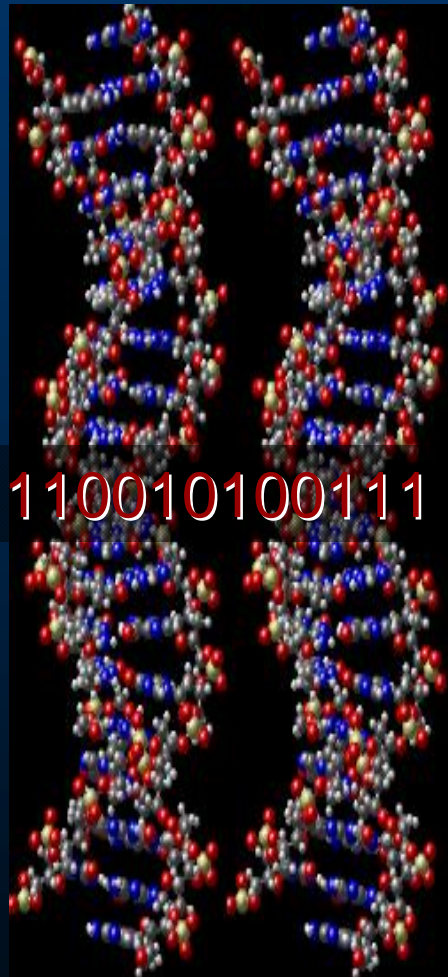
Mega possibilities @ the Intersection of Conventional Engineering & Genetic sciences & Information technologies

Chemical Fundamentals

- Thermodynamics
- Kinetics
- Transport sciences
- Surface properties

Conventional Unit Operations

- Separation processes
- Reactors
- Heat & Mass transfer systems



In flux of New Knowledge & research Methodologies

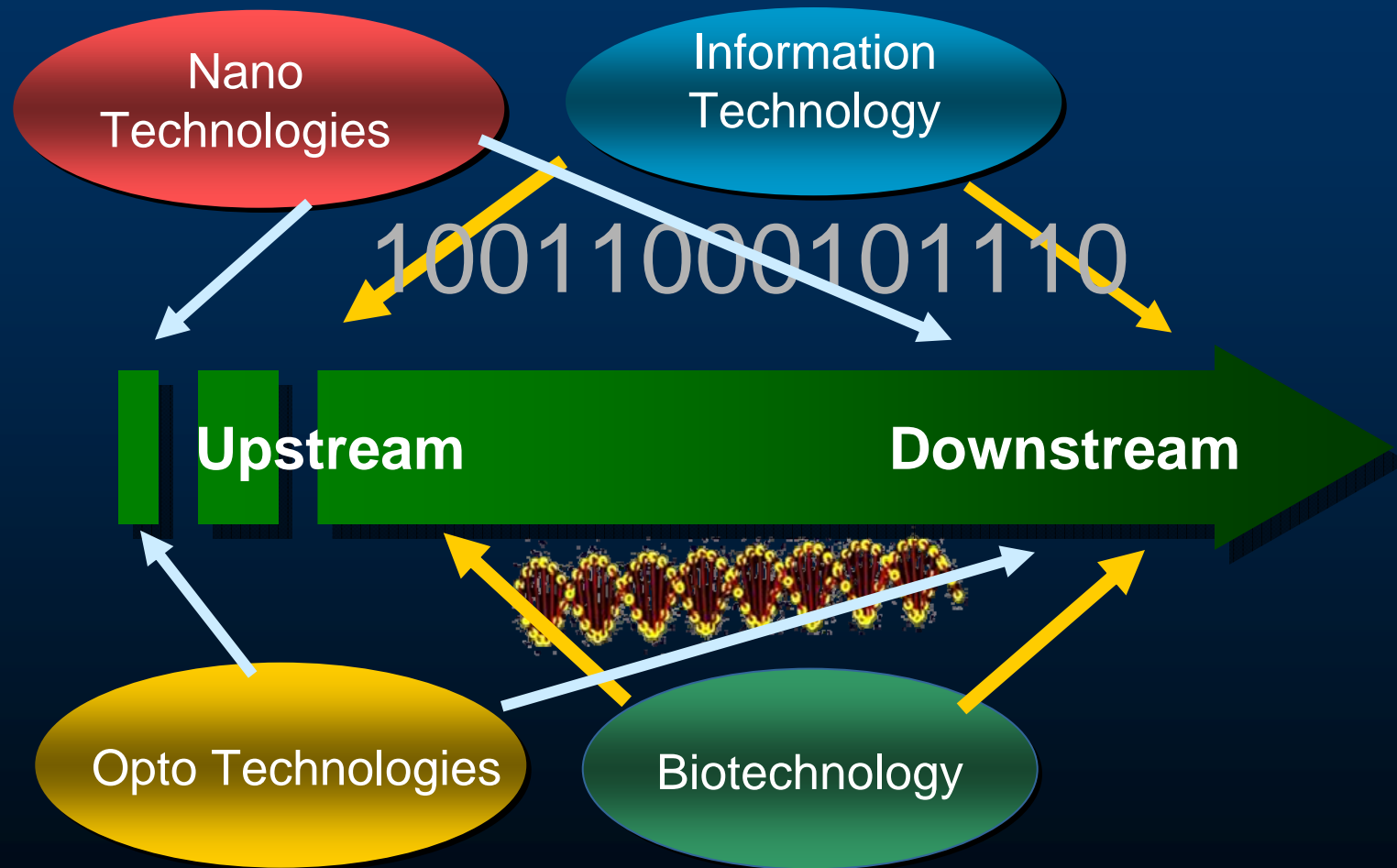
- Genomics
- Proteomics
- Micro fluidics
- Bio banking

New Convergence Technologies

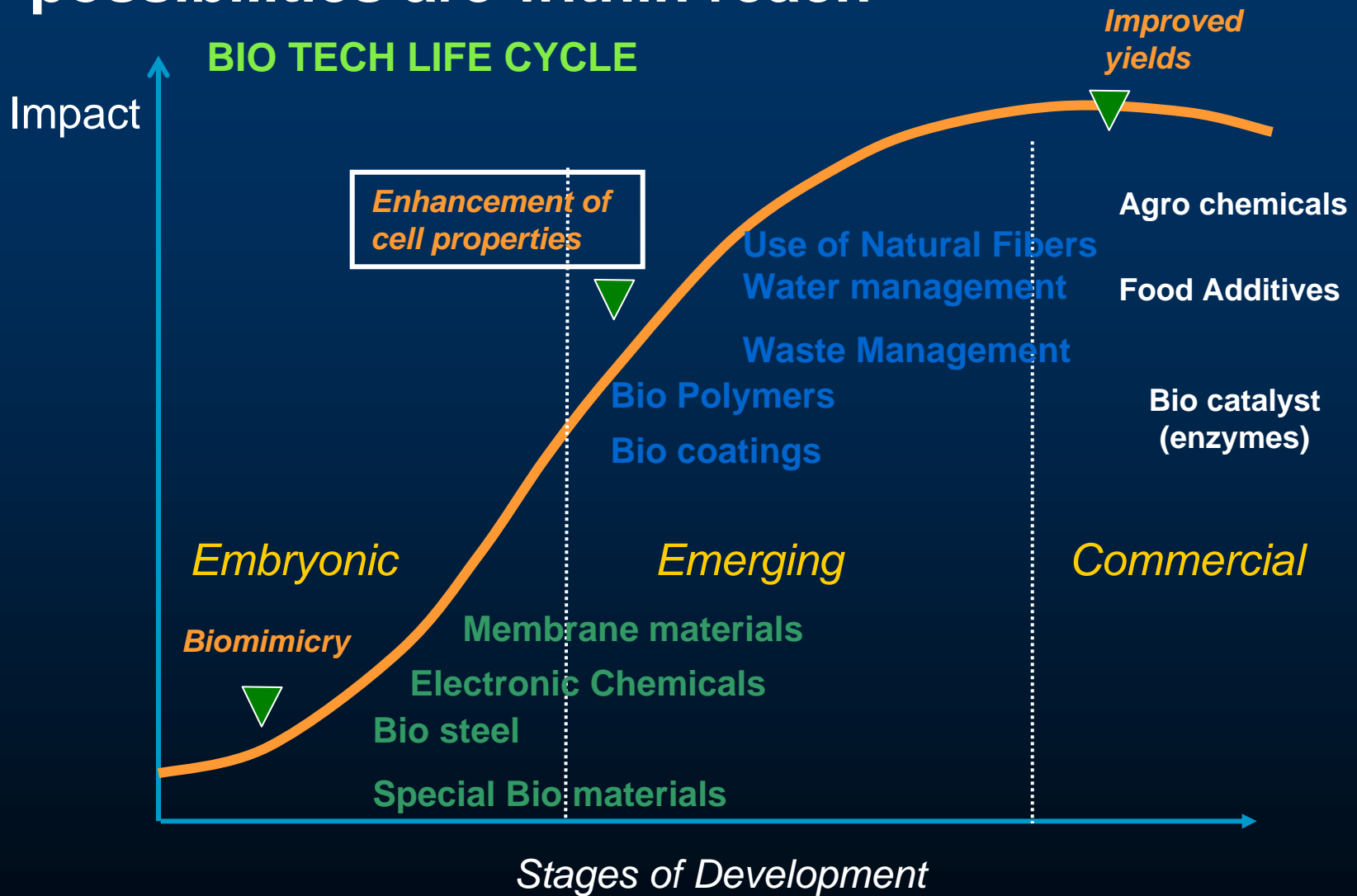
- Large database tools
- Predictive models
- Increased computational power

Together the New technologies could fundamentally renew the Process Industry – *which could indeed trigger a New Era full of possibilities*

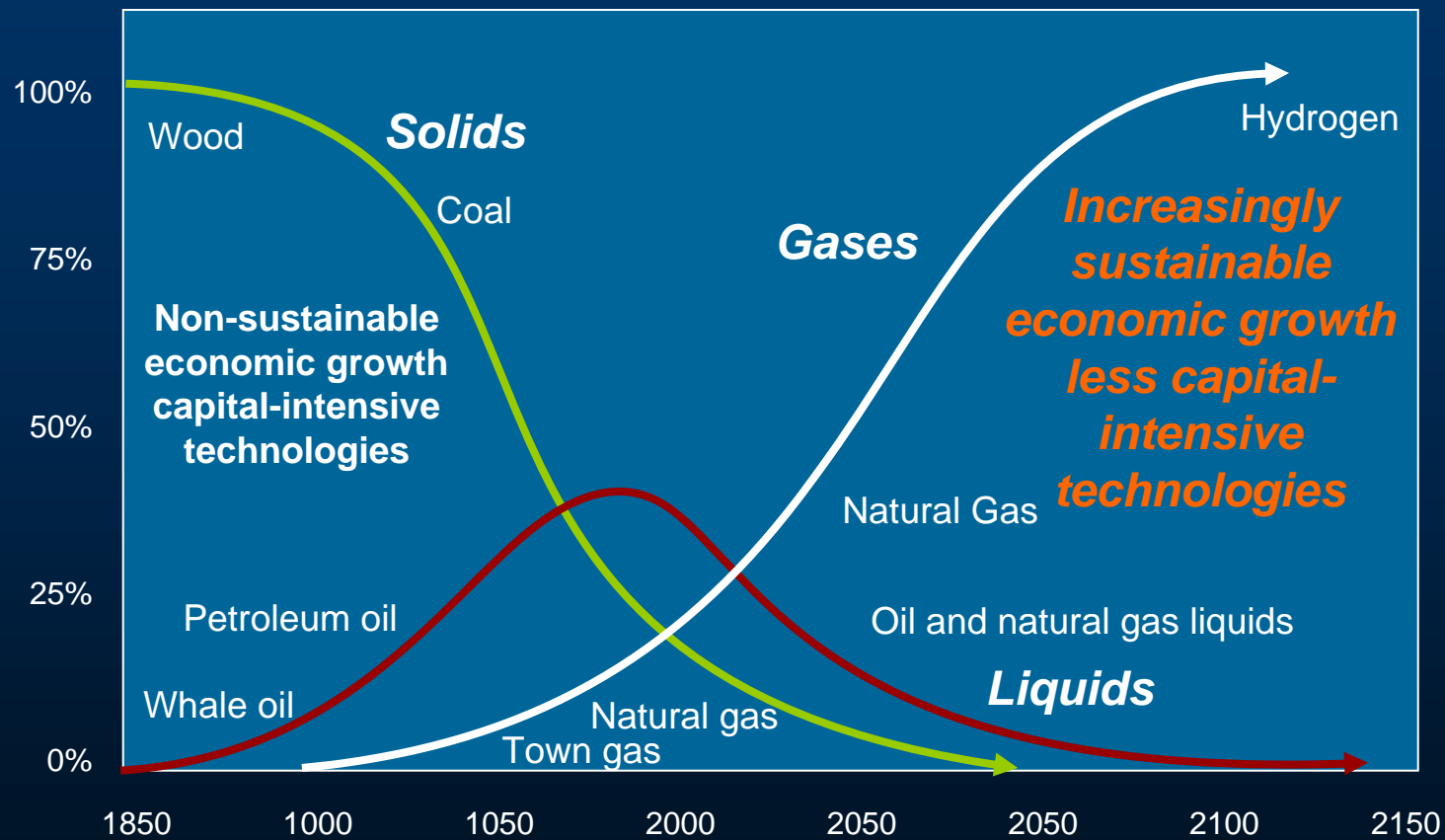
Process Industry Reconfiguration



For example through the Bio route Multiple possibilities are within reach



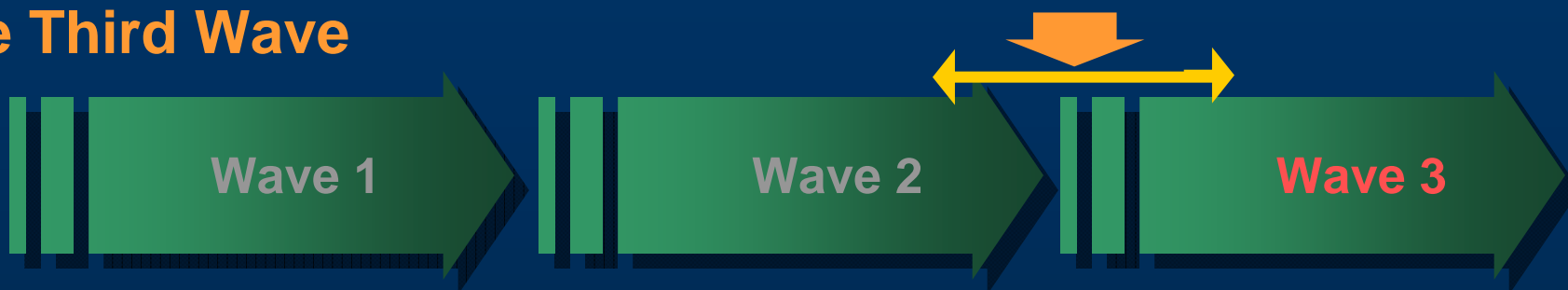
Shape of things to come...Energy Sector



...beyond carbon?

Indeed New technologies could fundamentally renew the Process Industry

The Third Wave



Energy

- *Solids (C)*
- *Liquids (HC)*
- *Gas (H)? Systems*

Agro Process

- *Fertilizers*
- *Crop Solutions*
- *Bio tech?*

Bio-Pharma

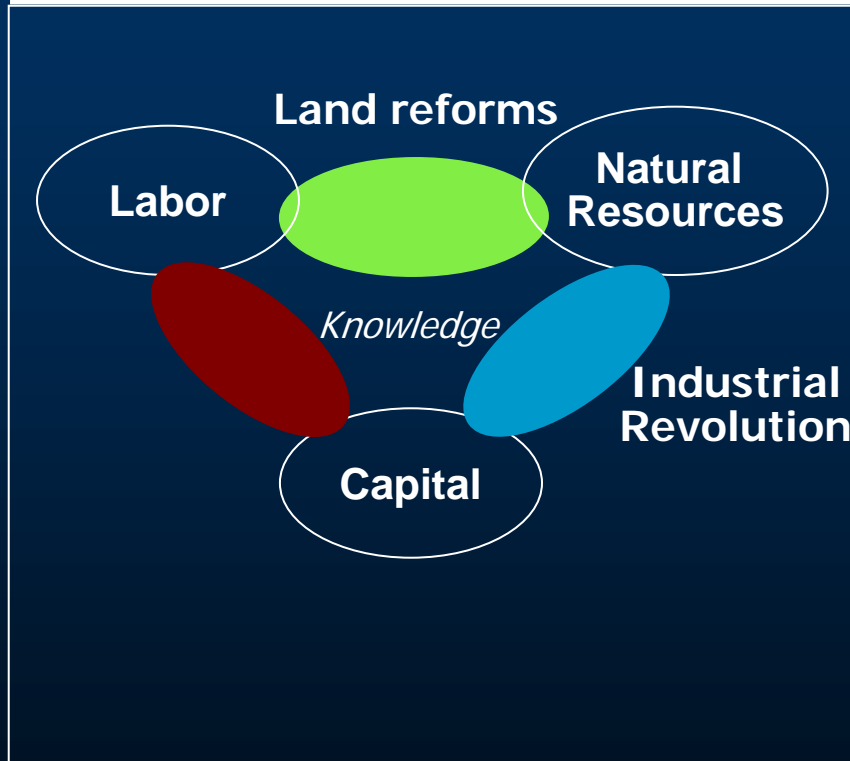
- *Serendipity*
- *Molecular Biology*
- *Convergence*

Chemicals

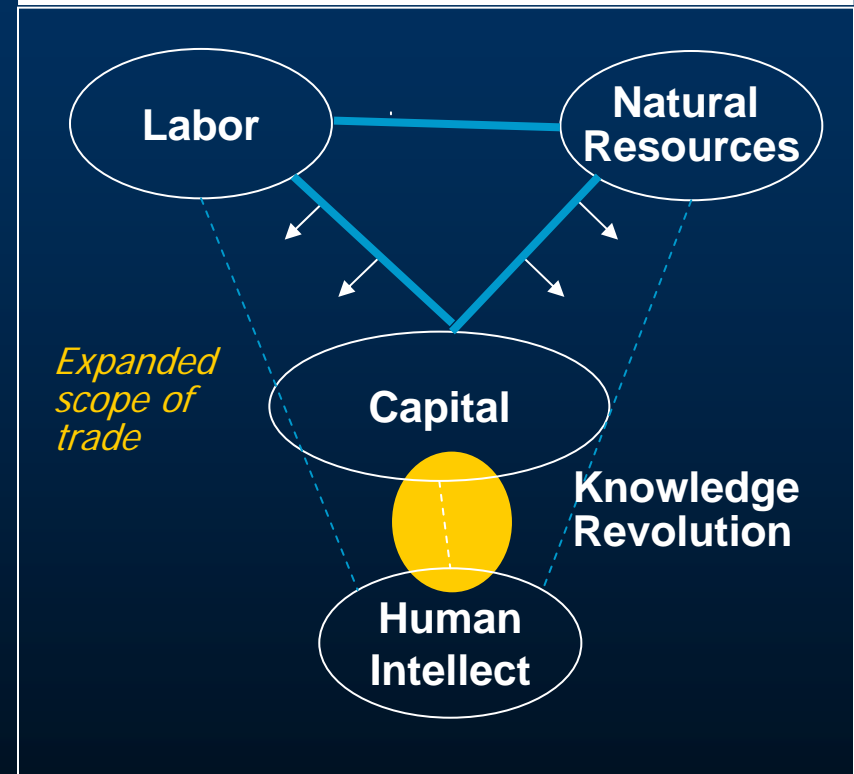
- *Inorganic*
- *Polymeric Sciences*
- *Multidimensional Solutions*

Overall the new possibilities will increasingly emerge as interactivity between Knowledge and Capital intensifies

Classical and Keynesian Economics



New Economic Paradigm

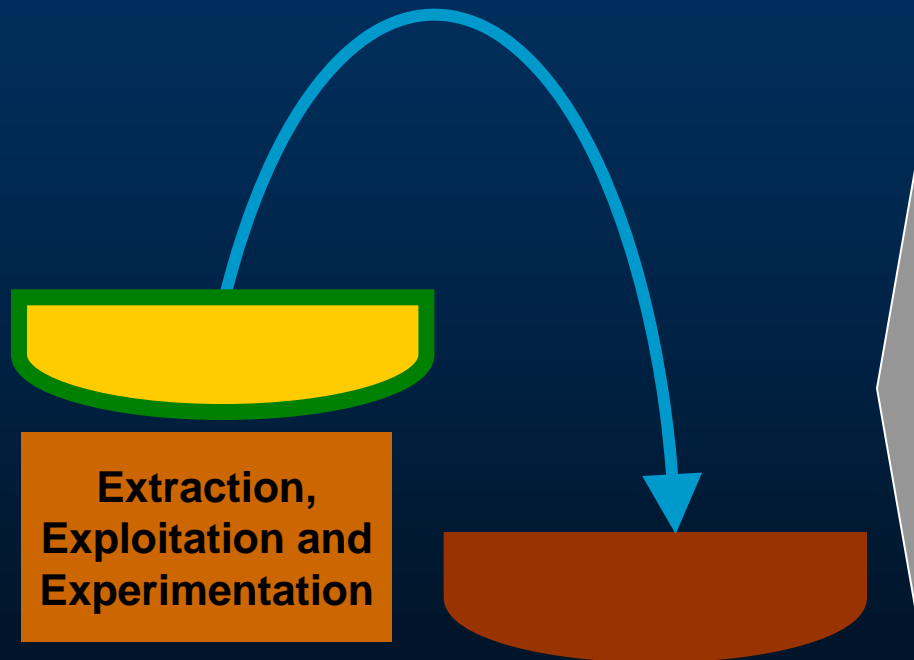


Agenda

1. **Strategic Possibilities in the Knowledge Intensive Economic Era?**
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3. **How to Uncover Game Changing Moves?**

Last 5,000 Years of Chemical Industry

*Limits of
Linear Mechanics*

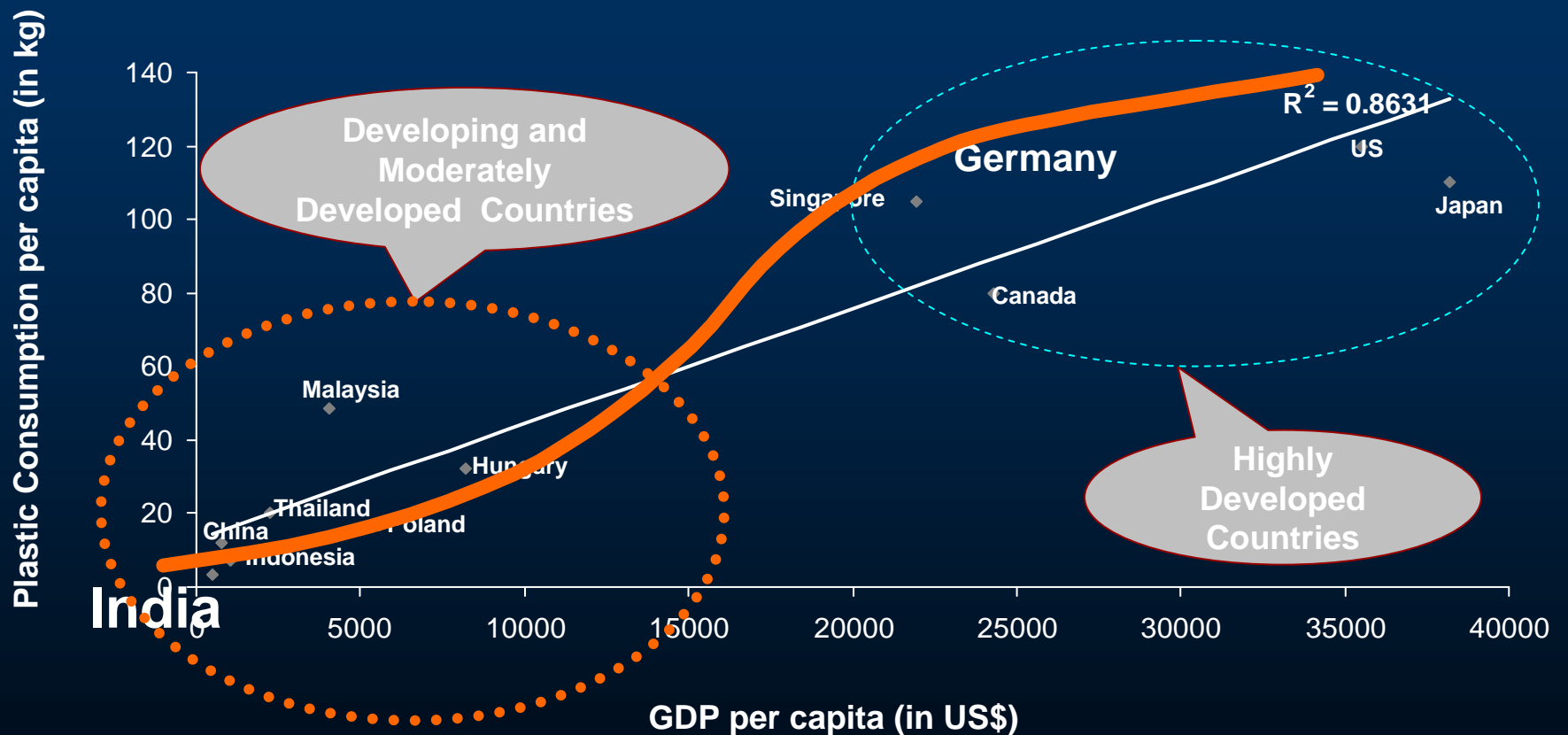


Limiting forces”

- *Supply of Resources*
- *Effect on Nature*
- *Concentrated Wealth
--Creation*

Could countries in early stage of the development curve follow the 19th Century model?

Plastic Consumption per capita in Selected Countries vs. GDP per capita (2003)^{1,2,3}



Boston Analytics Research

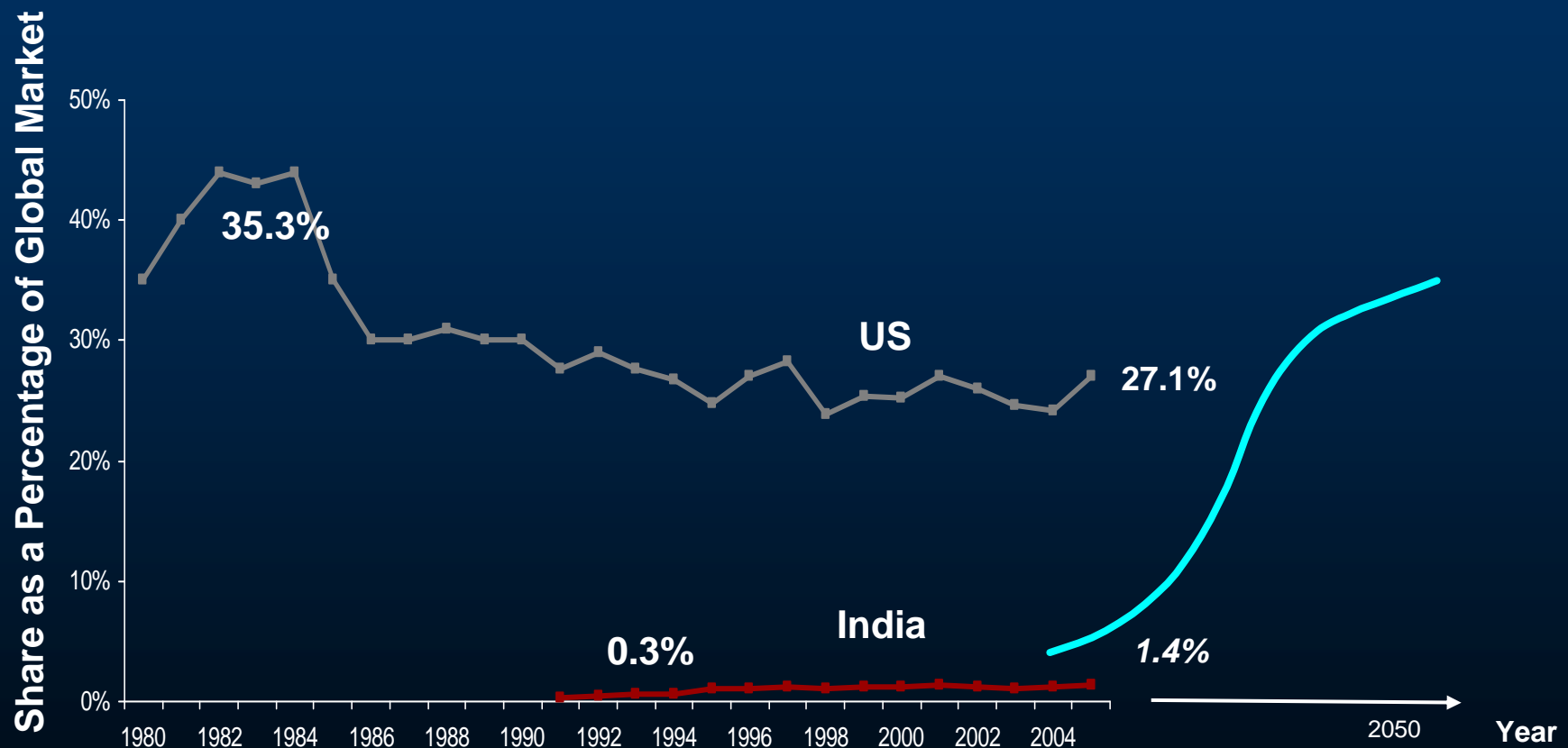
1. http://www.dailytimes.com.pk/default.asp?page=story_11-9-2003_pg5_12

2. Poland and its investment opportunity – BCG Report

3. <http://www.eia.doe.gov/>

Or Could India define the new path?

Share of US and India in the Global Chemical Industry¹

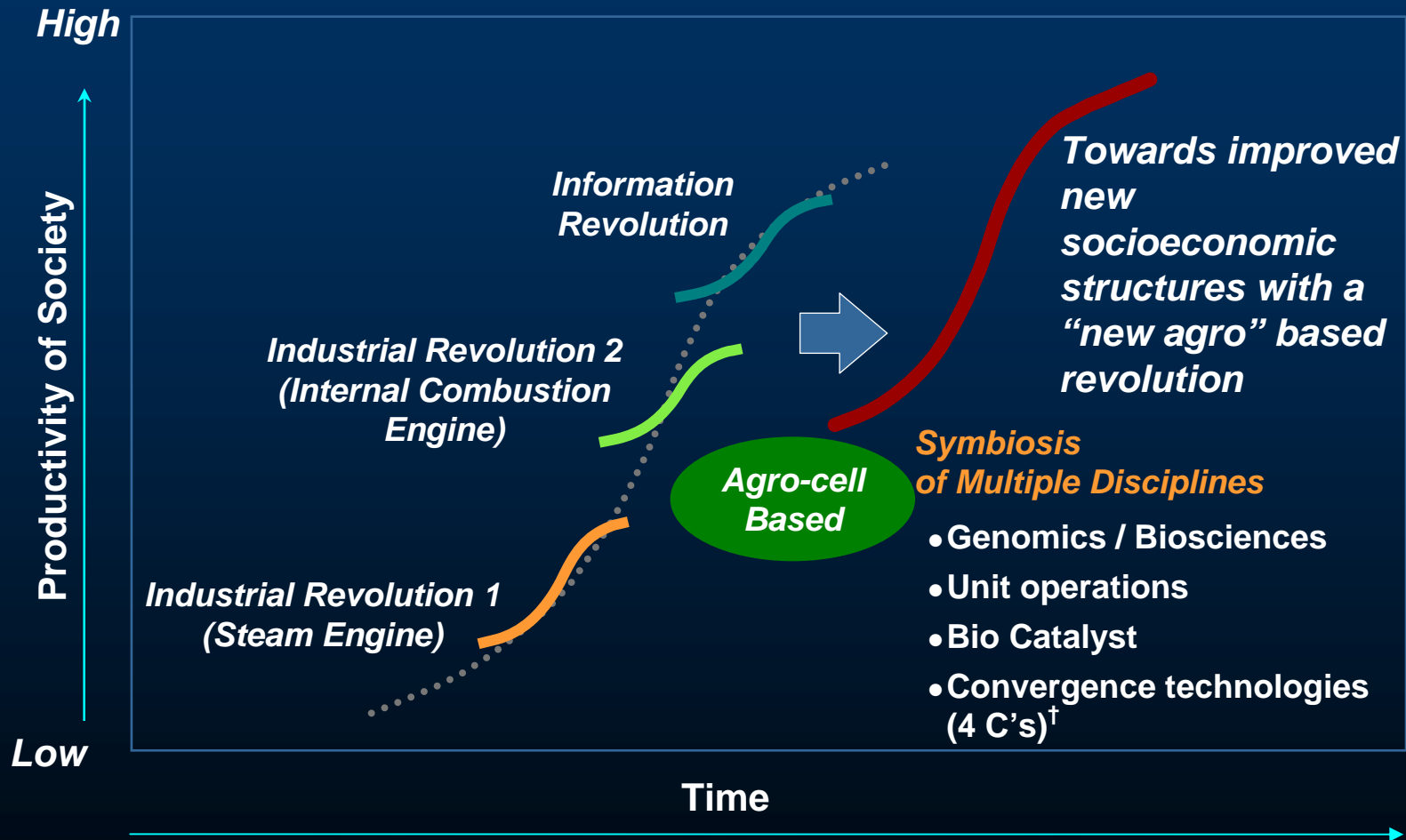


Note: The chemical industry is as defined according to the GICS code 151010. It includes Commodity Chemicals, Diversified Chemicals, Fertilizers and Agricultural Chemicals, Industrial Gases and Specialty Chemicals

Boston Analytics Research¹. Thomson One Banker

Towards an Agro cell based Economic Revolution

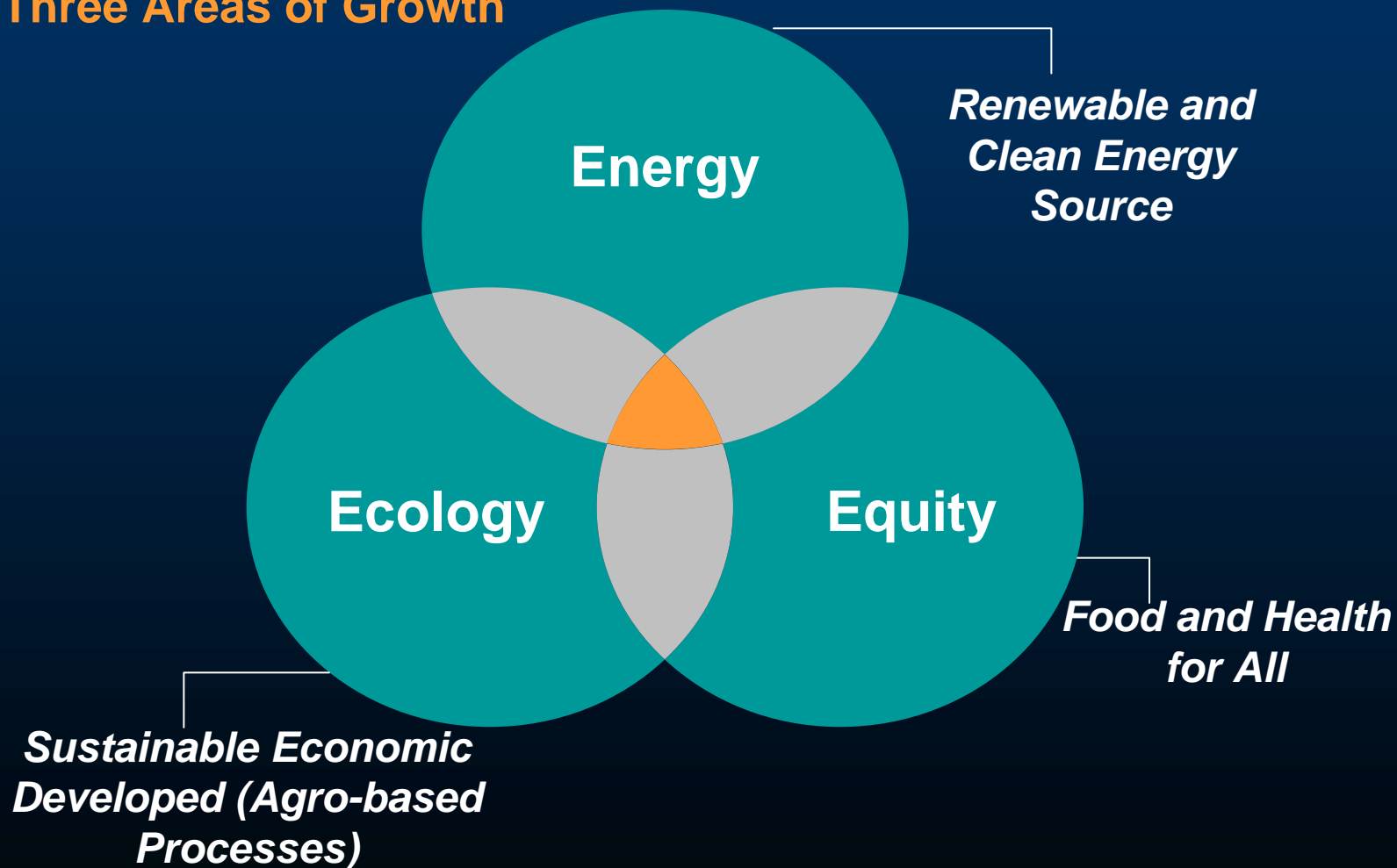
Development of a More Sustainable Economic Model



Chemical Industry @ Historic Crossroads

PROBLEMS ≈ OPPORTUNITIES

Three Areas of Growth



Potential Opportunities for Energy/Chemcos

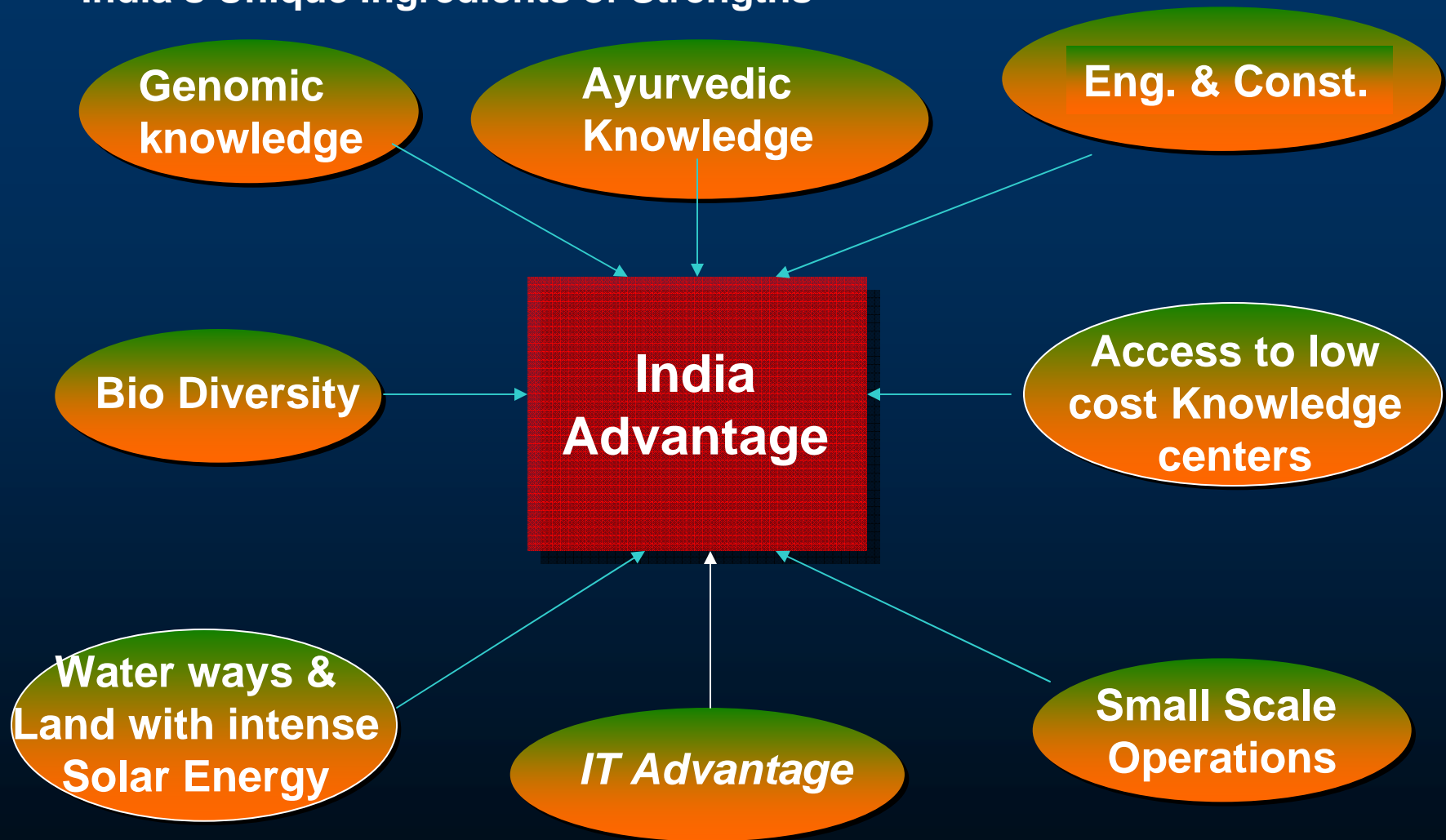
Ecology Friendly Process Solutions (Illustrative)[†]

Should Chemcos trigger the new movement?

Resource	Industry	Issues
Bio-mass	Energy & Chemicals	→ Knowledge sharing?
Wind farming		→ Low cost equipment?
Seed oils		→ Promotions?
Starches		
Cereal	Food and Beverage	→ Yield increase?
Fruits		→ Quality and consistency?
Vegetables		→ Distribution?
Tea		
Herbs	Pharma and Nutrition	→ Knowledge sharing?
Medical plants		→ Low cost equipment?
Algae / Azola		→ Promotions?

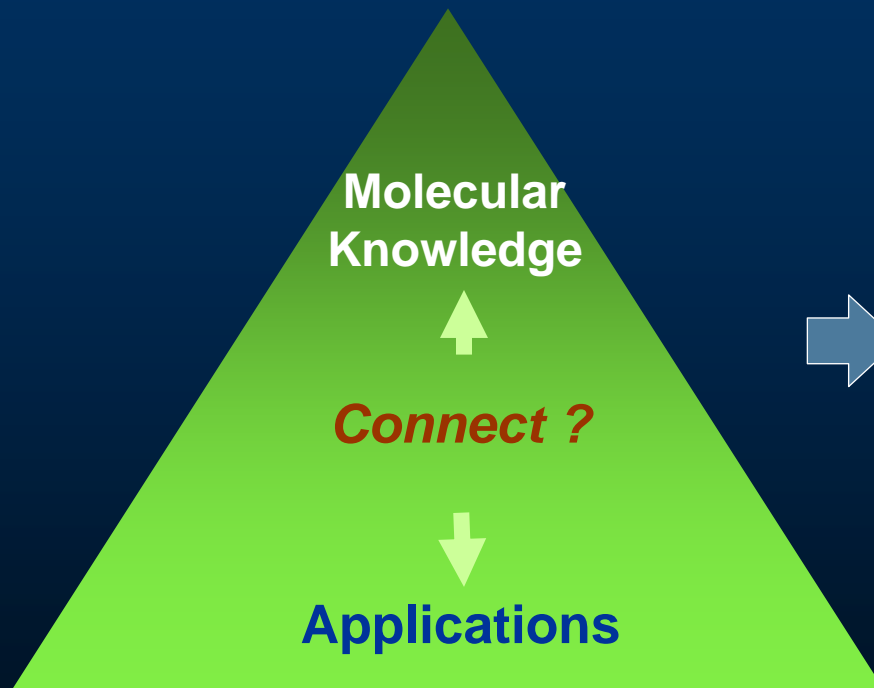
Harnessing India's Competitive Advantage

India's Unique Ingredients of Strengths

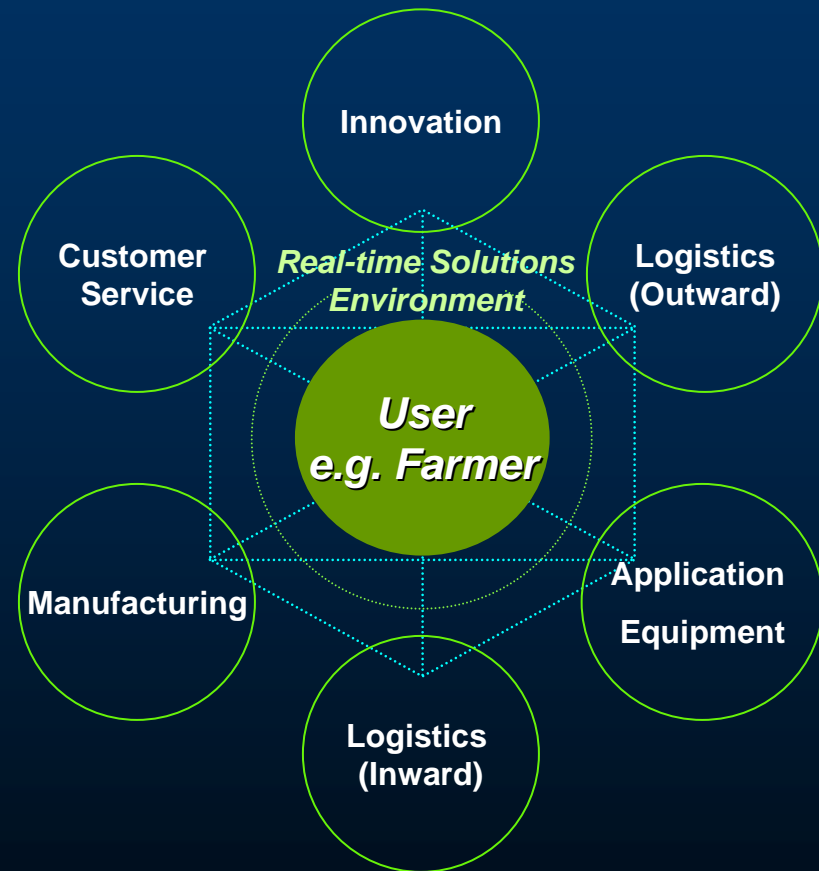


Organizational Implications could be Significant to Embrace the New Paradigm

Pyramid Structure



Networking Structure

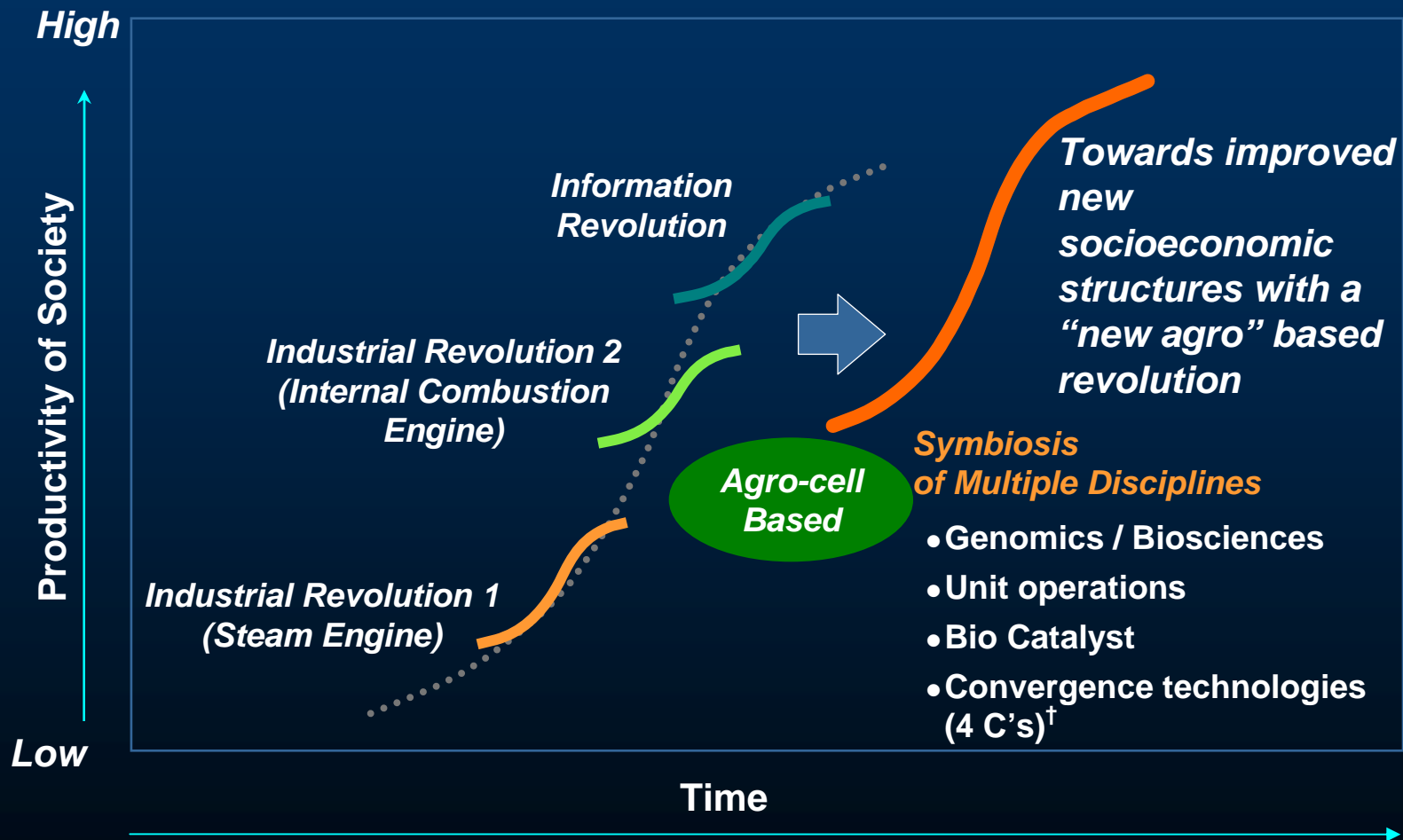


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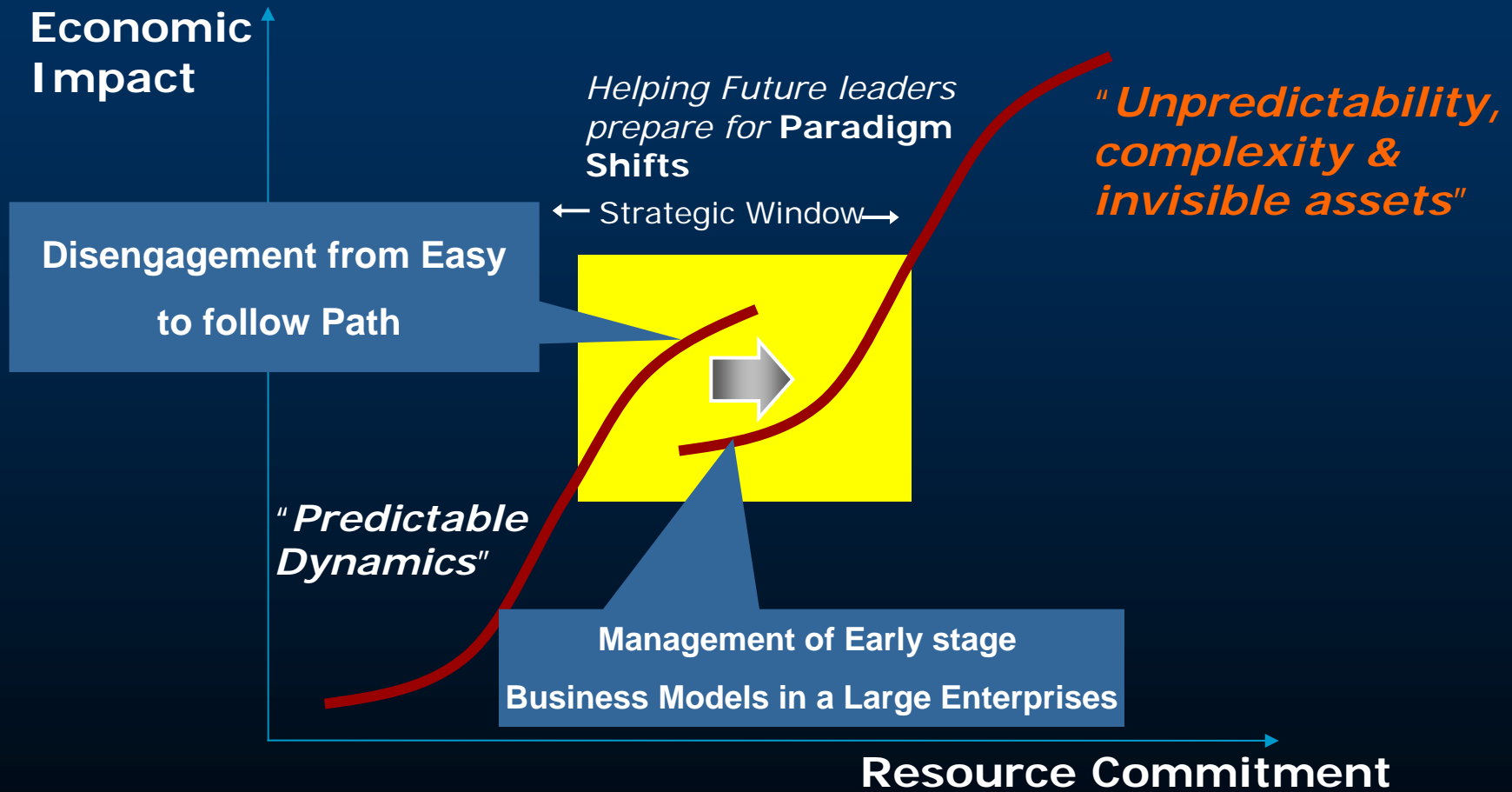
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Towards an Agro cell based Economic Revolution: *How to begin?*

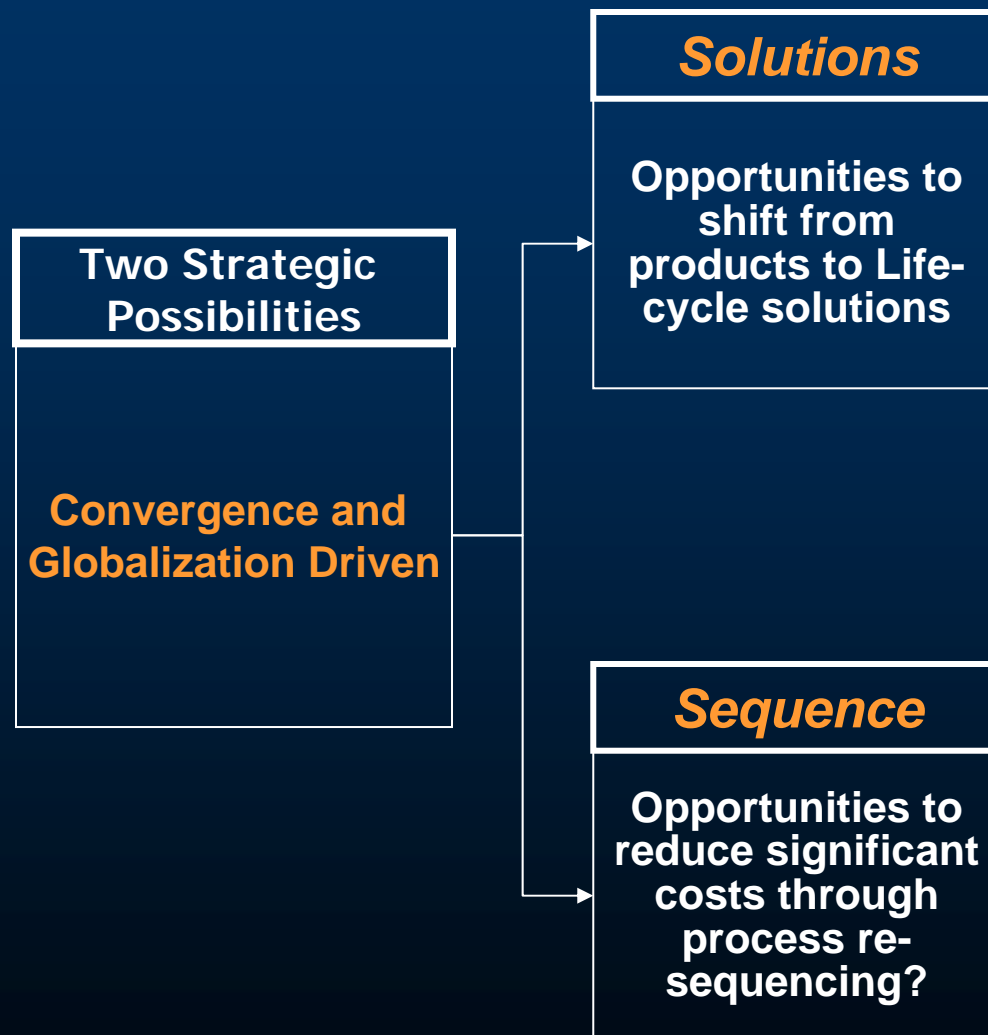
Development of a More Sustainable Economic Model



Leadership & Technologists will need to address fundamental phase shift requirements to develop the next generation Business Models



In the next decade the process industry could Commercialize the Convergent Opportunities Along Two Strategic Paths



Potential Value

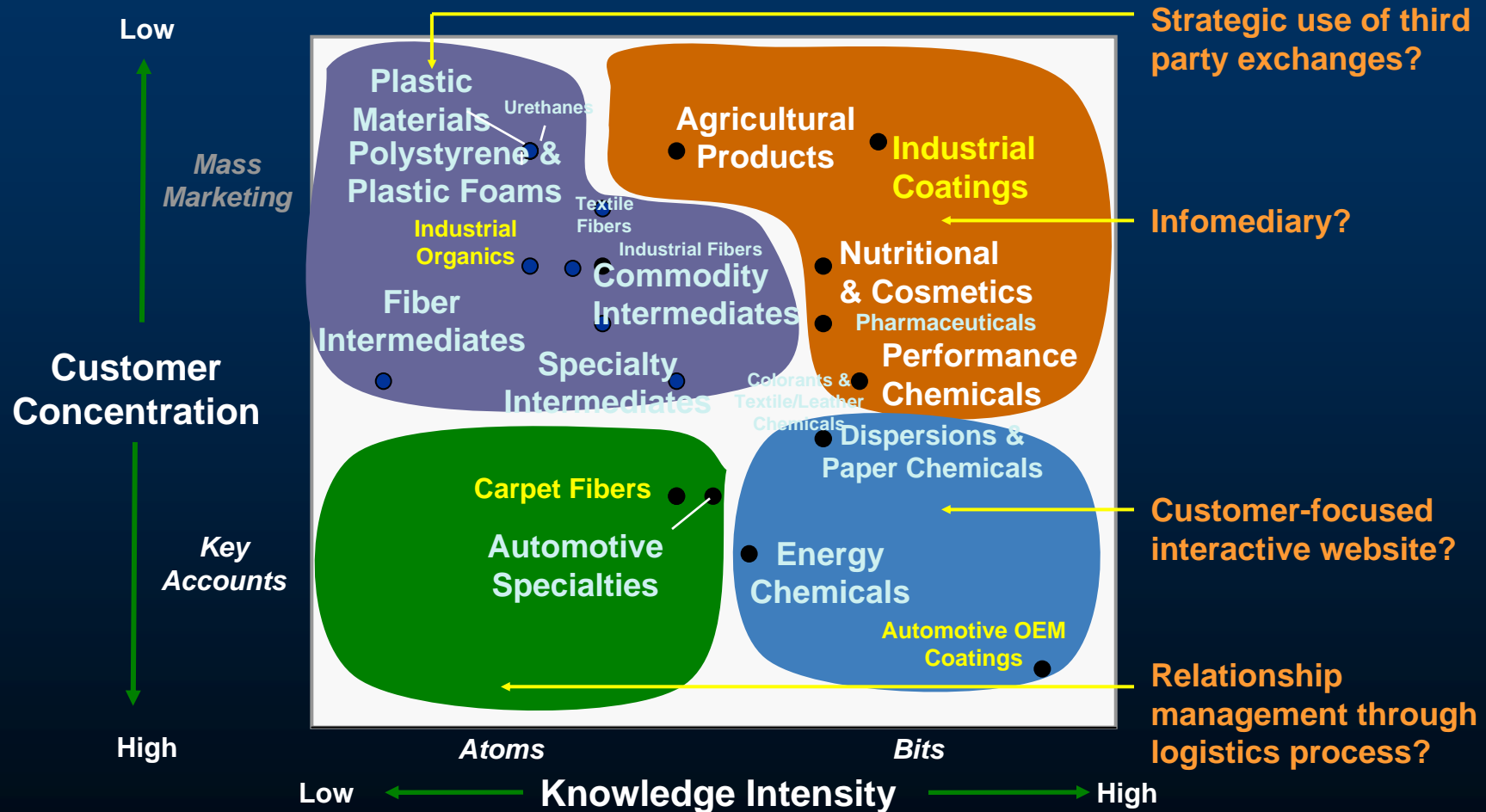
- Provide a end to end solution for life cycle economics & ecology
- Lead to revitalize several down stream industries
- Develop cross industry opportunities for creating new ecologies



- Create processes which are closer to thermodynamic requirements
- Re sequence steps in the value chain to take advantage of new processes vis-a-vis market trends

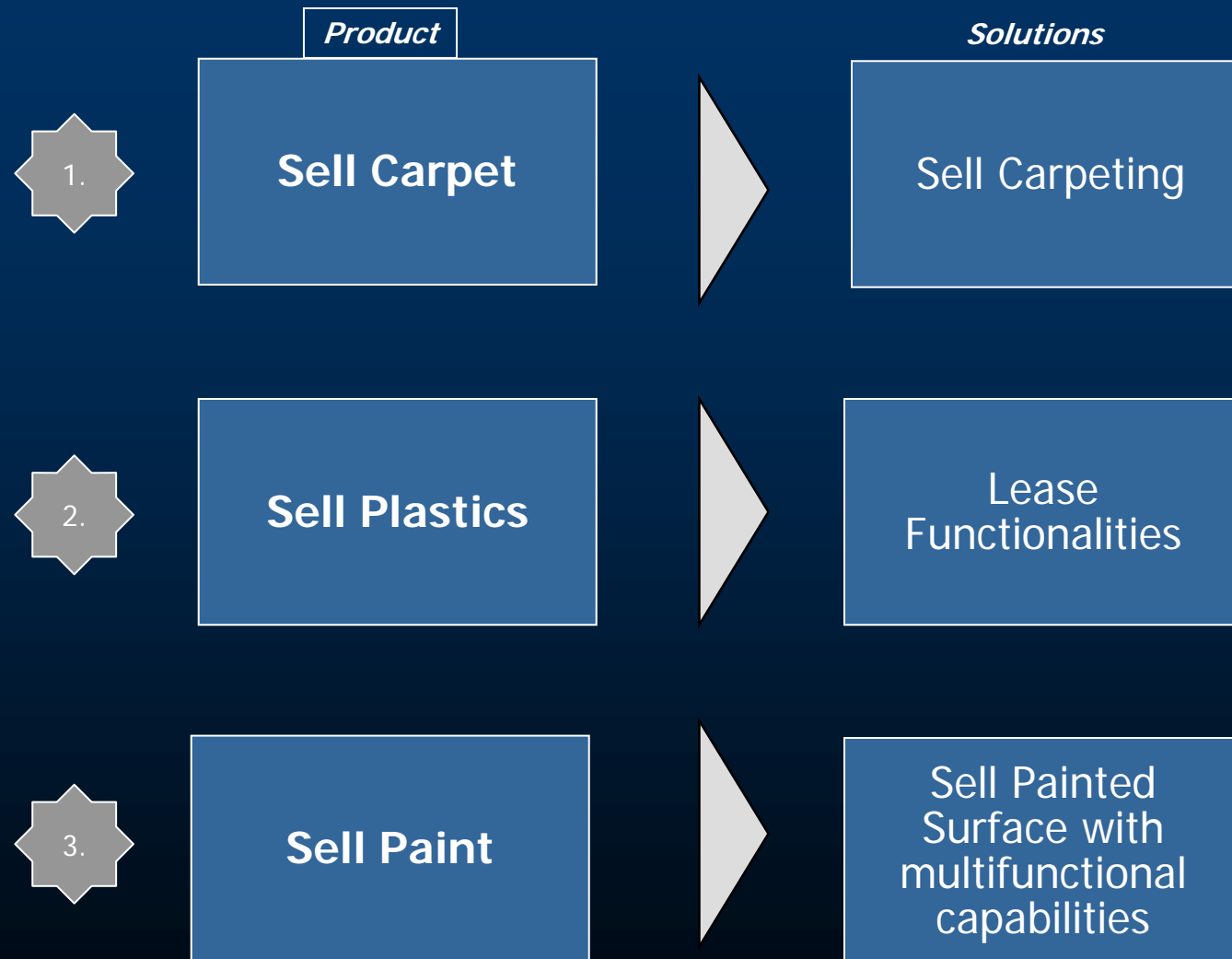
Effectiveness of likely solutions will depend upon the Strategic Positioning of the Product Clusters

Characteristics of a Chemical Company's Business



Source: Partha S Ghosh Analysis

Even in conventional applications “solutions” possibilities in the Process Industry could be significant

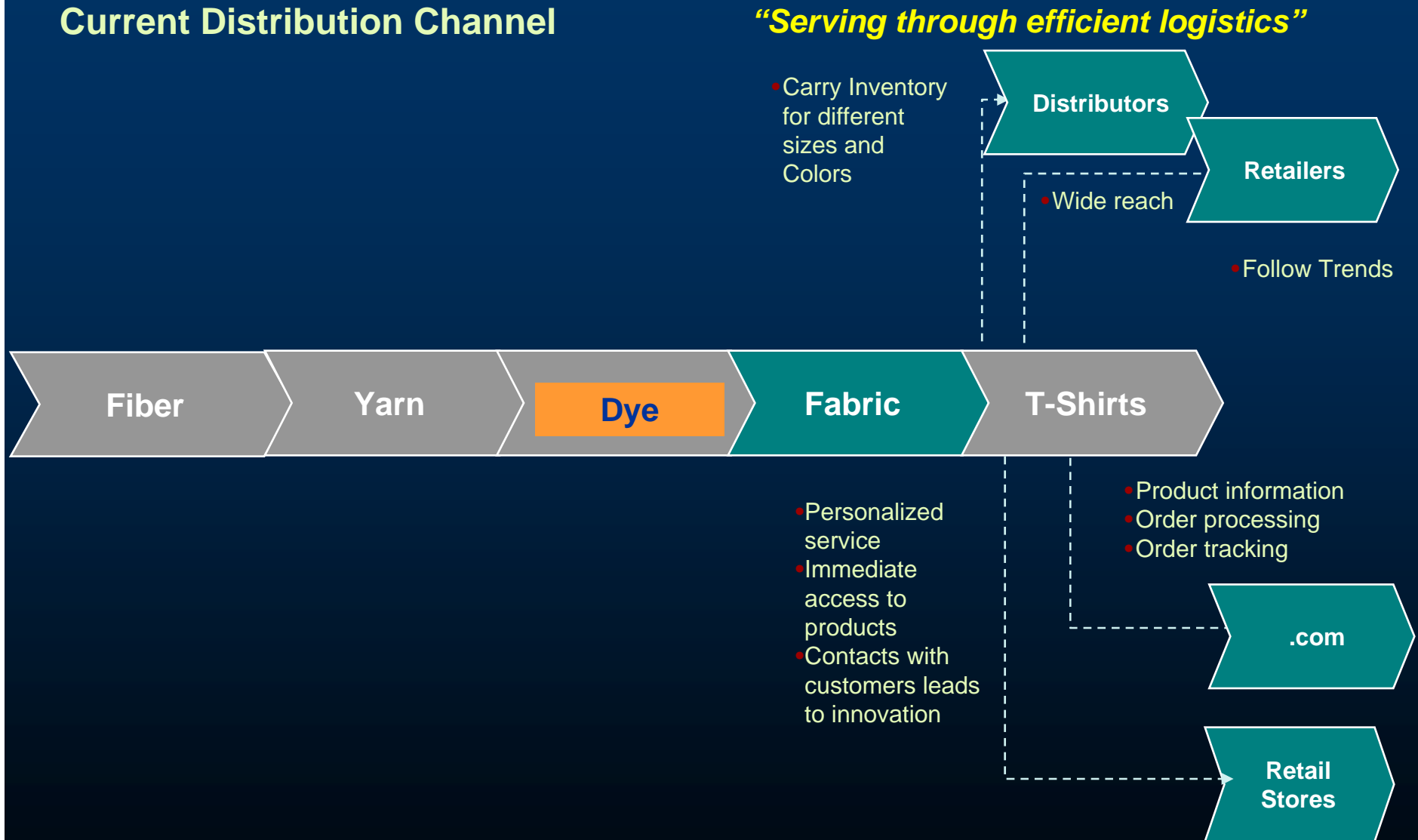


A few more examples

Companies	Solutions Thinking
1. Air Products	Not move Liquid Gases, but make the gases next to the Customer's Plant
2. Benetton	Dye not the fiber but the finished shirts
3. Paint Company	Sell not Paint but the painted surface
4. Interface	Product offerings must evolve in an ecosystem, expanding and enriching connectivity with partners and customers
5. Plastic Logic	Animated Posters and Electronic newspapers (printable electronics)

Sequencing Game: Typical Distribution Channel for T-Shirts

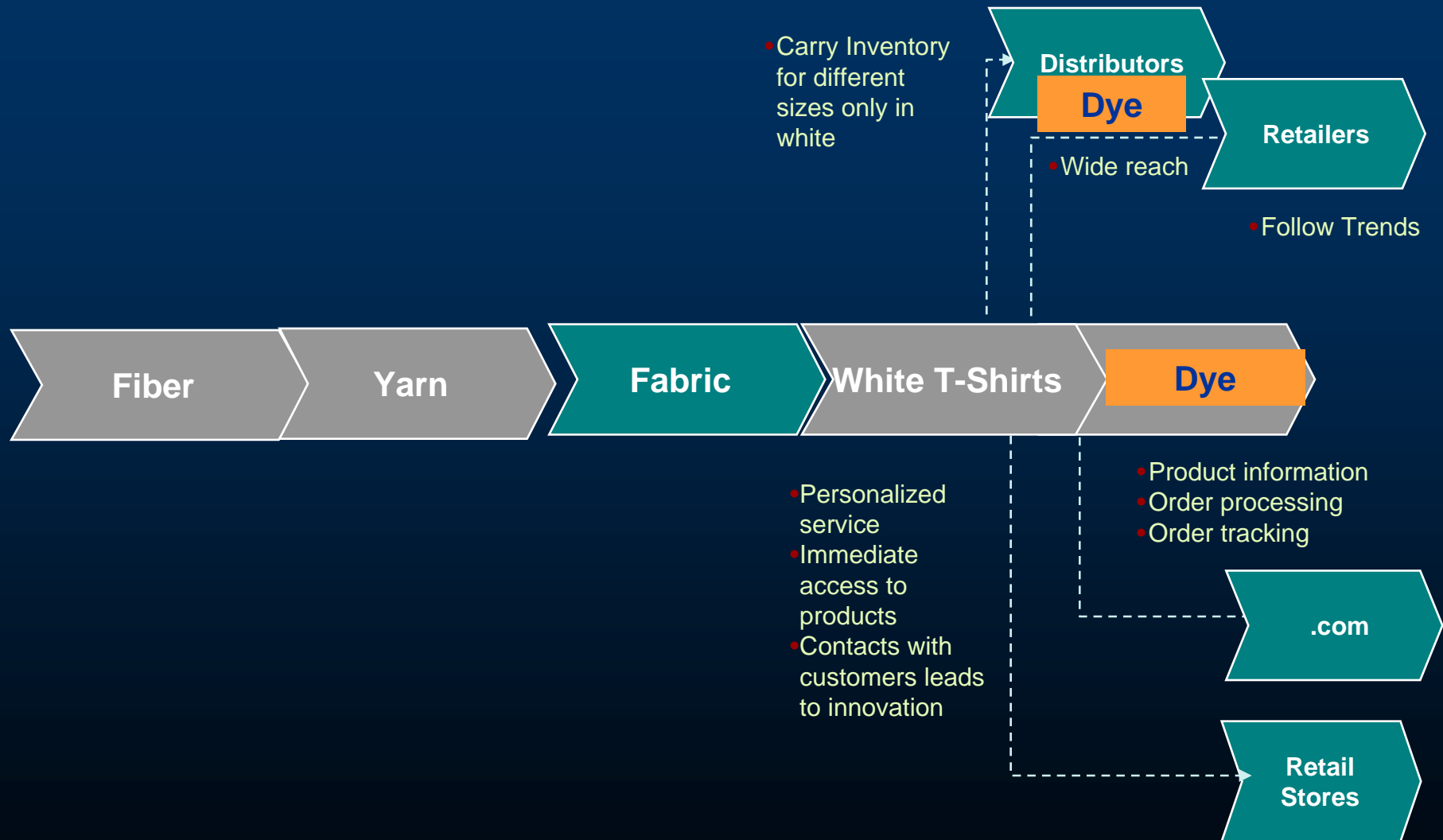
Current Distribution Channel



Benetton: Creating More Value out of the Distribution Channel

Current Distribution Channel

“Serving through efficient logistics”



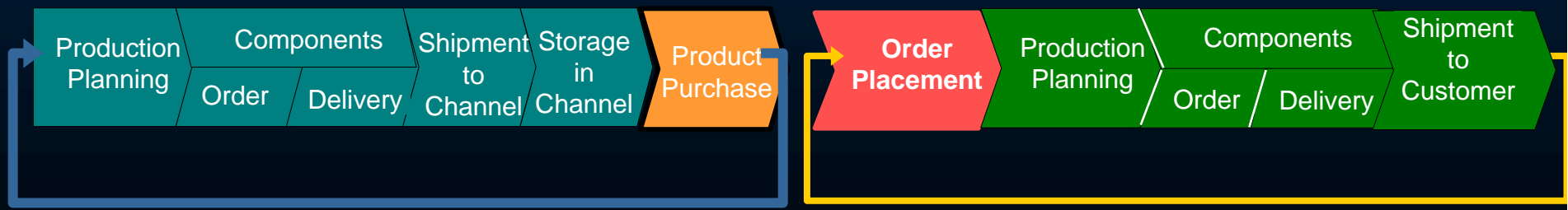
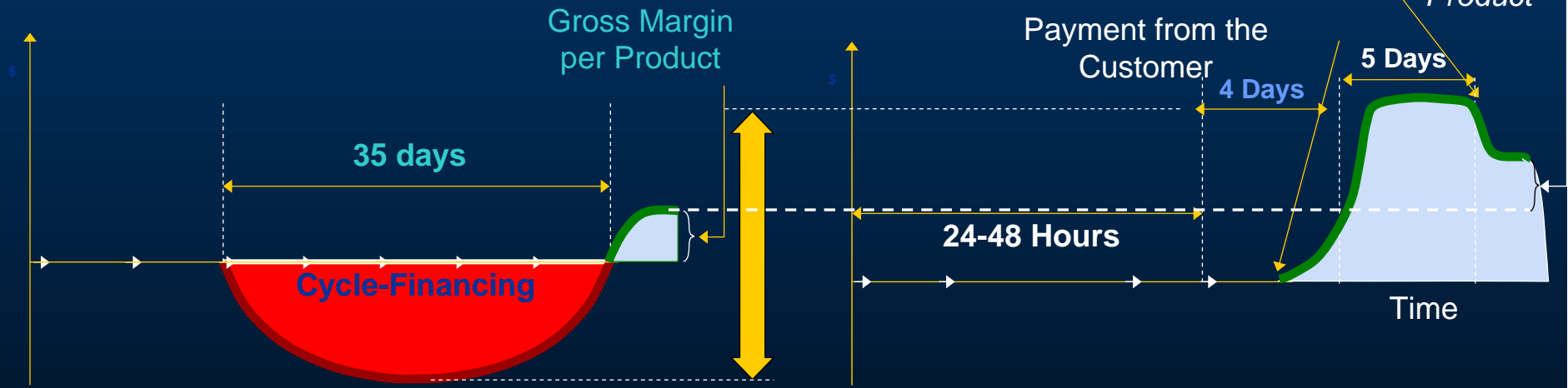
Process Simplification & Re-sequencing = Network

Manufacturing: Capital Efficiency Advantage

Illustrative

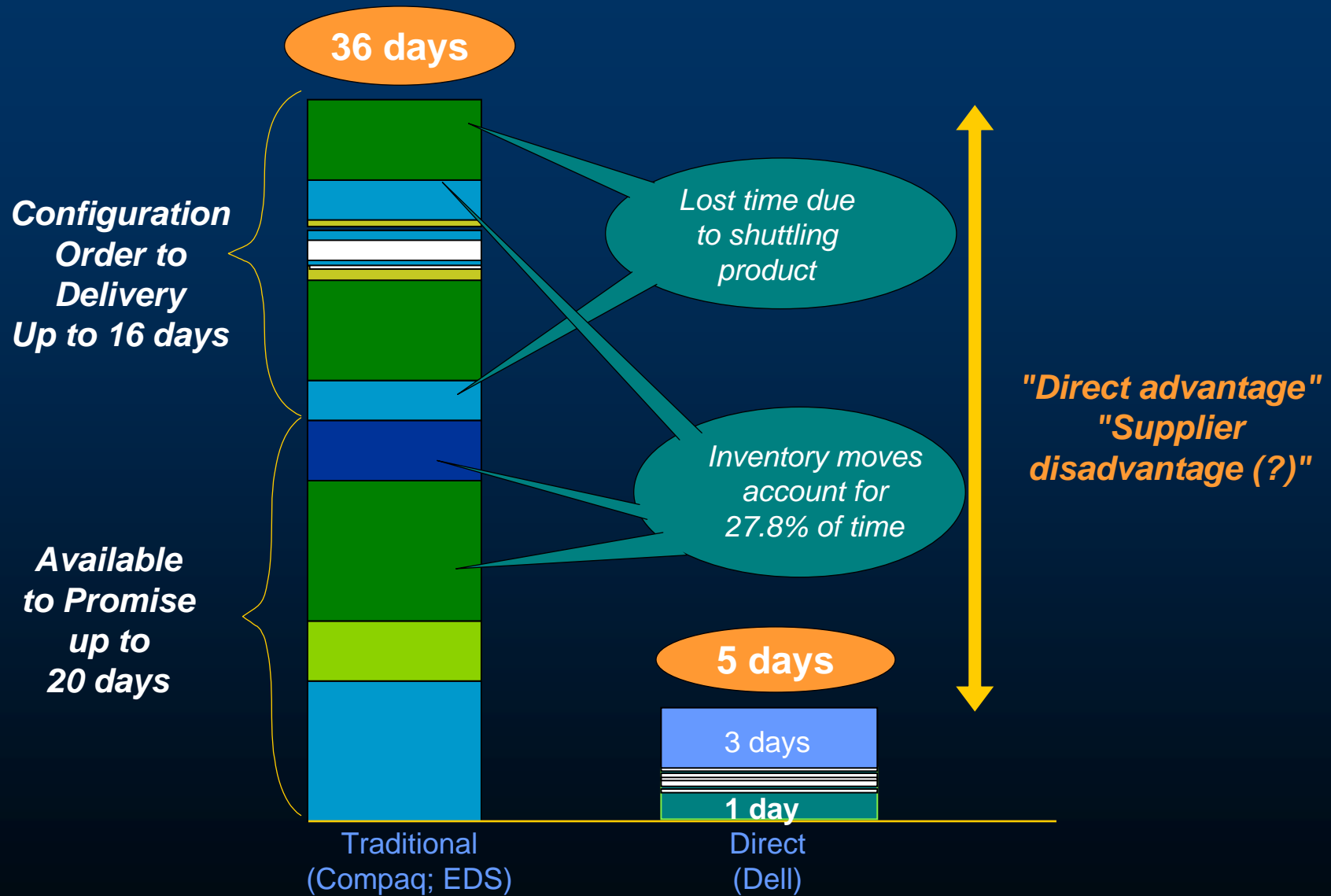
Conventional Model
Financial Flow/Production Cycle
Dollars

Direct/Internet Model
Financial Flow/Production Cycle
Dollars



Cycle Time Could Be Dramatically Reduced

Cycle Time – Order Entry to Delivery



Interface's Basic Principles (Seven Fronts)

Eliminate Waste: Eliminating all forms of waste in every area of business;

Benign Emissions: Eliminating toxic substances from products, vehicles & facilities;

Renewable Energy: Operating facilities with renewable energy sources · solar, wind, landfill gas, biomass and low impact hydroelectric;

Closing the Loop: Redesigning processes and products to close the technical loop using recovered and bio-based materials;

Resource-Efficient Transportation: Transporting people and products efficiently to reduce waste and emissions;

Sensitizing Stakeholders: Creating a culture that integrates sustainability principles and improves peoples lives and livelihoods;

Redesign Commerce: Creating a new business model that demonstrates and supports the value of sustainability-based commerce;

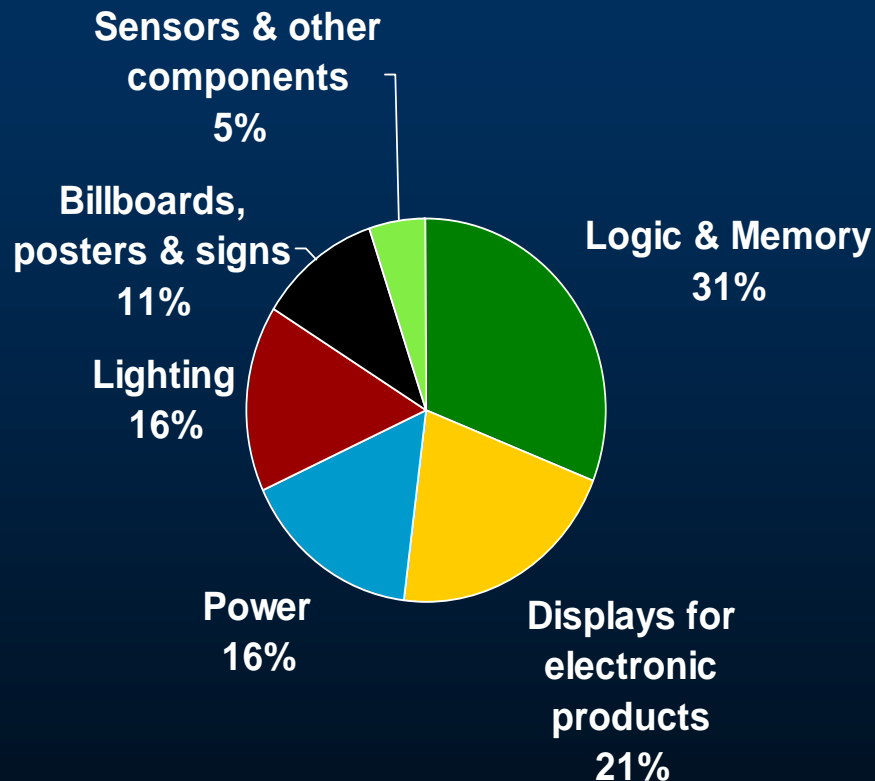
Interface Accomplishments

Product Reclamation - Reentry

- *The Reentry program diverted 83.92 million pounds of material from landfill between 1995 and 2005.*
- *In 2005, 17.2 million pounds was diverted from landfill and used in recycling (71%), energy capture and conversion (28%), and repurposed (1%).*

For example a variety of uses forecast for organic electronics and electrics, will require visionary solutions thinking

2020 world market [projected] = \$96 billion



Molecular Solutions will Require:

- Deep understanding of end use functionalities
- Systems oriented thinking
- Unorthodox view and thinking?



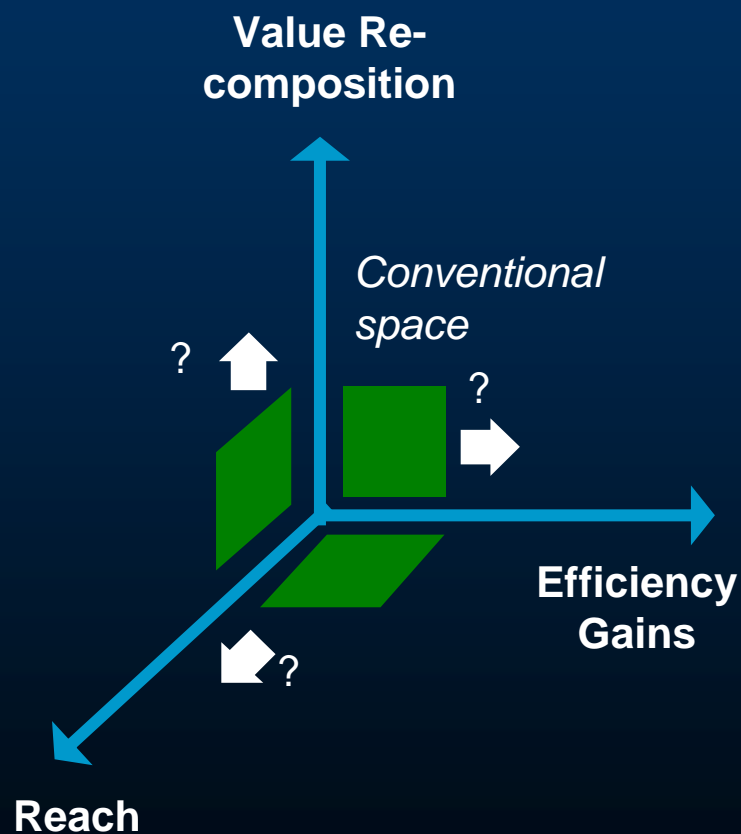
Semiconductors based on Organic Ink printed on flexible plastic substrates

Example: A Bottle of Pills may record the temperatures it has experienced, and an electronic display can advance or delay the expiration date accordingly

Source: IDTechEx

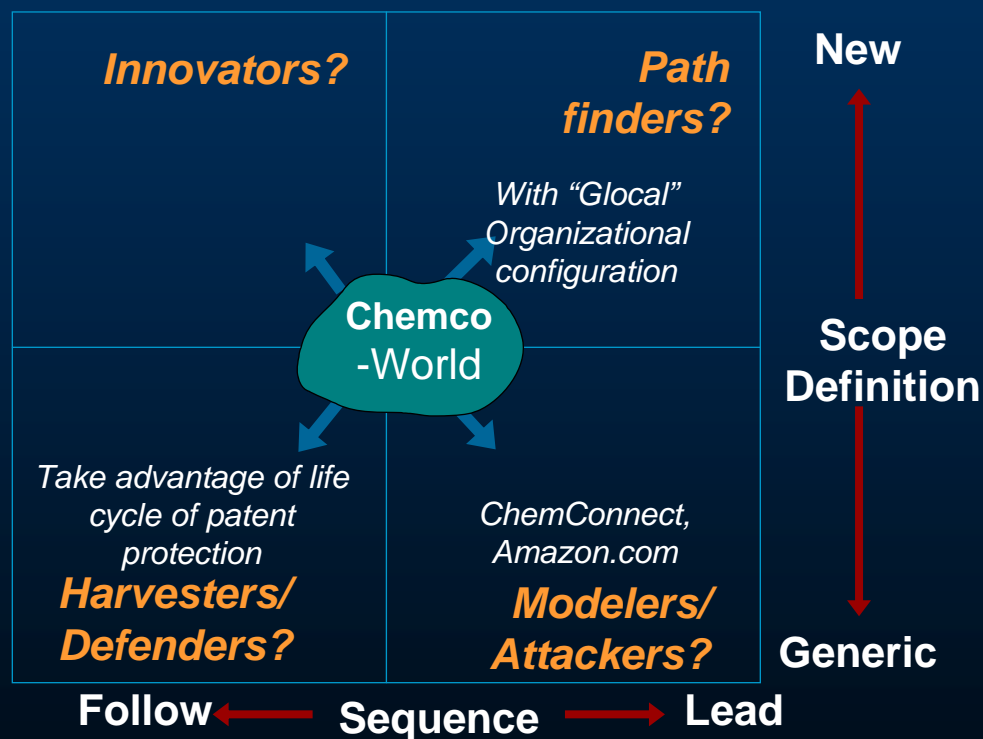
Chemical Manufacturers will need to find New Roles along three vectors

Basic Strategic Framework
Likely Strategic Plays



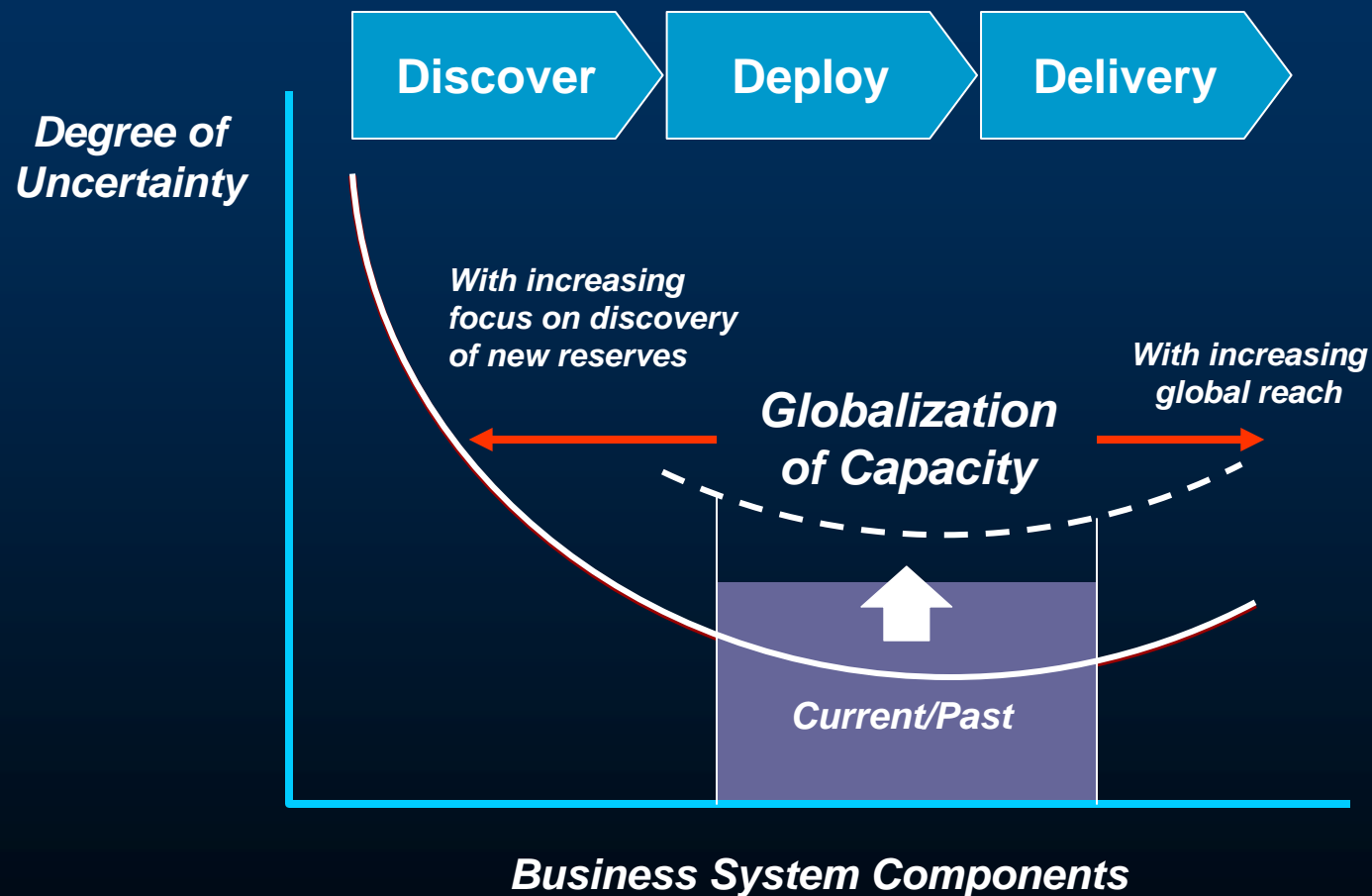
Strategic Gameboard
Likely Strategic Plays

Illustrative



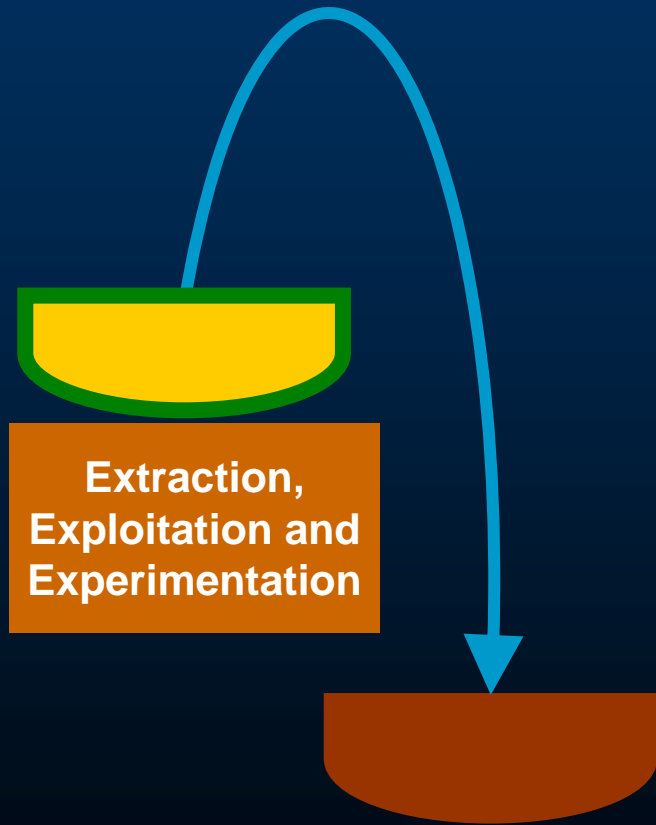
Risk Management Capacity Will Need to Be Fundamentally Reviewed

Business System (Simplified)

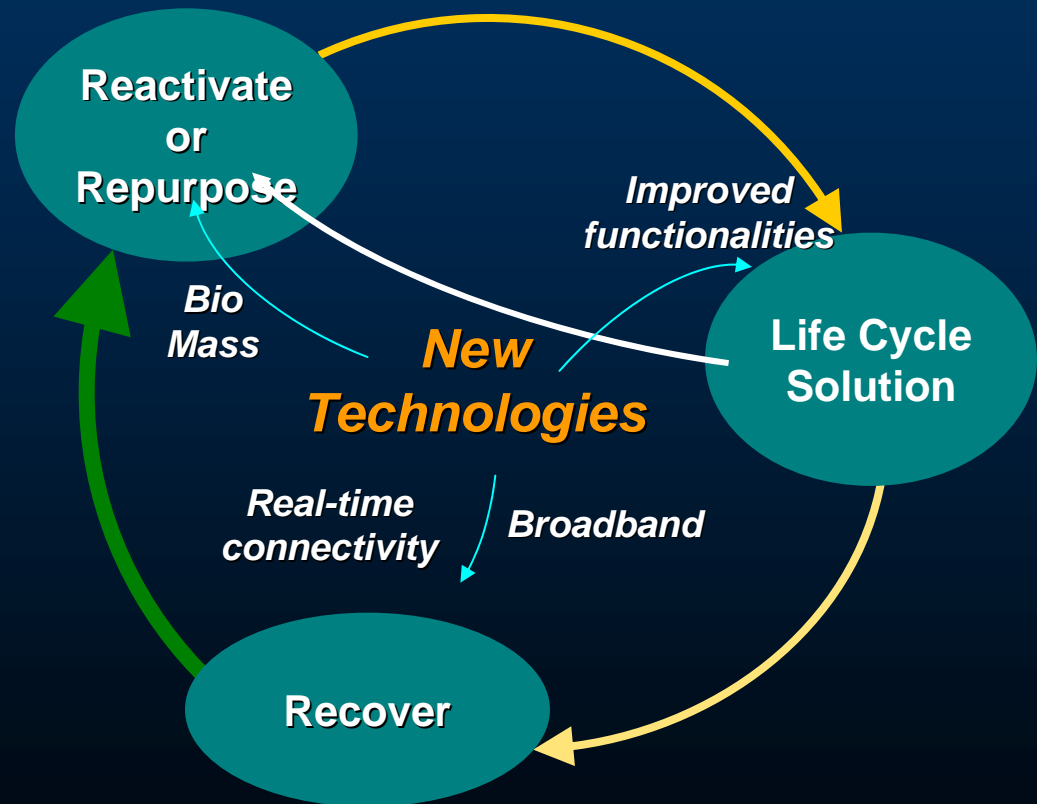


Last 5,000 Years Future Possibilities . . .

Economics of Linear Mechanics



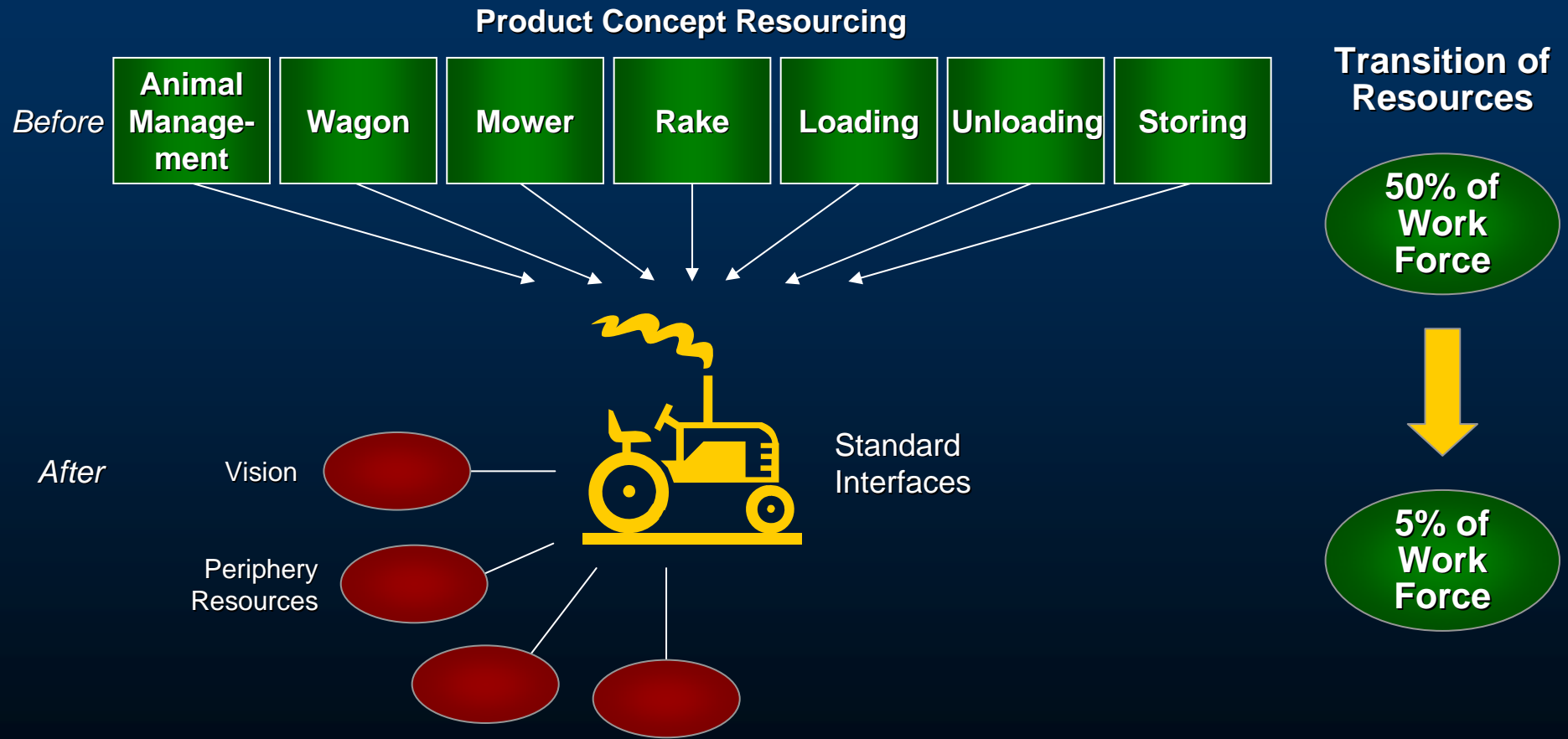
Economics of "Closed Loop Natural Dynamics"



Product Concepts Will Be Fundamentally Reconfigured to Provide More Intelligent & Sustainable Solutions: *Will Chemical Industry will take on the challenge?*

We Have Been Here Before?

Illustrative



Note: Tractor represents "mechanical" control center with "farmer-friendly" user interface