SCIENCE, TECHNOLOGY, INNOVATION AND MARKETS : THE INDIAN OPPORTUNITY

Dr. S. Sivaram,
National Chemical Laboratory,
Pune-411 008, INDIA

Tel : 0091 20 2590 2614
Fax : 0091 20 2590 2615
Email : s.sivaram@ncl.res.in
Visit us at : http://www.ncl-india.org

Solvay RD&T Centre
Vadodara

May 25, 2012

OUTLINE

- India @ 2012
- Indian Higher Education Systems
- Science and Technology Landscape
- Indian Chemical Industry : Some Features
- Opportunities for Innovation

INDIA IN 2012 : HOPE AND DESPAIR

Hope

- **Strong fundamentals of economy**
- **Markets driven by robust domestic consumption**
- **Favorable demographics**
- **Enlarging middle income group**
- **Large domestic savings (>35%)**
- **Growing urbanization**
- **More young people in colleges and universities**

INDIA IN 2012 : HOPE AND DESPAIR

Despair

- **Slowing down of economic growth**
- **Supply-demand imbalance**
- **High domestic inflation**
- **Growing fiscal deficit / growing subsidies**
- **Depreciating Indian Rupee**
- **Low investor confidence and flight of capital**
- **Political impasse**

INDIA ON THE MOVE

- India's GDP topped 1.63 trillion in 2011
- Over 65% of the households (over 700 million people) possess mobile phone yet only half this number have access to electricity
- India's billionaires have a combined net worth of over $100 billion, yet over half of India lives on less than $ 2 a day
- Growth driven by robust capital markets, free enterprise systems, strong culture of entrepreneurship and active civil society groups
- By 2020, India will have a population of about 325 million between 20 and 35 years of age and will drive one of the greatest consumer markets

THE OTHER DEMOGRAPHIC DIVIDEND

(The Economist, 2010)

- **Emerging markets are teeming with young entrepreneurs**
- **Median age in India will be 28 in 2020 compared to 37 in China, 38 in USA, 45 in Western Europe and 49 in Japan**
- **Direct correlation between age and entrepreneurial pre-disposition; young people are more innately inclined to overthrow the existing order than older people**
- **Drivers ICT, opportunity to leapfrog technologies; not hampered by legacy systems and mindsets**
- **Entrepreneurial energies are moving eastwards. The next Facebook is increasingly likely to be founded in India rather than in middle aged America or Europe**

CHALLENGE FOR INDIA'S GROWTH

- **Can India become an affluent nation in one generation?**
- **Can India escape the middle income trap ?**

This occurs when countries cannot compete with low-wage, low-income economies in manufacture/exports or with advanced economies in skill intensive innovative activities.

- **Sustained growth is harder to achieve. Lessons need to be learnt from the growth story of Phillipines, S. Africa and Brazil**

If India can sustain a GDP growth of 8-9% for the next 30 years, its per capita income can grow from US $ 1000 to US $ 10,000!

India 2039, Centennial Group, Brookings Institution

SCIENCE, TECHNOLOGY AND INNOVATION : AN EVOLVING LANDSCAPE

- India is poised to play a key and distinctive role in the emerging global economy
- A long national tradition of scholarship in arts and sciences and a burning desire among the young to be educated against all odds
- A strong and growing educational infrastructure to cater to the aspiring millions of young men and women
- Generous state support to science & technology
- India is becoming attractive for Indian S&T professionals to either stay back or return back
- India's ensuing demographic profile will make available more educated and qualified professional in the age group of 20 to 35, the youngest work force in the world.

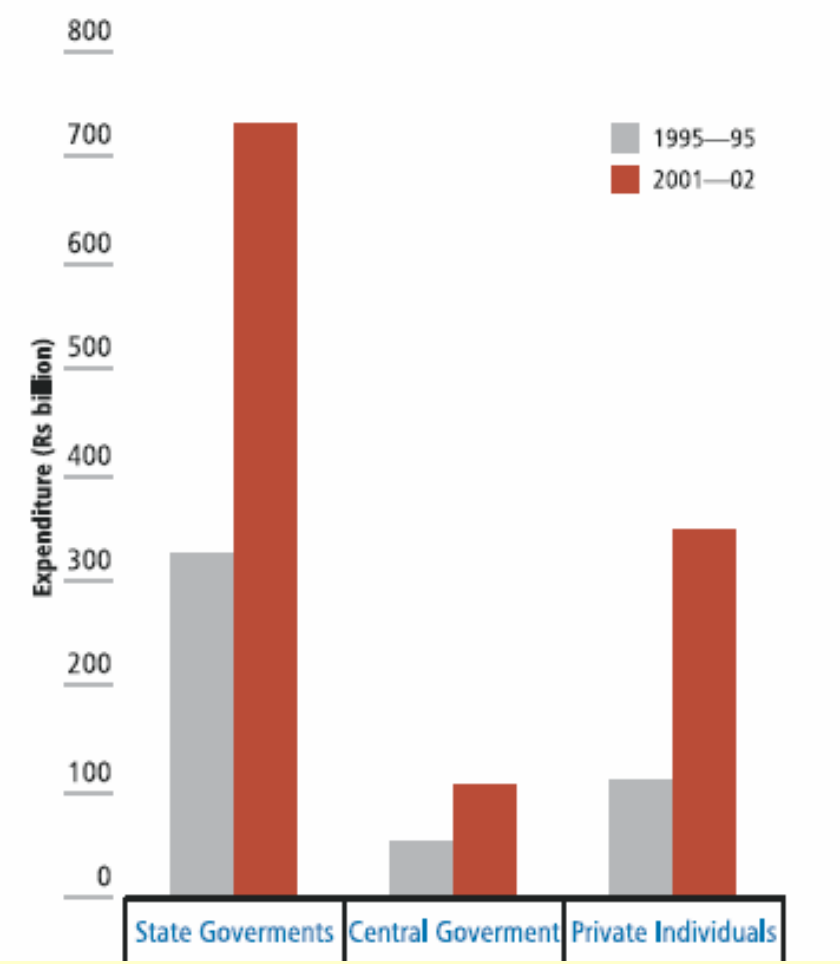
HIGHER EDUCATION SYSTEMS: MASSIVE EXPANSION

- **33 institutions of national importance, 40 central universities, 243 state universities 53 state private universities, 130 deemed universities, 5 institutions established under state legislature**
- **504 Universities, 25,751 colleges**
- **Several new universities have been announced; 5 IIT`s, 5 IISER`s, 14 world class universities and 16 Central Universities**
- **Massive support to science education right from high schools**
- **Several Fellowships to encourage students to pursue higher education and research in science and engineering**
- **New interdisciplinary centers of research in advanced materials including nano-science and technology, health sciences and technology and biotechnology are being set up**

EDUCATION :SOME FACTS

- About 8% young men and women enter the university system in India
- Of this less than 2% enter the organized employment market
- India's labor force will increase by 32 %, meaning 250 million additional jobs are needed by 2030
- About 26 million people are added every year to the existing educational system
- About 600,000 students compete for 6000 positions in IIT`s and IIM`s
- By 2025, OECD will have 35 million less people in the age group of 20-49; China will have 63 million less; India will add 140 million people in this age group
- Only 13 % of the 113 million in the age group 20-24 actually go to college; In China the GER is 23 %
- World will need ~ 100 million educated persons within the next 2 decades, but at current GER India can supply only 20 million

EXPENDITURE ON EDUCATION (RS BILLION)



Allocation for education for the period 2007-2012 is 20% of the Gross Budgetary Support. This amounts to five times more resources relative to the period 2002-07

SCIENCE AND TECHNOLOGY LANDSCAPE

- **Changing rapidly and significantly**
- **Definition of science has broadened to include applications and innovations**
- **R&D expenditure as a percentage of GDP from 0.9% (2008) to 1.1 % (2012)**
- **R&D Centres within industries from practically nil to over 1000**
- **Annual output of PhDs in science and engineering ~ 6000 targeted to increase to 15,000 by 2015 and 25,000 by 2025**
- **Full time equivalent researchers : 136 scientists per one million people**

In spite of this significant talent gap expected in the short term

THE INDIAN NATIONAL INNOVATION SYSTEM
PUBLICLY FUNDED INSTITUTIONS

- The Atomic Energy Research Establishments
- The Council of Scientific and Industrial Research
- The Indian Council of Medical Research
- The Indian Agriculture Research Institutions
- The Indian Space Research Organization
- The Defense Research and Development Organizations
- The Indian Metrological Department
- Research Institutes of the Departments of Science and Technology, Biotechnology and Ocean Development
- Ministry of New and Renewable Energy
- Ministry of Information Technology
- Ministry of Environment and Forests

SCIENTIFIC AGENCIES AND RESEARCH INSTITUTES IN INDIA

•Agriculture	84
•Defense research	53
•CSIR	38
•Medical research	27
•Science and technology	17
•Atomic energy	14
•Electronics / IT	14
•Space	8
•Biotechnology	5
•Other Government research institutions	285
•State level research institutions	800
•R&D centers of companies and “non-profit” research bodies	1500

R&D EXPENDITURE OF MAJOR SCIENTIFIC DEPARTMENTS

Ministry / Department	% share
•Atomic energy	41.4
•Space	15.2
•Agriculture	9.8
•Scientific and industrial research	7.3
•Environment and forests	7.0
•Science and technology	6.6
•IT	3.9
•Renewable energy	2.6
•Biotechnology	1.8
•Medical research	1.3
•Earth and ocean systems research	3.0

EXPENDITURE ON R&D BY FIELD OF SCIENCE (2008)

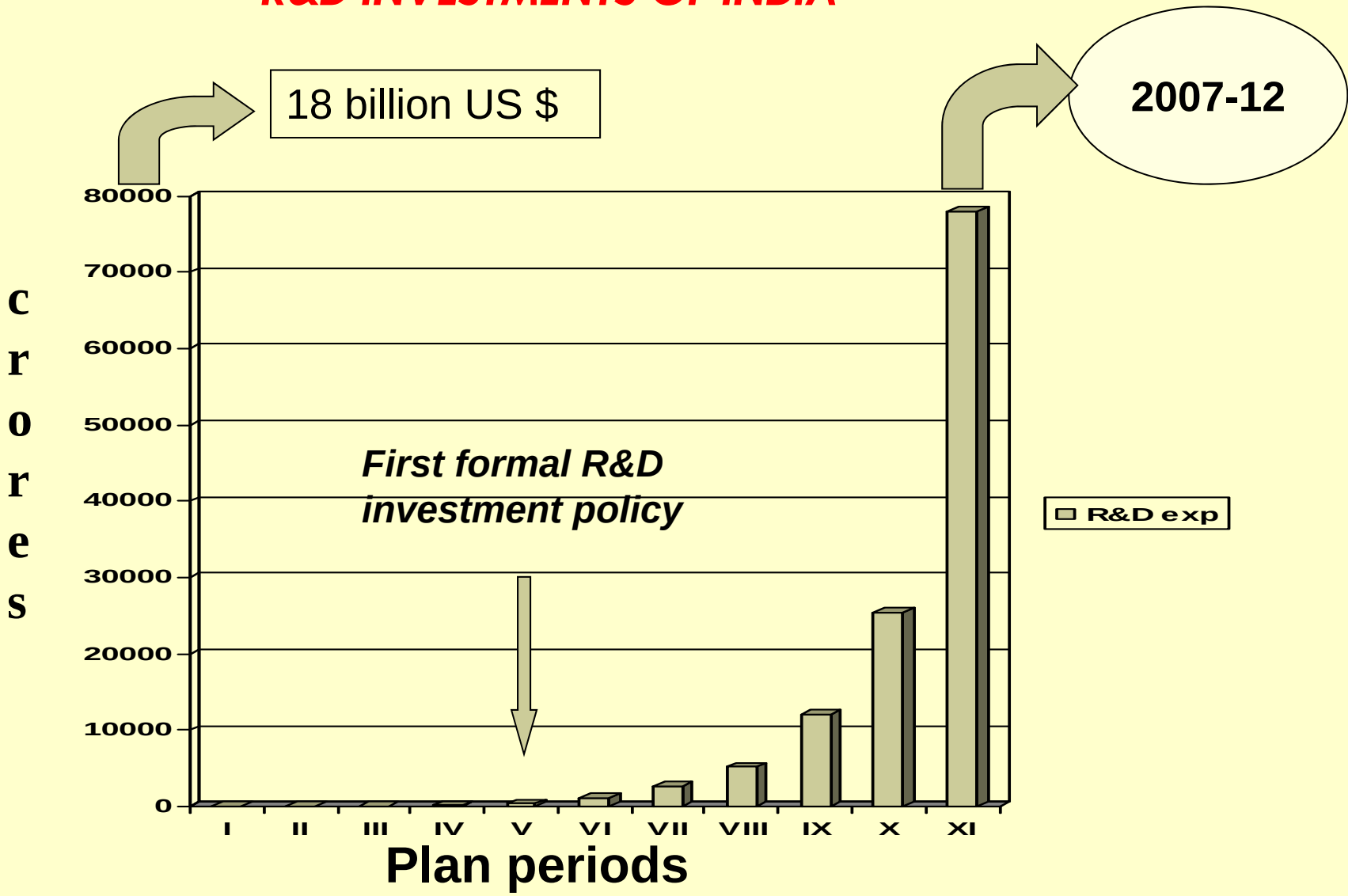
	% Share expenditure	
	Public	Private
Natural Science	87	13
Engineering and technology	88	12
Medical science	35	65
Agriculture	77	23
Total	72	28

SCIENTIFIC PUBLICATIONS

(M.Kolman, SciVal Spotlight, Elsevier)

- **Number of Research Papers : 266,230 (2010)**
- **In Chemistry, 20 % of the total literature is from India**
- **40% of chemistry papers recognized as leadership articles; for engineering it is 14.7 %, Math and Physics it is 10.3 % and medical sciences it is 4%**
- **In terms of output India is within the top ten and growing at 14 %**

R&D INVESTMENTS OF INDIA

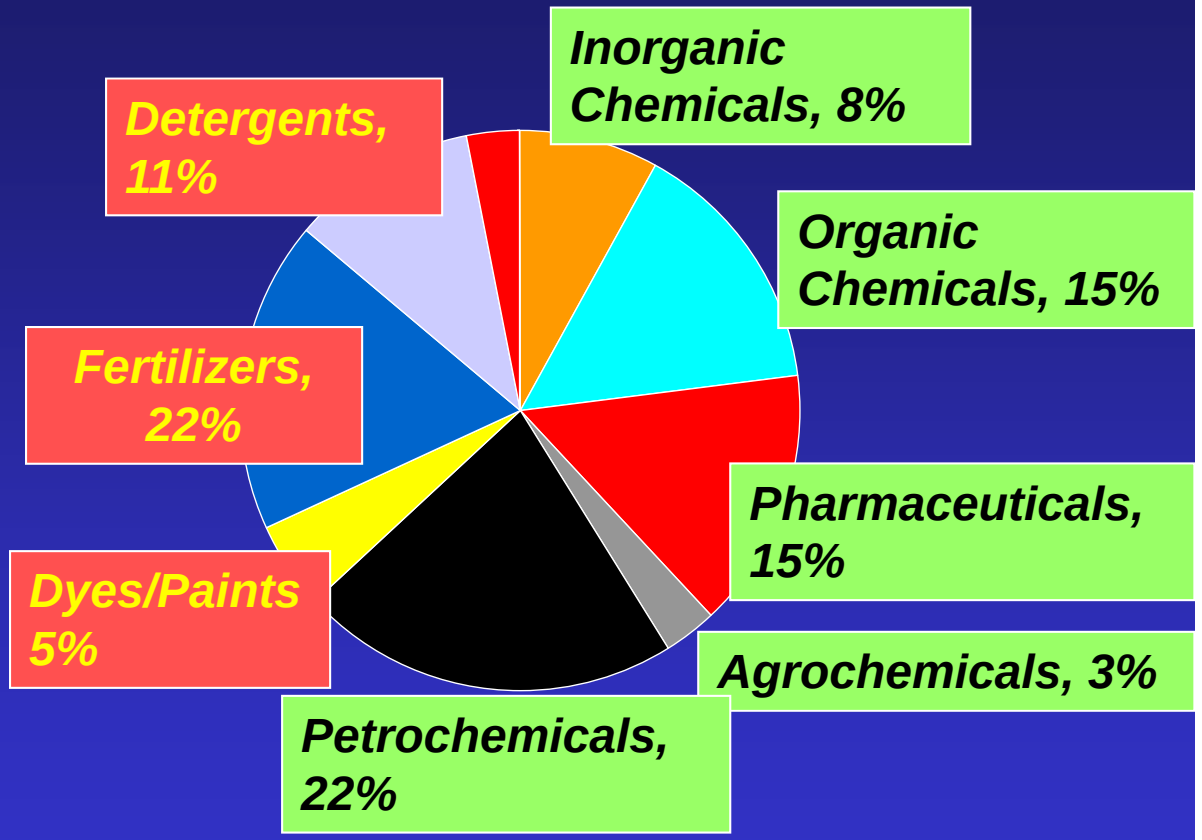


INDIAN CHEMICAL INDUSTRY

- **Chemicals , Global Market : US $ 3.4 trillion**
- **Specialty chemicals : US $ 750 billion**
- **Chemicals, Indian market : US $ 100 billion**
- **Specialty Chemicals (excluding agrochemicals) : US $ 21 billion**
- **Indian Growth Rate : 13 % CAGR**

INDIAN CHEMICAL INDUSTRY

- Chemical industry in India contributes to 3 % of its GDP and 14 % of its exports
- Indian Chemical industry 12 th largest in the world and 3 rd largest in Asia



INDIAN CHEMICAL INDUSTRY : GROWTH DRIVERS

- **Packaging**
- **Automotive**
- **Construction and housing**
- **Consumer goods**
- **Health care and wellness**

Growth through market expansion; demand driven growth

INDIAN INDUSTRY : RANKING

Industry Segment	Position
Pharmaceuticals	3 (volume) and 14 (value); $50 billion by 2020
Vaccines	60% of global production; current markets : $ I billion, expected to grow to 4-6 billion by 2020
Automobiles (2,3 and 4 Wheelers)	2
Tractors	3
Retail Food	$150 million by 2025 (40% of global market)
Renewable Energy	5; 15 Gw , 10% in total energy mix

INDIA POSITION IN GLOBAL AGRICULTURE

Category	Rank
Cattle and Buffaloes	1
Milk	1
Total pulses	1 (14 million tpa)
Irrigated area	1
Fruits and vegetables	2 (50 +80 million tpa)
Oil seeds	2
Wheat	2
Rice	2
Total cereals	3
Natural Rubber	2
Sugarcane	2 (240 million tpa)
Castor Seed	1 (1.2 million tpa)
Coconut	3 (11 million tpa)
Jute	1
Cotton	2 (6 million tpa)
Guar Gum	1

INDIA'S INNOVATION OPPORTUNITIES

- **Biomass**
- **Renewable Energy**
- **Water**
- **Public Health and Hygiene**
- **Housing and Infrastructure**
- **Mobility**

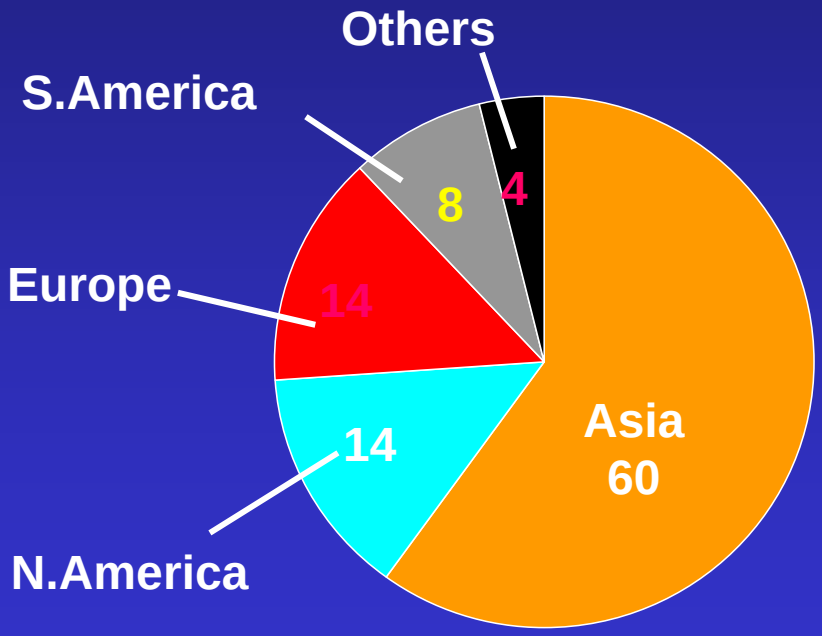
Business Model

Scale
Access
Affordability

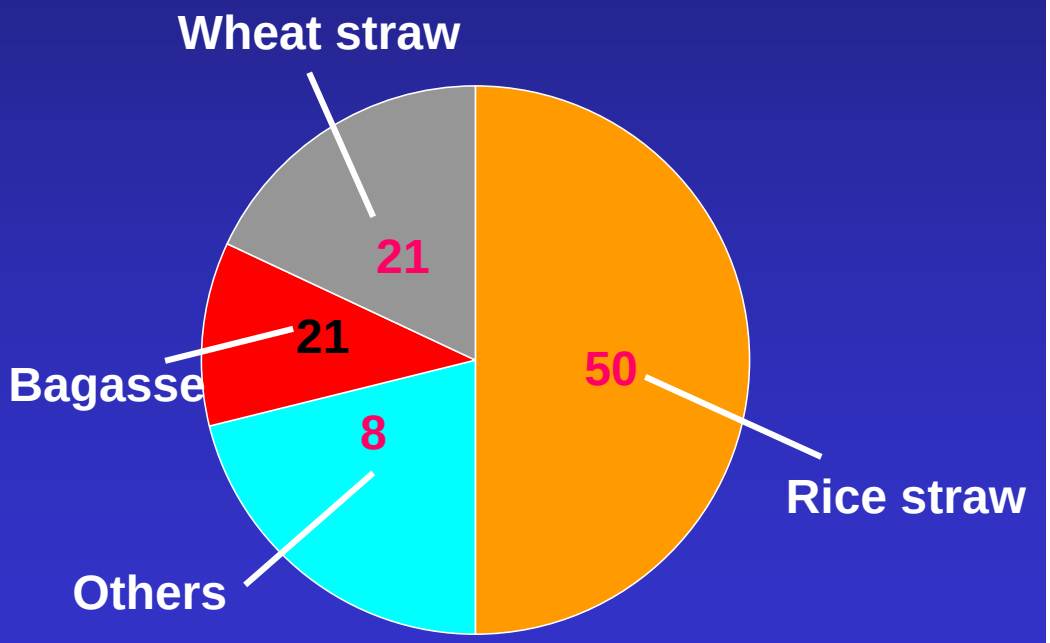
In the next five years 500 million people will be urbanized. This unprecedented rate of urbanization provides great opportunity for innovation

AVAILABILITY OF AGRICULTURAL RESIDUES

An unique Indian advantage ?

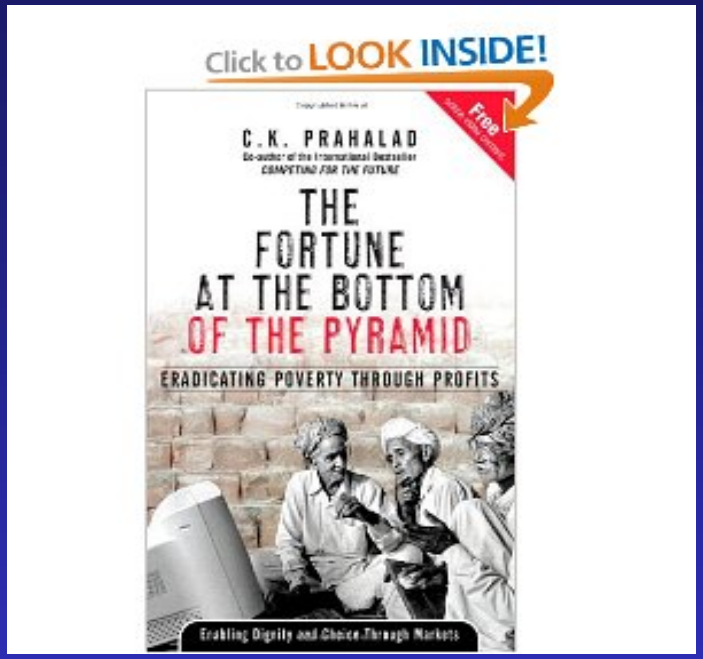


By Geography

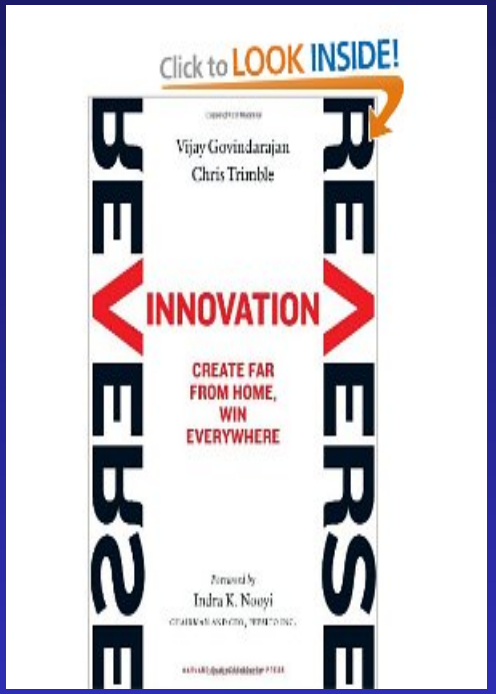


By type

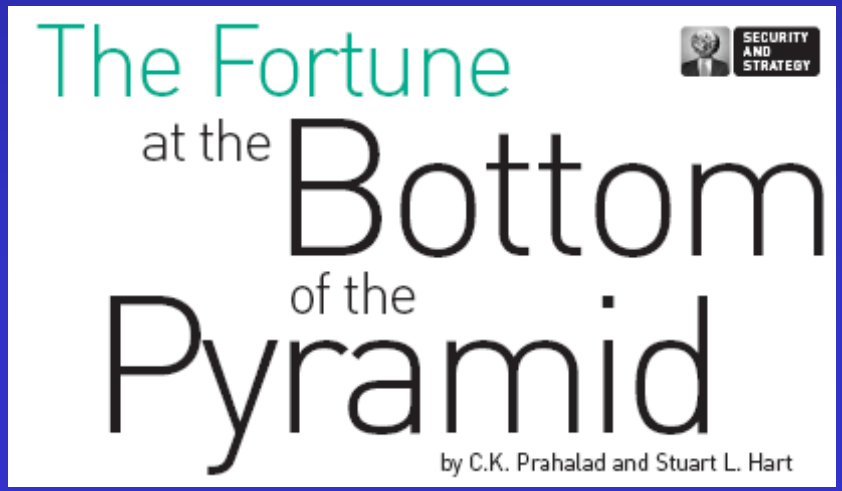
INNOVATION AND THE EMERGING ECONOMIES



September 2009



April 2012



PRODUCTS AND SERVICES FOR THE EMERGING MARKETS WEALTH AT THE BOTTOM OF THE PYRAMID

- **A four door automobile for less than $ 2500**
- **A mobile phone for less than $ 25**
- **A PC for less than $ 200 ; A Tablet for less than $100**
- **Lowest cost producer of off –patent generic drugs; the world's pharmacy**
- **Long distance calling at less than 10 cents per minute**
- **A heart valve at less than $ 400**
- **A by pass coronary surgery for less than $ 2000**
- **A cataract eye surgery at $ 30**
- **A baby diaper or female sanitary napkin at less than 10 cents per single use**
- **Shampoos , tooth paste and other personal care products at less than 3 cents per single use**
- **Vaccines that can be transported without a cold chain**

- ***Examine product design and development ground up***
- ***Re-examine afresh cost -performance paradigms***

THE CONCEPT OF REVERSE INNOVATION

- **Companies develop products in more developed economies and distribute them worldwide with some localization; exploit economies of scale in manufacturing**
- **This approach worked fine when developed economies accounted for the vast majority of the markets**
- **Thanks to faster growth of emerging economies like India and China and slowing down of growth of wealthy nations, this approach is no longer relevant**
- **Reverse Innovation calls for developing products exclusively for emerging economies and take these products to more developed economies**

THE CONCEPT OF REVERSE INNOVATION

- **Success in emerging economies is a prerequisite for continued vitality in developed ones for global companies**
- **The goal is to preempt local companies in emerging economies from creating these innovations and disrupting the global companies businesses in their own backyards**
- **There is a need to counter two fallacies about the emerging economies. They are,**

  - Emerging economies will largely evolve in the same way that developed economies did, and

  - Products that address emerging economies special needs cannot be sold in more developed economies because they are not good enough to compete there

Jeff Immelt, Vijay Govindarajan and C. Trimble

HBR, October 2009

THE THIRD WAVE IN GLOBALIZATION

- **Outsourcing of research and services exploiting cost arbitrage**
- **Setting up of R&D Centers in India and developing products and processes for the economically advanced markets**
- **Innovating for the emerging economies; create products and services with new price – performance envelope (50% solution @ 15% price or 70% performance at 50 % price and 30 % cost)**
- **Participate and aggressively grow in the domestic markets**

Global markets segmenting into resource rich regions,
(Middle East, Brazil, Canada), people rich regions (India and China)
and the Rest of the World (USA, Europe and Japan)

"We need an India specific strategy to sustain growth. You can not just import western solutions to India. You have to crack solutions which are right for India, right for the people, right for the country."

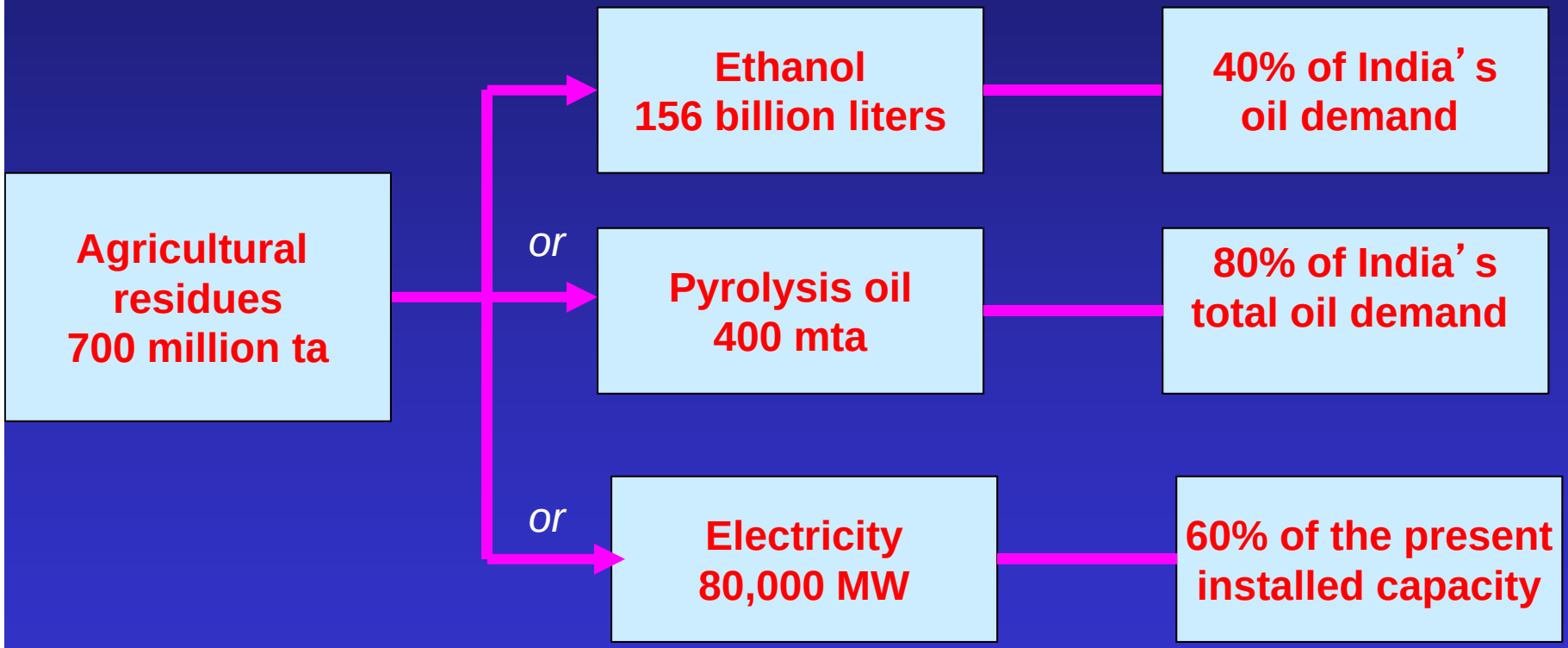
Indra Nooyi
WEF, New Delhi
10 November 2009

For India It is no longer a debate about making life style changes; it is about finding life changing solutions

Business is not about a few people making millions; it is a billion people just making it


1950 - 2010
Celebrating Sixty
Years of Science
THANK YOU

AGRICULTURAL RESIDUES : INDIAN PERSPECTIVE



BIOMASS POWER

- **Potential: 650 districts with 10 mw biomass power plant each**
- **Currently 650 mw biomass power**
- **Viable and sustainable solution**
- **10 mw power plant needs an investment of 50-60 crore ($ I million) and can provide employment to 2000 families in cultivation of energy crops, collecting, transportation and preparation**
- **Rice husk based bio-energy in West Champaran, Bihar, established in August 2007. 60 mini plants now functional powering 25,000 households in different parts of India**

- ***PRINCIPAL DILEMMAS***

"Either – or" to "both – and"

Low cost – high quality
High economic growth with low environmental impact
More growth with more inclusion
Flexibility to industry and fairness to workers
Include the non- included without excessive government subsidies
Inclusive and sustainable