



“Bio-Crude to Flexi Bio-Refinery”

RIL Bio-fuels Business Strategy & Execution Plan

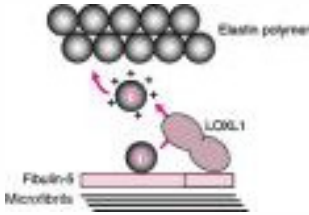
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On Behalf of Dr Srinivas Kilambi (President & CEO, Bio Refinery)

CREATING RIL's NEW ENERGY BUSINESS PLATFORMS



Cellulose



Enzyme / Catalyst



Ethanol



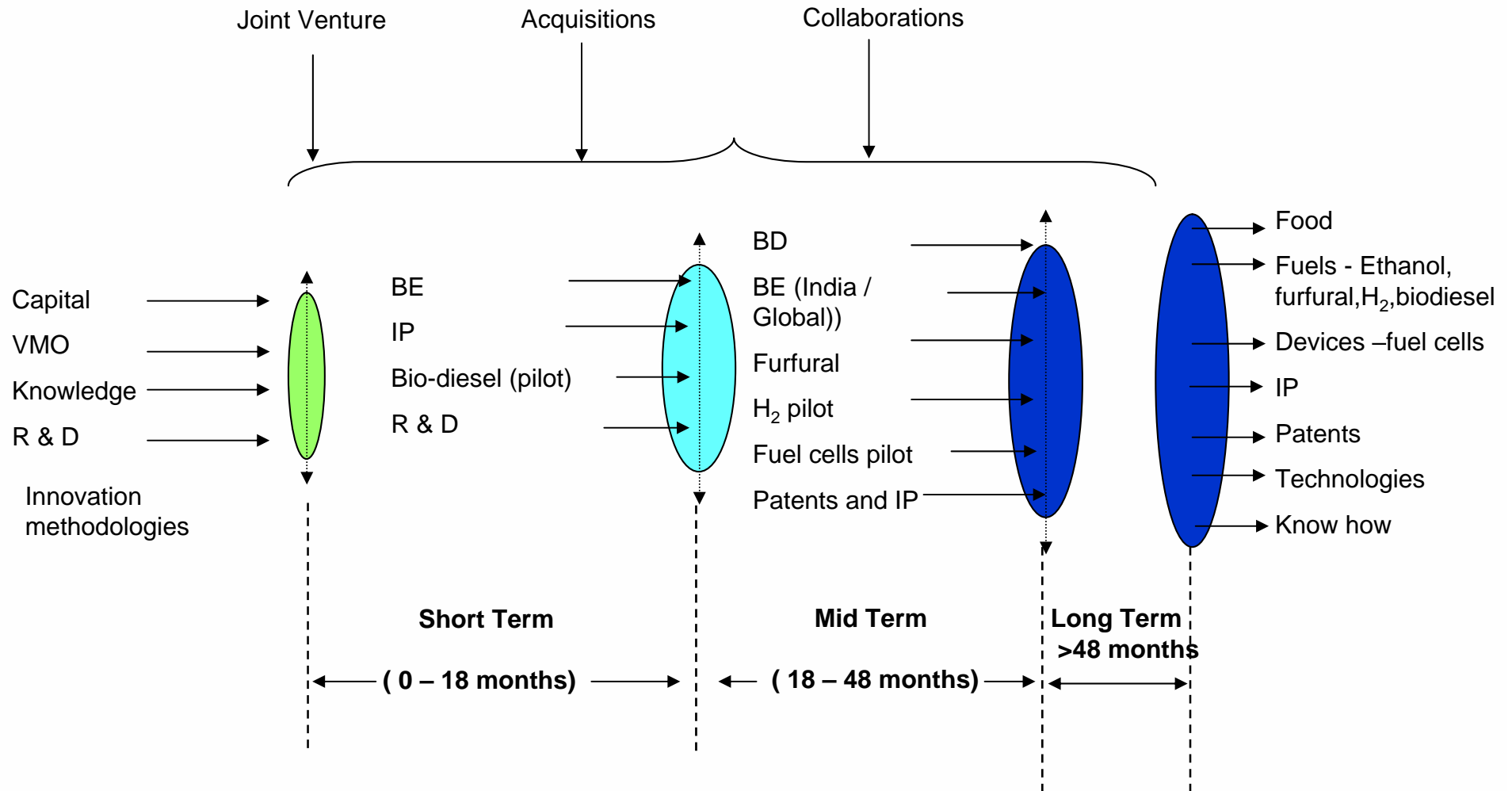
Vision Mission Objectives (VMO)

Vision, Mission, Objectives (VMO)

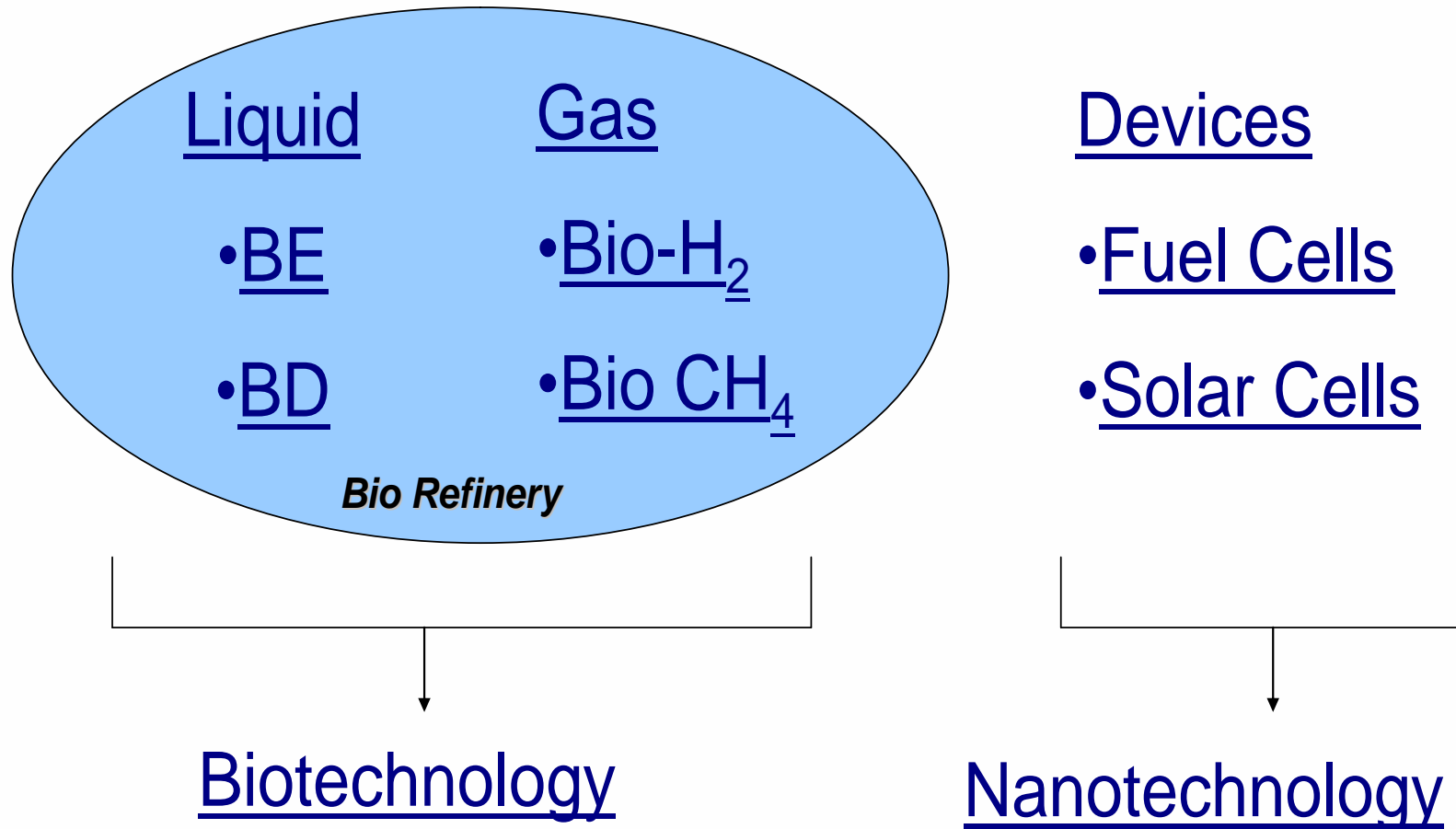


- **Conceive, initiate and lead the global convergence of Agricultural and Energy sectors**
- **Leverage the synergies between the two to create a global \$ 1+ Billion business by 2012 AD and an IPO by 2008-9.**
- **Usher India's 2nd Green (Food) revolution and Black (Energy) revolution in parallel.**
- **To produce the cheapest, fastest and best biomass based energy platforms starting with bio-ethanol.**
- **Global leadership in IP, in-house developed technologies & patents.**

RIL'S VMO REALIZATION STRATEGY



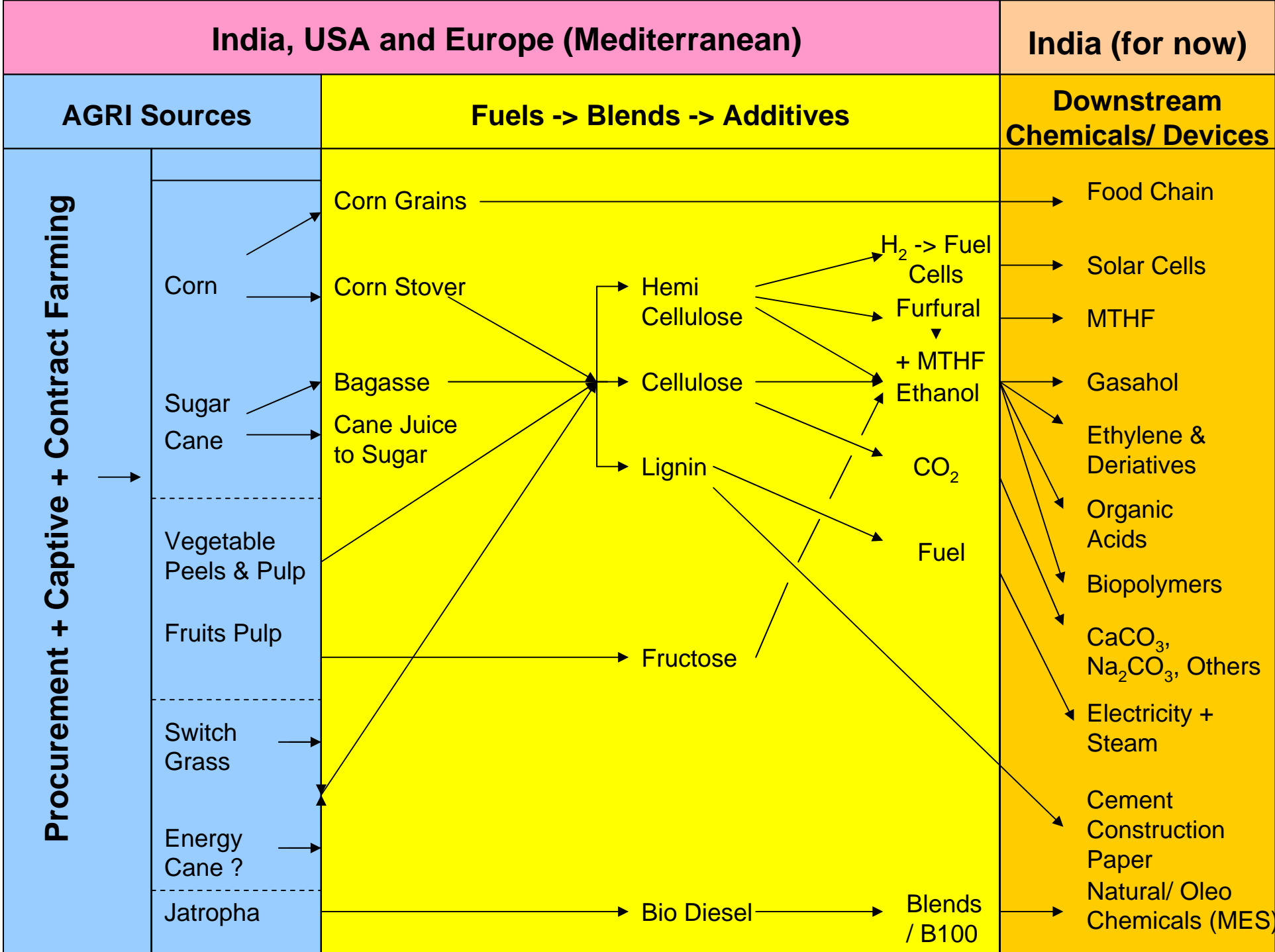
New Energy Business Platforms



What is a Bio-Refinery ?



- In direct analogy to a petrochemical refinery, a bio-refinery would:
 - Take a **variety of renewable** raw material inputs,
 - **Convert** these inputs into an initial group of **building blocks**,
 - And then, through various unit operations, convert these building blocks **into chemicals, fuels, and power**
- The bio-refinery model is extremely powerful because:
 - **Less fragmented** than a petrochemical refinery,
 - Properly focuses on the concept of **integrated unit operations**,
 - And a **much smaller number of platforms** from which a huge number of products can be derived.
- Bio-refinery offers **impressive energy and petrochemical supplementary** benefits.





Business Strategy

RIL-BR Business Strategy



\$ 1+ Billion Sales by 2011-12

India (Solo)

Blending (10 % in Fuel)	Industrial Chemicals
0.8 MTA	0.5 MTA
Total (@50% market share) = 0.65 MTA	
Additional 50% Market share of Potable Ethanol, Total = 0.95 MTA	

Global (Partner/JV)

US	BRAZIL	EU
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***To achieve \$ 1+ Billion Business Objective,
RIL BR would target Ethanol, bio-chemicals markets globally***

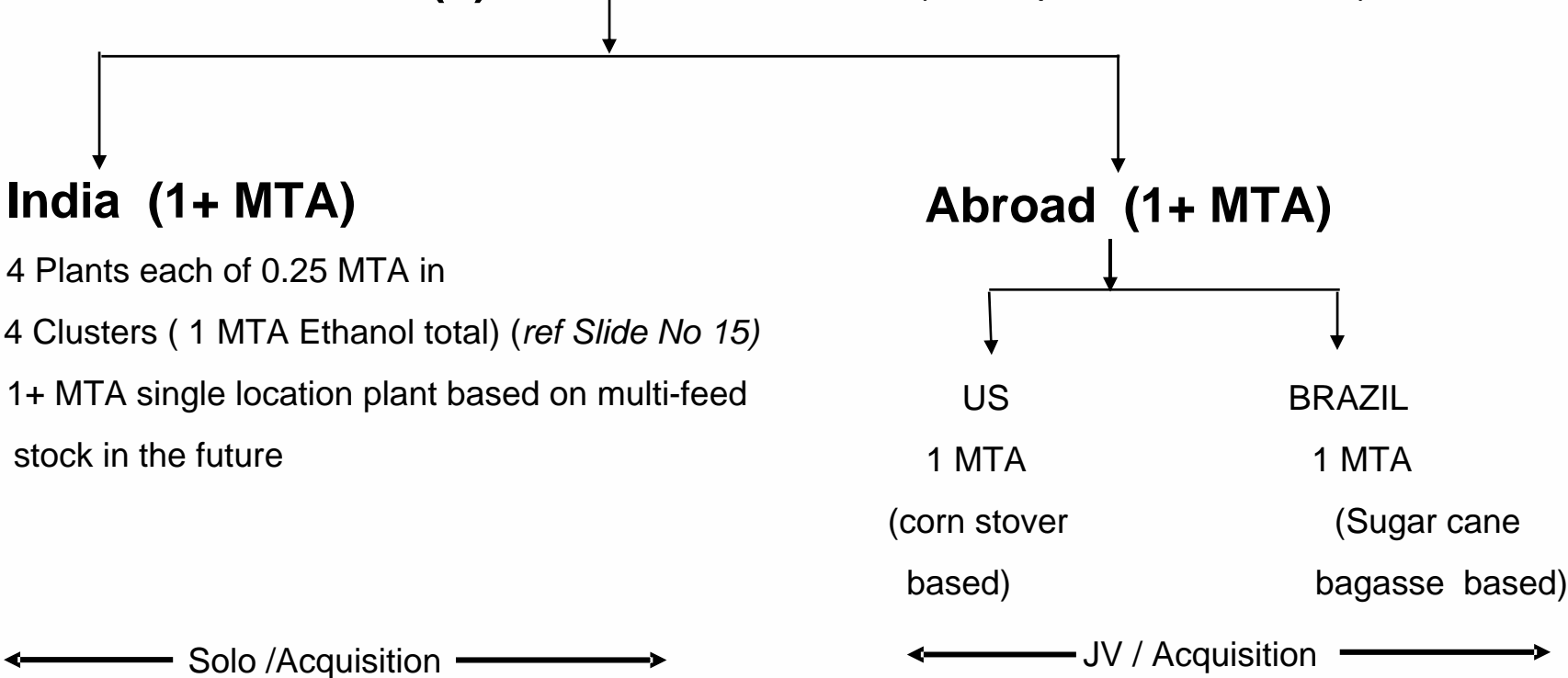


Manufacturing Strategy

Manufacturing Strategy



2(+) MTA Bioethanol *(corresponds to \$1 Billion)*



Bioethanol Cost -India -Scale-up Metrics



Parameter	Unit	Pilot Plant (425 TPA)	Semi commercial Plant (34,000 TPA)	Commercial Plant (2,50,000 TPA)
Capex (Budgetary estimates)	Mn Rs	100	1500	6250
Area	Acre	5	100	500
Capex per '000 TPA	Mn Rs	235	45	25
Area per '000 TPA	Acre	12	2.94	2.0
Capex charges <small>(distributed over 10 years)</small>	Rs/Kg	23.5	4.5	2.5

Feasible to target a Bioethanol price of 10 Rs/L with scale-up.



Raw Material Strategy

Total Biomass in India



RIL – BR is targeting only the Non-Food biomass as feedstock

Sources of biomass		Production* (Million tonne)	Corresponding Biomass(million tonne)
Food Grains (assuming biomass : grain ratio as 1:1) Least ratio assumed (Actual ratio > 1)	Rice	88	88
	Wheat	73	73
	Corn	15	15
	Sorghum	7.5	7.5
	Bajra	6.5	6.5
Bagasse(Dry basis)**			26.7
Banana Stem (Dry basis)			18.7
Cake + MSW			40
		Total	275.4

*Agriculture Statistics Division 04-05, **www.indiancommunity.com

Biomass required for 2 MTPA BE is 8-10 million tonnes which is only 3.6 % of the total biomass present in India

Raw Material Strategy – “Bio-Crude” Basket



- **“Bio-Crude” Basket – Multi feed-stock containing a mix of**
 - **Grain Biomass (Corn, Wheat, Rice straw/stover)**
 - **Bagasse (Cane, Sorghum, Switch grass)**
 - **Forest Residue (Saw dust, wood chips)**
 - **Fibrous Bio-Mass (Banana Stem, Vegetable / Fruit Stems)**
 - **De-Oiled Seed Cakes (Jatropha, peanut, corn etc)**
 - **Municipal Solid Waste (MSW)**

Produce Biomass through Organized Scientific Farming of Food + Energy Crops

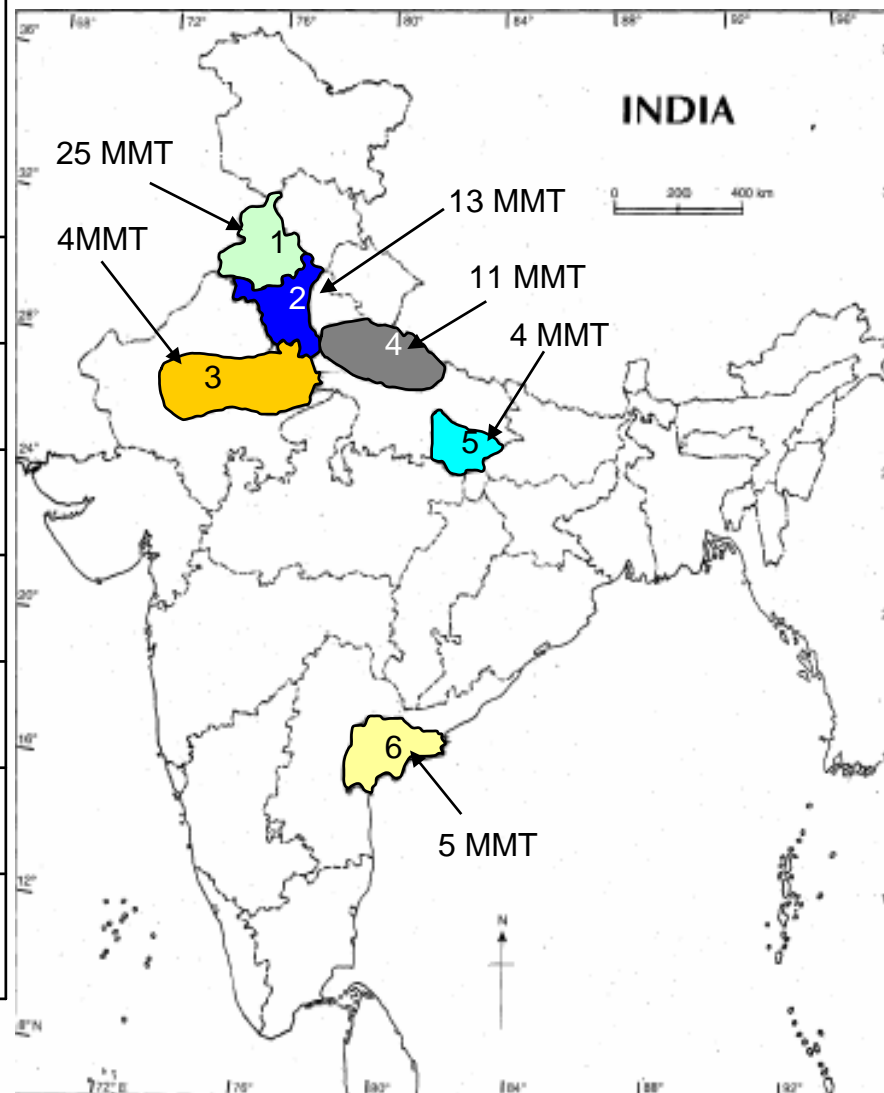
(Food Crops in Arable lands & Energy crops in Arid lands)

[HUMAN FUEL > AUTO FUEL](#)

Top grain producing Clusters in India and ethanol manufacturing potential



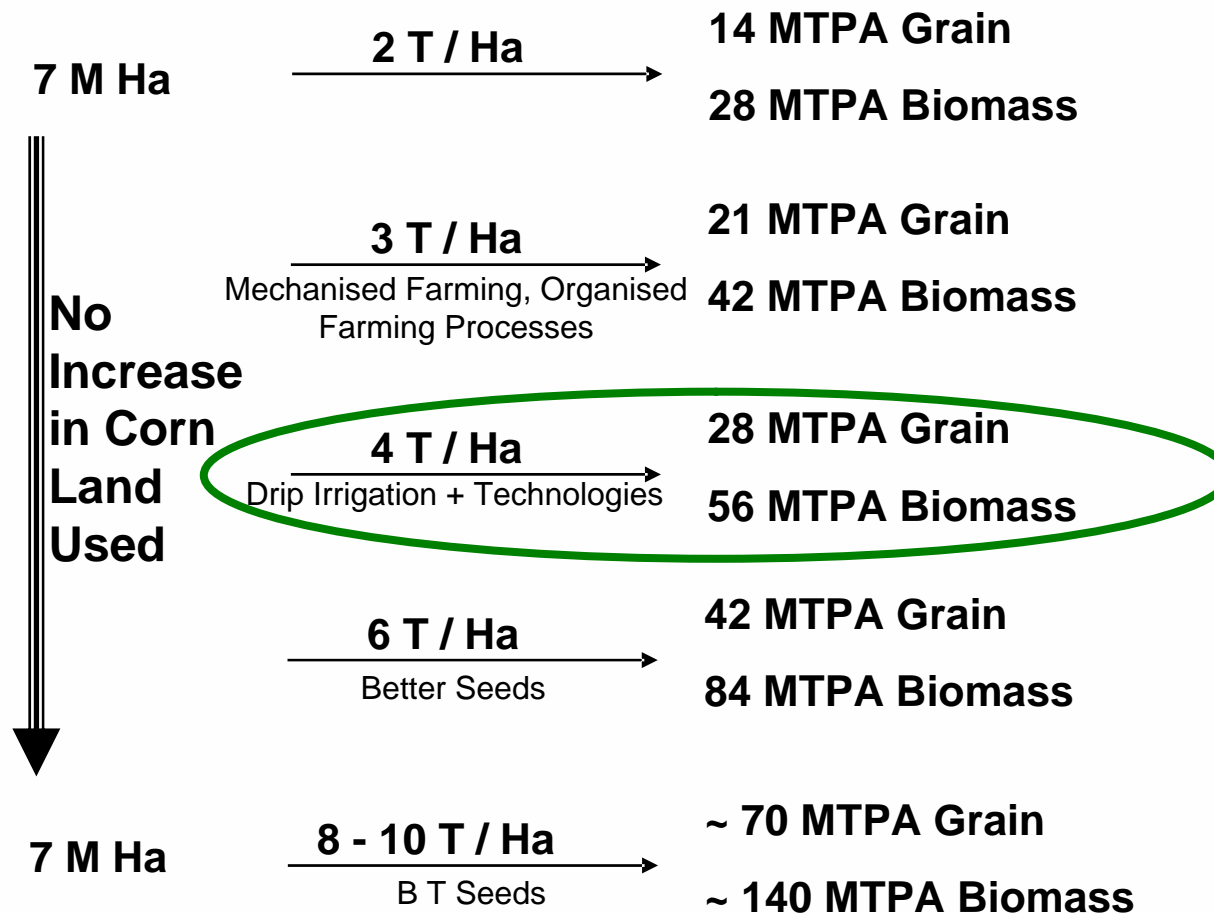
Cluster	State	Grain prodn. , MTA	Biomass prodn. MTA	10 % Biomass Availability For conversion	Potential ethanol prodn. MTA
1	Punjab	25	37.5	3.75	0.94
2	Haryana	13	19.5	1.95	0.49
3	Rajasthan	3.98	5.97	0.6	0.15
4	UP North	10.68	16.0	1.6	0.4
5	UP South	3.61	5.41	0.54	0.14
6	AP East	5.1	7.65	0.77	0.19
Total		61.37	92.06	9.21	2.30



Grain yield can be improved by high yielding variety e.g. Corn : 30 V 92 ..



Increase Production in the Same Farm



Farming Strategies

- Share Tractor
- Harvesting
- Buy
- No middle men
- Trouble Shooting
- Bulk Purchase
- Drip Irrigation
- Tech Farming
- Better Seeds

Raw Material Selection Strategy



Raw Material Selection Criterion (Dry Basis)

- **Cellulose + Hemi-cellulose \geq 60% (3 – 4 Kg RM / Kg Ethanol)**
 - *This will keep the equipment sizing at minimum, thus reducing the capital cost*
 - 30-40% bioethanol cost is attributed to raw material.
- **CIF Cost \leq Rs 1/Kg**
 - *Target would be to get total basket cost within this value, and if possible all the different raw materials*
 - *This will help ensure the total contribution of the raw material in final product is \leq Rs 4 / kg Ethanol*
- **Long term supply**
 - *RM Basket would eliminate the seasonality factor for procurement and also reduce dependence on a particular area / crop*
- **No Fermentation Inhibitors**
 - *Any fermentation inhibitors / toxins if present in any of the raw materials would deactivate the manufacturing process.*



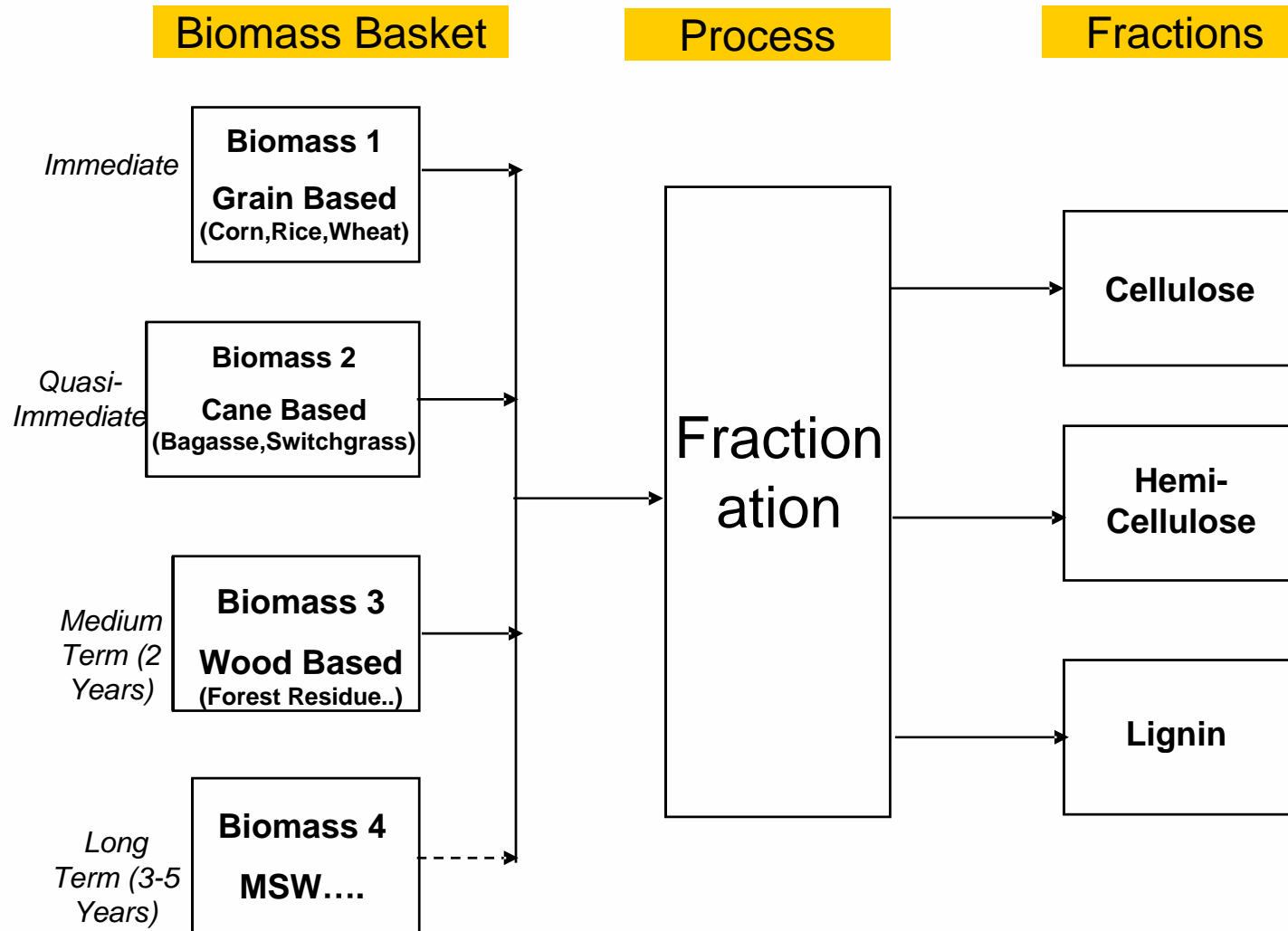
Technology Strategy

Technology & Process Know-how

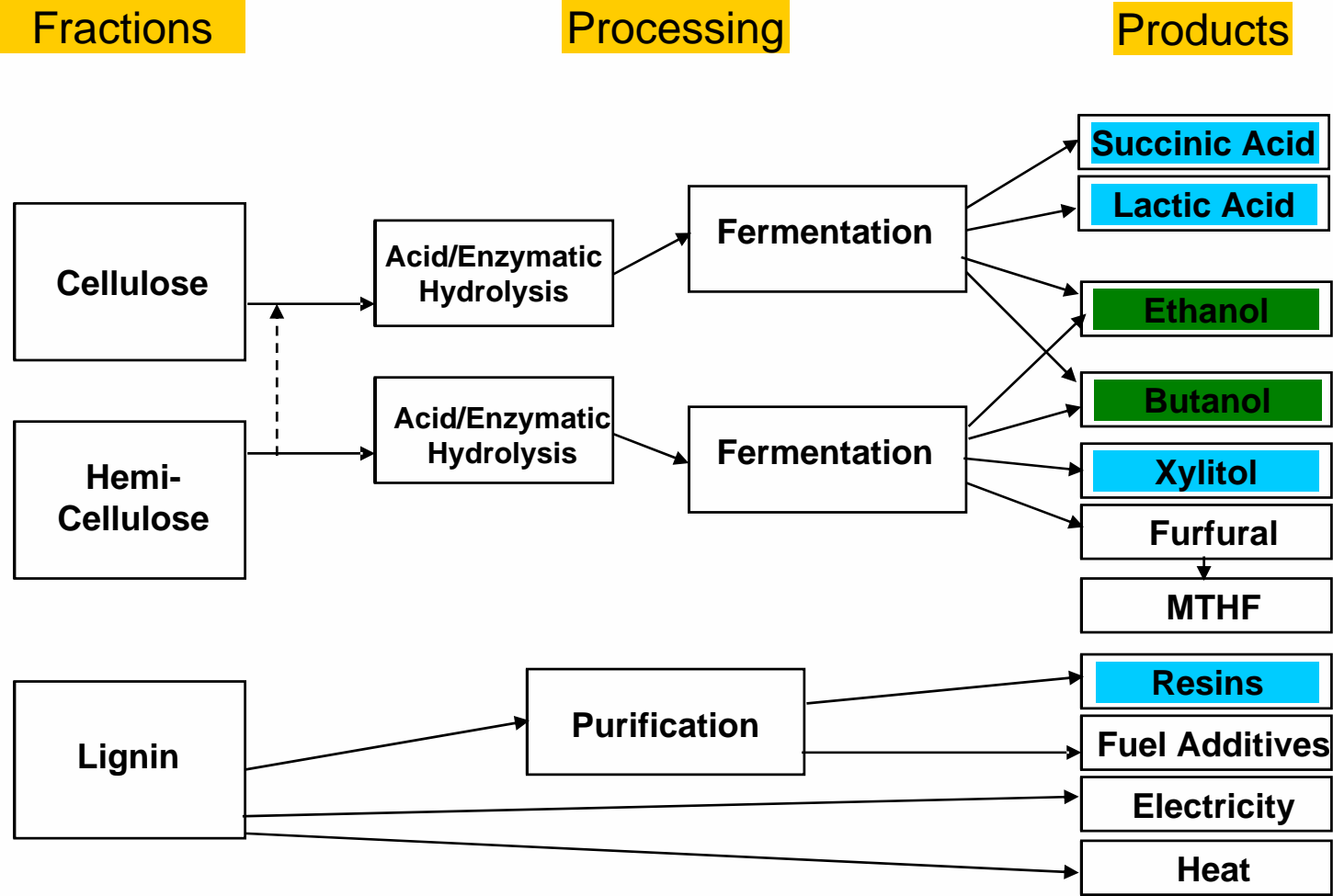


- **Fractionate Bio-Crude Basket into 3 pure fractions**
 - **Cellulose**
 - **Hemi-cellulose**
 - **Lignin**
- **Hydrolyse the fractions into fermentable sugars by Acid, Enzyme or Acid + Enzyme**
 - **Cellulose to Glucose**
 - **Hemi-cellulose to Xylose**
 - **Lignin as Inert**
- **Ferment / Co-ferment Glucose + Xylose to Ethanol / Butanol**
- **Membrane Technology (RO) and Pervaporation for drying**

Technology Pathways



Technology Pathways cont d...



Technology Highlights



Fractionization (Fundamental , 1st Principle approach) has the following benefits

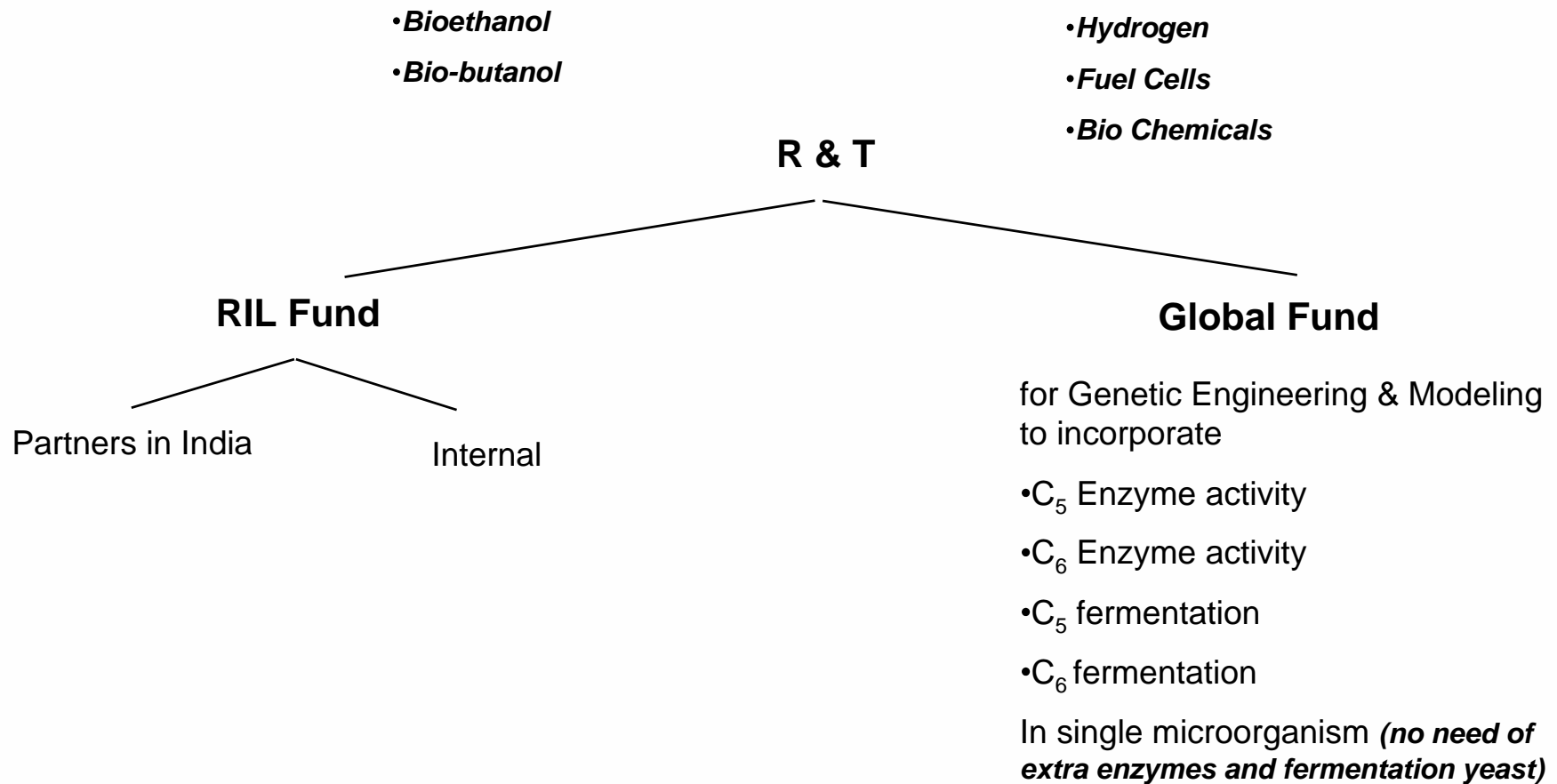
- 1. Takes the feedstock out of the equation by allowing flexibility through Multi-feedstock handling**
- 2. Pure Fraction such as lignin has higher value & can be sold at \$ 700/ton leading to 90% offset in ethanol costs**
- 3. Pure fraction reduces mass loading resulting in Smaller foot print & LOWER CAPITAL COSTS**
- 4. Pure cellulose can now be hydrolyzed by acid in lieu of enzymes with the following benefits**
 - a. 2 hr reaction time vs. 168 hr. (very low Capital Cost and Operating Cost)**
 - b. No inhibition , degradation products as pure Cellulose is used**
 - c. Eliminates the need for Biomass specified enzyme development**
- 5. Membrane technology offers largest surface area /volume (Lowest Capital Cost and Operating Cost)**

Research & Technology Plan (2-5 years)

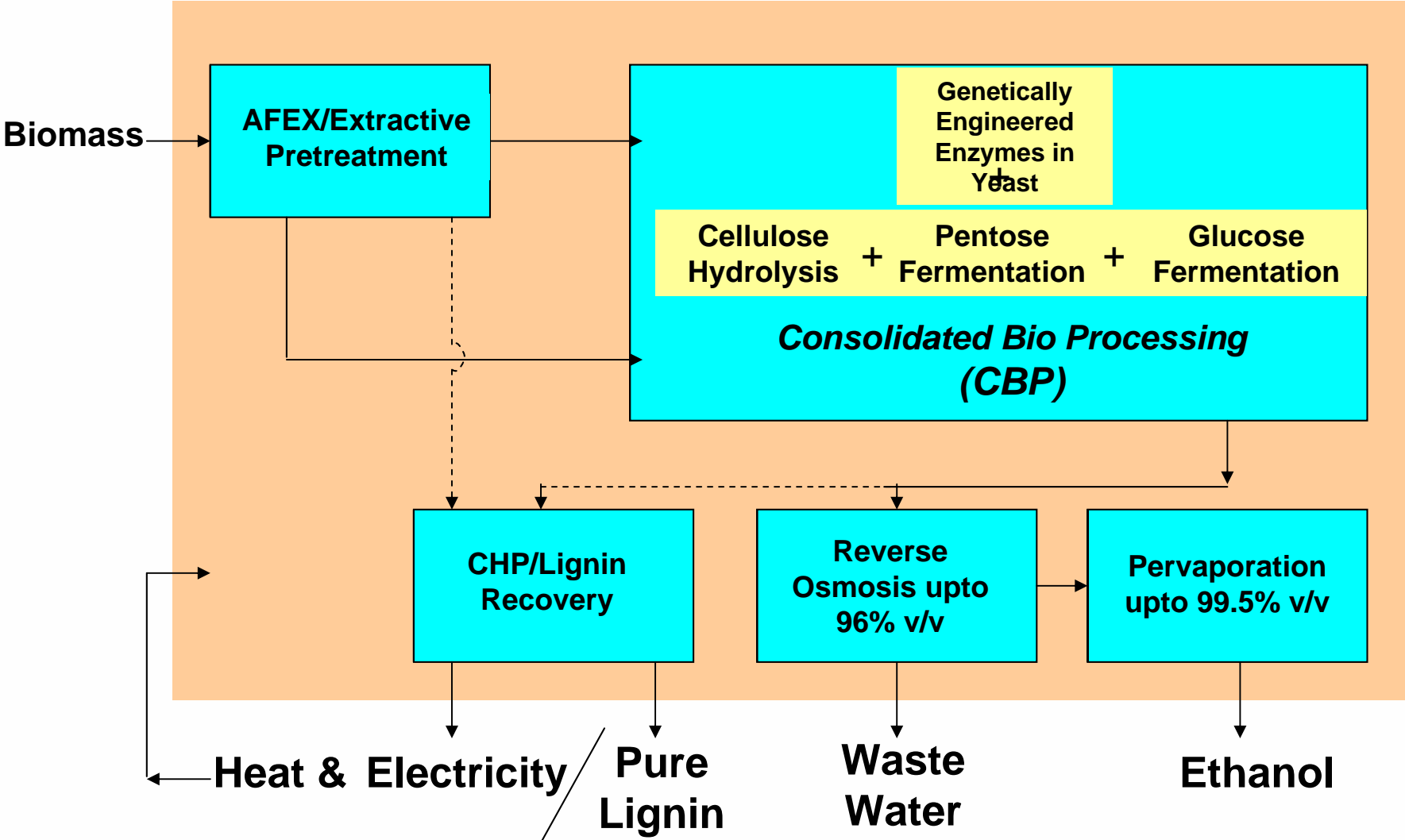


Conceive, Develop & Commercialize Futuristic Technologies

Targeted Areas/Technologies/Products



R & T Focus





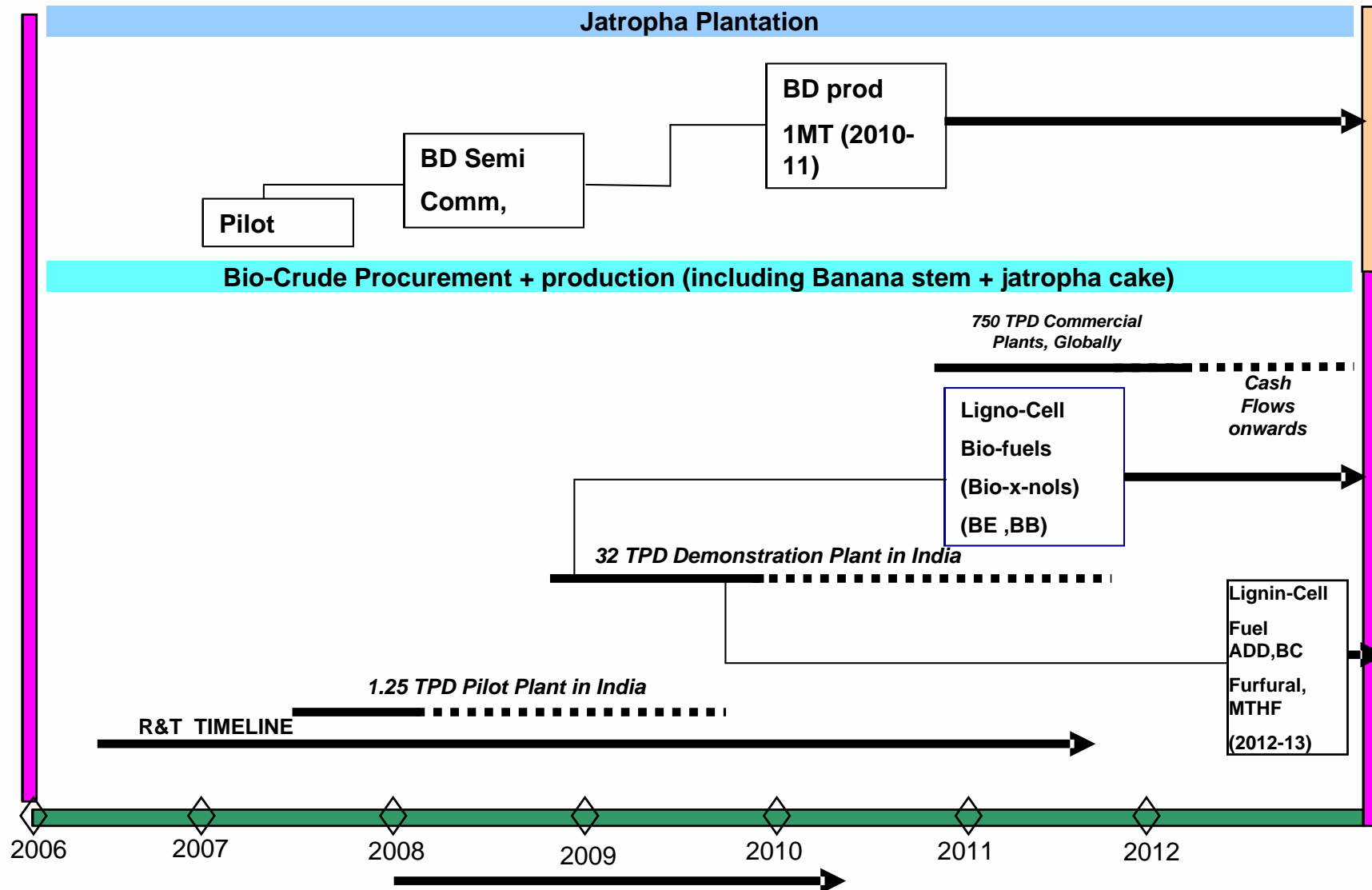
Implementation Plan

Implementation Plan

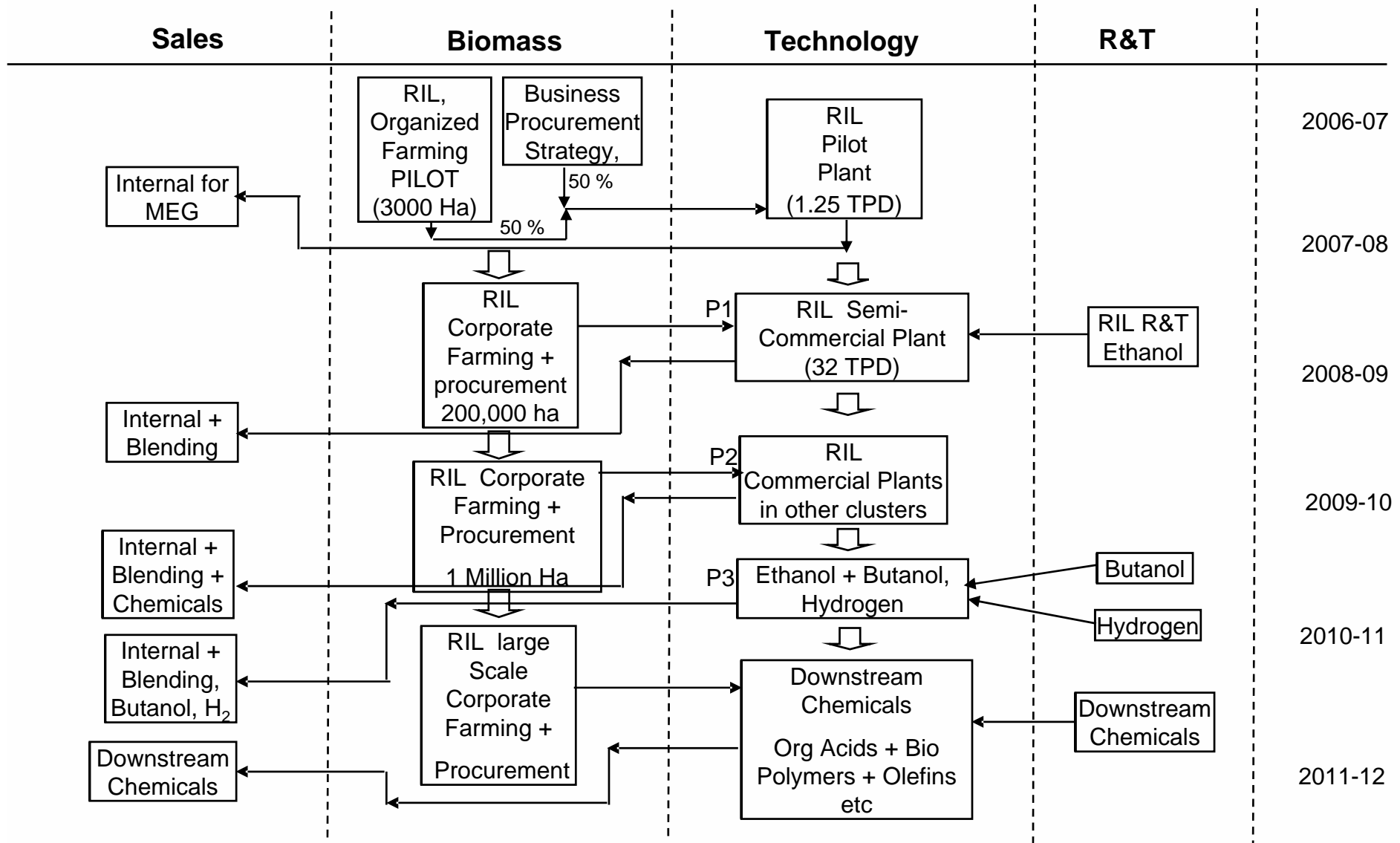


Ethanol produced (tons per day)	Biomass required (tons per day)	Production unit type	Engg commissioning and erecting period (months)	Start Date
1.25	5	Biomass Pilot	9	Oct 31 ,2007
32	125	Semi Commercial	27	Jan1 ,2009
750	3000	Commercial	45	July 1 ,2010

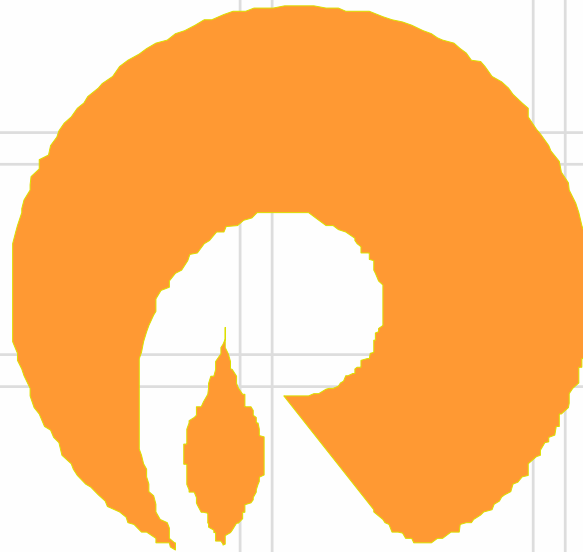
Implementation - Roadmap



RIL-BR Overall Business Strategy (> \$ 1 Billion = Rs 5000 cr. Business)



THANKS



Growth is life ...