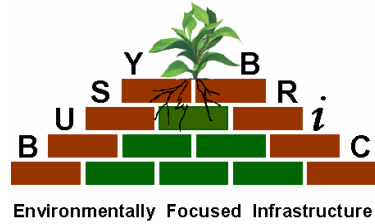


# Presentation On Clean Energy Project Design Concepts

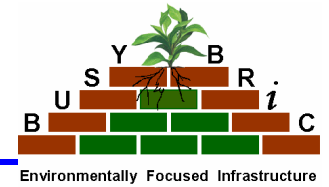
## The Technology Velocity Concept



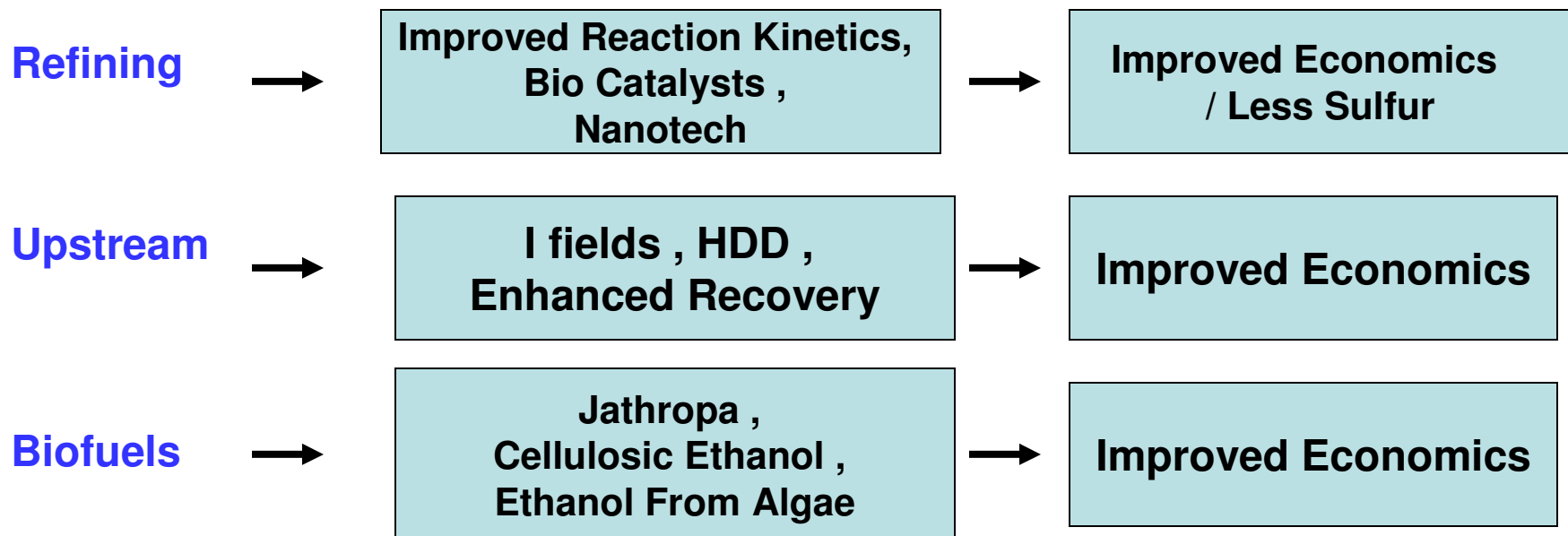
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# Current thinking within the Industry and where it will lead



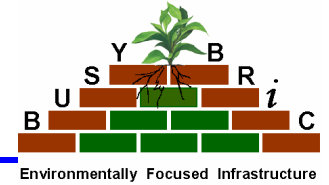
Business As Usual ( The right thing to do in each Business Segment ) :



The Industry is making the mistake in thinking that innovation within legacy concepts, technologies and existing assets will lead to an evolution of the Energy Industry.

A company could excel in all the above areas and still be forced to exit the business 10 years from now because these paths do not meet the fundamental market need of carbon abatement

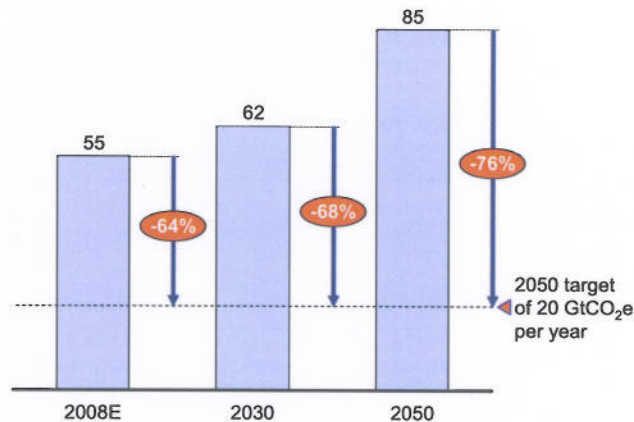
# Energy Technology Velocity ( Speed & Direction ) Drivers ...



1. Energy Technology Velocity will be influenced by the Carbon Abatement run rate required.

**SCIENCE SUGGESTS WE NEED TO REDUCE EMISSIONS BY APPROXIMATELY 76 PERCENT BY 2050 TO STABILIZE THE CLIMATE**

Global "business as usual" GHG emissions, GtCO<sub>2</sub>e\*



\* Gigatons of carbon equivalents.

Source: McKinsey analysis; IPCC; Stern Review (2006)

- 3 *Summary for Policy Makers*, 4th Assessment Report IPCC Working Group III, April 30–May 2007.
- 4 Nicholas Stern, *The Economics of Climate Change – The Stern Review*, 2006, and *Key Elements of a Global Deal on Climate Change*, 2008.

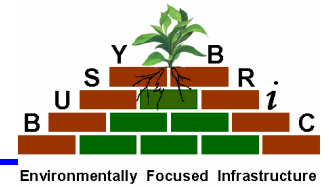
**Fundamental  
Market  
Need**

Graphic Source  
McKinsey & Company

McKinsey&Company

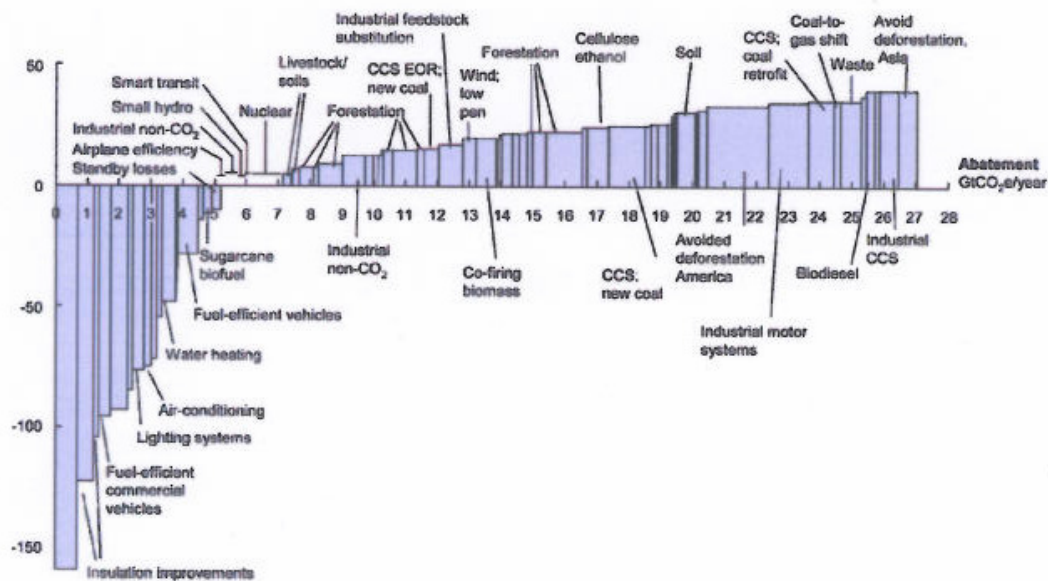
**An Energy Company's chances of survival will depend on how responsive it is to basic market needs and expected regulations on carbon abatement**

# Energy Technology Velocity ( Speed & Direction ) Drivers ...



The Energy Technology business plan is likely to have the following one page Agenda

**THE COST CURVE PROVIDES A "MAP" OF ABATEMENT OPPORTUNITIES**  
Cost of abatement, 2030, €/tCO<sub>2</sub>e\*

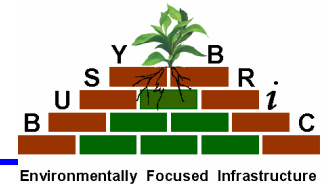


Graphic Source  
Mckinsey & Company

\* Tons of carbon equivalents.  
Source: McKinsey and Vattenfall analysis

Industry leadership and the Money will lie in Implementation of the Technologies  
The emphasis therefore needs to be on acquisition on niche players who own these future technologies.

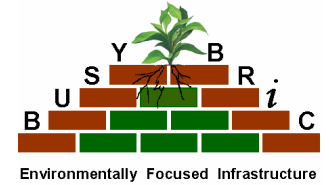
# Energy Technology Velocity ... Core Concepts



1. Energy Technology evolution is not the same thing as :
  - Refinery Technology improvements
  - Upstream Technology Improvements
  - Biotechnology innovations within energy
2. Energy Technology innovation will follow a very different Trajectory driven in the main by the impreative to increase carbon productivity from \$ **740** GDP / ton of CO<sub>2</sub> ( current level ) to \$ **7300** GDP / ton of CO<sub>2</sub> by 2050 ( MGI report June 2008 ) .
3. Market Imperatives : Move towards carbon abatement is no longer for informed dinner conversations. This movement has extremely strong regulatory backing. Regulation will be written to enforce limits.
3. The rate of technological change in the \$ 5 Trillion Energy Business is likely to mimic the rate of change in the semiconductor industry over the last 25 years.

**There is a need to move in the direction of the Clean Energy Juggernaut.**

# Energy Technology ... A Rapidly Evolving Landscape



Most people think of Intel as a Chip maker ...

But Intel recently put its Pentium Processor Design team to work on Solving the Electron Collection Mechanism in Quantum Dot Solar Cells.

This will make it possible to take solar cell efficiencies to 45 % Plus

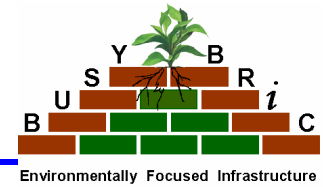
Since price discovery in commodities takes place at the margin, a newcomer ( Like Intel ) has to replace just that last million barrels of demand with an alternate energy offering ( He does not have to touch the remaining 79 Million barrels to destroy the economics of any new project that is coming online).

The financial implication of this move is that all new projects in the smokestack energy business must now be viable at US \$ 40 / Bbl WTI crude.

Intel's move into Solar Cells ( Spectrawatt ) ... represents the Convergence of VLSI Technology & Energy ... Intel is becoming an Energy Company and an oil company Like Exxon could now make a bid for Intel within 2 – 3 Years.

Please note that though Spectra watt recently announced the winding down of its Solar cell Manufacturing Plant project in Oregon ... this might be due to the current market conditions and may not represent a long term un-viability issue.

# Energy Technology Evolution ... Expected Forward Path

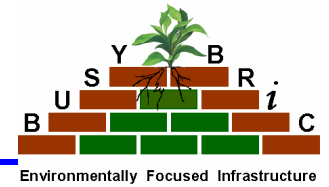


Unlike the conventional approach which takes a company to the wrong destination , Industry leadership will be achieved by following a totally different technology pathway :

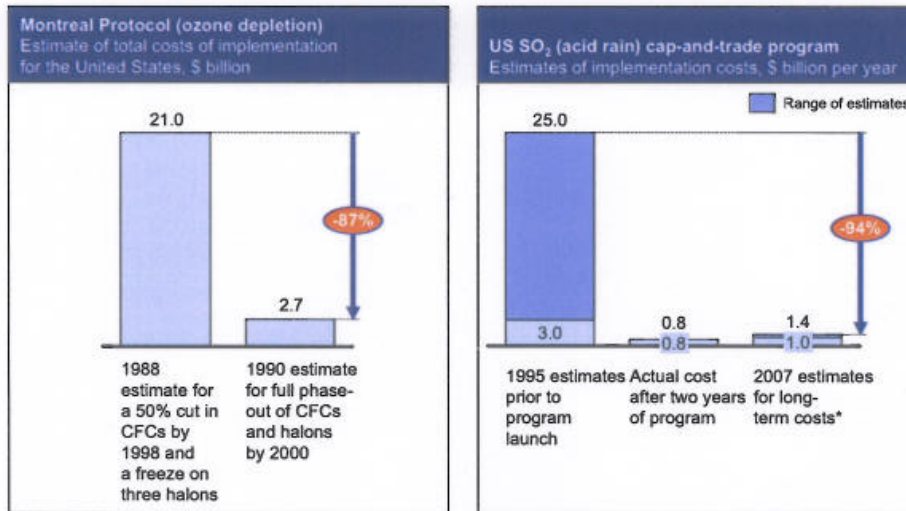
- Developing critical Insulation technologies – Cryogenic / High Temp
- Carbon Capture & Storage Technologies
  - Containment
  - Advanced Geological / Geophysical tools to identify containment sites
- Solar Energy breakthrough's – Nano Solar ( Intel's Entry )
- Wind Energy
- Fuel Cells ( Toyota 830 Km range car )
- High efficiency Reforming reaction
- High Temperature Nuclear Fission ( Heat for Reforming Reaction )

**Contrary to popular belief , the development of these technologies will actually be net – net positive to the GDP ( Mckinsey Global Institute study )**

# Technology Evolution ... Track record on costs



## THE MONTREAL PROTOCOL AND THE US SO<sub>2</sub> CAP-AND-TRADE SCHEME REDUCED EMISSIONS AT LOWER-THAN-EXPECTED COST



\* Long-term costs are higher than short-term costs because in Phase I (1995-99) the program covered only the most SO<sub>2</sub> emission-intensive power-generating units, whereas in Phase II (2000 and continuing) the program was broadened to cover almost all units.

Source: S. Barrett, *Environment and Statecraft: The Strategy of Environmental Treaty-Making*, 2003; Environmental Defense; D. Burtraw et al, *Economics of Pollution Trading for SO<sub>2</sub> and NO<sub>x</sub>*, 2005

Actual costs of Carbon Abatement will be very different .

A Key driver will be Relentless innovation.

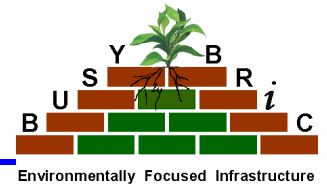
Innovation experience might be similar to the semiconductor / VLSI market over the last 25 years

Graphic Source  
Mckinsey & Company

Contrary to popular belief , the development of these technologies will be achieved at a fraction of today's expected costs



# Fundamental Issue Facing an Energy Project Designer In India

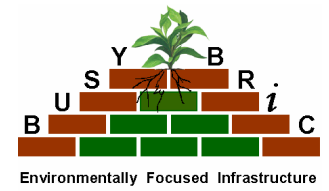


## 1. How do we migrate India from a **400** Million Middle Class to a **600** Million Middle Class ... Without Ruining the Environment ?

- 200 Million New Middle class means ... 50 million Nano's on our roads ( assuming 4 per family ) ... we will run out of clean air ... before we run out of Gasoline

2. Leadership cannot be expected from the west ... as they ( US & EU ) have \$ 5 Trillion Invested in the current oil Industry ... India with much lower investments in Conventional energy has much lower switching costs.

**There is a need to leapfrog Technologies ... and to think on a truly massive scale ... to design pathbreaking ... yet **low cost** projects ...**



**THANK YOU**

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