Analyse the Marginal Abatement Cost Curve of key emitting sectors to assess the potential for Low-Cost Abatement Opportunities

Jyoti Gujral, Sourabh Anand, R.V Anuradha & Sumiti Yadav

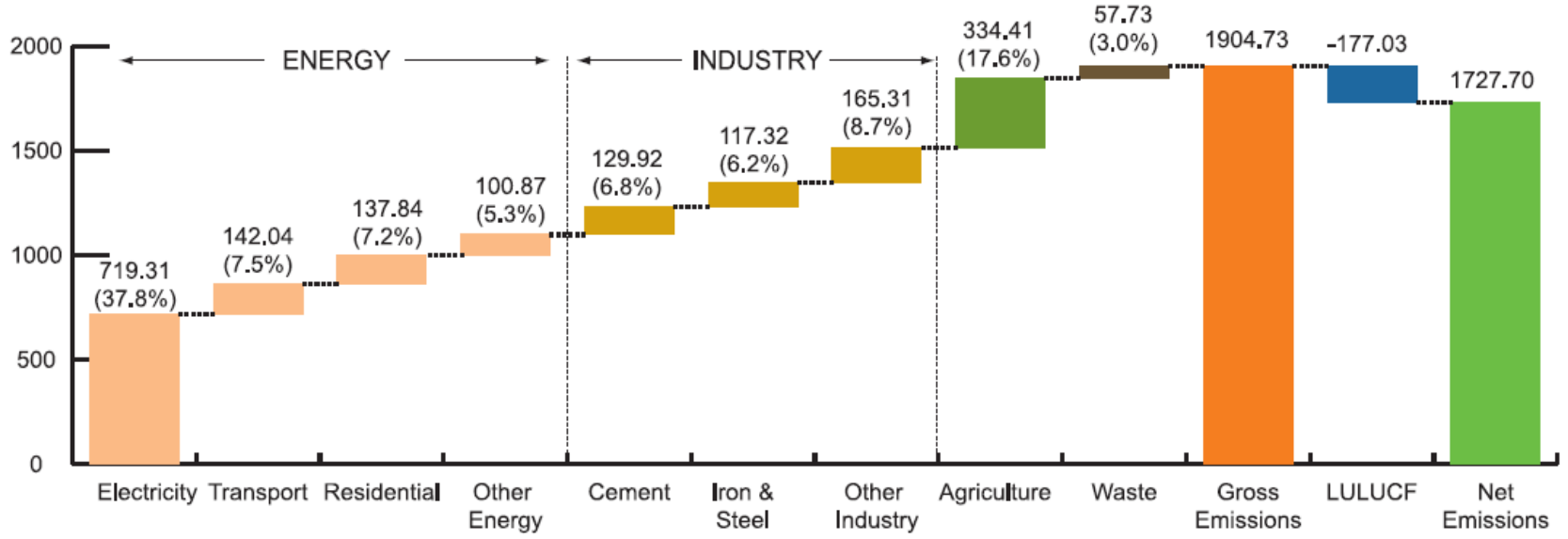
13th March 2014

Agenda

- India's GHG Profile and growing demand for energy
- India's mitigation strategy including for energy sector
- What would be the possible demand for offsets?
- What are the potential agriculture offsets (agriculture and forestry) that can serve the mitigation strategy of other sectors?
- Could large point emitters (for example thermal power plants, iron and steel and cement industries) use agri-offsets to help meet their emission reduction targets?
- How can they source agri offsets: Direct contracting or through Market Based Instruments (MBIs) ? How much will they pay?
- Could the government pay for such offsets as payment for environmental services (PES)? Are there any funds that can be leveraged for PES?

India's energy sector emitted 58% and Industry sector emitted 22% of total of total GHG emissions in 2007

GHG emissions from all sectors in 2007 (million tonnes of CO2 equivalent)



Note:

Other Energy: includes GHG emissions from petroleum refining, manufacturing of solid fuel, commercial & institutional sector, agriculture & fisheries and fugitive emissions from mining, transport and storage of coal, oil and natural gas.

Other Industry: includes GHG emissions from production of glass and ceramics, soda ash, ammonia, nitric acid, carbides, titanium dioxide, methanol, ethylene oxide, acrylonitrile, carbon black, caprolactam, ferro alloys, aluminium, lead, zinc, copper, pulp and paper, food processing, textile, leather, mining and quarrying, non specific industries and use of lubricants and paraffin wax.

Agriculture: includes GHG emissions from livestock, rice cultivation, agricultural soils and burning of crop residue.

Waste: includes GHG emissions from municipal solid waste (MSW), industrial and domestic waste water.

LULUCF: includes GHG emissions and removals from changes in forest land, crop land, grass land, wet land, settlements and combustion of fuel wood in forests.

- Without LULUCF, gross emissions was 1904.7 million tonnes in 2007
- Without LULUCF and agriculture, gross emissions was 1570.34 million tonnes in 2007
- Per capita CO2 equivalent emission was 1.5 tons/capita in 2007

Source: India GHG emissions 2007, INCCA

Break up of total emissions by different GHG types

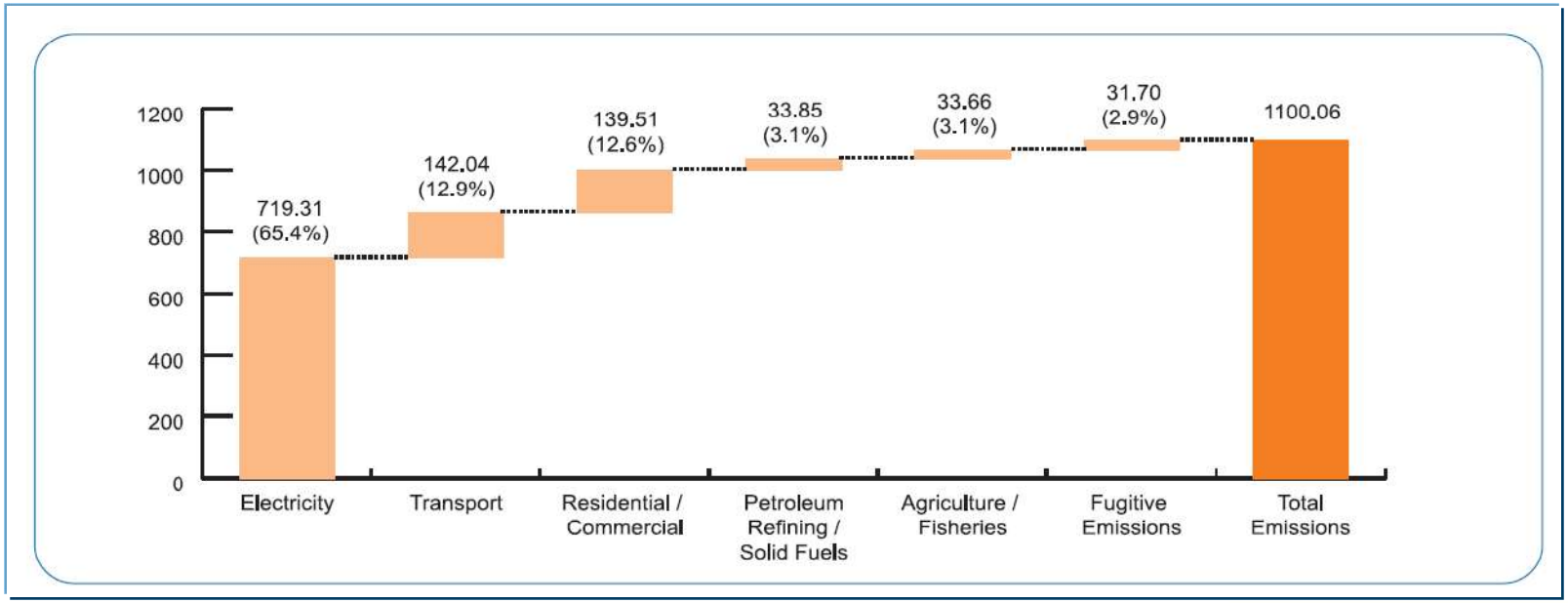
GHG Emissions by Sector (2007)

Sector	CO_2 (million tons)	CH_4 (million tons)	N_2O (million tons)	CO_2 -eq (million tons)
Electricity	715.83	0.08	0.011	719.31
Transport	138.86	0.23	0.009	142.04
Other energy activities	138.15	4.23	0.038	238.71
Cement	129.92	—	—	129.92
Iron and steel	116.96	0.009	0.001	117.32
Other manufacturing industries	158.98	0.14	0.019	165.31
Agriculture	—	13.78	0.146	334.41
Waste	—	2.52	0.015	57.73
TOTAL	1398.70	20.56	0.24	1904.75

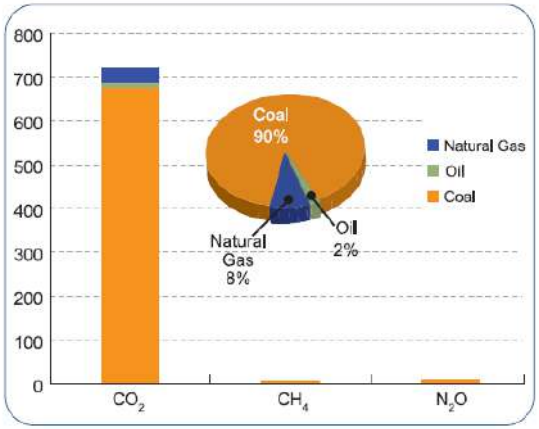
Source: India GHG emissions 2007, INCCA

Electricity generation accounts for 65.4% of the total GHG emissions from energy sector

GHG emissions from energy sector in 2007 (million tonnes of CO2 equivalent)



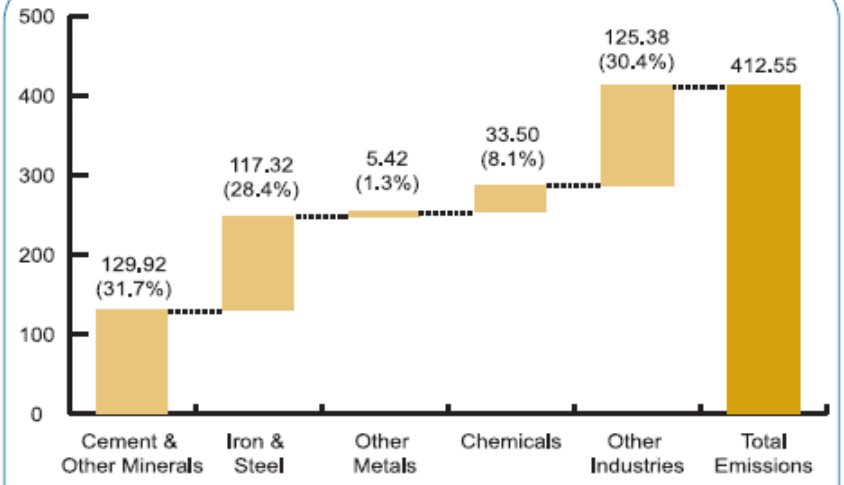
- Electricity generation includes both grid and captive
- Coal constituted about 90% of the total fuel mix used



Source: India GHG emissions 2007, INCCA

Of the total industry emissions, Cement and Iron & Steel contributed 60%

GHG emissions from industrial sectors in 2007 (million tonnes of CO2 equivalent)



Note:

Other Metals: includes GHG emissions from production of ferroalloys, aluminium, lead, zinc and copper.

Chemicals: includes GHG emissions from production of ammonia, nitric acid, adipic acid, caprolactam, carbide, titanium dioxide, petrochemicals and black carbon, methanol, ethylene, ethylene oxide, acrylonitrile, ethylene diochloride and vinyl chloride, monomer and other chemicals (see glossary for details).

Other Industries: includes GHG emissions from pulp and paper, food processing, textile and leather, mining and quarrying and non specific industries. It also includes emissions from non-energy product use.

Source: India GHG emissions 2007, INCCA

Emission intensity considered (Cement)

- 0.537 t CO2/t clinker produced

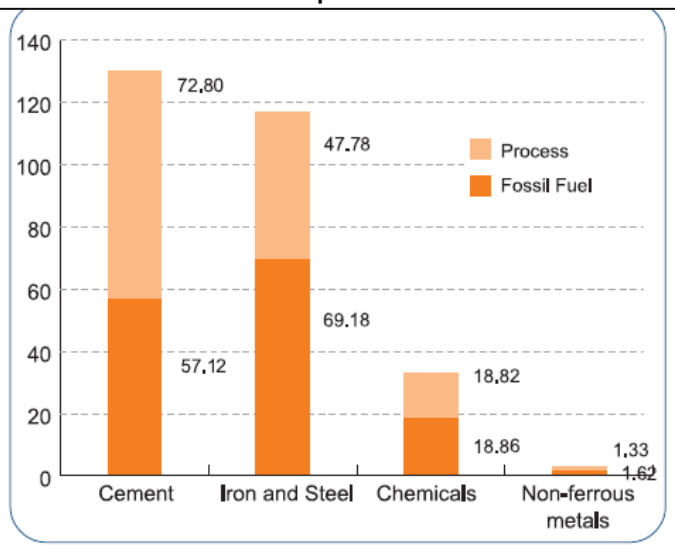
Emission intensity considered (Iron & Steel)

- 1.46 ton CO2/ton production (BOF)
- 0.08 ton CO2/ton production (EAF)
- 0.7 ton CO2/ton production (DRI)

Emission mix

- 56% of cement sector emissions were from process and 44% from fossil fuel combustion
- Fossil fuel combustion and process related emissions constitute 59% and 41% in Iron & Steel

Relative CO2 emissions due to fossil fuel combustion and process emission



Emissions data for selected countries

2008 Emissions Data for Selected Countries

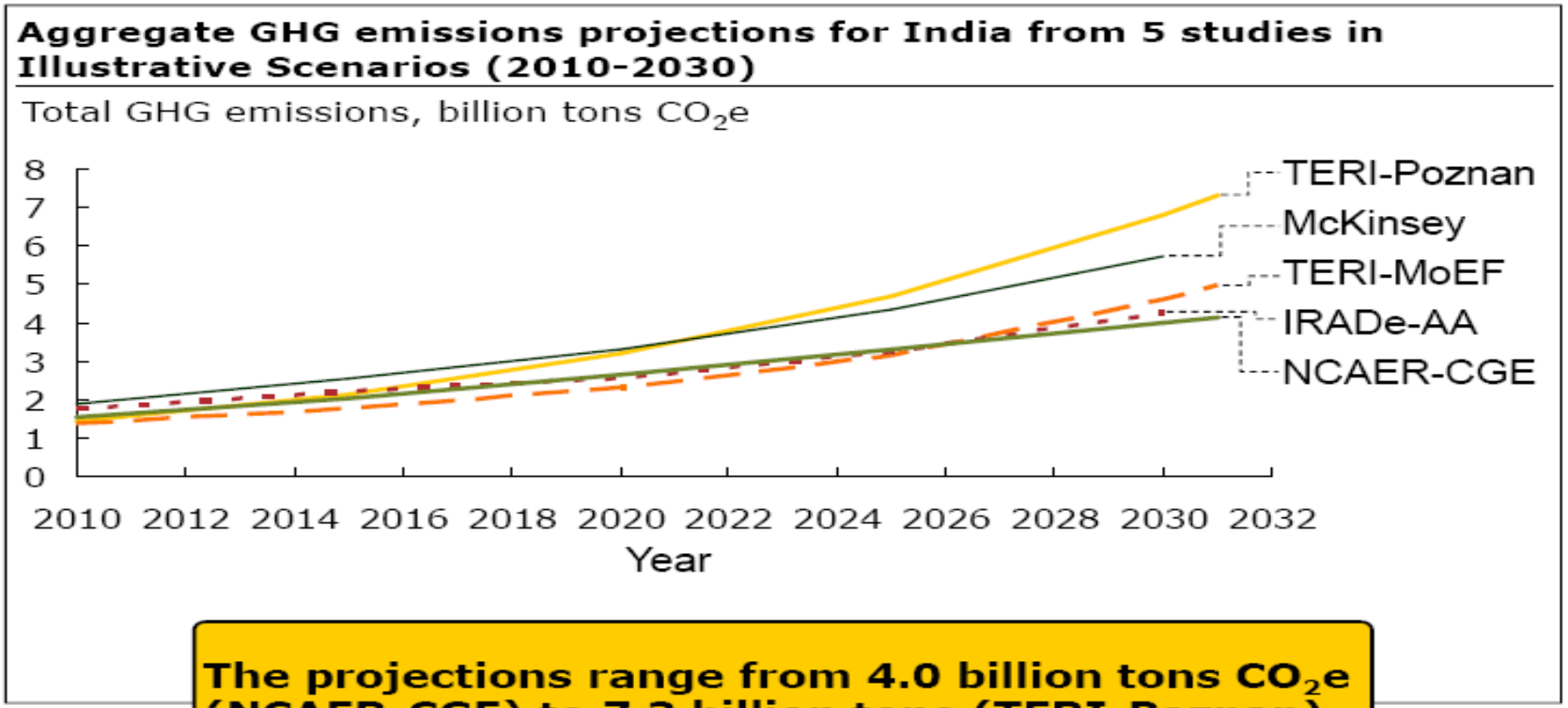
Region / Country	Population (million)	GDP (billion 2000 US$)	GDP ppp (billion 2000 US$)	Energy Cons. (MTOE)	CO_2 Emissions MT CO_2	Per-capita Energy Cons. (kgOE)	Energy Intensity KgOE/ $GDPppp	Kg CO_2/ $GDP ppp	Per-capita Electricity Cons. (kwh)	Per-Capita CO_2 Emission (tonnes)
World	6609	39493	61428	12029	28962	1.82	0.20	0.47	2752	4.38
China	1327	2623	10156	1970	6071	1.48	0.19	0.60	2346	4.58
Brazil	192	808.95	1561	235.56	347	1.23	0.15	0.22	2154	1.80
India	1123	771	4025	421	1146	0.53	0.10	0.28	543	1.18

- In per capita terms India emits 1.18 tonnes of CO2, China emits four times as much and US 16 times as much.
- Our emission intensity is 0.28 kg of CO2/$ of GDP in PPP terms

Source: Interim Report on Low Carbon Growth, Planning Commission

India's emissions are likely to more than double by 2030

India's Aggregate GHG emissions till 2030



The projections range from 4.0 billion tons CO_2e (NCAER-CGE) to 7.3 billion tons (TERI-Poznan)

Source: India's GHG Emissions Profile, Ministry of Environment & Forests Sept. 2009

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Report on low carbon strategies prepared by Planning Commission

- The report on “Low carbon strategies for inclusive growth” was prepared in 2011
- The report was aimed to provide inputs on low carbon inclusive growth for 12th five year plan
- The report suggests a menu of options to reduce GHG intensity in critical sectors of Indian economy
- The main sectors examined in this report are power, transport, industry, buildings and forestry
- The report has considered 2007 as the base year for analysis; based on this trend, the report has deduced the emissions for 2005 to assess the baseline GHG emissions for 2005 and help suggest strategies for 20-25% emission intensity reduction envisaged in NAPCC
- The report made projections for two growth outcomes: average real GDP growth rates of 8 and 9 percent up to 2020. And for each growth outcomes, expected range of emissions based on Determined Effort Scenario and Aggressive Effort Scenario is shown

Snapshot of 2020 situation @ 8% GDP growth (Planning Commission)

Particulars	2005 (derived)*	2007 (actual)	2020 projected (BAU)	2020 projected (determined efforts)	2020 projected (aggressive efforts)
GDP in Rs Billion (1999-00 prices)	NA	30,619	83,273	83,273	83,273
Installed capacity (MW) Net generation (billion kWh)	NA	NA 760	342,280 1962	332,080 1846	320,080 1717
Cement production (million tonne)	NA	165	500	500	500
Iron & Steel production (million tonne)	NA	53.1	200	200	200
Total Emissions (million tonnes CO_2e) • Power (million tonnes CO_2e) • Iron & Steel (million tonnes CO_2e) • Cement (million tonnes CO_2e)	NA	1570 598** 117 129	4270*** 1609 442 393.5	3537 1368 406 336	3071 1141 360 293.5
Emission intensity (gm CO2eq/Rs GDP) • Power (kg CO_2e/kWh) • Iron & Steel (MT CO_2e/tcs****) • Cement (MT CO_2e/tonne)	56.21 NA NA NA	51.28 0.81 2.21 0.79	51.28 0.82 2.21 0.79	42.47 0.74 2.03 0.67	36.87 0.66 1.8 0.59
Emissions reductions compared to BAU (million tonnes CO_2e)	NA	NA	NA	733	1199
Emissions with 2005 emission intensity* (million tonnes CO_2e)	1433	NA	4571	3537	3071

* Planning Commission computed based on 2007 data

**Different than NATCOM estimate of 719 million tonnes, this documented by Planning Commission

2007 level * tonne of crude steel

Our calculations are based on total emissions and generation

Sources of emission reduction

- Out of 733 million tonne CO_2e reduction in determined scenario, three sectors i.e. power, cement and iron & steel can reduce 334 million tonne CO_2e
- In the aggressive scenario, out of 1199 million tonne CO_2e reduction, these three sectors can reduce 640 million tonnes of CO_2e

	Reduction in Determined Effort in 2020 compared to BAU		Reduction in Aggressive Effort in 2020 compared to BAU	
	Energy savings Billion kWh	GHG reduction (million CO_2e)	Energy savings Billion kWh	GHG reduction (million CO_2e)
Power	264	241	505	468
• Consumption efficiency	• 105	• 96	• 217	• 201
• Appliances	• 80	• 73	• 147	• 136
• Agriculture pumps	• 5	• 5	• 10	• 9
• Industries	• 20	• 18	• 60	• 56
• Supply side abatement	• 93	• 85	• 157	• 145
• Buildings	• 66	• 60	• 132	• 122
• Rating system	• 24	• 22	• 35	• 32
• ECBC compliance	• 13	• 12	• 49	• 45
• Retrofitting	• 28	• 26	• 49	• 45
Iron & Steel	23	36	53	82
Cement	28	57.5	48	100

Potential abatement measures (Planning Commission-XII Plan)

- Advanced Coal Technologies;
- National Wind Energy Mission;
- National Solar Mission;
- Technology Improvement in Iron and Steel Industry;
- Technology Improvement in Cement Industry;
- Energy Efficiency Programmes in the Industry;
- Vehicle Fuel Efficiency Programme;
- Improving the Efficiency of Freight Transport;
- Better Urban Public and Non-motorized Transport;
- Lighting, Labelling and Super-efficient Equipment Programme;
- Faster Adoption of Green Building Codes;
- Improving the Stock of Forest and Tree Cover.

Report on environment and energy sustainability prepared by McKinsey

- The report was prepared in 2008-09 as a part of the study to identify and priorities opportunities for India to meet the closely linked challenges of energy security and environmental sustainability
- Core purpose of the report is to illustrate which measures have the greatest potential to reduce emissions, and correspondingly energy use, and which are the most feasible given the substantial challenges in funding, regulation, technology, capacity and market imperfections
- Primarily optimizes economic factors to identify the lowest cost technology solutions for abatement
- McKinsey developed GHG abatement cost curve for India covering five areas: power, emission intensive industries (cement, iron & steel, etc.), transportation, habitats, and agriculture and forestry
- They have estimated the feasible technical potential of each practice and technology for a given period with respect to a reference practice or technology

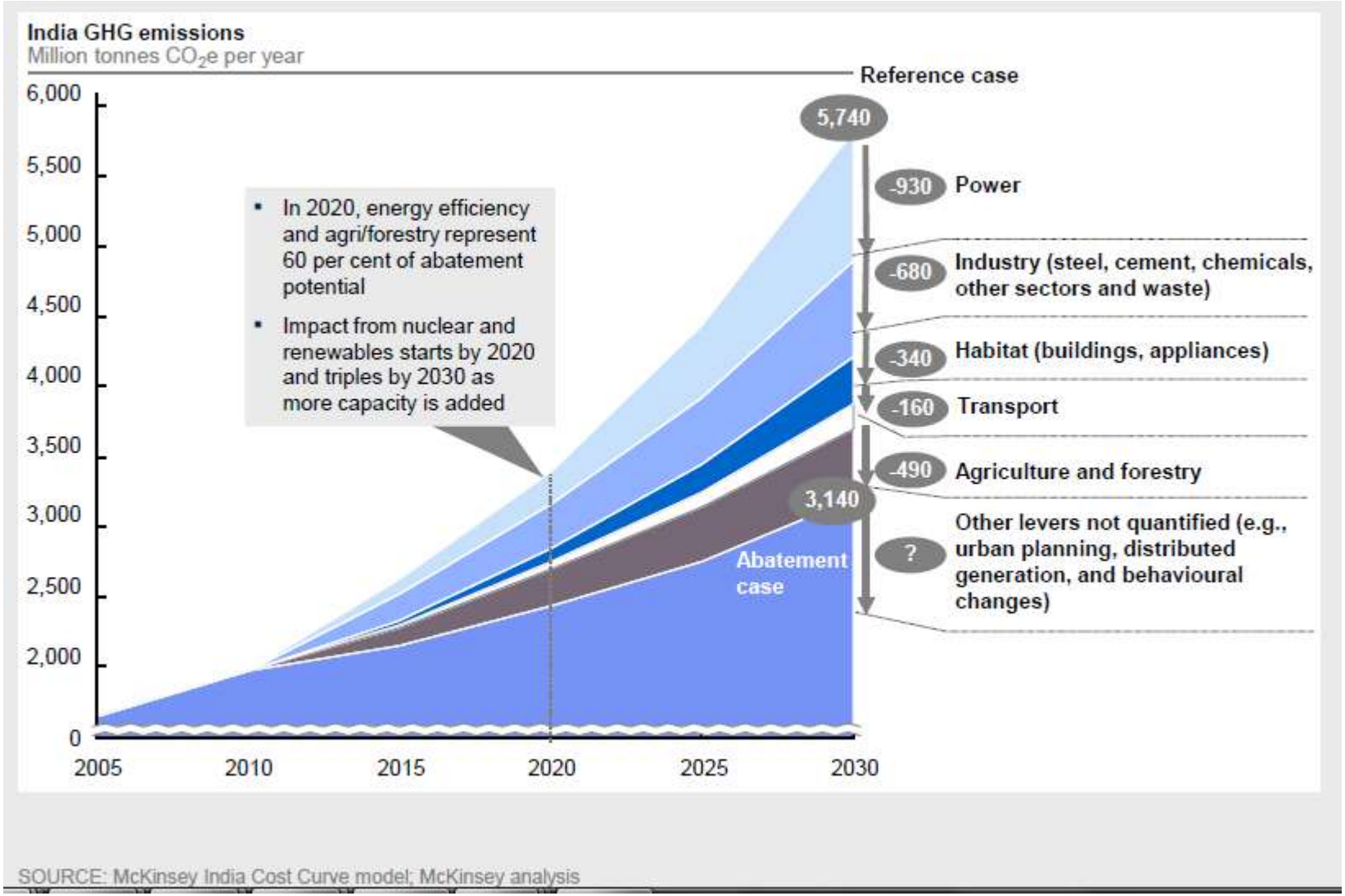
Report on environment and energy sustainability prepared by McKinsey

India- Opportunities

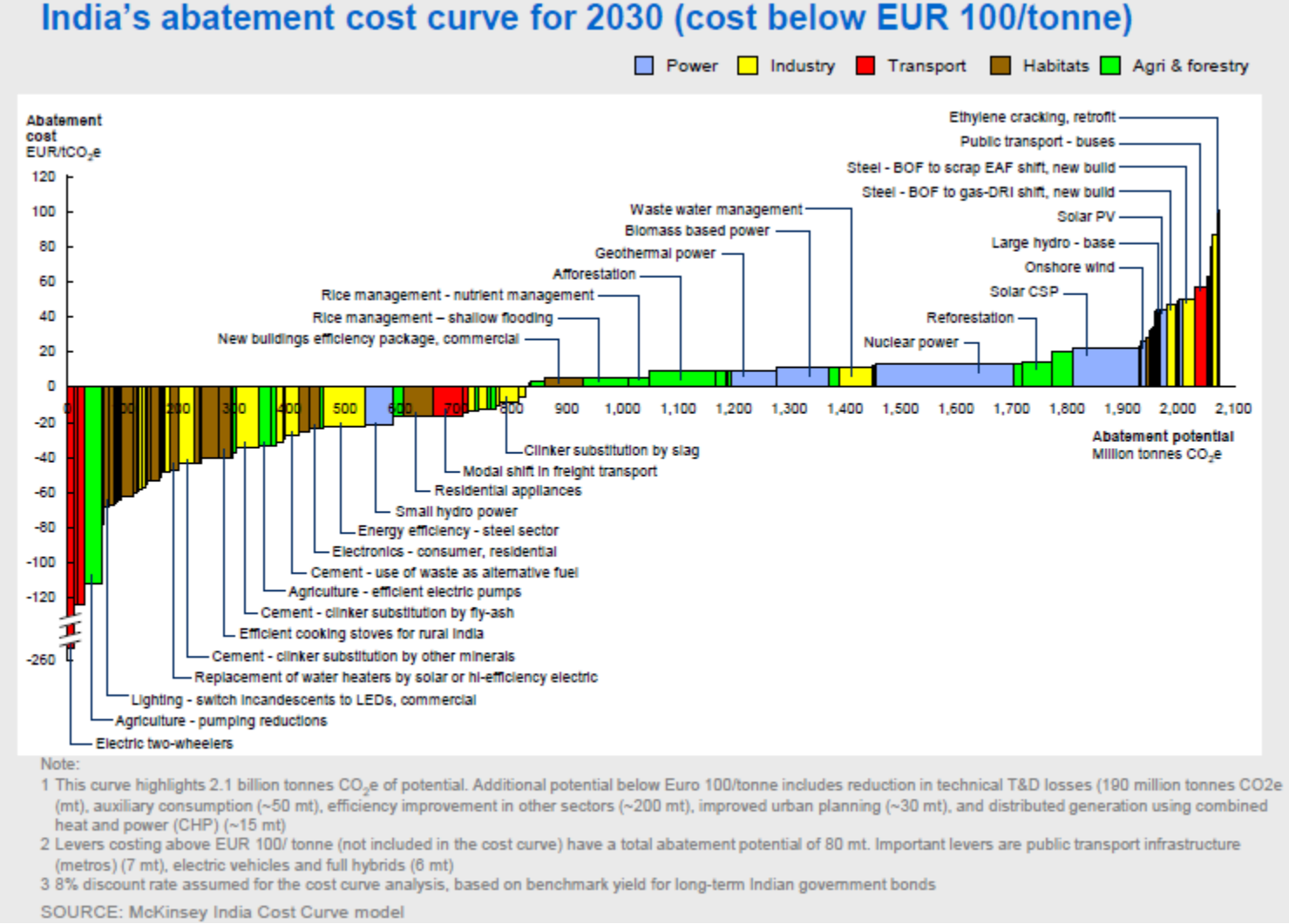
- Greater investment in:
- Energy Efficient Industry
- Clean Power Infrastructure
- Green Transportation
- Sustainable Habitat
- Sustainable Agriculture and Forestry

*(**Source**: McKninsey & Co., Environmental and Energy Sustainability: An Approach for India, 2009)*

Composition of abatement case over time (source: McKinsey)



India’s abatement cost curve for 2030 (cost below EUR 100/tonne)



Note:

1 This curve highlights 2.1 billion tonnes CO_2e of potential. Additional potential below Euro 100/tonne includes reduction in technical T&D losses (190 million tonnes CO2e (mt), auxiliary consumption (~50 mt), efficiency improvement in other sectors (~200 mt), improved urban planning (~30 mt), and distributed generation using combined heat and power (CHP) (~15 mt)

2 Levers costing above EUR 100/ tonne (not included in the cost curve) have a total abatement potential of 80 mt. Important levers are public transport infrastructure (metros) (7 mt), electric vehicles and full hybrids (6 mt)

3 8% discount rate assumed for the cost curve analysis, based on benchmark yield for long-term Indian government bonds

SOURCE: McKinsey India Cost Curve model

Source: McKinsey

Potential abatement opportunities (Mc Kinsey)

The Mc Kinsey study identified the following abatement options in Power sector in the MAC curve they developed for India:

The abatement options which have a negative costs to the economy

- Small hydro

The abatement options which have a positive cost to the economy less than $ 100/tonne

- Geothermal
- Biomass
- Others
- Distributed generation

Potential abatement opportunities (McKinsey)

The Mc Kinsey study identified the following abatement options in Agri & forestry in the MAC curve they developed for India:

The abatement options which have a negative costs to the economy

- Agri pumping reductions
- Efficient electric pumps

The abatement options which have a positive cost to the economy less than $ 100/tonne

- Rice management – nutrient management
- Rice management – shallow flooding
- Afforestation
- Reforestation

NAPCC focus is on two key measures for mitigation in energy sector

Energy Efficiency

- Demand side management measures
- Supply side management measures

NAPCC addresses it under the National Mission for enhanced energy efficiency

Fulfils both objectives:
i) energy security
ii) energy sustainability

Renewables / Clean energy

- Supply side management measures

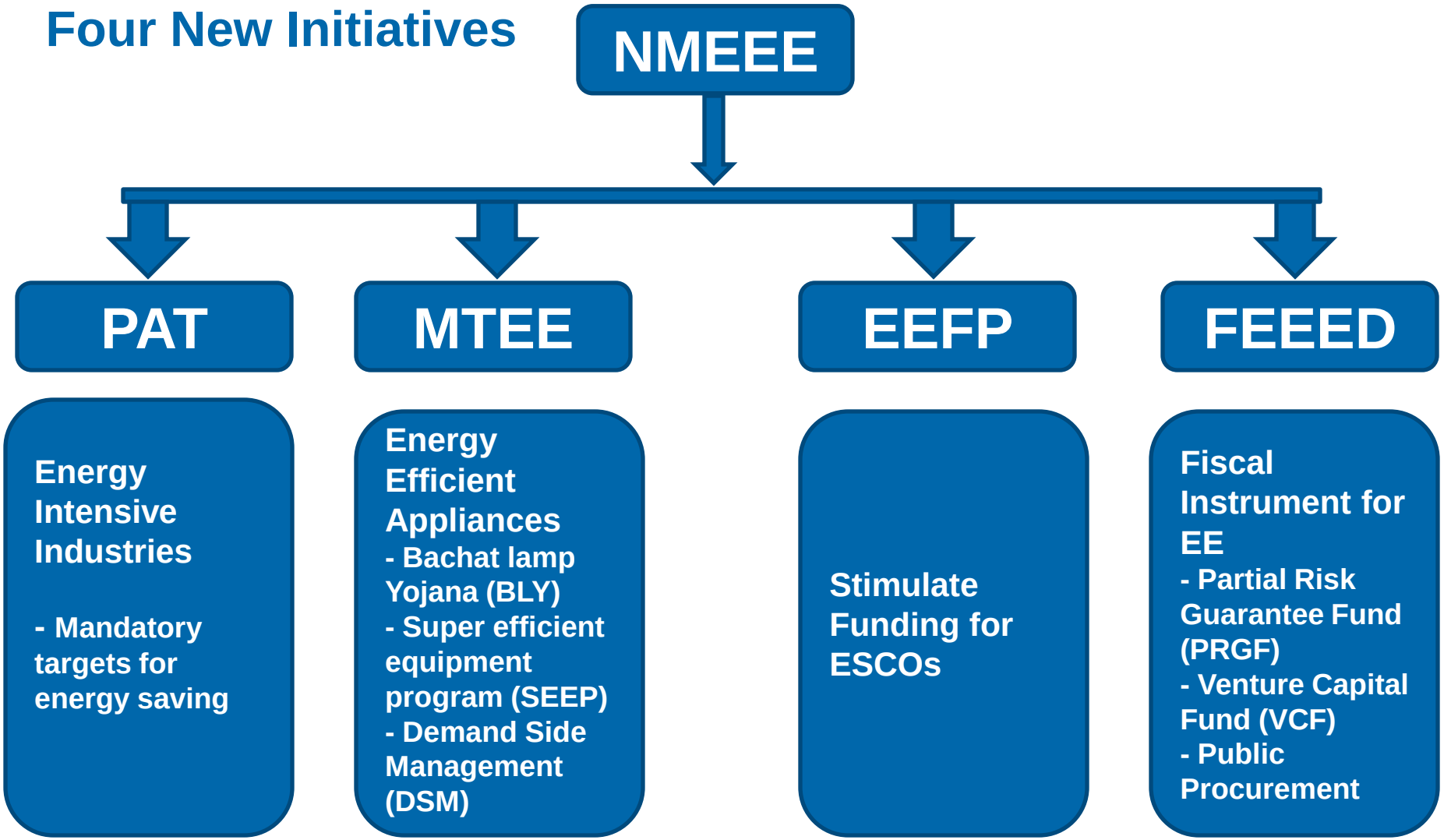
NAPCC addresses it under the National Solar Mission for promoting Solar

Planning Commission identifies National Wind Energy Mission as one of the key measures

Fulfils both objectives:
i) energy security
ii) energy sustainability

National Mission for enhanced energy efficiency (NMEEE)

Four New Initiatives



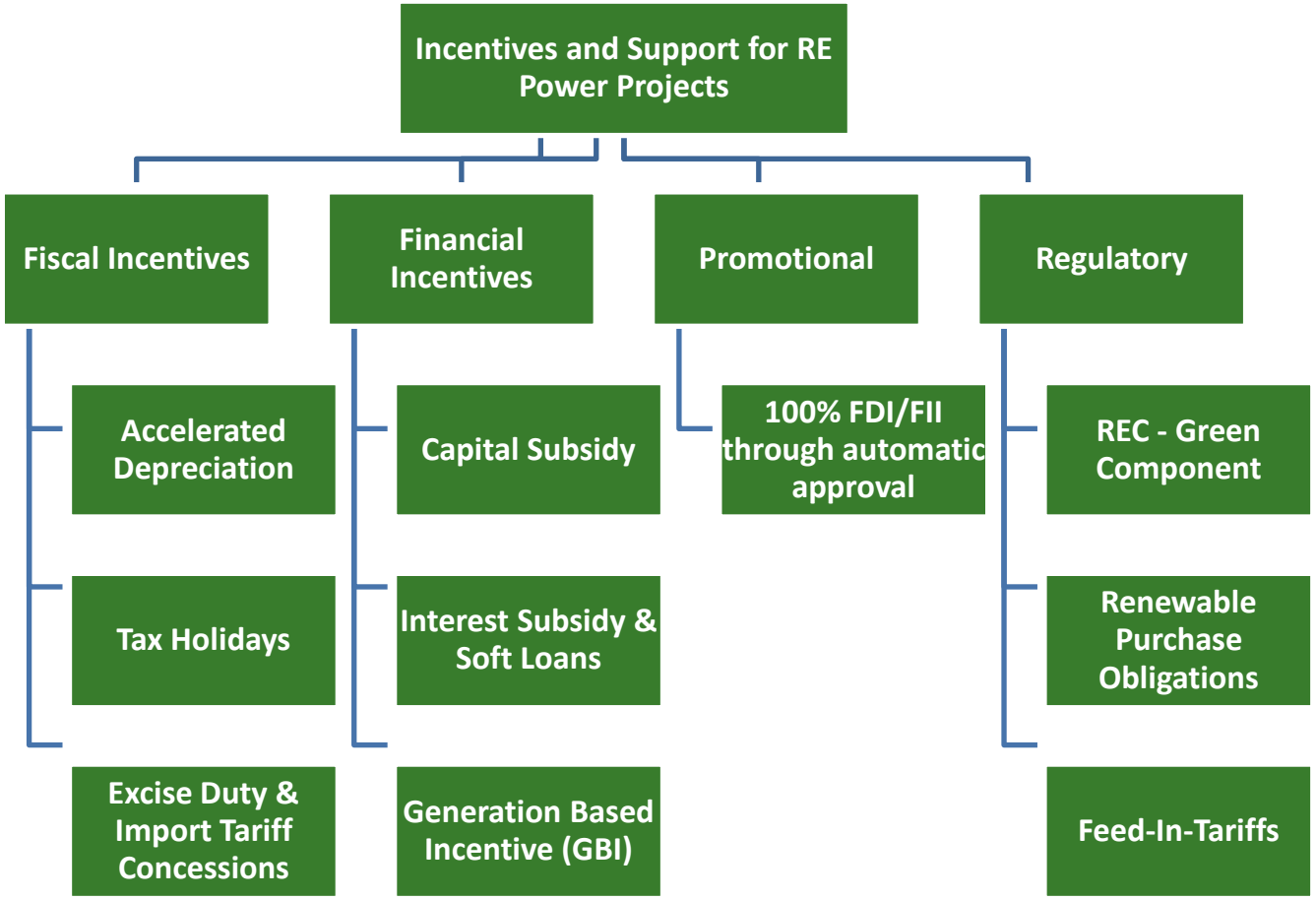
NMEEE , under NAPCC endorsed by steering Committee, Ministry of Power in 2008, except PAT most schemes yet to be finalized and rolled out

Major RE initiatives announced in 2013-14

Title	Month/Yr	Details
National Wind Energy Mission Launched	Jan 2013	Targeting 100 GW of wind power by 2022
Draft National Offshore Wind Energy Policy Released	May 2013	Suggesting to establish to establish ~1 GW wind farm (each along the coastline of Rameshwaram & Kanyakumari in TN)
Green Energy Corridors Announced	Apr 2013	Germany announced USD 1Bn incentive to enable supply of 30GW RE to grid by 2020
Prime Minister's announcement	Jan 2014	PM directed MNRE to target 100,000 MW solar power by 2027 in place of 2031
Announcement by 6 major PSUs	Jan 2014	BHEL, SECI, Power Grid and other PSUs to set up 4,000 MW solar plants in Rajasthan
MoU between MNRE and MoP&NG	Feb 2014	Aiming to enhance energy security along with clean energy development through investments in RE
MNRE's Announcement	Feb 2014	Plan to set-up a 5,000 MW solar power plant in Ladakh
Interim budget Announcement	Feb 2014	Finance Minister announced 4 ultra mega solar power projects (4x 500MW) in 2014-15
JNNSM Phase 2 Batch 1	Feb 2014	Allocation to 750 MW solar power projects made

Source: ICF Research based on news articles

Fiscal incentives for RE



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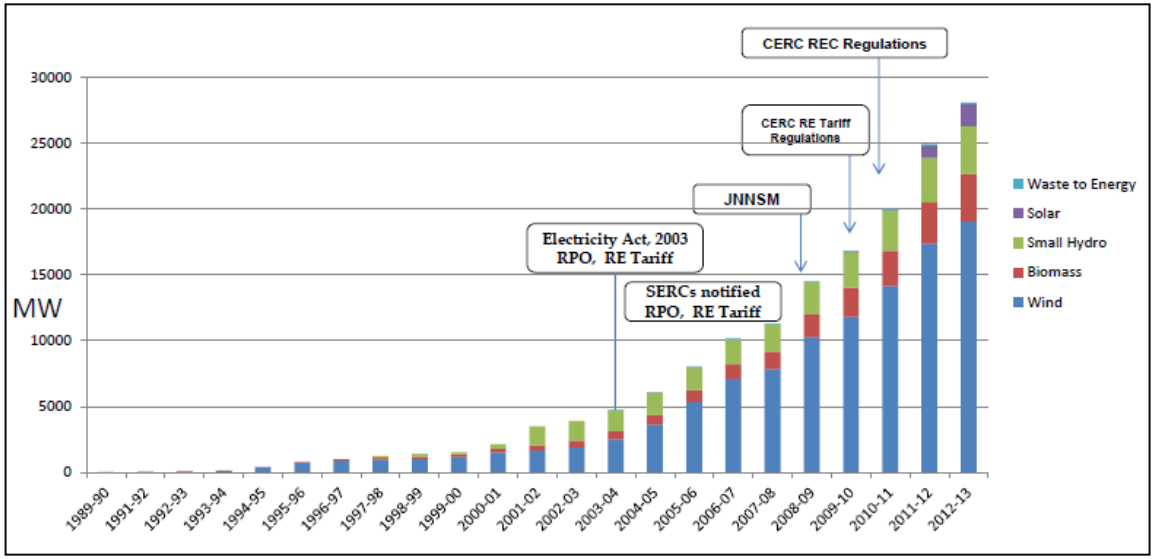
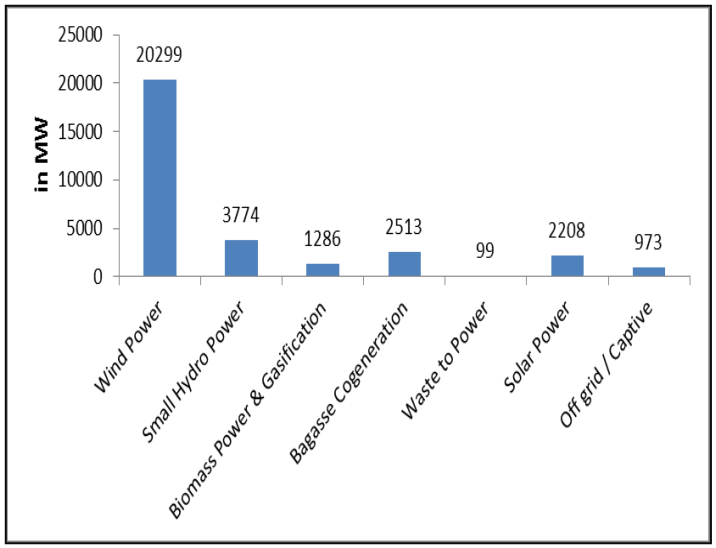
- How much will they pay?
- In the absence of a legal compliance requirement could the government pay for such offsets as payment for environmental services (PES)?
- Are there any funds that can be leveraged for PES?

Renewable Energy capacity addition in India is dominated by wind

Renewable Energy Capacity Addition and Major Milestones, MNRE



Grid Connected Renewable Energy Capacity as on 31st Jan 2014, MNRE

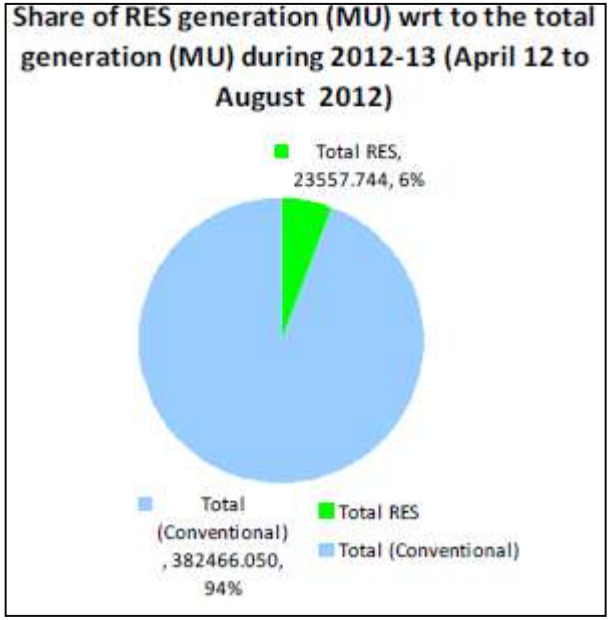


- India's renewable capacity has risen at an annual growth rate of **~19 percent** over the last five years (2007-2012); Wind has seen the fastest growth contributing around **67%** of the grid-connected installed capacity

- 30.1 GW has been installed so far; Solar is **2.2 GW**

Generation by renewable is around 5.5% in 2011-12 compared of installed capacity of 12.3%

GROWTH OF ENERGY GENERATION & Percentage share of generation from RES in the total energy generation			
Generation during the Year	Total Gross Energy Generation in India (MU)	Total Gross RES Energy Generation (MU)	% of Total Generation
1989 - 1990	245438	6	0.00
1991 - 1992	287029	39	0.01
1996 - 1997	395889	876	0.22
2001 - 2002	517439	2085	0.40
2006 - 2007	670654	9860	1.47
2007-2008	722626	25210	3.49
2008-2009	741167	27860	3.76
2009-2010	799850	36947	4.62
2010 - 2011	844846	41150	4.87
2011 - 2012*	928113	51226*	5.52
Source: General Review 2011, DMLF division, CEA, * Tentative			



Data for entire 2012-13 not available; 5 months data between Apr to Aug shows 6% share of RE

All states except Sikkim have set RPO

State	Year of Issue	2012-13	2016-17	2020-21
Andhra Pradesh	2012	4.75%	4.75%	
Assam	2010	4.05%		
Bihar	2012	3.75%		
Chhattisgarh	2011	5.25%		
Delhi	2012	3.25%	8.65%	
JERC (Goa & UT)	2010	2.60%		
Gujarat	2010	6.00%		
Haryana	2011	2.00%		
Himachal Pradesh	2011	10.00%	12.00%	16.00%
Jammu and Kashmir	2011	4.75%		
Jharkhand	2010	3.00%		
Kerala	2010	3.65%	4.85%	6.05%
Madhya Pradesh	2010	3.40%		
Maharashtra	2010	7.75%		
Orissa	2010	5.35%		
Punjab	2011	2.83%		
Rajasthan	2011	6.35%		
Tamil Nadu	2011			
Uttarakhand	2010	5.00%		
Uttar Pradesh	2010	5.00%		
West Bengal	2012		6.50%	

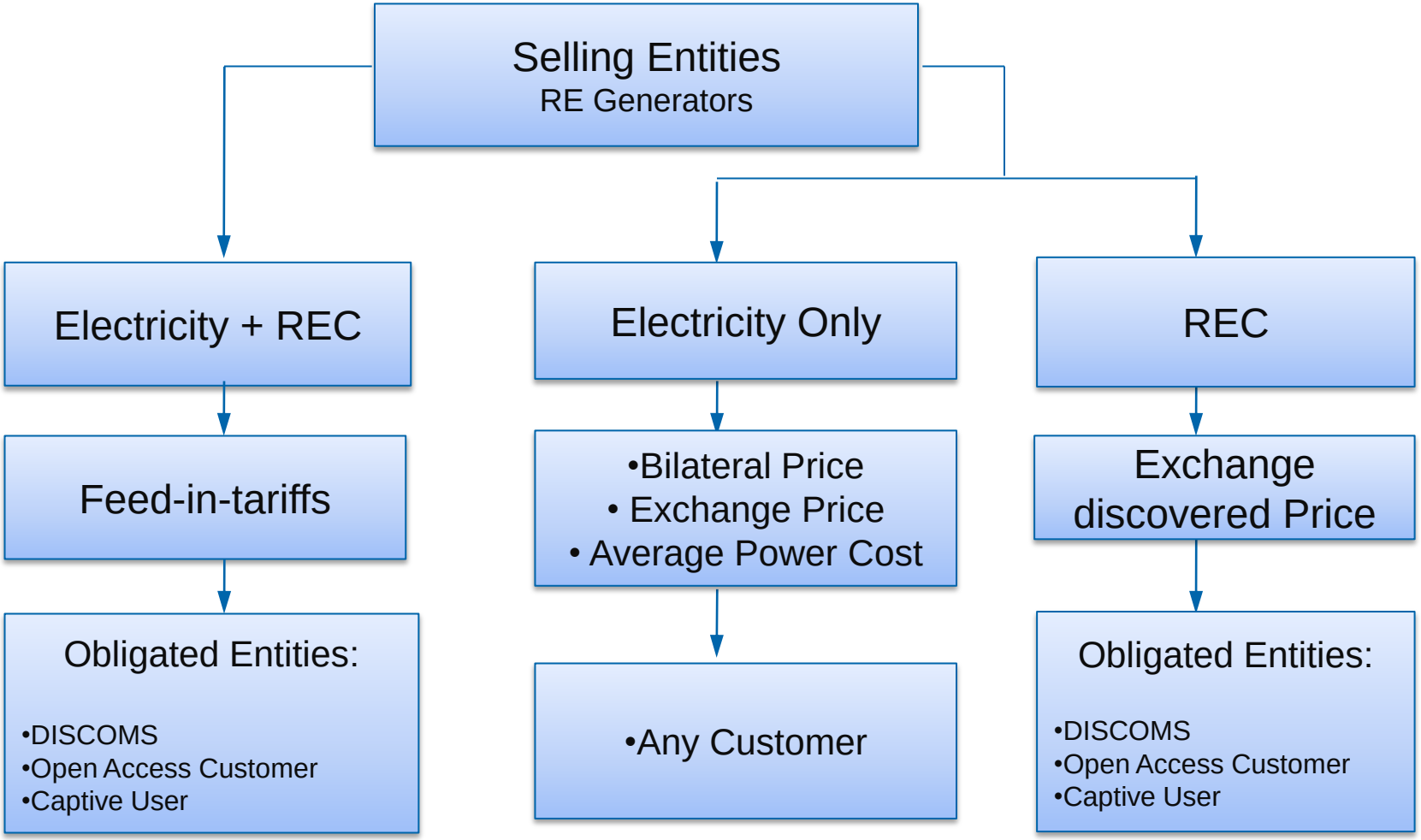
- There are year wise RPO targets; number shown for intermittent years only
- Data for North-east states are not shown; they have RPO except for Sikkim

Solar RPOs across states

State	Year of Issue	2012-13	2016-17	2020-21	2021-22
Andhra Pradesh	2012	0.25%	0.25%		
Assam	2010	0.15%			
Bihar	2012	0.25%	1.25%	2.50%	3.00%
Chhattisgarh	2011	0.50%			
Delhi	2012	0.15%	0.35%		
JERC (Goa & UT)	2010	0.40%			
Gujarat	2010	1.00%			
Haryana	2011	0.05%			
Himachal Pradesh	2011	0.25%	0.25%	2.00%	3.00%
Jammu and Kashmir	2011	0.25%			
Jharkhand	2010	1.00%			
Kerala	2010	0.25%	0.25%	0.25%	0.25%
Madhya Pradesh	2010	0.60%			
Maharashtra	2010	0.25%			
Orissa	2010	0.15%			
Punjab	2011	0.07%			
Rajasthan	2011	0.75%			
Tamil Nadu	2011				
Uttarakhand	2010	0.05%			
Uttar Pradesh	2010	1.00%			
West Bengal	2012		0.50%		

- There are year wise RPO targets in states where it has been fixed; number shown for intermittent years only
- Data for North-east states are not shown

Modes of Selling RE attributes



Source: Forum of Regulators, 2010

Feed in Tariff fixed by Regulatory Commissions

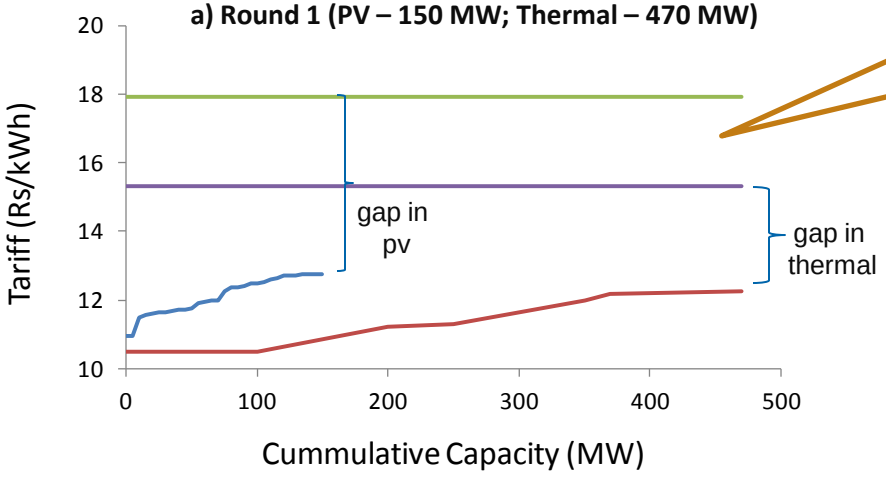
Renewable Type	CERC * (INR/kWh) for FY 12-13
Wind	3.35 to 5.36 (with Accelerated depreciation or AD)
Solar PV	9.35 (after AD)
Solar Thermal	11.22 (after AD)
Small Hydro	3.25 to (with AD) to 4.88 (without AD)
Biomass	5.12 to 5.83 (with AD)
Bagasse	4.61 to 5.73 (with AD)

- Feed in tariff specified by ERC which depends on technology type, size, capital cost, plf, etc.
- Every state ERC also determines feed-in-tariff applicable for RE developers based on technology type, size, capital cost, plf, etc.

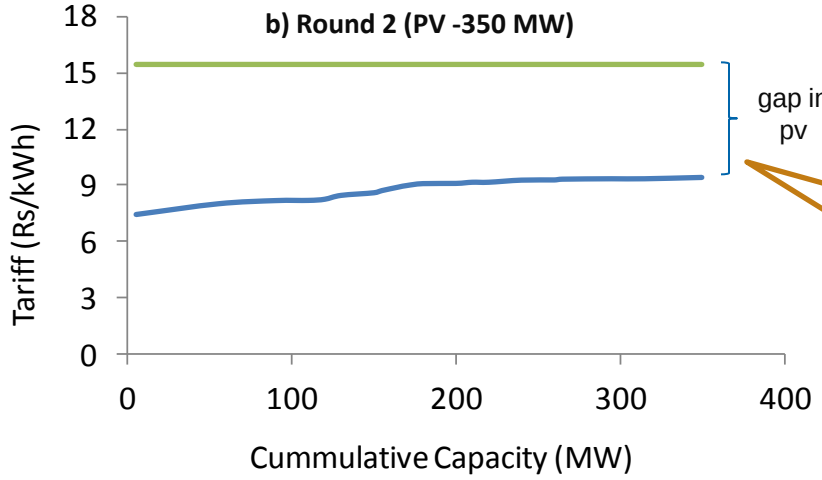
Source: MNRE

Tariff benchmarks discovered under JNNSM Phase- I

Supply Curves JNNSM:

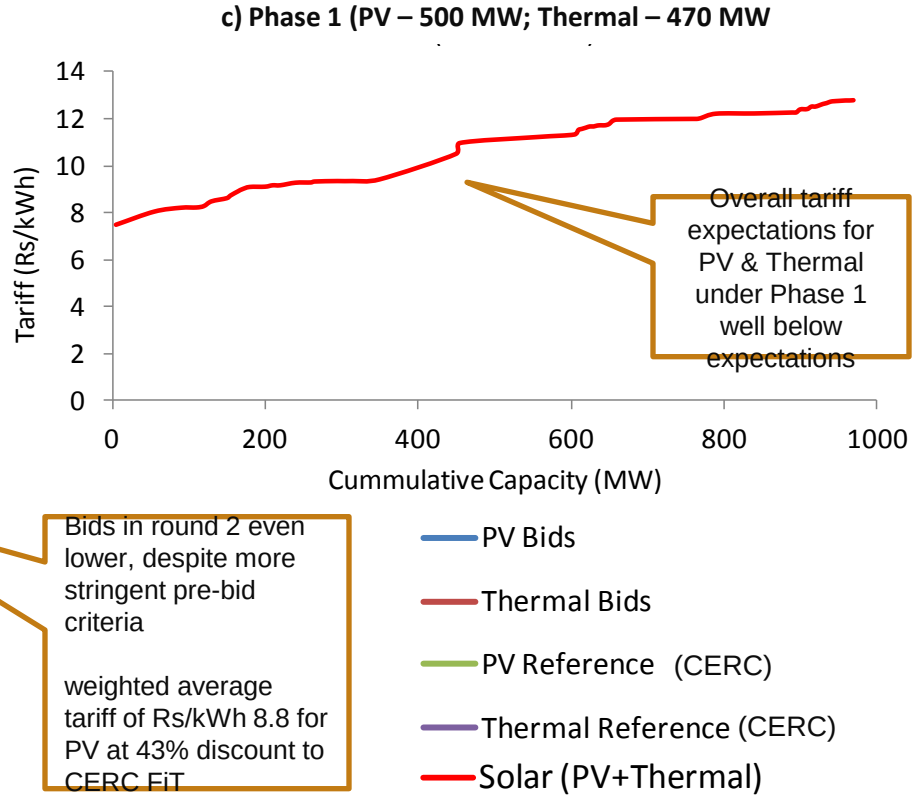


weighted average tariffs of Rs/kWh 11.5 & 12.2 for PV & Thermal at 25 & 32% discounts to CERC FiT



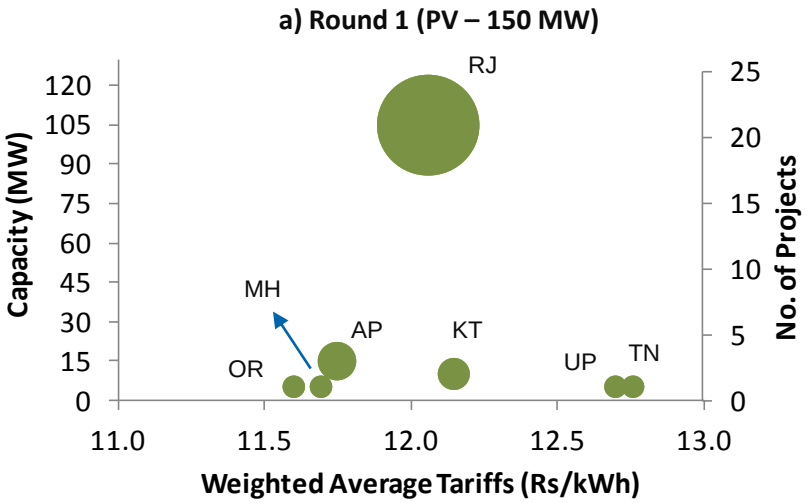
Bids in round 2 even lower, despite more stringent pre-bid criteria

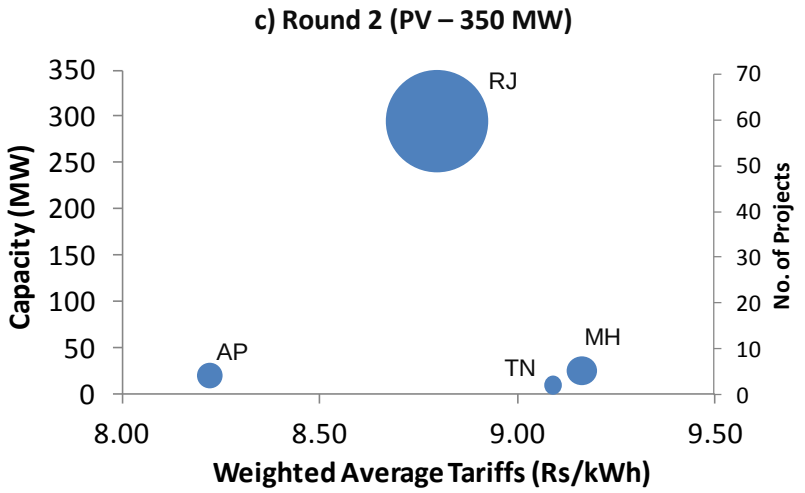
weighted average tariff of Rs/kWh 8.8 for PV at 43% discount to CERC FiT

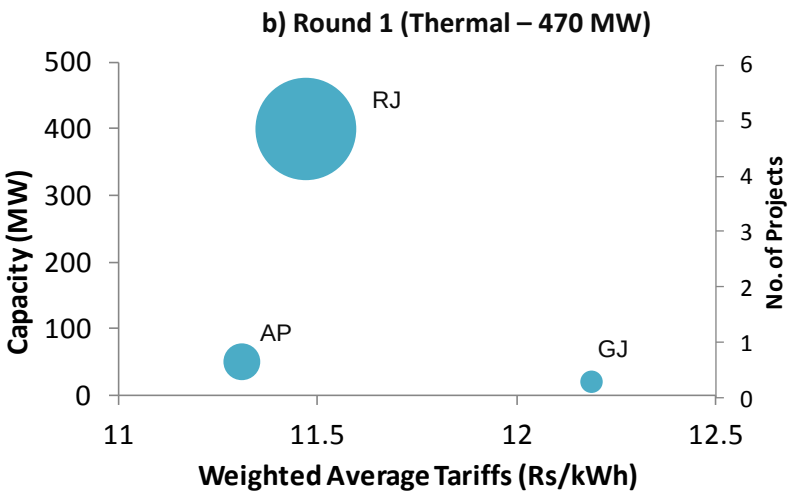


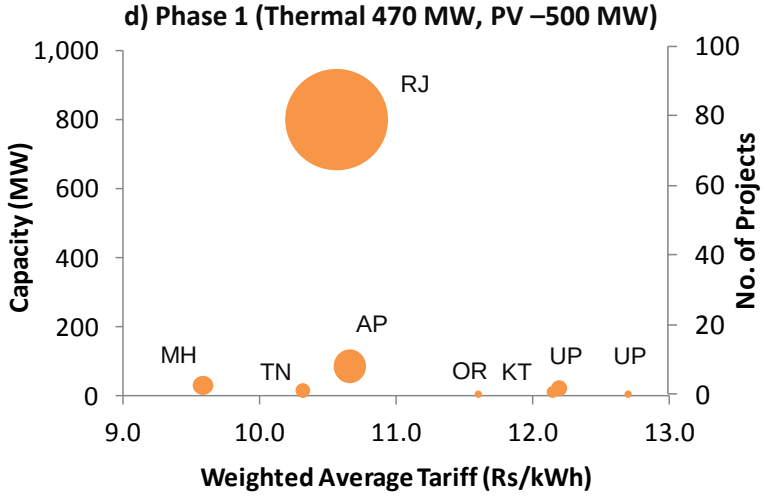
Source: ICF research

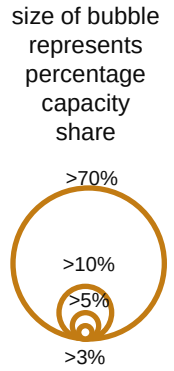
Weighted average tariffs in states











Source: ICF research

Target for renewable addition, Policy & Regulatory developments

- Ambitious plans to add renewable in next 10 years
  - 54,503 MW by the end of 12th five year plan i.e. addition of about 30,000 MW in 12th plan
  - Reaching 99,617 MW by the end of 13th five year plan
- NAPCC targets 15% renewable generation target by 2020 starting at 5% in year 2010, increasing 1% every year for 10 years; Suggests Separate Solar RPO of 0.25% by 2013 increasing to 3% of the electricity generation by 2022
- National Solar Mission has the following targets:

Segment	Target for Phase1	Cumulative Target for Phase2	Target for Phase 3
Utility Grid Power including rooftop	1,000-2,000 MW	4,000-10,000 MW	20,000 MW
Off-grid Solarapplications	200 MW	1000 MW	2000 MW
Solar collectors	7 million sq. metres	15 million sq. metres	20 million sq. metres

- CERC has issued comprehensive RPO and REC guidelines
  - SERCs in all major states have specified RPOs which are obligatory for power distribution companies, captive consumers, and open access consumers
- Current RE generation is around 6% which is lower than the national target of reaching 15% by 2020 (9% in 2014); The gap will remain even after 54,000 MW RE capacity by 2016-17
- Gap between 3% solar generation by 2022 will require around 30 GW solar capacity and Investment required is more than Rs 2,00,000 crores

Agenda

- India's GHG Profile and growing demand for energy
- India's mitigation strategy including for energy sector
- What would be the possible demand for offsets?
- What are the potential agriculture offsets (agriculture and forestry) that can serve the mitigation strategy of other sectors?
- Could large point emitters (for example thermal power plants, iron and steel and cement industries) use agri-offsets to help meet their emission reduction targets?
- How can they source agri offsets: Direct contracting or through Market Based Instruments (MBIs) ?
- How much will they pay?
- Could the government pay for such offsets as payment for environmental services (PES)? Are there any funds that can be leveraged for PES?

Regulatory regime for offsets / PES

- Overall regulatory regime can allow for offsets
- The regulatory regime for the specific sectors/funds need to be examined to see if agriculture offsets may be included
- Fungibility between different offsets and carbon markets can open up the market significantly.There is currently no GHG specific legislation in India. However, the existing legislative framework for regulation emissions into the atmosphere, under the Environment Protection Act, the Air Act and the regulatory framework thereunder, including the process for Environmental Clearances under the EPA, appears to provide some policy and regulatory space for GHG regulation in India. While these laws pre-date the UNFCCC and the Kyoto Protocol, their broad mandate is to ensure environmental protection through regulatory controls over pollutants, including atmospheric emissions.
- The Environment Protection Authority acting under its general powers under the Clean Air Act, has been considering GHG specific regulations.
- There is no explicit mandate under the NMSA for development of agricultural offset mechanisms. It may be necessary that the NMSA or any other regulatory requirement develops the basic premise for development of agricultural offsets, which are then consolidated under a broader framework of all available market based schemes such as RECs and EScerts.

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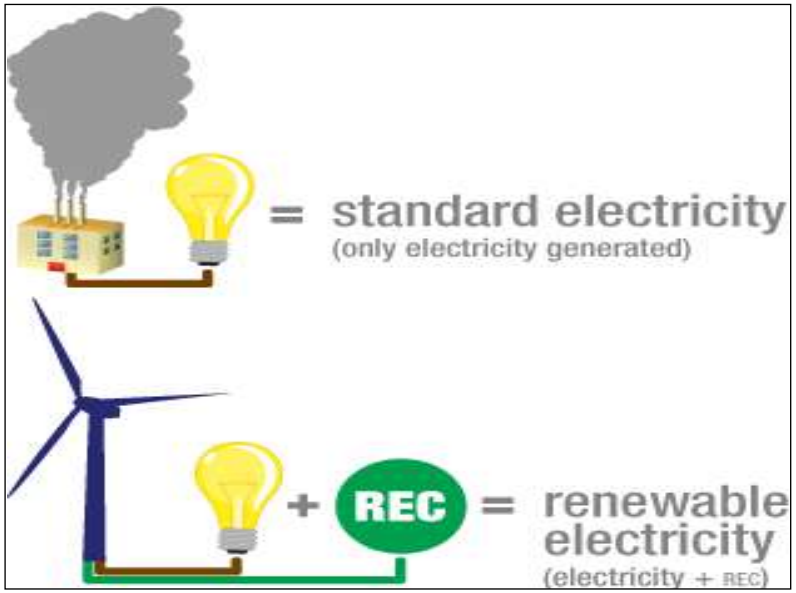
Key Points of CERC Regulations on REC Framework

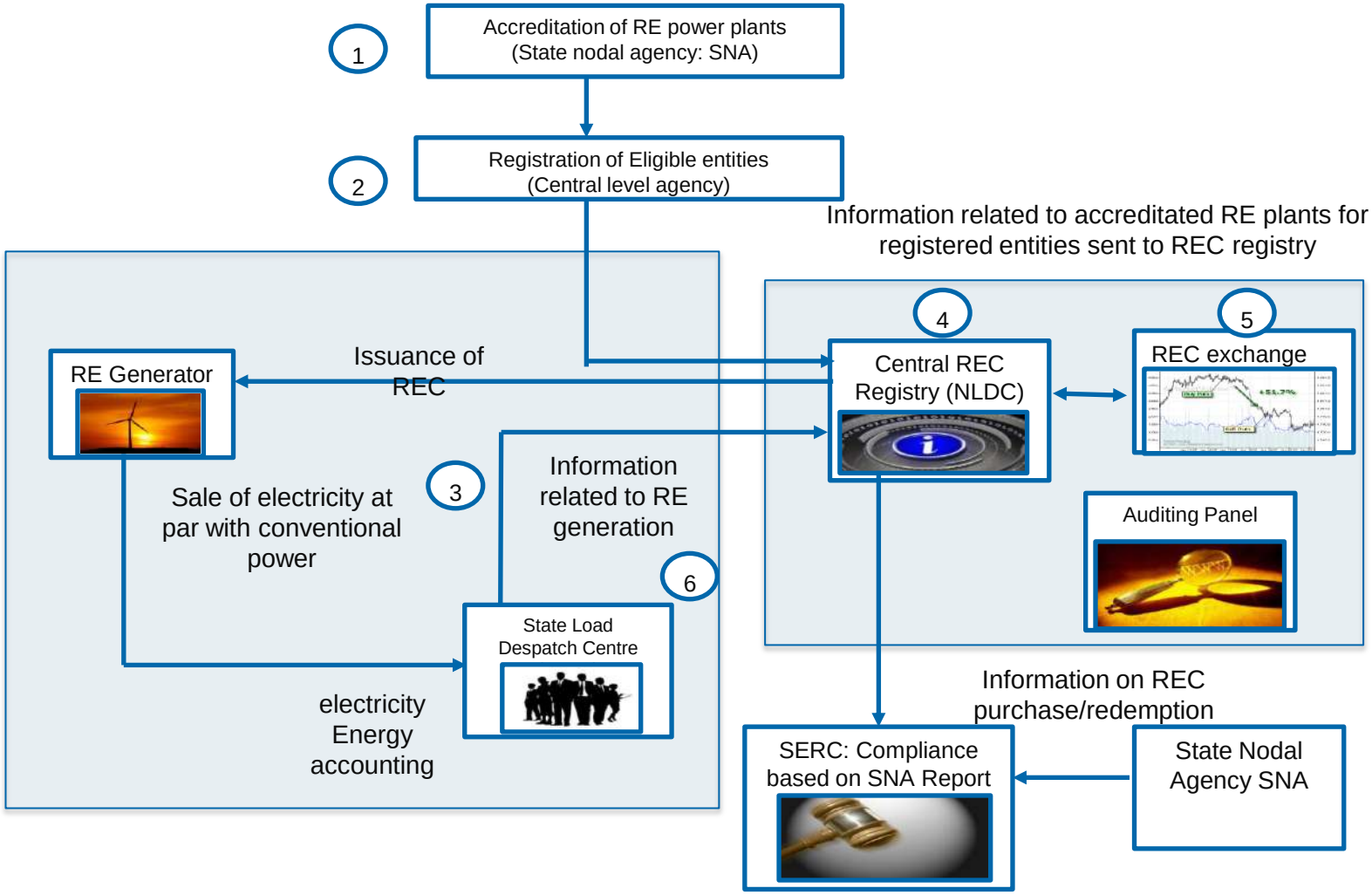
- Power Distribution companies, open access customers and captive generators are given renewable purchase obligations (RPO) by SERCs
- RPO can be met through purchase of renewable energy and/or REC
- RPO for each state to be decided by respective SERCs
- A Central Agency to be nominated by the CERC for registration of RE generators participating in the REC Scheme
- RECs to be issued in the denomination of 1 MWh
- RECs to be traded through Power Exchange within a price band of floor price and forbearance price notified by CERC
- Independent compliance auditors to be appointed by CERC

REC Mechanism

- RE generators selling power outside Feed-in-Tariff (FiT) are eligible to sell electricity and REC separately
- REC are issued to RE generators only (1 MWh generation from RE = 1 REC)
- Purchase of REC is considered as purchase of RE to meet RPO compliance

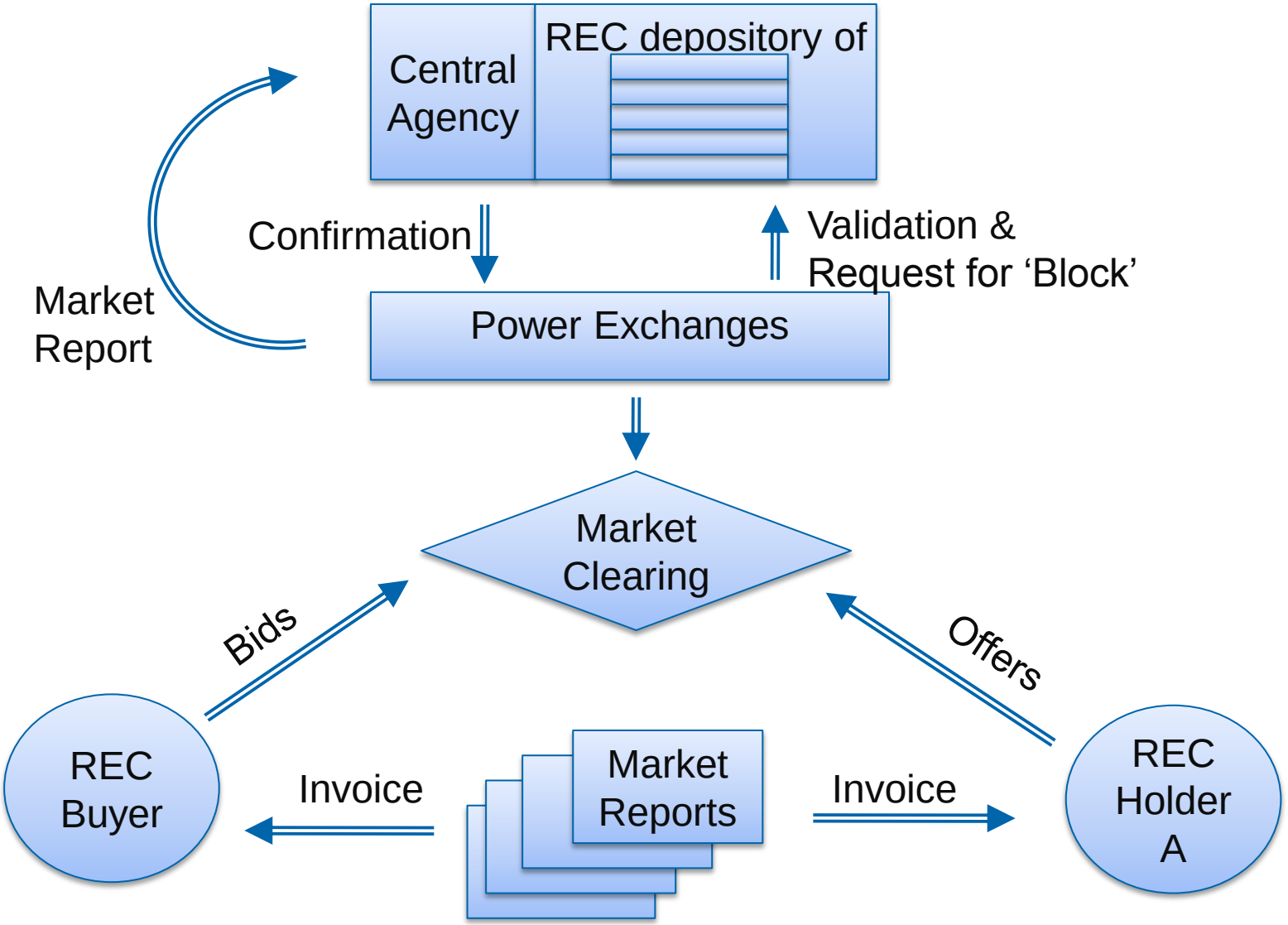


Operational Framework of REC



Source: NLDC / POSOCO

Trading RECs through Power Exchanges



Source: NLDC / POSOCO

Salient points of REC Pricing

- REC price depends on spot trading conditions
- Price band for REC trading has been fixed by the CERC (Floor price and Forbearance price)

CERC fixed Price Band for REC trading

Bound	Non solar REC (Rs/MWh)		Solar REC (Rs/MWh)	
	Upto FY 12	Beyond FY12	Upto FY 12	Beyond FY12
Forbearance	3,900	3,480	17,000	13,690
Floor	1,500	1,400	12,000	9,880

- Trading happens once in a month on IEX and PXIL

Renewable Energy Certificate market update

Summary Jan to Dec 2012		Cleared Volume (REC)	Cleared Price (Rs/REC)
Average *	Solar	472	12,740
	Non-Solar	1,65,217	2,126
Maximum	Solar	931	13,000
	Non-Solar	2,48,168	3,066
Minimum	Solar	5	12,500
	Non-Solar	54,976	1,500
Total	**Solar**	**3,782**	-
	Non-Solar	**19,82,614**	-

Source: IEX

Summary Jan to Dec 2013		Cleared Volume (REC)	Cleared Price (Rs/REC)
Average *	Solar	3,264	10,599
	Non-Solar	1,00,049	1,500
Maximum	Solar	6,983	13,400
	Non-Solar	3,07,260	1,500
Minimum	Solar	669	9,300
	Non-Solar	10,670	1,500
Total	**Solar**	**39,173**	-
	Non-Solar	**12,00,591**	-

* Simple average for traded months

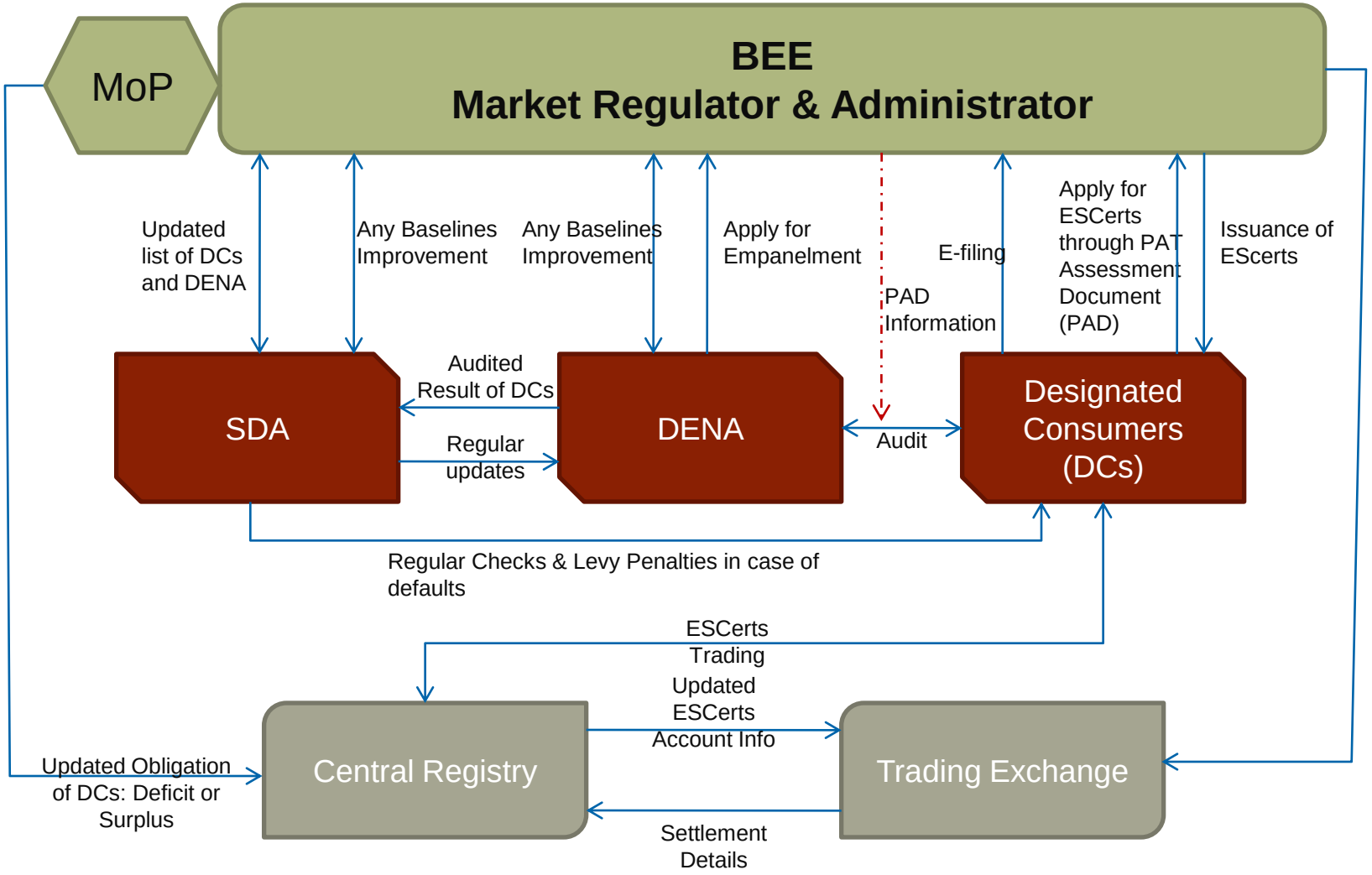
Perform Achieve Trade (PAT) ..An overview

- **Covers 478 designated consumers (DC) in 8 industrial sectors**
- **All DCs consumed about 165 mtoe energy i.e. about 35% of total energy consumption of the country**
  - About 70% of DCs consume 97% of the total energy consumption by these 8 sectors
- **Targets given to all DCs to achieve within a time frame**
  - Achievement > Target leads to issue of Escerts
  - Achievement < Target leads to Purchase Escerts / Penalty
- **Targets have been notified in March 2012 and to be achieved by March 2015 (3 years cycle)**
- **National Target = 6.686 mtoe at the end of 1st PAT Cycle (by March 2015)**
  - Thermal Power Plants : 3.1 mtoe (46% of national target)
  - Cement: 0.7 mtoe (10.5% of national target)
  - Iron & Steel : 1.65 mtoe (24% of national target)

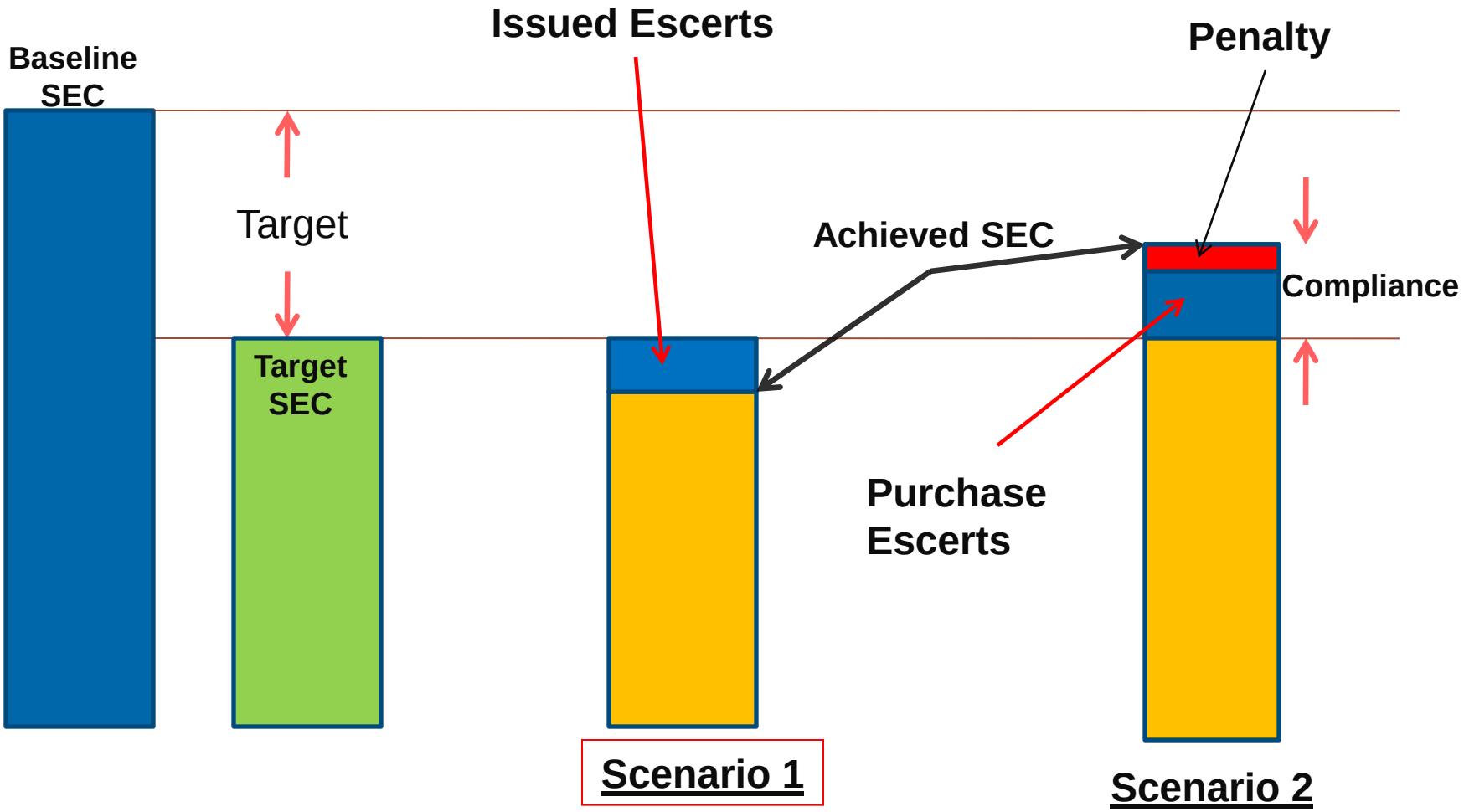
Industry Sector	Annual Energy Consumption Norm to be DC (toe)	No. of Identified DCs
Aluminum	7500	10
Cement	**30000**	**85**
Chlor-Alkali	12000	22
Fertilizer	30000	29
Pulp & Paper	30000	31
Power	**30000**	**144**
Iron & Steel	**30000**	**67**
Textiles	3000	90

Sector	MTOE
Power (Thermal)	104.14
Iron & Steel	28.00
Cement	11.87
Fertilizer	7.86
Aluminium	7.73
Paper	2.09
Textile	1.62
Chlor-Alkali	0.84
TOTAL	**164.15**

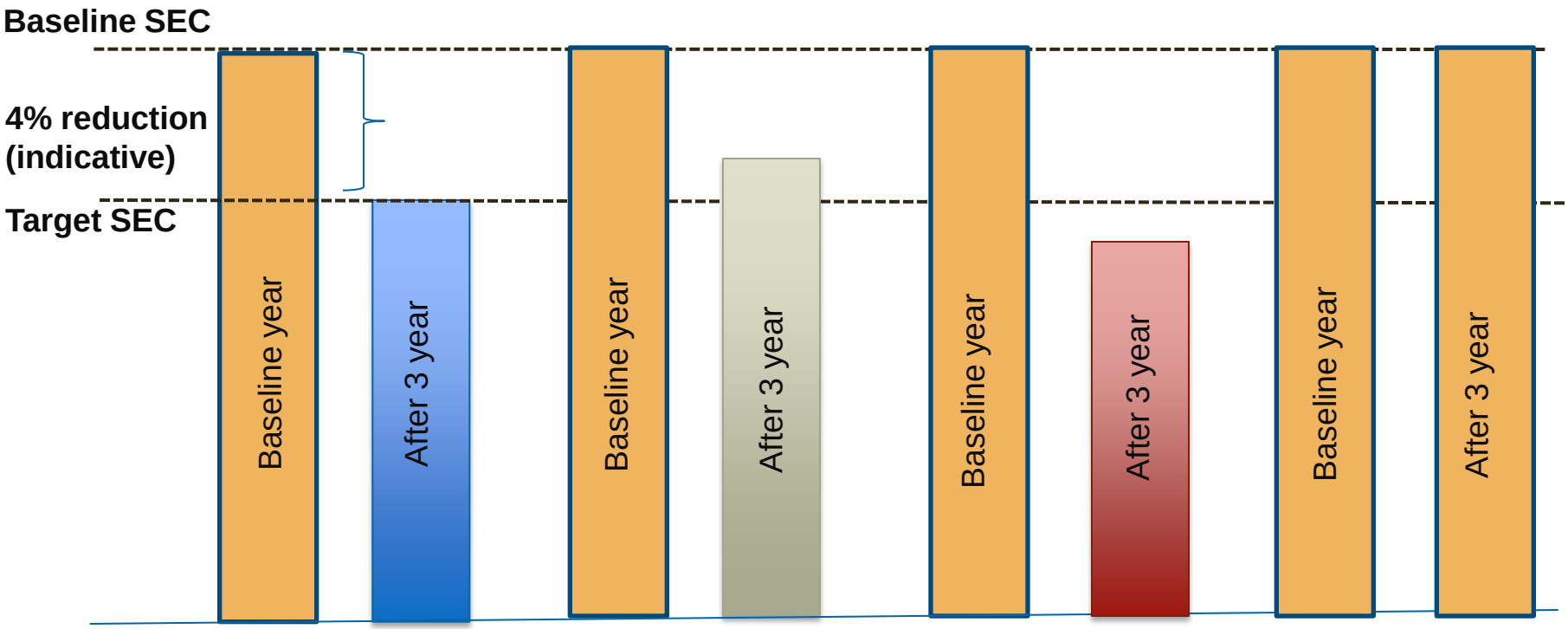
Institutional Design Schematic



Concept of Target, Compliance, Escerts & Penalty



Trading of Escert* will depend on various scenarios emerging after 3 years



Case A: Meeting
- No Escert to be bought/sold
- No Penalty

Case B:Underachieving
- Escert shortage
- Buy from Case C or pay penalty

Case C: Overachieving
- **Escert generated**
- **Sell to Case B or Case D Buyers**
- **Bank for future**

Case D: No Action
- Escert shortage
- Buy from Case C or pay penalty

*** 1 Escert = 1 toe saved in excess of the target**

Example to explain the calculation of Escert

Situation at the launch of scheme (in 2012)

Baseline SEC = 10 MTOE/unit of product
Baseline Production = 10000 units
Target for SEC Reduction = 4% reduction in SEC
Target SEC = 9.6 MTOE/unit of product
Reduction Requirement = 4000 MTOE

Situation at the end of 1st PAT cycle (in 2015)

Case A	Achieved SEC = 9.6	Meeting Target	No action
Case B	Achieved SEC = 9.8	Under Achievement of 2000 ESCerts	Buy ESCerts and/or pay penalty
Case C	Achieved SEC = 9.4	Over Achievement of 2000 ESCerts	Sell ESCerts and/or bank it
Case D	Achieved SEC = 10	Under Achievement of 4000 ESCerts	Buy ESCerts and/or pay penalty

Calculation of Penalty (Example)

- If non compliance: 8000 toe
- Penalty: Rs 1,000,000 + Rs 10,154 x 8000

  = 1,000,000 + 81,232,000

  = Rs 82,232,000 or Rs 82 Million

Penalty (P) = Wc x Pc + Wo x Po + Wg x Pg + We x Pe
Where,

- P is Rs 10154 for the year 2011-12 (to be updated every year)
- W is weighted average usage of Coal, Oil, Gas and Electricity
- P is the average price of Coal, Oil, Gas and Electricity for 1 toe equivalent

Important Time Lines

	Mandatory		Voluntary	
Submission of Form 1	Once in a year	30th June	NA	NA
Submission of Form A (Performance Assessment Document)	Once in 3 years	30th June 2015	Before Compliance year	30th June
Submission of Form B (Verification by AEA)	Once in 3 years	30th June 2015	Before Compliance year	30th June
Issuance of ESCerts	Once in a year	Aug 2015	Before Compliance year	Aug
Submission of Form D (Performance Compliance Document)	Once in 3 years	30th Nov 2015	NA	NA

Current status, Issues & Challenges

- **Normalization for Baseline incase there is a deviation from baseline scenario** : BEE is in the process of finalization of the same for all sectors
- **Standard Operating Procedures (SOPs) for DCs, Verifiers, SDAs regarding what, how and when to do:** Not available yet
- **Requirement of Accredited Energy Auditors:** Partial List available at BEE, but roles and responsibilities yet to be communicated
- **Capacity Building of DCs, Verifiers, SDAs for understanding their roles & responsibilities for compliance:** Yet to start
- **Uncertainty regarding the action taken by DCs to meet the target:** No such monitoring by BEE/SDA yet or reporting by DCs. So, it is difficult to guess how the Escerts trading /market is going to behave and hence the price of Escerts.
- **Trading Rules:** Although finalized by BEE, yet to be made public or available to DCs

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Terra prima funds PES from PCF

- Portuguese Carbon Fund (PCF) is a govt. financial instrument to assist in Portugal's compliance with the Kyoto Protocol set up under the National Program for Climate Change (NPAC), Portugal to buy credits from offsetting projects in developing countries or surplus credits from developed nations and to back national mitigation projects including agriculture.

- PCF initiated national projects such as Sown Bio-diverse permanent pastures rich in legumes (SBPPRL) - a carbon sequestration project focusing on sowing bio diverse pastures - an example of how payment for carbon soil sequestration can be implemented as an environmental service, at a large scale and with the involvement of farmers.

- PCF pays Terra Prima which in turn funds 80% of the farmers' costs for sowing activities and maintaining the project.

- Terra Prima also enters into a contract with an energy generator to help them establish green credentials and gets financial support. Contracts with Energias de Portugal (EDP) to sequester 7000 tons of CO2 per year through agro forestry management and improved pastures.

Terra prima Project

- SBPPRL – a special technique – through participation by farmers - mitigates carbon emissions at a reasonable cost, and has multiple other environmental, agricultural and economic benefits. Farmers are paid for the environmental service they provide (soil carbon sequestration), at values in the range of 130 €/ha to 150 €/ha, hence leading to a direct sequestration cost equal to 6.6 € / ton CO2.

- Payment made by the project + capital investment by farmer are used to

- buy the seed mixture and fertilizer (namely phosphorus, essential for legumes),

- to prepare the soil, and to sow and spread the fertilizer, at a cost up to 500 €/ha.

- Once this investment is made, the pasture can last for at least 10 years if correctly managed, with maintenance costs around 60 €/ha.

- Over this time, there is a reduction of fertilization costs (through increased soil productivity), land maintenance costs (through better control of spontaneous vegetation, also reducing fire risk) and feeding costs of animals (through greater pasture productivity).

- With SBP, farmers reduce the need to buy concentrate feed from outside the farm.

- SBP allow an estimated additional dry matter production on the order of 4 000 kg/ha (Teixeira, 2010). At conservative estimates that 2 kg of pasture dry matter replaces 1 kg of feed, and taking into account that the cost of feed is 0.2 €/kg, this implies a saving in concentrate feed equal to 400 €/ha.

Terra prima Project

- The promotion of carbon sequestration and the recovery of soils through SBP is also an incentive for farmers to associate the commercialization of SBP products (like bovine meat) to the image of an environmentally-friendly and socially beneficial activity.

- An inquiry to 1718 consumers showed that, on average, consumers would be willing to pay a surplus of 3.5 €/kg by meat associated to SBP (Teixeira, 2010).

- SBP benefits persist long after the farmer has ceased his contract with Terraprima. Hence, it is in the farmer's own economic interest to maintain the pasture, therefore ensuring the persistence of the sequestered carbon. 1000 farmers joined the project and are now implementing more sustainable soil management practices.

- Project demonstrates how soil carbon sequestration is an environmental service of Mediterranean agro-forestry systems that can be valued in carbon-based markets. This increases environmental awareness and leads farmers to new business perspectives.

- As an example, the environmental benefits of Sown Biodiverse Pastures can be an incentive to associate the commercialization of pasture products to the image of an environmentally-friendly and socially beneficial activity.

CAF can effectively finance PES models

Compensatory Afforestation Fund (CAF) can work on the lines of the PCF and support aggregators (like Terra Prima) to support mobilization of communities to make the payment for environmental services to these communities

Environmental services have been described to include climate regulation, carbon sequestration and health of soils, air and water regimes, supporting other services necessary for production of ecosystem services, and nutrient cycling. **The Guidelines for CAF are broadly worded and appear to envisage activities such as plantation or pastures outside of forest areas if they are related to any of the aims and objectives of State CAMPA**

Communities and other third party service providers (including private sector) may be mobilized for undertaking social forestry projects on areas identified for compensatory afforestation by communities and private sector given the huge backlog of CA schemes that are yet to be implemented. Plantation banks may be identified and state forest departments may directly fund such projects using CAF Funds and by contracting out forest management to communities and third party service providers. This would require inclusion of these programmes in the Annual Plan of Operations of the State and need to be submitted to the Ad-hoc CAMPA.

CAF could be utilized for payments for environmental services to farmers and local forest communities for development of pastures and fodder management programmes to support livestock production. It can supplement schemes proposed by DAC and MoEF if suitable models can be developed and promoted.

CAF can effectively finance PES models

CAF may be used to

- provide guarantees to banks for forestry and pasture projects with suitable notification on scope of Ad-hoc CAMPA.

Benefits

This approach would deliver two potential benefits to the economy;

(i) achieve more sustainable development by providing a mechanism by which the various negative externalities (social costs) associated with development can be better addressed, including vegetation and associated biodiversity loss, social impacts and GHG emissions, and in so doing reduce development approval compliance costs (including time delays) imposed on development agencies.

(ii) PES payments would provide comfort to banks (they could then securitize the future revenue streams much like securitization of annuities in case of infrastructure projects).

CAF can effectively finance CA under PES model

To ensure that compensatory afforestation is done efficiently and effectively and opportunities are explored to provide other industry services such as emissions offsets, the government can:

1) Use farmers/local tribals to grow forests and pay them for environmental services (similar to the ITC social forestry program or the Portugal carbon fund's Terra prima project); or

2) Involve third party specialist, under a contractual agreement (akin to a PPP), to implement and undertake compensatory afforestation agreements; and

3) Create a market based mechanism through which user agencies can easily and quickly purchase Compensatory Afforestation offsets and potentially other forms of offset for the purpose of mitigating greenhouse emissions

4) In the context of a market based mechanism approach, making user agencies responsible and accountable for their compensatory afforestation compliance requirements. They can directly or indirectly through use of specialist agencies identify and purchase the non-forest land and develop it as a forest area. (CPSU's like CIL and NTPC with a large number of projects may set up SPVs that can be made responsible for developing and managing the forest areas and mobilizing communities in that manner).

Central Sector Scheme for Fodder and Grazing Land Management (Proposed by MOEF)

- Formulation of a national policy on grazing-cum-fodder and pasture development in consultation with civil society organizations and domain experts.
- Designation of a suitable agency, like ICFRE, as Centre of Excellence on fodder and pasture development on CPRs to coordinate and steer various research, educational and extension programs under the proposed scheme.
- Mapping of ecologically sensitive grasslands across different agro-climatic zones and development of appropriate rehabilitation models.
- Rehabilitation and productivity enhancement of degraded forests through silvi-pastoral practices of integrating grasses and fodder trees under the instruments of Joint Forest Management.
- Develop fodder blocks in Forest Fringe Villages through revival and development of pastures on CPRs in collaboration with Panchayati Raj Institutions.
- Creation of fodder banks/ storage facilities in partnership with user groups.
- Development of seed/ germplasm banks and nurseries in every state for pasture development program in collaboration with research institutes.
- Promote incorporation of fodder trees with agricultural practices towards agro-forestry initiatives.

CAF can effectively fund Pastures under PES model

- Compensatory Afforestation Fund (CAF) can work on the lines of the PCF as above and support aggregators (like Terra Prima) to support mobilization of communities to develop pastures/common grazing lands and make the payment for environmental services to these communities.

- A new scheme on rangeland and silvi-pasture management for rehabilitation and productivity enhancement of rangelands, traditional grasslands on common/revenue lands around forest areas is to be formulated by MoEF and the same should be integrated within the agro forestry policy as well.

- A proper institutional framework is needed to develop appropriate models and mobilise communities to take this process forward. The Mission/Board proposed under the agro forestry policy may also promote these models and ensure that the Ad hoc CAMPA allows for these projects to be funded under the Annual Plan of Operations and integrated with the activities of the 'National Afforestation and Eco-development Board/Green India Mission"

NEXT STEPS: DEVELOPING THE MAC CURVES FOR THREE LARGEST EMITTING SECTORS

Cursory review of McKinsey vs Planning Commission report

McKinsey

- Reference case (penetration of few technologies and policy measures assumed)
- Abatement case (200 additional technologies and practices considered; List not available)

Base year is 2005
Target year is 2030
GDP growth 7.5%
Cost impact covered

Planning Commission

- BAU scenario (does not consider any change in electrical demand intensity, SEC, or carbon intensity)
- Determined efforts scenario (policies already in place or contemplated but implemented effectively)
- Aggressive efforts scenario (new policies introduced and implemented)

Base year is 2007
Target year is 2020
GDP growth 8%, 9%
Cost impact not covered

Critique on McKinsey report – common for all sectors (1/2)

- Discount factor - based on societal cost (8%) has been considered for all options. This is not applicable for private players. For private investment, WACC (weighted average capital cost) is the discount factor which will be more than 12% considering 16% ROE and 12% interest. At 8% discount factor, an option would have lower abatement cost/tonne. For example – Pulverized coal injection technology in steel plant has -599 INR/toe @ 12% discount factor, abatement cost would be -1485 INR/toe @ 8% discount factor. This may alter the sequence of options if arranged in ascending cost order

- Differentiation between existing and new system – It seems that options for existing and new system have been reported together. Since the abatement measures are different for existing plants and new plants, it would be good to have them separately for better clarity. Not clear if they have done so or not?

Critique on McKinsey report – common for all sectors (2/2)

- Taxes, subsidies, and transaction costs have not been considered. Including these costs would alter the cost level and possibly ranking order of measures. *For example – coke dry quenching (CDQ) technology is a new technology having technology cost of 100 crores for a 1 million tonne steel plant. On a life cycle costing basis, it is a negative cost option having -58 INR/toe cost. Since this technology is imported, if 20% import duty or transaction cost or tax is applicable then capital cost would rise to 120 crores and abatement cost per toe will become 2331 INR/toe (negative to positive)*

- Marginal abatement cost curve developed by McKinsey shows abatement options upto 100 Euro/tonne CO2. There is no rationale for this except that it was pegged to the CER It is less likely that India may consider such higher cost abatement options. Having a MAC curve with 20 Euro/tonne ceiling may be useful since prices of CER (when at peak) were also in the same range.

Critique on McKinsey report (Iron & Steel)

- Relevance of option: 7% shift in reference case and 14% in Abatement case from BF-BOF to gas based DRI-EAF has been assumed. The gas DRI route has not seen any improvement in last 15 years. Due to limitation of natural gas availability, no growth is expected in this segment and hence 14% looks difficult to achieve. Planning Commission estimation shows increase in BF-BOF route and reduction in DRI which is contrary to McKinsey's assumption.
- Differentiation between existing and new system – It seems that options for existing and new system have been reported together. Since the abatement measures are different for existing plants and new plants, it would be good to have them separately for better clarity. Whether any
- It is not clear whether any double counting has been considered

Critique on McKinsey report (Cement)

- Non consideration of option: *Proven technologies like use of six stage preheaters, vertical roller mills in grinding, high efficiency clinker coolers have existing penetration at 20-50%. Discussion of these technologies could not be found in the report*

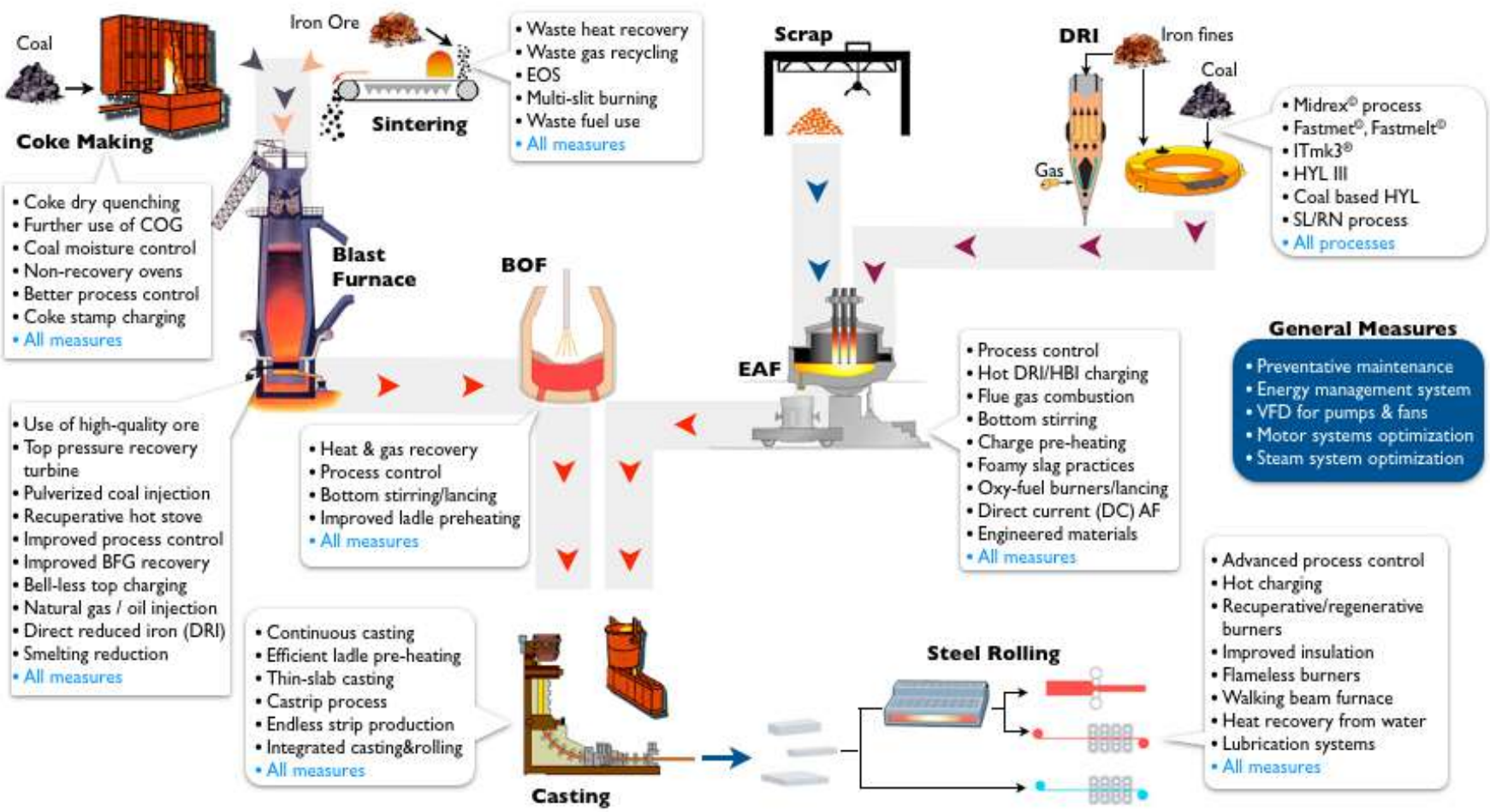
- Negative cost option: *Clinker substitution with fly ash is shown as a negative cost option. This may be true before 2009 when it was obligatory on part of power plants to supply fly ash for free for 10 years. These days cement manufacturers have to pay for fly ash and thus it may not be a negative cost option anymore.*

- Potential underestimation: *Waste heat recovery potential from clinker kiln exhaust to generate electricity seems to be understated by 50%. Actual potential is twice of what has been presented.*

Critique on McKinsey report (Thermal Power)

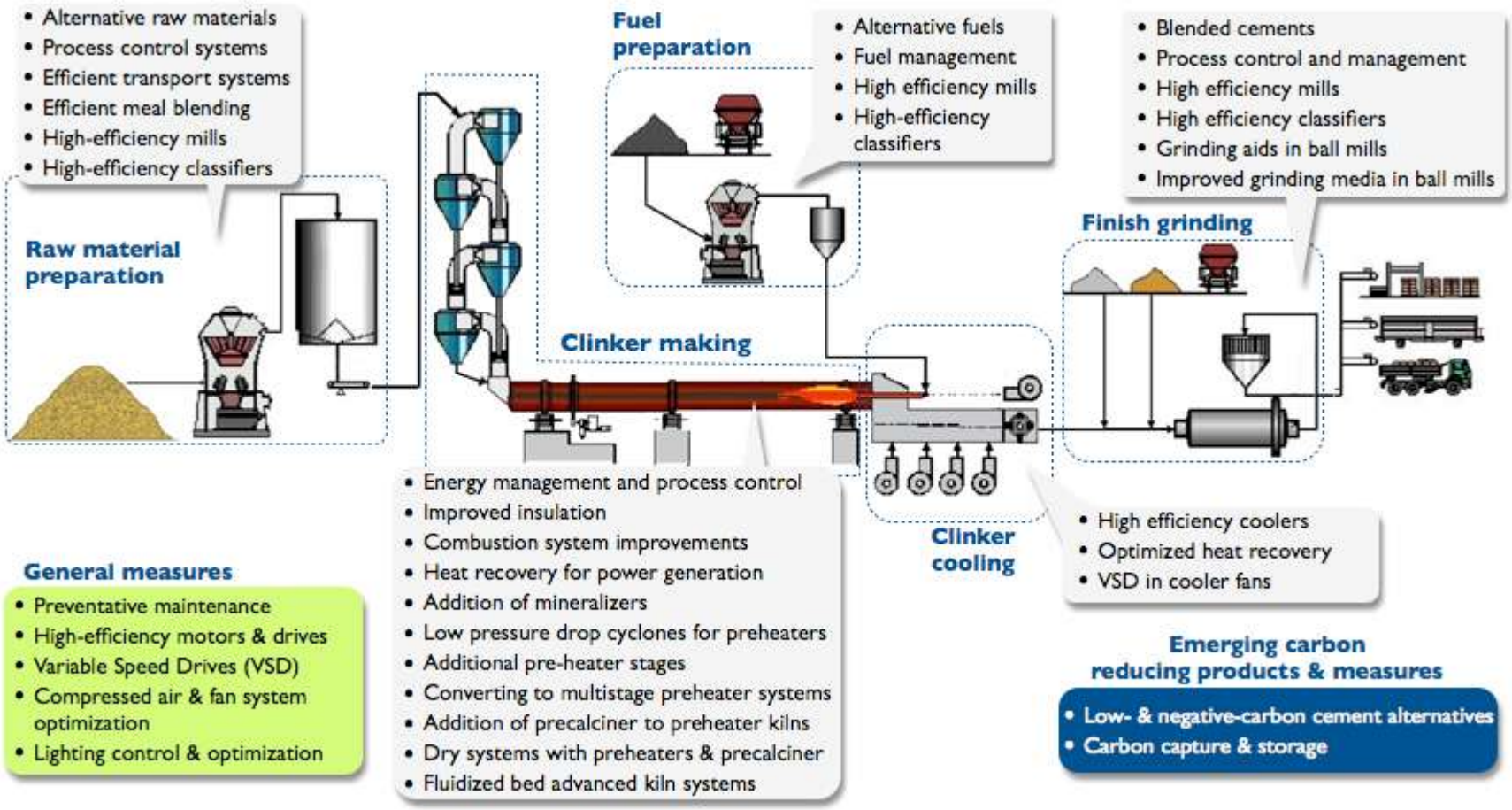
- Potential overestimation: Auxiliary power consumption between 6 to 8% in reference case and 5% in abatement case looks very ambitious. Existing plants by virtue of design can reach upto 7.3%. Even the new plants based on super-critical have APC of around 7%

Library of options for Iron & Steel



11 promising technologies are considered for Abatement case

Library of options for Cement

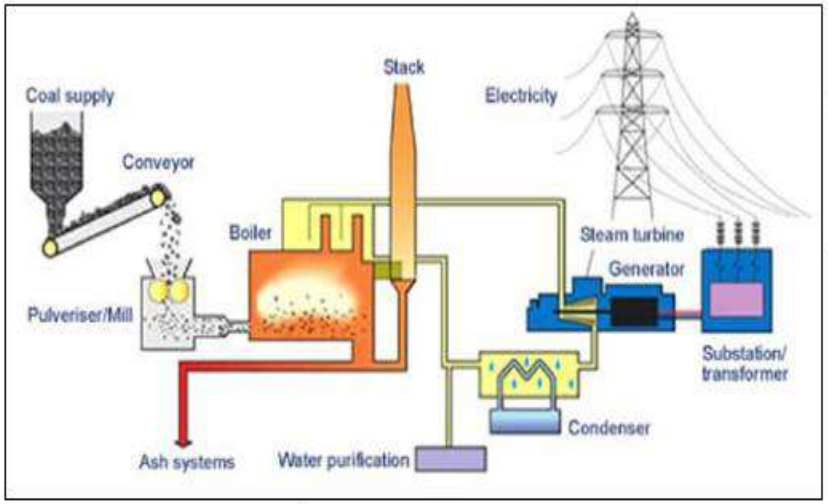


15 promising technologies are considered for Abatement case

Library of options for Coal power plant

Exhaust
a. Use of Wet FGD system
b. ESP design modificaiton and uprgadation to higher particulate removal efficiency
c. Advanced Pulse Jet Fabric Filters
d. Selective Catalytic Reduction
e. Sea Water FGD System
f. Semi Dry FGD
g. Selective Non Catalytic Reduction
h. ROFA ROTAMIX
g. SCR + Wet FGD
i. Electro Catalytic Oxidation

Overall Plant Efficiency
a. Integrated Management System Certified for Quality, Environment, OH&S
b. Online process monitoring and control through Plant Monitoring System
c. Use of Condition Monitoring and Diagnosis for enhanced equipment reliability
d. R&M/L.E. Program
e. Use of magneto drive in place of direct coupled drives



Coal Supply
a. Washed Coal - Impacts both efficiency and emission

Coal Handling Plant
a. Optimization of CHP parameters through micro- processor based control system
b. Use of energy efficienct belts and improved lubrication
c. Introduction of fine seperator/ Wibro grizzly feeders or Wobble feeders

Steam Turbo - Generator
a. Control of main steam parameters, attemperation, cylinder efficiency improvement
b. VFD for condensate extraction pump and optimization of operation parameters

Cooling Tower
a. Effectiveness enhancemnt of cooling tower
b. Condensor tube cleaning by bullet shot method for enhancing it's performance
c. Use of heat pump for reducing cooling tower load

Ash Handling System
a. Installation of dry ash handling system in place of wet system
b. Use of micro - processor based control system for dr/fly ash handling

Boiler
a. Re-introduction of HP heatrers in feed water circuit
b. Optimization of BPF parameters and use of VFD
c. Optimization of draft system parameters
d. Optimization of secondary air through advanced monitoring system
e. Improved thermal insulation of furnace & acessories
f. Surfacce coating of boiler tubes by high velocity oxy fuel process
g. Mathematical modelling of tubular air heaters for performance optimization

18 promising technologies are considered for Abatement case

Sector snapshot (Iron & Steel)

- Production
  - Current (2011-12): 73.8 million tonne, Installed capacity 89.3 million tonne (MoS)
  - Projected (2020): 200 million tonne (PC)

- Energy Consumption
  - Current: About 1700 million GJ (ICF)
  - Energy intensity: 17.2 GJ/tonne for EIF route to 27 GJ/tonne for BF-BOF
  - Historical trend: SEC reduction of 2.5% per annum
  - Savings Potential: 43% in BF-BOF and 20% in DRI-EAF compared to best available technology

- Major production route

As on 2011-12 (MoS)		Expected 2020 (PC)	
BF-BOF	37.5%	BF-BOF	57.5%
Smelt-BOF	5%	Smelt-BOF	20%
DRI-EAF	25.1%	DRI-EAF	7.5%
Scrap EIF	32.5%	Scrap EIF	15%

Major initiative for energy and emission (Iron & Steel)

1. Mandatory SEC reduction target by PAT scheme (2012-15)
   - 76 number of large industries consuming 28 million toe in 2010 are covered
   - Targeted SEC reduction of 3% to 9% with average 5% from 2010 baseline
   - Total energy savings target of 1.647 million toe
   - Scheme likely to continue beyond 2015
   - Expected investment mobilization of 2007 crores

2. Voluntary reduction of SEC by the sector
   - Participation in NECA (reported savings @ average 0.12 lakh per toe)
   - Competitive award scheme by Ministry of Steel

3. CPCB
   - Charter on corporate responsibility for environment protection (CREP) to reduce environment pollution, water consumption, energy consumption, solid waste & hazardous waste management, etc. as per mutually agreed targets
   - CDQ may be made mandatory for new plants

4. Technology transfer
   - Tata Steel (Coke dry quenching in 2011, Utilization of sensible heat from blast furnace hot stove waste)
   - RINL, Vishakhapatnam (Sinter cooler waste recovery, under progress)

Sector snapshot (Cement)

- Production
  - Current (2011-12): 247 million tonne, Installed capacity 340 million tonne (cement manufacturing association)
  - Projected (2017): 407 million tonne production; 479 installed capacity

- Energy Consumption
  - Current: About 14.5 million toe thermal; 23 billion kWh electrical (ICF)
  - Energy intensity: 750 kCal/kg clinker of thermal intensity; 85 kWh/tonne of cement as electrical intensity
  - Historical trend: 2% per annum improvement in thermal; 1.5% per annum improvement in electrical
  - Savings Potential: 11% in thermal and 30% in electrical compared to best available technology

- Major production route

As on 2011-12 (CMA)		Expected 2030 (ICF)
Ordinary portland (OPC)	31%	10%
Portland pozzolona (PPC)	61%	90%
Portland blast furnace slag (PBFS)	8%	

Major initiative for energy and emission (Cement)

1. Mandatory SEC reduction target by PAT scheme (2012-15)
   - 82 number of large industries consuming 11.87 million toe in 2010 are covered
   - Targeted SEC reduction of 4% to 7% with average 5% from 2010 baseline
   - Total energy savings target of 0.698 million toe
   - Scheme likely to continue beyond 2015
   - Expected investment mobilization of 3873 crores

2. Voluntary reduction of SEC by the sector
   - Participation in NECA (reported savings @ average 0.55 lakh per toe)

3. CPCB
   - Charter on corporate responsibility for environment protection (CREP) to reduce environment pollution, water consumption, energy consumption, solid waste & hazardous waste management, etc. as per mutually agreed targets

4. BIS
   - Bureau of Indian Standards permits use of upto 35% fly ash in PPC cement

Sector snapshot (Thermal power plant)

- Capacity
  - 58% of total capacity (223 GW) by March 2013 (CEA)
  - 73% of total generation (952 BU) in 2012-13 (CEA)
  - 66 GW capacity out of 98 GW planned addition in 12th plan (CEA)
  - PLF (2012): 73.32%

- Energy Consumption
  - Heat rate: net operating heat rate of 2423 – 5443 kcal/kWh
  - Auxiliary power consumption: 6% to 15% of gross generation
  - Savings Potential: Heat rate improvement potential to 2236 kcal/kWh; APC improvement potential to 7.3%

- Existing deviation in net heat rate

Deviation in Net Station Heat Rate from Design Net Heat Rate	Reduction Target for Deviation in Net Station Heat Rate (%)
Up to 5 %	10 %
More than 5% and Up to 10 %	17 %
More than 10% and Up to 20%	21 %
More Than 20 %	24 %

Major initiative for energy and emission (Thermal power plants) (1/2)

1. Mandatory SEC reduction target by PAT scheme (2012-15)
   - **142** number of large power plants consuming 104.56 million toe in 2010
   - Targeted net heat rate improvement of upto 10% with average 2% improvement from 2010 baseline
   - Total energy savings target of 3.1 million toe
   - Scheme likely to continue beyond 2015
   - Expected investment mobilization of 62000 crores

2. Technical standards defined by CEA
   - Norms for maximum continuous rating under worst fuel quality stipulated for the unit (2010 latest)
   - Norms for minimum Boiler efficiency (2010 latest)
   - Norms for minimum Gross turbine cycle heat rate for sub-critical and supercritical (2010 latest)
   - Norms for minimum generator efficiency at Rated load (2010 latest)
   - Guidelines and recommendation to ministry to push supercritical technology (12th plan)
     - 38% of the coal based plants with supercritical in 12th plan
     - 100% of the coal plants using supercritical from 13th plan onwards; MoEF may be advised not to clear any sub-critical plant
     - Coal linkages only for supercritical plants from 13th plan onwards

Major initiative for energy and emission (Thermal power plants) (2/2)

1. MOEF / CPCB norms on environment / emissions

- TPP located 1000 kms. from pit heads or those located in urban, sensitive and critically polluted areas to mandatorily use raw or blended or beneficiated coal with ash content not exceeding 34% on an annual average basis (1997)
- Mandatory Ash utilization and disposal
- Mandatory Fly ash disposal and utilization (1999)
- Norms on maximum Particulate Matter (1993)
- Requirements of Flue gas desulphurisation (Guideline)
- Different stack height specified for different power generation capacity and steam generation capacity for wider dispersal of $S0_2$ (1994)
- Mandatory EIA report for environmental clearance (1994)
- For coal plants dependent on domestic coal, environmental clearance to be considered if coal quality parameters (calorific value, sulphur content, ash content) are provided in EIA report (2012)
- For UMPP based on imported coal, environmental clearance to be considered if minimum coal quality parameters are met (minimum 5000 Kcal/kg calorific value, maximum 12% ash content, maximum 0.8% sulphur content) (2013)

Emission reduction impacts projected in different scenarios

Greater reduction in emissions

- BAU (no change in emission intensity)
- Determined efforts (23 to 25% reduction in intensity over 2005 level)
- Reference Case (29% reduction in emission intensity over 2005)
- Abatement Case (30 to 50% reduction potential compared to reference; 40% reduction in emission intensity over 2005)
- Aggressive efforts scenario (33 to 35% reduction in emission intensity over 2005)

McKinsey

Planning Commission

Elements of PAT-1 Cycle

- **Multi- Cycle Process :** First Cycle in 2012-2015, to continue with similar cycle time with revision of targets

- **Target Setting for PAT-1**
  - **Based on Gate-to-Gate SEC concept**: It is a plant based approach rather than project based approach as in CDM or typical emission trading schemes
  - **Based on Relative SEC concept**: Good performing plants get lesser target as compared to poorly performing plants. Targets are plant specific, rather than sector specific. But the energy saving quantum from a sector based on total national energy saving goal is ensured.

- **Monitoring & Verification**
  - DCs to record and monitor their energy purchase, sale and usage
  - DCs to report the verified data to SDA and BEE (Voluntarily in every year, but mandatorily at the compliance period)
  - Data verification to be done by Accredited Energy Auditors (AEA) listed by BEE. DCs to engage AEAs
  - Check Verification to be done by BEE on sample basis
  - Document based verification, rather than measurement based

Elements of PAT-1 Cycle

- **Incentivization for Excess Energy Saving**
  - Energy Saving Certificates (Escerts) can be issued w.r.t. energy saved to the excess of target
  - 1 Escerts = 1 toe saved in excess of the target
  - Early issuance is possible (after 1 year) No issuance so far
  - Escerts can be traded among all DCs of the 8 sectors for meeting compliance or banking
  - Banking is allowed for two consecutive cycles (i.e. PAT-1 & Pat-2)
  - Trading to be done on the Power Exchangers Platform (IEX/PXIL)

- **Penalty for Non-Compliance**
  - Quantum of non-compliance is the deficiency in meeting the target at the end of cycle and penalty is the energy cost of quantum of non-compliance plus a fixed amount of INR 10 lakh
  - Quantum of non compliance is provided in verification report and penalty is adjudicated by the state electricity regulatory commission
  - Converted energy cost is Rs 10,154 per toe (2011-12) which shall be periodically updated
  - Penalty for non-compliance being Rs. 10 lakhs and the value of non-compliance measured in terms of the market value of tonnes of oil equivalent as per Section 26(1A) of EC Act, 2001.

Escerts Calculation for Early Issuance (Example)

- Number of Escerts to be issued will be proportionate to the performance achieved during the duration (not less than 1 year)
- Early issuance limited to 80% of entitlement upto that year
- SEC will be adjusted at the end of that year

- Baseline, SEC(baseline) = 10 toe/tonne
- Target, SEC (target) = 7 toe/tonne
- Achieved after year 1, SEC (a) = 8.5 toe/t
- Production = 10000 tonne

AFTER YEAR 1

Escerts = [SEC(b) – ((SEC (b)– SEC (t))/3 – SEC(a)] x 80% x prod

= ((10 – (10-7)/3) – 8.5)) x 0.8 x 10000

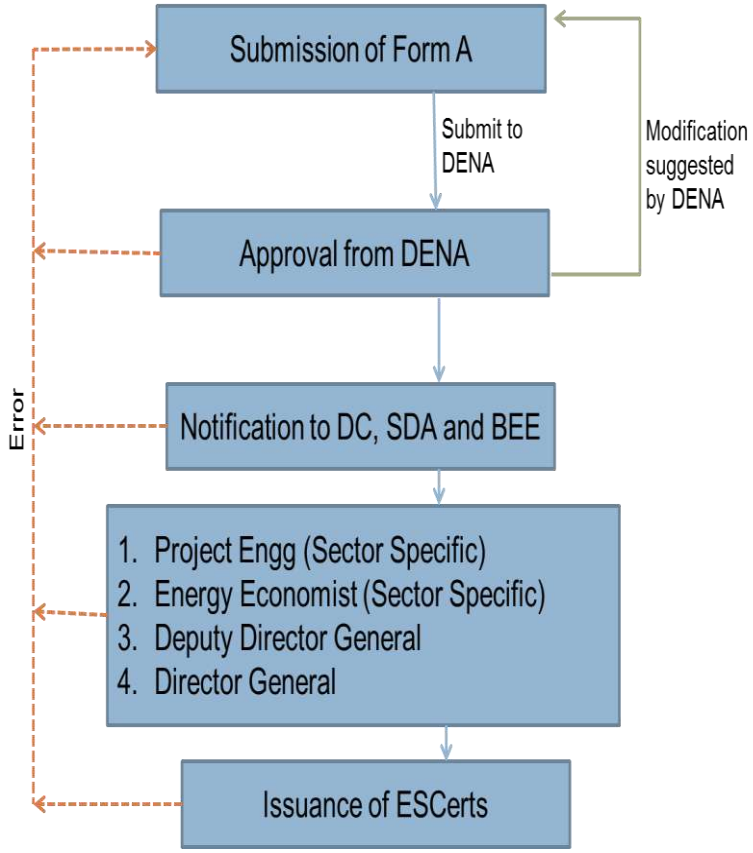
= (9-8.5) x 8000 = 4000 ESCerts

Revised Target = SEC(t) – (Escerts/Prod)

= 7 – (4000/10000) = 6.6 toe/t

Monitoring & Verification Process

Issuance of ESCerts



Compliance Mechanism