Implementation of PAT Scheme in Petroleum Refineries

By

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1. NAPCC & NMEEE
2. PAT – Regulatory Framework & Sectoral Coverage
3. PAT – Salient Feature & Implementation Framework
4. PAT Impact – Realized and Projected
5. Inclusion of Petrochemicals into PAT
National Action Plan on Climate Change (NAPCC)
Nation Mission for Enhanced Energy Efficiency (NMEEE)

- Energy Intensive Industries
  - Targets for Mandatory Energy Saving
- Stimulate Funding for ESCOs
- PAT
- EEFP
- NMEEE
- MTEE
- FEEED

Energy Efficient Appliances
- BLY
- SEEP
- DSM

Fiscal Instrument for EE
- Partial Risk Guarantee Fund (PRGF)
- Venture Capital Fund (VCF)
- Public Procurement
Perform, Achieve & Trade

A *market based regulatory instrument* to reduce specific energy consumption in industries, to *enhance the cost effectiveness* through tradable *energy saving certificates*.

- **Section 14 (g): Establish norms**
- **Section 14 (n): Direction to Industries**
- **Section 14A: Energy Saving Certificates**
- **Section 26: Penalty & Enforcement**
- **Section 27: Adjudication**
Sectoral Coverage

Criteria for Identification of Sectors

- Listed in Schedule of EC Act
- Intensity or quantity of energy consumed
- Amount of investment needed
- Capacity to invest
- Availability of energy efficient technology

Sectors in PAT Cycle I (2012-15)

1. Aluminum
2. Cement
3. Chlor Alkali
4. Fertilizers
5. Iron and Steel
6. Pulp and Paper
7. Textile
8. Thermal Power Stations
PAT 1 Coverage

TPES: 693 mtoe
TFEC: 480 mtoe
Industry: 313 mtoe
PAT I – 165 mtoe (52% of Industry)

TPES: Total Primary Energy Supply
TFEC: Total Final Energy Consumption
Industry includes Thermal Power Plants
mtoe: Million tonnes of Oil Equivalent

Baseline Year: 2010
Data Source: IEA and BEE
Sectoral Coverage: Cycle II and beyond

Additional Sectors in PAT Cycle II (2016-19)
1. Railways
2. Petroleum Refineries
3. Electricity Distribution Companies

Proposed Sectors in Coming Cycles of PAT
1. Chemicals
2. Commercial Buildings or Establishments
3. Hydel power stations, Electricity Transmission Companies
4. Petrochemical, Gas Crackers Naphtha Crackers
5. Port Trust
6. Sugar
7. Transport Sector (Industries and Services)
PAT 2 Coverage

TPES: Total Primary Energy Supply
TFEC: Total Final Energy Consumption
Industry includes Thermal Power Plants and Railways
mtoe: Million tonnes of Oil Equivalent

PAT II – 227mtoe (58% of Industry)

Target Energy Saving Share

- Railways 0.6%
- Aluminium 4.7%
- Chlor-Alkali 0.8%
- Fertilizer 3.6%
- Iron & Steel 17.8%
- Paper & Pulp 1.2%
- Textile 0.7%
- Refinery 8.2%
- Cement 9.5%
- Thermal Power Plant 53.0%

Target: 8.869 mtoe

Baseline Year: 2014-15
Data Source: IEA and BEE
PAT- Salient features

• Regulatory instrument linked with market mechanism
  - Certification of energy saving
• Consultative approach
  - Ministries/DCs/Associations/FIs/Research Organizations
• Outreach/ Capacity Development
  - Workshops/Seminars/ Visits
• “Self – competing”
  - Unit specific targets
• Relative responsibility
  - Less target for more efficient and more for less efficient
Target is Plant Specific …… Less for Energy Efficient and more for Inefficient Plants
Gate-to-Gate concept

All forms of Energy

Electricity (KWH)

FO (Ltr)

NG (SCM)

Coal (KG)

Others (KG or Ltr)

SEC = E / P

Baseline SEC

Target SEC

Y1 Y2 Y3

Reduction in SEC

Expressed in %
Concept of Target, Compliance, ESCerts & Penalty

- Baseline SEC
- Target SEC
- Issued ESCerts
- Achieved SEC
- Penalty
- Compliance

Scenario 1

Scenario 2

Saving Target

Purchase ESCerts
SEC (Specific Energy Consumption): Energy Consumed per unit production
**Target Setting**

**Policy objectives**

- **INDC**
  - Intended Nationally determined Contribution (INDC): reduction of emission intensity by 33-35% of GDP by 2030 from the base year of 2005

- **GOALS**
  - Reduction in energy intensity between 2016 and 2019 by 7%
## Typical PAT Cycle

<table>
<thead>
<tr>
<th>DC Notification</th>
<th>Data Collection &amp; Verification</th>
<th>Consultation</th>
<th>Ministerial Technical Committees &amp; Notification</th>
<th>Implementation</th>
<th>Achievement Verification &amp; ESCert Trading</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 6 Months</td>
<td>~ 6 Months</td>
<td>~ 3 Months</td>
<td>~ 3 Months</td>
<td>3 Years</td>
<td>~ 12 Months</td>
</tr>
</tbody>
</table>

- **Minimum Energy Consumption Notification**: Say 30000 toe for cement
- **11 Sectors notified so far**
- **Data Collection & 3rd party verification for Baseline**: Data collected from 1000 plus industries
- **With Industries, Associations, Ministries, Research Bodies etc.**: 250 Plus consultation meeting/workshops/visits
- **70 TCM to discuss Targets, Saving potential & international practices**: PAT1: 31.3.12 478 units, PAT2: 30.3.16 621 units, PAT3: 31.3.17 116 Units
- **Verification by Accredited Energy Auditors & Trading**: 427 industries verified for PAT1
## PAT Cycle I- Notified Sectors

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Sectors</th>
<th>Annual Energy Consumption Norm to be DC (mtoe)</th>
<th>No. of Identified DCs</th>
<th>Annual Energy Consumption (Million toe)</th>
<th>Share Consumption (%)</th>
<th>Apportioned Energy Reduction For PAT Cycle-1 (Million toe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power (Thermal)</td>
<td>30000</td>
<td>144</td>
<td>104.56</td>
<td>63.38%</td>
<td>3.211</td>
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<tr>
<td>2</td>
<td>Iron &amp; Steel</td>
<td>30000</td>
<td>67</td>
<td>25.32</td>
<td>15.35%</td>
<td>1.486</td>
</tr>
<tr>
<td>3</td>
<td>Cement</td>
<td>30000</td>
<td>85</td>
<td>15.01</td>
<td>9.10%</td>
<td>0.815</td>
</tr>
<tr>
<td>4</td>
<td>Aluminium</td>
<td>7500</td>
<td>10</td>
<td>7.71</td>
<td>4.67%</td>
<td>0.456</td>
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<tr>
<td>5</td>
<td>Fertilizer</td>
<td>30000</td>
<td>29</td>
<td>8.20</td>
<td>4.97%</td>
<td>0.478</td>
</tr>
<tr>
<td>6</td>
<td>Paper &amp; Pulp</td>
<td>30000</td>
<td>31</td>
<td>2.09</td>
<td>1.27%</td>
<td>0.119</td>
</tr>
<tr>
<td>7</td>
<td>Textile</td>
<td>3000</td>
<td>90</td>
<td>1.20</td>
<td>0.73%</td>
<td>0.066</td>
</tr>
<tr>
<td>8</td>
<td>Chlor-Alkali</td>
<td>12000</td>
<td>22</td>
<td>0.88</td>
<td>0.53%</td>
<td>0.054</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>478</td>
<td>164.97</td>
<td>100%</td>
<td>6.686</td>
</tr>
</tbody>
</table>

**Energy Saving**
- 8.67 mtoe
- 5635 MW
- 1.25% of India’s total primary energy supply

**Emission Reduction**
- 31 million tonnes of CO2
- 1.93% of India’s emissions

**Skill Development**
- Capacity building: 5000+ Engineers and operators
- 13718 Energy Auditors & Managers
- 219 Accreditation

**Savings**
- Rs 37,685 Crores ($5.8 Billion)
- from saved energy consumption and avoided generation

**Investment**
- Encouraged investments for energy efficient technologies for domestic manufacturing
- Rs 24,517 Crore ($3.8 Billion) invested
Sectoral Share of Target and Achievement

**Target Energy Saving Share**
- Thermal Power Plants: 48%
- Iron & Steel: 22%
- Cement: 12%
- Aluminium: 7%
- Chlor-Alkali: 1%
- Paper & Pulp: 2%
- Textile: 1%

**Achieved Energy Saving Share**
- Thermal Power Plants: 35%
- Iron & Steel: 25%
- Cement: 17%
- Aluminium: 8%
- Chlor-Alkali: 1%
- Fertilizer: 9%
- Paper & Pulp: 3%
- Textile: 2%

**Target: 6.686 mtoe**
**Achieved: 8.67 mtoe**
## PAT Cycle II- Notified sectors

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Sector</th>
<th>No. of DCs in PAT I</th>
<th>Additional DC in PAT Cycle-II</th>
<th>Total no. of DCs PAT -2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum</td>
<td>10</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Chlor-Alkali</td>
<td>22</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>Textile</td>
<td>90</td>
<td>14</td>
<td>99</td>
</tr>
<tr>
<td>4</td>
<td>Pulp &amp; Paper</td>
<td>31</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>Iron &amp; Steel</td>
<td>67</td>
<td>9</td>
<td>71</td>
</tr>
<tr>
<td>6</td>
<td>Fertilizer</td>
<td>29</td>
<td>8</td>
<td>37</td>
</tr>
<tr>
<td>7</td>
<td>Cement</td>
<td>85</td>
<td>27</td>
<td>111</td>
</tr>
<tr>
<td>8</td>
<td>Thermal Power Plants</td>
<td>144</td>
<td>22</td>
<td>154</td>
</tr>
<tr>
<td>9</td>
<td>Refinery</td>
<td>NA</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>DISCOMS</td>
<td>NA</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>11</td>
<td>Railway</td>
<td>NA</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>621</td>
</tr>
</tbody>
</table>

**PAT Cycle II**
Baseline Year: 2014-15
PAT Cycle 2016-2019
Assessment Year: 2018-19
Projected Impacts – PAT 2 (2016-19)

Energy Saving
17.5 mtoe
11407 MW
2.09% of India’s total primary energy supply

Emission Reduction
60 million tonnes of CO2
3-4% of India’s emissions

Skill Development
Capacity building: 12000+ Engineers and operators
15000 Energy Auditors & Managers
500 Accreditation

Savings
Rs 48110 Crores ($7.5 Billion)
from saved energy consumption and avoided generation

Investment
Encouraged investments for energy efficient technologies for domestic manufacturing
Rs 30,000 Crore ($4.6 Billion) (Projected)
Help meet global standards
- Cement sector is globally most energy efficient, Fertilizer is in process

Increased corporate attention
- Shift from Bench floor to Board room

Replication abroad
- Thailand, Bangladesh, Sri Lanka

Shoulders NDC commitments
- 34% of the MOP share of CO2 Mitigation of from PAT alone

Energy Benchmarking
- Adoption of M&V and Normalization process in ISO 50000

Specific Energy Consumption (SEC)
- tonne of oil equivalent /tonne of production
“Excellent ‘baseline’ data established”

“Excellent methodology and formats for monitoring developed - ACC, Ultratech etc. using these formats for regular monitoring”

The "Perform, Achieve and Trade" (PAT) mechanism is the most innovative and challenging initiative introduced under NMEEE (National Mission for Enhanced Energy Efficiency). FICCI

“It’s really interesting. There’s no other country in the world that’s doing this so ambitiously.” Noah Sachs, a law professor at the University of Richmond in Virginia, who spent the spring studying the program.

“The Indian program is particularly promising because it is a national, as opposed to a regional or statewide or provincial, program,” Richard Sandor, the chairman of Environmental Financial Products, a firm that has helped introduce several climate-related financial exchanges.
Accelerated Technology Adoption

- **Cement**
  - Waste Heat Recovery (WHR), Vertical Grinding Mill, VAM

- **Fertilizer**
  - Feed Stock Change-over, Steam Methane Reformer (SMR)

- **Pulp & Paper**
  - Black Liquor Recovery, High Pressure Boiler, Double Digestion

- **Thermal Power Plant**
  - Super Critical Technology, Coal Washeries, Dynamic Coal Balancing

- **Iron & Steel**
  - Waste Heat Recovery, Coke Dry Quenching, Top Recovery Turbine
PAT II and Beyond (Rolling Cycle)

- **PIII**: BY:2015-16, AY:2019-20
- **PIV**: BY:2016-17, AY:2020-21
- **PV**: BY:2017-18, AY:2021-22
- **PVI**: BY:2018-19, AY:2022-23
- **PVII**: BY:2019-20, AY:2023-24

**Yearly Targets:**

- **2012**: 478
- **2016**: 621
- **2017**: 116
- **2018**: 62
- **2019**: 1
- **2020**: 11
- **2021**: 6

**Note:** Left Over in existing sector + New Sectors
Inclusion of Petroleum Refineries into PAT Cycle - II
Indian Refineries

- India has 24 refineries:
  - Public Sector: 19
  - Private Sector: 3
  - Joint ventures: 2

- Indian refining industry is the 4th largest in the world

- Main outputs of refinery: LPG, Petrol, Naphtha, Aviation fuel, Kerosene, Diesel oil, Furnace oil

- Focus shifted from maximization of middle distillates to market driven economics – more secondary units

- Stringent Envn. Norms, fuel quality compliance & improved performance – ‘key’ for survival

- Evolving Refinery Configurations – highly complex & integrated with Petrochemicals / Power plants to up-grade bottom of the barrel for maximize profitability
Rationale for selecting Refinery sector

- The Energy Conservation (EC) Act, 2001 empowers the Central Government to establish and prescribe energy consumption norms for Designated Consumers (DCs)


- High Energy Saving Potential

- Prime Minister’s Council on Climate Change directed to include Petroleum Refineries, DISCOMs and Railways into PAT scheme

- Energy cost is major head and directly impacts on margins

- Established institutional structure for energy efficiency
Schedule of the EC Act, 2001

1. Aluminium;
2. Fertilizers;
3. Iron and Steel;
4. Cement;
5. Pulp and paper;
6. Chlor Akali;
7. Sugar;
8. Textile;
9. Chemicals;
10. Railways;
11. Port Trust;
12. Transport Sector (industries and services);
13. Petrochemicals, Gas Crackers, Naphtha Crackers and Petroleum Refineries;
14. Thermal Power Stations, hydel power stations, electricity transmission companies and distribution companies;
15. Commercial buildings or establishments;
Specific Energy Consumption – Trend Since 1984-85

Specific Energy Consumption
(Industry average)

Financial Year

( MBTUL/bbl/NRGE )
### Industry and PSU Average

![Graph showing the average energy consumption from 2004-2014 for MBN-INDUSTRY, MBN-PSU, NRGF-INDUSTRY, and NRGF-PSU.

#### MBN-INDUSTRY
- 2004-2005: 66.2
- 2005-2006: 68.7
- 2006-2007: 63.2
- 2007-2008: 61.1
- 2008-2009: 58.5
- 2009-2010: 58.6

#### MBN-PSU
- 2004-2005: 81.1
- 2005-2006: 76.4
- 2006-2007: 73.6
- 2007-2008: 70.7
- 2008-2009: 69.0
- 2009-2010: 67.8
- 2010-2011: 65.7
- 2011-2012: 63.2
- 2012-2013: 62.4
- 2013-2014: 61.5

#### NRGF-INDUSTRY
- 2004-2005: 5.7
- 2005-2006: 5.7
- 2006-2007: 6.8
- 2007-2008: 7.2
- 2008-2009: 7.6
- 2009-2010: 7.6

#### NRGF-PSU
- 2004-2005: 5.0
- 2005-2006: 5.2
- 2006-2007: 5.4
- 2007-2008: 5.4
- 2008-2009: 5.5
- 2009-2010: 6.0
- 2010-2011: 6.4
- 2011-2012: 6.4
- 2012-2013: 6.3
- 2013-2014: 6.3
The percentage reduction in MBN values is in the range of 4%-12%.
## Sectoral Targets - PAT Cycle – II

<table>
<thead>
<tr>
<th>S. No</th>
<th>Sector</th>
<th>No of DCs</th>
<th>Energy Consumption (million toe)</th>
<th>Energy Savings (million toe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thermal Power Plant</td>
<td>154</td>
<td>120.16</td>
<td>3.13</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>111</td>
<td>21.43</td>
<td>1.12</td>
</tr>
<tr>
<td>3</td>
<td>Aluminium</td>
<td>12</td>
<td>10.66</td>
<td>0.57</td>
</tr>
<tr>
<td>4</td>
<td>Chlor Alkali</td>
<td>24</td>
<td>1.77</td>
<td>0.101</td>
</tr>
<tr>
<td>5</td>
<td>Pulp &amp; Paper</td>
<td>29</td>
<td>2.68</td>
<td>0.15</td>
</tr>
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<td>6</td>
<td>Iron &amp; Steel</td>
<td>71</td>
<td>40.44</td>
<td>2.14</td>
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<td>7</td>
<td>Textile</td>
<td>99</td>
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<td>0.087</td>
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<td>8</td>
<td>Fertilizer</td>
<td>37</td>
<td>8.25</td>
<td>0.446</td>
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<td>9</td>
<td>Refinery</td>
<td>18</td>
<td>18.5</td>
<td>1.10</td>
</tr>
<tr>
<td>10</td>
<td>Railways</td>
<td>22</td>
<td>1.39</td>
<td>0.033</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>577</strong></td>
<td><strong>226.76</strong></td>
<td><strong>8.877</strong></td>
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</tbody>
</table>
Sectoral Targets - PAT Cycle – II

Energy Savings (million toe)

- Thermal Power Plant: 35%
- Cement: 13%
- Aluminium: 7%
- Chlor Alkali: 1%
- Pulp & Paper: 2%
- Iron & Steel: 24%
- Textile: 12%
- Fertilizer: 7%
- Refinery: 5%
- Railways: 1%
- Others: 0%
## Refinery wise Targets

<table>
<thead>
<tr>
<th>S.N</th>
<th>REFINERY</th>
<th>Baseline (New MBN)</th>
<th>Target (New MBN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MBN</td>
<td>Crude T'put Th.Bbls</td>
</tr>
<tr>
<td>1</td>
<td>RIL-DTA</td>
<td>51.6197</td>
<td>217283</td>
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<td>2</td>
<td>RIL-SEZ</td>
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<td>259844</td>
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<td>3</td>
<td>EOL</td>
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<td>142936</td>
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<td>NRL</td>
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<td>19771</td>
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<td>6</td>
<td>IOC-PANIPAT</td>
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<td>7</td>
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</tr>
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<td>8</td>
<td>IOC-MATHURA</td>
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<td>IOC-GUJARAT</td>
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<td>10</td>
<td>BPCL-MR</td>
<td>77.2812</td>
<td>96096</td>
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<tr>
<td>11</td>
<td>IOC-HALDIA</td>
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<td>55845</td>
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<td>12</td>
<td>BPCL-K</td>
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<td>MRPL</td>
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<td>HPCL-VISAKH</td>
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<td>16</td>
<td>HPCL-MUMBAI</td>
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<td>17</td>
<td>CPCL</td>
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<td>18</td>
<td>IOC-BONGAIGAON</td>
<td>98.6555</td>
<td>17729</td>
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</tbody>
</table>
Refinery Wise MBN Targets

Target For Petroleum Refineries under PAT Scheme

Relative Responsibility: Less target for more efficient & higher target for inefficient unit.
Thank you
- USA - 26 – 28% (Base 2005) – Med.
- China - 60 – 65 % (Base 2005) – Med.
- Russia - 25 – 30 % (Base 1990) – Inadeq
- South Korea - 37 % (Base 1990) – Inadeq.
- EU - 40 % (Base 1990) – Med.
- Australia - 26 – 28% (Base 2005) – Inadeq.
- Japan - 26 % (Base 2013) – Inadeq.
- Canada - 30 % (Base 2005) – Inadeq.
- India - 33 – 35 % (Base 2005)
Challenges

Programmatic Challenges

- Meeting increased efficiency norms requires substantial investment
  - Fiscal and Non-Fiscal incentives for energy efficient technologies deployment
  - Dedicated fund - Proposal for creating a fund sourced from NCEF for Financing Energy Efficiency projects in PAT and small scale industries. (India – UK bilateral, UK Carbon Trust)

- Enforcement
  - Strengthening of State Regulatory Commissions (SERCs) and State Designated Agencies (SDAs)

- Robust Monitoring & Verification
  - Capacity Building of Energy Professionals
Way Forward

- Expansion of the Program
  - Cover more sectors of economy to enhance EE (Widening and Deepening)
  - PAT under Rolling cycle
  - Accelerate market transformation for EE appliances/equipment
  - Creation of financial ecosystem to support EE projects
    - Partial Risk Guarantee Fund for Energy Efficiency
    - Venture Capital fund for Energy Efficiency
    - Industrial Energy Efficiency Fund
CO₂ mitigation by 2020 from Industries

Total CO₂ reduction by 85 million tonnes of CO₂ from all 13 sectors

CO₂ Mitigation by 2020

Cumulative Saving in mtoe

Expected CO₂ mitigation in mtCO₂

Cumulative CO₂ mitigation: 329 mtCO₂

Energy consumption Coverage up to 70%