ERI’s Research Activities in 2014

Jiang Kejun, Hu Xiulian

Energy Research Institute
21th AIM International Workshop
Nov. 13-15, 2015
Tsukuba
Modeling activities in 2014

- feasibility for 2 degree scenario: multiply 2 degree scenarios
- air pollution control policies assessment, co-benefit with GHG emission
- carbon pricing assessment: carbon tax, emission trading
- Provincial/City studies: Beijing Low Carbon Development Strategy, Guiyang Energy Planning
- Coal peaking study
- Rapid Energy Transition Scenario for China
- Energy Solution in rural area
- CD-LINK, LIMIT, IAMC, EMF30, MILES
- 2 degree Asia
Figure 2. Emission allowances by allocation category for Cat 1, i.e. 425-475 ppmCO2e, in 2030 relative to 2010 emissions (min, 20th percentile, 80th percentile, max). Number of studies in brackets. GHG emissions (all gases and sectors) in GtCO$_2$e in 1990 and 2010 were OECD90 13.4, 14.2, EIT 8.4, 5.6, ASIA 10.7, 19.9, MAF 3.0, 6.2, LAM 3.3, 3.8.
Figure 3. Emission allowances for various concentration levels in 2050 relative to 2010 emissions (min, 20th percentile, 80th percentile, max). Number of studies in brackets. GHG emissions (all gases and sectors) in GtCO₂e in 1990 and 2010 were OECD90 13.4, 14.2, EIT 8.4, 5.6, ASIA 10.7, 19.9, MAF 3.0, 6.2, LAM 3.3, 3.8
Primary Energy Demand: 2 degree scenario 1
Energy Demand in Transport under the 2 degree scenario
Energy Demand in Building under the 2 degree scenario
发电量

TWh

Power Generation

China 2020: Wind 250-300GW, Solar: 150GW
Figure 11. Hydropower Capacity and Additions, Top Six Countries for Capacity Added, 2013

Additions are net of repowering and retirements.
Figure 13. Solar PV Capacity and Additions, Top 10 Countries, 2013

Gigawatts

Germany: +3.3
China: +12.9
Italy: +1.5
Japan: +6.9
United States: +4.8
Spain: +0.2
France: +0.6
United Kingdom: +1.5
Australia: +0.8
Belgium: +0.2

Legend:
- Added in 2013
- 2012 total
2014

Newly Installed Renewable Energy Power

World: 134GW
China: 57GW

Newly Installed Nuclear Power

World: 3.7GW
China: 3GW
Rural Energy Demand in China
A 2 degree Asia: A good way to understand the global target

Scenario Analysis:
Japan
Korea
China
India
Thailand
Malaysia
Indonesia
Nepal
Vietnam
Required GHG reduction ratios in 2050 compared with year 2005, to meet the global 50% reduction are:

<table>
<thead>
<tr>
<th>Burden share scheme</th>
<th>World</th>
<th>Annex-I</th>
<th>Non-Annex I</th>
<th>Asia except Japan</th>
<th>China</th>
<th>India</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Korea</th>
<th>Malaysia</th>
<th>Thailand</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>pCAP</td>
<td>58</td>
<td>83</td>
<td>42</td>
<td>42</td>
<td>68</td>
<td>-51</td>
<td>15</td>
<td>83</td>
<td>85</td>
<td>67</td>
<td>61</td>
<td>12</td>
</tr>
<tr>
<td>pGDP</td>
<td>58</td>
<td>46-58</td>
<td>57-65</td>
<td>58-63</td>
<td>59-61</td>
<td>41-53</td>
<td>67</td>
<td>18-43</td>
<td>49-57</td>
<td>57-60</td>
<td>54-65</td>
<td>60-74</td>
</tr>
<tr>
<td>pCUM</td>
<td>58</td>
<td>95</td>
<td>34</td>
<td>43</td>
<td>97</td>
<td>-100</td>
<td>49</td>
<td>94</td>
<td>99</td>
<td>93</td>
<td>85</td>
<td>32</td>
</tr>
</tbody>
</table>

Minus is an increase of allowable emission compared with year 2005
Values of Indonesia and Malaysia are excluding emission/sink of LULC sectors
Ranges of pGDP are corresponding with ranges of GDP projections in references
pCAP: Equal per capita emission
pGDP: Equal per GDP emission
pCUM: Converge to equal cumulative emission per capita, after 2075

Matsuoka, et al., 2013, How to approach Asian Low-Carbon Societies?
Global Environmental Research, 17(1), 3-10
Feasibility of 50% global GHG emission reduction
source: 18th AIM workshop

### Reduction target in 2050 (compared with 2005, %)

<table>
<thead>
<tr>
<th>Region</th>
<th>pCAP ADV</th>
<th>pGDP ADV</th>
<th>pCUM ADV</th>
<th>pCAP CNV</th>
<th>pGDP CNV</th>
<th>pCUM CNV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>83</td>
<td>43</td>
<td>18</td>
<td>84</td>
<td>58</td>
<td>48</td>
</tr>
<tr>
<td>China</td>
<td>68</td>
<td>59</td>
<td>61</td>
<td>97</td>
<td>89</td>
<td>68</td>
</tr>
<tr>
<td>Indonesia</td>
<td>68</td>
<td>88</td>
<td>88</td>
<td>81</td>
<td>78</td>
<td>46</td>
</tr>
<tr>
<td>India</td>
<td>-51</td>
<td>41</td>
<td>53</td>
<td>-100</td>
<td>71</td>
<td>82</td>
</tr>
<tr>
<td>Korea</td>
<td>85</td>
<td>57</td>
<td>49</td>
<td>99</td>
<td>89</td>
<td>68</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-118</td>
<td>-163</td>
<td>-181</td>
<td>51</td>
<td>87</td>
<td>57</td>
</tr>
<tr>
<td>Taiwan</td>
<td>87</td>
<td>54</td>
<td>39</td>
<td>99</td>
<td>80</td>
<td>48</td>
</tr>
<tr>
<td>Thailand</td>
<td>61</td>
<td>54</td>
<td>45</td>
<td>85</td>
<td>80</td>
<td>68</td>
</tr>
<tr>
<td>Vietnam</td>
<td>12</td>
<td>60</td>
<td>74</td>
<td>32</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Singapore</td>
<td>75</td>
<td>14</td>
<td>-16</td>
<td>92</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>Philippines</td>
<td>-104</td>
<td>39</td>
<td>33</td>
<td>-370</td>
<td>67</td>
<td>-30</td>
</tr>
<tr>
<td>Oth. East Asia</td>
<td>68</td>
<td>89</td>
<td>95</td>
<td>81</td>
<td>80</td>
<td>87</td>
</tr>
<tr>
<td>Oth. South Asia</td>
<td>-120</td>
<td>4</td>
<td>52</td>
<td>-371</td>
<td>59</td>
<td>62</td>
</tr>
<tr>
<td>Oth. Southeast Asia</td>
<td>74</td>
<td>92</td>
<td>98</td>
<td>87</td>
<td>85</td>
<td>84</td>
</tr>
<tr>
<td>Oth. Oceania</td>
<td>33</td>
<td>45</td>
<td>65</td>
<td>43</td>
<td>56</td>
<td>29</td>
</tr>
<tr>
<td>Asia excl. JPN</td>
<td>42</td>
<td>56</td>
<td>63</td>
<td>43</td>
<td>83</td>
<td>79</td>
</tr>
<tr>
<td>Annex I</td>
<td>23</td>
<td>58</td>
<td>46</td>
<td>95</td>
<td>52</td>
<td>43</td>
</tr>
<tr>
<td>Non-Annex I</td>
<td>42</td>
<td>57</td>
<td>65</td>
<td>34</td>
<td>76</td>
<td>68</td>
</tr>
<tr>
<td>World</td>
<td>58</td>
<td>56</td>
<td>58</td>
<td>58</td>
<td>-22</td>
<td>49</td>
</tr>
</tbody>
</table>

### Result 2: Feasibility of reduction target of each region

#### ADV

- Large share of AFOLU
  - Developed countries
    - Both reduction projections and reduction targets are large.
    - Small GDP growth rate
    - Large CI improvement
  - Developing countries
    - Reduction projections: small
    - Some can’t achieve all the reduction targets

Horizontal line shows feasible ranges of GHG emission reductions based on TRN, PLG, PLG+, and RED cases.
LIMIT Project finding
Top Level

- Source: Measuring a fair and ambitious climate agreement using cumulative emissions
来自各国的情景分析：亚洲整体

2050相比1990减半：可行，整个亚洲tCO2

- 1990: 160亿；
- 2010: 180亿；2030: 180亿；
- 2050: 80亿，相比2010减少55%

Source: The 17th AIM International Workshop, Research Activities for Low-Carbon Asia

EAS region (China, Korea, Mongolia)

GAS: CO2 Excl. LUCF

Region: EAS

Emission allowances in 2030 (change from 2010)

- Capability (13)
- Equality (16)
- Res cap need (4)
- Equal cumulative per cap (4)
- Staged (10)
- Cost effectiveness (13)

Baseline (22)

EAS

40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0 130.0 140.0

2010 2020 2030 2040 2050

CO2 Emission Unit: 0.1 Billion t

Region: EAS

CHIN A BAU CHIN A H CHIN A L EAS BAU EAS H

-100% -80% -60% -40% -20% 0% 20% 40% 60% 80% 100%

Emission allowances in 2050 (change from 2010)

Cat 0 (400ppm) (10)
Cat 1 (450ppm) (42)
Cat 2 (500ppm) (6)
Cat 3 (550ppm) (42)
Cat 4 (650ppm) (28)

Baseline (22)

EAS 450ppm
Region: JPAUNZ (Japan, Australia, New Zealand)
Gas: GHG Excl. LUCF

Emission allowances in 2030 (change from 2010)
JPAUNZ

Emission allowances in 2050 (change from 2010)

Baseline (22)

450ppm
Region: SAS (Bangladesh, India, Pakistan)
Gas: CO2 Excl. LUCF

Emission allowances in 2030 (change from 2010)

-100%  -80%  -60%  -40%  -20%  0%  20%  40%  60%  80%  100%

Emission allowances in 2050 (change from 2010)

-100%  -80%  -60%  -40%  -20%  0%  20%  40%  60%  80%  100%  120%

CO2 Emission Unit: 0.1 Billion t

Region: SAS

Emission allowances in 2050 (change from 2010)

-100%  -80%  -60%  -40%  -20%  0%  20%  40%  60%  80%  100%  120%  140%
Region: PAS (Cambodia, Indonesia, Malaysia, Thailand, Vietnam)

GAS: GHG Excl. LUCF

- PAS
  -100%
  -80%
  -60%
  -40%
  -20%
  0%
  20%
  40%
  60%
  80%
  100%

Emission allowances in 2030 (change from 2010)

- Cat 0 (400ppm) (6)
- Cat 1 (450ppm) (37)
- Cat 2 (500ppm) (4)
- Cat 3 (550ppm) (17)
- Cat 4 (650ppm) (13)

Baseline (17)

Region: PAS

Emission allowances in 2050 (change from 2010)

- PAS H
- PAS L
- THA.I
- ND
- BAU

GHG Emission Unit: 0.1 Billion t

2010 2030 2050
China

- 中国tCO2
- 2010:80亿;
- 2030:约90亿（80-120）
- 2050:30亿（25-125）
- 2nd Source: 18th AIM workshop
- 3rd Source: Prof. Jiang ppt
Taiwan, China

- 1990: 1.11亿tCO2
- 2020回到2005水平, 2.57亿tCO2
- Source: The 17th AIM International Workshop, Taiwan’s Energy Conservation and Carbon Reduction
Japan

Result: GHG emission by scenario

- Baseline scenario: 26% reduction compared to 1990
- Other scenarios: 80% reduction

- 2010-13 亿tCO2eq
- 2030-8 or 11 亿tCO2eq
- 2050-2.6 or 9.2亿tCO2

Source: The 19th AIM International Workshop, Regional model Feasibility of 80% emission reduction in Japan

Japan

GHG emission by sector

• About a half of GHG emission in 2050 is emitted from industry sector
• Residential and commercial sector achieve nearly zero emission in 2050

- 2010-13亿tCO2eq
- 2030-8 or 11亿tCO2eq
- 2050-2.6 or 9.2亿tCO2

• Source: The 19th AIM International Workshop, Regional model Feasibility of 80% emission reduction in Japan

India

- 印度（tCO2）:
- 2010: 20亿
- 2030: 22-40亿
- 2050: 20-60+亿
- Source: The 17th AIM International Workshop, Low Carbon Society in Asia: Activities in India
Korea

- **Policy:** 2005 to 2020: 0.59亿t to 0.569-0.813亿t (单位及统计口径不明)
- 2005 to 2030: 0.21亿tC to 0.34亿tC
- **Source:** The 17th AIM International Workshop, The Integrated Assessment of Korea’s response to climate change

Thailand

- 2030相比2005: 政策情景增加75%
- 2005: 1.86亿tCO2
- 2030: 3.24亿tCO2
- Source: The 17th AIM International Workshop, Low-Carbon Society in Asia: LCS Activities in Thailand
Thailand

- **Source:** The 20th AIM International Workshop, Thailand NAMA Roadmap, INDC and Peak CO2 Scenarios in 2050
印尼

- 政策情景下，总GHG排放2020相比2010：从22.8亿到21.6亿，减少5%
- Source: The 17th AIM International Workshop, Activities in Indonesia
Malaysia

- **Research gas**: This includes energy, agriculture, and land use changes, accounting for 72% of total GHG emissions.
- **Policy Scenario**: From 1.45 billion tCO₂ in 2005 to 2.81 billion tCO₂ in 2030, an increase of 94%.
- **Source**: The 17th AIM International Workshop, Malaysian Low Carbon Societies: The way forward

Cambodia

III. Energy Circumstance in Cambodia

- **Demand for Electricity**
  - 70% Rural population lack access to electricity
  - Kerosene is predominantly used for domestic lighting
  - Some use car batteries for lighting and TV

- **Grid electricity will not be available for many years to come**

- **Need alternatives to supply electricity**

- **Solar Photovoltaics (PV) is a mature technology with a range of possible applications in Cambodia**

- **Source:** The 17th AIM International Workshop, Low Carbon Development in Cambodia

Bangladesh

- 更关注适应, 六个支柱
- 能源部门GHG排放: 2005-2030, 从0.4亿tCO2到1.45亿tCO2, 增长262%

Source: The 17th AIM International Workshop, Low Carbon Development—Bangladesh Perspective

Vietnam

1. GHG inventory: Inventory for the year of 2005 just finalized in May 2013. There have been three official inventories up to now.
   - In the inventory of 2005, LULUCF appears to be a big sink, then, the total emission seems to be almost the same as the inventory of 2000! *(need more elaborate in this issues)*

<table>
<thead>
<tr>
<th>Sectors</th>
<th>1994</th>
<th>2000</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Energy</td>
<td>25,637</td>
<td>52,773</td>
<td>101,564</td>
</tr>
<tr>
<td>2. Industrial Processes</td>
<td>3,807</td>
<td>10,006</td>
<td>14,591</td>
</tr>
<tr>
<td>3. Agriculture</td>
<td>52,450</td>
<td>65,091</td>
<td>80,583</td>
</tr>
<tr>
<td>4. LULUCF</td>
<td>19,380</td>
<td>15,105</td>
<td>-49,755</td>
</tr>
<tr>
<td>5. Waste</td>
<td>2,565</td>
<td>7,925</td>
<td>8,118</td>
</tr>
<tr>
<td>Total (mill tons of CO2 eq)</td>
<td>103,839</td>
<td>150,900</td>
<td>155,101</td>
</tr>
</tbody>
</table>

- Source: The 19th AIM International Workshop, Current status of LCS and AIM studies in Vietnam
Nepal

- Source: The 19th AIM International Workshop, Developing low carbon strategies for Nepal: Preliminary results from AIM/Enduse model analysis

Nepal

Source: The 20th AIM International Workshop, Analyses of Some Low Carbon Scenarios: Case of Nepal