The Costs and Benefits of Transition to a Green Economy in the Context of Energy and Climate Change

Jinmi Kim
Ph. D. Candidate
Center for Energy and Environmental Policy
University of Delaware
Contents

• The concepts of sustainable development and green economy
• Scope of analysis
• Methodology
• Results
• Costs and benefits of green economy
• Conclusion
Chronology of sustainable development and green economy

- 1987 WCDE, *Our Common Future*: Sustainable development has three pillars; Economy, Ecology and Society
- 1992 Rio Earth Summit: legally binding UNFCCC and CBD
- 2008 UNEP, *Green Economy Initiative*: new engine for growth, employment, poverty eradication
- 2011 OECD, *Towards Green Growth*: new sources of growth through productivity, innovation, new markets, confidence and stability. Green growth will reduce risks of negative shocks from resource bottlenecks and imbalance in natural systems
- 2011 UNEP, *Towards Green Economy*: Natural capital, poverty, jobs and social equity, energy, urban and mobility
- 2012 UNCSD, *Rio+20 ZOD document*: doubling rate of energy efficiency improvement by 2030 and doubling share of renewable energy in the global energy mix by 2030
- 2012 UNCSD, *Rio+20 Outcome document*: Poverty eradication is the greatest challenge and indispensable requirement for sustainable development; Green economy is one of tools for sustainable development
Assessment of climate change impacts

Risks and Impacts of Climate Change

IPCC 2001 TAR

IPCC 2007 AR4
Three boundaries have been overstepped:
- Climate Change
- Nitrogen and Phosphorus Cycles
- Biodiversity Loss
Green economy energy target and implication for climate change

IPCC Pathways towards stabilization

<table>
<thead>
<tr>
<th>Stabilization level (ppm CO₂-eq)</th>
<th>Global mean temp. increase at equilibrium (°C)</th>
<th>Year CO₂ needs to peak</th>
<th>Year CO₂ emissions back at 2000 level</th>
<th>Reduction in 2050 CO₂ emissions compared to 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>490 – 535</td>
<td>2.4 – 2.8</td>
<td>2000 - 2020</td>
<td>2000- 2040</td>
<td>-60 to -30</td>
</tr>
<tr>
<td>535 – 590</td>
<td>2.8 – 3.2</td>
<td>2010 - 2030</td>
<td>2020- 2060</td>
<td>-30 to +5</td>
</tr>
<tr>
<td>590 – 710</td>
<td>3.2 – 4.0</td>
<td>2020 - 2060</td>
<td>2050- 2100</td>
<td>+10 to +60</td>
</tr>
<tr>
<td>710 – 855</td>
<td>4.0 – 4.9</td>
<td>2050 - 2080</td>
<td></td>
<td>+25 to +85</td>
</tr>
<tr>
<td>855 – 1130</td>
<td>4.9 – 6.1</td>
<td>2060 - 2090</td>
<td></td>
<td>+90 to +140</td>
</tr>
</tbody>
</table>

IEA WEO 2011: Energy Mix for 450 Stabilization Scenario

Green Economy Energy Targets

- Doubling rate of energy efficiency improvement by 2030
- Doubling share of RE in the global energy mix by 2030
Motivation and Scope

• Will the green economy energy targets contribute to achieving climate stabilization?

• Cost assessment to meet green economy energy targets

• Assessment of climate benefits under the green economy energy targets

• Implication for transition to green economy
Methodology

• **Model: DICE**
  - Dynamic Integrated model of Climate and the Economy
  - based on the economic growth theory
  - Economic sector and geophysical sector

• **Case: Rio +20 target**
  - **Energy efficiency goal:** two fold increase in energy efficiency improvement by 2030
  - **Renewable energy goal:** two fold increase in the share of renewable energy in the global energy mix by 2030
Results of key climate related variables

- Emissions under green economy will be less than BAU, but continue rising
  - Energy efficiency improvements lead to reductions in emissions from BAU more than those expected from renewable energy expansion
  - In 2035, EE improvement reduces emissions 19.6% below BAU, and in 2105 the emissions will be 40% below BAU
• **Cumulative emissions will exceed the level required for climate stabilization**
  - The cumulative emissions for 2005-2055 will be 1953.9 Gt CO2 which exceeds 1,000 Gt CO2 for climate stabilization

• **Atmospheric carbon concentration will be less than BAU, but not be stabilized**
  - By 2105, 706 ppm under BAU and 609 ppm under the green economy goal
• **Global mean temperature will be less than BAU, but continue rising**
  - Under BAU, the temperature will be 3.19°C above pre-industrial level by 2105
  - Under the green economy, the global mean temperature is less than 3 °C, but warming continues.
Costs of a Green Economy

Abatement Cost

The Relation Between Abatement Costs and Emissions Reductions
Incremental abatement cost ($/tC) is rising at an increasing rate over time

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4</td>
<td>15.2</td>
<td>33.8</td>
<td>43.0</td>
<td>53.7</td>
<td>69.2</td>
<td>83.8</td>
<td>100</td>
<td>122.2</td>
<td>142.3</td>
<td></td>
</tr>
</tbody>
</table>

Present value of total abatement cost for green economy energy targets is less than $1 trillion ($0.61 trillion)

<table>
<thead>
<tr>
<th></th>
<th>Present value Abatement Cost (Trillion of 2005 U.S. dollar)</th>
<th>Cumulative emissions (GtC)</th>
<th>Global temperature (2100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td>0.0014</td>
<td>1487</td>
<td>3.19</td>
</tr>
<tr>
<td>Green Economy</td>
<td>0.6109</td>
<td>1107</td>
<td>2.74</td>
</tr>
</tbody>
</table>
Benefits of a Green Economy

Benefit of green economy is equal to the reduced climate damages due to green economy energy goals

- Climate damages under BAU rise to $7.56 trillion in 2105 from $0.084 trillion in 2005.
- The green economy reduces the climate damages 13% relative to BAU in 2025 and 25% relative to BAU in 2105.
Present value of total benefit of green economy energy goals is more than $1 trillion ($1.8 trillion)

<table>
<thead>
<tr>
<th></th>
<th>Present value Climate Damages (Trillion of 2005 U.S.)</th>
<th>Cumulative emissions (GtC)</th>
<th>Global temperature (2100)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BAU</strong></td>
<td>13.5</td>
<td>1487</td>
<td>3.19</td>
</tr>
<tr>
<td><strong>Green Economy</strong></td>
<td>11.7</td>
<td>1107</td>
<td>2.74</td>
</tr>
</tbody>
</table>
## Cost-Benefit Comparison

- **PV of benefit ($1.8 T) > PV of abatement cost ($0.6 T)**

<table>
<thead>
<tr>
<th></th>
<th>Present value Climate Damages (Trillion of 2005 U.S.)</th>
<th>Present value Abatement Cost (Trillion of 2005 U.S. dollar)</th>
<th>Cumulative emissions (GtC)</th>
<th>Global temperature (2100)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BAU</strong></td>
<td>13.5</td>
<td>0.0014</td>
<td>1487</td>
<td>3.19</td>
</tr>
<tr>
<td><strong>Green Economy</strong></td>
<td>11.7</td>
<td>0.6109</td>
<td>1107</td>
<td>2.74</td>
</tr>
</tbody>
</table>
More ambitious mitigation action is warranted

Cost and Benefit at the Margin

- Marginal Damage
- Marginal Abatement Cost
- Emissions
- BAU
- Green Economy

$
Immediate Actions required for Sustainable Development

• Global GHG emissions must peak in 2000-2015 to achieve temperature stabilization below 2 degree C warming
• Find ways to reverse biodiversity loss and nitrogen and phosphorus flows below critical threshold points

Will Green Economy Deliver Answer to this Call?

• Targets for RE and Efficiency Improvement fail to achieve climate stabilization
• More ambitious mitigation actions will be justified because global net benefit of mitigation of CO2 will increase from such actions
• But the magnitude of net benefit is subject to large uncertainty because of uncertainty on the future climate damages
• If green economy fails to achieve climate stabilization, would other goals of the green economy (poverty eradication, natural capital sustainability, social equity,..) have any relevance?

Conclusion
Thank you.