The SSP-RCP scenario framework: status and next steps

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The SSP-RCP scenarios framework

O’Neill et al., 2020.
SSPs

1: Sustainability
2: Middle of the Road
3: Regional Rivalry
4: Inequality
5: Fossil-fueled Development

SSP narratives, quantitative elements: 2017 special issue of *Global Environmental Change*. SSP Database, hosted by IIASA.
### SSP Narratives

<table>
<thead>
<tr>
<th>SSP3: Regional Rivalry</th>
<th>SSP5: Fossil-fueled development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-pole Cold War</td>
<td>Rise of the global middle class</td>
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<tr>
<td>Conflict, focus on security</td>
<td>Rapid technological progress</td>
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<tr>
<td>Barriers to trade, migration</td>
<td>Large investments in human well being (health, education)</td>
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<tr>
<td>Little investment in health, education</td>
<td>Well functioning institutions</td>
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<tr>
<td>Slow technological progress</td>
<td>Rapid economic growth</td>
</tr>
<tr>
<td>Weak institutions</td>
<td>Fossil-centered energy system</td>
</tr>
<tr>
<td>Slow income growth</td>
<td></td>
</tr>
</tbody>
</table>

O’Neill et al., 2015.
SSP-based emissions scenarios

SSPs 1-5

Narratives

Quantitative Elements

Mitigation Policies

IAM scenarios:
Energy, Land use, Emissions

Riahi et al., 2017.
Representative Concentration Pathways (RCPs)

Radiative forcing (from concentrations) → Climate System Changes (CMIP6)

SSP-based concentration/forcing pathways

O’Neill et al., 2016; Riahi et al., 2017.

Tebaldi et al., 2020.
The “matrix architecture”

**Shared Socioeconomic Pathways**

- **SSP1**: Sustainability
- **SSP2**: Middle of the Road
- **SSP3**: Regional Rivalry
- **SSP4**: Inequality
- **SSP5**: Fossil-fueled Development

<table>
<thead>
<tr>
<th>Climate</th>
<th>2100 forcing level (W/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>7.0</td>
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<tr>
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<td>6.0</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
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<tr>
<td></td>
<td>3.4</td>
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<tr>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>1.9</td>
</tr>
</tbody>
</table>

**Original RCP levels**
SSP use

Wide use
~2200 total papers
2014-2021 using SSPs

Diverse fields
Impacts, emissions, extensions

Prominent use in assessments
IPCC, IPBES, US NCA, UNEP GEO

Areas of rectangles proportional to numbers of papers in each category. Pure climate modeling applications not included. As of end 2019.

O’Neill et al., 2020.
Many extensions

Quantitative elements
Spatial population
Income distribution
Infrastructure (roads)
Urban land
Governance
Regions
Europe
US regional
CCRAF
AgMIP

Demog.
Educ.
Sectoral shift

Prosperity (SSP5)
Low Impact
High Impact

Poverty (SSP4)
Low Impact
High Impact

Climate Change could result in MORE THAN 100 MILLION additional people living in POVERTY by 2030

Hallegatte & Rozenberg, 2017.

Additional people below extreme poverty threshold, 2030
IPCC food security risk assessment

IPCC Special Report on Climate Change and Land (2019)
Extensions to the framework
  Further work in income distribution, spatial vulnerability, determinants of biodiversity

Updating SSPs
  Base year, near-term outlook (is high scenario too high?)

Additional “reference” scenarios
  Impacts and/or policy in the reference scenario

Adding or removing scenarios
  High scenario too high? No “degrowth” scenario?

Scenarios of outcomes

CMIP7 and the role of climate model emulation
Thank you