The Pathway to the Target

Reducing the Risk for Current & Future Generations

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Climate Action is but one Development Goal
Climate Change Action is Moving Forward

Signatories of the Paris Agreement aim to hold

“the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels”

within “the context of sustainable development and efforts to eradicate poverty”
Climate change is already upon us, affecting health & well-being

Damages especially large for poorest populations

Some long-term impacts, e.g. sea-level rise & glacier melting, are cumulative

Hence urgent need to limit near-term climate change
Linking Climate Change and other Development Goals

Need to reduce climate change in near-term as well as long-term

Need to reduce burden of air pollution

Need to feed a growing population

Emissions of short-lived climate pollutants affect all these factors
Public Health & SLCPs

Global Deaths Attributable to 20 Leading Risk Factors 2010

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Deaths in Millions</th>
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<tbody>
<tr>
<td>High blood pressure</td>
<td></td>
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<tr>
<td>Tobacco smoking, including second-hand smoke</td>
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<tr>
<td>Diet low in fruits</td>
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<tr>
<td>Alcohol use</td>
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<td>Household air pollution from solid fuels</td>
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<tr>
<td>High fasting plasma glucose</td>
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<tr>
<td>High body-mass index</td>
<td></td>
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<tr>
<td>Ambient particulate matter pollution</td>
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<tr>
<td>Physical inactivity and low physical activity</td>
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<tr>
<td>Diet high in sodium</td>
<td></td>
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<tr>
<td>Diet low in nuts and seeds</td>
<td></td>
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<tr>
<td>High total cholesterol</td>
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<tr>
<td>Diet low in vegetables</td>
<td></td>
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<tr>
<td>Diet low in whole grains</td>
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<tr>
<td>Diet low in seafood omega-3 fatty acids</td>
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<tr>
<td>Childhood underweight</td>
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<tr>
<td>Diet high in processed meat</td>
<td></td>
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<tr>
<td>Diet low in fiber</td>
<td></td>
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<tr>
<td>Lead exposure</td>
<td></td>
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<tr>
<td>Suboptimal breastfeeding</td>
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</tbody>
</table>

Global Burden of Disease, 2012

Schmale et al., Nature Climate Change, 2014

Premature deaths avoided (millions)

- Strong and immediate SLCP reduction
- Delay of SLCP mitigation until 2040

Uncertainty ranges

2010 2020 2030 2040
Agriculture & SLCPs

Methane \(\sim 7.5x\) impact of \(\text{CO}_2\) to date on crop yields \(\text{(Shindell, Earth’s Future, 2016)}\)
## Agriculture & SLCPs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Response to CO2</th>
<th>Response to CH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Drought</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Fertilization</td>
<td>↑</td>
<td>-</td>
</tr>
<tr>
<td>Ozone</td>
<td>-</td>
<td>↓</td>
</tr>
</tbody>
</table>

### Projected: High vs Low Emiss

- **CO₂**: $-3.3±5.2$
- **CH₄**: $-15.6±5.1$
- **Halocarbons**: $-4.7±4.0$
- **N₂O**: $-1.1±0.3$

Shindell, Earth’s Future, 2016
Why worry about the Pathway to the Targets?

Climate-related damages to public health, ecosystems, & infrastructure.

SDGs for poverty reduction, agriculture & food security, healthy lives, sustainable & modern energy, liveable cities.
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Consider the path to the target!

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Additional Benefits of Action

- Biomass stoves
  Time (women’s employment, children’s education)
  Reduced deforestation

- Efficient kilns/coke ovens
  Time & fuel (50%)

- Methane capture
  Increased energy security

- Limit Agricultural Waste Burning
Policies affecting SLCPs inextricably link near-term climate, human health, agriculture and sustainable development
The Pathway to the Target

Keep current long-term target

Add goal of slowing global warming during next 25 years by half

Would require reducing BC-related emissions ~75%, anthropogenic methane ~25%, eliminating growth in HFCs by 2030

New goal addresses near-term impacts, pace of change, and climate-SDGs link
How Controlling the Pathway could lead to a better world

Large public health and agricultural benefits for current generations, especially women, children and the poor

Reduced damages from climate change during the next few decades

Reduced damages from cumulative effects such as sea-level rise on future generations

Synergy with long-term climate goal: Political good-will from tangible, rapid benefits of clean air; Enable achievement of targets without strong overshoot
Metrics: Definitions

Emissions (e.g. kg y\(^{-1}\))

Emissions metrics (e.g. impact tonne\(^{-1}\))

Exposure metrics (e.g. pollution concentration d\(^{-1}\))

Impact metrics (e.g. climate, air quality-related impacts)

Valuation metrics (e.g. US$)
Metrics

Emissions
  Day 2

Emissions metrics
  SAP endorsed AGTP (no CO$_2$e!); Mean AGTP25 & AGTP100

Exposure metrics
  annual PM$_{2.5}$; several for ozone

Impact metrics
  Climate: dT; Health: prem. deaths/YLL; Crops: tons/% yield

Valuation metrics