CIRCLE

Costs of Inaction and Resource scarcity:
Consequences for Long-term Economic growth

# The economic consequences of climate change

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IAMC

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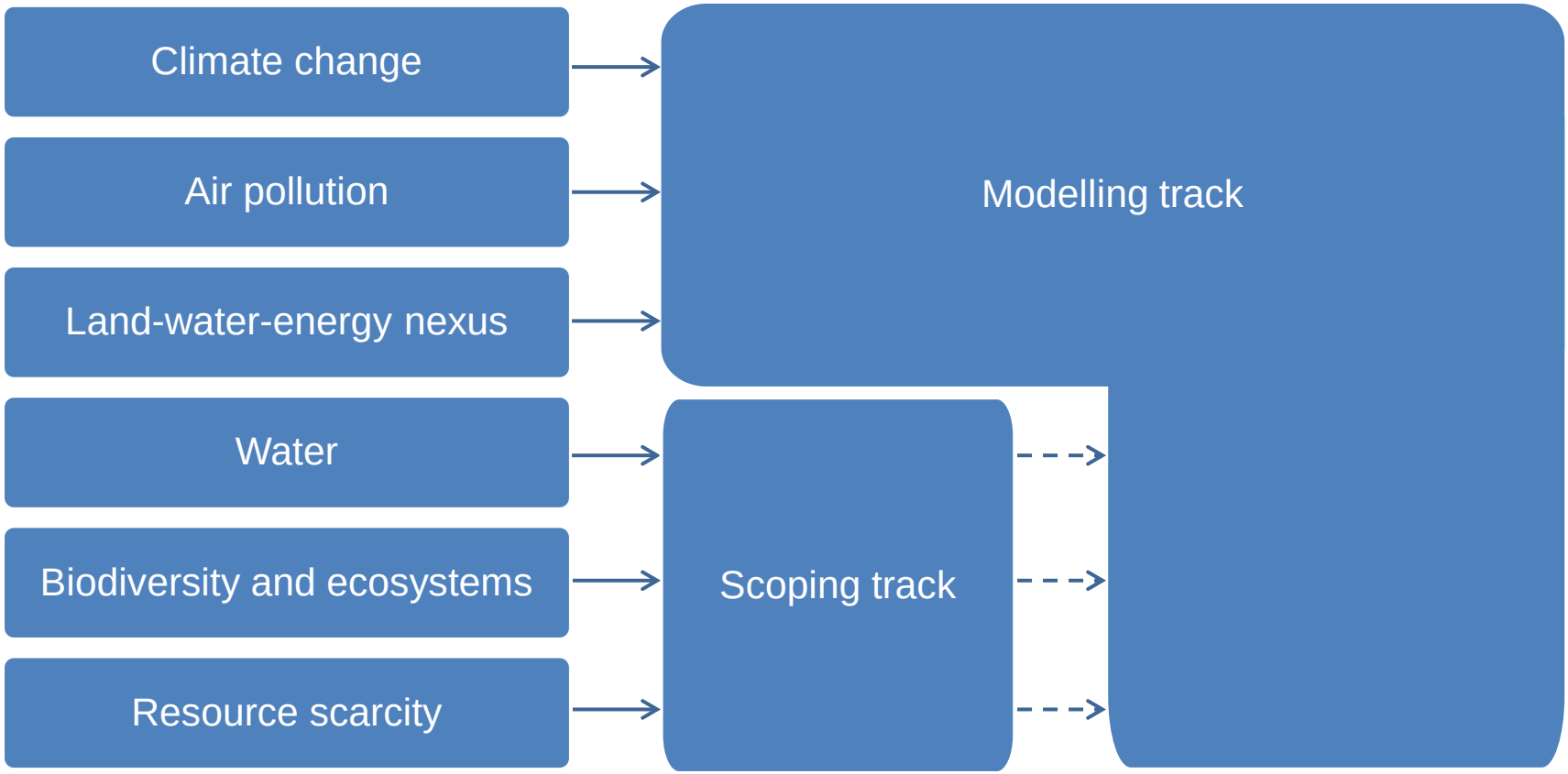
# CIRCLE project themes and tracks

CIRCLE looks at **costs of inaction** and **benefits of action**: feedbacks from environmental challenges on economic growth




CIRCLE: **C**osts of **I**naction and **R**esource scarcity: **C**onsequences for **L**ong-term **E**conomic growth

# Introduction

The Economic Consequences of Climate Change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- Part of the CIRCLE project
  - Next year link to work on air pollution and land-water-energy nexus
- Aim: assess the economic consequences of climate change
- Until 2060, multi-sector, multi-region General Equilibrium production function approach: climate change affects drivers of growth
  - but just one central projection
- After 2060, stylised Integrated Assessment Model approach
- Based on collaboration with several expert groups, incl. FEEM, CERE, NIES

# Production function approach

- Impacts of environmental damages on the economy are modelled directly as changes in the production function variables (e.g. labour productivity)
- Allows calculating the costs of environmental damages to the macro-economy and studying how the economies adjust to the presence of environmental damages
- Model impacts and economic feedbacks within a Computable General Equilibrium (CGE) model, ENV-Linkages
- Project economic growth for future decades and calculate future macro-economic costs of environmental damages
- Use GDP as key indicator of economic growth

# Methodology for climate damages

- Collaboration with existing impact studies
  - Methodology largely based on the FEEM ICES model
  - Data for a subset of damages from sectoral EU projects, obtained with help of FEEM
  - Additional data from range of collaborators, incl. NIES, VU University Amsterdam, IIASA, IPTS-JRC
  - Data consistency on damages is ensured by choosing damages corresponding to an appropriate temperature pathway (no simple damage functions relating everything to global $\Delta T$)
- Damages calculated in ENV-Linkages model to 2060
  - Autonomous adaptation takes place via sectoral adjustments and international trade
- Stylised calculations with AD-DICE to 2100
  - Baseline and damages to 2060 harmonised with ENV-Linkages

# Selected impacts of climate change

## Included in the modelling

- Agriculture: yield changes for 8 crop sectors, and fisheries
- Coastal zones: capital and land losses due to sea level rise
- Health: diseases and labour productivity losses from heat stress
- Energy demand
- Tourism demand
- Capital damages from hurricanes

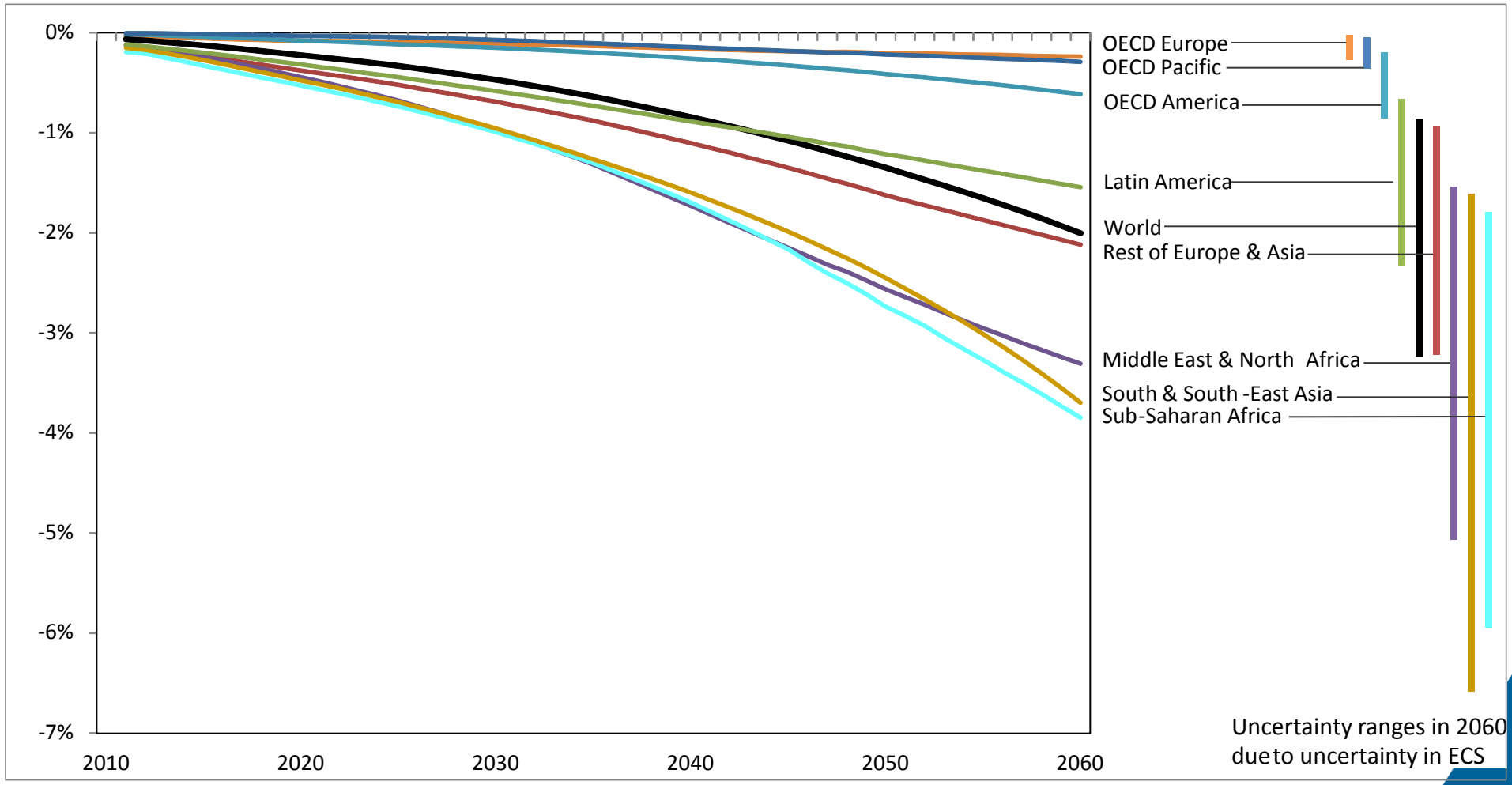
## Stand-alone analysis

- Fatalities from heatwaves
- Urban damages from river floods
- Ecosystems: biodiversity (crude approximation)

## Still not quantified

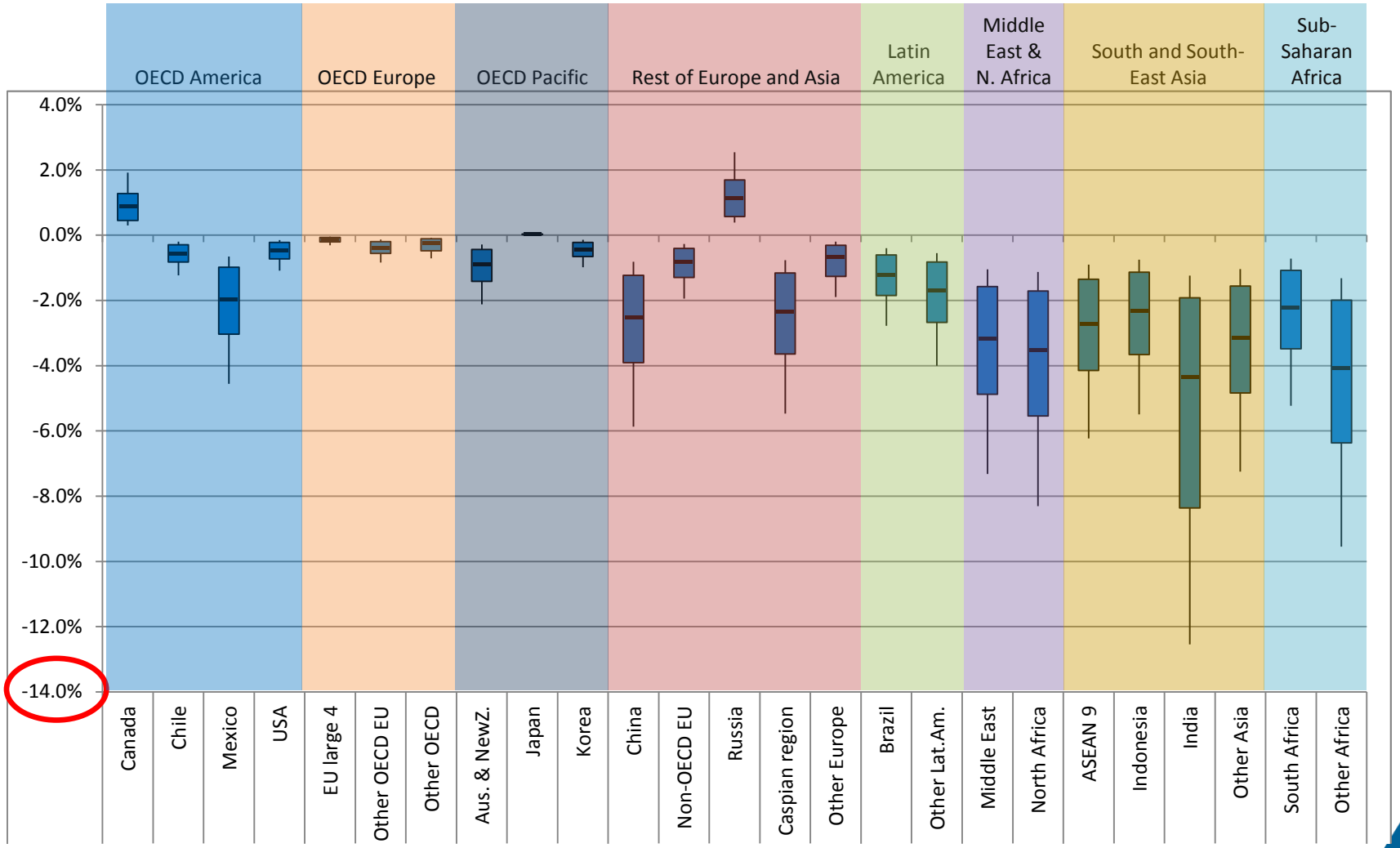
- Large-scale disruptive events, …

# Regional cost of selected climate impacts



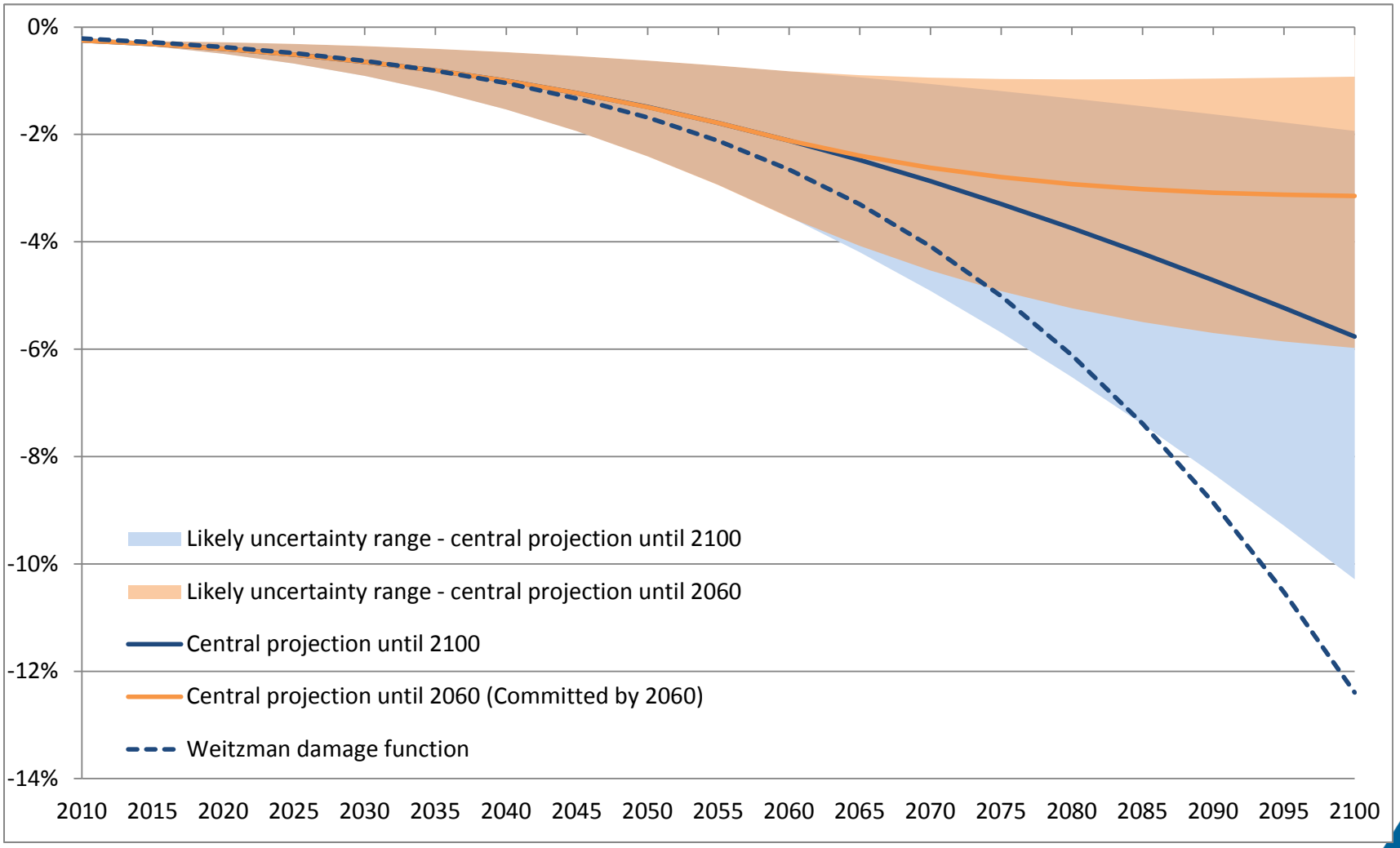

*Source: ENV-Linkages calculations*

# Regional results and uncertainty from climate sensitivity – year 2060



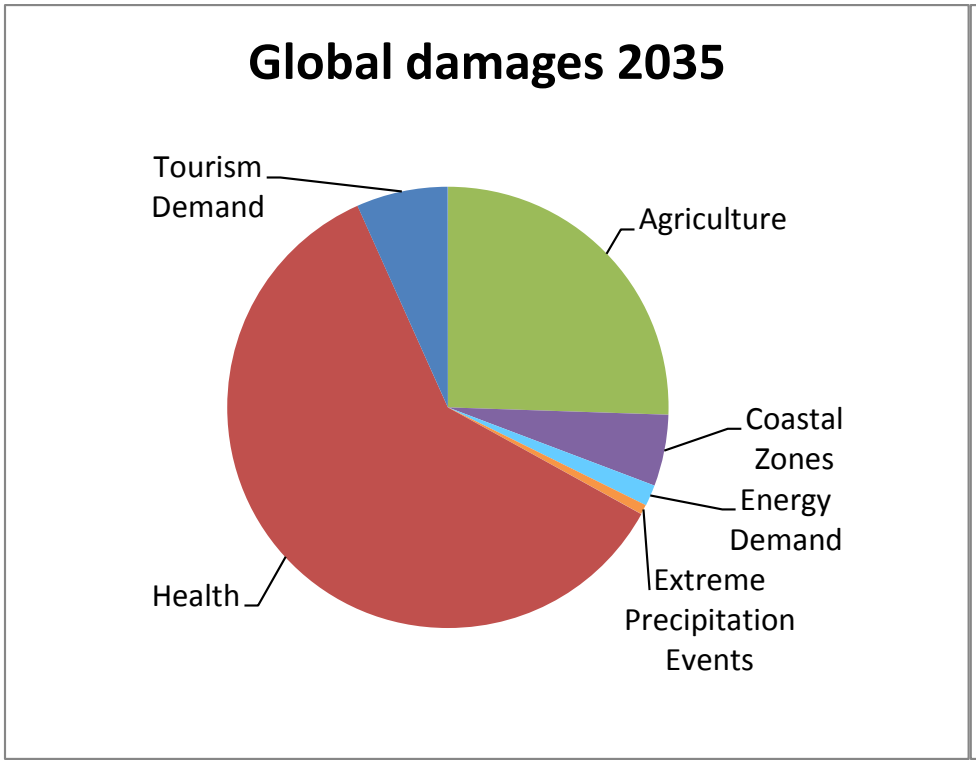

*Source: ENV-Linkages calculations*

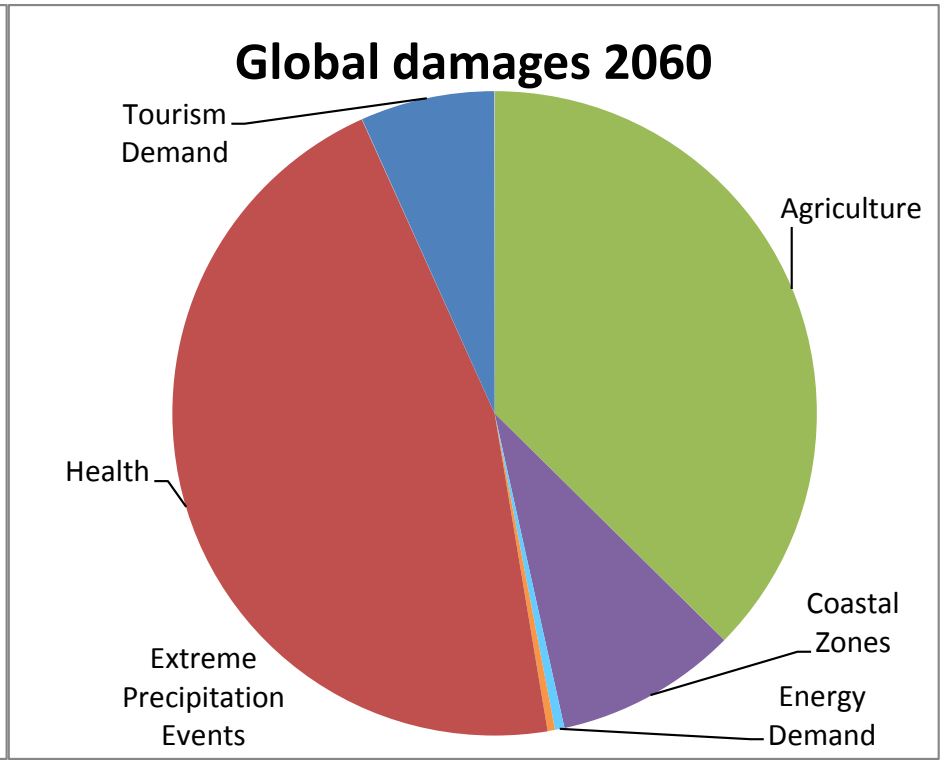
# Long-term damages




*Source: AD-DICE calculations*

# Global importance of different impacts




Global GDP loss:

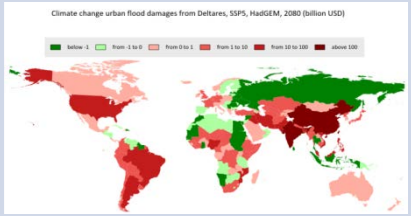
0.3-1.0%

1.0-3.3%

*Source: ENV-Linkages calculations*

# Other important consequences

## Urban flood damages



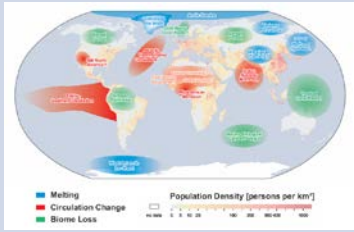

## Premature deaths from heat stress

| OECD country | Current climate | | 2050 | |
|---|---|---|---|---|
| | Mortality (thousands) | Costs (billion USD) | Mortality (thousands) | Costs (billion USD) |
| Canada | 1 | 3 | 8 | 23 |
| Chile | 0 | 0 | 1 | 4 |
| Mexico | 1 | 4 | 12 | 36 |
| USA | 11 | 2 | 63 | 27 |
| EU large 4 | 11 | 34 | 66 | 197 |
| Other OECD EU | 8 | 17 | 44 | 104 |
| Other OECD | 1 | 4 | 13 | 39 |
| Aus. & New Z. | 1 | 2 | 3 | 9 |
| Japan | 3 | 8 | 10 | 30 |
| Korea | 1 | 2 | 6 | 17 |
| OECD total | 38 | 75 | 226 | 487 |

## Loss of biodiversity and ecosystems

| | RCP6.0 | RCP8.5 |
|---|---|---|
| Most OECD countries | 0.5 | 1.1 |
| Chile | 0.3 | 0.6 |
| Mexico | 0.4 | 0.9 |
| Non-OECD EU | 0.3 | 0.7 |
| Brazil | 0.1 | 0.2 |
| Russia | 0.2 | 0.4 |
| India | 0.0 | 0.1 |
| Indonesia | 0.0 | 0.1 |
| China | 0.2 | 0.5 |
| South Africa | 0.4 | 0.8 |
| Other regions | 0.0-0.1 | 0.0-0.3 |

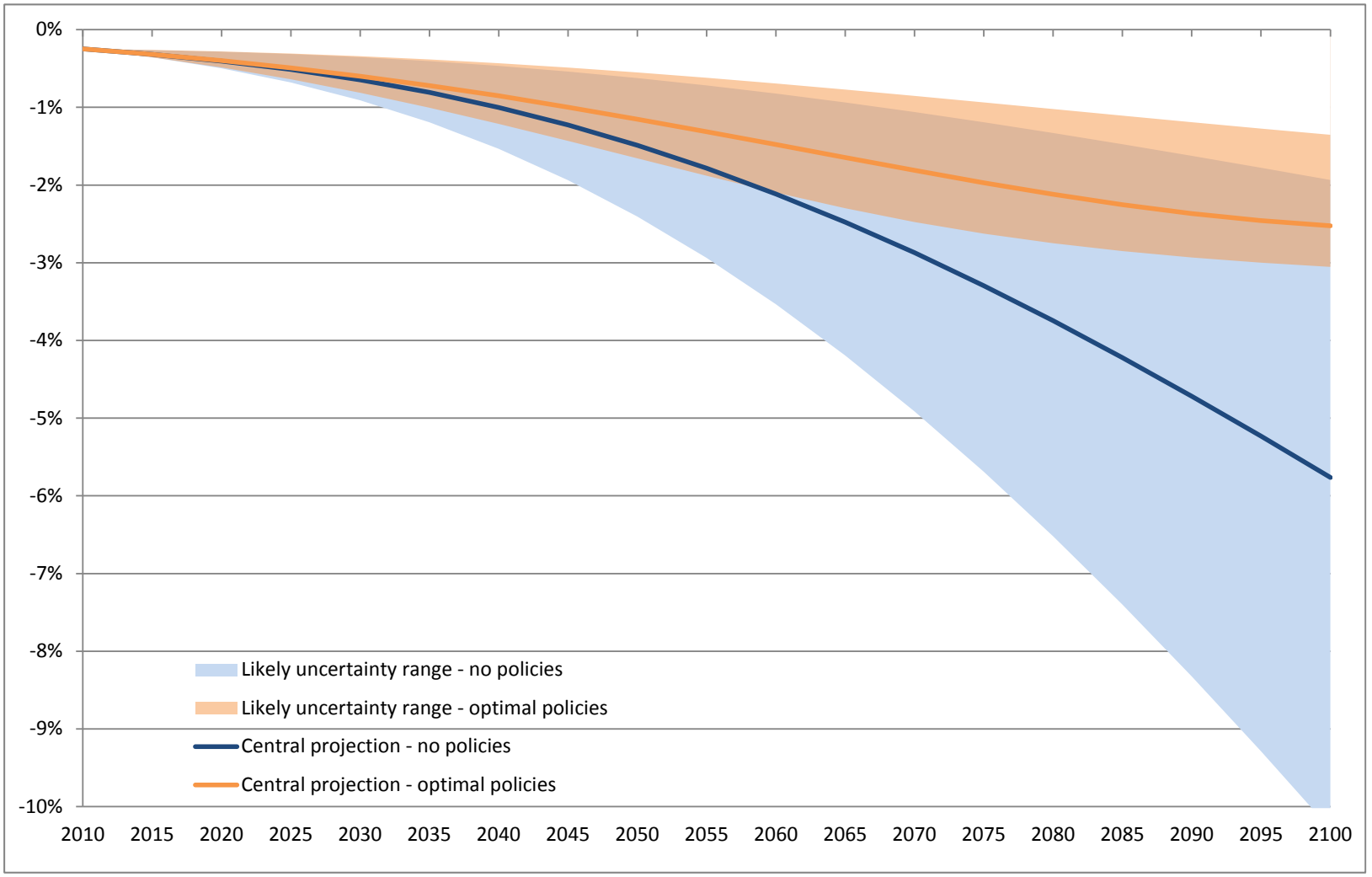
## Tipping points




…and many more that could not be quantified!

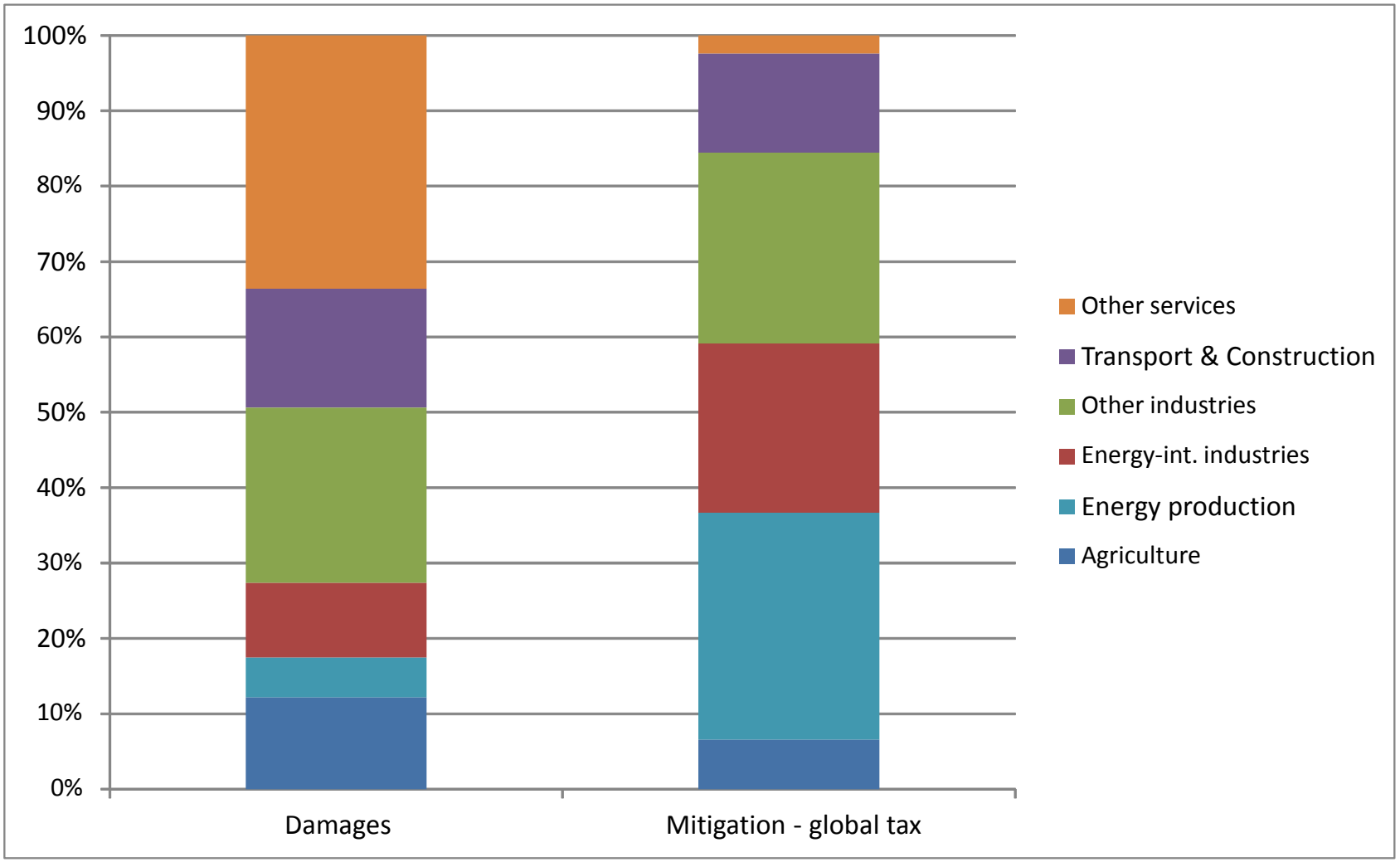
*Source: Own calculations based on various sources*

# Damages with policy controls




*Source: Preliminary AD-DICE calculations*

# Sectoral damages and mitigation costs




*Source: ENV-Linkages calculations*

# Main messages (I)

1. Almost all regions significant negative market and non-market impacts, plus downside risks
   - Global GDP cost 1.0-3.3% by 2060, 2-10% by 2100
   - Largest losses in Africa and Asia
   - Largest losses from health and agricultural impacts
   - Largest losses to capital and labour
   - Costs increase more than proportionately with temperature
2. Losses spread across economies
   - All sectors and regions are indirectly affected
3. Consequences are unavoidable and enduring
   - Emissions commit the world to long-lasting impacts

# Main messages (II)

4. Ambitious adaptation and mitigation can reduce future impacts and limit risks
   - Ambitious policies can reduce macroeconomic costs by 2100 from 2-10% to 1-3%
   - Adaptation is important to ensure consequences of climate change remain limited
   - Ambitious global mitigation can help avoid half of the economic consequences and limit downside risks
   - Distribution of policy costs and benefits across regions and sectors will not be proportional (but both imply a shift towards more services)


# THANK YOU!

For more information:

www.oecd.org/environment/CIRCLE.htm

www.oecd.org/environment/modelling

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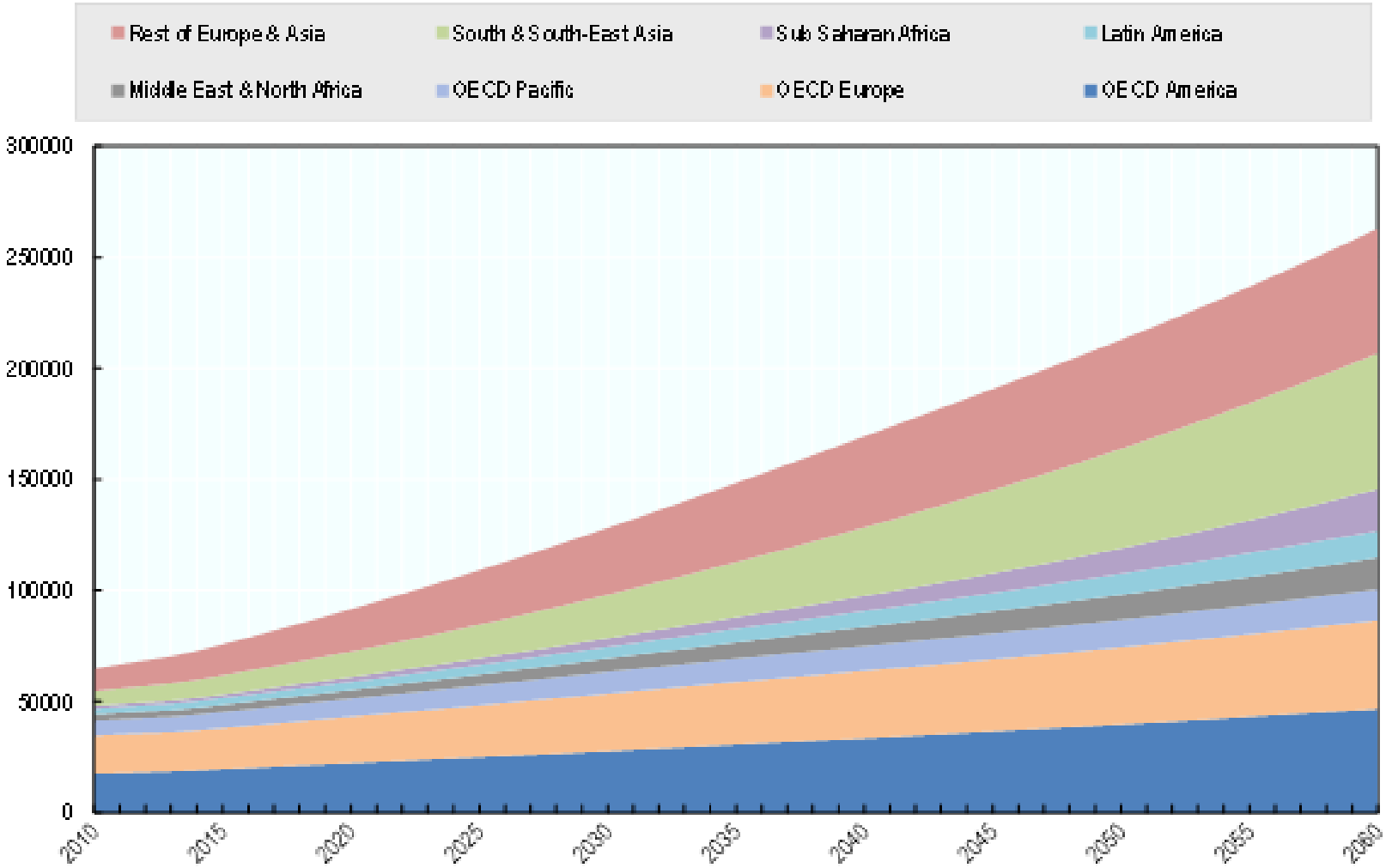
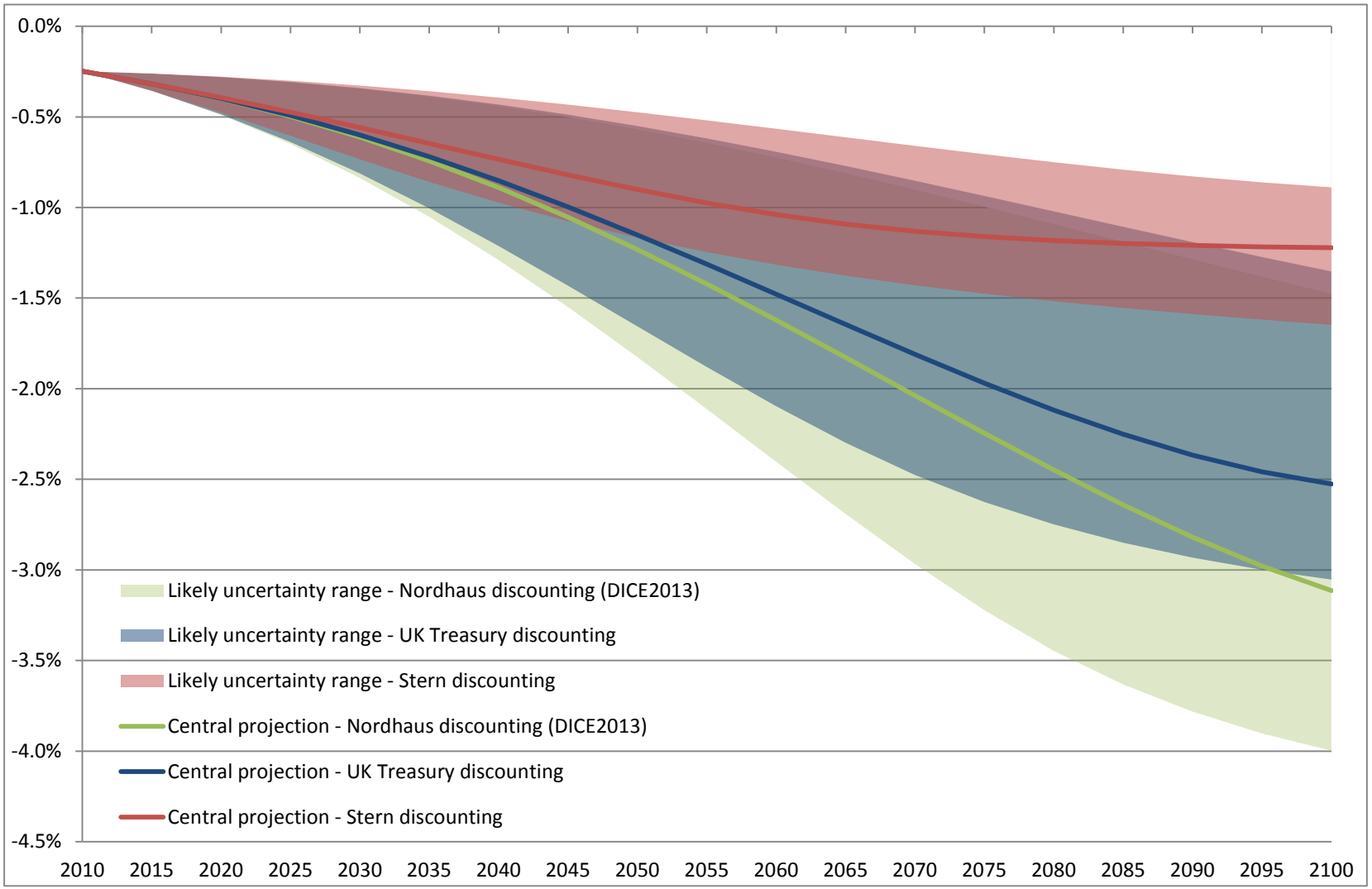
# No-damage baseline GDP projection




*Source: ENV-Linkages calculations*

# Global damages under optimal mitigation – alternative discounting rules




*Source: AD-DICE calculations*