

# The Role of Burden Sharing Regimes for Reaching a 2°C Climate Target

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# Key messages

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- Burden sharing mechanisms are appropriate to compensate for climate policy costs for selected regions, esp. until 2050
- Emerging economies are different with respect to their socio-economic characteristics, and the design of the burden sharing scheme determines which regions are compensated
- Adequate carbon certificate trade is essential, otherwise negative financial impacts for reaching the 2°C climate target may occur

# Agenda

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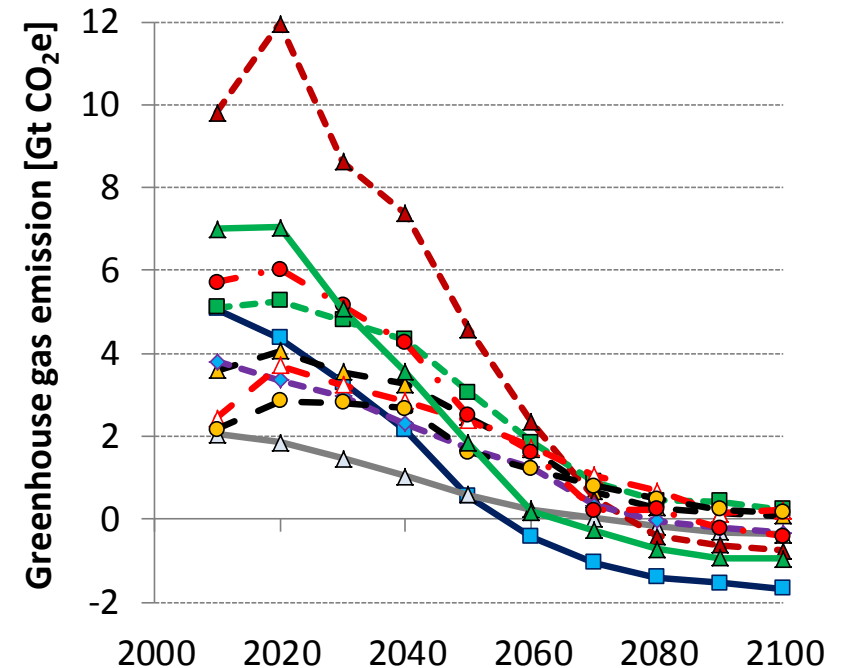
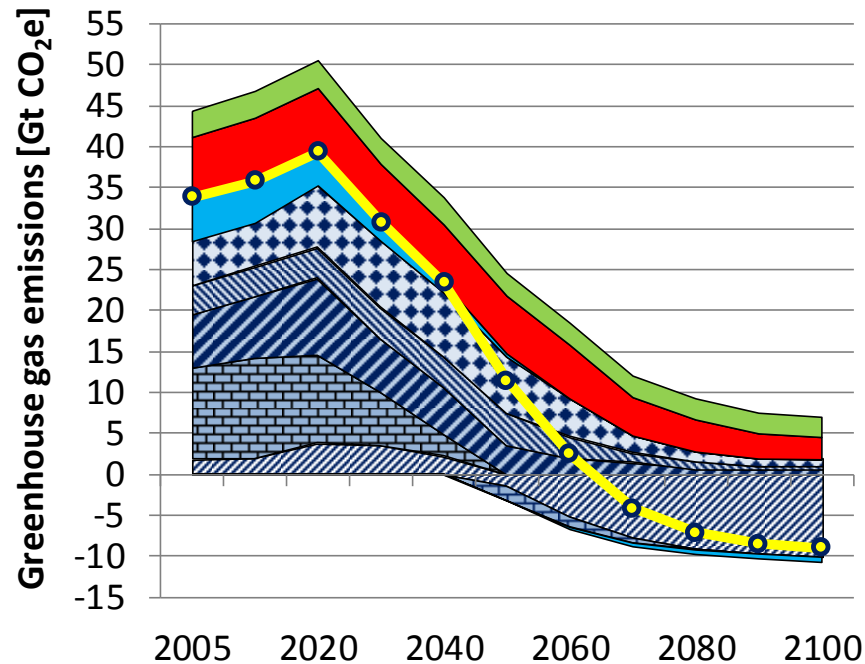
- Introduction and approach
  - TIAM-ECN energy system model
  - Reference GHG mitigation scenario
  - Burden sharing schemes
- Resource sharing scheme
- Effort sharing scheme
- Impact of limited certificate trade
- Conclusions

# TIAM-ECN model approach

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- Global energy system model
  - 15 world regions (reporting in this study refers to a set of 10 super-regions)
  - Time horizon: 2005 – 2100 (10-year intervalls)
  - 6 time slices per year (day/night and seasonal)
  - Supply and demand sectors, representing various energy conversion pathways and climate change mitigation measures
  - Endogenous trade of energy, emission certificates and captured CO<sub>2</sub>
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- Study conducted within LIMITS EU-FP 7 project  
[www.ecn.nl/units/ps/themes/energy-and-emission-scenarios/global-european-projections/limits](http://www.ecn.nl/units/ps/themes/energy-and-emission-scenarios/global-european-projections/limits)  
[www.feem-project.net/limits](http://www.feem-project.net/limits)

# Cost optimal GHG mitigation to reach 2°C climate stabilisation



- |   |                           |               |                     |
|---|---------------------------|---------------|---------------------|
| N <sub>2</sub> O Total                  | CH <sub>4</sub> Total     | Europe        | Africa              |
| CO <sub>2</sub> Land-use                | CO <sub>2</sub> Transport | Pacific OECD  | China               |
| CO <sub>2</sub> Households + commercial | CO <sub>2</sub> Industry  | Latin America | Reforming Economies |
| CO <sub>2</sub> Electricity production  | CO <sub>2</sub> Upstream  | India         | Middle East         |
| CO <sub>2</sub> Total net               |                           | Other Asia    | North America       |

# Two burden sharing schemes

- **Resource Sharing: Population related regime:**

- key parameter = GHG emissions per capita
- equalisation of per capita emissions with contraction and convergence until 2050

$$\frac{E_r(t)}{E_w(t)} = \frac{T_2 - t}{T_2 - T_1} * \frac{E_r(T_1)}{E_w(T_1)} + \frac{t - T_1}{T_2 - T_1} * \frac{P_r(t)}{P_w(t)}$$

$E_r(t)$ : Regional emissions in time step  $t$

$E_w(t)$ : Global emissions in time step  $t$

$P_r(t)$ : Regional population in time step  $t$

$P_w(t)$ : Global population in time step  $t$

$T_1$ : Reference year for grandfathering (here: 2020)

$T_2$ : Target year for convergence (2050)

- **Effort Sharing: GHG mitigation cost related regime:**

- key parameter = policy costs as percentage of GDP
- GHG mitigation efforts to be harmonised

$$\left(\frac{C_r}{Y_r}\right)_t = \left(\frac{C_w}{Y_w}\right)_t \quad \forall t \in \{2020, 2025, \dots, 2100\}$$

$C_r$ : Regional absolute mitigation costs

$C_w$ : Global absolute mitigation costs

$Y_r$ : Regional GDP

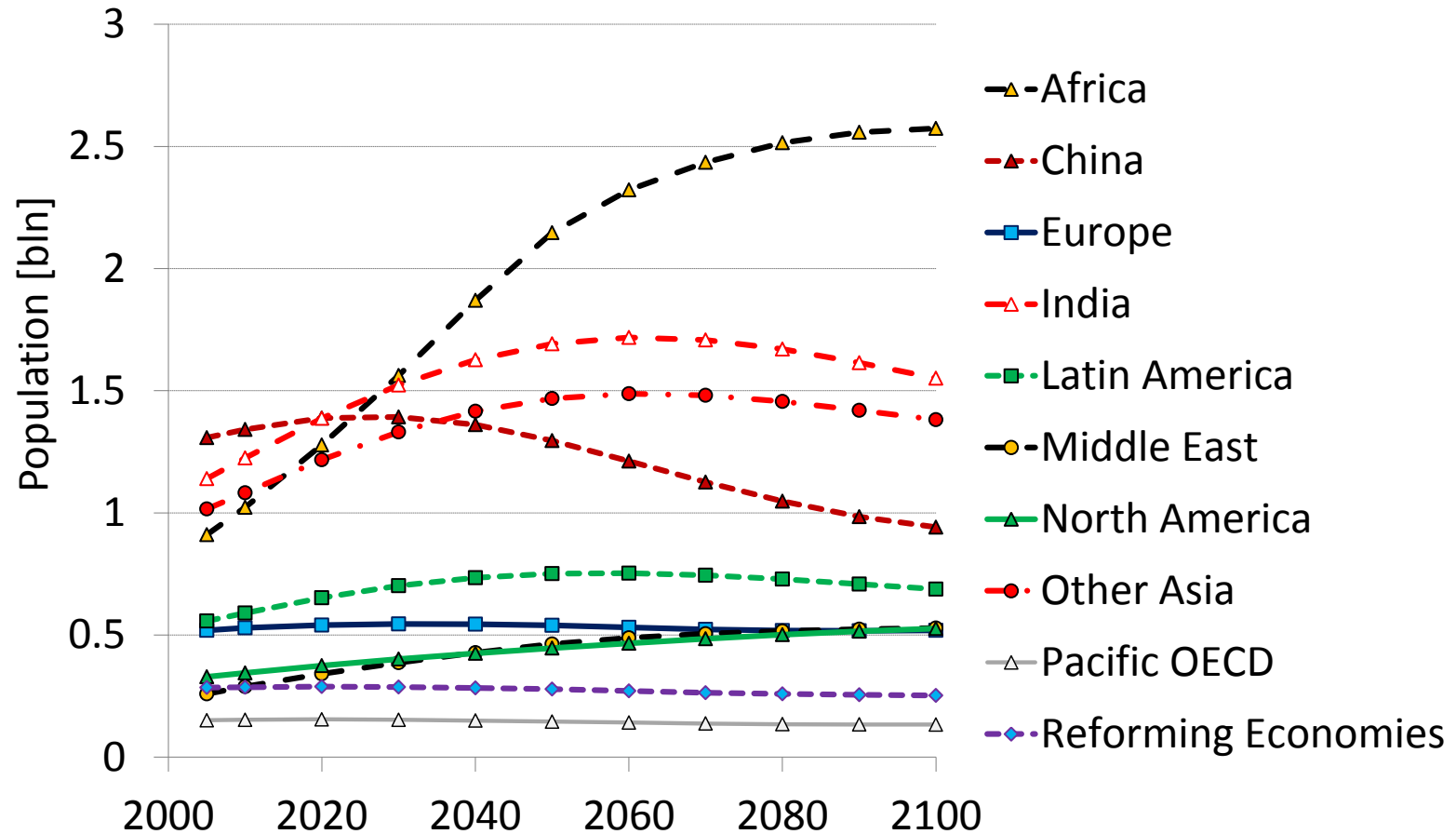
$Y_w$ : Global GDP

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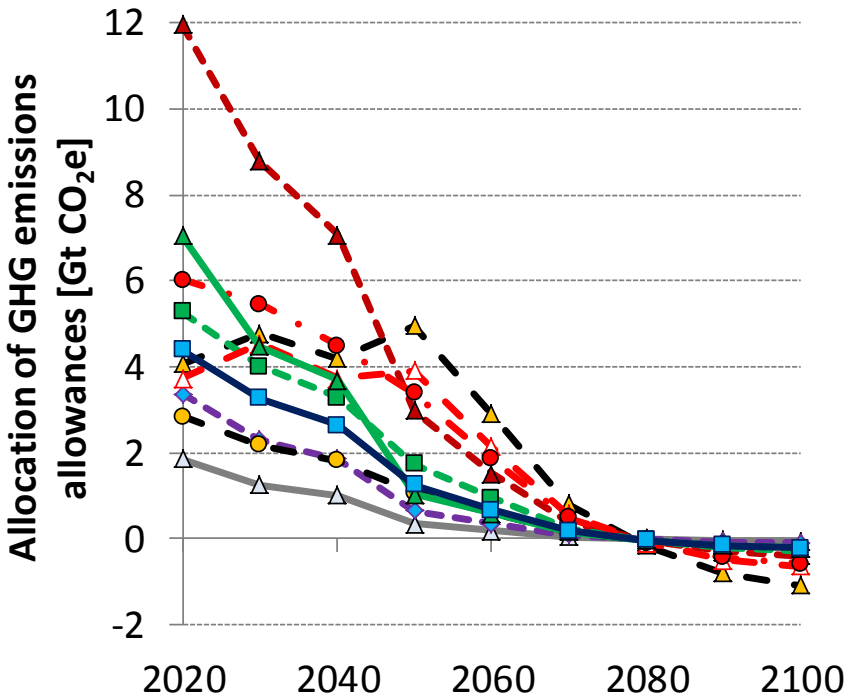
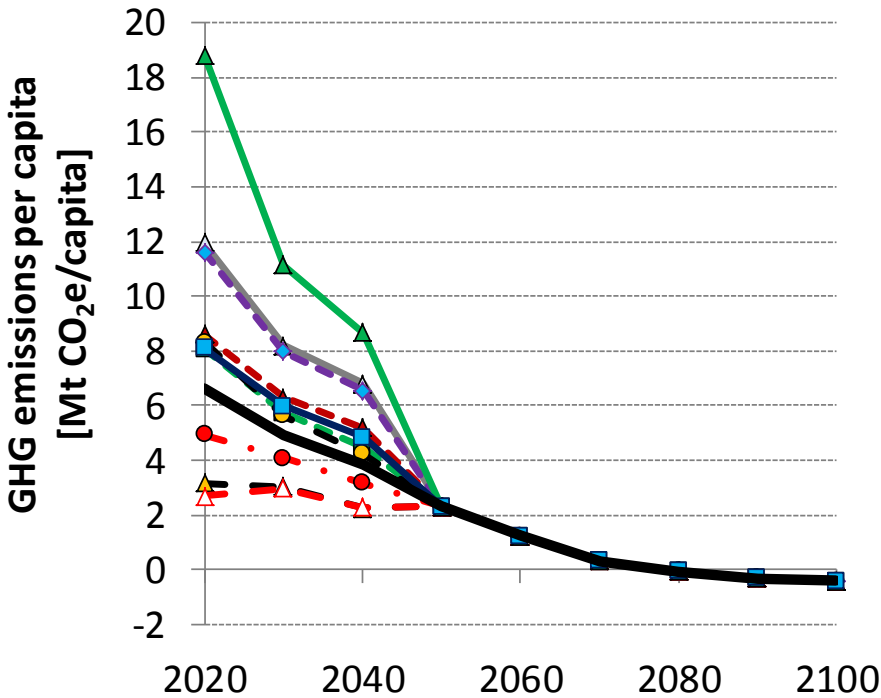
# Population development



Source: UN 2011, own calculations

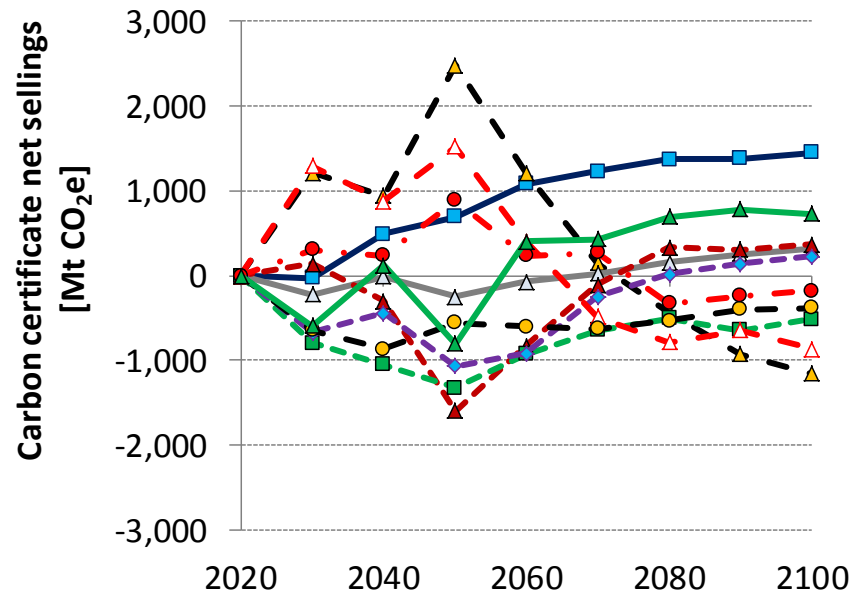


# Certificate allocation under Resource Sharing

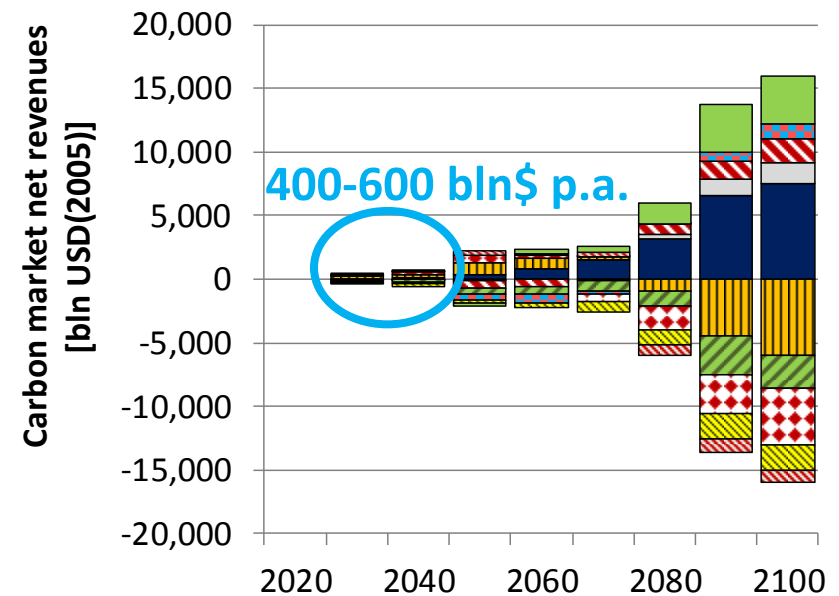


- ▲- Africa
- ▲- Pacific OECD
- ▲- China
- Latin America
- ◆- Reforming Economies
- ▲- India
- Middle East
- Other Asia
- ▲- North America
- Europe
- World

# Certificate trade and GHG market capital flow under Resource Sharing



- Europe
- △— Pacific OECD
- Latin America
- △— India
- Other Asia
- △— Africa
- △— China
- ◇— Reforming Economies
- Middle East
- △— North America



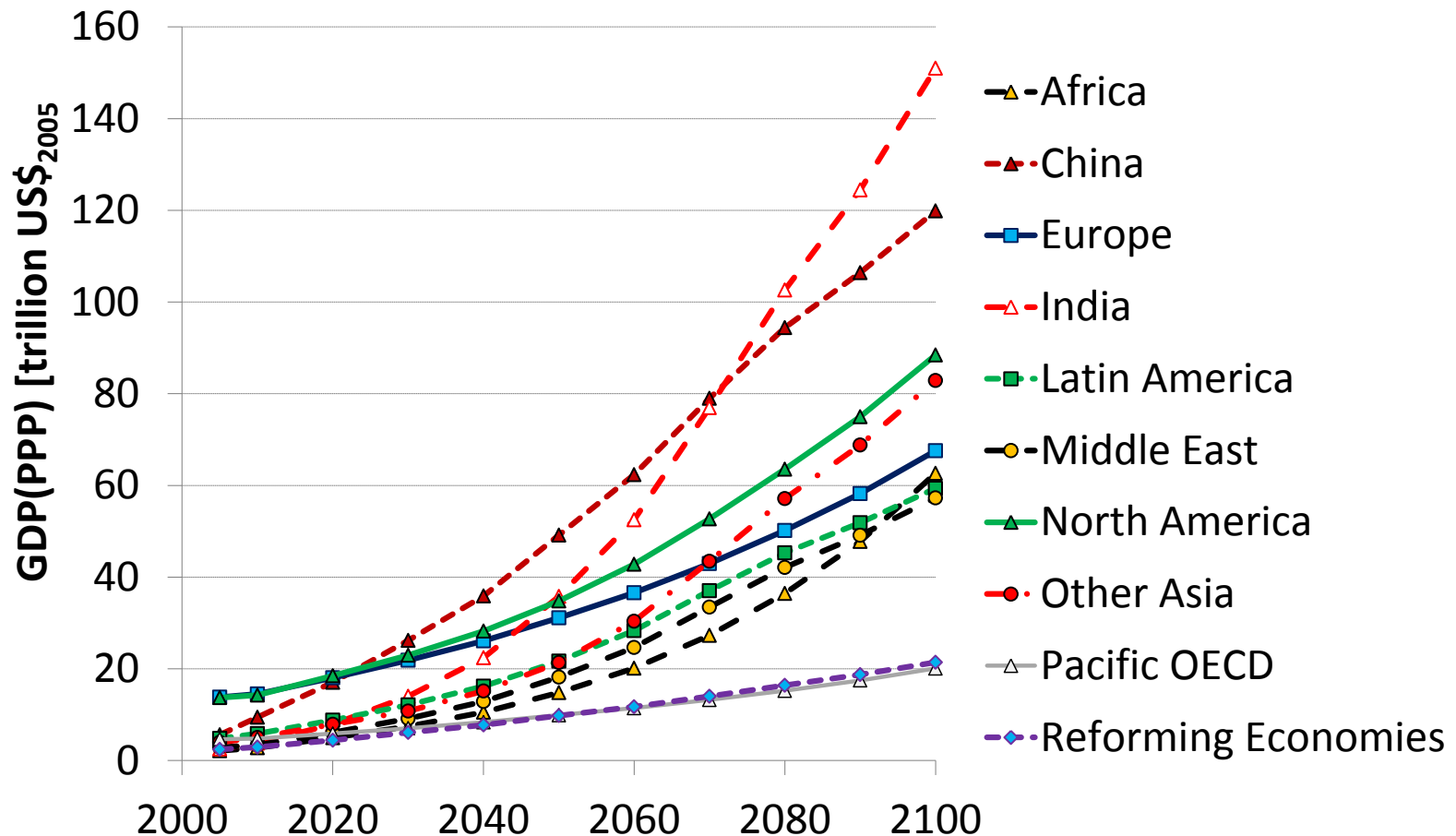
- Europe
- Pacific OECD
- Latin America
- ◆ India
- ▨ Other Asia
- ▨ Africa
- ▨ China
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- ▨ Middle East
- North America

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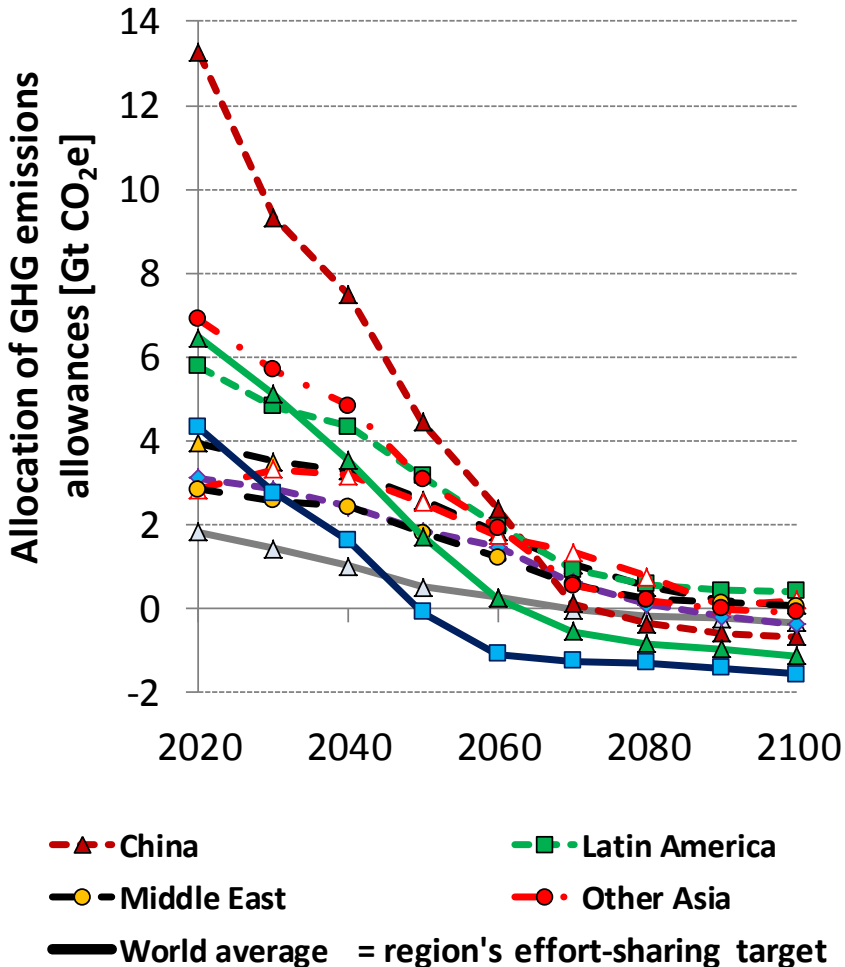
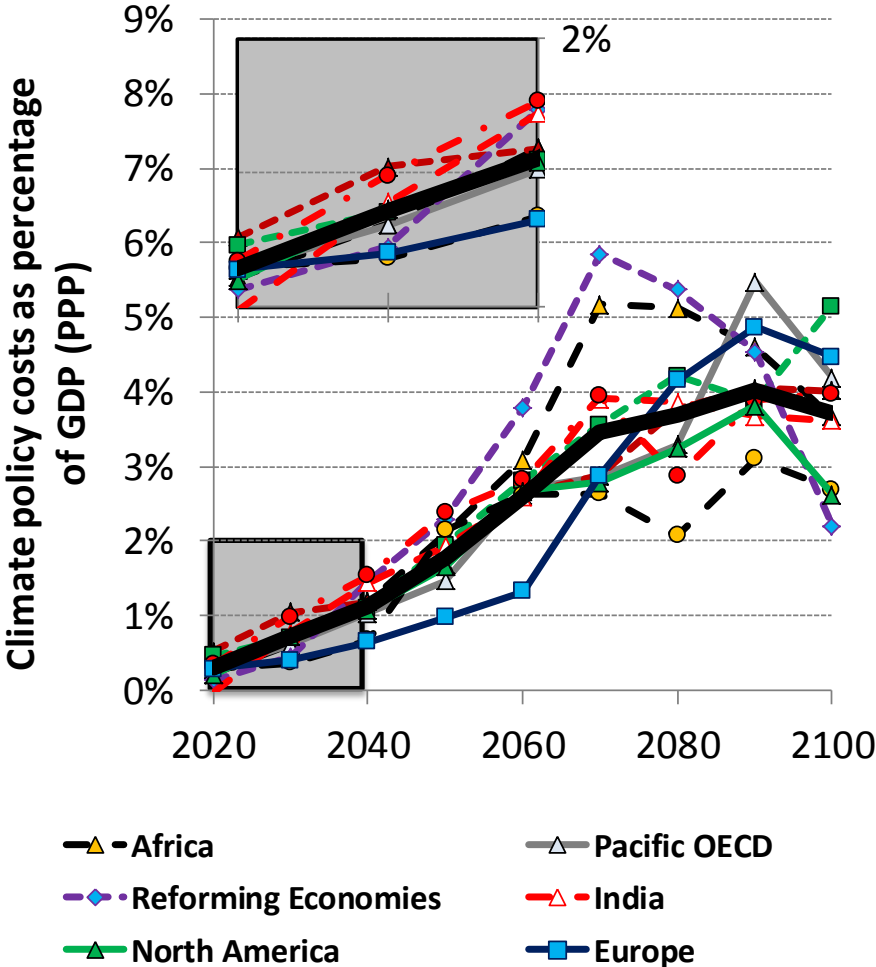
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# Development of GDP (PPP)

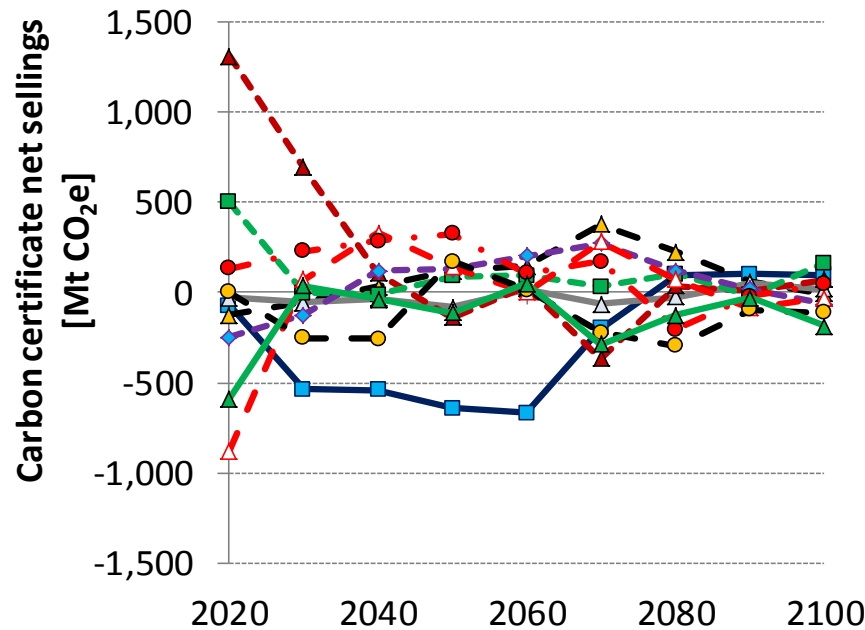


Source: IEA 2012, own calculations

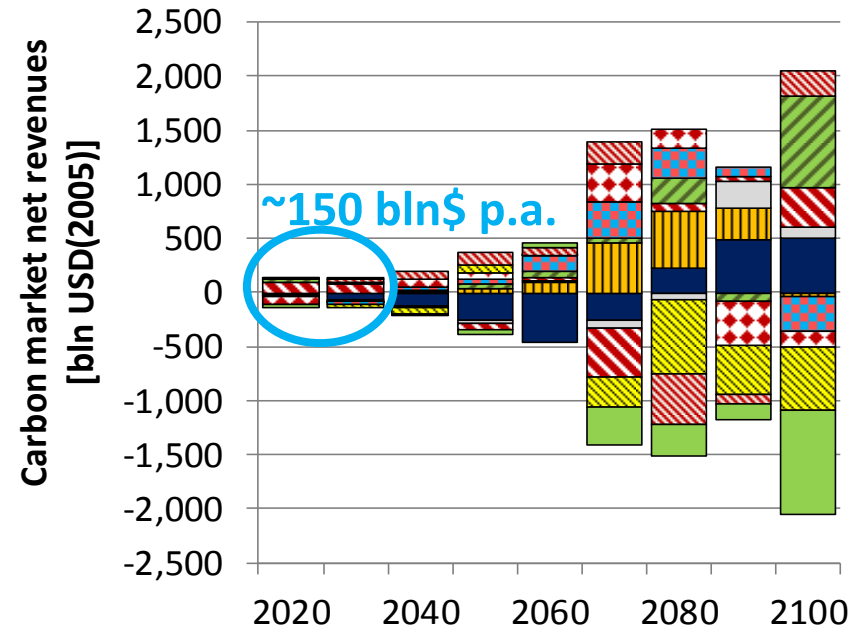
# Certificate allocation under Effort Sharing



# Certificate trade and GHG market capital flow under Effort Sharing



- Europe
- ▲ Pacific OECD
- Latin America
- ▲ India
- Other Asia
- ▲ Africa
- ▲ China
- ◆ Reforming Economies
- Middle East
- ▲ North America



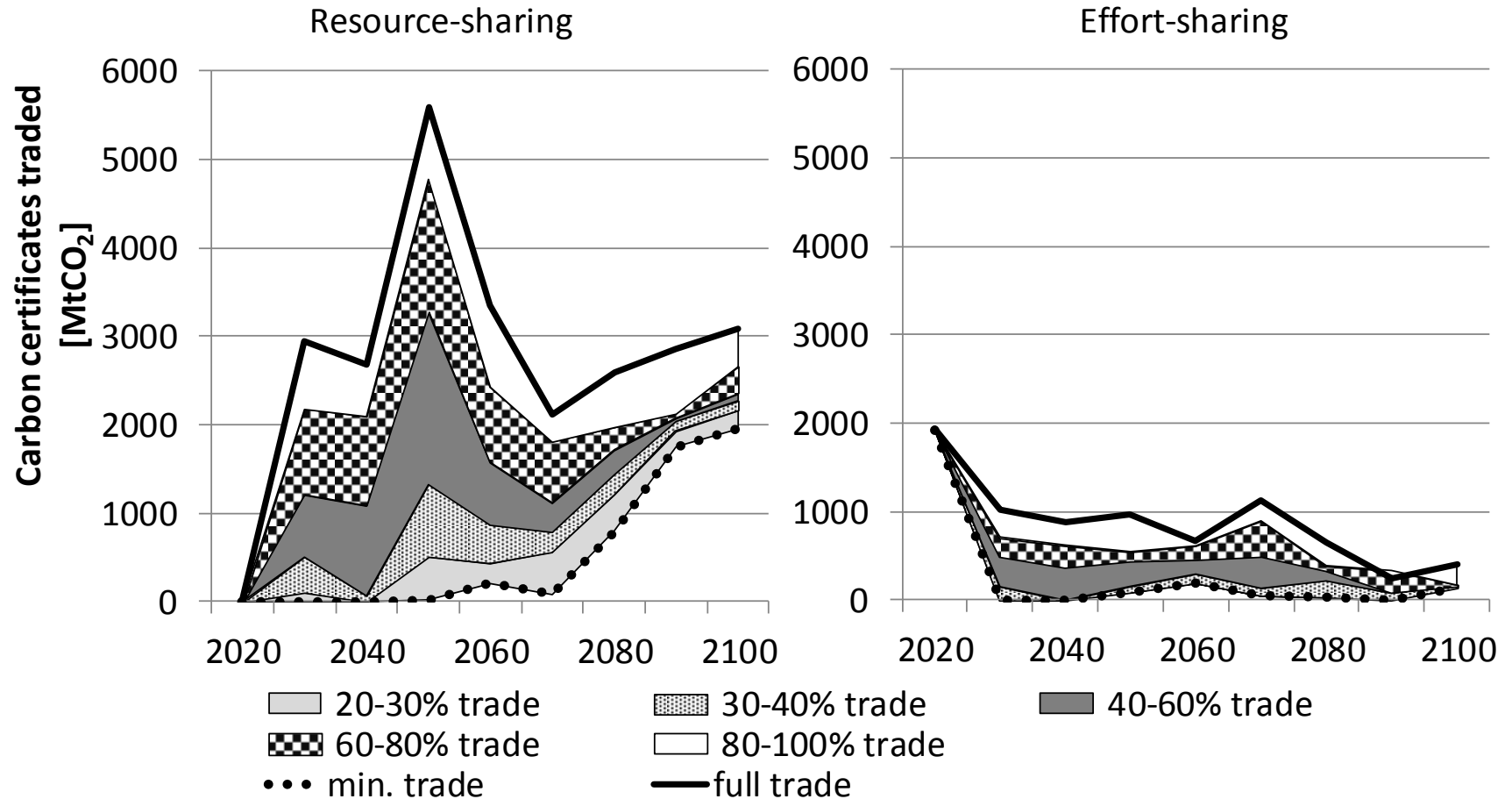
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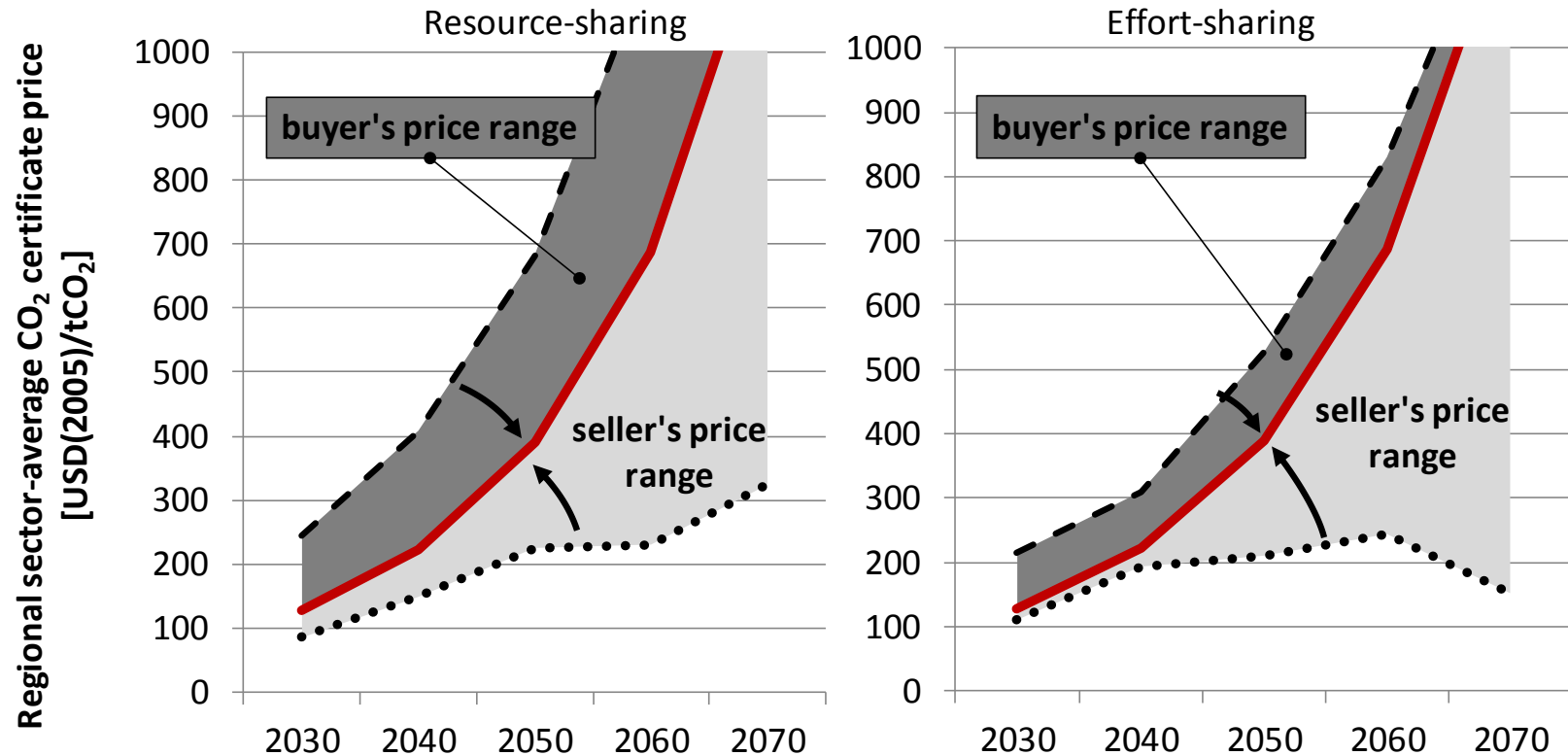
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# Timing effects of limited certificate trade



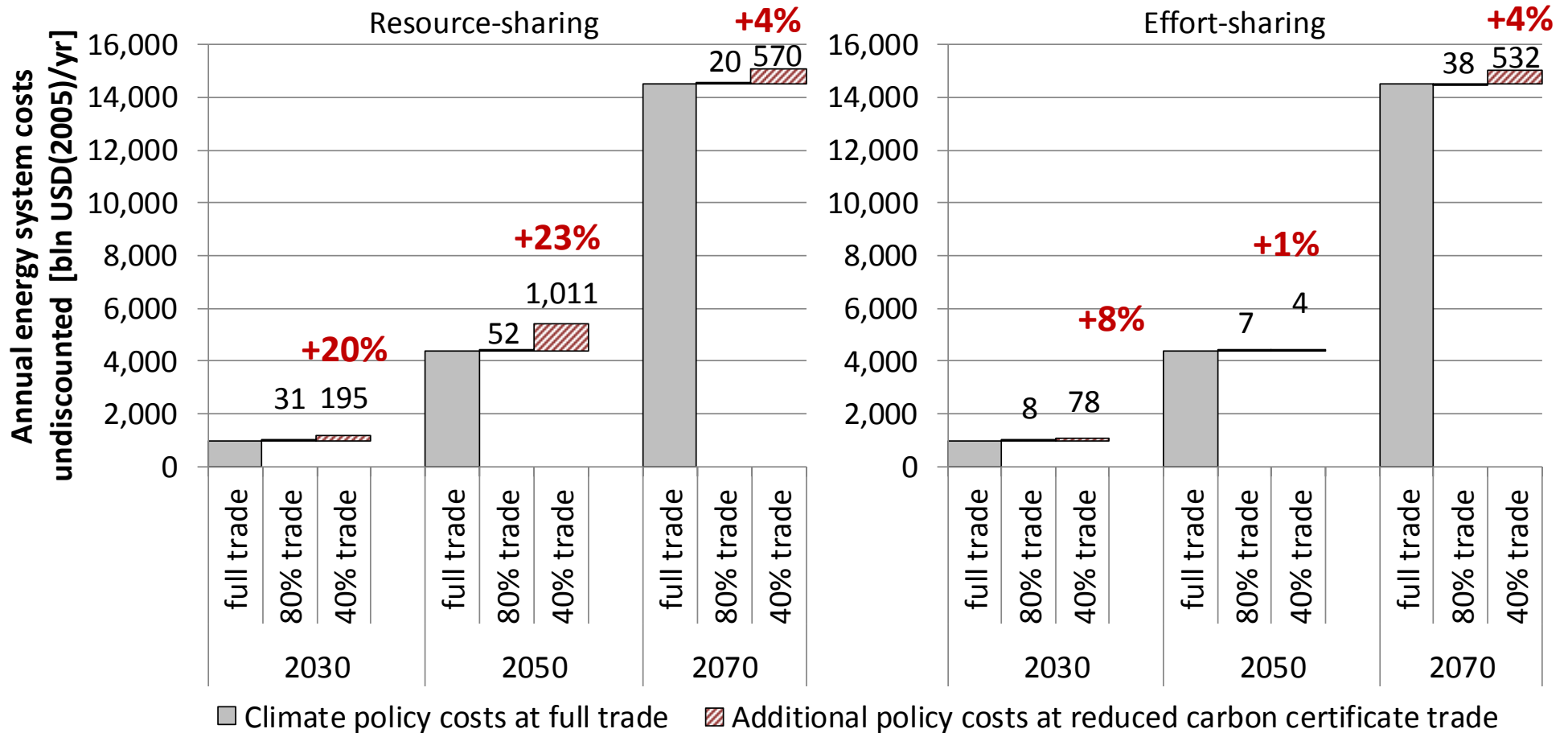


# Certificate price effects



- minimum among selling regions at 40% trade level
- full trade
- - - maximum among selling regions at 40% trade level
- range of CO<sub>2</sub> price decrease for certificate buying countries
- range of CO<sub>2</sub> price increase for certificate selling countries

# Effects on policy costs



# Conclusions

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- Design of burden sharing scheme determines which regions are compensated for their costs for climate change mitigation
- 70% less certificate trade under effort sharing (GDP related) than under resource sharing scheme (population related)
- Until 2050, compensation of regions with high population growth (Africa, India, Other Asia) under resource sharing scheme, and regions with strong economic growth (China) under effort sharing scheme
- Well functioning certificate trade mechanism is required, otherwise additional policy costs to reach climate target up to +20% of policy costs in the medium term (2030)
- Limited opportunities to trade permits influence carbon certificate price in selling and buying regions (2030: up to 120 USD/tCO<sub>2</sub>)

# Thank you!

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# References

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# CO<sub>2</sub> storage potential

