

Climate change mitigation in Latin America

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Systems Models and Economic Models

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Outline

1. Rationale
2. Model description of E3ME and TIAM-ECN & their linkage
3. Results
4. Conclusion

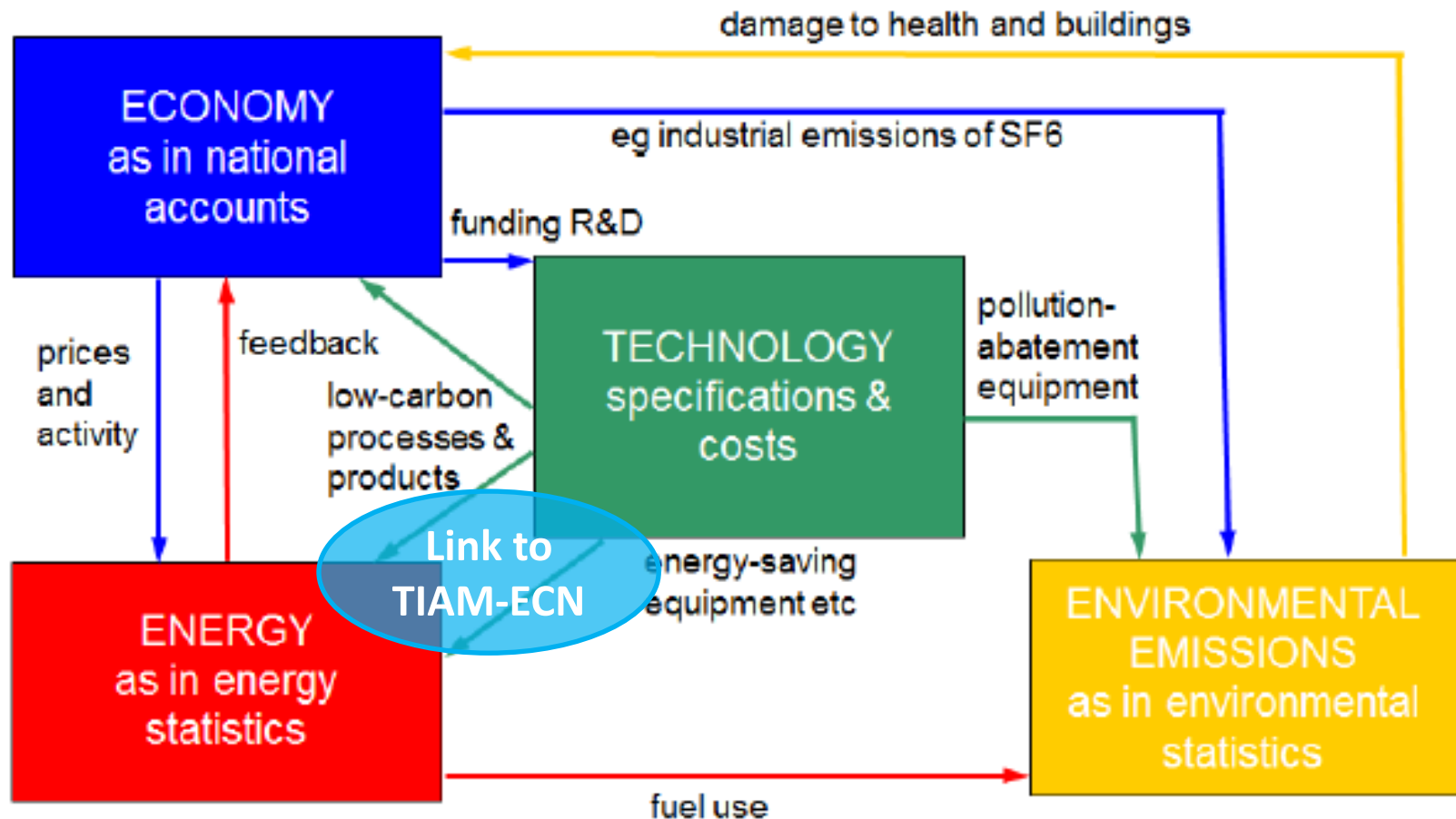
Rationale of model linkage

(energy system model & macro-economic model)



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- Energy system costs are not representative of whole economy impacts
 - Distribution and timing of impacts matters
 - Downstream: energy system costs are absorbed differently by different consumers
 - E.g. demand response
 - Trade flows
 - Upstream: energy system 'suppliers' (capital, fuel, etc.) have differing economic characteristics with implications for macroeconomic impacts
 - Technology diffusion/transfer
 - Innovation can be cross sectoral (e.g. batteries)

E3 interactions within E3ME



TIAM-ECN model characterisation

- Global, technology rich, long-term energy system model
- Economic optimisation: determination of cost optimal configuration of the system
- 20 world regions with trade of energy, emission certificates and captured CO₂
- All energy supply and demand sectors (from resource extraction to the final end use of energy)
- Comprehensive energy technology portfolio, e.g. hydrogen and synfuel production, CCS in power, industry and upstream sector, renewables for heat and power
- Emissions: CO₂, CH₄, N₂O



Model linkage

TIAM-ECN inputs to E3ME



e3me

E3ME outputs



→ TIAM-ECN representative for the energy system part of E3ME

TIAM-ECN results impact on the economy



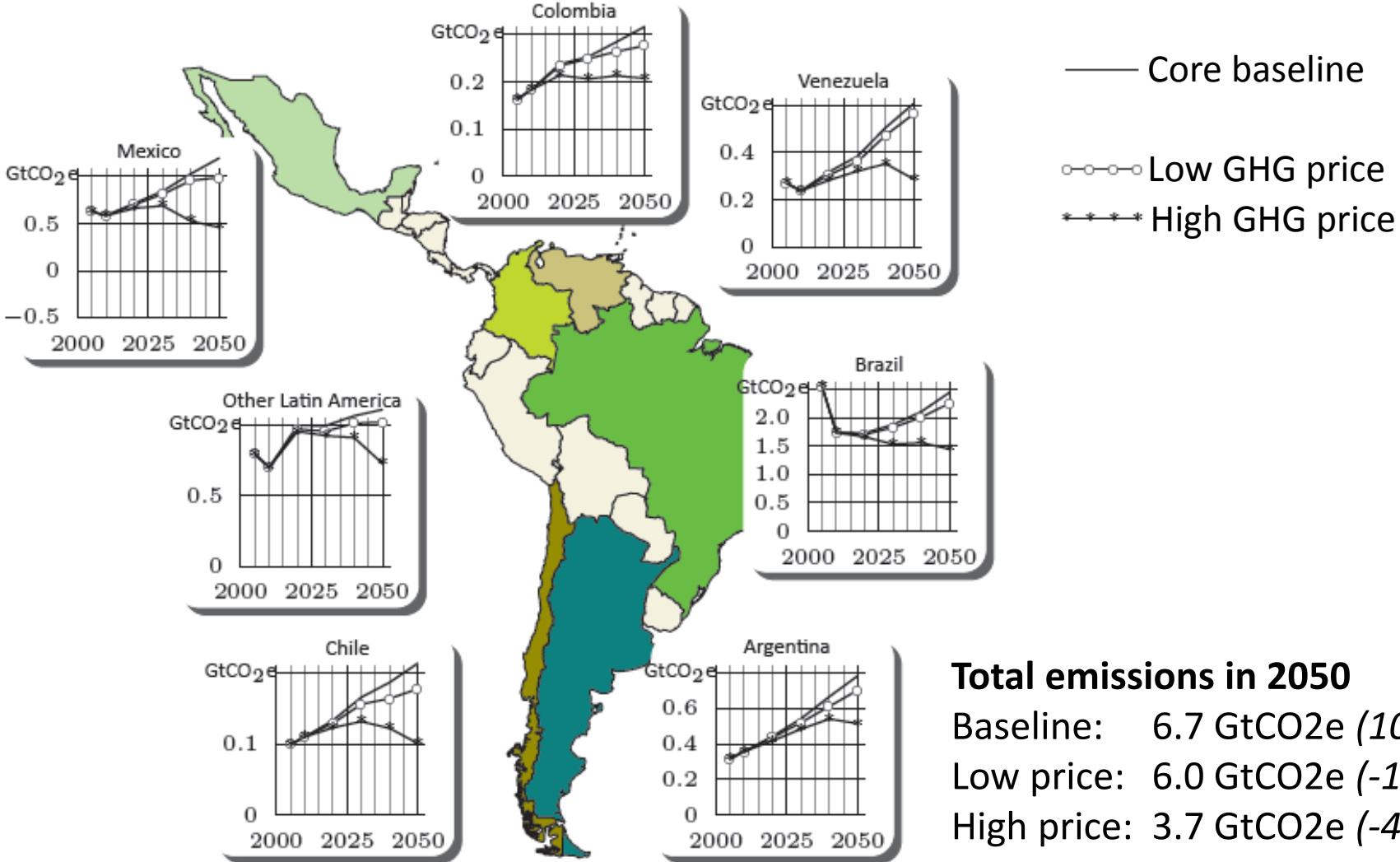
Three main channels through which the TIAM-ECN results impact on the economy:

- level of investment in energy technologies, the upstream impact of that investment and the way the investment is financed
- electricity prices and industry costs, and the consequential impact on demand
- mix of energy demand by fuel in the economy

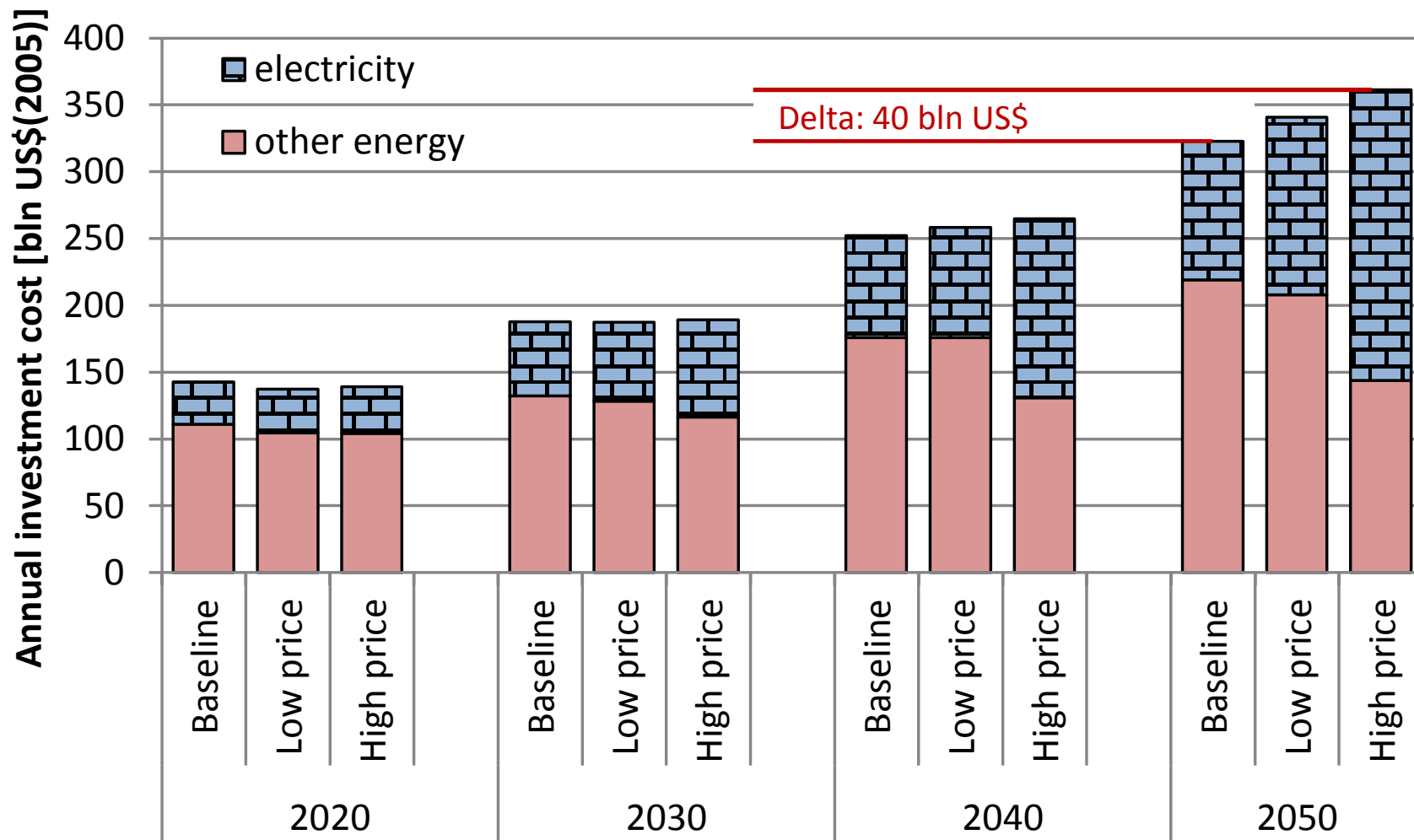
Scenario definition & assumptions

- **3 scenarios:**
 - **Core baseline** (No policy promoting climate change mitigation)
 - **Low price path for GHG emissions** (10 \$/tCO₂e in 2020 and + 4% p.a. afterwards)
 - **High price path for GHG emissions** (50 \$/tCO₂e in 2020 and + 4% p.a. afterwards)
- Population growth according to UNDP medium fertility rate

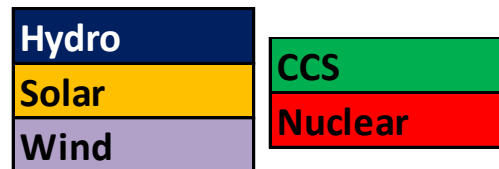
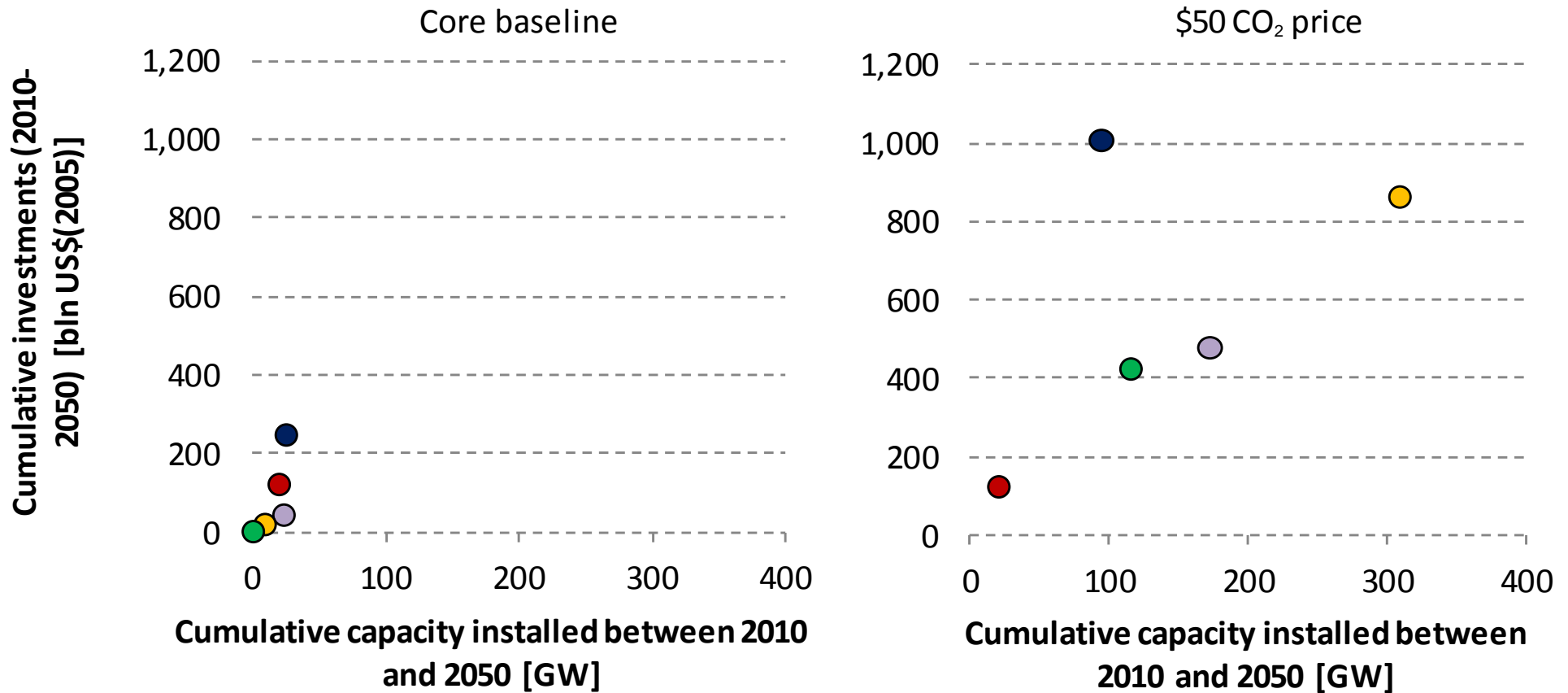
GHG emission development in Latin America



Investments in the energy supply sector (TIAM-ECN)

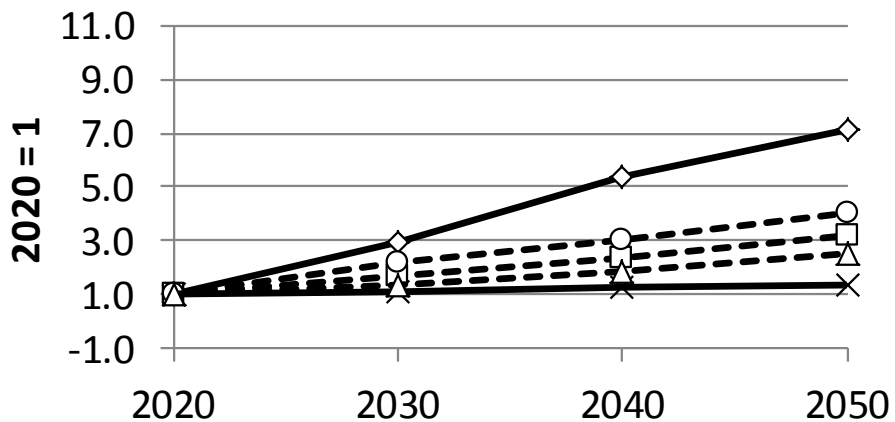


Low-carbon technology investments vs. capacity



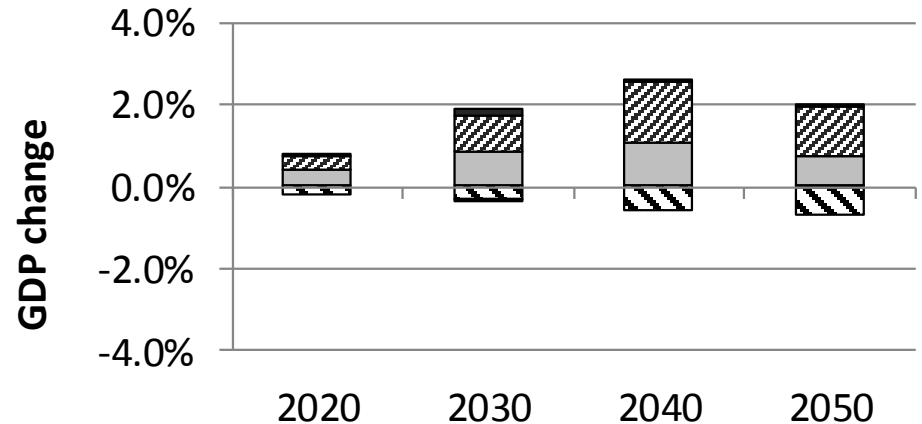
GDP impacts in Latin America in the high carbon price scenario

Energy technology costs
(investments and O&M costs)



- ◇— Electricity production
- ×— Other supply
- Industry
- Residential, commercial, agriculture
- △- Transport

Decomposition of impact on
Gross Domestic Product

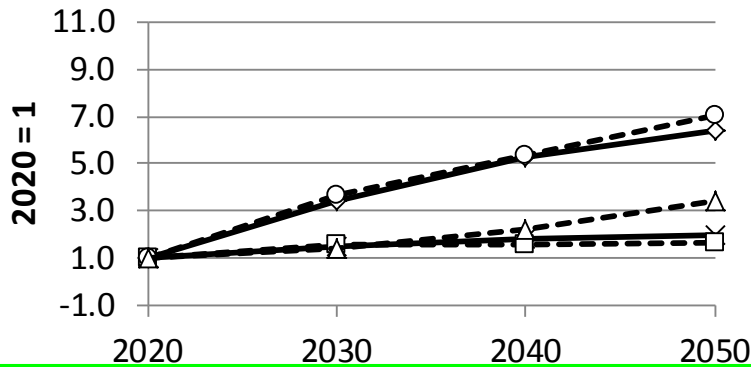


- Exports
- Imports
- Consumer spending
- Investment

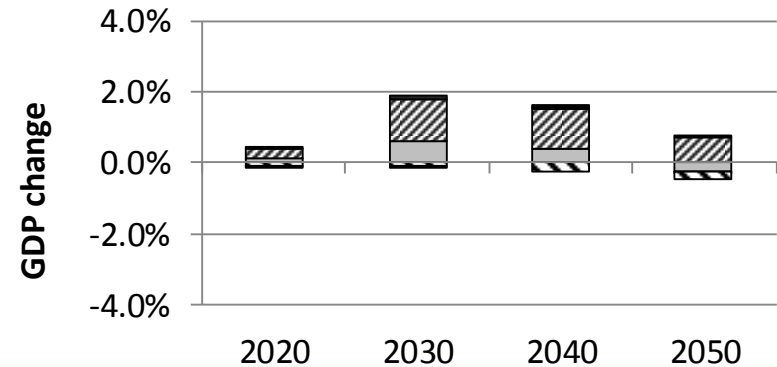
GDP impacts in Brazil and Mexico in the high carbon price scenario



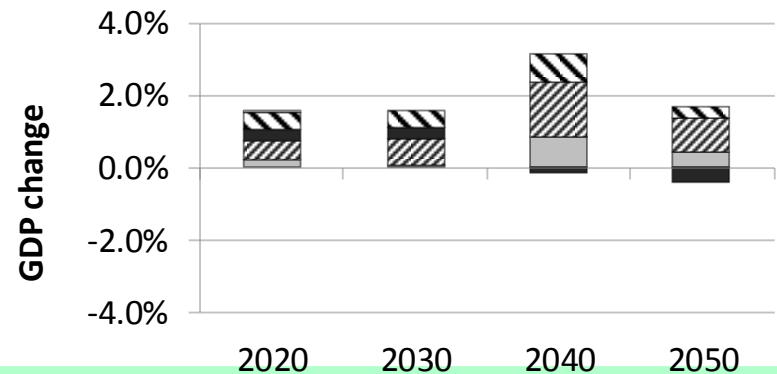
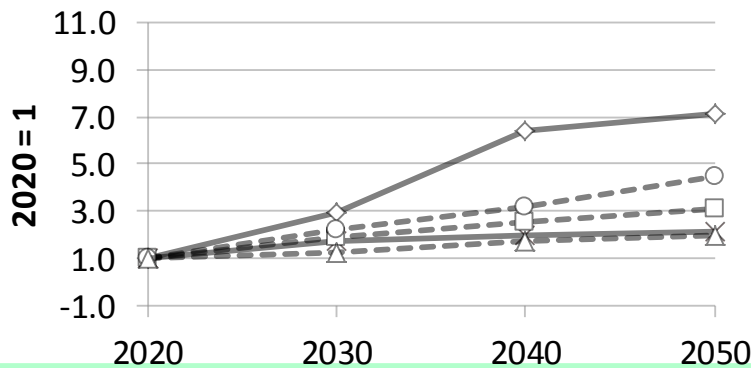
Energy technology costs
(investments and O&M costs)



Decomposition of impact on
Gross Domestic Product

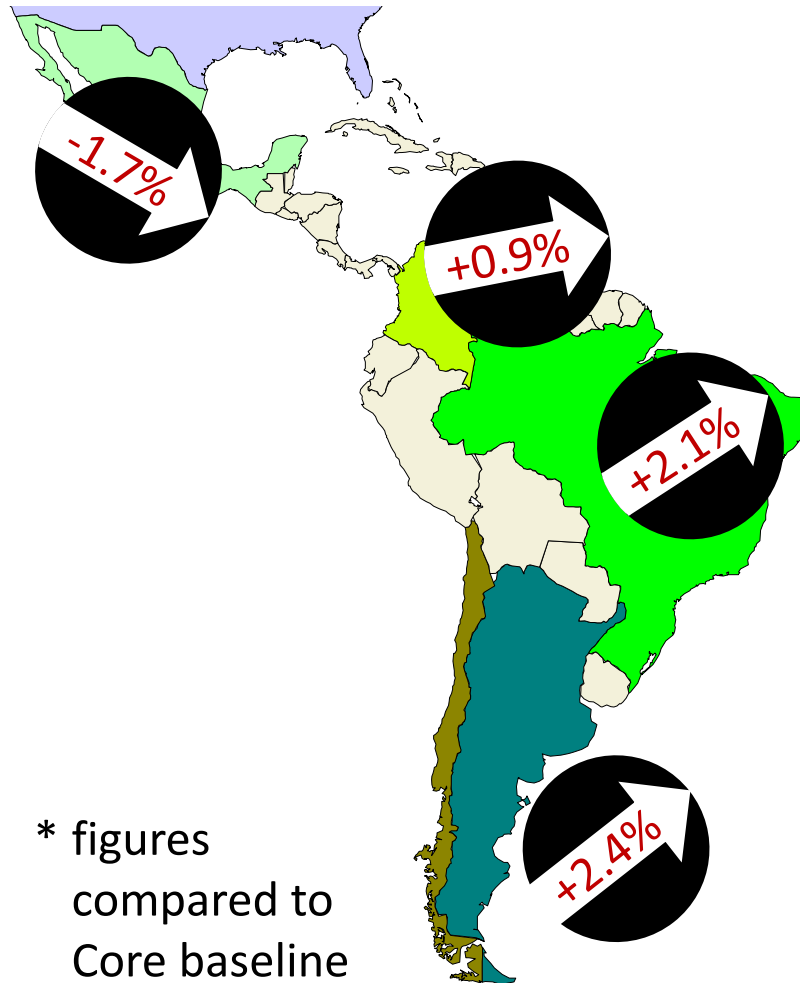


Mexico:



- ◆ Electricity production
- Consumer spending
- × Other supply
- Exports
- △- Transport
- ▨ Investment
- Industry
- Residential, commercial, agriculture
- ▩ Imports

Long-term (2050) employment effects under high carbon price*



- Employment increases on average by 1.4%
- Unemployment declines by 30% (+5 mln. jobs)

* figures compared to Core baseline

Conclusions

- With increasing GHG emission reduction obligation energy supply investments shift towards electricity technology
- Among low-carbon technology significant investments in hydro and solar technology under high carbon tax
- Investments in low-carbon technology don't crowd-out investments in other sectors if capital can be transferred from non-productive assets to productive assets. This results in:
 - Positive macro-economic effects
 - Stabilisation of consumer spending if carbon tax is recycled
 - Increase of employment

Outlook

- E3ME delivers insights into demand response
 - Different demand scenarios
 - Update of demand elasticity factors for TIAM-ECN (long-term option)
- Recycling of carbon tax revenues to be reflected in TIAM-ECN
 - Carbon prices are used representatively in energy system models
 - If assumed revenue is recycled into economy, how does this offset the impact?
 - Demand response?
 - Technology-specific subsidy: NCAP_ISUB
 - Consumer-specific: COM_SUBPRD

Acknowledgements

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For more information about CLIMACAP project visit:
<http://www.climacap.org>

Thank you!



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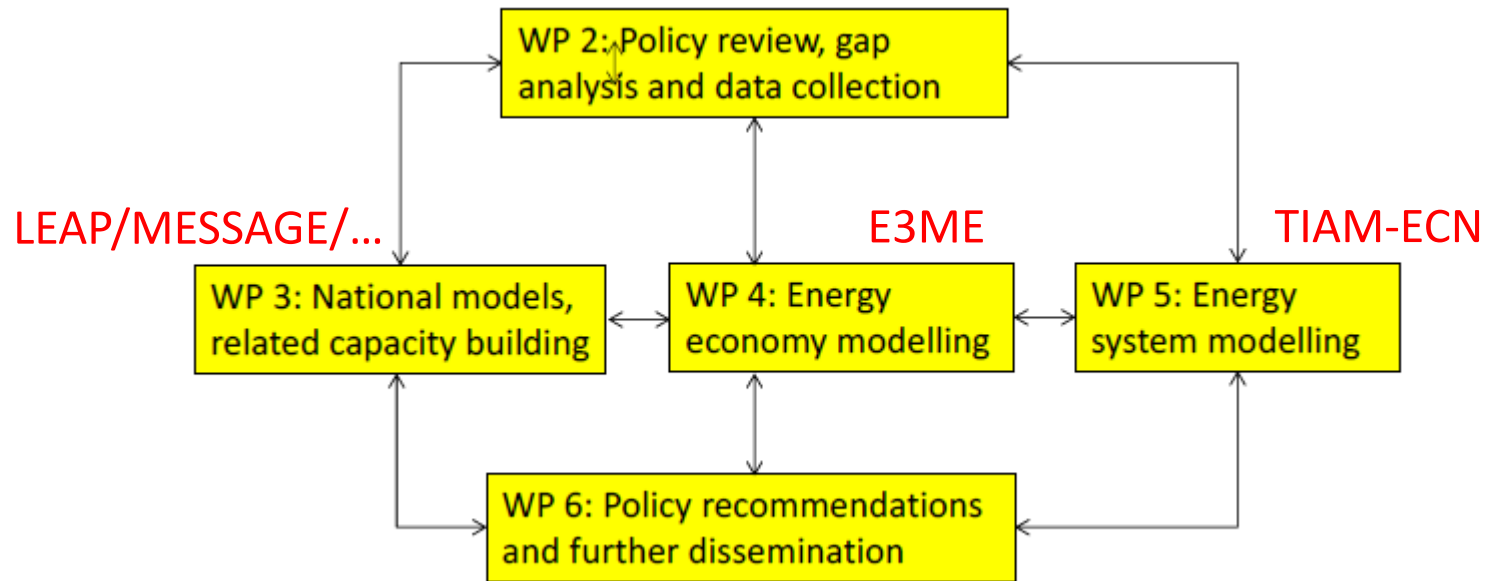
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- Supplementary material

Model interaction in CLIMACAP project



GDP impact relative to CO₂ impact, Latin America

