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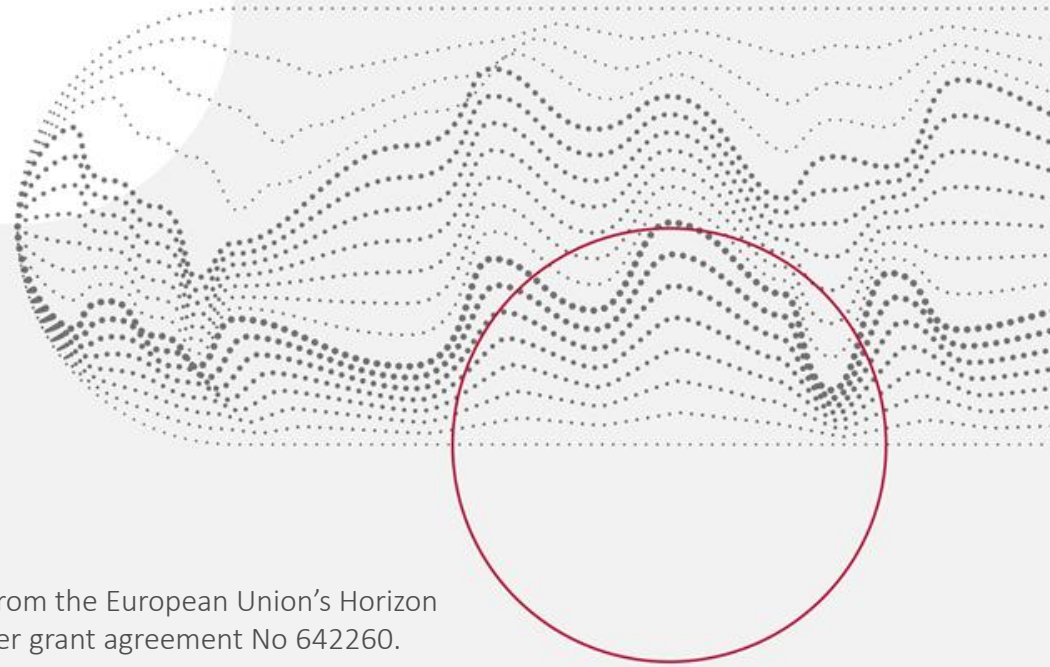
MEMO model

Marek Antosiewicz



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Who we are?

- Independent research institute specialising in the field of:
  - Labour markets, demography, education
  - Energy and climate policies
  - Public finance
- We utilise both quantitative and qualitative tools:
  - Macroeconomic DSGE modelling
  - Microsimulation modelling
  - Energy system modelling
  - Fuzzy cognitive mapping, MCDA
- We have worked with entities such as the: World Bank, European Commission, Horizon2020, OECD, Polish Ministries, Regional Governments, National Bank of Poland, MAPS, European Climate Foundation and many others.

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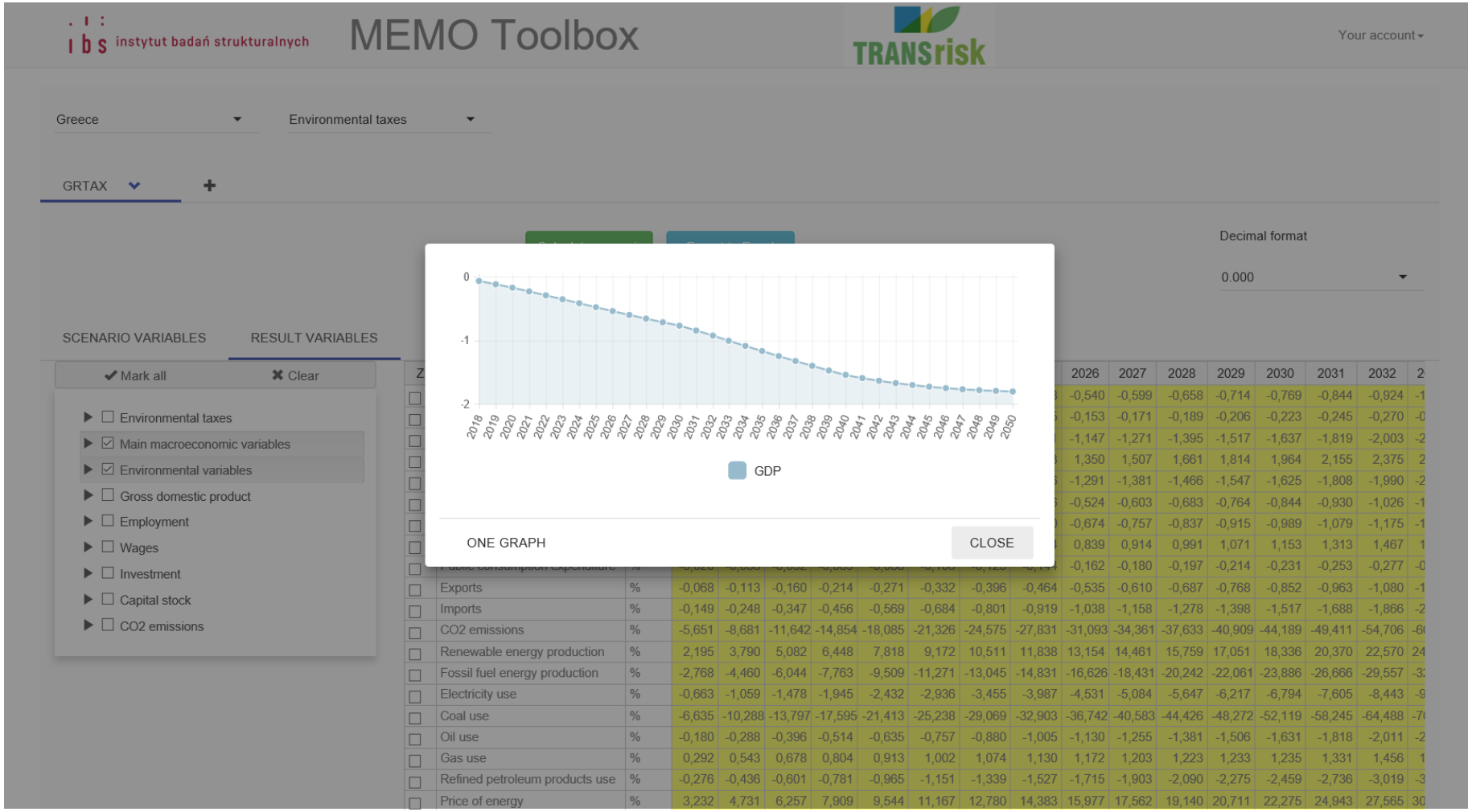
What we did in TRANSrisk

- In-depth analysis of Polish case study
  - Development of pathways for switching to renewables
  - Modelling of energy system
  - Assessment of macroeconomic cost
  - Stakeholder engagement
- Carbon tax simulations for Chile for energy poverty case study
- Macroeconomic mitigation toolbox
  - DSGE model for Chile, Greece and Poland
  - Models embedded in easy to use application

Snapshot of MEMO toolbox (https://transrisk.ibs.org.pl)



Climate policy assessment models

- Integrated Assessment Models
- Macroeconometric Models
- Computable General Equilibrium
- Dynamic Stochastic General Equilibrium

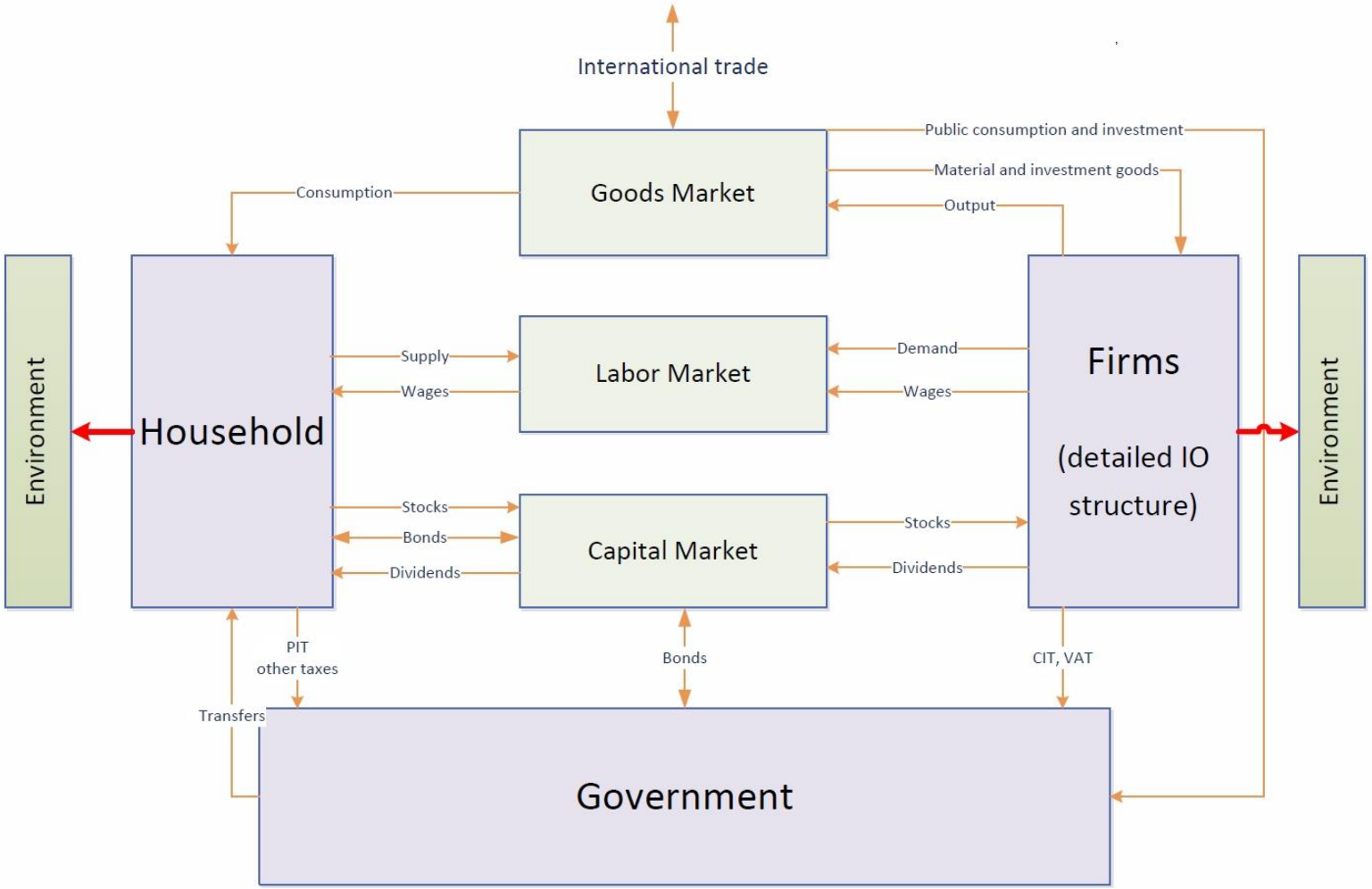
From CGE to DSGE

CGE	DSGE
1 period optimization, behavioral decision rules	Rational expectations, intertemporal optimization
Used mainly to analyse tax and trade policies	Can be used for a wide range of policy analysis: investment plans, taxes, monetary policy
Many separate economic areas	1 or 2 country model
40+	10-20, but model accounts for more economic mechanisms: technological adaptation, labour market frictions, investment frictions
Simple solution method	Complex solution method, fine tuning of each model

MEMO model

- Input output (multi-sector) embedded in DSGE framework
- Main agents of model
  - Household
  - Firms
  - Government
  - Open economy

Model Scheme



Key features of model

- Labour market modelled using search and matching mechanism
- Technological adaptation
- Modelling of raw materials
- Several electricity generation sectors
- Trade – single country
- Time horizon until 2050
- Nested CES production function according to KLEMS

Macroeconomic, top down modelling

Policies and shocks	Show responses of
Taxes and subsidies Electricity sector expansion plans Sector investment plans Changes in foreign demand Changes in prices	GDP and GDP components Unemployment Employment Wages Trade Energy efficiency Emissions (variables in sector disaggregation)

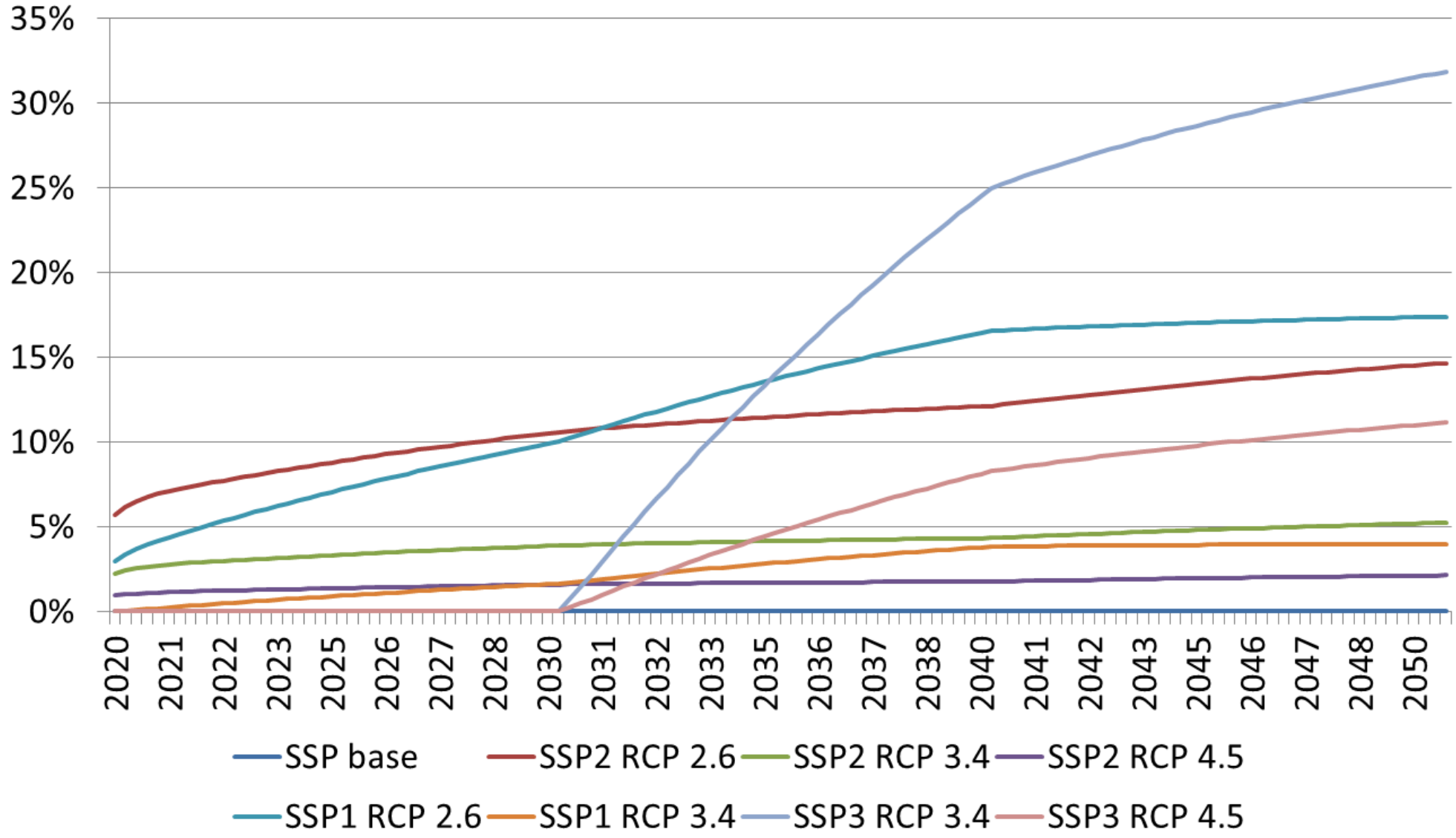
MEMO has been used for

- Poland and Polish voivodships
  - Climate mitigation policies
  - Impact of EU cohesion spending
  - Investment plans
- Macedonia
  - Climate mitigation policies
- EU
  - FP7 Dynamix project – materials and resource use
- Chile
  - MAPS project
- Antosiewicz, M.; Lewandowski, P.; Witajewski-Baltvilks, J. Input vs. Output Taxation—A DSGE Approach to Modelling Resource Decoupling. *Sustainability* 2016, 8, 352.

Carbon tax simulations for Chile

Model	Scenario	Region	Variable	Unit	2005	2010	2020	2030	2040	2050	2060
AIM/CGE	SSP3-34	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	111.048	184.253	248.186
AIM/CGE	SSP3-45	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	36.766	64.576	120.954
AIM/CGE	SSP3-60	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	17.009	28.588	28.588
GCAM4	SSP4-26	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	20.000	69.903	113.865	185.474	302.118
GCAM4	SSP4-34	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	20.000	34.614	56.383	91.842	149.600
GCAM4	SSP4-45	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	20.000	20.344	33.138	53.978	87.925
GCAM4	SSP4-60	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	20.000	2.114	3.444	5.610	9.138
GCAM4	SSP4-Baseline	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IMAGE	SSP1-26	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	8.815	32.722	71.763	99.968	109.976
IMAGE	SSP1-34	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	5.429	16.708	22.955	32.805
IMAGE	SSP1-45	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.816	3.516	3.035	7.290
IMAGE	SSP1-Baseline	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MESSAGE-GLOBIOM	SSP2-26	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	16.681	34.342	52.004	84.710	137.983
MESSAGE-GLOBIOM	SSP2-34	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	6.633	12.601	18.568	30.245	49.266
MESSAGE-GLOBIOM	SSP2-45	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	2.742	5.154	7.566	12.324	20.075
MESSAGE-GLOBIOM	SSP2-60	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.479	0.962	1.444	2.352	3.831
MESSAGE-GLOBIOM	SSP2-Baseline	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
REMIND-MAGPIE	SSP5-26	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	3.000	39.500	143.300	260.000	493.100
REMIND-MAGPIE	SSP5-34	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	3.000	19.660	66.770	121.000	231.600
REMIND-MAGPIE	SSP5-45	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	3.000	19.850	56.710	92.380	150.500
REMIND-MAGPIE	SSP5-60	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	3.000	9.280	22.270	36.280	59.100
REMIND-MAGPIE	SSP5-Baseline	R5.2LAM	Price|Carbon	US$2005/t CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Results for energy price of carbon tax simulations for SSPs



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Thank you for your attention!

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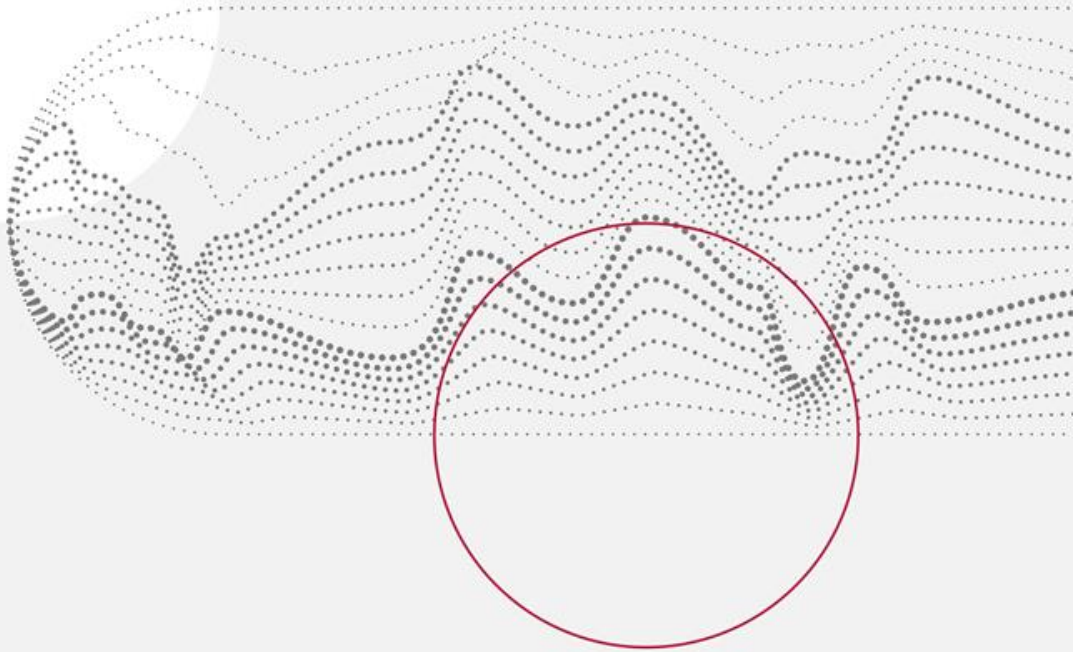

TRANSrisk
TRANSITION PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE POLICIES