Climate Policies as a hedge against the uncertainty on future oil supply

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1 Introduction

2 The IMACLIM-R model
- A CGE model
- A recursive architecture

3 Methodology to build scenarios
- Complying with different levels of uncertainty
- Our hypothesis for oil and gas markets

4 Results
- In BAU scenarios: high GDP losses due to oil scarcity
- Climate policies are costly as well
- The hedge brought by climate policies

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Main messages

We analyze in a common modeling framework

- macroeconomic costs of future oil scarcity
- macroeconomic costs of climate policies

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To do so

- we use a global energy-economy CGE model
- we build hundreds of scenarios to explore the uncertainty surrounding the main drivers of macroenergetic contexts

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To do so

- we use a global energy-economy CGE model
- we build hundreds of scenarios to explore the uncertainty surrounding the main drivers of macroenergetic contexts

We find that

- the costs of oil scarcity and climate policies are of the same order of magnitude
- climate policies reduce the costs of oil scarcity

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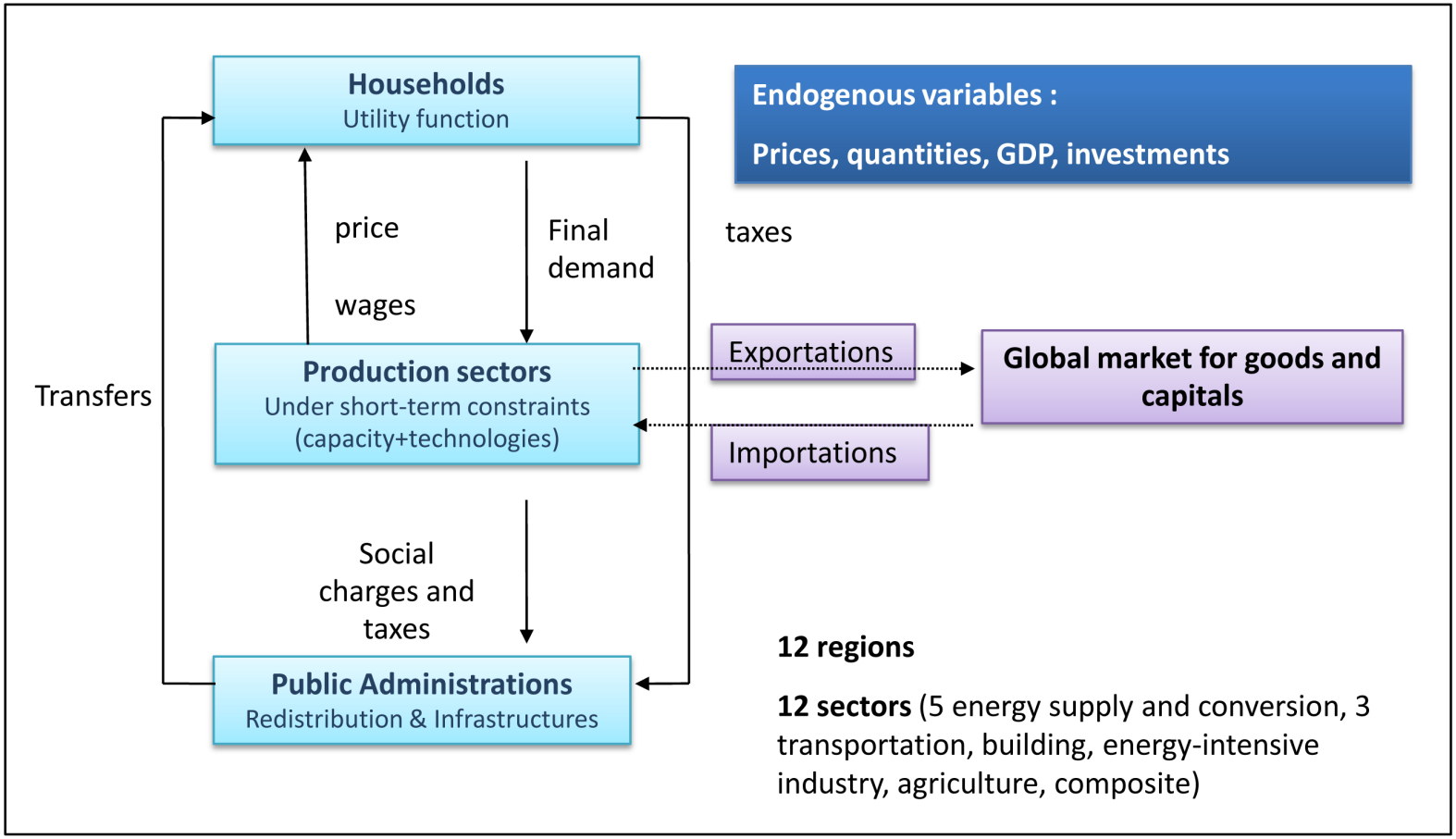
What was the model built for?

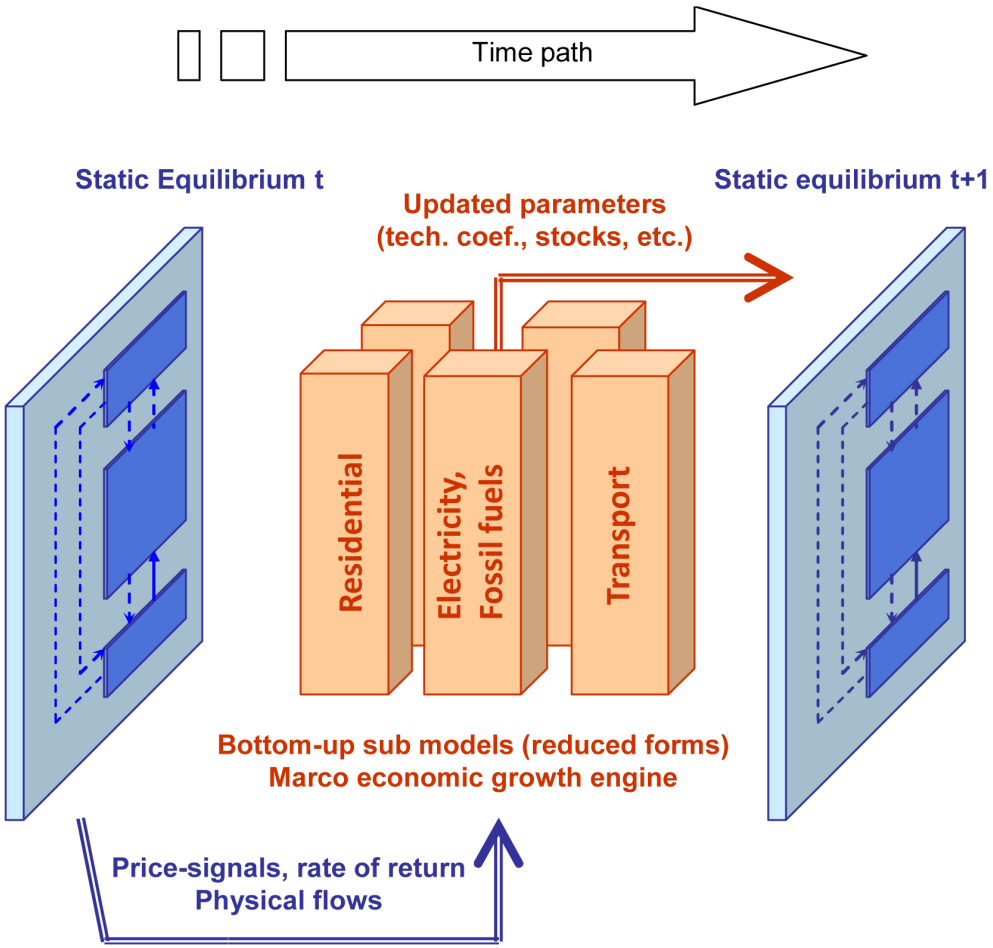
Analyzing coherent energy-economy scenarios

- The model **endogenously** calculates...
  - energy prices
  - carbon price
  - GDP
  - new technologies market shares
  - ...
- ... using assumptions such as:
  - oil reserves and extraction costs
  - technologies costs
  - investors' tradeoffs
  - desired CO2 emissions levels
  - ...

A general equilibrium is solved at each time step



A distinction is made between short-term and long-term constraints



The dynamic modules allow a dialog between economists and engineers

They are reduced forms of bottom-up models representing

- Technological choices
- Capital accumulation
- Energy efficiency

Economic growth is endogenous

Long-term growth is a "Solow growth model"

It is driven by exogenous trends of

- population growth (UN median scenario)
- labor productivity growth (convergence assumption)

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But in the short run, actual growth is constrained by

- available capital flows for investments
- under-utilization of production factors (labor and capital)

Example of a dynamic module

The oil sector

- Reserves are distinguished according to the type of oil and the region
- A bell-shaped curve for each "field" production capacities
- Two types of producers :
  - Middle-East countries : adapt their production to influence the world oil price
  - The others : price takers

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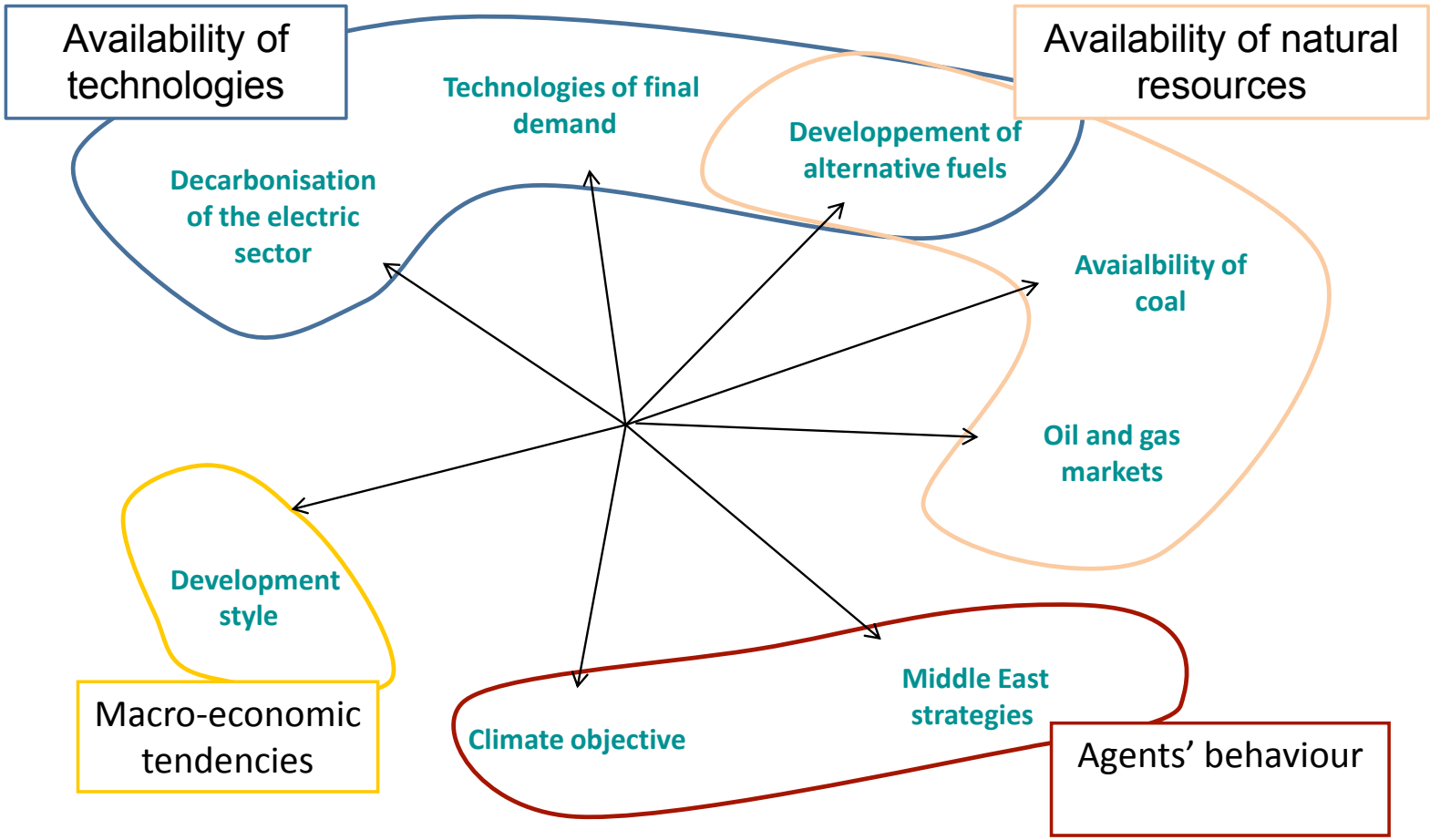
Scenarios: neither "best guest" nor "most likely" scenarios

- Hundreds of exogenous parameters necessary to calibrate the model
- Their value are debated or they encompass poorly-understood mechanisms
- They are different from endogenous outputs resulting from model runs

Example: Maximum market share of electric cars.

Parameter sets - Combining hypotheses to create 576 scenarios



Parameters choices for the "oil and gas markets" set

	Assumption 1: oil and gas largely available	**Assumption 2: oil and gas limited**	**Assumption 3: oil and gas very constrained**
Ultimately recoverable resources	3.6 Tb	3.1 Tb	3.1Tb
Inertia on non conventional production	No	Yes	Yes
Sustained investments in the post-peak oil phase	Yes	Yes	No
Gas price indexation	Until 80$/bl	Always	Always

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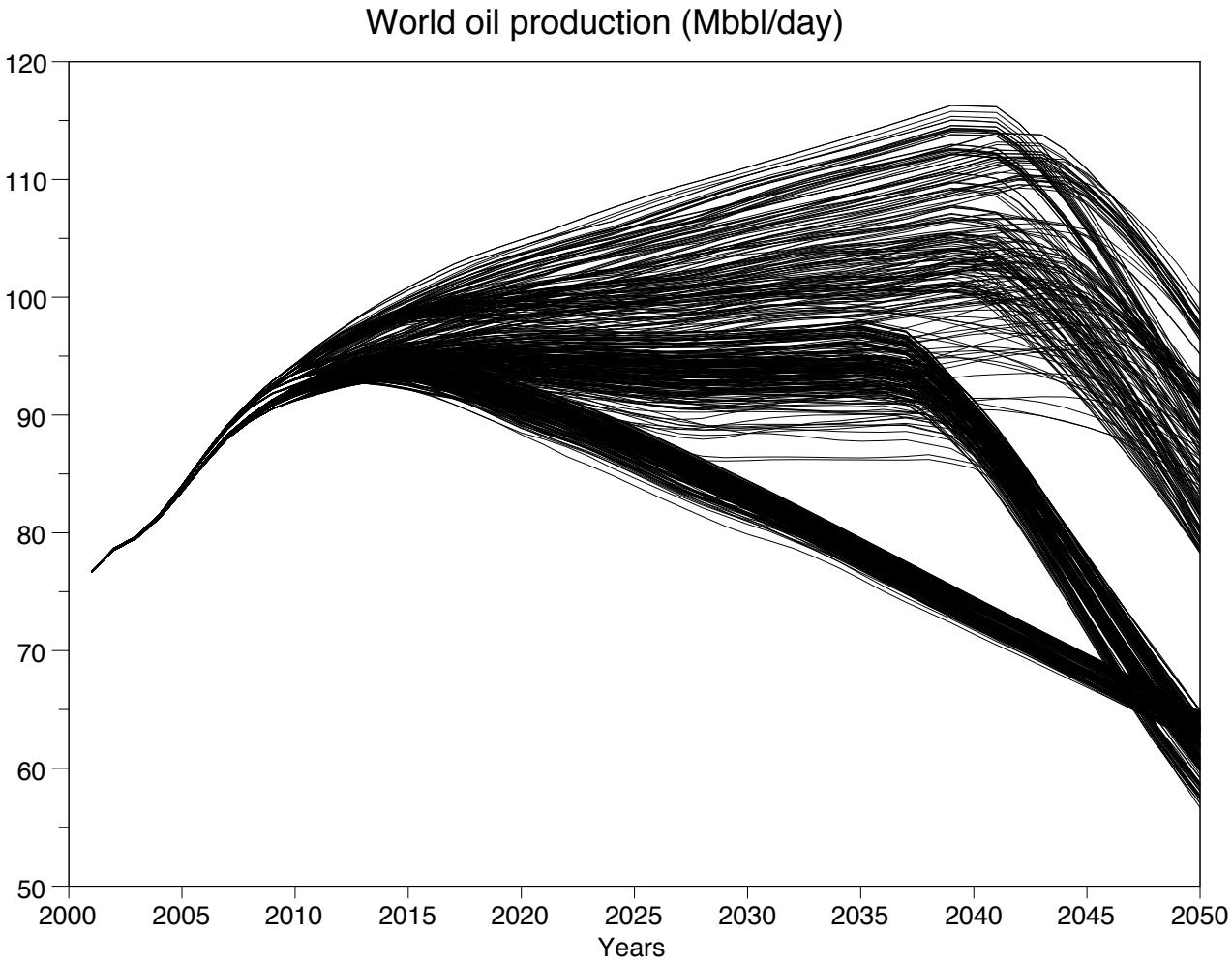

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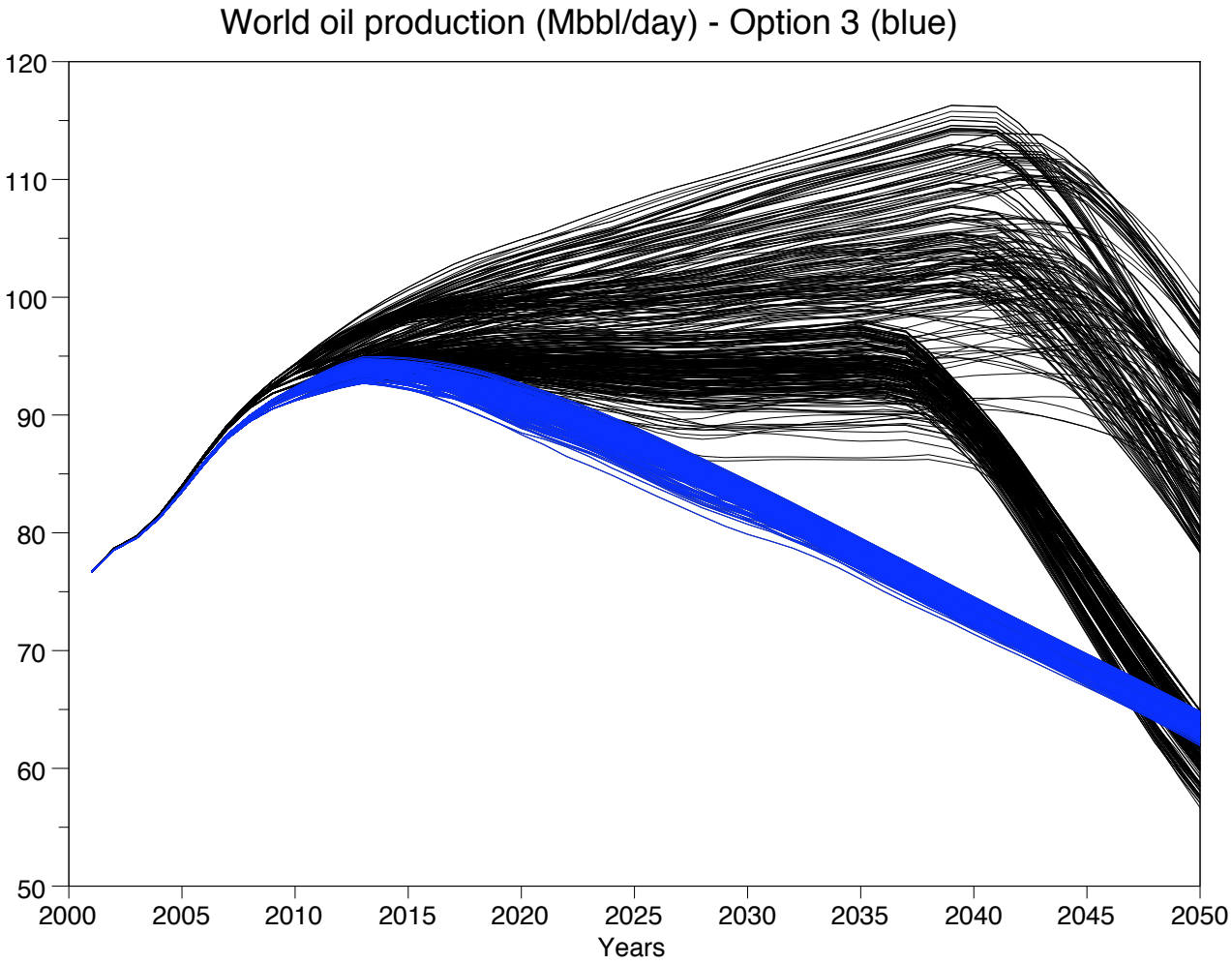

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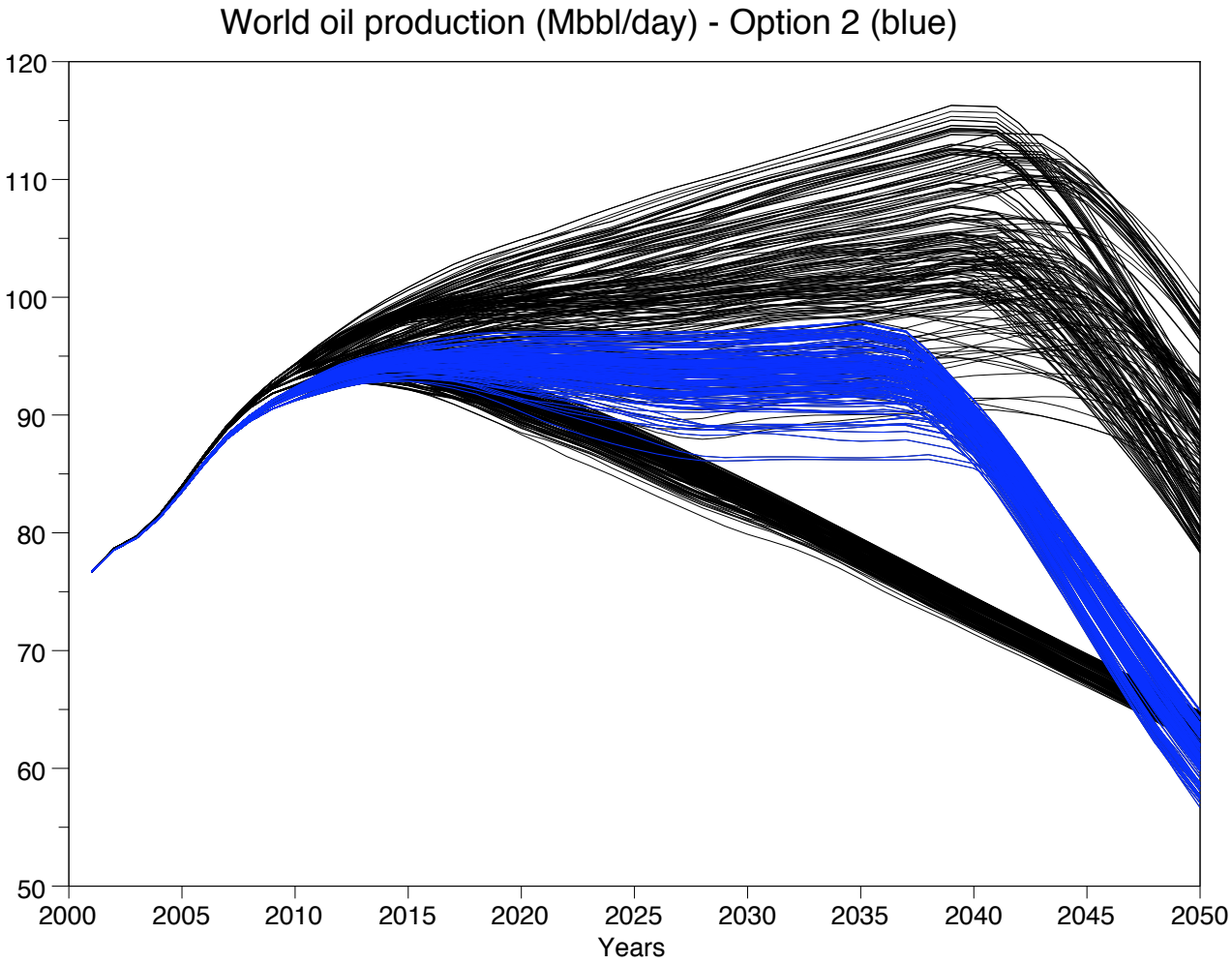

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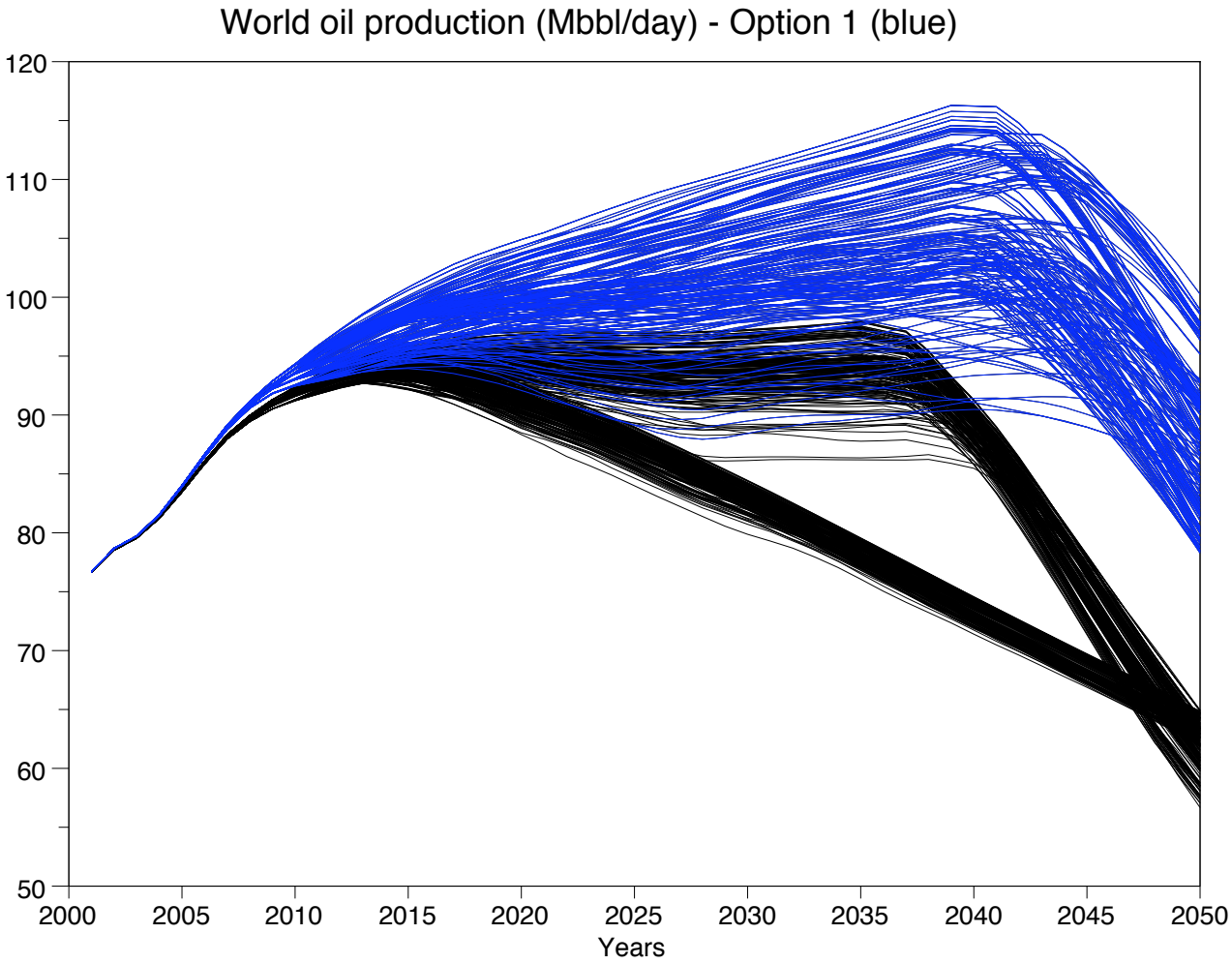
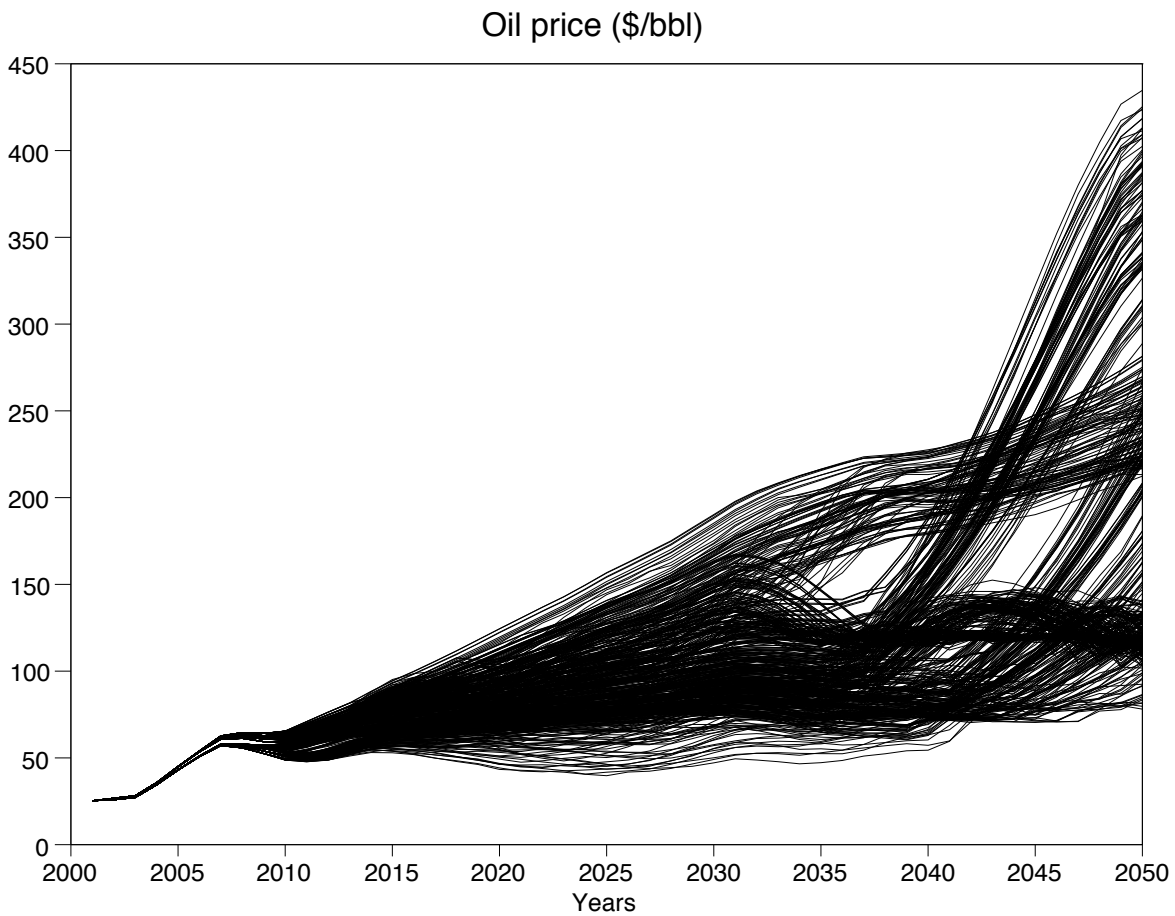


Oil prices depend on production assumptions in the short-run and on other parameter sets in the long-run



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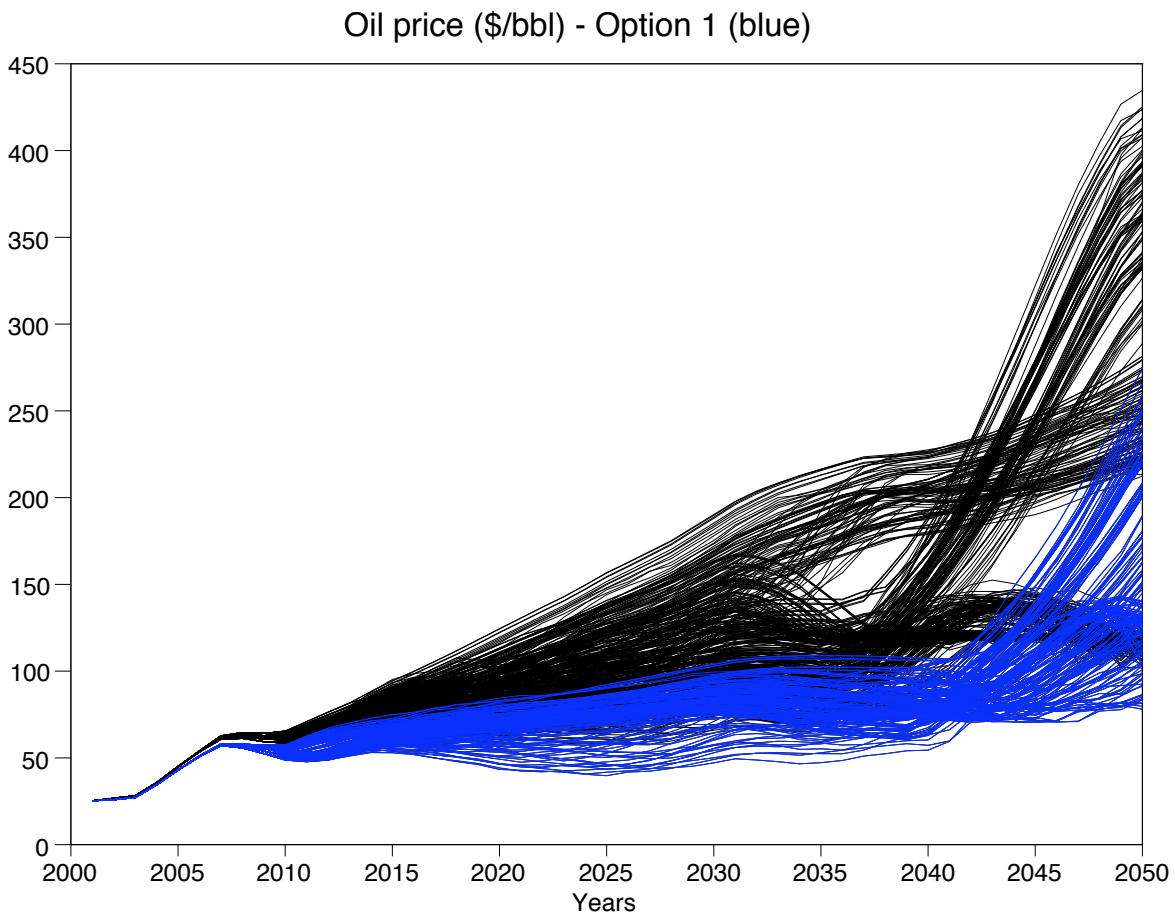

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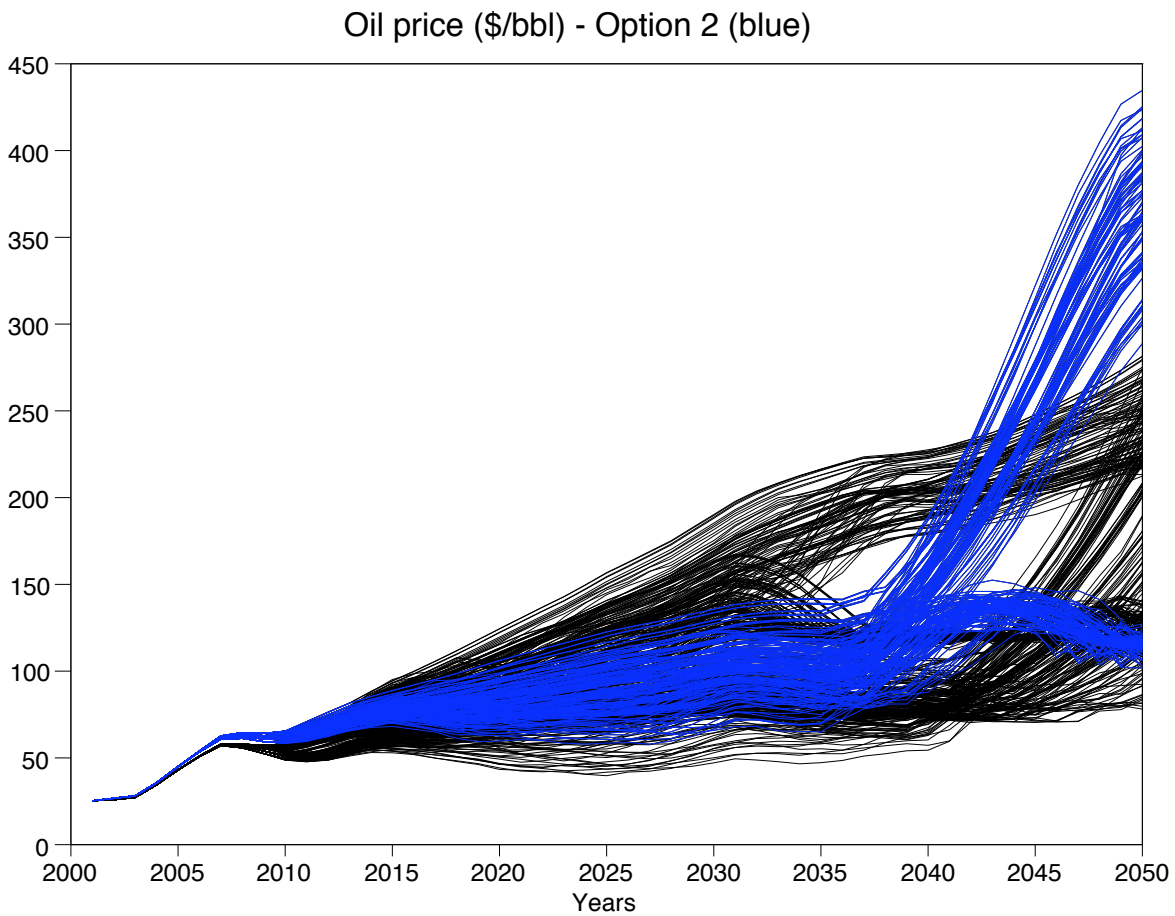

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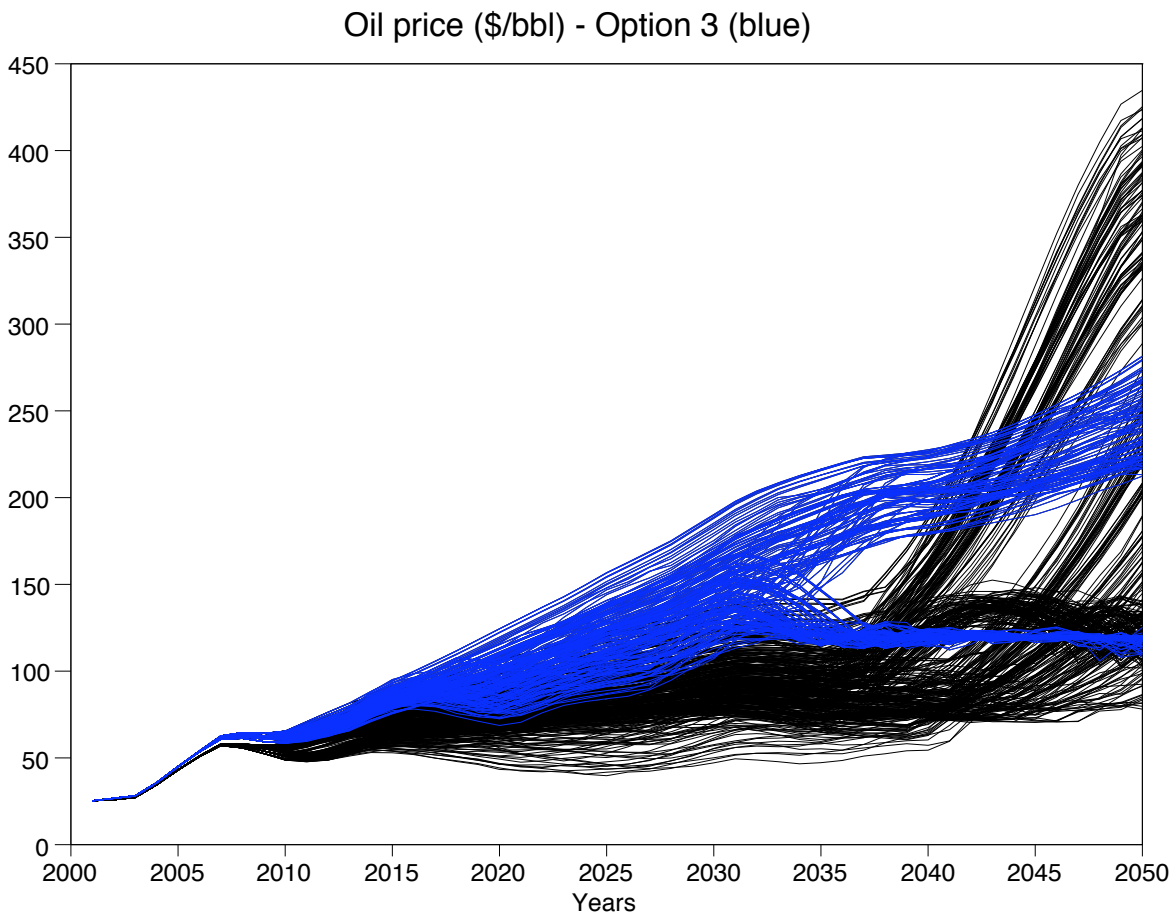
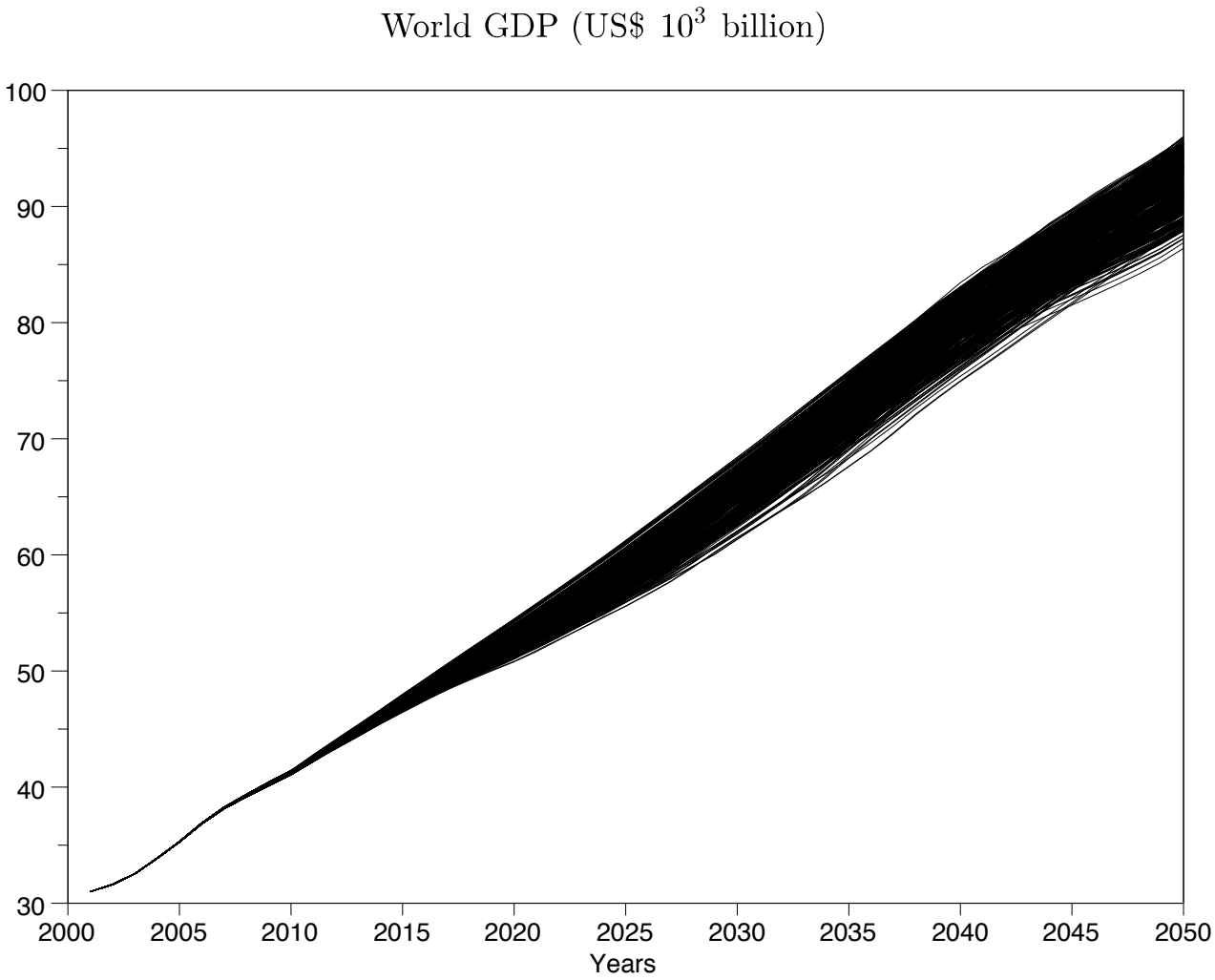


GDP seems to decrease with increasing constraints on oil supply



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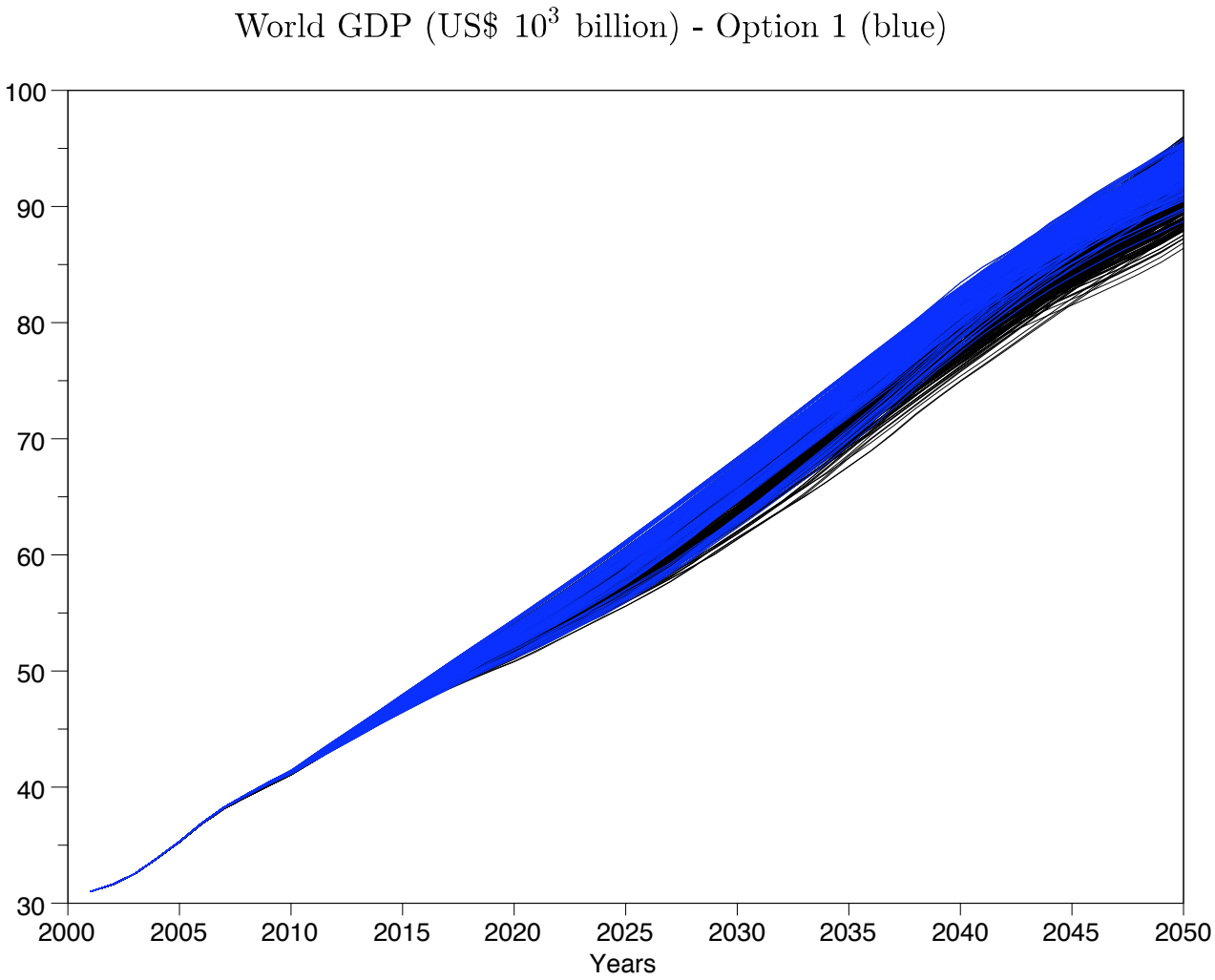

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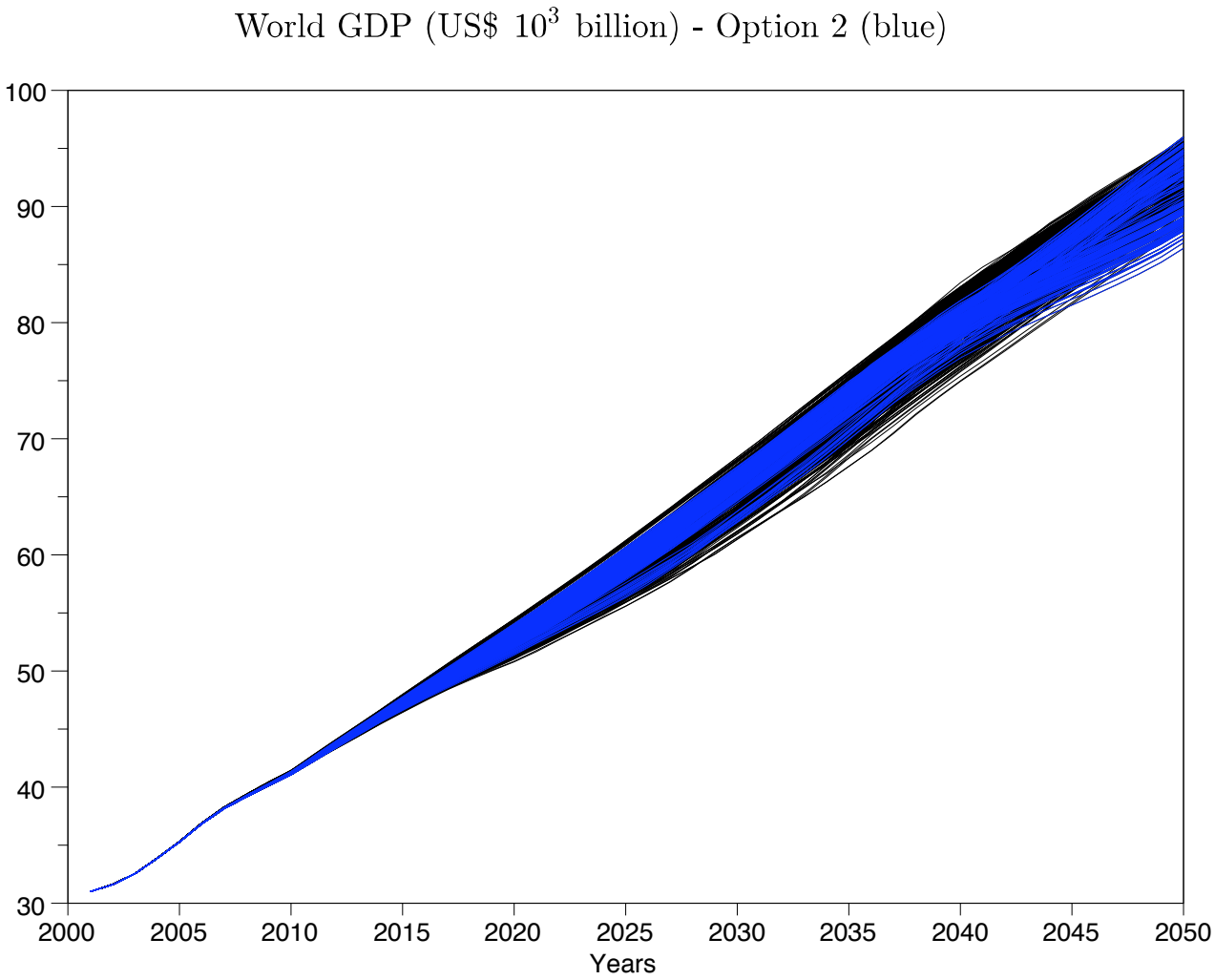

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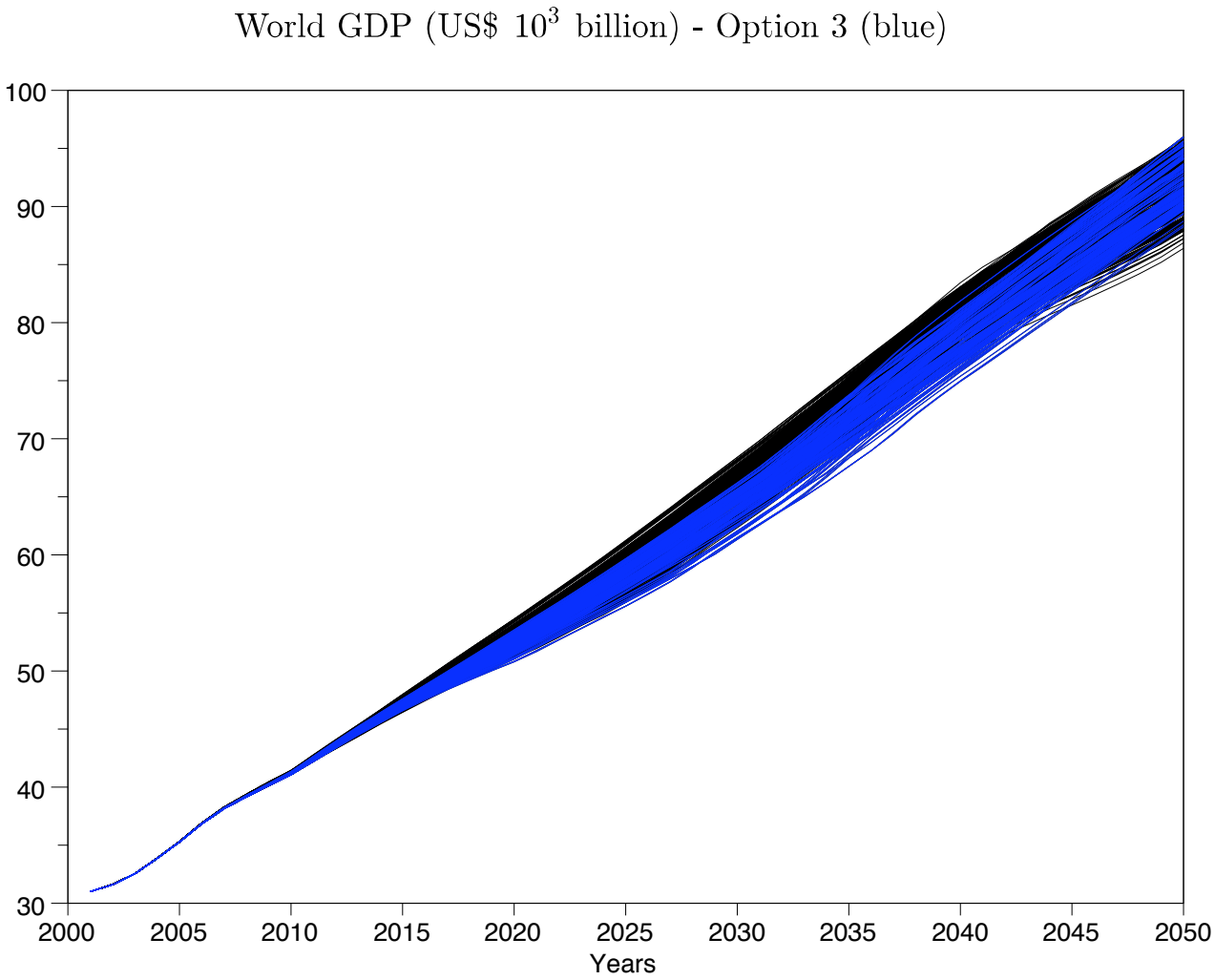
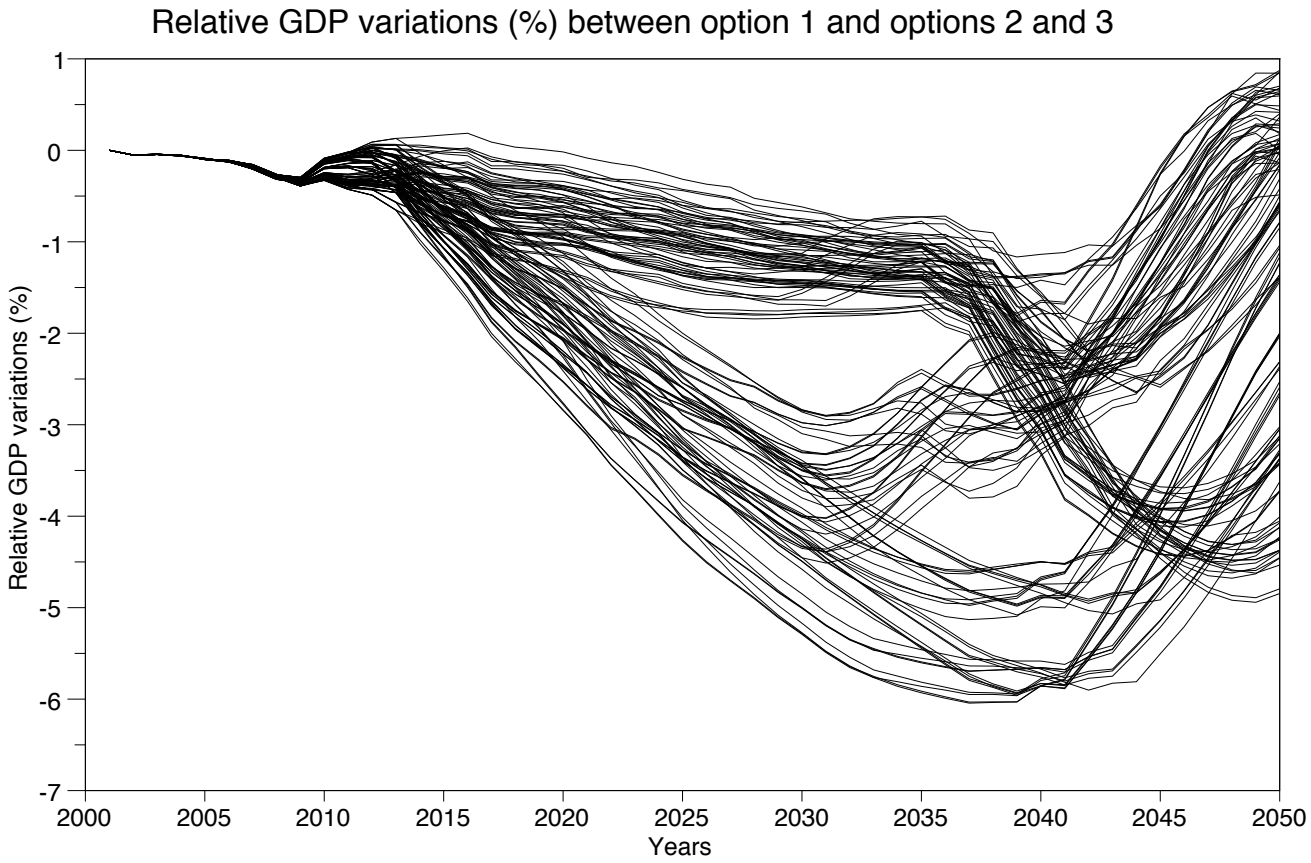


GDP relative variations (%) between the different options for oil supply

The effects of oil constraints on GDP depend on investments and alternative liquid fuels supply



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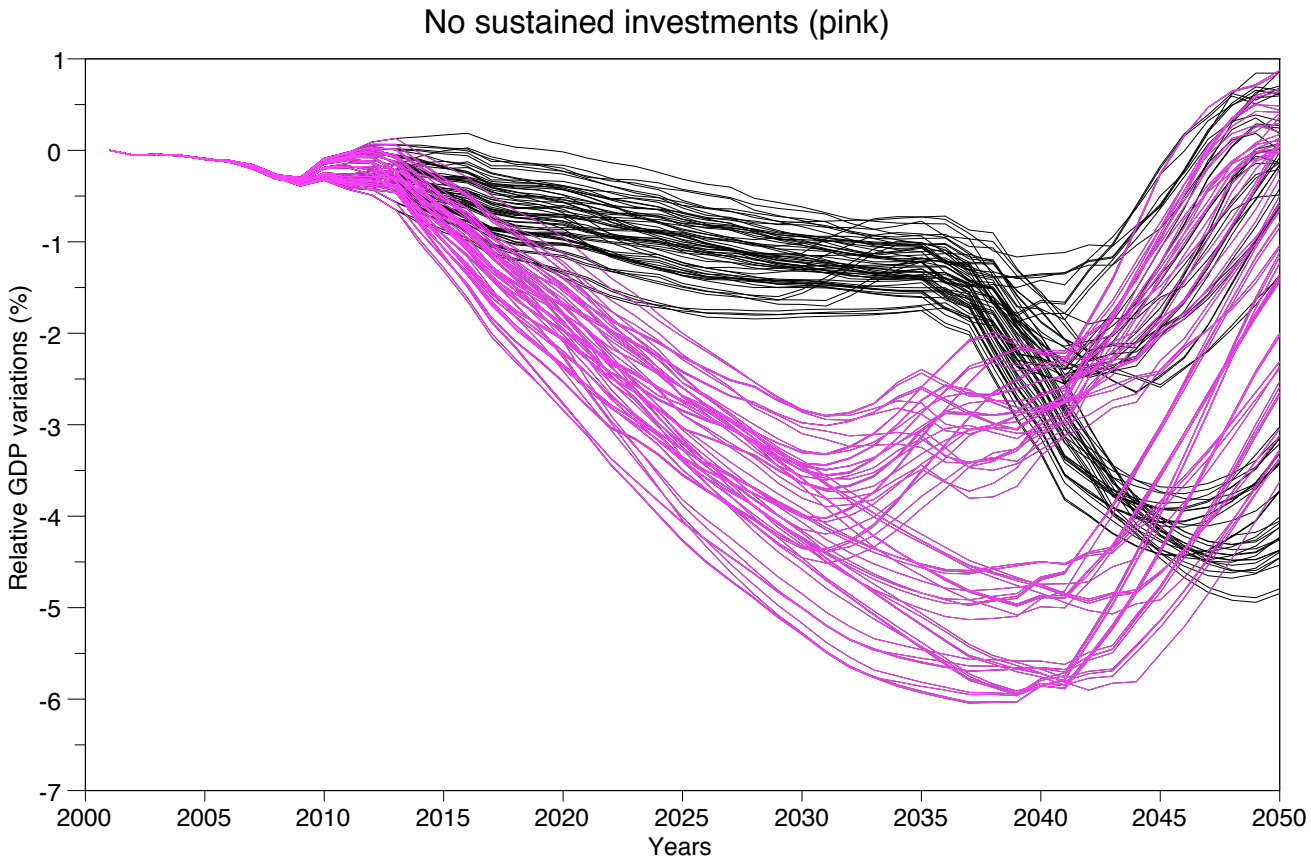

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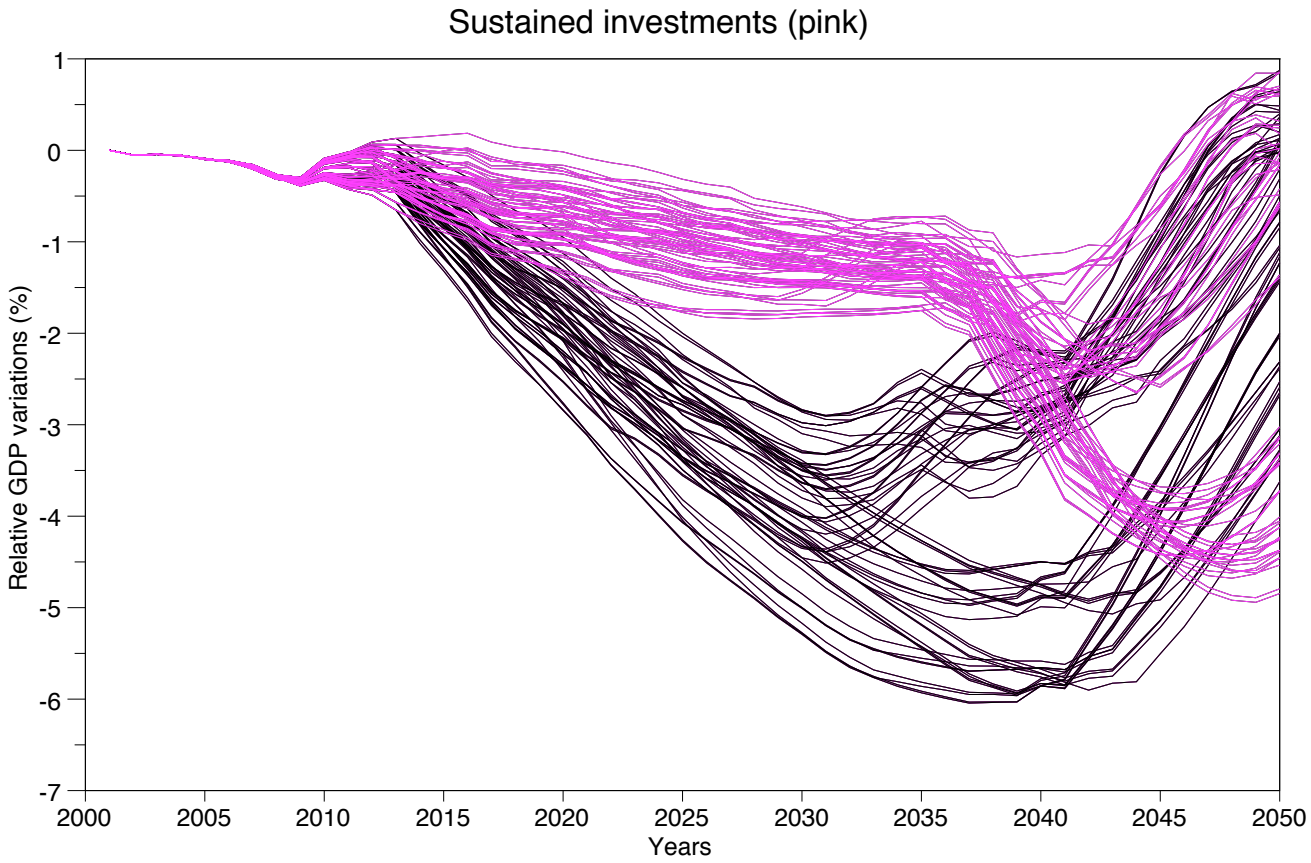
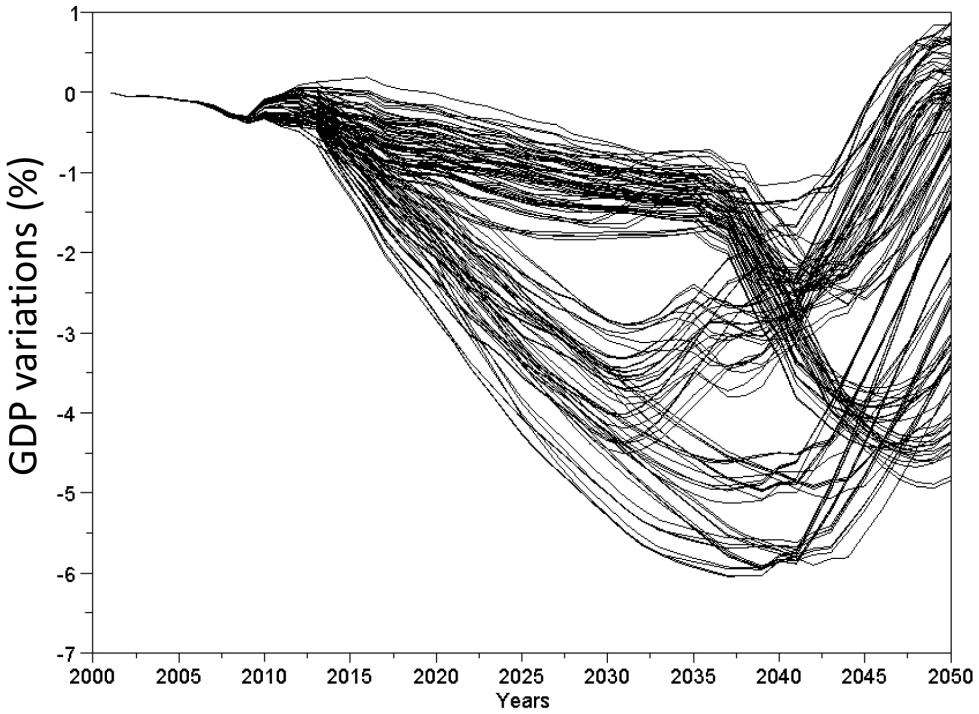


Oil scarcity costs and climate policies costs interact

	Assumption 1: oil and gas largely available	**Assumption 2: oil and gas limited**	**Assumption 3: oil and gas very constrained**
BAU	Reference case	**-1.3%** [-0.6 ; -2.1]	**-2.6%** [-1.8 ; -3.7]
450 ppm	**-1.7%** [-0.4 ; -4.4]	**-2.3%** [-1.0 ; -4.8]	**-3.3%** [-2.0 ; -5.7]
Net cost of climate policies	1.7% [0.4 ; 4.4]	1.0% [0.0 ; 3.1]	0.7% [0.0 ; 2.7]

Climate policies seem to reduce GDP losses due to oil scarcity

Relative GDP variations due to oil constraints



Only BAU scenarios

1

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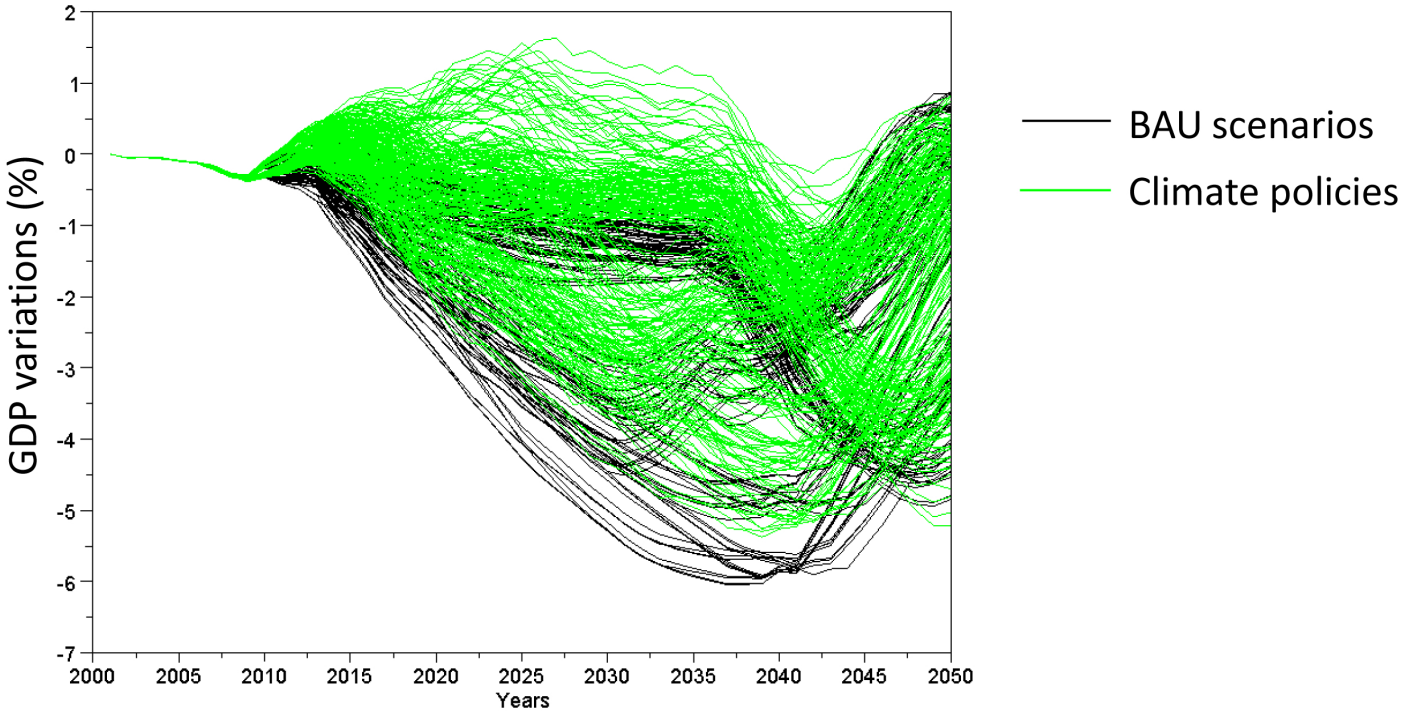
Relative GDP variations due to oil constraints



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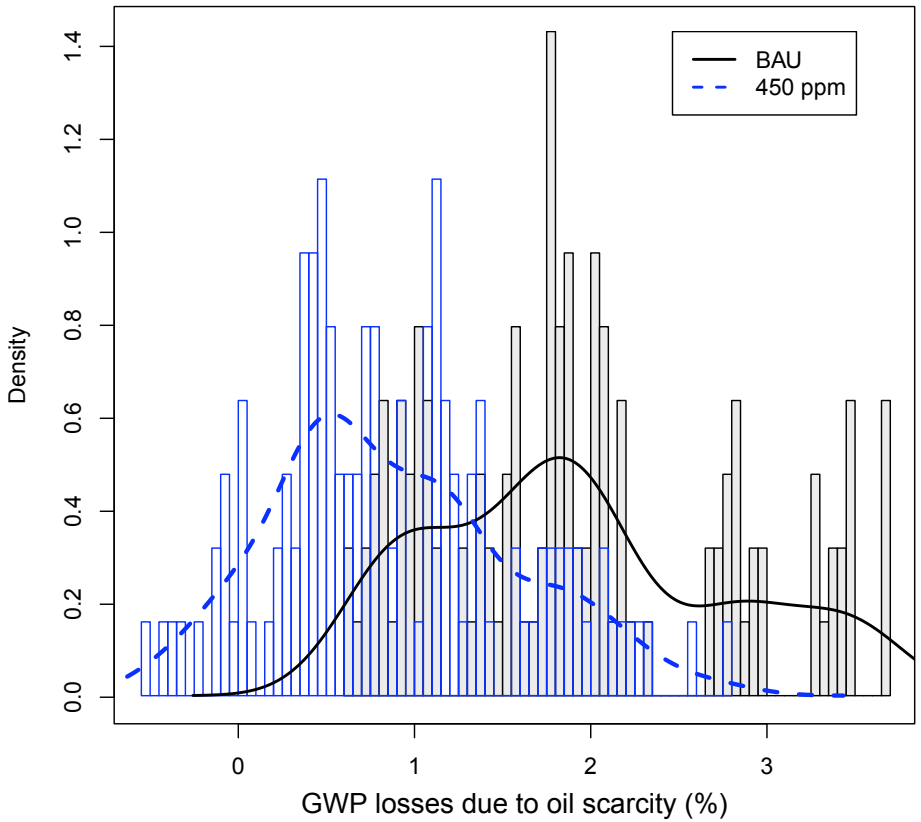
The hedge brought by climate policies

Histogram and smoothed densities of GDP losses (in %) due to constrained oil supply (discounted GWP between 2010 and 2050, with a 3% discount rate).



Climate policies reduce losses due to oil scarcity.

Net present value of this hedge:

11,500 US$b

Thank you for your attention

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