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Effects of economic crises and the cost of capital on technology choice

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Energy Economics Group, Paul Scherrer Institut

International Energy Workshop

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Outline

Economic growth and energy supply

Economic crisis

- → Reduction in energy demand (Blandford et. al, 2009)
- → Lower energy investments (WEO 2009)

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Scenario analysis of cost of capital in energy sector

- → Effects on optimal technology decisions
- → Changes to electricity demand
- → Effectiveness of climate policies (carbon-free generation technologies)

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Scenario analysis of cost of capital in energy sector

- → Effects on optimal technology decisions
- → Changes to electricity demand
- → Effectiveness of climate policies (carbon-free generation technologies)
- → Technology innovation and climate stabilization

MERGE-ETL model

- Intertemporal general equilibrium model
- Determines optimal technological choices to provide energy services (max. utility function)
- 9 regions: USA, WEUR, Japan, CANZ, EEFSU, China, India, Middle East and Rest of the World.

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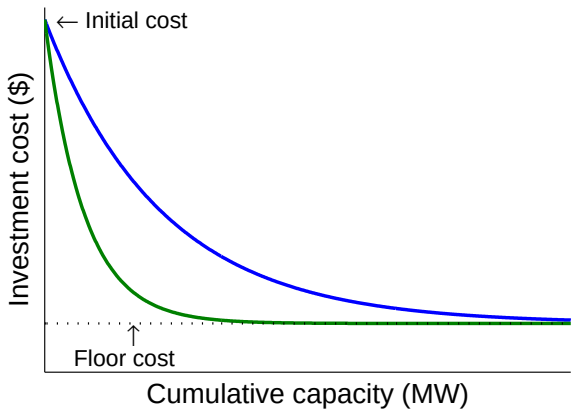
Endogenous technology learning



- Accumulation knowledge → declining investment costs
- Learning curve: wind, solar, ccs technologies

Cost of capital in MERGE

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  $\longrightarrow$ Energy cost:

$$EC = \underbrace{\sum_{i \in rt} r_i R_i}_{\text{resource extraction}} + \underbrace{\sum_{t \in et} c_t(r) E_t}_{\text{electricity prod.}} + \underbrace{\sum_{t \in nt} c_t(r) N_t}_{\text{non-electric prod.}}$$

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- Revenue from higher interest rates is recycled:

$$rev = \sum_{t \in et} \left[c_t(r) - c_t(5\%)\right] E_t + \sum_{t \in nt} \left[c_t(r) - c_t(5\%)\right] N_t$$

$$Y + rev = I + C + EC$$

Scenario description

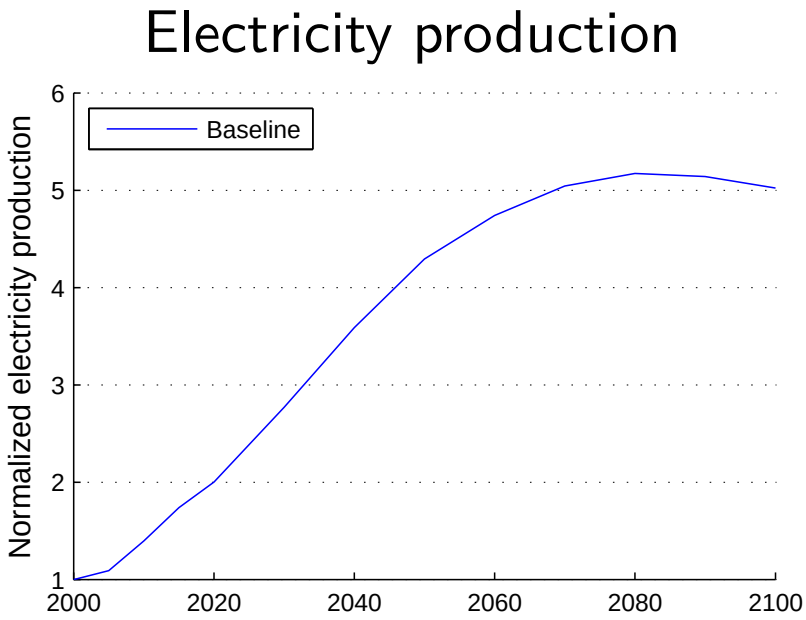
Business as usual (BAU) set

- No climate policy
- Scenarios: Baseline (5%), 7%, 10% and 12%

550ppm set

- Atmospheric GHG concentration = 550 ppm CO_2
- Scenarios: Baseline (5%), 7%, 10% and 12%

Global electricity production and price



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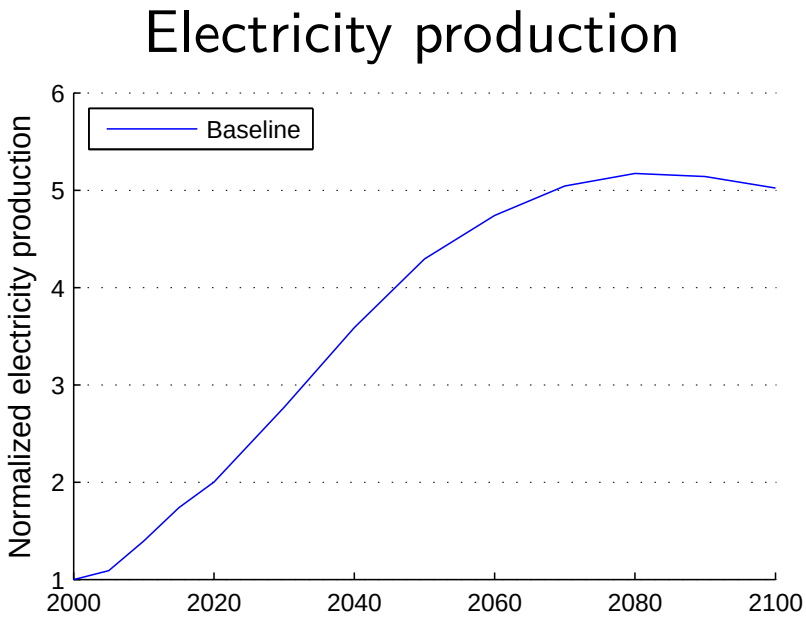

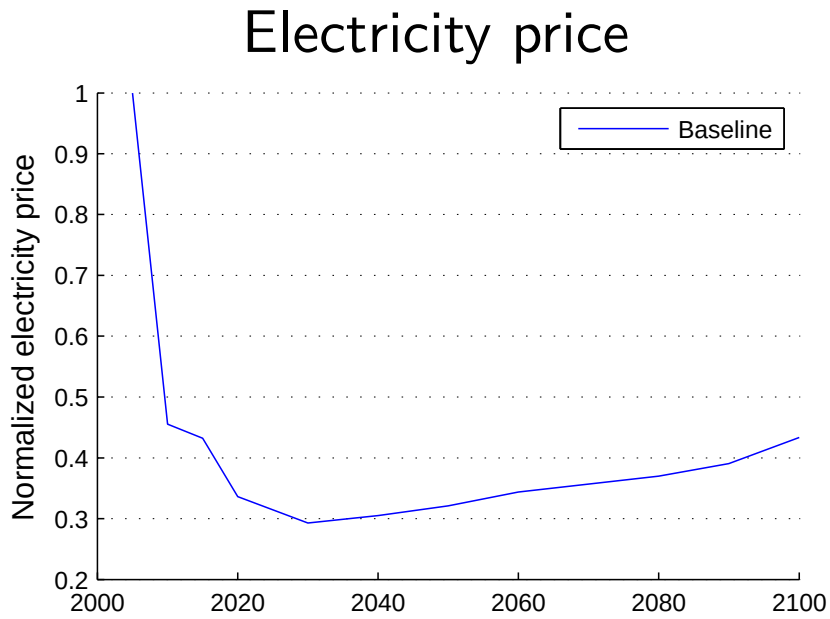

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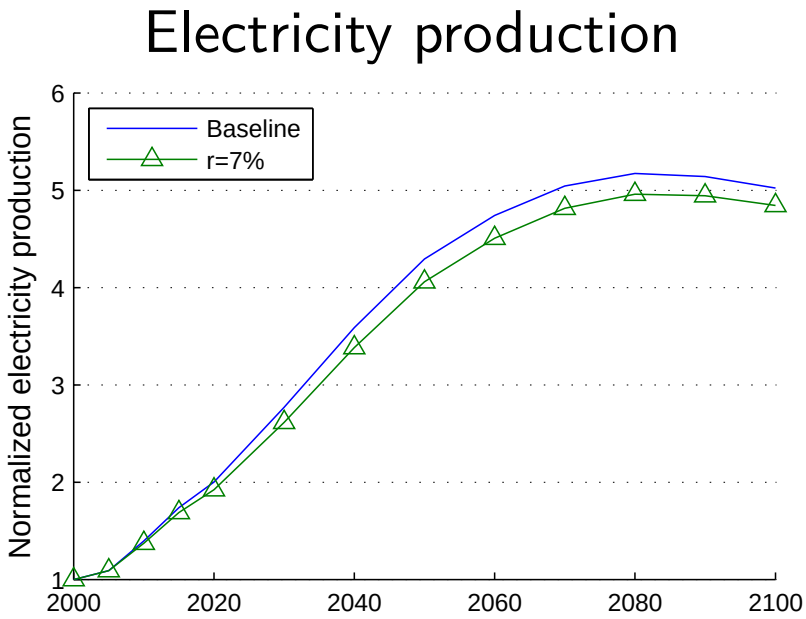

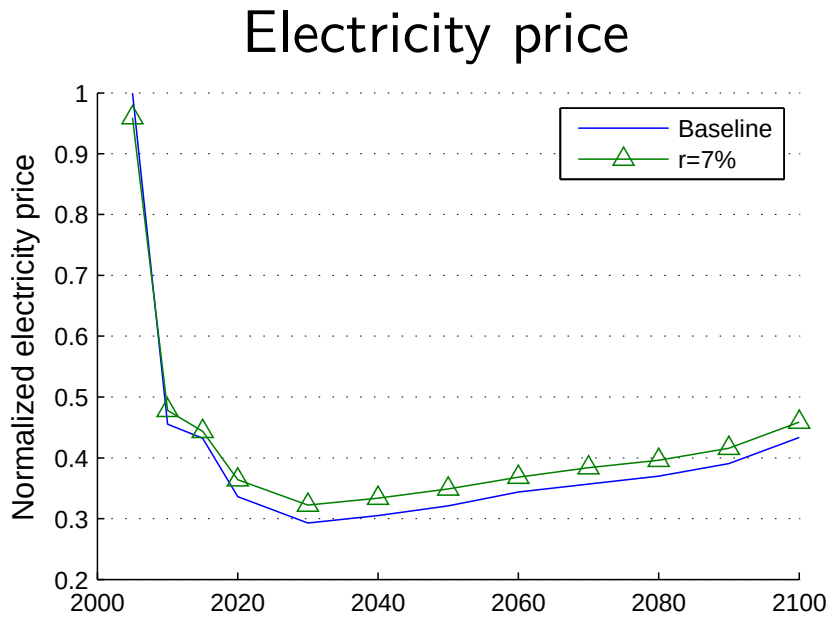

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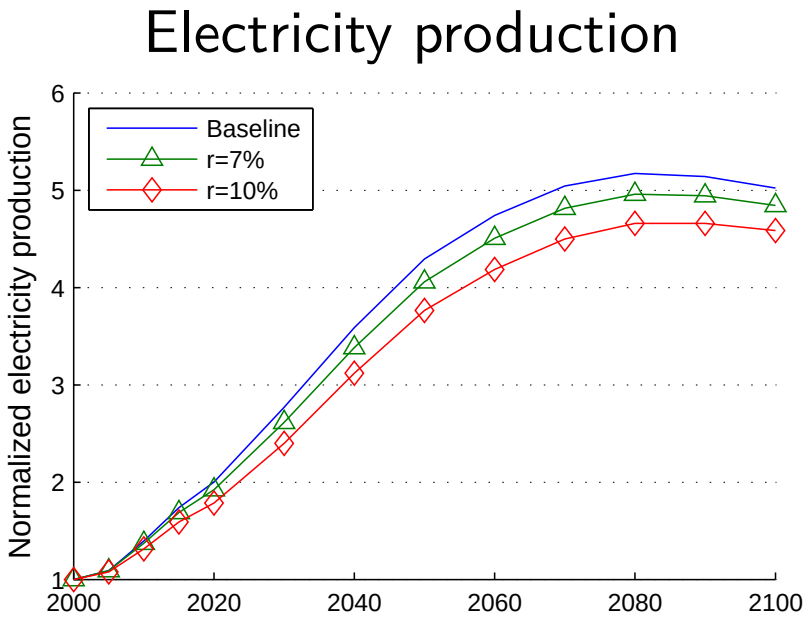

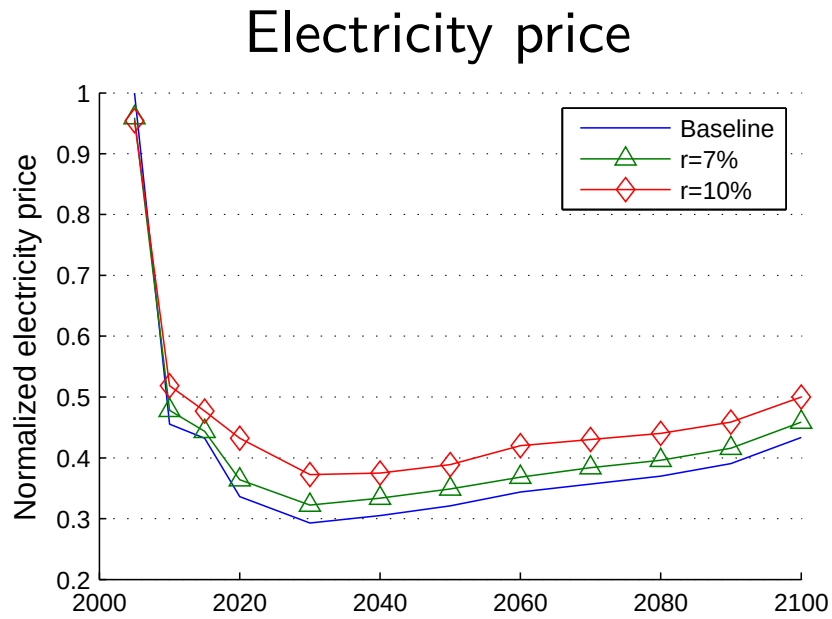

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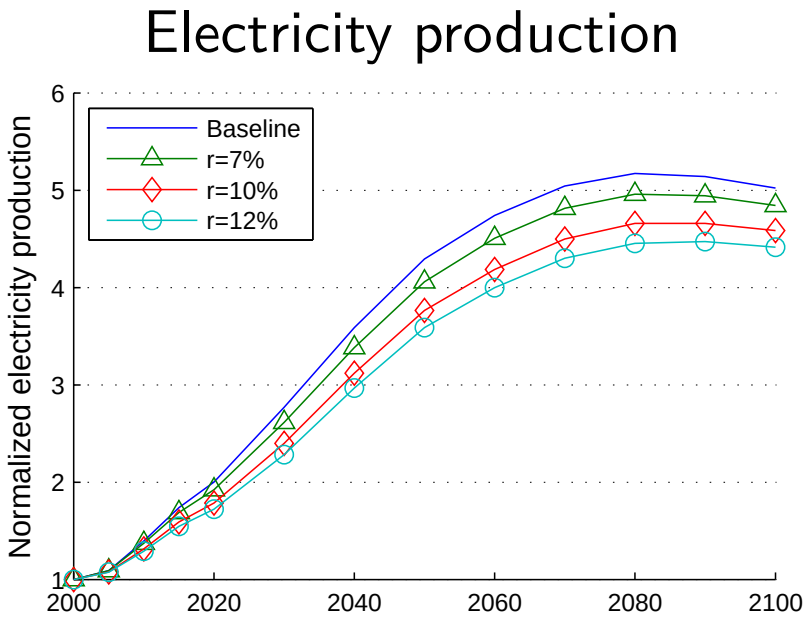

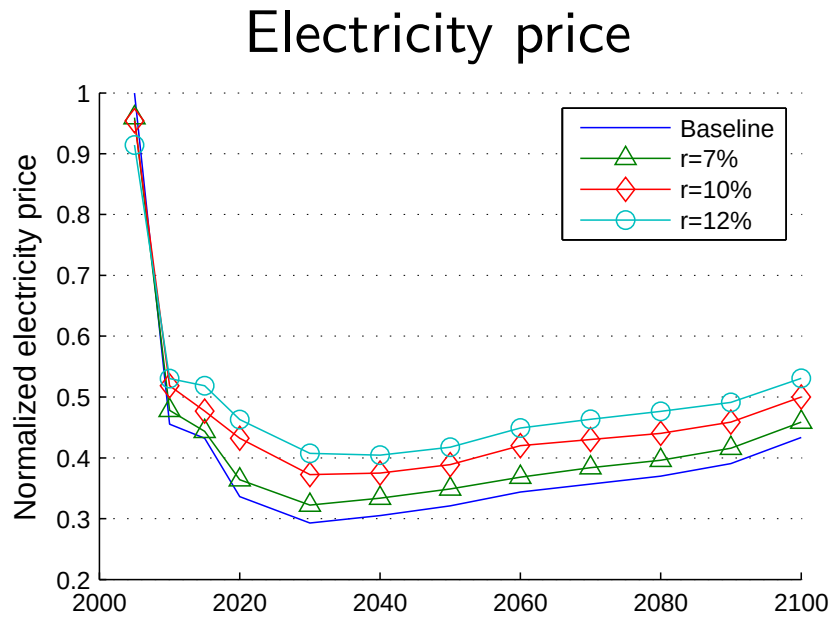

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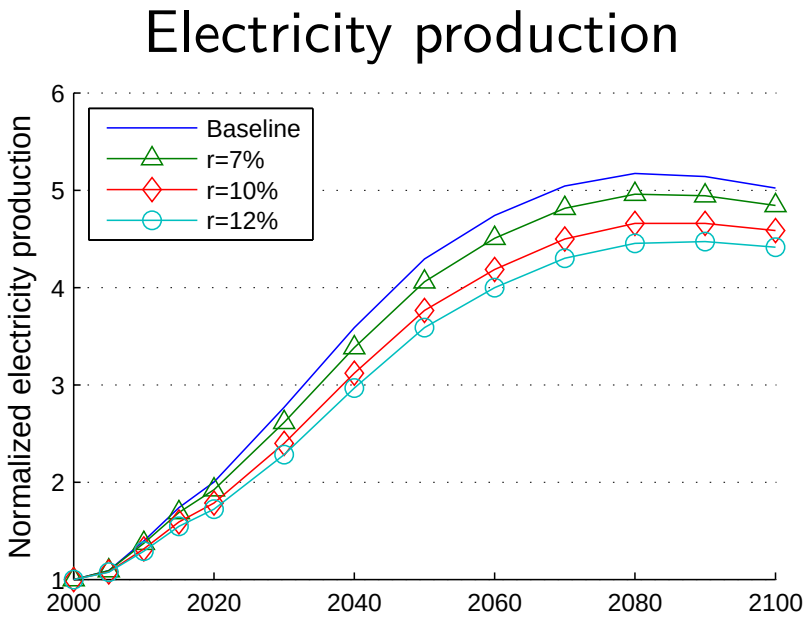
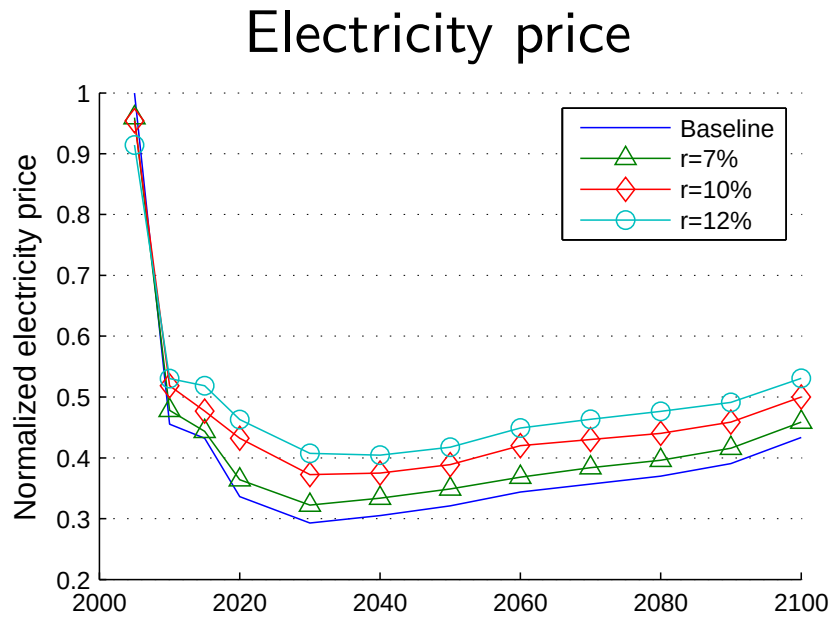
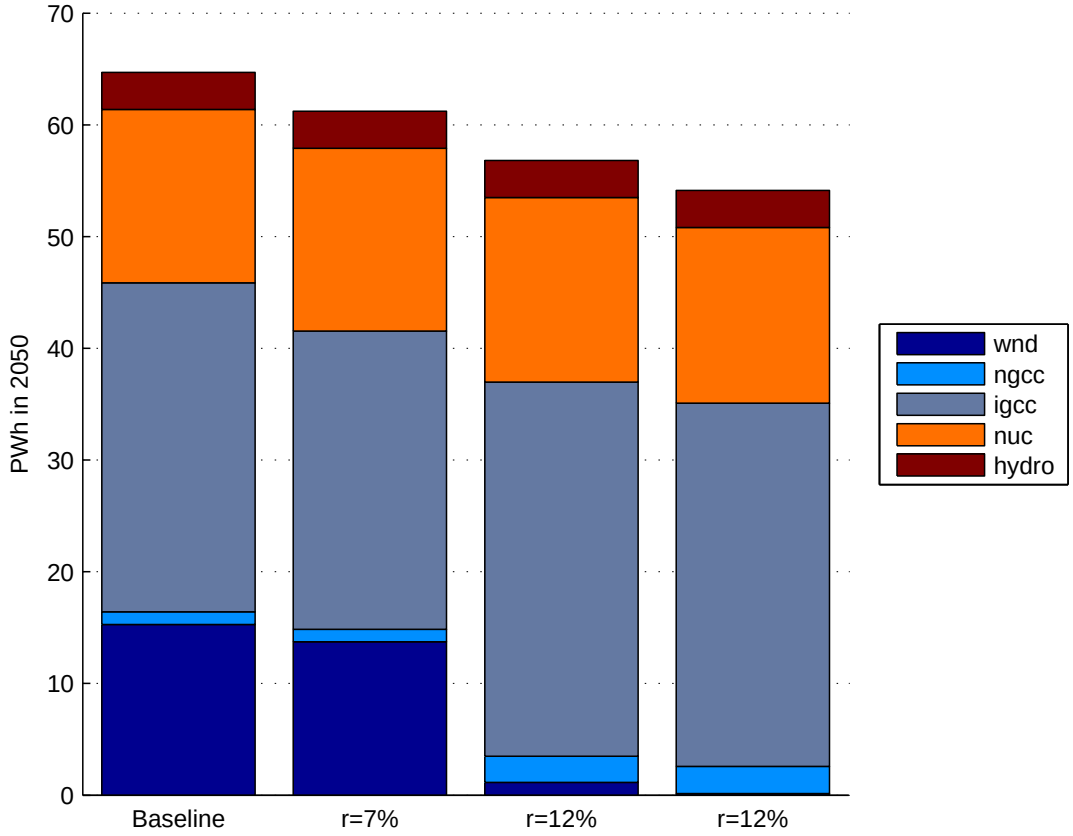




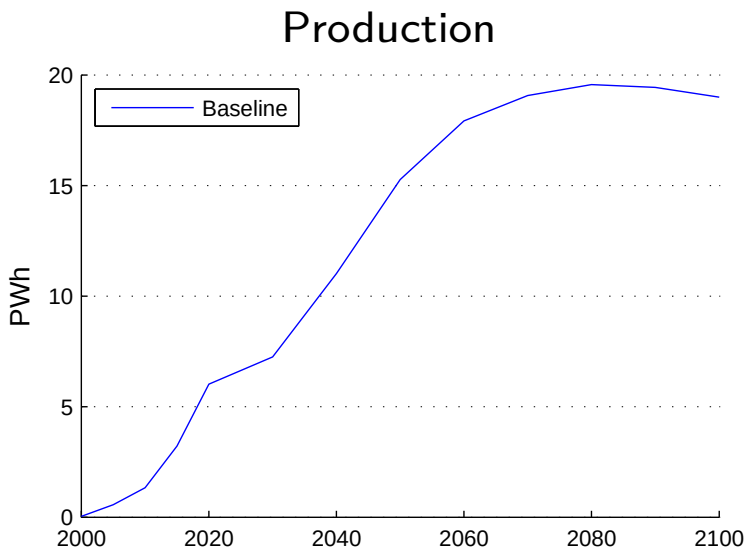
$\uparrow$ cost of capital $\rightarrow$ $\uparrow$ price $\rightarrow$ $\downarrow$ demand $\rightarrow$ $\downarrow$ production

Electricity production 2050



Technology deployment and learning

Wind technology



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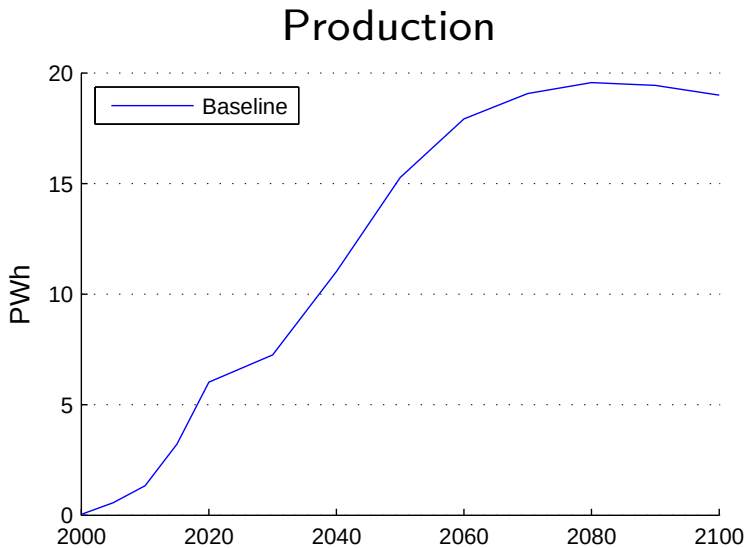

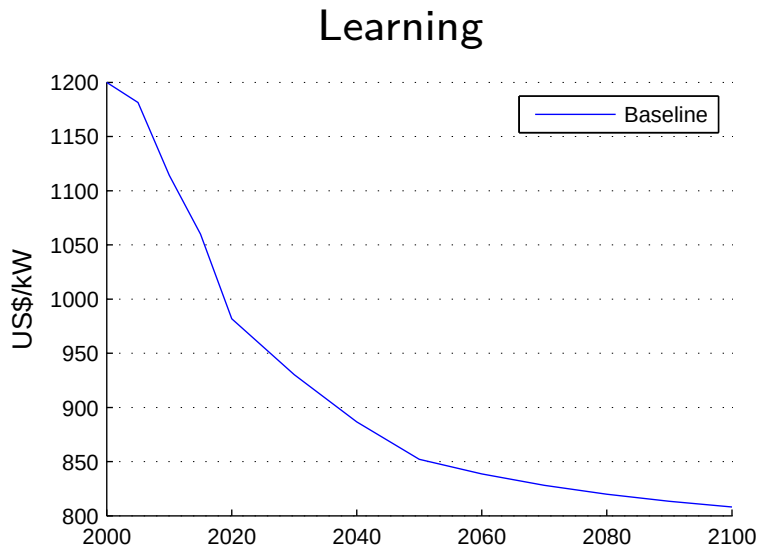

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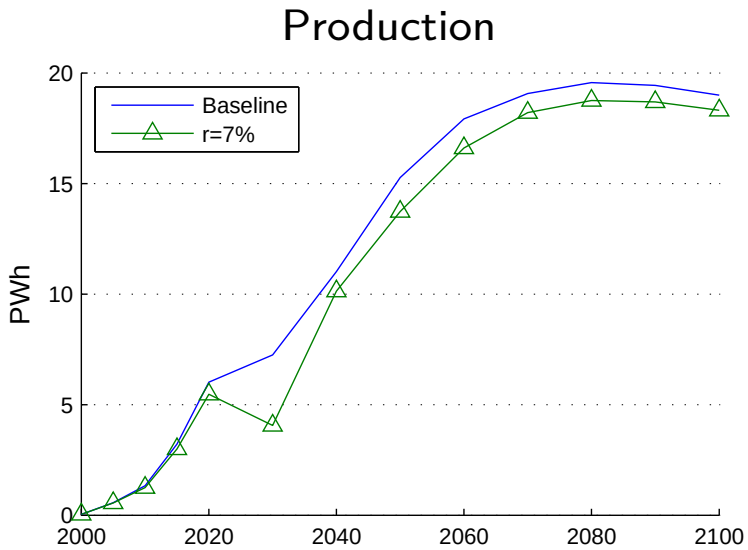

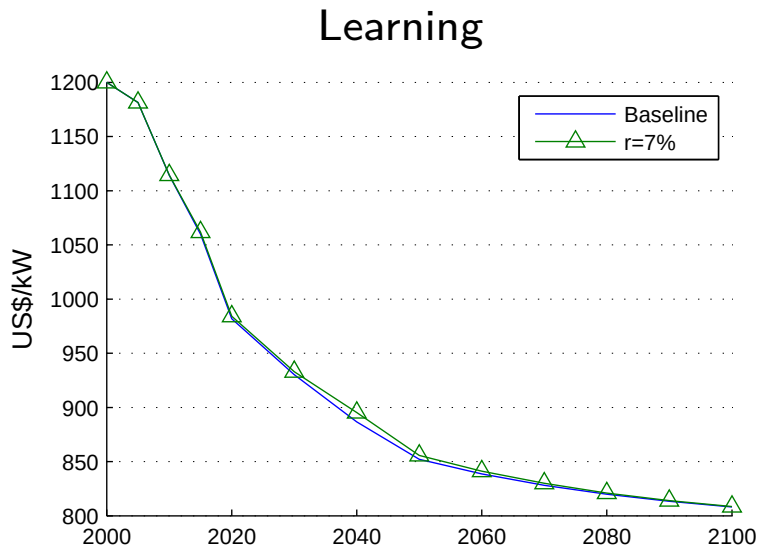

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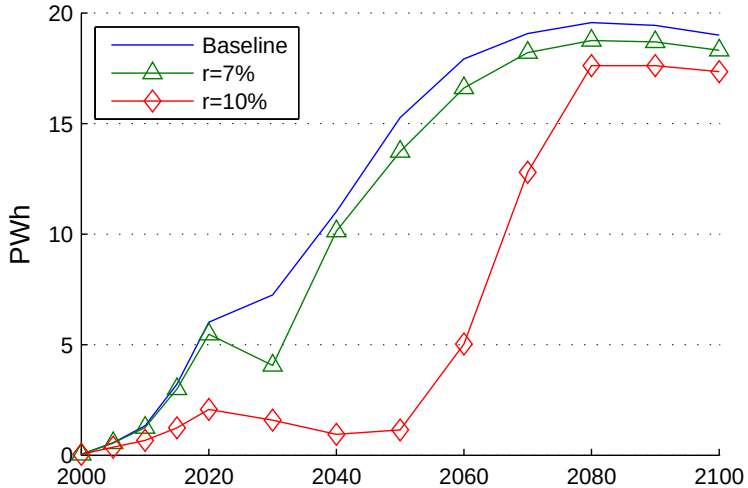

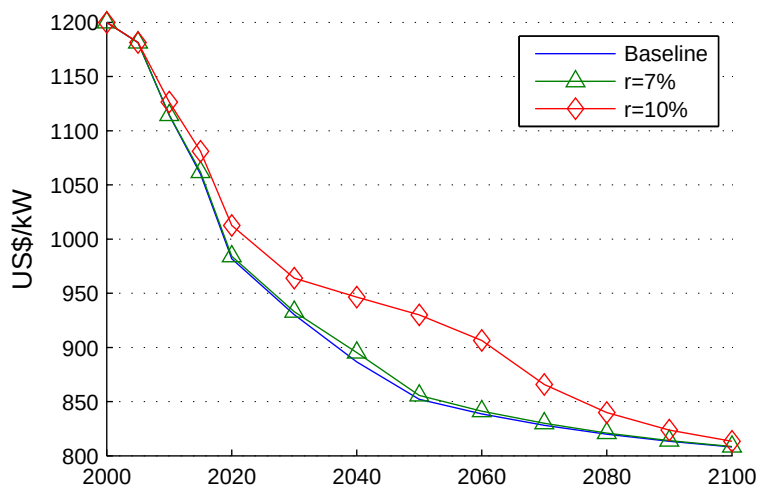

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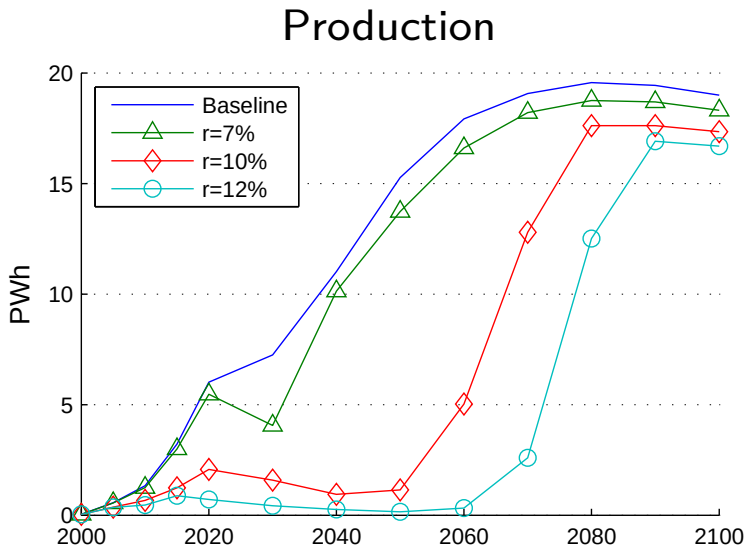

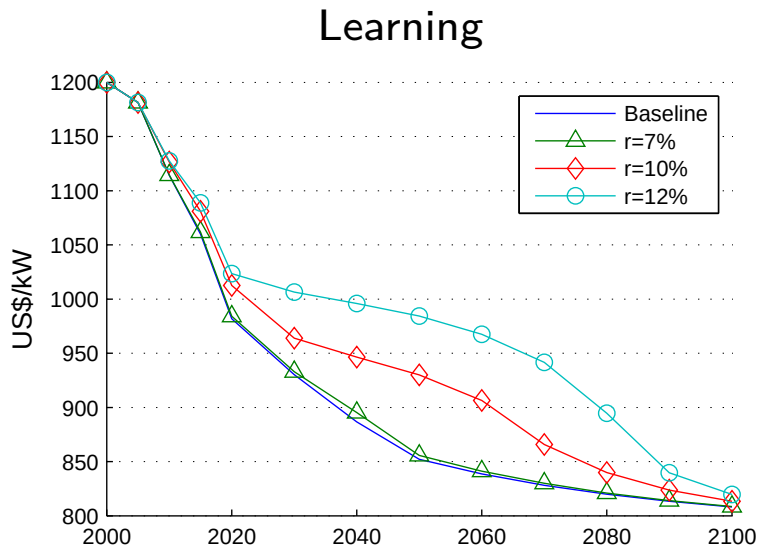

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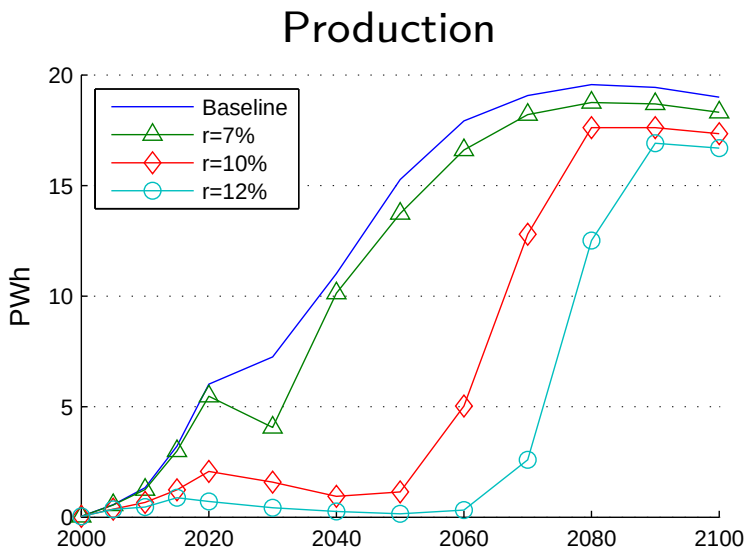
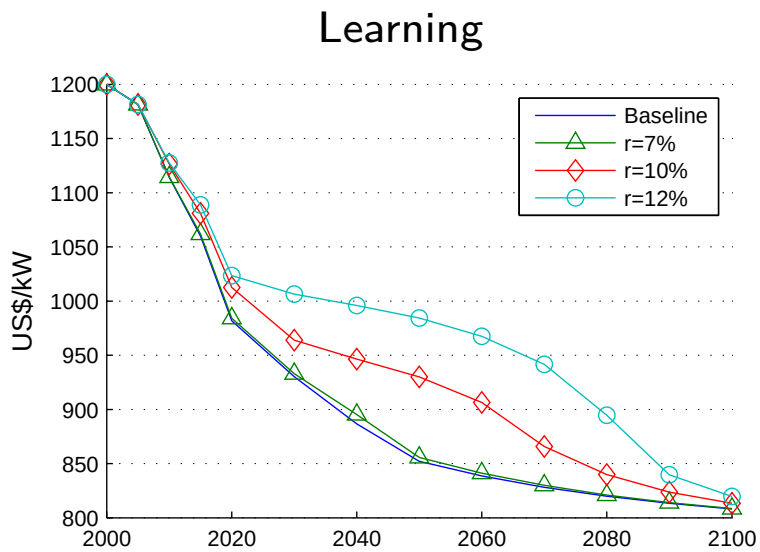
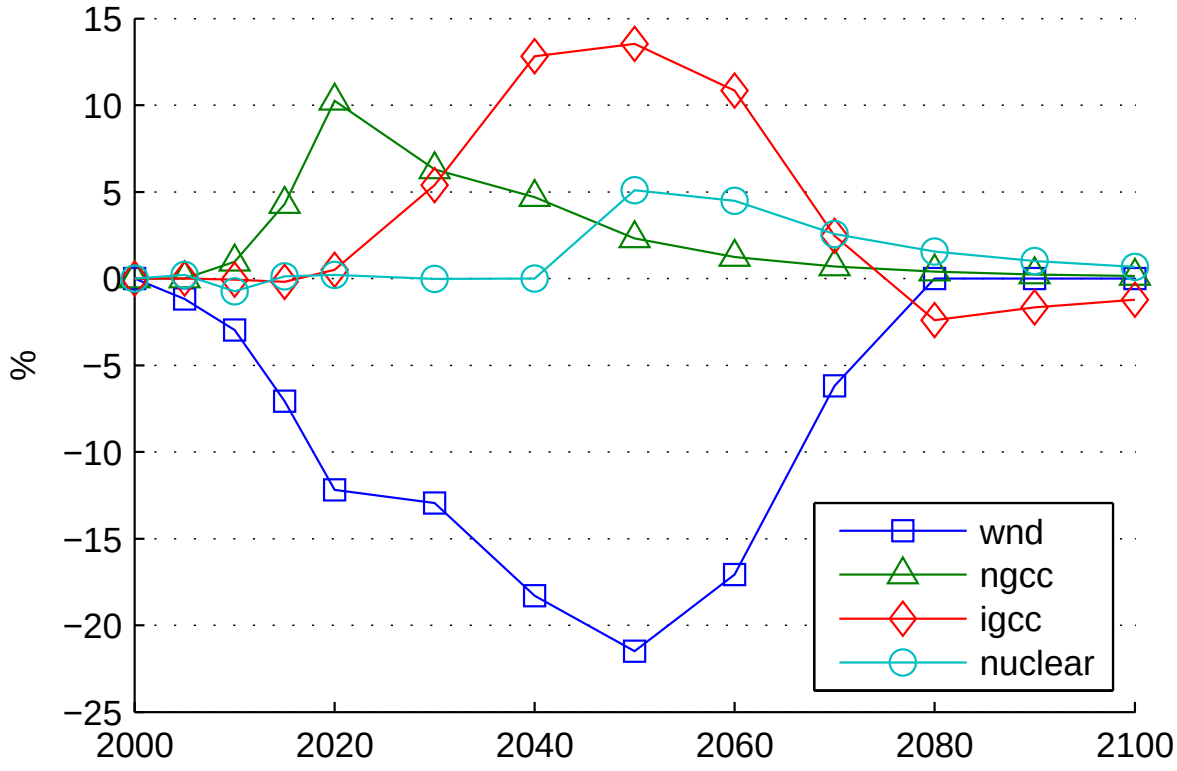




↑ cost of capital → delayed deployment capital intensive technologies
→ slow rate technological improvement
→ increase in the deployment of NGCC and IGCC

Comparison shares baseline and 10% scenario



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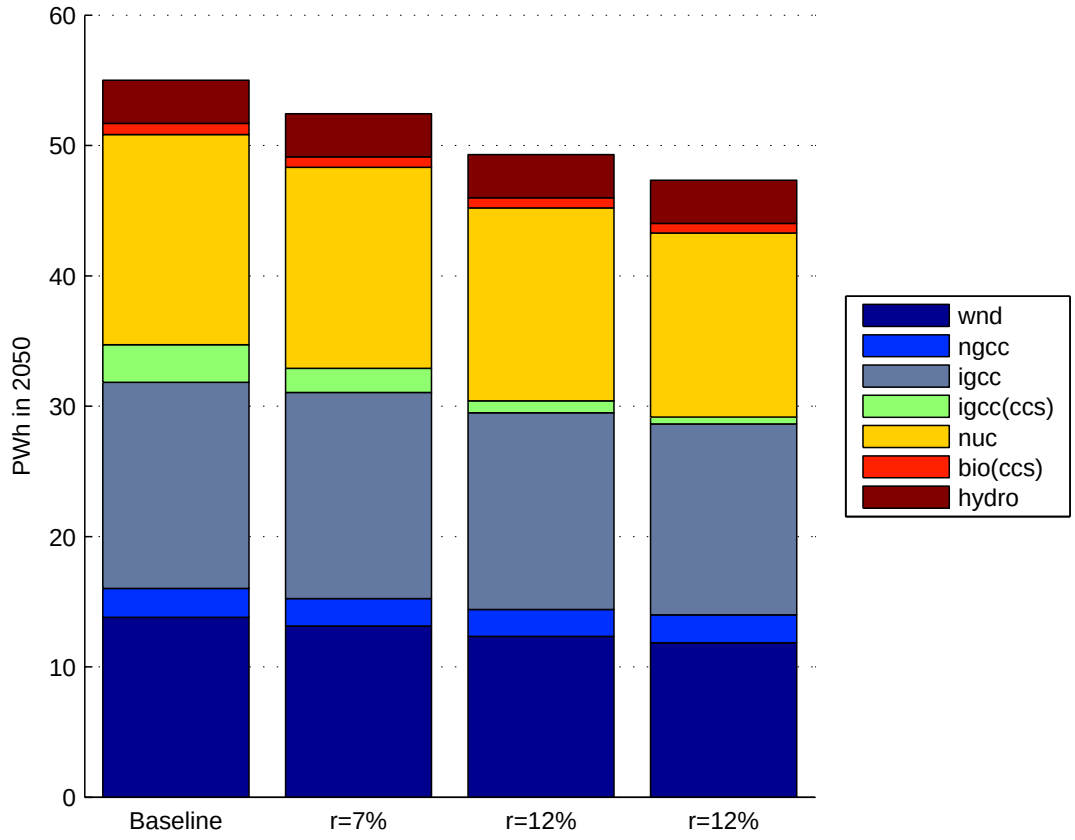

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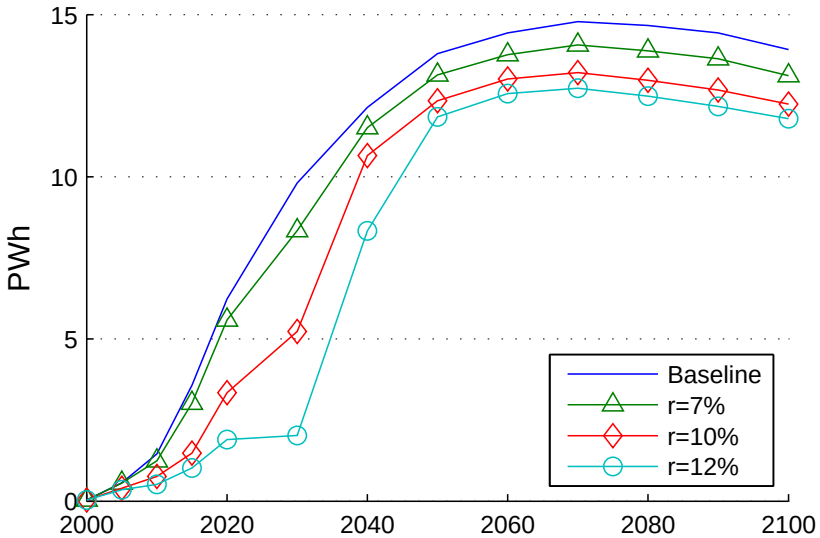

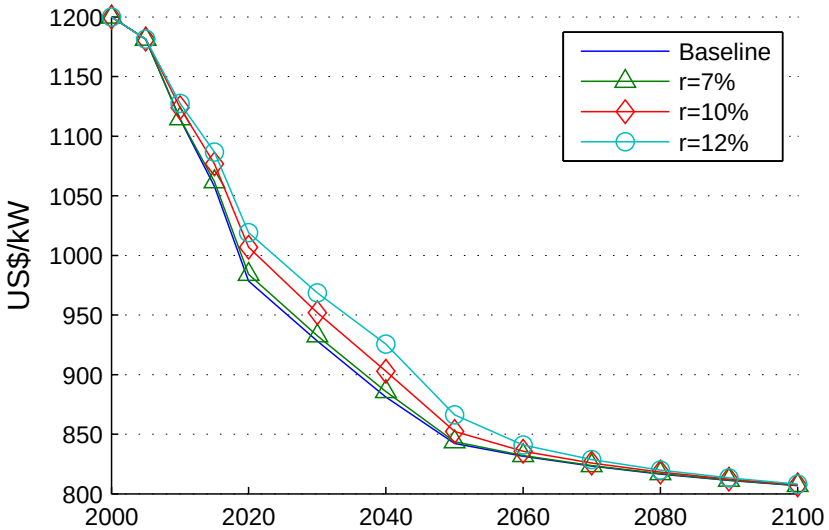

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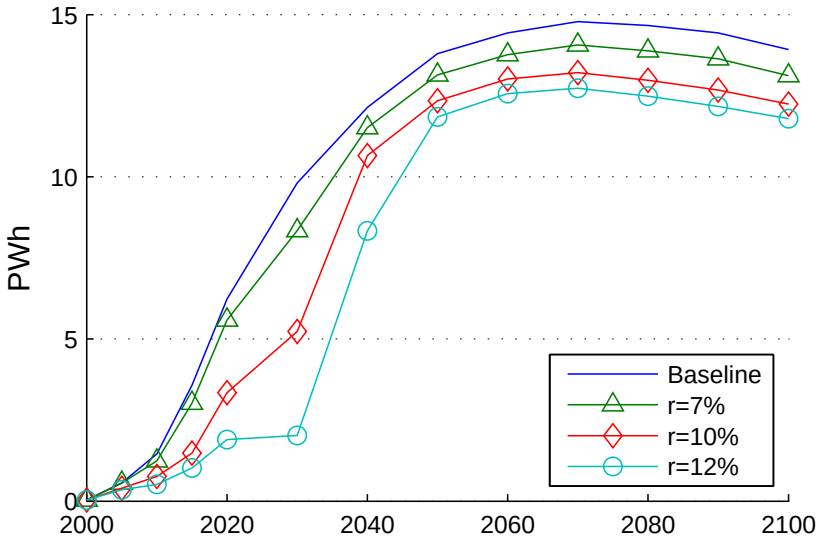

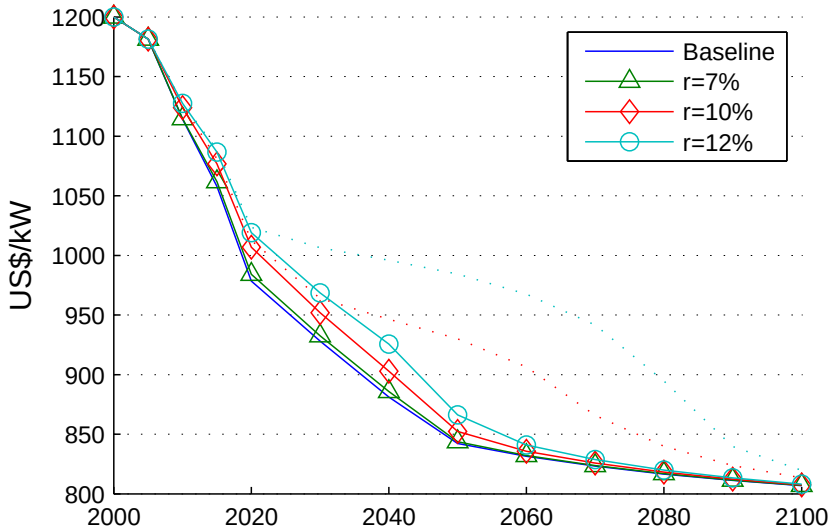

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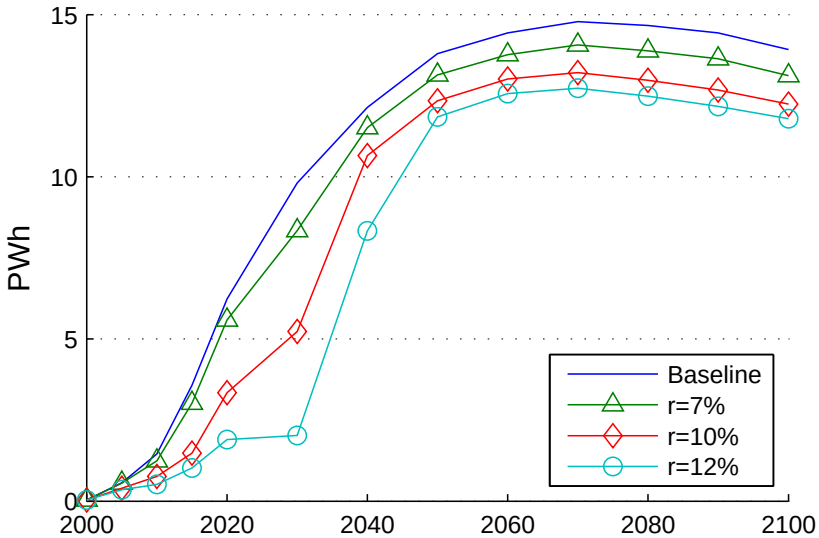
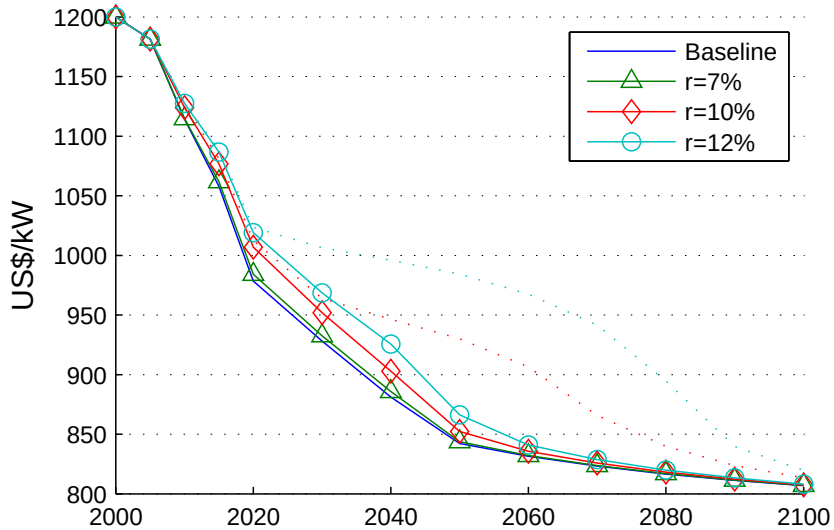
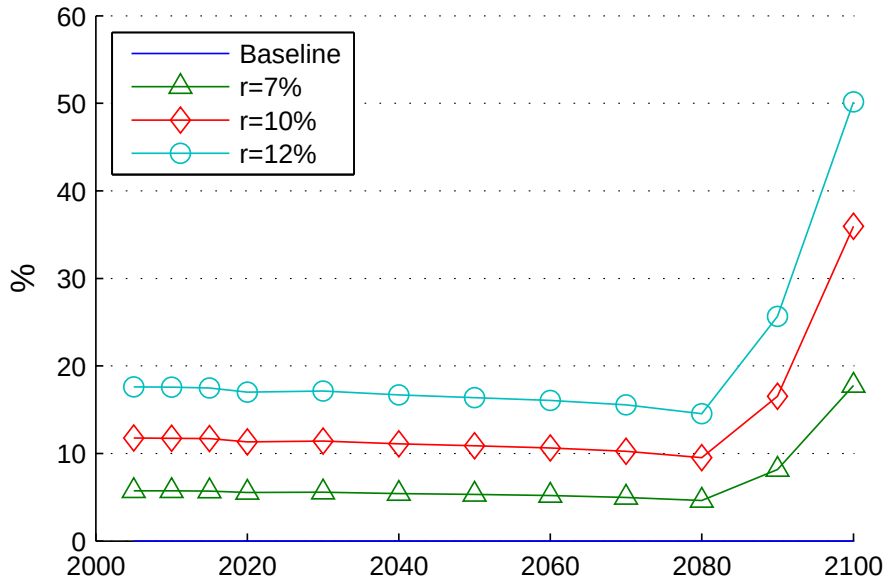




↑ cost of capital → less impact on technology choice with climate policy

→ Wind, solar PV and technologies with CCS are still deployed

Carbon price



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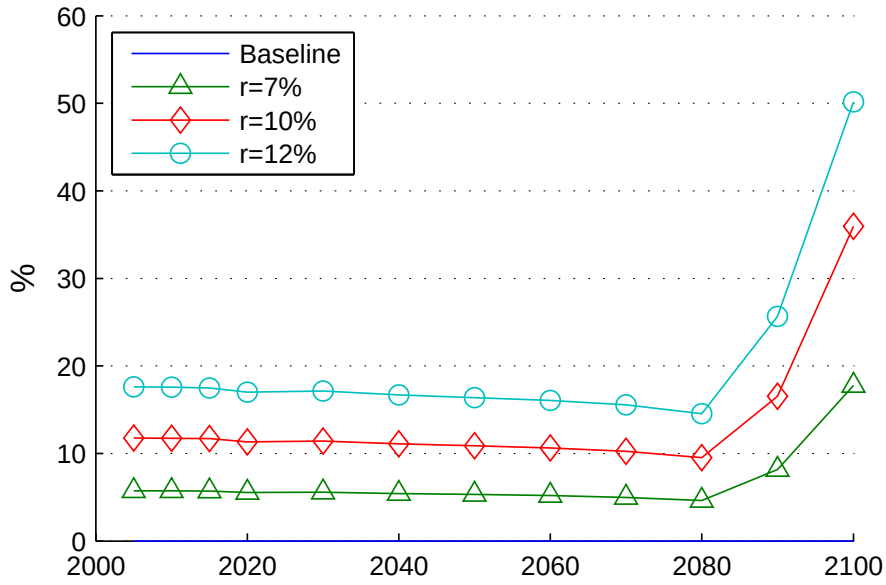

↑ cost of capital → ↑ carbon price

Discussion

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Important linkages between the cost of capital, technology deployment and climate change mitigation.

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  Important role for energy efficiency

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- Electricity demand decreases with higher costs of capital. Important role for energy efficiency
- Deployment of capital-intensive technologies is likely to be delayed when the cost of capital is higher. Opportunities for learning-by-doing

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Overall

Important linkages between the cost of capital, technology deployment and climate change mitigation.

- Electricity demand decreases with higher costs of capital. Important role for energy efficiency
- Deployment of capital-intensive technologies is likely to be delayed when the cost of capital is higher. Opportunities for learning-by-doing
- Need for a stronger climate policy (or a higher carbon price)
  - → Higher economic costs for climate stabilization ↔ Importance of supporting financial stability
  - → Reduction of incentives for developing countries to join global mitigation regimes

Outlook

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- Cost of capital remains high for the long term. Recovery after the financial crisis

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- Cost of capital changes just in the energy supply sector
- Cost of capital remains high for the long term. Recovery after the financial crisis
- A financial crisis is likely to affect differently the different regions of the world. Scenarios with different cost of capital

Thank you for your attention