Integrated Economic-Environmental Modeling for Evidence-Based Public Policy and Investment Design

ISIM-IEEM Chile Exercises: Nationally Determined Contributions

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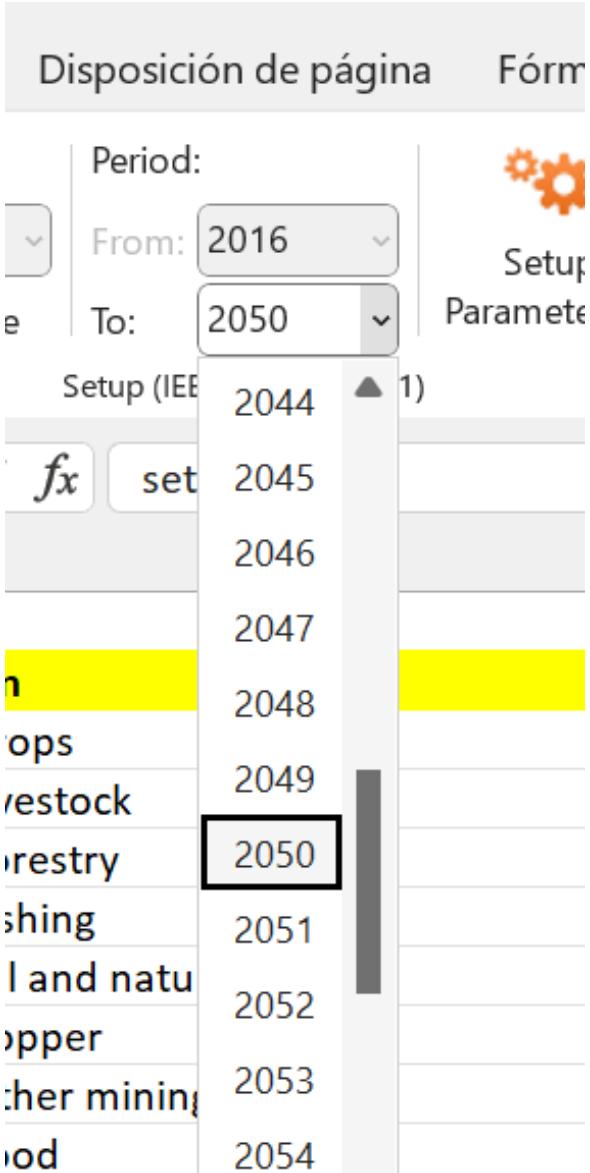
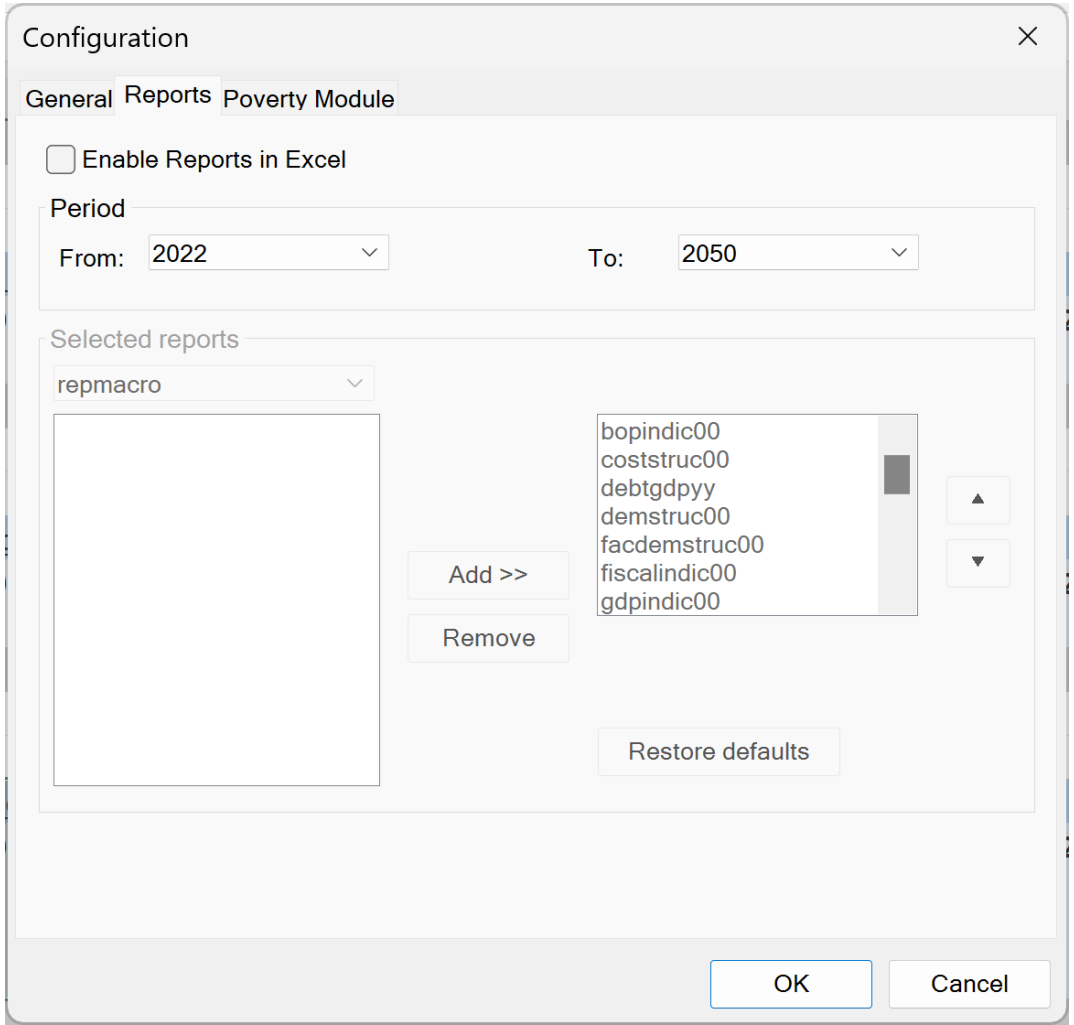
In Period, Select 2050 as Last Simulation Year



In Configuration, Select Period 2022-2050 to Calculate Average Annual Growth Rates

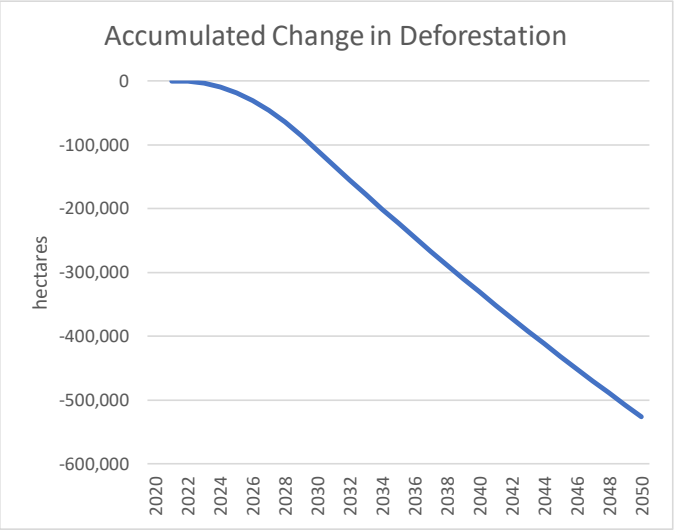


Scenario Definitions: Shocks

- **BASE**: business-as-usual scenario
- **REDEFOR**: reduction in deforestation
- **AFFOR**: increase in forest area, including land area for forestry
- **RESTORE**: increase in forest area, including land area for forestry
- **COMBI**: **REDEFOR** + **AFFOR** + **RESTORE** + increase in total factor productivity due to reduced erosion and increased pollination
- **COMBI2**: same as combi wihout increased increase in TFP
- In all cases, assume that (a) direct tax rate is the clearing variable for the government budget, and (b) non-government investment is the clearing variable for the non-government savings-investment balance.

Scenario Definitions: REDEFOR

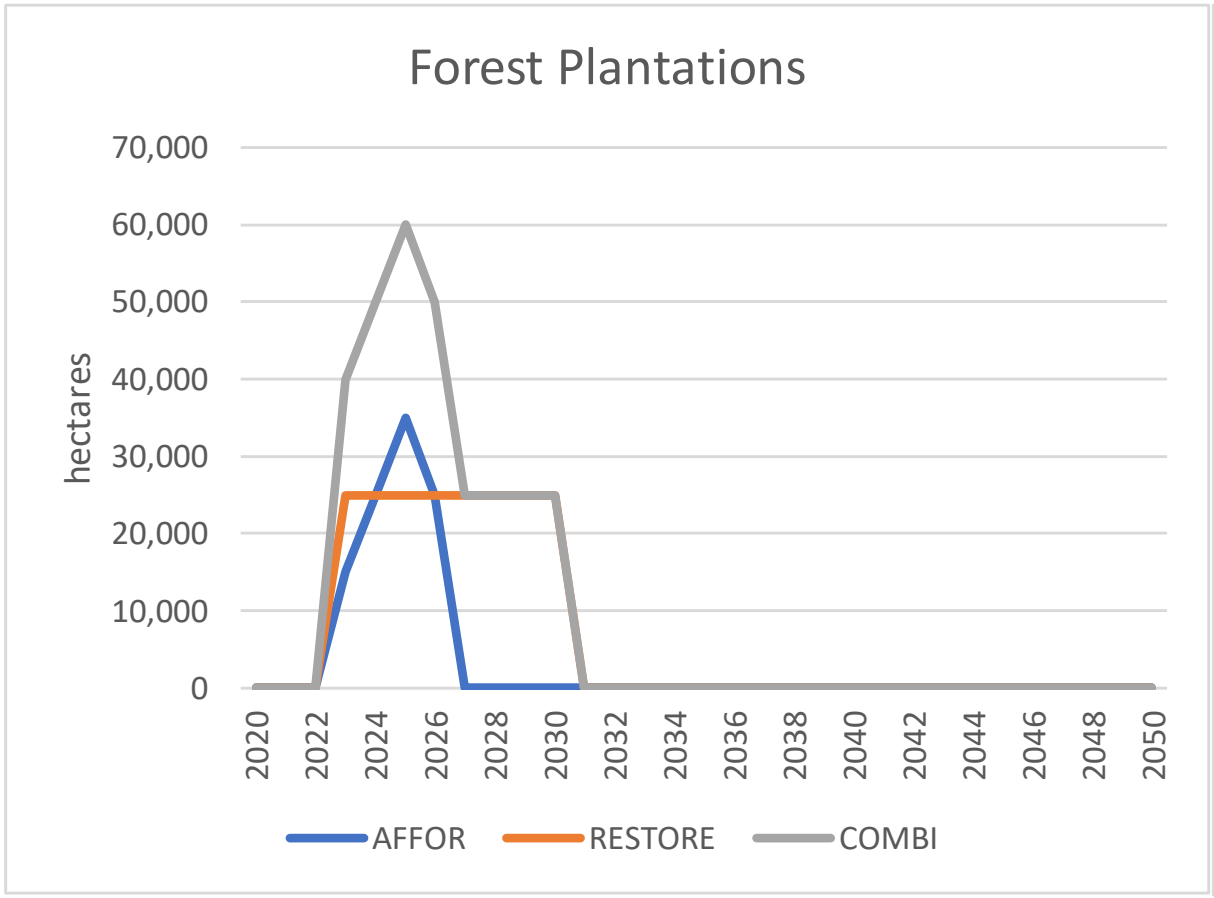
- 25% reduction in deforestation by 2030 with respect to the average rate of deforestation registered between 2001 and 2013.
- The deforestation rate is reduced linearly beginning in 2023 until reaching a 25% reduction by 2030 which is maintained until 2050.
- The cost of reducing deforestation is distributed equally from 2023 to 2050; cost estimated for Brazil of USD538.70 per hectare/year.
  - 90% recurrent government expenditure and 10% government investment.
  - 50% financed by non-reimbursable grants and 50% through international development loans with standard repayment terms.

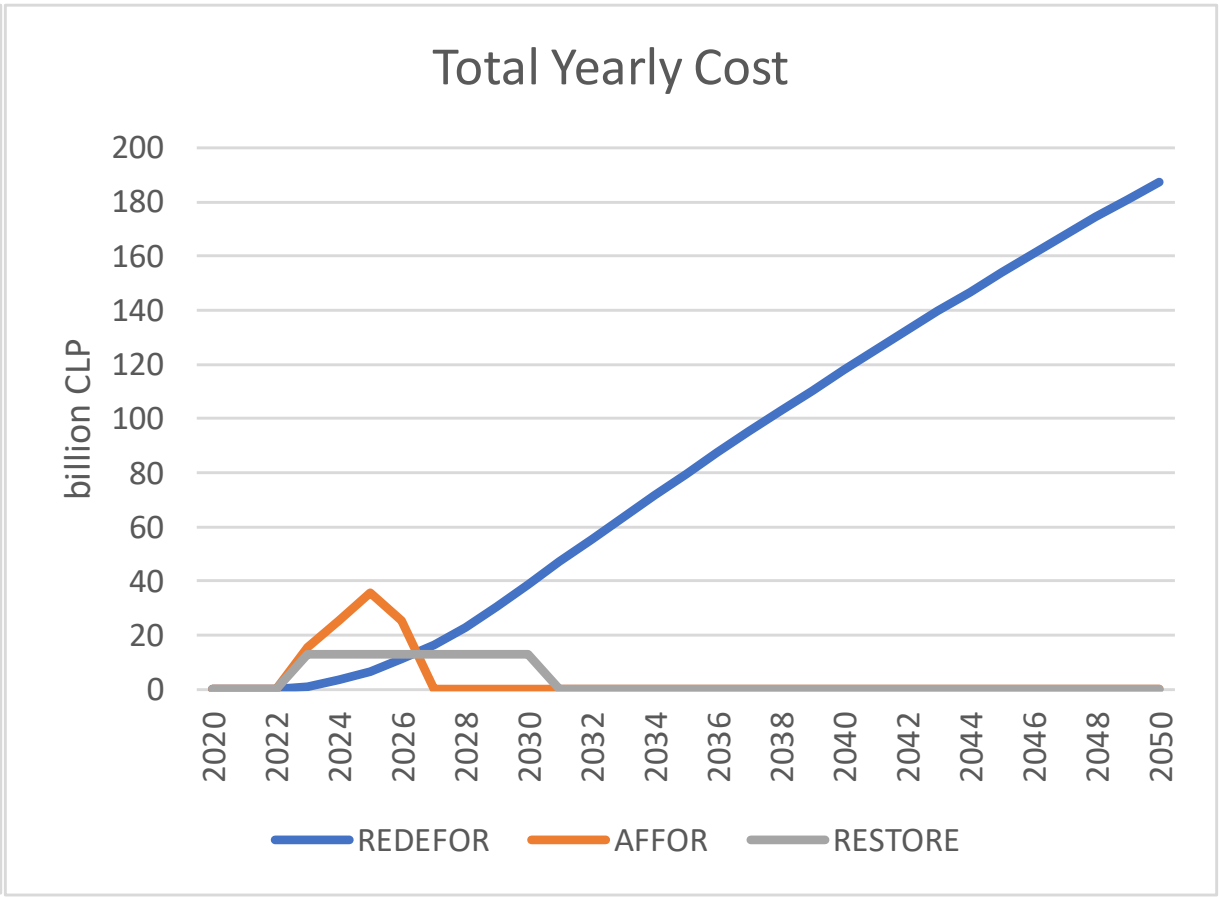


Scenario Definitions: AFFOR

- 200,000 new hectares of forest plantations on areas designated as shrub and herbaceous vegetation areas in the LULC map; these areas do not currently generate economic value.
- The afforestation will commence in 2023 with planting of 15% of the total area followed by 25%, 35% and 25% in 2024, 2025 and 2026, respectively.
- 50% of the new forest plantations will be used for forestry production beginning 10 years after establishment.
- The cost of afforestation was estimated in 2015 CLP986,251.
  - 100% government investment
  - 50% financed by non-reimbursable grants and 50% through international development loans with standard repayment terms.

Scenario Definitions: Forest Plantations and Total Yearly Cost



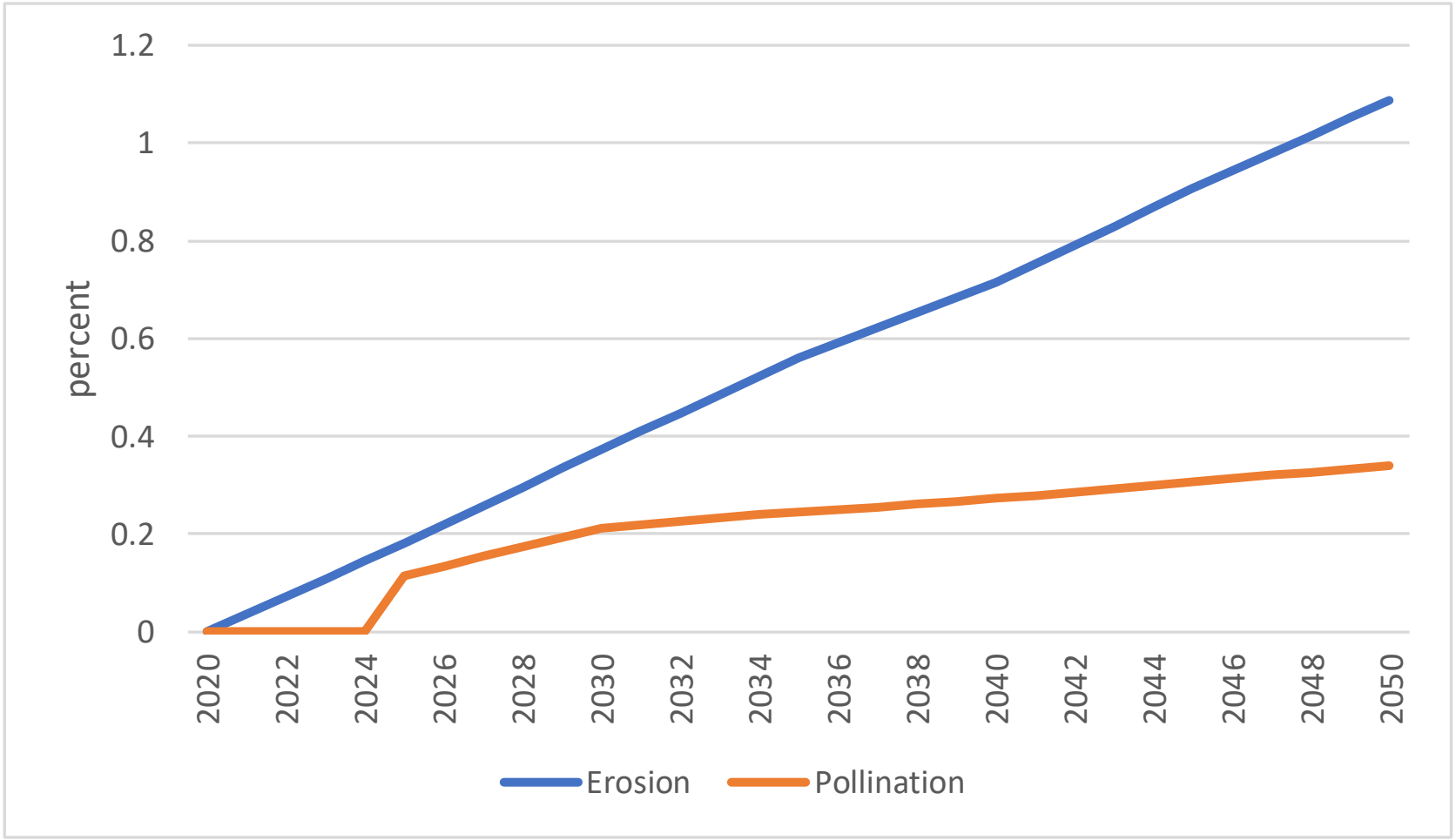


Scenario Definitions: Total Yearly Cost (GDP%)

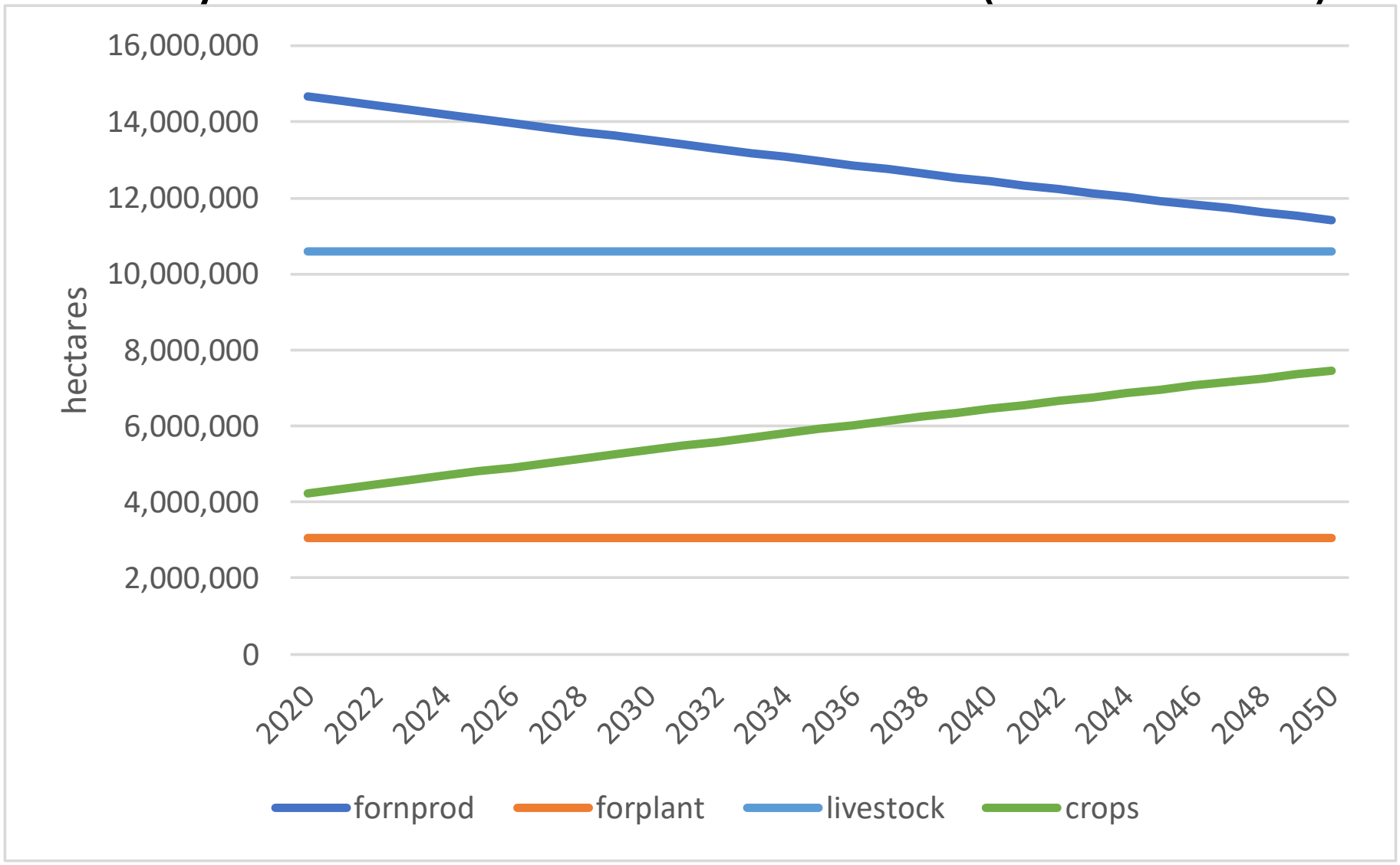
Scenario Definitions: RESTORE

- 200,000 ha restored to native forest conditions by 2030.
- The restoration will also take place in areas designated as shrub and herbaceous vegetation areas in the LULC map and currently do not generate economic value.
- The restoration will start in 2023, restoring 12.5% per year and concluding in 2030.
- 100% of the new forest plantations will be used for forestry production beginning 10 years after establishment.
- The cost of restoration was estimated at 50% of the cost of afforestation

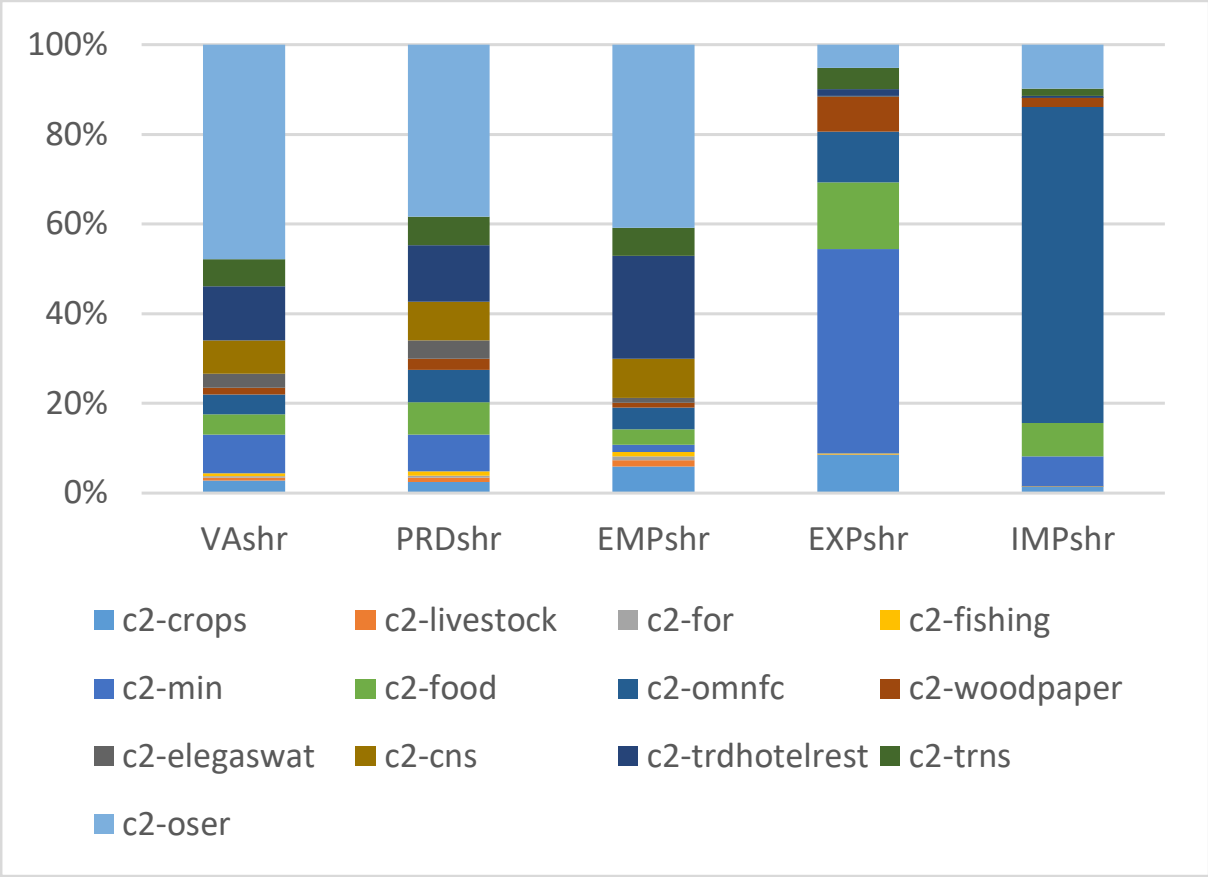
Scenario Definitions: COMBI – TFP shocks (% level deviation from base)

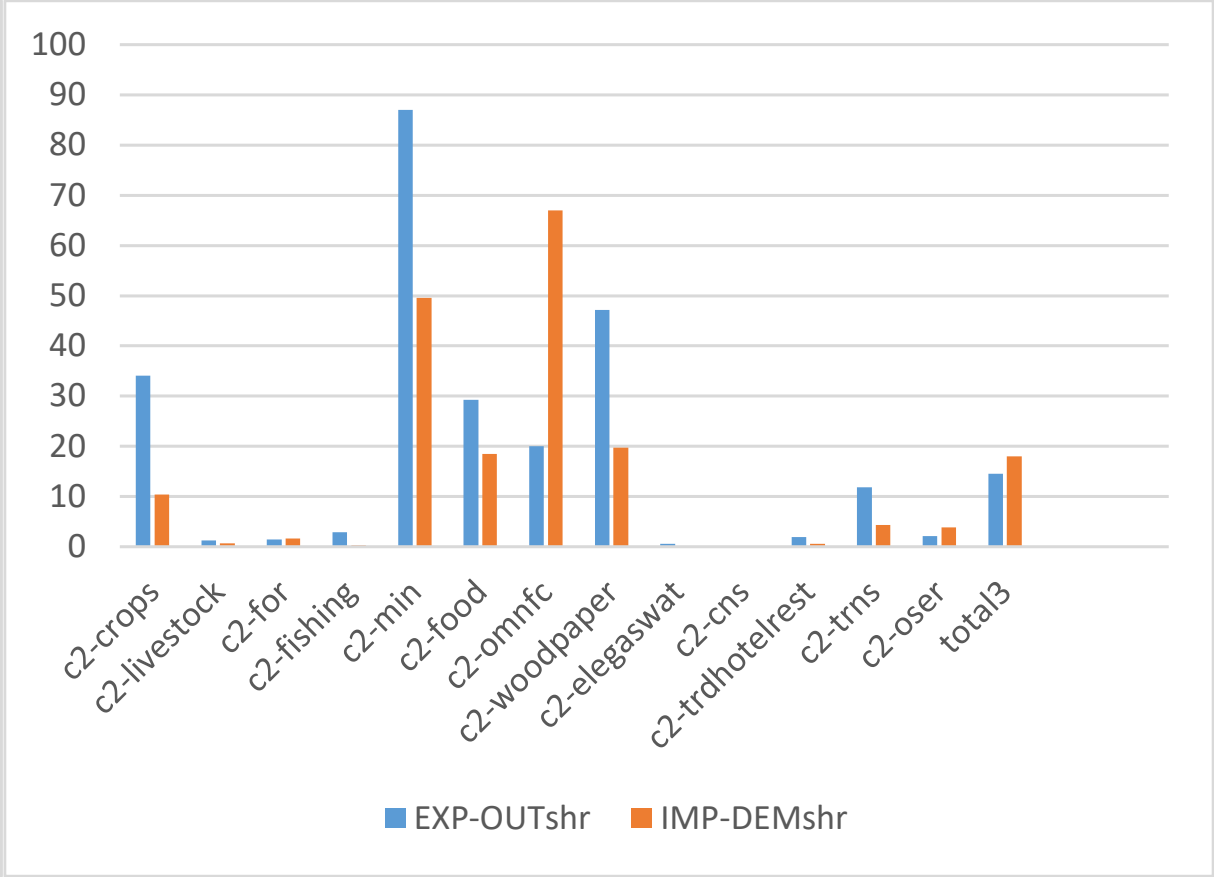


Key Data: base land use (hectares)



Key Data: Base-Year Sectoral Structure – importance of agriculture and forestry





Key Equations and Variables: Land Used in Forestry and Land Used in Agriculture

$$QFS_{f,t} = QFS_{f,t-1} + dqfsexog_{f,t} + QFS_f^{00} \cdot \left(\frac{\frac{WFAVG_{f,t}}{CPI_t}}{\frac{WFAVG_f^{00}}{CPI^{00}}} \right)^{\eta_f^{qfs}} - QFS_f^{00} \qquad f \in FLANDFOR$$

$$QFS_{f,t} = QFS_{f,t-1} + dqfsexog_{f,t} + QFS_f^{00} \cdot \left(\frac{\frac{WFAVG_{f,t}}{CPI_t}}{\frac{WFAVG_f^{00}}{CPI^{00}}} \right)^{\eta_f^{qfs}} - QFS_f^{00} + QDEFOR_{t-1} \qquad f \in FLANDAGR$$

$$QFOREST_t = QFOREST_{t-1} - QDEFOR_{t-1} + dqforest_t$$

Key Equations and Variables: Genuine Savings Calculation

$$GenuineSAV_t = GNSAV_t - DeprCapStock_t - DeplForStock_t - DeplMinStock_t - EmiVal_t$$

$GNSAV_t$ = Gross National Savings ($GNDI_t - PrvCon_t - GovCon_t$)

$GNDI_t$ = Gross National Disposable Income

$DeprCapStock_t$ = depreciation of reproducible capital sotck

$DeplForStock_t$ = depletion of forest stock

$DeplMinStock_t$ = depletion of mineral stock

$EmiVal_t$ = Cost of damage from CO2 emissions; US$30 per ton of CO2

Key Equations and Variables: Genuine Savings Calculation – cont.

For natural capital, the value of depletion is defined as

$$\sum_{i=t}^{t+T-1} \frac{qdepl_t \cdot unitrent_t}{(1+intrat)^{i-t}}$$

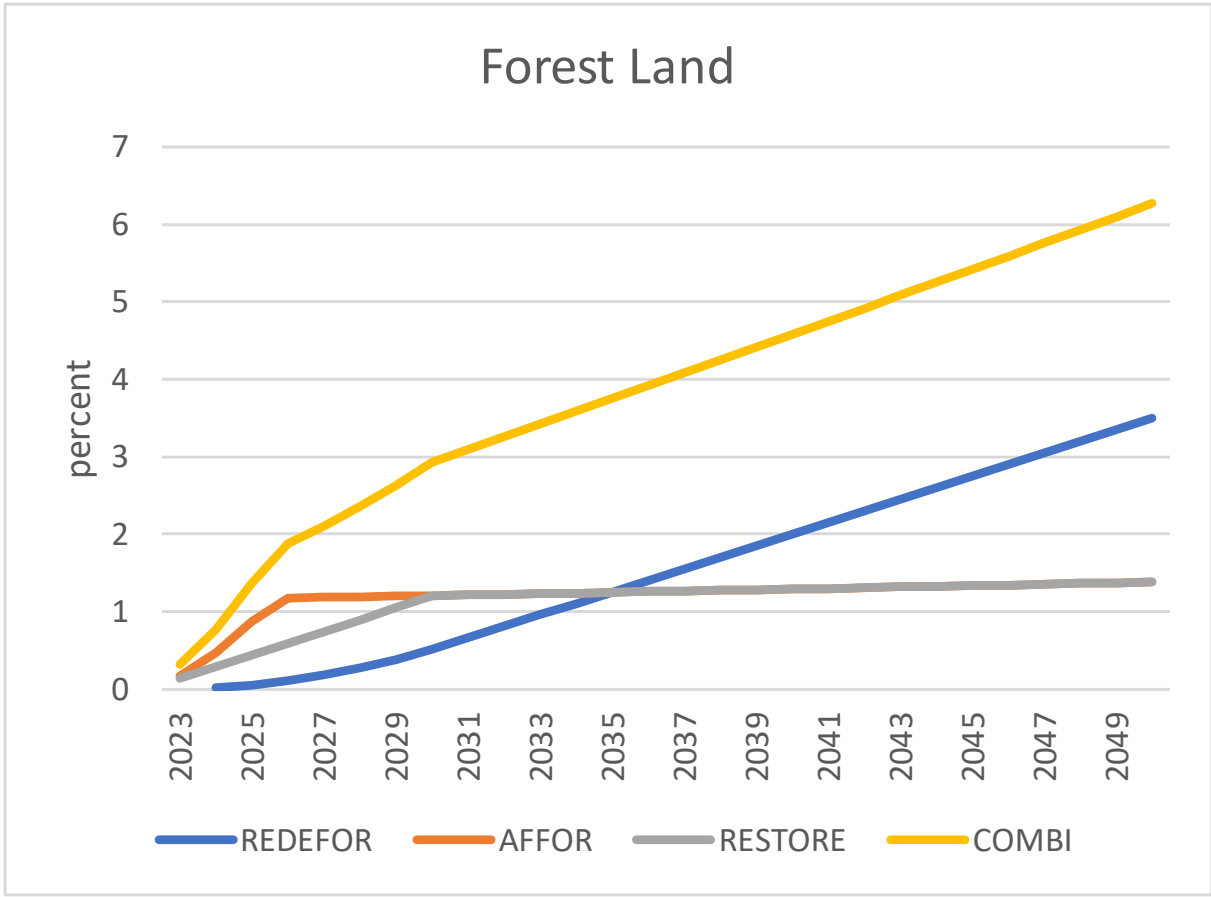
where

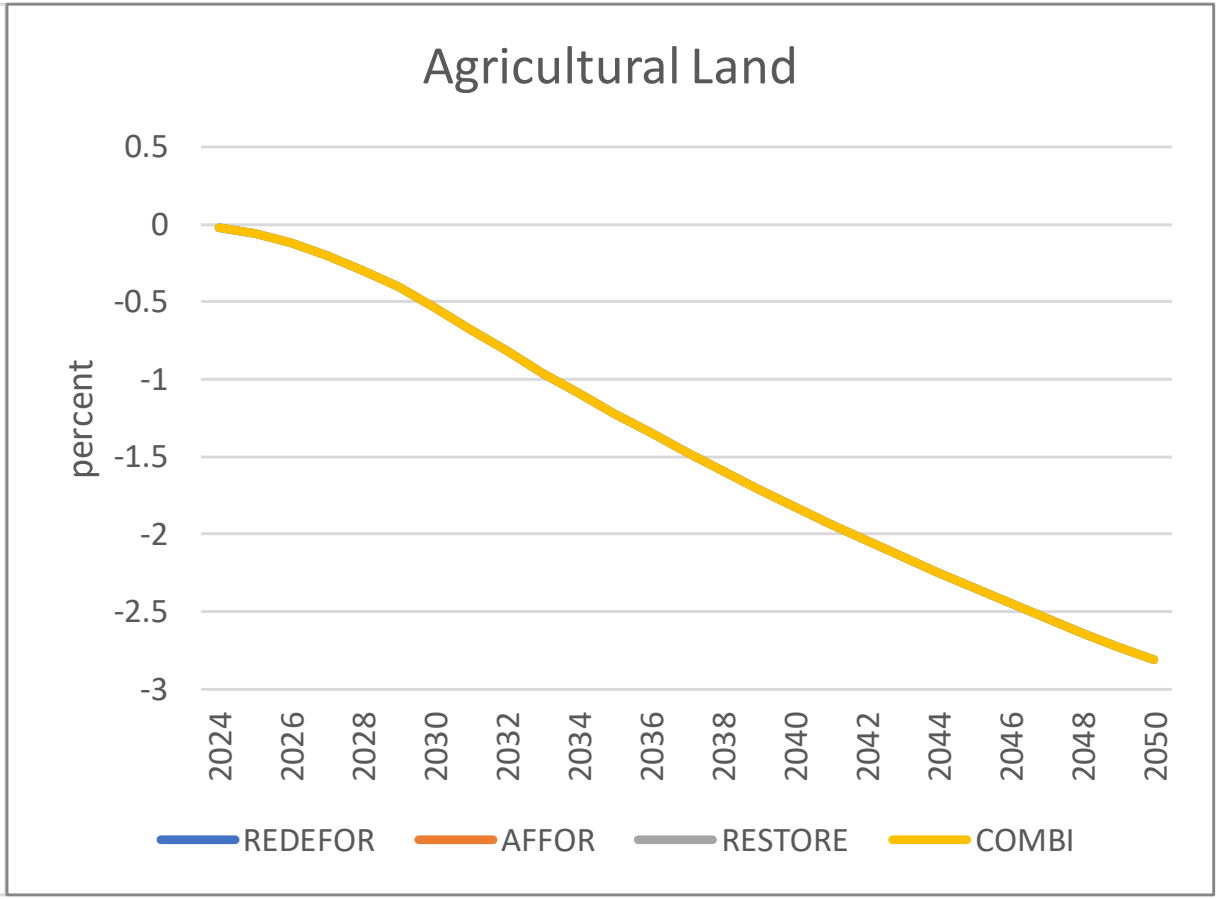
$qdepl_t$ = quantity of the resource extracted

$unitrent_t$ = unit rent in year t

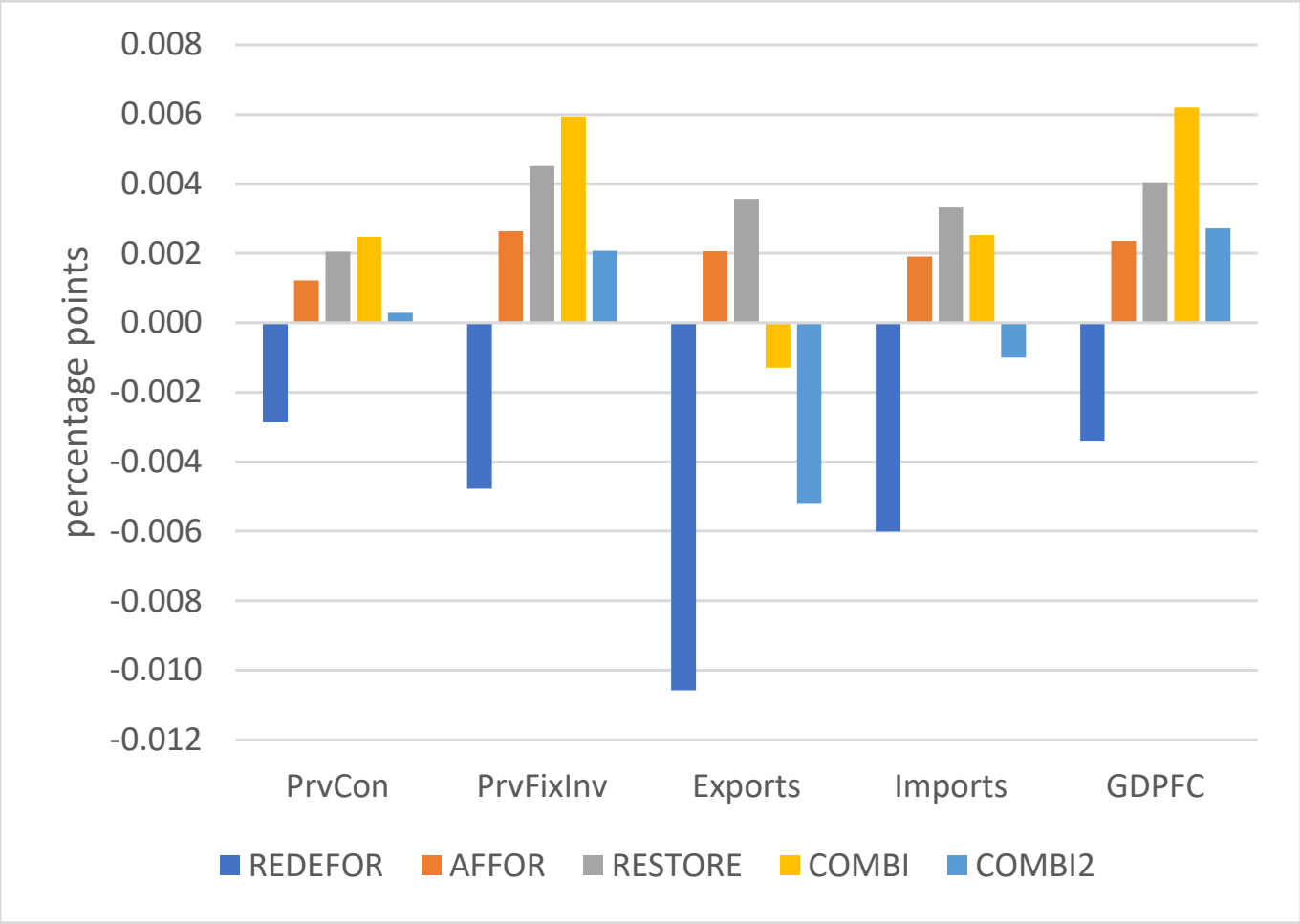
$intrat_t$ = interest rate (4% as in WB)

Land Use Changes (% level deviation from base)

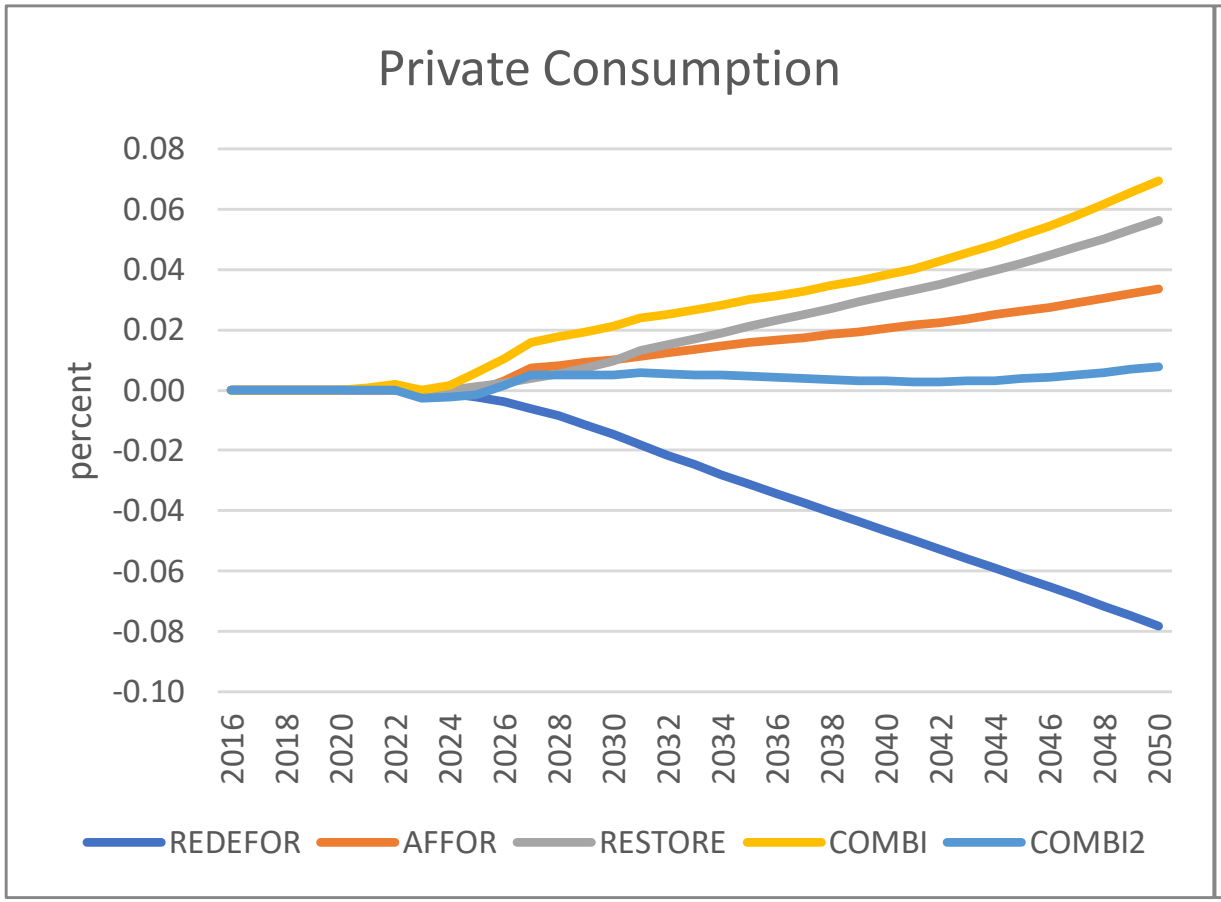


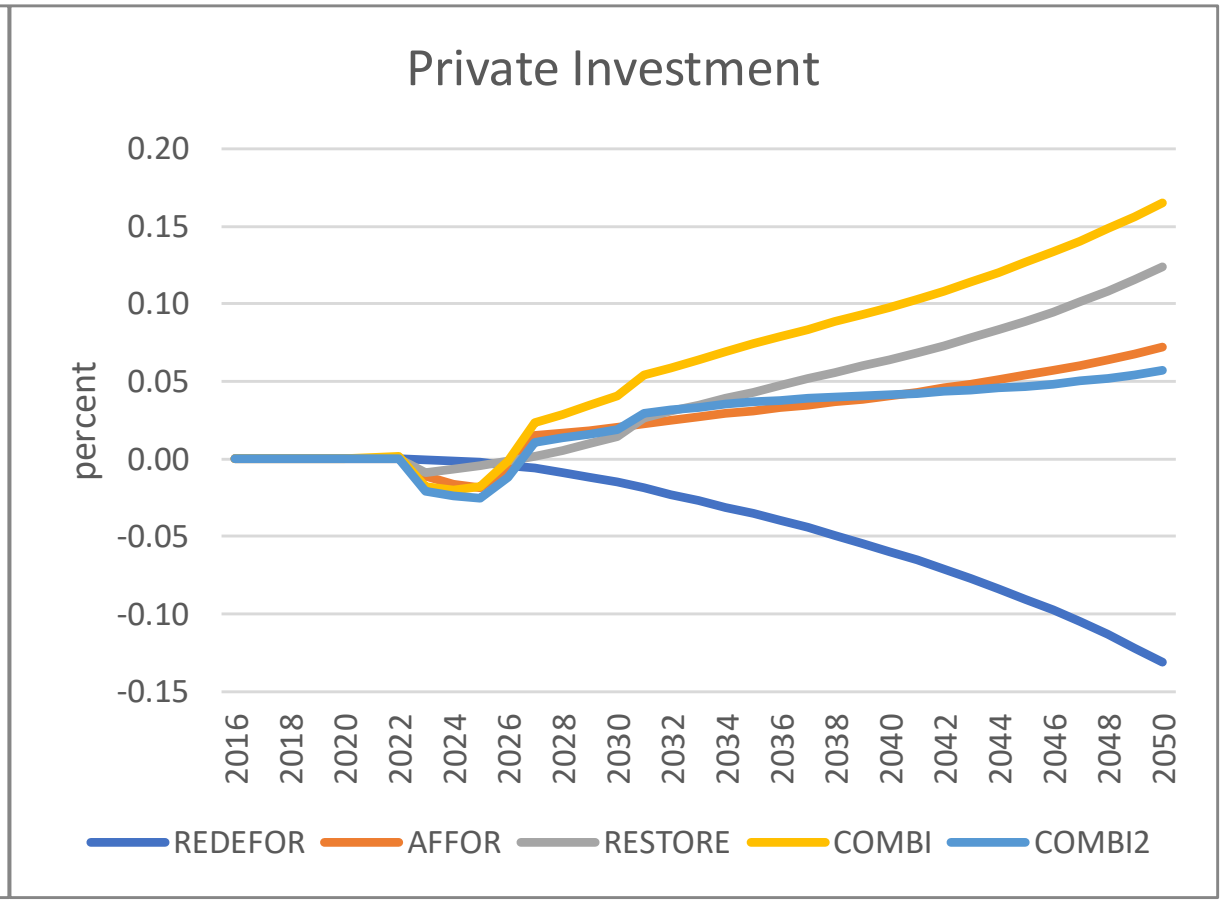


Macro Results (average growth rate 2023-2030 pp deviation from base)

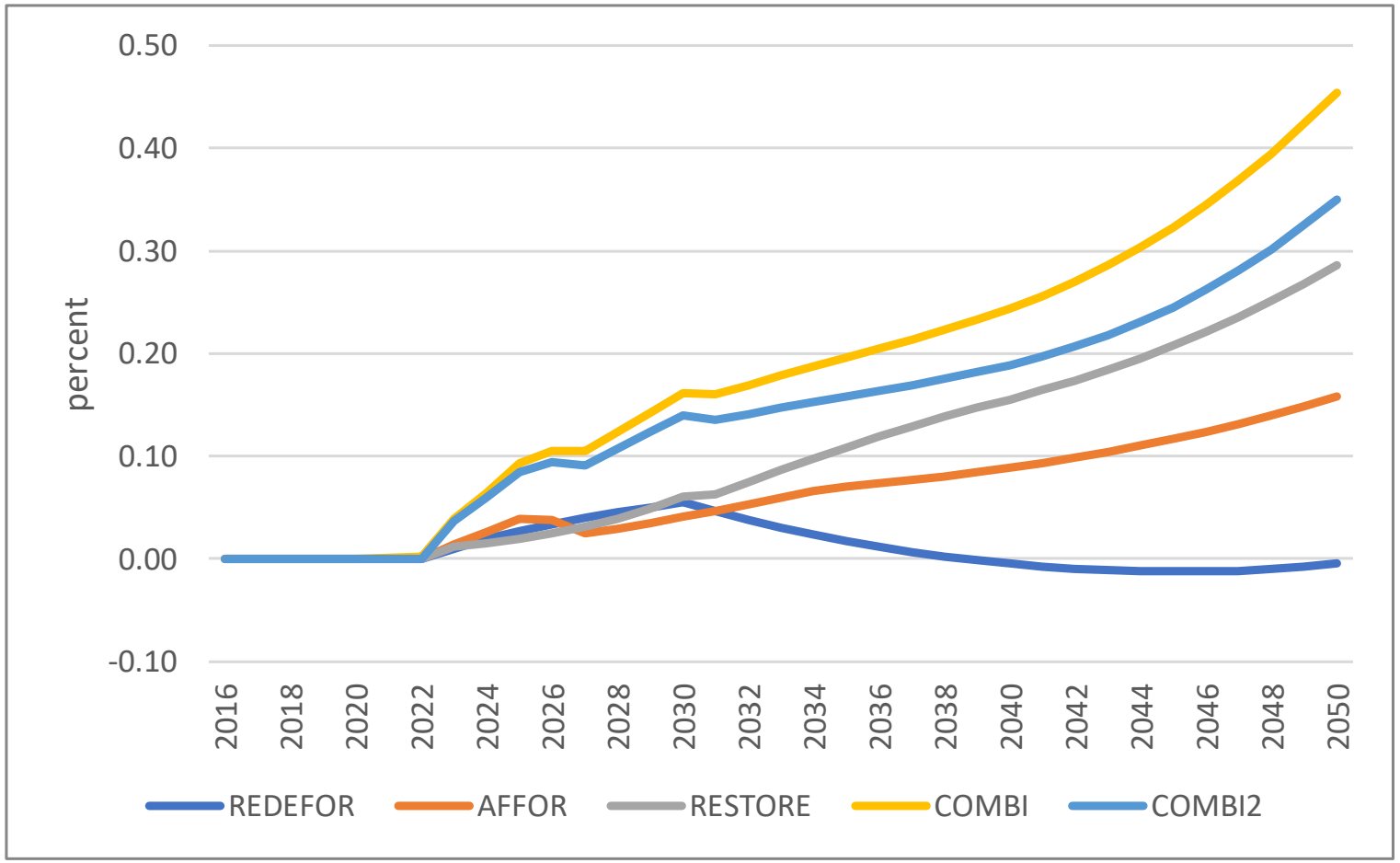


Real Private Consumption and Investment (% level deviation from base)





Genuine Savings (% level deviation from base)



Sectoral Output (average growth rate 2023-2030 pp deviation from base)