C3A Annual Symposium
December 2-6, 2024
World Bank Paris

Research Segment

Session 8 - The financial sector in the transition

Chair: Daniel Garzón Hernández

December 6th, 2024
2:00-3:30pm CET

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THE BARTLETT INSTITUTE FOR SUSTAINABLE RESOURCES

The challenge of phasing-out fossil fuel finance in the banking sector

Authors: J. Rickman, M. Falkenberg, S. Kothari, F. Larosa, M. Grubb & N. Ameli

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Banks have given almost $7tn to fossil fuel firms since Paris deal, report reveals

Among world's top 60 banks those in US are biggest fossil fuel financiers, while Barclays leads way in Europe

A pump jack over an oil well near Dacono, Colorado. US banks contributed 30% of the total $705bn provided in 2023, the report found. Photograph: David Zalubowski/AP

Climate campaigners sue BNP Paribas over fossil fuel finance

Action against one of Europe's largest financial institutions is the first climate-related lawsuit against a commercial bank

Isabella Kaminski

Mon 27 Feb 2023 15.05 CET

Share

BNP Paribas is accused of supporting companies that aggressively develop new oil and gas fields and infrastructure. Photograph: Sarah Meyssonnier/Reuters

BNP Paribas to stop funding new gas projects as litigation risk mounts

Bank pledges to step away from some fossil fuels ahead of annual meeting of shareholders

Climate activists protesting outside a branch of BNP Paribas in Paris in January. The bank is one of the world's top 20 financial backers for companies in the oil and gas sector © Sarah Meyssonnier/Reuters

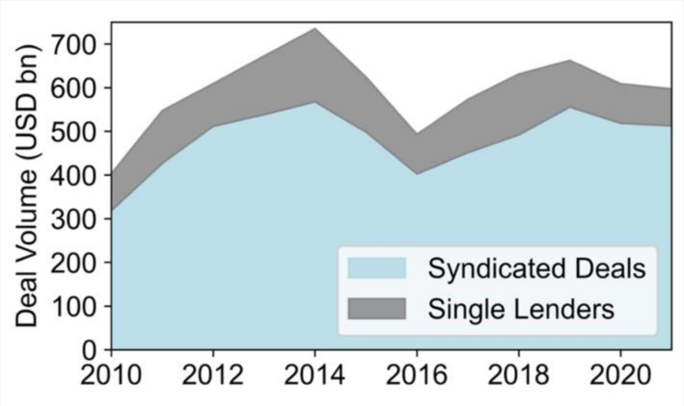
Sarah White in Paris and **Kenza Bryan** in London MAY 11 2023 11

Banks finance fossil fuel companies.
Fossil fuel companies develop new fossil fuel projects.

If banks do not finance fossil fuel companies, new fossil fuel projects will not be developed.

Freed funds may be invested in green energy?

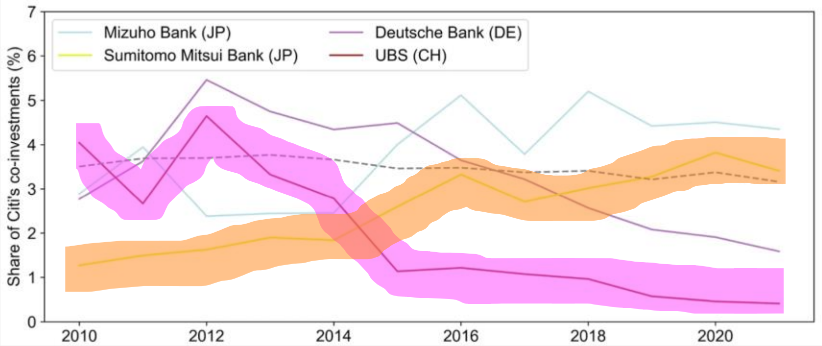
The Problem: Fossil fuel financing is syndicated



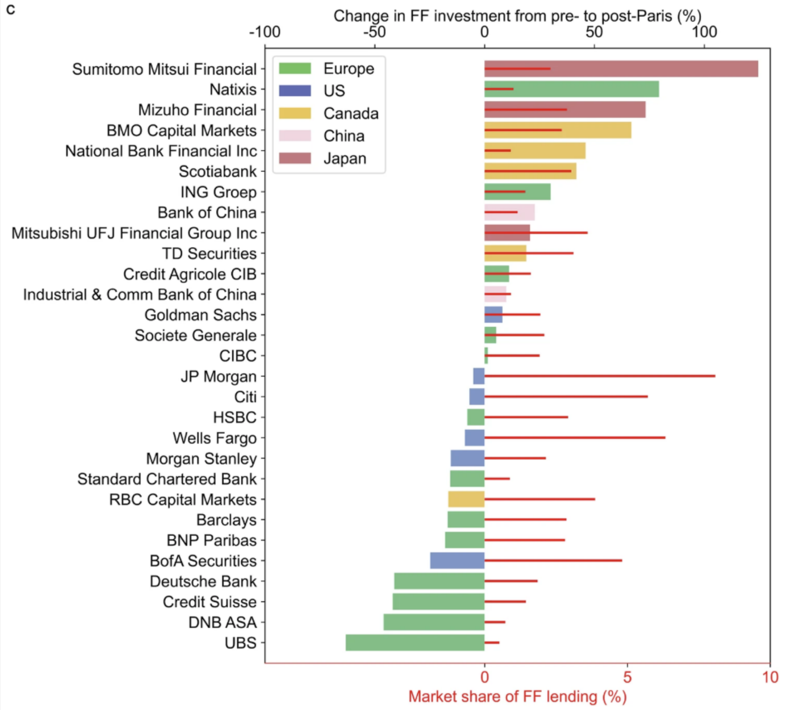
Syndicated lending makes up 80% of deals by value

Phase-out by some banks is being offset

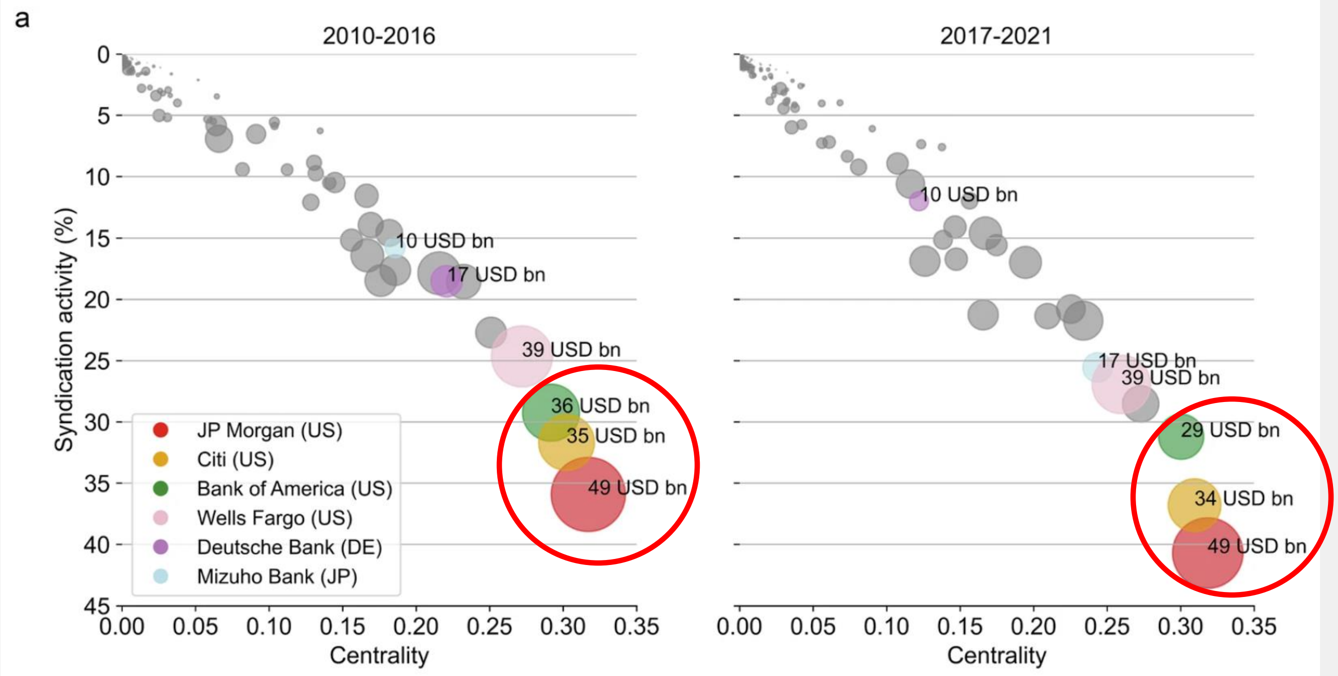
- Syndicates are flexible.
- Banks can be replaced.
- No net reduction in financing:
  2010-16: $584 bn/yr
  2016-21: $592 bn/yr



SMBC has substituted DB



Direct phase-out hides indirect involvement



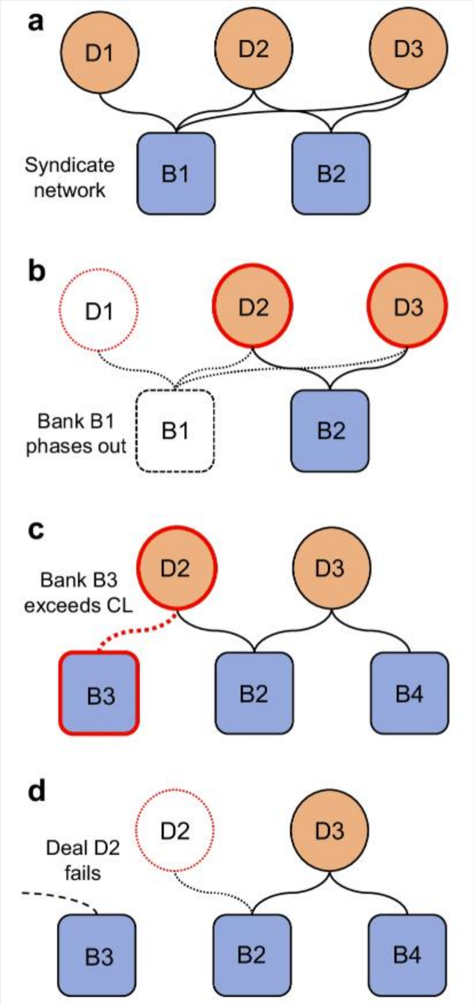
How does substitution impact fossil fuel phase-out?

Develop a simple model using real syndicate data.

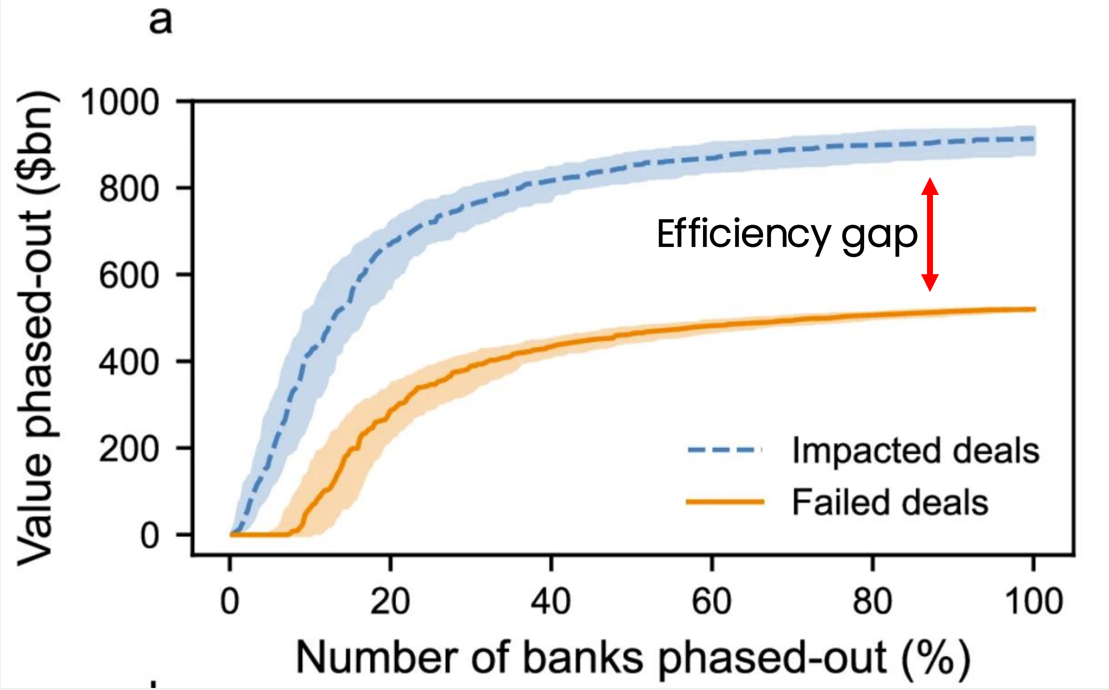
- Bloomberg data from 2010 – 2021. $7tn worth of deals.
- 14,391 bonds and loans via 709 banks.

- Sequentially phase-out banks.
- If a deal has a shortfall in funding, it must find a new syndicate partners (different methods tested).
- Deals which fail to find a new partner fail.
- Deals which do find a new partner survive.
- Limit to a bank's maximum fossil fuel holdings (absolute exposure limit, or relative change limit)

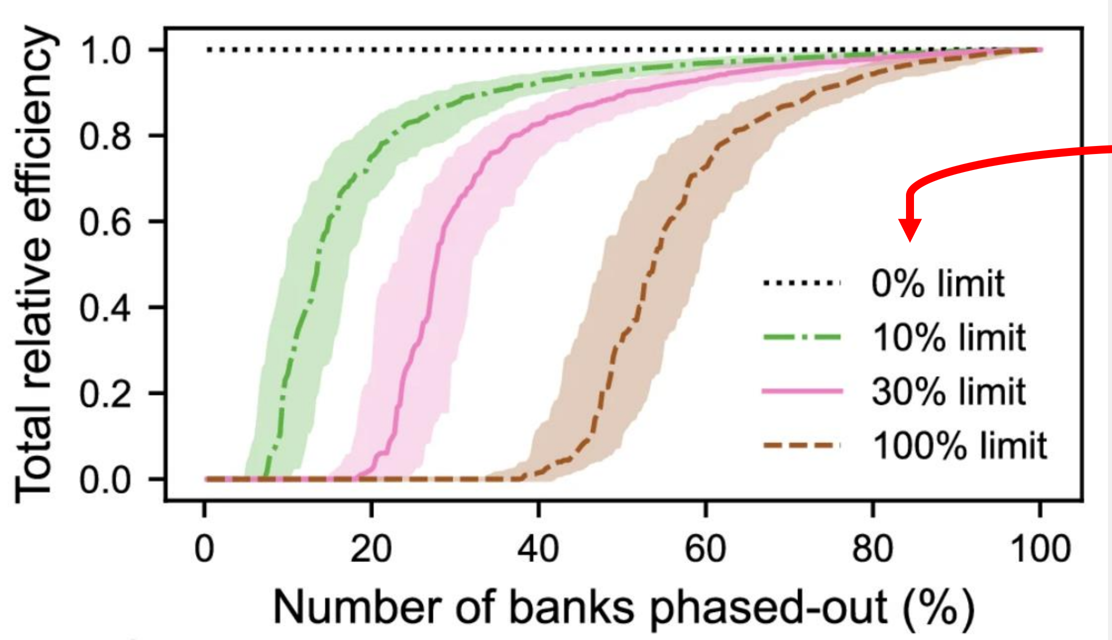
How bank level phase-out translate to project level phase-out?



Substitution results in an "efficiency gap"



Efficiency transition is sensitive to asset limits



Limit to annual % change in FF assets.

Why not absolute?

Transition to efficiency reached earlier if systemically important banks are targeted first!

Absolute limits only effect largest banks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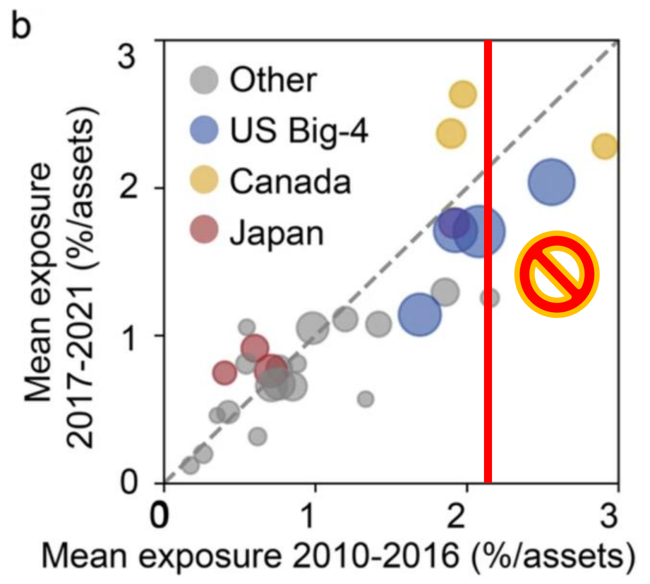
SUSTAINABILITY ■ SEPTEMBER 2 2022

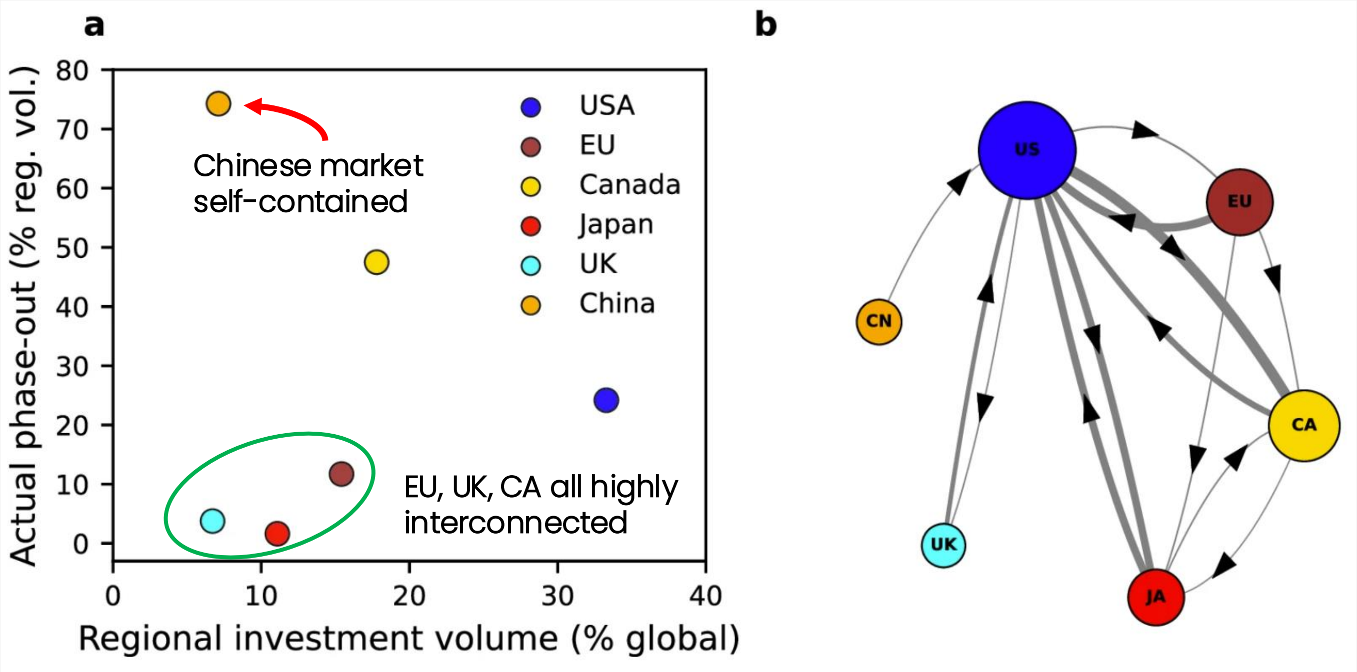
Capital adequacy requirement for new fossil fuel projects gains EU support

Supporters say the 1250% requirement will target the projects that do the most environmental damage. Victor Smart reports.

by Victor Smart



Limited regional regulations are insufficient



Substitution prevents phase-out

Growing evidence that substitution makes fossil fuel financing resilient against uncoordinated phase-out of finance.

Substitution concentrates finance, building risk.

Major US, Canadian, and Japanese banks are the key.

Proposed solutions ineffective?

Regulations targeting banks in one specific regions are unlikely to be effective (EU).

Capital requirements likely only impact the largest financers of fossil fuels.

Lack of discussion on how to regulate at the system level, rather than bank level.

Better modeling needed

Our model is extremely simple and needs developing:

- How will the cost of capital develop?
- To what extent are individual banks critical to syndicates?
- How else will fossil fuel projects be financed?

The way forward for finance ministries

Introduce New Dynamic Prudential Regulations:

- Develop capital requirements tailored to fossil fuel exposure that include dynamic caps to manage the rate of new fossil fuel investments, rather than static thresholds.

Incorporate Syndicated Loan Networks in Policy Design:

- Policies should address the syndicated nature of fossil fuel deals, perhaps by limiting the ability of remaining banks in syndicates to expand their exposure to phased-out deals.

Focus on Systemically Important Banks:

- Prioritize the phase-out of fossil fuel lending by the largest and most influential banks. This targeted approach can accelerate the transition with fewer overall systemic impacts.

Enhance Transparency and Monitoring:

- Increase disclosure requirements for fossil fuel lending and syndication activities. This will improve tracking of finance substitution and ensure accountability.

nature communications

Article https://doi.org/10.1038/s41467-024-51662-6

The challenge of phasing-out fossil fuel finance in the banking sector

Received: 13 December 2023

Accepted: 14 August 2024

Published online: 10 September 2024

Check for updates

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A timely and well-managed phase-out of bank lending to the fossil fuel sector is critical if Paris climate targets are to remain within reach. Using a systems lens to explore over $7 trillion of syndicated fossil fuel debt, we show that syndicated debt markets are resilient to uncoordinated phase-out scenarios without regulatory limits on banks' fossil fuel lending. However, with regulation in place, a tipping point emerges as banks sequentially exit the sector and phase-out becomes efficient. The timing of this tipping point depends critically on the stringency of regulatory rules. It is reached sooner in scenarios where systemically important banks lead the phase-out and is delayed without regional coordination, particularly between US, Canadian and Japanese banks.

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BRACKEN ■ SEPTEMBER 10

Why banks' fossil fuel policies fail

A system designed to share risk is preventing isolated bank policies from bearing fruit, and may lead to future systemic concerns

by Max Falkenberg and Nadia Ameli

Bloomberg

Green | ESG & Investing

Bankers Ratcheting Up Oil Deals Drive Deepening Market Split

- Texas Capital ranks among banks making biggest inroads
- Banks are spreading risk through new syndication models

By Natasha White
September 10, 2024 at 9:00 AM UTC
Updated on September 10, 2024 at 2:53 PM UTC

Q&A
Discussion

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Capital Adjustment Costs and Nationally Determined Contributions - How to Avoid Double Transitions of Energy Capital?

Authors:
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What constitutes optimal investment paths for the clean energy transition, given different initial conditions of advanced vs. emerging market economies?

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Motivation

How to set up the capital stock to transition from a fossil-fuel- to a renewable-based energy system, accounting for disparities in existing capital stocks between advanced and emerging markets?

Setup:

- Energy demand of advanced economies is served by existing energy infrastructure, whereas emerging market economies have growing energy supply needs.
- Today fossil-based technology is ~ 40 % more productive; by 2030, just 10% more
- Dirty and clean energy technologies are highly substitutable in the long run but require costly infrastructure adjustment → capital adjustment costs

→ The danger of a potential double transition of the energy capital stocks in the next decades is due to high ongoing dirty energy investment rates in some countries and weak (or weakening) nationally determined contributions during the mid-transition

Results in a Nutshell:

- An **advanced economy** like EU is cleaner but with legacy dirty capital: main challenges are phaseout and stranded assets.
- An **emerging economy** like India or Peru is faster growing with larger overall investment needs.

➢ Due to the expected clean energy productivity convergence, clean energy investment expands immediately to smooth adjustment costs and meet growth needs.

➢ Modest additional climate policy is sufficient to reduce initial buildup in dirty energy capital stocks.

➢ Under the central calibration, compared to carbon budgets consistent with current NDCs, climate policies in line with reaching 1.5 C globally entail modest welfare costs in terms of consumption.

Capital Adjustment Costs

- Convex adjustment costs make fast changes in capital stocks very costly.
- Convex capital adjustment costs capture the increasing opportunity costs to use scarce resources, such as skilled workers, appropriate capital, or production lines, to perform the capital stock transition.

  Example: Retrofitting all buildings in a country in three months much more expensive than doing it over three decades *(Vogt-Schilb et al. 2018).*

- Adjustment costs in capital stock transformation can operationalize the endogenous change in substitutability between clean and dirty energy sources.

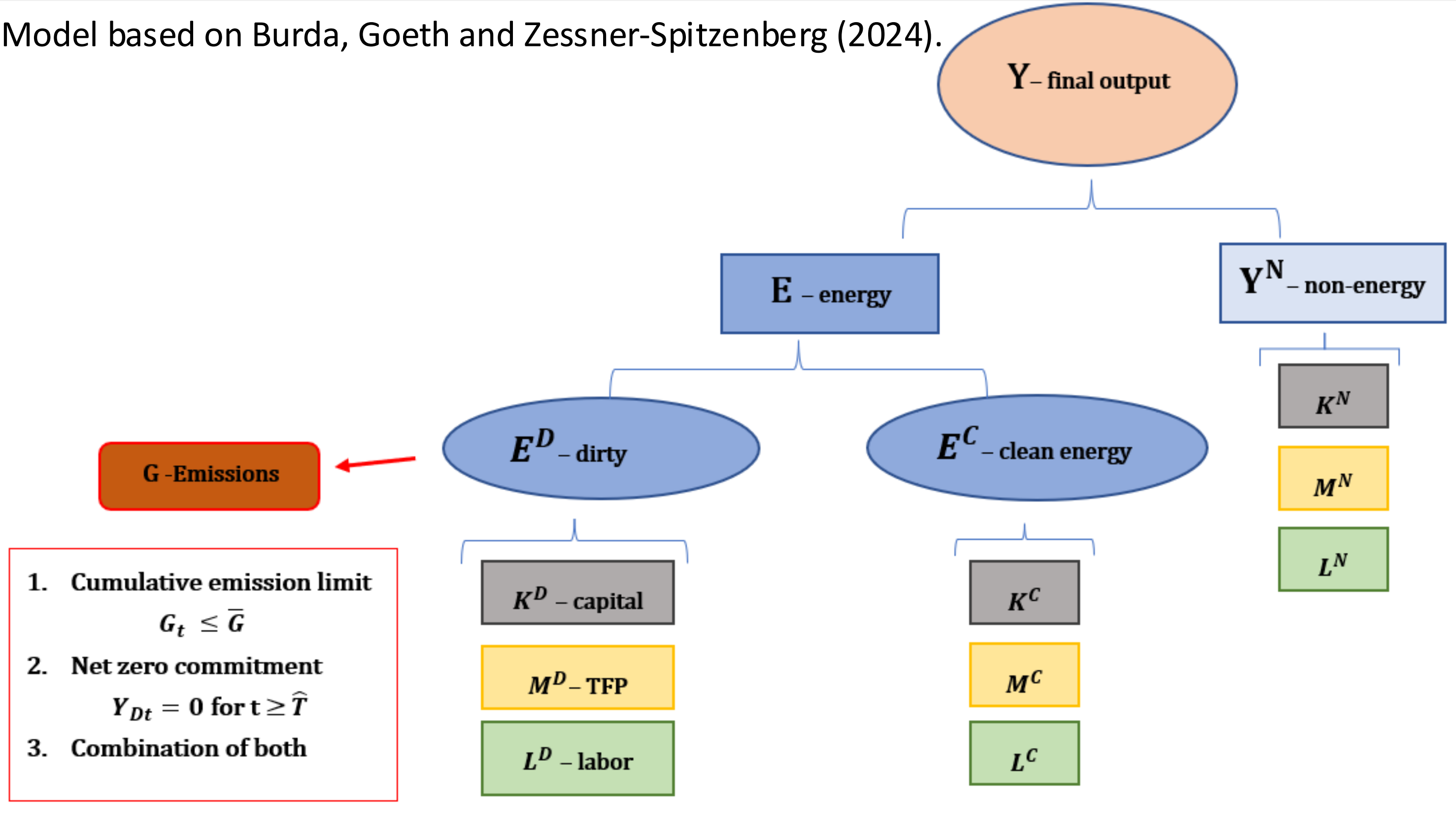
Clean Technology Catching Up

	2021	2030	2021	2030	
	EU		**India**		
Sector	$\frac{M_D}{M_C}$		$\frac{M_D}{M_C}$		Unit of Measurement
Electricity	0.57	0.52	0.89	0.98	VALCOE
Heating	1.19	0.78	1.19	0.78	LCOH
Transportation	1.56	1.56	1.56	1.56	LCOD
Industry (Steel)	2.3	1.5	1.4	1.1	Prod. cost
Average	1.4	1.09	1.26	1.11	

Table: Productivity advantage of dirty energy technology over clean energy technology in several sectors over time.

Production Structure of our Four Sector Growth Model

Model based on Burda, Goeth and Zessner-Spitzenberg (2024).



What characterizes the optimal investment path for the clean energy transition, given different initial conditions?

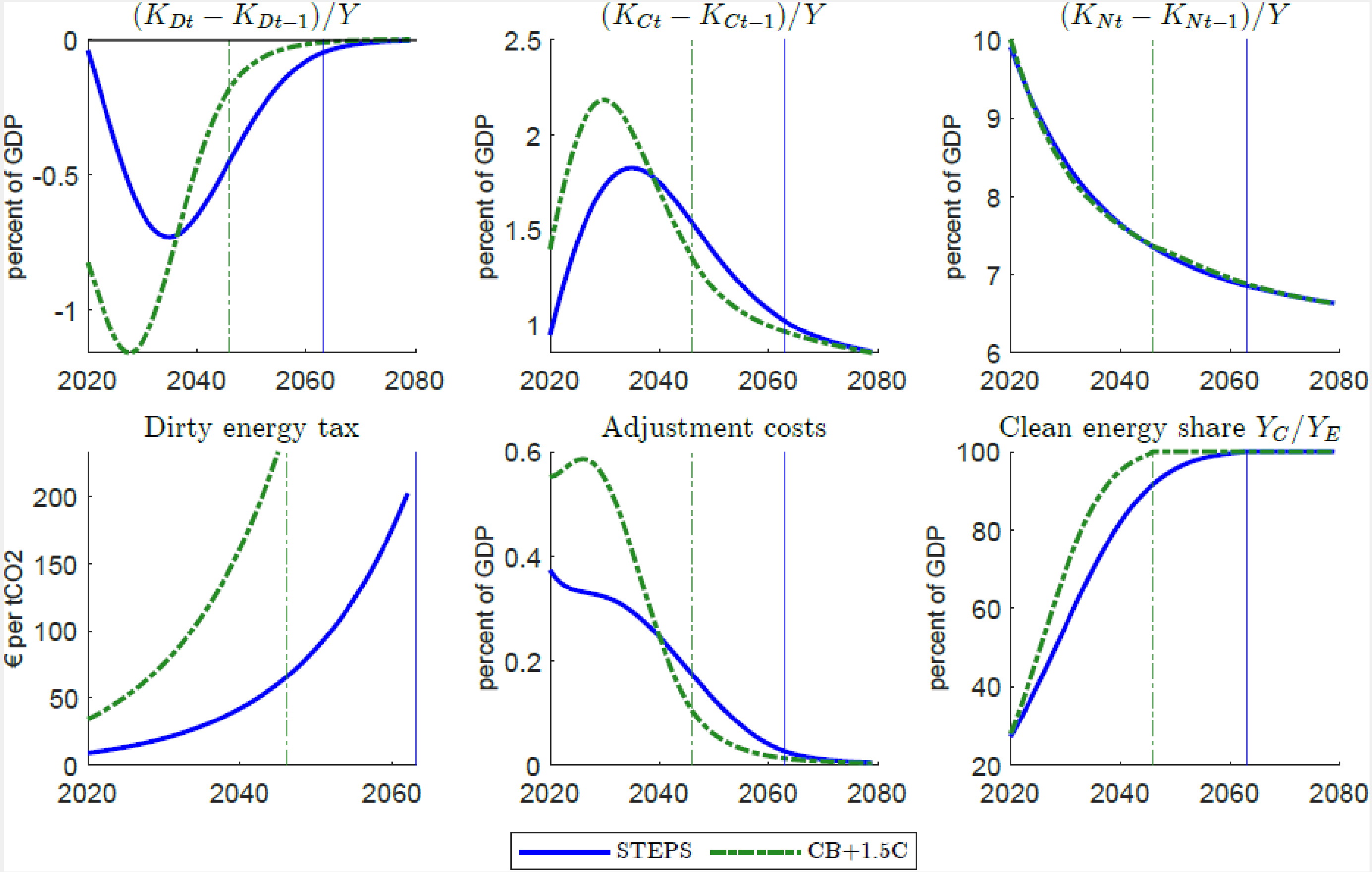
Different Cumulative Carbon Budget Scenarios

1. STEPS: carbon budget that corresponds to the *stated policies scenario* including carbon pricing (Baseline)

2. CB+1.5C: corresponds to a carbon budget including carbon pricing associated with meeting 1.5C globally

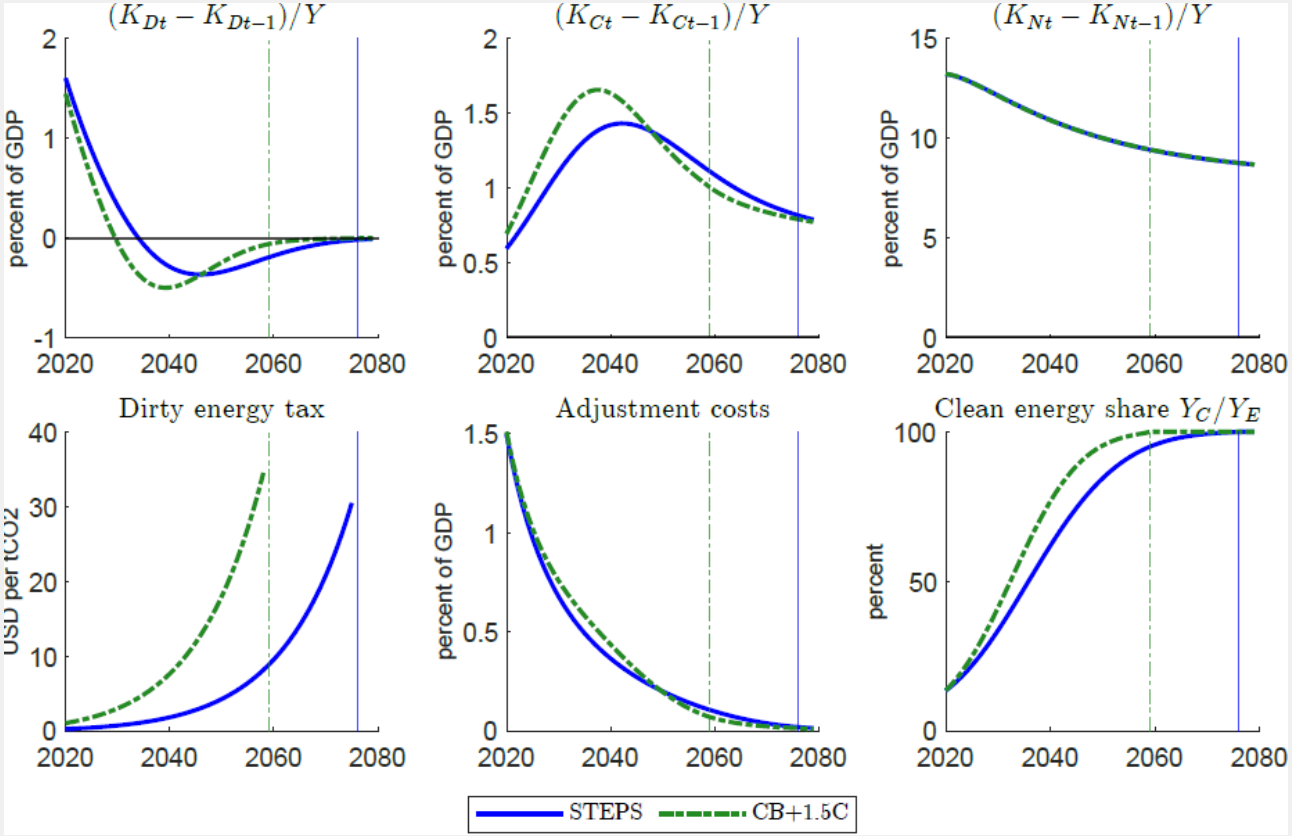
→ Calculation of carbon budgets based on Climate Action Tracker data

EU



$(K_{Dt} - K_{Dt-1})/Y$
$(K_{Ct} - K_{Ct-1})/Y$
$(K_{Nt} - K_{Nt-1})/Y$
percent of GDP
Dirty energy tax
€ per tCO2
Adjustment costs
Clean energy share Y_C/Y_E
2020
2040
2060
2080
STEPS
CB+1.5C

India



$(K_{Dt} - K_{Dt-1})/Y$
$(K_{Ct} - K_{Ct-1})/Y$
$(K_{Nt} - K_{Nt-1})/Y$
Dirty energy tax
Adjustment costs
Clean energy share Y_C/Y_E
percent of GDP
USD per tCO2
percent
2020
2040
2060
2080
STEPS
CB+1.5C

Key Messages

- Due to the expected productivity convergence, an emerging economy like India or Peru always expands clean energy investment immediately.
- In India and Peru even a modest climate policy is sufficient to avoid an initial buildup in dirty energy capital stocks.
- In both nations, the pursuit of the 1.5°C climate target significantly curtails emissions yet implies higher costs for the initially elevated clean energy investment.

Policy Implication: Delaying climate action creates a risk of a double transition of the energy capital stocks, which entails higher costs in the long run, given costly capital adjustment

The Total Carbon Price - Why **net** fiscal incentives for fuels matter…

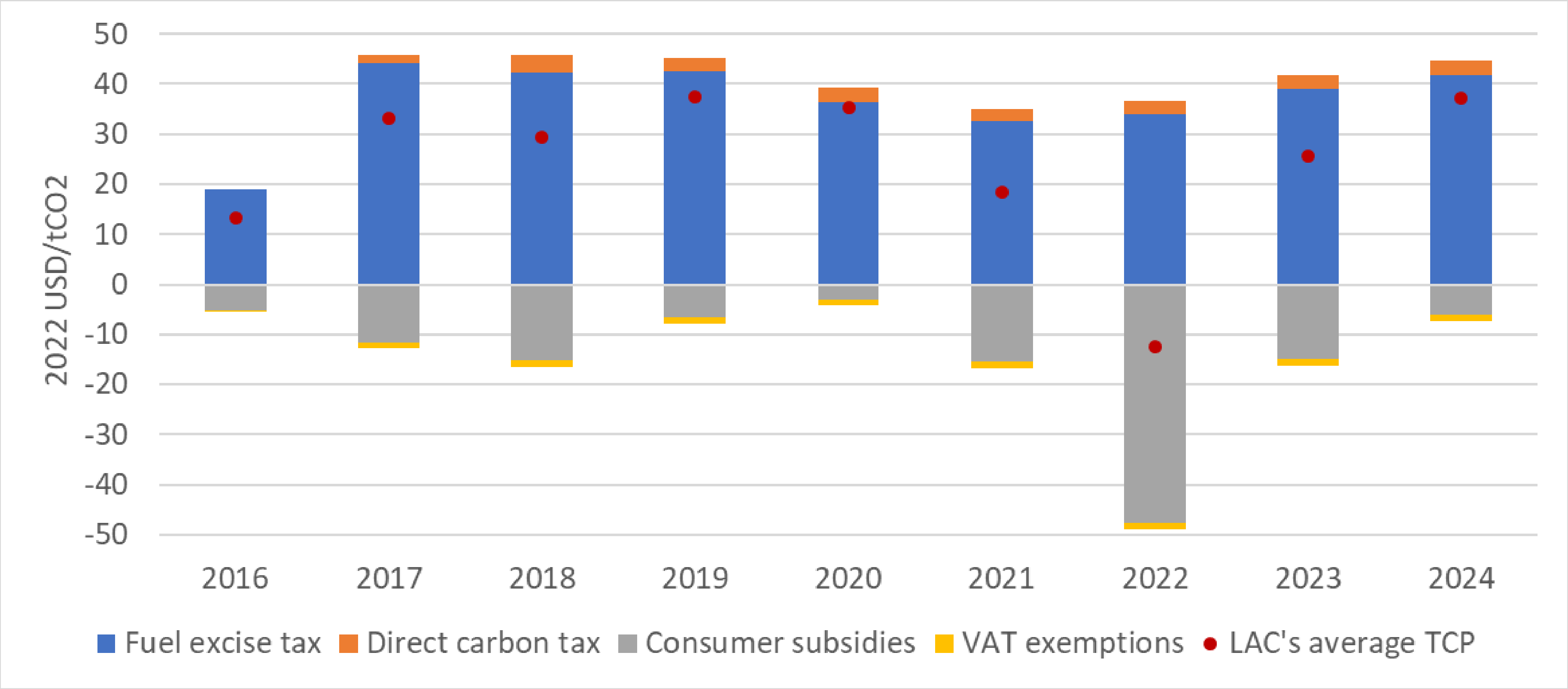
World Bank (2024): Taxing and subsidizing energy in Latin America and the Caribbean: Insights from a Total Carbon Price Approach

Total Carbon Price (TCP)

Direct and indirect priced-based fiscal instruments considered in the TCP metric

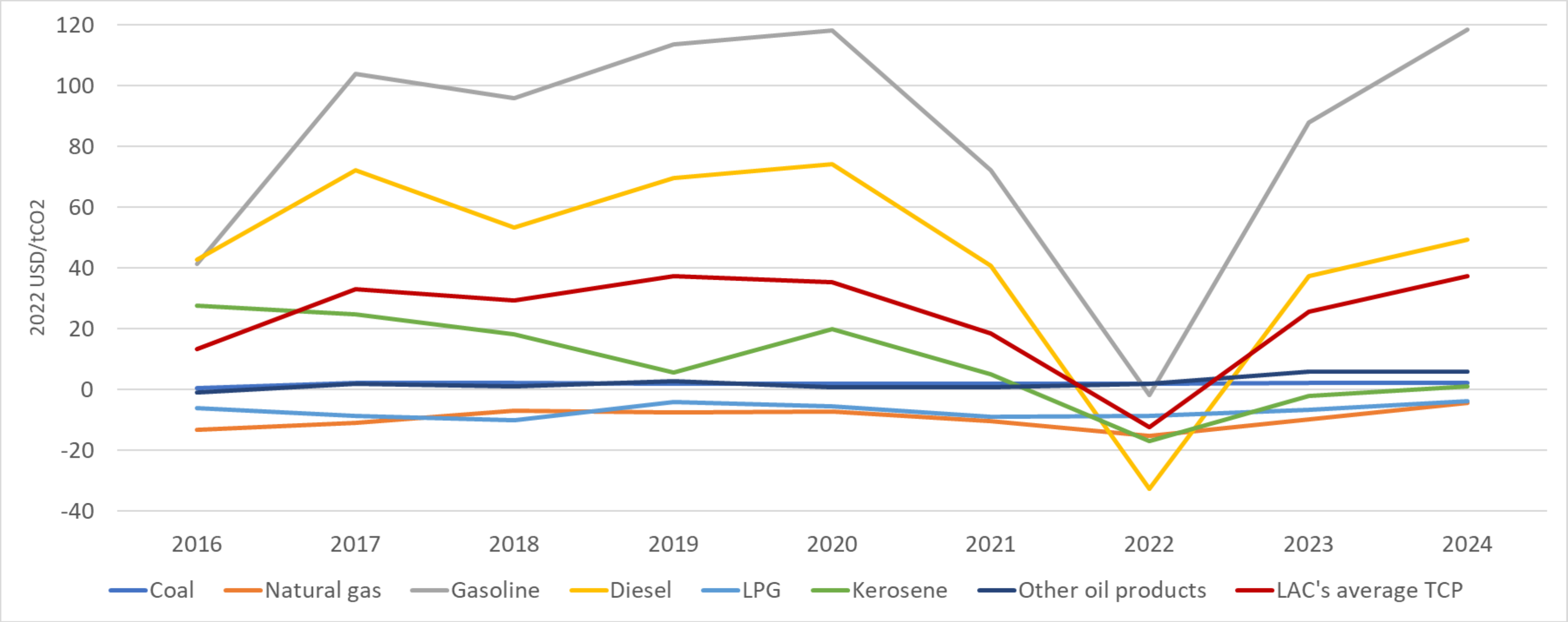
	Price-based instruments	+ or – in energy price
Direct	Carbon tax	+
	Emissions Trading Systems average marginal price	+
	Tradable performance standard	+
Indirect	Fuel excise tax	+
	Producer-side subsidies[1]	-
	Consumer-side subsidies	-
	VAT deviation from standard rate (exemption or reduced rate)	-

Contribution of Each Tax Component to Latin America's Average Total Carbon Price



Source: World Bank (2024)

Average Total Carbon Price of Each Fuel in Latin America



Source: World Bank (2024)

Conclusion

- In LAC, there is a wide dispersion between TCPs for different fuel.
- The main overall tax burden is due to fuel excise taxes.
- Large FF subsidies in LAC are mostly for natural gas and LPG
- Different fuels are used differently in different sectors (e.g., diesel and gasoline concentrated in transportation, natural gas in power generation and industry).
- Since fiscal incentives are differentiated by fuels and not by emission content, investment signals for decarbonizing each sector differ substantially.

Policy implication: emission based (direct) carbon price more favorable to guide investment to low carbon alternatives in all sectors.

"Due to expected productivity convergence, it is optimal for emerging market economies to immediately increase investment in clean energy technology, even without further climate policy. Delaying climate action in emerging markets risks a double transition of energy capital stocks, leading to higher long-term costs due to costly capital adjustments."

Anna-Maria Goeth, *Capital Adjustment Costs and Nationally Determined Contributions - How to Avoid Double Transitions of Energy Capital?*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Appendix

Details Total Carbon Price in LAC

Countries included: Argentina, Chile, Colombia, Mexico, Jamaica, Peru, Paraguay, Uruguay.

Methodology:

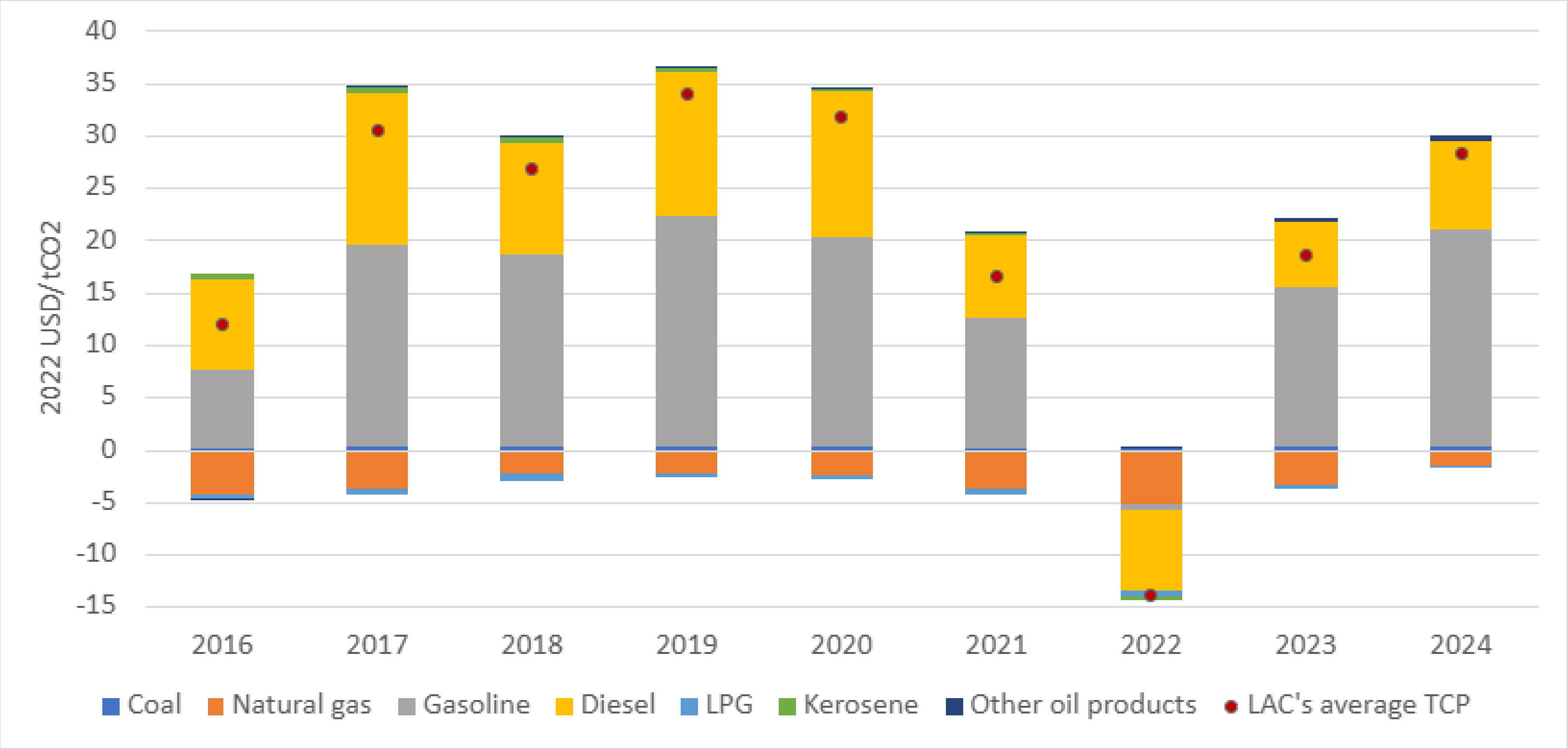
$$Net\ tax\ burden_{\ gasoline,t} = \underbrace{X\ \frac{\$}{liter}}_{exise\ tax} + Supply\ cost * \underbrace{0.08}_{8\%\ special\ road\ tax} \frac{\$}{liter} - \underbrace{X\ \frac{\$}{liter}}_{\substack{Subsidies: \\ net\ compensations\ from\ the\ FEPC}}$$

Net tax burden of a fuel (\$/unit) → to total carbon price (TCP) of a fuel (\$/ tCO_2) using fuel-specific emissions factors, which account for the amount of CO_2 emitted by each fuel type. E.g. 1 liter of diesel releases 2.7 kg of CO_2, whereas gasoline releases 2.2 kg of CO_2 per liter.

Total carbon price for fuel $\boldsymbol{f}$ in year $\boldsymbol{t}$: sum of the direct (DCP_{tf}) and indirect (ICP_{tf}) tax burdens expressed in CO_2 terms.

Fuel-specific TCPs are then summed and weighted according to their CO_2 emission shares in the country to estimate the **country-level total carbon price ($\boldsymbol{TCP_t}$)**. Emission shares are adjusted to account for the use of biofuels. $TCP_t = \frac{1}{emissions_t} \sum_f TCP_{tf} \times emissions_{tf}$

Contribution of each fuel to Latin America's Average Total Carbon Price

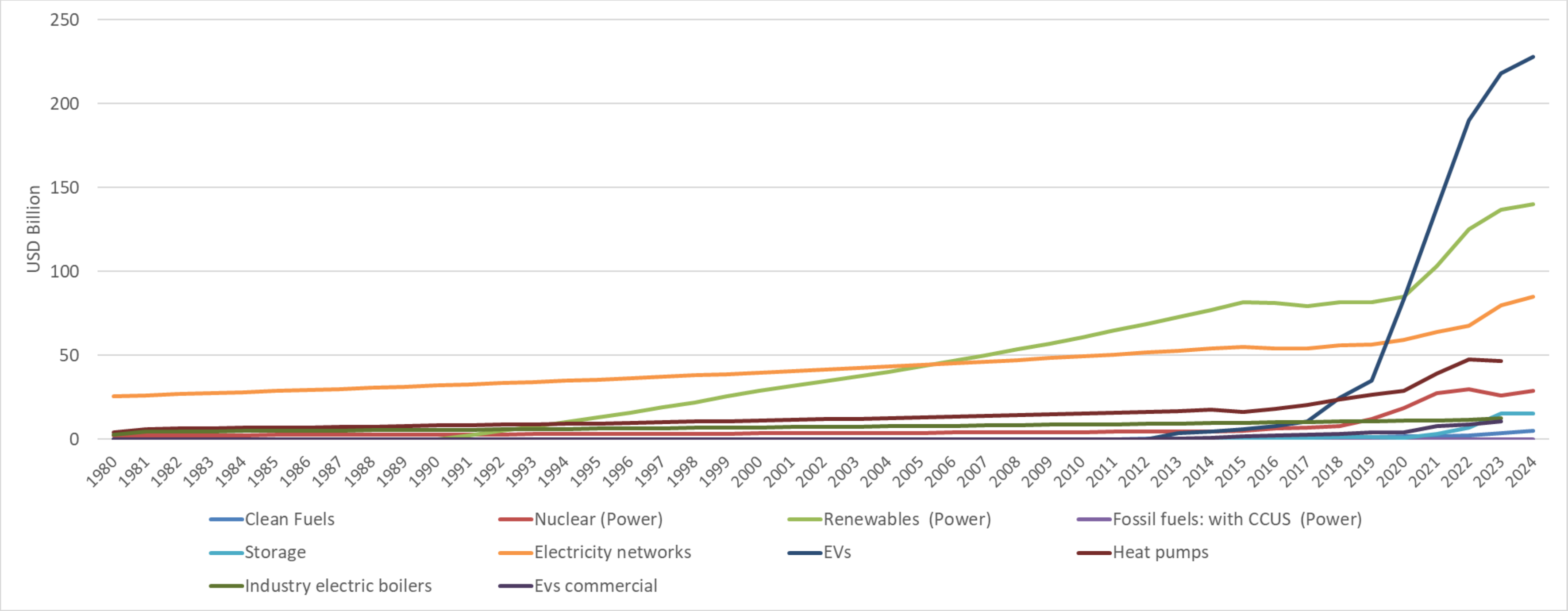


Source: World Bank (2024)

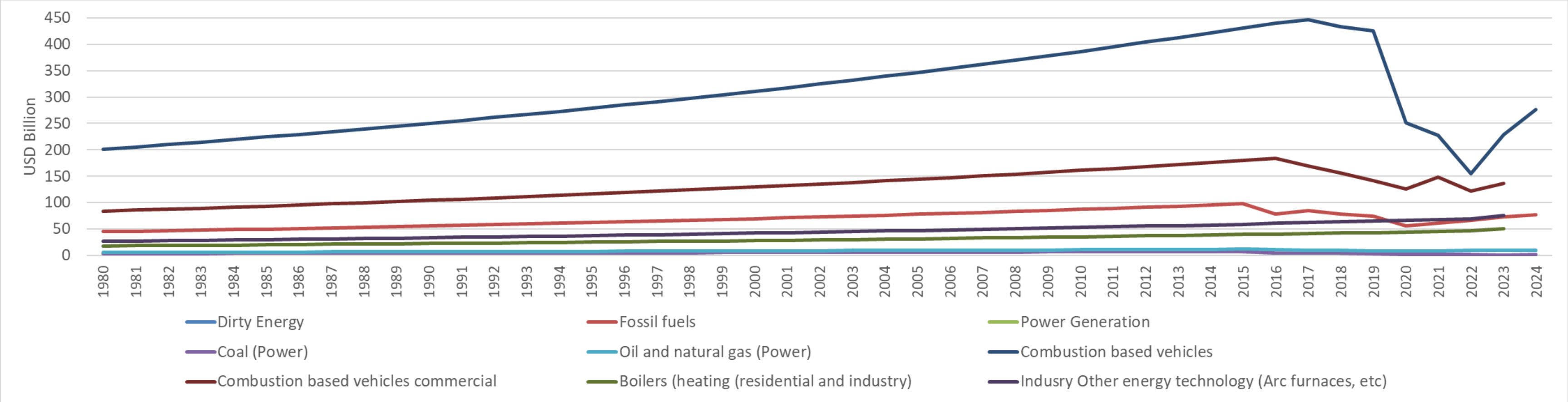
Future Research: Energy Sector Capital Stocks

- Constructing a measure for the clean and dirty energy capital stocks in India and Europe using the perpetual inventory method
- **Input data:** investment data on all energy related investment from 1970/80 2023 in the sectors: transport, power, industry, heating.

Clean energy investment in the EU



Dirty energy investment in the EU



Clean Technology Catching Up

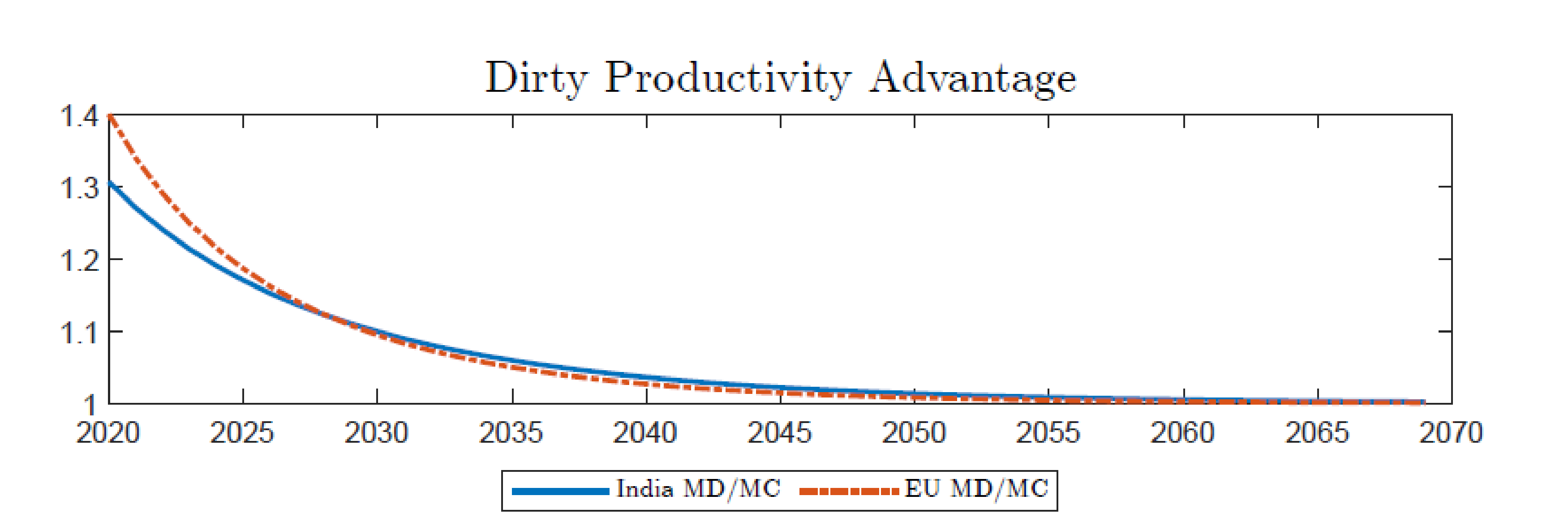


Figure: Development of the dirty productivity advantage in the EU and India in the stated policy scenario

Quantitative Analysis of the Green Energy Transition in the EU vs. India

Table: Remaining carbon budget (2020-2050) for 1.5°C and 2°C targets for India and the EU

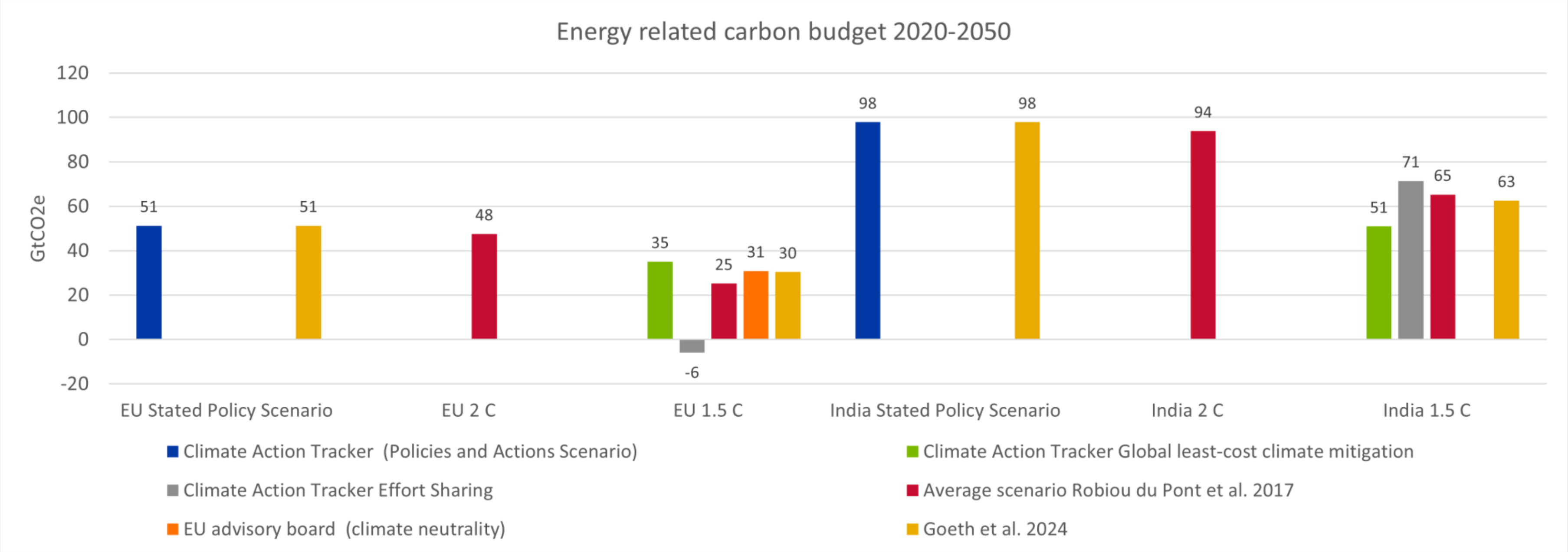
	Remaining Carbon Budget (GtCO2)	
	STEPS	1.5°C
India	98	63
EU	51	30

Data source: Climate Action Tracker.

Energy capital is associated with energy use in different sectors including:

- manufacturing, construction, housing, electricity, transportation & storage

Carbon Budget Comparison



Welfare comparison between transition scenarios in the EU and India

EU Scenario	Phase -out year	Carbon budget $GtCO_2e$	CO_2 Price (€/ton)	Δ Welfare during transition % ch. to STEPS Reference	Stranded assets $\frac{K_D(\bar{T})}{Y(\bar{T})}$	Avg. adj. costs $\frac{\Omega}{Y}$ to 2060
CBSTEPS	2064	51	9		0.4	0.2
CB+1.5C	2047	29	34	-0.2	1.4	0.3

India Scenario	Phase -out year	Carbon budget $GtCO_2e$	CO_2 Price (USD/ton)	Δ Welfare during transition % ch. to STEPS Reference	Stranded assets $\frac{K_D(\bar{T})}{Y(\bar{T})}$	Avg. adj. costs $\frac{\Omega}{Y}$ to 2060
CBSTEPS	2077	98	0.2		0.2	0.4
CBSTEPS+NZ2070	2070	98	0.2	0	0.5	0.4
CB+1.5C	2060	63	1	-0.03	0.5	0.4

Calibration Strategy

- **External Calibration** for $\{\epsilon, \alpha_{C,D}, \delta_i, \theta, \beta, \frac{MD}{MC}\}$ with $i \in [N, D, C]$ (from Literature)
- **Internal calibration** for $\{\gamma, K_0, \frac{K_{C0}}{K_0}, \frac{K_{D0}}{K_0}, \sigma, \alpha_N\}$ with $i \in [N, D, C]$ to match empirical targets.

Empirical Targets	Model	EU Data	Model	India Data
Initial dirty energy share in GDP $\frac{Y_{D0}}{Y_0}$	6 %	6 %	7%	7 %
Initial capital output ratio $\frac{K_1}{Y_1}$	2.55	2.55	2.1	2.1
Initial emissions as share of remaining carbon budget	4.8%	4.8 %	2.3 %	2.3 %
Initial share of investment expenditure				
clean energy $\frac{I_{C0}}{I_0}$	5.8 %	5.8%	3.4%	3.4 %
dirty energy $\frac{I_{D0}}{I_0}$	2 %	2%	8 %	8 %
Initial labor share $\frac{wL}{Y}$	58%	58%	52%	52 %

Table: Moments Matched

Calibration Strategy I

Table: Parameter Values: External calibration

Parameter	Value	Source
Ela. of subs. btw. interm. inputs N & E ϵ	0.45	Bretschger and Ara (2022)
Output elasticity wrt labor α_D	0.35	
Output elasticity wrt labor α_C	0.3	
Depreciation rate δ_N	0.07	Arkolakis and Walsh (2023)
Depreciation rate δ_C	0.03	Arkolakis and Walsh (2023)
Depreciation rate δ_D	0.02	Arkolakis and Walsh (2023)
Inverse of intertemp. subst. ela. θ	2	
Discount factor β	0.98	
Adjustment cost parameter $c_{N,D,C}$	5; 20	Bontempi et al. (2004); Hall (2004)
Rel. prod. of dirty energy technology $\frac{M_D}{M_C}$	1.4	IEA and own calc.

Calibration Strategy I

Table: Parameter Values: External calibration

Parameter	Value EU	Value India
μ CO_2 intensity of dirty energy ($\frac{tCO_2}{1000EUR\ \ or\ \ USD}$)	3.05	11.68
CO_2 intensity of GDP ($\frac{tCO_2}{1000EUR\ \ or\ \ USD}$)	0.18	0.82

Calibration Strategy II

Table: Parameter Values: Internal calibration

Parameter	Value EU	Value India
Weight on non-energy input in production γ	0.99	0.995
Share of initial dirty energy capital $\frac{K_{D0}}{K_0}$	0.12	0.06
Share of initial clean energy capital $\frac{K_{C0}}{K_0}$	0.06	0.014
Initial capital stock K_0	0.5	0.29
Initial share in carbon budget σ	3.8	5.7
Non-energy technology output elasticity wrt labor α_N	0.61	0.54

Social Planner Problem

Maximize PDV of utility from consumption

$$\max_{\{K_t^C, K_t^D, L_t^C, L_t^D, G_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(C_t) \quad \text{with} \frac{C_t^{1-\theta}}{1-\theta}$$

subject to the final production constraint

$$Y_t = \left(\gamma Y_{Nt}^{\frac{\epsilon-1}{\epsilon}} + (1-\gamma) Y_{Et}^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}.$$

Energy is produced using clean and dirty energy:

$$Y_{Et} = Y_{Dt} + Y_{Ct}.$$

All inputs (clean & dirty energy, non-energy) are produced with respective Cobb-Douglas technologies

$$Y_{it} = M_{it} K_{it-1}^{1-\alpha_i} L_{it}^{\alpha_i}, \qquad i \in \{N, D, C\} \quad \text{with} \quad \alpha_C < \alpha_D < \alpha_N.$$

Social Planner Problem continued

Resource constraint:

$$Y_t = C_t + \sum_{i \in \{N,D,C\}} I_{it} + \sum_{i \in \{N,D,C\}} \Omega^i(K_{it}, K_{it-1}).$$

Capital adjustment costs: symmetric & sector-specific (Aguiar & Gopinath, 2007)

$$\Omega^i(K_{it}, K_{it-1}) = \frac{c_i}{2}\left(\frac{I_{it}}{K_{it-1}} - \delta_i - z_i\right)^2 K_{it-1} \quad \forall\, i = C, D, N$$

Central scenario assumption: Excess investment below and beyond depreciation & growth incurs adjustment costs → costs on net investment but replacement investment is free.

Sensitivity: costs based on gross investment

Solution method: Extended path method (Maliar et al. 2020)

Social Planner Problem continued

Fixed labor endowment: $\bar{L} = L_t^D + L_t^C + L_t^N$

Capital and investment: $K_{it} = (1 - \delta_i) K_{it-1} + I_{it}.$

Total capital: $K_t = K_t^D + K_t^C + K_t^N$

Atmospheric carbon accumulation: $G_t = G_{t-1} + \mu Y_{Dt}$

Atmospheric carbon limit: $G_t \leq \bar{G}$

Clean technology catch-up: $a_{Ct} = 1 - \frac{b_M}{(1+\kappa_M)^t}$ with $\lim_{t\to\infty} a_{Ct} \to 1$

$\rightarrow$ $\{K_{i0}, M_{i0}\}_{i\in\{N,D,C\}}$ and G_0 initially given
$\rightarrow$ Technology in non-energy & dirty energy grow at a constant rate g

Ramsey problem and decentralization

Decentralized economy with a Ramsey planner maximizing social welfare by choosing an excise tax τDt on firms operating the dirty energy technology.

- τ_{Dt} decentralizes the social planner solution
- Optimal τ_{Dt}

$$\tau_{Dt} = \frac{\nu_t}{\lambda_t} \quad \tau_{Dt} = \infty \text{ for } \; t > T.$$

Social Planner Problems: Solution Overview

Carbon budget policy:

- We set up the Lagrangian problem and solve for FOCs
- Solve the well-defined optimization problem for given T → standard Lagrangian conditional on T and a given carbon budget
- Find optimal T that maximizes discounted utility.
- Ramsey optimal excise tax on dirty energy give a carbon budget

Welfare Measure

As the measure to compare welfare across two scenarios A and B, we use the percentage variation in consumption between 2023 and 2060 that compensates agents in scenario B for living in scenario A permanently, following Burda and Zessner-Spitzenberg 2022.

We define Λ as

$$\sum_{t=2023}^{2060} \beta^t U\left(\left(1+\frac{\Lambda}{100}\right) C_t^B\right) + \sum_{t=2061}^{2273} \beta^t U(C_t^B) = \sum_{t=2023}^{2273} \beta^t U(C_t^A),$$

We choose 2060, in order to relate transition costs to consumption during the time the transition occurs.

Welfare Measures - Comments

- The choice of the year 2060 only affects scaling of welfare effects, not their sign.
- If we were to choose a later point as the cutoff, welfare effects would be scaled down, as losses would be distributed over more periods.
- Importantly, we include the utility stream after 2060 in the comparison to ensure that differences in capital accumulation up to this point are reflected in the welfare measure.
- At the end of the simulation horizon, all paths have reached the same terminal capital stocks which makes the comparison meaningful.
- By letting the interval on which the variation is computed approach infinity along with the simulation horizon, one recovers the standard measure of welfare in terms of permanent consumption (see Lucas 1987 for example).

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Assessing the macrofinancial consequences of a Net Zero energy transition through hard coupled energy-macroeconomic models.

A case study for Morocco

Authors:

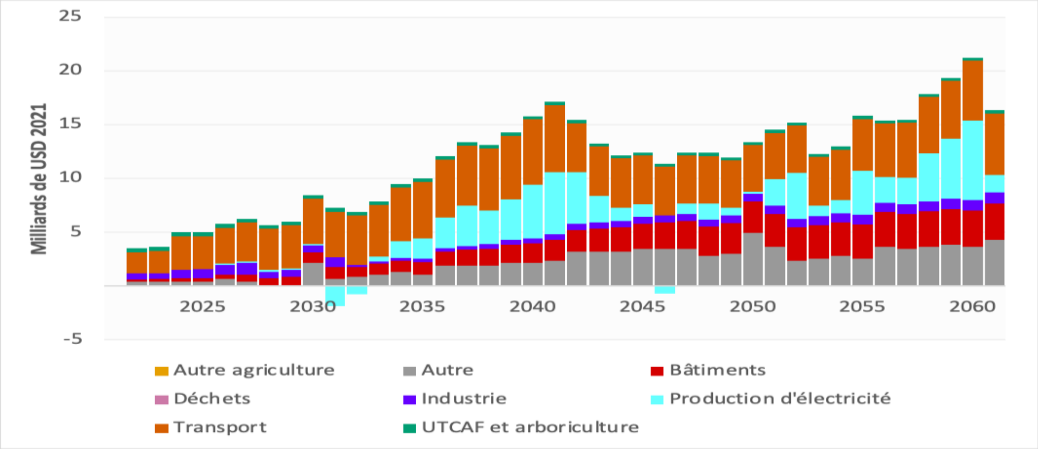
Antoine GODIN, based on a study with Ministry of Energy and Sustainable Development, Ministry of Finance, Stockholm Environment Institute, among others.

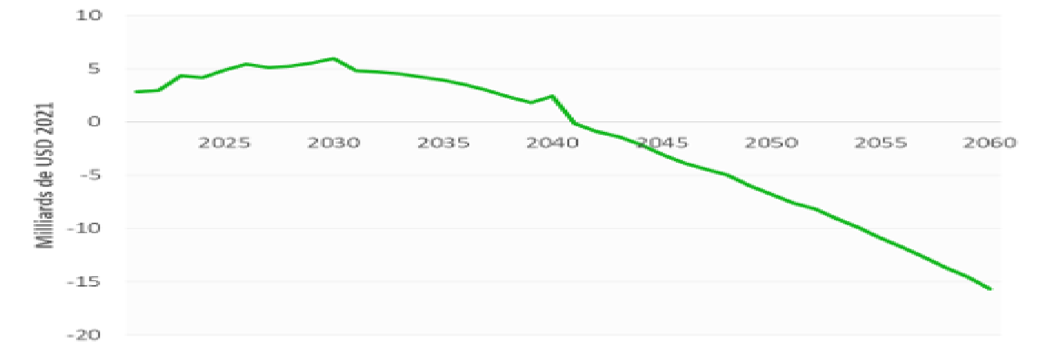
Macroeconomic perspective

Objectives

- Understand the **macroeconomic and financial consequences** of different policy implementation and financing systems .
- Discussion **on coordination** between fiscal, monetary and financial policies
- Highlight the vulnerabilities **and opportunities that emerge** from SNBC

Methodology based on **participatory approach**





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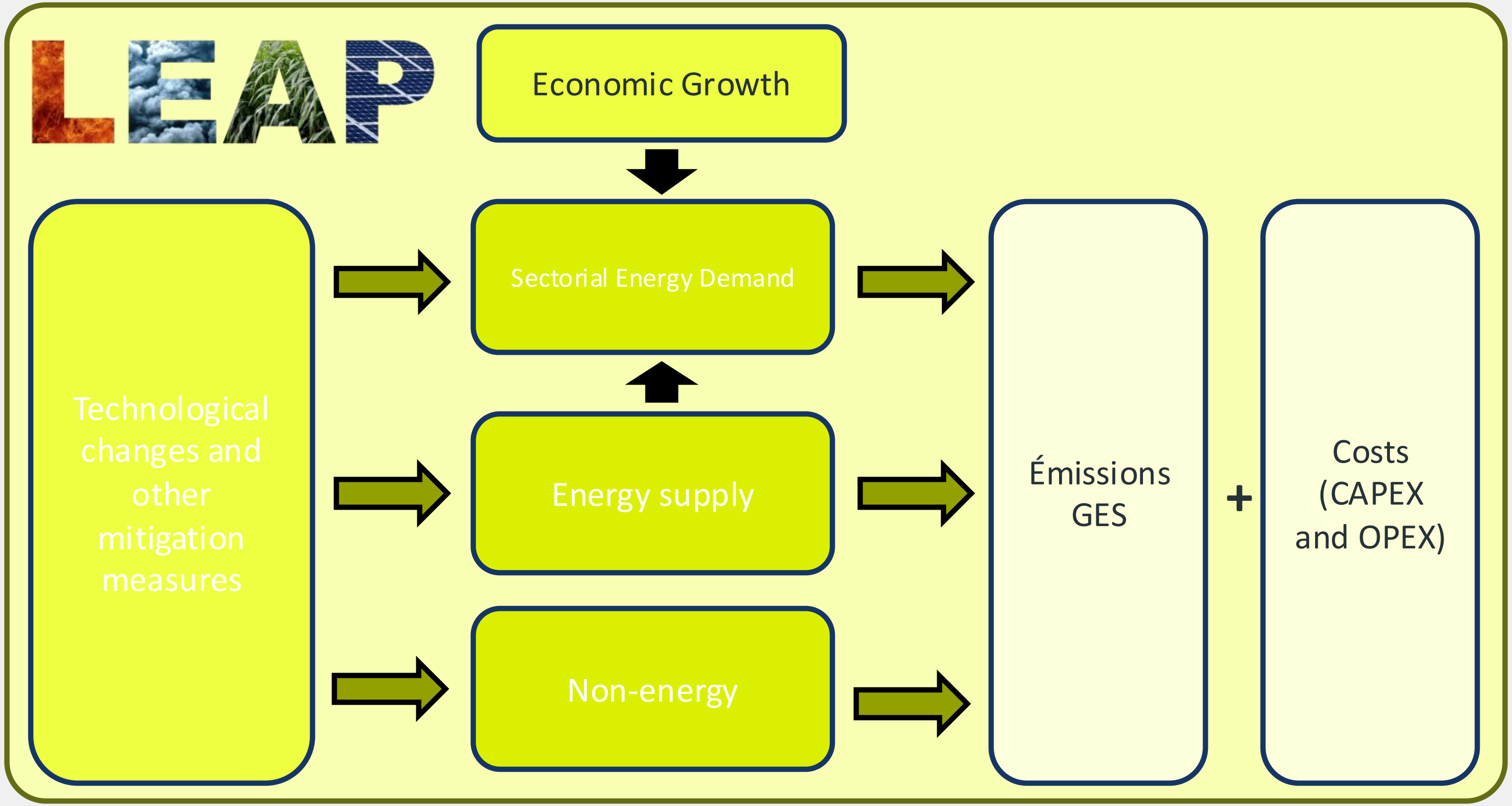
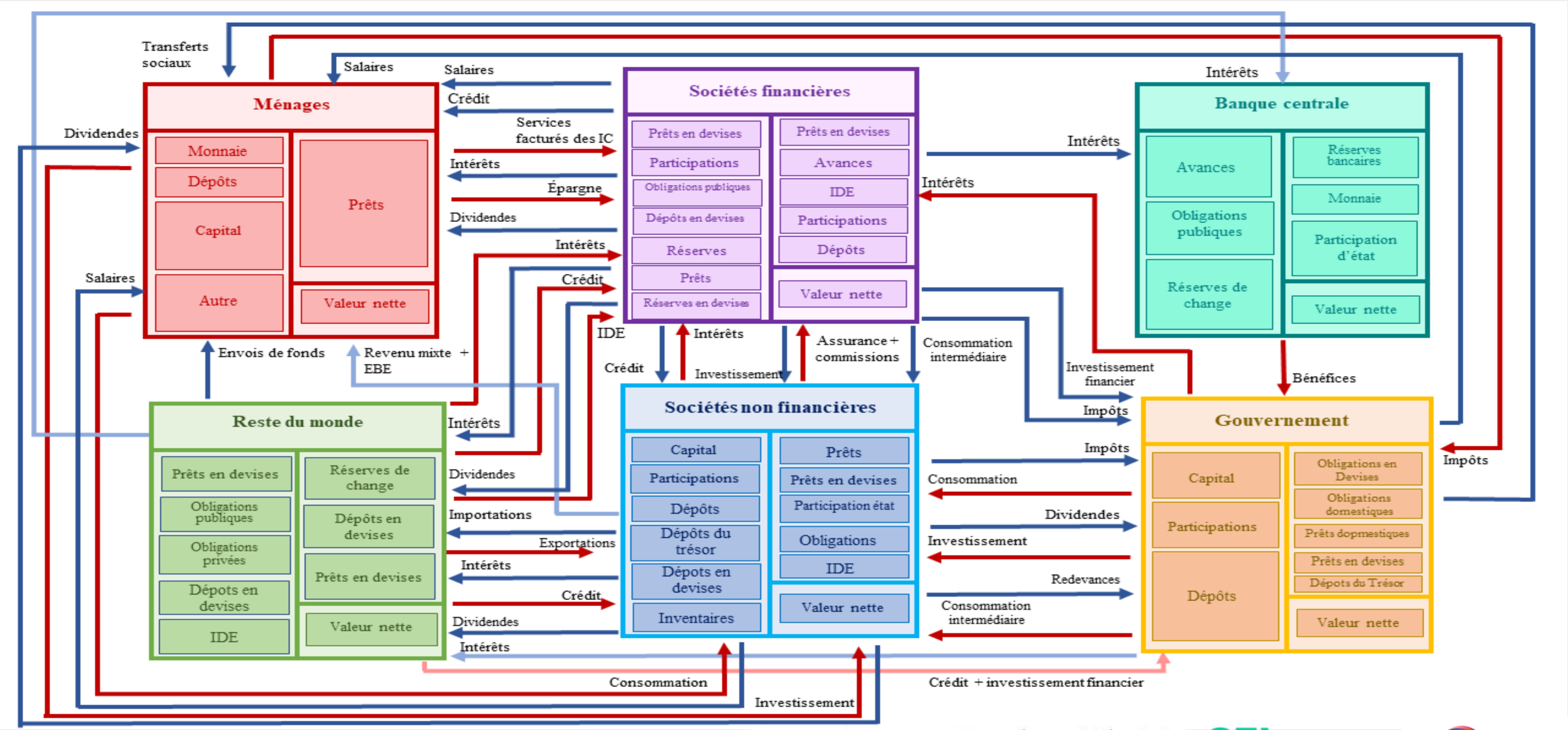
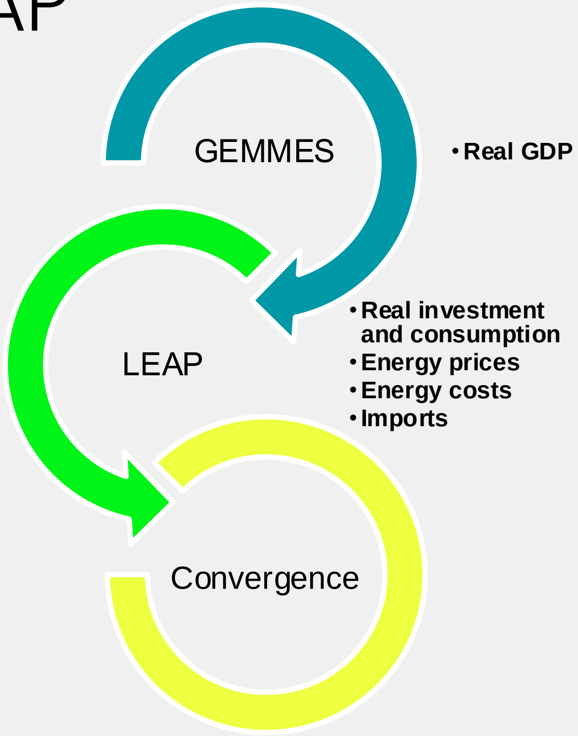
LEAP Model

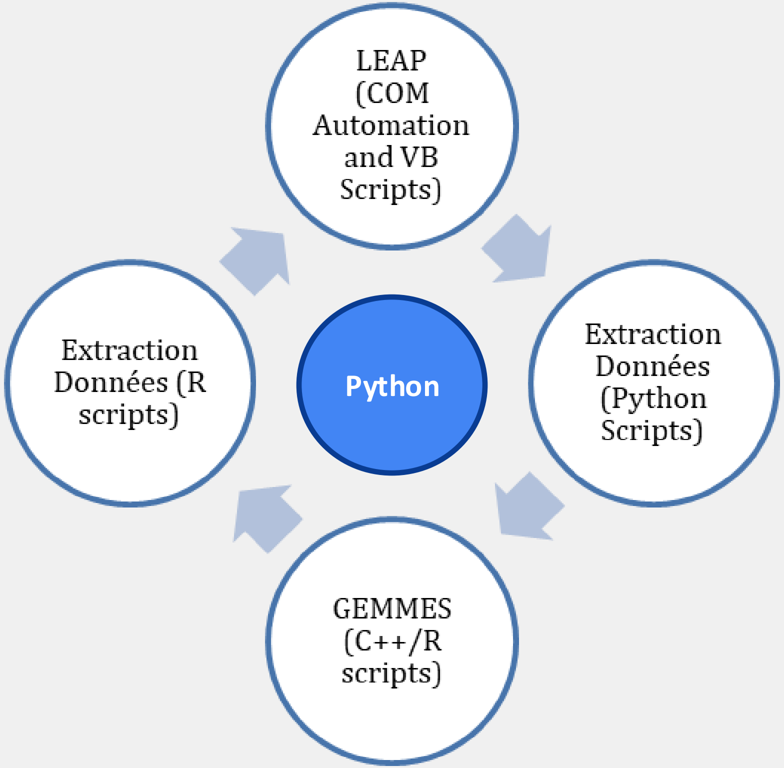

LEAP
Economic Growth
Technological changes and other mitigation measures
Sectorial Energy Demand
Energy supply
Non-energy
Émissions GES
+
Costs (CAPEX and OPEX)

GEMMES model – accounting structure



Coupling principles between GEMMES and LEAP

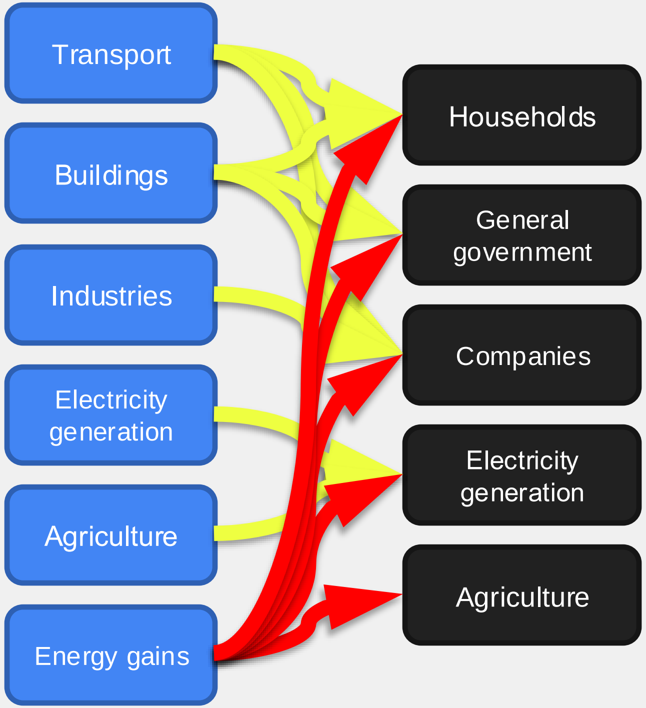




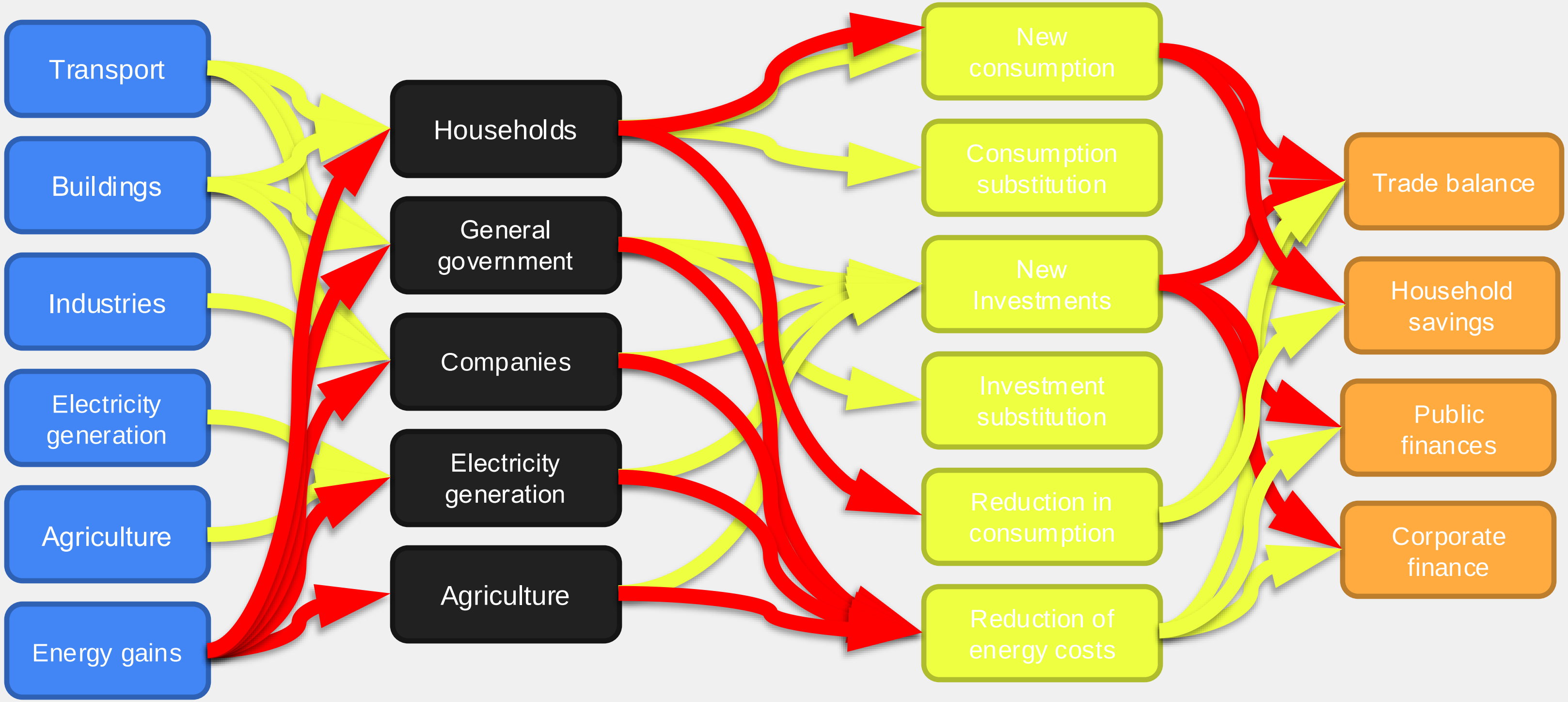
Who pays the bill?

Distribution of agents

- **Investment/consumption costs per agent and** technology
- **Economic gains/costs** from energy transfer and energy efficiency
- Discuss **profitability** by technology and agent
- Financial options by technology **and agent**



The construction scheme of the scenario



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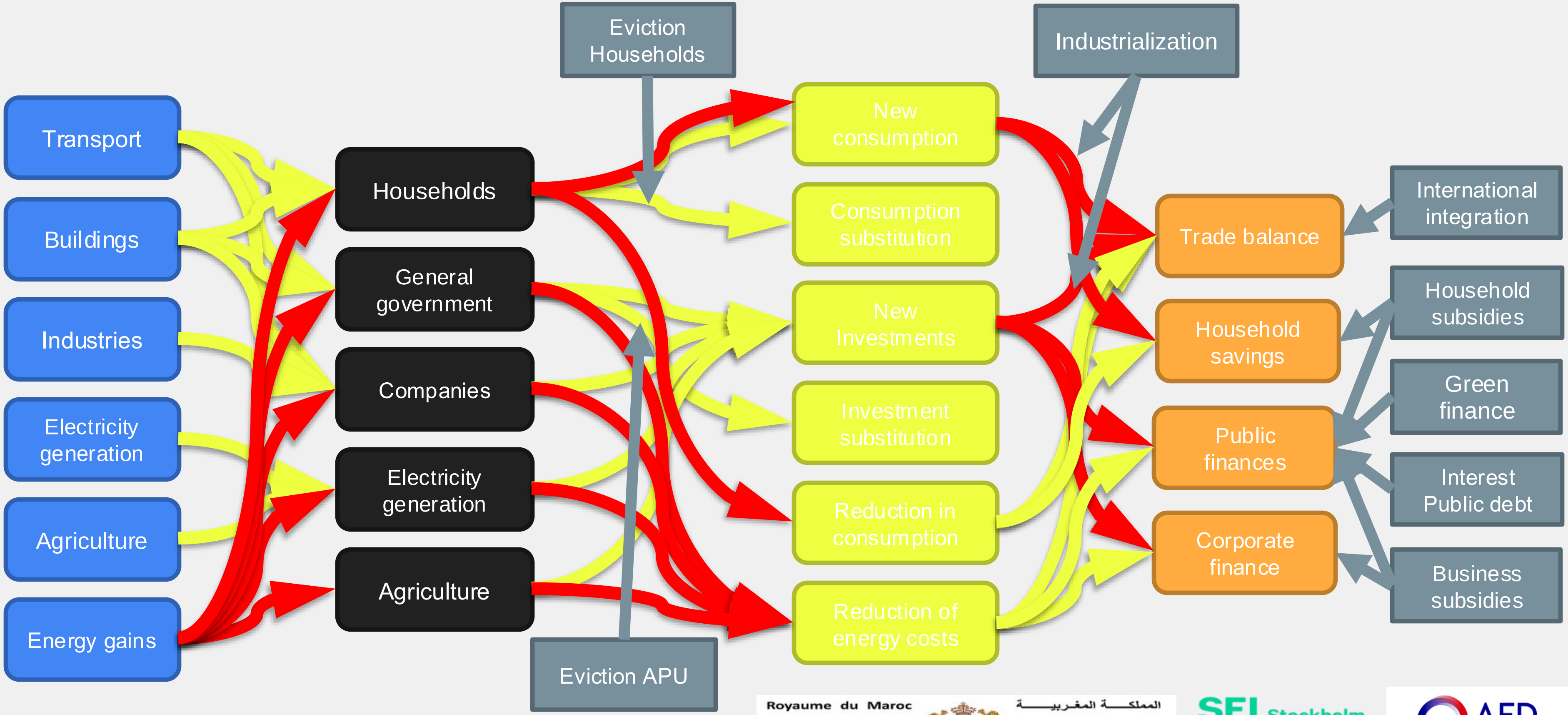

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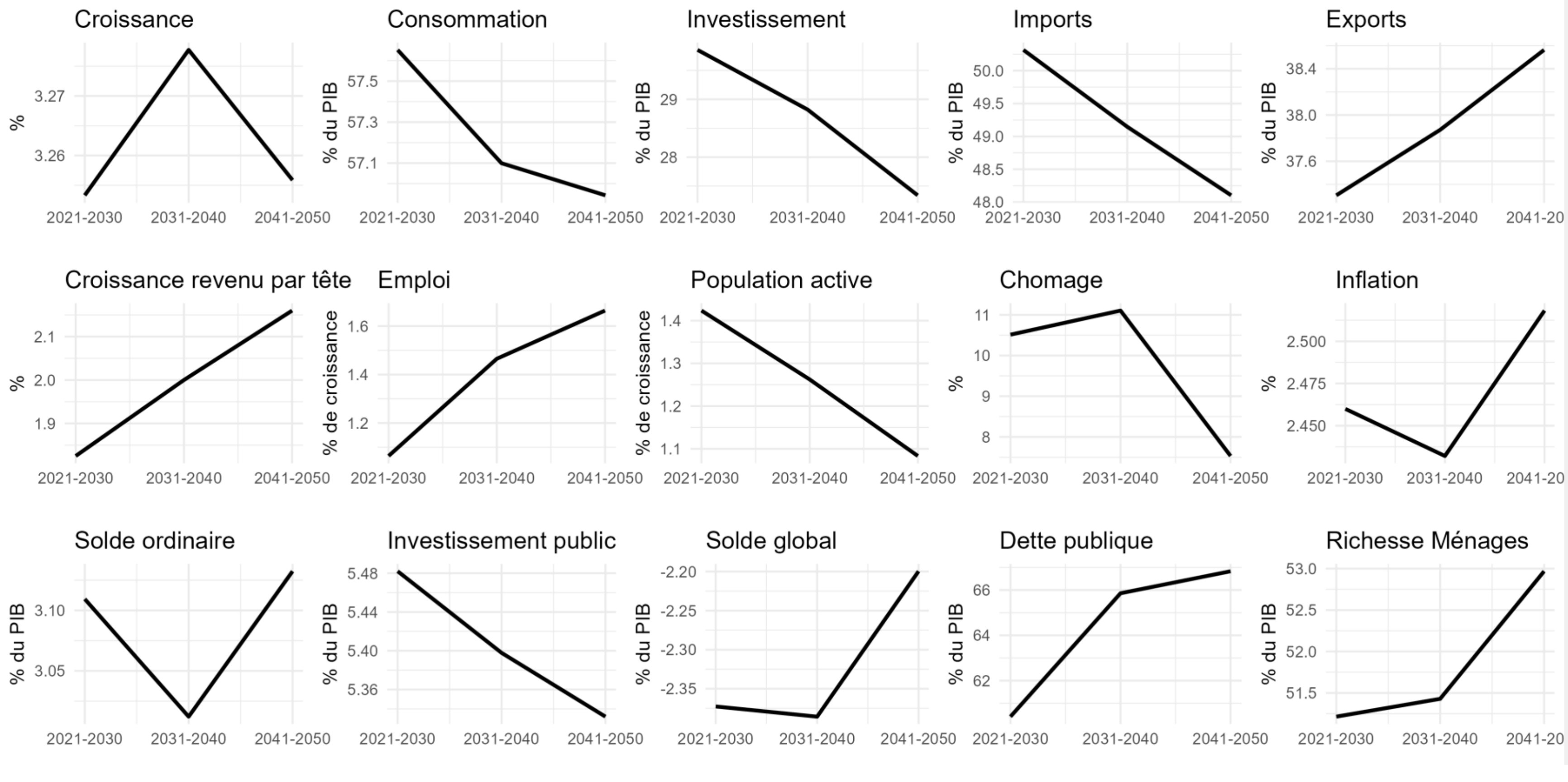
Calibration

- Data
  - Public data sources
  - 2007-2019
  - Financial data gaps and inconsistencies

- Calibration
  - CMAES plus initial point adaptation
  - 2019 as reference point for initial conditions and other values

- Out-of-sample issues

Baseline



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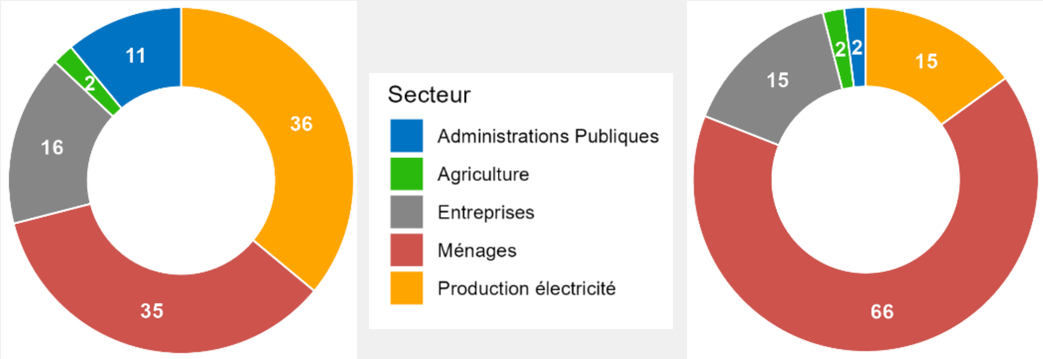
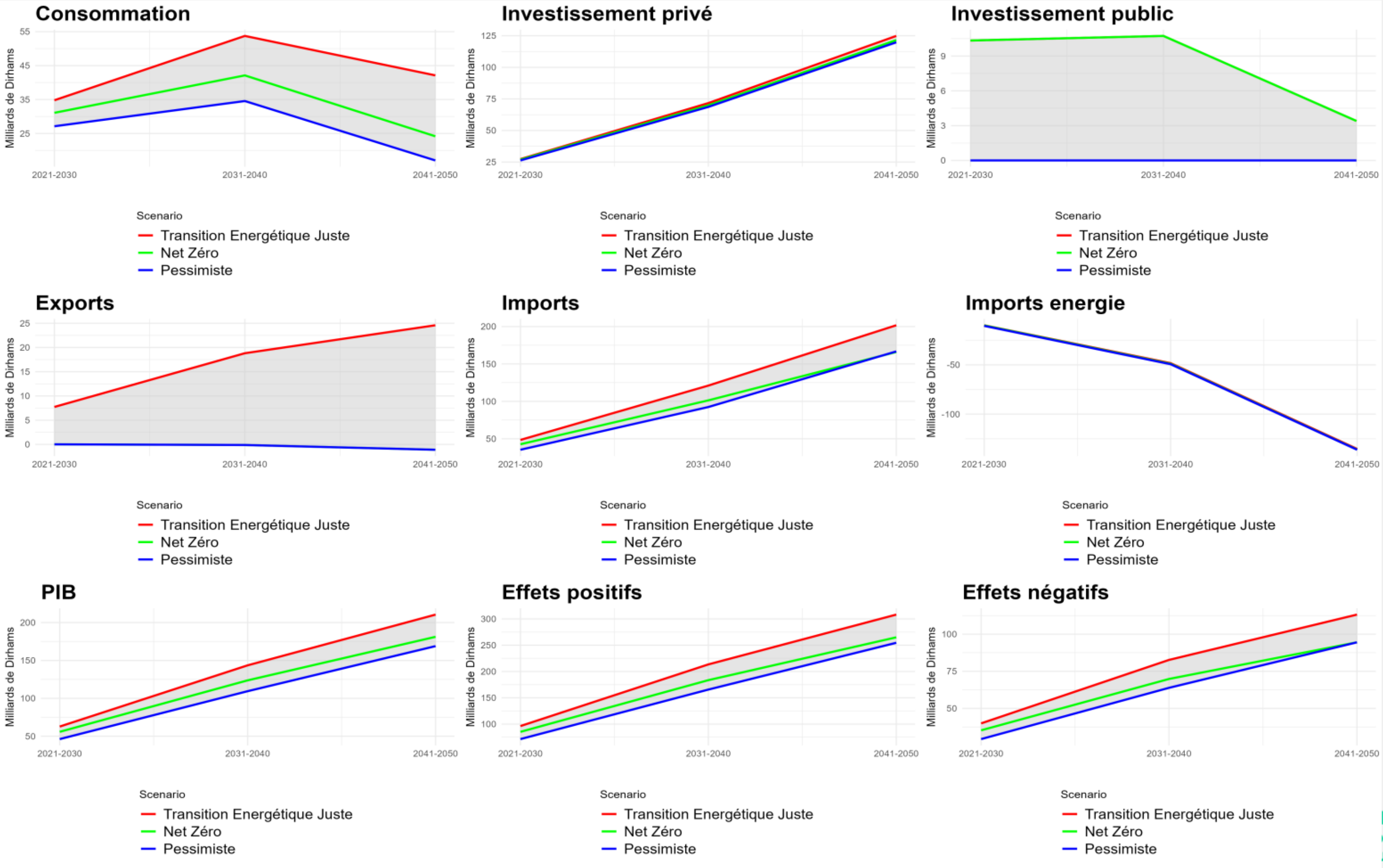
First result – asymmetries between payers and beneficiaries

Investment

Energy gains



Main aggregates



Conclusion

The Moroccan (LT-LEDS)

- Shows positive economic results **…**
- **…with inflation risks** …
- …but is not a **development strategy in** itself
- Can **be used** to promote industrialization and just transistion
- May not generate full **potential if there** are policy failure(s)

Scenario	PIB per Capita (%)	Déficit Commercial (% of GDP)	Imports (% of GDP)	Epargne ménages (% of GDP)	Investissement Public (% of GDP)	Déficit Public (% of GDP)	Dette Publique (% of GDP)	Dette Entreprises (% of GDP)	Inflation (Pts of %)
Transition Energétique Juste	9.73	0	-1.23	-0.78	0.2	-0.45	-11.71	-2.07	1.9
Intégration Internationale	9.63	-0.02	-1.24	-1.01	0.2	-0.73	-16.15	-2.06	1.89
Net Zéro	8.38	0.29	-1.32	-1.03	0.24	-0.52	-12.17	-1.67	1.85
Défaillance Industrielle	7.96	0.4	-1.13	-1.04	0.25	-0.45	-10.83	-1.52	1.83
Défaillance Investissement Public	8.21	0.02	-1.46	-1.03	-0.21	-0.84	-15.43	-1.61	1.82
Défaillance Finance Verte	8.43	0.31	-1.31	-1.02	0.24	-0.27	-8.2	-1.69	1.85
Pessimiste	7.81	0.11	-1.3	-1.04	-0.2	-0.75	-13.84	-1.46	1.81

Variable

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Coordination with the financing policies

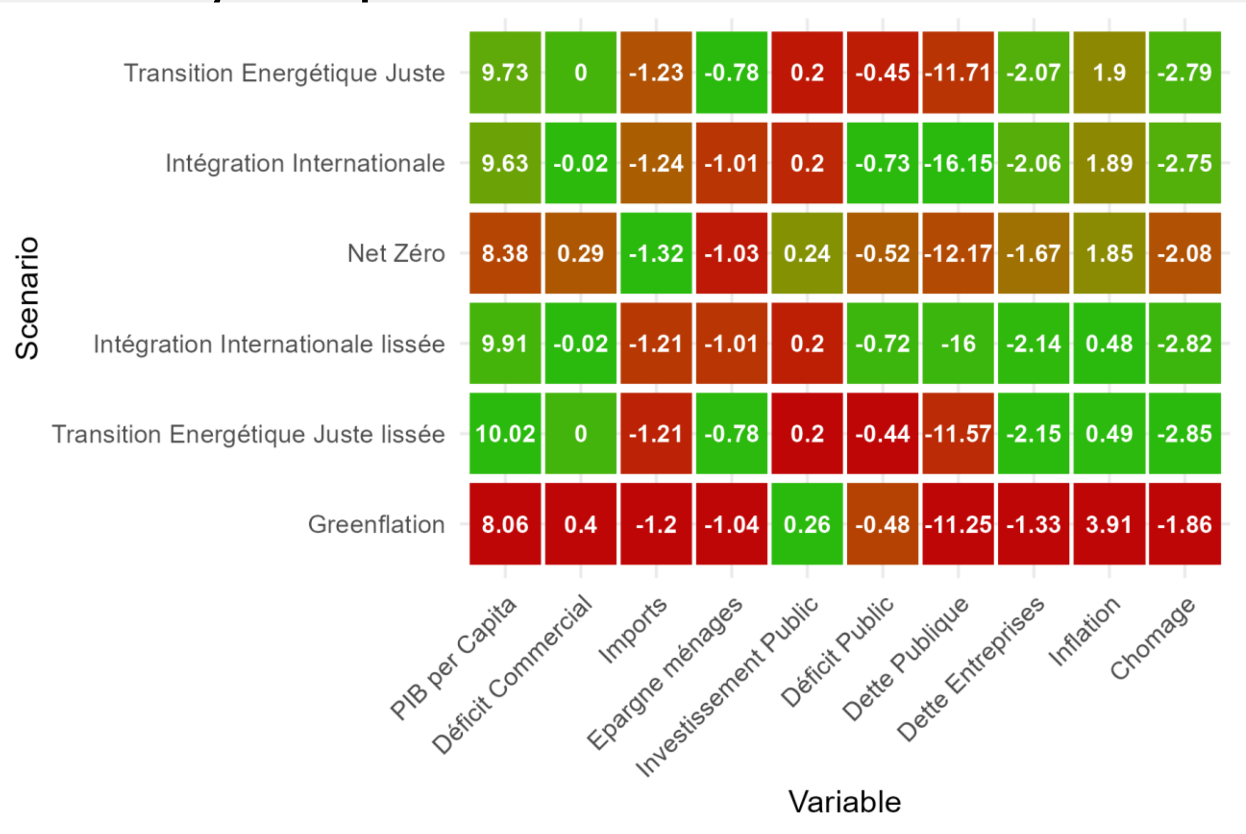
- The economic gains associated with (LT-LEDS) also depend on coordination with funding policies
  - uncertainties surrounding household and APU contributions in terms of investments needed for the transition.

- Potential crowding-out effects for these two economic agents:
  - The Commission has therefore decided to set up financing mechanisms which help to eliminate any trade-offs that may arise between the environmental and social dimensions.

- For households:
  - Soft loans to help finance the investments required for the transition (notably mobility and residential), using energy gains to offset rate differentials.

- FOR public administration:
  - Raising finance to improve the profitability of green investments.

Inflationary impacts



Conclusion

The National Low Carbon Strategy is a transformative tool that also has positive macroeconomic impacts.

- The transition to renewable energy sources that will guarantee energy sovereignty, through reduced dependence on fossil fuel imports.
- contribution to the achievement of the competitiveness shock proposed by the NMD, through the eventual provision of green energy at competitive prices,
- creation of opportunities for industrial integration and upscaling for part of the Moroccan productive fabric.

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Thank you

C3A, a program funded and hosted by WORLD BANK GROUP