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GREEN FINANCE RESEARCH ADVANCES

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ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

A comparative analysis of modelling approaches to assess transition impact

Speakers: Florian Jacquetin, Gaël Callonnec

Draft results - do not quote

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Summary

1. Challenges of transition risks impact assessment
2. Impact of a Net Zero 2050 orderly transition scenario
3. How to model a disorderly transition

Summary

Risk model assessment

Collective declination of NGFS Scenarios for France and impact assessment:

- Mobilization of three macroeconomic models used in the assessment of the Law on Energy Transition for Green Growth (2015) and the French Commission on the Shadow Price of Carbon (Quinet, 2019)

- Mobilization and combination with the toolbox developed by the Banque de France for the climate pilot exercise (Allen et al., 2020; Devulder & Lisack, 2020)

Alignment with the NGFS Scenario Analysis Framework (1/2)

Representation of 4 of the 6 reference scenarios of the NGFS (Phase II)

		Physical risk	Transition risk			
Category	**Scenario**	**Policy ambition**	**Policy reaction**	**Technology change**	**Carbon dioxide removal**	**Regional policy variation⁺**
Orderly	Net Zero 2050	1.5°C	Immediate and smooth	Fast change	Medium use	Medium variation
	Below 2°C	1.7°C	Immediate and smooth	Moderate change	Medium use	Low variation
Disorderly	Divergent Net Zero	1.5°C	Immediate but divergent	Fast change	Low use	Medium variation
	Delayed transition	1.8°C	Delayed	Slow/Fast change	Low use	High variation
Hot House World	Nationally Determined Contributions (NDCs)	~2.5°C	NDCs	Slow change	Low use	Low variation
	Current Policies	3°C+	None – current policies	Slow change	Low use	Low variation

Lower risk

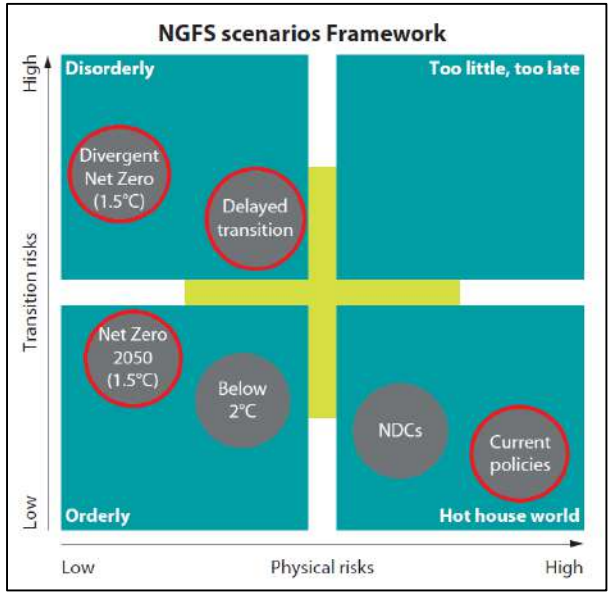
Moderate risk

Higher risk

Selection of the most distant scenarios in terms of public action.

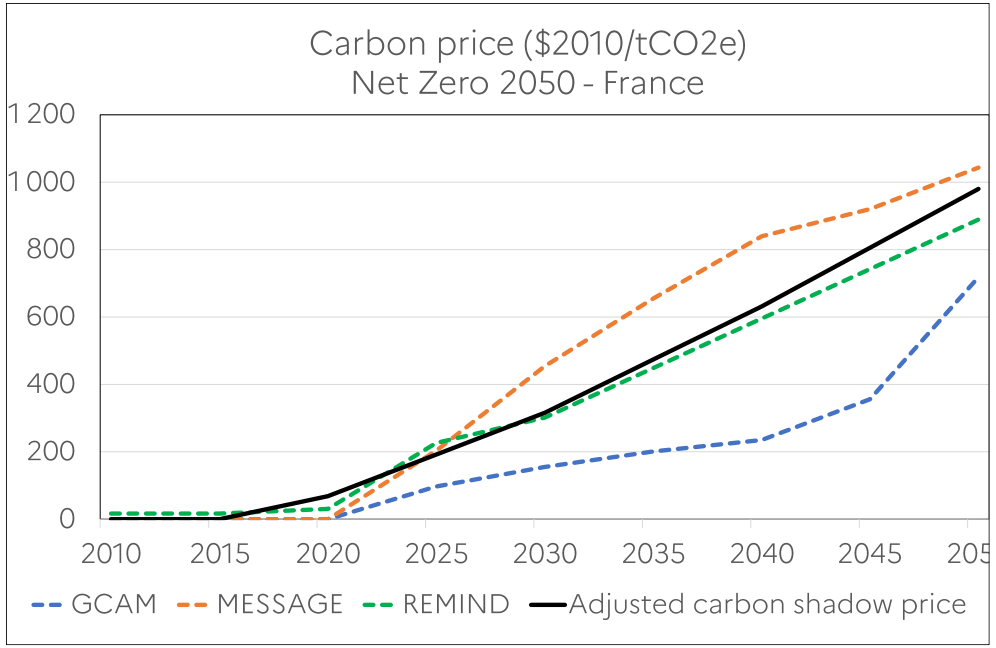
Focus on the disorderly transition risk :

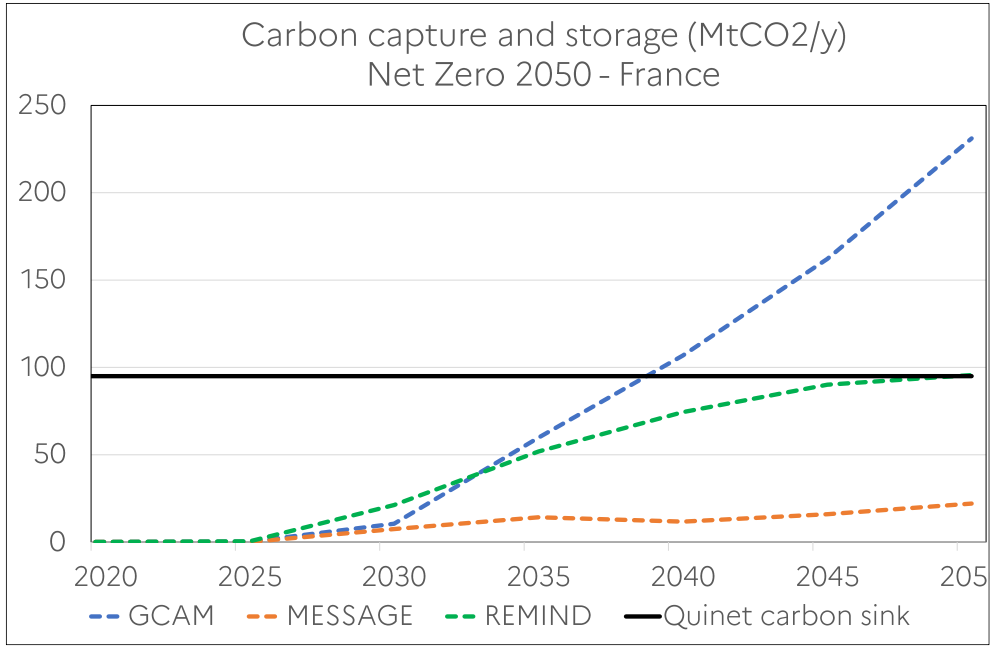
- A Delayed transition scenario
- A Divergent Net Zero scenario



Alignment with the NGFS Scenario Analysis Framework (2/2)

- ✓ The models share a common public action assumption rather than the same carbon neutrality objective
- ✓ Economics is driven by a common labour productivity assumption (GDP is not aligned with NiGEM or the NGFS database)
- ✓ REMIND's carbon price assumption is consistent with the French shadow price (Quinet, 2019)





Summary

Modelling assumptions (1/2)

Common assumptions:

- **Taxation of CO2 emissions only (energy and, if possible, production-related emissions)**

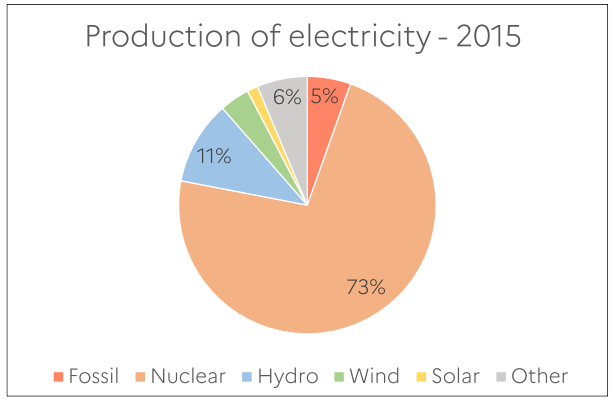
- No additional cost for CCS technology development
- No exoneration for sectors included in an emission trading scheme
- Redistribution of 100% of tax revenues to households and firms (50/50)
- Budgetary and monetary policies are supposed to be neutral

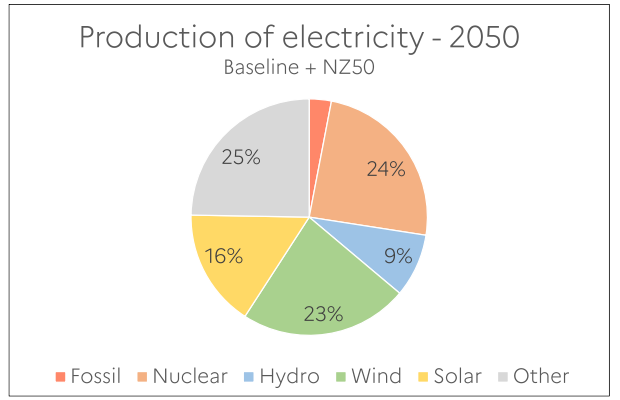
	Series	Domestic	Rest of the world
Socio-economic	Active population	Insee	NGFS database
	Labour aumenting factor	NGFS database	
Prices	Coal	Remind carbon price	NiGEM assumption
	Gas		
	Oil		
	Final demand prices	Endogenous path	NiGEM assumption + distorsion of sectoral model
Final demand	Final demand	Endogenous path	NiGEM assumption + distorsion of sectoral model
	Final energy demand		
Monetary policy	Passive monetary policy (constant real interest rate for main refinancing operations)		
Fiscal policy	Redistribution of 100% carbon tax revenus to households and firms (50/50)		
Wage equation	Depending on the model (Wage Setting or Phillips Curve)		

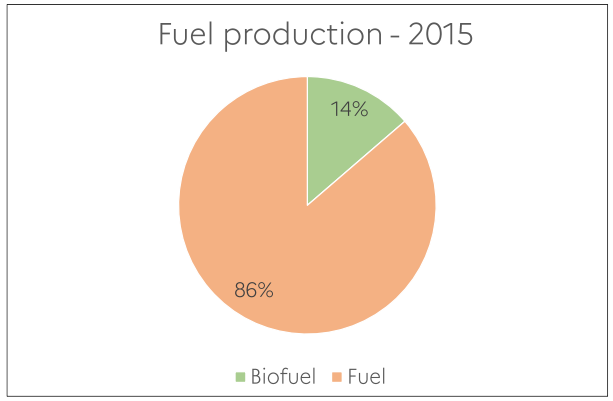
Modelling assumptions (2/2)

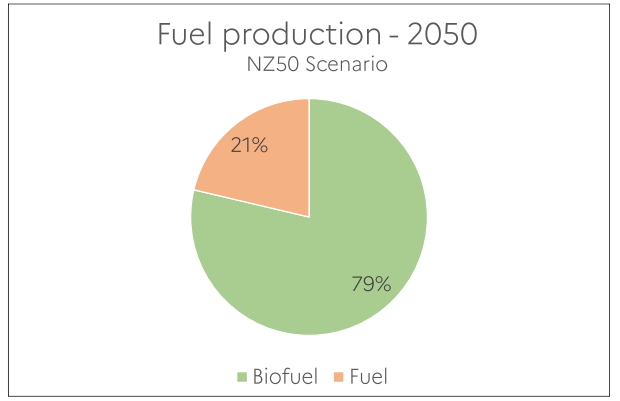
ADEME assumptions:

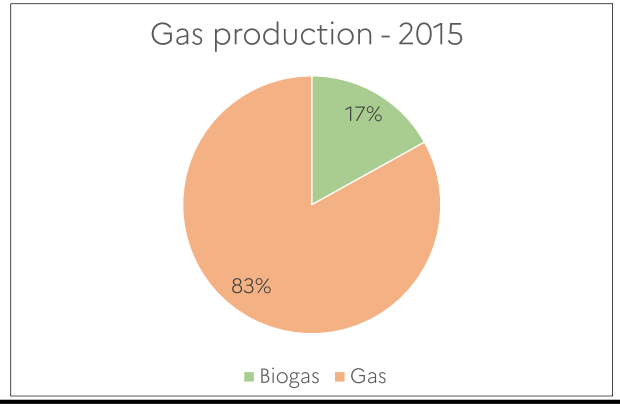
- Energy mix consistent with the Multiannual Energy Plan (in both baseline and NZ50 scenarios)
- NZ50 includes a renewable scenario consistent with the assumptions of the National Low Carbon Strategy
- **NGFS assumption**: Prices of imported coal and gas fall by ~90% because of the fall in the world energy demand
- Redistribution to sectors according to their relative share in the French production

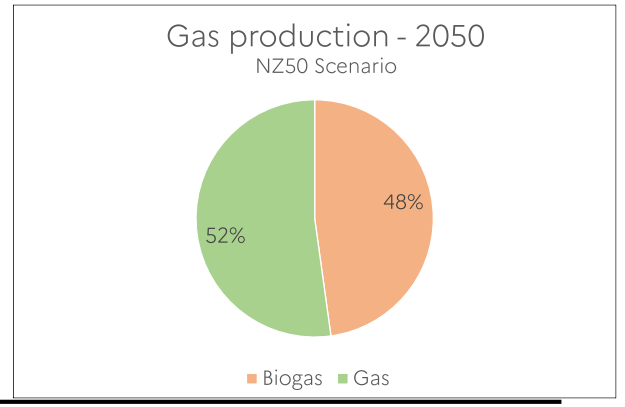












The THREE-ME model (1/2)

Multisectoral Macroeconomic Model for the Evaluation of Environmental and Energy Policies

Co-developed by ADEME (French Agency for Ecological Transition) and OFCE (French Economic Observatory)
Third version since 2008 (see Reynès et al., 2021)
Publications :

- Public policy planning : Visions ADEME (2013, 2017), French Energy Transition Law (2014), Value for Climate Action (2019), National Low Carbon Strategy (2020), Transitions 2050 (2021)
- Specific surveys : 100% Renewables Energy Mix (2016), Macroeconomic impact of the carbon tax (2019), High Council on Climate (2020)

A Neo-Keynesian « Computable General Equilibrium » Model

- Similar foundations and dynamics as public models (Mésange of the Treasury, E-Mod of the OFCE)
- But calibrated coefficients (and not econometrically estimated)
- Slow adjustments of prices and quantities to their optimum
- Keynesian multiplier effects and possibilities of temporary or permanent underutilization of the production capacity

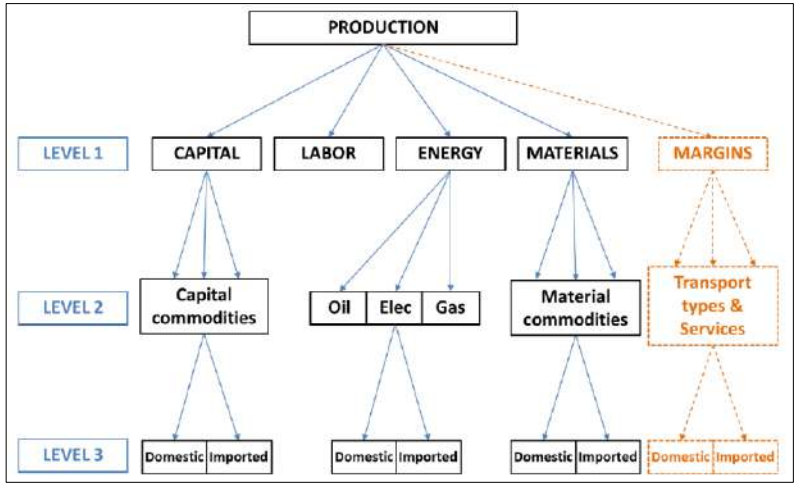
The THREE-ME model (2/2)

Three-ME overcomes the limitations of the standard top-down CGE models

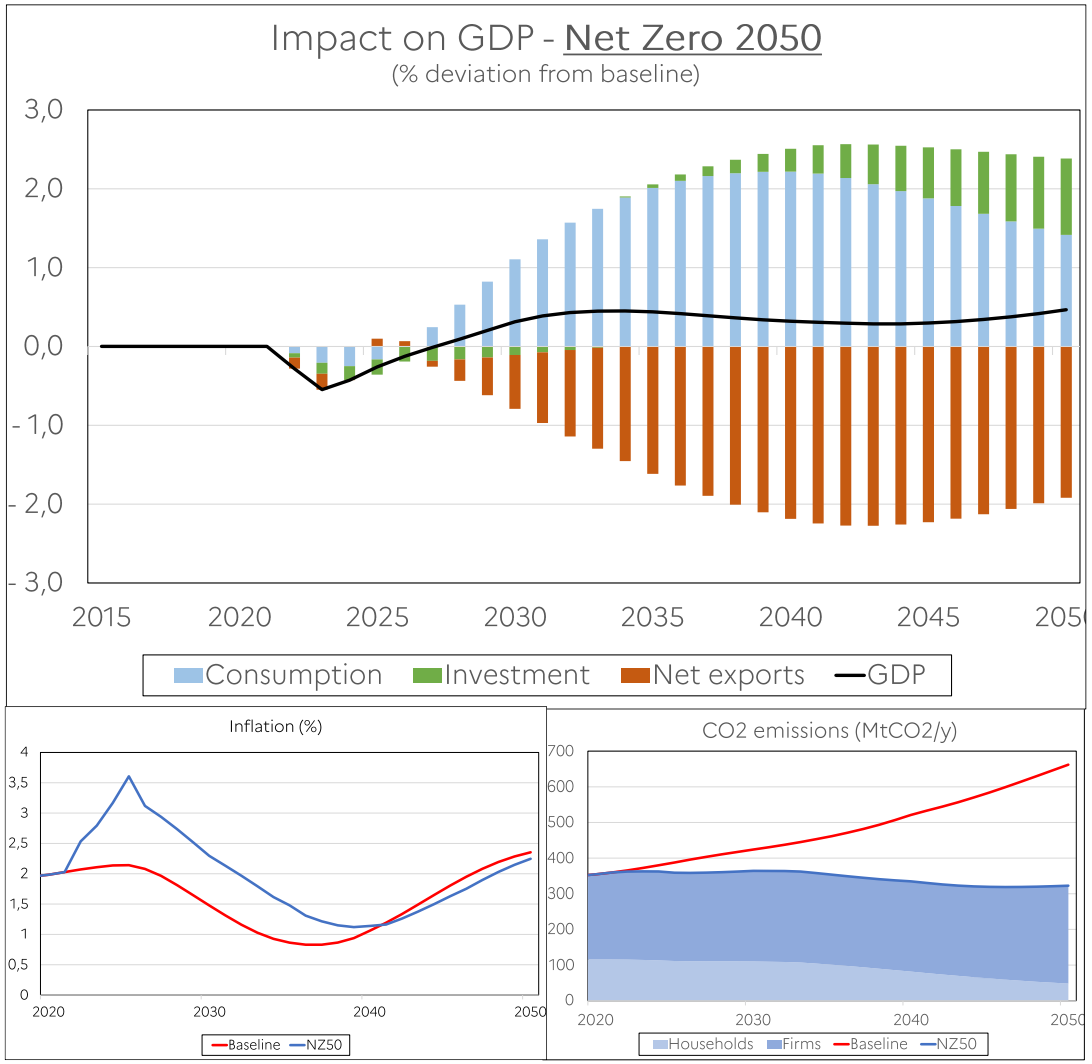
- ✓ Effort on the disaggregation level (28 commodities and 33 sectors, including 14 energetic sectors) based on emissions factors, exposure to international competition and propagation of transition shocks in the domestic value chain

- ✓ An hybrid block represents the non-linear relation between income and energy consumption
  Distinction between necessity and luxurious goods and association between energy and households' capital stock

- ✓ GCES Production function - Generalized Constant Elasticity of Subsitution (3 levels)
  More flexible framework that facilitates the analyze of the substitution properties of nested CES functions (Reynès, 2017)



Macroeconomic impact of the Net Zero 2050 Scenario (1/2)



Shock : Linear increase of the carbon tax *globally*.

Up to 2030 :

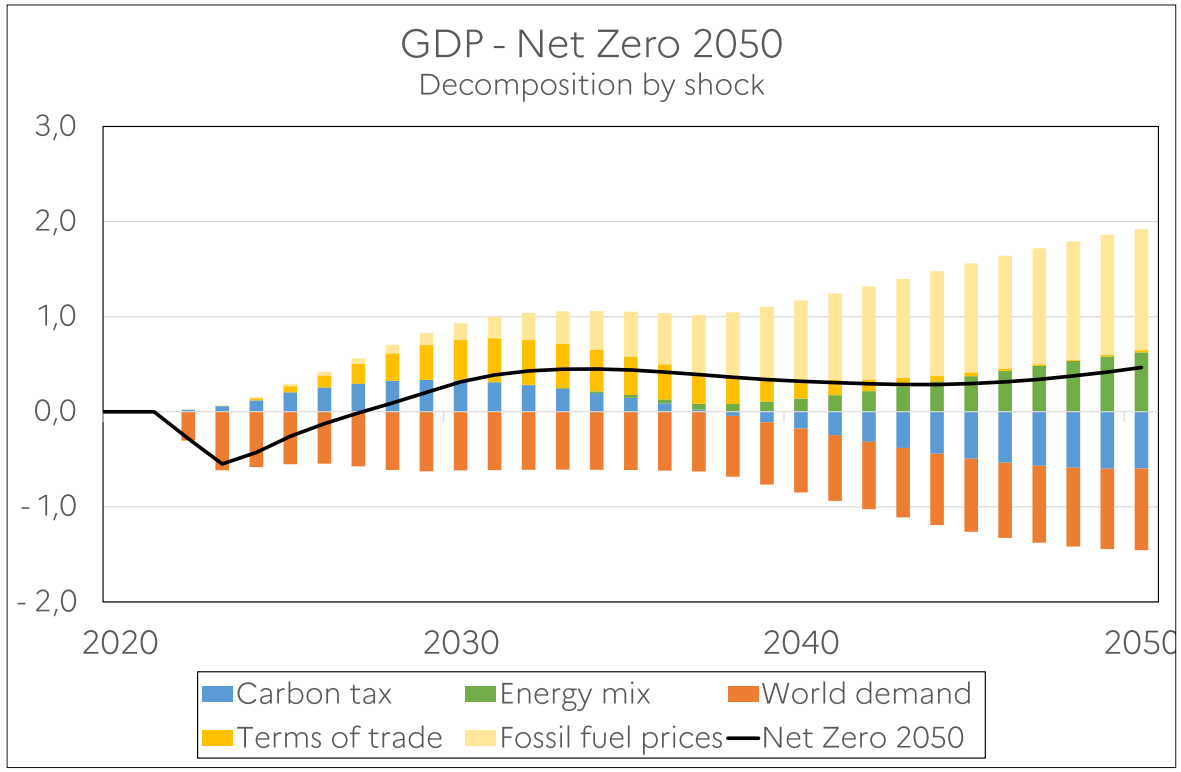
- Immediate slowdown caused by external demand
- Rigidities of agent's behaviour limit the short run impact of energy efficiency investments and the redistribution of the carbon tax to households and firms
- Lower efficiency investments compared to the 2nd version of the model

2030 to 2050 :

- Benefits of the redistribution and the transition investments
- Significant relocation of the energy production
- Double dividend partially crowded out by external trade

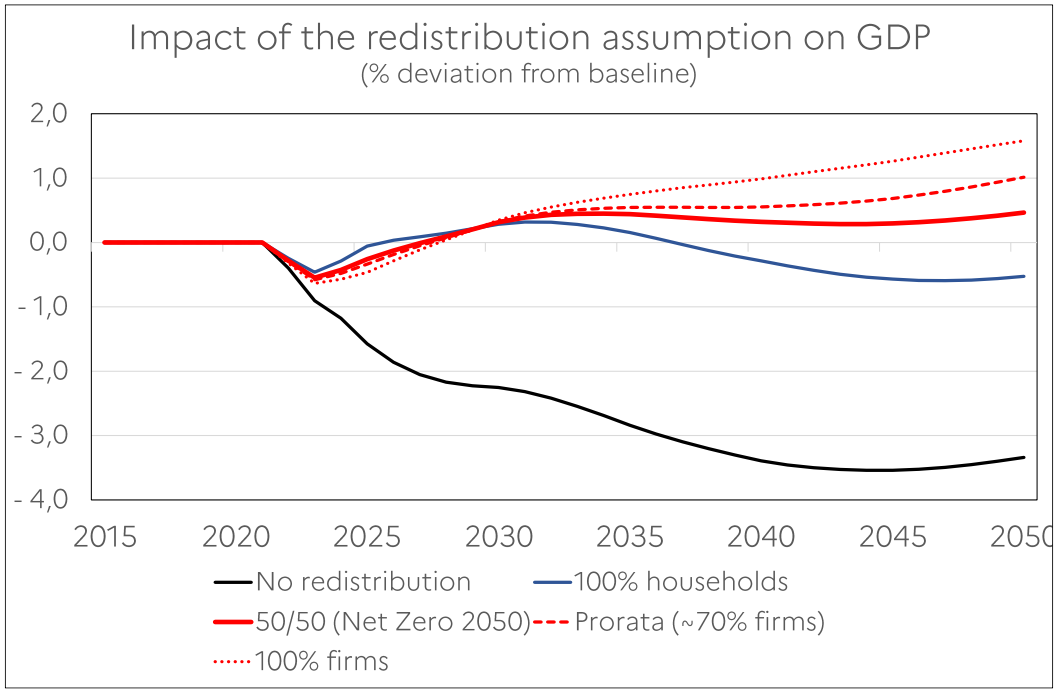
- Climate objectives are not reached (~-50 % in CO2 emissions in 2050)

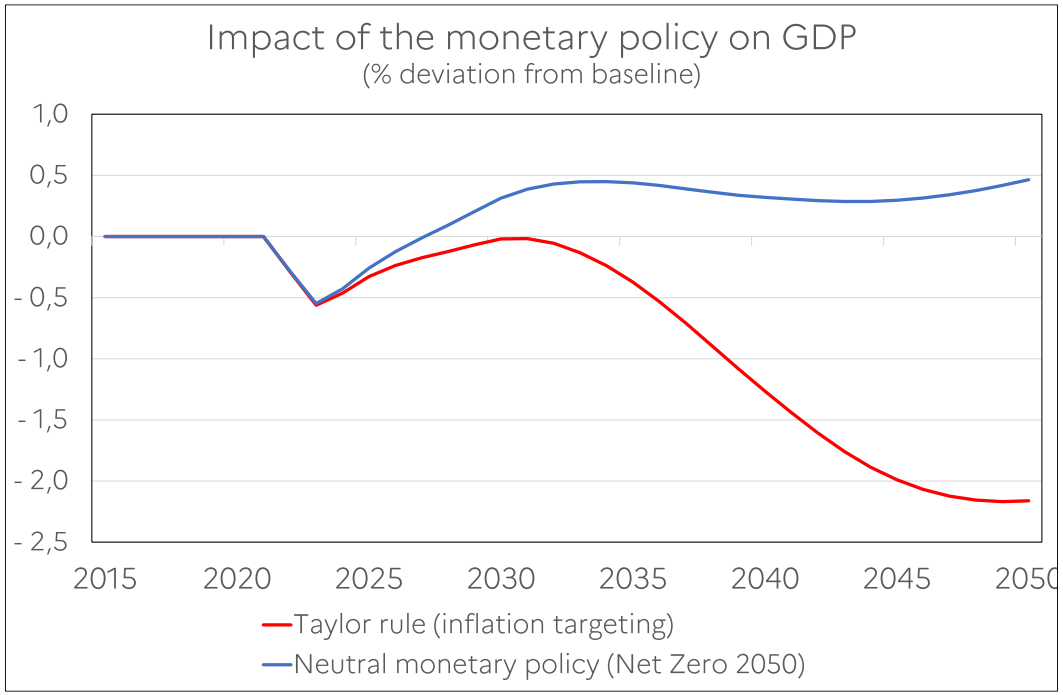
Macroeconomic impact of the Net Zero 2050 Scenario (2/2)



- Slight positive impact due to domestic policy
- Path extremely sensitive to external assumptions
- Fall in fossil fuel prices supports purchase power and competitiveness but induces a rebound effect and reduces the environmental impact of the action

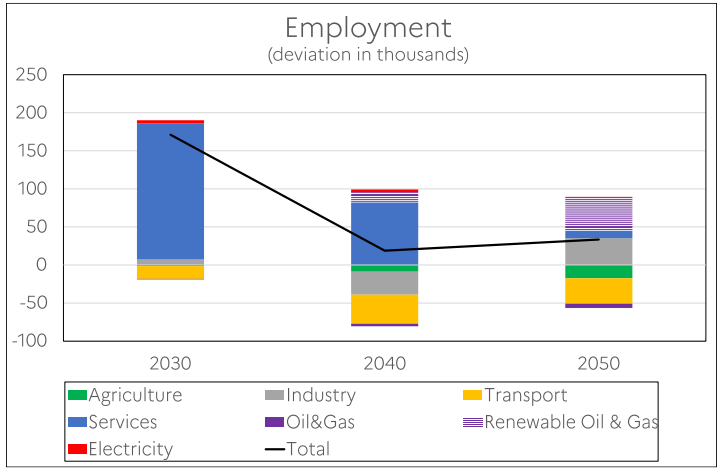
Sensitivity to redistribution and monetary policy

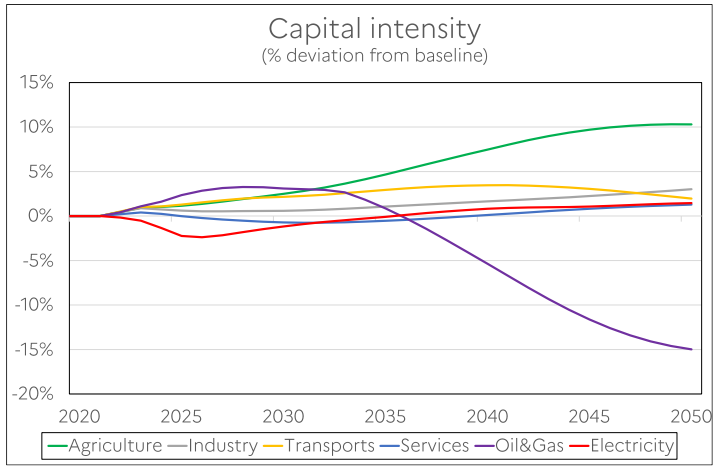


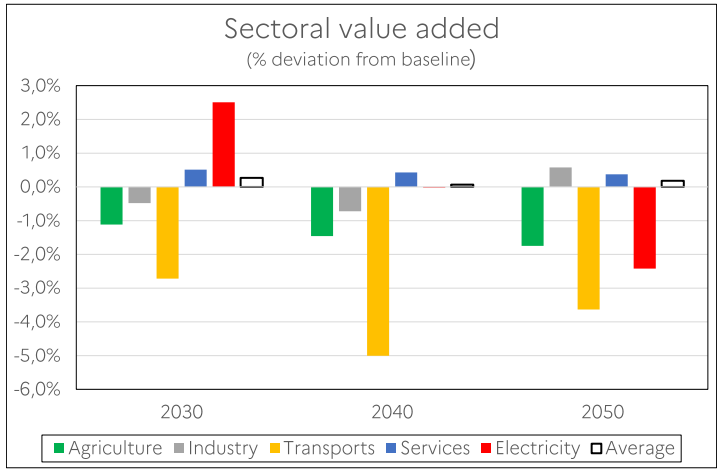


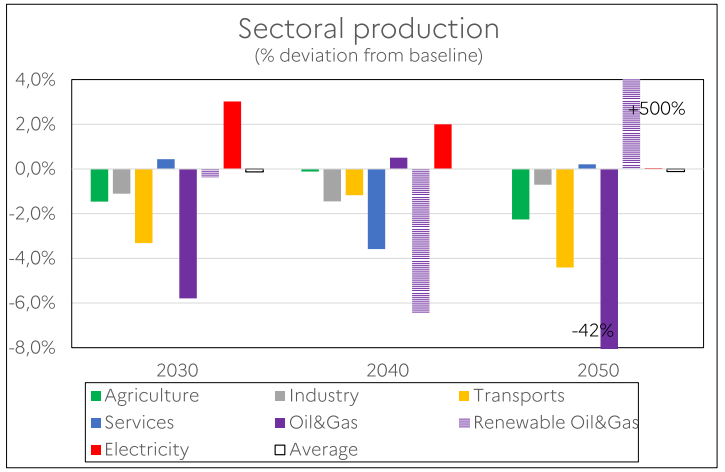
Note: Redistribution and monetary policy change only at the domestic level. The trade scenario is unchanged. The sensibility of the change in real interest rate to inflation gap (target: 2%) is set at 0.05.

Sectoral transition in the NZ50 Scenario









Note: Oil & gas value added is not included (negative accounts).

Summary

Properties of a disorderly transition: the Divergent Case

Category	Scenario	Policy ambition	Policy reaction	Technology change	Carbon dioxide removal	Regional policy variation+
Disorderly	Divergent Net Zero	1.5°C	Immediate but divergent	Fast change	Low use	Medium variation

Source: NGFS (2021)

Assumptions

- A climate target similar to the NZ50 (1.5 °C in 2100 after a limited temporary overshoot)
- Carbon prices in transport and buildings are supposed to be three times higher than in the supply and industry sectors
- Low availability of carbon sequestration

Methodology

- Calibration of the model at a granular scale to differenciate taxation policy and redistribution by sector and agent

➢ At a national scale, possibility of a larger economic gain
➢ At a global scale, possibility of larger slowdown effects

Properties of a disorderly transition: the Delayed Case

Category	Scenario	Policy ambition	Policy reaction	Technology change	Carbon dioxide removal	Regional policy variation+
Disorderly						
	Delayed transition	1.8°C	Delayed	Slow/Fast change	Low use	High variation

Assumptions

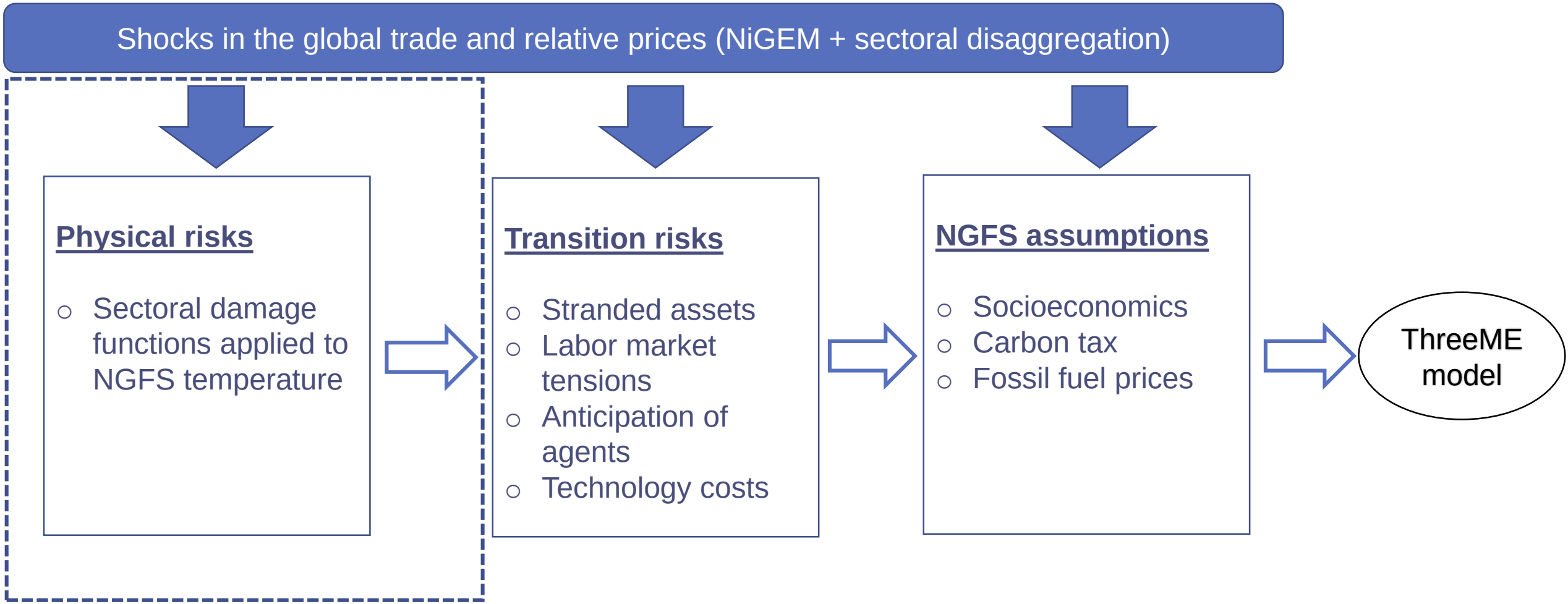
- Fossil recovery and climate inaction until 2030, then implementation of a carbon price trajectory consistent with long-term targets. Climate target of the NZ50 is not reached (< 2°C)
- Economic agents do not anticipate the sudden policy shift
- Low availability of carbon sequestration

Example of the French pilot exercise (2020) and the BoE Scenario (2021)

Issues : Neo-Keynesian macroeconomic framework, supply/demand adjustment and physical constraints

- Possibility of emergence of new sectors in a short delay regarding physical constraints (ex: biofuel)
- Increasing financing costs for households and industry related to stranded assets (see IRENA, 2017)
- Recruitment tensions in the labor market of emerging sectors, especially in agriculture and transport
- Effects on renewables costs and CCS costs

Stacked simulations and methodologies



Conclusion, limitations and work in progress

- Exploratory exercise with the Three-ME « V3 » with an « endogenous » trade scenario.
- Slight positive impact of an orderly transition scenario on the trend economic path, despite negative short run effects related to the immediate slowdown in the world demand for French products.

- Dependancy on the NiGEM simulations and outputs (especially regarding the double dividend theory and the monetary assumption).
- Strong sensitivity to fossil fuel prices projections. Possibility of the introduction of a conservative slowdown (e.g. IEA WEO).

- Calibration of the hybrid bloc (electric vehicles penetration) in the Three-ME V3.
- Next stacked simulations (disorderly transition scenarios).

Thank you for your attention !

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