Scenarios for Assessing Climate-related Financial Risk:

An Economy-wide Framework for Assessing Global Transition Risk in the Energy Production Sector

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Question

- What is the potential loss of asset values (values of “stranded assets”) when climate policies are in place?

Tool

Computable general equilibrium (CGE) model	
Feature	**Detail**
Global coverage	• GTAP 8 database • 18 regions
Multi sectors	• 14 sectors with energy sector details • Backstop options (IEA and EIA)
GHG emissions	• CO_2 emissions (IEA; PBL Netherlands EAA) • Other GHGs (EDGAR)
Dynamics	• Recursive dynamics • Solve at 5-year time steps up to 2040
Capital stock details	• Malleable capital can move b/w sectors • Vintage capital is sector-specific

Scenarios

Name	Detail
No Policy	• No explicit climate policies • From 2025 new coal power is advanced coal power
Paris Forever	• NDCs met via power & transport sectors PAMs • If PAMs are not enough, GHGs emissions are priced • Beyond 2030 policies remain at 2030 levels
Global Action Post-Paris	• Up to 2030 similar to Paris Forever • Beyond 2030, besides PAMs of Paris Forever, global cap-n-trade on GHGs • Goal: keep warming $\leq 2°C$
Deep Cuts Post-2070	• Warming target is the same: $\leq 2°C$ • Negative emissions options will be available from 2070 onward • 2030-2070 emission cuts can be relaxed

Stranded assets

Name	Detail
Stranded value	• Loss of rents from fossil fuel resources (e.g., lower prices, more fuel left in the ground) • Include stranded equipment in the extraction sectors such as drilling rigs, which are inputs to the refined oil sector
Stranded capital	• lower returns to capital in fossil fuel consumption sectors • Only calculate the value of stranded coal power plant capital, as coal-fired generation will be most affected by climate policies

Stranded assets

- Stranded value

$$vout_{s,f,t} = pd_{s,f,t} \cdot q_{s,f,t}$$

$$sdvout_t = \sum_{f=\{coal,oil,gas\}} (vout_{vref,f,t} - vout_{policy,f,t})$$

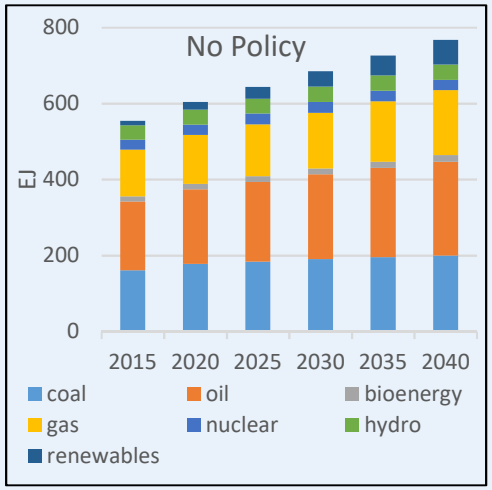
$$psdvout = \sum_{t=1}^{t=T} sdvout_t / (1+r)^{t-1}$$

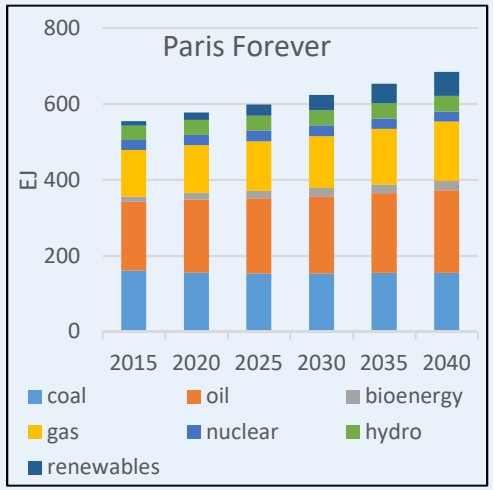
- Stranded capital

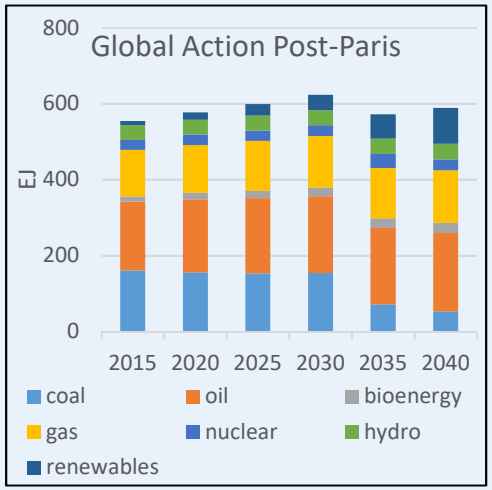
$$strv_{v,t} = pvk_{no\_policy,t,v} \cdot vk_{no\_policy,t,v} - pvk_{policy,t,v} \cdot vk_{policy,t,v}$$

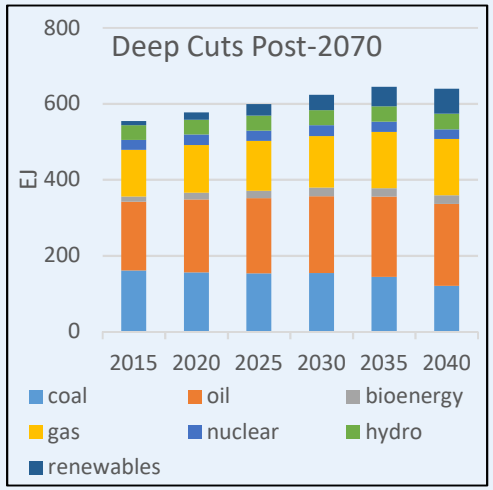
$$strv = \sum_{t=1}^{t=T} \sum_{v|v=\{v5,v10,v15,v20\}} strv_{v,t} / (1+r)^{t-1}$$

Primary energy use

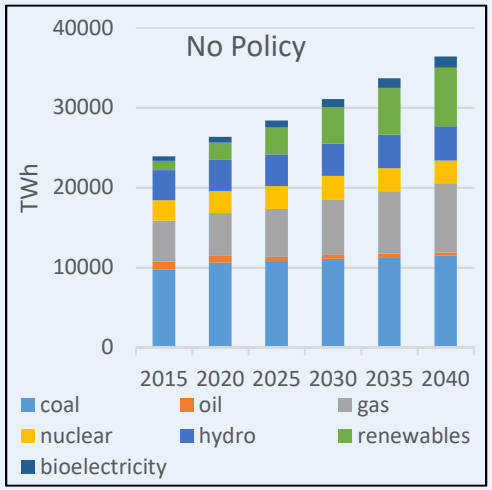


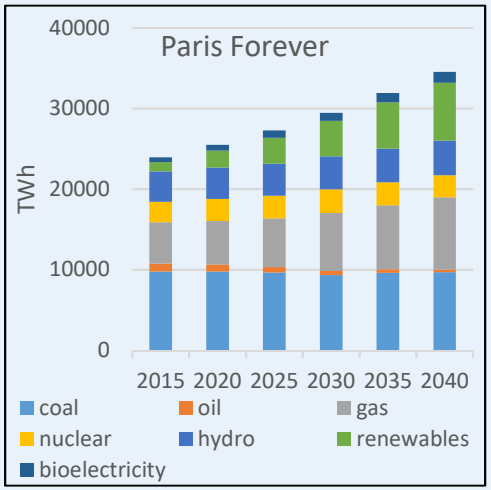


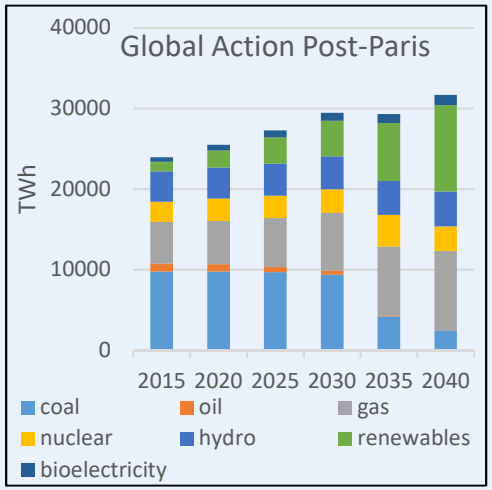


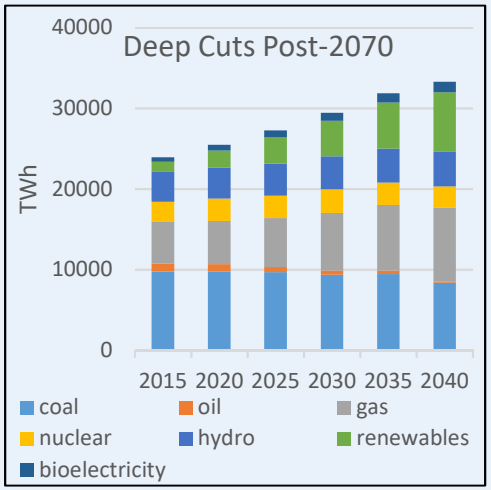


Power generation

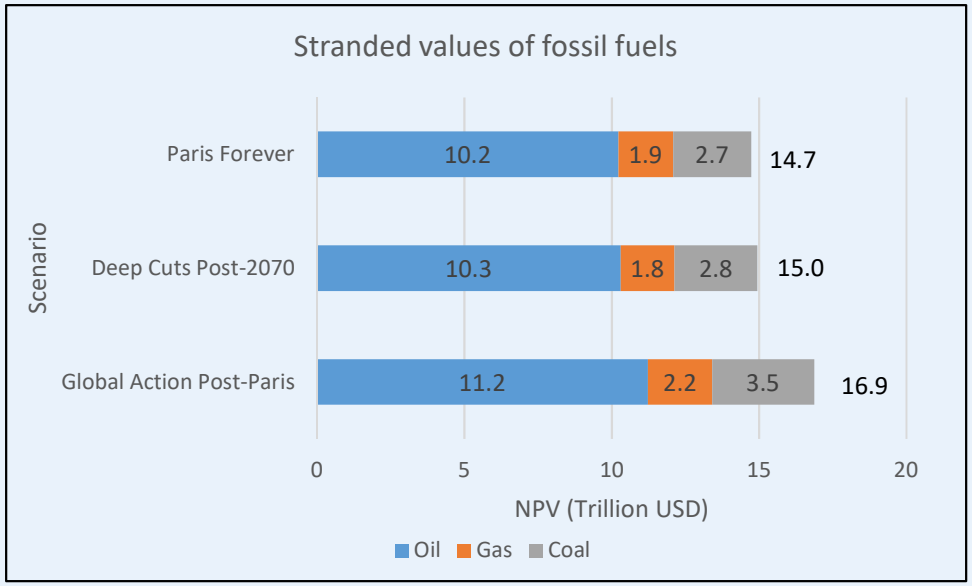




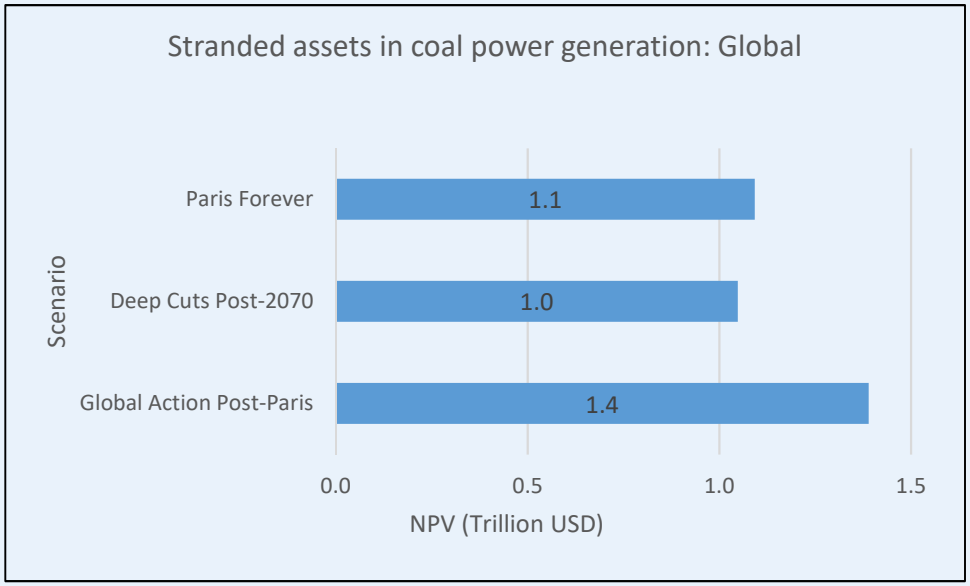




Stranded values of fossil fuels



Stranded capital of coal power generation



Conclusions

- Using an energy-economic CGE with k-stock details to estimate stranded assets
- Firms can combine our analysis with their asset portfolios details to determine their climate-related transition risk exposure

Future research directions

- Use metrics presented in this study for bridging the divide between climate scenarios and credit and loan assessment
- Analyze the issue based on a forward-looking framework
- Consider both transition and physical risks using an IAM

Appendix

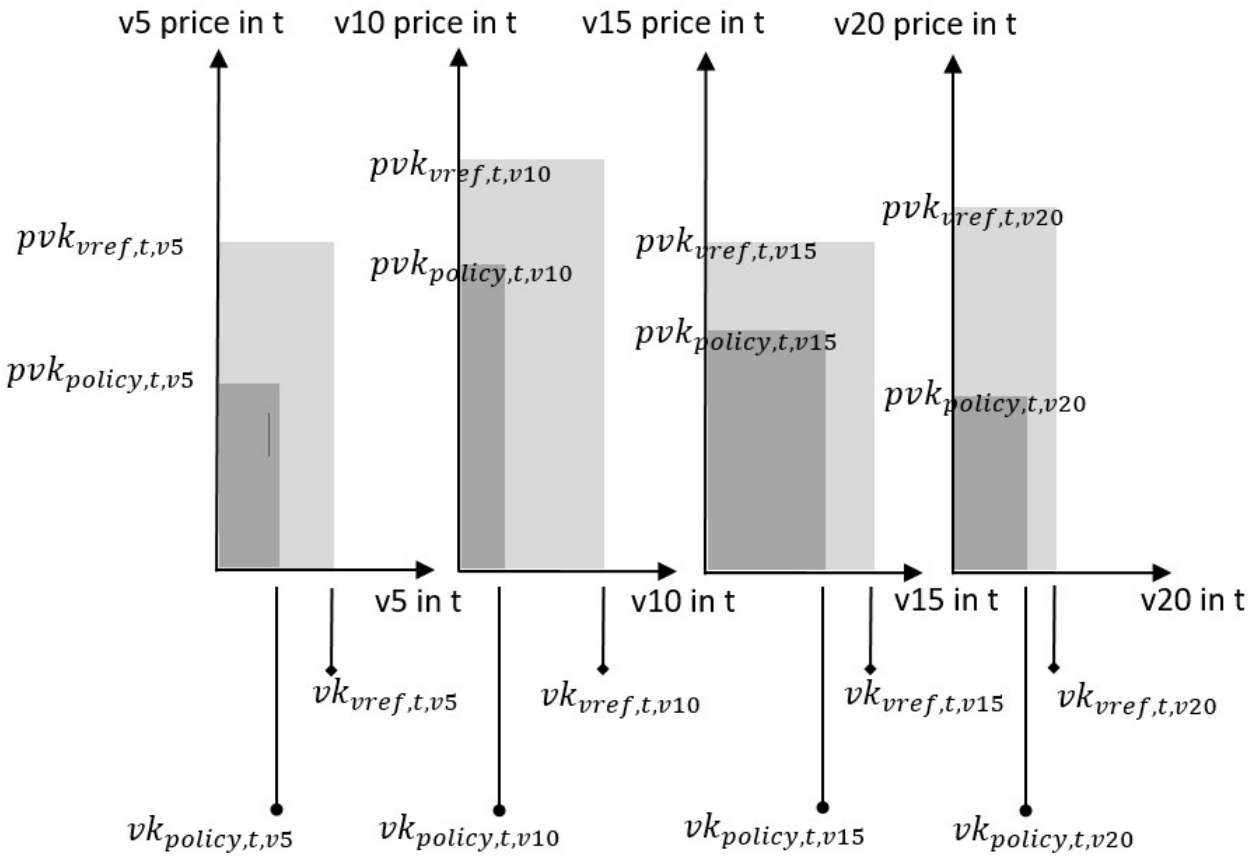


Figure 1. Estimation of stranded capital in coal power generation

Appendix

Table A01. NDCs and Assumed Performance in 2030

Region	NDCs		CO_2-e 2005 Mt or t/$1000	Other Features	Expected CO_2-e
	Type/Base	Reduction			
USA	ABS 2005	26-28% by 2025	6220		25%
EUR	ABS 1990	40% by 2030	5370 (1990)	27% renewables in electricity by 2040	40%
CAN	ABS 2005	30% by 2030	789	Mainly land use & forestry with 18% reduction in industrial	25%
JPN	ABS 2005	25% by 2030	1260	2.5% LUCF. Nuclear = 20-22% of electric, solar/wind = 9%, also biomass. Assumes ITMOs. Target = 1.04b ton CO_2-e	20%
ANZ	ABS 2005	26-28% by 2030	596		20%
BRA	ABS 2005	37% by 2025	2.19	45% of primary energy renewable by 2030; LUCF down 41% 2005-12	35%
CHN	CO_2 INT 2005	60-65% by 2030	2.55	INDC is CO_2 only, discount to account for other gases. CO_2 peak by 2030, Non-fossil 20% of primary energy	55%
KOR	BAU	37% by 2030	NA	PAMs on renewables and autos (no detail)	25%
IND	INT 2005	30-36% by 2030	2.29	2.5-3.0b tons CO_2 from forests. 40% non-fossil electric. Assumes un-specified financial assistance.	30%
IDZ	BAU	29% by 2030	NA	Role of LUCF (63% of current emissions) not clear. Industrial emissions increase.	30%

Source: Jacoby et al. (2017)