RFF-CMCC -EIEE Seminar

April 11, 2019 - h 12.00 pm CEST

Asset Prices and Climate Policy

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ASSET PRICES AND CLIMATE POLICY

Frederick van der Ploeg (University of Oxford)

Armon Rezai (WU Wien)

Outline

- Temperature targets imply a carbon budget.
- Most studies have focused on amount of natural assets locked-up. Reserves of big oil and gas companies are much bigger (not counting state companies).
- What are the financial implications of climate policy
  - Risks of stranded fossil-fuel assets? Short the oil and gas majors?
  - Risks for other financial assets?
  - Risks for fossil-fuel-dependent sovereign countries?
    Race to burn the last ton of carbon?

Stranded Assets

- Assets that undergo unanticipated drops in profitability and valuation (and become liabilities?)
- Fossil-fuel based industries
- Most important threats:
  - Climate policy
  - Technological Change
- Relevance and magnitude subject to ongoing research

Two Sets of Issues (Dietz, 2017)

Unburnable Fossil Fuel

- How much unburnable carbon is there really?

Assumes we will - as opposed to should - adhere to a low carbon budget

Valuation of Companies

- Why are fossil fuel assets (over-) valued?

Sensitive to the design and timing of policy

Link between stranded assets and company valuations is difficult

One slide of theory

- The emission of greenhouse gases is the world‘s largest negative externality (Stern, 2007).
- Internalizing this externality creates a surplus (‘efficiency gains’) which is up for grabs.
- Most of the benefits accrue to future generations.
- Economic benefits (e.g. less damage) might be capitalized and visible in today’s prices (earlier presentations today).
- While, in aggregate, climate policy is beneficial, owners of certain asset classes will undoubtedly lose.

Carbon budgets and climate targets

- Recent climate research argues that time path of emissions does not matter (much). Peak temperature is a function of cumulative emissions.

$$PT = TCRCE \times CE$$

TCRCE is the transient climate response to cumulative emissions, CE.

- Best estimate for TCRCE is 2°C / TtC (= 0.002 °C/GtC) with a 5-95% confidence range of 1.4-2.5°C / TtC. (Allen et al., 2009): $PT = 1.2 + 0.002 \times CE_{2017}$
- Ignoring uncertainty and assuming that 600 GtC have been burnt already, the carbon budget is 400 GtC for 2°C.
- If target is 1.5 degrees, it is only 150 GtC. Only fifteen years left.

2°C target and stranded natural assets

Implication

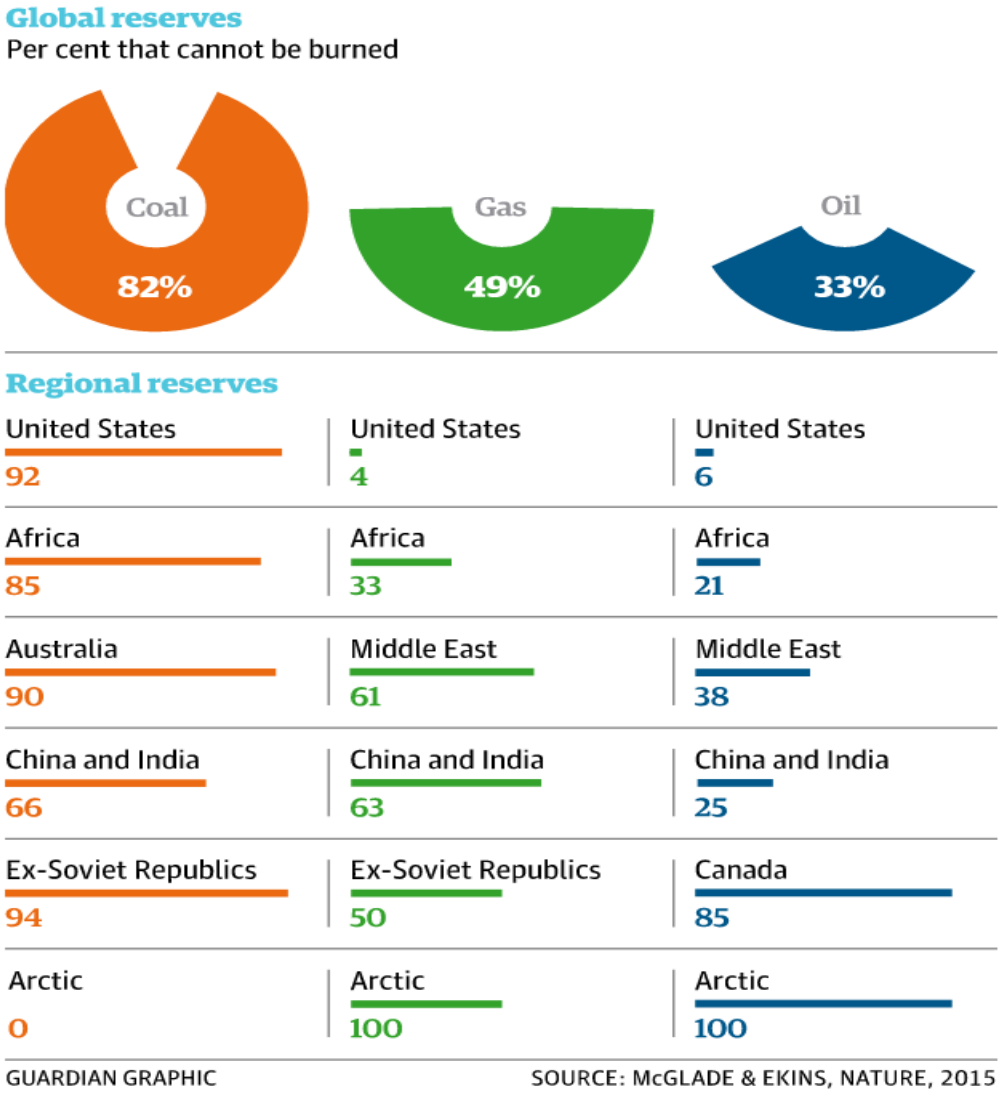
Forget "peak oil"!

Keep 82% of coal, 49% of gas, and 33% of oil unburnt.

Reserves 3x and resources 10x the carbon budget.

In Middle East 260 billion barrels of oil cannot be burnt. Regional distribution dubious.

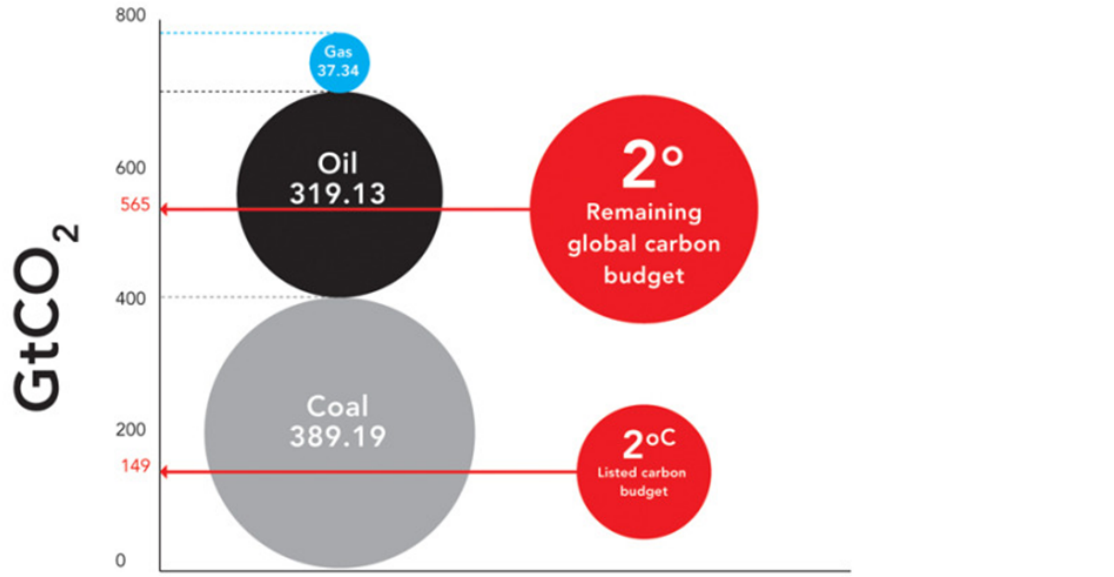
(McGlade and Ekins, 2015)



The carbon bubble

Carbon dioxide emissions potential of listed fossil fuel reserves

Fig.3



Source: *Unburnable Carbon: Are the World's Financial Markets Carrying a Carbon Bubble?, Carbon Tracker 2011*

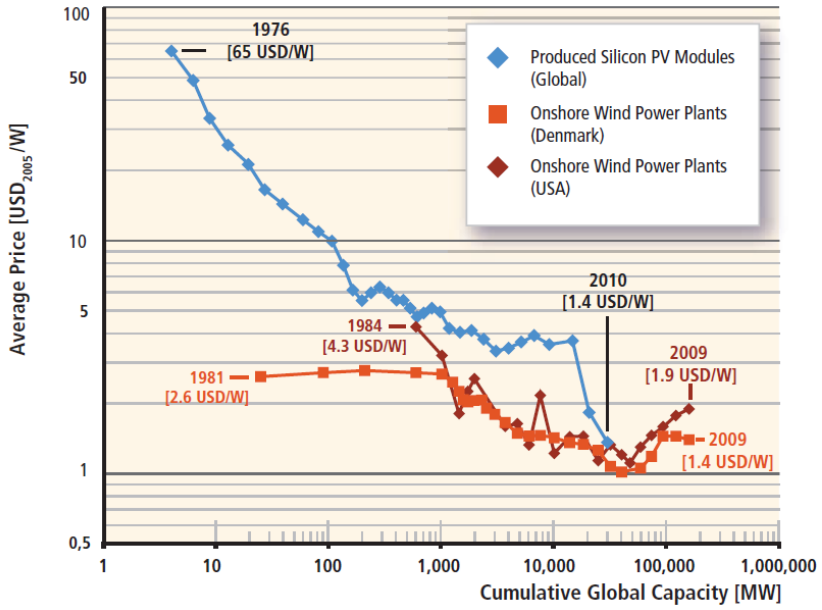
Carbon Tracker Initiative

Stranded physical capital in the power industry

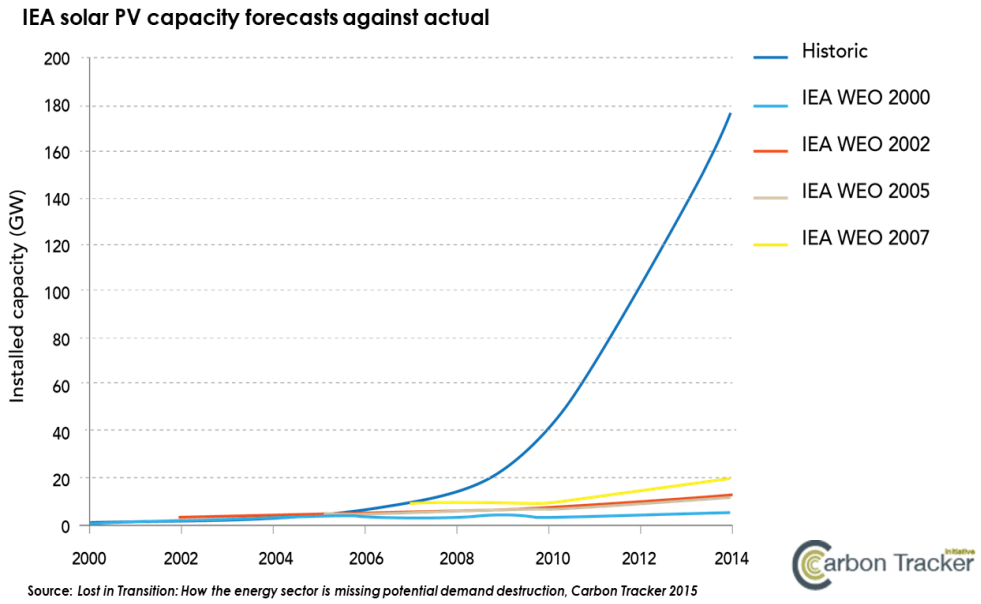
- Pfeiffer et al. (2016) define the “2°C capital stock” as the global stock of infrastructure which, if operated to the end of its normal economic lifetime, implies warming of 2°C or more (with 50% probability).
- Using IPCC carbon budgets and the AR5 scenario, they show that the “2°C capital stock” will be reached in 2017 even when other sector do their share of staying below 2oC. Hence, no new emitting infrastructure can be built anymore unless other infrastructure is scrapped or retrofitted with CCS!
- Pfeiffer et al. (2017) show that keeping warming below 1.5°C cuts utilisation of coal-fired electricity up to 2050 from 60 to 29%.

“New wind and solar generation costs fall below existing coal plants”

FT 8/11/2018



Source: IPCC (2012), Renewable Energy Sources and Climate Mitigation, SRREN. Available at: https://www.ipcc.ch/report/srren/



Source: Carbon Tracker Initiative (2015), Lost in Transition: How the energy sector is missing potential demand destruction, S. 4. Available at: https://www.carbontracker.org/reports/lost_in_transition/

Why do assets get stranded?

- (1) imperfectly anticipated climate policy and (2) irreversibility of or costs for adjusting investment in dirty capital stocks.
- Adjustment costs: intertemporal or intra-sectoral.
- Stranded assets imply scrapping of dirty capital and discrete crash in the share prices of carbon-based industries. Hence, the so-called “carbon bubble”.
- We focus at exploration (and exploitation) investments by the oil, gas and coal industry, and the need to lock up carbon in the crust of the earth (Pindyck, 1978).

Focus on International Carbon Companies: optimal discoveries, exploration and depletion

$$\underset{I,R\geq 0}{\text{Max}}\, V(0)=\int_0^{\infty}\left[pR-I-\frac{\phi}{2}\frac{I^2}{K}-\mathrm{G}(S)R\right]e^{-rt}dt \quad \text{subject to}$$

$$\dot{S}=\mathrm{D}(K)-R,\quad S(0)=S_0,\ \text{and}\ \dot{K}=I-\delta K,\quad K(0)=K_0$$

$$\text{Hence,}\ p\geq h+\mathrm{G}(S)\perp R\geq 0,\quad I=\frac{1}{\phi}(q-1)K,$$

$$\dot{h}=rh+\mathrm{G}'(S)R \quad \text{or}\ h(t)=\int_t^{\infty}\left[-G'\big(S(s)\big)R(s)\right]e^{-r(s-t)}ds,$$

$$\dot{q}=(r+\delta)q-\mathrm{D}_K(K)h-\frac{\phi}{2}(I/K)^2,\quad h(0),q(0)\ \text{free.}$$

Equilibrium conditions

Market equilibrium:

$$R = \Phi\left(h + \mathrm{G}(S) + \tau\right) \equiv \mathrm{R}(S, h+\tau),\ \mathrm{R}_S = \Phi'\mathrm{G}' > 0, \mathrm{R}_{h+\tau} = \Phi' < 0$$

End of fossil fuel era (perfect substitute back-stop, unit cost b)

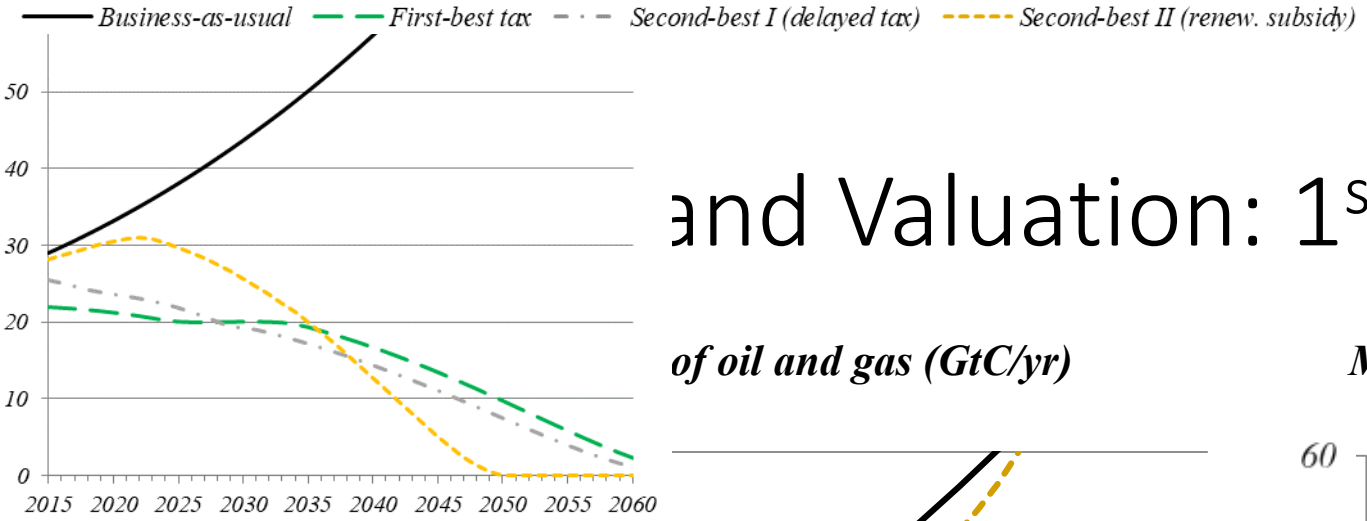
$$G(S(T)) + \tau(T) = b(T) - \theta$$

Peak warming:

$$PW = \gamma_0 + \gamma_1 R_{cumulative}$$

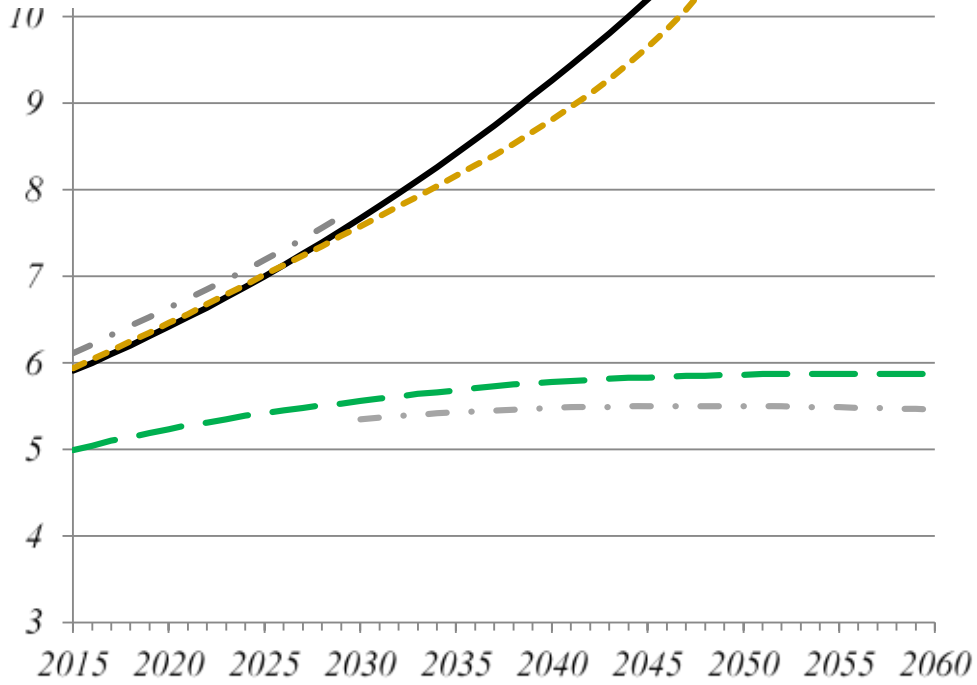
Safe carbon budget (set τ such that):

$$PW \le 2^o C \ \rightarrow\ E \le (2 - \gamma_o) / \gamma_1$$

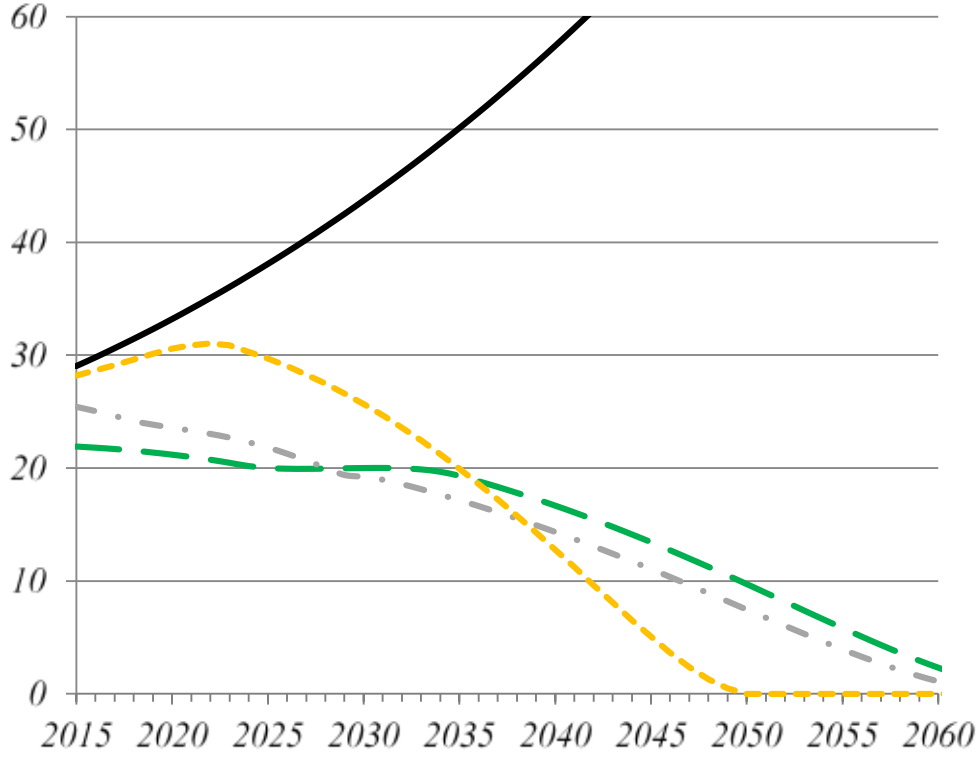


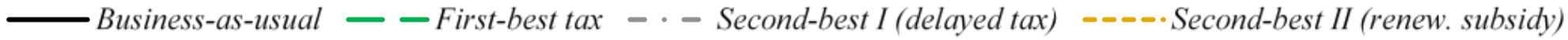
and Valuation: 1st and 2nd best policies

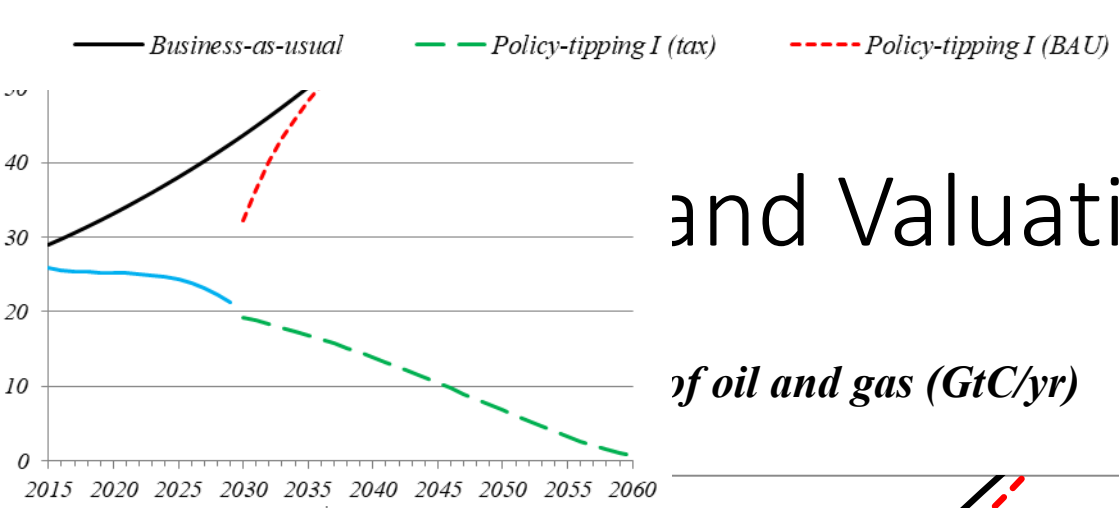
of oil and gas (GtC/yr)



Market Valuation of the oil and gas industry ($T)

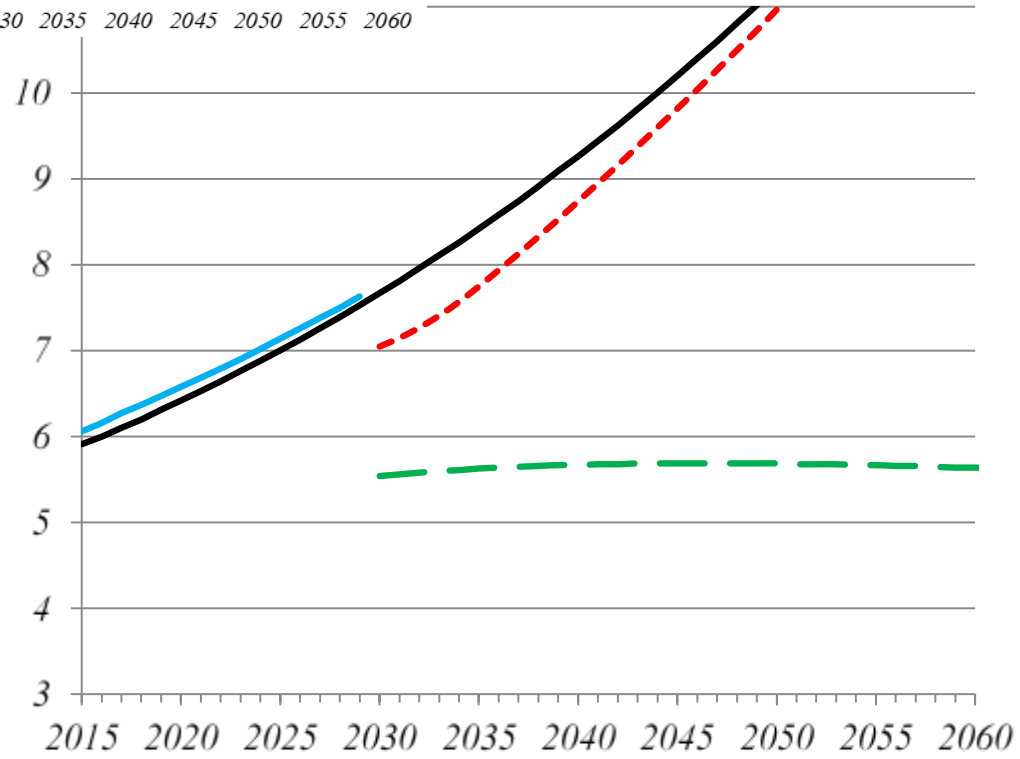






and Valuation: 'risk' of tipping into policy

of oil and gas (GtC/yr)



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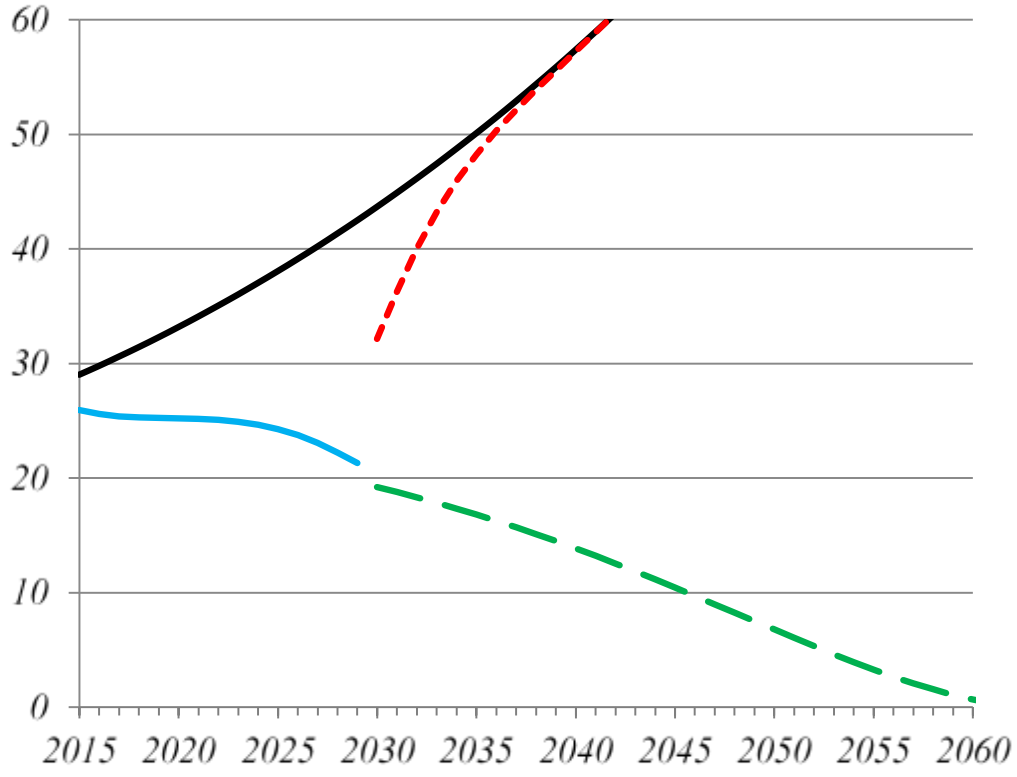
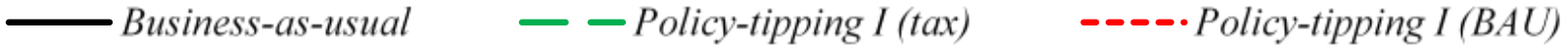
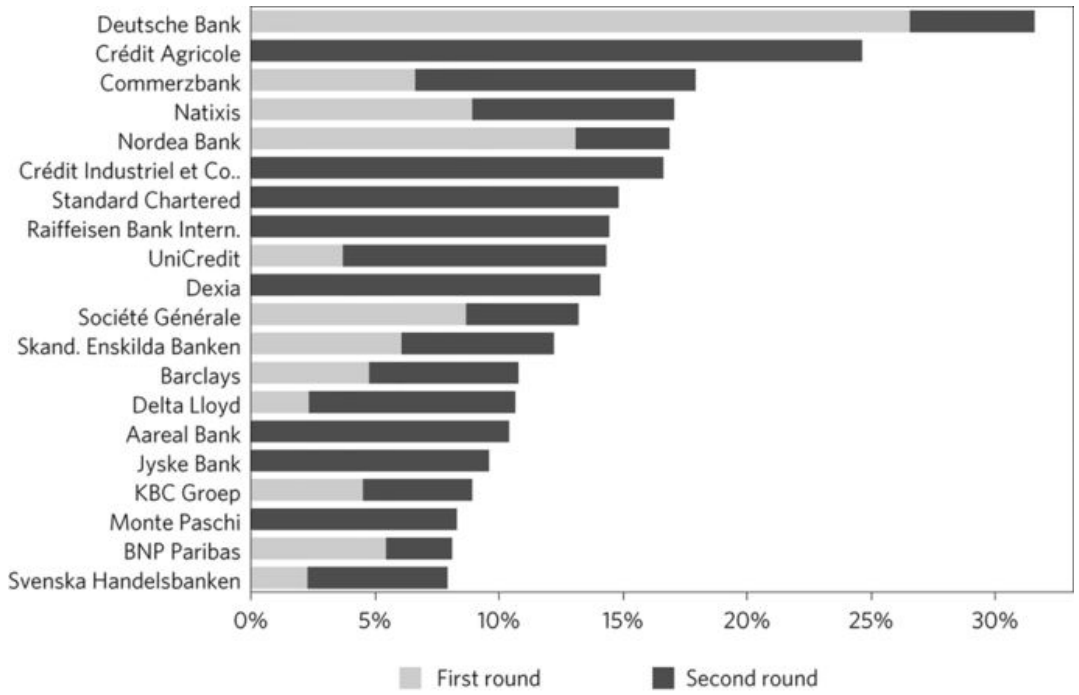




Financial markets

- Carbon Tracker Initiative (2011) suggests 20-30% of the market capitalisation of the stock exchanges of London, San Paolo, Moscow, Australia and Toronto is fossil fuel based.
- Bansal et al. (2016) use real market data in the U.S. to estimate the negative impact of long-run shifts in temperature on share prices.
- Andersson et al. (2016) argue that the cost of hedging against the risk of climate policy suddenly being toughened with carbon-free trackers is now very small indeed as the market is not anticipating it. Do this by investing in carbon-free tracker indices (e.g., MCCC).

Systemic risks



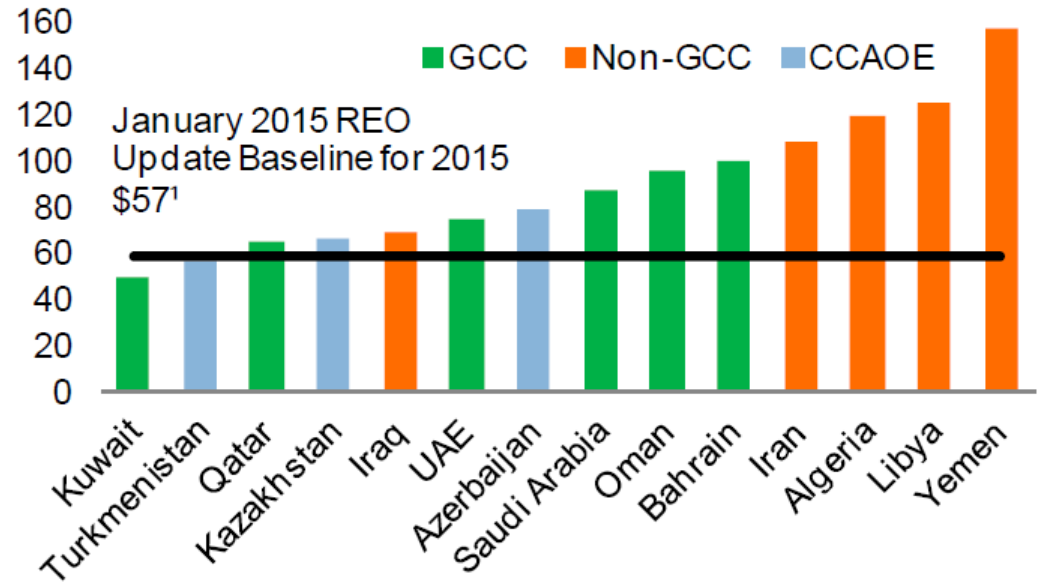
Source: Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G., (2017), A climate stress-test of the financial system, *Nature Climate Change*, *7*(4), 283. Available at: https://www.nature.com/articles/nclimate3255

Sovereign risks

- Oil and gas exporters (Russia, Algeria, Venezuela, Nigeria, Norway and Brazil) have been hit by crash in world oil price.
- Norway has managed by dipping in its huge SWF and managed to mitigate their depreciation of their currency.
- Nigeria and others have had huge depreciations, high budget deficits, loss of foreign reserves and inflation. Russia did less bad, since it did a big once and for all depreciation of the Ruble.
- Still, these countries suffer if they commit to Paris COP-21 as they have stranded carbon assets.
- Russian cannot burn 20% of oil and 60% of gas reserves in view of COP-21, so Russia's budgetary policies will be even more unsustainable and more tightening of fiscal stance is required - a further 1 %-point of GDP on top of what is needed to deal with sustained lower oil prices.

Country Risks

Figure 12. Fiscal Breakeven Prices, 2015
(U.S. dollars per barrel)



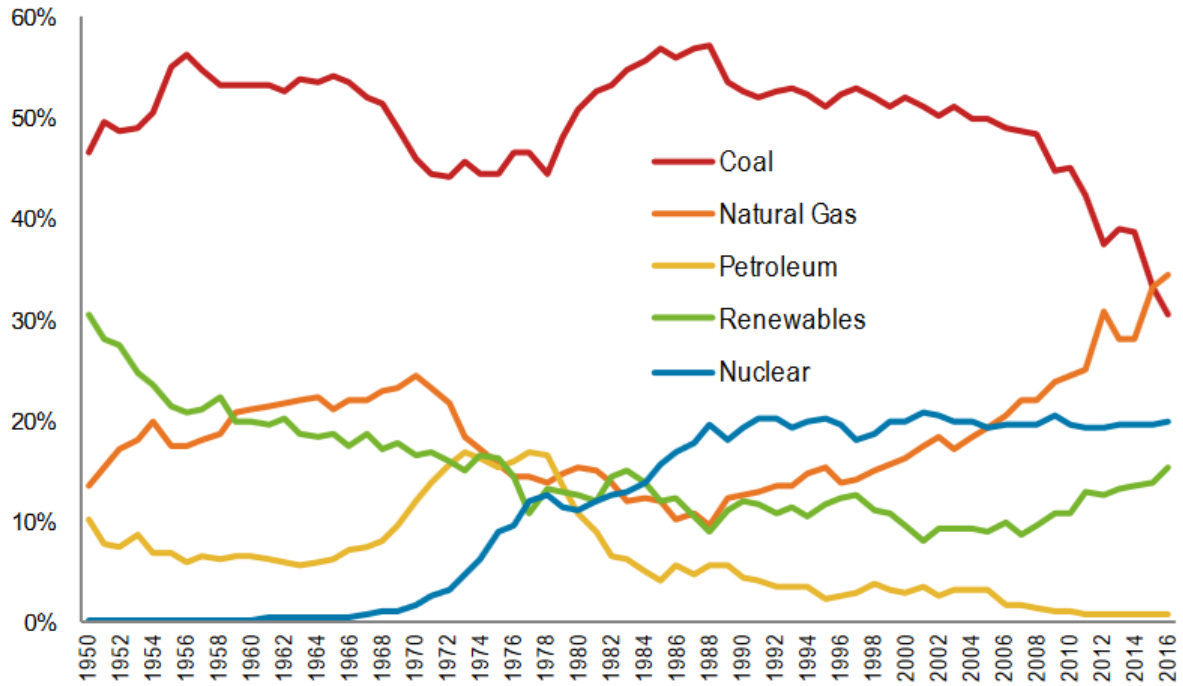
Source: IMF (2015), Learning to Live with Cheaper Oil Amid Weaker Demand - Regional Economic Outlook: Middle East and Central Asia, January 2015 Update. Available at: https://www.imf.org/en/Publications/REO/MECA/Issues/2016/04/05/Learning-to-Live-With-Cheaper-Oil-Amid-Weaker-Demand1

US coal: a cautionary tale

Columbia Center on Global Energy Policy (2017) Can Coal Make a Comeback?

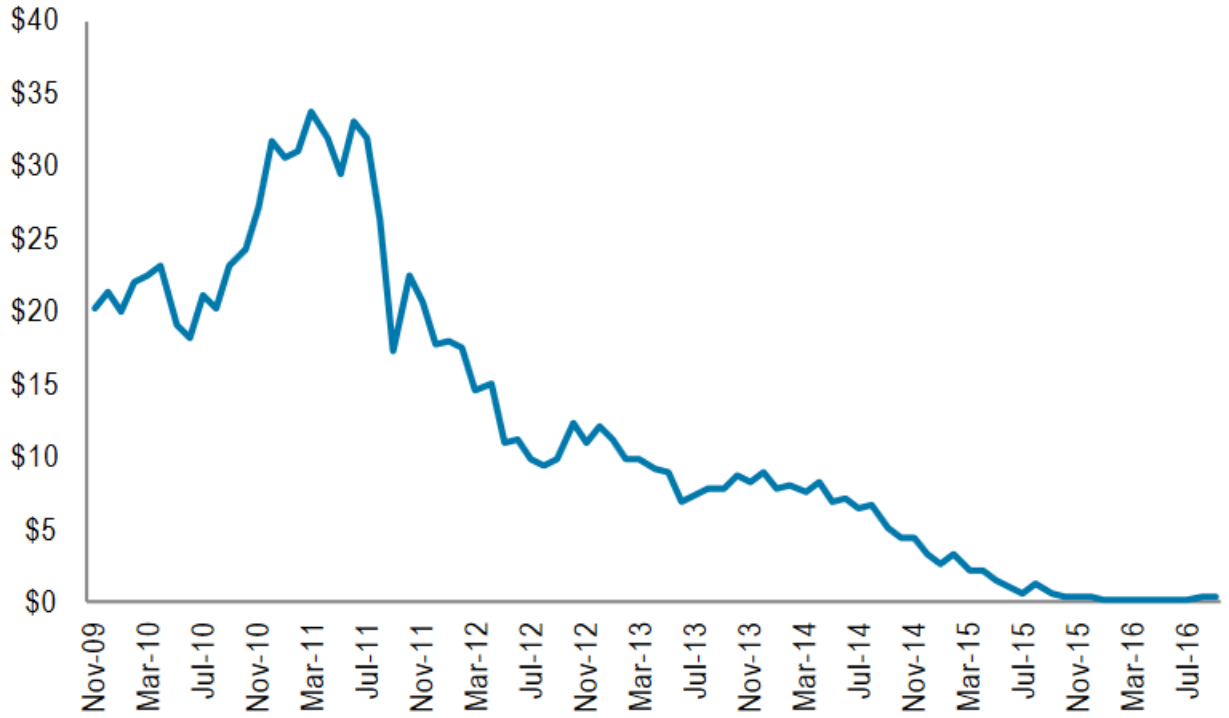
"I actually think the next decade for coal is going to be one of the best decades we've ever had."

Steve Leer, Chairman of Arch Coal, as quoted in the Wall Street Journal, February 2011



US coal: canary in the coal mine?

Figure 5: Market Capitalization of Four Largest US Coal Companies
Billion USD



Source: Bloomberg

ines:

2011

03/2011

in 03/2016

Spares

Oversight and regulation

- Governors of central banks have warned for carbon bubbles and financial and fiduciary risks of holding large investments in fossil fuel; e.g., Carney (2015).
- Insurance companies and especially pension funds should be concerned too.
- Need 2°C stress tests for investment portfolios!
- Not clear which capital market regulators are held responsible for carbon-related systematic risks and who is responsible for ensuring that full corporate disclosure of carbon risks takes place.
- Follow Sweden and the divestment campaign?

Intergenerational effects of climate policy

- Karp and Rezai (2014) use OLG model to show that a traded asset capitalises the returns from limiting future global warming so benefit current (i.e., older) generations.
- A carbon tax hurts the current younger generations via erosion of real wage but future generations benefit.
- Intergenerational conflict is not between generations alive at different times, but between generations living alive at the time the policy is implement.
- Karp and Rezai (2017) show that small climate policies can boost welfare of younger generations too if EIS is high enough, so some climate policy can be politically sustained.
- Generally, need climate-debt (Bovenberg and Heijdra, 2002) and climate-pension deals (von Below et al., 2016).
- New task for financial industry.

Q&A Session

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Forthcoming RFF-CMCC – EIEE Webinar

"Capital stranding cascades: The impact of decarbonisation on productive asset utilization"

May 9, 2019 – h. 12:00 pm CEST

Presenter: Emanuele Campiglio, Vienna University of Economics and Business (WU)
Moderator: Francesco Lamperti, Institute of Economics, Scuola Superiore Sant'Anna (Pisa) and RFF-CMCC European Institute on Economics and the Environment (EIEE), Centro Euro- Mediterraneo sui Cambiamenti Climatici, Italy

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