STRANDED ASSETS
PROGRAMME

SMITH SCHOOL OF ENTERPRISE AND THE ENVIRONMENT

UNIVERSITY OF OXFORD

# Stranded Assets and the Environment

30th September 2015

Vienna, Austria

**Ben Caldecott**
Founder & Director, Stranded Assets Programme
Smith School of Enterprise and the Environment
University of Oxford

Email: ben.caldecott@smithschool.ox.ac.uk
Twitter: @bencaldecott

# What are stranded assets in the environmental context?

- Unanticipated or premature write-down, devaluation or become liability.
  - Creative destruction
  - Technology and regulation
  - Extreme events
- Confluence of new risks may make some assets more prone to stranding.
  - Significant and accelerating
- Rarely understood or considered in decision making, especially amongst investors.
- Significant benefits associated with managing these risks.

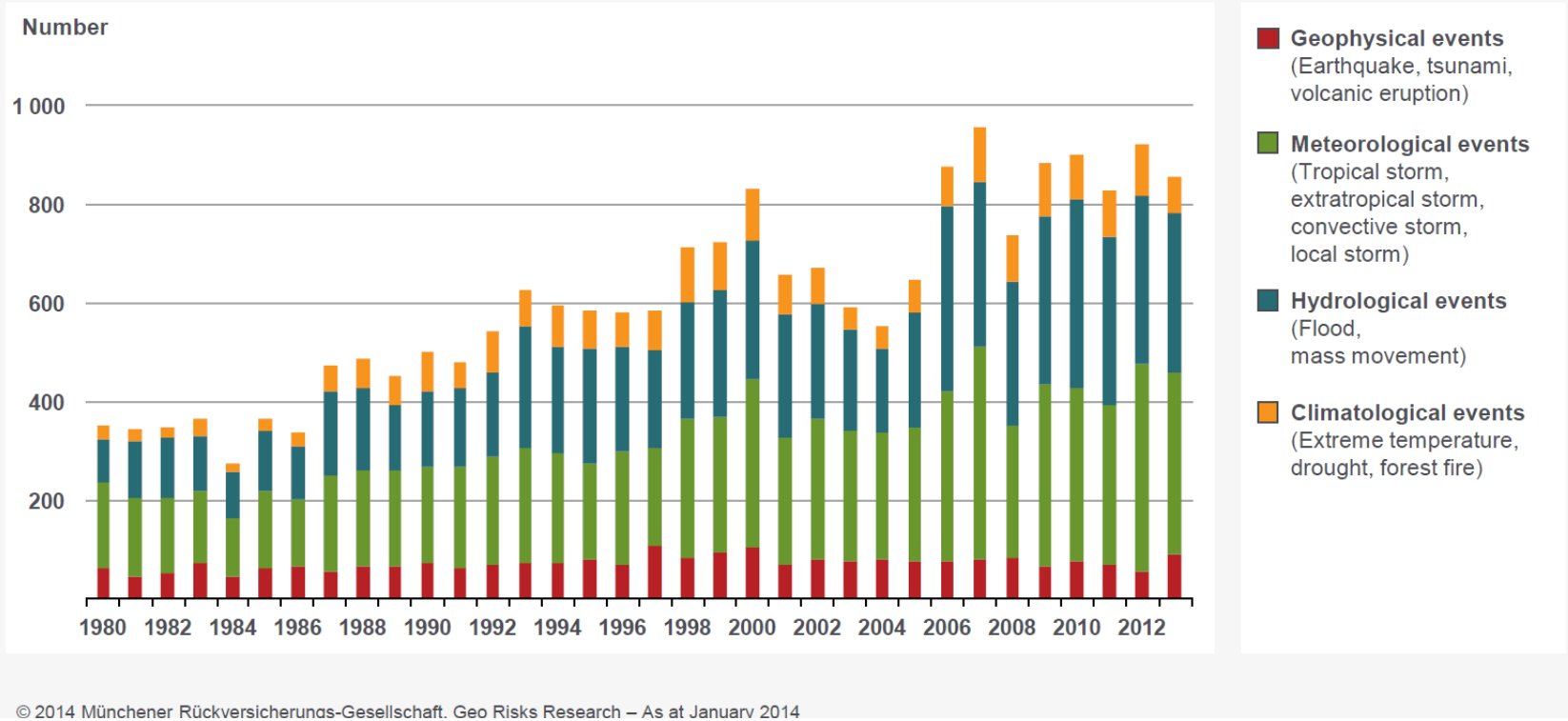
# Climate change

NatCatSERVICE

## Loss events worldwide 1980 – 2013

### Number of events

Munich RE



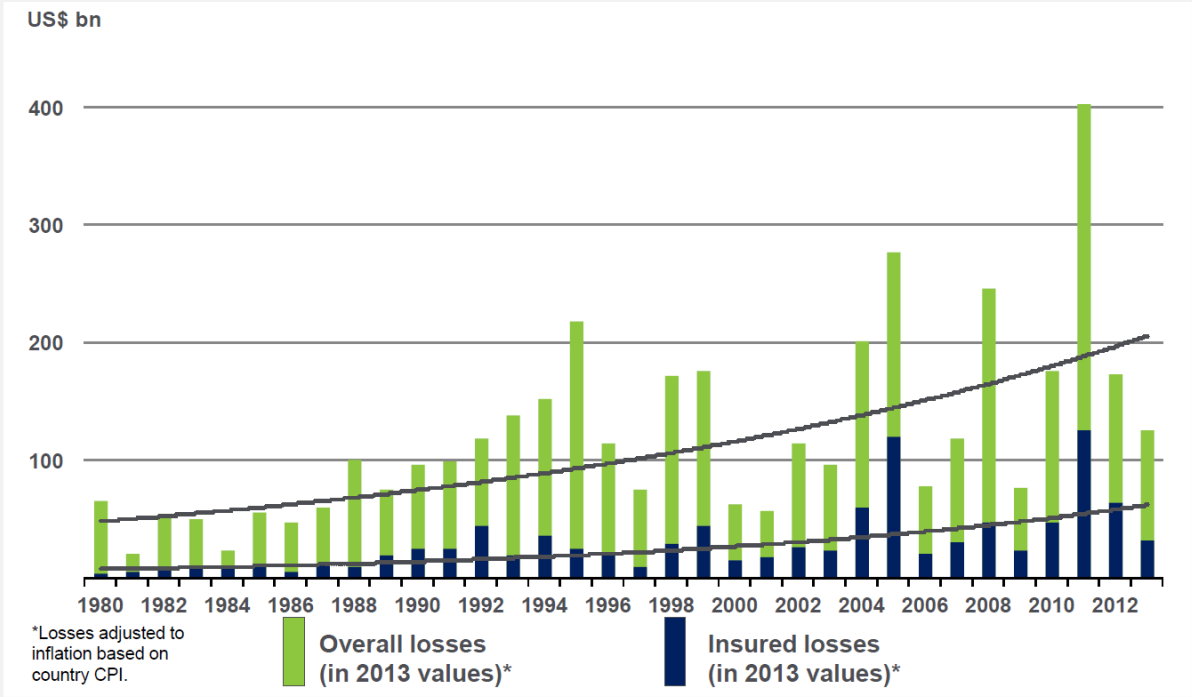
# Climate change

Global Natural Catastrophe Update

## Loss Events Worldwide 1980 – 2013

Overall and insured losses

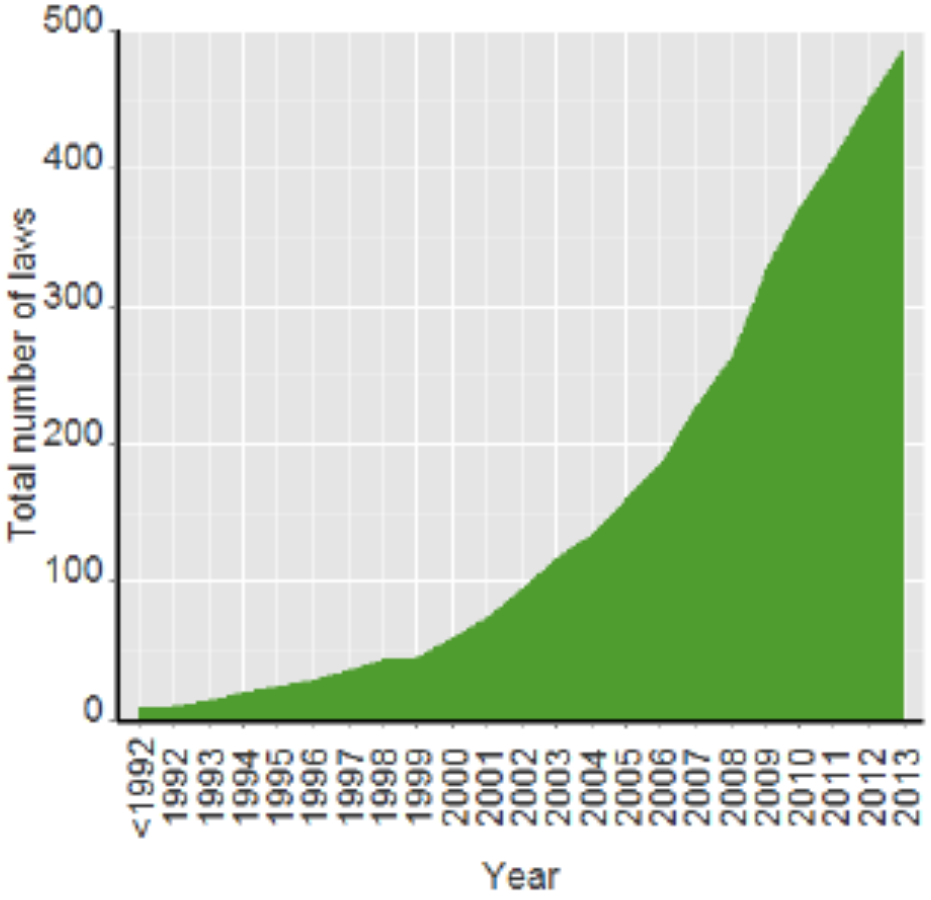
Munich RE




Source: Geo Risks Research, NatCat*SERVICE* – As at January 2014

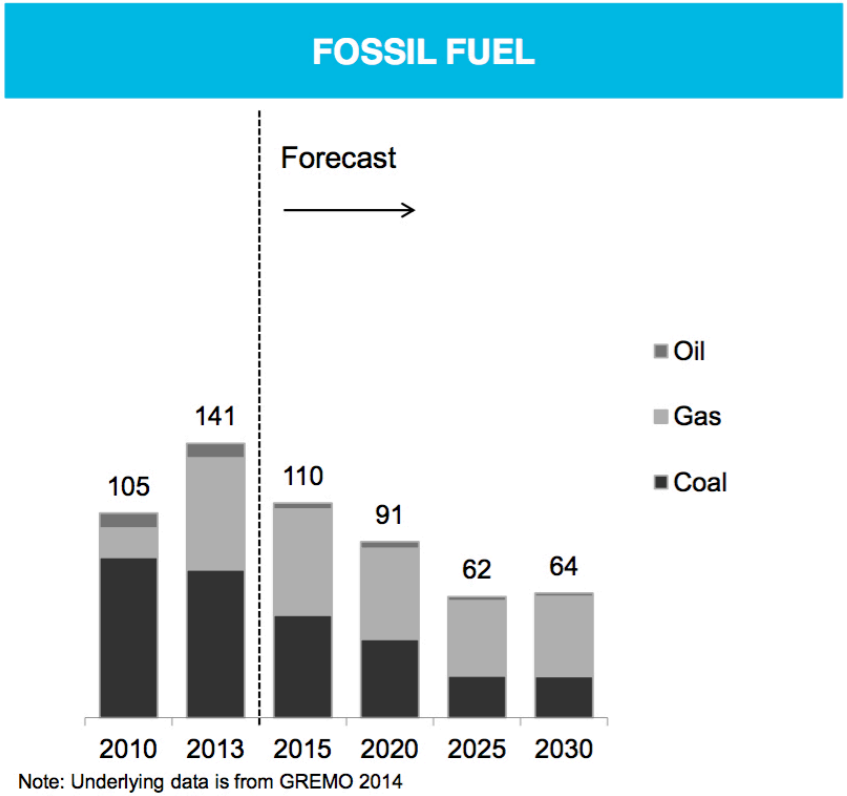
# Government regulations

- Over the past decade climate change regulations globally have increased rapidly.
- According to Globe International, 88% of global CO2 emissions come from 66 countries.
- These countries currently have 487 laws pertaining to climate change, up from <100 in 2002, and <40 in 1997.

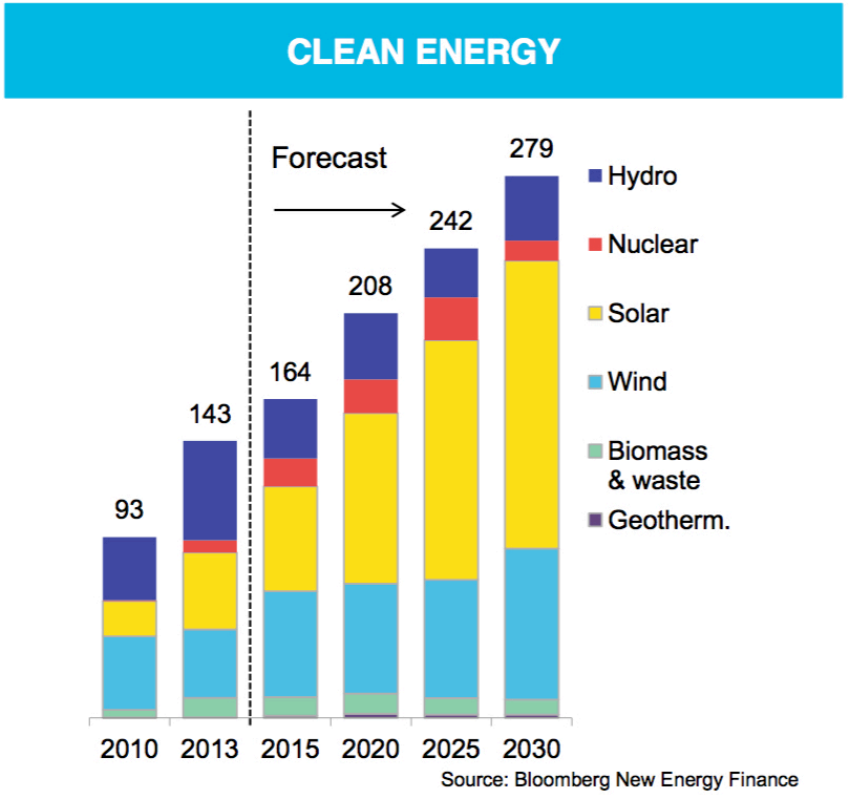



Source: Globe International, Globe Climate Legislation Study 4th edition

# New technologies – clean vs fossil generation investment (bn $)

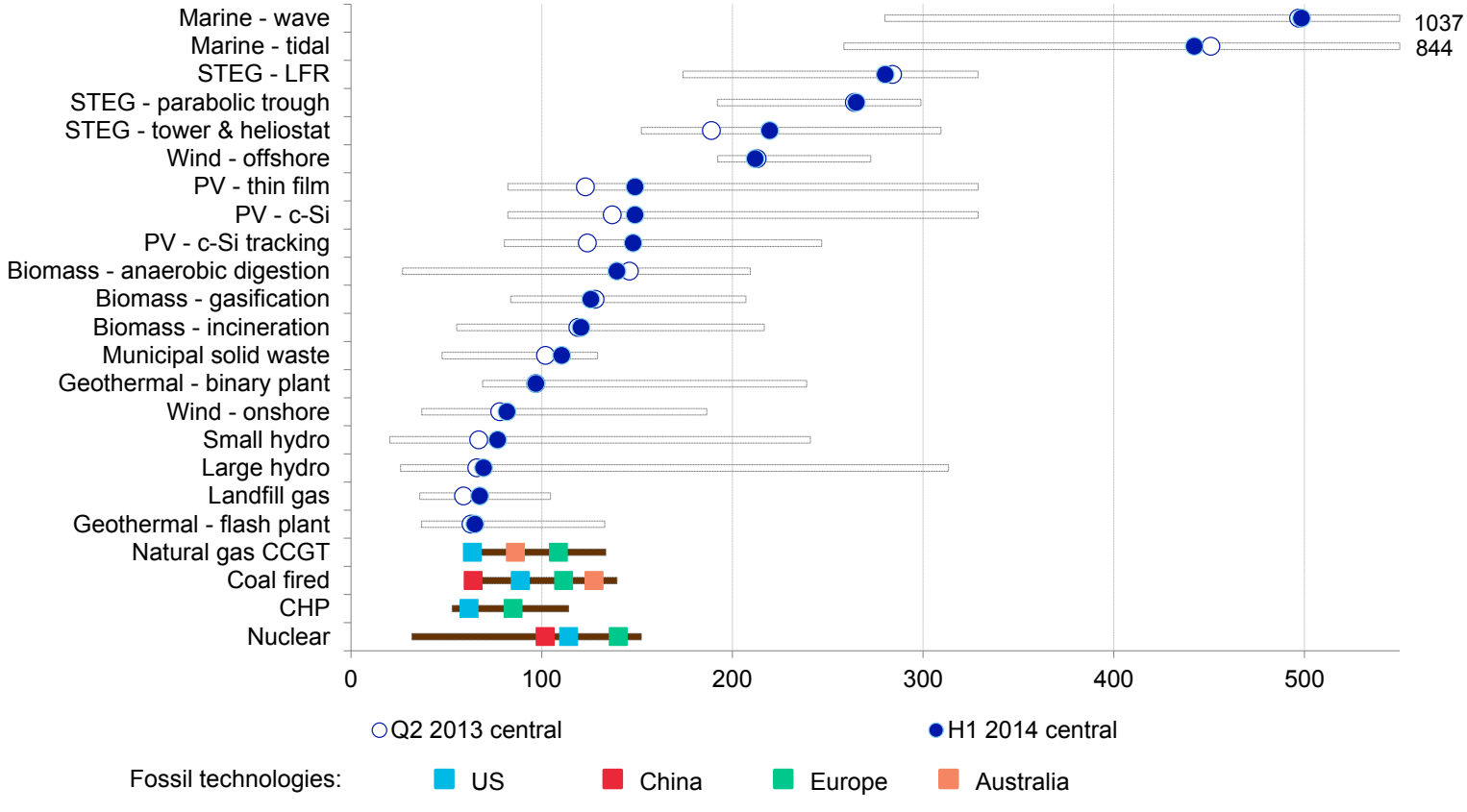



Note: Underlying data is from GREMO 2014



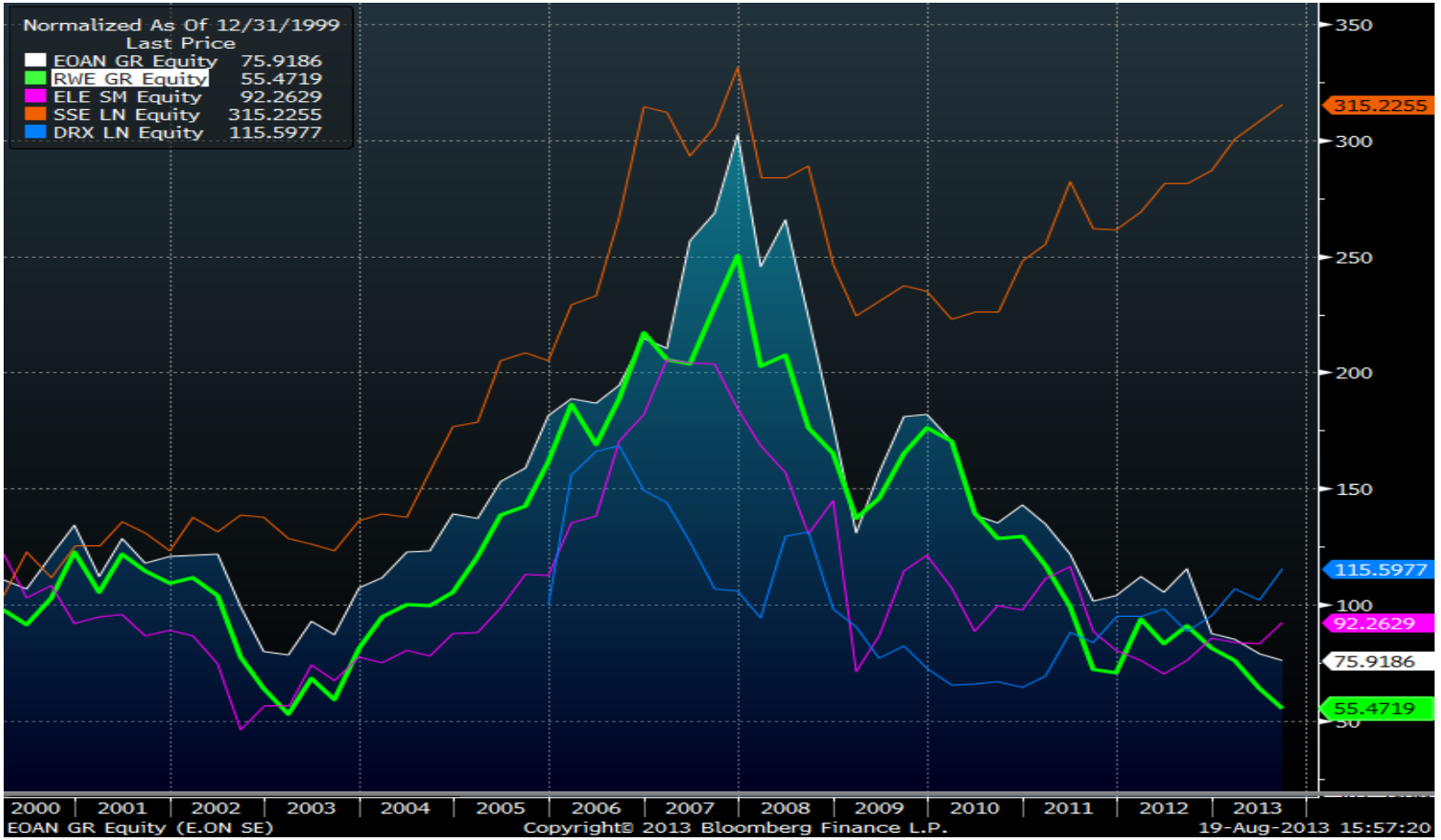

Source: Bloomberg New Energy Finance

# New technologies – LCOE Q2 2013 vs H1 2014, $/MWh



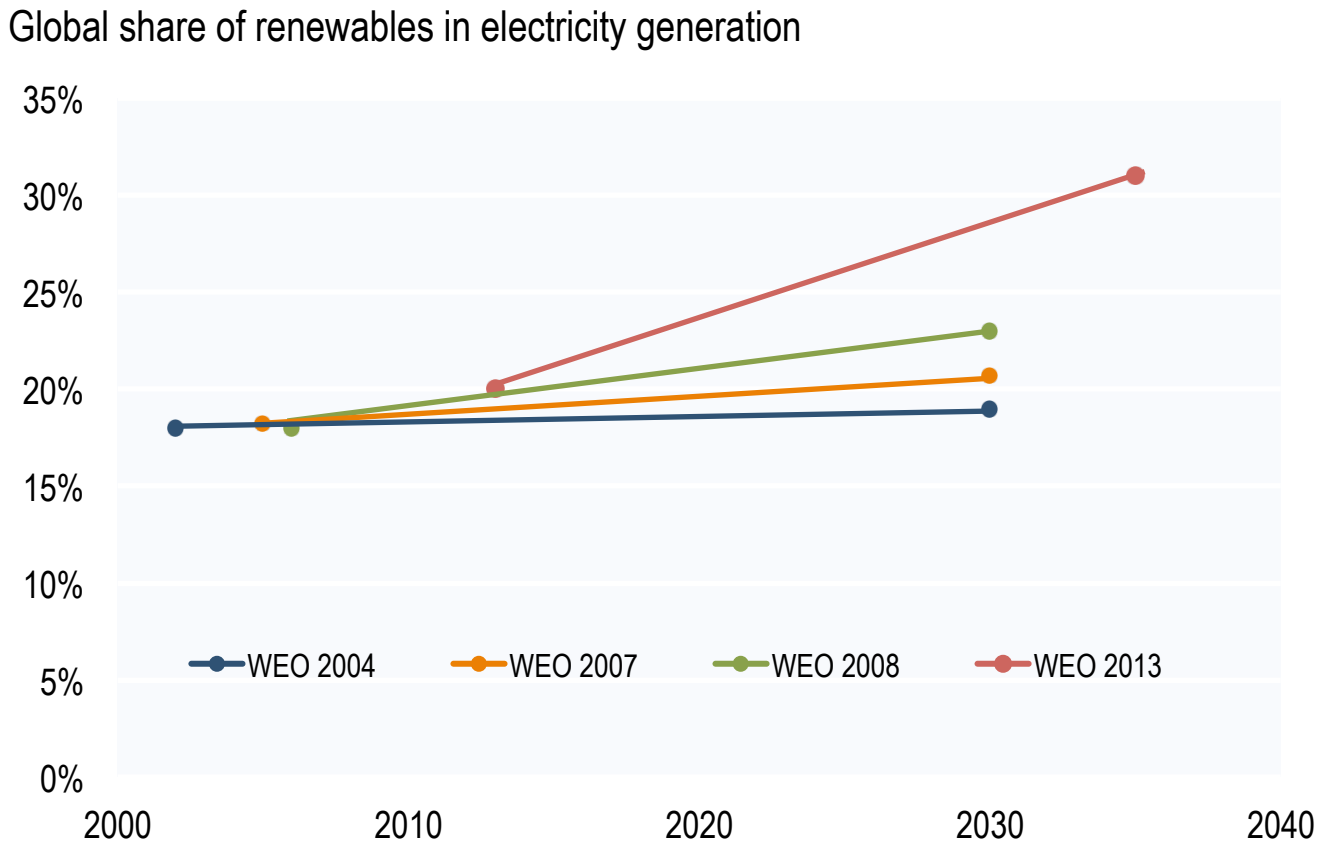

Source: Bloomberg New Energy Finance

# New technologies – EU Utility Share Prices



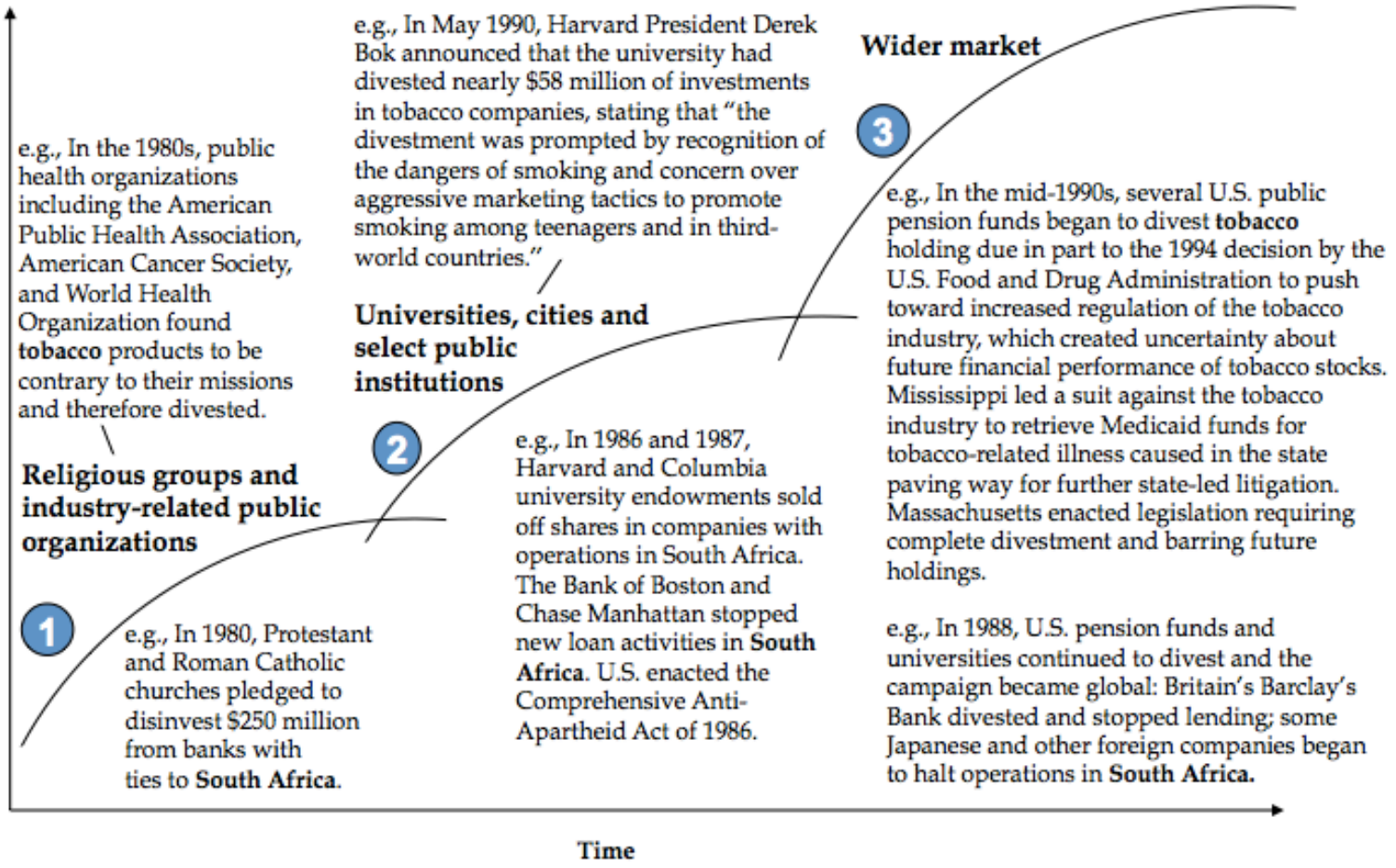

Source: Bloomberg

# Technologies move faster than projections




Source: OECD analysis based on projections of IEA World Energy Outlooks in Reference Scenarios of WEO 2004, 2007 and 2008, and New Policies Scenarios in WEO 2013.

# The three waves of a divestment campaign



# Stranded assets – A developing literature


2011 2012 2013

## ‘Unburnable Carbon’ – significant attention, what impacts?

- Implications of “carbon bubble” imposed by climate policy for the value of fossil-fuel industry has inspired debate

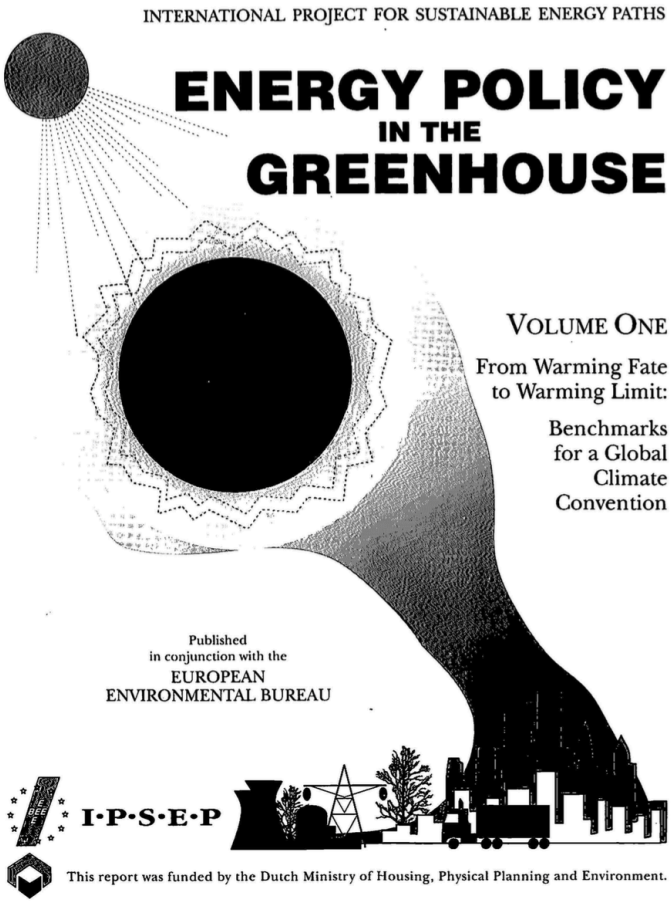
## Nuanced perspective? Components of value, sectoral and geographic approaches

- Acknowledgement of environment-related risks
- Increasing involvement of actors: Banks, Analysts, Universities, IGOs
- Examination of more detailed risk, impact, and response profiles
- Shift beyond equity to examining debt, capex, cost of capital
- Differentiation among assets, projects, products – move to cost-curve approach

## Mixed actions and responses across the investment chain

- Increasing public awareness and concern in different countries/regional markets
- Development of fossil-fuel divestment campaigns in the US and EU
- Shareholder resolutions, notable divestment actions, pressure for increased performance

# 'Energy Policy in the Greenhouse: From Warming Fate to Warming Limit' by Florentin Krause, Wilfrid Bach, and Jon Koomey (September 1989)




**5. Allowable depletion of fossil fuel resources**

**A 300 btC budget means major restrictions on the use of global fossil resources. The quantitative implications for alternative fuel mixes can be seen from the data in Table I.4.3. At the 1985 mix of fuels, the consumption of fossil resources would be limited as follows:**

- **no more than 64 percent of total oil resources;**
- **no more than 47 percent of conventional gas resources;**
- **no more than 22 percent of the cheaper coal resources.**

**These figures clash with the conventional assumption that all conventional oil and gas resources would probably be consumed before a major shift away from fossil fuels would occur. Our analysis suggests that:**

- **climate stabilization requires keeping significant portions of even the world's conventional fossil resources in the ground.**

**Such a requirement is a stark contradiction to all conventional energy planning and illustrates the magnitude of the greenhouse challenge.**

# Fossil Fuels – not just about listed reserves

- **Upstream/Production**
  - Exploration and production
  - Most work on stranded assets focused on listed reserves in London and NYC

- **Midstream/Transmission**
  - Pipelines and Transmission
  - Redundant infrastructure – e.g. Australia and grid reinforcements

- **Downstream/Generation**
  - Refineries
  - Generation assets
  - Subcritical coal – most at risk (carbon, air, and water)

- **Other sectors too!**
  - Agriculture
  - Property
  - Transport
  - Etc etc

# Upstream: Environment-related factors changing demand

**Environment-related factors that could reduce demand for Australian coal**

- Carbon pricing and trading
- Coal to liquids and chemicals
- Coal quality
- Energy intensity and efficiency
- Environmental concern
- Gas and shale gas
- Iron and steel sector
- Local pollution
- Non-fossil fuel energy and electricity
- Water

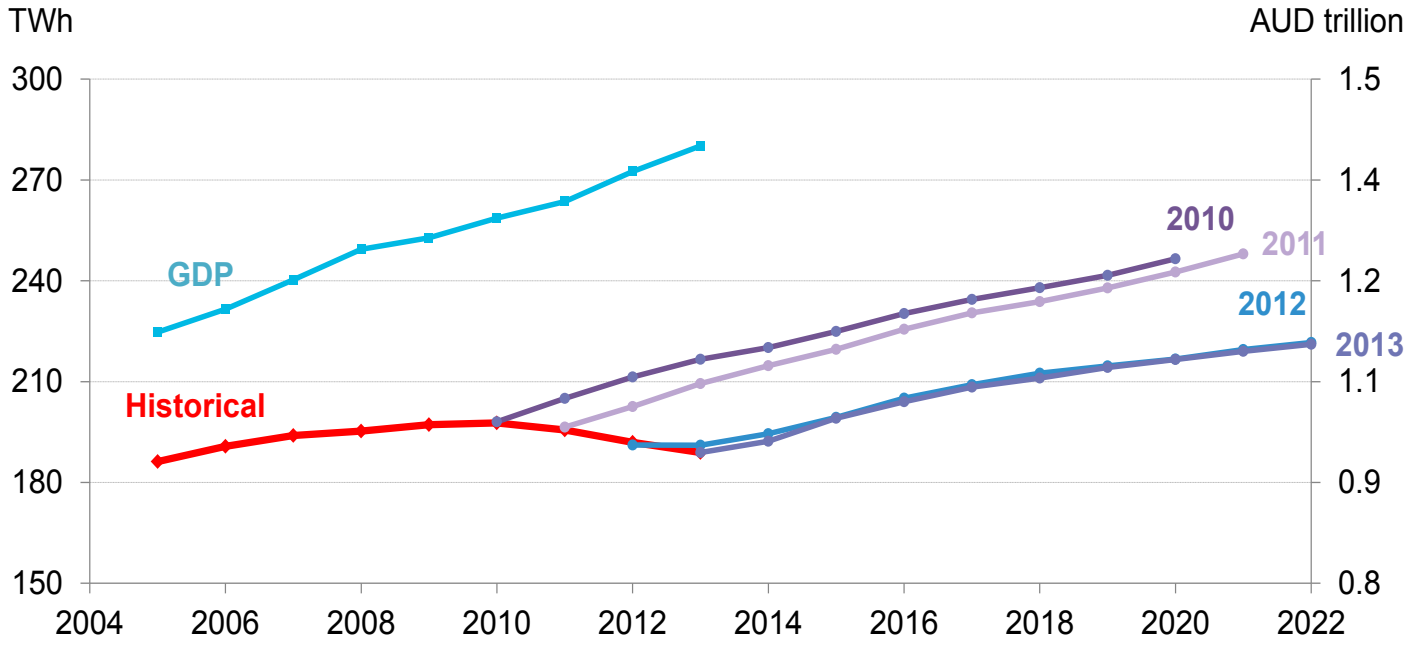
**What is exposed?**

- Value of mineral resources in the ground
- Value of infrastructure investments
- Revenue from mining royalties and company tax; losses from joint ventures and under-utilised or unused infrastructure

**Who is exposed?**

- Publically-listed coal intensive companies; companies exposed to the supply chain – infrastructure and transport
- Investors and employees in coal companies and dependent companies
- State and federal governments
- Towns and cities exposed to significant mining sector employment

# Midstream: Energy demand and "poles and wires"




Source: Australian Energy Market Operator, Reserve Bank of Australia, Bloomberg New Energy Finance

- **Retail prices for electricity in Australia have nearly doubled since 2007.**
- **By a large margin greatest source of increase has been the network charges for transmitting and distributing.**
- **Over-engineered given falling demand and encouraging death spiral phenomenon.**

# Downstream: Subcritical coal

**•Coal provides 40% of the world's electricity, with 1,617 GW of global capacity. Of this capacity, 75% is subcritical, 22% supercritical, and 3% ultra-supercritical.**

**•Average subcritical coal-fired power station (SCPS) emits 75% more carbon pollution than an average advanced ultra-supercritical - the most up-to-date form of coal-fired power station - and uses 67% more water. More vulnerable to concerns about climate change, air pollution, and water stress.**

| Generation Efficiency | Carbon Intensity | Air Pollution | Water Stress |
|---|---|---|---|
| Old Inefficient Subcritical | 100 | 100 | 100 |
| Old Efficient Subcritical | 84 | 84 | 85 |
| New Subcritical | 68 | 68 | 70 |
| Supercritical | 57 | 57 | 60 |
| Ultra-Supercritical | 52 | 52 | 55 |
| Advanced Ultra-Supercritical | 48 | 48 | 51 |

Note: Indicated levels of environmental effects based off of ceteris paribus generating conditions for a closed-cycle wet-cooled plant. Water stress levels based off of EPRI (2008).[13]

**•To limit global emissions to a level consistent with a 2°C future, the IEA estimates that it will be necessary to close a quarter (290 GW) of subcritical generation worldwide by 2020.**

- Subcritical coal accounted for 8.6 GtCO2 of emissions globally in 2009. For context, in 2010 annual gross greenhouse gas emissions globally totalled ~50 GtCO2-equivalent.

# Top 20 corporate portfolios highest carbon intensity

| Rank (Rank by total SCPS MWh) | Portfolio/Company | Country | State owned | Listed | Number of SCPSs | Total SCPS MWh | SCPS portfolio mean carbon intensity (kg CO2/MWh)† |
|---|---|---|---|---|---|---|---|
| 1 (84) | Neyveli Lignite Corp Ltd | India | YES | YES | 2 | 16,725,380 | 1,447 |
| 2 (93) | Mp Power Generating Co Ltd | India | YES | NO | 3 | 14,472,000 | 1,342 |
| 3 (44) | GDF Suez | France | NO | YES | 10 | 30,125,526 | 1,279 |
| 4 (64) | Kazakhmys Plc | Kazakhstan | NO | NO | 4 | 22,748,920 | 1,277 |
| 5 (74) | West Bengal Power Dev Corp | India | YES | NO | 5 | 18,568,000 | 1,269 |
| 6 (81) | Ogk-2 (second Generation Co) | Russia | NO | NO | 4 | 17,067,700 | 1,253 |
| 7 (33) | Maharashtra State Power Gen Co | India | YES | NO | 7 | 37,556,000 | 1,243 |
| 8 (96) | Electricity Generating Authority of Thailand | Thailand | YES | NO | 4 | 13,631,406 | 1,240 |
| 9 (87) | Termoelectrica | Romania | YES | NO | 17 | 15,257,687 | 1,226 |
| 10 (56) | Rao Ues Russia | Russia | YES | NO | 23 | 25,275,890 | 1,222 |
| 11 (48) | Cez As | Czech Republic | YES | YES | 13 | 29,522,734 | 1,220 |
| 12 (82) | East China Electric Power Corp | China | YES | NO | 8 | 17,035,085 | 1,186 |
| 13 (99) | Damodar Valley Corp | India | YES | NO | 5 | 13,048,590 | 1,178 |
| 14 (85) | Pt Indonesia Power - Suralaya | Indonesia | YES | NO | 1 | 16,644,000 | 1,170 |
| 15 (78) | Westar Energy Inc | United States | NO | YES | 3 | 17,637,600 | 1,155 |
| 16 (16) | North China Grid Co Ltd | China | YES | NO | 29 | 72,872,466 | 1,154 |
| 17 (51) | Guizhou Electric Power Co | China | YES | NO | 9 | 27,641,800 | 1,149 |
| 18 (36) | Polska Grupa Energetyczna | Poland | YES | YES | 2 | 36,020,000 | 1,141 |
| 19 (95) | Xishan Coal And Electricity | China | YES | YES | 3 | 13,660,800 | 1,140 |
| 20 (20) | State Grid Power Corp | China | YES | NO | 28 | 58,341,956 | 1,136 |

# Top 20 corporate portfolios highest PM 2.5 air pollution

| Rank (Rank by total SCPS MWh) | Portfolio/Company | Country | State owned | Listed | Number of SCPSs | Total SCPS MWh | SCPS portfolio mean 100km radius PM 2.5 levels |
|---|---|---|---|---|---|---|---|
| 1 (49) | State Power Central Co | China | YES | NO | 6 | 28,836,060 | 75 |
| 2 (16) | North China Grid Co Ltd | China | YES | NO | 29 | 72,872,466 | 66 |
| 3 (10) | China Resources Power Holdings | China | YES | YES | 29 | 97,645,759 | 66 |
| 4 (20) | State Grid Power Corp | China | YES | NO | 28 | 58,341,956 | 61 |
| 5 (53) | Shenergy Company Ltd | China | YES | YES | 3 | 27,240,107 | 60 |
| 6 (82) | East China Electric Power Corp | China | YES | NO | 8 | 17,035,085 | 59 |
| 7 (80) | Punjab State Electricity Board | India | YES | NO | 3 | 17,197,000 | 53 |
| 8 (54) | Citic Pacific Ltd | China | YES | YES | 6 | 26,846,285 | 52 |
| 9 (8) | China Power Investment Corp | China | YES | NO | 41 | 129,003,080 | 51 |
| 10 (2) | Huadian Group | China | YES | YES | 69 | 284,448,220 | 50 |
| 11 (52) | Beijing Energy Invest Holding | China | YES | NO | 4 | 27,519,000 | 48 |
| 12 (95) | Xishan Coal And Electricity | China | YES | YES | 3 | 13,660,800 | 48 |
| 13 (70) | Uttar Pradesh Rajya Vidyut | India | YES | NO | 5 | 21,017,800 | 47 |
| 14 (4) | China Datang Corp | China | YES | YES | 52 | 211,691,720 | 46 |
| 15 (1) | China Huaneng Group | China | YES | YES | 66 | 320,928,260 | 44 |
| 16 (74) | West Bengal Power Dev Corp | India | YES | NO | 5 | 18,568,000 | 43 |
| 17 (3) | China Guodian Group | China | YES | YES | 65 | 267,433,170 | 43 |
| 18 (51) | Guizhou Electric Power Co | China | YES | NO | 9 | 27,641,800 | 43 |
| 19 (83) | Rajasthan Rv Utpadan Nigam | India | YES | NO | 4 | 16,837,000 | 42 |
| 20 (99) | Damodar Valley Corp | India | YES | NO | 5 | 13,048,590 | 41 |

# Top 20 corporate portfolios greatest water stress

| Rank (Rank by total SCPS MWh) | Portfolio/Company | Country | State owned | Listed | Number of SCPSs | Total SCPS MWh | SCPS portfolio mean water stress |
|---|---|---|---|---|---|---|---|
| 1 (52) | Beijing Energy Invest Holding | China | YES | NO | 4 | 27,519,000 | 100.00% |
| 2 (79) | Origin Energy | Australia | NO | YES | 1 | 17,482,000 | 100.00% |
| 3 (95) | Xishan Coal And Electricity | China | YES | YES | 3 | 13,660,800 | 100.00% |
| 4 (97) | Intermountain Power Agcy | United States | NO | NO | 1 | 13,556,000 | 100.00% |
| 5 (83) | Rajasthan Rv Utpadan Nigam | India | YES | NO | 4 | 16,837,000 | 98.72% |
| 6 (80) | Punjab State Electricity Board | India | YES | NO | 3 | 17,197,000 | 92.22% |
| 7 (84) | Neyveli Lignite Corp Ltd | India | YES | YES | 2 | 16,725,380 | 91.51% |
| 8 (16) | North China Grid Co Ltd | China | YES | NO | 29 | 72,872,466 | 87.97% |
| 9 (30) | Saudi Electricity Co | Saudi Arabia | YES | YES | 78 | 41,446,725 | 86.32% |
| 10 (42) | Korea Southern Power (kospo) | South Korea | YES | YES | 2 | 31,095,500 | 84.43% |
| 11 (82) | East China Electric Power Corp | China | YES | NO | 8 | 17,035,085 | 76.79% |
| 12 (64) | Kazakhmys Plc | Kazakhstan | NO | NO | 4 | 22,748,920 | 72.08% |
| 13 (85) | Pt Indonesia Power - Suralaya | Indonesia | YES | NO | 1 | 16,644,000 | 68.76% |
| 14 (61) | Gujarat Urja Vikas Nigam Ltd | India | YES | NO | 8 | 23,366,839 | 68.56% |
| 15 (90) | J-power | Japan | NO | YES | 4 | 14,642,370 | 66.81% |
| 16 (26) | Xcel Energy | United States | NO | YES | 11 | 49,584,827 | 66.47% |
| 17 (91) | Delta Electricity | Australia | YES | NO | 2 | 14,633,400 | 65.49% |
| 18 (49) | State Power Central Co | China | YES | NO | 6 | 28,836,060 | 64.95% |
| 19 (4) | China Datang Corp | China | YES | YES | 52 | 211,691,720 | 64.24% |
| 20 (76) | Tamil Nadu Electricity Board | India | YES | NO | 5 | 18,136,518 | 63.72% |

# Why do stranded assets matter?

- **Size of potential VaR and risk at variety of levels, sectors and geographies**
  - e.g. listed and unlisted, equity, debt, sovereign, business models, and development strategies

- **Stranded assets are beginning to have real impacts today**
  - Firms in many sectors have been left with significant asset impairments and write-downs, necessitating changes in strategy

  - **Asset stranding is occurring in unexpected and counterintuitive ways in some sectors**
  - Domino effect and correlation

  - **Asset stranding may increase the costs of achieving sustainable and resilient economies, for firms, governments, and society**
  - Potential negative impacts on efficient transitions to sustainable business models, the ability of governments to facilitate effective low-carbon transitions, and the stability of the global economy and financial system

# Criticisms and counter arguments

- *"Short term valuations insulate investors from these long term risks."*
  - **Counter argument**: Some environment-related risk factors are actually quite immediate, with complex relationships emerging.

- *"Markets already appropriately value environmental risks."*
  - **Counter argument**: Vast quantities of evidence show that global financial markets are mispricing or ignoring these risk factors.

- *"This is just the same as creative destruction elsewhere in the economy, why care?"*
  - **Counter argument**: Confluence of related risk factors is significant; drivers, consequences and responses to such stranding are still not understood.

- *"Even if there are stranded assets, markets will have time to readjust."*
  - **Counter argument**: Flexibility depends on time horizons; exits always appear bigger than they actually are and liquidity could be a major problem under certain scenarios.

# Systemic risk?

**•Levels of exposure across different parts of the financial and economic systems likely to be very significant.**

- Listed equities are the only area where we currently have ok data.

**•Bank of England tests:**

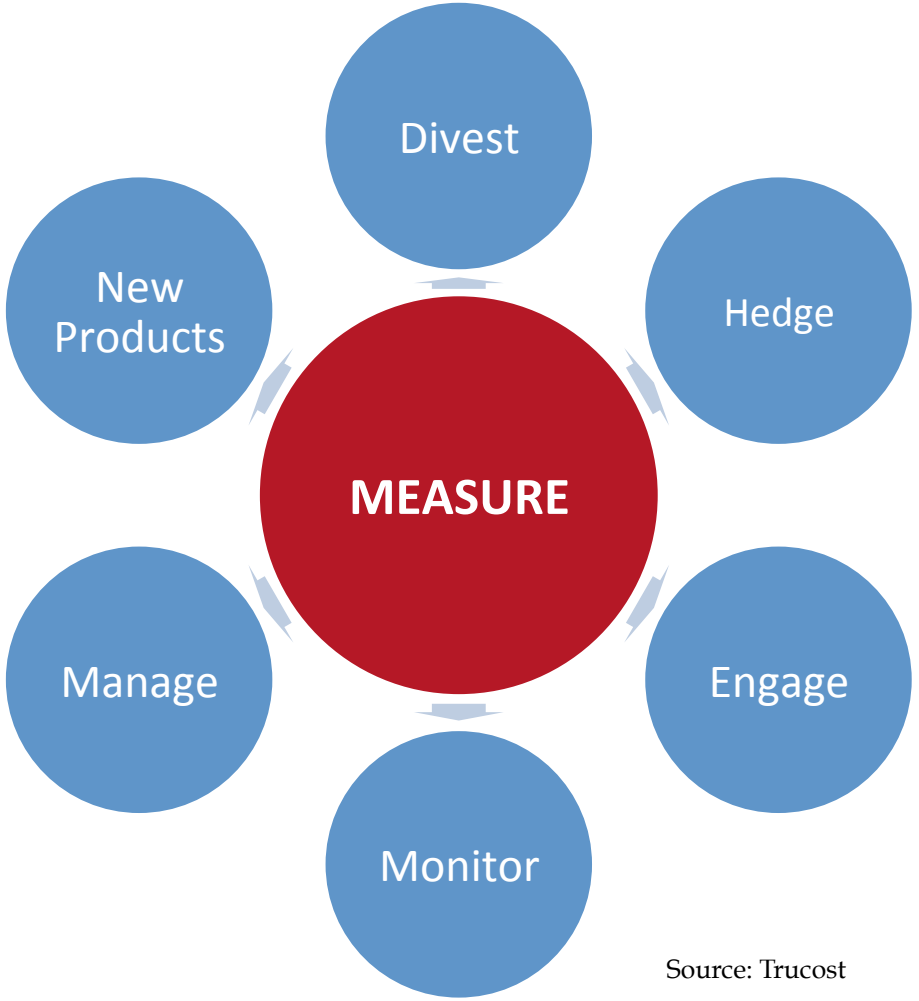
- Exposures of financial institutions to carbon-intensive sectors are large relative to overall assets;
- Impact of policy and technology is not already being priced into the market, either through lower expected returns or higher risk premia;
- Subsequent correction would not allow financial institutions to adjust their portfolios in an orderly manner.

**•What could central bankers and financial regulators do?**

- Track exposure; stress testing; macro-prudential tools to deflate exposure.

# Managing risk

- Need to understand whether risks are material and when they might be material.
- Monitor, measure, track.
- Scenarios and stress testing.
- Time horizons, sequencing and correlations.
- Quantitative vs qualitative (risk vs uncertainty).
- Embed in credit risk/due diligence processes.




Source: Trucost