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Our research path

2011



UNBURNABLE CARBON

Based on carbon budget allowed to keep below 2° C of global warming, there is more fossil fuel listed on the world's capital markets than can be burned.

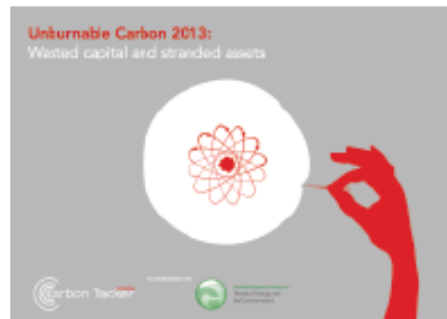


2013



WASTED CAPITAL & STRANDED ASSETS

We alerted the financial world that \$674bn invested annually in “unburnable” fossil fuel assets can potentially become stranded.



2014



CARBON SUPPLY COST CURVE

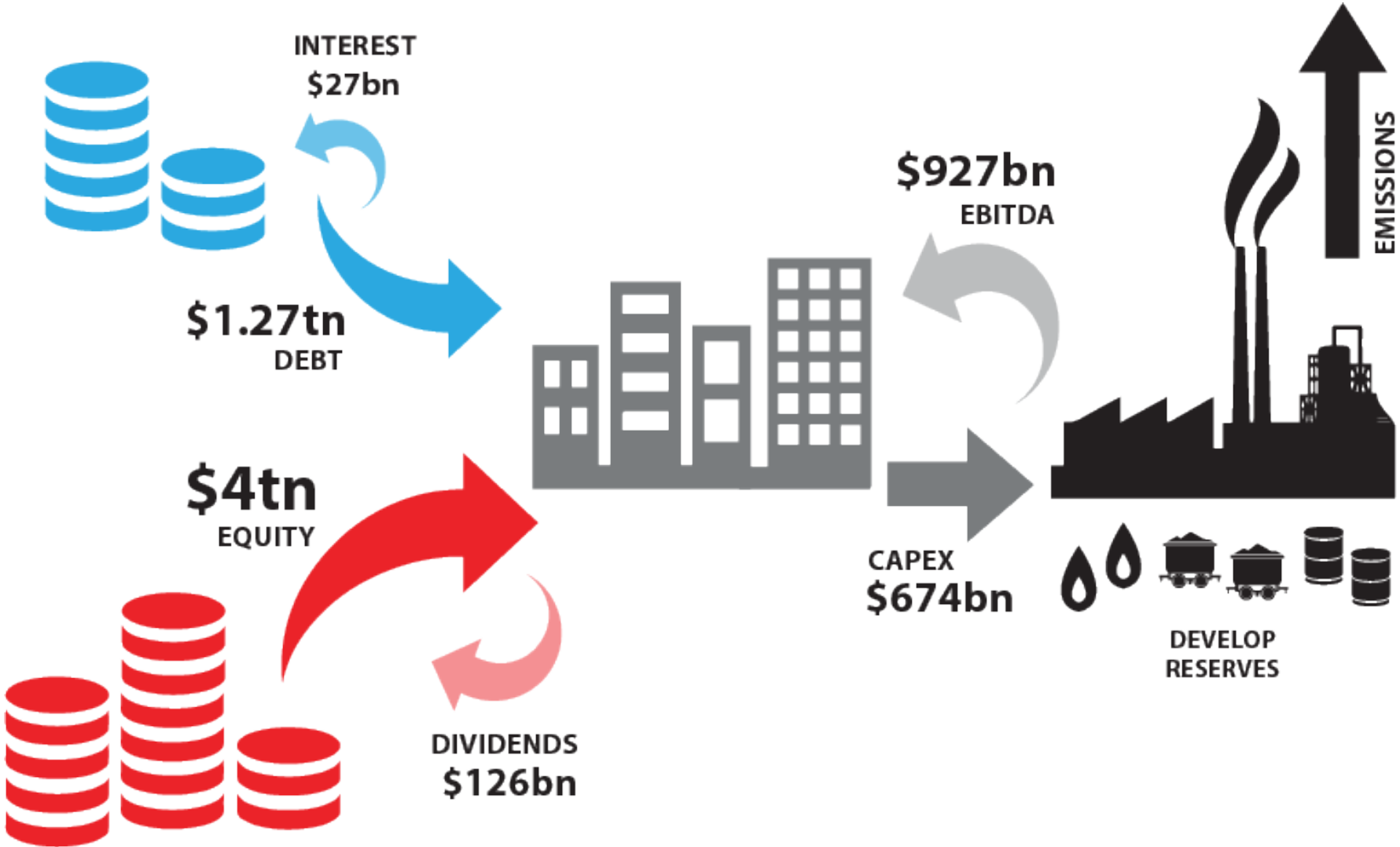
Investors now need more market insight in order to understand how to manage the carbon asset risk. The first report of the new research series is focused on oil.



There is an overhang of carbon: Fossil fuel reserves > carbon budget

- [IEA](#): *“No more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2 °C goal, unless carbon capture and storage (CCS) technology is widely deployed.”*
- [Shell](#): *“The issue of the bubble arises because the combined proven oil, gas and coal reserves currently on the books of fossil fuel companies (and governments in the case of NOCs) will produce far more than this amount of CO₂ when consumed.”*
- [BP](#): *“We agree that burning all known reserves would probably cause global temperatures to rise by more than 2°C – and that addressing this issue will require the efforts of governments, industry and individuals.”*

Rebalancing is needed between flows of capital in extractives companies.



2013 – the year of peak coal capex?

The Telegraph

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Killer coal finally falls out of fashion

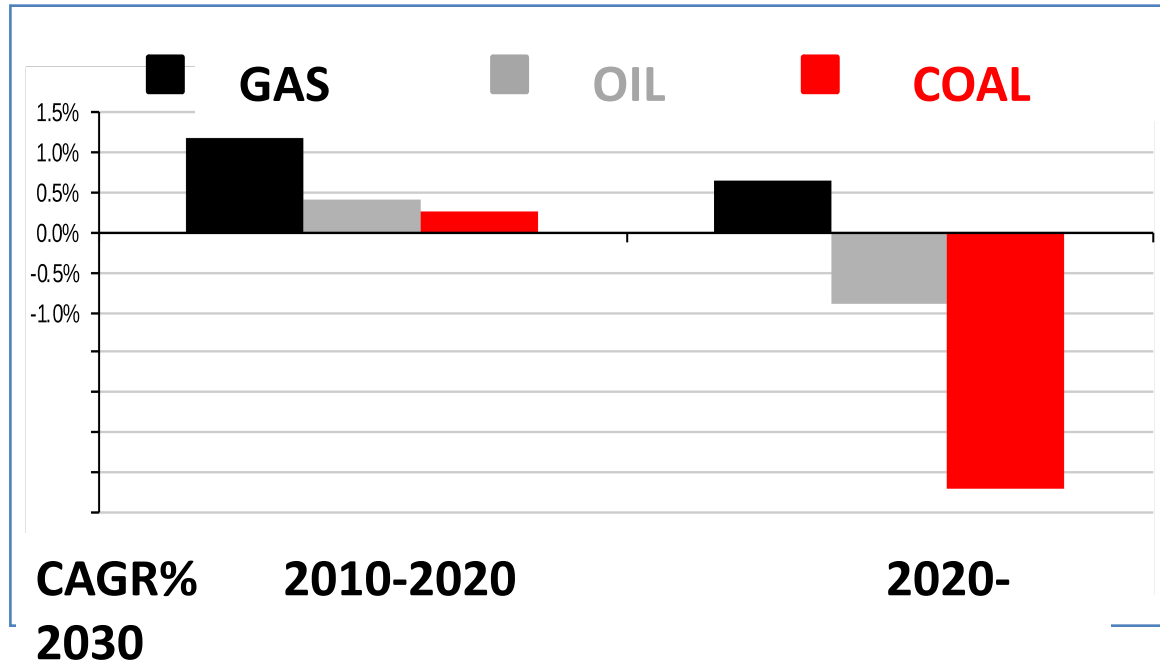
There are welcome signs that coal – possibly the planet's deadliest substance – is being sidelined in India and China


BERNSTEINRESEARCH

Asian Coal & Power: Less, Less, Less...
The Beginning of the End of Coal

- Expensive coal not competitive in a soft market
- Risk of oversupply weakening prices and asset values further
- China taking action on air quality and carbon
- Structural decline or cyclical phase?

IEA 450ppm scenario impacts demand



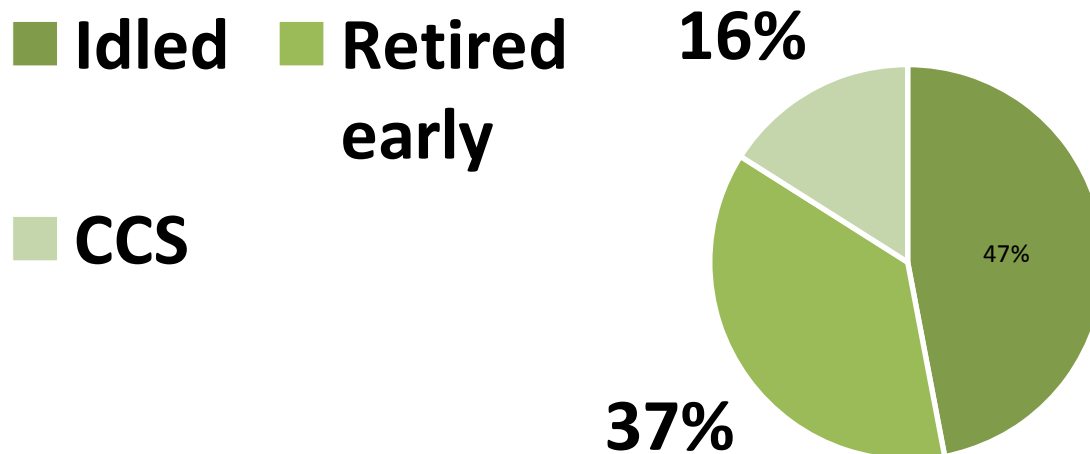
- Impact on price?
- Coal most exposed?

“Only 20% of global coal reserves can be developed by 2050 without CCS in the 450 scenario”

(IEA Redrawing the Energy Climate map 2013)

IEA identify impaired generation assets

Power Generation Assets



(IEA Redrawing the Energy Climate map 2013)

- 2300GW affected under 450ppm scenario
- Over half of existing power generation capacity

Implications for credit ratings

**S T A N D A R D
& P O O R ' S**
RATINGS SERVICES

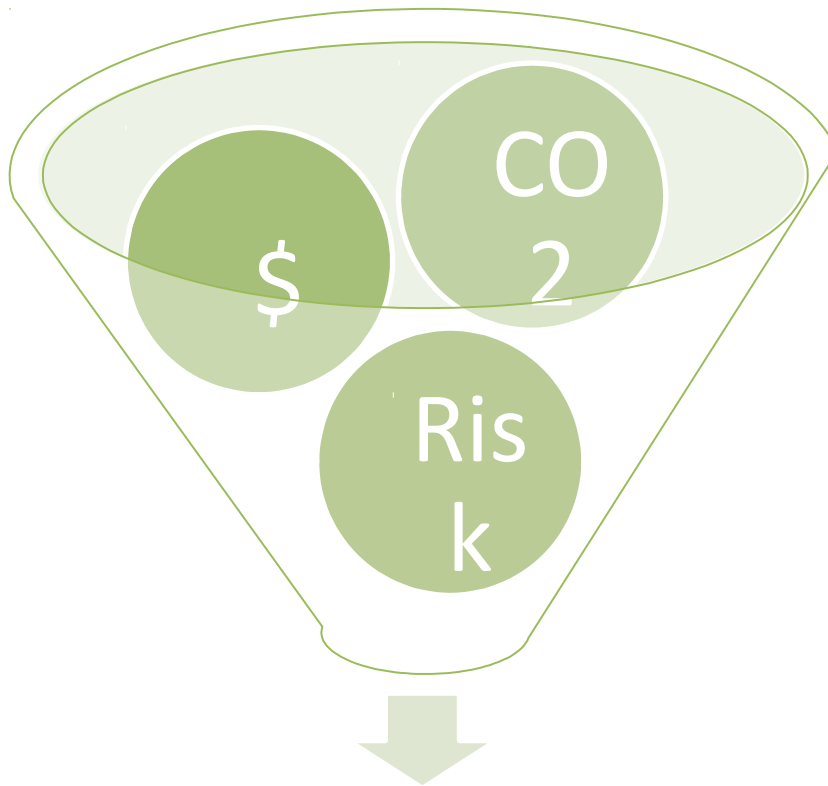
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What A Carbon-Constrained Future
Could Mean For Oil Companies'
Creditworthiness

“Financial models that only rely on **past performance** and creditworthiness are an insufficient guide for investors.”

Analysis of oilsands operators: “We note that under a meaningfully lower long-term oil price, the commercial viability of undeveloped reserves and hence the core **business model** could come into question unless development costs also fall. This could potentially result in a downgrade of more than one notch if we were to place less reliance on undeveloped or probable reserves than at present.”

Which oil reserves and which potential capital expenditure is at risk?



CAPEX TO REVIEW

Inputs:

Rystad Energy database of project economics and estimated ultimately recoverable reserves

900GtCO₂ Carbon Budget with 360GtCO₂ allocated to oil as a 2°C reference scenario

Output:

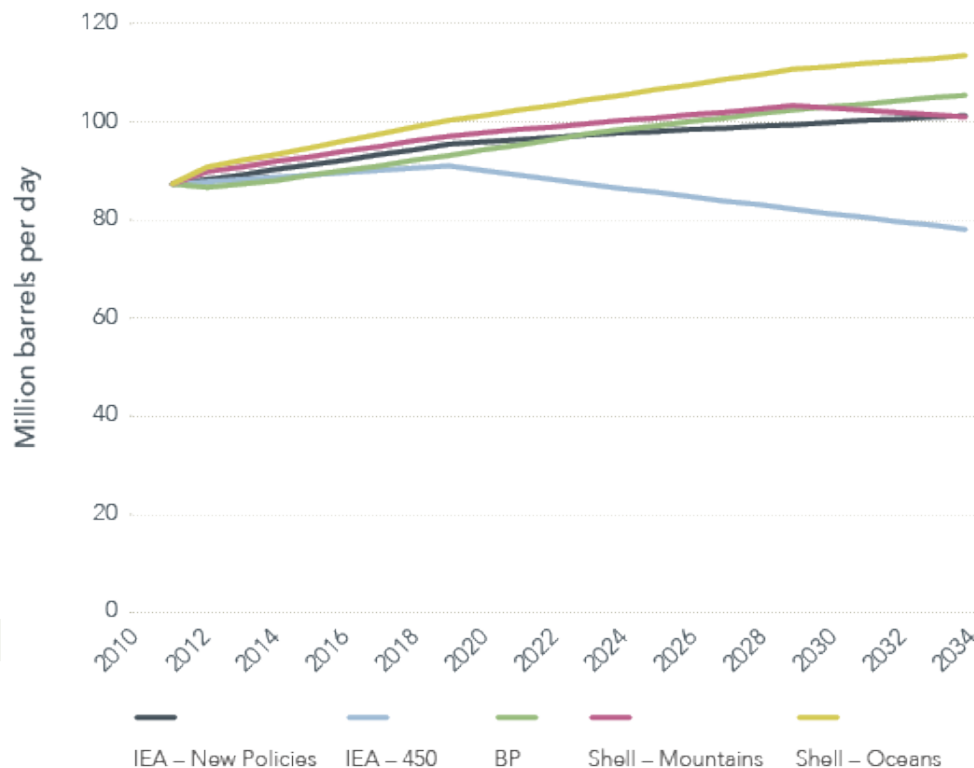
Breakdown by price, geography, oil type and company

Demand & Price Assumptions

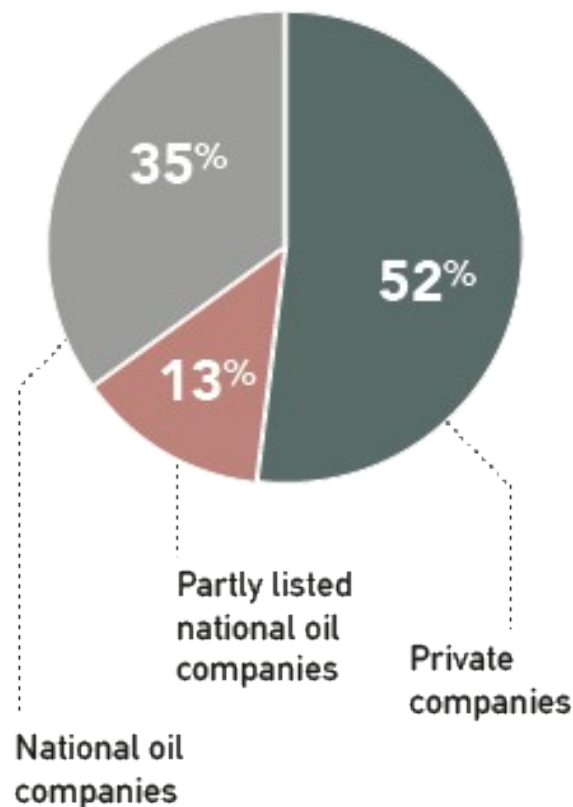
Key drivers

- Chinese Economic Growth
- Vehicle Efficiency & Alternatives
- Air quality measures
- Oil price outlook

Investors need to understand resilience to a range of scenarios, not just BAU.



Ownership: Private sector has a major role in potential oil production (2014-2050)



*% of total potential
oil production 2014-2050*

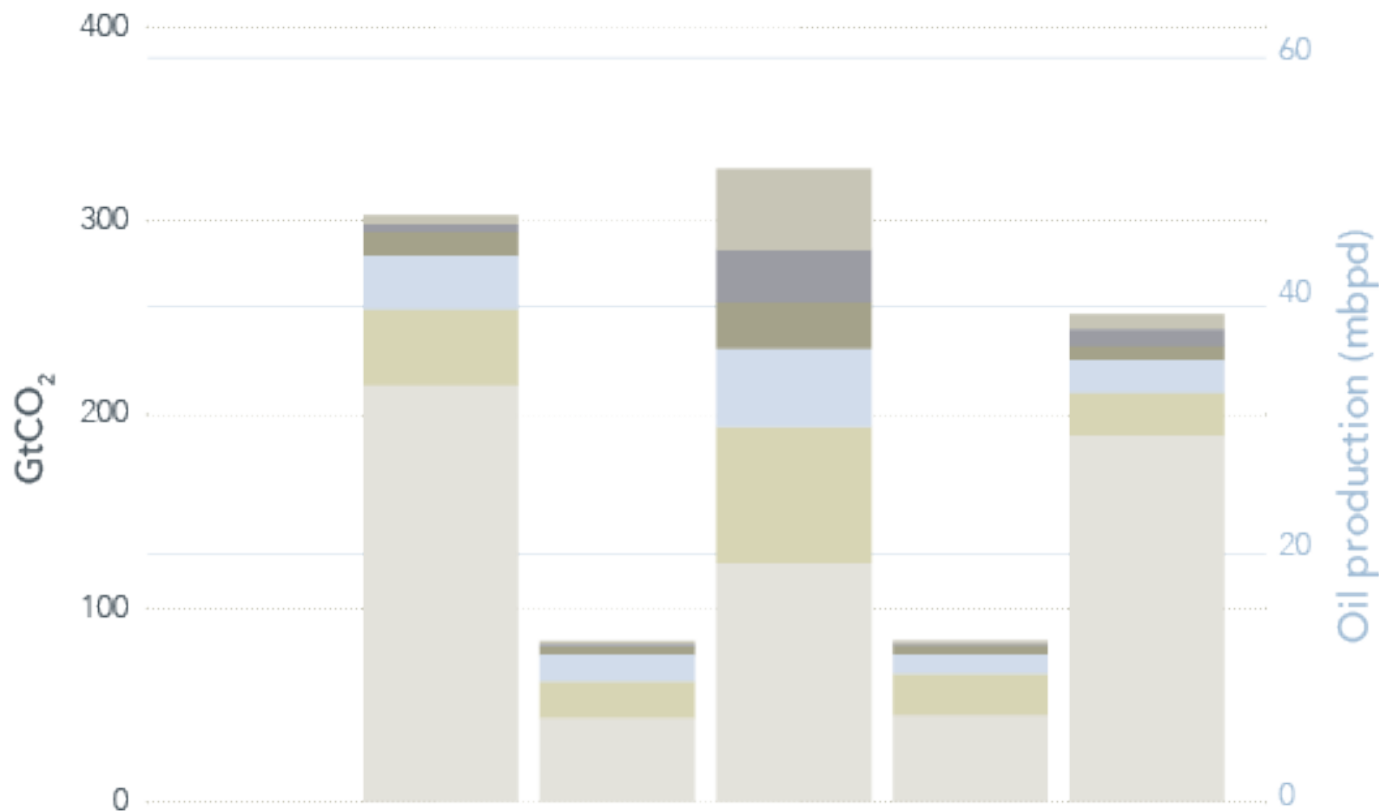
Potential Production:

This paints a different picture to the basic macro level reserves statistics which are dominated by governments.

Who owns cheap oil?

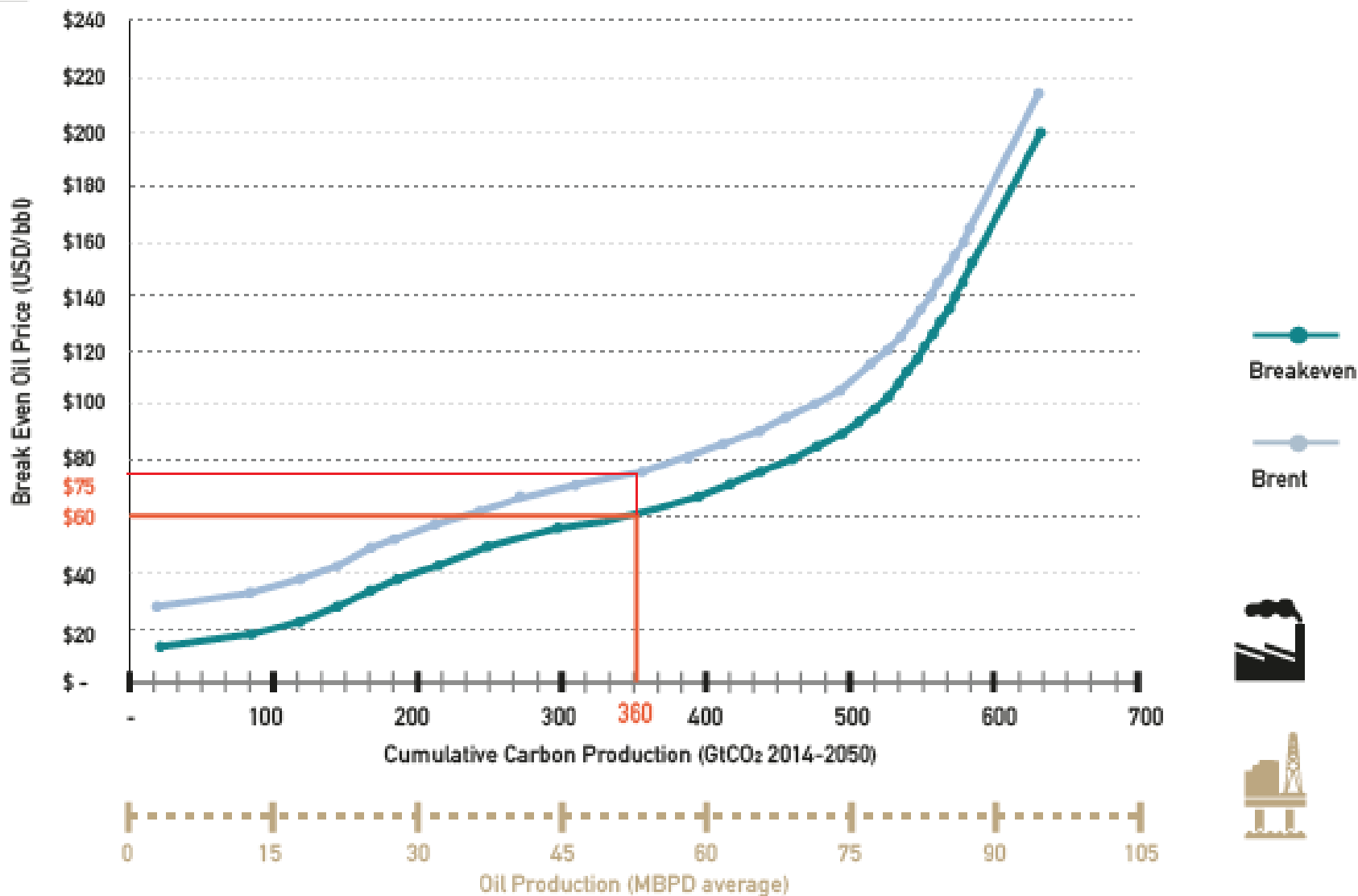
Need to know where it is on the cost curve to understand if it marginal production under a low demand/price scenario

Ownership: Distribution across the cost curve varies between company types



	NOCs	Part-listed	Private	Majors	OPEC
Above \$150	5	2	42	1	8
\$120-150	4	1	27	2	9
\$100-120	12	4	24	4	7
\$80-100	28	14	42	10	17
\$60-80	39	19	70	21	22
\$0-60	215	43	125	46	189

Carbon Supply Cost Curves: Oil

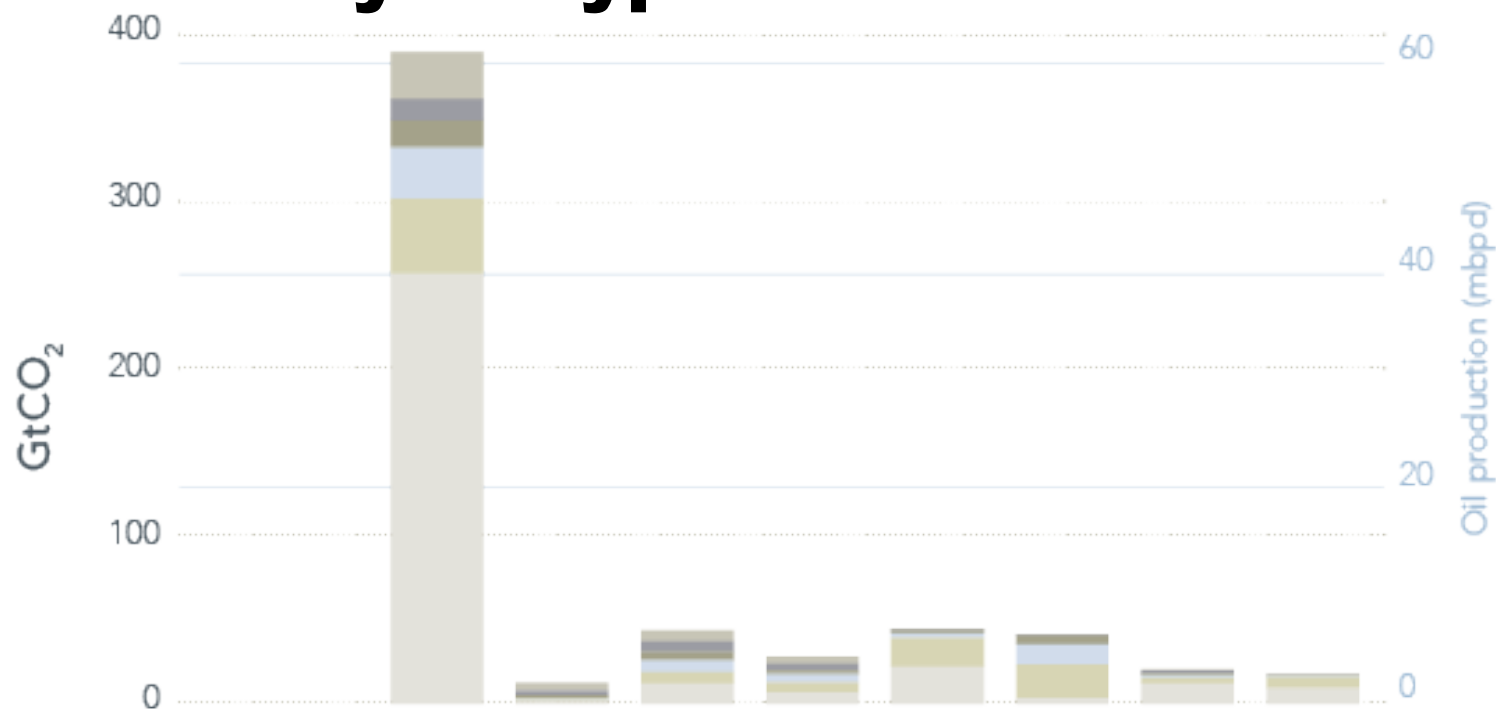


(2014-2050)

Focusing on oil production requiring above \$95

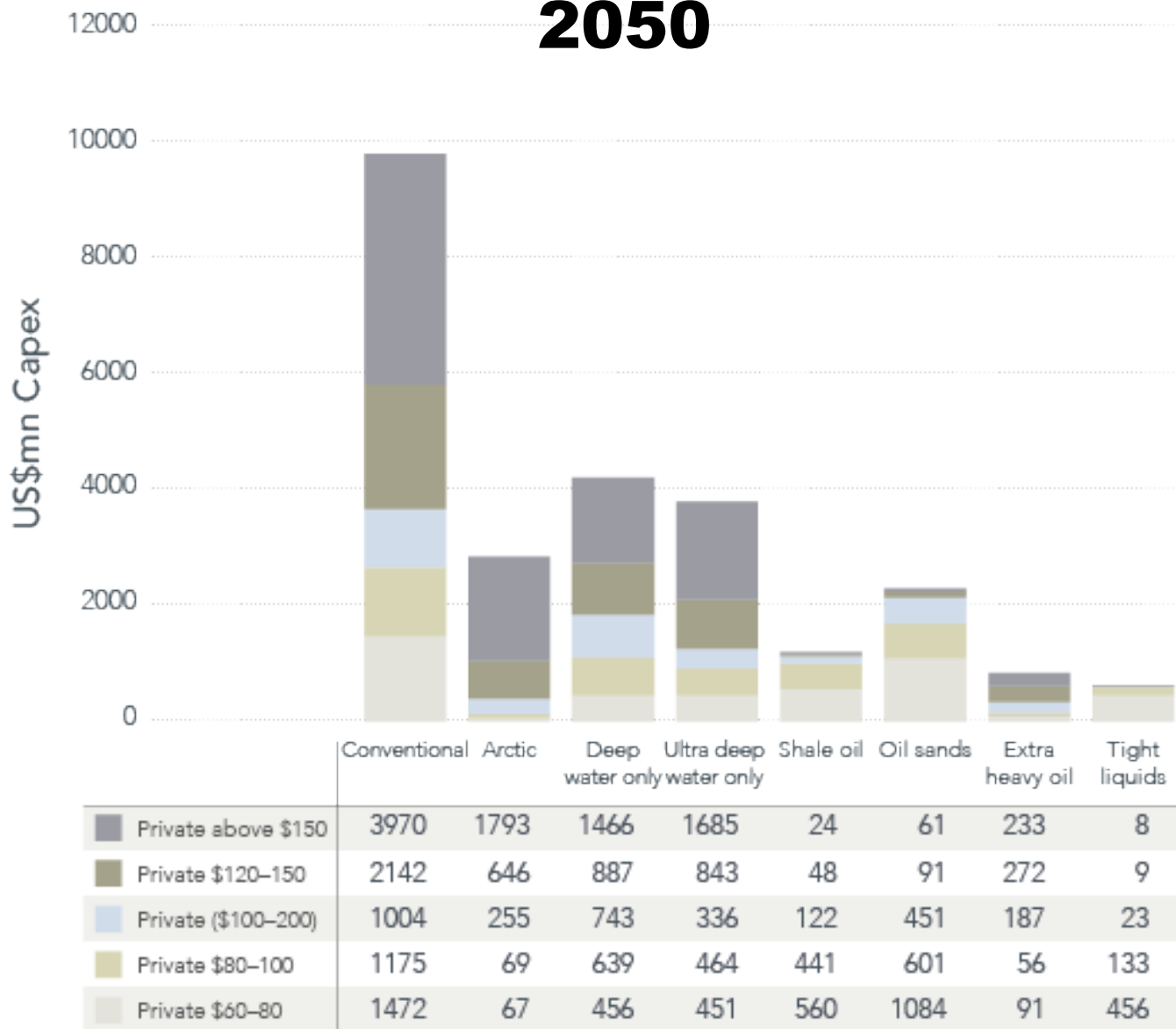
- **Oil production < \$75** oil price is within reference 2°C carbon budget to 2050
- **Oil production >\$95** oil price is exposed to a lower price/demand scenario
- **Oil production requiring \$75 - \$95** oil price is marginal, depending on:
 - Political risk dynamics
 - Carbon budget allocated to oil

Breakeven prices of carbon production by oil type 2014–2050



	Conventional	Arctic	Deep water only	Ultra deep water only	Shale oil	Oil sands	Extra heavy oil	Tight liquids
Above \$150	22	5.3	6.7	4.6	0.2	0.0	0.2	0.0
\$120-150	11	2.5	6.0	4.3	0.2	0.9	2.4	0.0
\$100-120	14	1.4	5.2	1.9	2.0	5.5	0.7	0.2
\$80-100	30	1.0	7.0	5.1	3.0	11.9	1.5	1.2
\$60-80	43	1.2	6.6	5.8	17.3	20.4	3.5	6.5
\$0-60	258	1.1	12.2	6.6	21.9	2.9	12.0	9.1

Breakeven price band split by oil type 2012–2050



Filtering it down to the next decade of oil capex

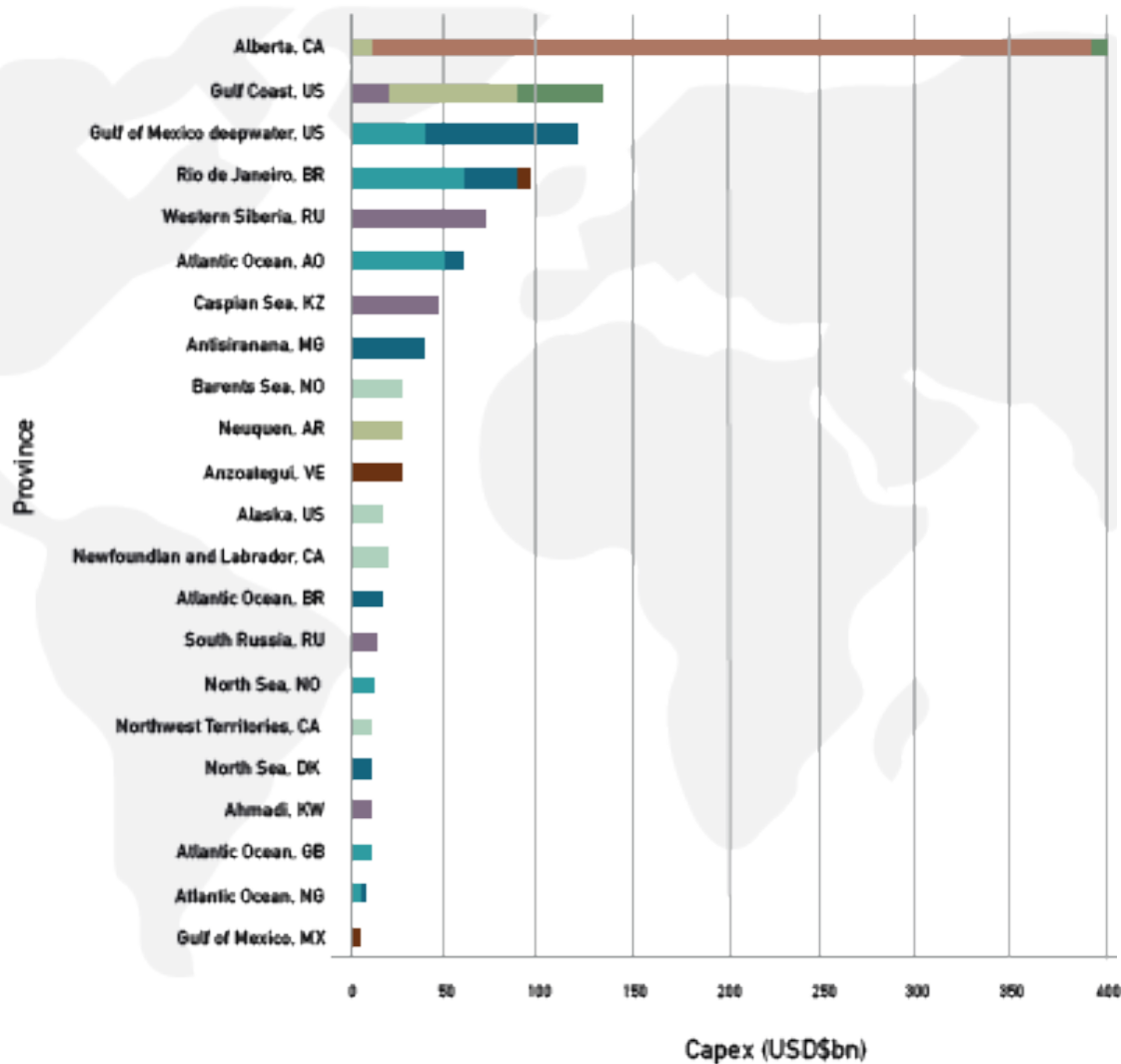
Having mapped out the potential production globally to 2050, we focused in on:

- Production requiring an oil price **> \$95**
- Capex projected between now and **2025** in Rystad

This indicated around **\$1.1trillion** of capex for projects requiring over \$95/bbl oil price over the next decade in the major provinces being considered for development.

Key locations by CAPEX (2014 to 2025) and carbon production (2014 to 2050)

Top 5 provinces by oil category above \$80



Companies with the highest absolute CAPEX exposure requiring above \$95/bbl price

Capex (2014-2025) US\$million



Company	conventional	arctic	deep-water	ultra deep water	shale oil	oil sands	extra heavy	tight liquids	high cost/risk total	company total
Petrobras	26		79,336				4,089		83,452	454,317
ExxonMobil	1,736	3,944	22,307	20,066	2,286	18,075	5	4,927	73,346	290,012
Rosneft	69,009	456			129			92	69,686	264,661
Shell	49	152	20,254	15,869	1,169	25,898			63,392	314,551
Total	58	50	17,188	26,909		11,987			56,193	197,674
Chevron	3,062	4,942	20,095	12,857		7,435		7,384	55,774	247,093
BP	228	6,546	11,039	24,223		3,978			46,014	253,066
Gazprom	44,214	420	9		81				44,724	111,881
Statoil	2	22,432	8,329		22	7,848			38,634	218,578
CNRL		2	1			38,507		45	38,555	74,917

Companies with the largest relative exposure:

50%+ of the total CAPEX requires over \$95/bbl

Capex (\$2015) US million



Company	conventional	arctic	deep-water	ultra deep water	shale oil	oil sands	extra heavy	tight liquids	high cost/risk total	%high risk high cost
CNRL		2	1			38,507		45	38,555	51%
Cenovus Energy	244					25,650	2,961		28,855	62%
OGX Petr. e Gas			21,117	4,681			2,340		28,138	91%
Athabasca Oil Sands						23,634		65	23,698	89%
Laricina Energy						14,428			14,428	97%
Teck Resources Ltd.						12,502			12,502	100%
MEG Energy						12,278			12,278	64%
OSUM						11,755			11,755	99%
Denbury Resources	9,656								9,656	57%
Queiroz Galvao E&P			182	5,626			1,755		7,562	100%

Oil Carbon Supply Cost Curves: Key takeaways

1. Demand and price assumptions need challenging
2. The private sector will determine the fate of the marginal oil at the high end of the cost curve
3. There is \$1.1trillion of Capex over the next decade that requires high oil prices
4. Deepwater and Unconventional projects have added technical risk and costs
5. The majors have a spread along the cost curve which should be reviewed
6. Independent specialists are betting on high oil prices to deliver their business model

Avoiding another Kashagan



- Initially billed at \$10bn in 2005
- Latest estimate \$50bn in 2014
- Production delayed again
- Technical risk – gas, ice
- Political risk

Value over volume

- **Something has to give:** companies cannot maintain dividends, cover rising opex and continue to increase capex
- A **focus on returns** is needed to prevent expenditure on high cost, high risk projects in the pursuit of replacing reserves
- Explaining which capex options they are turning down will **demonstrate implementation** of this strategy

\$1.1 trillion: questions for investors

1. Can companies **justify capex** on projects requiring **over \$95/bbl**?
2. Should majors limit exposure to the high end of the cost curve?
3. Do independents have a **robust business model in a low demand/price/carbon scenario**?
4. Are companies demonstrating a **value over volume strategy** in how they allocate capex?
5. Are you making it clear to analysts, managers and companies that you want **returns not volume**?
6. Is the **reserves replacement ratio** a good indicator of performance which will create shareholder value?
7. Are companies providing enough **detail on the demand and price assumptions** underpinning their capex decisions?
8. Are companies **transparent** about where they sit on the cost curve?

Thank you.

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