Developing estimates of depletion for the UK natural capital accounts

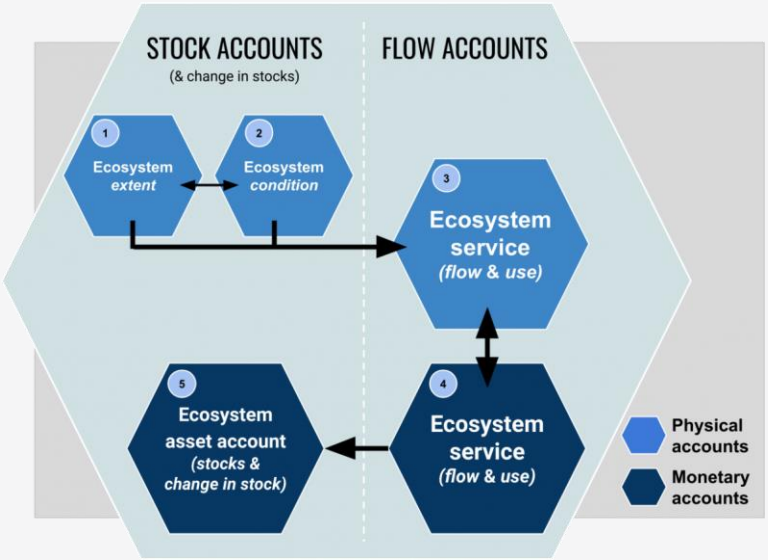
Sonia Carrera & Alec Jacobs
Natural Capital Accounts
Environment Division
natural.capital.team@ons.gov.uk

22 July 2025

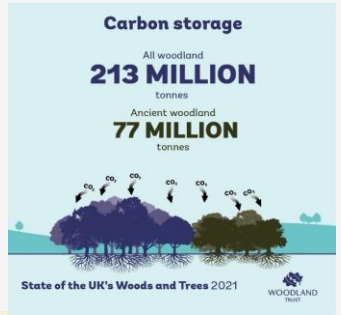
Office for National Statistics

UK natural capital accounts

- Physical and monetary estimates of services provided by the UK's natural capital
- Generated £87 billion annual value in 2022, worth £1.8 trillion in asset value
- 16 ecosystem services: provisioning, regulating and cultural



Informed by the [SEEA Ecosystem Accounting]



What is depletion?

Depletion, in physical terms, is the decrease in the stock of a natural resource, due to extraction occurring at a level greater than that of regeneration

Degradation considers changes in the capacity of environmental assets to deliver a broad range of ecosystem services and the extent to which this capacity may be reduced through the action of economic units

Depletion can be considered a specific form of **degradation**

Why measure it?

- SEEA account
- SNA 2025 revision
- Better “net adjusted” economic metrics (Net Domestic Product)
- Comprehensive income and wealth accounting – “Beyond GDP”
- Indicators and costs in sustainability

Why measure it – GDP vs NDP

Two (example countries) – **A** & **B**

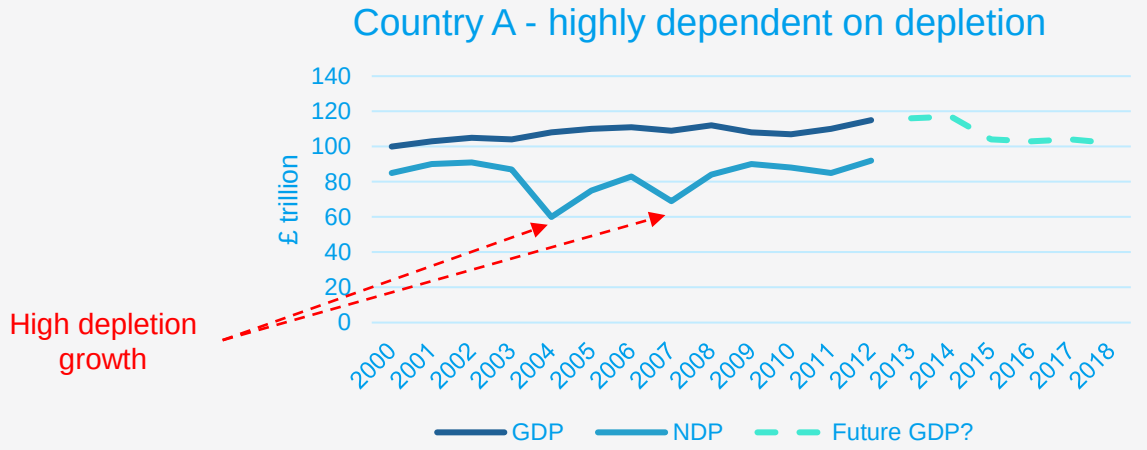
Country A – highly dependent on industries which deplete natural resources.

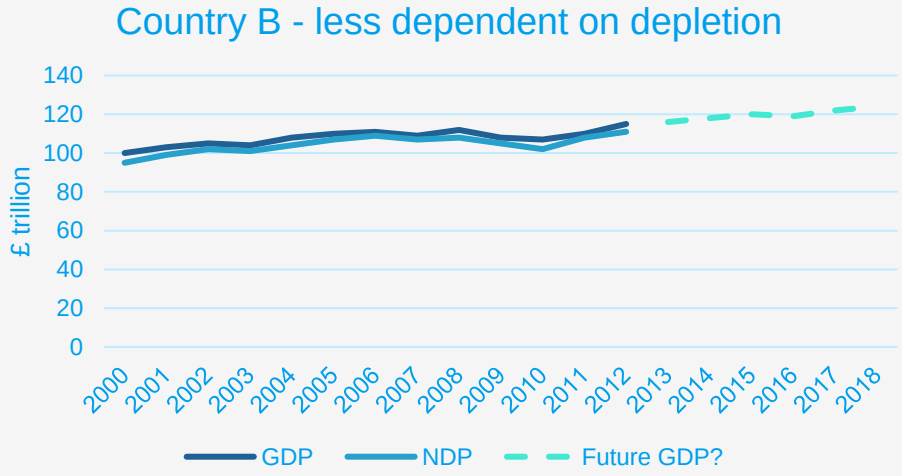
Significant divergence between GDP and NDP

Country B – less dependent on depletion activities

NDP tracks GDP

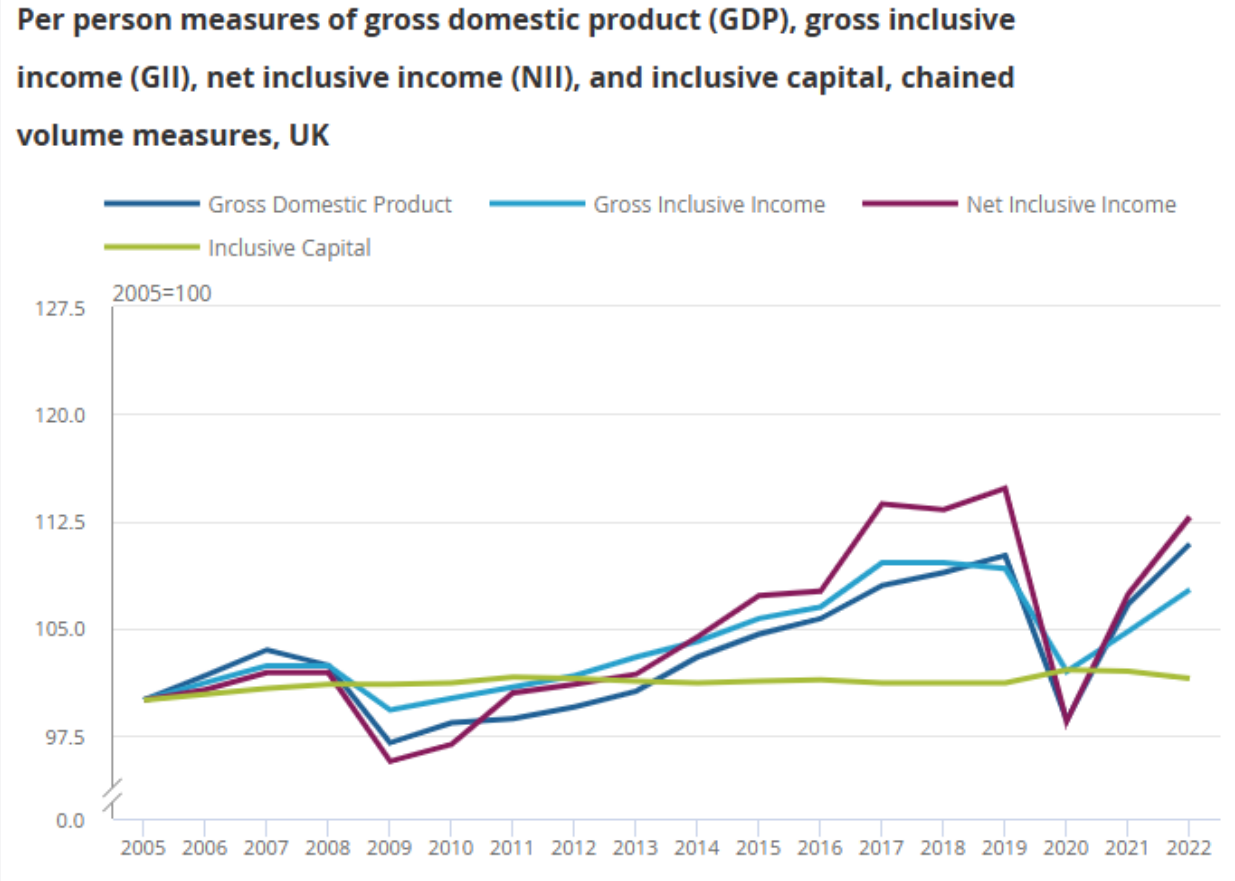
Country A has greater limitations on future GDP growth?





What we have done to date at the ONS

- Experimental measures of depletion for oil, gas, minerals and coal (the focus of this webinar)
- Experimental measures of inclusive income and wealth



Depletion - Theory

Depletion - physical

- Extraction, harvesting or production by human agents
- Only occurs when it is greater than population growth or regeneration (renewables)
- One of several factors that can lead to a changes in stock (reappraisals, new discoveries etc.)
- Depletion flows vs stock volumes

Resource rents

- Main monetary valuation technique for provisioning services
- Estimates the value of the input of the natural service
- Flow values projected forwards to derive the asset value

Equals **Gross operating surplus—for the derivation of resource rent**	
Less **User costs of produced assets**	
Consumption of fixed capital (depreciation) + return to produced assets	
Equals **Resource rent**	
Depletion + net return to environmental assets[b]	

Depletion - monetary

- Price in situ – the value of reserves ‘in the ground’:

$$Price\ in\ situ = \frac{Asset\ value}{Physical\ reserves}$$

- Unit price for each reserve - assumes production is subject to average prices and produced across an average production profile (proportionally)
- In contrast to the resource rent which only considers the economic circumstances with the accounting period (depletion value NOT equal to annual value)

Depletion - monetary

$$Monetary\ depletion = price\ in\ situ\ \times physical\ depletion$$

- Depletion therefore represents the ***opportunity cost*** – the income foregone by extracting now rather than in the future
- Sensitive to changes in assumptions you make about changes in prices, production profile, discounting rate etc. (asset value)

Other changes in stock

Other changes in stock

- Catchall term to encompass the net effect of new discoveries, reappraisals, reclassifications, normal and catastrophic losses and regeneration (renewables)
- Derived due to data limitations
- Stock can increase despite depletion
- $\text{Monetary other changes in stock} = \ price\ in\ situ \times physical\ other\ changes\ in\ stock$

Price effect

Price effect

- Asset value can change dramatically across time – even if the physical stock remains the same
- Arises due to the change in the resource rents (e.g. industry profitability) over time

$$\Delta V_t = (V_t - V_{t-1}) = P_{t-1}\Delta X_t + X_t \Delta P_t$$

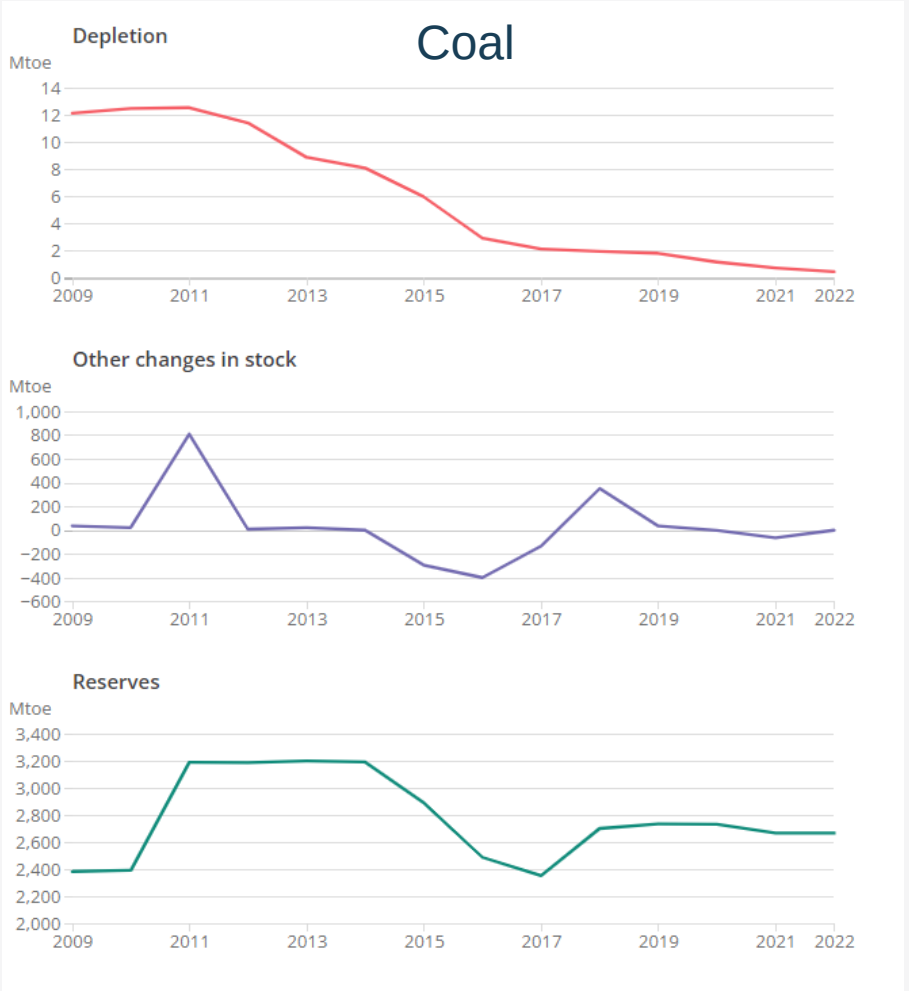
Results

Coal

Coal

- Marked decline in coal depletion, drop of 96% since 2009
- Other changes in stock added 390 mtoe between 2009 and 2022
- Reserves increased by 12% between 2009 and 2022

No monetary estimates available

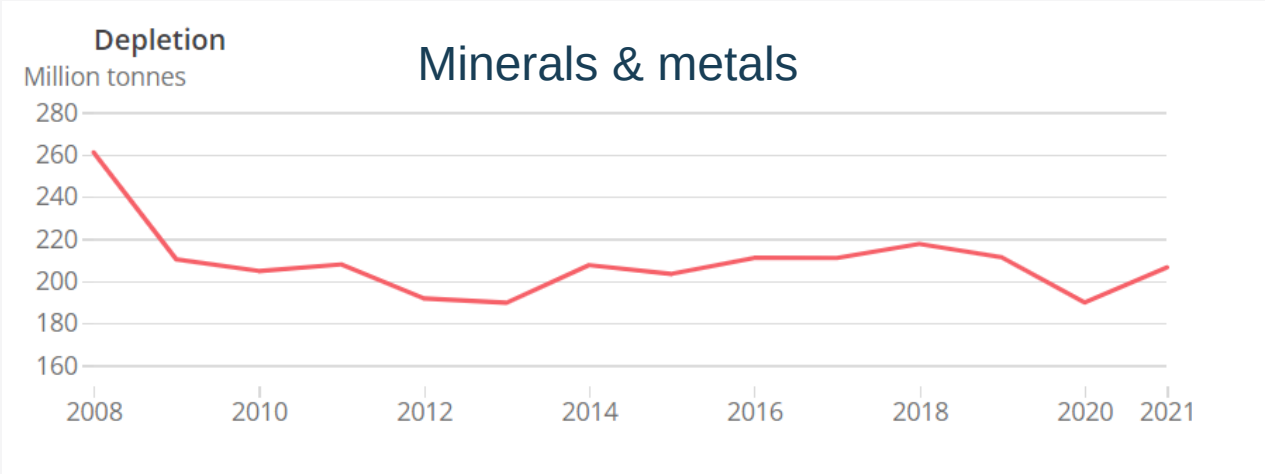


Minerals and metals

Minerals and metals

- Peak production in 2008 at 261 million tonnes
- Declined by 19% in 2009
- Ranged between 190 and 218 million tonnes between 2009 and 2021

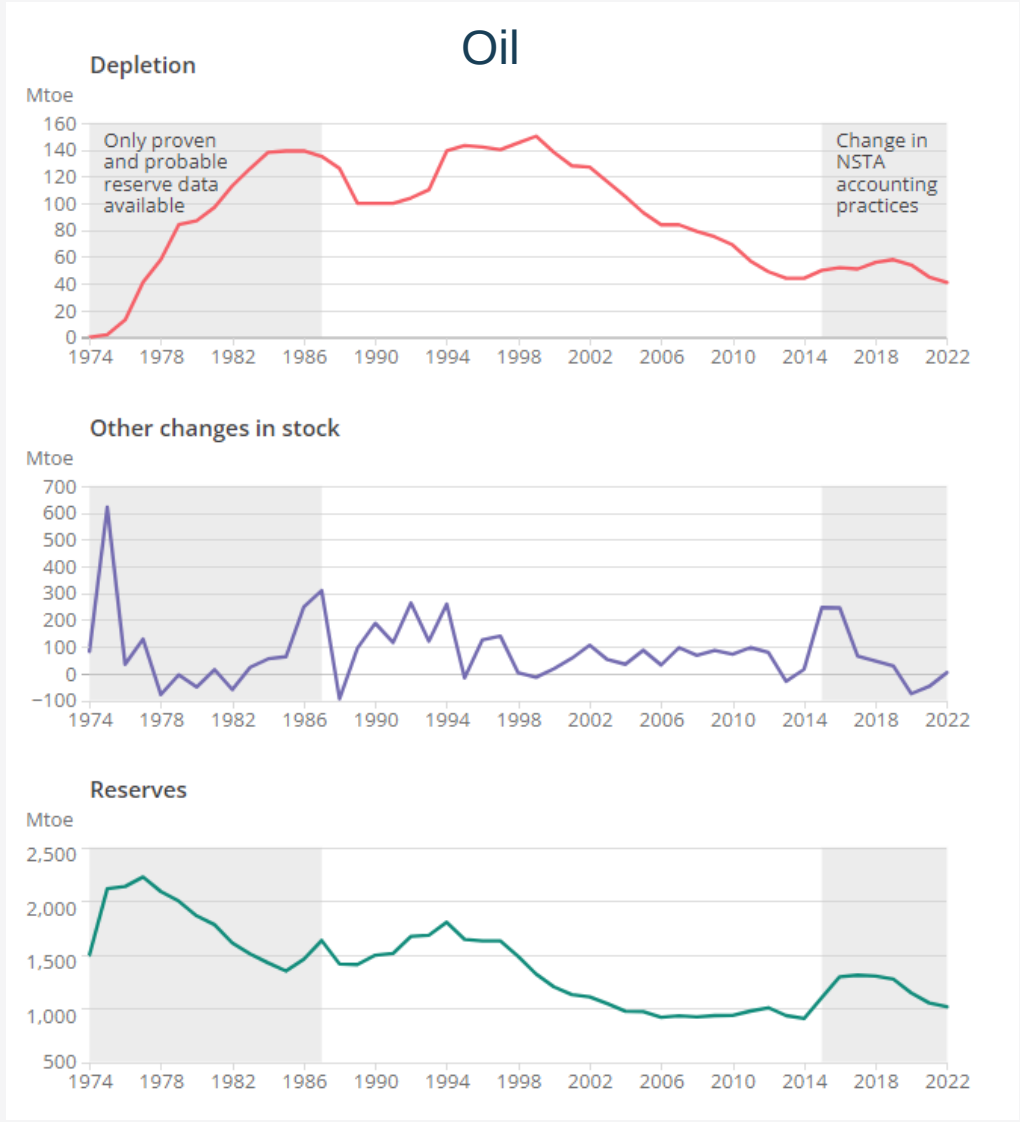
No monetary estimates available



Oil and gas

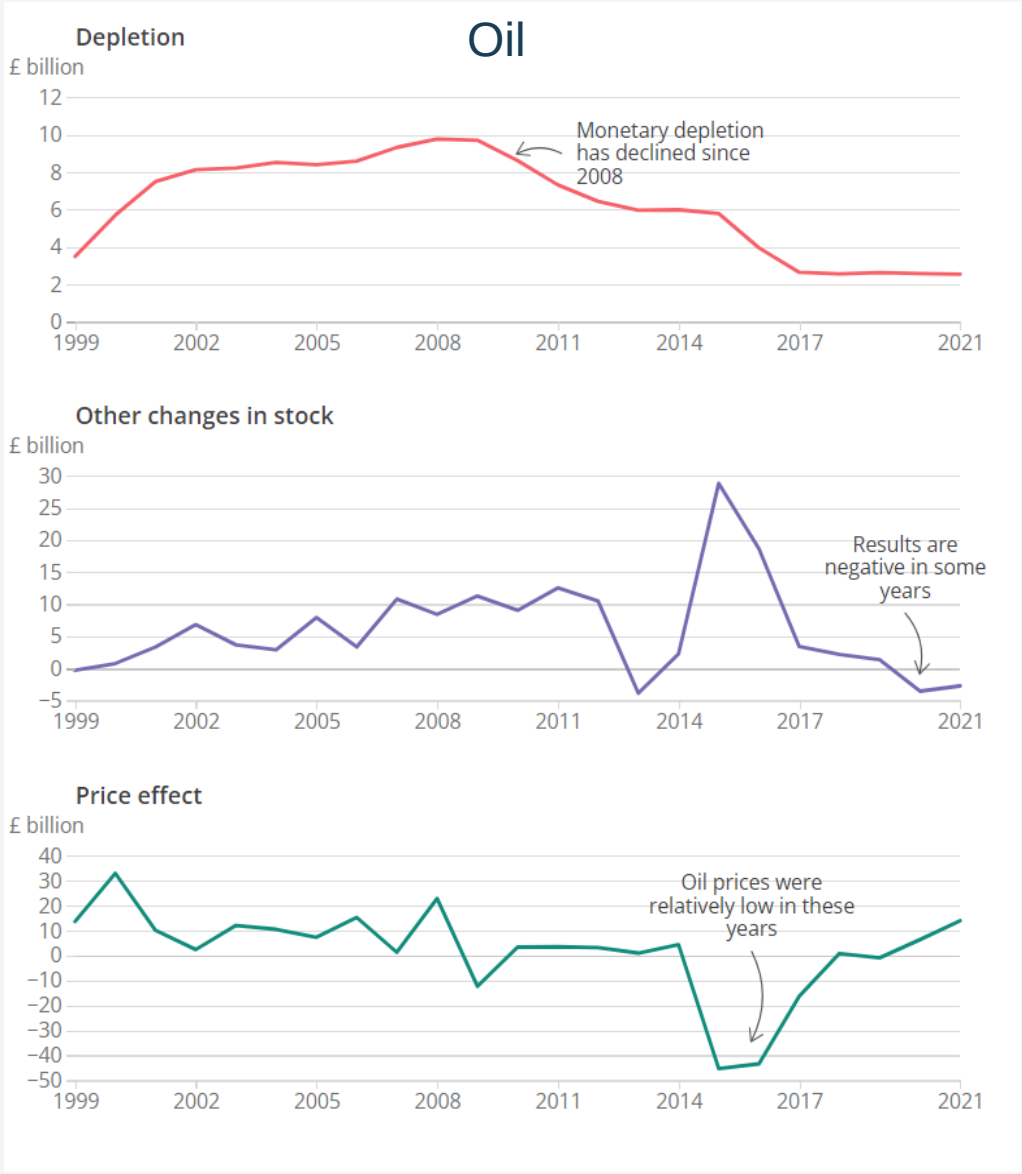
Oil - physical

- Depletion consistently above 100 mtoe between 1982 – 2004. Peaking in 1999 at 150 mtoe. Has since declined to 41 mtoe in 2022
- Other changes in stock are positive in 80% of years and added 3,967 to reserves over time series
- Depletion > other changes in stock in 61% of years, causing reserves to decline
- Reserves declined to 1,014 mtoe in 2022, a 38% reduction since 1987
- Results for gas follow a similar trend



Oil - monetary

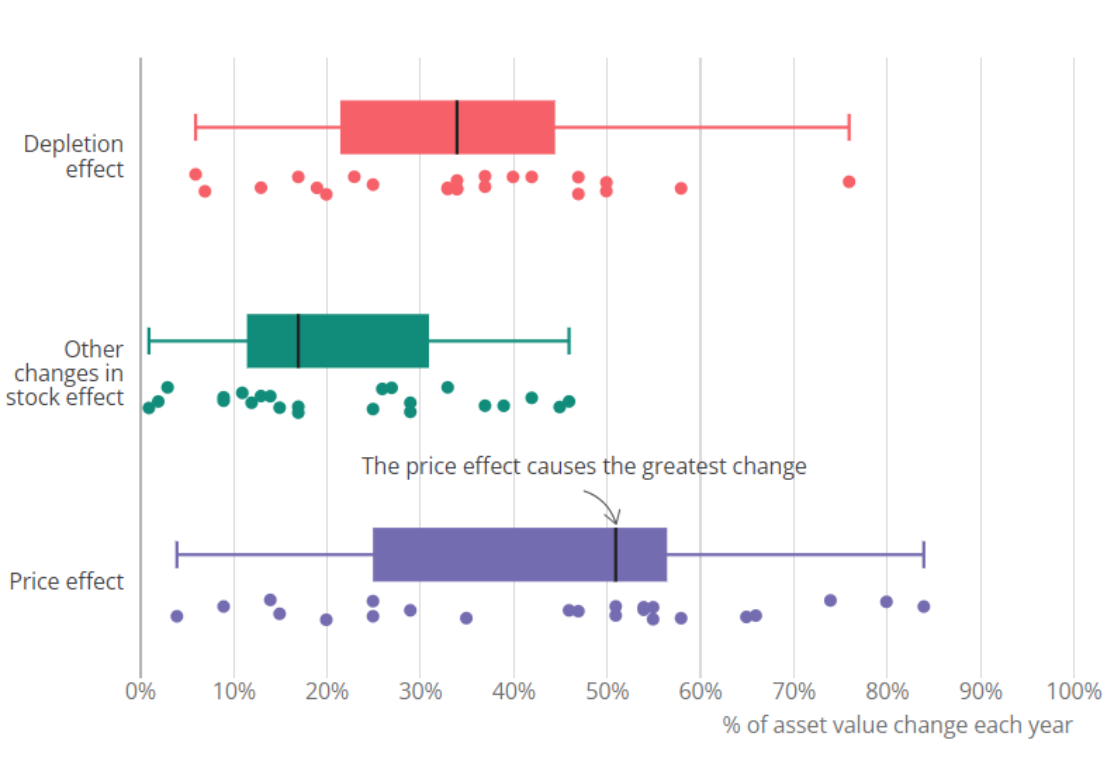
- Depletion rose from £3.5 billion in 1999 to its peak in 2008 at £9.8 billion, before diminishing to £2.5 billion in 2021.
- Other changes in stock added £137.1 billion to the asset value over the time series.
- The price effect is volatile but positive in most years, and between 1999 and 2021, added £46.4 billion to the value of the asset.
- Positive correlation of 0.3 between physical and monetary depletion
- Results for gas follow a similar trend



Monetary depletion – Oil & gas

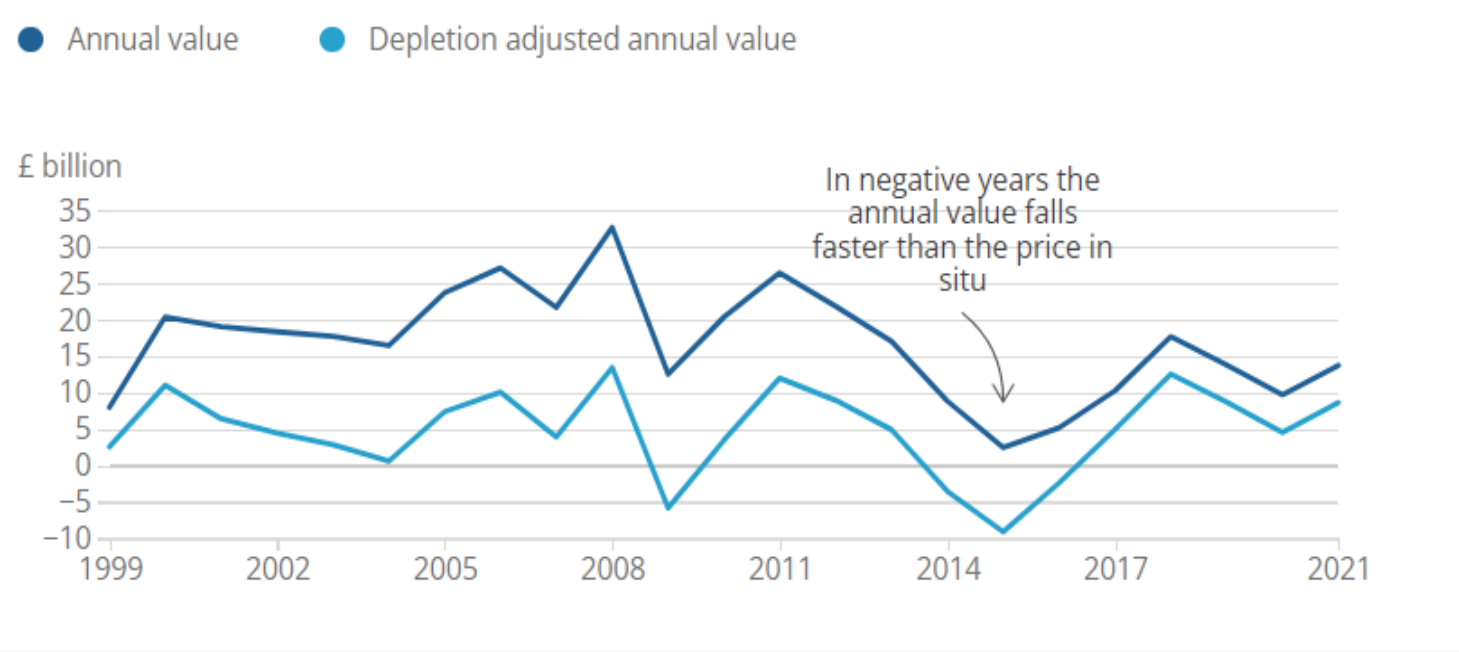
Three factors which explain the change in the asset value year on year. On average:

- Depletion – 34%
- Other changes in stock – 22%
- Price effect – 44%



Monetary depletion – Oil & gas

- Depletion adjusted annual value is lower by £4.8 billion on average over time series
- Several years where results are negative
- Happens when annual value falls faster than the price in situ
- Results can also be netted off against industry gross value added and GDP



Conclusions

Compilation challenges

- Data availability - need for complete reserve data; lack of data on production costs of oil and gas
- Valuation method - Negative data for coal provisioning
- We’ll need to develop complex models of biological growth rates for renewables

Possible future developments

- **Monetary values** – for coal, mineral and metals
- **Renewables** – energy, timber and fish
- **Productionise** – from experimental estimates to official statistics
- **More** – depletion for more ecosystem services
- **Degradation** – linking condition to declining productivity
- **Whose depletion?** – Assigning the value of depletion out to actors (industry vs government)