Unadjusted social cost of carbon (SCC)	$2,387	per tonne	Note: the Wang, Deng et al 2019 metastudy gave this as the upper bound, albeit the average was significantl lower. This higher number is justified because in an actuarial or investment context we need to consider tail risks which are omitted from standard SCC / IAM models	
1$ of economic harm (i.e. loss in GDP) lead	$1	of reduction in ag	Decent enough approximation but limitations are shown here: https://www.msci.com/documents/10199/a134c5d5-dca0-420d-875d-06adb948f578	
Portfolio assumptions				
Imagine that the portfolio contains				
Fossil fuel sector	2.33%			
All other sectors	97.67%		https://www.thebalance.com/what-is-the-sector-weighting-of-the-s-and-p-500-4579847. Important to apply this at the level of the whole sector; working at the level of one company introduces complex (and unnecessary) competition effects	
Discount rate	6%			

ACTION: STOP FOSSIL FUEL FIRMS FROM BUILDING NEW COAL POWER PLANTS

Action for shareholders:
Impose a rule on fossil fuel companies that they may not build new coal power plants
Actions need to be strong, forceful stewardship, including the threat of (e.g.) "vote no" (i.e. voting not to re-elect a director)

Loss to the specific company/sector affected
If we (investors) intervene to change what the company would otherwise have done, how much worse off will the portfolio be because of direct reductions in profit?

Implications for portfolio of not building new coal plant

Number of coal plants not being built	100		
Wattage of 100 putative coal plants	60,000	MW	One website said: "a typical coal plant is about 600 MW" (https://www.restaurantnorman.com/how-much-energy-does-a-power-plant-produce-in-a-day/). Also the Schlissel technical report used 600MW as an example size of coal plant: "This would mean a cost of well over $2 billion for a new 600 MW coal plant" (Source: https://schlissel-technical.com/docs/reports_35.pdf)
no of hours in a year	8760	hours/year	
Capacity factor	0.64		Our world in Data uses an average capacity factor of 64% in their calculations. Search for "an average capacity factor of 64%" to find it on the page
100 coal plants could generate	336,384,000	MWh/year	
100 coal plants could generate	336,384	TWh/year	
Global total coal wattage	9000	TWh (presumably)	Electricity Mix - Our World in Data. I read it off the chart (could also have downloaded the data for a more precise figure)
100 coal plants constitute	3.74%	of total coal wattage	
			E.g. the return on the fossil fuel sector goes from 8% to 4.26%. A more rigorous model would need to consider this in more detail. This assumption has been done crudely: in some ways it's conservative because the assumption of 3.7376% is based on just the coal sector, but the following assumption of 2.33% is based on the whole fossil fuel sector. It's also conservative because if the action leads to a new coal plant being displaced by another power plant, the profits from that would likely also accrue to the universal owner.
Loss of return on sector from not building new facility	3.74%		
Proportion of the portfolio invested in the fossil fuel sector	2.33%		https://www.thebalance.com/what-is-the-sector-weighting-of-the-s-and-p-500-4578847. Important to apply this at the level of the whole sector: working at the level of one company introduces complex (and unnecessary) competition effects
Loss of return on whole portfolio	0.09%	each year	
Discount rate	6.00%		
PV of Loss of return on whole portfolio	1.29%		

Gain to the whole portfolio
If we (investors) intervene to change what the company would otherwise have done, how much better off will the portfolio be because of changed externalities?

Stopping a company from building a new coal power plant would lead to
(a) a coal power plant not being built
(b) another power plant being built (because we're not changing overall energy demand)

Number of coal plants not being built	100		
Wattage of 100 putative coal plants	60,000	MW	One website said: "a typical coal plant is about 600 MW" (https://www.restaurantnorman.com/how-much-energy-does-a-power-plant-produce-in-a-day/). Also the Schlissel technical report used 600MW as an example size of coal p
no of hours in a year	8760	hours/year	
Capacity factor	0.64		Our world in Data uses an average capacity factor of 64% in their calculations. Search for "an average capacity factor of 64%" to find it on the page
100 coal plants could generate	336,384,000	MWh/year	

1 MWh of coal energy can generate (one estimate)	766	kgCO2eq	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
1 MWh of coal energy can generate (one estimate)	846	kgCO2eq	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
1 MWh of coal energy can generate (one estimate)	990	kgCO2eq	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
1 MWh of coal energy can generate (one estimate)	1003	kgCO2eq	*Source: https://www.eia.gov/tools/faqs/faq.php?id=74&t=11*
1 MWh of coal energy can generate	906	kgCO2eq	Straight average of the above estimates; a fuller anlaysis needs to apply more judgement about which figure to use here
1 MWh of coal energy can generate	0.906	tonCO2eq	

$900 Ackerman and Stanton 2012

Unadjusted social cost of carbon (SCC)	$2,387	per tonne	Note: the Wang, Deng et al 2019 metastudy gave this as the upper bound; albeit the average was significant lower. This higher number is justified because in an actuarial or investment context we need to consider tail risks which are omitted from standard SCC / IAM models
Adjustment: could reduce this since this figure is higher than most estimates	-		This would incorporate the possibility of different discount rates, among other things
Adjustment: SCC is a point projection and excludes tail risks	-		No adjustment applied; this understates the social cost of carbon since tail risks could be material, although it did help to justify why the SCC figure chosen is higher than is standard
Social cost of carbon to use	$2,387	per tonne of CO2	
Note: social cost of carbon is a particular area of focus and future research -- estimates of this vary widely.			

Estimate 1: expected duration of coal power plant	46	years	Quantifying operational lifetimes for coal power plants under the Paris goals	Nature Communications: note this is historic assumptions for new plants may be different
Estimate 2: expected duration of coal power plant	30	years	Life Cycle Assessment of Coal-fired Power Production (mid gov): 30 years was the assumption used in this analysis
Expected duration of coal power plant	38	years	Straight average of the above estimates; a fuller anlaysis needs to apply more judgement about which figure to use here; assume that at the end of the lifetime of this plant it's replaced by new, more efficient renewables with minir
Discount rate	6%		This needs some thought. E.g. is it consistent with the discount rates in the SCC? But model does not seem to be very sensitive to this, since it feeds into both costs and benefits

Social Cost of Carbon saved by the 100 coal plants not existing	**$10,799,647,715,247**	

If investors stop the coal power plant from coming into existence, this does not intrinsically change the overall demand for energy. So we should expect one of the following to happen

		Probability	Rationale
New power plant	Coal	0%	This assumes that asset owners are effective at implementing a broad-brush ban on new coal plants, and that this applies across the industry. However there are necessarily some parts of the global industry which are only minim
New power plant	Gas	0%	Although renewables are cheap, there are still constraints on their usage (e.g. sun doesn't always shine/wind doesn't always blow + battery issue not solved). In truth, clean energy should probalby be assigned some probability, b
New power plant	Solar	0%	Set to zero to be conservative
New power plant	Geothermal	0%	Set to zero to be conservative
New power plant	Wind	0%	Set to zero to be conservative
New power plant	Marine	0%	Set to zero to be conservative
New power plant	Nuclear	100%	Set to zero to be conservative
New power plant	River hydro	0%	Set to zero to be conservative
No new power plant (i.e. inadequate power production)		0%	Given that the energy industry has strong profit incentives for creating new infrastructure to meet energy needs, this seems unlikely. A fuller model would assign some probability to this outcome and model the extent to which the e

		gCO2eq/KWh	
New power plant	Coal	906	*Source: 2011 update of Parliamentary Office of Science and Technology p2* and https://www.eia.gov/tools/faqs/faq.php?id=74&t=11
New power plant	Gas	488	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
New power plant	Solar	86	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
New power plant	Geothermal	38	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
New power plant	Wind	36	*Source: 2011 update of Parliamentary Office of Science and Technology p2-3*
New power plant	Marine	23	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
New power plant	Nuclear	26	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
New power plant	River hydro	7.5	*Source: 2011 update of Parliamentary Office of Science and Technology p2*
No new power plant (i.e. inadequate power production)		0	

Note: the figures in the above table are quite out of date, and may misstate the carbon intensity. Especially newer technologies (renewables) may be improving more quickly, and therefore potentially particularly prone to being overstated by these old numbers
Question mark over whether it's really possible to replace all new coal plants with renewables, given the constraints on renewables. Assuming that it is possible because of EIA reports suggesting that we should stop new fossil fuel plants

Assume the replacement power plants are	Nuclear		
Assume replacement plants are new Nuclear plants with the same wattage:	336,384,000	MWh/year	
1 KWh of Nuclear energy can generate	26	gCO2eq	
1 MWh of Nuclear energy can generate	26	kgCO2eq	
1 MWh of Nuclear energy can generate	0.026	tonCO2eq	
Assume same adj SCC as for coal	$2,387	per tonne of CO2	

Estimate 1: expected duration of Nuclear power plant	20		Natural gas power plants - how they work and their efficiency-Jason Mumbler's Energy and Environment Blog
Estimate 2: expected duration of Nuclear power plant	22		https://www.eia.gov/todayinenergy/detail.php?id=30872#:~:text=The%20capacity%2Dweighted%20average%20age,%2C%20and%20nuclear%20(36).
Expected duration of Nuclear power plant	21	years	assume that at the end of the lifetime of this plant it's replaced by new, more efficient renewables with minimal carbon footprint
Discount rate	6%		This needs some thought. E.g. is it consistent with the discount rates in the SCC?

Social Cost of Carbon generated by the 'replacement' Nuclear plant	**$245,585,412,676**	

Social Cost of Carbon saved by the coal plant not existing	$10,799,647,715,247		
Social Cost of Carbon generated by the "replacement" Nuclear plant	$245,585,412,676		
If the coal plant is replaced by a Nuclear plant it leads to a saving of	$10,554,062,302,571		
Assume that $1 of extra economic output leads to	$1	of extra profit	Decent enough approximation but limitations are shown here: https://www.mscl.com/documents/10199/a134c5d5-dca0-420d-875d-06ad9b948f57$
The in-expectation impact on the world's profits is	**$10,554,062,302,571**		
Let's say the portfolio's value is	$1,000,000,000		Assumption, all cancels out in the end
Value of world's assets	$418,342,000,000,000		Global wealth report – Credit Suisse (credit-suisse.com): table at bottom of page 7
The portfolio's share in global assets is	0.0002%		
Extra profit for portfolio from externalities	**$25,228,312**		
The loss incurred directly to the assets	**$12,928,816**		
Ignoring intergenerational inequity risks, is the action justified?	**Yes**		

Intergenerational inequity
Intergenerational inequity could arise if (a) material climate-related costs arise many years in the future and (b) asset prices don't fully reflect the climate risks/opportunities in the next few years

Probability that material climate-related risks occur within the next few years	2%	I.e. how likely is it that (if we don't take strong action now) climate risks will lead to substantial downsides which are sufficient to constitute the lion's share of the harms that we might model, and that those downsides occur in the next few years?
Probability that carbon risks are fully reflected in prices soon (e.g. in 5 yrs)	40%	This is the probability of the not intergenerational inequity scenario
Appetite for intergenerational inequity	50%	If the intergenerational inequity scenario arises, then some individuals would benefit if the institutional asset owner took action, whereas others would lose out. This factor means that in the intergenerational inequity scenario, we are 50% as willing

Extra profit for portfolio from externalities (adj for intergenerational inequity)	$17,306,622
The loss incurred directly to the assets	$12,928,816
Is the action justified?	**Yes**

Is a new coal plant profitable?	Profitability of a new co	$ 1	per MWh of clean dark spread (a measure of profitability at baseload for a 40% efficient			
Is a new coal plant profitable?						
Is a new coal plant profitable?	Plant wattage for a typi	600	MW	Source: "This would mean a cost of well over $2 billion for a new 600		
Is a new coal plant profitable?	no of hours in a year	8760	hours/year			
Is a new coal plant profitable?	Capacity factor	1		https://ourworldindata.org/grapher/electricity	suggests this should be 0.64	
Is a new coal plant profitable?	1 coal plant could gene	5256000	MWh/year			
Is a new coal plant profitable?	Profit per year	$5,256,000				
Is a new coal plant profitable?	Initial cost	$2,000,000,000		Source: "This would mean a cost of well over $2 billion for a new 600		
Is a new coal plant profitable?	Investment return	0.26%	Looks surprisingly low. Is there an error in the figures somewhere			
Is a new coal plant profitable?						
Is a new coal plant profitable?	I doubt that the true investment return is only 0.26%					
Is a new coal plant profitable?	It appears that coal power plants are still being built, see e.g. this website (https://www.miningreview.com/coal/global-coal-exit-list-1000-companies-driving-climate-chaos/)					
Is a new coal plant profitable?	*Since the Paris Climate Agreement was signed, the world's installed coal-fired*					
Is a new coal plant profitable?	*capacity has grown by 137 GW, an amount equal to the operating coal plant*					
Is a new coal plant profitable?	*fleets of Germany, Russia, Japan and Turkey combined. While many new coal*					
Is a new coal plant profitable?	*projects were scrapped in 2021, up to 480 GW of new coal-fired power capacity*					
Is a new coal plant profitable?	*and 1,600 Mtpa of new thermal coal mining capacity are still in the pipeline.*					
Is a new coal plant profitable?	*If realized, these projects would increase the world's coal power capacity by 23% and thermal coal production by 27%. Out of the 1,030 companies listed on the 2021 GCEL, 803 companies are still planning to develop new coal power plants, new coal mines or new coal transport infrastructure.*					
Is a new coal plant profitable?	It would be surprising if there were still this much activity being financed if the in-expectation return were so low					