



GREEN TRANSITION

GRENFIN SUMMER SCHOOL 2023

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BUSINESS GAME



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GAMMA
PORTFOLIO



PACTA ANALYSIS

- Scope and Coverage
- Climate Scenario Analysis

**GREEN
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ROADMAP

- Investment portfolio tool, representative of a portfolio held by insurance companies
- Assesses the alignment of an investment portfolio with international climate objective i.e. **Paris Agreement** (2015)
- Investment portfolio - special focus on **equities** and corporate bonds
- Inserting data on PACTA online platform
- **Bottom up approach** with a time horizon : 5 years
- Sector covered: '**carbon relevant**' as power, coal, oil, automotive, cement, steel, aviation and transport

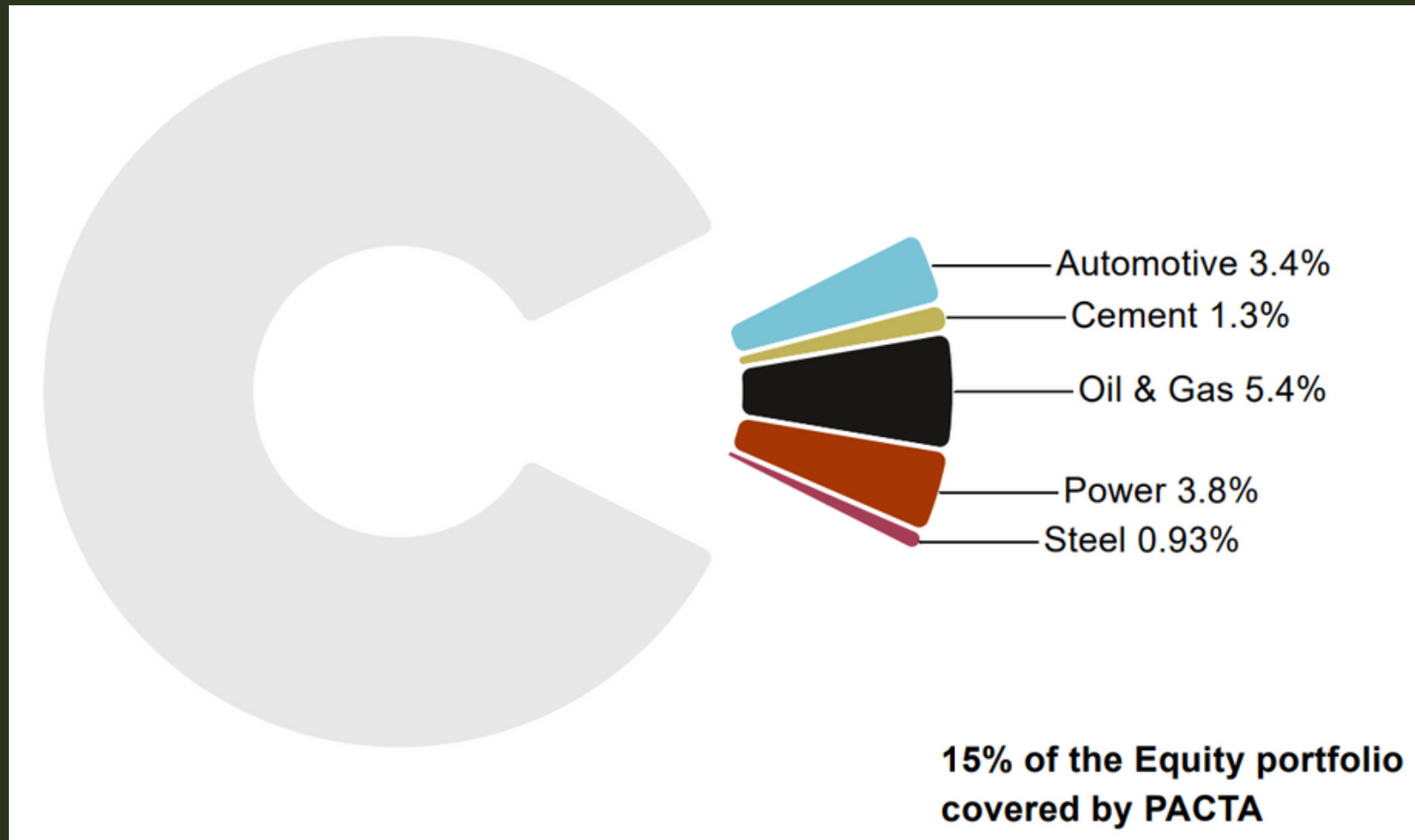


ASSEST COVERAGE

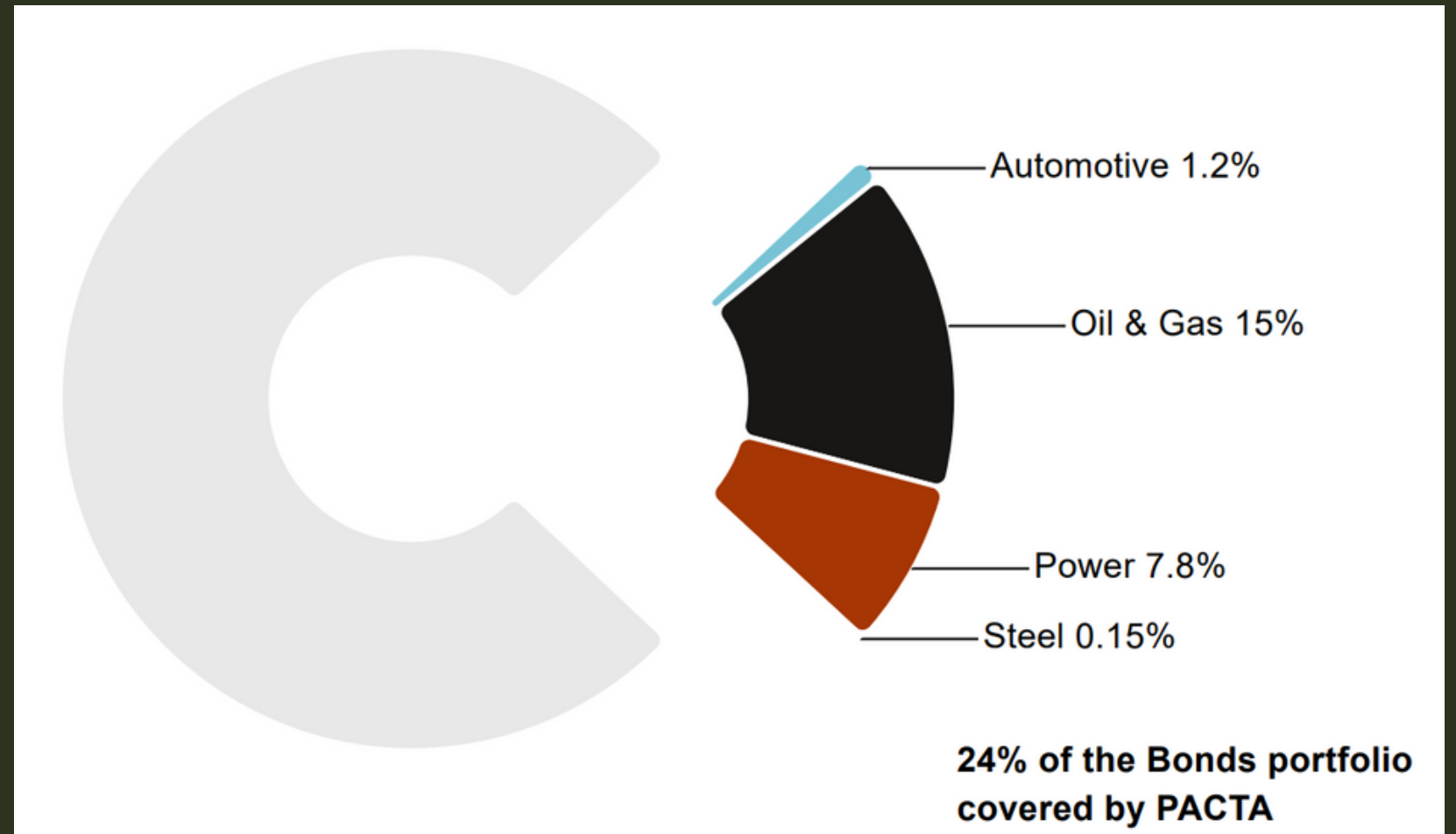
Asset Class	Portfolio value invested (M USD)	Portfolio value invested (%)	Included in the analysis	Value breakout per means of investment	
Corporate Bonds	226.68	83%	Yes	226.68	Direct
Listed Equity	46.94	17%	Yes	46.94	Direct
Total	273.62	100%		273.62	



SECTOR COVERAGE



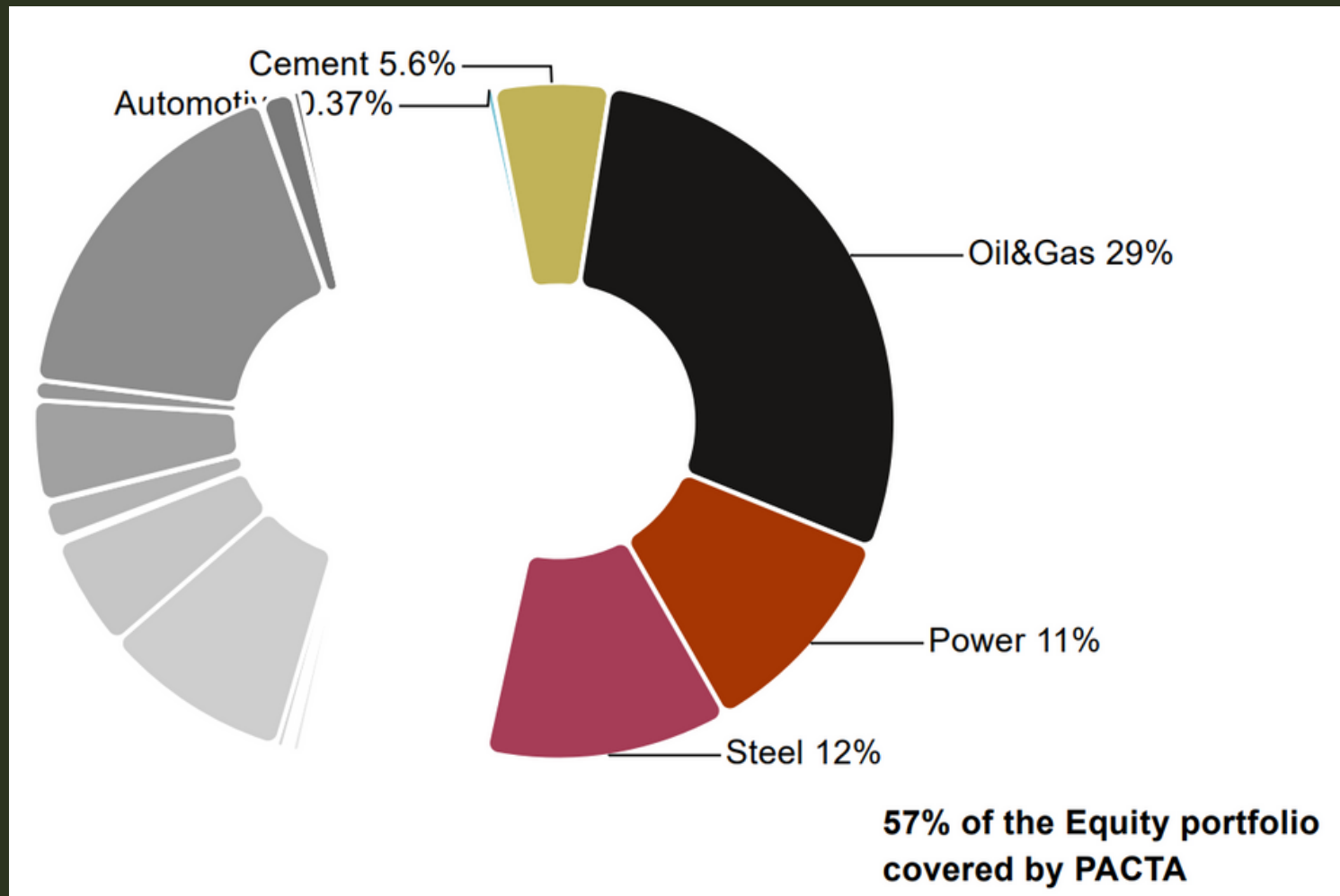
Listed Equity



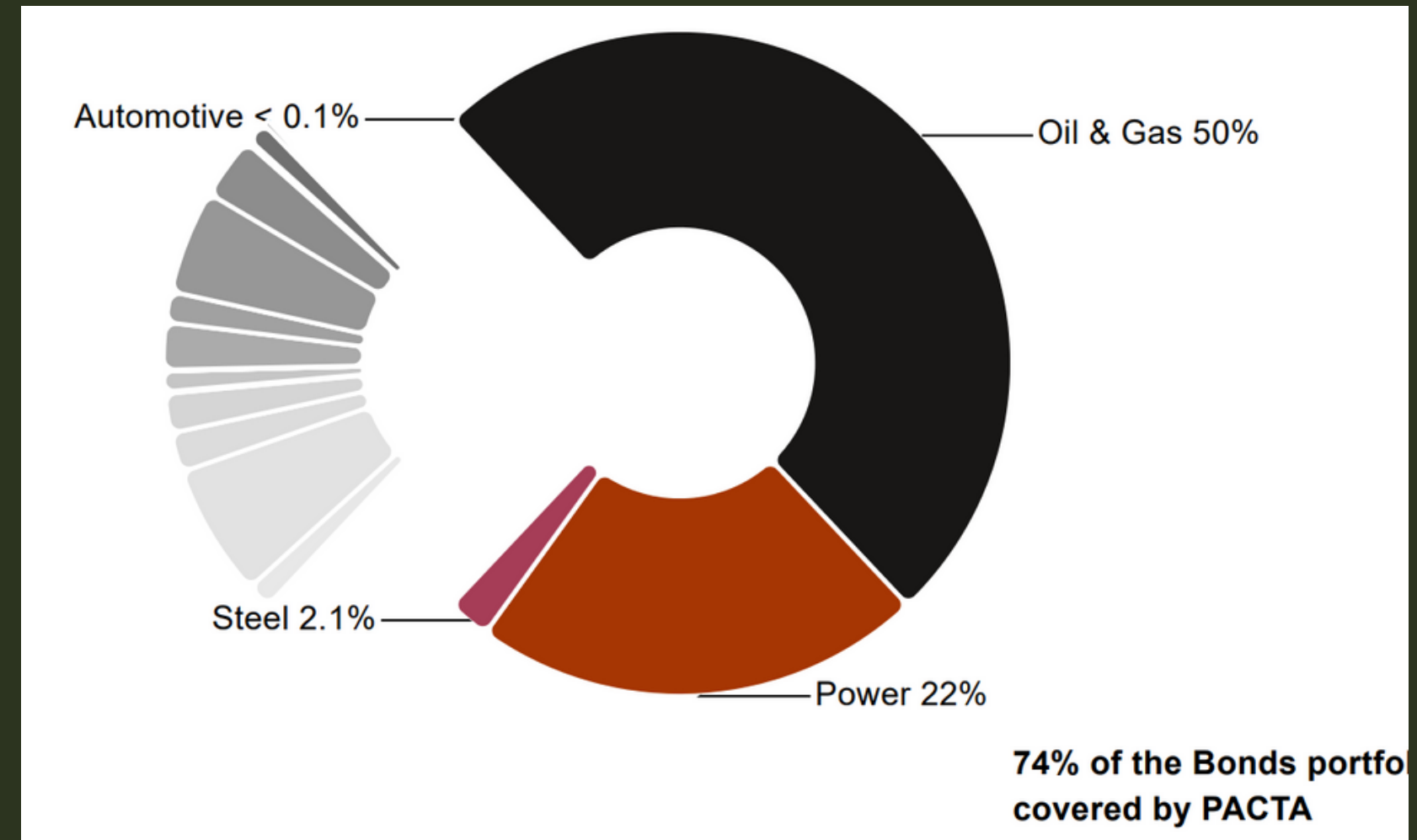
Corporate Bonds



CO2 EMISSIONS



Listed Equity

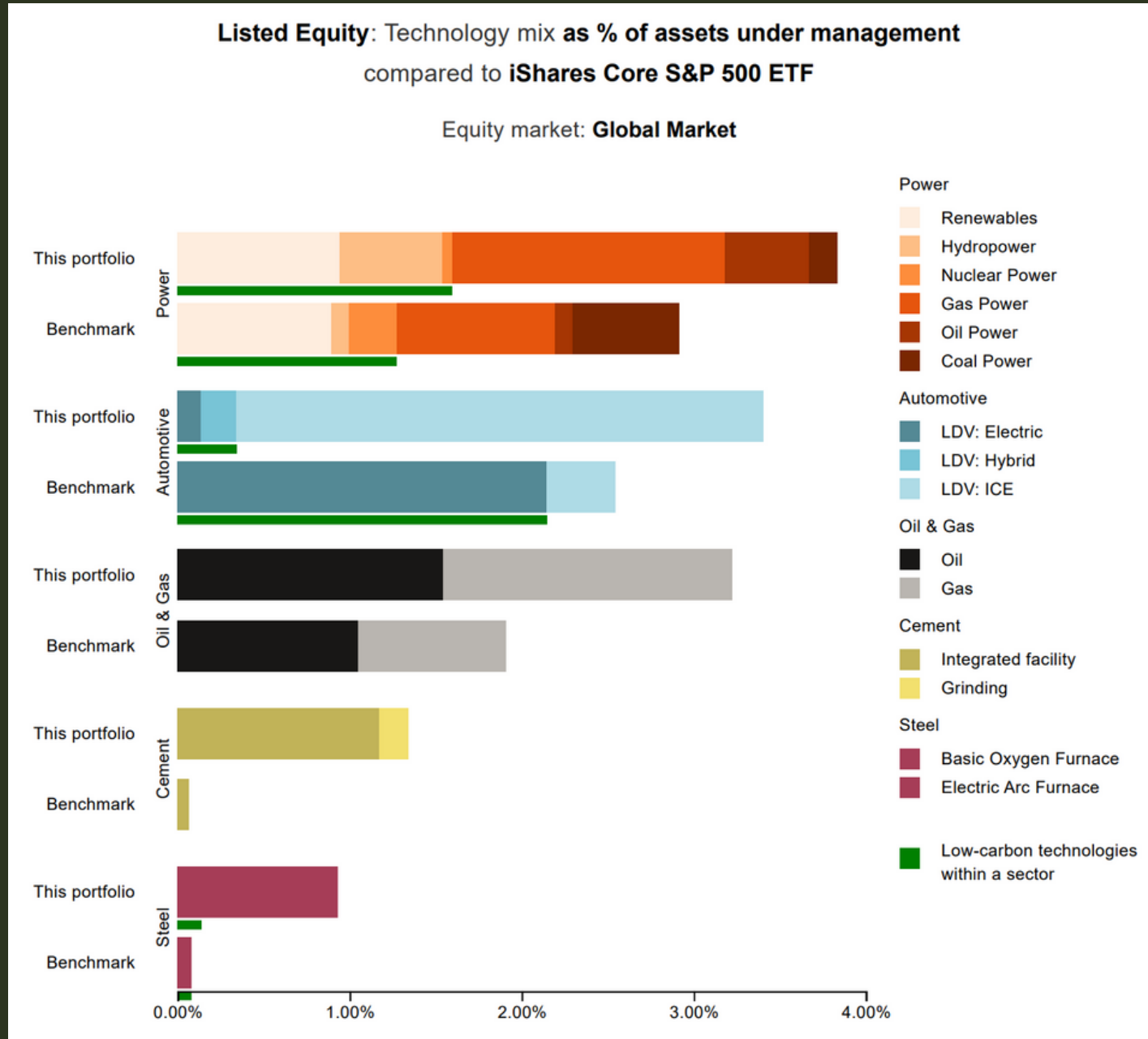


Corporate Bonds

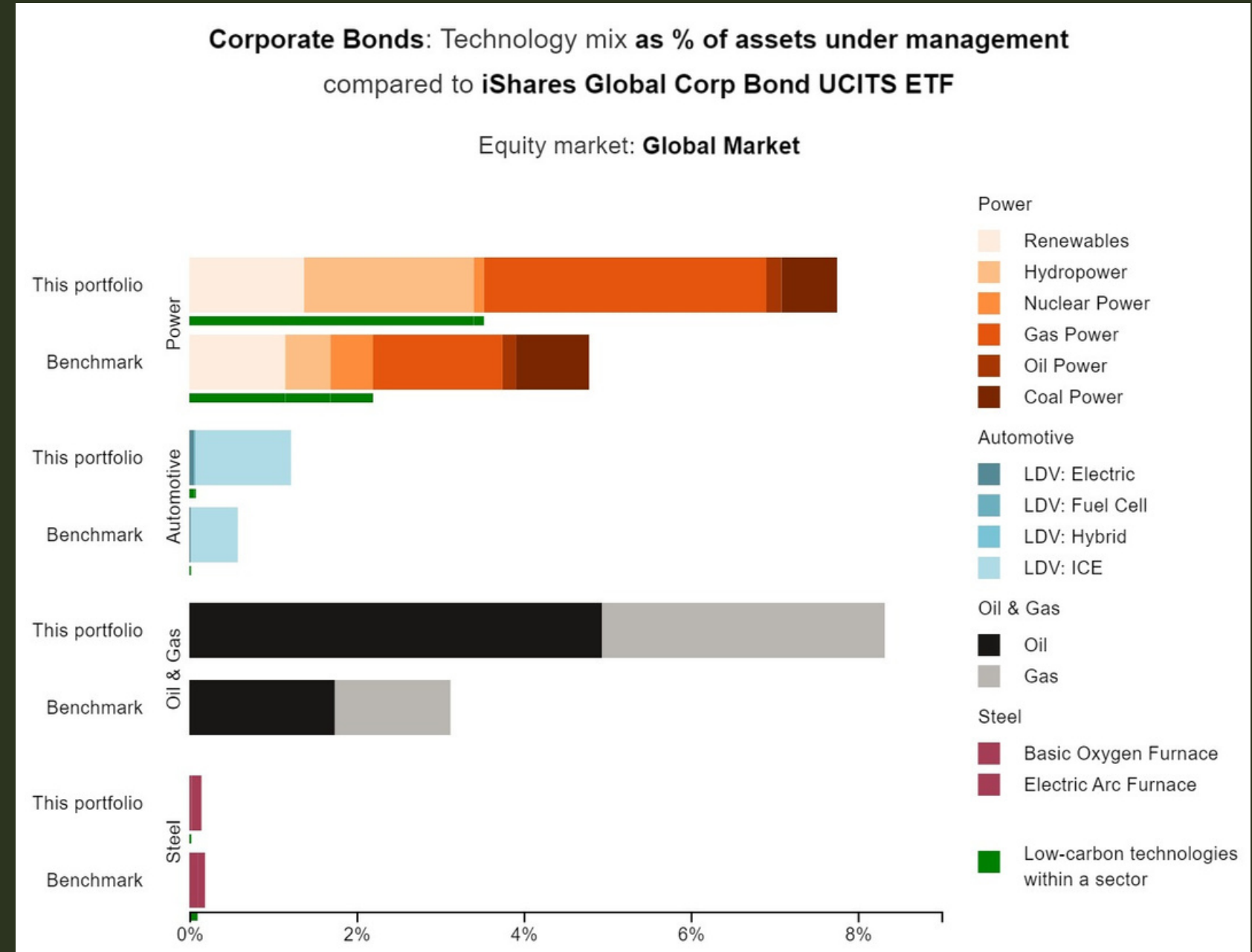
EMISSIONS EXPOSURE TO CLIMATE RELEVANT SECTORS



CURRENT EXPOSURE



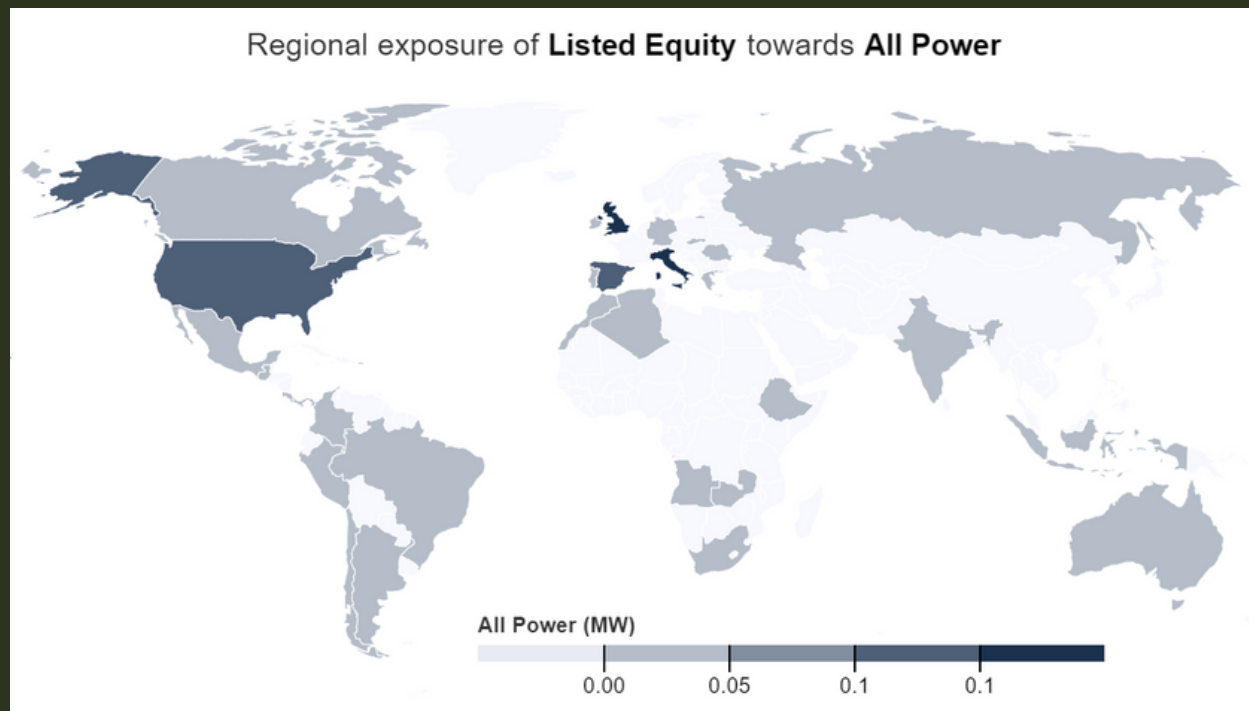
Listed Equity



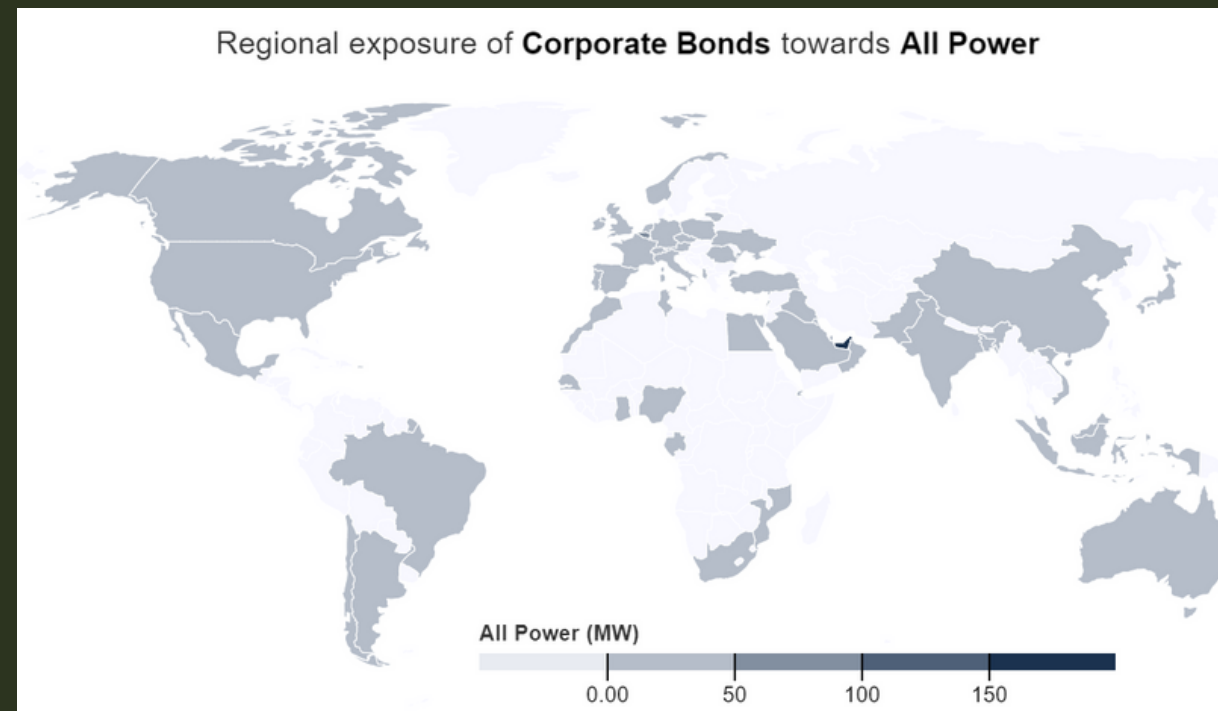
Corporate Bonds



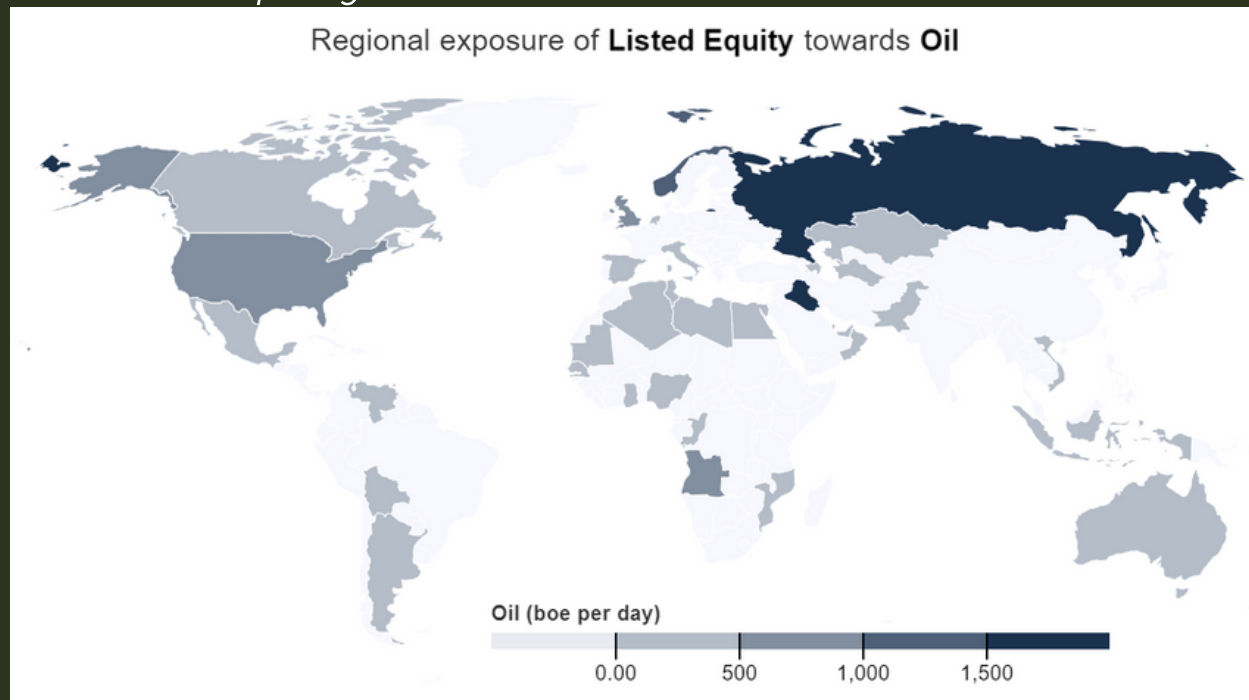
GEOGRAPHICAL EXPOSURE



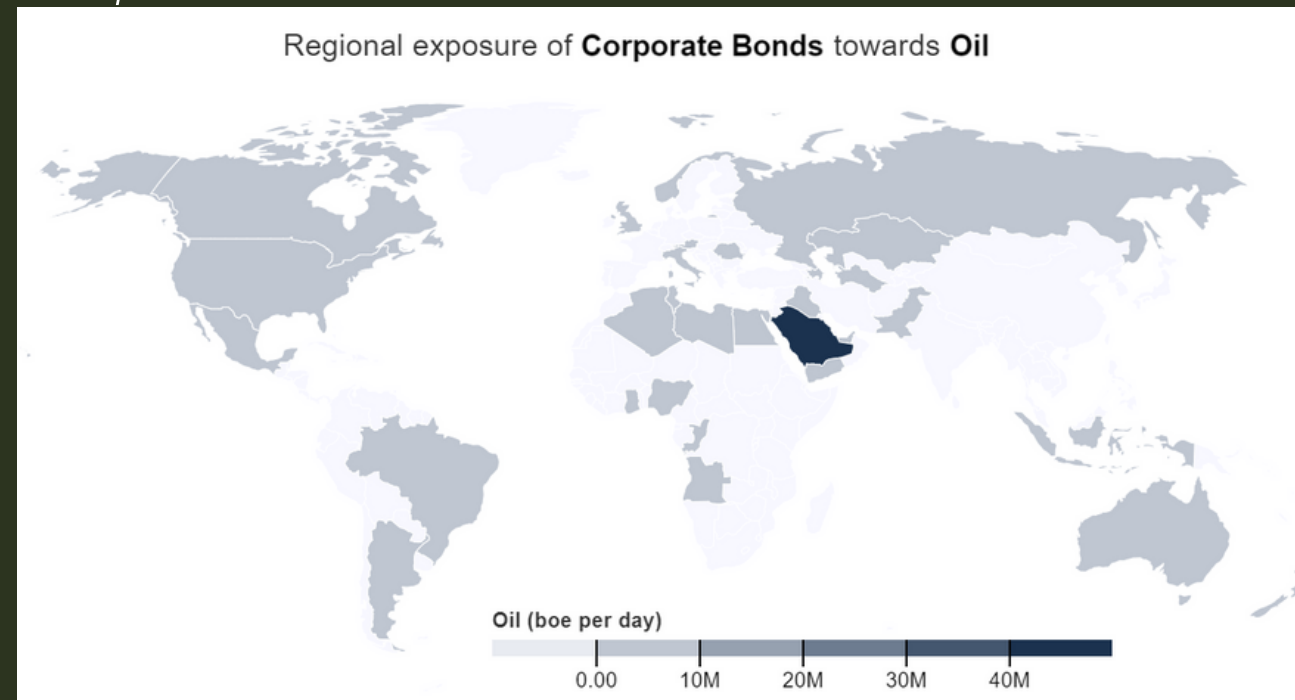
Listed Equity - All Power



Corporate Bonds - All Power



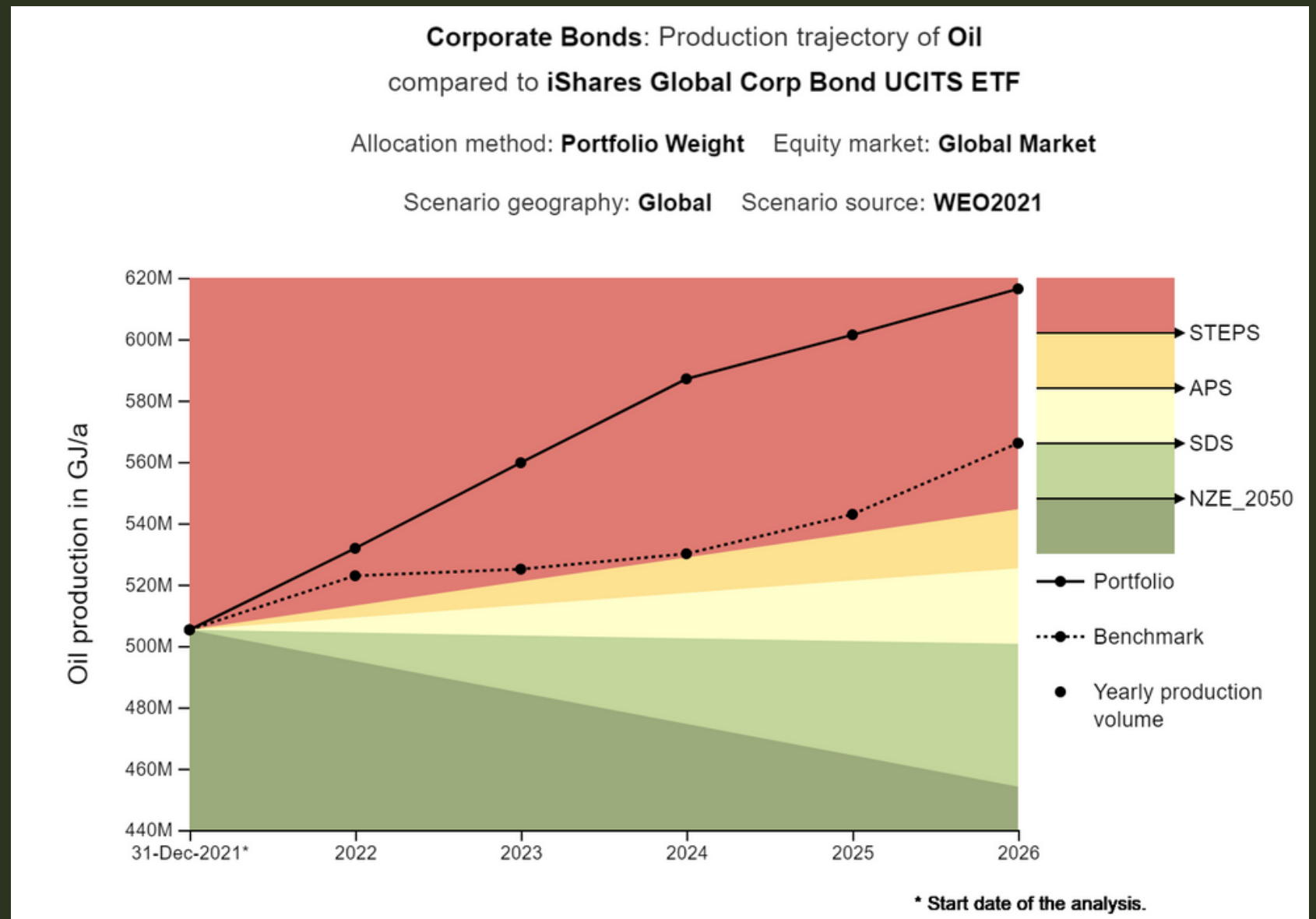
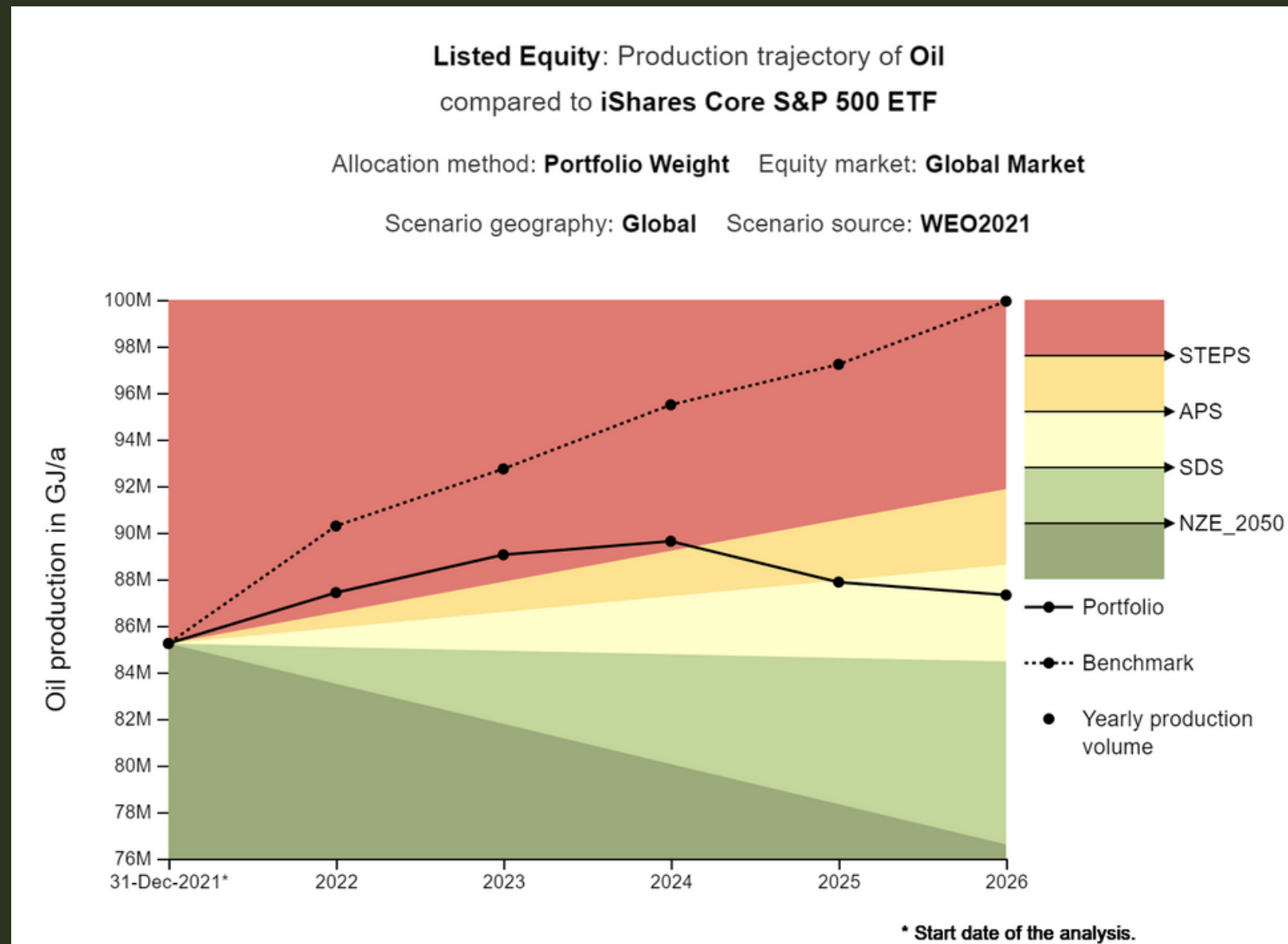
Listed Equity - Oil



Corporate Bonds - Oil



ALIGNMENT OF PRODUCTION TRAJECTORIES

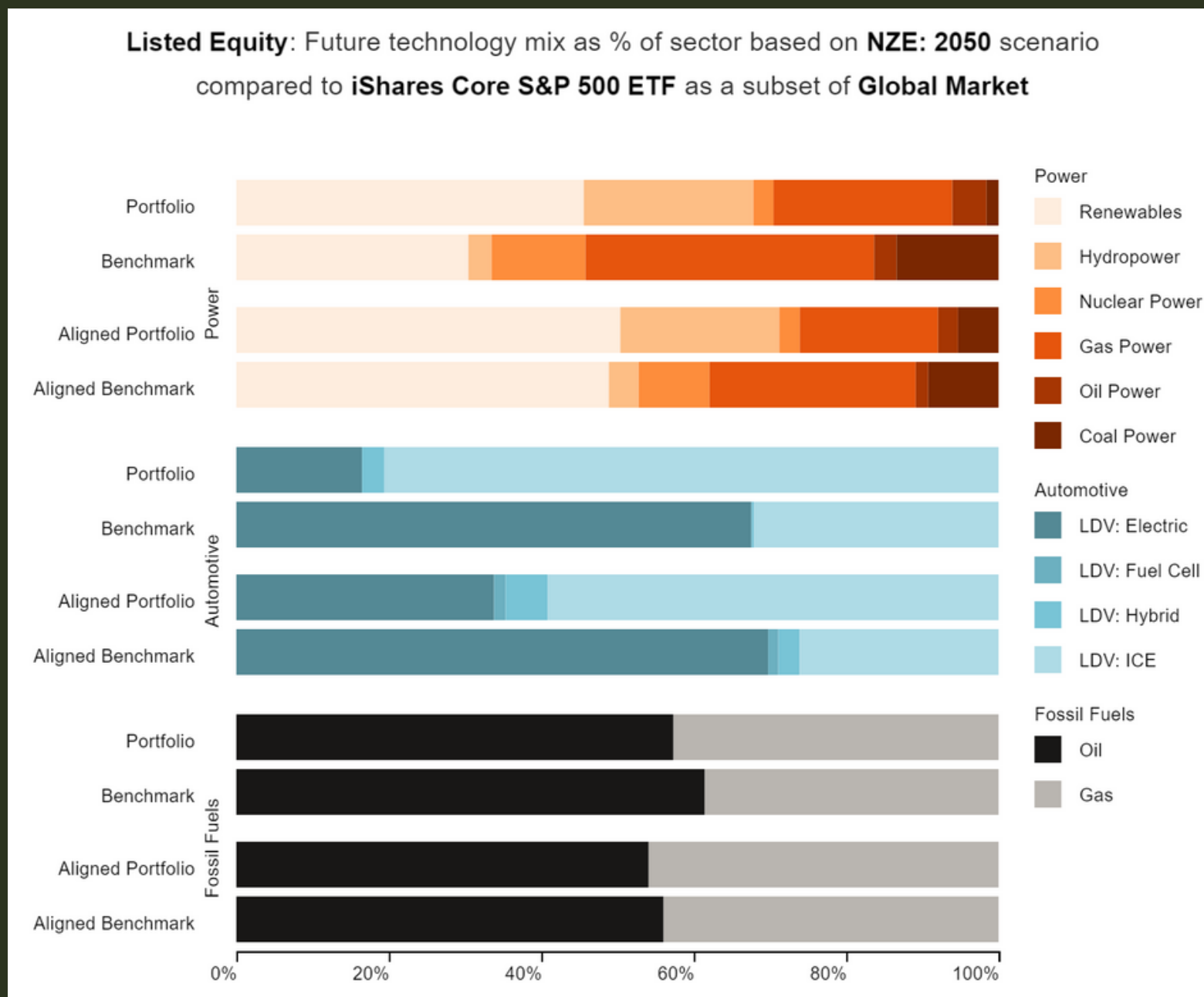


Listed Equity

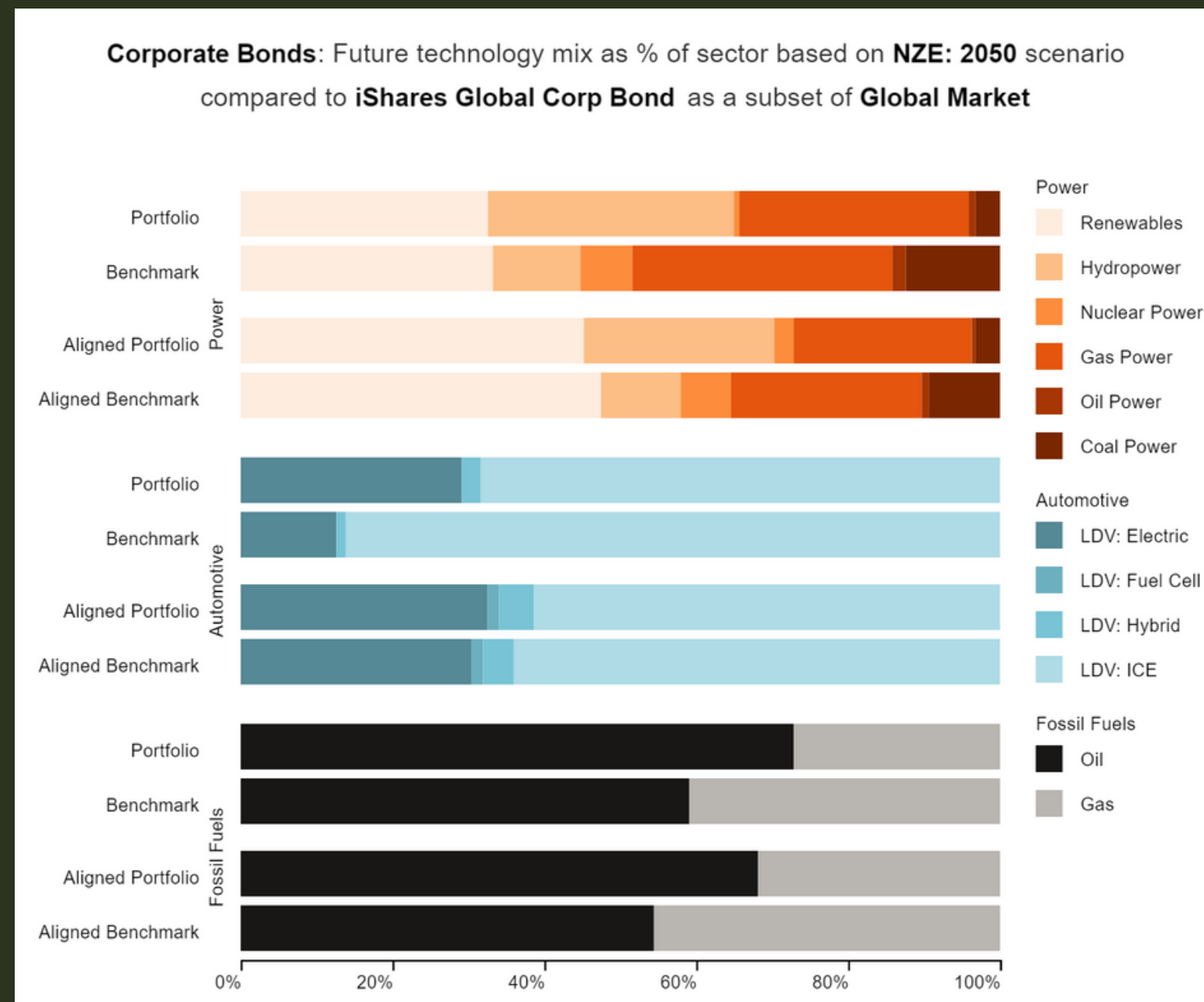
Corporate Bonds



FUTURE TECHNOLOGY BREAKDOWN



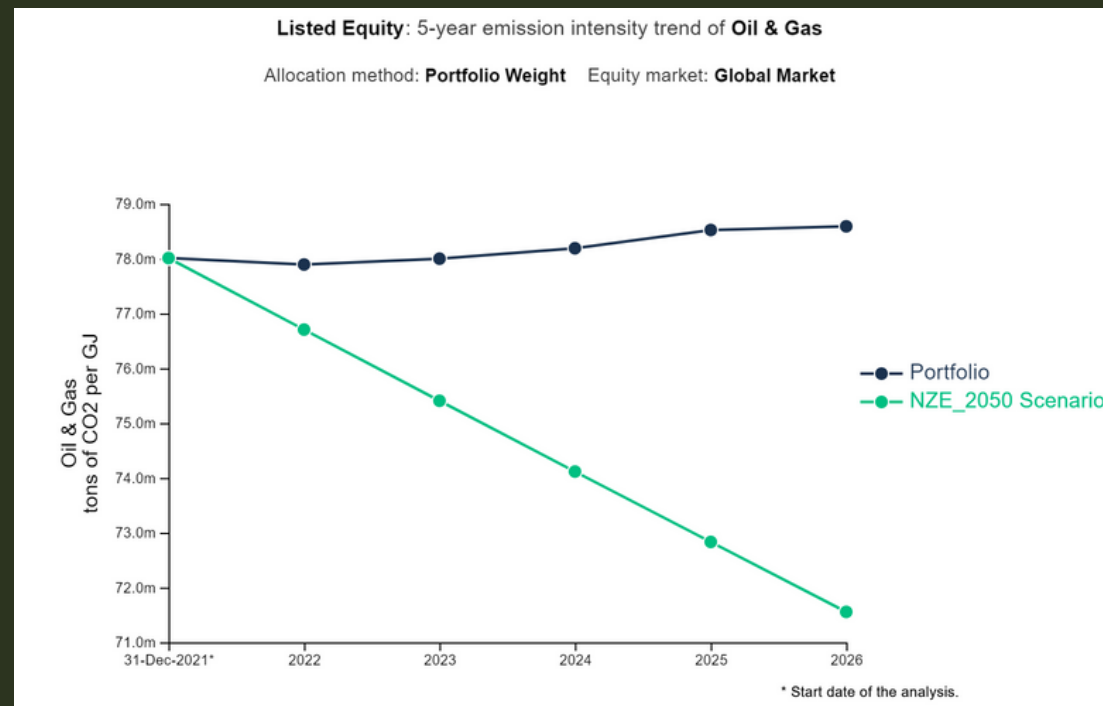
Listed Equity



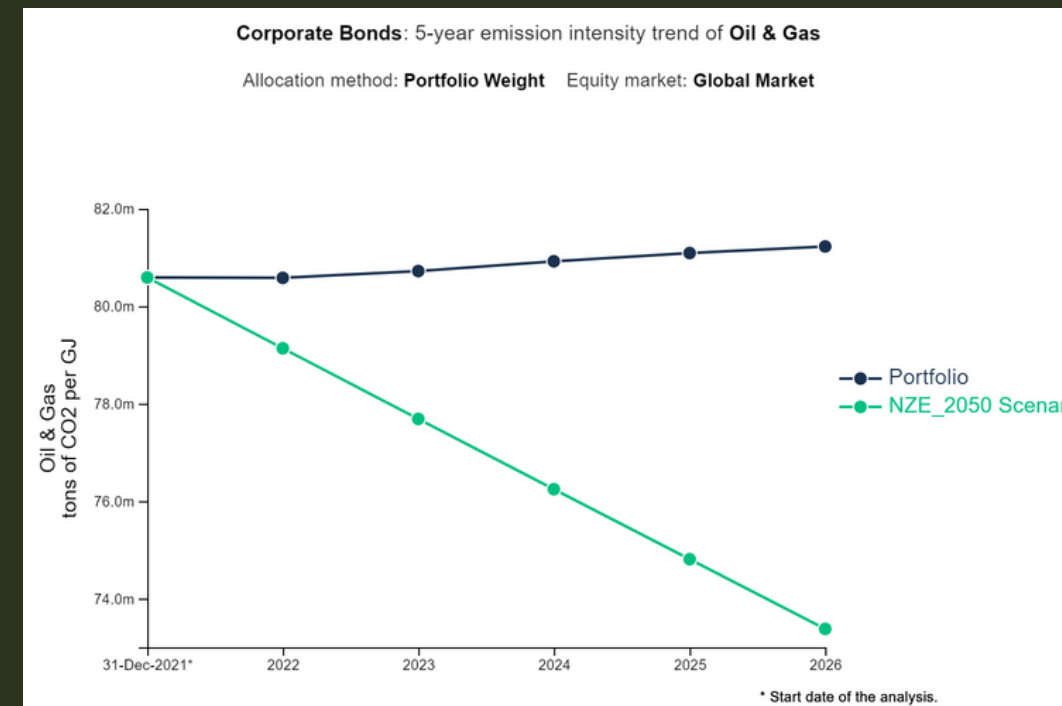
Corporate Bonds



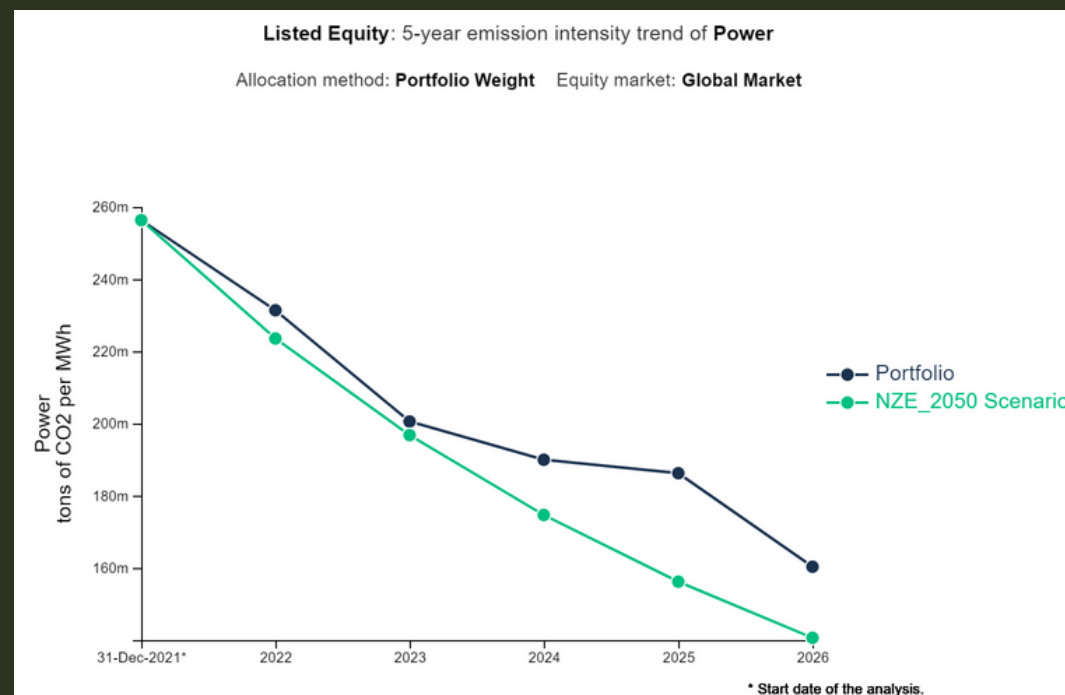
ALIGNMENT OF EMISSION INTENSITIES



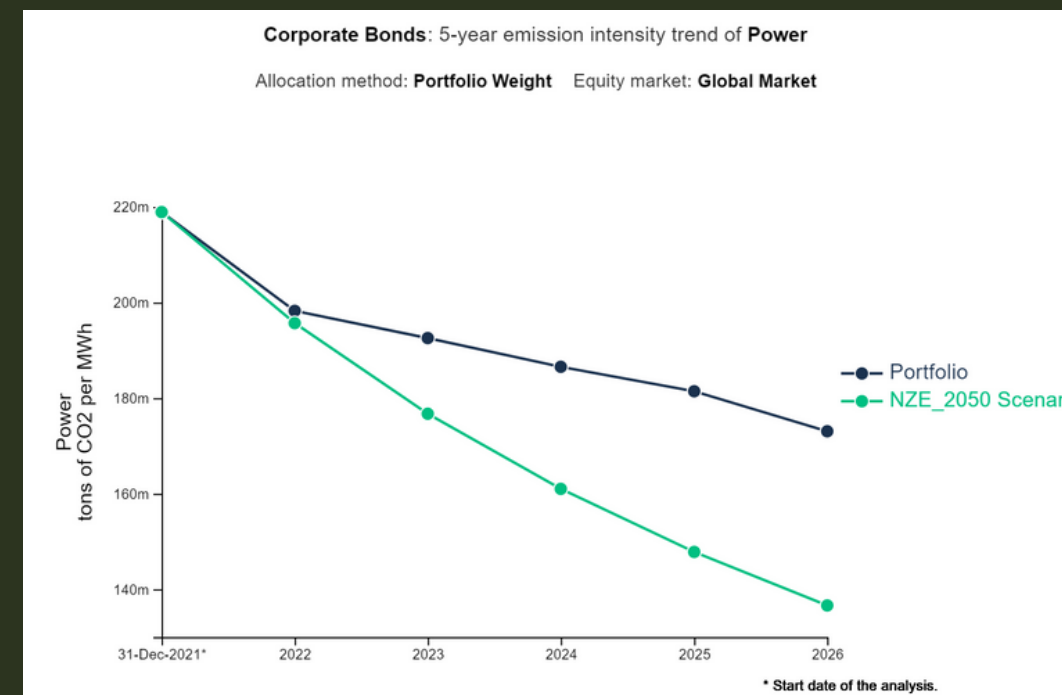
Listed Equity - Oil & Gas



Corporate Bonds - Oil & Gas



Listed Equity - Power

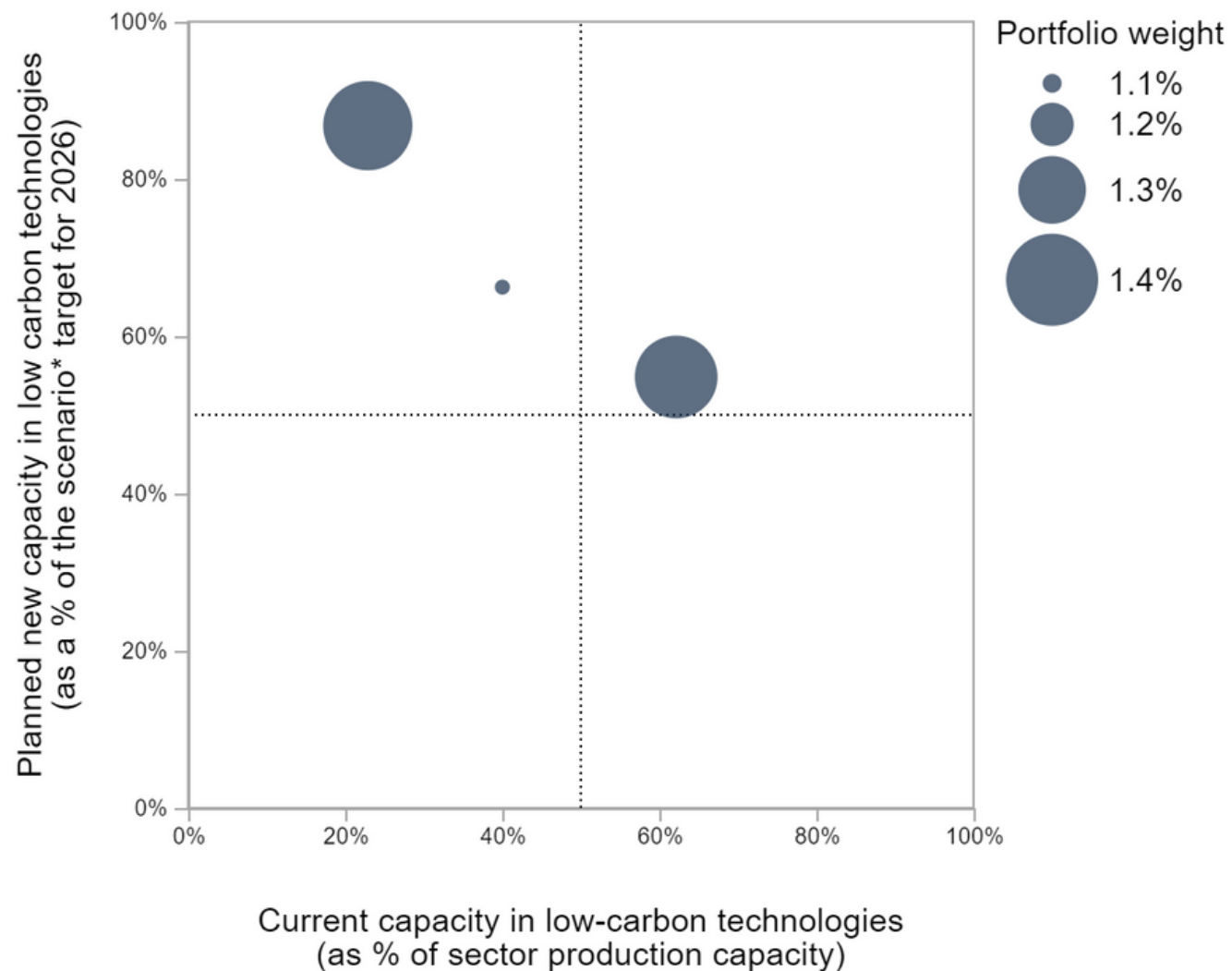


Corporate Bonds - Power

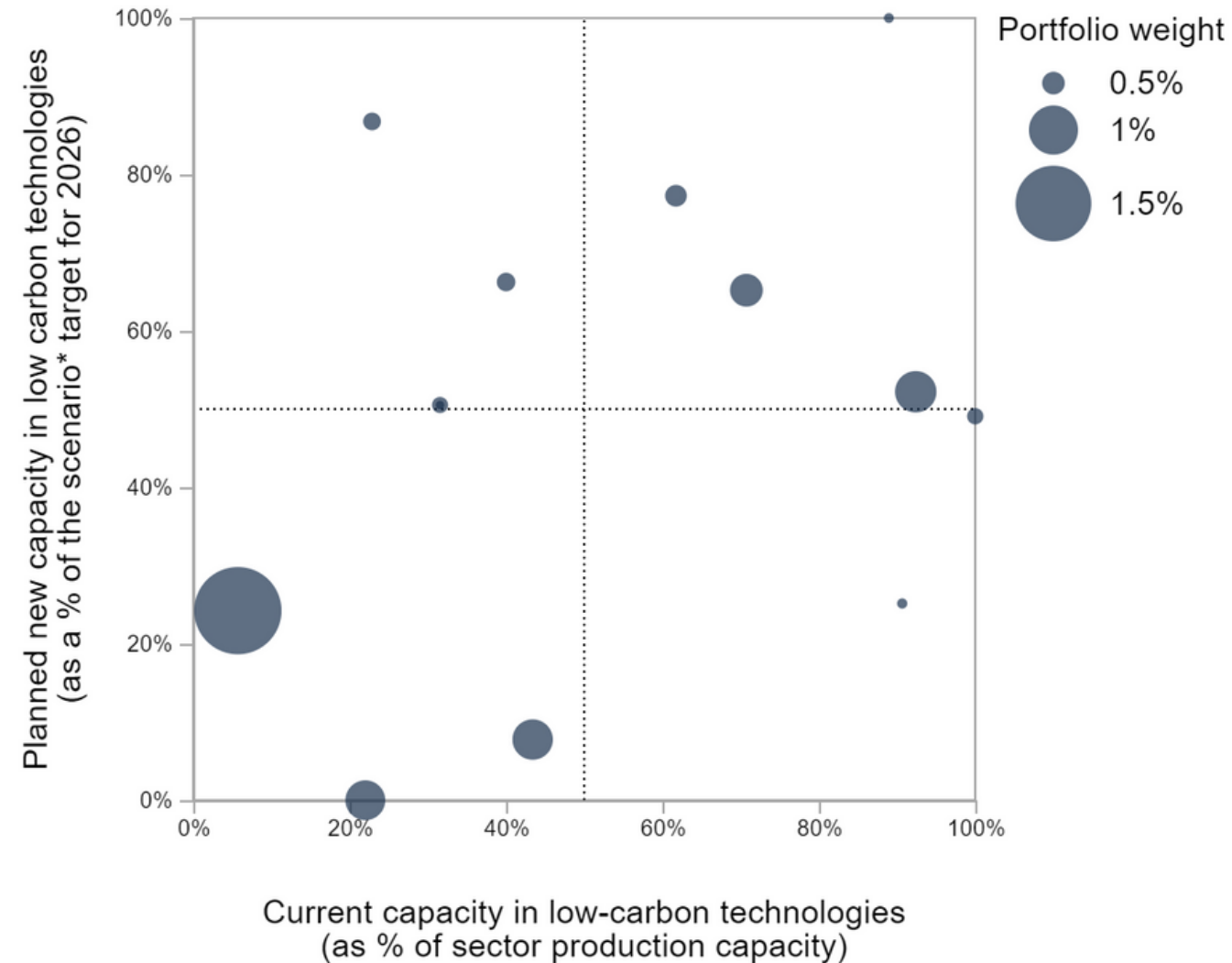


COMPANY LOW- AND HIGH-CARBON SPLIT

Listed Equity: Current low carbon technology share vs. future scenario compatibility of planned production of **Power** companies in this portfolio.



Corporate Bonds: Current low carbon technology share vs. future scenario compatibility of planned production of **Power** companies in this portfolio.



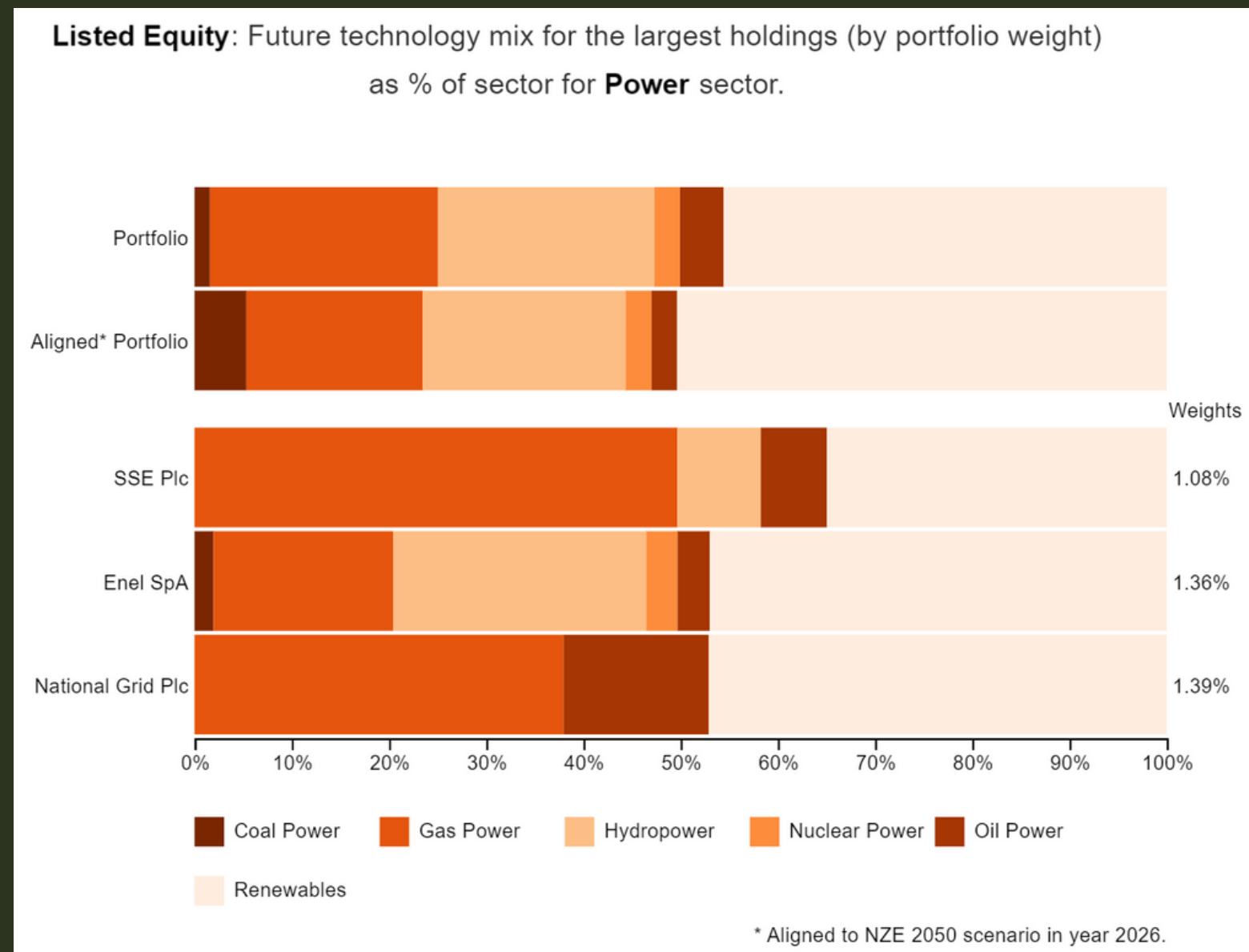
Listed Equity

Corporate Bonds

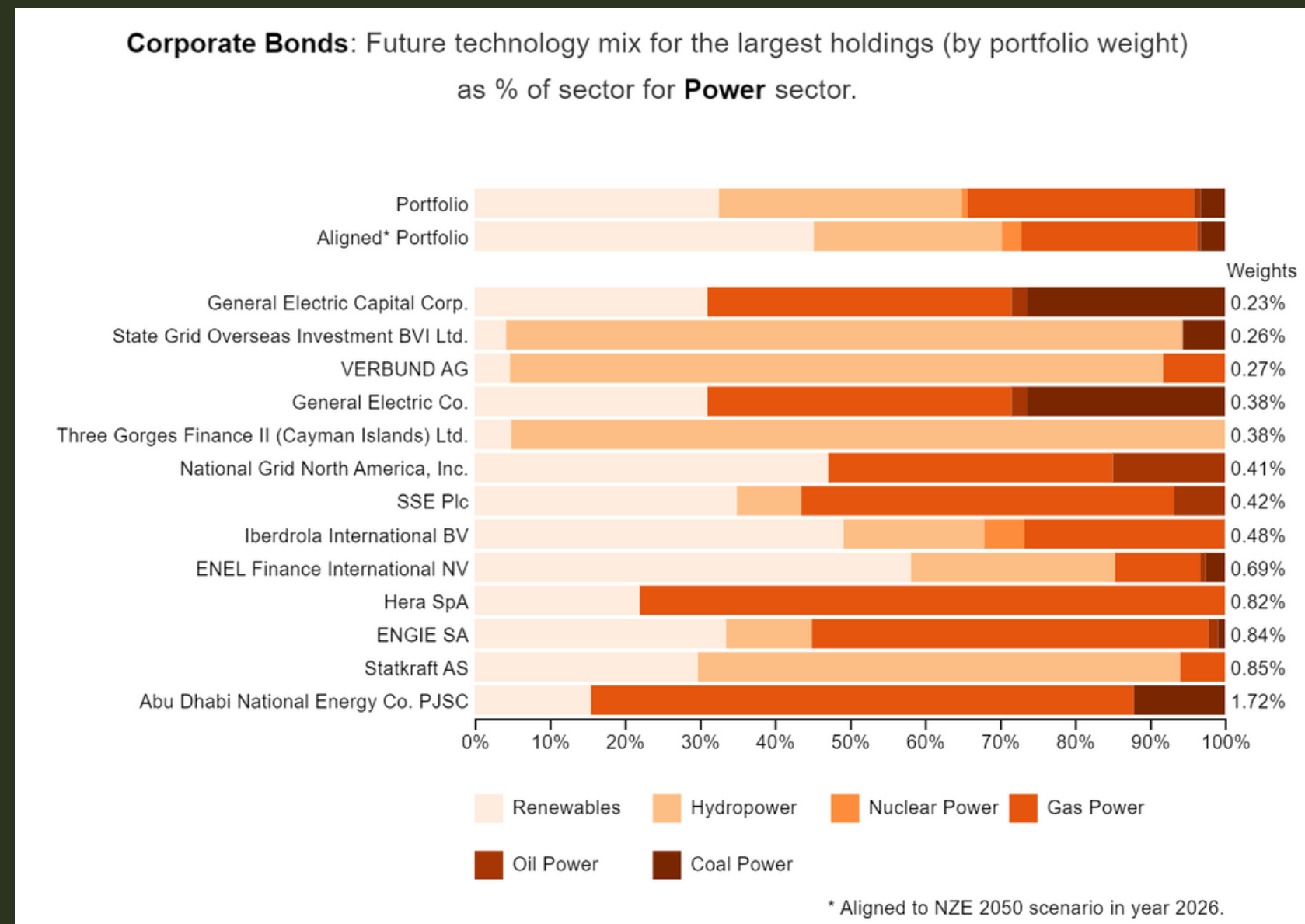


COMPANY TECHNOLOGY EXPOSURE

POWER SECTOR



Listed Equity



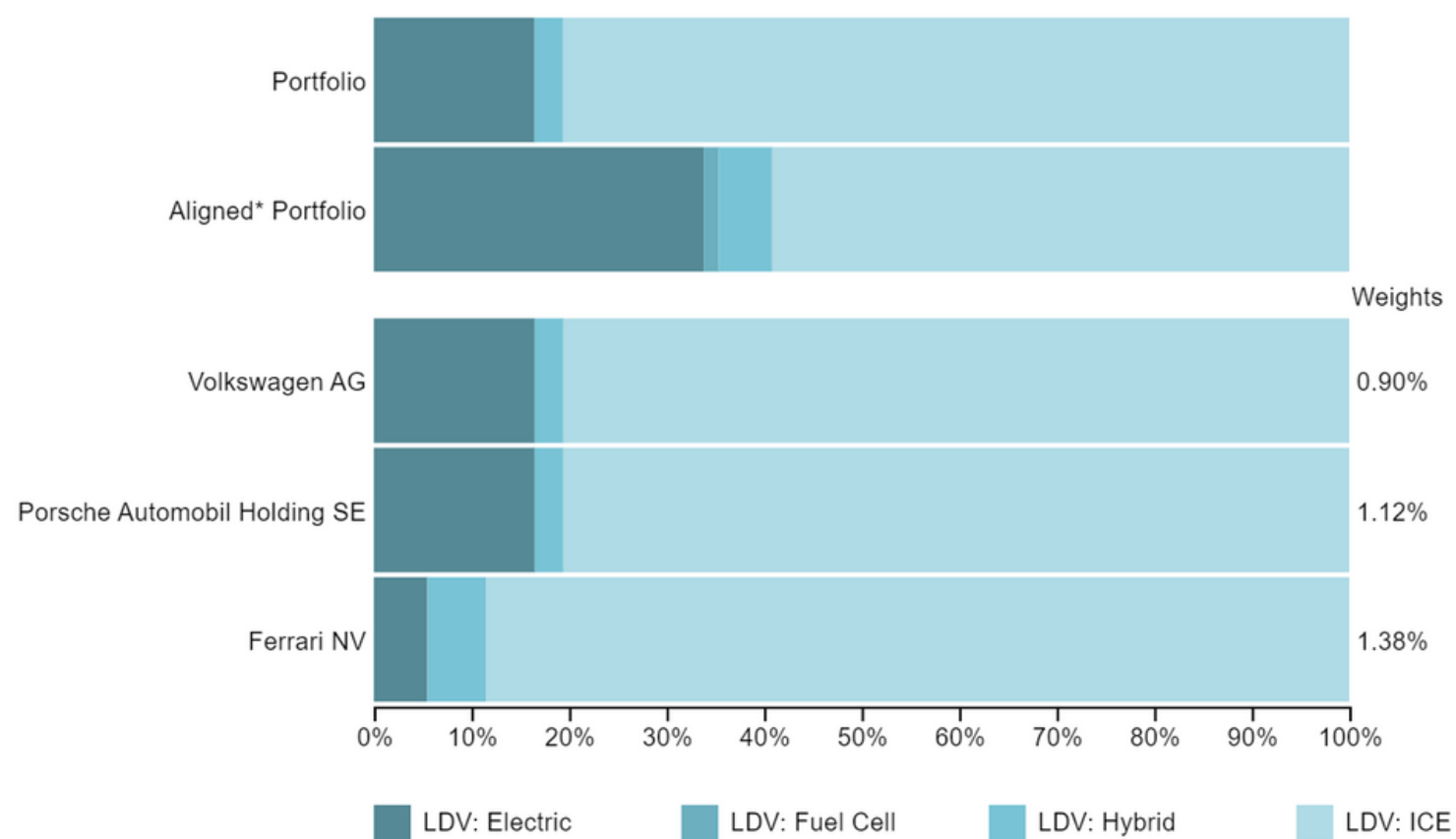
Corporate Bonds



COMPANY TECHNOLOGY EXPOSURE

AUTOMOTIVE SECTOR

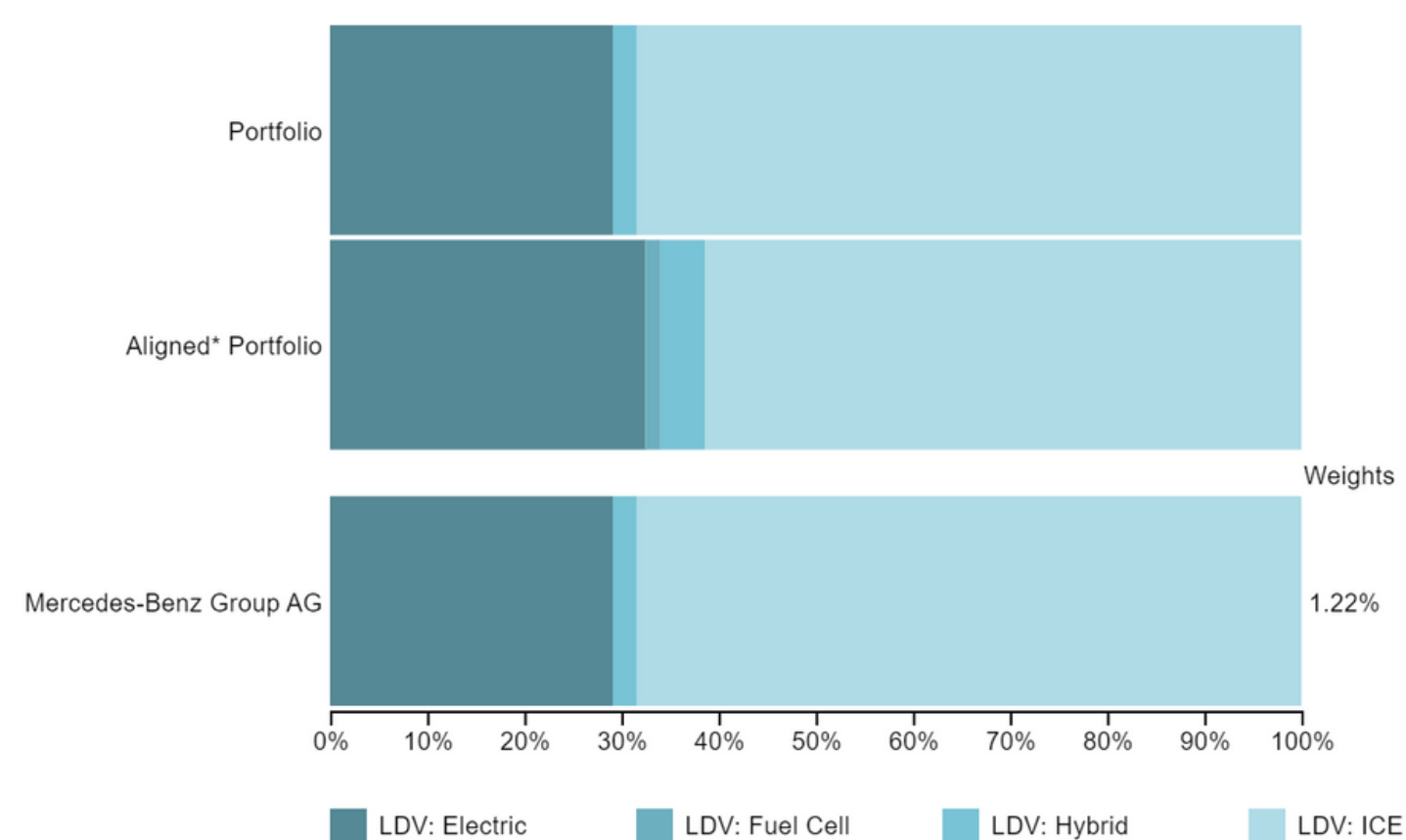
Listed Equity: Future technology mix for the largest holdings (by portfolio weight) as % of sector for **Automotive** sector.



* Aligned to NZE 2050 scenario in year 2026.

Listed Equity

Corporate Bonds: Future technology mix for the largest holdings (by portfolio weight) as % of sector for **Automotive** sector.



* Aligned to NZE 2050 scenario in year 2026.

Corporate Bonds



IORP CLIMATE STRESS TEST



eiopa

European Insurance and
Occupational Pensions Authority

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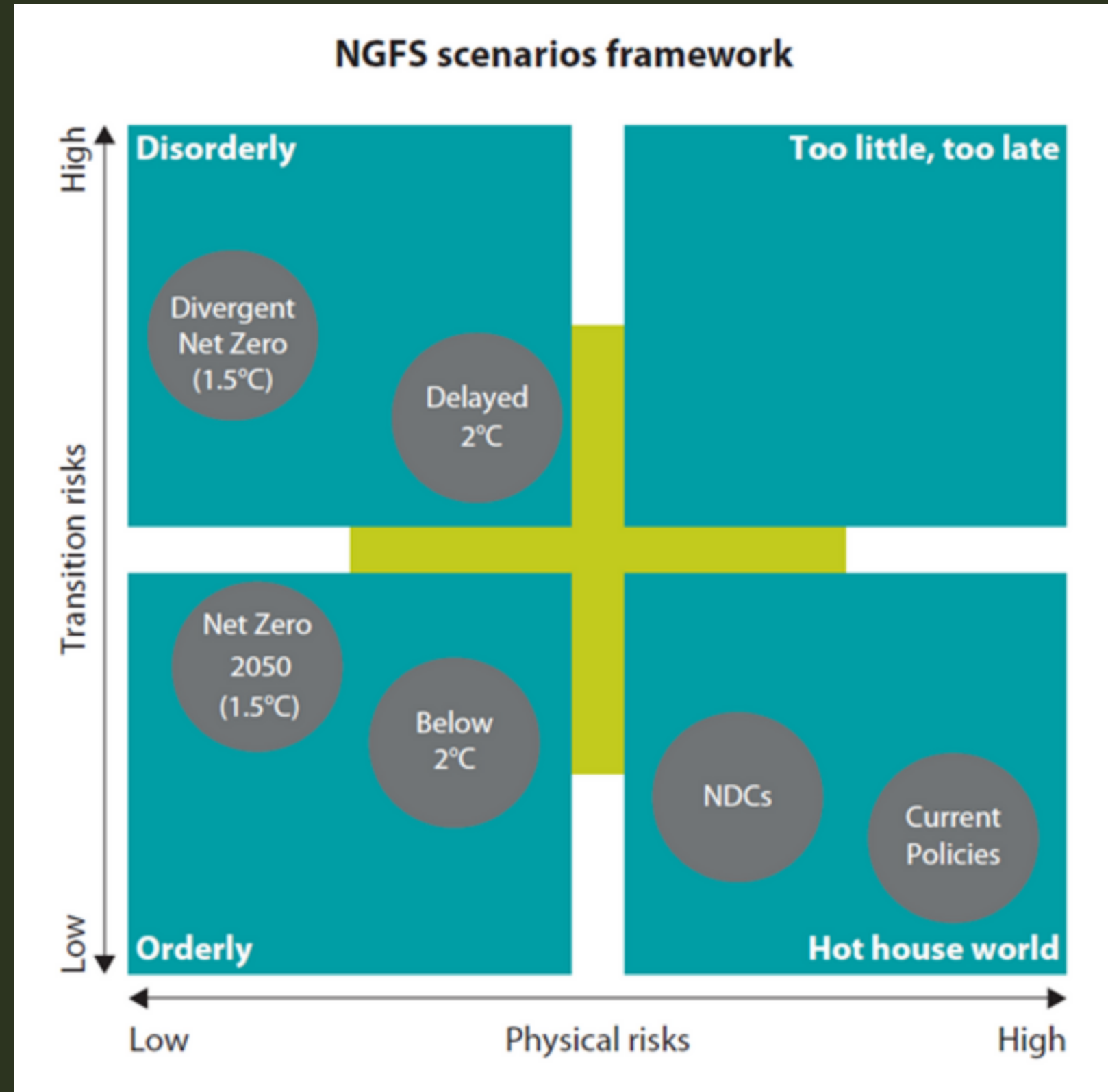


ROADMAP

- Suppose a disorderly transition scenario as the one shown by NGFS
- Find what this scenario implies (shock)
- Compare the portfolio value before and after the shock
- Understand how to improve portfolio performance



THE ADVERSE SCENARIO



ASSET CLASSES

EQUITIES, PROPERTIES, INVESTMENT FUNDS,
CORPORATE BONDS AND GOVERNMENT BONDS

ISIN	Currency	Market Values	Shock	Market W shock	CONVERTED
LU1775982249	USD	272542	-14,300%	233568,49	205389,11
MU0129U00005	USD	2408308	-14,300%	2063919,96	1814913,78
IE00B296YK09	EUR	281161	-37,776%	174951,03	174951,03
LU0283739885	USD	213352	-37,776%	132757,22	116740,43
LU0780248950	EUR	23702	-37,776%	14748,45	14748,45
LU0853555463	USD	1039563	-37,776%	646862,88	568820,68
LU1775948141	USD	1052898	-37,776%	655160,52	576117,23
LU1775981431	GBP	653089	-37,776%	406381,36	484133,15
LU0088277610	USD	5665123	-37,776%	3525094,46	3099801,67
LU0088883458	GBP	484425	-37,776%	301431,03	359102,97
LU1079698293	EUR	20679867	-37,776%	12867943,84	12867943,84
LU0561981480	EUR	2483	-14,300%	2127,93	2127,93
					20284790,28



ASSET CLASSES

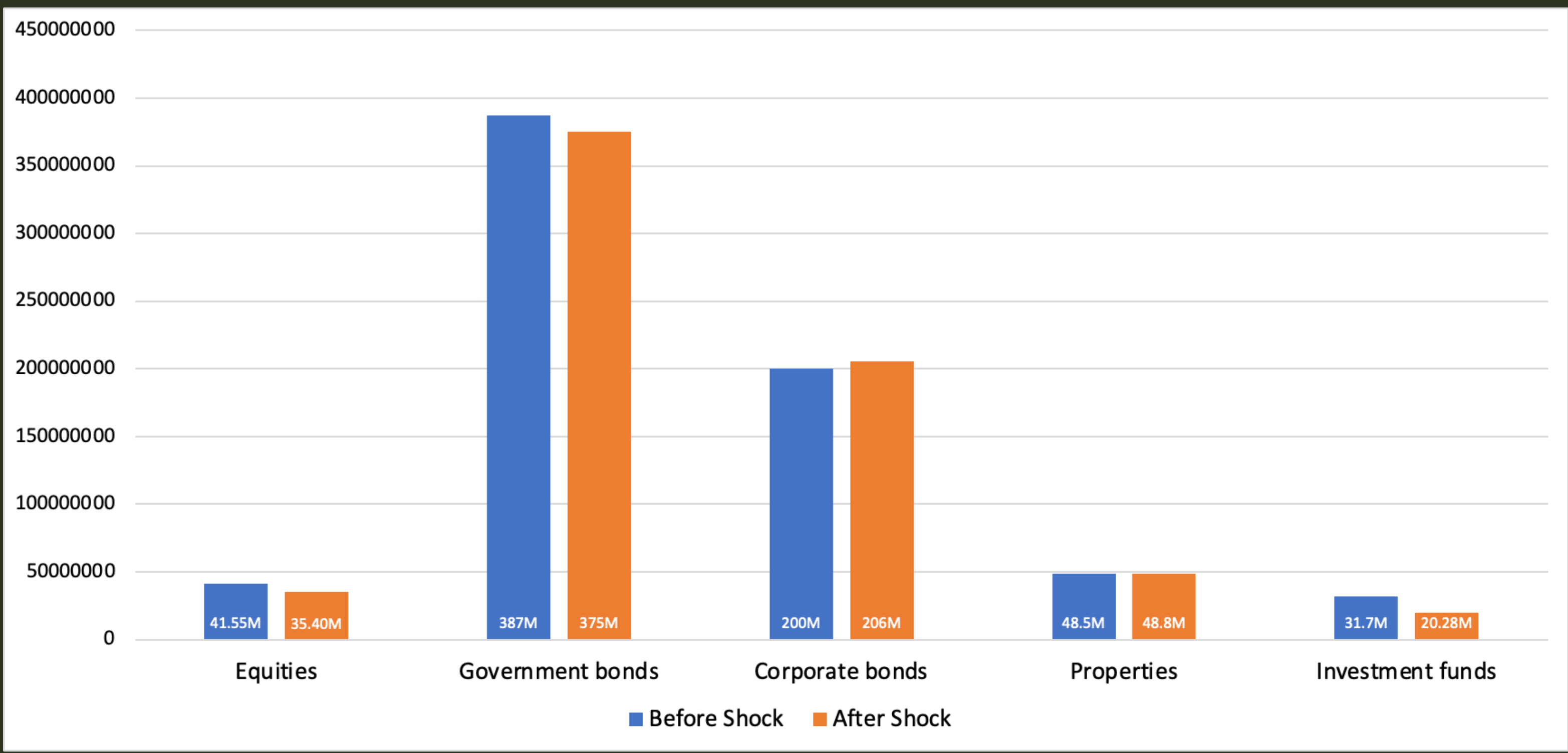
INVESTMENT FUNDS

ISIN	Currency	Market Values	Shock	Market W shock	CONVERTED
LU1775982249		Asset Allocation			205389,11
MU0129U00005					1814913,78
IE00B296YK09		% Long	% Short	% Net Assets	174951,03
LU0283739885	Stock	97.23	0.00	97.23	116740,43
LU0780248950	Bond	0.00	0.00	0.00	14748,45
LU0853555463	Property	0.00	0.00	0.00	568820,68
LU1775948141	Cash	0.76	0.07	0.69	576117,23
LU1775981431	Other	2.08	0.00	2.08	484133,15
LU0088277610					3099801,67
LU0088883458					359102,97
LU1079698293					12867943,84
LU0561981480					2127,93
					20284790,28



ASSET CLASSES

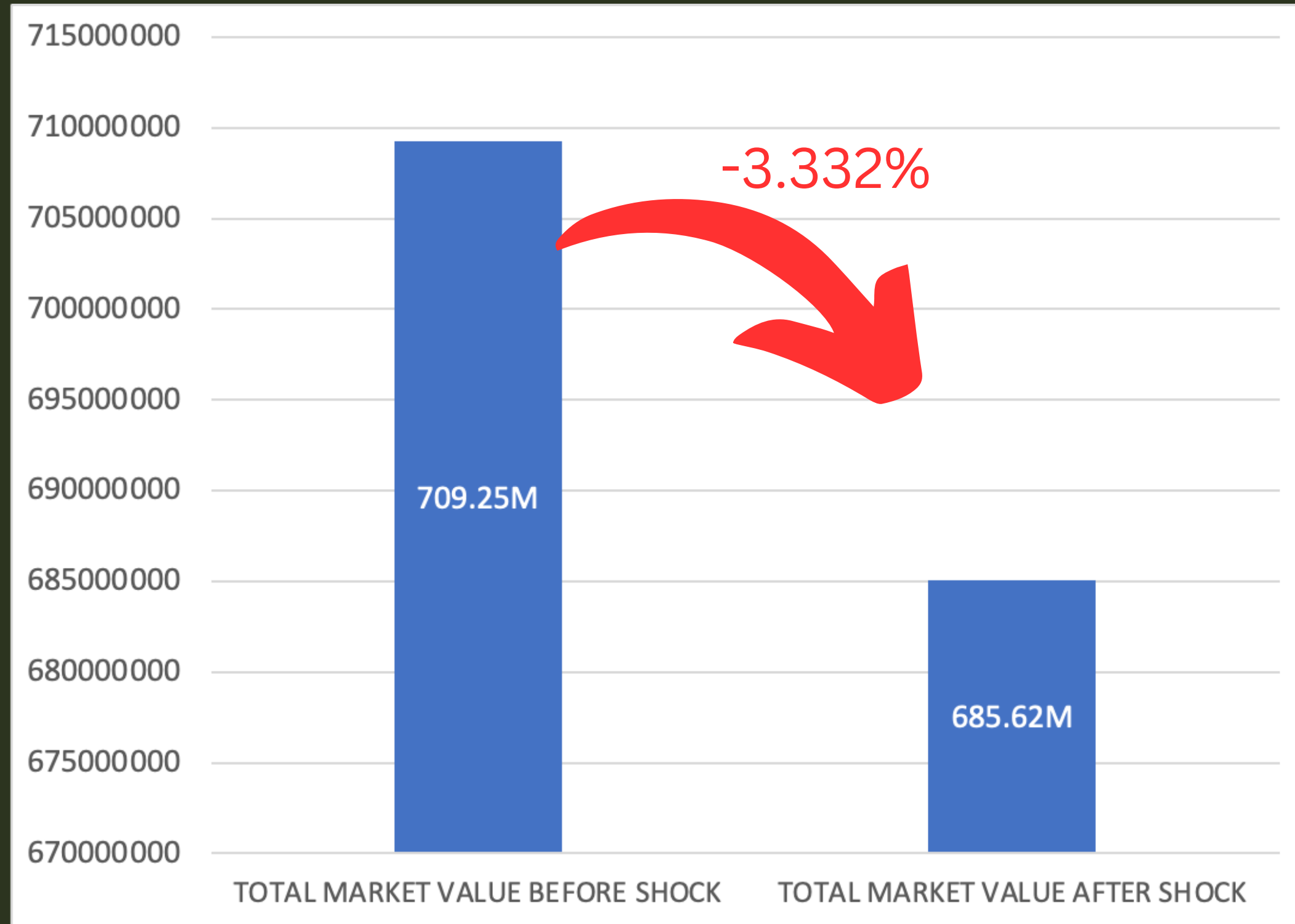
COMPARISON FOR BEFORE AND AFTER SHOCK



% CHANGE DUE TO SHOCK



SHOCK IMPACT ON PORTFOLIO VALUE



ESG STRATEGY ASSET ALLOCATION

- Focus on Equities
- Implementation of ESG scoring
- Asset reallocation

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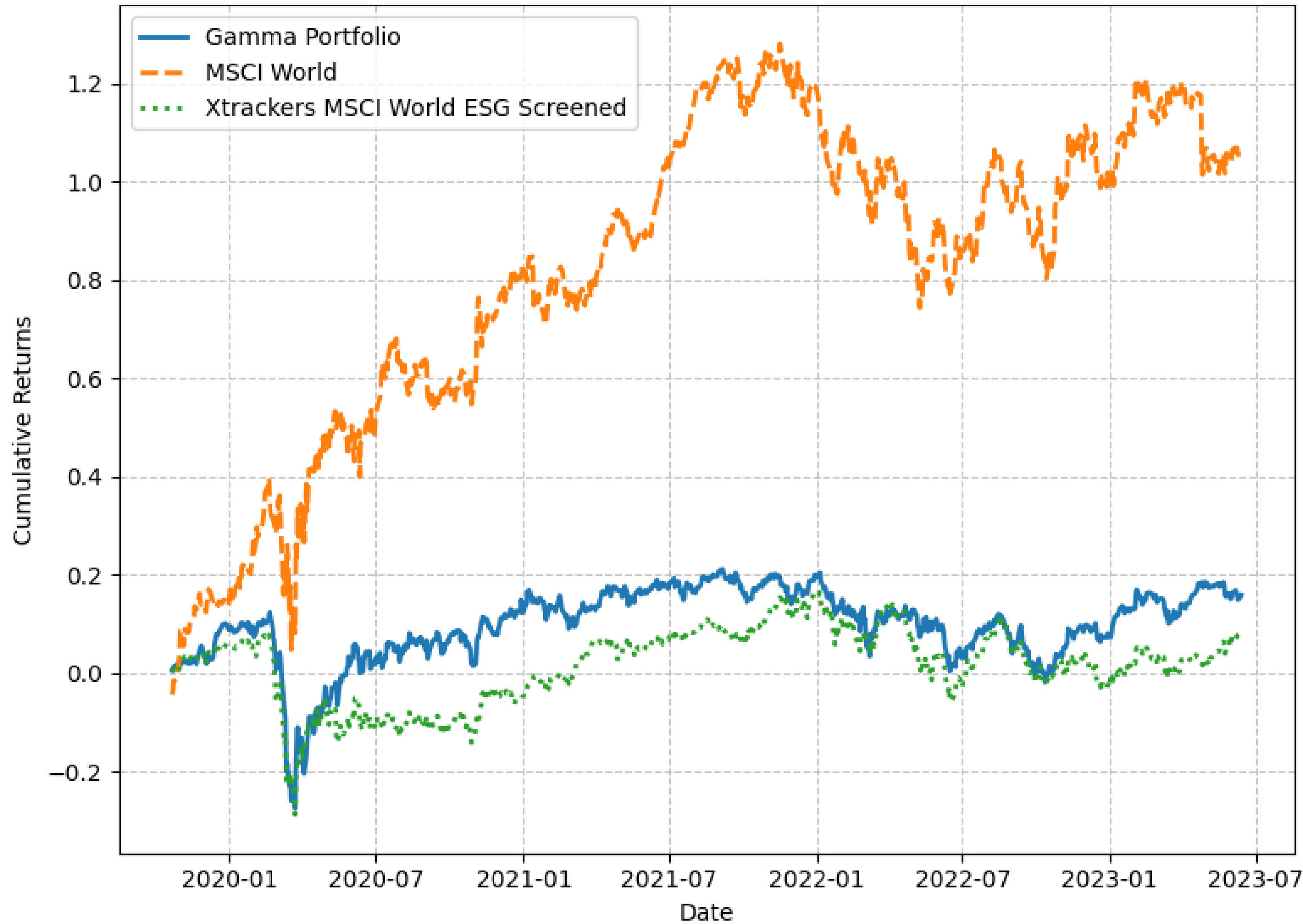


OUR STRATEGY

- Retrived ESG scoring from Refinitiv Database
- Data Cleaning
- Keep investor's risk profile unchanged
- Focus on Equities:
 - Overweighting ESG leaders
 - Increase exposure to Energy sector
 - Same risk level
- Understand how PACTA analysis changed



Gamma Portfolio vs. Benchmarks



GAMMA PORTFOLIO

AVERAGE MONTHLY RETURNS:
0.5%

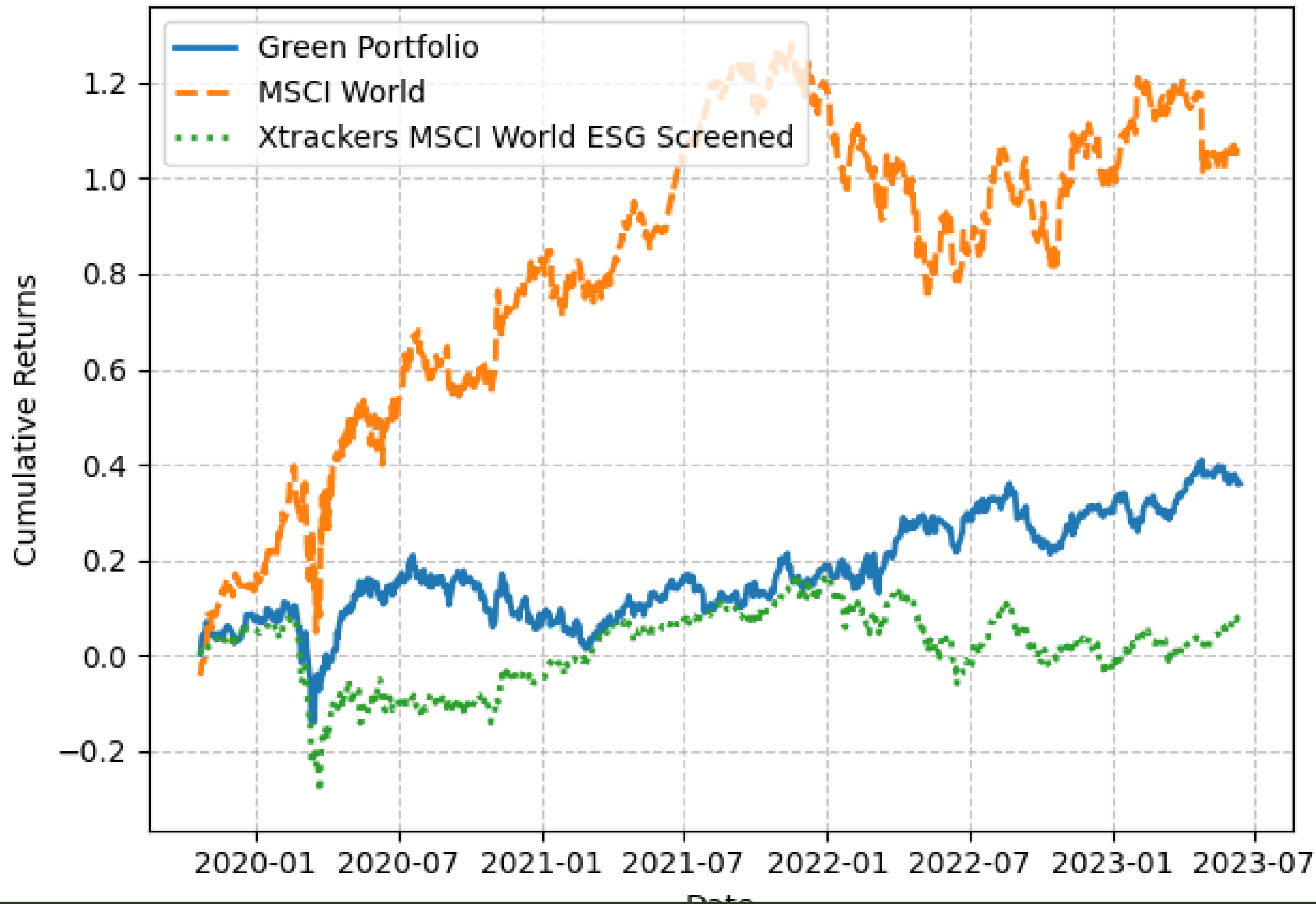
STANDARD DEVIATION:
6.6%

ESG SCORE: 56,40

ENVIRONMENTAL PILLAR SCORE: 43,71



Green Portfolio vs. Benchmarks



GREEN PORTFOLIO

AVERAGE MONTHLY RETURNS:

0.5% → 1.1%

STANDARD DEVIATION:

6.6% → 6.3%

ESG SCORE:

56,4 → 84,36

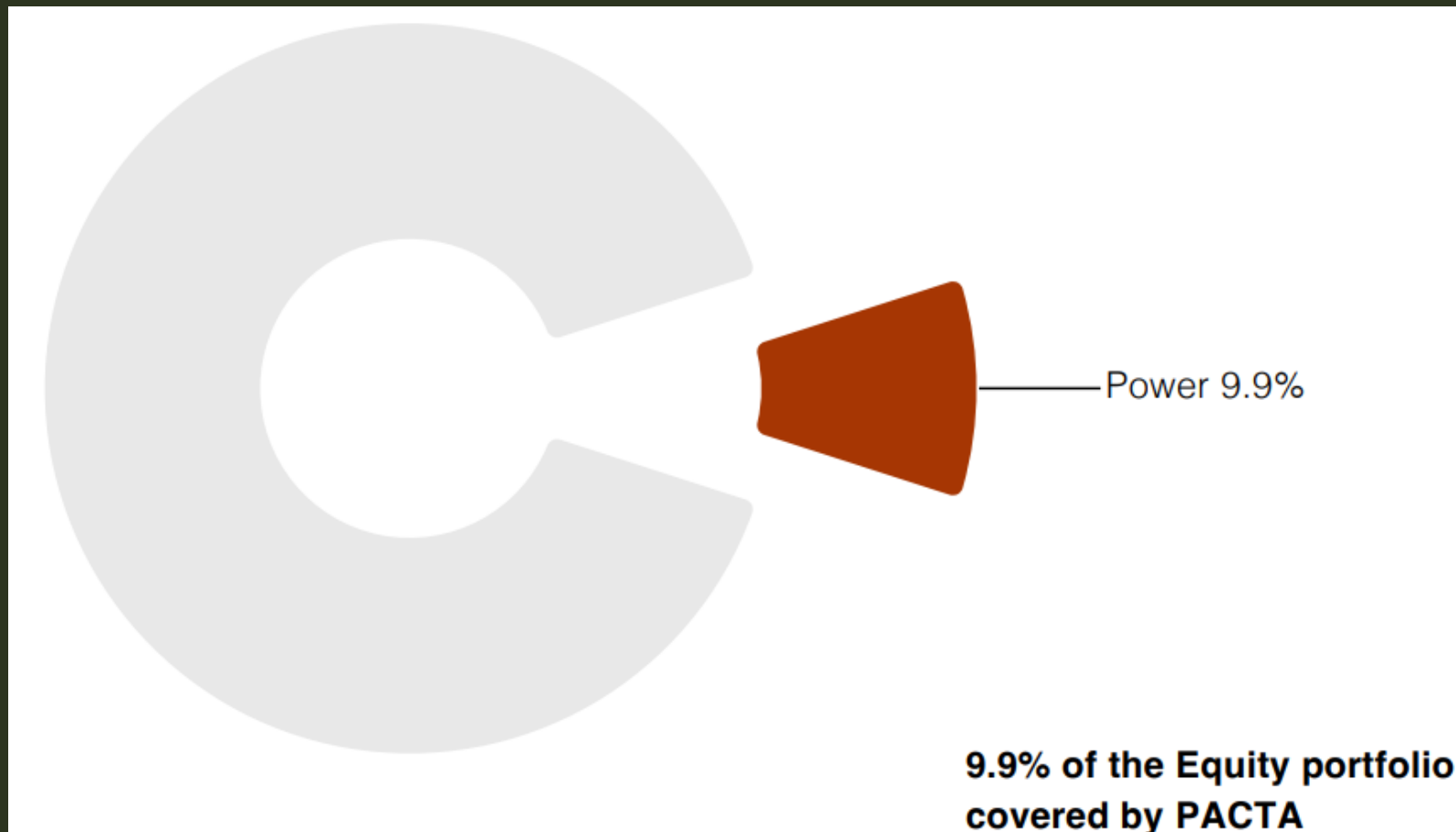
ENVIRONMENTAL PILLAR SCORE:

43,71 → 77,84

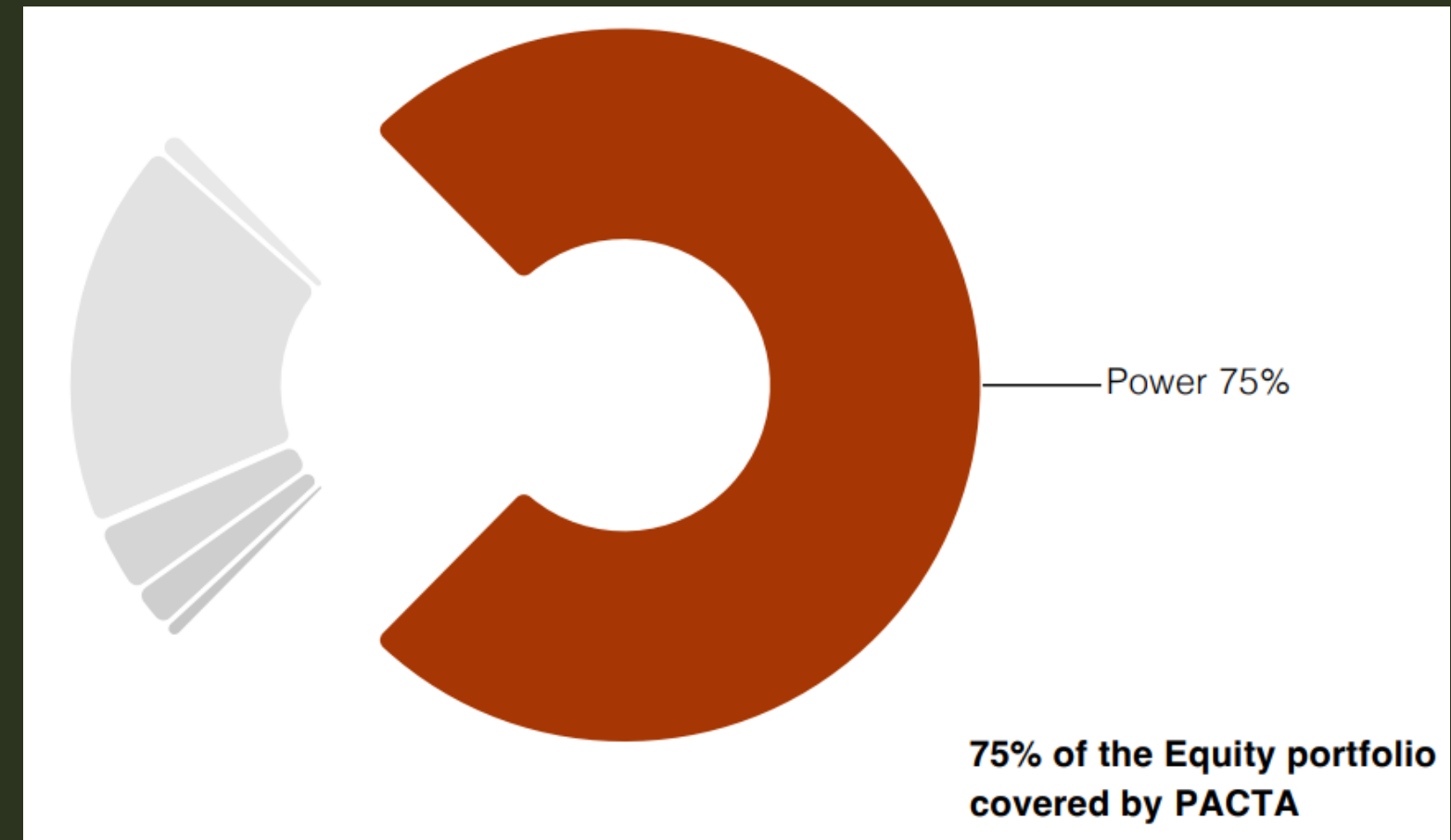


REVISED PACTA

SECTOR COVERAGE & CO2 EMISSIONS



Sector Coverage



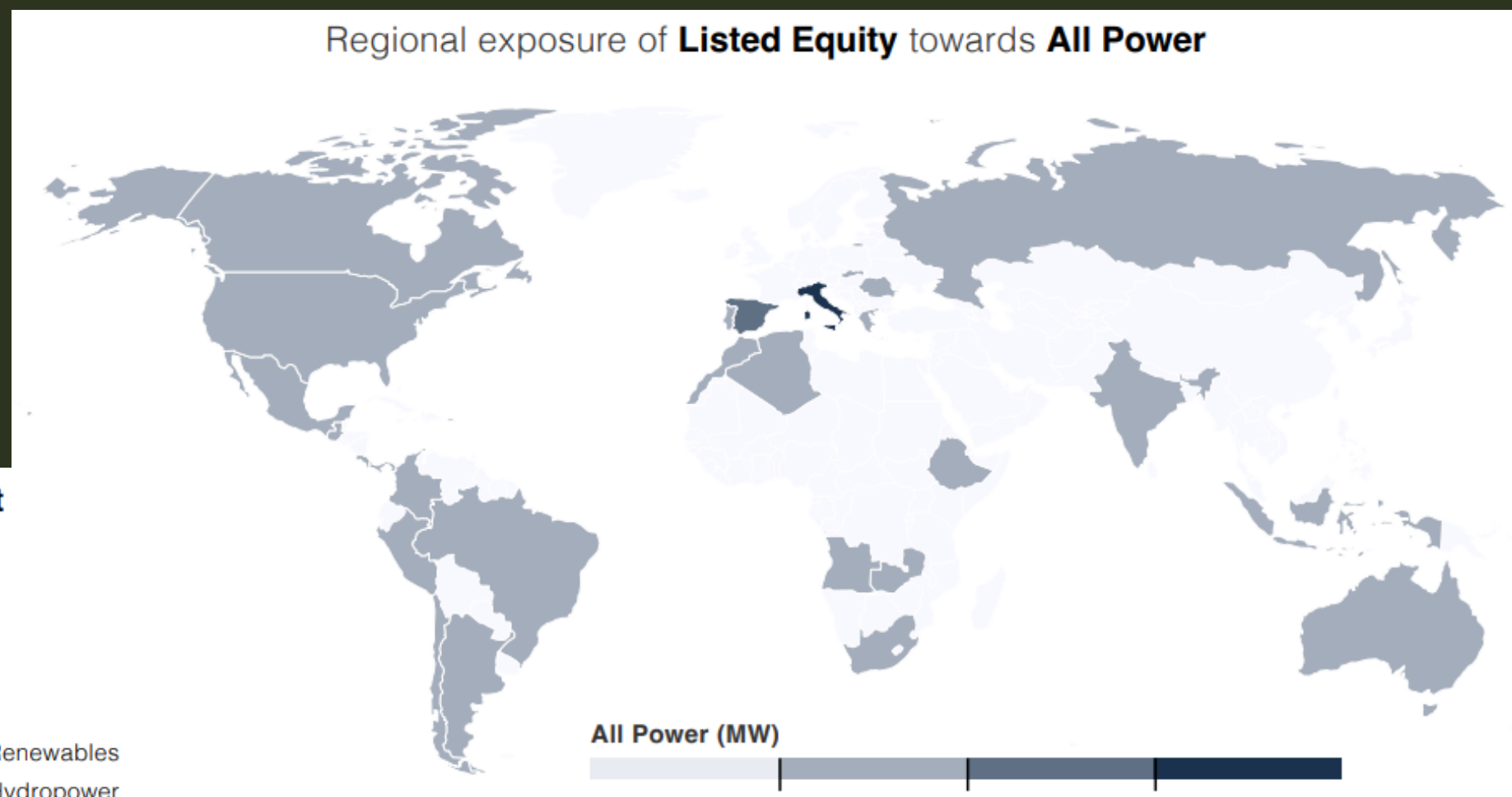
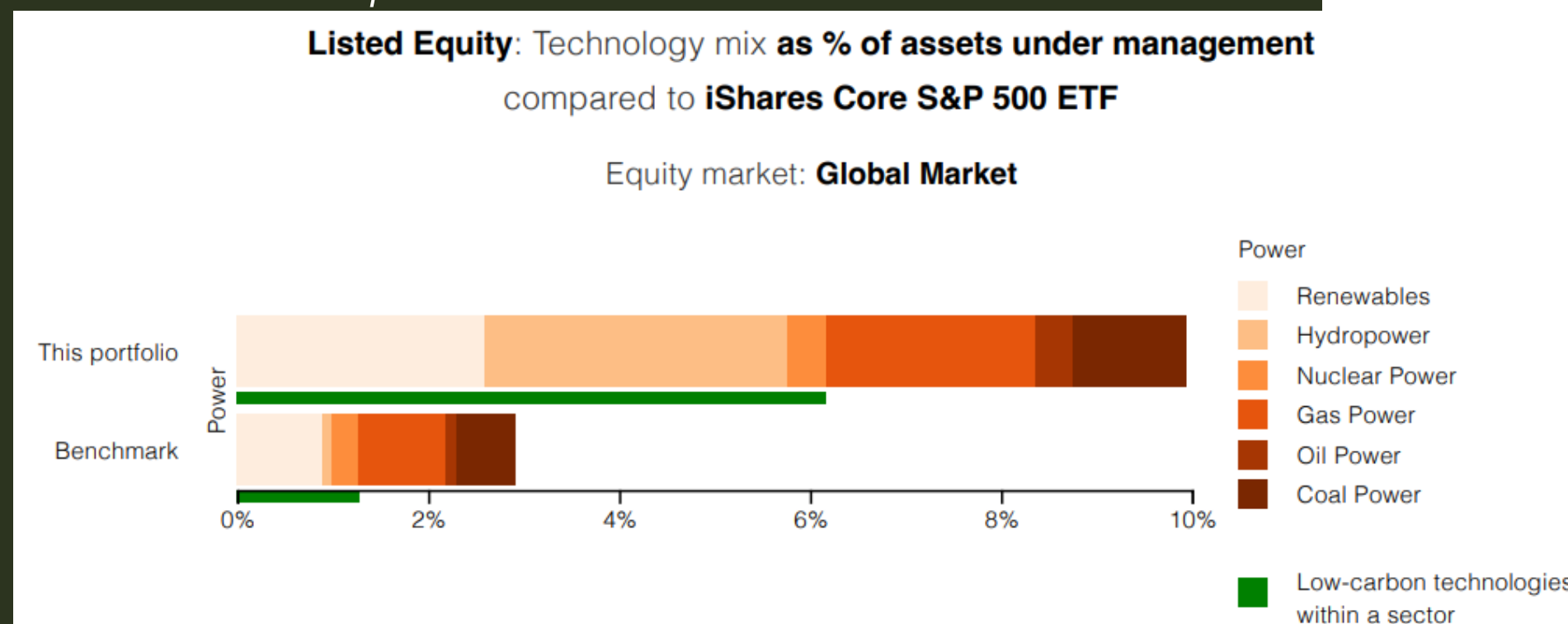
CO2 Emissions



REVISED PACTA

EXPOSURE TO CLIMATE RELEVANT SECTORS

Current Exposure

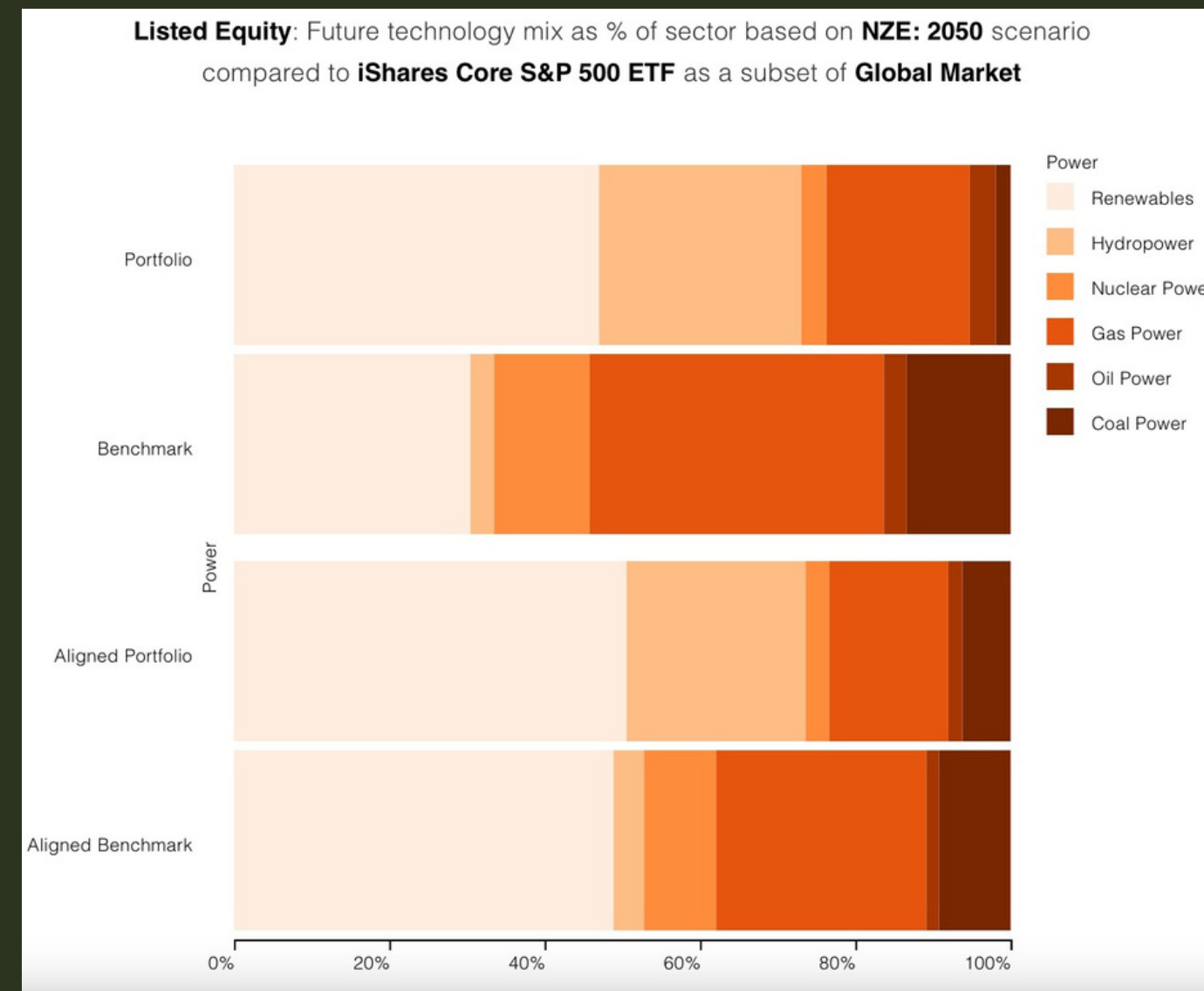
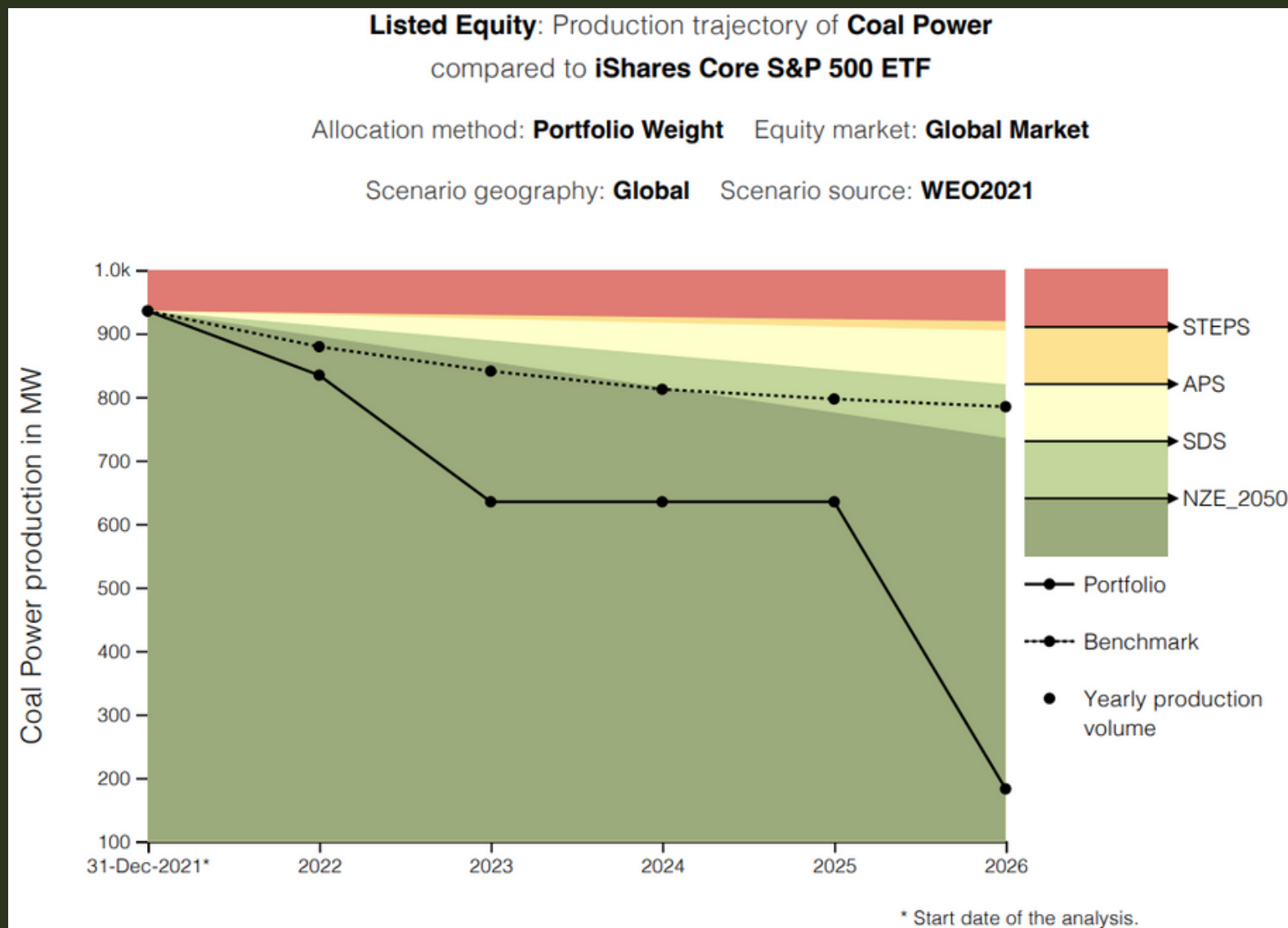


Geographical Exposure



REVISED PACTA

ALIGNMENT WITH CLIMATE SCENARIOS



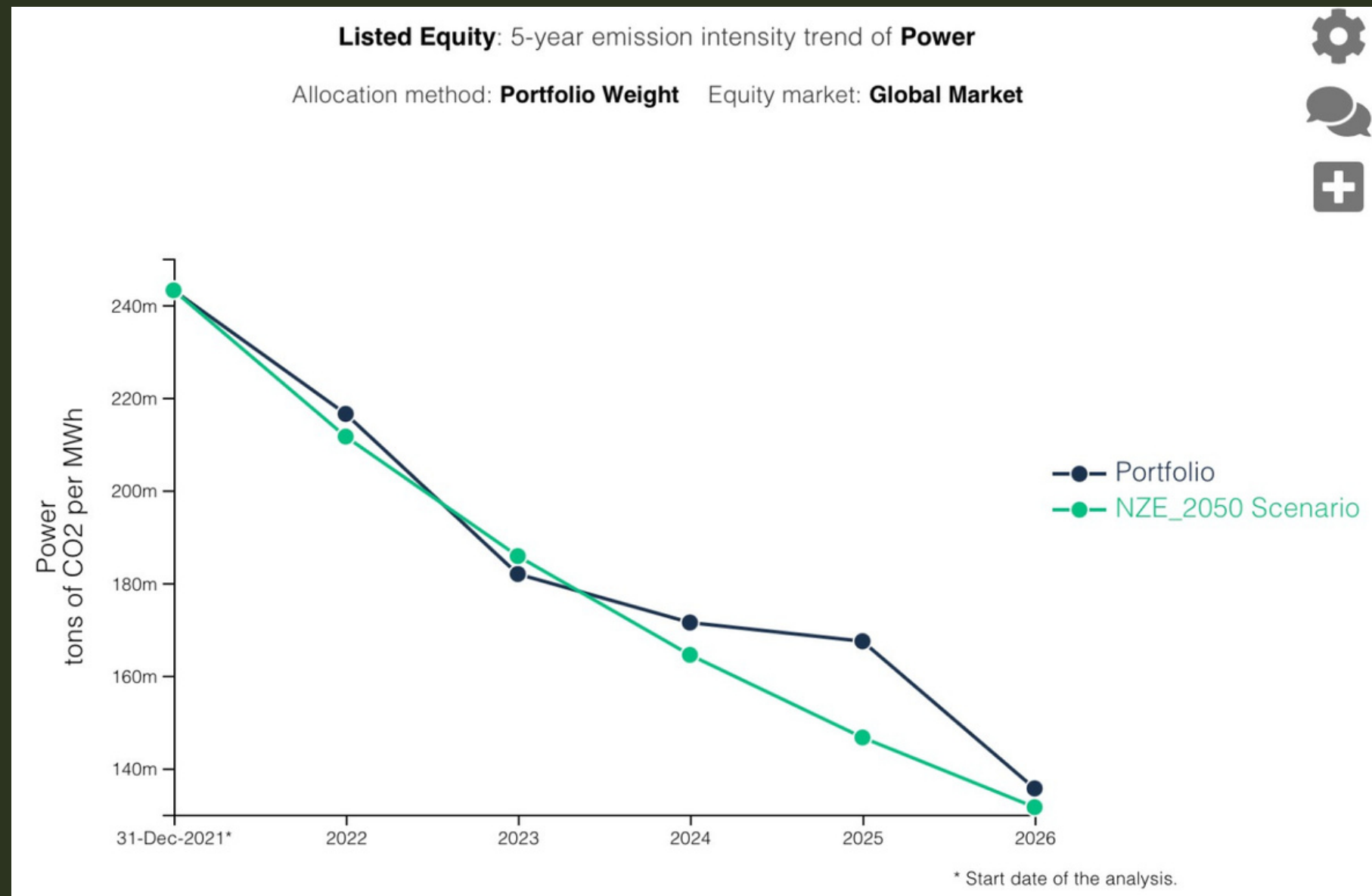
Alignment with Production Trajectories

Future Technology Breakdown



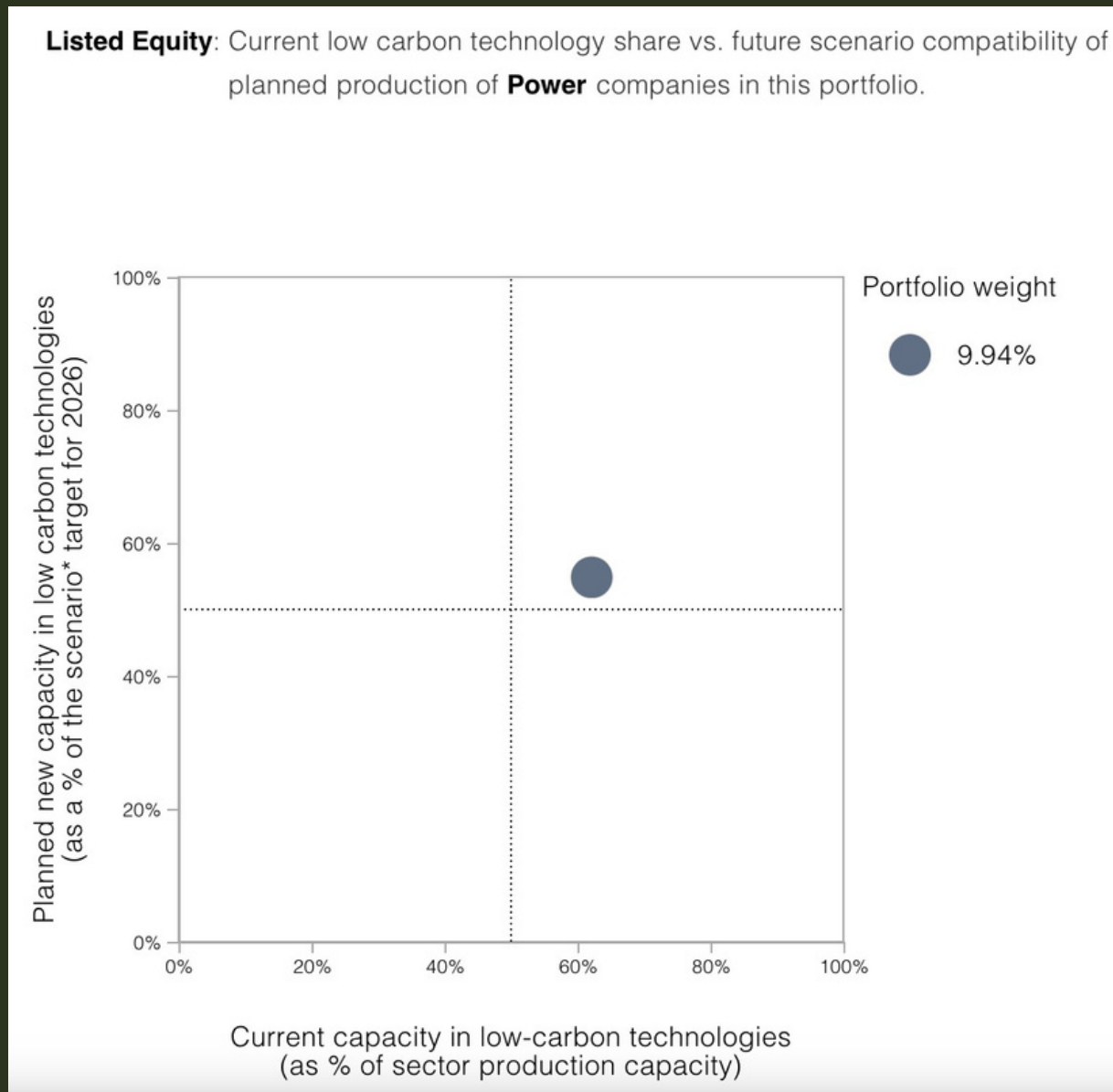
REVISED PACTA

ALIGNMENT WITH EMISSION INTENSITIES

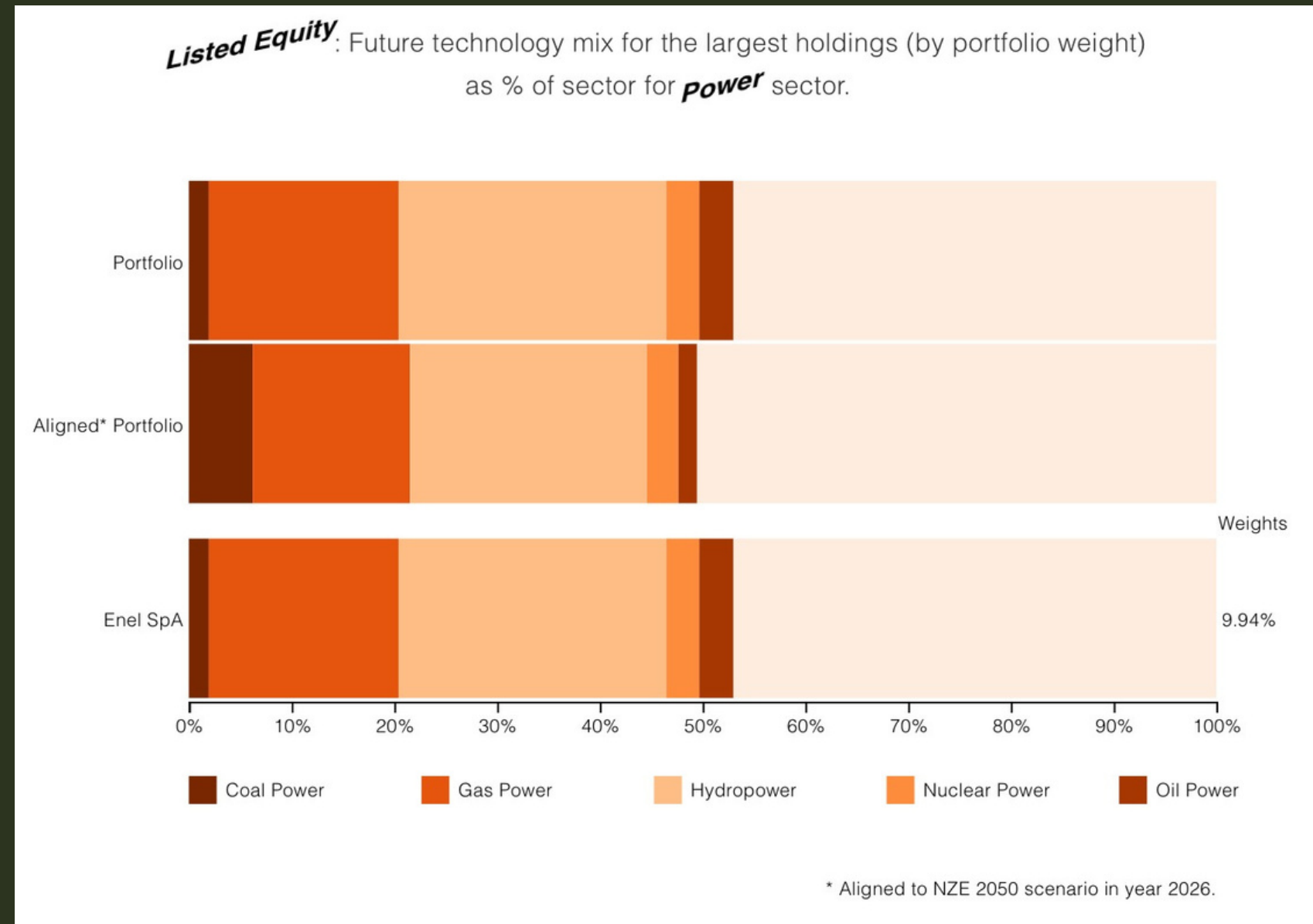


REVISED PACTA

COMPANY LEVEL RESULTS: ENEL SPA



Company Low- and High-Carbon Split

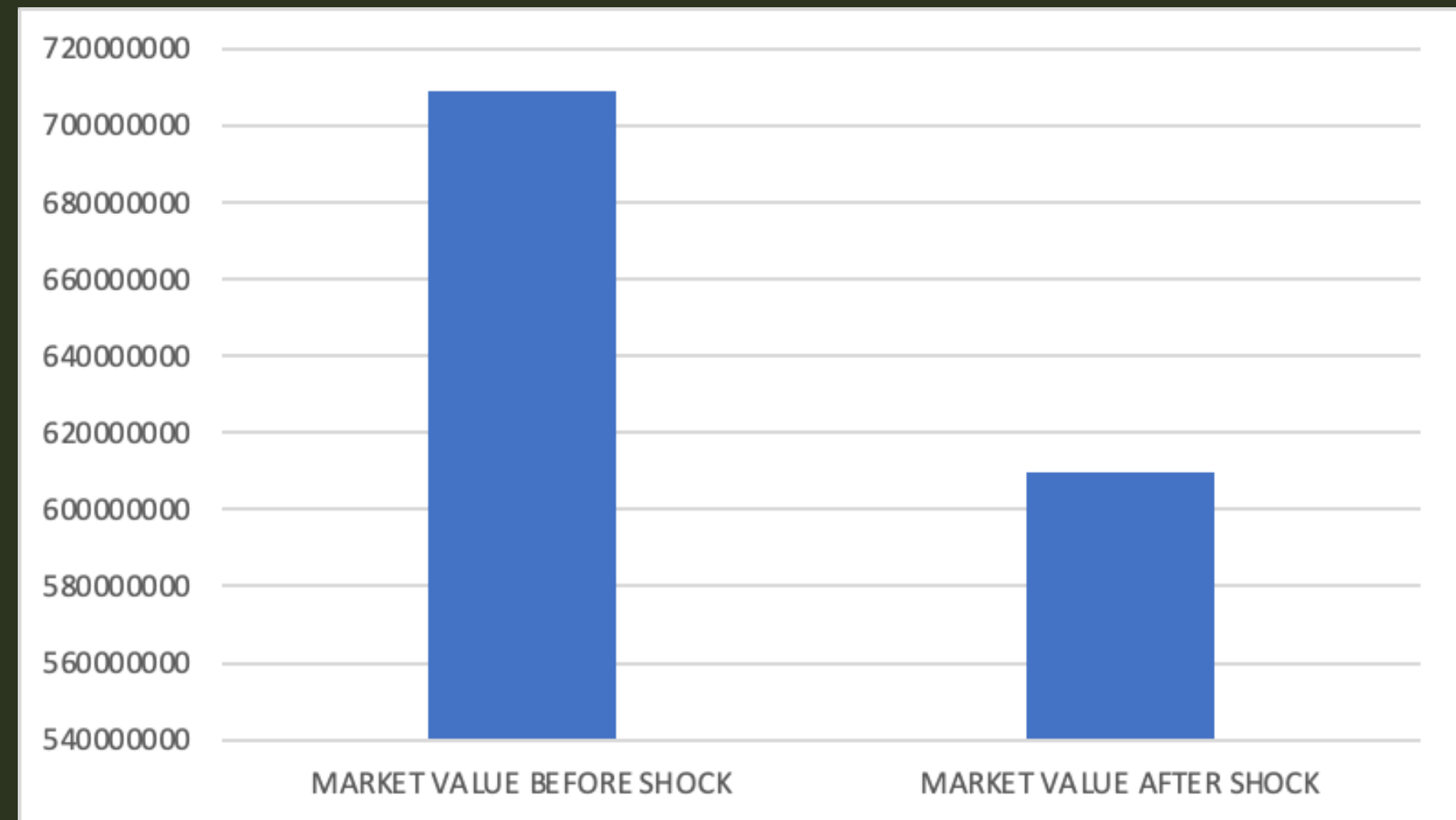


Company Technology Exposure



STRESS TEST FOR THE GREEN PORTFOLIO

-14%



% Change in value due to a disorderly transition shock

Change in value of the Green Portfolio



HEDGING STRATEGY

- Part 1 - Contract Specification
- Part 2 - Models and Calibration
- Part 3 - Pricing of Quanto Options
- Part 4 - Consideration on Hedging

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1 - CONTRACT SPECIFICATION

The financial instrument used for hedging purposes is a Quanto option written on the equity portfolio and on the temperature index. We use this instrument to protect the portfolio from the rise of temperature levels during the warm season.

<i>Protection period</i>	<i>June</i>
<i>Temperature index</i>	<i>CDD based on London temperatures</i>
<i>Asset</i>	<i>Highly diversified equity <u>portfolio</u></i>
<i>Tick Value</i>	<i>€25 <u>MwH/CDD</u></i>
<i>CDD Strike Price (K1)</i>	<i>€1.500</i>
<i>Portfolio Strike Price (K2)</i>	<i>€2.741</i>
<i>Payoff Double Put</i>	$\max[(K1 - CDD), 0] \times \text{tick} \times \max[(K2 - S), 0]$
<i>Payoff Double Call</i>	$\max[(CDD - K1), 0] \times \text{tick} \times \max[(S - K2), 0]$



1 - CONTRACT SPECIFICATION

Analysis of stock prices and log-returns time series

Recovery of London temperature information and data

Construction of the customised option payoff

Usage of stochastic dynamics to track the trends



2 - MODELS

Portfolio : Geometric Brownian Motion

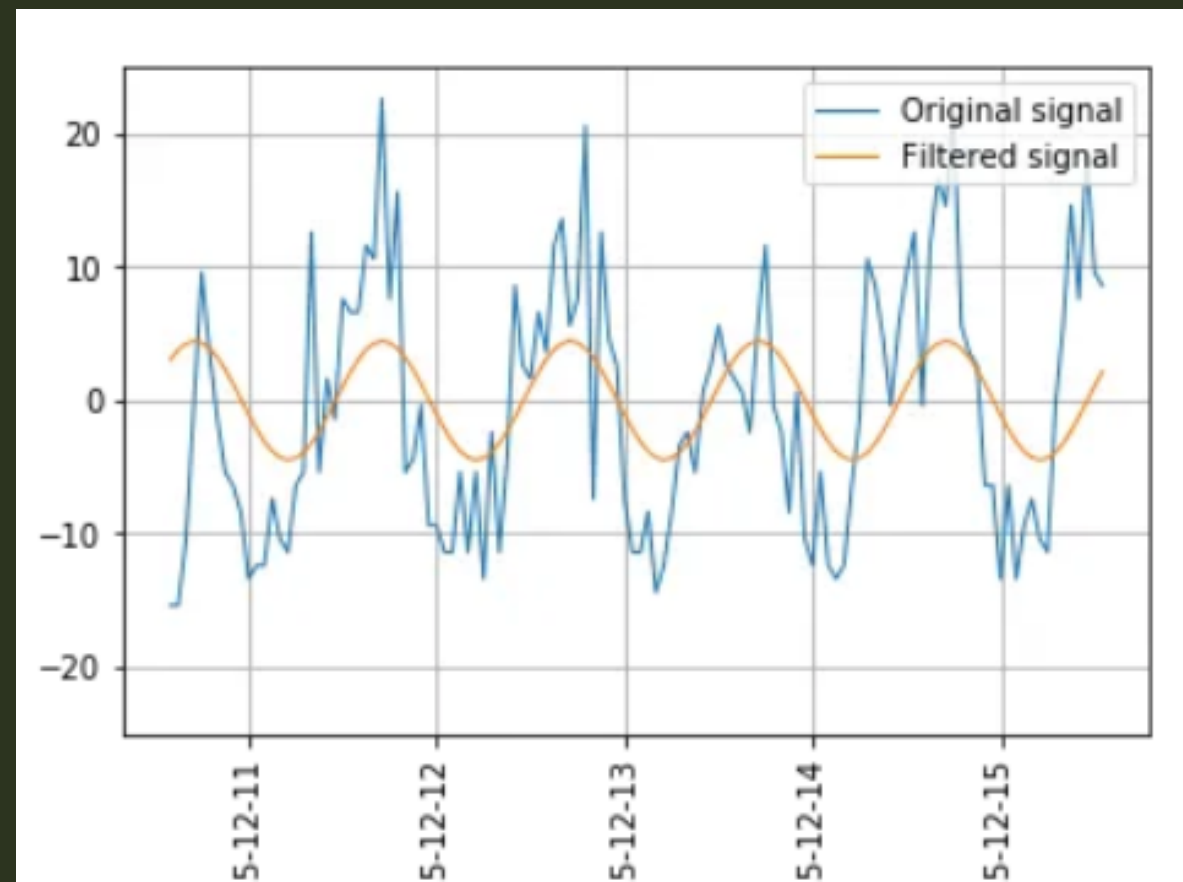
$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

Temperature : Ornstein-Uhlenbeck process + seasonality component

- Mean-reversion
- Seasons (Winter is colder than Summer)

$$dr_t = -\theta(r_t - \mu) dt + \sigma dW_t$$

Seasonality ?



$$s_N(x) = \frac{a_0}{2} + \sum_{n=1}^N \left(a_n \cos\left(\frac{2\pi nx}{P}\right) + b_n \sin\left(\frac{2\pi nx}{P}\right) \right)$$



2 - CALIBRATION

Geometric Brownian Motion

- mu : Mean of log returns
- sigma : Standard deviation of log returns

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

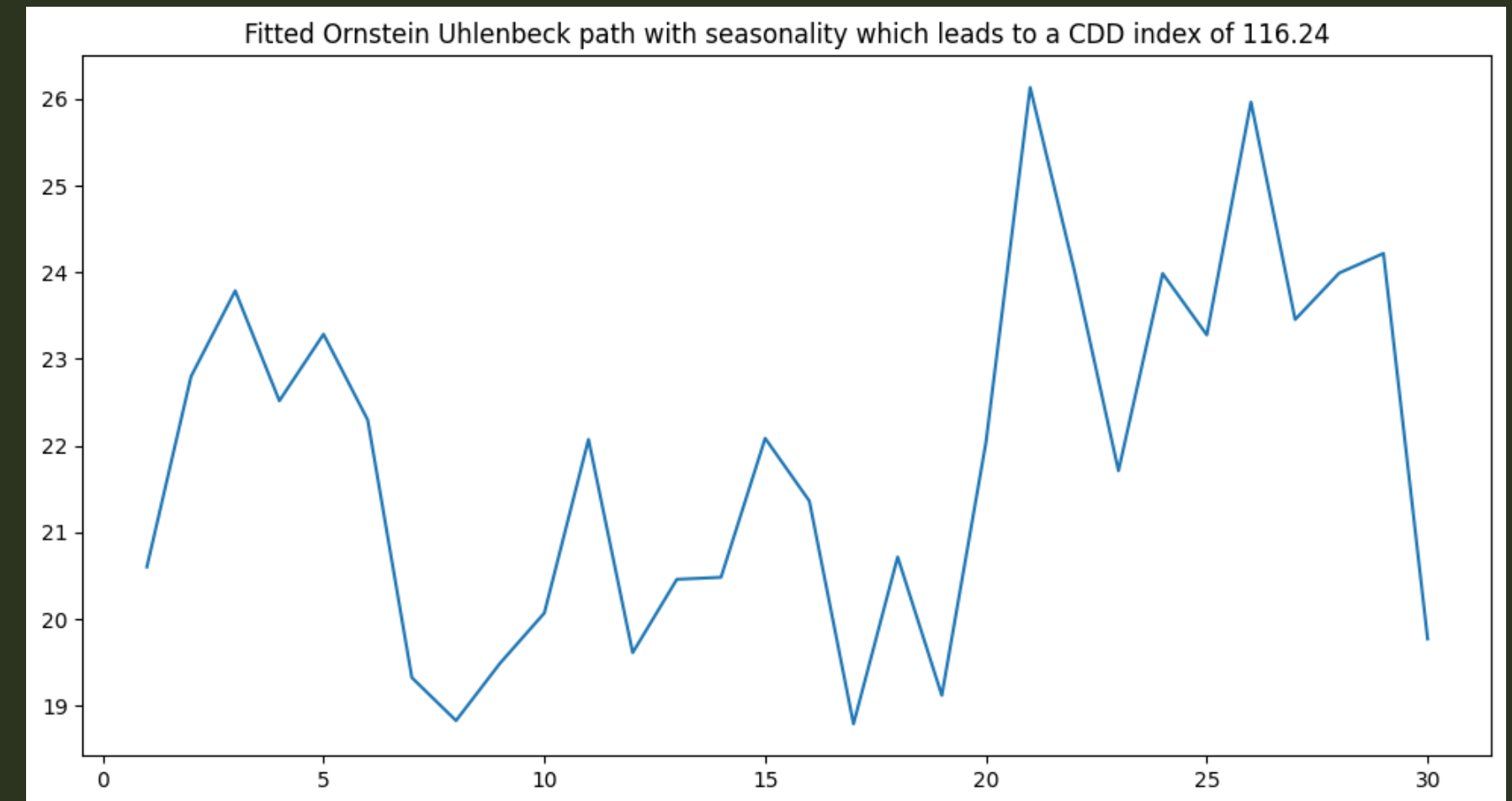
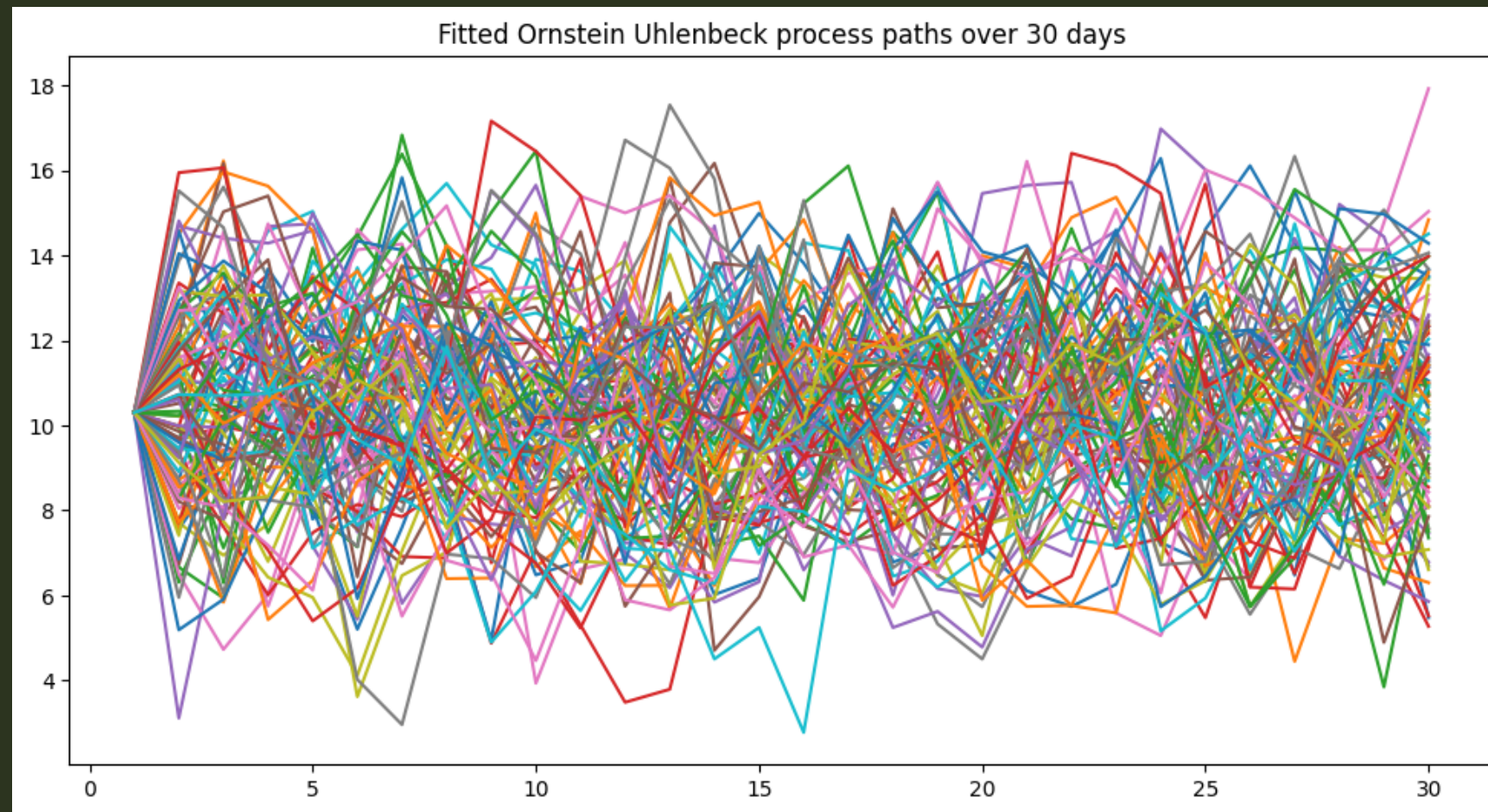
Ornstein-Uhlenbeck process + seasonality component

- Compute the Fourier transform
- Subtract it from historical data
- Fit the Ornstein-Uhlenbeck process (can be done by fitting an AR(1) time series)

-> Simulate new data by simulating an Ornstein-Uhlenbeck and adding back the 'seasons'



2 - SIMULATION



$$\text{CDD} = \sum_{i=1}^M \max(T - 18.3, 0)$$



OPTION & INDEX

SINCE WE WANT TO HEDGE JUNE WE ARE USING THE CDD (COOLING DEGREE DAYS) INDEX TO PRICE THE OPTIONS WE WANT TO USE

$$CDD = \sum_{i=1}^n (T_d - T_b)^+$$



MODEL- QUANTO OPTIONS

Protection Period	June
Temperature Index	CDD based on Lodnon temperatures
Stock Index	EY Portfolio
tick value	25 x Mwh/CDD
Strike CDD (K1)	M*(strike temperature-bench mark)
Strike CDD (K2)	initial value
Payoff Quanto option1	$\max(0; M * K1 - CDD) \times \text{tick} \times \max(\text{Portfolio} - K2)$
Payoff Quanto option2	$\max(0; CDD - M * K1) \times \text{tick} \times \max(K2 - \text{Portfolio})$



PRICING - QUANTO OPTION

WHY SHOULD THE CALL PRICE BE LOWER THAN THE PUT PRICE?

- **CASE: WE PREDICT OUR PORTFOLIO TO DECREASE IF THE WEATHER INCREASES**
- **SINCE HOLDING A CALL ON THE PORTFOLIO MEANS THAT WE EXPECT THE PORTFOLIO TO INCREASE THE PRICE OF THE CALL SHOULD BE LOW COMPARED TO THE PUT OPTION PRICE**



PRICING - CALL CALL / PUT PUT

USING CDD INDEX

QUANTO PRICE: PUT & PUT = 3100,91

QUANTO PRICE: CALL & CALL = 194,59



4 - HEDGING STRATEGY

Calculating the hedging volume using ARMAX model

$$R_t = \delta + \beta R_{t-1} + \gamma T^{\circ C}$$

R_t denoted as Log differences on the daily return of portfolios

R_{t-1} as 1 Time lag order

T = Absolute temperature (Daily in London) - Benchmark degrees (initially set up as 18)



Estimate the log percentage loss (or gain) of daily returns on the portfolio related to the change of temperature by the regression



4 - HEDGING STRATEGY

Detected Significant Gamma on Specific Assets

```
const      -0.0008    0.001    -1.
y.L1      -0.0058    0.023    -0.
x1        -1.649e-05  7.88e-05  -0.
Roots
=====
Real      Imaginary
-----
AR.1      -172.3951    +0.0000
K
AutoReg Model
=====
Dep. Variable: y
Model: AutoReg-X(1)
Method: Conditional MLE
Date: Wed, 28 Jun 2023
Time: 22:36:49
Sample: 1
1973
=====
coef      std err
-----
const      0.0007    0.001    0.516
y.L1      0.0830    0.022    3.697
x1        0.0002    0.000    1.180
Roots
=====
Real      Imaginary
```

Gamma 0.02 %

Based on our model, when temperature increases from the benchmark temperature (18), the log return of the asset (Cruise company) will increase by 0.02 % .

We may construct a quanto options to hedge the loss ($0.02 \% * T$) in the scenario of temperature decreases.



THANK YOU FOR YOUR ATTENTION!

GREEN TRANSITION GROUP

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Kai Klaus,

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Nuri Can Ozkan

