

How you measure transition risk matters: Comparing and evaluating climate transition risk metrics

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Philip Fliegel

Humboldt-Universität zu Berlin (PECan Research Group)



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ZU BERLIN



Climate Risks on Financial Markets

- | Two types of climate related risks matter on financial markets
- | Physical climate risks
- | Climate transition risks
 - . Unexpectedly quick transition to a low carbon economy
 - . Triggered by either climate policies, technological developments, climate litigation and changing preferences
 - . Will benefit (harm) some green (brown) companies

There is Widespread Confusion on How to Best Measure Firms Climate Transition Risk

- | Options proposed in the climate finance literature:
- | E scores (Pastor et al., 2022) - but which?
- | Emission levels (Bolton & Kacperczyk, 2021a; 2021b) - which scopes?
- | Emissions intensities (Ardia et al., 2022, Aswani et al., 2023) - which scopes?
- | Estimated taxonomy alignment (Bassen et al., 2022) - how reliable are estimates?
- | Sector/technology classifications (Fliegel, 2023; Jourde & Stalla-Bourdillon, 2023) - which one?
- | Text based approaches (Sautner et al. 2023)
- | Evaluations of the best metric is largely missing
- | How can firms climate transition risk be measured best?

Very Little Research on This Vital Topic

- I Some authors show a large divergence even within metrics:
 - . For ESG scores (Berg et al., 2022)
 - . For corporate emission data (Busch et al., 2022)
- I Divergence between transition risk metrics:
 - . Estimated taxonomy alignment and ESG scores (Bassen et al., 2022; Dumrose et al., 2022)
 - . Emissions and E scores (Wilkins et al., 2023)
- I Evaluation of transition risk metrics: Never done explicitly
 - . Apel et al. (2023): Emissions and sector screens sensitivity to transition shocks
 - . Ardia et al. (2022): Emission based portfolios sensitivity to transition shocks

Real World and Academic Relevance

I Academic contribution

- . Show that choosing a specific risk metric has direct consequences for results
- . Most comprehensive climate transition risk dataset: Using reported taxonomy data - including forward looking Capex
- . Going beyond only documenting divergence: Evaluating different risk metrics
- . Reconcile the diverging results for the pricing of transition risk: Is there a brown/green premium?
- . Method can be utilized for other and emerging data sources

I Real world relevance:

- . Aid investors in determining the true transition risk exposure of portfolios
- . Thereby: Align actual investments with preferences
- . Enable real impact through cost of capital channel
- . Help ending greenwashing

2 Step Methodological Approach...

- | Step 1: Perform rank correlation of all available climate transition risk metrics
- | Step 2: Use news indices capturing unexpected shocks to transition risk in order to evaluate transition risk metrics
- | Financial data: Stock returns, financial data and factors from: Reuters EIKON, Compustat and K. French's online database
- | Data on climate metrics: Bloomberg, Reuters EIKON and directly from scholars

9 Climate Transition Risk Metrics

- | Sector/Tech classification (TRBC - Re nitiv EIKON)
- | E-scores (Re nitiv EIKON)
- | E-scores (MSCI)
- | Emission intensities: scope 1-2, scope 1-3 (Re nitiv EIKON)
- | Taxonomy alignment of revenues/capex (Bloomberg)
- | Text based measures (Sautner et al. 2023)
- | Additionally, 2 novel metrics mixing emissions/taxonomy alignment with TRBC

Availabilites of Climate Transition Risk Metrics

Climate Transition Risk Metric	Global	Europe
E - scores (Relative)	7,962	1,690
Scope 1 emissions	5,310	1,450
Scope 2 emissions	5,320	1,456
Scope 3 emissions	3,062	1,101
TRBC	23,509	3,038
CC Exposure opportunity	4,519	1,084
CC Exposure regulation	4,519	1,084
Climate Change exposure	4,519	1,084
Taxonomy revenue risk	-	1,179
Taxonomy capex risk	-	1,098

Step 2 Empirical Strategy

- | I use the portfolio sensitivity to transition risk shocks to evaluate transition risk metrics
- | Form sorted Long Brown and Green as well as BMG portfolios based on different transition risk metrics - top 20% lowest 20%
- | Time window from 2010 until 2021 with monthly value weighted rebalancing
- | Transform taxonomy alignment into a risk measure following Dumrose et al. (2022) but adding a 50% eligibility condition
- | There are many different transition risk indices proposed in the literature - I opt for Apel et al. (2023)

$$R_{it} - RF_t = \alpha_i + \beta_1(RM_{kt} - RF_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \beta_6 \text{Transition-Shock}_{it}$$

Motivation
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Methods
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Results
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Discussion/Conclusion
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References
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Appendix
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Traditional Transition Risk Indices vs. Apel et al. (2023)

Extreme Divergence Between Climate Transition Risk Metrics

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Tax. Revenue alignment	1.000									
(2) Tax. Capex alignment	0.725	1.000								
(3) Tax. Opex alignment	0.770	0.797	1.000							
(4) Total Emission Intensity	-0.256	-0.284	-0.324	1.000						
(5) Scope 1-2 Emission Intensity	-0.303	-0.310	-0.352	0.600	1.000					
(6) TRBC	-0.086	-0.147	-0.124	0.244	0.223	1.000				
(7) E Score	0.167	0.244	0.192	-0.266	-0.225	-0.085	1.000			
(8) CC exposure regulation	0.253	0.271	0.247	-0.275	-0.299	-0.078	0.236	1.000		
(9) CC exposure opportunity	0.466	0.454	0.461	-0.404	-0.450	-0.240	0.221	0.417	1.000	
(10) CC exposure	0.497	0.488	0.473	-0.445	-0.517	-0.257	0.228	0.603	0.888	1.000

Monthly Value Weighted BMG - Europe

VARIABLES	(1) BMG TRBC	(2) BMG Tax. Revenue	(3) BMG Tax. Capex	(4) BMG Emission Intensity	(5) BMG Scope 1-2 Emission Intensity	(6) BMG E-Score	(7) BMG CC Opp/ Reg	(8) BMG CC Exposure	(9) BMG MSCI E- score
Market	0.16* (1.91)	0.42*** (3.37)	0.29*** (3.28)	0.01 (0.26)	0.03 (0.66)	0.01 (0.46)	-0.15*** (-4.26)	-0.09** (-2.32)	0.01 (0.22)
SMB	-0.90*** (-3.99)	-0.19 (-0.75)	0.38* (1.98)	-0.32*** (-4.70)	-0.04 (-0.38)	0.90*** (16.25)	-0.03 (-0.38)	0.25* (1.82)	-0.06 (-0.58)
HML	0.64** (2.37)	0.13 (0.44)	-0.14 (-0.48)	0.33*** (2.95)	0.55*** (2.93)	0.11 (0.98)	-0.50*** (-5.77)	-0.78*** (-4.53)	0.53*** (3.90)
RMW	0.34 (1.07)	-0.50 (-1.33)	-0.36 (-0.95)	0.04 (0.31)	0.21 (0.92)	-0.24** (-2.01)	-0.21 (-1.63)	-0.34 (-1.39)	0.89*** (4.92)
CMA	0.28 (0.65)	-0.96** (-2.11)	-0.59 (-1.24)	0.05 (0.30)	0.09 (0.46)	-0.68*** (-5.17)	0.28* (1.97)	0.22 (0.95)	-0.05 (-0.22)
TRI Inn.	-1486.33 (-1.46)	-2523.43** (-2.37)	-898.22 (-1.17)	225.05 (0.61)	695.49 (1.25)	-702.98** (-2.01)	-434.35 (-1.20)	-497.29 (-0.82)	408.66 (0.87)
Constant	-0.86* (-1.97)	-0.37 (-0.75)	-0.01 (-0.03)	-0.22 (-1.56)	-0.57*** (-2.84)	0.43*** (4.54)	-0.08 (-0.63)	0.40* (1.72)	-0.62*** (-3.10)
Observations	132	132	132	132	132	132	132	132	132
R ²	0.316	0.272	0.192	0.342	0.376	0.677	0.311	0.455	0.212

Monthly Value Weighted Brown Portfolios - Europe

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Brown TRBC	Brown Tax. Revenue	Brown Tax. Capex	Brown Emission Intensity	Brown Scope 1-2 Emission Intensity	Brown E-Score	Brown CC Opp/ Reg	Brown CC Exposure	Brown MSCI E- score
Market	0.66*** (12.87)	0.92*** (8.96)	0.83*** (10.33)	0.69*** (15.91)	0.70*** (17.81)	0.66*** (11.57)	0.63*** (14.93)	0.62*** (13.31)	0.75*** (10.30)
SMB	-0.50*** (-3.92)	-0.15 (-0.74)	-0.01 (-0.04)	-0.23** (-2.27)	-0.24** (-2.58)	0.48*** (4.16)	-0.31*** (-3.57)	-0.08 (-0.57)	0.14 (0.78)
HML	0.91*** (5.07)	0.34 (1.31)	0.27 (1.23)	0.27*** (2.50)	0.47*** (3.88)	0.25 (1.53)	0.23** (2.09)	-0.16 (-0.83)	0.30 (1.57)
RMW	1.01*** (5.25)	0.05 (0.16)	0.20 (0.67)	0.42*** (2.97)	0.46*** (3.27)	0.34 (1.65)	0.46*** (3.11)	0.26 (1.07)	0.92*** (3.53)
CMA	-0.12 (-0.48)	-1.16*** (-3.72)	-0.64*** (-2.10)	-0.14 (-1.01)	-0.18 (-0.98)	-0.65*** (-3.49)	-0.12 (-0.76)	-0.04 (-0.22)	0.13 (0.55)
TRI Inn.	1142.86*** (2.89)	-439.52 (-0.58)	748.55 (1.29)	448.90 (1.50)	909.43*** (2.95)	-118.59 (-0.25)	550.11* (1.89)	464.27 (0.90)	-775.22 (-1.07)
Constant	-0.05 (-0.21)	0.31 (0.77)	0.42 (1.33)	0.18 (1.07)	0.19 (1.01)	0.74*** (4.18)	0.20 (1.20)	0.60*** (2.96)	0.06 (0.24)
Observations	132	132	132	132	132	132	132	132	132
R ²	0.782	0.655	0.687	0.830	0.849	0.789	0.811	0.674	0.712

Monthly Value Weighted Green Portfolios - Europe

VARIABLES	(1) Green TRBC	(2) Green Tax. Revenue	(3) Green Emission Capex	(4) Green Tax. Intensity	(5) Green Scope 1-2 Emission Intensity	(6) Green E-Score	(7) Green Opp/ Reg	(8) Green CC Exposure	(9) Green CC MSCI E- score
Market	0.51*** (6.74)	0.51*** (8.26)	0.54*** (10.03)	0.69*** (12.82)	0.68*** (12.39)	0.65*** (13.87)	0.77*** (15.70)	0.71*** (17.19)	0.75*** (12.40)
SMB	0.40* (1.77)	0.05 (0.28)	-0.38** (-2.54)	0.10 (0.83)	-0.19 (-1.47)	-0.41*** (-4.13)	-0.27* (-1.89)	-0.32*** (-2.71)	0.21 (1.40)
HML	0.27 (1.20)	0.20 (1.18)	0.41** (2.24)	-0.06 (-0.38)	-0.08 (-0.37)	0.14 (0.99)	0.74*** (5.57)	0.63*** (5.13)	-0.22 (-1.34)
RMW	0.67*** (2.67)	0.56** (2.32)	0.57** (2.01)	0.39* (1.81)	0.26 (1.08)	0.58*** (3.51)	0.68*** (3.48)	0.62*** (3.96)	0.04 (0.16)
CMA	-0.39 (-1.03)	-0.19 (-0.67)	-0.04 (-0.13)	-0.18 (-1.11)	-0.26 (-1.44)	0.04 (0.34)	-0.39* (-1.75)	-0.25 (-1.14)	0.19 (0.76)
TRI Inn.	2643.89*** (3.08)	2098.60*** (3.27)	1661.46** (2.43)	238.63 (0.53)	228.64 (0.45)	599.08** (2.02)	999.16** (2.37)	976.25*** (2.69)	-1169.19* (-1.72)
Constant	0.76** (2.39)	0.64** (2.35)	0.39 (1.43)	0.36* (1.67)	0.71*** (3.22)	0.26 (1.65)	0.24 (1.12)	0.16 (0.77)	0.63*** (2.88)
Observations	132	132	132	132	132	132	132	132	132
R ²	0.434	0.517	0.573	0.725	0.707	0.807	0.818	0.833	0.706

Monthly Value Weighted Green Portfolios - Global

VARIABLES	(1) Green TRBC	(2) Green Emission	(3) Green Scope 1-2 Emission	(4) Green E-Score	(5) Green CC Opp/Reg	(6) Green CC Exposure	(7) Green MSCI E-score
Market	0.61*** (9.78)	0.85*** (23.47)	0.91*** (21.60)	0.81*** (25.45)	1.00*** (17.26)	0.88*** (22.65)	0.94*** (23.75)
SMB	0.18 (0.92)	-0.06 (-0.82)	-0.20 (-1.45)	-0.31*** (-4.21)	0.02 (0.20)	-0.04 (-0.45)	-0.07 (-0.95)
HML	0.09 (0.55)	-0.22 (-1.94)	-0.23* (-1.90)	0.05 (-0.85)	0.41*** (4.64)	0.39*** (6.22)	-0.06 (-0.71)
RMW	0.71** (2.59)	0.07 (0.51)	0.19 (0.97)	0.23*** (2.82)	-0.11 (-0.54)	0.07 (0.53)	-0.08 (-0.43)
CMA	0.11 (0.43)	-0.22 (-1.55)	-0.52** (-2.32)	0.15 (1.27)	-0.42** (-2.10)	-0.26 (-1.54)	0.07 (0.44)
TRI Innovation	2067.10** (2.59)	-95.97 (-0.29)	-353.06 (-0.53)	377.22* (1.90)	1215.64*** (3.45)	1136.93*** (4.40)	-870.07* (-1.89)
Constant	0.68** (2.26)	0.53*** (5.17)	0.65*** (3.64)	0.16* (1.79)	0.23 (1.47)	0.13 (1.11)	0.40*** (2.93)
Observations	132	132	132	132	132	132	132
R ²	0.496	0.905	0.803	0.921	0.830	0.865	0.905

Exploring Novel Mixed Transition Risk Metrics

VARIABLES	(1) Green Emission Intensity TRBC	(2) Green Taxonomy Revenue TRBC	(3) Green Taxonomy Capex TRBC
Market	0.63*** (9.54)	0.57*** (11.28)	0.56*** (10.23)
SMB	0.31* (1.87)	-0.08 (-0.49)	-0.40** (-2.60)
HML	0.46* (1.95)	0.30* (1.95)	0.51*** (3.05)
RMW	0.45 (1.41)	0.54** (2.21)	0.65** (2.57)
CMA	-0.56** (-2.03)	-0.10 (-0.36)	-0.06 (-0.20)
TRI Inn.	961.70*** (2.15)	2210.84*** (3.31)	1724.18*** (2.53)
Constant	0.17 (0.58)	0.51** (2.07)	0.34 (1.36)
Observations	132	132	132
R ²	0.677	0.606	0.612

How is Climate Transition Risk Priced?

VARIABLES	(1) BMG TRBC	(2) BMG Tax. Revenue	(3) BMG Tax. Capex	(4) BMG Emission Intensity	(5) BMG Scope 1-2 Emission Intensity	(6) BMG E-Score	(7) BMG CC Opp/ Reg	(8) BMG CC Exposure	(9) BMG MSCI E- score
Market	0.16* (1.91)	0.42*** (3.46)	0.29*** (3.32)	0.01 (0.25)	0.02 (0.64)	0.01 (0.51)	-0.14*** (-4.20)	-0.09** (-2.32)	0.01 (0.21)
SMB	-0.90*** (-3.91)	-0.18 (-0.70)	0.35* (1.97)	-0.32*** (-4.70)	-0.05 (-0.40)	0.90*** (15.53)	-0.03 (-0.37)	0.25* (1.84)	-0.06 (-0.61)
HML	0.61** (2.26)	0.09 (0.29)	-0.16 (-0.54)	0.34*** (2.95)	0.57*** (3.02)	0.10 (0.87)	-0.51*** (-5.91)	-0.79*** (-4.61)	0.53*** (4.00)
RMW	0.33 (1.03)	-0.52 (-1.37)	-0.36 (-0.97)	0.04 (0.32)	0.21 (0.93)	-0.24** (-2.00)	-0.21* (-1.67)	-0.35 (-1.40)	0.89*** (4.93)
CMA	0.31 (0.72)	-0.91* (-1.96)	-0.58 (-1.19)	0.04 (0.27)	0.08 (0.39)	-0.67*** (-5.12)	0.28** (1.99)	0.23 (1.01)	-0.06 (-0.25)
Constant	-0.82* (-1.88)	-0.31 (-0.63)	0.01 (0.03)	-0.23* (-1.66)	-0.59*** (-3.04)	0.45*** (4.91)	-0.07 (-0.54)	0.41* (1.82)	-0.63*** (-3.19)
Observations	132	132	132	132	132	132	132	132	132
R ²	0.306	0.251	0.188	0.341	0.368	0.668	0.507	0.452	0.208

How you Measure Transition Risk Matters

- | Rank correlations show that simply choosing a transition risk metric will substantially influence (bias) results
- | TRBC, Taxonomy, text based measures and Relative E-scores are good in identifying green companies transition risk
- | There should be more robustness tests for climate transition risk metrics
- | There is a case for mixing some climate transition risk metrics
- | It might be necessary to use different transition risk metrics for brown or green portfolios
- | No reliable measure for brown (high risk) companies
 - . Climate transition risk shocks indices might not be accurate
 - . Financial markets might not price carbon stranding risks (lobbying-bailout?)

Reconciling the Pricing Debate on Transition Risk

- | Whether scholars find a brown or green premium is dependent on the climate transition risk metric chosen
- | Brown premium when sorting portfolios for Relative E-scores and text-based measures
- | Green premium for TRBC, MSCI E-scores and emission based portfolios

Limitations

- | Early stage reporting of EU taxonomy alignment
- | No taxonomy scores outside of Europe
- | Most good transition risk shock indices are based on US media information
- | No time series of TRBC and Taxonomy based transition risk metrics

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Appendix - Full Data Availability

VARIABLES	(1) Green TRBC	(2) Green Tax Revenue	(3) Green Tax, Capex	(4) Green Emission Intensity	(5) Green 1-2 Emission Intensity	(6) Green E-Score	(7) Green Opp/ Reg	(8) Green CC Exposure
Market	0.53*** (4.00)	0.48*** (7.36)	0.53*** (9.36)	0.75*** (9.43)	0.68*** (11.52)	0.72*** (13.21)	0.77*** (14.14)	0.70*** (16.23)
SMB	0.32 (0.90)	-0.12 (-0.74)	-0.52** (-3.30)	0.04 (0.22)	-0.33** (-2.27)	-0.46** (-3.61)	-0.32** (-2.04)	-0.38** (-3.14)
HML	0.41 (1.07)	0.13 (0.72)	0.42* (2.08)	-0.07 (-0.33)	0.01 (0.03)	0.26* (1.80)	0.81*** (6.13)	0.61*** (5.69)
RMW	-0.04 (-0.08)	0.61** (2.31)	0.58* (1.91)	0.24 (0.75)	0.38 (1.53)	0.61*** (3.31)	0.65*** (3.27)	0.56*** (3.71)
CMA	-0.98* (-1.83)	-0.01 (-0.03)	0.04 (0.13)	-0.58** (-2.39)	-0.18 (-0.93)	-0.15 (-1.14)	-0.73*** (-3.84)	-0.41*** (-2.77)
TRI Inn.	2420.71 (1.57)	2122.97*** (3.25)	1822.12*** (2.64)	178.48 (0.30)	162.01 (0.30)	716.21* (1.93)	632.91 (1.36)	874.73*** (2.77)
Constant	1.07* (1.90)	0.58** (2.14)	0.37 (1.27)	0.51* (1.68)	0.66*** (2.68)	0.26 (1.39)	0.35 (1.63)	0.17 (0.94)
Observations	132	132	132	132	132	132	132	132
R2	0.306	0.439	0.534	0.599	0.661	0.801	0.798	0.831

TRBC Based Green Portfolio

TRBC Based Brown Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Automobiles & Auto Parts	19	12.42	12.42
Energy - Fossil Fuels	10t9	71.24	83.66
Utilities	25	16.34	100.00
Total	153	100.00	

Green Taxonomy Revenue Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Cyclical Consumer Products	1	2.13	2.13
Cyclical Consumer Services	1	2.13	4.26
Healthcare Services & Equipment	1	2.13	6.38
Industrial & Commercial Services	5	10.64	17.02
Industrial Goods	7	14.89	31.91
Mineral Resources	4	8.51	40.43
Real Estate	2	4.26	44.68
Renewable Energy	2	4.26	48.94
Software & IT Services	3	6.38	55.32
Technology Equipment	1	2.13	57.45
Transportation	3	6.38	63.83
Utilities	17	36.17	100.00
Total	47	100.00	

Brown Taxonomy Revenue Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Automobiles & Auto Parts	3	5.88	5.88
Chemicals	1	1.96	7.84
Cyclical Consumer Products	4	7.84	15.69
Cyclical Consumer Services	4	7.84	23.53
Energy - Fossil Fuels	2	3.92	27.45
Food & Beverages	1	1.96	29.41
Industrial & Commercial Services	6	11.76	41.18
Industrial Goods	6	11.76	52.94
Mineral Resources	3	5.88	58.82
Real Estate	2	3.92	62.75
Renewable Energy	1	1.96	64.71
Software & IT Services	8	15.69	80.39
Technology Equipment	2	3.92	84.31
Telecommunications Services	1	1.96	86.27
Transportation	6	11.76	98.04
Utilities	1	1.96	100.00
Total	51	100.00	

Green Taxonomy Capex Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	1	1.49	1.49
Chemicals	1	1.49	2.99
Cyclical Consumer Products	1	1.49	4.48
Cyclical Consumer Services	1	1.49	5.97
Energy - Fossil Fuels	3	4.48	10.45
Food & Beverages	1	1.49	11.94
Healthcare Services & Equipment	1	1.49	13.43
Industrial & Commercial Services	3	4.48	17.91
Industrial Goods	6	8.96	26.87
Mineral Resources	2	2.99	29.85
Real Estate	1	1.49	31.34
Renewable Energy	3	4.48	35.82
Software & IT Services	4	5.97	41.79
Technology Equipment	2	2.99	44.78
Transportation	3	4.48	49.25
Utilities	34	50.75	100.00
Total	67	100.00	

Brown Taxonomy Capex Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Automobiles & Auto Parts	3	3.85	3.85
Chemicals	1	1.28	5.13
Consumer Goods Conglomerates	2	2.56	7.69
Cyclical Consumer Products	5	6.41	14.10
Cyclical Consumer Services	7	8.97	23.08
Energy - Fossil Fuels	1	1.28	24.36
Food & Beverages	1	1.28	25.64
Food & Drug Retailing	1	1.28	26.92
Healthcare Services & Equipment	1	1.28	28.21
Industrial & Commercial Services	9	11.54	39.74
Industrial Goods	3	3.85	43.59
Mineral Resources	3	3.85	47.44
Pharmaceuticals & Medical Research	1	1.28	48.72
Real Estate	4	5.13	53.85
Renewable Energy	1	1.28	55.13
Retailers	7	8.97	64.10
Software & IT Services	15	19.23	83.33
Technology Equipment	2	2.56	85.90
Telecommunications Services	1	1.28	87.18
Transportation	8	10.26	97.44
Utilities	2	2.56	100.00
Total	78	100.00	

Green Total Emission Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Academic & Educational Services	1	0.46	0.46
Automobiles & Auto Parts	4	1.84	2.30
Consumer Goods Conglomerates	6	2.76	5.07
Cyclical Consumer Products	5	2.30	7.37
Cyclical Consumer Services	23	10.60	17.97
Energy - Fossil Fuels	1	0.46	18.43
Food & Beverages	4	1.84	20.28
Food & Drug Retailing	5	2.30	22.58
Healthcare Services & Equipment	9	4.15	26.73
Industrial & Commercial Services	37	17.05	43.78
Industrial Goods	15	6.91	50.69
Mineral Resources	1	0.46	51.15
Pharmaceuticals & Medical Research	12	5.53	56.68
Real Estate	12	5.53	62.21
Renewable Energy	1	0.46	62.67
Retailers	7	3.23	65.90
Software & IT Services	45	20.74	86.64
Technology Equipment	16	7.37	94.01
Telecommunications Services	5	2.30	96.31
Transportation	3	1.38	97.70
Utilities	5	2.30	100.00
Total	217	100.00	

Brown Total Emission Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	5	2.30	2.30
Automobiles & Auto Parts	14	6.45	8.76
Chemicals	23	10.60	19.35
Consumer Goods Conglomerates	1	0.46	19.82
Cyclical Consumer Products	9	4.15	23.96
Cyclical Consumer Services	2	0.92	24.88
Energy - Fossil Fuels	25	11.52	36.41
Food & Beverages	11	5.07	41.47
Food & Drug Retailing	3	1.38	42.86
Industrial & Commercial Services	6	2.76	45.62
Industrial Goods	37	17.05	62.67
Mineral Resources	26	11.98	74.65
Personal & Household Products & Services	3	1.38	76.04
Real Estate	6	2.76	78.80
Renewable Energy	3	1.38	80.18
Retailers	5	2.30	82.49
Software & IT Services	2	0.92	83.41
Technology Equipment	5	2.30	85.71
Transportation	13	5.99	91.71
Utilities	18	8.29	100.00
Total	217	100.00	

Green Scope 1-2 Emission Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Academic & Educational Services	1	0.35	0.35
Automobiles & Auto Parts	2	0.70	1.05
Chemicals	1	0.35	1.39
Consumer Goods Conglomerates	1	0.35	1.74
Cyclical Consumer Products	17	5.92	7.67
Cyclical Consumer Services	34	11.85	19.51
Energy - Fossil Fuels	3	1.05	20.56
Food & Beverages	1	0.35	20.91
Food & Drug Retailing	2	0.70	21.60
Healthcare Services & Equipment	8	2.79	24.39
Industrial & Commercial Services	38	13.24	37.63
Industrial Goods	14	4.88	42.51
Mineral Resources	2	0.70	43.21
Personal & Household Products & Services	2	0.70	43.90
Pharmaceuticals & Medical Research	14	4.88	48.78
Real Estate	24	8.36	57.14
Renewable Energy	1	0.35	57.49
Retailers	18	6.27	63.76
Software & IT Services	70	24.39	88.15
Technology Equipment	22	7.67	95.82
Telecommunications Services	3	1.05	96.86
Transportation	5	1.74	98.61
Utilities	4	1.39	100.00
Total	287	100.00	

Brown Scope 1-2 Emission Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	26	9.06	9.06
Automobiles & Auto Parts	8	2.79	11.85
Chemicals	22	7.67	19.51
Consumer Goods Conglomerates	1	0.35	19.86
Cyclical Consumer Products	10	3.48	23.34
Cyclical Consumer Services	6	2.09	25.44
Energy - Fossil Fuels	34	11.85	37.28
Food & Beverages	17	5.92	43.21
Food & Drug Retailing	2	0.70	43.90
Healthcare Services & Equipment	2	0.70	44.60
Industrial & Commercial Services	11	3.83	48.43
Industrial Goods	9	3.14	51.57
Mineral Resources	49	17.07	68.64
Personal & Household Products & Services	1	0.35	68.99
Pharmaceuticals & Medical Research	2	0.70	69.69
Real Estate	21	7.32	77.00
Renewable Energy	3	1.05	78.05
Software & IT Services	3	1.05	79.09
Technology Equipment	4	1.39	80.49
Telecommunications Services	3	1.05	81.53
Transportation	23	8.01	89.55
Utilities	30	10.45	100.00
Total	287	100.00	

Green Refinitiv E-Score Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	8	2.37	2.37
Automobiles & Auto Parts	10	2.96	5.33
Chemicals	14	4.14	9.47
Cyclical Consumer Products	25	7.40	16.86
Cyclical Consumer Services	20	5.92	22.78
Energy - Fossil Fuels	15	4.44	27.22
Food & Beverages	21	6.21	33.43
Food & Drug Retailing	9	2.66	36.09
Healthcare Services & Equipment	10	2.96	39.05
Industrial & Commercial Services	27	7.99	47.04
Industrial Goods	35	10.36	57.40
Mineral Resources	19	5.62	63.02
Personal & Household Products & Services	4	1.18	64.20
Pharmaceuticals & Medical Research	18	5.33	69.53
Real Estate	30	8.88	78.40
Renewable Energy	1	0.30	78.70
Retailers	14	4.14	82.84
Software & IT Services	9	2.66	85.50
Technology Equipment	7	2.07	87.57
Telecommunications Services	9	2.66	90.24
Transportation	14	4.14	94.38
Utilities	19	5.62	100.00
Total	338	100.00	

Brown Refinitiv E-Score Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	4	1.18	1.18
Automobiles & Auto Parts	6	1.78	2.96
Chemicals	5	1.48	4.44
Consumer Goods Conglomerates	6	1.78	6.21
Cyclical Consumer Products	20	5.92	12.13
Cyclical Consumer Services	17	5.03	17.16
Energy - Fossil Fuels	6	1.78	18.93
Food & Beverages	10	2.96	21.89
Food & Drug Retailing	3	0.89	22.78
Healthcare Services & Equipment	10	2.96	25.74
Industrial & Commercial Services	42	12.43	38.17
Industrial Goods	52	15.38	53.55
Mineral Resources	4	1.18	54.73
Personal & Household Products & Services	1	0.30	55.03
Pharmaceuticals & Medical Research	16	4.73	59.76
Real Estate	14	4.14	63.91
Renewable Energy	4	1.18	65.09
Retailers	9	2.66	67.75
Software & IT Services	64	18.93	86.69
Technology Equipment	21	6.21	92.90
Telecommunications Services	3	0.89	93.79
Transportation	13	3.85	97.63
Utilities	8	2.37	100.00
Total	338	100.00	

Green CC Exposure Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	8	3.69	3.69
Automobiles & Auto Parts	11	5.07	8.76
Chemicals	10	4.61	13.36
Consumer Goods Conglomerates	1	0.46	13.82
Cyclical Consumer Products	6	2.76	16.59
Energy - Fossil Fuels	29	13.36	29.95
Food & Beverages	1	0.46	30.41
Industrial & Commercial Services	23	10.60	41.01
Industrial Goods	28	12.90	53.92
Mineral Resources	27	12.44	66.36
Real Estate	5	2.30	68.66
Renewable Energy	9	4.15	72.81
Retailers	4	1.84	74.65
Software & IT Services	3	1.38	76.04
Technology Equipment	10	4.61	80.65
Telecommunications Services	1	0.46	81.11
Transportation	6	2.76	83.87
Utilities	35	16.13	100.00
Total	217	100.00	

Brown CC Exposure Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Academic & Educational Services	1	0.46	0.46
Applied Resources	1	0.46	0.92
Chemicals	1	0.46	1.38
Consumer Goods Conglomerates	1	0.46	1.84
Cyclical Consumer Products	7	3.23	5.07
Cyclical Consumer Services	28	12.90	17.97
Food & Beverages	5	2.30	20.28
Food & Drug Retailing	5	2.30	22.58
Healthcare Services & Equipment	27	12.44	35.02
Industrial & Commercial Services	16	7.37	42.40
Industrial Goods	7	3.23	45.62
Mineral Resources	1	0.46	46.08
Personal & Household Products & Services	1	0.46	46.54
Pharmaceuticals & Medical Research	26	11.98	58.53
Real Estate	9	4.15	62.67
Retailers	13	5.99	68.66
Software & IT Services	46	21.20	89.86
Technology Equipment	11	5.07	94.93
Telecommunications Services	3	1.38	96.31
Transportation	8	3.69	100.00
Total	217	100.00	

Green CC Exposure Opp/Reg Portfolio

TRBC Business Sector	Freq.	Percent	Cum.
Applied Resources	5	4.13	4.13
Automobiles & Auto Parts	10	8.26	12.40
Chemicals	4	3.31	15.70
Cyclical Consumer Products	2	1.65	17.36
Energy - Fossil Fuels	14	11.57	28.93
Food & Beverages	2	1.65	30.58
Food & Drug Retailing	1	0.83	31.40
Industrial & Commercial Services	11	9.09	40.50
Industrial Goods	22	18.18	58.68
Mineral Resources	12	9.92	68.60
Real Estate	1	0.83	69.42
Renewable Energy	6	4.96	74.38
Retailers	5	4.13	78.51
Software & IT Services	2	1.65	80.17
Technology Equipment	7	5.79	85.95
Telecommunications Services	2	1.65	87.60
Transportation	3	2.48	90.08
Utilities	12	9.92	100.00
Total	121	100.00	

