



Portfolio Carbon Footprint

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1. Acknowledgement

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2. Introduction

In the spring of 2013, the San Francisco State University Foundation committed “to limit direct investments in companies with significant production or use of coal and tar sands.” (SF State Foundation, 2013) As part of the divestment commitment, the Foundation agreed to estimate the carbon footprint of the foundation’s equity portfolio. This document describes the process used to estimate the carbon footprint. For the purpose of this exercise, only equity holdings in the custody of UBS in August 2014 were considered.

A carbon footprint is defined as “the total amount of greenhouse gases that are emitted into the atmosphere each year by a person, family, building, organization, or company.” (United States Environmental Protection Agency, 2013) This includes, but is not limited to, gases such as carbon dioxide, methane, and nitrous oxide. There are various global standards for measuring the carbon footprint of a company. Among these, the Greenhouse Gas (GHG) Protocol is the most widely used. This project considered emissions reported to the Carbon Disclosure Project (CDP) as well as the GHG Protocol.

2.1 Greenhouse Gas Protocol

The first version of the GHG Protocol was published in 2001 and emerged from a partnership between the World Resources Institute (WRI) and World Business Council for Sustainable Development. It is “the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.” (The Greenhouse Gas Protocol, 2012)

The GHG Protocol classifies emissions into three categories:

“Scope 1: All direct GHG emissions.

Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.

Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.”

(The Greenhouse Gas Protocol, 2012)

2.2 Carbon Disclosure Project

The Carbon Disclosure Project (CDP) works with companies, investors and governments in order to promote environmental sustainability. It “has incentivized thousands of companies and cities across the world’s largest economies to measure and disclose their environmental information” (CDP Worldwide, 2015) in accordance with a set of approved standards, one of which is the GHG Protocol. As a result, certain companies report emissions using two standards: GHG Protocol and another standard approved for the CDP. Wherever both these figures are available and distinct, the higher figure has been used to estimate the portfolio carbon footprint. This allows the estimate to account for the worst possible scenario.

3. Methodology

The carbon footprint was calculated for equities in the portfolio since equities represent ownership of the underlying company. Fixed income investments and other alternative investments were not considered. Scope 1, 2 and 3 emissions were included in the calculation wherever available. For companies that did not report Scope 3 figures, the sum of Scope 1 and 2 emissions was used as total company emissions. For companies which did not have emissions data on Bloomberg, emissions were estimated using industry averages. These averages were computed using a sample set consisting of stocks from selected indices and from within the portfolio.

The methodology involved three key phases: (1) gathering the required data from various data sources, (2) calculating the portfolio footprint for companies that publicly report emissions and (3) estimating the portfolio footprint for companies which do not publicly report emissions. The below sections describe these three steps in detail.

3.1 Data Gathering

3.1.1 Portfolio Data

The holdings in the portfolio were obtained from the custodian. The equity portion was split from the rest of the holdings for the calculation of the carbon footprint. As listed in Table 1, asset classes Equities and Equities ETF/fund made up the equity portion of the portfolio.

Asset Class	Total USD Value
Equities	\$19,559,050
Equities ETF/fund	\$3,993,157
Fixed Income	\$9,029,472
Non Traditional	\$3,139,780
Grand Total	\$35,721,457

Table 1 Equity Portion of Portfolio includes Equities and Equities ETF/fund

The ETFs were further split into their member equities using the equation below:

$$\text{Number of shares of ETF Member in Portfolio} = \frac{(\text{Value of ETF in Portfolio} * \text{Percentage Weight of Stock in ETF})}{\text{Price of Stock}}$$

Equation 1 Conversion of ETF holdings to individual equity holdings

The Percentage Weight of Stock in ETF as well as the Price of Stock were obtained from Bloomberg. The price of non-US stocks was converted to USD using current foreign exchange rates.

For example, the portfolio contained 2,465 shares of Ishares Trust Core S&P 500 ETF (Ticker IVV) with a total value of \$477,569. The number of shares of Microsoft contributed by this position was calculated as follows:

$$\begin{aligned} \text{Number of MSFT US shares from ETF} &= \frac{\text{Value of ETF held} * \text{Weigh of MSFT US in ETF}}{\text{Price of MSFT US}} \\ &= \frac{\$477,569 * 1.89\%}{\$43.2} = 209 \text{ shares of MSFT US} \end{aligned}$$

The final result of this process gave a complete list of equities held in the portfolio, either through direct investments or indirectly through ETFs, along with the value of each equity holding.

3.1.2 Bloomberg Data

We obtained the data points listed in Table 2 for each stock in the portfolio from Bloomberg so that emissions could be calculated for stocks that report emissions publicly and estimated for the rest.

Description
Identifier (Sedol)
Identifier (Ticker)
Exchange where Security is listed
Last Price
Currency of Last Price, Market Capitalization
Sales Turnover
Currency of Sales Turnover
Market Capitalization
CDP Scope 1 emissions
CDP Scope 2 emissions
Total GHG Emissions
GHG Scope 1 Emissions
GHG Scope 2 Emissions
GHG Scope 3 Emissions
Security Type
Industry Sector
Industry Group

Table 2 Bloomberg data set for Equities in Portfolio

Next, we collected data points listed in Table 3 for securities in S&P500 index and Russell2000 index from Bloomberg. This data was used to calculate the industry averages, which allowed us to estimate emissions when none were reported.

Description
Identifier (Sedol)
Sales Turnover
Currency of Sales Turnover
CDP Scope 1 emissions
CDP Scope 2 emissions
GHG Emissions
GHG Scope 1 Emissions
GHG Scope 2 Emissions
GHG Scope 2 Emissions
Industry Sector
Industry Group

Table 3 Bloomberg data set for Market Indices used in Industry Average calculation

In order to convert figures such as revenues and stock prices into USD, foreign exchange rates were retrieved from Bloomberg.

3.2 Calculation of Portfolio Footprint for Stocks that report emissions

Using the data set obtained in Table 2, the portfolio footprint for stocks that report emissions was calculated as follows:

- a) Stocks that either reported emissions were considered valid for this calculation. The carbon footprint for each company was calculated as follows.

$$\text{Company Footprint} = \text{Maximum} (\text{CDP Scope 1} + \text{CDP Scope 2}, \text{Total GHG Emissions})$$

Equation 2 Calculation of Company Footprint for Investee Companies Publicly Reporting Emissions

The maximum reported figure was taken since this gives the worst possible scenario. While the reported figures for CDP and GHG were observed to be very close or identical in most cases, there were occasional discrepancies. For example, Exxon Mobil (XOM US) reports both CDP and GHG figures. The company’s total footprint in metric tons of CO₂ equivalents was calculated as follows:

$$\begin{aligned} \text{Company footprint for XOM US} &= \text{Max} (146,000,000; 126,000,000) \text{ mtCO}_2\text{e} \\ &= 146,000,000 \text{ mtCO}_2\text{e} \end{aligned}$$

- b) The carbon footprint for the company’s shares held in the portfolio was calculated as follows:

$$\begin{aligned} & \textit{Portfolio Footprint for Shares Held in Company} \\ & = \textit{Company Footprint} * \frac{\textit{Value of Shares Held}}{\textit{Market Capitalization}} \end{aligned}$$

Equation 3 Portfolio Footprint Calculation for Investee Companies Publicly Reporting Emissions

In the above equation, Market Capitalization must be converted into USD where necessary since the Value of Shares Held is in USD. For example, Exxon Mobil’s portfolio footprint was calculated as follows:

$$\begin{aligned} \textit{Portfolio footprint from XOM US holdings} & = 146,000,000 \textit{ mtCO}_2\textit{e} * \frac{\$11,891}{\$422,332,451,533} \\ & = 4.111 \textit{ mtCO}_2\textit{e} \end{aligned}$$

The carbon footprint for companies held within the portfolio that publicly report emissions is given by the sum of the figures obtained from Equation 3.

3.3 Estimation of Portfolio Footprint for Stocks that do not report emissions

When emission figures were not reported publicly, industry averages of emissions intensity were used to estimate the carbon footprint of stocks in the portfolio. We defined emissions intensity as the total emissions per dollar of revenue. The process is detailed below.

3.3.1 Calculation of Industry Averages

We used a combined data set, including reported emissions data for portfolio holdings (Table 2) and for members of market indices (Table 3), to calculate the average emissions per dollar of revenue for industry groups and industry sectors. Only companies that had positive revenue figures were considered. The classification of industry sectors and industry groups (Table 4) was taken directly from Bloomberg as well.

The industry averages of emissions intensity were calculated as follows:

- a) For industry groups with sufficient sample points in the data set, the average emissions intensity was calculated by dividing the total emissions for all data points within the group by their total USD revenue.
- b) For industry groups with insufficient sample points in the data set, the average emissions intensity for the industry sector was used. This was calculated by dividing total emissions for all data points in the sector by the total USD revenue for these data points.

- c) For industry sectors with insufficient data points, a default value of emissions intensity was used. This was calculated by taking the weighted average emissions intensity for all the portfolio companies that do not report emissions.

Sector	Group	Sector	Group	Sector	Group
Basic Materials	Chemicals	Consumer, Non-cyclical	Agriculture	Government	Multi-National
Basic Materials	Forest Products & Paper	Consumer, Non-cyclical	Beverages	Industrial	Aerospace/Defense
Basic Materials	Iron/Steel	Consumer, Non-cyclical	Biotechnology	Industrial	Building Materials
Basic Materials	Mining	Consumer, Non-cyclical	Commercial Services	Industrial	Electrical Compo & Equip
Communications	Advertising	Consumer, Non-cyclical	Cosmetics/Personal Care	Industrial	Electronics
Communications	Internet	Consumer, Non-cyclical	Food	Industrial	Engineering & Construction
Communications	Media	Consumer, Non-cyclical	Healthcare-Products	Industrial	Environmental Control
Communications	Telecommunications	Consumer, Non-cyclical	Healthcare-Services	Industrial	Hand/Machine Tools Machinery – Constr & Mining
Consumer, Cyclical	Airlines	Consumer, Non-cyclical	Household Products/Wares	Industrial	Machinery-Diversified
Consumer, Cyclical	Apparel	Consumer, Non-cyclical	Pharmaceuticals	Industrial	Metal Fabricate/Hardware
Consumer, Cyclical	Auto Manufacturers	Diversified	Holding Companies-Divers	Industrial	Miscellaneous Manufactur.
Consumer, Cyclical	Auto Parts & Equipment	Energy	Coal	Industrial	Packaging & Containers
Consumer, Cyclical	Distribution/Wholesale	Energy	Energy-Alternate Sources	Industrial	Transportation
Consumer, Cyclical	Entertainment	Energy	Oil & Gas	Industrial	Trucking & Leasing
Consumer, Cyclical	Home Builders	Energy	Oil & Gas Services	Industrial	Shipbuilding
Consumer, Cyclical	Home Furnishings	Energy	Pipelines	Technology	Computers
Consumer, Cyclical	Housewares	Financial	Banks	Technology	Office/Business Equip
Consumer, Cyclical	Leisure Time	Financial	Diversified Finan. Serv.	Technology	Semiconductors
Consumer, Cyclical	Lodging	Financial	Insurance	Technology	Software
Consumer, Cyclical	Office Furnishings	Financial	Investment Companies	Utilities	Electric
Consumer, Cyclical	Retail	Financial	Real Estate	Utilities	Gas
Consumer, Cyclical	Storage/Warehousing	Financial	REITS	Utilities	Water
Consumer, Cyclical	Textiles	Financial	Savings & Loans		
Consumer, Cyclical	Toys/Games/Hobbies	Financial	Private Equity		

Table 4 Industry Sectors and Groups Classification

3.3.2 Estimation of Portfolio Footprint

The footprint for companies that did not report emissions was estimated as follows:

- a) The company footprint was calculated using the industry group average or the industry sector average as follows:

Estimated Company Footprint

$$= \text{Group (or Sector) Average of Emissions per Dollar Revenue} \\ * \text{Revenue of Company}$$

Equation 4 Estimation of Company Footprint using Industry Averages

For example, the company footprint for China Mobile Limited (CHL US) was estimated as follows:

Estimated company footprint for CHL US

$$= \text{Emissions per \$ Revenue for Telecommunications Industry Group} \\ * \text{Revenue of CHL US} \\ = 0.000052 \text{ mtCO}_2\text{e}/\$ * \$100,828,320,000 \\ = 5,289,624 \text{ mtCO}_2\text{e}$$

b) The footprint of individual portfolio holdings is calculated using Equation 3 in Section 3.2.

$$\text{Portfolio footprint from CHL US holdings} = 5,289,624 \text{ mtCO}_2\text{e} * \frac{\$88,355}{\$243,659,138,503} \\ = 1.918 \text{ mtCO}_2\text{e}$$

c) For investee companies that did not have revenue data or market capitalization data, manual estimations were used where possible. The remaining companies were ignored in the calculation as they represented a negligible portion of the portfolio.

d) The sum of all estimations from part (b) and (c) above gives the total carbon footprint from portfolio companies that do not report emissions.

3.4 Carbon Footprint of Portfolio

We calculated the total carbon footprint of the equity portfolio by taking the sum of calculated emissions from Part 3.2 and the estimated emissions from Part 3.3.

3.5 Comparison with a Benchmark

The steps above can be repeated for the constituents of a benchmark index, such as the S&P500 index, for comparison.

4. Limitations of the Method

There are several limitations to this methodology. The most prominent of these are listed below:

- a) The portfolio used for this calculation only contains equities in the custody of UBS and does not give a complete carbon footprint of the Foundation's equity holdings.
- b) Variables like stock prices, foreign exchange rates and ETF member weights were captured on a specific day. Variations in these figures can cause variations in the final carbon footprint figure.
- c) The standards used by companies that report emissions are not uniform. Even though the figures used conform to standards approved by the Carbon Disclosure Project, verifying the comparability of these standards was outside the scope of this exercise.
- d) Many companies did not Scope 3 figures. Therefore, the emissions figures for these companies may be understated. This can have a significant impact for companies where substantial emissions occur in upstream and downstream activities.
- e) The method of taking industry averages provides a rough approximate. The accuracy of this approximation can be improved by considering additional factors such as country of domicile, countries of operation, product lines, etc.

5. Conclusion

The carbon footprint exercise was undertaken with the view to better understand the carbon risk in the portfolio. However, portfolio carbon footprints cannot be used in isolation to guide investment or divestment decisions, due to limited data availability. Furthermore, a carbon footprint does not differentiate between emissions created to manufacture a solar panel versus emissions created to manufacture oil pipelines. Therefore, such an analysis must be juxtaposed against other factors in order to guide decision making.

6. Bibliography

Bloomberg L. P. (2014)

CDP Worldwide. (2015). *Catalyzing business and government action*. Retrieved from Carbon Disclosure Project Web site: <https://www.cdp.net/en-US/Pages/About-Us.aspx>

SF State Foundation. (2013). *Resolution Regarding Fossil Fuel Divestment*. San Francisco.

The Greenhouse Gas Protocol. (2012). *About*. Retrieved from The Greenhouse Gas Protocol Web site: <http://www.ghgprotocol.org/about-ghgp>

The Greenhouse Gas Protocol. (2012). *FAQ*. Retrieved from The Greenhouse Gas Protocol Web site: <http://www.ghgprotocol.org/calculation-tools/faq>

UNEP FI Climate Change Advisory Group and Investment Commission. (2013, July). *Portfolio Carbon*. Retrieved from United Nations Environment Programme Finance Initiative: http://www.unepfi.org/fileadmin/documents/UNEP_FI_Investor_Briefing_Portfolio_Carbon.pdf

United States Environmental Protection Agency. (2013, September 9). *Glossary of Climate Change Terms*. Retrieved from United States Environmental Protection Agency Web site: <http://www.epa.gov/climatechange/glossary.html>

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