

## The Key Financial Outcomes

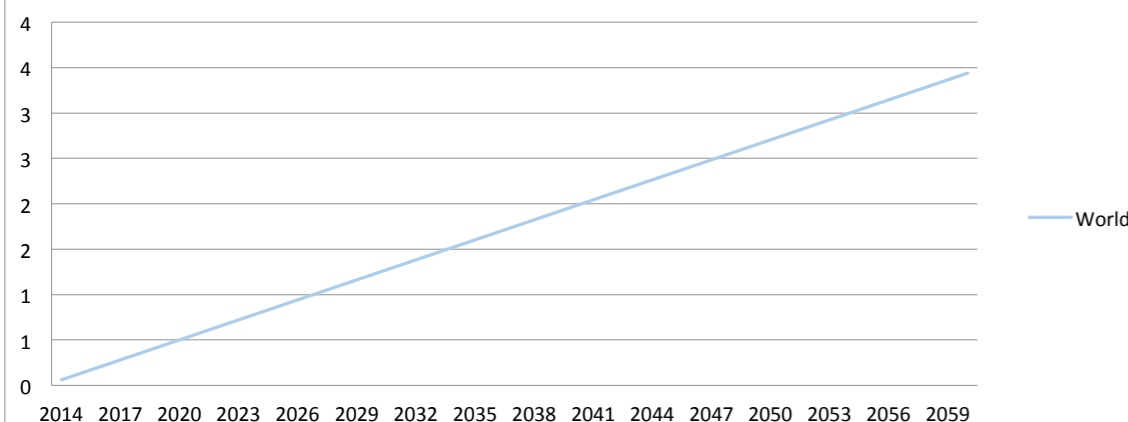
Global Implementation Units Installed in 2060	Cumulative First Cost 2015-2060	Marginal First Cost 2015-2060	Net Operating Savings 2015-2060	Lifetime Operating Savings 2015-2060	Lifetime Cashflow NPV (OPT compared to BAU)	Global Functional Units in 2060
TW	3,439 \$ Billion USD	3,494.86 \$ Billion USD	600.55 \$ Billion USD	11,331.87 \$ Billion USD	18,503.25 \$ Billion USD	832.19 TWh
		ADDITIONAL COST	NET SAVINGS	NET SAVINGS	NET SAVINGS	

Report results from:	
Year 1	Year 2
2015	2060
(Min 2015)	(Max 2060)

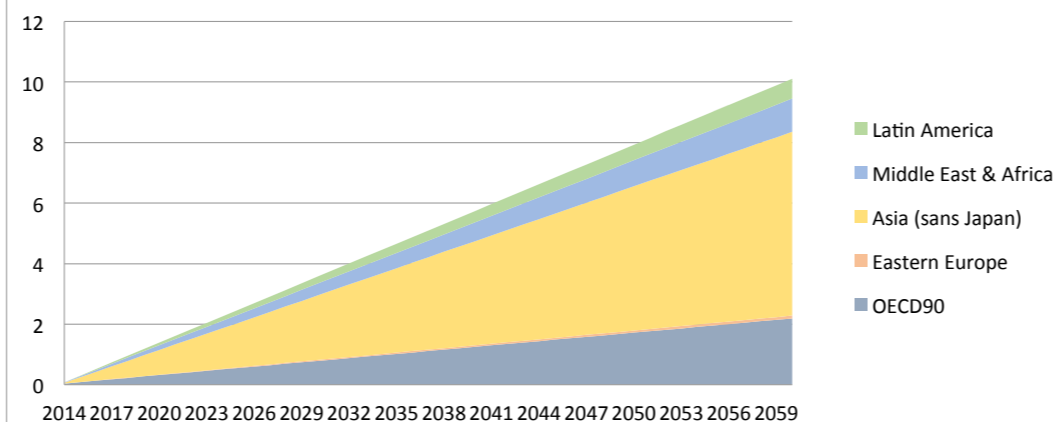
## The Key Climate Outcomes

Max Annual Emissions Reduction	Total Emissions Reduction	Approximate PPM Equivalent	Approximate PPM rate in 2060
3.08 Gt CO <sub>2</sub> / yr	73.33 Gt CO <sub>2</sub> (2015-2060)	5.78 ppm CO <sub>2</sub> -eq (2060)	0.220 ppm CO <sub>2</sub> -eq (change from 2059 to 2060)

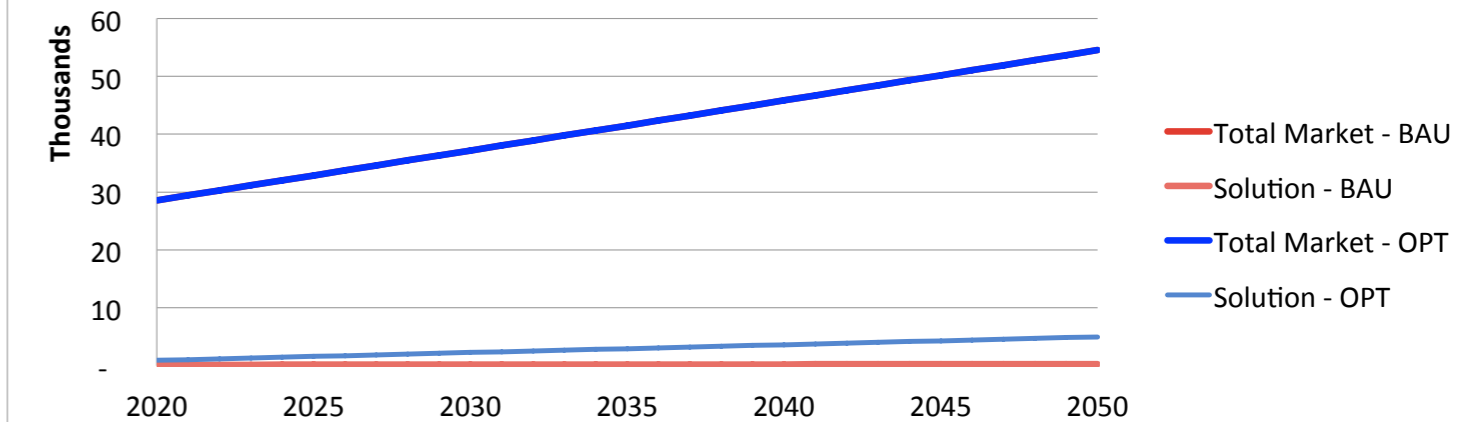
### Adoption



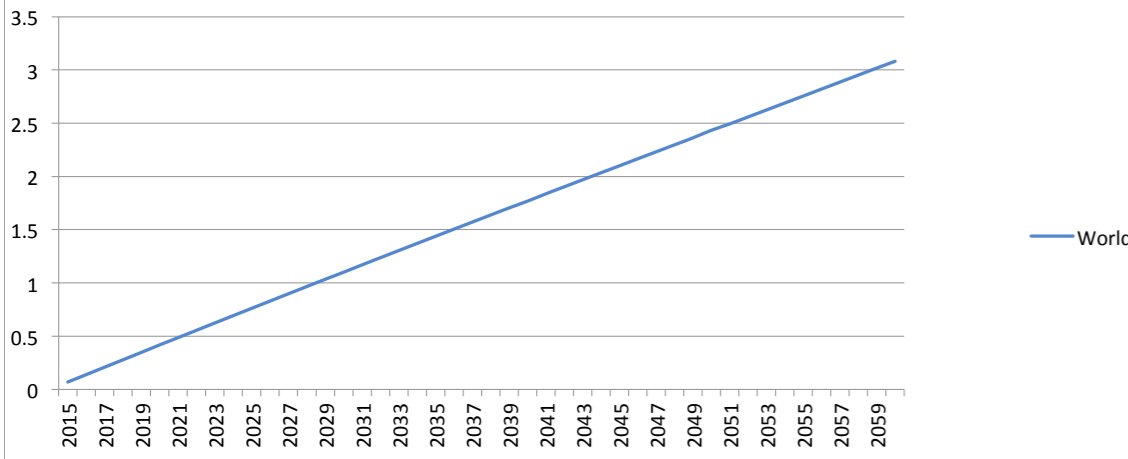
### Adoption, by country/region



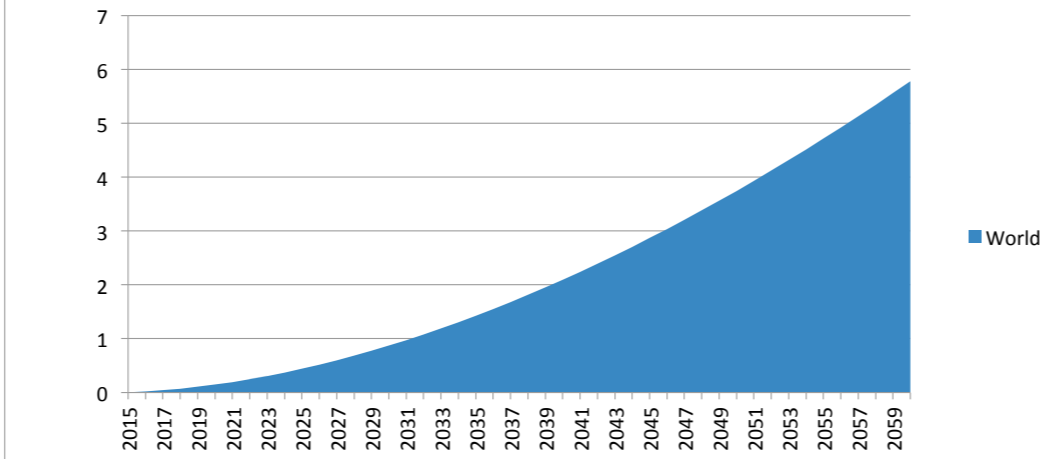
### Year-to-Year Growth of Solution



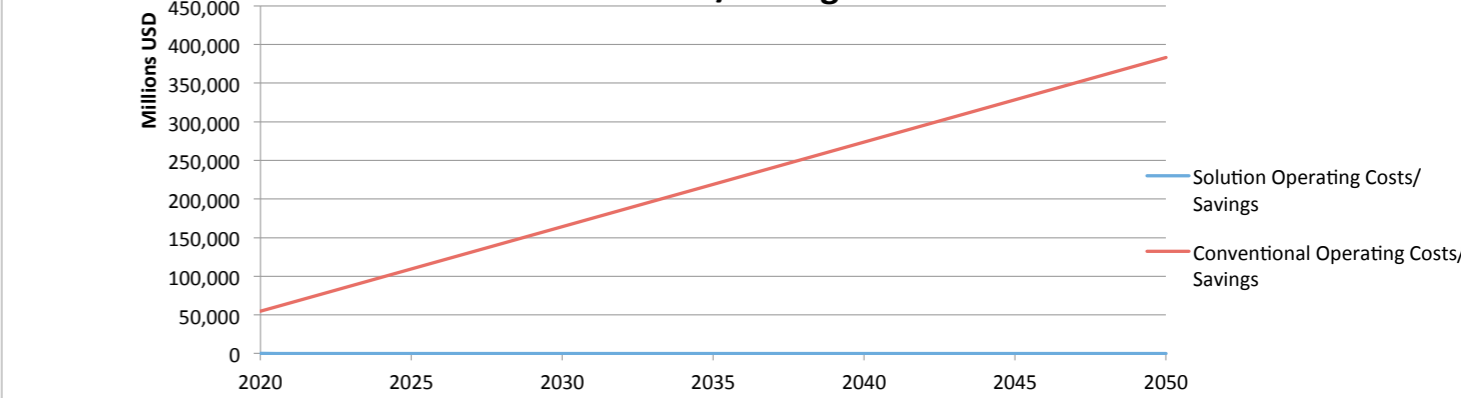
### MMT CO<sub>2</sub>-eq Reductions



### PPM CO<sub>2</sub>-eq Reductions



### Net Cost/Savings



This Graph shows the Operating Cost of The Increased Solution Adoption in the OPT versus what that Increased Adoption (in Conventional Technology) Would have costed in the Reference Scenario

## MASTER CONTROL BUTTONS

First, notice the color of the cells... they're not arbitrary! Each color has a meaning... Green is probably where you're being asked for your input!

- A. Light Yellow cells appear on the Main Controls Sheet and depict the RESULTS of the model
- B. Green cells indicate where data should be entered
- C. Blue cells indicate where data can be adjusted but probably doesn't need to be
- D. Orange cells indicate results which should not be modified
- E. Researchers that customize cells should change the color to light red
- F. Bright yellow cells with a message box provide more information

Results
Data Input -- add data
Probably do not modify
DO NOT MODIFY
Customized formula
Note

To get started, just fill in green areas, and sure to include sources for all assumptions must be indicated on appropriate sheets

Name of Fellow(s)	Anna Goldstein	Aven Satre-Meloy	Chad Frischmann	[Enter your name]	[Enter your name]
Version	v0.3	v0.4.6	v0.6.4	[Enter version of model]	[Enter version of model]
Date of Submission	20151005	20160731	20170125	[Enter date of final submission]	[Enter date of final submission]

Enter name of Solution here:	Utility-scale Solar PV	
Enter the Functional Unit:	TWh	e.g. Terawatt hours (TWh), Passenger kilometers (Pkm), kilo-Calories of food (kCal)
Enter the Implementation Unit of Measure?	TW	e.g. Terawatts (TW), Number of Vehicles, Head of Livestock
Measurement System	ISO Standard	All data should be converted to ISO Standards.
Base Year:	2014	The default Base Year for current Drawdown Prognostications is 2014

# TOTAL ADDRESSABLE MARKET & CURRENT ADOPTION INPUTS

Total Addressable Market (TAM)

[CLICK HERE TO START BY ENTERING THE TOTAL ADDRESSABLE MARKET](#)

CHOOSE SOURCE:

CURRENT Market	ALL SOURCES
2020 - 2050 Market	Baseline Cases

CURRENT Market  
2050 BAU Market  
2050 OPT Market

2014	22,548.30	TWh
2050	54,535.28	TWh
2050	54,535.28	TWh

NOTE: Total Addressable Market is represents total functional demand.

\* If you chose 'ALL SOURCES', an average of all source prognositcations is used.

## Current Adoption of Solution in Functional Units

	Adoption (%)	Adoption in 2014
World	0.50%	113 TWh
OECD90	0.74%	71 TWh
Eastern Europe	0.00%	0 TWh
Asia (sans Japan)	0.66%	53 TWh
Middle East & Africa	1.14%	20 TWh
Latin America	0.17%	3 TWh
China	0.30%	16 TWh
India	0.25%	3 TWh
EU	1.20%	41 TWh
USA	0.25%	11 TWh

	Based on Current Adoption Variable Meta-Analysis	Based on Existing Prognostications
World: IRENA RE Statistics 2016	112.84	113
All sources (corrected) - AVERAGE	71.31	0
OECD90: IEA 2DS Projection, ETP 2016 (Utility-scale Solar PV)		0
All sources (corrected) - AVERAGE	53.21	0
All sources (corrected) - AVERAGE	19.92	0
All sources (corrected) - AVERAGE	2.84	0
All sources (corrected) - AVERAGE	15.94	0
All sources (corrected) - AVERAGE	3.28	0
All sources (corrected) - AVERAGE	40.73	0
All sources (corrected) - AVERAGE	10.79	0

## Current Adoption Mix as % of TAM

Coal	38.70%
Natural gas	21.88%
Nuclear	10.72%
Oil	4.74%
Hydroelectric	17.82%
Solar Photovoltaic	0.83%
Wave and Tidal	0.00%
Wind Onshore	3.06%
Wind Offshore	0.11%
Biomass and Waste	1.77%
Concentrated Solar Power	0.04%
Geothermal	0.33%
Total addressable market (base year):	100.00%

Utility-scale Solar PV 0.50%

Indicate Source(s) / Assumptions: The World Bank Data in The Shift Project Data Portal  
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<http://www.tsp-data-portal.org/Breakdown-of-Electricity-Generation-by-Energy-Source#spQvChart>  
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[http://www.irena.org/DocumentDownloads/Publications/IRENA\\_RE\\_Statistics\\_2016.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Statistics_2016.pdf)  
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[http://www.irena.org/DocumentDownloads/Publications/IRENA\\_RE\\_Statistics\\_2016.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Statistics_2016.pdf)

# FINANCIAL ANALYSIS INPUTS

## CONVENTIONAL Technology/Practice

	First Cost	First Cost Learning Rate	Lifetime Capacity	Average Annual Use	Variable Operating Cost (VOM)	Fixed Operating Cost (FOM)	Type of Fuel Consumed	Fuel Cost Conventional
	per implementation unit	expressed as efficiency (1-learning rate)	use until replacement is required	annual use	per functional unit of measure	per implementation unit		per functional unit
	\$1,923.37078	2.00%	182,411	4,947	\$0.00375	\$32.95140	Conventional Grid Generation (weighted average of Coal, Oil, NG)	\$0.0733
	\$ per install + acquisition per kW		hours	hours	US\$2014 per kWh	US\$2014 per kW		US\$2014/kWh
mean	\$1,923.37078		182411.276	4946.840	0.004	32.951		\$0.0734
High	\$3,234.15565		230970.612	6646.392	0.007	64.657		
Low	\$612.58590		133851.940	3247.289	0.000	1.246		
Stats. Corrected?	Y		Y	Y	Y	Y		
Weighted Average?	Y		Y	Y	Y	Y		
Total Sources:	12		7	23	8	9		
Choose Source?	Sources		Sources	Sources	Sources	SOURCE ID: Author/Org, Date, Info		
	Data		Data	Data	Data	Data		

## ADDITIONAL INPUTS FOR Coal & Gas plants:

	2005-2014 Average CONVENTIONAL Fuel Price per functional unit	Weighted Average CONVENTIONAL Plant Efficiency	Coal Plant Efficiency	Natural Gas Plant Efficiency	Oil Plant Efficiency
	If applicable	If applicable	If applicable	If applicable	If applicable
	\$0.0301	41.02%	37.16%	48.29%	39.00%
	US\$2014/kWh	%	%	%	%
mean	0.034465	41.02%	37.16%	48.29%	39.00%
High	0.060330	83.11%	43.07%	57.31%	39.00%
Low	0.008601	-1.07%	31.25%	39.28%	39.00%
Stats. Corrected?	Y	Y	Y	Y	Y
Weighted Average?	Y	Y	N	N	N
Total Sources:	3	3	5	8	1
Choose Source?	World: PD Common Fuel Data- Coal/Oil/Gas, based on IEA (2016), Third Quarter	Sources	Sources	Sources	Sources
	0.030069	Data	Data	Data	Data

## Utility-scale Solar PV

	First Cost	First Cost Learning Rate	Lifetime Capacity	Average Annual Use	Variable Operating Cost (VOM)	Fixed Operating Cost (FOM)	Type of Fuel Consumed	Fuel Cost Solution
	per implementation unit	expressed as efficiency (1-learning rate)	use until replacement is required	annual use	per functional unit of measure	per implementation unit		per functional unit
	\$1,561	19.24%	48,344	1,842			Fuel	
	\$ per install + acquisition per kW		hours	hours	US\$2014 per kWh	US\$2014 per kW		US\$2014/unit
mean	\$2,273.36364	Cost at 2020	48343.8000	1841.669	#DIV/0!	25.3361		Fuel cost (2016)
High	\$2,985.96352	\$1,040.63	52331.1294	2333.420	#DIV/0!	37.2639		
Low	\$1,560.76375	Cost at 2030	44356.4706	1349.917	#DIV/0!	13.4084		
Stats. Corrected?	Y	\$788.21	Y	Y	Y	Y		
Weighted Average?	N	Cost at 2050	N	N	N	N		
Total Sources:	22	\$619.21	4	21	0	13		
Choose Source?	Sources	Cost at 2060	Sources	Sources	Sources	Sources		
	Data	\$575.03	Data	Data	Data	Data		

## General Financial Variables

NPV Discount	10.00%
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# EMISSIONS REDUCTION INPUTS

Electricity Grid-based Emissions			
Is this primarily a REPLACEMENT or REDUCTION solution?	Average Electricity Used CONVENTIONAL	Energy Efficiency Factor SOLUTION	ALTERNATIVE APPROACH Annual Energy Used SOLUTION
Choose one:			
<b>REPLACEMENT</b>			
mean	#DIV/0!	#DIV/0!	#DIV/0!
High	#DIV/0!	#DIV/0!	#DIV/0!
Low	#DIV/0!	#DIV/0!	#DIV/0!
Stats. Corrected?	Y	Y	Y
Weighted Average?	N	N	N
Total Sources:	0	0	0
Choose Source?	Sources	Sources	Sources
	Data	Data	Data

Fuel Combustion-based Emissions			
Fuel Consumed CONVENTIONAL	Fuel Efficiency Factor SOLUTION	Type of Fuel Consumed	Fuel Emissions Factor
Fuel unit (litres=default) per TWh		Fuel % saved	Fuel Conventional t CO2-eq per fuel unit ( TJ)
		<b>Conventional Grid Generation (weighted average of Coal, Oil, NG)</b>	
mean	#DIV/0!	#DIV/0!	<b>149.17456381</b>
High	#DIV/0!	#DIV/0!	<b>0.00000000</b>
Low	#DIV/0!	#DIV/0!	<b>0.00000000</b>
Stats. Corrected?	Y	Y	Fuel
Weighted Average?	N	N	#N/A
Total Sources:	0	0	#N/A
Choose Source?	Sources	Sources	#N/A
	Data	Data	Source: 2006 IPCC Guidelines for National Greenhouse Gas

Default  
Upper  
Lower  
  
Default  
Upper  
Lower

Annual Direct Emissions (excl. electricity- or fuel-based)		
What type of GHG is emitted?	Direct Emissions CONVENTIONAL	Direct Emissions SOLUTION
	t CO2-eq per TWh	t CO2-eq per TWh
mean	#DIV/0!	#DIV/0!
High	#DIV/0!	#DIV/0!
Low	#DIV/0!	#DIV/0!
Stats. Corrected?	Y	Y
Weighted Average?	N	N
Total Sources:	0	0
Choose Source?	Sources	Sources
	Data	Data

Indirect Emissions (CO2-eq)	
Indirect CO2-eq Emissions CONVENTIONAL	Indirect CO2-eq Emissions SOLUTION
t CO2-eq per TWh	t CO2-eq per TWh
mean	<b>47157</b>
High	47157
Low	60767
Stats. Corrected?	Y
Weighted Average?	0
Total Sources:	6
Choose Source?	Sources
	Data

Optional	
CH4-CO2eq Tons Reduced	N2O-CO2eq Tons Reduced
t CH4-CO2eq per TWh	t N2O-CO2eq per TWh
mean	#DIV/0!
High	#DIV/0!
Low	#DIV/0!
Stats. Corrected?	Y
Weighted Average?	N
Total Sources:	0
Choose Source?	Sources
	Data

Based on functional or implementation units?

Based on CO2eq?

## General Climate Variables

Use CO2-eq?	Choose Source:	Choose Range:
Use CO2-eq for ppm or calc	REF Case Grid Emission Factors	REF Case Grid Emission Factors
<b>Yes</b>	<b>Meta-Analysis</b>	<b>Mean</b>

# ADDITIONAL INPUTS

(be sure to explain in detail any additional variables you add!)

	Lifecycle indirect CO2 emissions per functional unit by PV type	% of PV Generation from Utility Scale PV	Solar PV Module Learning Rate	Utility-Scale PV BOS Learning Rate	% of PV System Installed Costs from Module
	<b>47173.89</b>	<b>60%</b>	<b>20%</b>	<b>17%</b>	<b>34%</b>
	t CO2-eq/TWh	%	%	%	%
mean	47173.88889	0.598889	0.196222	0.168000	0.340000
High	63606.97311	0.670398	0.231153	0.208694	0.400000
Low	30740.80467	0.527380	0.161291	0.127306	0.280000
Stats. Corrected?	Y	Y	Y	Y	Y
Weighted Average?	N	N	N	N	N
Total Sources:	18	3	9	5	2
Choose Source?	Sources	Sources	Sources	Sources	Sources
	Data	Data	Data	Data	Data

	VARIABLE	VARIABLE	VARIABLE	VARIABLE
	If applicable	If applicable	If applicable	If applicable
mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
High	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Low	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Stats. Corrected?	Y	Y	Y	Y
Weighted Average?	N	N	N	N
Total Sources:	0	0	0	0
Choose Source?	Sources	Sources	Sources	Sources
	Data	Data	Data	Data

\*\* Copy and paste cells to add more variables