

# Verification of ClimateCypher Climate Data Outputs with System Advisor Model (SAM)

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# XMY Data Generation

- ▶ XMY: eXtreme Meteorological Year
- ▶ We will now be able to produce P01, P10, P90 and P99 climate data
- ▶ Recent Enhancement in ClimateCypher
  - An in-house software package of Exemplary Energy.
  - Production of hourly and half hourly weather data for a period - usually decades
  - Derivation of climate data - Reference Meteorological Years (RMY)

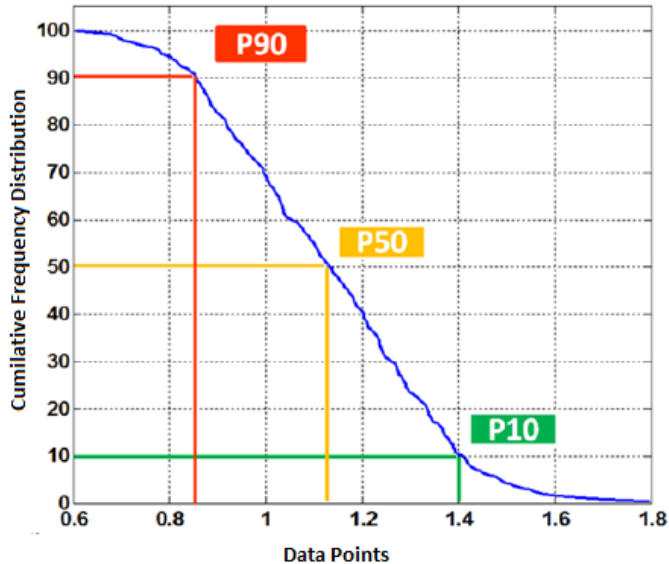


# Focus of this work

- ▶ Generation of P01 and P99 weather data
- ▶ Refining the P10 and P90 weather data generation



# What is P01, P10, P90 & P99?



- ▶ P90 - It is a conservative value that means that 90% of the calculated estimates will be equal or is less than P90 value
- ▶ P50 - It denotes the value which occurs 50% of the time in the given sample. Usually the mean/median of the sample.
- ▶ P10 - It is an optimistic value that means that 10% of the calculated estimates will be equal or less than P10 value
- ▶ P01 and P99 are extreme conservative and optimistic figures

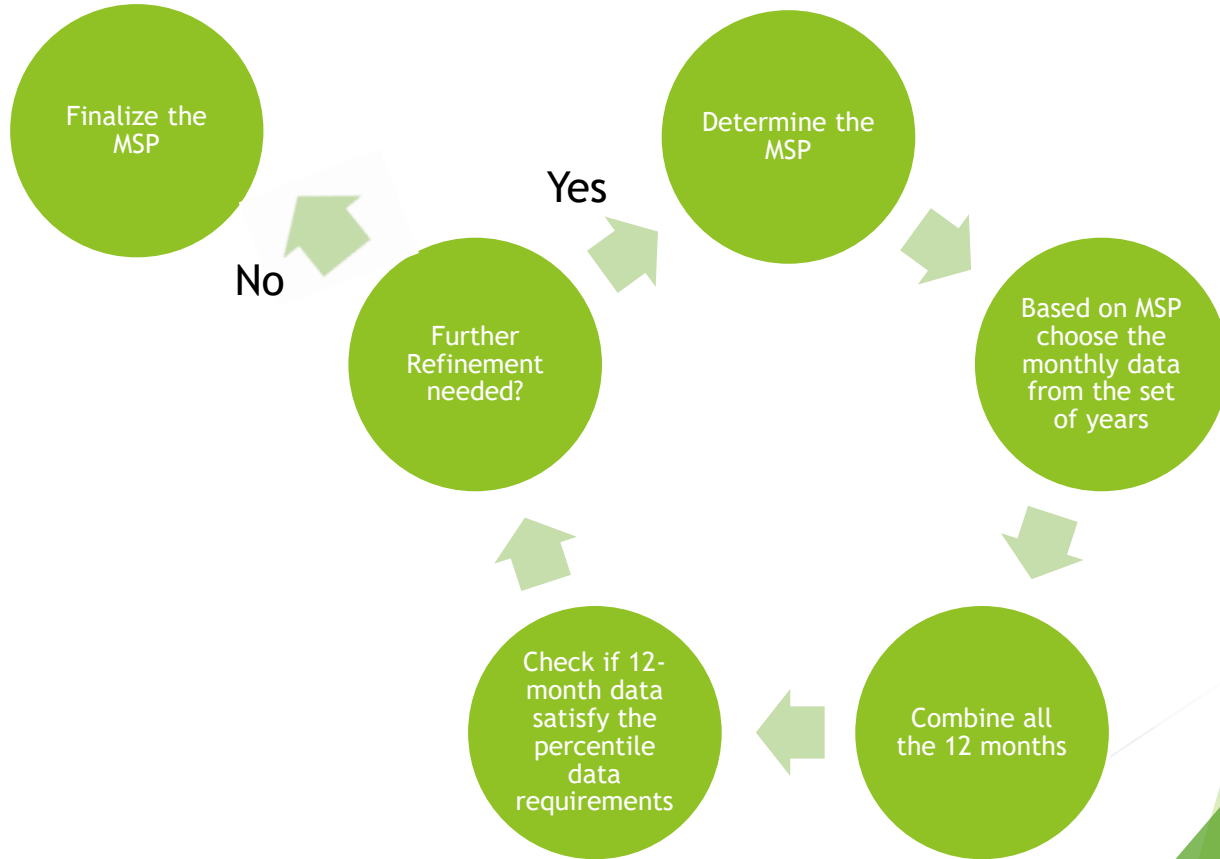
# Use of XMY data

Renewable energy is quite dependent on the weather conditions, thus XMY weather data can have design and financial applications like:

- ▶ Understanding the building energy performance in the extreme conditions
- ▶ Best Year Data- It is used to calculate the USE (unserved energy).
- ▶ Worst Year Data - It is used by investors to manage the risk of variability of the renewable sources to determine factors like the DSCR (Debt Service Coverage Ratio).



# Methodology

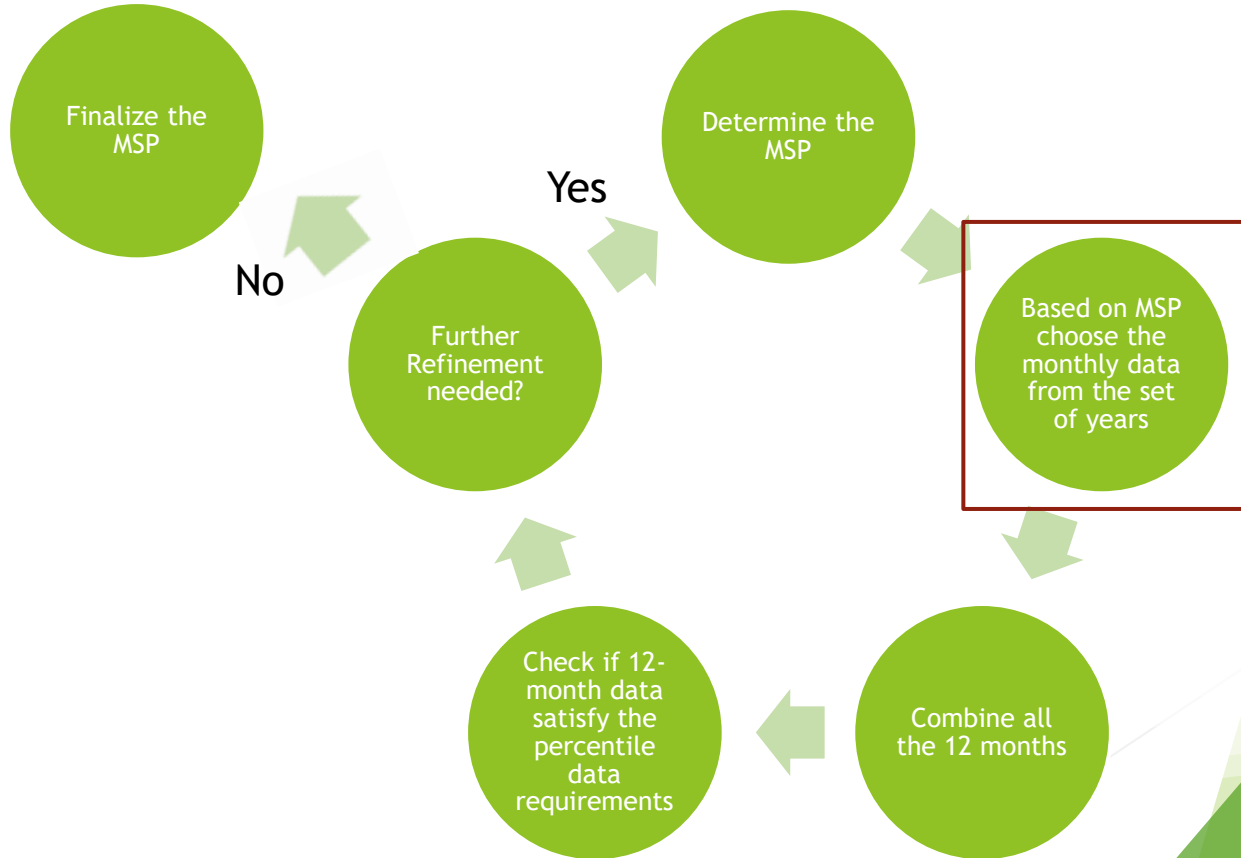


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# Methodology



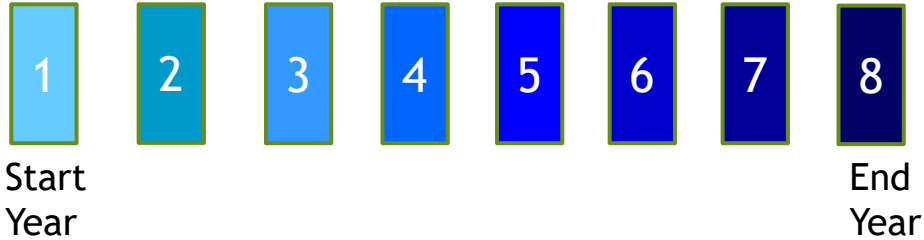
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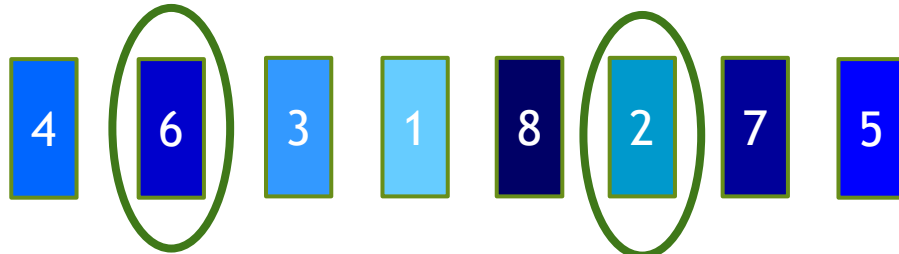
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# Methodology

Years numbered for determining  
Percentile month



Selected based on Ranking



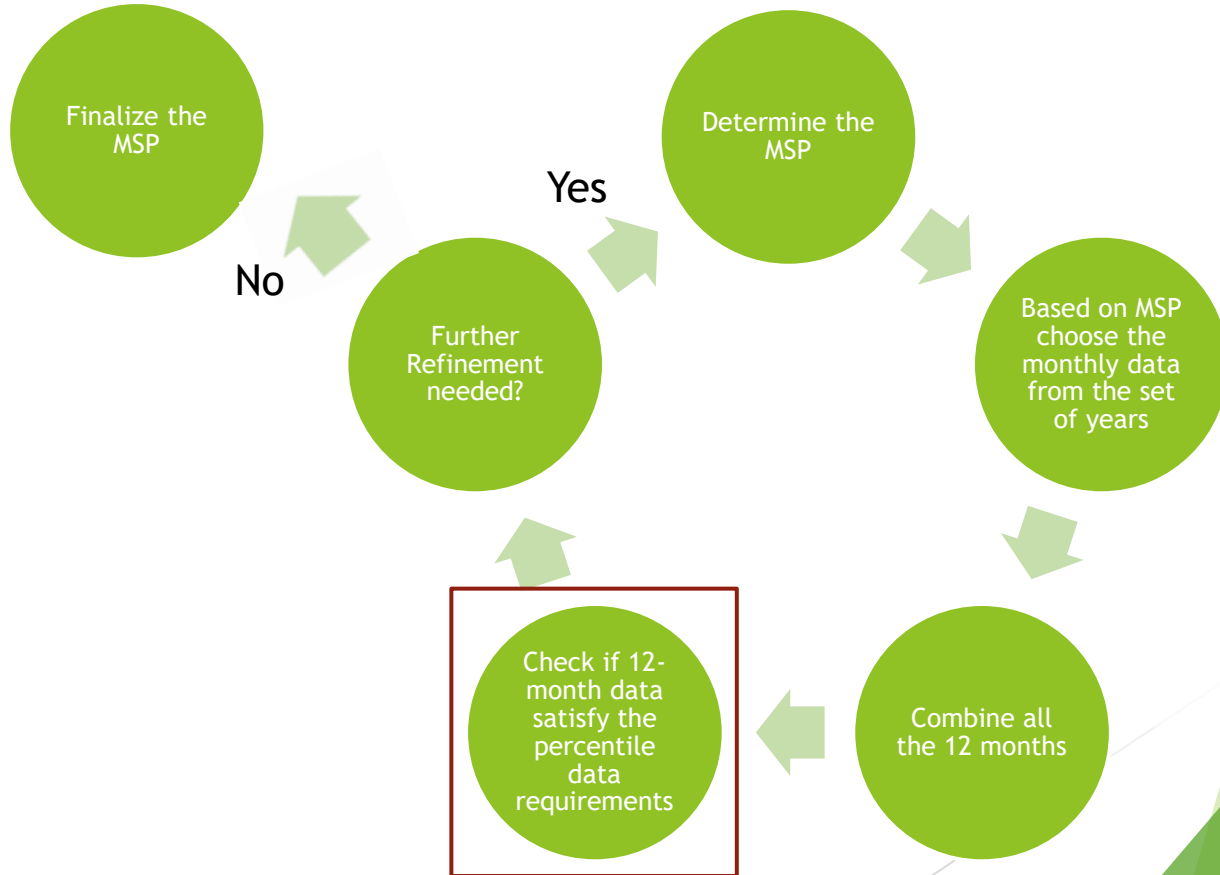
P10 month  
chosen based on  
an Empirically  
determined  
factor

P90 month  
chosen based on  
an Empirically  
determined  
factor





# Methodology



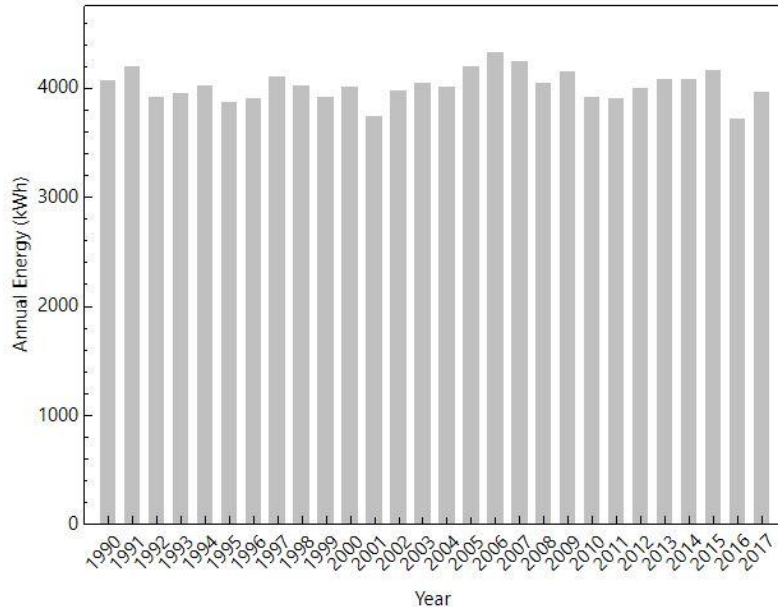
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# System Advisor Model

- ▶ Software developed by National Renewable Energy Laboratories (NREL)
- ▶ Capable of modelling different renewable energy systems
- ▶ Used the P50/P90 simulation functionality

	P10	P50	P90
Daily average solar irradiance (kWh/m <sup>2</sup> /day)	4.90041	4.69485	4.46519
Annual AC system output (kWh)	4192.61	4008.17	3845.11
Annual energy (kWh)	4192.61	4008.17	3845.11
Capacity factor (%)	15.9536	15.2518	14.6313
Energy yield (kWh/kW)	1397.54	1336.05	1281.7



# Climate Zones and Locations under study

Climate Zone	Location	Latitude(°)	Tilt Angle(°)
1	Darwin	-12.42	20
	Townsville	-19.25	20
2	Brisbane	-27.39	30
	Mackay	-21.12	20
3	Alice Spring	-23.8	30
	Tennant Creek	-19.64	20
4	Alice Spring	-23.8	30
	Oodnadatta	-27.56	30
5	Adelaide	-34.92	30
	Sydney	-33.95	30
	Perth	-31.93	30
	Richmond	-33.6	30
	Swanbourne	-31.96	30
	Toowoomba	-27.54	30
6	Melbourne	-37.81	30
	Glen Innes	-29.73	30
7	Canberra	-35.31	30
	Hobart	-42.9	40
	Armidale	-30.53	30
8	Cabramurra	-35.94	30
	Mount Buller	-37.15	30



# Verification

- ▶ Generate the Percentile weather data for the period 1990-2017 through ClimateCypher.
- ▶ Using SAM, generate the yearly energy outputs and determine the Percentile energy outputs for this period.
- ▶ Generate the energy output corresponding to ClimateCypher generated percentile weather file.
- ▶ Compare the energy outputs.

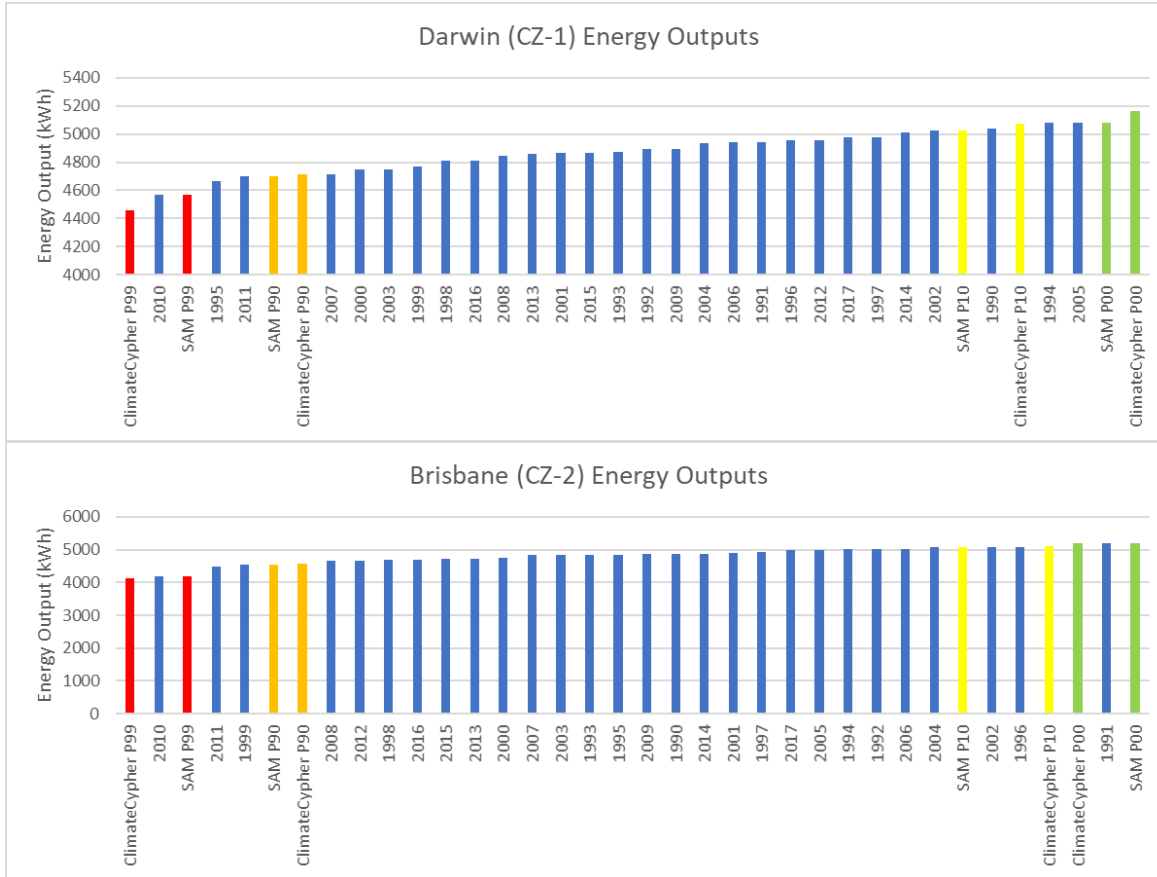


# Results

Climate Zone	Location	MSP	Percentage Difference			
			P00	P10	P90	P99
1	Darwin Townsville	0.20 0.35 0.75 0.93	1.52%	0.91%	0.27%	-2.47%
			0.20%	-0.13%	0.90%	0.56%
2	Brisbane Mackay	0.20 0.35 0.80 0.95	-0.08%	0.92%	0.59%	-1.20%
			0.54%	0.07%	-0.40%	-0.97%
3	Alice Spring Tennant Creek	0.25 0.36 0.81 0.85	1.37%	0.67%	-1.69%	2.19%
			-0.09%	0.71%	-0.67%	0.53%
4	Alice Spring Oodnadatta	0.25 0.36 0.81 0.90	0.33%	0.62%	-1.24%	0.47%
			-1.69%	-0.25%	-0.54%	1.40%
5	Adelaide	0.23 0.36 0.76 0.90	1.12%	-0.42%	0.23%	0.23%
	Sydney		0.69%	0.17%	1.37%	0.40%
	Perth		0.44%	0.48%	0.20%	-1.58%
	Richmond		1.23%	-0.42%	-1.97%	-2.17%
	Swanbourne		0.18%	0.07%	-1.65%	1.62%
	Toowoomba		1.01%	1.15%	2.31%	2.43%
6	Melbourne Glen Innes	0.15 0.25 0.75 0.90	1.38%	1.26%	-1.22%	-1.96%
			0.54%	1.80%	0.57%	-0.24%
7	Canberra	0.19 0.31 0.76 0.87	0.22%	-0.02%	-1.48%	-1.19%
	Hobart		0.39%	0.10%	1.53%	2.40%
	Armidale		0.94%	-0.57%	1.47%	-1.38%
8	Cabramurra Mount Buller	0.20 0.35 0.70 0.85	-0.29%	-0.42%	-1.61%	-0.13%
			-0.33%	-1.48%	-0.65%	1.43%



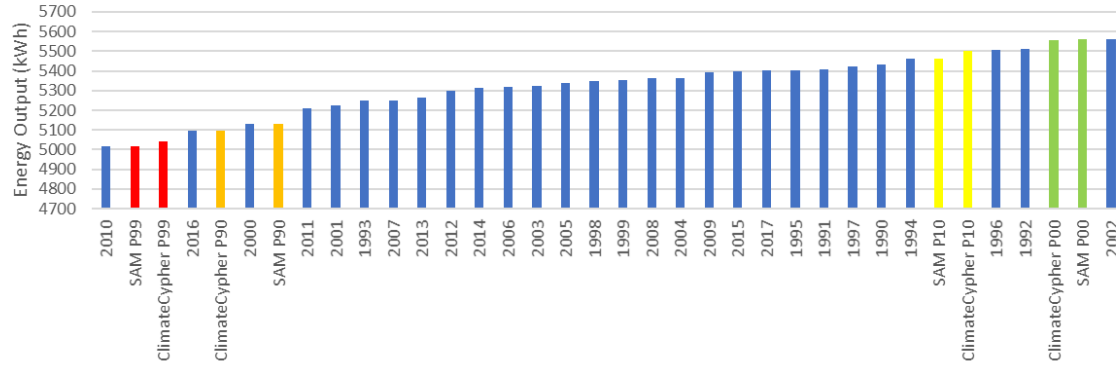
# Results



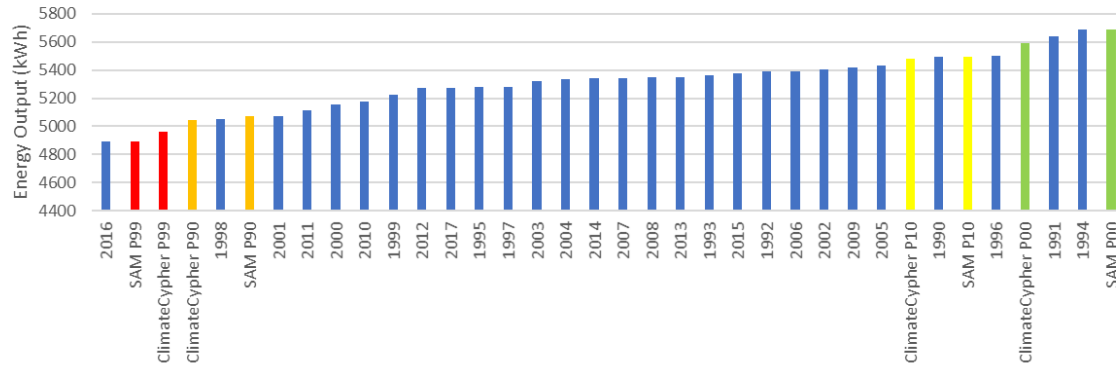
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# Results

## Tennant Creek (CZ-3) Energy Outputs



## Oodnadatta (CZ-4) Energy Outputs



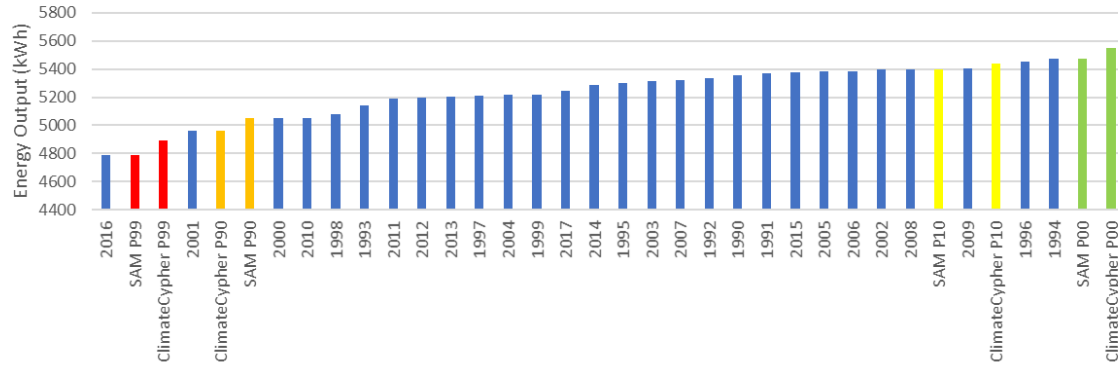
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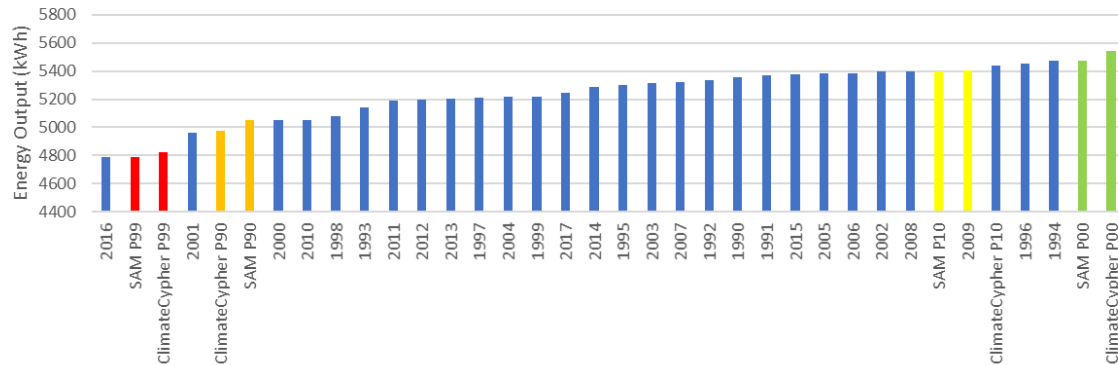
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# Results

### Alice Springs (CZ-3) Energy Outputs



### Alice Springs (CZ-4) Energy Outputs

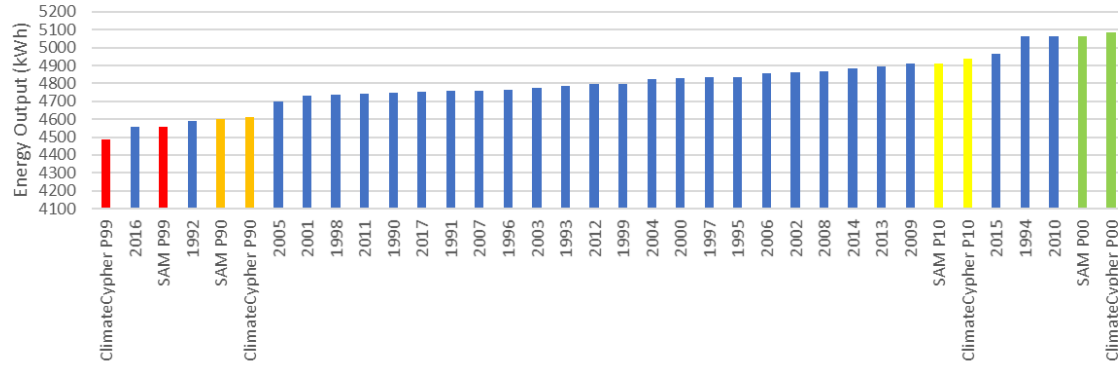


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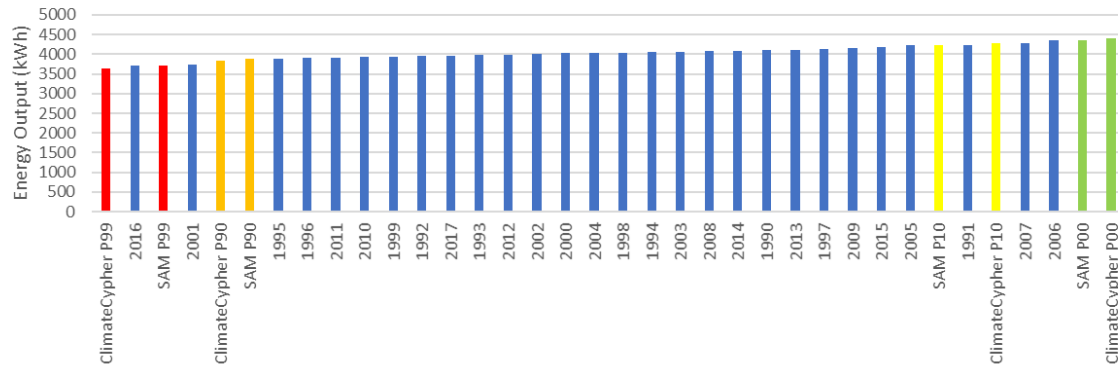


# Results

## Perth (CZ-5) Energy Outputs



## Melbourne (CZ-6) Energy Outputs

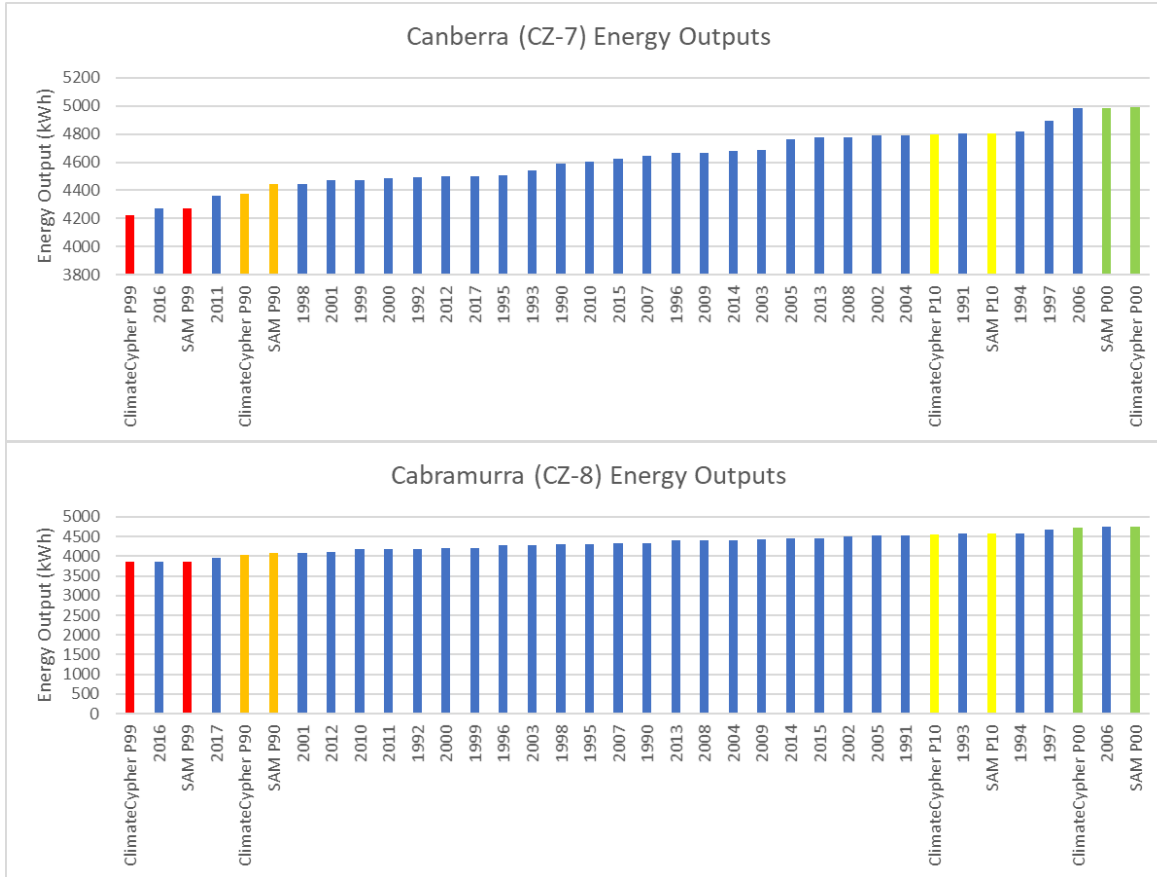


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# Results



Thank You

Questions?



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