Bay Area useR group

December 9, 2019

Residential Solar Forecast & Financial analytics

(probably more than you wanted to know)

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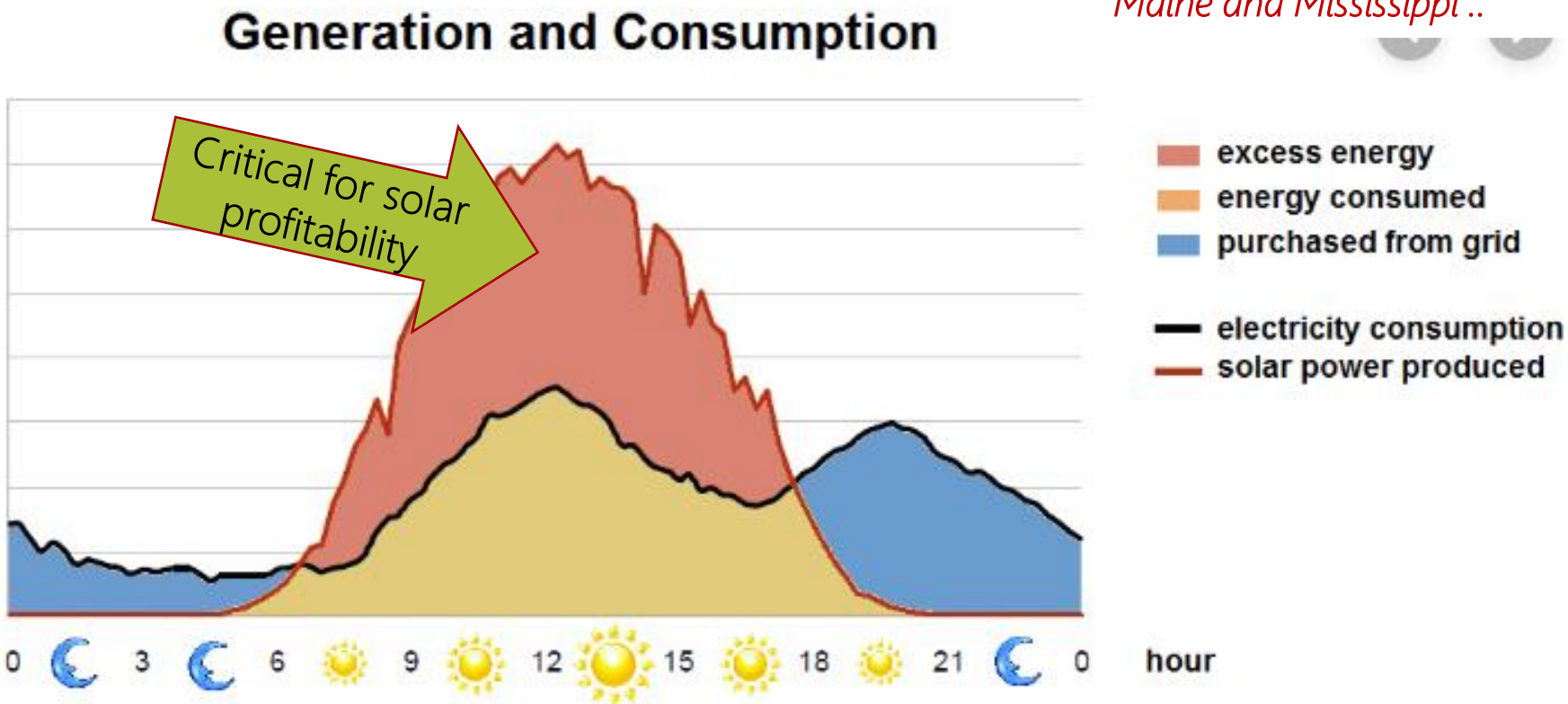
Agenda

- Quick intro to Solar NEM (Net Energy Metering)
- How good are the self-service analytics at pge.com
- Analysis approach, packages and environment
- Findings – generation models, forecast, $$ savings, sensitivity

Solar NEM

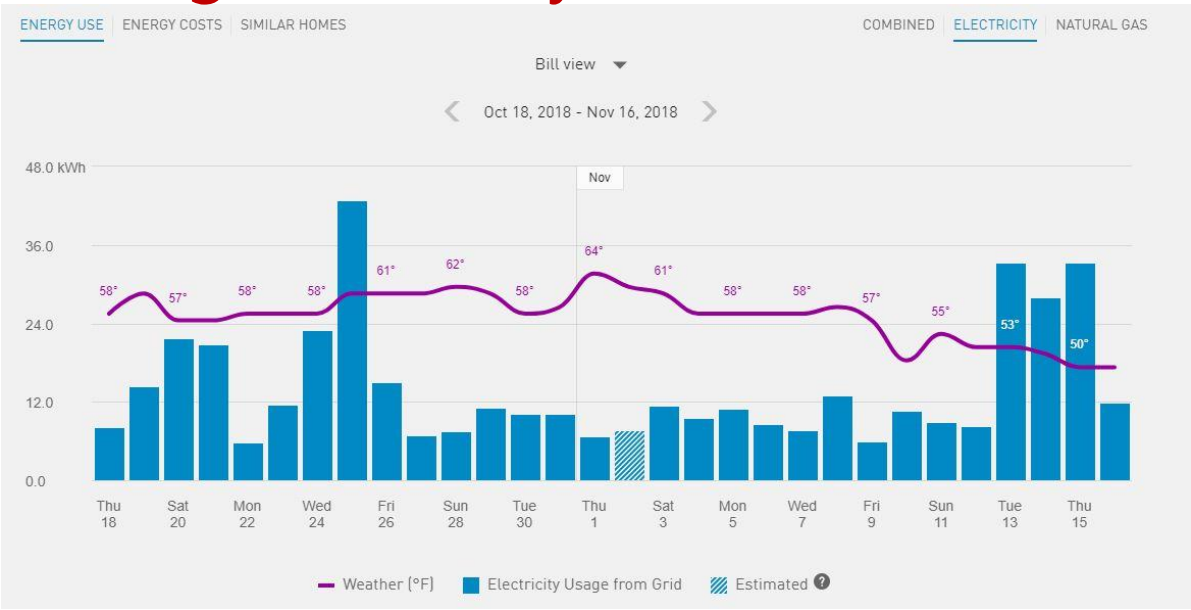
- PG&E credit for energy fed back into the grid at retail TOU (time of usage) rates
- 12 month True-Up billing cycle
- Under threat (especially with PG&E Bankruptcy)
  - Michigan changed NEM policy making it less profitable
  - No NEM states: *Arizona, Georgia, Hawaii, Indiana, Nevada, Maine and Mississippi ..*



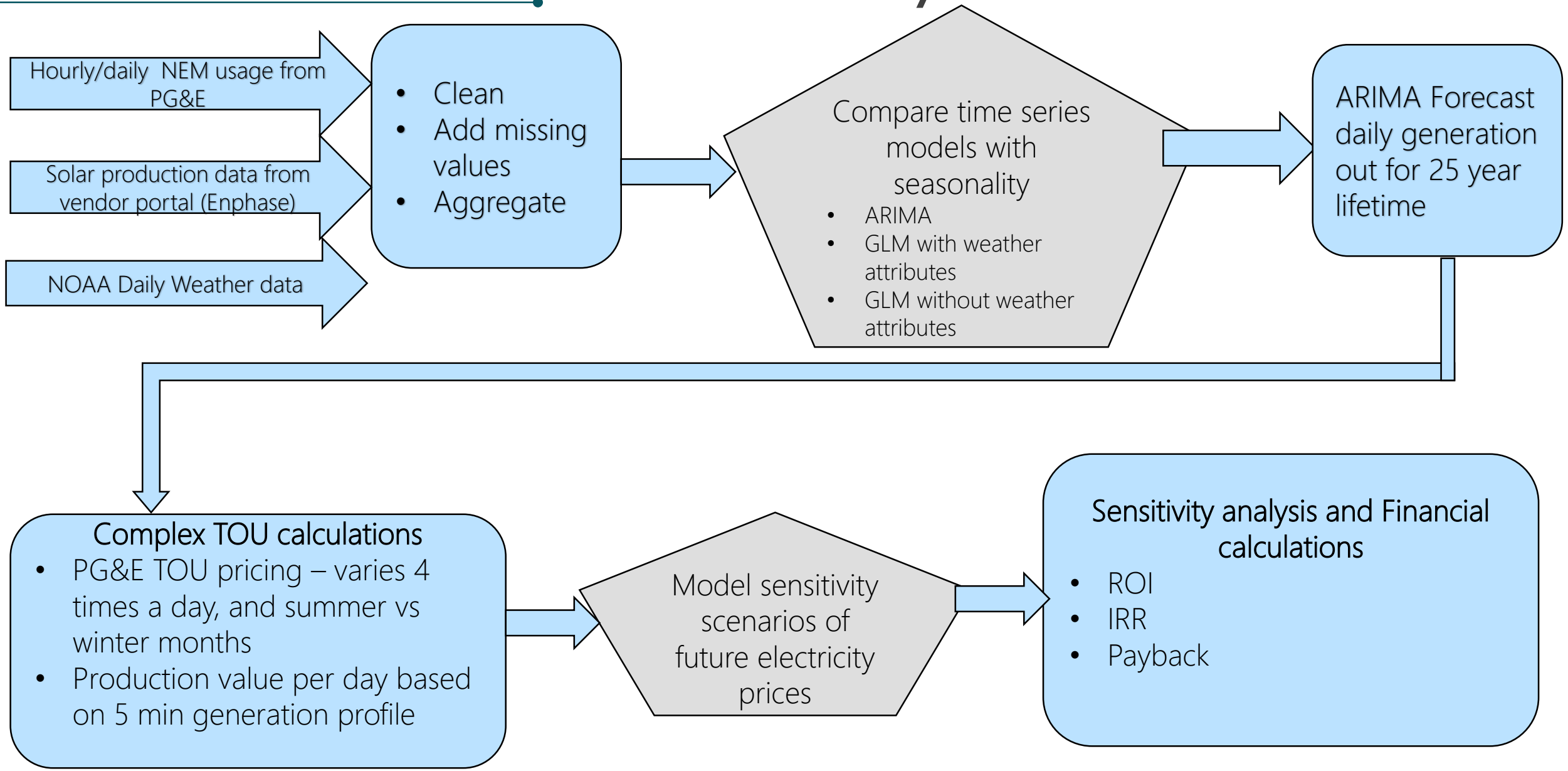
PG&E's online analytics

Can't use online PG&E Opower analytics to answer:

- What is my actual usage profile (i.e. not NEM) ?
- How is my electricity usage trending on a year on year basis ?
- What is the consumption forecast ?
- Is Solar saving me money ?



R based analysis



R packages and resources

Resources and reference

- Hadley's R for Data Science book
- Rob J Hyndman blog and book on forecasting
- StackOverflow
- StackExchange.

Environment:

- RStudio
- Charts hosted on Rpubs
- Plotly visualization

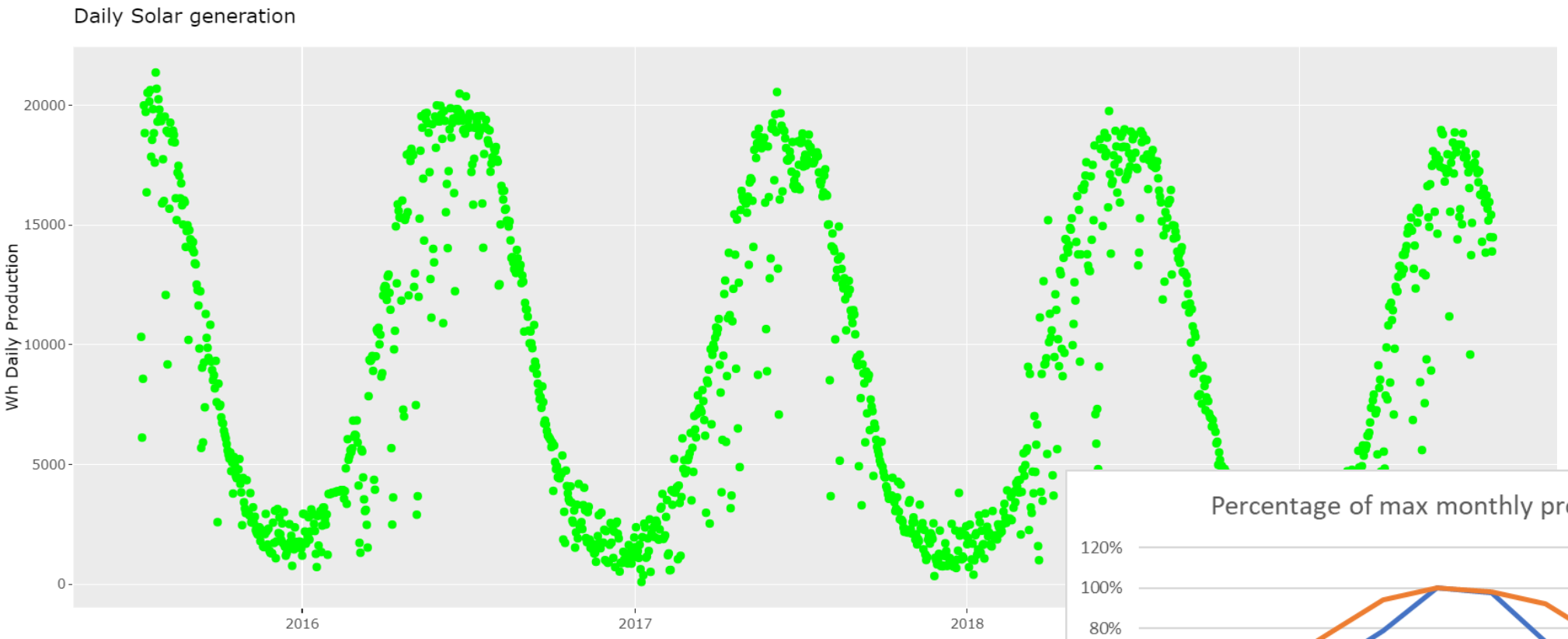
Github repo:

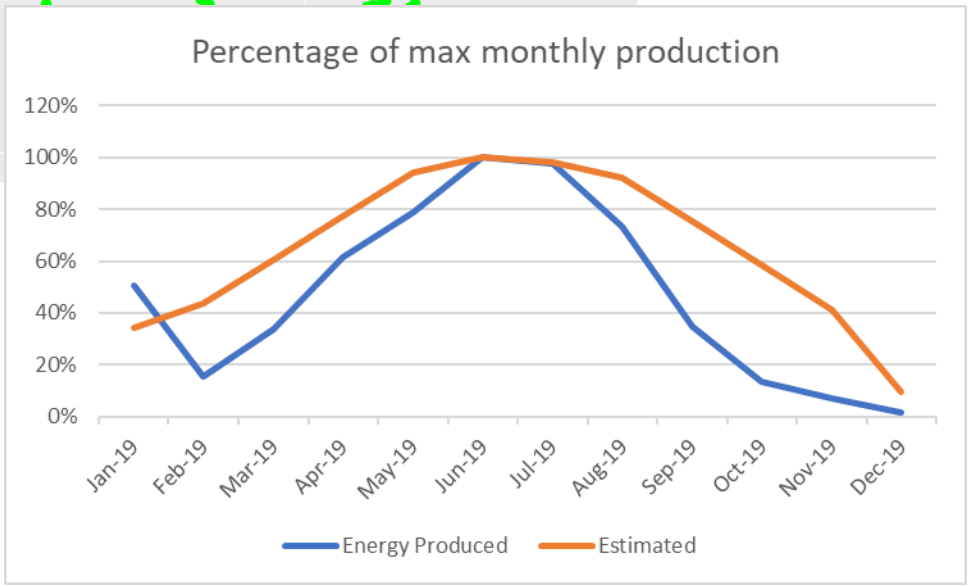
https://github.com/makanig/solarHomeEnergyAnalytics

Key Packages

library(tidyverse)
library(forecast)
library(plotly)
library(FinCal) => financial calcs
library(data.table)
library(lubridate)
library(TSstudio)

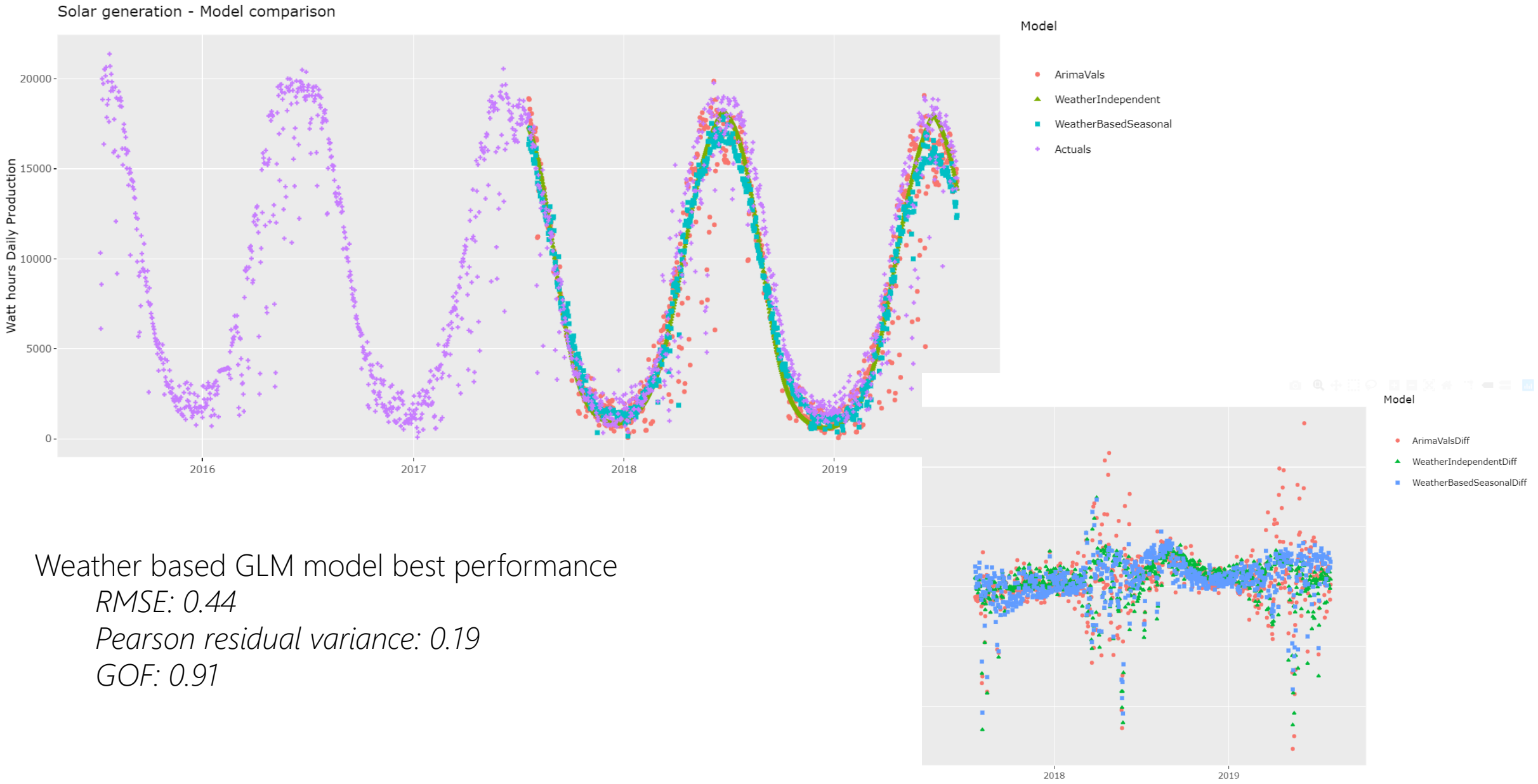
Findings – Generation varies more than expected





- I saw more production variation than expected
- Note slight downward trend
- For new installs, future NEM policy is key to profitability

Findings – Model comparison



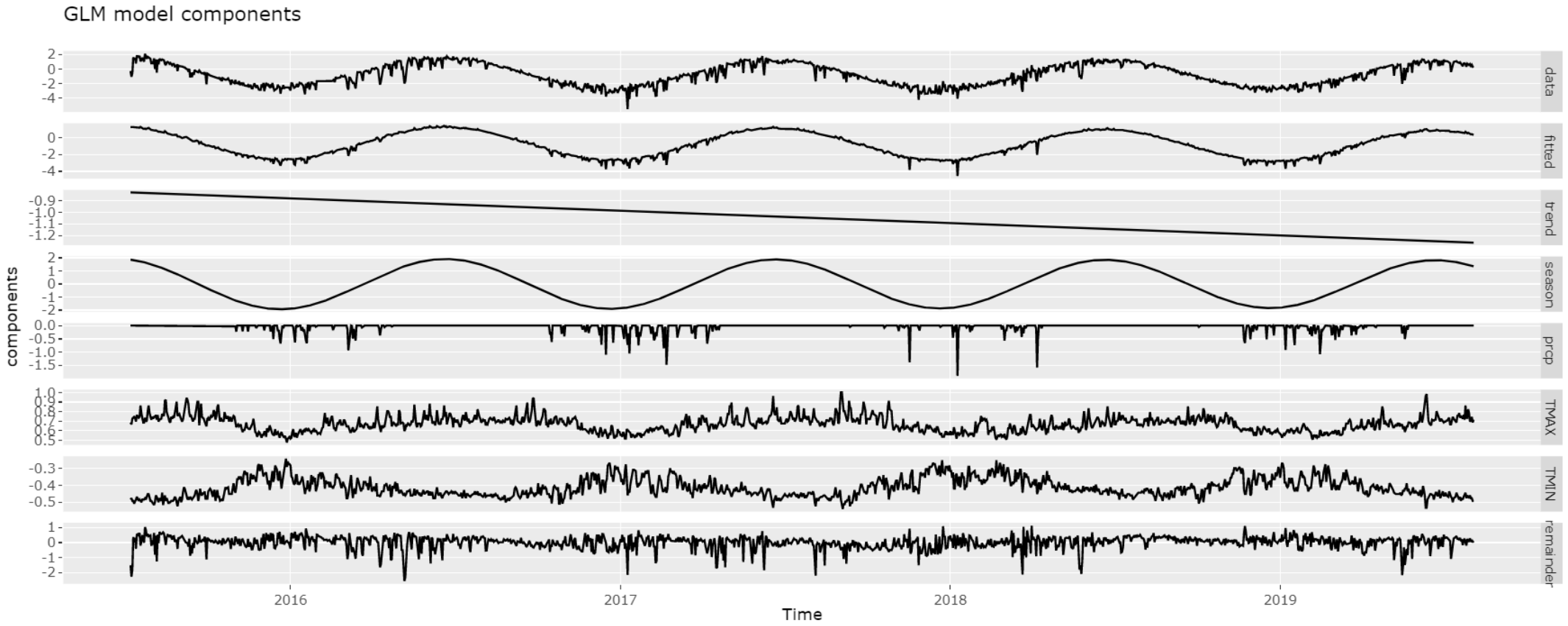
Weather based GLM model best performance

RMSE: 0.44

Pearson residual variance: 0.19

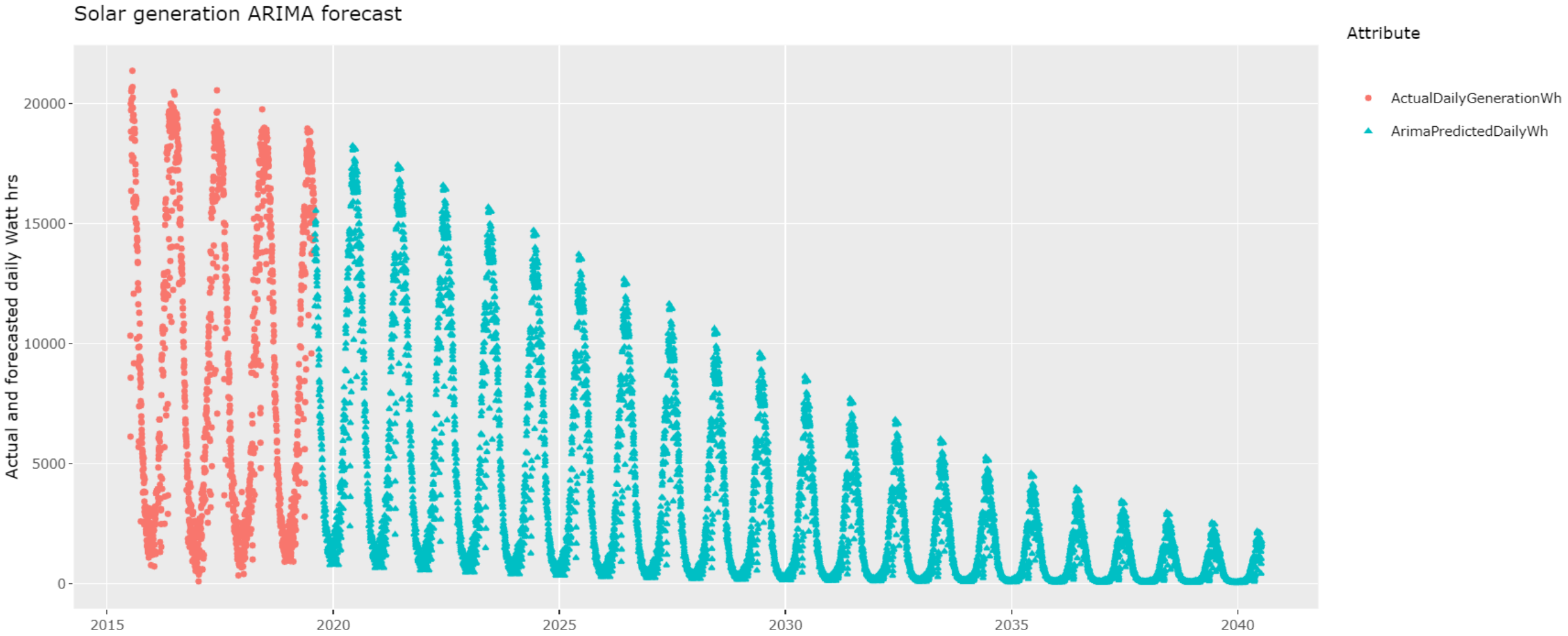
GOF: 0.91

Findings – GLM weather model components



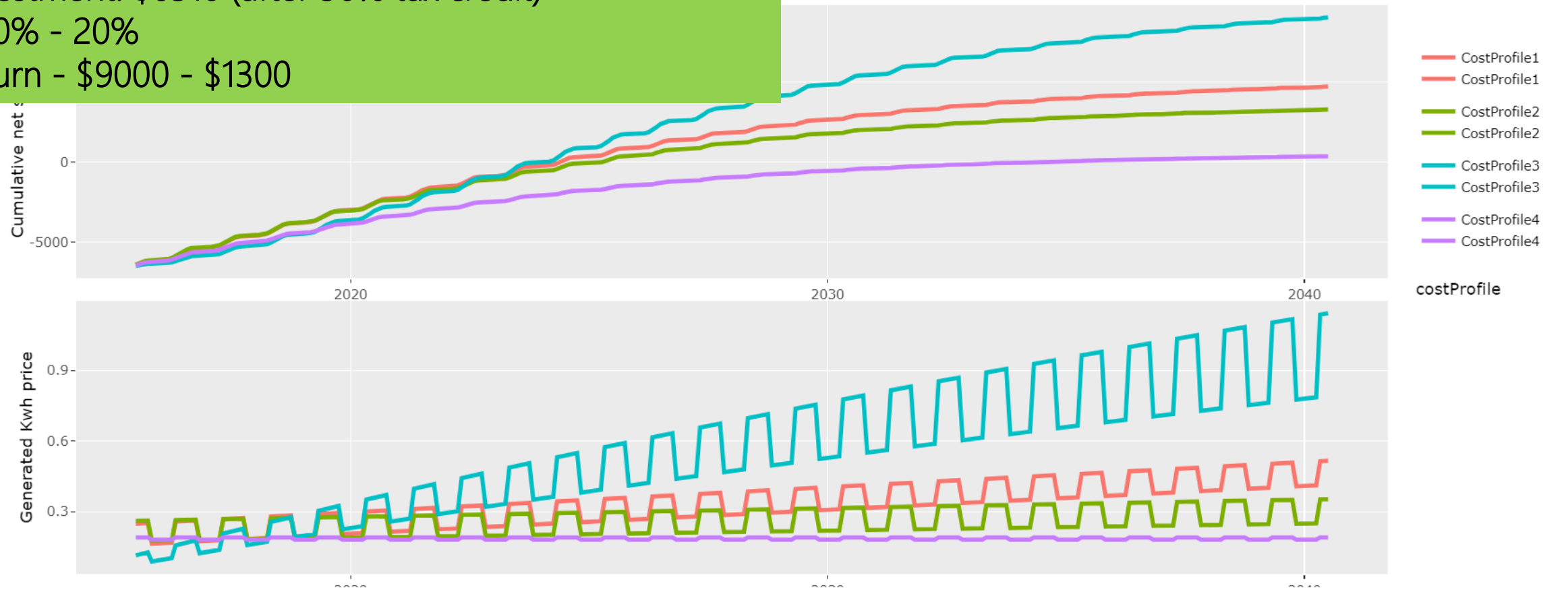
Use this to fit a seasonal/sinusoidal pattern
solarDf$xc<-cos(2*pi*solarDf$DATE_Numeric/365)
solarDf$xs<-sin(2*pi*solarDf$DATE_Numeric/365)
*glm(energyProducedWhLog ~ xc+PRCP +DATE_Numeric*xc +TMAX + TMIN, data=solarDf)*

Findings – ARIMA daily generation forecast



Degradation at ~2% is overestimated

Solar investment is profitable
Net investment: $6516 (after 30% tax credit)
ROI: 130% - 20%
Net return - $9000 - $1300



	paybackYrs	DATE	IRR	NetReturn	ROI
	8.65	2024-03-01	10 %	$9004	138 %
	8.91	2024-06-01	7 %	$4694	72 %
	9.82	2025-05-01	6 %	$3272	50 %
	11.91	2027-06-01	3 %	$1333	20 %