



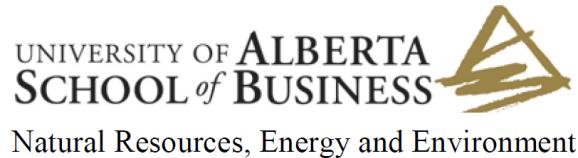
The Nerd Value of Solar Power

Andrew Leach

Nerd Nite YEG February 2019

How did we come to install solar power?

- I gave my students an assignment each year on installing solar using my own house and family as the 'clients'
- I got updated quotes each year (Thanks, Kyle Kasawski!)



Natural Resources, Energy and Environment

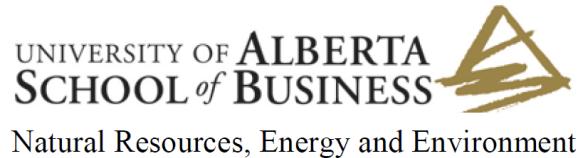
BUEC 463/563: Energy Industries and Markets

Mini-case #4 – Renewable energy investments

For this case, you are to provide a recommendation to my family with respect to the installation of solar power on my house. Here is the relevant information. First, my house is quite solar-ready, as we have an optimal location (a south-facing, custom designed roof segment with limited shading from neighbours or trees) with easy access to our electrical service entrance, so balance of system and installation costs will be relatively low. Second, our house is highly energy-efficient, so a solar array will get us close (but not quite) to NetZero. Third, we have a very particular decision to make with some cash we have available: invest in solar panels or lump down cash on our mortgage. We hold a variable-rate mortgage at prime minus 0.75%, so today our opportunity cost of capital for this project is about 2.15%.

How did we come to install solar power?

- Each year, students would reliably find that it didn't make financial sense
- In 2017, one group explained that, if a solar power system would generate a cup of coffee per day of nerd value, it would have a 20% rate of return



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How much did it cost?

The Financials

System cost \$18,900.00

Alberta Solar
Rebate -\$5,670

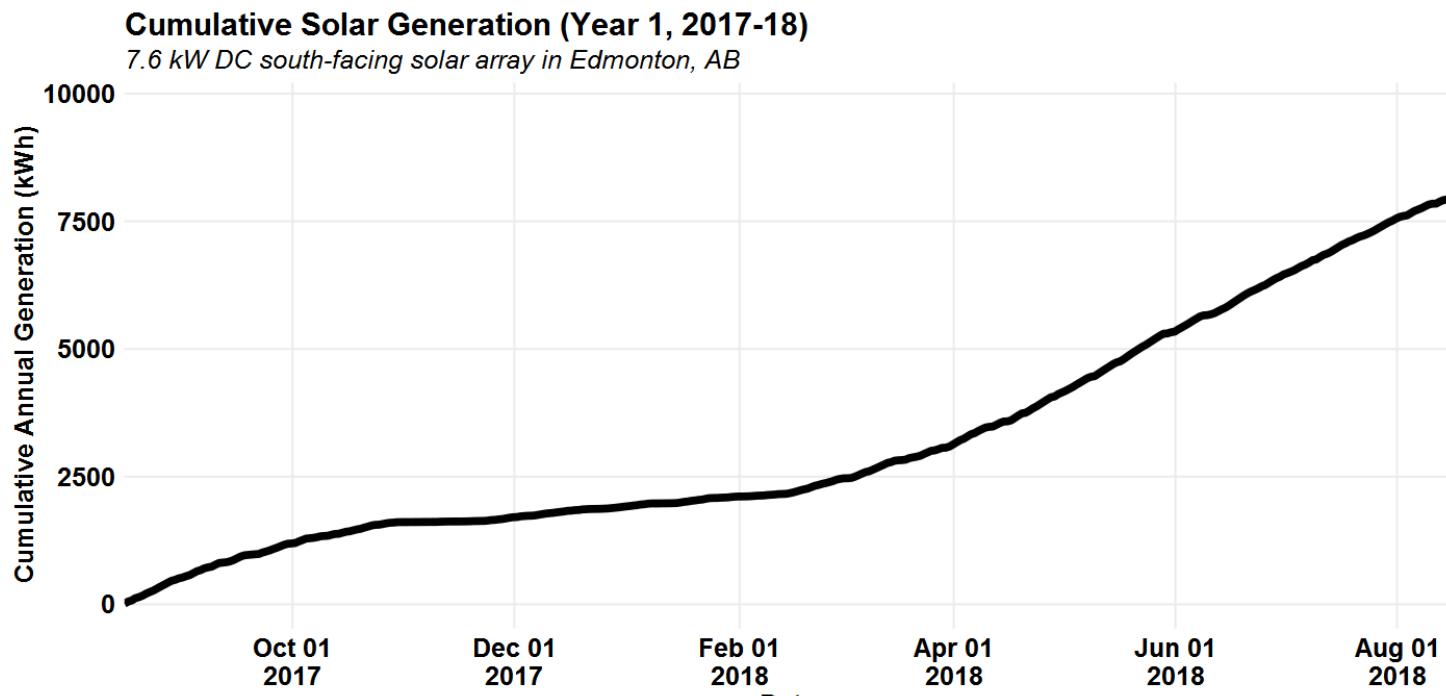
Cost to you **\$13,230.00**

Solar People Inc.

Take advantage of Alberta's
upcoming solar rebate program!

- Total system cost (installed) was \$18,900 or \$2.50 per watt
- Rebate from Energy Efficiency Alberta covered 30%, or \$5670
- Our total cost (installed) was \$13,230, or \$1.62 per watt

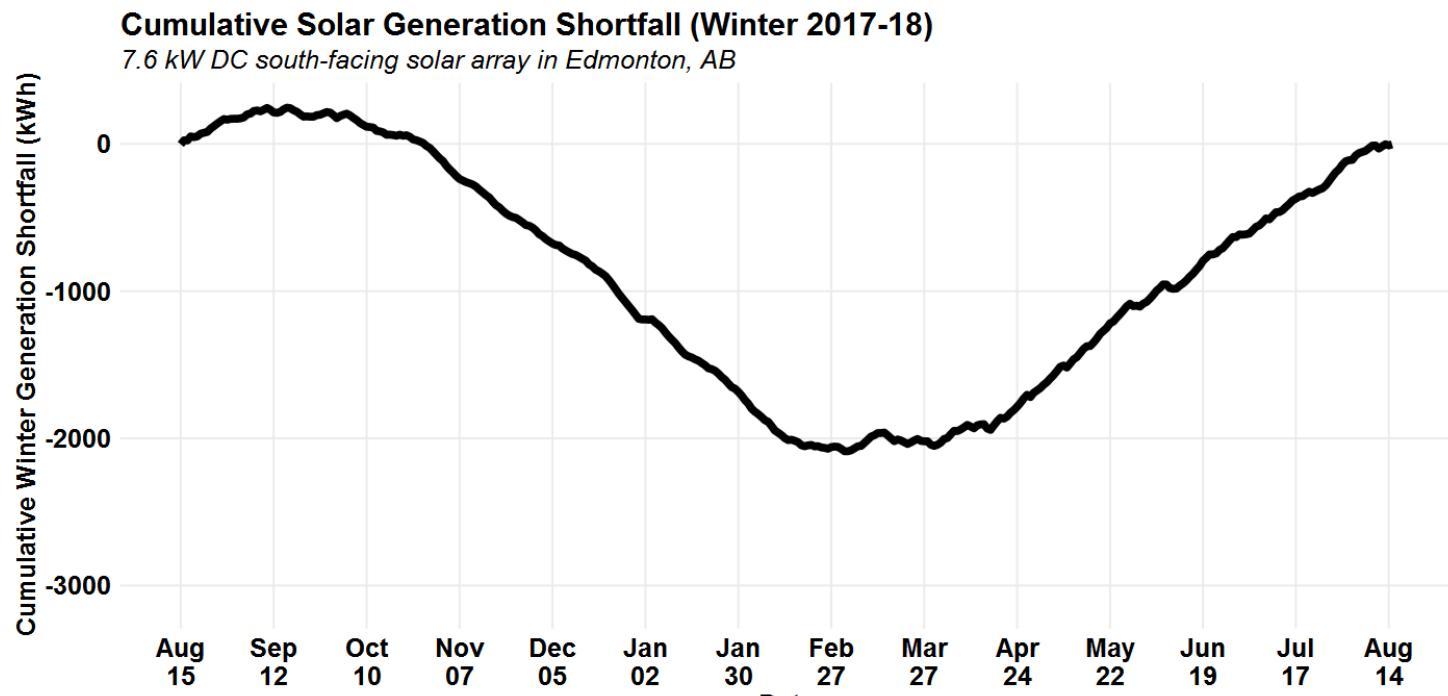
How much does it generate?



Source: SolarPeople system data via Neurio API, graph by Andrew Leach
Total cumulative year 1 generation was 7954kWh.

- Expected generation was 9000kWh in year 1, and we generated 7954kWh
- Should expect 0.5% annual degradation, so a 25 year lifetime should yield about 210,000 kWh of electricity

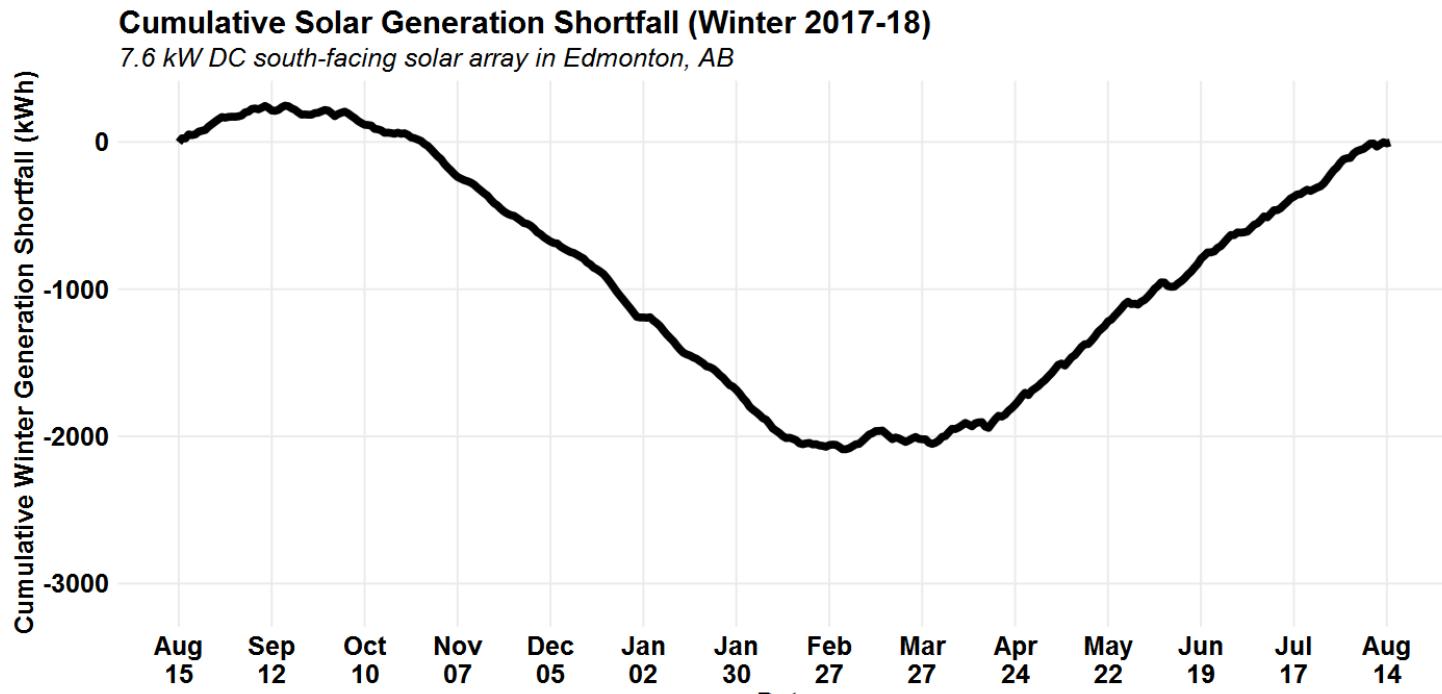
Do you generate as much as you consume?



Source: SolarPeople system data via Neurio API, graph by Andrew Leach
Maximum cumulative shortfall for 2017-2018 was 3123kWh, or roughly 250 Tesla Powerwalls

- Yes. We ended up at net zero almost exactly in year 1
- We need to do a lot less laundry or we won't be there again in year 2

Does this mean you could be off-grid?

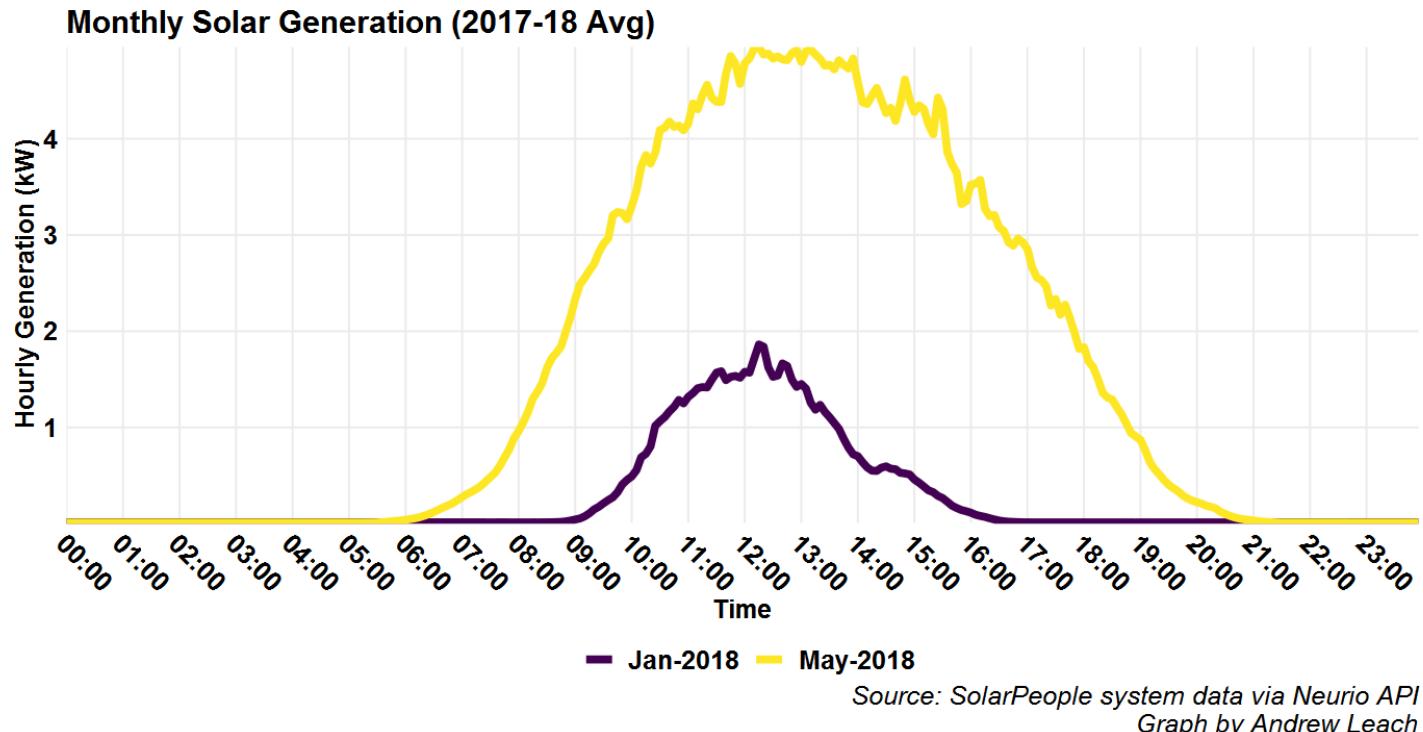


Source: SolarPeople system data via Neurio API, graph by Andrew Leach
Maximum cumulative shortfall for 2017-2018 was 3123kWh, or roughly 250 Tesla Powerwalls

- No. Edmonton has great solar in the summer, but not much in the winter
- Moving that much power from summer to winter would require millions of dollars worth of batteries and a lot more generation to offset battery losses.

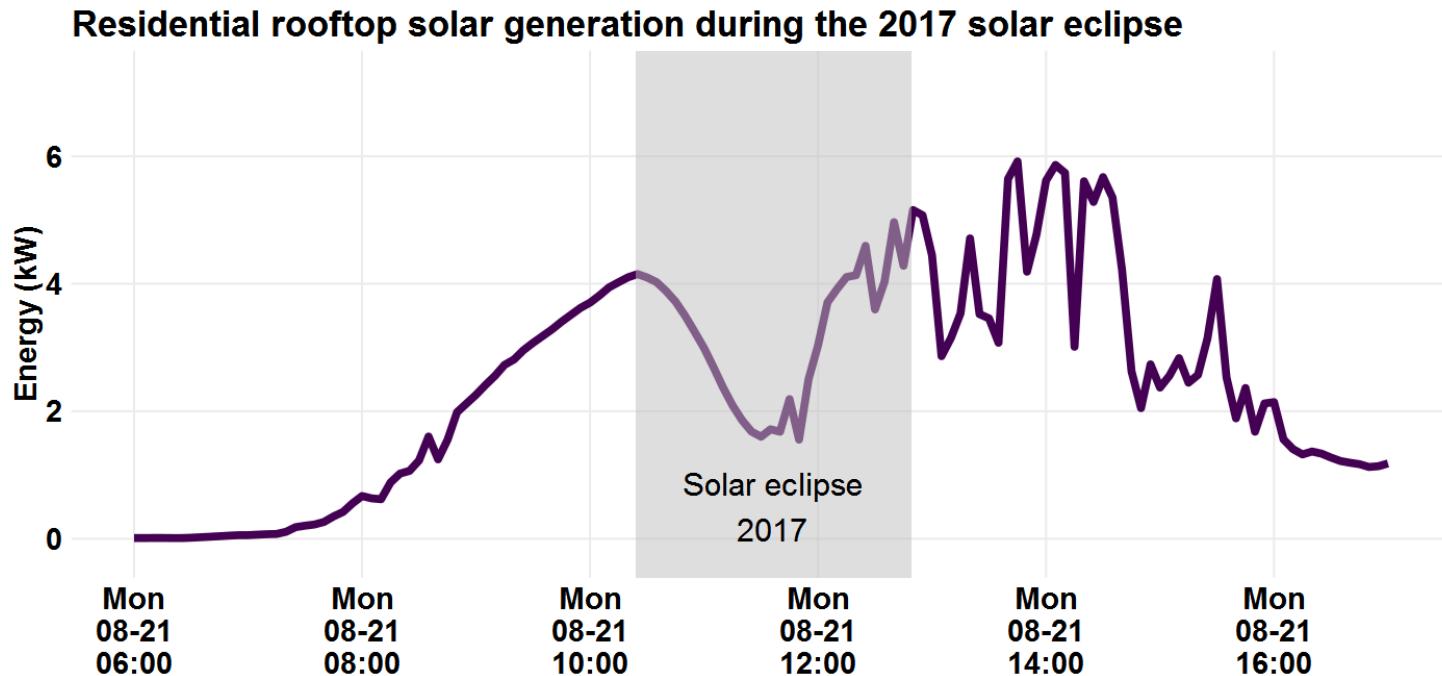
Winter vs Summer

- We get fantastic solar in the spring and summer, not so much in January



Fun with your solar power system

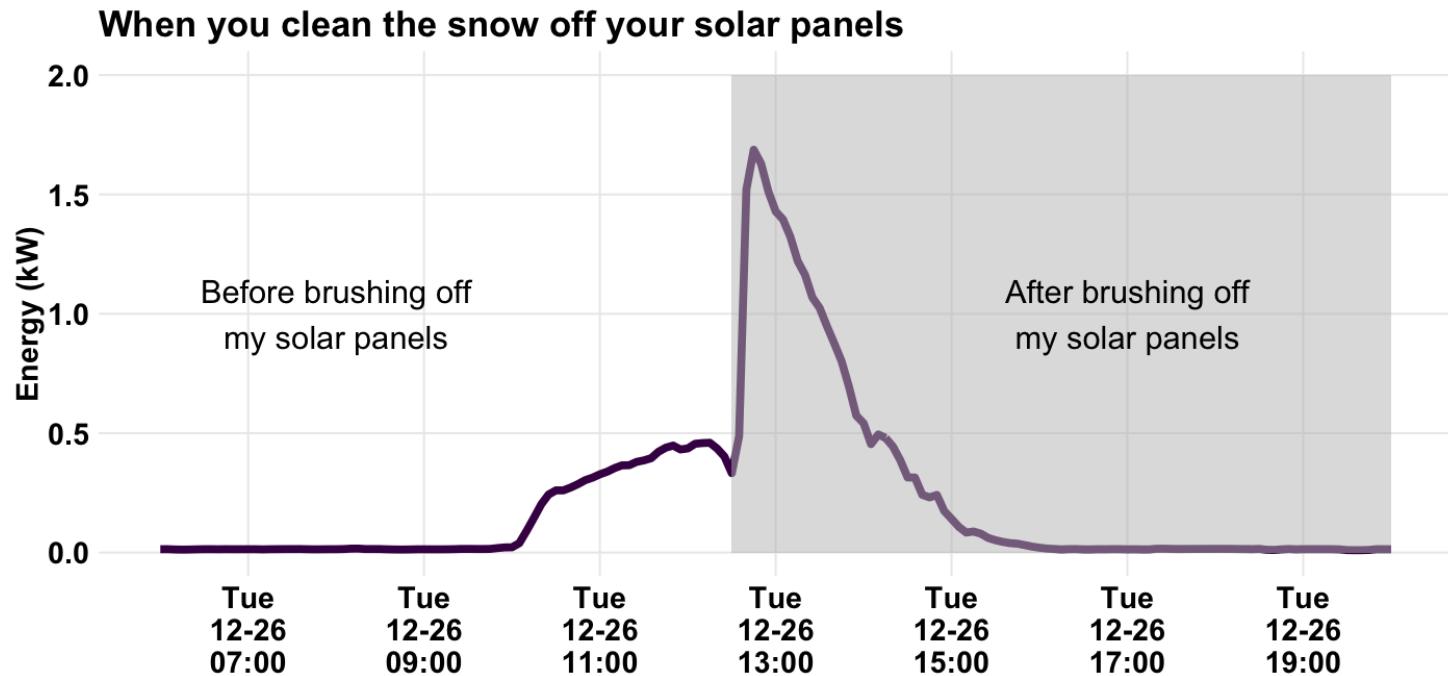
- Watch an eclipse from your basement!



Source: SolarPeople system data via Neurio API
Graph by Andrew Leach

Fun with your solar power system

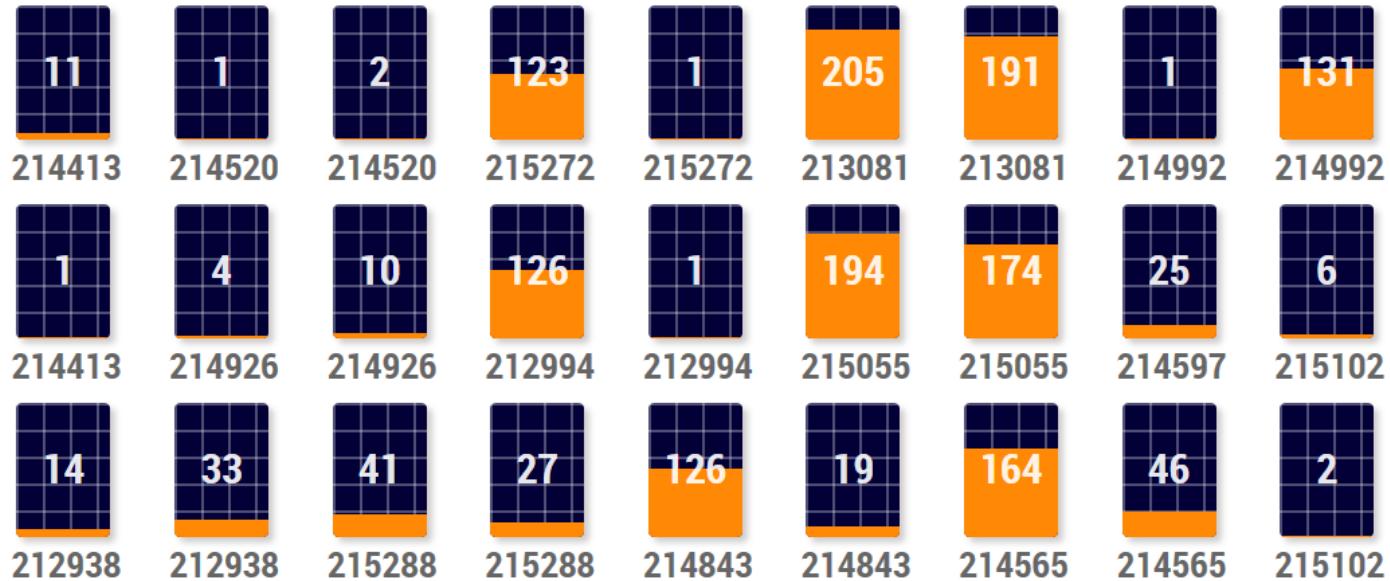
- Check whether shoveling snow matters!



Source: SolarPeople system data via Neurio API
Graph by Andrew Leach

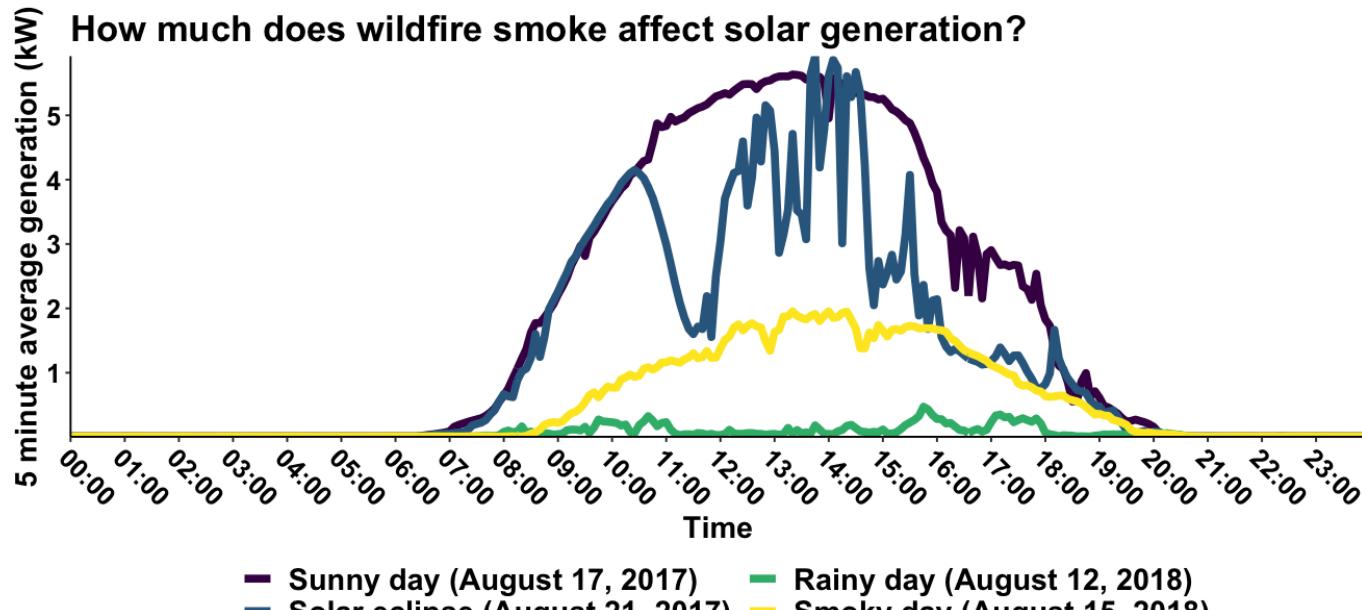
Fun with your solar power system

- Check whether shoveling snow matters!



Fun with your solar power system

- See how wildfire smoke compares to an eclipse!



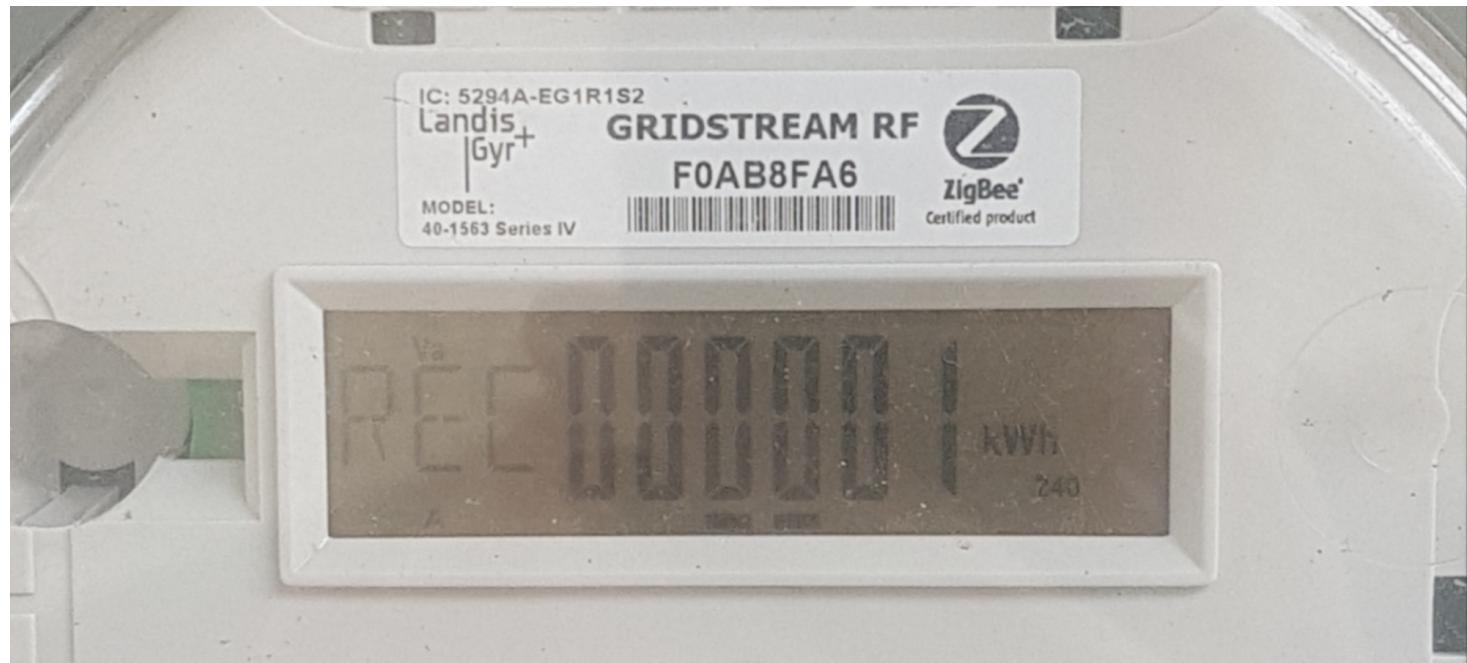
Source: SolarPeople system data via Neurio API for a 7.6kW south-facing solar array in Edmonton, AB
Graph by Andrew Leach

Alright Mr. Economist, show me the money



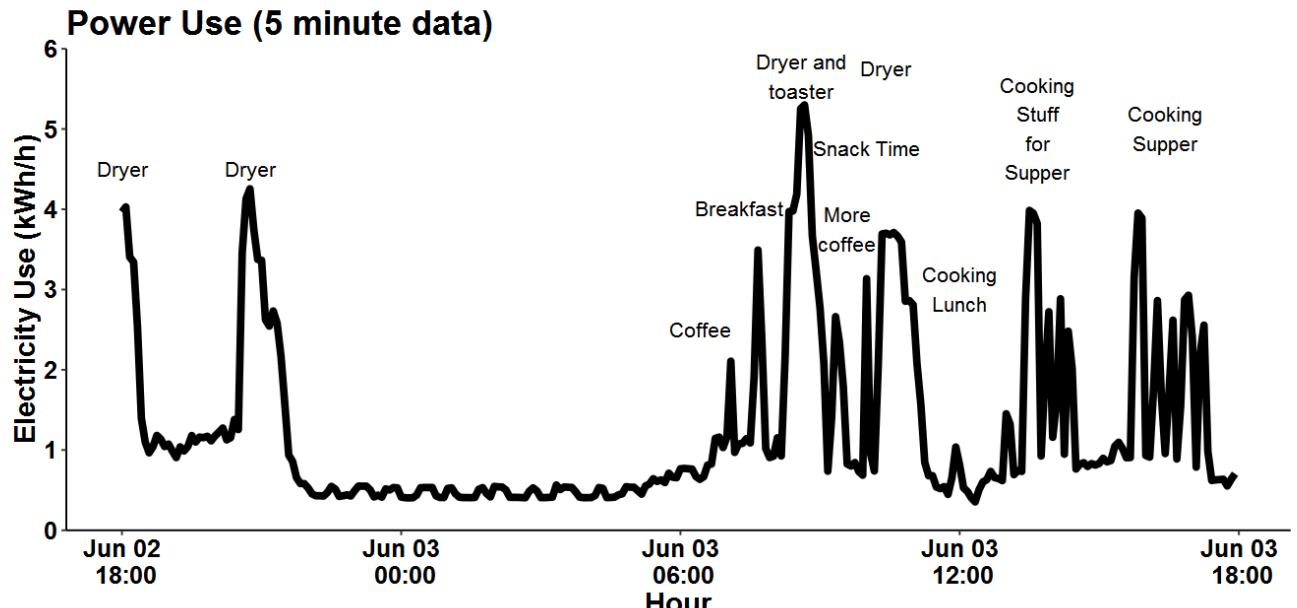
Alright Mr. Economist, show me the money

- Two main sources of savings: avoided transmission and delivery costs and sales back to the grid of excess power
- Meter measures receipts (power sent to the grid) and deliveries (power purchases)



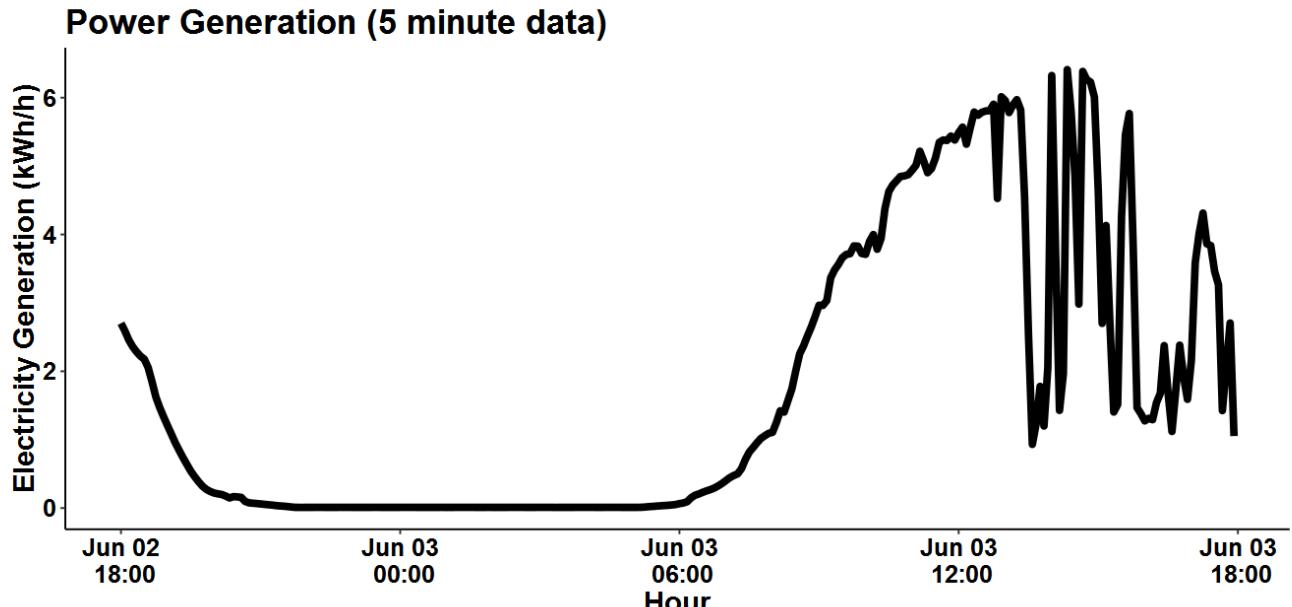
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- A typical day at home involves a lot of intermittent power use



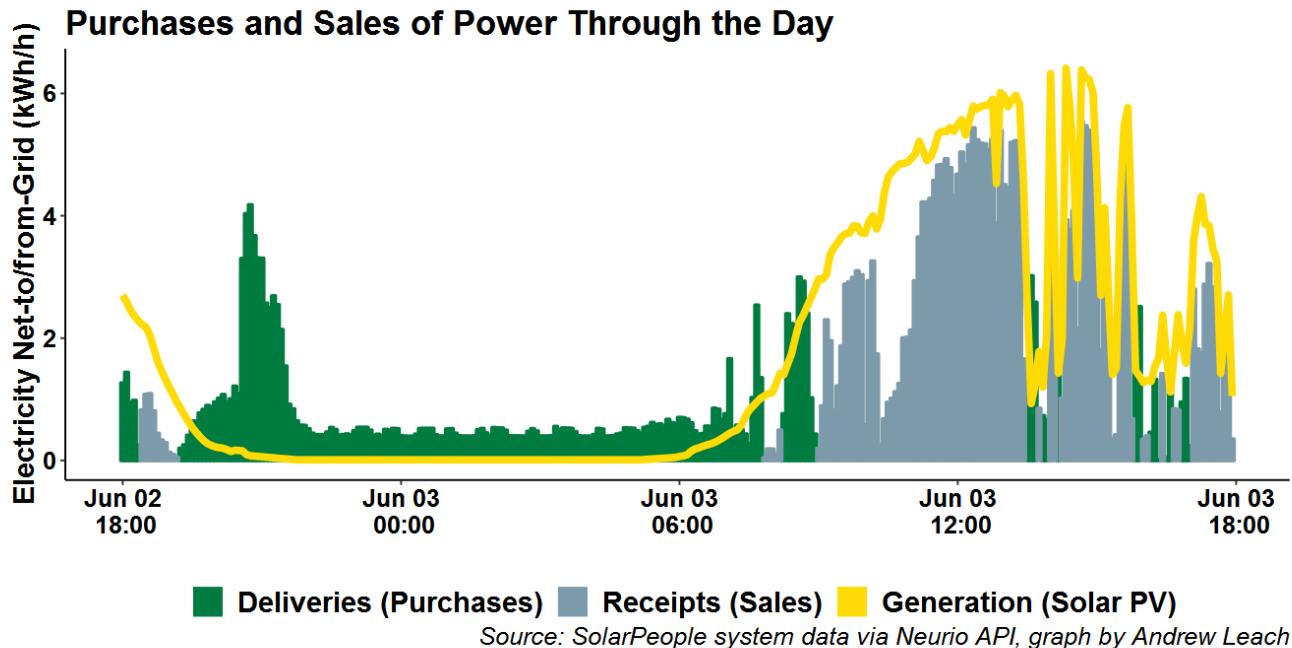
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- Power generation tends to be more predictable but isn't always greater than use



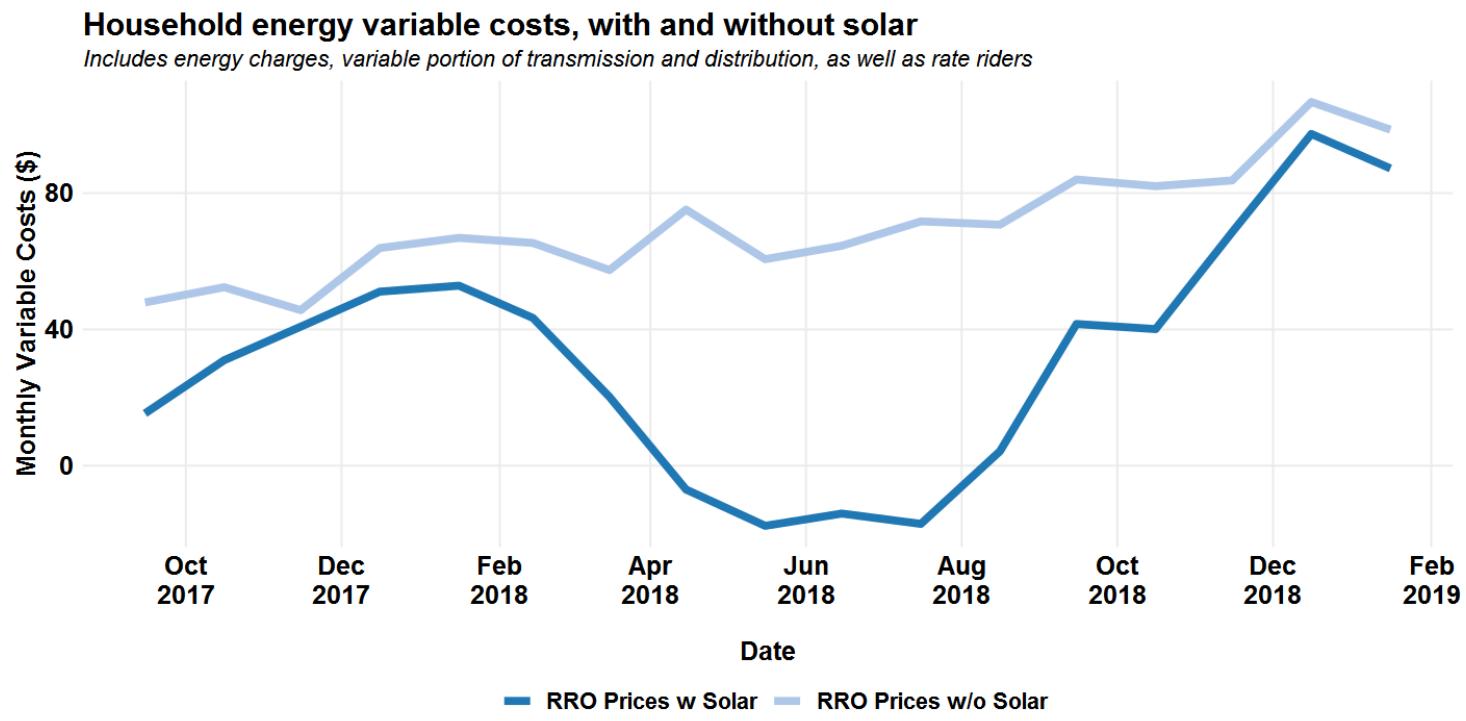
Alright Mr. Economist, show me the money

- So, on any given day, we're delivering power some minutes and selling it others



Alright Mr. Economist, show me the money

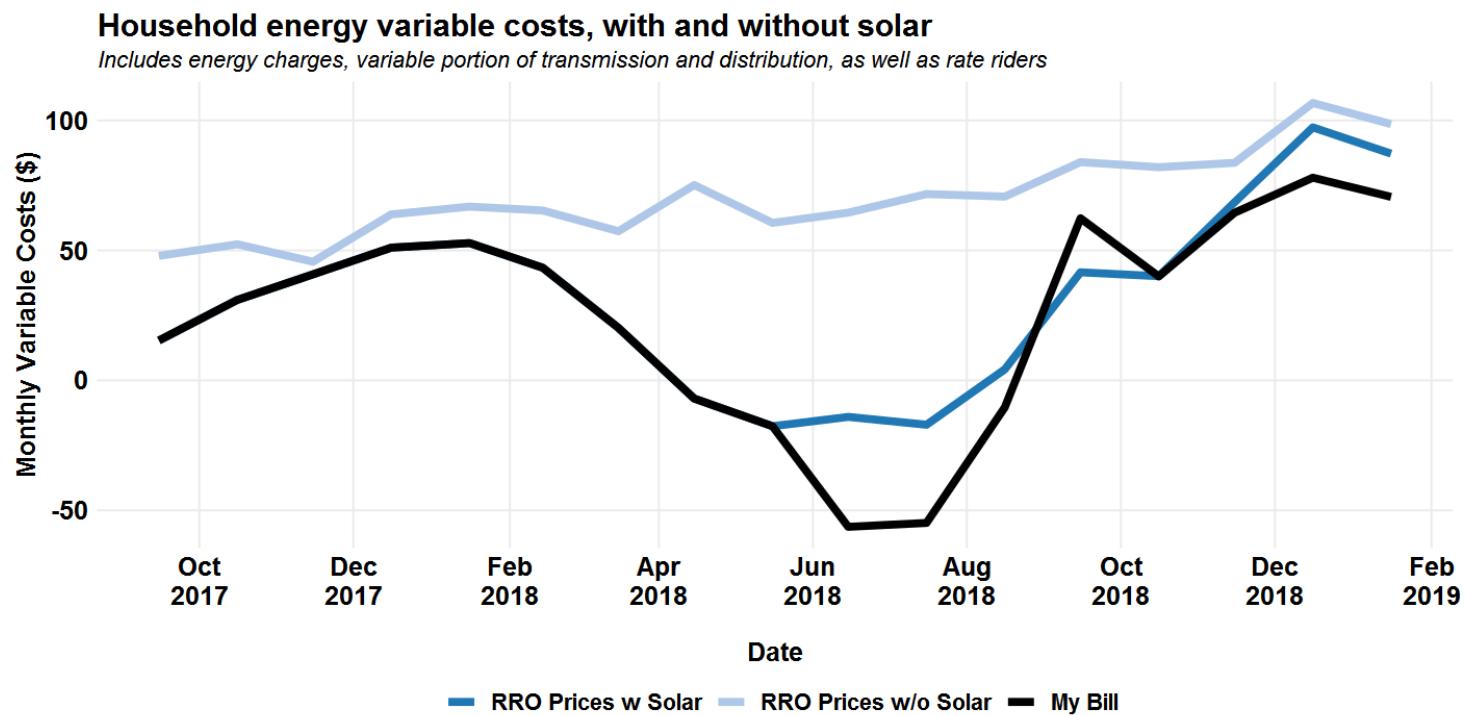
- transmission and distribution costs are charged on power deliveries
- power prices (same price all month long) paid on deliveries and rebated for sales



Source: Household power data via Neurio API, graph by Andrew Leach

Alright Mr. Economist, show me the money

- Special pricing for solar microgenerators in the summer months improves things
- I used Alberta Cooperative Energy, but other providers offer a similar plan



Source: Household power data via Neurio API, graph by Andrew Leach
Total savings from solar for period shown vs RRO priced consumption: \$773.33

Alright Mr. Economist, show me the money

Retailer charges - June 9 to July 12, 2018

Retailer charges (before GST)	\$ (64.60)
Fixed price electricity charges	
58 kWh X \$0.15/kWh =	8.70
174 kWh X \$0.15/kWh =	26.10
129 kWh X \$0.15/kWh =	19.35
Billing administration fee	6.50
Fixed price micro-generation credits	
835 kWh X \$-0.15/kWh =	(125.25)

Distributor charges - June 9 to July 12, 2018

(distribution services provided by EPCOR Distribution & Transmission Inc.)

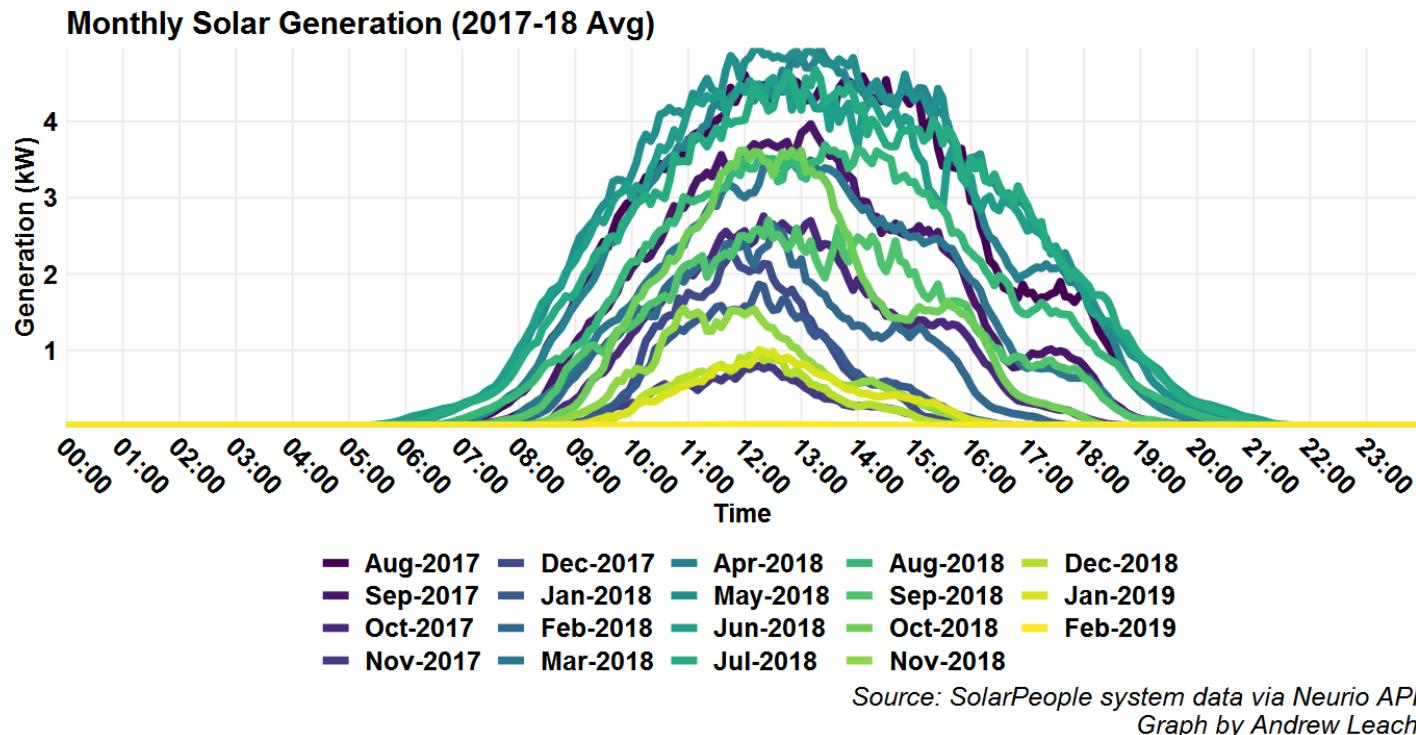
Balancing pool consumer allocation	1.16
Local access fee (Edmonton)	2.92
Transmission charges	11.35
Variable charges and rider(s)	11.35
Distribution charges	24.39
Fixed charge	21.11
Variable charges and rider(s)	3.28

Total retailer and distributor charges for the current
billing period (before GST) \$ (24.78)

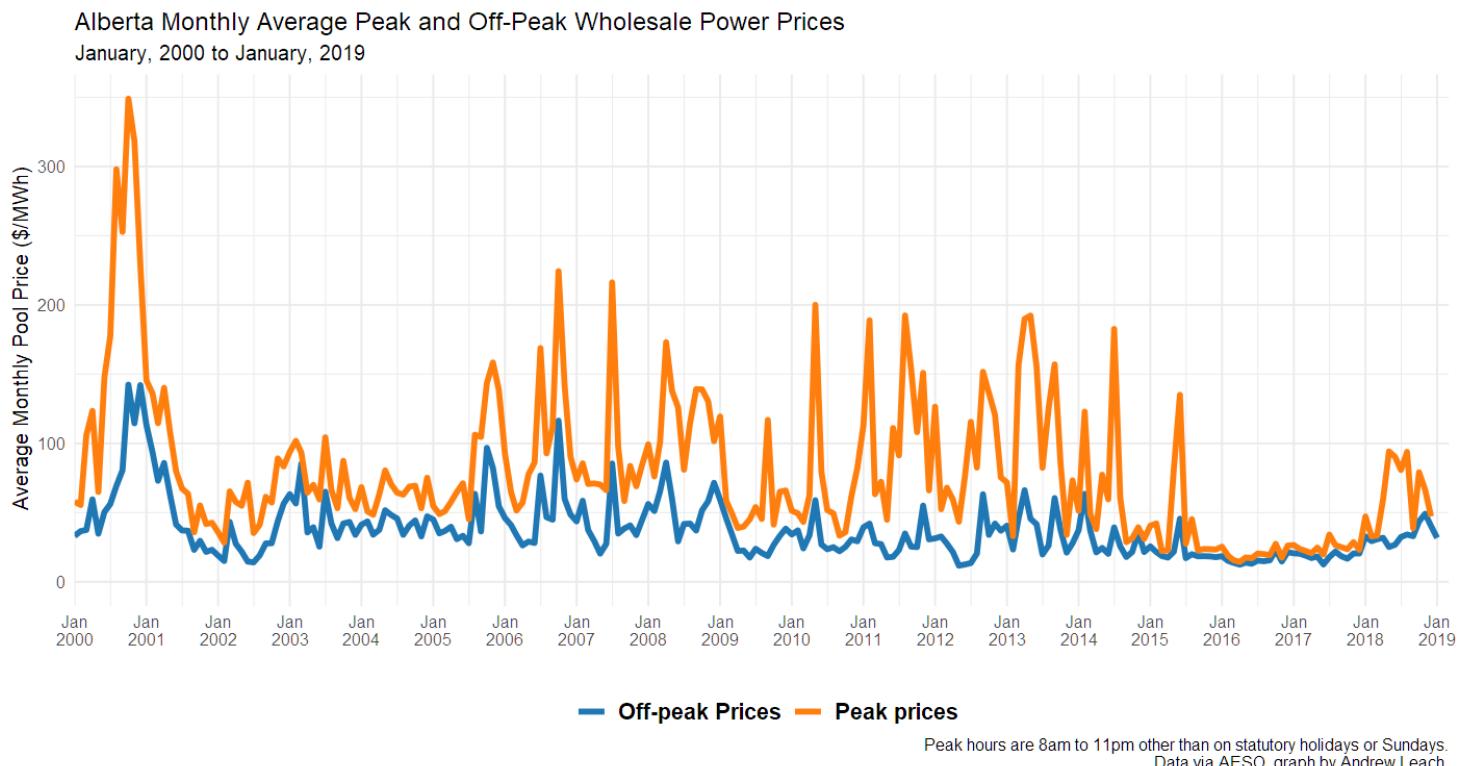
What's the payback? Were your students correct?

- At current and expected future power prices and other variable charges, I'll capture about a 0.5% rate of return
- If microgeneration premia continue to be available, in addition to future energy and transmission prices, I'll capture about a 3.5% rate of return
- If microgeneration premia continue to be available, in addition to future energy and transmission prices, and you account for a cup of coffee per day in nerd value, I'll capture about a 14.5% rate of return
- No question they were correct - I've already had enough enjoyment out of it to eliminate any potential losses from the investment

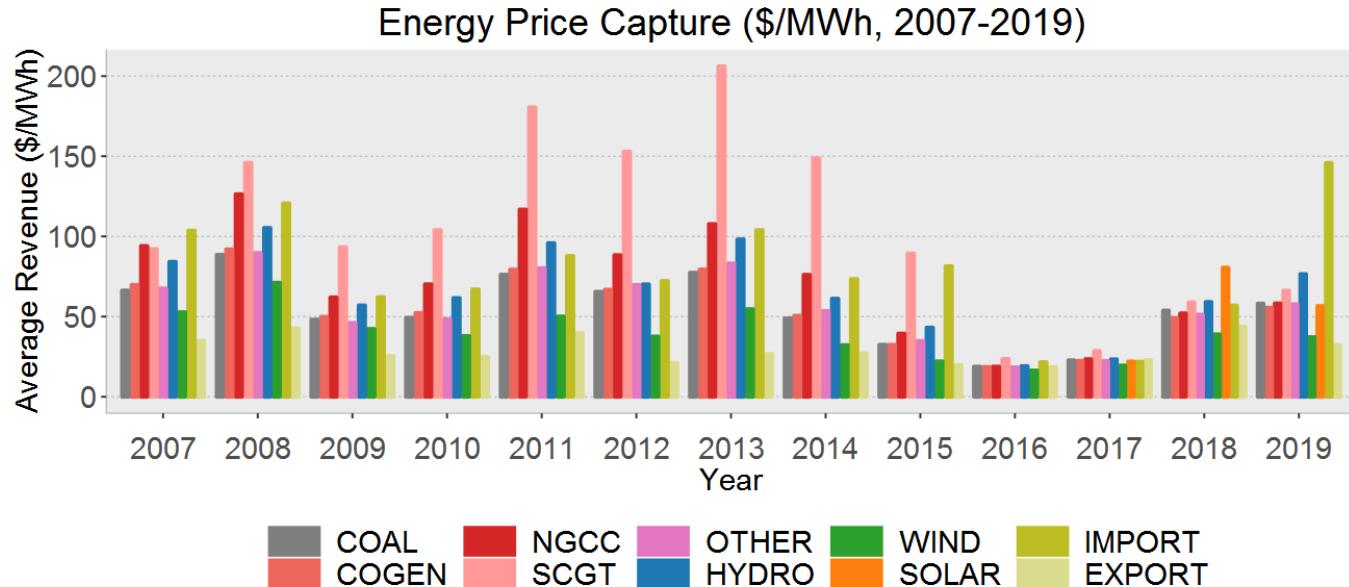
Solar Generation



Power Prices



Pool Price Capture



Source: AESO Data, accessed via NRGStream
Graph by @andrew_leach