Topics Today

The building
Electricity estimate & generation
Finances
Pitch to the owners & decision process
Publicity
Challenges & Results
Lessons learned
System design & Installation
Technical details
About me

Energy geek
Sales career
Passion for energy conservation and climate change
Landlord owner 2007 - 2016
Strata council 2009 - 2016
Central Park Strata, Victoria

1977 wood frame
4 storeys
64 suites
Low end, young and old
Half rented
Good condition
2013 Depreciation Report
$100K Reserve fund (2014)
Why on Central Park?

- Big flat roof
- NO shade
- Easy run down side of building
- Space in electrical room
- Roof shade for south suites
Solar Hot Water?

20 flat plates, 3 x 120 gal tanks: $80,000

Capital Regional District: extended 25% Rebate to MURBs to March 2015
CRD: Analysis of savings - $2,100 / year @ $12.74/GJ in 2014
Actually reduces carbon emissions from natural gas

Vancouver Island gas price down 31% in 2015 for small commercial
Balance supply / demand

When do we use it? – one ‘dumb’ gas meter
More pumps and maintenance a challenge with a strata
Common Area Loads

- Hallway lights
- Outdoor lights
- Ventilation fans
- Washing machines
- Baseboard heat (rarely)
- NOT suites
Grid Tied PV System

60 x 245w Hanwha panels
14.7 kW
No batteries!
Installed May/June 2015
Functioning well in 2020
Step 2: $0.1317 / kWh in 2015

Fixed Price, all in: $ 3.00 /watt

BC Hydro Net Metering Program

BRUCE MACKENZIE - THE SOLAR WAY
System Size

Lots of roof area
Not too big - must keep *buying* power
Under $1,000 per unit
Limited choices of 208V/3 phase inverters – 10 or 11.4 kw
Proposed 48 or 60 panels - $40,100 or $46,270 incl GST & permit
Council favoured bigger one
What’s a watt?

The *rate* of electricity use

Regular hallway light bulb = 13 watts

Run it for one hour = 13 watt-hours

Run it for 77 hours = 1,000 watt-hours = 1 kilowatt-hour (kWh)

Solar panel = 245 watts at maximum output

60 Solar panels = 14,700 watts = 14.7 kilowatts

Full power for one hour = 14.7 kWh
How much electricity (1)?

HES-PV ‘Round Number’ : 1,100 hours of max. power / year

14.7 kilowatts X 1,100 hours = 16,170 kilowatt-hours / year
How much electricity (2)?

Estimate from pvwatts.nrel.gov detailed calculator based on Victoria location, YYJ airport weather: 16,372 kWh / year
How much electricity (3)?

Actual 2014 results from 6 x 250w panels at 1814 Crescent Road, Ross Bay, 20° slope: 1,835 kWh / yr

Adjusted to 60 x 245w panels: 18,000 kWh/yr
How much annual savings?

Electricity (kwh)/year \times \text{Cost per kWh} = \$\text{Savings}

2015: 16,225 kWh/year \times \$0.1317 / kWh = $2,136

2019: 16,225 kWh/year \times \$0.1489 / kWh = $2,369

2025: 16,225 kWh/year \times \$0.1644 / kWh = $2,668
Cost?

$46,271.50 Complete
Includes panels, wiring, inverter
Includes 5% GST
Solar systems are PST Exempt
Includes electrical permit
Includes labour, installation
Includes mounting brackets, bricks to hold them down
Strata Process

Straw vote at 2011 AGM
Meeting with supplier September 2014
Investigation of Solar Hot Water
Lots of calculations, investigation, gathering info
Discussion with strata council
Fixed price proposal from HES-PV and P2TP
Information meetings with owners
Chats with owners in hallways and parking lot would have been valuable
Strata Process continued

Strata council meeting pre-AGM to decide which system to propose
Detailed description for owners in AGM package
Information meeting with owners
Support from Property Manager – Dockside Green?

February 2015: Strata Annual General Meeting
15 minute presentation
Electrician present, honest answers, passion
Lots of questions, answer EVERY concern
Most no’s were proxies – can’t argue with them
75% needed - Vote was 18-6
Pitch to Owners

Kilowatt hours, PV, net metering lesson
Proven system, millions in operation
Absolutely fixed price quote, no extras (except engineering)
No holes in the roof
Warranties, expected lifetimes, zero maintenance
Save some money – 4.5% return
Dividend, not payback
“What is the payback on the granite countertops?”
Opinion from REALTOR® (next slide)
You asked me to comment on the effect that installing the solar system as attached to your email would have on the saleability of a unit at 909 Pembroke.

It is my opinion the effect on a potential buyer would be a positive one in that this is a progressive and innovative strata that is obviously being proactive in its responsibilities as custodians of their building. I am also of the opinion that once potential buyers and their banks for financing became aware of this approach to managing the costs it would have a positive effect on sales.

I believe that it will certainly make the units easier to sell and as the general public become more familiar with the cost saving features of solar electricity it will have a positive effect on sales prices as well. I personally commend you to for taking this step and I encourage you to let other strata’s know what you are doing and the positive effect it has on your bottom line.

As you are aware the market has not been kind to older condo buildings in the past few years so anything you do to improve the quality of life in your building will have a positive effect both in saleability and in prices.

Warmly
Donna Curtis
Associate Broker, Partner
donna@lprealestate.ca
LP REAL ESTATE GROUP OF CONSULTANTS
RE/MAX Camosun
| 4440 Chatterton Way, Victoria BC, V8X 5J2
www.lprealestate.ca | www.findyourhousewithamouse.ca

BRUCE MACKENZIE - THE SOLAR WAY
## How much per unit?

<table>
<thead>
<tr>
<th>Description</th>
<th>Building Total</th>
<th>Per Unit (varies with unit area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Size: 14.7 Kw (60 panels) - 11.4 kw Inverter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual output: 16,225 kWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total installed cost, with tax</td>
<td>$46,271.50</td>
<td>$555 - $865</td>
</tr>
<tr>
<td>Install cost per month, repaid over 60 months</td>
<td>$771.97</td>
<td>$9.25 - $14.42</td>
</tr>
<tr>
<td>Forecast Annual Common Area Energy Savings in 2015</td>
<td>$2,100</td>
<td>$25 - $39</td>
</tr>
<tr>
<td>Simple Return on Investment (ROI): 4.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast Annual Common Area Energy Savings in 2030</td>
<td>$3,000</td>
<td>$35 - $55</td>
</tr>
<tr>
<td>Simple Return on Investment (ROI): 6.3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Single Family

- $5,000 - $10,000
- Paid up front or financed

Strata

- $735 per owner
- Paid over 5 years
Results 2015 – 2020

Central Park Strata Electricity Production
kilowatt-hours per month

BRUCE MACKENZIE - THE SOLAR WAY
## Results 2015 – 2020

<table>
<thead>
<tr>
<th>Month</th>
<th>Predicted (pvwatts)</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>System Cost 2020</th>
<th>Estimated Savings</th>
<th>Years running</th>
<th>Annual ROI</th>
<th>Running total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>408</td>
<td>369</td>
<td>499</td>
<td>342</td>
<td>458</td>
<td>276</td>
<td>$47,000</td>
<td>$10,731</td>
<td>4.75</td>
<td>4.81%</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>718</td>
<td>689</td>
<td>607</td>
<td>637</td>
<td>570</td>
<td>762</td>
<td>$47,000</td>
<td>$9,401</td>
<td>4.00</td>
<td>5.00%</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>1231</td>
<td>1345</td>
<td>1095</td>
<td>1516</td>
<td>1687</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Apr</td>
<td>1699</td>
<td>2047</td>
<td>1782</td>
<td>1664</td>
<td>1806</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>May</td>
<td>2304</td>
<td>2383</td>
<td>2236</td>
<td>2667</td>
<td>2374</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Jun</td>
<td>2125</td>
<td>1808</td>
<td>2516</td>
<td>2474</td>
<td>2309</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Jul</td>
<td>2394</td>
<td>2582</td>
<td>2585</td>
<td>2744</td>
<td>2731</td>
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<td></td>
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<td></td>
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<tr>
<td>Aug</td>
<td>2235</td>
<td>2222</td>
<td>2342</td>
<td>2316</td>
<td>2093</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sep</td>
<td>1576</td>
<td>1689</td>
<td>1703</td>
<td>1561</td>
<td>1529</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oct</td>
<td>945</td>
<td>920</td>
<td>807</td>
<td>1102</td>
<td>1107</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>534</td>
<td>542</td>
<td>429</td>
<td>410</td>
<td>511</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>354</td>
<td>291</td>
<td>310</td>
<td>332</td>
<td>307</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yr. Ending</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-Jun</td>
<td>16524</td>
<td>17595</td>
<td>16868</td>
<td>17599</td>
<td>17832</td>
<td>52063</td>
<td>17354</td>
</tr>
<tr>
<td>100%</td>
<td>106%</td>
<td>102%</td>
<td>107%</td>
<td>108%</td>
<td>105%</td>
<td></td>
<td>105%</td>
</tr>
</tbody>
</table>

5% more electricity than predicted by pvwatts

5% simple Return On Investment - ‘Dividend’
## What about today?

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price / installed watt</td>
<td>$ 3.00</td>
</tr>
<tr>
<td>kWh / year / installed watt</td>
<td>1.100</td>
</tr>
<tr>
<td>Step 2 electricity price / kWh</td>
<td>$ 0.1317</td>
</tr>
<tr>
<td>Value of electricity generated</td>
<td>$ 0.1449</td>
</tr>
<tr>
<td>Annual rate of return ‘dividend’</td>
<td>4.8%</td>
</tr>
<tr>
<td>Simple payback (years)</td>
<td>21</td>
</tr>
</tbody>
</table>
Reality Check

Does it reduce GHGs?

93% ‘clean’ electricity in BC – 9 kg CO2e/MWh → 150 kg/year
2.6 kg CO2/l diesel → saving ~60 litres diesel / year

Site C – do we need more electricity?

<table>
<thead>
<tr>
<th>Greenhouse Gas Intensities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Total BC Hydro electricity generation</td>
</tr>
<tr>
<td>BC Hydro fossil fuel electricity generation</td>
</tr>
<tr>
<td>Total electricity generation</td>
</tr>
</tbody>
</table>

Notes:
- GHG intensities are reported in carbon dioxide equivalent metric tonnes per gigawatt hour (t CO2e/GWh).
Lessons learned

Look for efficiency first – LED exterior lights
Have ALL the facts ready for owners
Check the measurements for the roof plan
Financial return not big for everyone
Owners wanted to ‘do something’
Electric vehicles will actually save GHGs
Follow us?

Energy efficiency? LEDs, ventilation ...

What rate(s) (per kWh) are you paying for power in the common areas?

How much power does your building use in the common areas? What does it cost annually?

What is a reasonable budget number for each unit, i.e., how much do you think each owner?...

How would you pay for it—by a special assessment, or by withdrawing from and paying back to the strata Contingency Reserve Fund? Repay over what time period?

How much room do you have on your roof for solar panels in full sun?

What size of system makes sense technically?

How much electricity could it generate (per year)?

How much would that reduce your total annual electric bill?

How much would that reduce the common area costs per unit per year?

How much will the system cost?

What’s the return on investment (i.e., $$ saved per year / cost of system)?

Is the roof strong enough?
Now – The Gory Details?
Common Area Power use

PIP grant 2009:
- LED exit signs
- CFL exterior floods
- CFLs in lobby
- Saved 13,678 kWh/year

Dog dish 13w hallway lights
BIG parking lights
2013: 48,042 kWh
2014: 48,461 kWh
2014: $5,011
First Ballasted System in Victoria?

No holes in roof!
Structural Engineering – Dead Load

Ballasted system
Net dead load of 6-7 lb/sq. ft.
Roof extra capacity – 2x10 @ 16” o.c.
Structural engineering cost:
  ◦ Levelton estimate: approx $4,500
  ◦ Herold final invoice: $388.50
Structural Engineering – Seismic

Specific to ballasted systems on flat roofs
Structural Engineering – Wind

Specific to ballasted systems on flat roofs
Applied by HES-PV
Installation Process

Roof layout

Electrical room temperature
Installation Process

Five strings of 12 panels
Crane to lift panels
How to lift 700 patio bricks?
Pallets? How many? Where to put them?
Several weeks wait for rubber support blocks for conduit
Maintenance

Wash once / year with the roof skylights

Warranty:

- Inverter: 15 years
- Panels: > 82% output after 25 years
- The rest is ‘just’ wiring
Replace the roof?

Just unplug and lift the panels, move the brackets

No holes in the roof
Weight

1 Panel: 18 kg (40 pounds)

1 Panel: 1 metre (3 feet) x 1.6 metres (5 feet)

About 4 pounds / square foot

Victoria snow: 42 pounds / square foot
Damage

Rated for 1 inch hail stones

Rated for hurricane winds (low to the roof)

Mike?

Earthquake rated by Structural Engineers Association of California
# Roof Temperature in Sun

<table>
<thead>
<tr>
<th>Reading</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air temperature</td>
<td>about 27</td>
</tr>
<tr>
<td>Existing open roof surface in full sun</td>
<td>about 62</td>
</tr>
<tr>
<td>Top surface of the panels</td>
<td>about 50</td>
</tr>
<tr>
<td>Roof surface under the panels</td>
<td>about 38</td>
</tr>
<tr>
<td>The top concrete pad in a ballast stack</td>
<td>43</td>
</tr>
<tr>
<td>The bottom concrete pad in a ballast stack</td>
<td>38</td>
</tr>
</tbody>
</table>
Internet Connection

Fronius Data Manager on inverter
$60-70/month from Telus or Shaw (1/3 of net benefit)
Borrowed Internet from nearby suite
Nowhere to run a wire
Internet Connection
Internet Connection
Publicity – Lobby Display
Publicity – Lobby Display

Raspberry Pi
Linux Server
Central Park Strata - Victoria

CURRENT POWER

Offline

ENERGY BALANCE TODAY

ENERGY EARNING

Total
11,372.84 CAD

CO2 SAVINGS TOTAL

967.65 kg

CENTRAL PARK STRATA - VICTORIA

VICTORIA

Partly Cloudy
Wind: 1 m/s (W)

Today: 4°
Sat: 8°
Sun: 7°
Mon: 8°
Tue: 9°
Wed: 10°
Thu: 9°
Fri: 8°

My PV systems  Central Park Strata - Victoria
Victoria condo powers up with strata-initiated solar project

CARLA WILSON / TIMES COLONIST
JUNE 13, 2015 06:00 AM

Email  Print

BRUCE MACKENZIE - THE SOLAR WAY
June 2, 2015

Dear Bruce,

Congratulations on Central Park Strata’s move to install solar panels! I read about the installation in VicNews and wanted to express my gratitude, pride, and thanks.

We all have a responsibility to make long-term decisions today, which will affect the living conditions and happiness of future generations. It can be easier to drive our choices based on short-term gains, but by broadening our focus and challenging the way we think, we can affect long-lasting improvements from the ground up, providing opportunities to everyone for years to come.

Thank you, your Council and all residents for being proactive, forward-looking, and for taking leadership in the clean, local energy revolution.

Sincerely,

Lisa Helps
Victoria Mayor
Publicity – Mayor’s Letter

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Thank you, your Council and all residents for being proactive, forward-looking, and for taking leadership in the clean, local energy revolution.

Sincerely,

Lisa Helps
Victoria Mayor
“... in a very progressive complex. As soon as you enter the building you will see the electronic display that shows savings created by the solar panels on the roof.”
Publicity – BCSEA blog

19 pages of excruciating detail for future stratas

www.bcsea.org/solar-on-strata
• Join Us!

More Info:
www.bcsea.org/solar-on-strata
The Numbers:

- Grid-tied / Net-metered
- 60 panels (14.7 kw)
- 16,000 kWh / year
- Powers common areas (~ 1/2)
- $2,100 power savings / year 2015/16
- $47,000 system cost – average $750 per suite
- 5.0% Return On Investment (ROI)