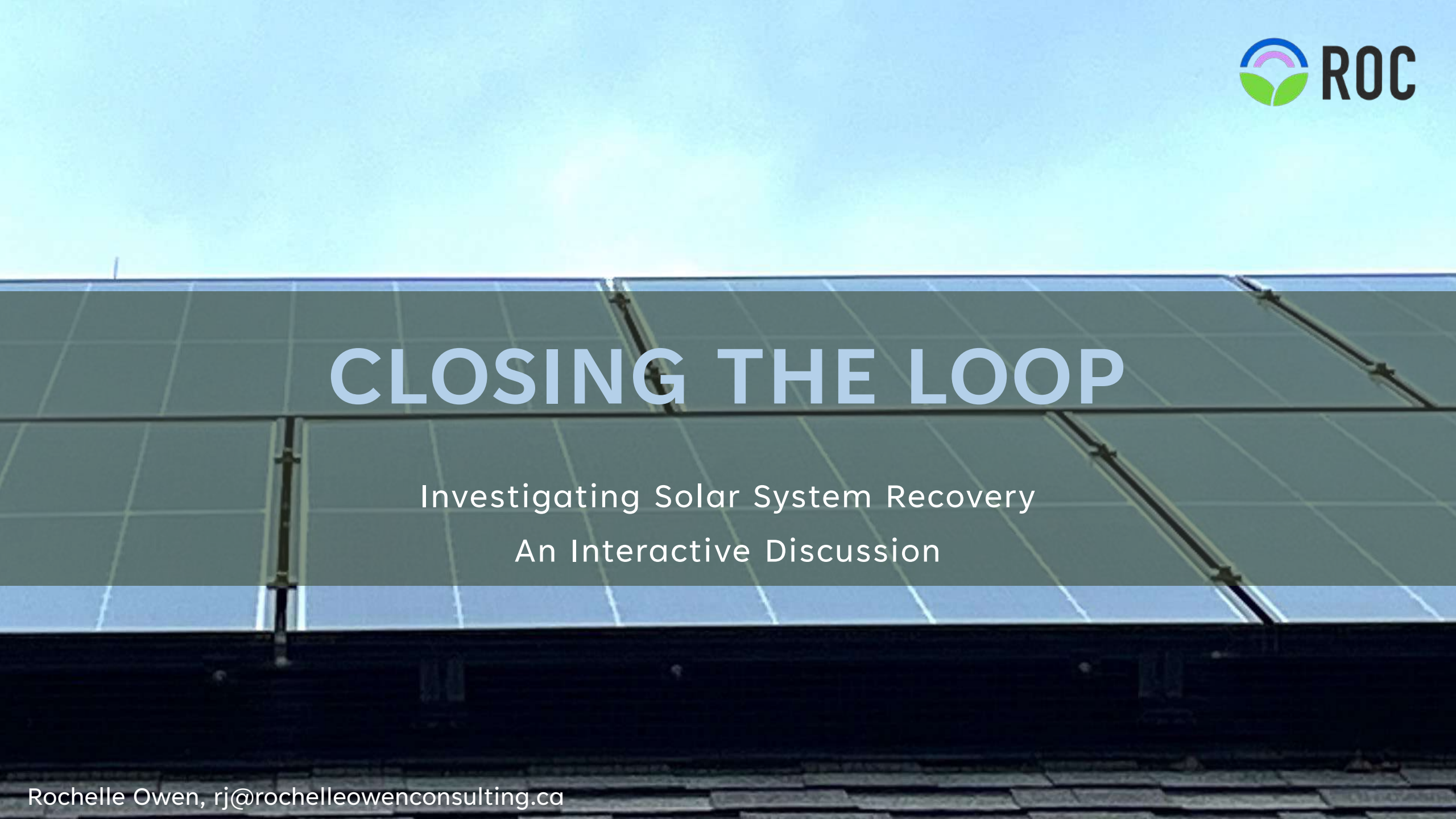


CLOSING THE LOOP

Investigating Solar System Recovery

An Interactive Discussion

Rochelle Owen, rj@rochelleowenconsulting.ca

1995-6 – Minister Adams and I. Minister Adams, former NS Minister of Environment, received the Order of Canada and Order of NS, ushered in the 1995 Solid Waste Management Strategy and regulations, including the creation of the RRFB now Divert NS.

BIO

- 32+ years in the sustainability and environmental field.
- Worked on solid waste, climate and energy issues through this time.
- At previous jobs and at home have been involved in 15 solar projects: thermal (2), PV (11) and air projects (2).
- My solar PV battery system that I installed to run my office created a perfect home for pigeons. Our innovative solar thermal system froze; we also have PV and are looking at another system.

PRESENTATION OUTCOMES

SOLAR PHOTOVOLTAIC (PV) SYSTEM

How it Works

How it is Connected

Key Components

SUSTAINABILITY

Life Cycle Thinking

- Human/ Env. Rights
- Pollution (including GHGs)
- Governance

CLOSING THE LOOP

- Economic Instruments
- Recovery of Materials

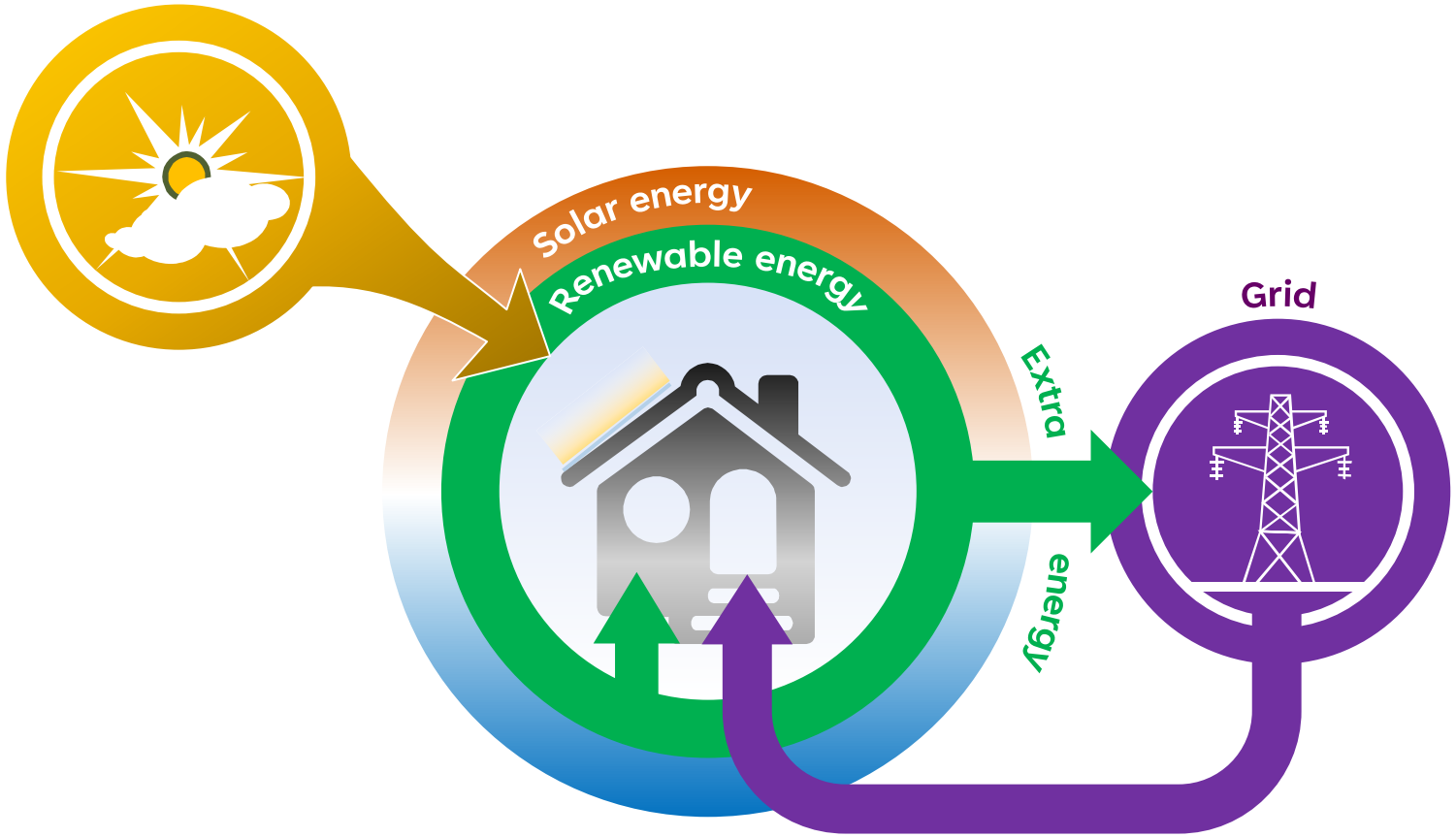
NEXT STEPS

Options for Action

- Presentation draws from experience, gray and academic literature, recent conversations/meetings. Some highlighted resources are provided at the end of the document.

Solar Photovoltaic

Direct conversion of light (photons) to electricity (electrons).



-No Moving Parts in the Panel

-When light falls on the material (semi-conductors) in the solar cells (32-96 in a panel) electrons break free and become part of a direct electric current.

OFF-GRID

Not connected to the Electrical Grid: Solar panels, racking, cabling, inverter(s) – micro or string, **controller(s),** Batteries.

GRID CONNECTED

Front Metered

- Connects to Transmission or Distribution directly
- Utility Scale, Community Solar

Behind the Meter

- Net Metering – Bi-Directional Flow
- Totally! Behind the Meter – Reverse Power Relay – No Export to the grid

Solar panels, racking, cabling, inverter(s) – micro or string, **switch gear**, **meters, may or may not use Batteries, starting to see requirements for pest protection (metal meshing).**

Solar System Components

01	Solar Panels	Metal, Plastic Polymer/Glass, Aluminum, Cooper, [Silicon, Boron, Phosphorus], [Cadmium telluride], …
02	Racking	Metal
03	Cabling	Metal, plastic
04	Inverters, Switch Gear, Controllers, Meters	Metal (steel), cooper, aluminum, brass; electronics e.g. circuit boards, glass, plastic
05	Batteries	**Lead Acid:** Metal (s) like lead, Plastic, Liquid – Sulfuric Acid and Water **Lithium Ion:** Metal (s) like Lead, Cooper, Organic Chemicals including Lithium, Plastic Other technology
06	Animal Protection	Metal

SOLAR PANEL TYPES

- Silicon
  - Monocrystalline (Silicon) – Black – 16% -24%
  - Polycrystalline (Silicon) – Blue – 14%-20%
- Thin Film
- III-V Solar Cells (e.g. satellites)
- New technologies with organic elements

Thin Film – backpack solar charger

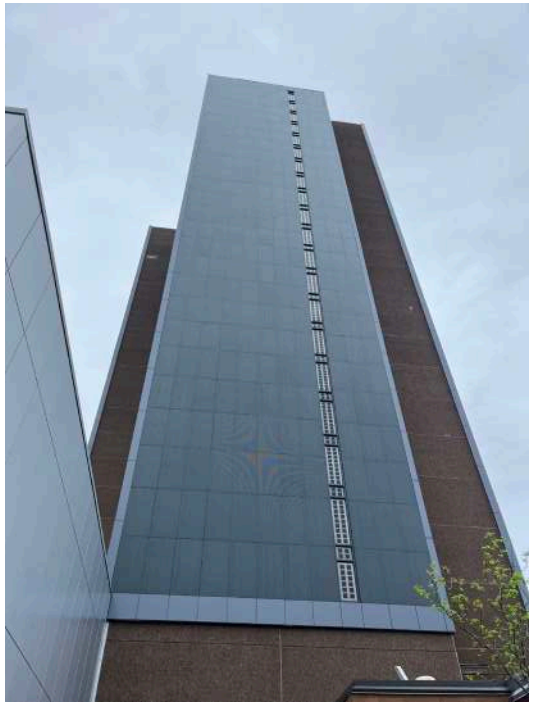
Monocrystalline, Dalhousie University

Polycrystalline, Dalhousie University

String inverter

String inverter

Micro inverter

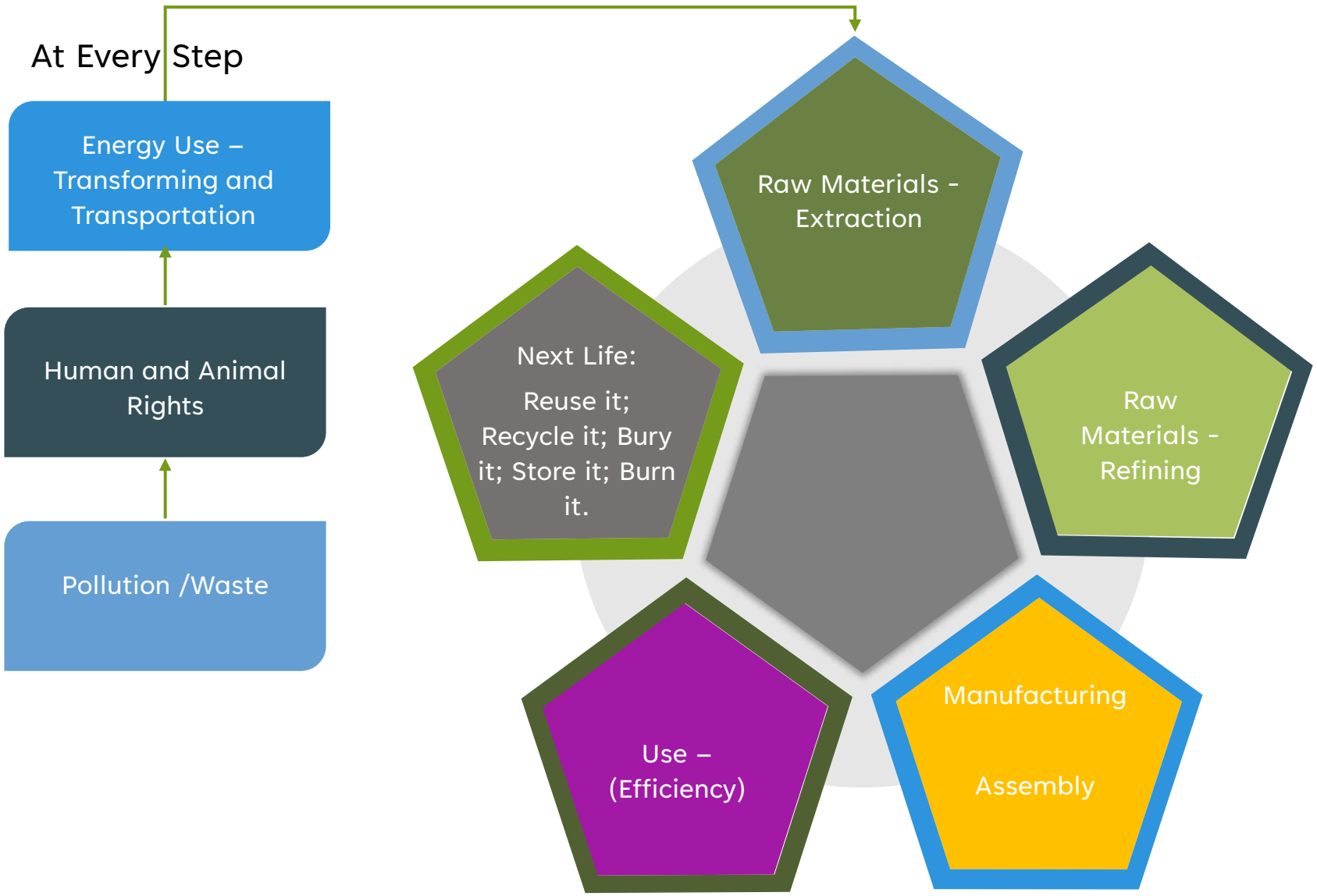


Building Integrated Solar PV, SMU. Silicone based – could also have been thin film.

In house meter

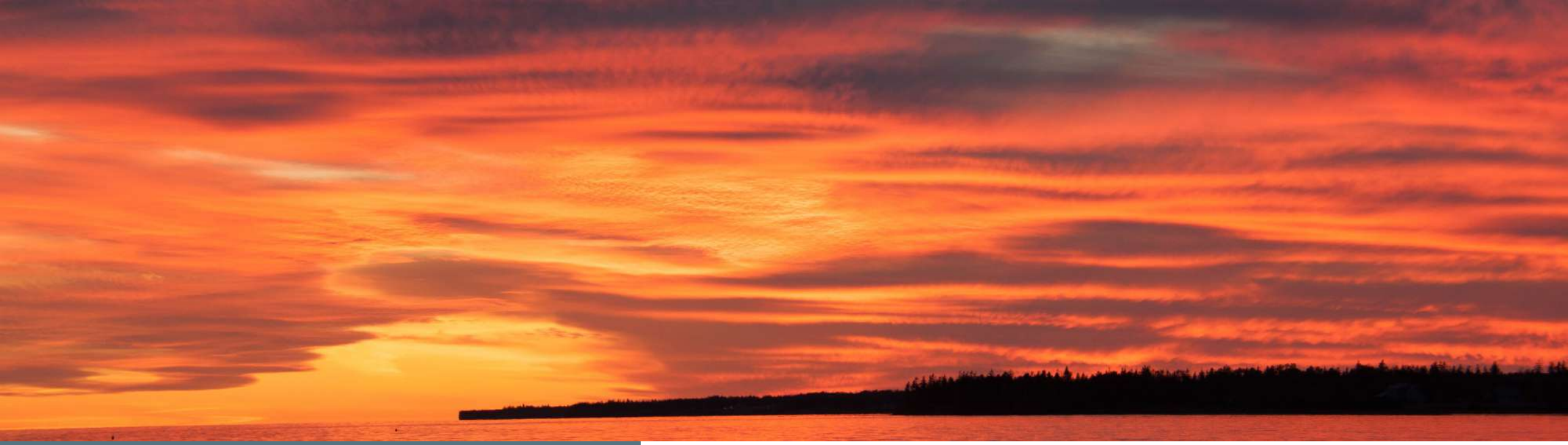
Wire mesh guards below the panels

Life Cycle Thinking



MUSINGS

- Current Canadian recycling options are non-existent.
- Webinar discussion with Solar Alberta last week suggested they are exploring panel recycling as an electronic product potentially for the electronics stream.
- With US and recent Canadian forced labour legislation more panels are being stopped at the border regarding concern of human rights especially in the raw materials processing. Need to be cognizant of the changing landscape and keep practicing sustainable procurement.
- Research is ongoing to improve panel efficiency and materials.
- No current economic instrument to cover next life activity. If something does not change the municipal taxpayer will be left with the costs.
- Let’s not bury electronic waste.



NEXT STEP IDEAS TO STIMULATE DISCUSSION

- Store it for the short term with $20 recovery fee
- EPR – costs paid to existing system like Electronics Products Recycling Association
- Ban from landfill
- Next step policy and governance work to move this along

Resources

- Canada's National Observer: https://www.nationalobserver.com/2020/11/27/features/canada-solar-panel-recycling-problem
- Canadian Renewable Energy Association (CanREA): https://renewablesassociation.ca/wp-content/uploads/2021/04/Recycling-Solar-Panels-English-Web.pdf
- International Energy Association: https://iea-pvps.org/wp-content/uploads/2021/11/IEA-PVPS-Task12-LCA-PV-electricity-_-Slides.pdf
- Investigation of Solar PV recycling (2020)– Office of Sustainability and Clean Leader Intern Hannah Dvorski - MREM student. Research Paper.
- March 05, 2024. "Waste from solar photovoltaic (PV) panels will be collected, treated and recovered at the expense of manufacturers, following a vote by energy ministers meeting in Brussels today (4 March)." - https://www.euronews.com/green/2024/03/04/solar-panel-makers-to-pay-for-their-waste Classified as electronic waste.
- National Renewable Energy Lab: https://www.nrel.gov/research/re-photovoltaics.html; https://www.nrel.gov/docs/fy13osti/56487.pdf