Estimating Hourly Energy Generation of Distributed Photovoltaic Arrays: A Comparison of Two Methods

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Let’s Ask A Question...

- How much electricity is being generated by distributed PV systems in a given region in Australia right now?
• How much electricity is being generated in Canberra, Australia right now?
• How much electricity is being generated in Canberra, Australia right now?
This is not an easy question to answer!

- Distributed PV systems are (mostly) not actively monitored
- They are highly nuanced
- Their exact locations are hard to access
- Clouds have widely varying characteristics
- Solar radiation – a rapidly changing variable
How can we begin to answer this question?
Comparing Two Methods

• **Method 1**

• **Method 2**

Method 1: Pyranometer

DISC Model

Reindl Model

Sandia Performance Models

Estimated Energy
Method 2: PV System

- Esra Clear-Sky
- Reindl Transposition
- Sandia Performance Models

\[ K_{PV_1} \]

\[ K_{PV} \text{ Calculation} \]

\[ K_{PV_1} * PV_{CLR_2} \]

Estimated Energy at Site 2
Data: Pyranometers and PV Systems

- 29 Rooftop PV Systems
- 4 Pyranometer Sites
- 3 Sites with PV and Pyranometer Co-located

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Methodology:

Estimate the hourly energy generation at each site using both methods.
Method 1

Pyranometer hourly analysis using site 641

Estimated kWh/kWp

RMSE = 0.159
MAPE = 75.0%
MBE = 0.7%

Method 2

KPV hourly analysis using site 641

Estimated kWh/kWp

RMSE = 0.188
MAPE = 64.4%
MBE = 6.5%
Pyranometers know best?

Calibration error?
Conclusion

- **Method 1** performs *slightly* better

- **Unless** the sites are “close enough”
  - ~5km or less and **Method 2** performs best

- PV system data appears to be approximately as good as pyranometer data for energy output estimates