



Managing peak demand and energy costs through PV
and intelligent scheduling of water heaters at two
schools in South Africa

Stellenbosch University

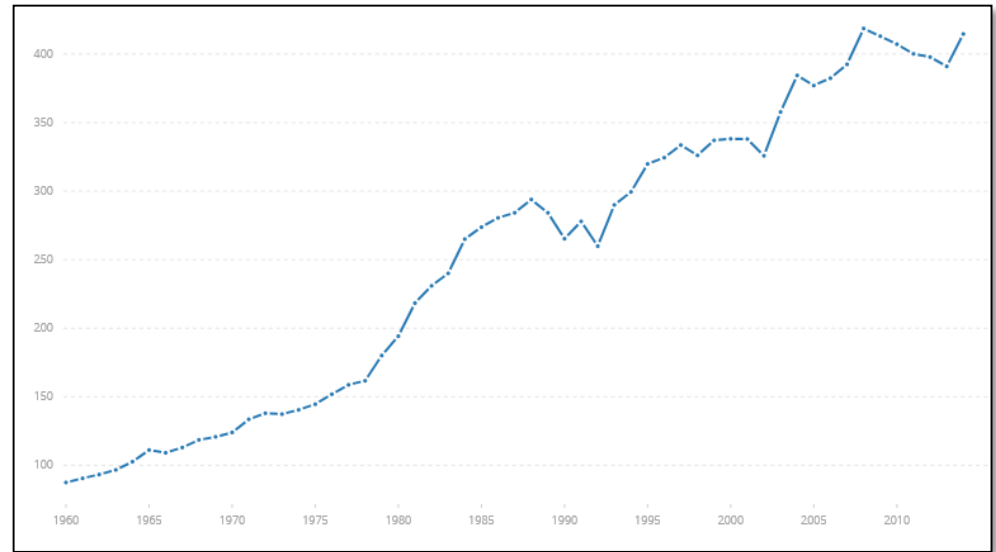
Stefan Gerber, A. Rix, M.J. Booysen
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Introduction

Motivation:

- Global emissions are increasing
- South Africa is coal heavy
- Many schools are underfunded and can benefit from solar intervention



South Africa's CO₂ emissions from solid fuel consumption (millions of tons); Site: Worldbank.org



Introduction

Overview:



Stellenbosch Primary (with EWHS)



Eikestad Primary (no EWHS)

- Two primary schools evaluated
- Both employ a demand-based tariff structure
- Primary objectives:
 - Reduce emissions
 - Reduce utility bill

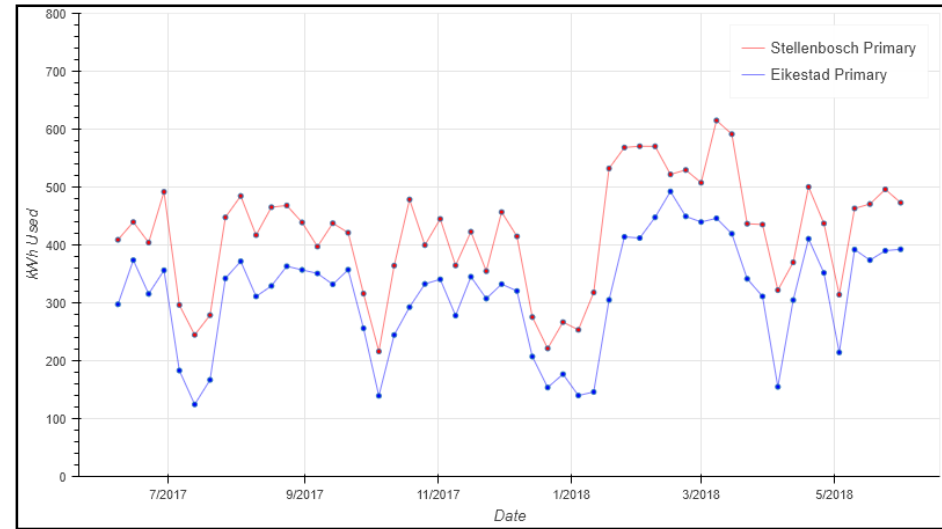


Simulation Setup

Approach:

4 Configurations:

- *Baseline*
 - *Smart Scheduling EWH*
 - *Solar intervention*
 - *Solar and Smart Scheduling EWH intervention*
- Simulate configurations using:
 - Verified Solar and EWH models
 - Using data obtained by sensors

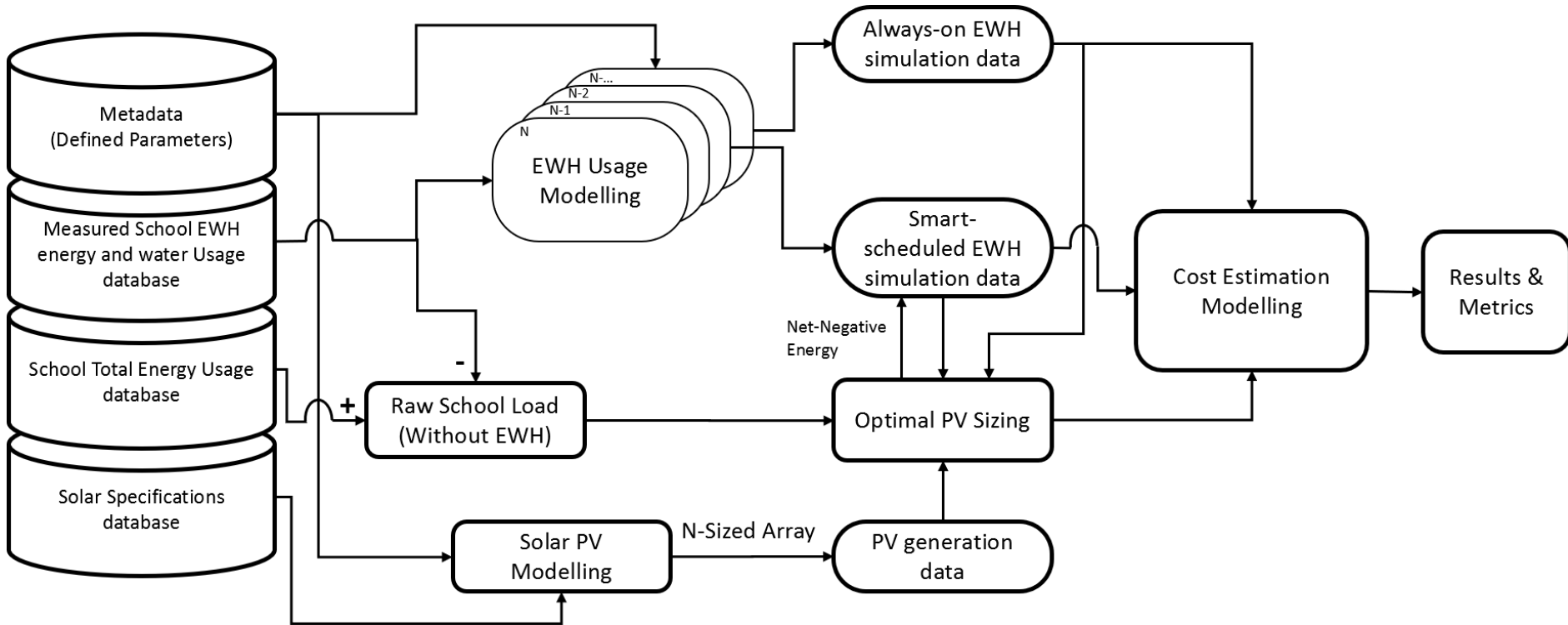


Average daily measured energy usage for both Schools (plotted for each week)



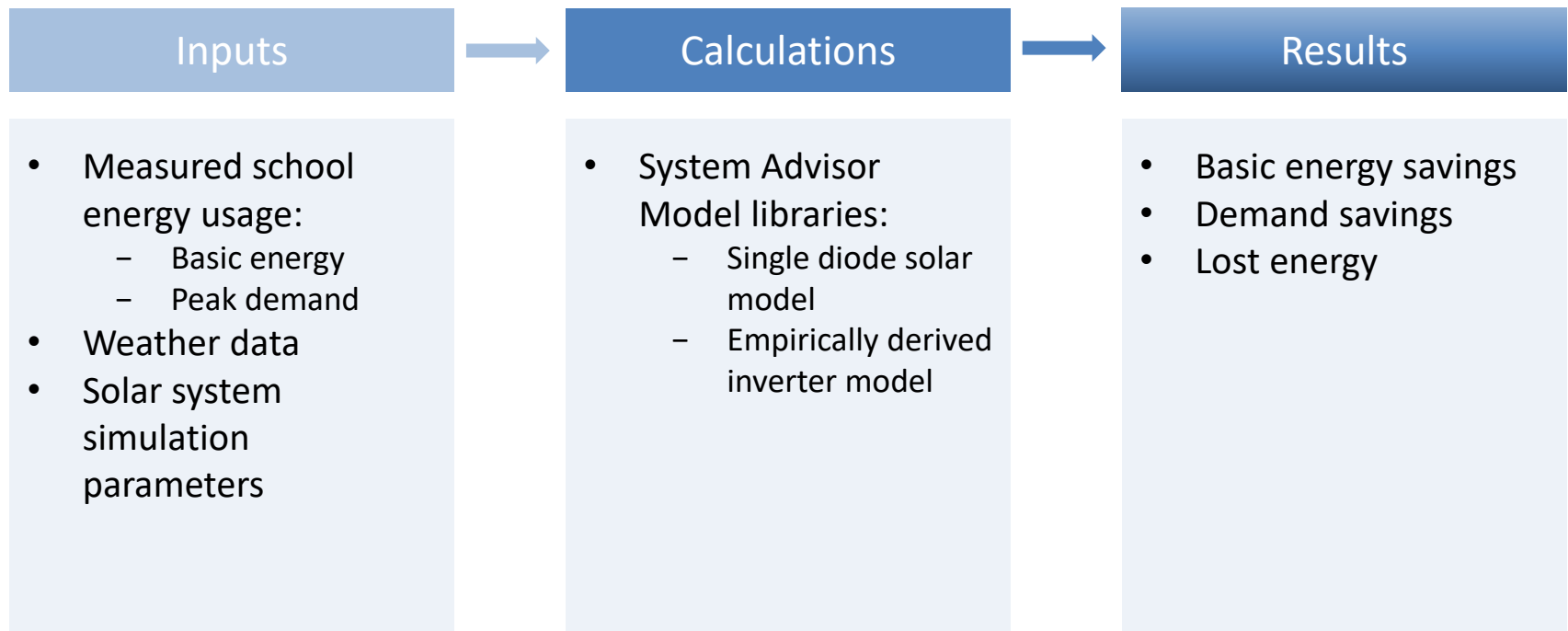
Simulation Setup

System Simulation Diagram:



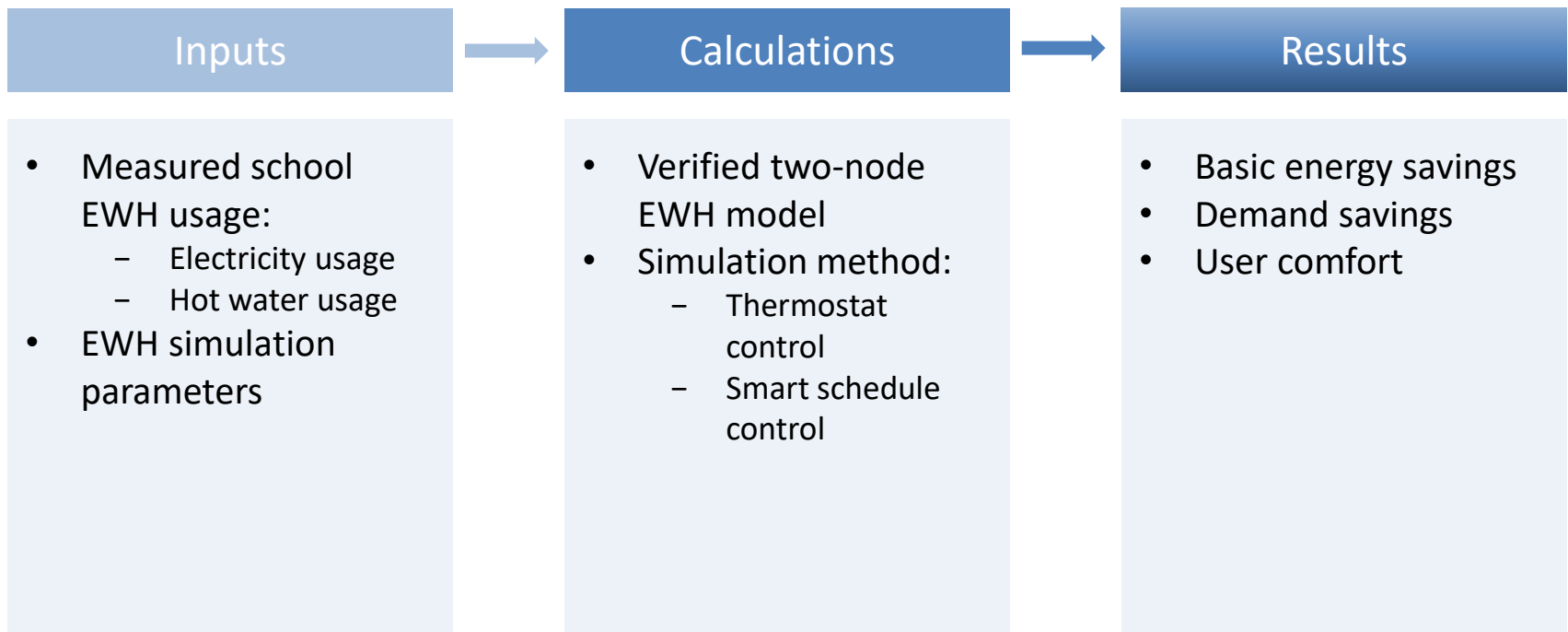
System Modelling

Solar PV simulation:



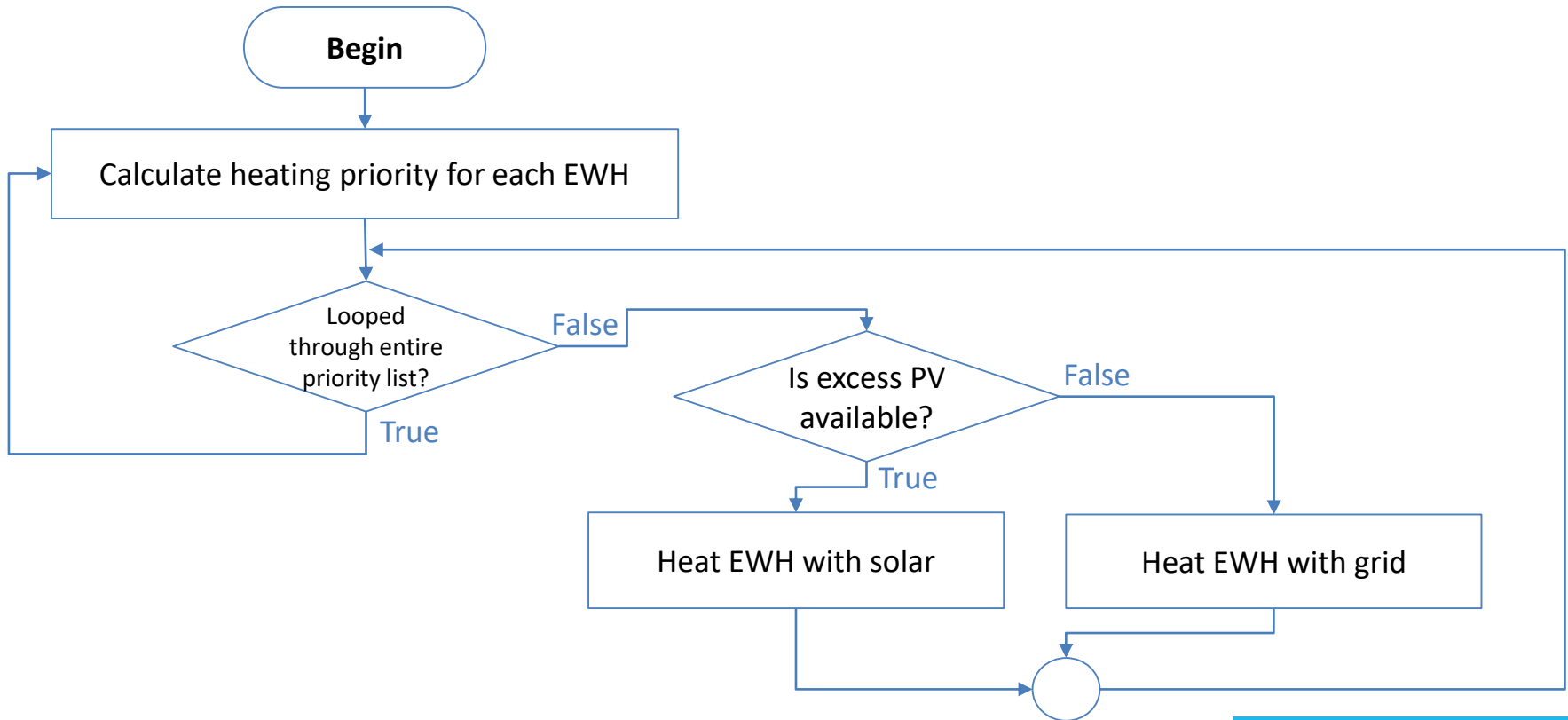
System Modelling

EWH simulation:



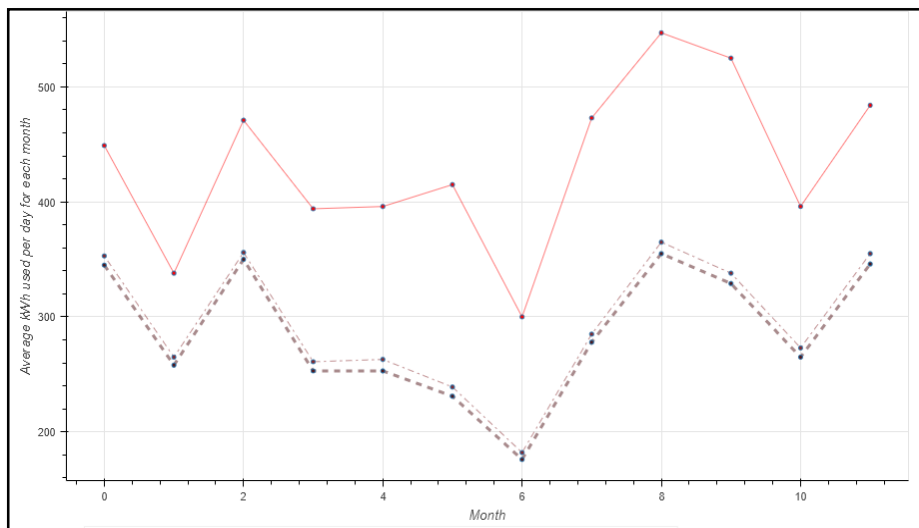
System Modelling

EWH Smart-Scheduling algorithm:

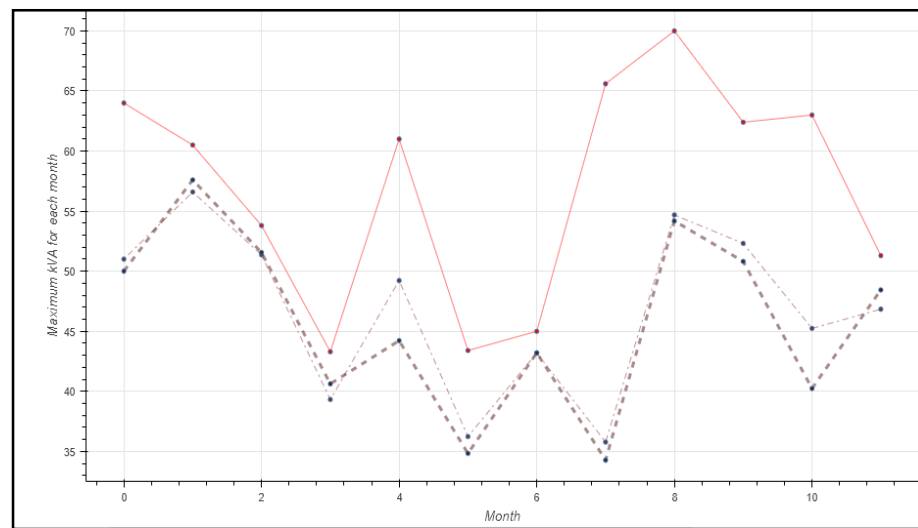


Results

Energy and peak demand savings:



Average kWh used per day



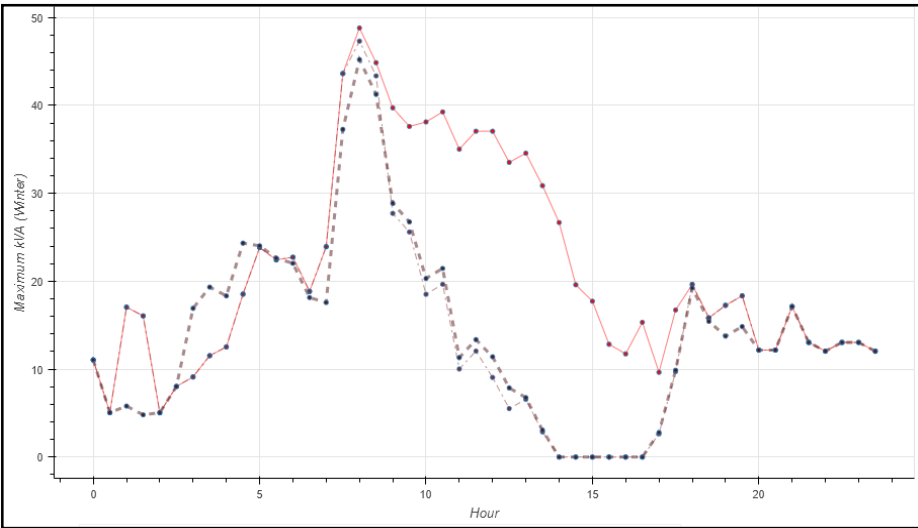
Maximum kVA per month

— Stellenbosch Primary: Base - - - Solar intervention - - - Solar & Smart Scheduling intervention

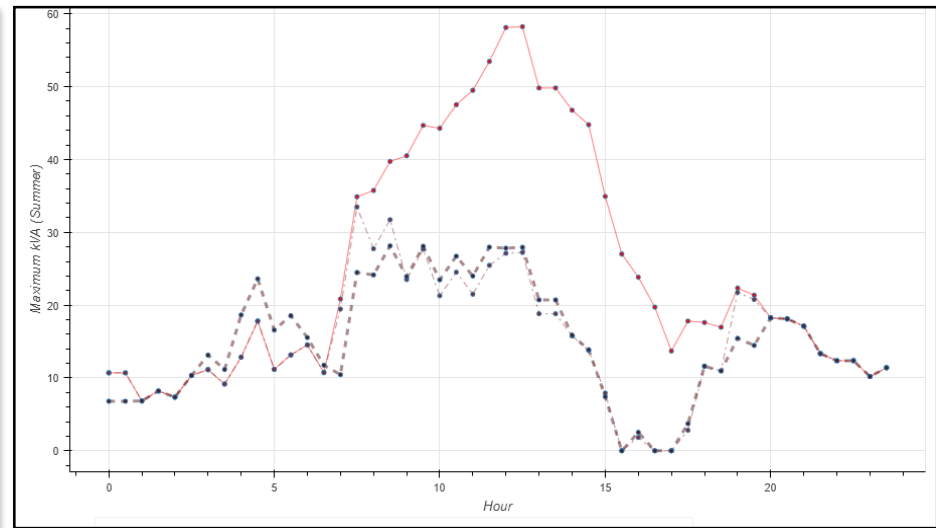


Results

Seasonality:



Max kVA for a winter's day



Max kVA for a summer's day

— Stellenbosch Primary: Base - - - Solar intervention - - - Solar & Smart Scheduling intervention



Results

Simulation results for Stellenbosch Primary:

Parameter	School Baseline	With smart-scheduling intervention	With solar intervention	With solar and smart-scheduling intervention	Unit
Total Energy Usage	157.3	155.6 (1.08%)	109.2 (30.7%)	105.4 (32.7%)	MWh
Mean Daily Energy Usage	430	426	299	289	kWh
Daily peak demand [min,median,max]	[8,37,72]	[8,36,71] (2.70%)	[0,30,55] (19.1%)	[0,29,54] (21.2%)	kVA
Yearly CO ₂ Emissions	117 065	115 808	81 274	78 445	kg
Percentage utility bill reduction	0	1.4	23.6	25.8	%



Results

Simulation results for Eikestad Primary:

Parameter	School Baseline	With solar intervention	Unit
Total Energy Usage	114.8	71.8 (37.4%)	MWh
Mean Daily Energy Usage	315	197	kWh
Daily peak demand [min,median,max]	[6,31,62]	[0,25,55] (19.3%)	kVA
Yearly CO ₂ Emissions	85 436	50 458	kg
Percentage utility bill reduction	0	30.13	%



Conclusion

- Interventions resulted in reductions in utility bill and emissions.
- The estimated payback period was favorable, making it viable for the schools investigated.
- Optimal battery storage can possibly lead to improved results.



Thank you

