ELECTRICAL AND COMP. ENGINEERING UNIVERSITY OF NEVADA, LAS VEGAS IEEE 58TH INTERNATIONAL MWSCAS 2015, FORT COLLINS COLORADO, USA

TITLE: APPLICATION OF USED ELECTRIC VEHICLE BATTERIES TO BUFFER PHOTOVOLTAIC OUTPUT TRANSIENTS

Presented by

Yacouba Moumouni, Ph.D. Candidate

Co-author :

R. Jacob Baker, Ph.D

CONTENTS

1. ABSTRACT

- Methods to mitigate the effects of power transients associated with grid-tied concentrated photovoltaic (CPV) systems due to fast-moving cloud coverage
- Buffering CPV intermittency with used electric vehicle batteries
- Goals :1) to smooth out the intermittent solar power and; 2) to defer part of the peak load to a convenient time
- Real data were utilized to conduct this study
- Results showed 1) Unit was capable of a constant 20 kW; 2) Unit was able to shift the less valuable off-peak electricity to on-peak time

2. INTRODUCTION

- Solar variability affects photovoltaic
- PV fields have large and frequent ramp events (challenge for grid operators)
- Cloud coverage is dependent on: system size, shape, transparency, speed, etc.
- Used electric-vehicle (EV) batteries are proposed

2. INTRODUCTION CONT.

- Ways to reduce peak load

  - Demand Side Management (DSM)
  - Time Of Use pricing (TOU)
  - Energy storage System (ESS)

    - Absorption of surplus power
    - Allowance of energy to be utilized at convenience

2. INTRODUCTION CONT.

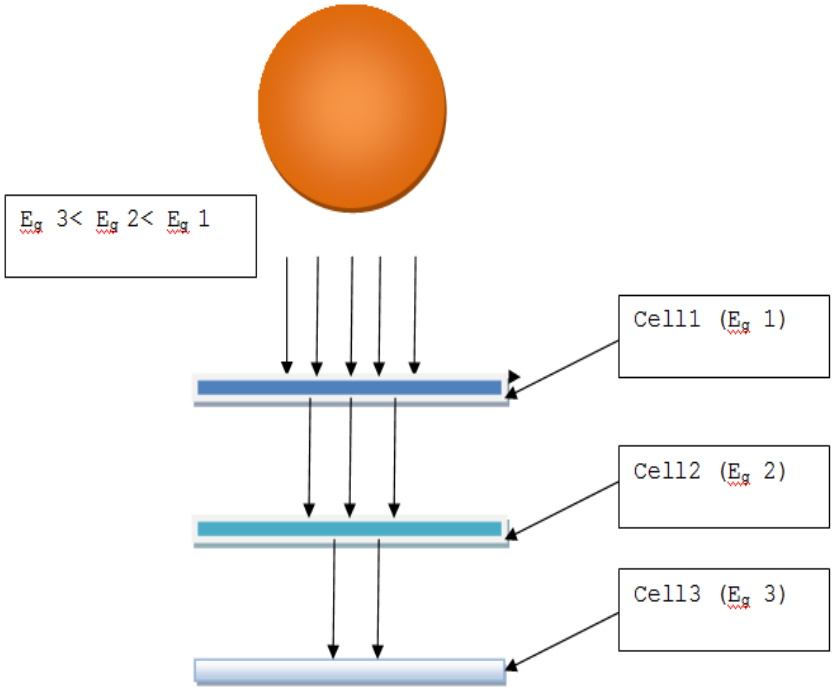
- Research focus

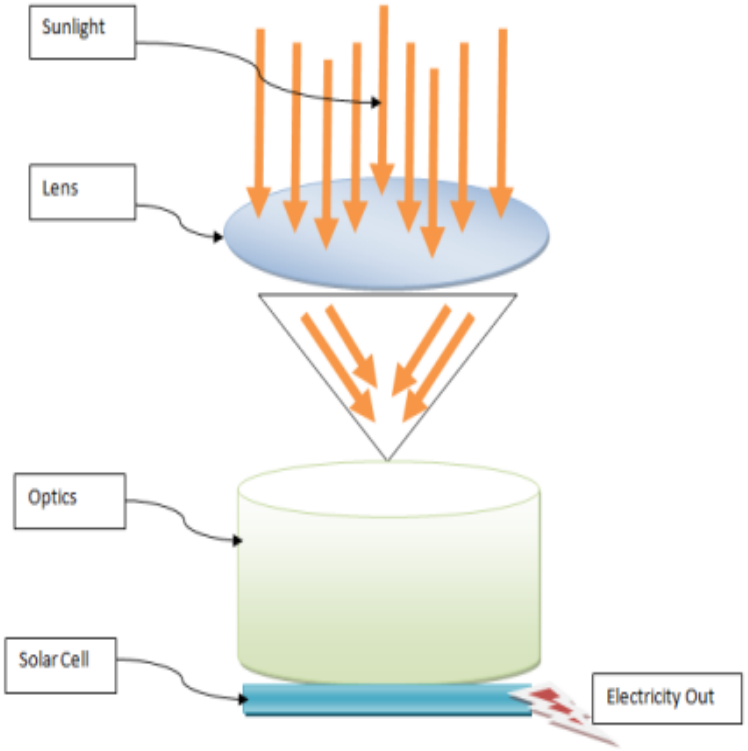
- Smoothing the CPV power transients due to cloud coverage with energy storage system, ESS1

- Shifting less expensive power to the peak demand time, with ESS2

3. DESCRIPTION OF THE CPV SYSTEM UNDER STUDY

- Highly efficiency
- Triple junction
- Less material used





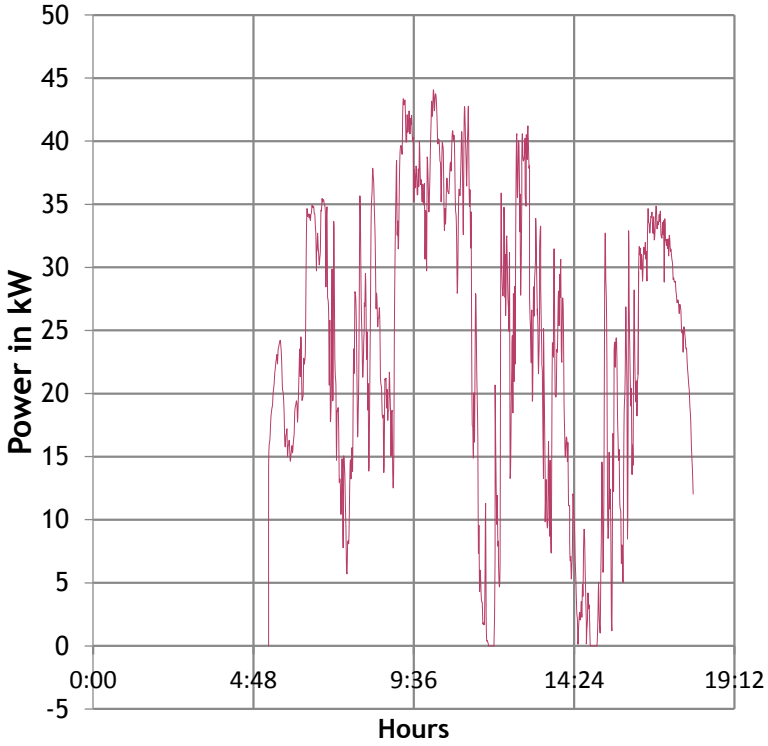
3. DESCRIPTION (CONTINUED)

- Dual-axis tracking
- Eff. in excess of 29%
- Name plate AC capacity 53kW ±5%
- Op. three phase 480VAC
- Op. Temp -10°C to +50°C

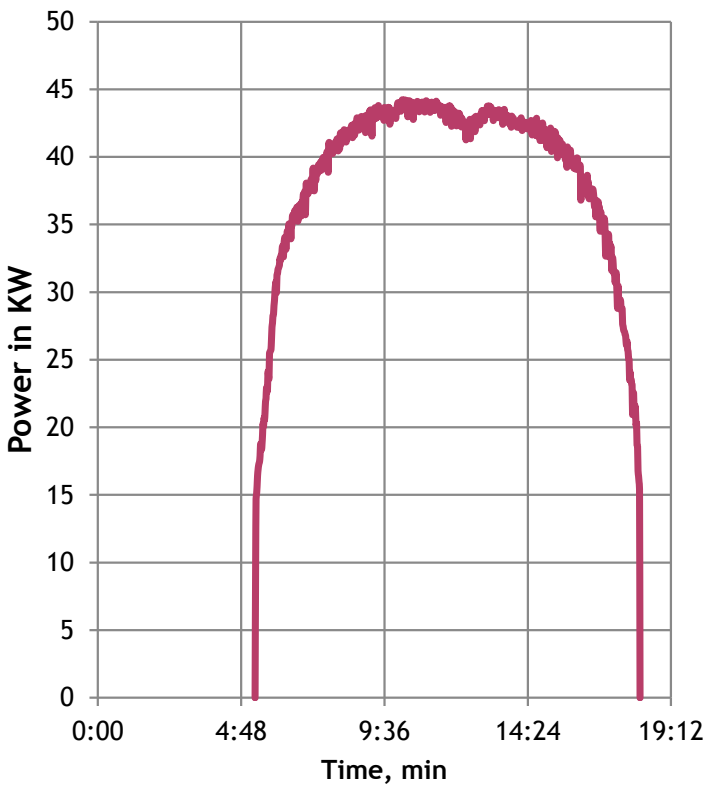
Characteristics	CPV Amonix 7700

3. DESCRIPTION (CONTINUED)

Output Cloudy Day



Output Clear day



4. PROCEDURES AND CONTROL STRATEGIES

- Collected Summer CPV 7700 data
- Collected NV Energy summer load
- Checked missing data prior to simulation
- Built Matlab codes

4. PROCEDURES AND CONTROL STRATEGIES (CONT.)

Variables and Assumptions

- Variables
  - 15kW Power (ref.)
  - Battery capacity

- Assumptions
  - Inv. Output was 38kW
  - Inv. Eff. 88%
  - Discharge time 0.34h for ESS1
  - Discharge time ESS2 6 hours
  - Round trip loss 12%
  - Battery nominal 24V

- Final ideal value achieved after few trials

4. PROCEDURES AND CONTROL STRATEGIES (CONT.)

Output without ESS

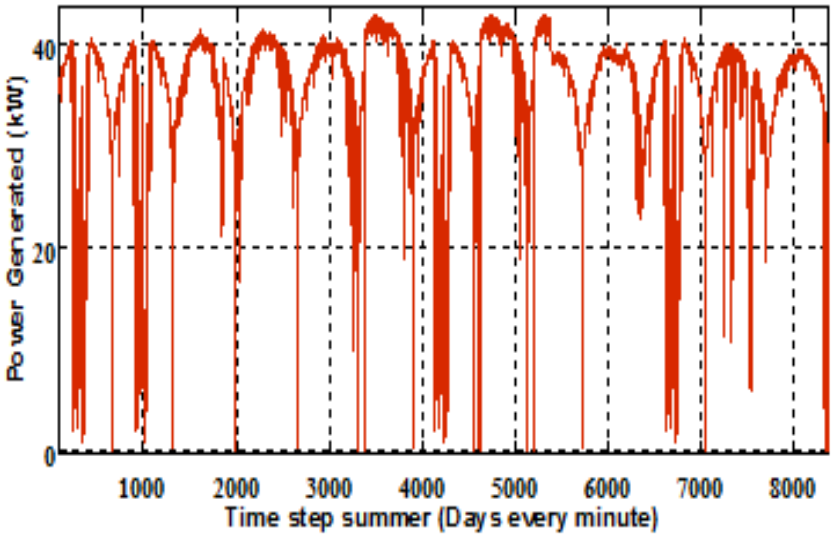
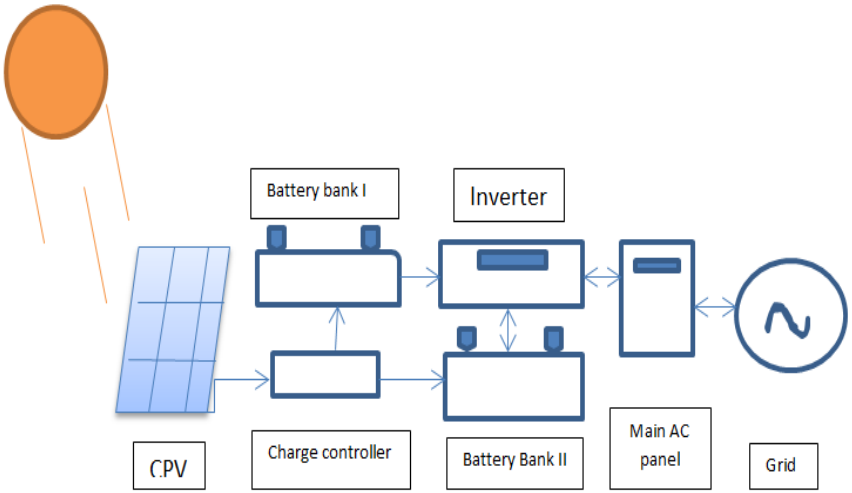
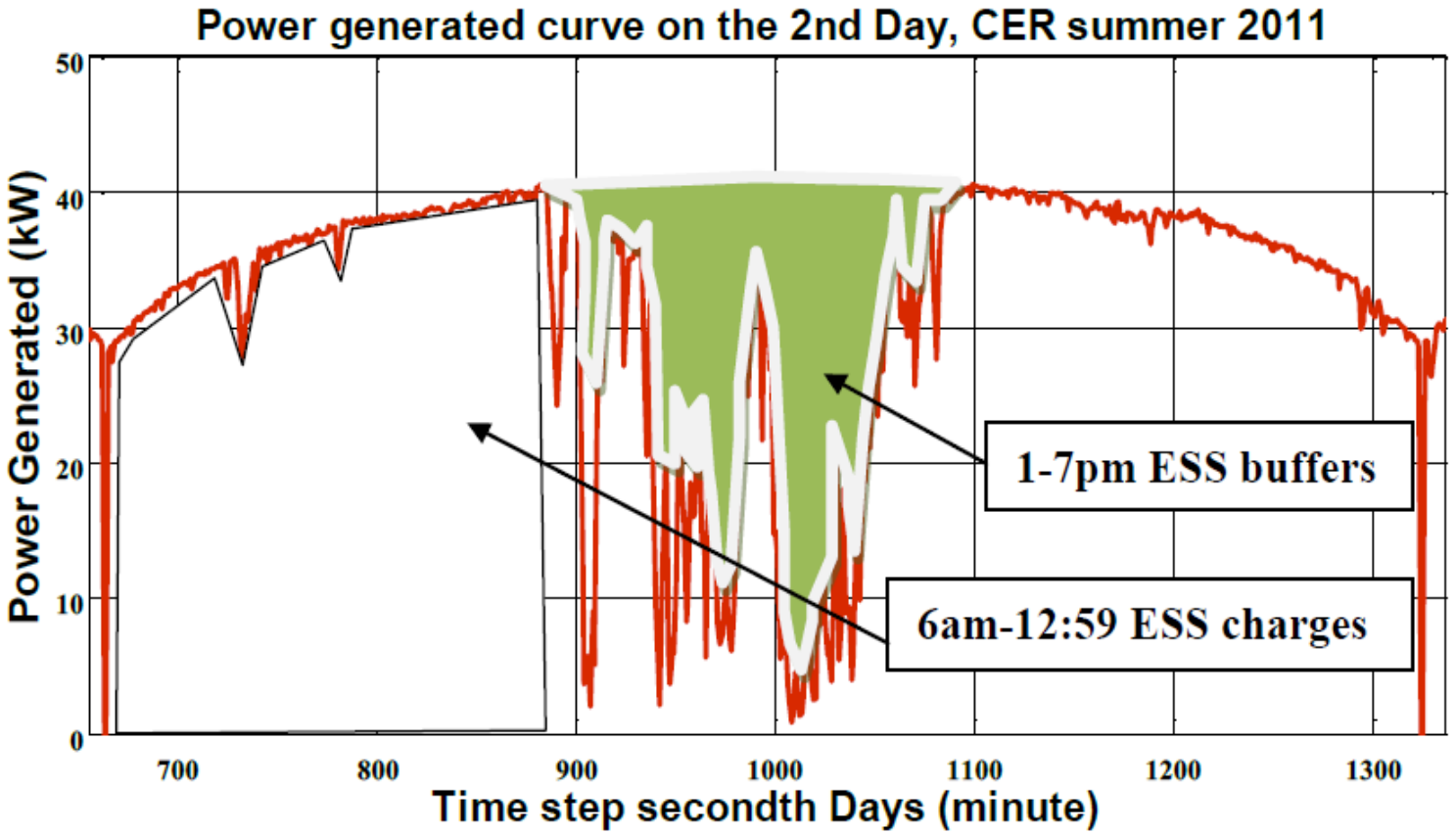


Diagram of the system



4. PROCEDURES AND CONTROL STRATEGIES (CONT.)

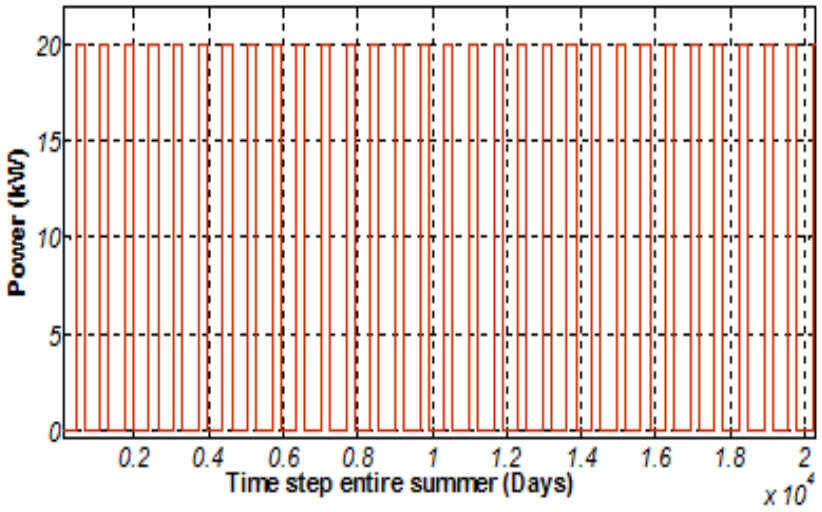
System's setup

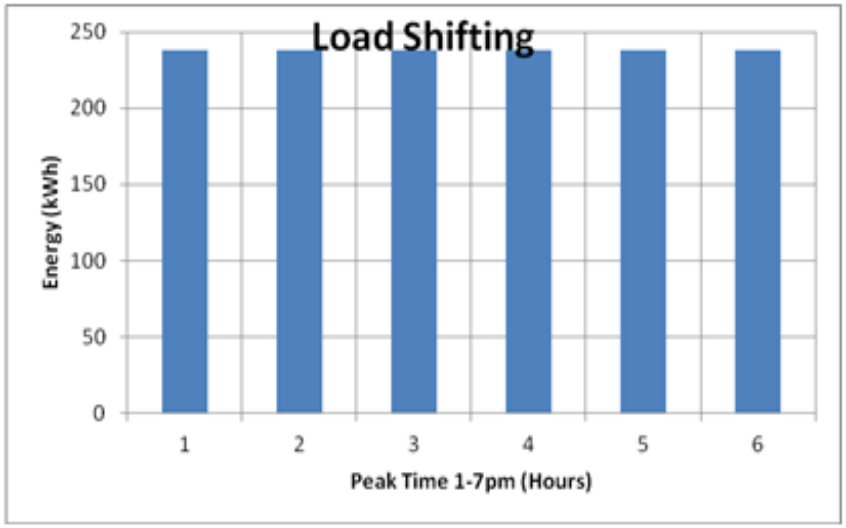


5. BATTERY PARAMETERS AND FUNCTIONS

Designation	kWh	Functions
ESS1	20	Power smoothening
ESS2	368	Load shifting
ESS Total	388	Both Functions

6. SIMULATION RESULTS AND ANALYSIS





Constant 20kW based on 20.436kWh ESS1 for the entire Summer

Constant 238 kWh Load shifted, ESS2

7. CONCLUSION

- Ways to reduce CPV Variability was investigated
- Power reliability and availability were increased
- Voltage, frequency, and p.f angle quality increased
- Proposed Used automotive batteries for Economic and Environmental reasons
- Intent was to prove the technical feasibility of a grid-tied CPV
- Study aims to foster a large scale renewable penetration
- Results show that the proposed size of the partially degraded battery (388kWh) achieves a desired outcome of a constant 258kW of power

8. REFERENCES

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QUESTIONS AND ANSWERS

- Thank you,