

Electrical Distribution Design for a Townhouse Development

Dependent vs. Independent PV + Shared BESS System

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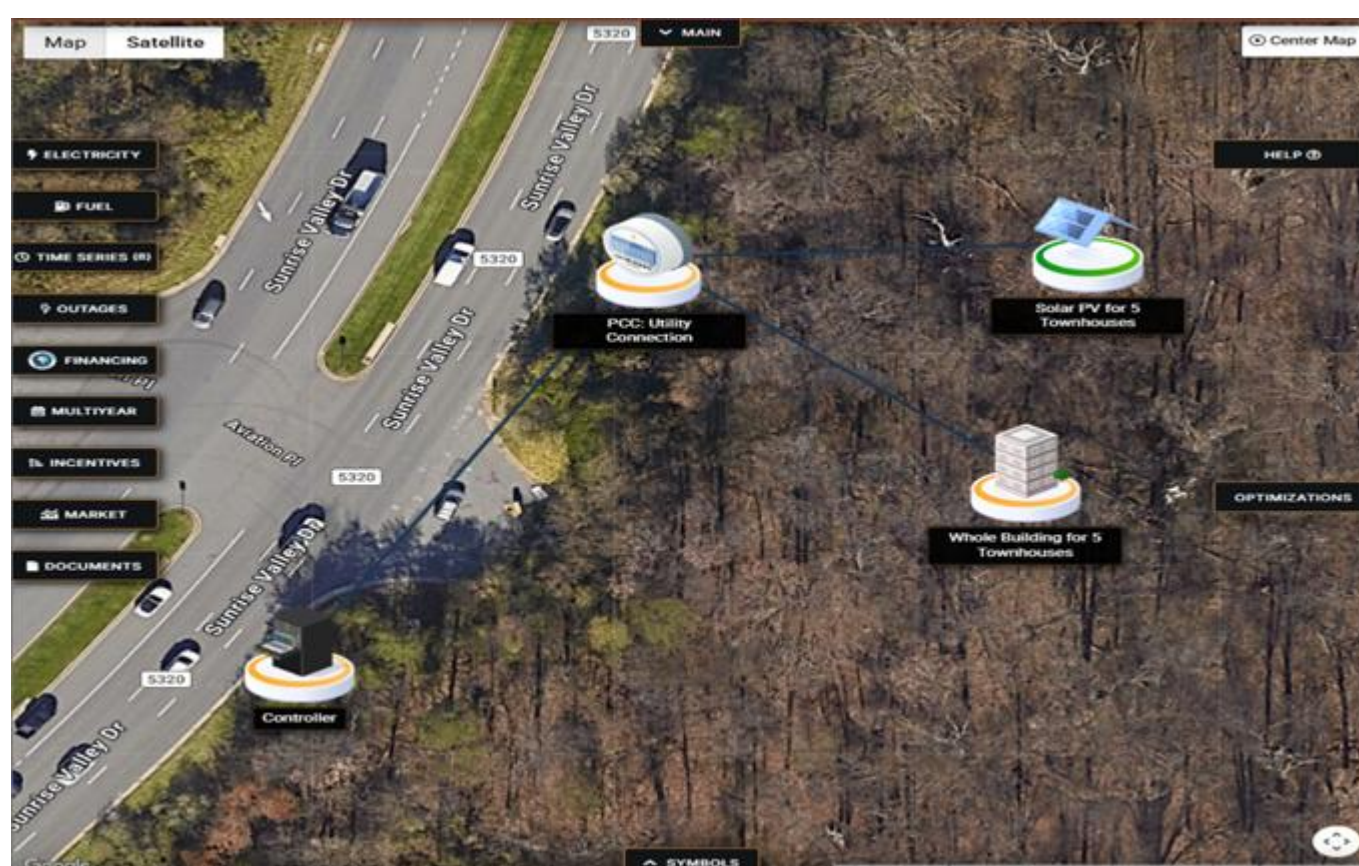
INTRODUCTION

- Increasing electrical demand and rising energy costs require improved resiliency
- Traditional utility-dependent systems rely entirely on grid supply
- Limited flexibility during peak demand and outage conditions
- Independent system integrates PV, BESS, and EV charging
- Goal: evaluate technical and economic benefits

PROJECT OBJECTIVE

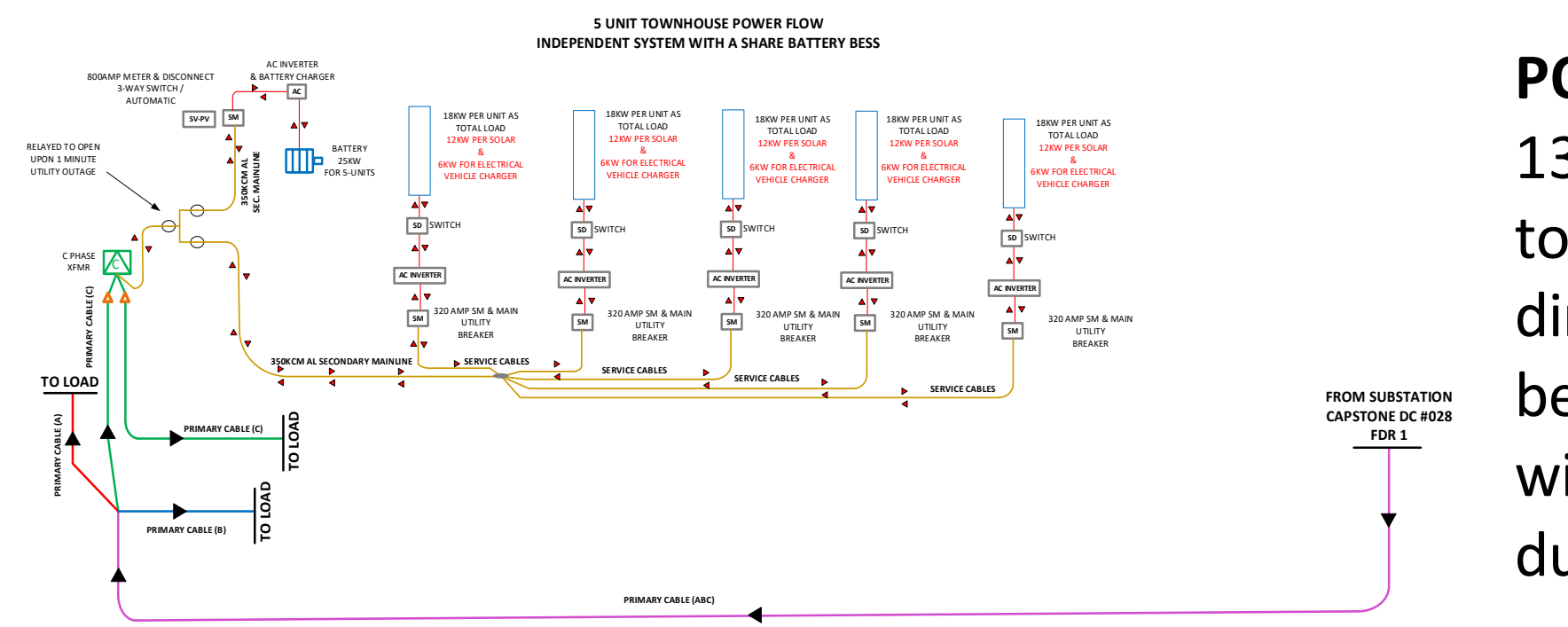
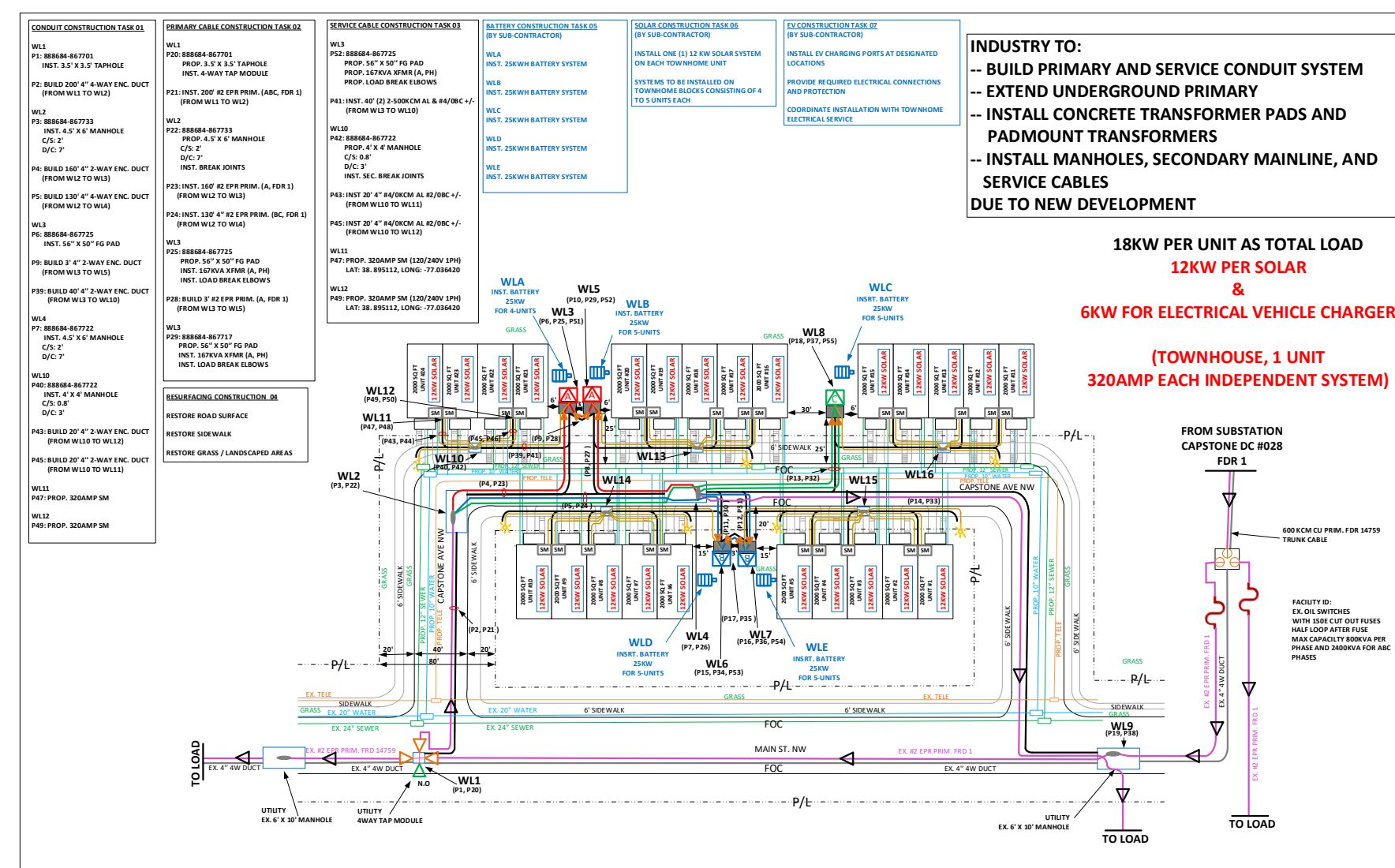
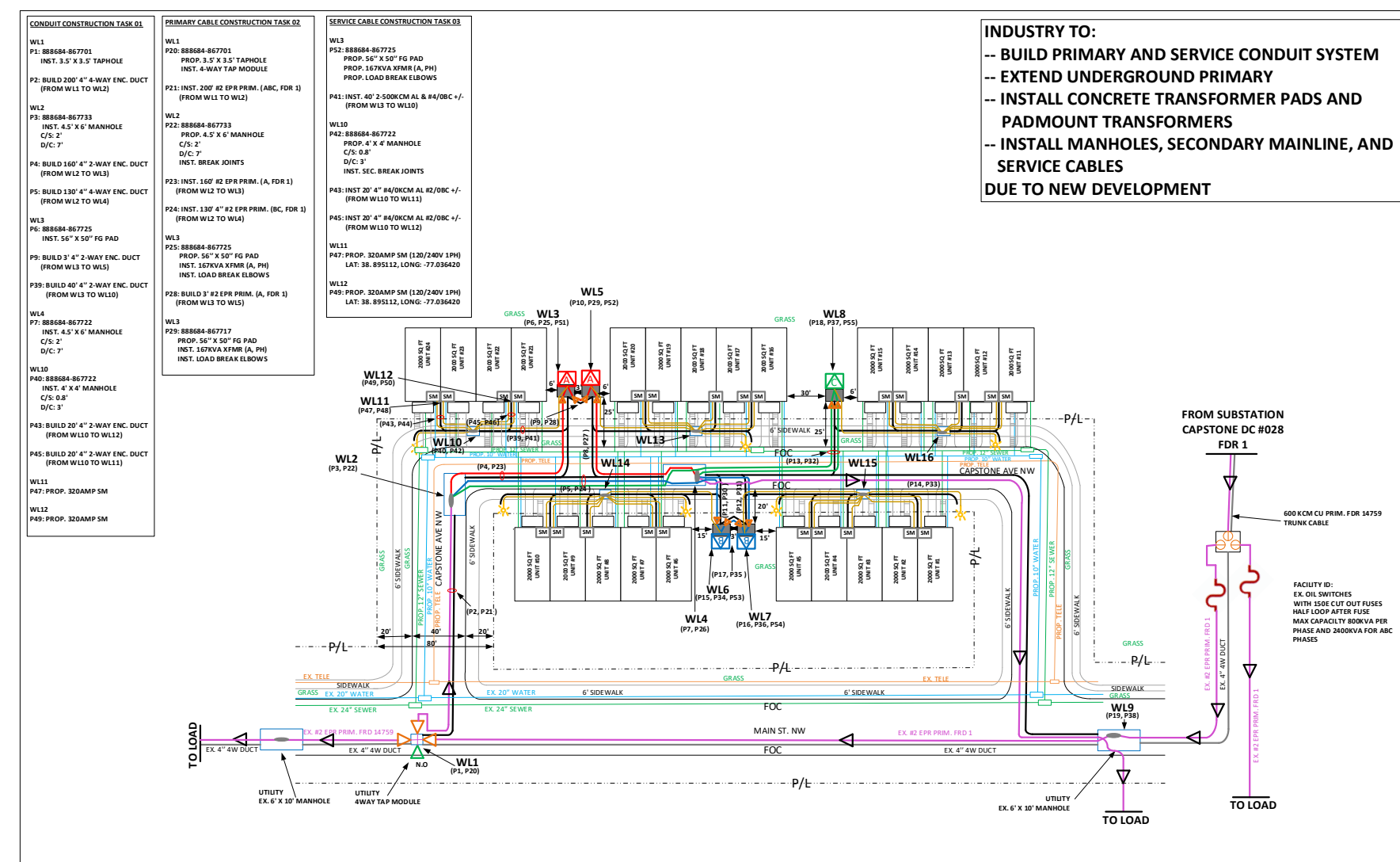
The objective is to compare a conventional Dependent System with a Shared Independent System based on constructability, cost, performance, and long-term value. The study evaluates peak demand reduction, solar utilization, grid dependency, and investment recovery.

XENDEE MODELING



A real-world site was modeled in XENDEE using a 5-townhouse cluster with a utility PCC, controller, aggregated load, and rooftop PV. The model evaluates PV-only and PV + BESS scenarios using PJM pricing and single-node economic analysis.

SYSTEM ARCHITECTURE



POWER FLOW DIAGRAM

13.8 kV feeder stepped down to 120/240 V; supports bi-directional power flow between grid and PV/BESS, with relay-controlled islanding during outages.

CONSTRUCTIBILITY & CONSTRUCTION PHASING

Task 01 – Civil & Conduit

- Install conduit, manholes, transformer pads

Task 02 – Primary Installation

- Extend UG primary, install transformers

Task 03 – Secondary Installation

- Install mainline and service cables

Task 04 – Restoration

- Restore thoroughway, landscaping, and site conditions

Additional (Independent Only)

- Battery installation
- PV installation
- EV charger installation

Tasks 01–04 are identical for both systems; Tasks 05–07 are unique to the Independent System.

RESULTS

Baseline peak demand is approximately 60 kW. With PV-only, daytime demand is reduced but peak demand remains. With PV + BESS, peak demand is reduced to approximately 48 kW due to energy shifting.

COST ANALYSIS

System	Utility Cost (Secondary)	DER Cost (PV+BESS+EV)	Total Cost
Dependent	603000	-	603000
Independent	606000	1430000	2036000

The Independent System increases upfront cost due to DER integration, while the Dependent System remains the lowest-cost constructability solution.

ECONOMIC ANALYSIS

XENDEE results show PV-only provides ~3.3% savings, while PV + BESS increases savings to ~10.4%. Battery storage enables peak demand reduction and improved solar utilization. Despite higher upfront cost, the Independent System is expected to recover investment in approximately 10 years based on ~10% annual return.

KEY ASSUMPTIONS

- Utility constructs full system; customer pays secondary only
- PV: 12 kW per unit (288 kW total)
- Battery: 5 units, 125 kWh total
- EV: 24 Level 2 chargers
- Critical loads supported (not full-home backup)

CONCLUSION

The Independent System provides improved resiliency, reduced peak demand, and better long-term performance compared to the Dependent System. While initial cost is higher, the integration of PV, shared storage, and EV infrastructure offers a viable and scalable solution for future residential developments.