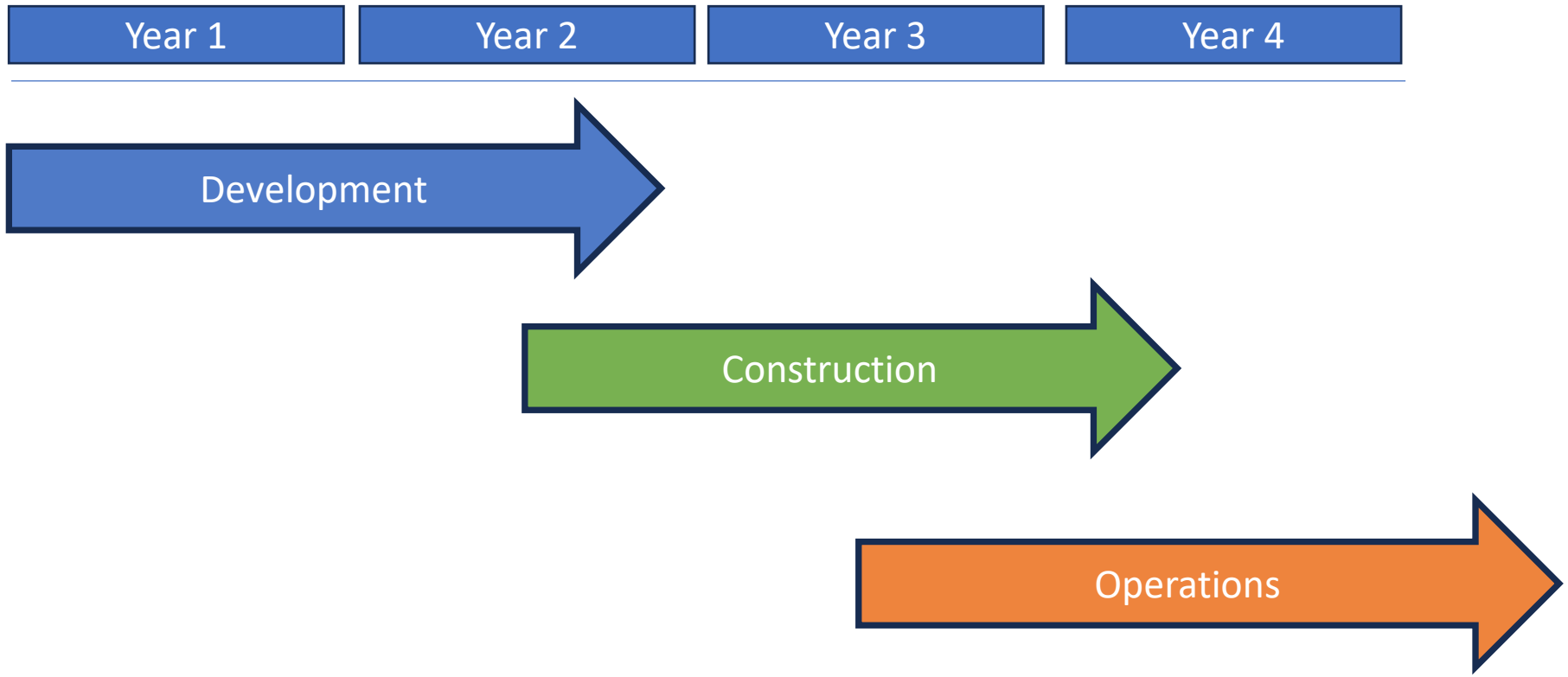
Some Considerations When Adding Solar+Storage To Housing Developments

Project Timeline



Nomenclature

- Solar – PV (Photovoltaic)
- Solar Module/Panel
- Inverters – Convert DC (solar or battery) to AC (household)
- NEM – **N**et **E**nergy **M**etering
- Storage - Battery Energy Storage System – Battery, Charge controller, inverter/converter, monitoring/communications
- Batteries/Storage
  - Capacity/Power – Expressed in kW – What's needed to get something moving, like an elevator.
  - Energy –Expressed in kWh or MWh – operation over time

Nomenclature Storage Specific Details

- **Energy capacity (kWh)** – Energy capacity is the amount of power the battery can store and is the biggest factor in the battery's price. Larger capacity batteries cost more but can power more appliances or provide backup power for a longer period of time.
- **Power output** – The power output indicates how much power (kW) the battery can deliver all at once. The higher the power output, the more devices and appliances it can power at the same time.
- **Peak power** is the amount of energy the battery can provide for a short time to handle the initial surge required by most large appliances.
- **Continuous power** is the amount of energy the battery can steadily supply.
- **Round-trip efficiency** – Round-trip efficiency is the percentage of energy stored in the battery that may be retrieved later. The higher the battery's round-trip efficiency, the less energy is lost in the storage and transfer process.
- **Depth of Discharge (DoD**) – The Depth of Discharge is the maximum percentage of the battery that can be discharged relative to its total capacity before recharging is recommended. Look for a battery with a maximum DoD of 90% or more.

Considerations

- What is the objective? Why do you want solar or storage?
- Is there a mandate or minimum size requirement.
- Common/Tenant load offsets
- NEM Status, Local Regulatory Issues
- Buy/Finance/Lease/PPA
- Available Subsidies
- Geographic Location – Weather Implications
- Internal and Contractor Solar+Storage Experience

Considerations

- Load Determination and Offset for Solar and Storage
- Solar System Physical Size & Location
- Storage System Physical Size & Location
- Landscaping, Particularly Tree Positioning
- General Contractor Experience with PV & Batteries
- Do you need an Owner’s Representative?

Development

Load Estimating

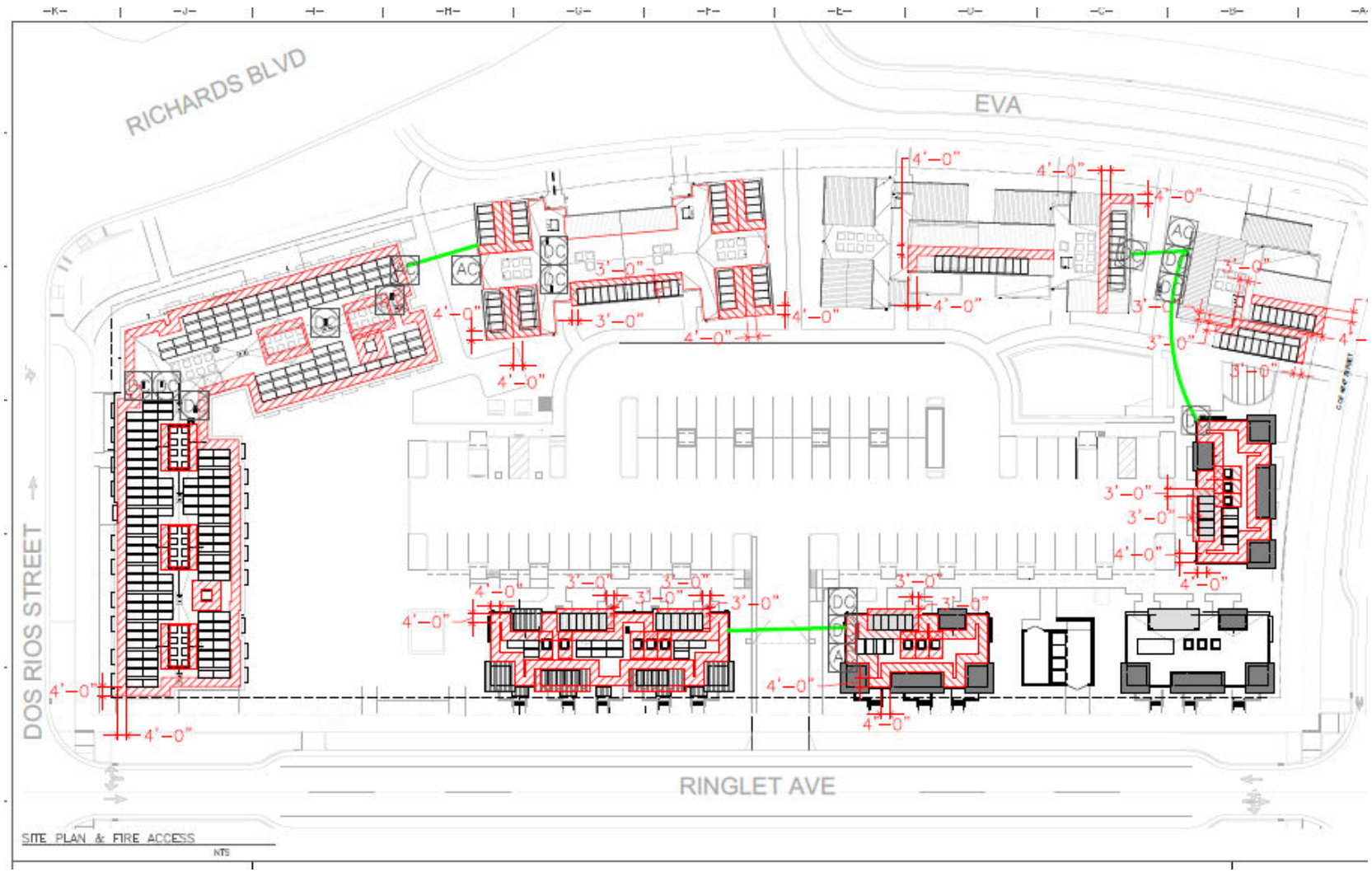
Needed for Solar and Storage Sizing

COMMON SPACES	Load	Load (W)	Daily Use (hours/day)	TOTAL kWH/Year	kWh/Day
Outdoor		**700**		**2391**	**7**
	Parking Lot Lights	650	10	2372.5	6.5
	Parking Fence Operators	50	1	18.3	0.1
Indoor		**29662**		**107415**	**294.3**
	Mini split	9000	8	26280.0	72.0
	HVAC	16200	8	47304.0	129.6
Management		**117016**		**205805**	**563.8**
	Refrigerator	429	8	1252.7	3.4
	Dishwasher	3600	1	1314.0	3.6
	Oven	19200	0.1	700.8	1.9
	Range	3150	0.1	115.0	0.3
	Microwave	3600	0.5	657.0	1.8
	Disposal	1125	0.05	20.5	0.1
	Kitchen Exhaust Fan	100	0.1	3.7	0.0
	Coffee Maker	2000	1	730.0	2.0
	Office Computers (200 w per Computer)	2000	9	6570.0	18.0
	US Computers (200 w per Computer)	1000	9	3285.0	9.0
	Data /communications/fire control	2000	24	17520.0	48.0
	Computer Lab (200 W per Computer)	2000	10	7300.0	20.0
	Television (42 in LCD)	0	8	0.0	0.0
	Swimming Pool Pump	1492	10	5445.8	14.9
	Swimming Pool Lighting	104	4	151.8	0.4
	Fitness Center	500	8	1460.0	4.0
	Television (42 in LCD)	250	8	730.0	2.0
	Maintenance Area	500	8	1460.0	4.0
	Elevator	5000	5	9125.0	25.0
	Irrigation pumps	2280	2	1664.4	4.6
	Booster pumps	13104	6	28697.8	78.6
	Copy machine/printer(LG=1)	42	8	122.6	0.3
	Security cams, comp,	2090	24	18308.4	50.2
	Bathroom hand dryer	2000	0.25	182.5	0.5
	Water heater (IWH - all combined)	18000	1.1	7227.0	19.8
	Electric Carts	900	10	3285.0	9.0
	EV Charging Stations	28800	8	84096.0	230.4
	Trash compactor	0		0.0	0.0
	Cooridor exhaust fans	500	24	4380.0	12.0

Load Determination & Battery Sizing

Estimate kWh/Building										
Building	**Lights**	**Booster**	**EV Charges**	**Jockey Pump**	**Other**	**Total (kWh/yr)**	**PV Offset Size (kW)**	**kWh/Day**	**Powerwall Equivalent**	**Solar Connected To Building**
E	16412				160868	177280	118.0	486		E
D1	3745					3745	2.5	10		E
D2	3876					3876	2.6	11		C
C	2781	28698				31479	21.0	86		C
A5	1639			1664		3303	2.2	9		A3-1
A3-1	1646		42000		18	43664	29.1	120		A3-1
A3-2	551					551	0.4	2		no solar
A3-3	551					551	0.4	2		C
						264450	**176**	**725**	**56**	

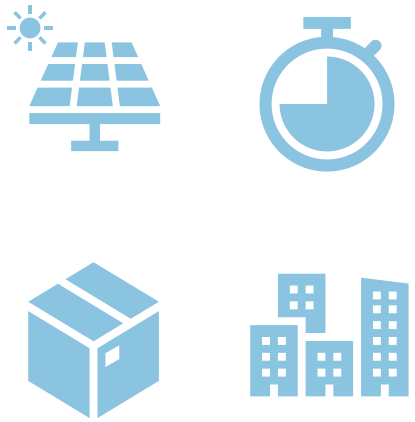
Connecting Solar Between Buildings



Development Issues

SOLAR

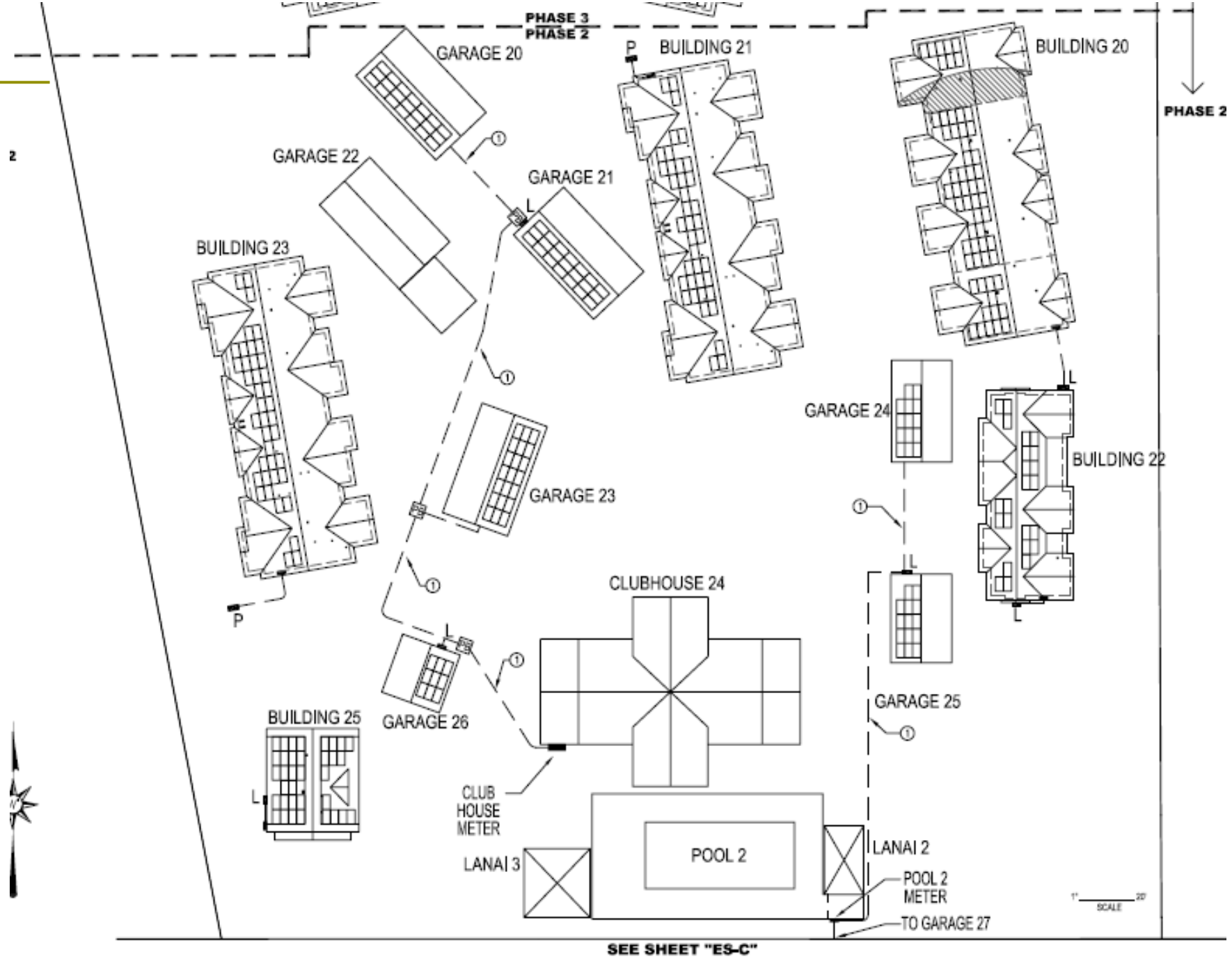
- System Size
- Location Carport, Roof, Ground
- Shading
- Connecting Solar Between Buildings
- Reduce Common Meters
- Addresses change causing permit & IX revisions/delays



STORAGE

- Load Offset
- Use - Emergency Backup, Non-Export, NEM 3.0 Time
- Space
- Fire Suppression
- Permitting Time
- Interconnection Agreement Time
- Expected Lifetime/Operations

Development



Storage Specific Items

- Solar Inverters/Controls Compatible with Storage Controls
- Storage Control Meets Use Criteria
- Chemistry : Lithium Ion, LiFeP (lithium iron phosphate), Flow
- Thermal Events
- Ambient Temperature & Exposure to Sun
- Location/Placement
  Powerwall - 4'x3'x1' 13 kWh
  PowerPack – 4 large refrigerators/custom sizing 100's to 1000's kWhs


vinyasun
TESLA
TESLA

Development Concerns

Architectural Changes Driving PV+S Changes

Changes In PV Panels Common – 18 Month Cycle

Regulatory Changes - NEM, Subsidies, Codes Associated With Storage

If Storage Is Included - Get The Subcontractor Or Owners Rep Involved ASAP

Remember Any Critical Sizing Issues (Financing Or Regulatory Mandates)

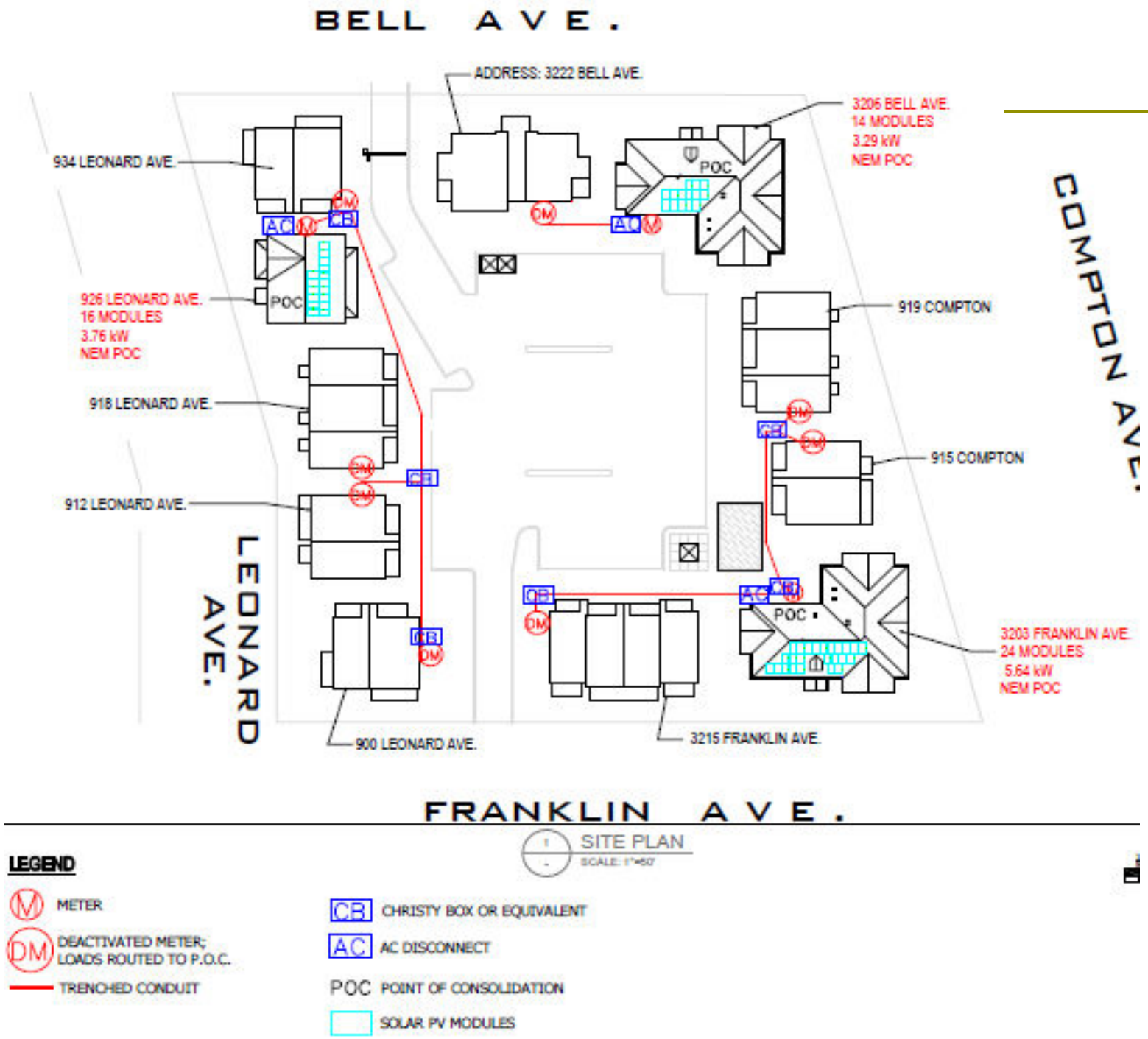
Adding Large Loads (EV Chargers)

Value Engineering

Concerns Specific to Rehab

- Get the Subcontractor or Owners Rep Involved ASAP
- Electrical Code Changes
- Regulatory Changes- NEM, Subsidies
- Replacing Original PV with New
- Roof Structural Evaluation
- Space for Equipment at Ground Level
- Partnership/Investor/”Other Interested Parties” Consent to Install
- Aesthetics

Development



11 Accounts > 3 Accounts = $2400/yr Savings

90% Common Load Offset From Solar

Solar Costs

Factors Driving Costs

- Mounting Location + Type
- Roof Type & Slope
- System/Array Size
- Single or Multi-Building
- Inverter Type
- Labor Market

Installed Cost Range

- $2/W Large Single Flat Roof
- $5/W Multiple 2kW to 10kW pitched roofs
- Carports – add $1/W

Costs – Storage (Residential Scale Systems)

Solar Battery Brand	Unit cost*(no Install)	Capacity	Warranty
Tesla Powerwall	$10,000 – $13,000	13.5 kWh	10 years70% capacity
Generac PWRcell	$10,000 – $17,000	9.0 – 18.0 kWh	10 years
LG Chem RESU	$6,000 – $11,000	9.6 – 16.0 kWh	10 years60% – 70% capacity
Enphase	$3,000 – $9,500	3.4 – 10.5 kWh	10 years70% capacity
Sonnen	$9,000 – $36,000	5.0 – 30.0 kWh	10 years & 10,000 cycles
Panasonic EverVolt	$12,000 – $13,000	4.6 – 17.1 kWh	10 years60% capacity
Simpliphi	$4,200 – $23,500	4.9 – 22.8 kW	10 years or 10,000 cycles
Eguana Evolve	$10,000 – $13,000	12.2 – 12.8 kWh	10 years60% capacity
Electriq Power	$9,800 – $22,000	10.0 – 20.0 kWh	10 years

Subsidies/Incentives

- Searchable Database By State
  - Database of State Incentives for Renewables & Efficiency®
    - https://www.dsireusa.org/
- Sales Tax Exemptions
- Property Tax/PILOT Programs
- Direct Payments based on system size
- Feed In Tariff
- IRA

Subsidies IRA

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Projects Under 1MWac															
Base ITC*	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	22.5%	15%	0%
Bonus for Meeting Domestic Content Minimums**		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Bonus for Siting in "Energy Community"		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Allocated Low-Income Bonus* **															
Low-Income Community as Defined by the New Markets Tax Credit or on Indian Land		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	7.5%	5%	0%
Qualified Low-Income Residential Building Project or Qualified Low-Income Economic Benefit Project		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	15%	10%	0%

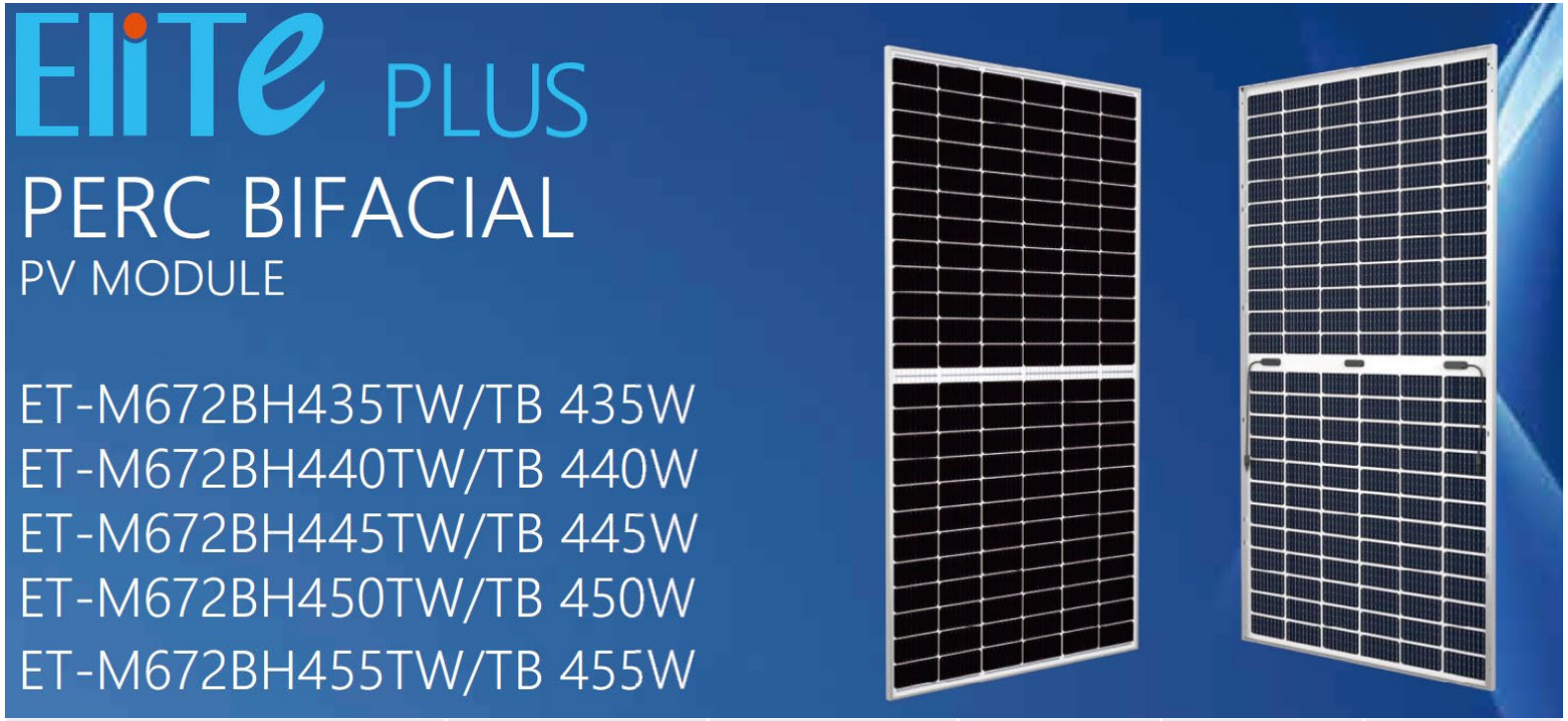
Construction - Considerations

- General Contractor/Sub-Contractor Experience
- Consider Finding Ways To Avoid Poor Quality Low Bids.
  - Craft Solar+Storage RFP, vetting subs
- Approve General Contractor/Sub-contractor contract –
  - Deliverables, monitoring, production estimates, performance guarantees, workmanship warranty
- Owner Final Sign Off Before Final Payment To Sub
  - Deliverables
  - System Operating fully
  - Monitoring Set-up
  - Monitoring access
    - Account – generic email (Green@**** or XYZ@****)
    - Administrative Level Access

Construction – Issues

- Solar Module Changes – Cost Implications
- Design Changes - Cost And Minimum Size Implications
- Subsidies/Interconnection Applications submitted
- Permitting Times For Storage Can Be 3-12 Months
- Regulatory Changes (NEM 3.0, Solar Contractor Vs Electrician)

PV Panel Cost Changes



Name Plate(W)	435	440	445	450	455
Module Cost (@$0.80)	$ 348	$ 352	$ 356	$ 360	$ 364
100kW Cost	$ 87,000	$ 88,000	$ 89,000	$ 90,000	$ 91,000

Operations – Issues

- These Systems Are Not Install and Ignore/Forget
- Property Management Focus
- Maintenance
  - Visual Inspections
  - Physical Maintenance
  - Cleaning – Panels, String Inverters, Batteries
- System Monitoring
- Utility Invoice Monitoring
- Insurance
- Warranty Work, Infant Mortality
- Investor Reports – Report Solar Savings As It May Impact Investor Federal Tax Returns

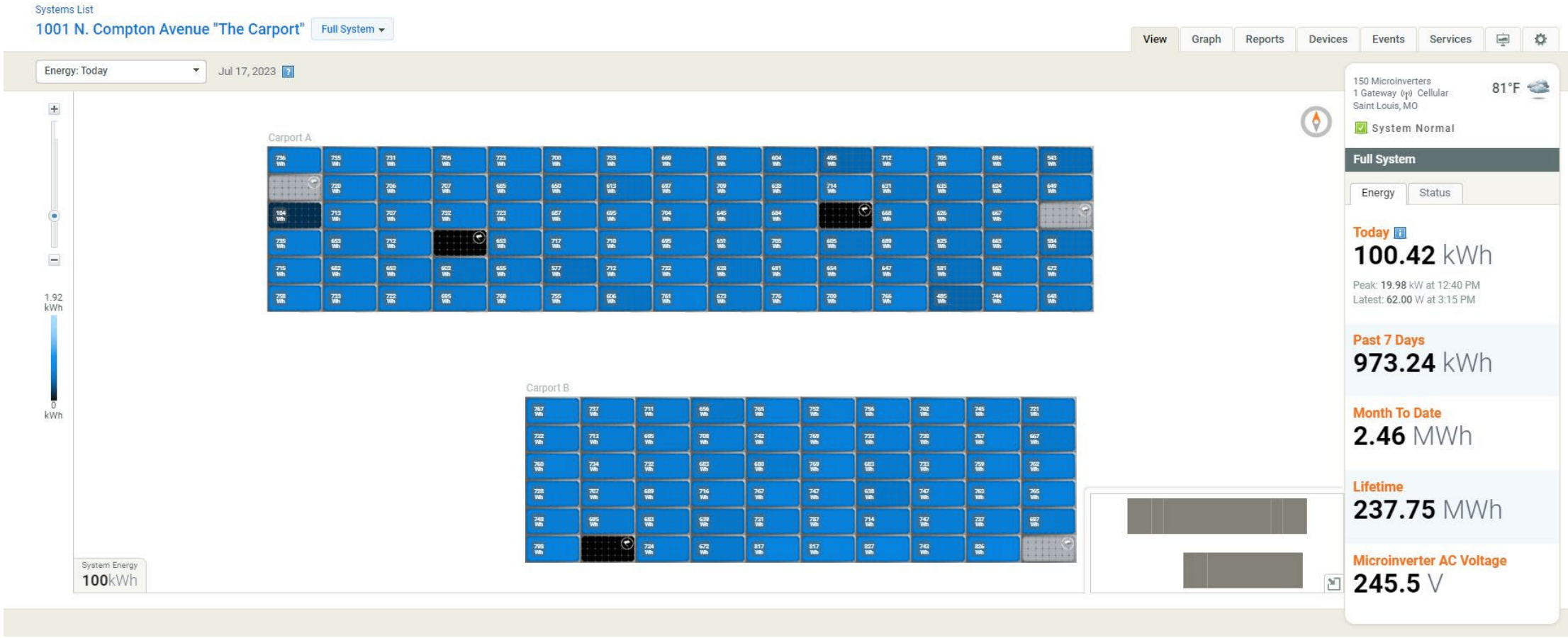
Operations – Longer Term Considerations

- Maintenance/Warranty/Damage
- Trees/Animals
- System Monitoring, Equipment Failure, Service Plan Extension
- Utility Invoice Monitoring
- Tariff and billing changes
- Regulatory Changes
- Utility Invoice Monitoring
- Recycling

Operations – Costs

- Reserve Accounts – String Inverters, Warranty Labor, Maintenance, Monitoring
- Equipment Replacement – String Inverters, Monitoring, Vandalized PV
- Maintenance/Warranty/Damage
- Trees/Animals
- System Monitoring, equipment failure, service plan extension
- Insurance

Monitoring Set-Up/Remote Viewing



Visual Inspections

Visual Inspections

Resources

- NREL - National Renewable Energy Laboratory
  - https://www.nrel.gov/
- Rocky Mountain Institute
  - https://rmi.org/
- Solar Energy Industry Association
  - https://www.seia.org/
- Database of State Incentives for Renewables & Efficiency®
  - https://www.dsireusa.org/

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