Residential Electric Services and Electrification

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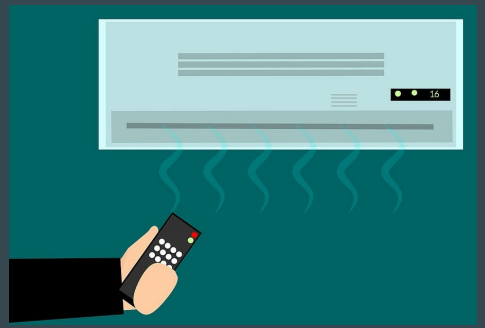
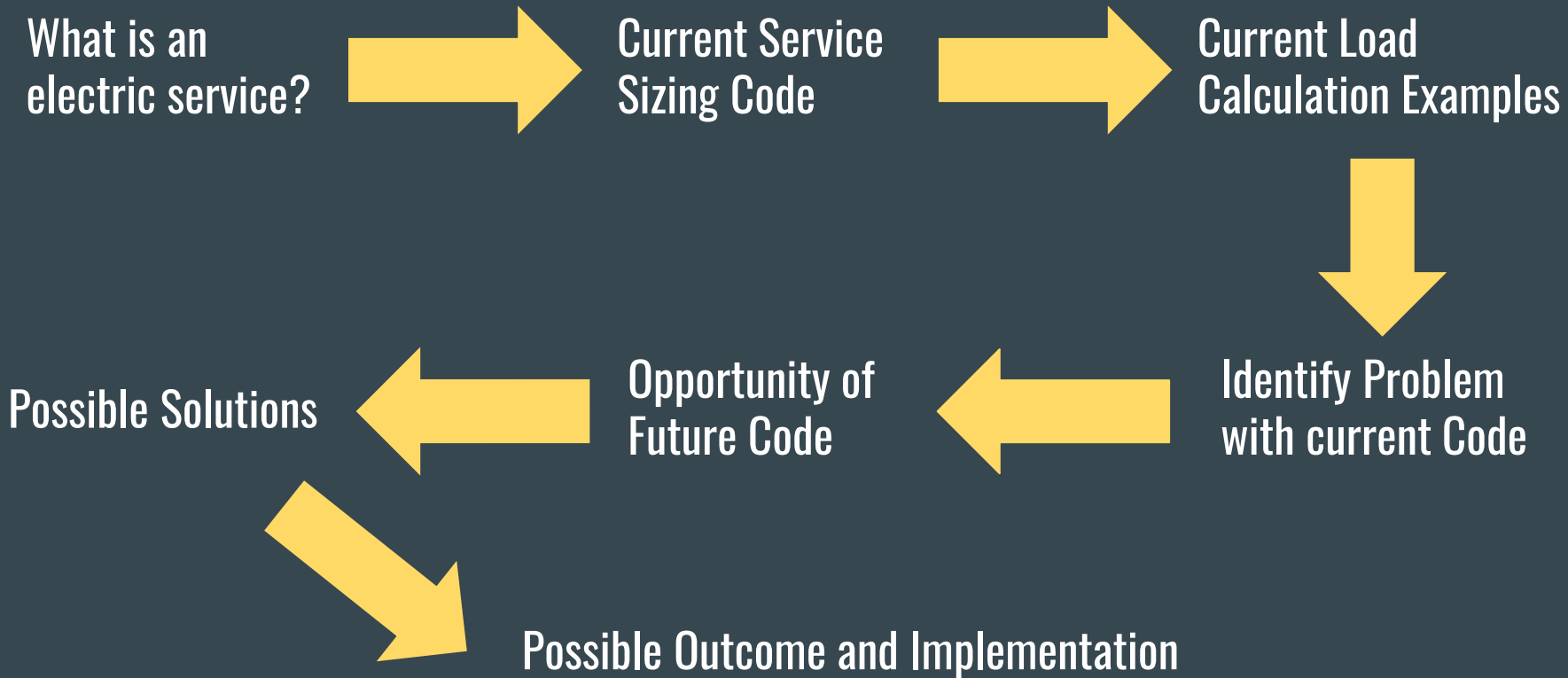
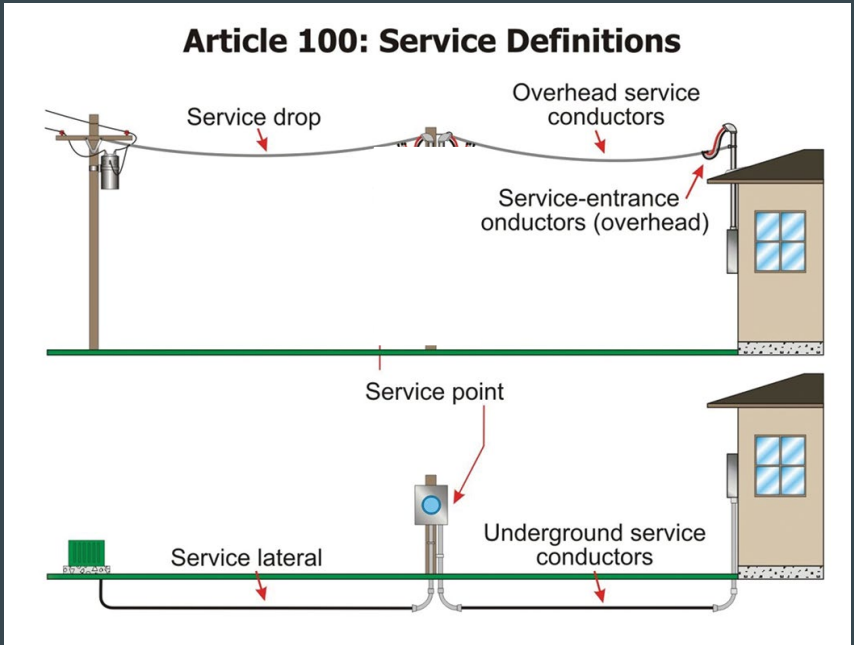


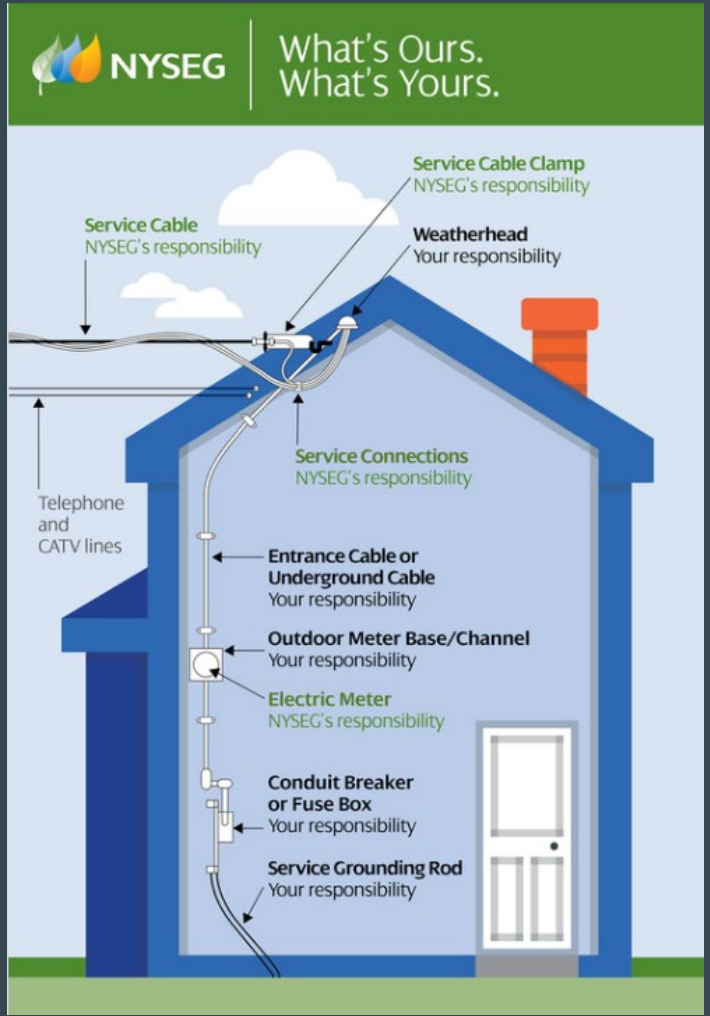
Topics


What is an electric service?
Current Service Sizing Code
Current Load Calculation Examples
Identify Problem with current Code
Opportunity of Future Code
Possible Solutions
Possible Outcome and Implementation

What is an Electric Service?

NEC 2023 definition: The conductors and equipment connecting the serving utility to the wiring of the premises served.





Varieties of Electric Services

Location of meter- pole/post, side of house, inside in basement or garage

Location of main service disconnect(s) in meter cabinet, separate panel, main breaker panel

Location of breakers/fusesexterior or interior panel

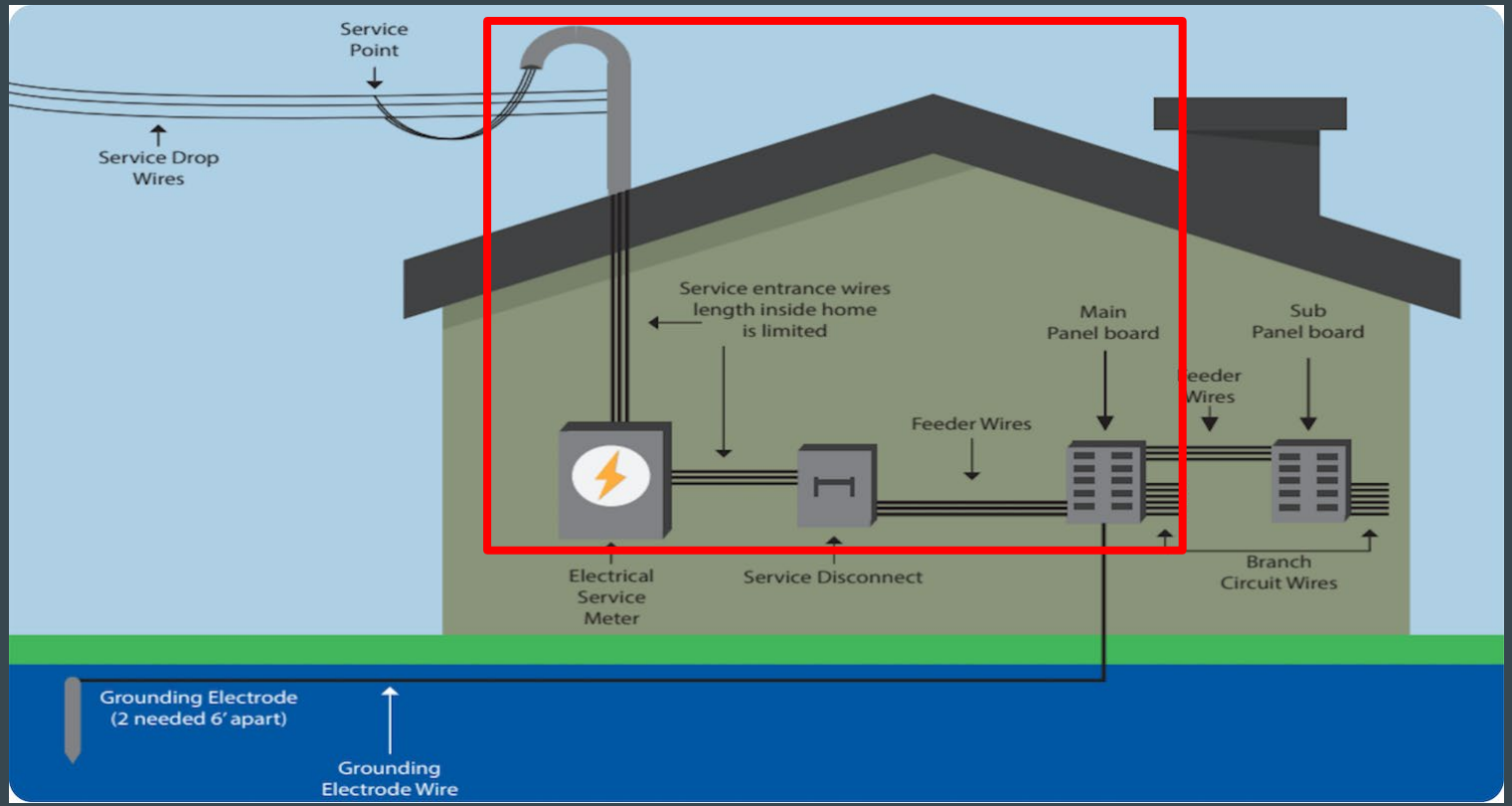
Service Size 100, 150, 200, 400+ Amps

*exterior emergency disconnect required starting in 2020 NEC





What is changed during an upgrade of an overhead service?



Energy Consumption vs Energy Capacity

Energy consumption and production is the use of energy over time typically measured in kWh. For residential services this is how you are billed.

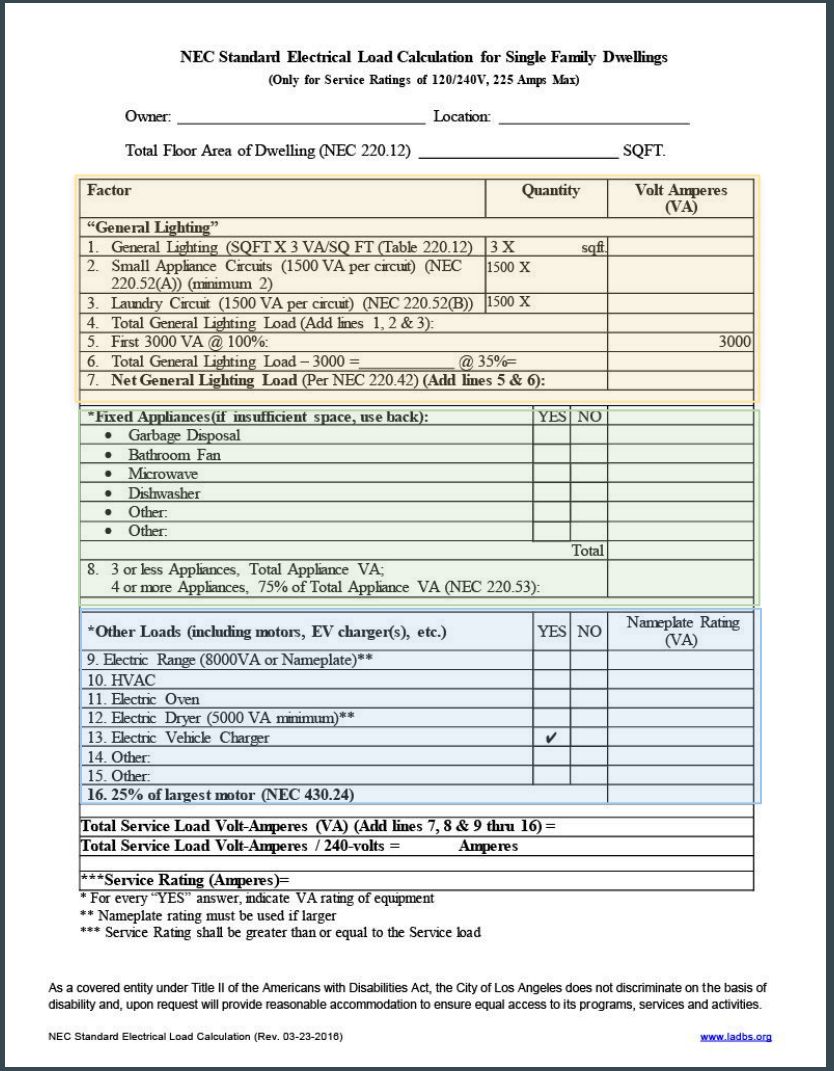
- Examples of energy production upgrades are solar, wind, hydroelectric, etc.

Energy capacity and peak demand is the instantaneous use of energy typically measured in Amps for residential services. On the utility side it is often measured in kW or kVA. Commercial services are billed by peak demand in addition to their kWh consumption.

- Examples of energy capacity upgrades are electric service, transformer and substation upgrades, wire replacement, and storage for produced energy

Electric Load Calculations

- Current Code NYS adopted NEC 2017 in 2020
- Electric service load calculation requirements are count in Article 220 Part III
- Residential load calculated in three section:
  - General lighting (includes small appliance and laundry circuits)
  - Appliance loads (other than ranges, dryers, space heating, space cooling)
  - Remaining loads (typically all 240 volt items)
- No service can be loaded more than 80% of the service size



NEC Standard Electrical Load Calculation for Single Family Dwellings

(Only for Service Ratings of 120/240V, 225 Amps Max)

Owner: _____ Location: _____

Total Floor Area of Dwelling (NEC 220.12) _____ SQFT.

Factor	Quantity	Volt Amperes (VA)
"General Lighting"		
1. General Lighting (SQFT X 3 VA/SQ FT (Table 220.12)	3 X sqft.	
2. Small Appliance Circuits (1500 VA per circuit) (NEC 220.52(A)) (minimum 2)	1500 X	
3. Laundry Circuit (1500 VA per circuit) (NEC 220.52(B))	1500 X	
4. Total General Lighting Load (Add lines 1, 2 & 3):		
5. First 3000 VA @ 100%:		3000
6. Total General Lighting Load – 3000 = _____ @ 35%=		
7. **Net General Lighting Load** (Per NEC 220.42) **(Add lines 5 & 6):**		

*Fixed Appliances (if insufficient space, use back):	YES	NO	
• Garbage Disposal			
• Bathroom Fan			
• Microwave			
• Dishwasher			
• Other:			
• Other:			
		Total	
8. 3 or less Appliances, Total Appliance VA; 4 or more Appliances, 75% of Total Appliance VA (NEC 220.53):			

*Other Loads (including motors, EV charger(s), etc.)	YES	NO	Nameplate Rating (VA)
9. Electric Range (8000VA or Nameplate)**			
10. HVAC			
11. Electric Oven			
12. Electric Dryer (5000 VA minimum)**			
13. Electric Vehicle Charger	✓		
14. Other:			
15. Other:			
16. 25% of largest motor (NEC 430.24)			

Total Service Load Volt-Amperes (VA) (Add lines 7, 8 & 9 thru 16) =

Total Service Load Volt-Amperes / 240-volts = Amperes

***Service Rating (Amperes)=**

* For every "YES" answer, indicate VA rating of equipment

** Nameplate rating must be used if larger

*** Service Rating shall be greater than or equal to the Service load

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NEC Standard Electrical Load Calculation (Rev. 03-23-2016) www.ladbs.org

Example: Fossil Fuel Non-Electrified Home

House Details: 2000 square feet, kitchen, laundry, microwave, dishwasher, well pump

Fossil Fuel Appliances: gas furnace, gas range, gas dryer, gas water heater, ICE vehicle

"General Lighting"

	Watts/VA
General lighting	3 x 2000 sq.ft. 6000
Small appliance	1500 x 2 3000
Laundry	1500 x 1 1500
Total	10500

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400
Total	2400

Total Watts 9525

Amps 39.7

Other Loads

	Watts/VA
Electric Range	0
Electric Dryer	0
EV	0
Water Heater	0
Well Pump	1500

Space Heating

Example: Fully Electrified Home

House Details: 2000 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 4-zone ASHP, induction range, dryer, HPWH, One EV, bathroom heater

"General Lighting"

	Watts/VA
General lighting	3 x 2000 sq.ft. 6000
Small appliance	1500 x 2 3000
Laundry	1500 x 1 1500
Total	10500

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400
Total	2400

Total Watts 51,685

Amps 215.4

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (Level 2)	11520
Water Heater	4500
Well Pump	1500

Space Heating(ASHP + supplemental) 13140

Example: Fully Electrified Home - Load Managed - no bathroom heat

House Details: 2000 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 4-zone ASHP, induction range, dryer, HPWH, One EV

"General Lighting"

	Watts/VA	
General lighting	6000	3 x 2000 sq.ft.
Small appliance	3000	1500 x 2
Laundry	1500	1500 x 1
Total	10500	
First 3000 @ 100%		

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400
Total	2400

Total Watts 38,665

Amps 161.1

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (Level 2) load managed	0
Water Heater	4500
Well Pump	1500

Space Heating(ASHP)

Example: Fully Electrified Home - Load Managed - no bathroom heat

House Details: 1800 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 4-zone ASHP, induction range, dryer, HPWH, One EV

"General Lighting"

	Watts/VA	
General lighting	5400	3 x 1800 sq.ft.
Small appliance	3000	1500 x 2
Laundry	1500	1500 x 1
Total	9900	

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400
Total	2400

Total Watts 38,455

Amps 160.2

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (level 2) load managed	0
Water Heater	4500
Well Pump	1500

Space Heating(ASHP)

Example: Larger Fully Electrified Home

House Details: 2500 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 5-zone ASHP, induction range, dryer, HPWH, One EV, 2x bathroom heater

"General Lighting"

	Watts/VA	
General lighting	7500	3 x 2500 sq.ft.
Small appliance	3000	1500 x 2
Laundry	1500	1500 x 1
Total	12000	

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400

Total Watts

56,710

Amps

236.3

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (Level 2)	11520
Water Heater	4500
Well Pump	1500

Space Heating(ASHP + supplemental) 17640

Problem Identification

- Peak Demand on the Grid will increase drastically with electrification
- Rolling blackouts and brownouts are expected if upgrades to the grid are delayed
- Upgrades are often required with current code
- Grid upgrades will be paid for by taxpayers and ratepayers
- Building upgrades will be paid for by homeowners and building owners

Opportunity: NEC 2023 Changes to Service Sizing

New to 2023 is section 220.70 which is at the very end of Article 220 Part III. It states:

"220.70 Energy Management Systems (EMSs). If an energy management system (EMS) is used to limit the current to a feeder or service in accordance with 750.30, a single value equal to the maximum ampere setpoint of the EMS shall be permitted to be used in load calculations for the feeder or service.

The setpoint value of the EMS shall be considered a continuous load for the purposes of load calculations."

Example: Larger Fully Electrified Home

House Details: 2500 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 5-zone ASHP, induction range, dryer, HPWH, One EV, 2x bathroom heater

"General Lighting"

	Watts/VA	
General lighting	7500	3 x 2500 sq.ft.
Small appliance	3000	1500 x 2
Laundry	1500	1500 x 1
Total	12000	

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400

Total Watts

56,710

Amps

236.3

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (Level 2)	11520
Water Heater	4500
Well Pump	1500

Space Heating(ASHP + supplemental) 17640

Example: Larger Fully Electrified Home

House Details: 2500 square feet, kitchen, laundry, microwave, dishwasher, well pump

Electric Appliances: 5-zone ASHP, induction range, dryer, HPWH, One EV, 2x bathroom heater

"General Lighting"

	Watts/VA	
General lighting	7500	3 x 2500 sq.ft.
Small appliance	3000	1500 x 2
Laundry	1500	1500 x 1
Total	12000	

First 3000 @ 100%

Fixed Appliances

	Watts/VA
Microwave	1000
Dishwasher	1400

Total Watts

~~Total 3400~~ 37,700

Amps

157.1

Other Loads

	Watts/VA
Electric Range	8000
Electric Dryer	5000
EV (Level 2) load managed	0
Water Heater load managed	0
Well Pump	1500

Space Heating(ASHP+ load managed ER 14650

Difference in peak demand for one house

House not load managed peak demand is 236.3

House load managed peak demand capped at 160 with EMS

That is a difference of 76.3 amps which is 18.3 kW of peak demand reduced for a single house with little to no effect to the homeowner.

When this is extrapolated to many home this is a huge relief to the grid, especially when combined with utility scale storage.

Possible Solutions

State level action: Implementing NEC 2023

State level action: Amend NEC 2017 to include NEC 2023 sections 220.70, 750.30(C) and 750.30(D)

Local level action: local law or ordinance doing the above
- Executive Law §379 authorizes the legislative body of a local government (city, town, village, and Nassau County) to enact or adopt local laws and ordinances that impose standards for construction that are "higher" or "more restrictive" than the corresponding standards imposed by the Uniform Code.

Local level action: educate local code enforcement officers about this change and encourage their acceptance of 2023 EMS allowance.

Devices Solutions

Span Smart Panel - already approved and listed for this purpose

EV only manager - already approved and listed for this purpose

Expected Industry

- Because this change is new as of this year, I expect more options to become available through other manufacturers
- More smart panel options
- More EMS devices for individual circuits of homeowner choosing

Code Enforcement Feedback

City of Ithaca - have not been able to ask, electric inspector is out for surgery

Town of Ithaca - said they did not believe that the 2023 change falls into the more restrictive category, but would look into it

Outside of Town and City - we have never been required to produce a load calculation when a 200 amp service is installed, so little-to-no oversight/enforcement, usually third party inspectors so depends on the inspector

- There is an argument that can be made that this is more restrictive but I would recommend checking with a lawyer (can the county help with this)

Outcome and Implementation

Outcomes possible if implemented:

- Peak Demand will be reduced when compared to EMS not installed
- Decreased need for grid upgrades
- Potential avoided replacement cost for homeowners
- Potential utility control for opt-in ratepayers as needed to smooth peak demand

What action the Legislature can take to help the solution get implemented:

- Resolution to state encouraging code change through Legislature vote
- Educate local officials of their authority on code enforcement
- Draft sample local law for municipalities to adopt code change