Fixes applied to all files

- Spelling errors in names corrected, names otherwise standardized to match campus map
- Split into two files for power (kW) and energy (kWh)
- NaNs removed
- Boeing and NC:UVA columns removed
- DST gap/duplicates fixed
    - There's an hour that doesn't exist in March and an hour that happens twice in November. Theoretically, all the existing data could be used by just shifting every point between March and November back an hour. There are a few reasons for not doing this.
        - Every meter has an hour-long gap in the "duplicate" hour in November. I guess they don't like it when the timestamp they're trying to record matches an existing timestamp. Or maybe this is intentional behavior. Either way, there's no data for the hour starting at 2 am on 11/06 (the one that becomes 1 am, so it has the same timestamps as the hour before it).
        - There's no data for 2-3 am on 3/13 because that hour didn't exist. Dealing with missing data is something we already have to do in a lot of other places, so it can use the same protocol to get back to a normal 24-hour day.
        - Most importantly, a trend that happens at the same time every day depends on the local time, not the total time that has elapsed in the year. If the same energy spike happens at the same time in the same building every single day, moving every data point back an hour would obscure that trend. **NOTE: My original data cleaning and graphing made this error unintentionally. Don't use graphs generated from fall for final stuff.**
    - Better fix: Delete the duplicate hour because there's no data there anyway. Treat the missing hour like any other missing data.
        - If missing data is not corrected: Blank hour is added, blank.
        - If missing data is corrected: Blank hour is added with realistic values.
- Obviously wrong values removed
- In the EV charging data, the last data points of the last two days of the year (12/30 11:45 pm and 12/31 11:45 pm) are missing
- Several times, the kWh meters went down and came back up after a gap. In some cases, the energy used during the gap is all recorded at the time it comes back online. To correct this, I have spread the energy used evenly across the gap. While it's reasonable that after a power failure, more energy would be used at once when the power comes back, in most cases, the spike is so high that this is definitely not the case.
    - For the existing solar panels, an example is a sudden spike to over 100 kWh for a single 15-minute period at 11:30 pm after a sudden drop to 0 kWh and a constant 0 kWh for 6 hours.

Document names

- Basic split: just the fixes named above, no missing data corrected
- TBD

Buildings to be analyzed file

- Bookstein Hall, Chaparral Hall, Nordhoff Hall, Oviatt Library, Santa Susana Hall, Valera Hall, and the Valley Performing Arts Center were all misspelled in the list they gave us, along with a couple more obvious misspellings. Listing them here for reference when naming them by memory and whatnot
- Oviatt Library was renamed to just University Library because apparently Oviatt was racist (this is probably like a Marvin Center -> USC situation where nobody will care if we say the wrong name, but just FYI)
- In the reverse situation, University Hall was renamed Valera Hall in 2021 and the Valley Performing Arts Center was renamed to The Soraya in 2017
- There's some confusing stuff with the parking lots/structures.
    - PL 2 - They meant to write B2. Renaming it accordingly.
    - PL:E6 or PL:E7 - This one is named "Parking Lot E6" and says it's named PL:E6 in the data and PL:E7 on the map. There is no E7 on the map and the square that would be E7 is just houses. Renaming this one to PL:E6 everywhere.
    - PL:B3 or PL:B4 - This one is named "Parking Lot B3" and says it's named PL:B3 in the data and PL:B4 in the map. Unfortunately, unlike E6/E7, both lots B3 and B4 do exist. I'm going with what's in the data here (the corresponding column is named B3). Renaming this one to PL:B3.
    - PS:G3 or PS:G4 - There is no parking structure G4, just a lot. G3 matches the data. Renaming to PS:G3.
- Boeing site solar - Says defunct, and the data is 0.0 for the whole year. Since it's also outside of our available construction range, I'm removing this entirely.
- NC:UVA has energy usage, but no entry in the name list. NC:H and NC:R have both data and entries. All three are outside of our construction range. Confusingly, the original version of the file included NC:UVA. They intentionally removed it, but forgot(?) to remove the corresponding data. I will assume their intent was to remove it entirely. If this was the wrong choice, it won't change the totals much because NC:UVA used very, very little energy.
- See above for PL:G3. I'd guess this one was removed because it only had data for half the year. I have removed the PL:G3 data.
- See above again for Monterey Hall. This only has kWh data every hour and no kW data. I'm removing it from the spreadsheet. It's also outside our construction range.
- PL:B3 has no data, despite having an entry in the spreadsheet. Removing this one for convenience.
- See above for SN (Santa Susana Hall)
- See above for SUC (Sustainability Center)
- MDF has data but no entry. Added to building list.

Actual list of buildings we can put solar on. They removed some buildings from v2 of the list that supposedly dictates this (according to the updated use case info), but didn't update the total

count in the use case. Also, some buildings seem to have been removed just for having incomplete data, which isn't a likely reason to disqualify them from solar, and some of the buildings in the list are ones we can't build on anyway, but they're still included in the count of 43. Based on all this, I don't think these choices were double-checked. So, I've made some educated guesses and put notes as necessary.

Definitely allowed:

- Art and Design Center
- Arbor Grill
- Bookstein Hall
- Bayramian Hall
- Campus Store Complex
- Donald Bianchi Planetarium
- Chaparral Hall
- Citrus Hall
- Cypress Hall
- Education
- Eucalyptus Hall
- Jacaranda Hall
- Jerome Richfield Hall
- Lilac Hall
- Live Oak Hall
- Magnolia Hall
- Manzanita Hall
- Nordhoff Hall
- University Library
- Parking Lot B2
- Parking Lot B3
- Parking Lot E6
- Physical Plant Management
- Parking Structure B3
- Parking Structure B5
- Parking Structure G3
- Redwood Hall
- Santa Susana Hall
- Sierra Center
- Sierra Hall
- Sequoia Hall
- Student Recreation Center
- Sierra Tower
- Sustainability Center
- Valera Hall
- University Student Union
- The Soraya

Probably allowed:

- Parking Lot G3
    - Removed from the updated list of buildings, but not removed from the data.

Might be allowed:

- Main Distribution Center

https://github.com/xelaphon/solar-cup ← the old versions of everything are in here so will update

(these will be color-coded on the map)

- Color code prices on map
- This week: Match prices based on rate schedule
- Test comparison with old data
- Add hour/minute as separate data
- Next week: EV charging

Notable: there are limits on how much of a rebate you can get from EV charging (https://www.ladwp.com/commercial-services/programs-and-rebates-commercial/commercial-ev-charging/commercial-ev-charging-station-rebate-program)

https://codes.iccsafe.org/content/CAFC2019JUL21S/chapter-9-fire-protection-and-life-safety-systems

SECTION 1204
SOLAR PHOTOVOLTAIC POWER SYSTEMS

1204.1 General. Solar photovoltaic systems shall be installed in accordance with Sections 1204.2 through 1204.5, and the *California Building Code* or *California Residential Code*. The electrical portion of solar PV systems shall be installed in accordance with the *California Electrical Code*.

1204.2 Access and pathways. Roof access, pathways, and spacing requirements shall be provided in accordance with Sections 1204.2.1 through 1204.3.3. Pathways shall be over areas capable of supporting fire fighters accessing the roof. Pathways shall be located in areas with minimal obstructions, such as vent pipes, conduit or mechanical equipment.

Exceptions:

1. Detached, nonhabitable Group U structures including, but not limited to, detached garages serving Group R-3 buildings, parking shade structures, carports, solar trellises and similar structures.
2. Roof access, pathways and spacing requirements need not be provided where the fire code official has determined that rooftop operations will not be employed.

1204.2.1 Solar photovoltaic systems for Group R-3 buildings. Solar photovoltaic systems for Group R-3 buildings shall comply with Sections 1204.2.1.1 through 1204.2.1.3.

Exceptions:

1. These requirements shall not apply to structures designed and constructed in accordance with the *California Residential Code*.
2. These requirements shall not apply to roofs with slopes of 2 units vertical in 12 units horizontal or less.

1204.2.1.1 Pathways to ridge. Not fewer than two 36-inch-wide (914 mm) pathways on separate roof planes, from lowest roof edge to ridge, shall be provided on all buildings. Not fewer than one pathway shall be provided on the street or driveway side of the roof. For each roof plane with a photovoltaic array, not fewer than one 36-inch-wide (914 mm) pathway from lowest roof edge to ridge shall be provided on the same roof plane as the photovoltaic array, on an adjacent roof plane or straddling the same and adjacent roof planes.

1204.2.1.2 Setbacks at ridge. For photovoltaic arrays occupying 33 percent or less of the plan view total roof area, a setback of not less than 18 inches (457 mm) wide is required on both sides of a horizontal ridge. For photovoltaic arrays occupying more than 33 percent of the plan view total roof area, a setback of not less than 36 inches (457 mm) wide is required on both sides of a horizontal ridge.

1204.2.1.3 Alternative setbacks at ridge. Where an automatic sprinkler system is installed within the dwelling in accordance with Section 903.3.1.3, setbacks at the ridge shall conform to one of the following:

1. For photovoltaic arrays occupying 66 percent or less of the plan view total roof area, a setback of not less than 18 inches (457 mm) wide is required on both sides of a horizontal ridge.
2. For photovoltaic arrays occupying more than 66 percent of the plan view total roof area, a setback of not less than 36 inches (914 mm) wide is required on both sides of a horizontal ridge.

1204.2.2 Emergency escape and rescue openings. Panels and modules installed on Group R-3 buildings shall not be placed on the portion of a roof that is below an emergency escape and rescue opening. A pathway of not less than 36 inches (914 mm) wide shall be provided to the emergency escape and rescue opening.

1204.2.3 Locations of DC conductors. *Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. Conduit runs between sub arrays and to DC combiner boxes shall be installed in a manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes shall be located such that conduit runs are minimized in the pathways between arrays. DC wiring shall be installed in metallic conduit or raceways when located within enclosed spaces in a building. Conduit shall run along the bottom of load bearing members.*

1204.3 Other than Group R-3 buildings. Access to systems for buildings, other than those containing Group R-3 occupancies, shall be provided in accordance with Sections 1204.3.1 through 1204.3.3.

Exception: Where it is determined by the fire code official that the roof configuration is similar to that of a Group R-3 occupancy, the residential access and ventilation requirements in Sections 1204.2.1.1 through 1204.2.1.3 are a suitable alternative.

1204.3.1 Perimeter pathways. There shall be a minimum 6-foot-wide (1829 mm) clear perimeter around the edges of the roof.

Exception: Where either axis of the building is 250 feet (76 200 mm) or less, the clear perimeter around the edges of the roof shall be permitted to be reduced to a minimum width of 4 feet (1219 mm).

1204.3.2 Interior pathways. Interior pathways shall be provided between array sections to meet the following requirements:

1. Pathways shall be provided at intervals not greater than 150 feet (45 720 mm) throughout the length and width of the roof.
2. A pathway not less than 4 feet (1219 mm) wide in a straight line to roof standpipes or ventilation hatches.
3. A pathway not less than 4 feet (1219 mm) wide around roof access hatches, with not fewer than one such pathway to a parapet or roof edge.

1204.3.3 Smoke ventilation. The solar installation shall be designed to meet the following requirements:

1. Where nongravity-operated smoke and heat vents occur, a pathway not less than 4 feet (1219 mm) wide shall be provided bordering all sides.
2. Smoke ventilation options between array sections shall be one of the following:
    2.1. A pathway not less than 8 feet (2438 mm) wide.

2.2. Where gravity-operated dropout smoke and heat vents occur, a pathway not less than 4 feet (1219 mm) wide on not fewer than one side.

2.3. A pathway not less than 4 feet (1219 mm) wide bordering 4-foot by 8-foot (1219 mm by 2438 mm) venting cutouts every 20 feet (6096 mm) on alternating sides of the pathway.

1204.3.4 Locations of DC conductors. *Conduit, wiring systems, and raceways for photovoltaic circuits shall be located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall to reduce trip hazards and maximize ventilation opportunities. Conduit runs between sub arrays and to DC combiner boxes shall be installed in a manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box. The DC combiner boxes shall be located such that conduit runs are minimized in the pathways between arrays. DC wiring shall be installed in metallic conduit or raceways when located within enclosed spaces in a building. Conduit shall run along the bottom of load bearing members.*

1204.4 Ground-mounted photovoltaic panel systems. Ground-mounted photovoltaic panel systems shall comply with Section 1204.1 and this section. Setback requirements shall not apply to ground-mounted, free-standing photovoltaic arrays. A clear, brush-free area of 10 feet (3048 mm) shall be required for ground-mounted photovoltaic arrays.

1204.5 Buildings with rapid shutdown. Buildings with rapid shutdown solar photovoltaic systems shall have permanent labels in accordance with Sections 1204.5.1 through 1204.5.3.

1204.5.1 Rapid shutdown type. The type of solar photovoltaic system rapid shutdown shall be labeled with one of the following:

1. For solar photovoltaic systems that shut down the array and the conductors leaving the array, a label shall be provided. The first two lines of the label shall be uppercase characters with a minimum height of $^{3}/_{8}$ inch (10 mm) in black on a yellow background. The remaining characters shall be uppercase with a minimum height of $^{3}/_{16}$ inch (5 mm) in black on a white background. The label shall be in accordance with Figure 1204.5.1(1) and state the following:

   SOLAR PV SYSTEM EQUIPPED
   WITH RAPID SHUTDOWN.
   TURN RAPID SHUTDOWN SWITCH
   TO THE "OFF" POSITION TO SHUT
   DOWN PV SYSTEM AND REDUCE
   SHOCK HAZARD IN ARRAY.

2. For photovoltaic systems that only shut down conductors leaving the array, a label shall be provided. The first two lines of the label shall be uppercase characters with a minimum height of $^{3}/_{8}$ inch (10 mm) in white on a red background and the remaining characters shall be capitalized with a minimum height of $^{3}/_{16}$ inch (5 mm) in black on a white background. The label shall be in accordance with Figure 1204.5.1(2) and state the following:

   THIS SOLAR PV SYSTEM EQUIPPED
   WITH RAPID SHUTDOWN. TURN RAPID
   SHUTDOWN SWITCH TO THE "OFF"
   POSITION TO SHUT DOWN CONDUC-
   TORS OUTSIDE THE ARRAY. CONDUC-
   TORS WITHIN ARRAY REMAIN
   ENERGIZED IN SUNLIGHT.

1204.5.1.1 Diagram. The labels in Section 1204.5.1 shall include a simple diagram of a building with a roof. Diagram sections in red signify sections of the solar photovoltaic system that are not shut down when the rapid shutdown switch is turned off.

1204.5.1.2 Location. The rapid shutdown label in Section 1204.5.1 shall be located not greater than 3 feet (914 mm) from the service disconnecting means to which the photovoltaic systems are connected, and shall indicate the location of all identified rapid shutdown switches if not at the same location.

1204.5.2 Buildings with more than one rapid shutdown type. Solar photovoltaic systems that contain rapid shutdown in accordance with both Items 1 and 2 of Section 1204.5.1 or solar photovoltaic systems where only portions of the systems on the building contain rapid shutdown, shall provide a detailed plan view diagram of the roof showing each different photovoltaic system and a dotted line around areas that remain energized after the rapid shutdown switch is operated.

1204.5.3 Rapid shutdown switch. A rapid shutdown switch shall have a label located not greater than 3 feet (914 mm) from the switch that states the following:

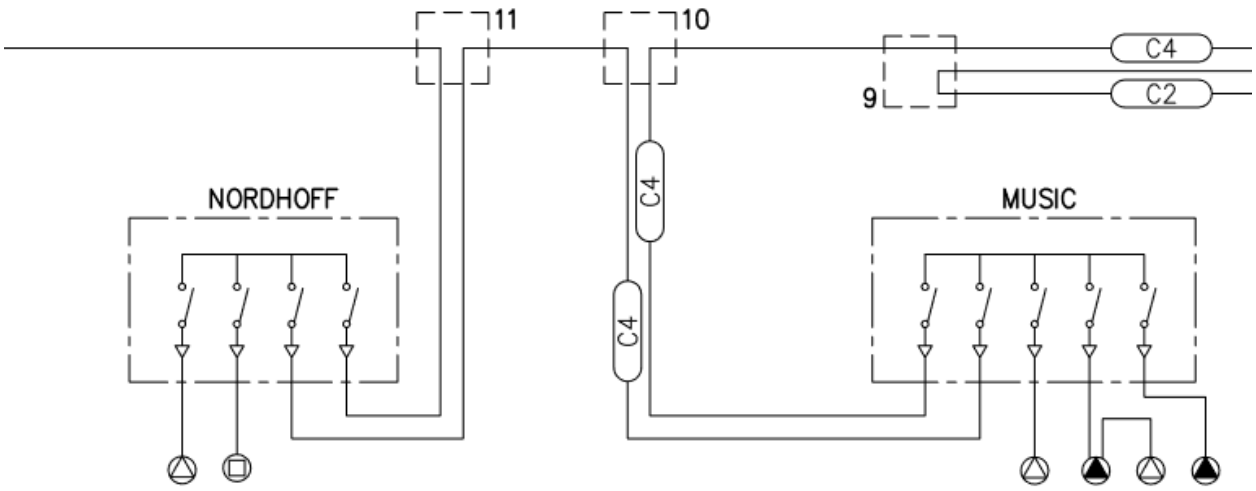
RAPID SHUTDOWN SWITCH
FOR SOLAR PV SYSTEM

1205.8 Outdoor installation. Stationary fuel cell power systems located outdoors shall be separated by not less than 5 feet (1524 mm) from the following:

1. Lot lines.
2. Public ways.
3. Buildings.
4. Stored combustible materials.
5. Hazardous materials.
6. High-piled stock.
7. Any portion of a designated means of egress system.
8. Other exposure hazards.

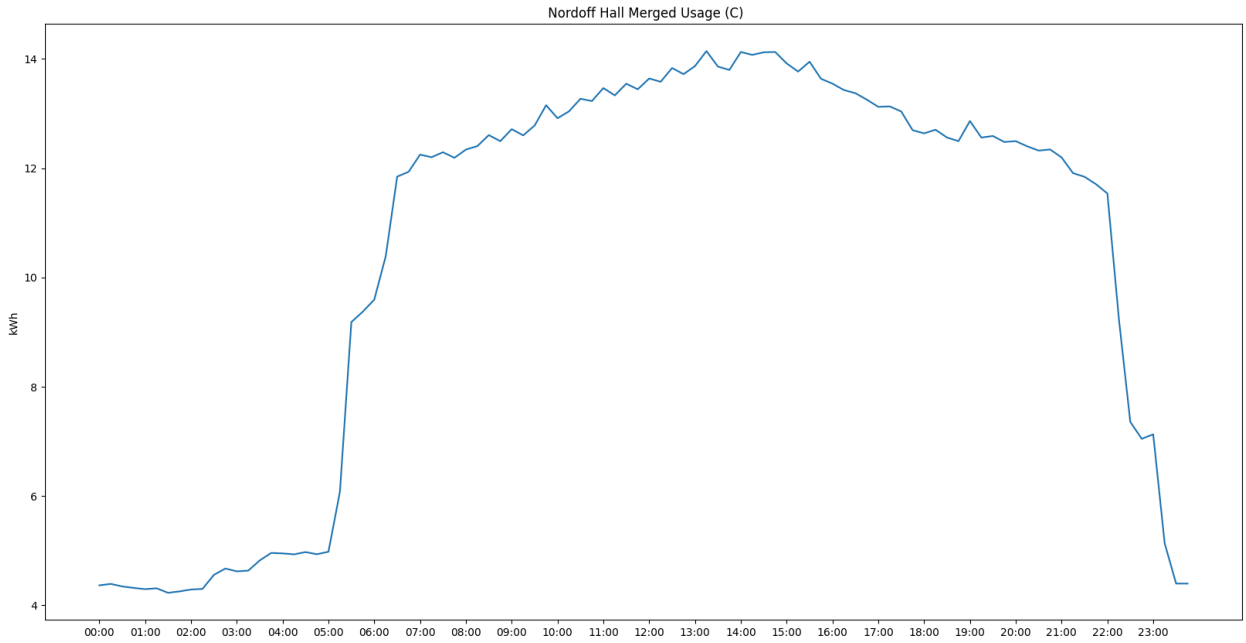
I'm pretty sure the buildings we care about are all non-R3, so the stuff we care about is:

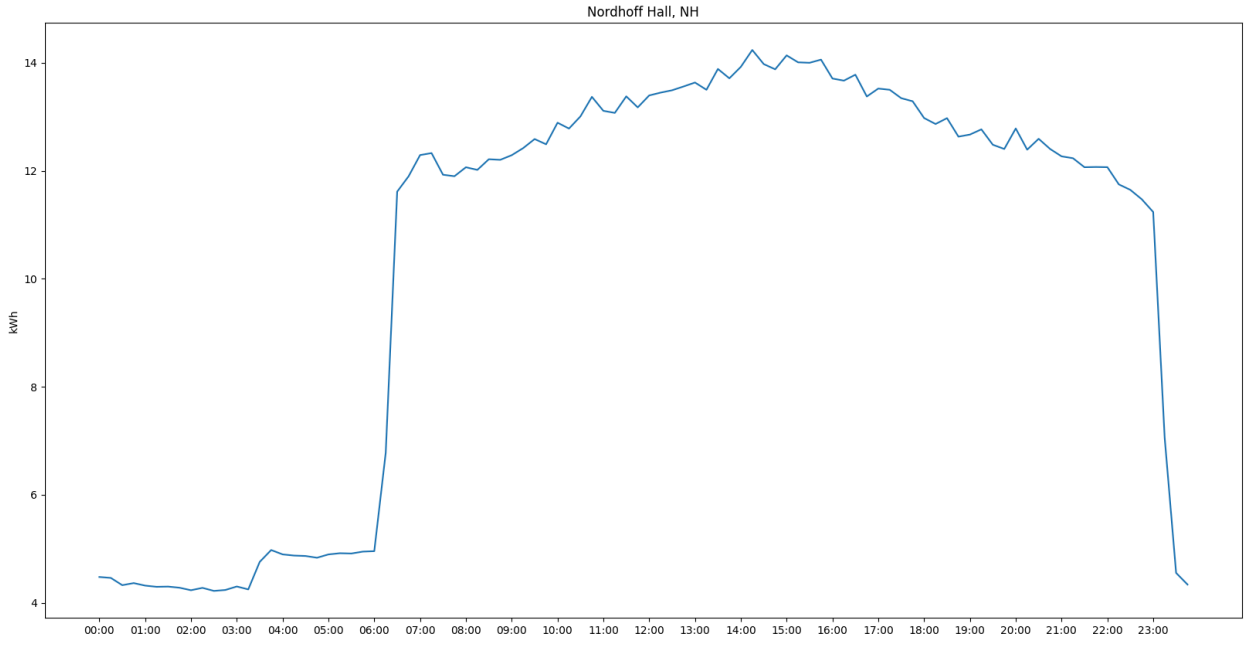
- 6 ft perimeter setback
    - Unless either axis of the building is less than 250 ft, in which case it can be 4 ft
- Pathways at least every 150 ft in both directions between array sections
    - Pathways need to be 8 ft wide?
- Pathways (4 ft wide) in straight lines to roof standpipes, ventilation hatches, and roof access hatches (must be able to get to the roof edge from the access hatch)
- Must be a 4 ft pathway bordering non-gravity-operated smoke and heat vents
- Ground systems require 10 ft perimeter?
- Batteries must be at least 5 ft from roads, buildings, exits, and hazards



^ Single line diagrams provided - find out what the switches mean? Also, compare with node map and see if the numbers are the same

Result of correcting for daylight savings time:




Nordhoff Hall, NH
kWh
14
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10
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6
4
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05:00
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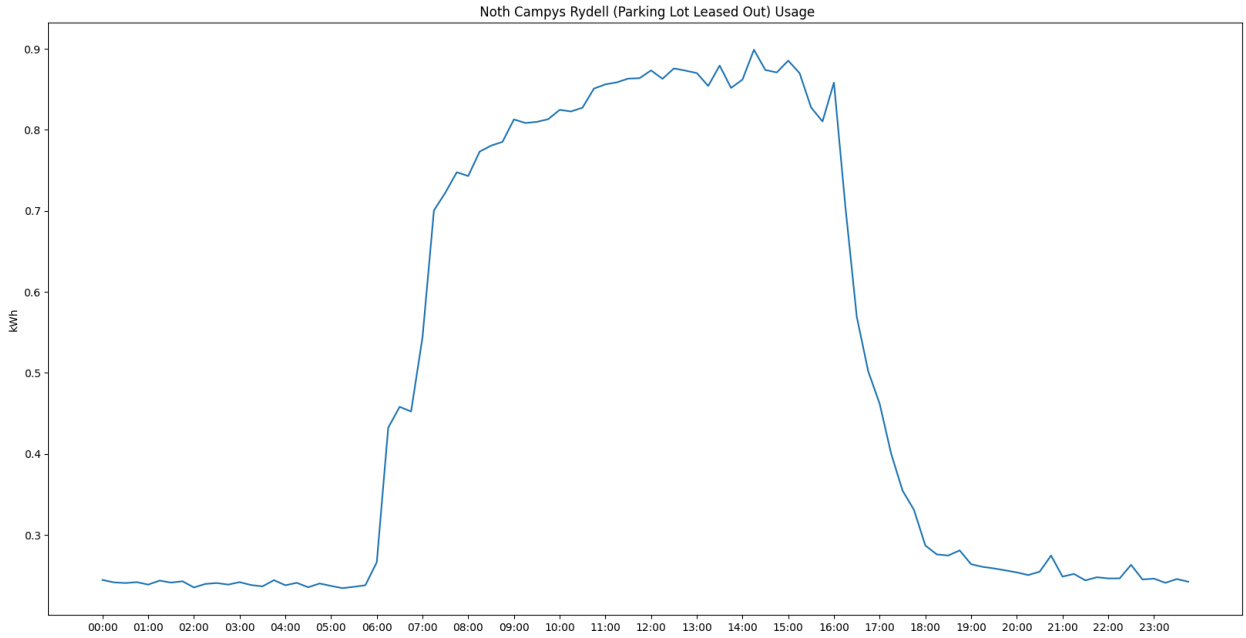
23:00


Noth Campys Rydell (Parking Lot Leased Out) Usage
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0.5
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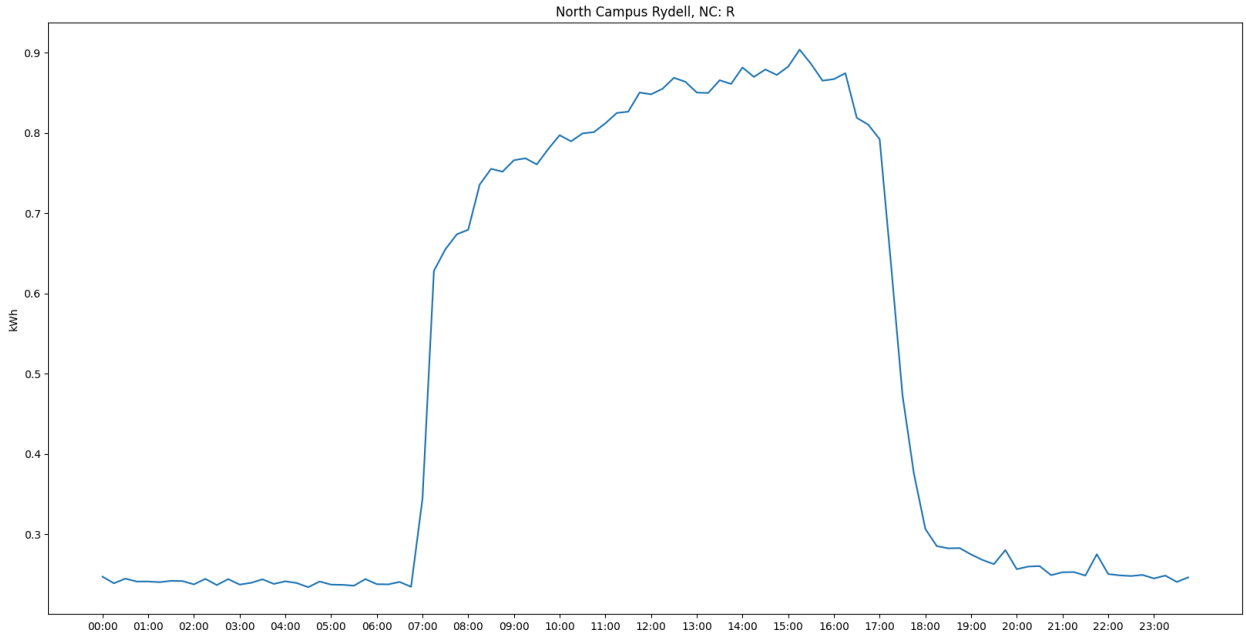
North Campus Rydell, NC: R
kWh
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