LOW ENERGY DEMAND AND RESILIENCE

May 22, 2019 MW COG CEEPC

Edward Yim, Energy Administration

DEPARTMENT OF ENERGY & ENVIRONMENT

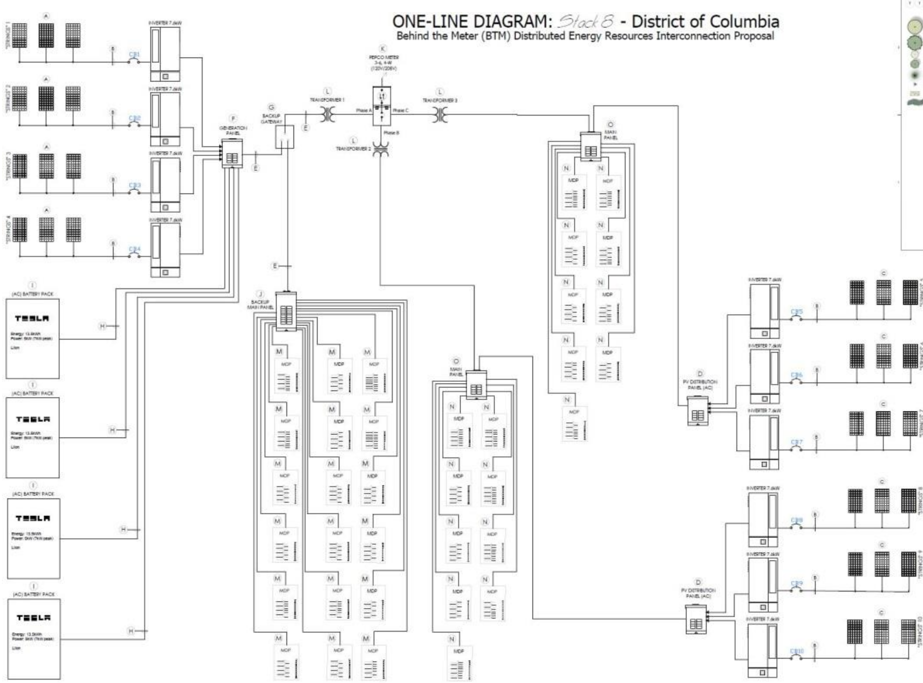
GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

INCREASING ENERGY RESILIENCE

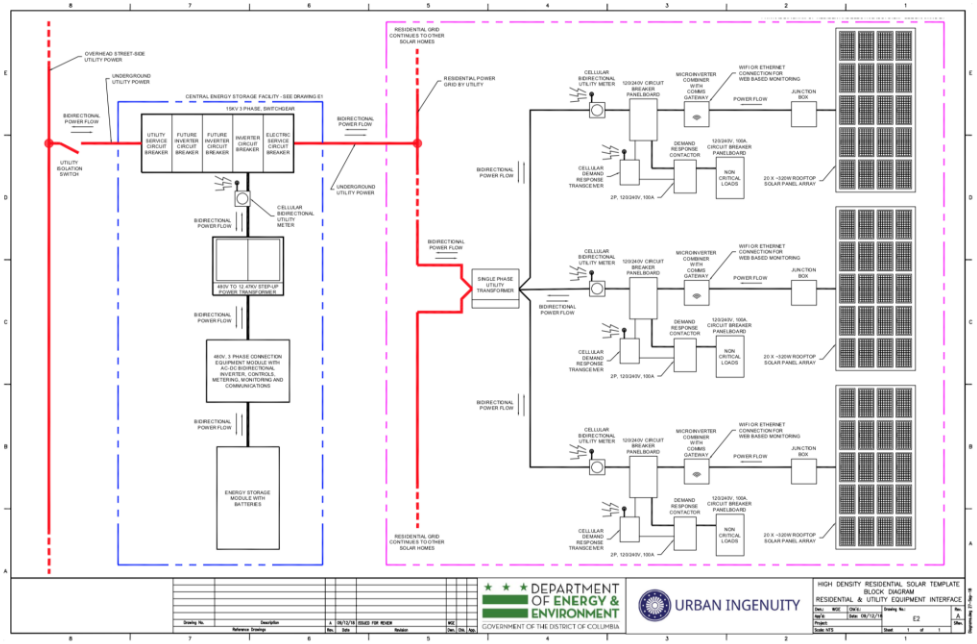
Objective:

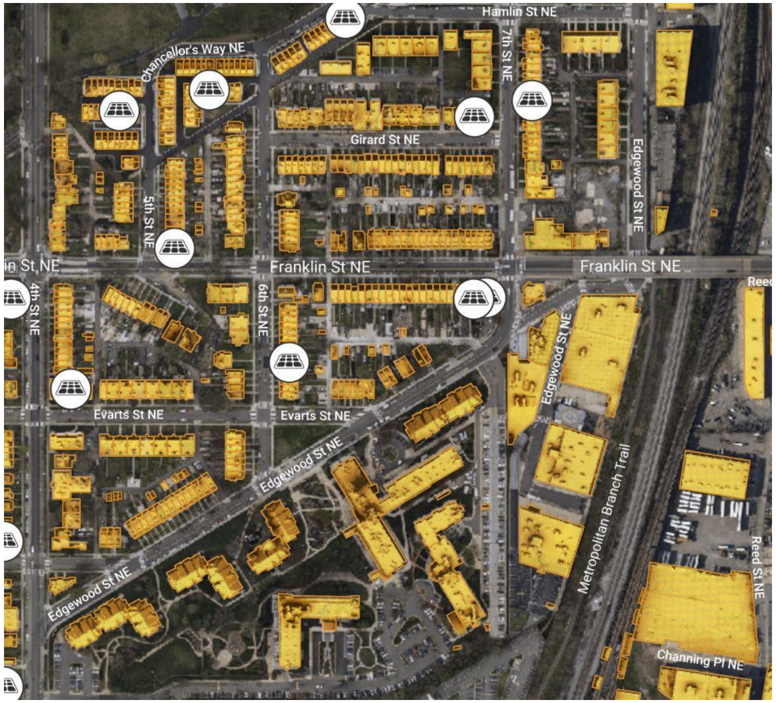
- For individual buildings and HOAs:
  - Streamline the interconnection process for intentional islanding for a single-owner building or campus
  - Avoid months of unpredictable permit delays and potential technical studies that can cost a significant amount of money
- For residential neighborhoods with rooftop solar:
  - Provide an engineering design that aggregates rooftop solar backed up by battery energy storage that can function as a microgrid for that neighborhood

SINGLE OWNER ISLANDING SCHEME



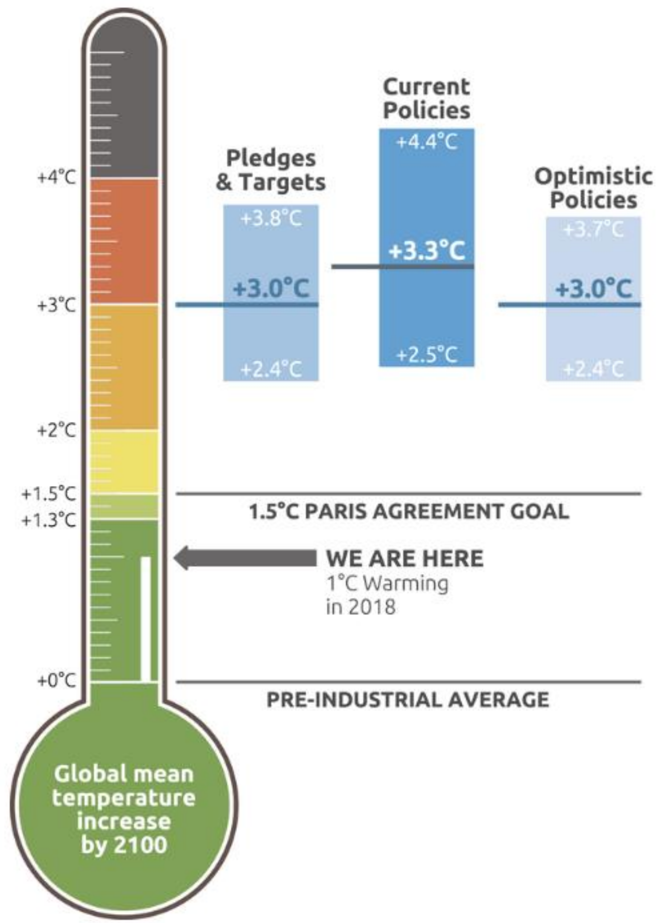
SOLAR NEIGHBORHOOD ISLANDING





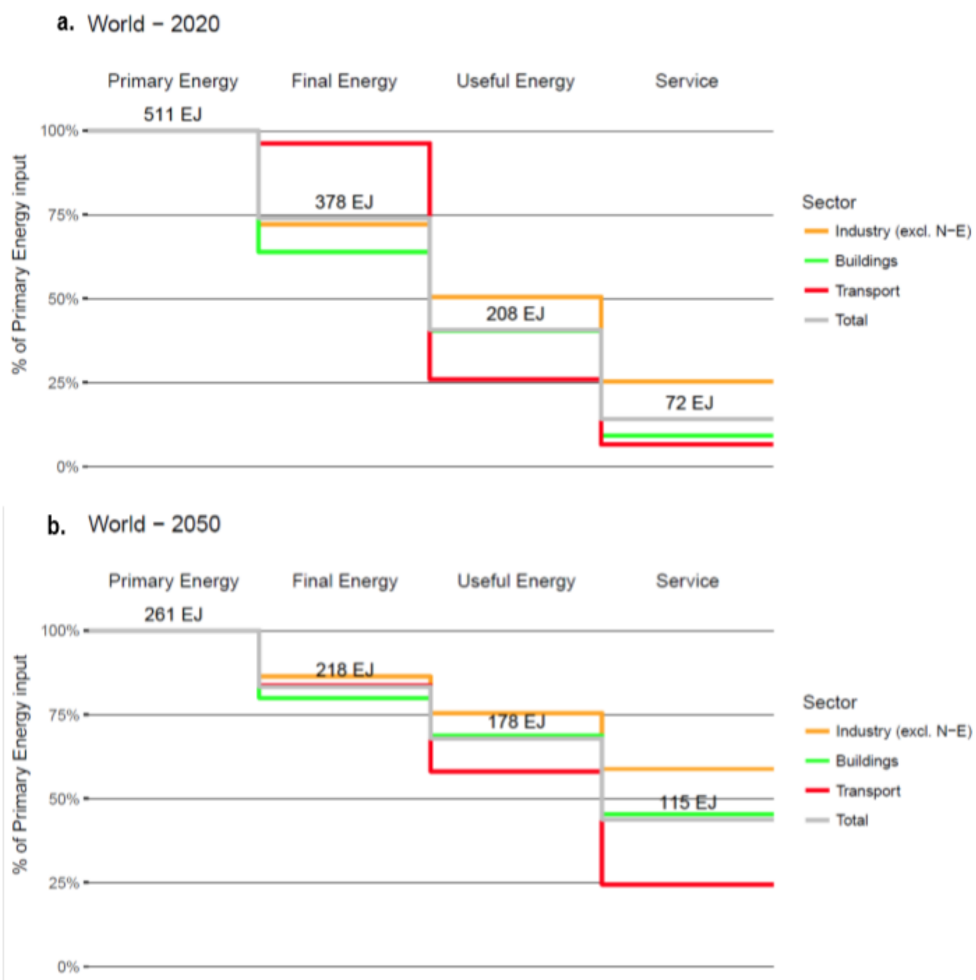
URGENCY: 1.5ºC

- 1.5ºC Carbon Budget: 420 $GtCO_2$ (66% probability) by 2050
- 2018 CO_2 Emissions: 37.1 $GtCO_2$ (2% increase from 2017)
- 11 years to Budget Exhaustion (or 8 years w/ non-CO_2 RF)
- Paris NDC Commitments: ≈40 $GtCO_2$ by 2030
- 1.5ºC Pathways: 20 – 29 $GtCO_2$ by 2030
- Current Levels: 3ºC – 4ºC (Runaway Global Warming)



https://climateactiontracker.org/global/cat-thermometer/

IMPORTANCE OF DEMAND OVER SUPPLY



Conversion Ratio:

Primary to Service
7: 1

Demand Efficiency:

50% reduction of primary energy

60% more energy for consumption

"A Low Energy Demand Scenario for Meeting the 1.5°C Target and Sustainable Development Goals Without Negative Emissions Technologies, Nature Energy, 3, 515-527, June 4, 2018

IMPORTANCE OF LOW DEMAND

Intermediate Energy Demand

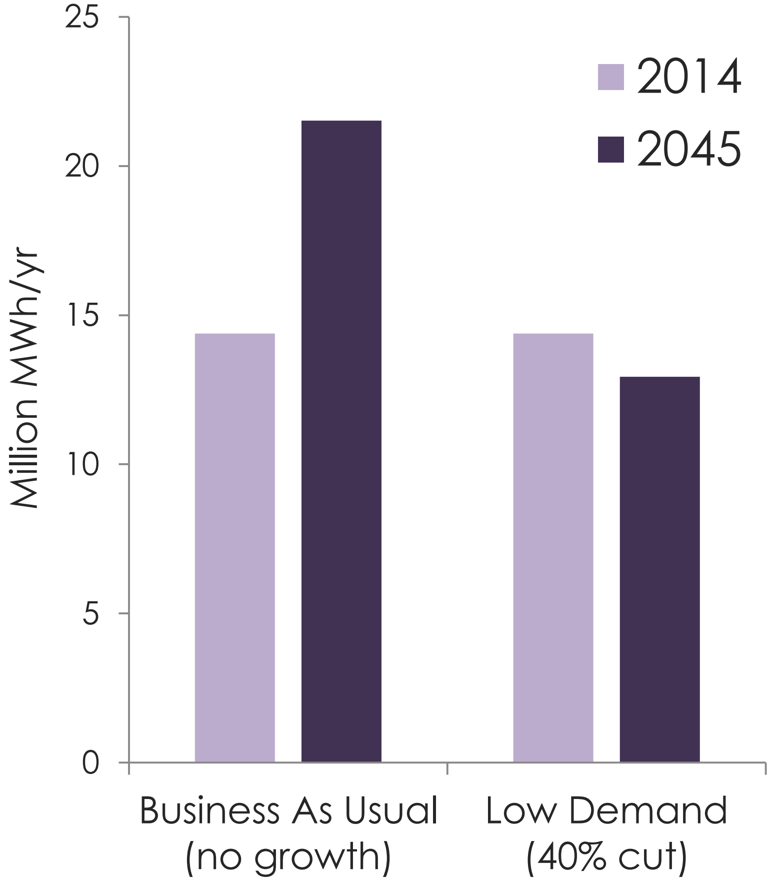
Mitigation costs	NoCP	56	52	48	44	40	36
From 2020 until 2050:							
Full portfolio	INF	INF	66%	61%	56%	INF	INF
No new nuclear	INF	INF	INF	73%	66%	INF	INF
Limited land measures	INF	INF	INF	INF	INF	INF	INF
No CCS	INF	INF	INF	INF	INF	INF	INF

Low Energy Demand

	NoCP	52	48	44	40	36	32
From 2020 until 2050:							
Full portfolio	24%	22%	21%	20%	23%	30%	INF
No new nuclear	26%	24%	22%	21%	24%	32%	INF
Limited land measures	44%	39%	37%	34%	32%	39%	INF
No CCS	INF	INF	INF	65%	52%	53%	INF

"2020 emissions levels required to limit warming to below 2 C", Nature Climate Change, Dec. 16, 2012

D.C.'s BUILDING ENERGY SCENARIO



Population in the District:
2014: 658,893   2045: 987,000

- Difference between BAU and LED:
- Additional supply requirement in BAU:
  - 7.1 million MWh/yr
  - ≈ 800 MW nuclear plant similar to Calvert Cliffs
  - ≈ 2,376 MW of wind farm (37% capacity factor)
  - ≈ 3,326 MW of solar farm (26% capacity factor)
    - Roughly the size of the Bowie or Alexandria

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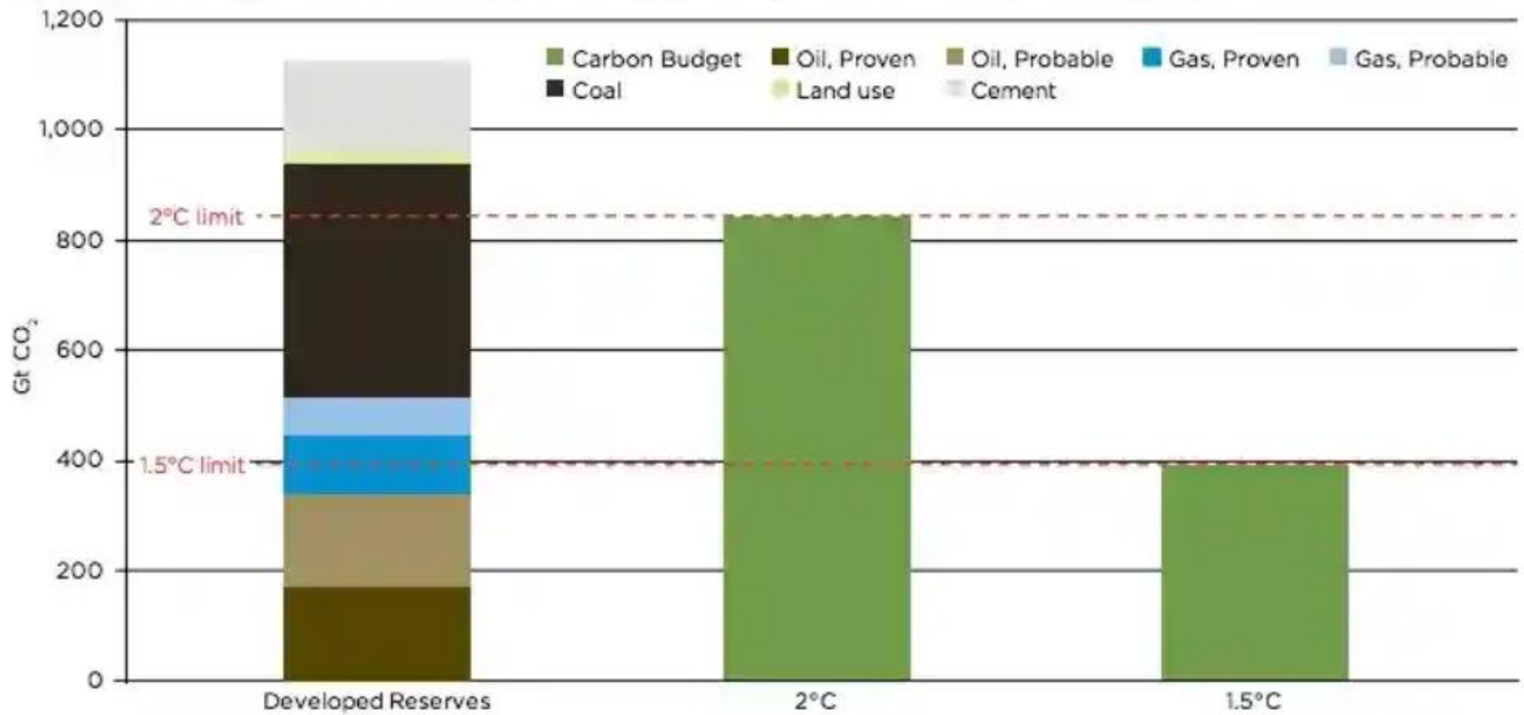
THE NEED FOR ELECTRIFICATION

Figure ES-1: Emissions from Developed Fossil Fuel Reserves, Plus Projected Land Use and Cement Manufacture



▲ Photograph: Rystad Energy, International Energy Agency (IEA), World Energy Council, Intergovernmental Panel on Climate Change (IPCC)

- 1.5°C : ≈65% of stranded O&G investment

THANK YOU

For questions, email
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A NEW APPROACH TO SOLAR SATURATION

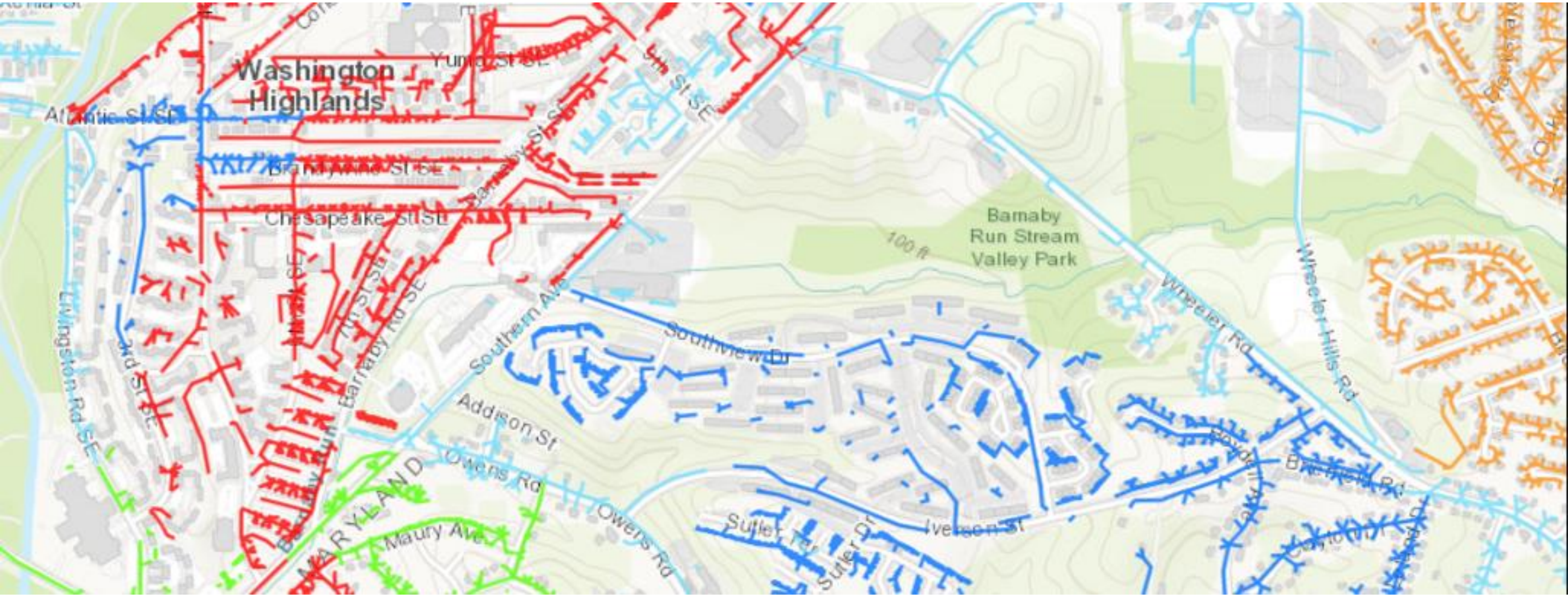
Briefing to MWCOG

MAY 22, 2019

URBAN INGENUITY

The Danger of Success: Clean Energy DC Plan and Omnibus Act

- 100% RPS by 2032 with 10% local solar carve-out
- Roughly 1,000 GWh / year solar or ~800 MW installed solar capacity
- ➢ Yet individual feeders can only accommodate distributed generation equal to roughly 15% of their peak capacity.



Saturation-level solar installation still doesn't help meet peak grid demand:

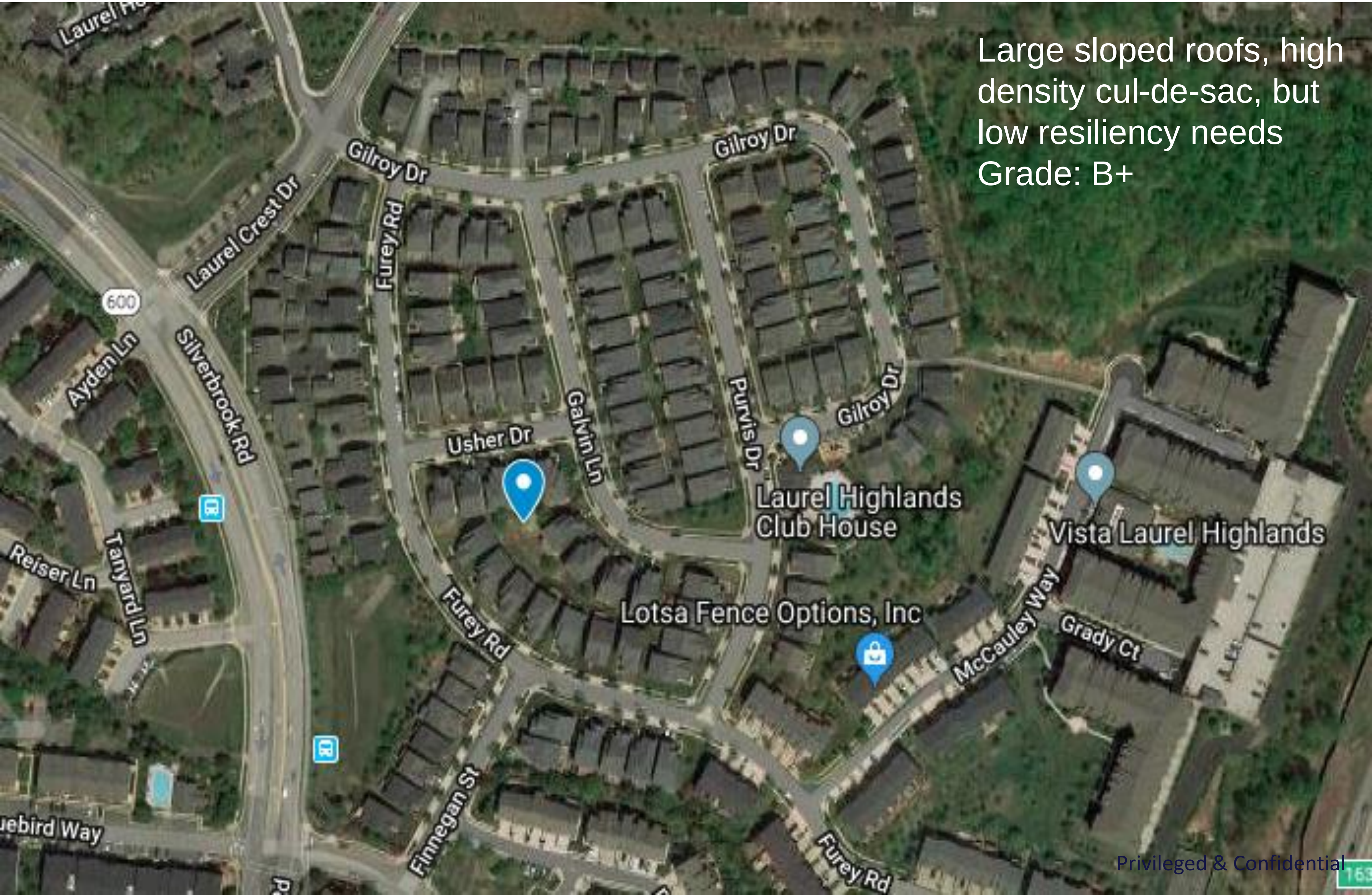
- Maximum output doesn't match time of peak load (especially for evening use in residential neighborhoods)
- Solar deployments tend to be diffuse, not concentrated into load pockets that need NWAs
- Isolated solar and solar without storage does not provide resiliency benefits, missed opportunity for protecting:
  - Critical infrastructure protections, government continuity, etc.
  - Vulnerable demographics, low-resiliency neighborhoods, etc.

High-Density Deployment with Full Resiliency, Suitable for NWA

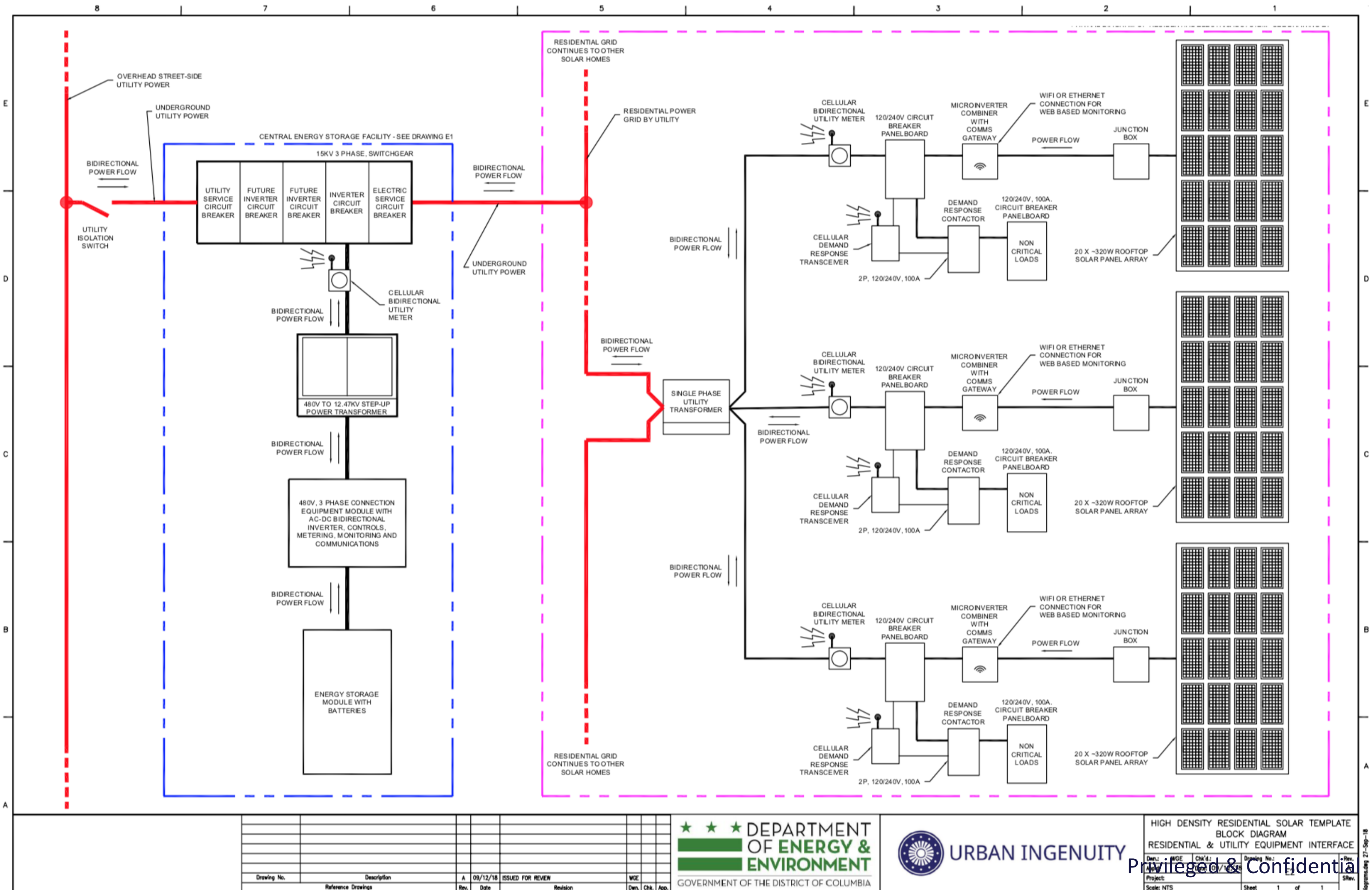
- Remove limitations from hosting capacity issues
- Add rooftop solar to 80% or more of residences
- Integrate storage, sectionalize local grid, fully islandable
- Leverage *existing* utility distribution infrastructure

Lowest-Cost Solution

- Save solar deployment costs via economies of scale ("opt-out")
- Limit utility expense for increasing hosting capacity
- Make storage economical via NWA incentives and / or resiliency investment



Large sloped roofs, high density cul-de-sac, but low resiliency needs
Grade: B+


OVERHEAD STREET-SIDE UTILITY POWER
UNDERGROUND UTILITY POWER
BIDIRECTIONAL POWER FLOW
UTILITY ISOLATION SWITCH
CENTRAL ENERGY STORAGE FACILITY - SEE DRAWING E1
15KV 3 PHASE, SWITCHGEAR
UTILITY SERVICE CIRCUIT BREAKER
FUTURE INVERTER CIRCUIT BREAKER
FUTURE INVERTER CIRCUIT BREAKER
INVERTER CIRCUIT BREAKER
ELECTRIC SERVICE CIRCUIT BREAKER
CELLULAR BIDIRECTIONAL UTILITY METER
BIDIRECTIONAL POWER FLOW
480V TO 12.47KV STEP-UP POWER TRANSFORMER
BIDIRECTIONAL POWER FLOW
480V, 3 PHASE CONNECTION EQUIPMENT MODULE WITH AC-DC BIDIRECTIONAL INVERTER, CONTROLS, METERING, MONITORING AND COMMUNICATIONS
BIDIRECTIONAL POWER FLOW
ENERGY STORAGE MODULE WITH BATTERIES
BIDIRECTIONAL POWER FLOW
UNDERGROUND UTILITY POWER
RESIDENTIAL GRID CONTINUES TO OTHER SOLAR HOMES
RESIDENTIAL POWER GRID BY UTILITY
BIDIRECTIONAL POWER FLOW
SINGLE PHASE UTILITY TRANSFORMER
BIDIRECTIONAL POWER FLOW
BIDIRECTIONAL POWER FLOW
BIDIRECTIONAL POWER FLOW
RESIDENTIAL GRID CONTINUES TO OTHER SOLAR HOMES
CELLULAR BIDIRECTIONAL UTILITY METER
120/240V CIRCUIT BREAKER PANELBOARD
MICROINVERTER COMBINER WITH COMMS GATEWAY
WIFI OR ETHERNET CONNECTION FOR WEB BASED MONITORING
JUNCTION BOX
POWER FLOW
DEMAND RESPONSE CONTACTOR
120/240V, 100A. CIRCUIT BREAKER PANELBOARD
CELLULAR DEMAND RESPONSE TRANSCEIVER
NON CRITICAL LOADS
2P, 120/240V, 100A
20 X ~320W ROOFTOP SOLAR PANEL ARRAY
Drawing No.
Description
Reference Drawings
A
09/12/18
ISSUED FOR REVIEW
WGE
Rev.
Date
Revision
Dwn.
Chk.
App.
DEPARTMENT OF ENERGY & ENVIRONMENT
GOVERNMENT OF THE DISTRICT OF COLUMBIA
URBAN INGENUITY
HIGH DENSITY RESIDENTIAL SOLAR TEMPLATE
BLOCK DIAGRAM
RESIDENTIAL & UTILITY EQUIPMENT INTERFACE
Dwn.: WGE
Chk'd.:
Drawing No.:
Rev.
Project:
SRev.
Scale: NTS
Sheet 1 of 1
Diagrams.dwg 27-Sep-18

Approach: New Configuration of Off-the-Shelf Components

- Generic, but customizable for specific sites
- Open source design, but utilizing existing commercial products
- Innovative, but leveraging pieces that already work
- More than 95% of desired capabilities inherent in ordinary components

DOEE support for Open-Source Design Package

- UI is eager to promote regional dissemination of this model
- Drawings and narrative basis-of-design, currently in progress
- Made available to all jurisdictions by end of FY19
- Suitable to support pilot-project RFPs & Implementation efforts

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Demand reduction as climate strategy

Flywheel Development

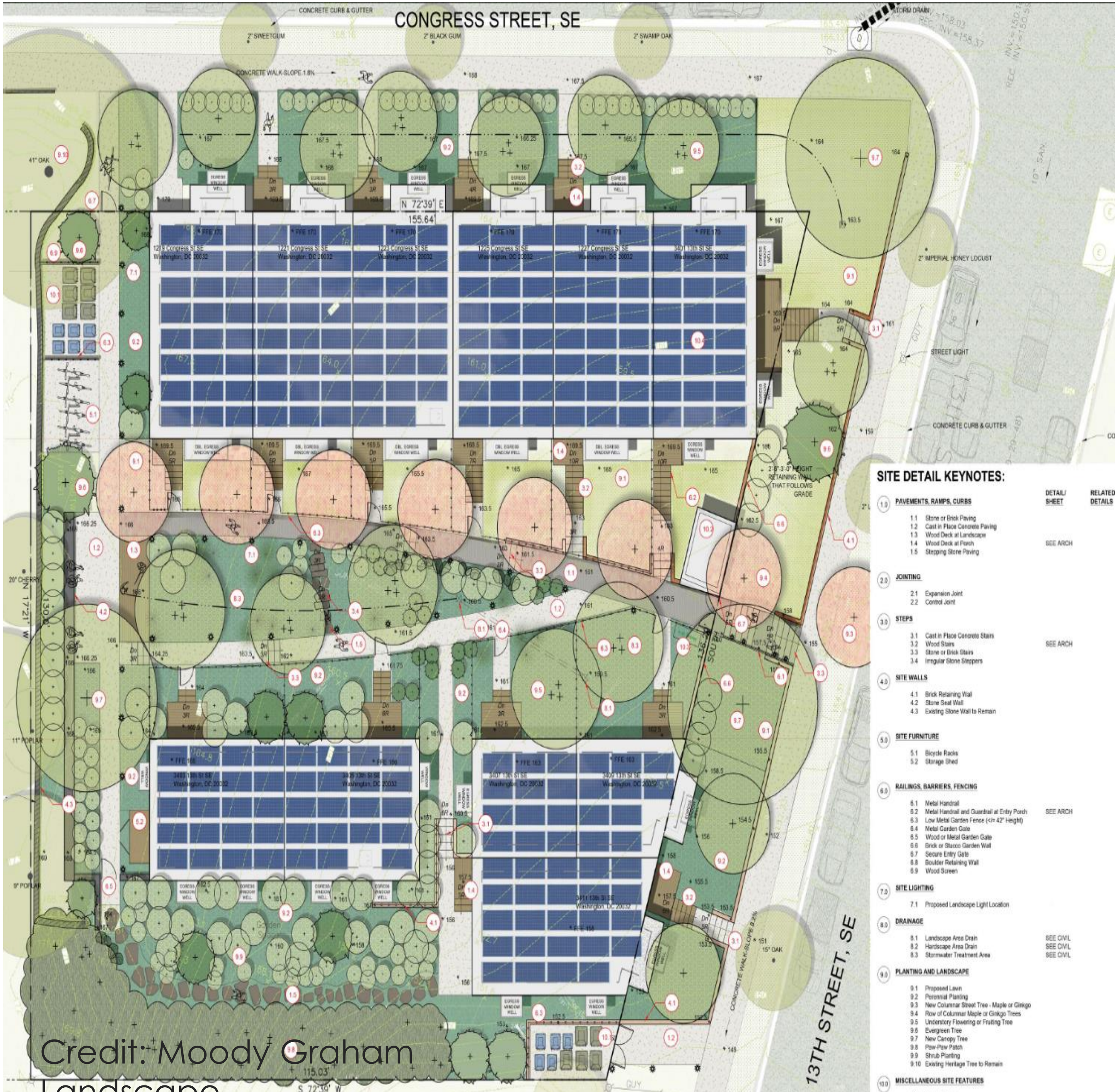
May 22, 2019

Achieving Climate Goals through Demand Reduction

Stack Eight

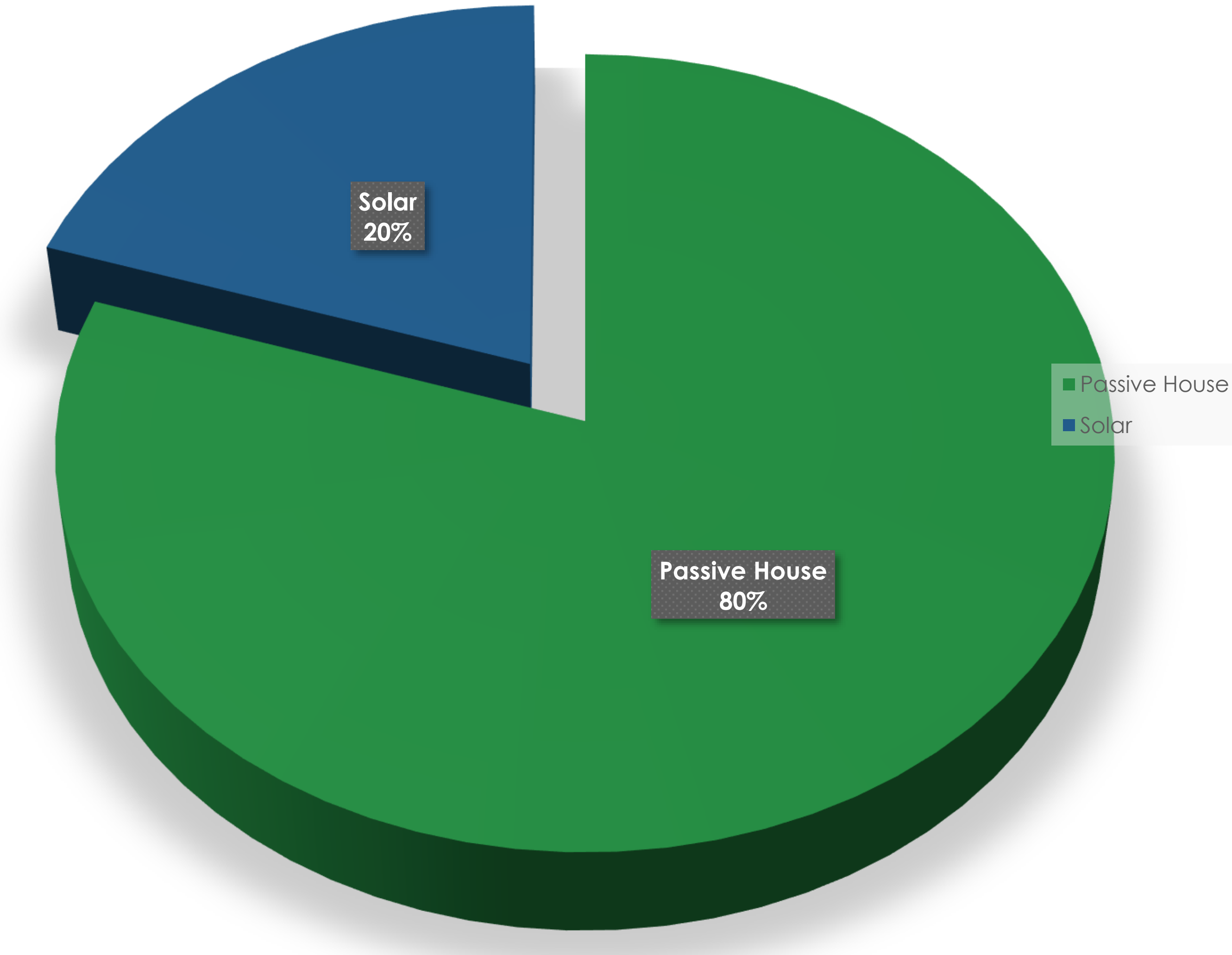
View from 13th St SE

Roosevelt Memorial
The Pentagon
SOUTHWEST WASHINGTON
The Yards Park
SOUTHEAST WASHINGTON
Pennsylvania Ave SE
395
DISTRICT OF COLUMBIA
VIRGINIA
PENTAGON CITY
BARRY FARM
AURORA HIGHLANDS
Ronald Reagan Washington National Airport
Suitland Pkwy
DISTRICT OF COLUMBIA
Potomac River
295
Interstate 395 HOV
7
Hillcrest Heights
5
POTOMAC YARD
DEL RAY
420
Marlow Heights
Janneys Ln
295
Potomac River
Temple Hills
Google
Forest Heights

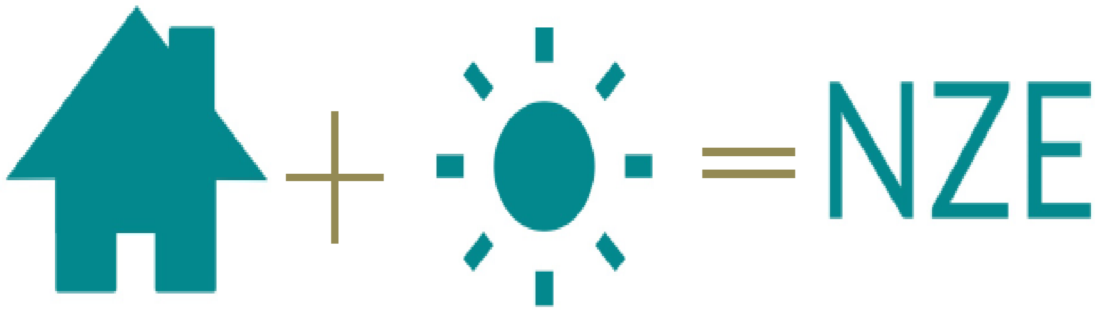


Credit: Moody Graham Landscape

Passive House



Getting to Net Zero with Passive House



Super-Efficient Building

Solar Panels

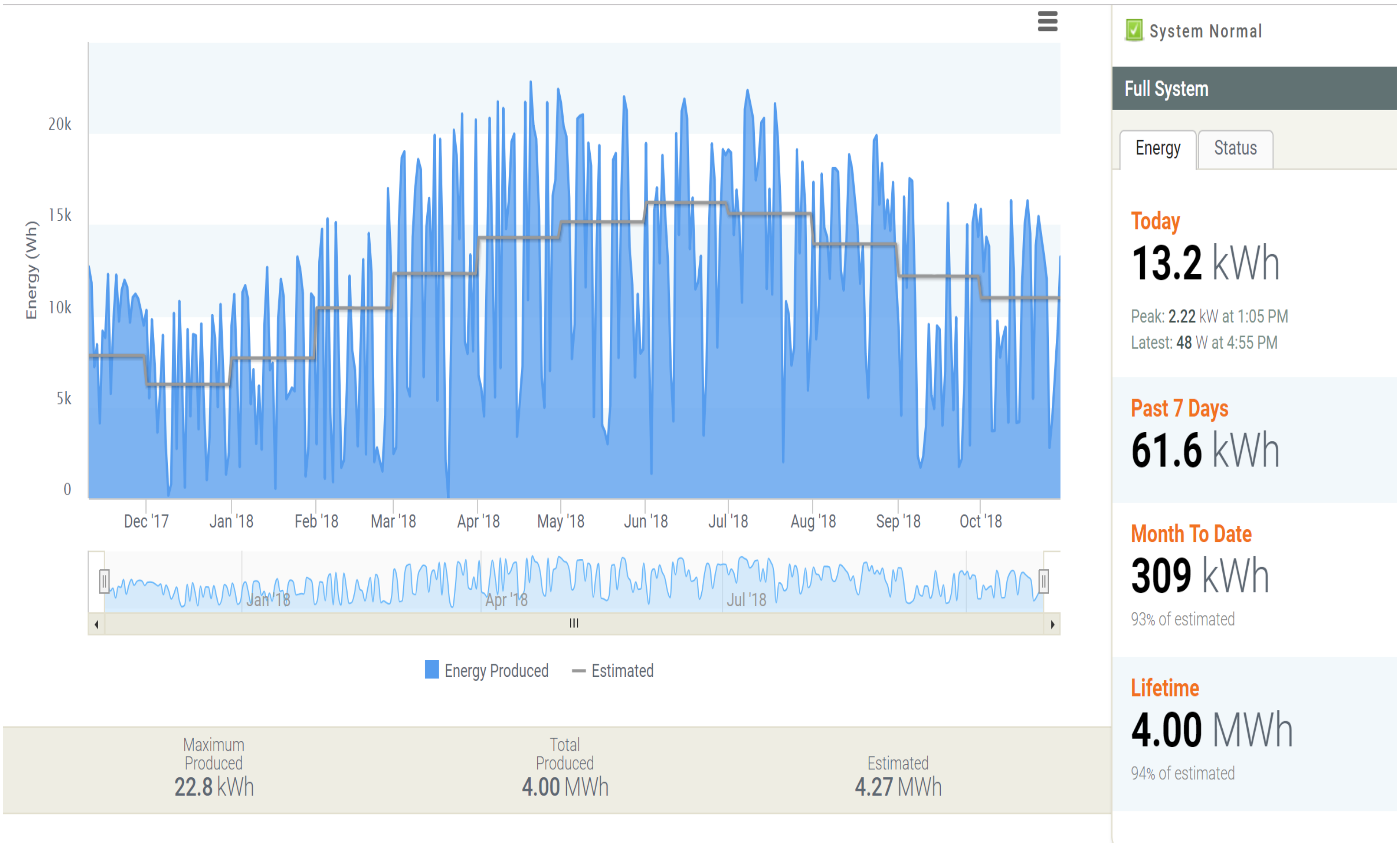
Net Zero Energy

1. Solar Potential Analysis: *Conduct solar potential analysis of rooftops. How much solar can we generate on site?*

2. Determine Maximum Energy Use: Passive House standard sets a limit on maximum energy use per square foot per year: 4.29 kWh/ft2/year.

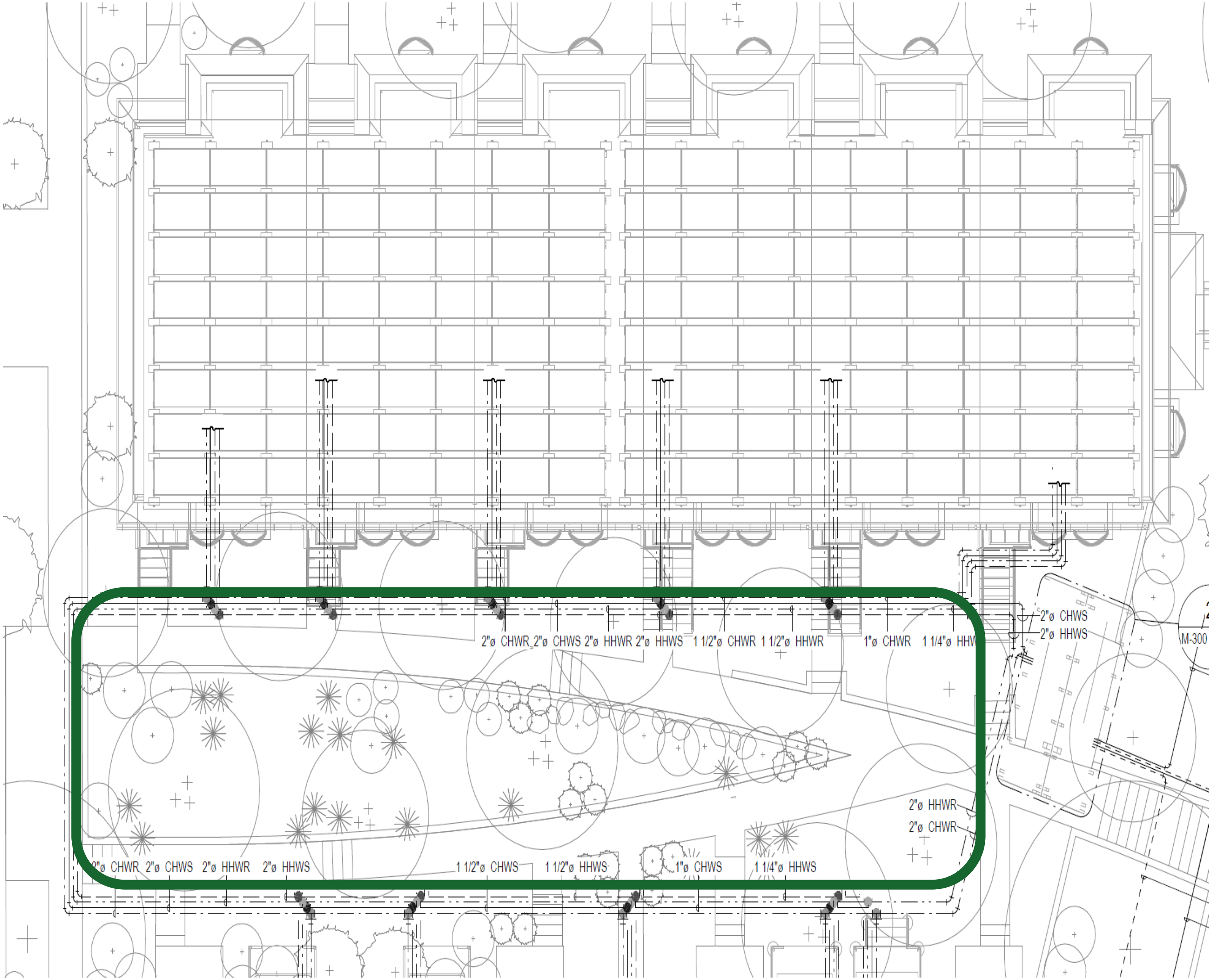
3. If the solar generation = Passivhaus energy use, we are done. Otherwise, we need to beat the Passivhaus maximum allowable energy use.

Net Zero on Annual Basis



Decentralized Backup Power

District Energy Loop



Geothermal & Thermal Mass

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