

# Power Manager and Renewables

A Low Friction Approach



MAY 11, 2023



BUILDING A SMARTER ENERGY FUTURE®

# Duke Energy

One of the **LARGEST** energy holding companies in the U.S.



**8.2 MILLION**

Retail electric customers in six states



**1.6 MILLION**

Natural gas customers in five states



**27k\*** EMPLOYEES

\* 27,859 employees as of December 31, 2022.  
\*\* Includes owned and contracted within our regulated jurisdictions.



Headquarters: *Charlotte, N.C.*



We own and operate diverse power generation assets in North America, including a portfolio of **natural gas, coal, renewable wind, solar, energy storage, nuclear, hydro and microgrid projects.**

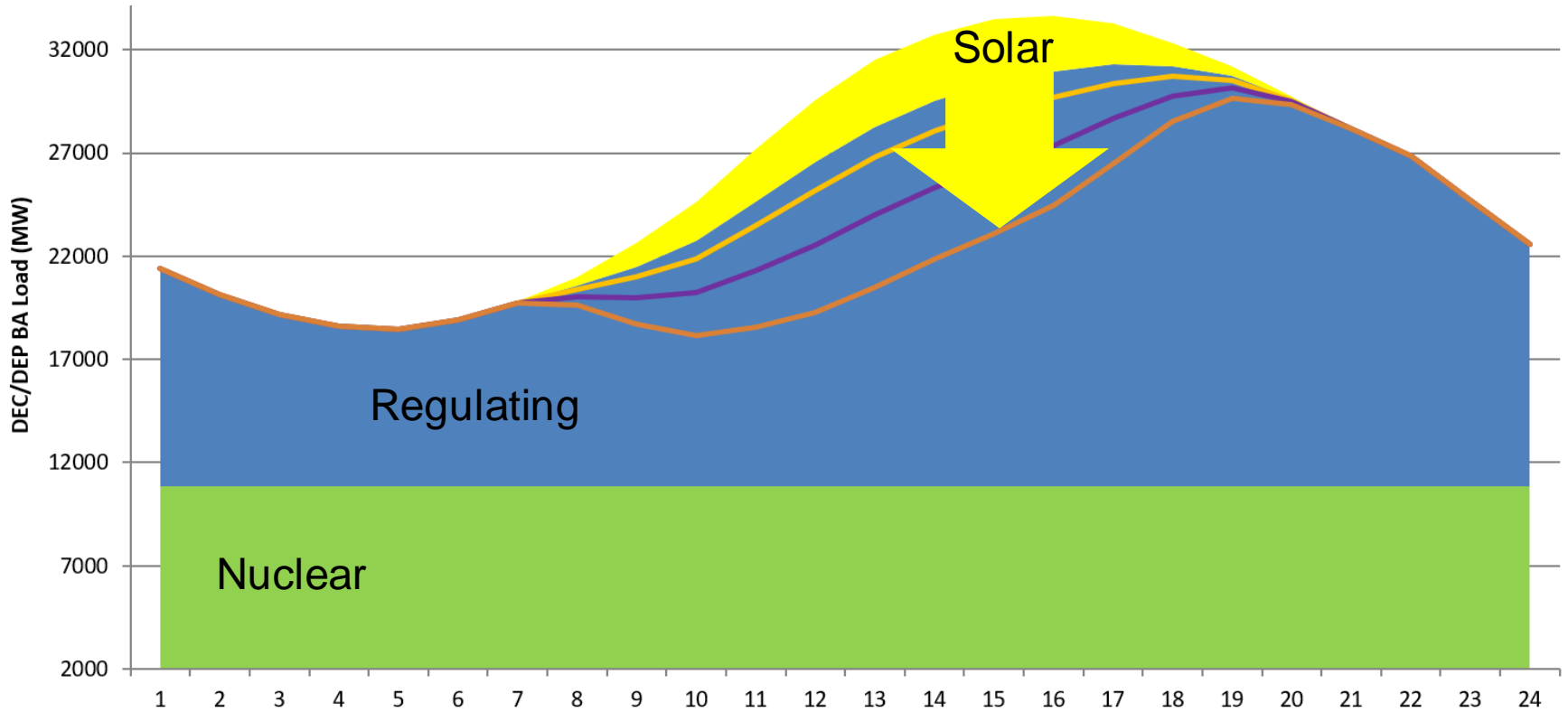
**11,900 megawatts (MW)** including 6,651 MW regulated and 5,279 MW commercial wind and solar owned, operated or contracted with an updated goal of **30,000 MW** wind and solar by 2035.\*\*

**\$145+ BILLION**  
CAPITAL PLAN

**85%** (\$123 billion) funding investments in the grid and our clean energy transition.



# Here Comes the Sun – I say!\*



\*thank you George Harrison

# The Challenge



How can we utilize our direct load control option to reduce load when electricity demand is still high and renewable supply is waning? To help:

- Avoid the cost of bringing additional generation online
- While maintaining customer satisfaction, despite potentially: more frequent events, done later in the day and with longer durations

# The Approach – “Low Friction” Cycling Options

## Current Options

- 100% full shed
- 64% and 50% TrueCycle
  - Reduce expected compressor runtime by 64% and 50%

## Future Steps

- Learn from the ~250,000 customers (301,000 ACs) on our DLC program in the Duke Energy Carolinas jurisdiction
- Add TrueCycle Strategies below 50%
- Conduct EM&V tests this summer with new strategies
- Resource Innovations (evaluator) use test results to create a new Time/Temperature Matrix for estimating load reduction capabilities
- Utilize the TTM to determine which strategy to use to meet the load reduction needs with the least impact to our customers

# How much load might we reduce?

## Duke Energy Carolinas - Power Manager AC Switch

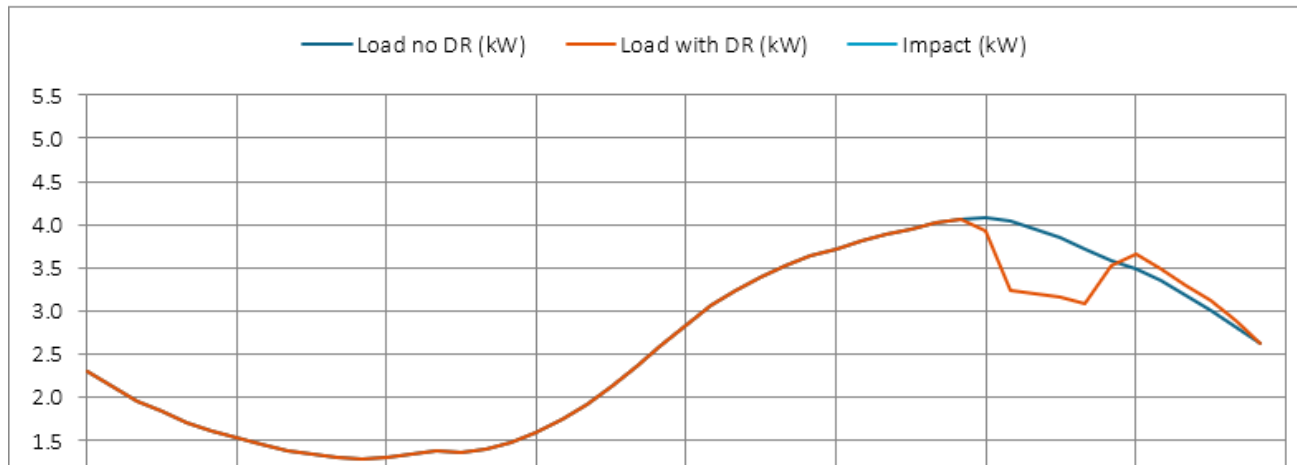
### April 2023 Time Temperature Matrix - Maximum Event Period Temperature

| Inputs                |                 |
|-----------------------|-----------------|
| Dispatch Type         | Normal Dispatch |
| Event Start Time      | 6 PM            |
| Event Duration        | 2               |
| Event Period Max Temp | 90              |
| # Customers           | 249,100         |

| Event Window Average Impacts |                       |
|------------------------------|-----------------------|
| Load without DR              | 3.89 kW per customer  |
| Load with DR                 | 3.17 kW per customer  |
| Impact per Customer          | -0.72 kW per customer |
| Program Impact               | -191.7 MW             |
| % Impact                     | -18.5 %               |

Line Loss (gross up to Generator) 1.067359

| Impact @ Gen |
|--------------|
| 64% Cycle    |
| -191.7 MW    |
| 50% Cycle    |
| -149.7 MW    |
| 40% Cycle    |
| -119.8 MW    |
| 35% Cycle    |
| -104.8 MW    |
| 30% Cycle    |
| -89.8 MW     |
| 25% Cycle    |
| -74.9 MW     |
| 20% Cycle    |
| -59.9 MW     |
| 15% Cycle    |
| -44.9 MW     |
| 10% Cycle    |
| -29.9 MW     |



# What about “low friction” and customer satisfaction?

## Current

| Forecast Avg. Minutes |     | Control Strategy |            |              |            |              |            |
|-----------------------|-----|------------------|------------|--------------|------------|--------------|------------|
|                       |     | 100%             |            | 64%          |            | 50%          |            |
|                       |     | Closed Relay     | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay |
| Running               | Off |                  |            |              |            |              |            |
| 30                    | 0   | 0                | 30         | 10.8         | 19.2       | 15           | 15         |
| 25                    | 5   | 0                | 30         | 9            | 21         | 12.5         | 17.5       |
| 20                    | 10  | 0                | 30         | 7.5          | 22.5       | 10           | 20         |
| 15                    | 15  | 0                | 30         | 7.5          | 22.5       | 7.5          | 22.5       |
| 10                    | 20  | 0                | 30         | 7.5          | 22.5       | 7.5          | 22.5       |
| 5                     | 25  | 0                | 30         | 7.5          | 22.5       | 7.5          | 22.5       |

## Future

| Forecast Avg. Minutes |     | Possible Future Control Strategies - all to be tested in 2023 EM&V Study |            |              |            |              |            |              |            |              |            |              |            |              |            |
|-----------------------|-----|--|------------|--------------|------------|--------------|------------|--------------|------------|--------------|------------|--------------|------------|--------------|------------|
|                       |     | 40%  |            | 35%          |            | 30%          |            | 25%          |            | 20%          |            | 15%          |            | 10%          |            |
|                       |     | Closed Relay   | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay | Closed Relay | Open Relay |
| Running               | Off |  |            |              |            |              |            |              |            |              |            |              |            |              |            |
| 30                    | 0   | 18   | 12         | 19.5         | 10.5       | 21           | 9          | 22.5         | 7.5        | 24           | 6          | 25.5         | 4.5        | 27           | 3          |
| 25                    | 5   | 15   | 15         | 16.25        | 13.75      | 17.5         | 12.5       | 18.75        | 11.25      | 20           | 10         | 21.25        | 8.75       | 22.5         | 7.5        |
| 20                    | 10  | 12   | 18         | 13           | 17         | 14           | 16         | 15           | 15         | 16           | 14         | 17           | 13         | 18           | 12         |
| 15                    | 15  | 9  | 21         | 9.75         | 20.25      | 10.5         | 19.5       | 11.25        | 18.75      | 12           | 18         | 12.75        | 17.25      | 13.5         | 16.5       |
| 10                    | 20  | 7.5  | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 8            | 22         | 8.5          | 21.5       | 9            | 21         |
| 5                     | 25  | 7.5  | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       | 7.5          | 22.5       |

Closed Relay = Allows AC to run, if needed.

Open Relay = Prevents AC from running.

## 2022 – Two late season low friction events

August 31, Wednesday

- 15% Cycling from 4:00 to 6:00 pm, system average temp 88.5°
- Lessons learned:
  - We used “no ramp-in”, but some customers (Gen1 LCR4700) were controlled for much of or all the first 30 minutes. Going forward, we will not use the “no-ramp” option.
  - Continuing use of a ramp-out TBD.
  - Increase to 20 calls vs 2 (prior day) and 3 (day after) calls to our event hotline\* number after 4:00 pm.

September 6, Tuesday

- 25% Cycling from 5:00 to 7:00 pm, average temp 84°
- A few pop-up showers in the service area brought down the temp from 87° HE 5:00 pm.
- 4 pm+ hotline\* calls: 7 and 10 pre and post days, 14 event day
- Per Franklin Energy manager: “It was like it never happened.”

\*compared to 558 on the last non-friction event (50% cycling, 4 - 6 pm, 95°)



Thank you!



*BUILDING A SMARTER ENERGY FUTURE*®