

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1164

In the Matter of)	TESTIMONY OF
Application of Duke Energy)	ERIC WILLIAMS
Carolinas, LLC, for Approval of)	PUBLIC STAFF –
Demand-Side Management and)	NORTH CAROLINA
Energy Efficiency Cost Recovery)	UTILITIES
Rider Pursuant to G.S. 62-133.9 and)	COMMISSION
Commission Rule R8-69		

May 22, 2018

1 **Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND**
2 **PRESENT POSITION.**

3 A. My name is Eric Williams. My business address is 430 North
4 Salisbury Street, Raleigh, North Carolina. I am a Financial Analyst in
5 the Economic Research Division of the Public Staff - North Carolina
6 Utilities Commission. My qualifications are included in Appendix A
7 to this testimony.

8 **Q. WHAT ARE YOUR DUTIES AT THE PUBLIC STAFF?**

9 A. My duties with the Public Staff include conducting studies on the
10 weather normalization of energy sales, electric utility meter sampling
11 plans, electric utilities' long-range peak demand and energy
12 forecasts, and the integration aspect of electric utilities' integrated
13 resource plans (IRPs). I also review electric utilities' avoided cost
14 biennial filings, as well as avoided cost issues for annual rider
15 proceedings involving fuel, renewable energy, and demand-side
16 management and energy efficiency (DSM/EE).

17 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS**
18 **PROCEEDING?**

19 A. The purpose of my testimony is to discuss the appropriate avoided
20 capacity cost, avoided energy cost, and avoided transmission and
21 distribution (T&D) cost that should be used to evaluate the ongoing
22 cost-effectiveness of the DSM/EE programs of Duke Energy
23 Carolinas, LLC (DEC), as well as to calculate DEC's portfolio

1 performance incentive (PPI) pursuant to the Cost Recovery
2 and Incentive Mechanism for Demand-Side Management
3 and Energy Efficiency Programs (Sub 1032 Mechanism) attached
4 to the Agreement and Stipulation of Settlement approved on
5 October 29, 2013, in Docket No. E-7, Sub 1032. Revisions to the
6 Sub 1032 Mechanism (after incorporation of the revisions,
7 the Revised Mechanism) were approved in the Commission's
8 *Order Approving DSM/EE Rider, Revising DSM/EE Mechanism, and*
9 *Requiring Filing of Proposed Customer Notice* issued
10 August 23, 2017, in Docket No. E-7, Sub 1130 (Sub 1130).

11 **Q. IN SUB 1130, WHAT REVISIONS TO THE MECHANISM WERE**
12 **PROPOSED BY THE PUBLIC STAFF AND THE COMPANY AND**
13 **APPROVED BY THE COMMISSION REGARDING AVOIDED**
14 **CAPACITY COSTS?**

15 A. The Public Staff and DEC proposed and the Commission approved
16 revisions to Paragraphs 19, 23 and 69 of the Sub 1032 Mechanism,
17 said revisions providing that the avoided energy and capacity
18 benefits used for program approval and the initial estimate of the PPI
19 and any PPI true-up, as well as for review of ongoing cost-
20 effectiveness, would use:

21 projected avoided capacity and energy benefits
22 specifically calculated for each program, as derived
23 from the underlying resource plan, production cost
24 model, and cost inputs that generated the avoided
25 capacity and avoided energy credits reflected in the
26 most recent Commission-approved Biennial

1 Determination of Avoided Cost Rates for Electric
2 Utility Purchases from Qualifying Facilities as of
3 December 31 of the year immediately preceding the
4 date of the annual DSM/EE rider filing.

5 **Q. WHAT IS “THE MOST RECENT COMMISSION-APPROVED**
6 **BIENNIAL DETERMINATION OF AVOIDED COST RATES FOR**
7 **ELECTRIC UTILITY PURCHASES FROM QUALIFYING**
8 **FACILITIES” FOR PURPOSES OF THIS DSM/EE RIDER**
9 **PROCEEDING?**

10 A. The applicable avoided cost proceeding is Docket No. E-100,
11 Sub 148 (Sub 148), in which the Commission issued an order
12 establishing rates on October 11, 2017.

13 **Q. IS THE AVOIDED ENERGY COST THAT DEC USED TO**
14 **EVALUATE THE ONGOING COST-EFFECTIVENESS OF ITS**
15 **DSM/EE PROGRAMS REASONABLE?**

16 A. Yes. The avoided energy cost that DEC used to evaluate the
17 ongoing cost-effectiveness of its DSM/EE programs is based on the
18 approved 2016 Sub 148 proceeding and the agreed methodology of
19 the Revised Mechanism.

20 **Q. WHAT DID THE COMMISSION ORDER IN DOCKET NO. E-100,**
21 **SUB 148 REGARDING AVOIDED CAPACITY COSTS AND**
22 **RESULTING RATES?**

23 A. In Sub 148, the Commission concluded that “G.S. 62-156(b)(3)
24 requires that, when calculating avoided capacity rates using the
25 peaker method, a utility’s standard offer to purchase should include

1 a capacity credit for those years when the utility's most recent
2 IRP demonstrates a need for capacity."¹ G.S. 62-156(b)(3) was
3 amended in 2017 by the General Assembly in Part I of Session Law
4 2017-192 (House Bill 589) to require that with regard to power sales
5 by small power producers to public utilities, "a future capacity need
6 shall only be avoided in a year where the utility's most recent biennial
7 integrated resource plan filed with the Commission pursuant to
8 G.S. 62-110.1(c) has identified a projected capacity need to serve
9 system load and the identified need can be met by the type of small
10 power producer resource based upon its availability and
11 reliability of power, other than swine or poultry waste for which
12 a need is established consistent with G.S. 62-133.8(e) and (f)."
13 The Commission's Sub 148 Order noted that the witnesses for DEC,
14 Duke Energy Progress, LLC, Dominion Energy North Carolina,
15 and the Public Staff all supported the use of zero capacity values for
16 certain years. The Commission also concluded that "PURPA² was
17 not intended to force a utility and its customers to pay for capacity
18 that it otherwise does not need."³

¹ *Order Establishing Standard Rates and Contract Terms for Qualifying Facilities*, Docket No. E-100, Sub 148, October 11, 2017 (Sub 148 Order), p. 48.

² Section 210 of the Public Utility Regulatory Policies Act of 1978 (PURPA).

³ Sub 148 Order, pp. 48-49.

1 **Q. WHAT WAS THE IMPACT OF THE COMMISSION'S**
2 **CONCLUSIONS ON QUALIFYING FACILITY (QF) CAPACITY**
3 **RATES?**

4 A. The result is that for at least as long as the Sub 148 order is in effect,
5 "new" QFs seeking to sell their energy and capacity to DEC will not
6 be paid capacity payments until new capacity is needed in 2023,
7 as identified in the Company's 2016 IRP.⁴ The zero avoided capacity
8 costs for the years through 2022 are combined with positive capacity
9 payments beyond 2023 and levelized such that the avoided capacity
10 cost rates are reduced to reflect the use of zero capacity values.

11 **Q. IN THE SUB 148 ORDER, DID THE COMMISSION NOTE THE**
12 **LINK BETWEEN PURPA-BASED AVOIDED COSTS AND THE**
13 **COMPANY'S DSM/EE PROGRAMS?**

14 A. Yes. The Commission noted that "... in addition to providing
15 the basis for electric power purchases from QFs by a utility,
16 the Commission-determined avoided costs are utilized in, among
17 other applications, the determination of the cost-effectiveness of
18 DSM/EE programs and the calculation of the performance incentives
19 for such programs...."⁵

⁴ "New" QFs would consist of those facilities that had not previously established a legally enforceable obligation with DEC to sell their energy and capacity to the utility under a prior avoided cost rate structure.

⁵ Sub 148 Order, p. 69.

1 **Q. WHAT IS THE PUBLIC STAFF’S POSITION ON HOW DSM/EE**
2 **CAPACITY COSTS SHOULD BE TREATED UNDER THE**
3 **REVISED MECHANISM?**

4 A. The Public Staff’s position is that the avoided cost rates for capacity
5 that are used in the calculation of ongoing cost-effectiveness and
6 utility incentives for DSM/EE programs should be consistent with the
7 avoided cost rates for capacity for PURPA-based QFs, as provided
8 in the Revised Mechanism and noted above in the Sub 148 Order.
9 As such, DSM/EE ongoing cost-effectiveness and utility incentives
10 should be based on consistent assumptions from the approved
11 2016 Biennial Avoided Cost rates which include an avoided capacity
12 value of zero prior to 2023.⁶

13 **Q. PURSUANT TO PARAGRAPHS 23 AND 69 OF THE REVISED**
14 **MECHANISM, SHOULD ONGOING COST-EFFECTIVENESS**
15 **AND UTILITY INCENTIVES FOR DSM/EE PROGRAMS BE**
16 **DETERMINED BASED ON AVOIDED CAPACITY VALUES**
17 **GREATER THAN ZERO IN THE YEARS PRIOR TO AN**
18 **IDENTIFIED NEED FOR NEW CAPACITY IN THE COMPANY’S**
19 **IRP?**

20 A. No. In order to be consistent with the Sub 148 Order and the Revised
21 Mechanism, determinations of ongoing cost-effectiveness and utility

⁶ Actual DSM/EE avoided capacity rates would be levelized across the life of a given measure, with the levelized calculation including zeros for years prior to 2023. For measure lives that end before 2023, the avoided capacity rate would be zero.

1 incentives of both new DSM/EE programs and new vintages of
2 existing DSM/EE programs starting in vintage 2019 should be based
3 on avoided capacity rates that reflect zero avoided capacity value in
4 years prior to the identified need for new capacity in the Company's
5 IRP (2023).

6 **Q. DID THE COMPANY USE AVOIDED COST CAPACITY RATES**
7 **THAT WERE BASED ON CONSISTENT ASSUMPTIONS AS**
8 **APPROVED IN THE LAST BIENNIAL AVOIDED COST**
9 **PROCEEDING?**

10 A. No. In assessing the ongoing cost-effectiveness of its DSM/EE
11 programs and the appropriate level of utility incentives, the Company
12 used avoided cost rates that reflected a full capacity value, based on
13 the peaker method, beginning in year one. Public Staff witness
14 Williamson discusses the Public Staff's review of ongoing
15 cost-effectiveness in more detail, and Public Staff witness Maness
16 discusses the determination of the PPI utility incentive.

17 **Q. DID THE PUBLIC STAFF EXPECT THE COMPANY TO USE FULL**
18 **AVOIDED COST CAPACITY VALUES IN ITS CALCULATIONS OF**
19 **ONGOING COST-EFFECTIVENESS AND UTILITY INCENTIVES**
20 **FOR ITS DSM/EE PROGRAMS?**

21 A. No. Given the Public Staff's understanding of the Revised
22 Mechanism and the Commission's conclusions in Sub 148
23 referenced earlier in my testimony, the Public Staff did not expect the

1 Company to use full avoided cost values for capacity in the years in
2 which capacity is not needed and that QF contracts receive zero
3 avoided cost value for capacity.

4 In the Company's 2017 DSM/EE rider proceeding in Docket
5 No. E-7, Sub 1130, Public Staff witness Hinton's testimony explicitly
6 linked the PURPA-based avoided capacity and avoided energy costs
7 to the savings and financial incentives of the Company's DSM/EE
8 programs, which was not challenged or rebutted in the proceeding.
9 Furthermore, Company witness Timothy J. Duff stated in his
10 Sub 1130 supplemental and rebuttal testimony that "another benefit
11 of the agreement is that it eliminates the potential for avoided energy
12 and avoided capacity costs to be based upon inconsistent
13 assumptions."⁷ Mr. Duff further testified that "the proposed revisions
14 eliminate this potential problem by aligning the assumptions for both
15 avoided energy and avoided capacity rates, as a result of using the
16 most recently approved avoided energy and capacity costs from the
17 same proceeding."⁸

18 **Q. HAS THE COMPANY EXPLAINED WHY IT INCLUDED FULL**
19 **AVOIDED COST CAPACITY VALUE FOR DSM/EE PROGRAMS**
20 **BEGINNING IN YEAR 1?**

⁷ T., p. 65.

⁸ T., p. 75.

1 A. Yes. In Data Request 3-1, the Public Staff asked the Company
2 whether it had included avoided capacity cost benefits in every year
3 during the life of each measure. The Company indicated that it had
4 done so. The Public Staff then asked how this approach was
5 consistent with the Sub 148 Order. The Company quoted the
6 applicable language of the Revised Mechanism referenced above
7 and then responded:

8 The Company has followed the agreed upon
9 mechanism by establishing avoided capacity and
10 energy cost benefits "...derived from the underlying
11 resource plan, production cost model, and cost inputs"
12 used in the most recent Commission-approved
13 Avoided Cost Proceeding. Due to fundamental
14 differences between a QF and a DSM/EE measure, the
15 avoided cost benefits for EE and DSM programs
16 should not be, and were not intended to be, exactly the
17 same as those used to establish QF payments. For
18 example, the currently approved DEC DSM/EE
19 mechanism specifically allows avoided energy rates to
20 be modeled differently for DSM/EE programs (which
21 uses the projected hourly EE portfolio) than for QF's
22 (which uses a flat 100 MW power purchase). In this
23 case, the resulting avoided energy rates for DSM/EE
24 are different than for QF purchases, while being
25 "derived from" the same underlying data and models.
26 The mechanism, however, does not address the
27 specifics required to properly determine the avoided
28 capacity costs of DSM/EE programs. DSM/EE
29 measures are different and must be evaluated
30 differently than Qualifying Facilities. The Public Staff
31 questions appear to contend that because avoided
32 capacity credits for a QF are calculated based upon the
33 projected in-service date for the next avoidable
34 generating unit, then that same assumption should
35 also be applied to the calculation of avoided capacity
36 costs for DSM/EE measures. If indeed the case, that
37 contention fails to recognize that the capacity credits
38 for a QF were derived after inclusion of the DSM/EE
39 portfolio in the resource plan. The very fact that the

1 DSM/EE portfolio has been included in the resource
2 plan is why the QF capacity credit is zero for the period
3 2018-22. The valuation of QF capacity credits is
4 incremental to a resource plan which already includes
5 the DSM/EE portfolio. If the DSM/EE portfolio had not
6 been included in the resource plan, then the QF
7 capacity credits would have been the same as those
8 used in the DSM/EE valuation of cost effectiveness
9 because the removal of the DSM/EE portfolio would
10 have resulted in an immediate resource need.

11 **Q. DO YOU AGREE WITH THE COMPANY'S BASIS FOR**
12 **INCLUDING FULL AVOIDED COST CAPACITY VALUE FOR**
13 **DSM/EE PROGRAMS BEGINNING IN YEAR 1?**

14 A. No. My position is consistent with the testimony in the Sub 1130
15 proceeding of Public Staff witness John Robert Hinton, Director of
16 the Economic Research Division, who testified that "the use of
17 PURPA-based avoided costs appropriately links the Company's
18 DSM/EE savings and financial incentives with the avoided cost rates
19 it *pays qualified facilities*, will lead to better estimates of the costs
20 avoided by the Company's DSM/EE programs, and will provide a
21 more accurate view of the *value* of DSM and EE."⁹ (emphasis added)
22 Mr. Hinton further testified that "... the use of PURPA-based avoided
23 costs *links* the savings and financial incentives afforded the
24 Company for its DSM/EE programs with the *rates it pays QFs* for
25 avoided energy and *avoided capacity*. Therefore, I believe that the
26 *use of PURPA-based avoided energy and capacity costs will lead to*

⁹ T. p. 257.

1 *better estimates of the costs avoided by the Company's DSM/EE*
2 *programs thereby providing a more accurate view of the value of*
3 *DSM and EE.”¹⁰*

4 The Company, based on the particular way it determines its IRP,
5 assumes that DSM/EE is included *a priori* and that the supply-side
6 resource plan follows from it. However, an *Integrated* Resource Plan
7 is meant to treat demand- and supply-side resources on an even
8 playing field by identifying the combination of demand- and supply-
9 side resources that lead to the lowest system cost.

10 **Q. IS THE COMPANY CORRECT IN SAYING THAT REMOVING THE**
11 **BLOCK OF DSM/EE PROGRAMS FROM THE IRP WOULD**
12 **RESULT IN A MORE IMMEDIATE NEED FOR NEW CAPACITY?**

13 A. The Company is correct in its contention that removing the block
14 of DSM/EE programs from the IRP would result in a more
15 immediate need for new capacity; however, the very same argument
16 holds with respect to projected QFs in the IRP. Removing projected
17 QFs would also result in a more immediate need for capacity. In fact,
18 DEC concludes in DR 14-4 that “if all anticipated future QF contracts
19 were removed from the DECarolinas 2016 Resource Plan, the need
20 for new capacity would advance one year, from December 2022 to
21 December 2021.”

¹⁰ T. pp. 250-51.

1 DEC's argument that the capacity value of DSM/EE is derived from
2 the fact that its removal would result in changes to the resource plan
3 applies equally to QF capacity; thus, QF capacity would also have
4 value prior to 2023.

5 Nevertheless, the General Assembly and Commission have
6 determined that customers should not have to pay for capacity that
7 the Company does not need and that new QFs should receive the
8 equivalent of zero avoided capacity cost payments until capacity is
9 needed. As the Commission noted, "... the Commission-determined
10 avoided costs are utilized in, among other applications, the
11 determination of the ongoing cost-effectiveness of DSM/EE
12 programs and the calculation of the performance incentives for such
13 programs...."¹¹ Those Commission-determined avoided costs for
14 avoided capacity for DEC are zero until 2023. Therefore, DSM/EE
15 programs should be evaluated and given incentives according to the
16 Commission-determined avoided costs, and those avoided costs
17 include zero value for capacity prior to 2023.

18 **Q. DOES THE COMPANY ACKNOWLEDGE THAT INCREMENTAL**
19 **DSM/EE SHOULD BE TREATED IN THE SAME WAY AS QFS**
20 **WITH RESPECT TO AVOIDED CAPACITY?**

¹¹ Sub 148 Order, p. 69.

1 In its response to Data Request 14-3, the Company stated in part,
2 “It is wholly consistent to treat avoided capacity value for existing EE
3 the same way existing QFs are treated with respect to capacity
4 valuation, while treating incremental EE capacity value in the same
5 manner incremental solar QF capacity value is being treated.”
6 Thus, it is the Public Staff’s understanding that if DEC proposed
7 a new DSM/EE program that is incremental to the block of DSM/EE
8 in the IRP, DEC would agree that this incremental DSM/EE would be
9 treated the same as new QFs, thereby receiving the equivalent of no
10 avoided capacity cost payment prior to 2023.

11 **Q. TO YOUR KNOWLEDGE, DOES DEC HAVE A DEFINITIVE LIST**
12 **OF PROGRAMS INCLUDED IN THE DSM/EE BLOCK IN THE IRP?**

13 A. No. My understanding is that DEC’s projection of the programs
14 composing the DSM/EE block is rather fluid. DEC’s DSM/EE block
15 is based on projections of participation and savings associated with
16 the Company’s approved DSM/EE portfolio, as well as the
17 Company’s market potential study for DSM/EE in effect at the time
18 the IRP is developed. This process also assumes that where
19 possible, cost-effective programs will continue and that as other
20 cost-ineffective programs are phased out, new, but not necessarily
21 identified, programs will take their place.

22

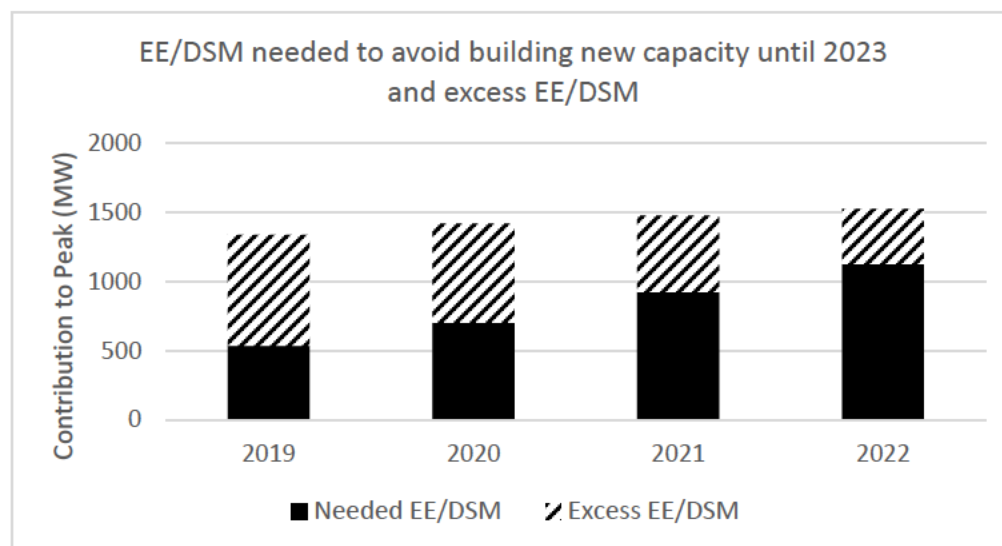
1 **Q. HOW CAN A NEW DSM/EE PROGRAM BE DETERMINED AS**
2 **INCREMENTAL TO THE BLOCK OF DSM/EE PROGRAMS**
3 **INCLUDED IN THE IRP AND THEREFORE NOT BE ENTITLED TO**
4 **RECEIVING CAPACITY CREDIT UNTIL 2023?**

5 A. It appears that under DEC's approach, this determination would be
6 made by the Company. With the constant modifications to DSM/EE
7 programs, application of evaluation, measurement, and verification
8 (EM&V) results, and beginning and ending of programs and
9 measures, it would be difficult, if not impossible, to verify the
10 Company's determination.

11 **Q. SETTING ASIDE YOUR ASSERTION THAT DEC'S DSM/EE**
12 **PROGRAMS SHOULD BE TREATED THE SAME AS QFS WITH**
13 **RESPECT TO AVOIDED CAPACITY VALUE, PLEASE DISCUSS**
14 **THE IMPLICATIONS OF DEC'S CONTENTION THAT ALL**
15 **DSM/EE PROGRAMS WITHIN THE IRP BLOCK SHOULD HAVE**
16 **FULL CAPACITY VALUE PRIOR TO 2023.**

17 A. I evaluated DEC's Table 8-C "Summer Projections of Load, Capacity,
18 and Reserves" in its 2016 IRP, filed in Docket No. E-100, Sub 147,
19 to determine how much capacity from DSM/EE really is needed to
20 avoid building new capacity until 2023. I removed enough DSM and
21 EE capacity (as they contribute to peak) to maintain a 17% reserve
22 margin from 2019 through 2022, so that the new capacity need
23 remains in 2023. My evaluation indicates that beginning in 2019,

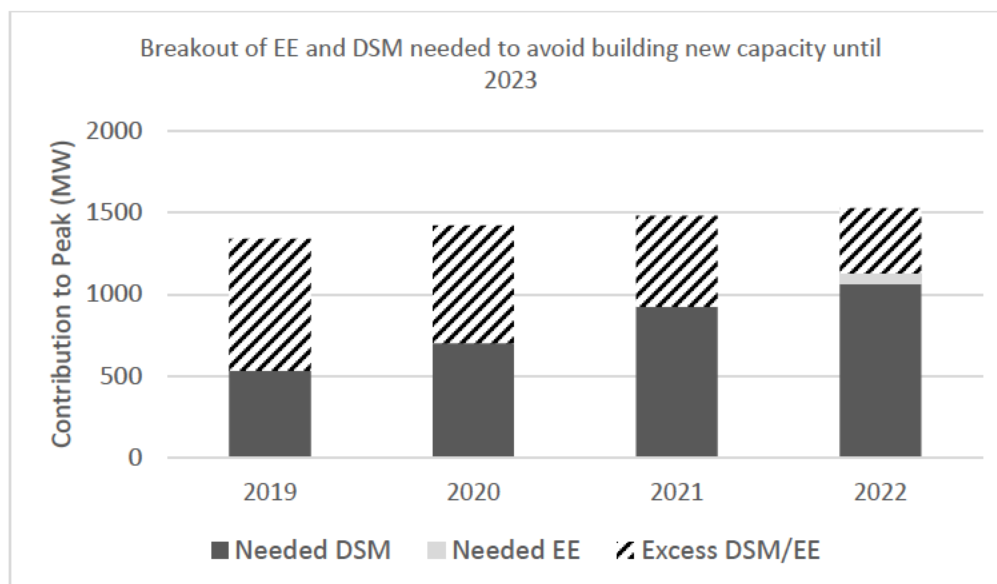
1 only about 40% of the DSM/EE block from the IRP is needed to
2 maintain a 17% reserve margin. By 2022, about 74% of the DSM/EE
3 block is needed.



4

5 **Q. WHAT IS THE ACTUAL CONTRIBUTION OF INDIVIDUAL**
6 **DSM/EE PROGRAMS TO MAINTENANCE OF THE CURRENT**
7 **CAPACITY EXPANSION PLAN?**

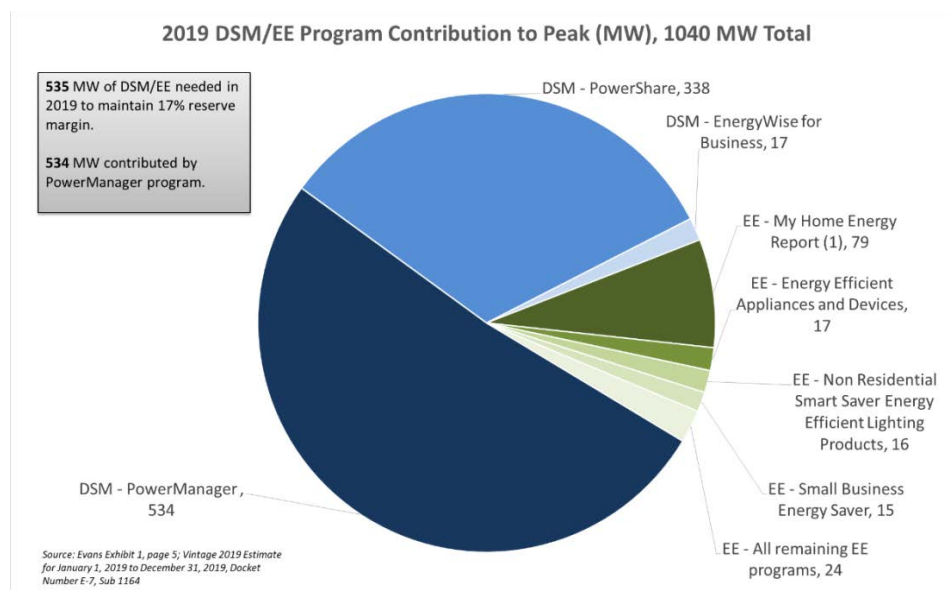
8 A. My review indicates that DSM programs could comprise 100% of the
9 needed DSM/EE resources from 2019 through 2021 and 95% in
10 2022 in order to maintain a 17% reserve margin (and delay the need
11 for new capacity until 2023).



1

2 Not only can DSM programs contribute all the DSM/EE resources
 3 needed (535 MW) to maintain a 17% reserve margin in 2019,
 4 one DSM program – Power Manager – can contribute nearly the
 5 whole required amount by itself (534 MW). The following figure
 6 provides a detailed breakout of 2019 DSM programs in variations of
 7 blue and EE programs in variations of green. A detailed breakout of
 8 DSM/EE programs was not generated by DEC and is not available
 9 for the years 2020 – 2022 to show how the breakout may change
 10 over time.

11 The capacity provided through DSM programs means that, in effect,
 12 all new EE programs and all new vintages of existing EE programs
 13 are incremental to the needed DSM/EE block in the IRP and
 14 therefore do not provide any needed capacity to the system.



1

2 Residential lighting and most other EE programs – which appear to
 3 be the types of programs that the Company is continually replacing
 4 in the IRP block – have little, if any, impact on the need for
 5 new capacity. It is my understanding from Public Staff witness
 6 David M. Williamson that the DSM programs in the DSM/EE IRP
 7 block, on the other hand, are stable and expected to continue for the
 8 foreseeable future. Therefore, even under the Company's argument
 9 (i.e., any DSM/EE that avoids building capacity until 2023
 10 should receive full capacity payments), only a small fraction of *all*
 11 EE programs likely contribute any capacity value, and any new
 12 EE program or EE vintage would contribute effectively no capacity
 13 value and would, thus, be ineligible to receive the full value of
 14 capacity payments.

1 I want to reiterate that the Public Staff disagrees with the Company's
2 argument on the grounds that it is inconsistent with the Revised
3 Mechanism and it contradicts the Commission Order in Sub 148 that
4 clearly states that 1) ratepayers should only pay for capacity in years
5 it is needed and 2) the Commission-determined avoided costs (i.e.
6 zeros for capacity before 2023) be used in determining the ongoing
7 cost-effectiveness of all DSM/EE programs and in calculating the
8 performance incentives for such programs. Public Staff witnesses
9 Michael C. Maness and David M. Williamson will address the issues
10 of DSM/EE ongoing cost-effectiveness and utility incentives in more
11 detail in their testimony.

12 **Q. ARE THERE ANY OTHER MATTERS THAT YOU WOULD LIKE**
13 **TO DISCUSS?**

14 A. Yes. In the last proceeding, the Public Staff and the Company
15 agreed to review and update the T&D avoided cost rates.
16 This methodology to calculate the avoided T&D rate was established
17 in 2014, following the Sub 1032 proceeding. The Company has
18 updated its studies using the same methodology that was previously
19 found to be reasonable. I believe the updated avoided T&D rate
20 used to determine continuing cost-effectiveness and the PPI is
21 appropriate for use in this rider.

22 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

23 A. Yes, it does.

QUALIFICATIONS AND EXPERIENCE

ERIC LEE WILLIAMS

I received a Bachelor of Arts in Economics and Political Science, with a minor in History, from the University of Kentucky in 1994. I also received a Master of Arts in Law and Diplomacy with concentrations in Development Economics and International Environmental Policy from the Fletcher School of Law and Diplomacy at Tufts University in 1997. I have 18 years of experience in energy economics and energy systems analysis. In 1998, I joined Tellus Institute, where I worked in the Electricity program and did analysis and wrote testimony on behalf of my supervisor on the issue of electricity restructuring. In late 1999, I was an Economist at the Energy Information Administration working on international energy forecasting and climate change policy analysis.

In 2000, I joined the Center for Clean Air Policy, a small NGO / think tank, as a Senior Policy Analyst. I programmed an electricity dispatch model that integrated a distributed generation (DG) diffusion model to understand the cost and environmental dynamic between DG and the existing system when providing owners of back-up diesel generators an economic incentive to generate.

In 2005, I joined a team of independent consultants assisting Arizona and New Mexico develop climate change state action plans. I led the electricity working groups in each state, evaluating greenhouse gas (GHG) reduction measures proposed by stakeholders.

Later in 2005, I joined the Nicholas Institute at Duke University as a Senior Research Economist to Co-Direct the Climate Change Policy Partnership.

I led research in the partnership, which focused on identifying barriers and developing solutions for the adoption of low-carbon energy infrastructure. I brought the National Energy Modeling System (NEMS) to the Institute and used it for a variety of energy and climate policy analyses. I also directed research on many other topics, including on barriers to utility energy efficiency programs.

In 2010, I started work as an Energy/Environmental Economist at the International Atomic Energy Agency in Vienna, Austria. I assisted developing countries assess their energy plans. I developed a capacity expansion model for Sub-Saharan Africa. I also conducted research on the impacts of climate change and extreme weather on energy infrastructure. I was a Contributing Author to the Intergovernmental Panel on Climate Change Assessment Report 5 Working Group II.

In 2014, I entered into a PhD program at Duke University to study energy systems modeling. I left the program early to join the Public Staff at the beginning of 2016. While at the Public Staff, I developed an IRP model that is integrated with a unit commitment model (UCM) with the purpose of identifying if the capacity expansion projected in the IRP is flexible enough to accommodate the increase on PV capacity in North Carolina.

In 2017, I left the Public Staff for a short-term opportunity to work in Paris at the Organization for Economic Cooperation and Development (OECD). I returned to the Public Staff in November 2017 and resumed my current duties. I have since re-written my IRP-UCM model that I plan to use in review of the 2018 IRP.