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BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Duke Energy Ohio, Inc. for an Energy Efficiency Cost Recovery Mechanism and for Approval of Additional Programs for Inclusion in its Existing Portfolio.	))))))	**Case No. 11-4393-EL-RDR**

COMMENTS BY MEMBERS OF THE OHIO CONSUMER AND ENVIRONMENTAL ADVOCATES

Christopher J. Allwein, Counsel of Record (0084914)
Williams, Allwein and Moser, LLC
1373 Grandview Ave., Suite 212
Columbus, Ohio 43212
Telephone: (614) 429-3092
Fax: (614) 670-8896
E-mail: callwein@williamsandmoser.com

Attorney for the Natural Resources Defense Council

JANINE L. MIGDEN-OSTRANDER
CONSUMERS' COUNSEL

Jeffrey L. Small, Counsel of Record
Melissa R. Yost
Assistant Consumers' Counsel
Office of the Ohio Consumers' Counsel
10 West Broad Street, Suite 1800
Columbus, Ohio 43215-3485
614-466-8574 (Telephone)
small@occ.state.oh.us
yost@occ.state.oh.us

Trent A. Dougherty, Counsel of Record
Nolan Moser
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212-3449
(614) 487-7506 - Telephone
(614) 487-7510-Fax
trent@theOec.org
nolan@theoec.org

Attorneys for the Ohio Environmental Counsel

Henry W. Eckhart, Counsel of Record
1200 Chambers Road, Suite 106
Columbus OH 43212-1703
Phone: (614) 461-0984
Fax: (614) 485-9487
henryeckhart@aol.com

Attorney for the Sierra Club

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I. INTRODUCTION

The undersigned members of the Ohio Consumer and Environmental Advocates[1] ("OCEA") offer Comments in the above-captioned case regarding the Duke Energy Ohio, Inc. ("Duke" or the "Company") proposal to create an Energy Efficiency and Peak Demand Reduction Rider ("Rider EE/PDR"). OCEA offers these Comments in accordance with an Attorney Examiner Entry dated September 12, 2011 issued by the Public Utilities Commission of Ohio ("PUCO" or "Commission").[2] The Application, filed by the Company on July 20, 2011, presents important questions regarding Duke's cost recovery of EE/PDR program costs, avoided costs, and the consideration of new programs.

[1] These comments are signed by the Ohio Consumers' Counsel ("OCC"), the Natural Resources Defense Council ("NRDC"), the Ohio Environmental Council ("OEC") and the Sierra Club.

[2] Entry at 2, ¶7(a) (Sept. 12, 2011).

The undersigned members of OCEA offer the following Comments for consideration by the Commission.

II. COMMENTS

A. Decoupling and Incentives

OCEA recommends the Commission institute certain modifications to the Company's proposed decoupling and incentive mechanisms. Duke proposes a new mechanism for recovering the costs of energy efficiency programs, which includes a new performance incentive designed to encourage energy efficiency deployment beyond the minimum required by law and a lost revenue recovery mechanism that would be implemented if its Application for a type of partial decoupling is not approved by the Commission in the pending Electric Security Plan case, Docket No. 11-3549-EL-SSO. Duke also requests Commission approval for several new energy efficiency programs. Because Duke asks for approval of several new energy efficiency programs in this docket, the Company should be required to develop several additional programs with stakeholders as part of the existing Duke Energy Community Partnership ("Collaborative"). The programs can be included in Duke's next Program Portfolio Plan filing, or in a supplemental rider filing.

1. Program Cost Recovery Mechanism

Ohio Administrative Code Section 4901:1-39-07 allows an electric utility to submit a request for approval of a mechanism to recover costs of implementing an approved Program Portfolio Plan , including energy efficiency and peak demand reduction program costs, appropriate lost distribution revenues, and shared savings. Duke proposes its cost recovery

mechanism because of the expiration of its current cost recovery mechanism, Rider SAW, on December 31, 2011.[3]

In addition to programs approved by the Commission in the Company's last Program Portfolio Plan, Duke is proposing to collect costs of several supplemental programs included in the Application. OCEA supports the Company's proposal to collect costs of implementing and evaluating energy efficiency, peak demand reduction, and demand response programs. The energy efficiency programs that are a part of the Company's approved Program Portfolio Plan, and the supplemental programs, pass both the utility cost test and the total resource cost test,[4] meaning, respectively, that the programs are a better investment of utility dollars than new supply and are cheaper on a service territory-wide basis than new supply. Collecting program costs is allowed by rule, and is one of the necessary attributes of a successful implementation of utility energy efficiency.

According to the "Aligning Utility Incentives with Cost Effective Energy Efficiency" report of the National Action Plan on Energy Efficiency, "reasonable opportunity for program cost recovery is a necessary condition for utility program spending, as failure to recover these costs produces a direct dollar-for-dollar reduction in utility earnings, all else being equal, and sends a discouraging message regarding further investment."[5] The Commission should approve Duke's proposal to collect costs based on projected program expenditure, subject to true-up.

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[3] Duff Testimony at 3, Lines 11-17 (July 20, 2011).

[4] AJO Attachment 3 and 4.

[5] "Aligning Utility Incentives with Investment in Energy Efficiency," National Action Plan for Energy Efficiency, November 2007, Page ES-2.

2. Removing the throughput incentive

OCEA notes that recovery of lost distribution revenue, to the extent it occurs, should not be in the form of a lost revenue adjustment mechanism ("LRAM"). Duke does not request that the Commission approve a LRAM, a charge that would collect from customers the distribution revenue the Company would have received had its energy efficiency programs not taken place.[6] OCEA members have argued in several Commission proceedings that lost revenue recovery is not an ideal way to ensure that a utility is able to recover its fixed costs of providing distribution service as cost effective energy efficiency programs required by O.R.C. Section 4928.66 reduce customer usage.[7] Lost revenue recovery is problematic for multiple reasons:

- LRAMs *do not remove the throughput incentive*: a utility still keeps revenue it generates above its authorized revenue and is motivated to boost sales.
- Utilities can game a LRAM by running an energy efficiency program that looks good on paper but saves little or nothing in practice, such as a behavior change program that does not use experimental design. The utility keeps the revenue associated with the unsaved energy while also collecting lost revenues for ineffective programs.
- LRAMs lead a utility to avoid investing in market transformation programs. Unless a program can be measured and evaluated with high confidence, it cannot generate "lost revenues" in a LRAM. This biases a utility to implement only programs from which savings can be easily evaluated, and still provides a

[6] Duff Testimony at 9, line 10-12.

[7] See, e.g., *In re Distribution Company Rate Structures*, Case No. 10-3126-EL-UNC. OCEA Comments at 17 (Feb. 11, 2011).

disincentive for utilities to argue for stronger efficiency codes, proactively promote efficiency in conversations with customers, or otherwise use its relationships with customers to increase efficiency.

- LRAMs are inherently asymmetrical and penalize consumers by failing to protect them from utility over-collection: a utility gets to claim lost revenues from energy efficiency programs without having to give up "found revenues" from other factors, such as abnormal weather.
- LRAMs are imprecise: there is no check to see if the "lost revenue" is really needed to cover fixed costs. In a situation where high load growth is diminished by energy efficiency, remaining sales may be more than adequate to recover fixed costs, yet the utility may be entitled to a LRAM anyway, creating a regulated windfall.
- LRAMs are costly. Lost revenues are generally collected for an agreed-upon amount of time after an energy efficiency measure is installed, or until a rate case resets rates for new levels of consumption in a service territory.

While a lost revenue recovery mechanism is not ideal, OCEA supports the Company's right to propose a mechanism if an application for decoupling is not approved. The utility cannot be expected to simply absorb the cost of its energy efforts.

Instead of a LRAM, Company witness Duff states that the Company proposes an alternative in its current ESP proposal, Case No. 3549-EL-SSO ("ESP Case").[8] In that case, the Company proposes what it calls a formula rate (Rider DR) that would load distribution costs

[8] For rider detail, see the Direct Testimony of James E. Ziolkowski.

incremental to those included in its current rates into a per-customer charge. While an alternative is needed to a LRAM, the undersigned parties cannot support the formula rate as proposed.

As proposed by Duke, the formula rate would *not* accomplish the goal of decoupling - i.e. the elimination of the utility's incentive between rate cases to increase sales of energy. Although the utility would load incremental distribution investment and O&M into a customer charge, the Company would continue to experience revenue variability according to how much energy and demand its customers use, benefiting financially if customers use and demand more and losing financially if customers use and demand less. This variability remains because the Company's proposal retains the volumetric distribution rates from Case No. 08-709-EL-AIR, with no provision for an annual decoupling true-up to adjust rates to ensure the utility collects its base distribution revenue requirement, no less and no more. The non-removal of the throughput incentive means that Duke's incentives would not be aligned fully with its customers: Duke may incur financial harm if it helps its customers cost-effectively reduce energy use.

In addition, Duke's proposal is problematic because it loads incremental investment (plus return) and O&M into a fixed charge per-customer, even though some costs are customer-related and others are demand-related. This charge per-customer would have the effect of increasing the portion of a customer's bill that does not vary with usage. Each year, as the fixed charges increase, Rider DR will lengthen the payback period customers experience with energy efficiency and customer-sided renewable investments and, thus, lessen their incentive to make them. Each year, as the fixed charges increase, Rider DR would result in weakening the price

signals about the future cost of electricity, further lessening customer interest in energy efficiency or customer-sited renewables.

In the ESP Case, the Commission (if the PUCO approves any Rider DR) should at a minimum modify the Company's Rider DR proposal as follows:

- The fixed charges currently in its distribution schedules remain as set in Case No. 08-709-EL-AIR. Duke would design rates resulting from its annual Rider DR filings into per kWh or per kW charges, as appropriate to each distribution rate schedule.
- Subsequent to each calendar year, Duke would make a filing that reconciles its actual variable distribution revenues with the variable distribution revenues it anticipated collecting under Rider DR and its current variable distribution rates. In other words, revenues it charges and collects pursuant to the fixed parts of each rate schedule would not be subject to the decoupling mechanism. These would continue to vary, if at all, according to the number of accounts.
- Duke would design any over-collection into a credit (per kWh or per kW) to return to customers or any under-collection into a surcharge the collect from customers, during the following calendar year. The reconciliation filings can be made at the same time as the Rider DR filings.

The above-stated proposal would actually accomplish decoupling – freeing Duke to focus on helping its customers save money through energy efficiency – without having significant affect on customers themselves (for example, by increasing fixed charges). The proposal is also simple to administer: Duke and Commission staff need only compare what the

Company intended to collect under its variable distribution charges and Rider DR with what it actually collected.

B. Shared Savings Incentive

The Company, as allowed by rule, requests an incentive that would allow it to retain a portion of the net bill savings its energy efficiency programs produce for customers when it saves more energy and demand than the minimum required by O.R.C. 4928.66.[9] Under Duke's proposal, it would receive no incentive when it fails to achieve the targets in O.R.C. 4928.66, 7.5% of the net system benefits when it achieves between 100 and 110% of the targets, 10% of the net benefits when it achieves between 110% and 115% of the targets, and 15% of the net benefits when it achieves more than 115% of the target. The Company states that its banked savings would be used for compliance and for determining the percentage of net benefit it retains.[10] The Company would similarly use the savings from self direct mercantile customers in determining the percentage of net benefit it retains, but the Company specifically states that it would exclude the avoided cost savings from the self direct program from the shared savings calculation, and would thus not collect an incentive for the operation of this program. Duke would subject the shared savings incentive to an annual reconciliation based on the results of the Commission's verification report.

A model based on shared savings incentives is generally preferable to other incentive models because it encourages utilities to increase program savings (net benefits), rather than program spending (like budget-based incentives). . A "shared savings" incentive allows a utility

[9] Duff Testimony at 5.

[10] Id. at 7-8.

to retain a portion of the net bill savings its programs create for customers (program costs and incentives or incremental cost subtracted from avoided cost impacts) when it reaches a threshold of program performance. OCEA supports the elimination of Duke's complicated Save-a-Watt incentive. While the Company's movement towards a shared savings incentive is positive, the Commission should make several changes to the Company's proposal.

First, the Commission should ensure the incentive excludes alleged avoided cost savings from transmission and distribution ("T&D") projects. Duke witness Duff does not discuss the treatment of transmission and distribution projects. The measurement of savings from T&D projects has been controversial.[11] OCEA members have noted the conflict between claimed savings by the FirstEnergy electric distribution utilities, the recommendations of the Commission's expert consultant regarding development of a Technical Reference Manual ("TRM") for Ohio, and standard energy efficiency measurement practice (an energy efficiency program's savings are measured relative to what would have happened in the absence of a program).[12] While a FirstEnergy application regarding T&D savings has been approved, the Commission took that step while at the same time recognizing that measurement issues remain under review pending the Commission's completion of efforts in the TRM docket.[13] In addition to measurement uncertainty, shared savings incentives are meant to encourage energy efficiency that utilities achieve in partnership with its customers, not for improvements to its own system.

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[11] See, e.g., *In re FirstEnergy's T&D Savings*, Case Nos. 09-951-EL-EEC, et al., OCEA Second Motion for Hearing at 3-13 (Jan. 6, 2011).

[12] Id.

[13] *In re FirstEnergy's T&D Savings*, Case Nos. 09-951-EL-EEC, et al., Order at 6-7, ¶(16) (June 8, 2011).

Second, the Commission should adjust the tiers so that small incremental increases in savings do not produce large changes in the amount of incentive the Company receives. Such "big steps" create opportunities for gaming.

Third, the Commission should adjust the savings percentages so that a utility collects a maximum of 13% of the net benefits from energy efficiency programs when it exceeds the targets by 15%. The Company's incentive, as proposed, does not include a cap, a feature of other Ohio shared savings mechanism. AEP-Ohio's incentive allows the Company to keep the lesser of 15% of the net benefit of its programs (excluding mercantile self-direct and transmission and distribution savings) or 17% of the program investment, when it exceeds the target by 15%.[14] A 15% shared savings incentive is also generous compared to what other states have found necessary to encourage energy efficiency performance. Colorado, for example, awards its utilities 12% of net benefits when its utilities reach 150% of the state's "modest" targets. Georgia Power receives 10% of the net benefits its programs create for customers when it exceeds 50% of targets. Idaho Power also receives 10% of net benefits when certain programs exceed identified metrics.[15]

Designing the proper level of "shared savings" is an imperfect task: the goal is to reward the Company for performance while ensuring that the utility's return is comparable to its other investment opportunities. Reducing the incentive for Duke (and eventually for other utilities) will allow a more reasonable sharing of benefits between the Company and its customers, while still allowing the Company to benefit from deploying all cost effective energy efficiency. Under

[14] See AEP Energy Efficiency Portfolio Case No. 09-1089-EL-POR, et al.

[15] All examples from "State Energy Efficiency Regulatory Frameworks," Institute for Electric Efficiency, July 2010.

OCEA's proposal, if the Company exceeds the Company's estimated 5-year energy efficiency target by 15% while keeping cost effectiveness the same the Company will have created $475.5 million in avoided cost savings for customers (net of program costs), entitling it to $61.82 million in incentive. Given that this would be for exceeding an aggressive but achievable target, such an incentive is not unreasonable. The actual incentive is likely to be lower than the above scenario, however, because expanded programs will likely produce fewer avoided cost savings per unit of investment as very cheap lighting opportunities become fully exploited.

There are also several layers of Commission oversight over the Company's energy efficiency effort: the Company has to secure Commission approval and Collaborative feedback for major changes to program budget or design. The portfolio as a whole must pass the total resource cost test. Furthermore, under the shared savings model, the Company only gets an incentive if its programs save money for customers.

Under the OCEA shared savings proposal, the Company would be rewarded at a reasonable rate when it exceeds Ohio's aggressive energy efficiency targets. The Commission should modify the Company's proposal to comply with OCEA's recommendations, according to the chart below and the provisions above.

Achievement of Annual Target	**Shared Savings Percentage**
≤ 100%	0 %
> 100 – 105%	5%
> 105 – 110%	7.5%
> 110 – 115%	10%
> 115%	13%

Finally, a shared savings incentive program without a cap would be new to Ohio. The incentive mechanism should be limited in time to protect customers from unforeseen events that

could lead to significant increases in the incentive amount. Consistent with Ohio Adm. Code 4901:1-39-04(A), the Commission should review the incentive mechanism results for Duke's energy efficiency programs after a three-year period, and make any modifications (if needed) at that time.

C. Low-Income Program

The Company should work with members of the Collaborative to work out the final design and delivery of a more comprehensive program for low-income households than the program supported by the Company. Duke proposes a new Low Income Neighborhood Program ("LINP"). The Company currently offers a Low Income Services program that "offers a refrigerator replacement program that complements weatherization services offered by other parties."[16] The LINP would target neighborhoods with at least 50% of households that are at or below 200% of the federal poverty guidelines, but would be available to all Duke customers in a chosen neighborhood. [17] Proposed directly installed measures include "CFLs, water heater and pipe wrap, low flow shower heads/faucet aerators, window and door air sealing and HVAC filter replacements."[18] Duke states that the program would "be used as a lead generation source for other Duke Energy Ohio and external energy efficiency programs."[19] The LINP has an estimated cost effectiveness of 2.31 on the TRC, and 1.33 from the UTC. This is predicated on an average annual savings per participant of 942 kWh per year.[20] This program is modeled after

[16] Casey Mather Testimony at 4 (July 20, 2011). This program saves an average of 1,259 kWh per participant per year., see AOJ Attachment 5 of Company filing.

[17] Id. at 6.

[18] Id. at 5.

[19] Id. at 6.

[20] Company AJO Attachment 6.

a Progress Energy Carolinas program with an estimated savings value of 928 kWh per year.[21] The 942 kWh savings figure has been challenged by a low income weatherization provider as being overstated based on their actual program bill analyses.[22]

OPAE has proposed a low income program "that would provide deeper savings.[23] OPAE's proposed program has two components: 1) a baseload efficiency program with similar measures to the LINP, but with an Energy Star refrigerator replacement and 2) a more comprehensive weatherization program for electric heated households.[24] The baseload program savings range from 695 to 1,775 kWh per year depending on the customer usage profile. The weatherization program saves from 2,913-3,151 kWh per year.[25] OPAE's recommended program could also be delivered as a neighborhood program or piggybacked with other existing programs.[26]

The OPAE-proposed program is more comprehensive and achieves more savings per participant.The Company should work with OPAE as well as the Collaborative to work out the final design and delivery of the program.

D. Monitoring and Verification Plan

Process evaluations should be conducted within a year of the program launch and impact evaluations should take place within 18 months of program launch. In AJO Attachment 2, the

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[21] http://ncuc.commerce.state.nc.us/cgi-bin/webview/senddoc.pgm?dispfmt=&itype=Q&authorization=&parm2=NBAAAA87111B&parm3=000135586. Duke's program provides 5 more CFLs than Progress' program.

[22] From discussion on the LINP proposal at a 6/15/11 Duke Collaborative meeting.

[23] OPAE 2/28/11 memo included as Attachment 1.

[24] A copy of the OPAE proposal is contained as Attachment 2.

[25] Id.

[26] See Attachment 1.

Company states that the expected timeframe for conducting the new program evaluations: for Process Evaluation, the Company proposes a range of six months to two years, and for Impact Evaluations a range of 12 months to 24 months is proposed.[27] The 24-month timeframe for producing an evaluation report is too long for the purposes of gauging the performance of the three programs and recommending potential changes to the program design to improve performance. The Commission should require that process evaluations be conducted within a year of program launch and impact evaluations take place within 18 months of program launch.

E. Duke's Proposed Appliance Recycling Program

OCEA supports the Appliance Recycling Program as proposed by the Company.[28] Similar programs have been a successful part of other Ohio Electric Distribution Utility ("EDU") Companies' programs.[29] This addition was previously recommended by some members of OCEA in Duke's last energy efficiency benchmark proceeding.[30] OCEA recommends that this part of the Application be approved as proposed.

F. Expedited Approval of Pilot Programs.

The undersigned members of OCEA also support the expedited pilot program as proposed by witness Tim Duff.[31] The Company's projection of current program impacts shows a gap between the energy efficiency targets and program performance in future years. The programs proposed in the Application will assist in reducing the possibility of non-compliance,

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[27] Ashlie Ossege Testimony. Duke describes its proposed evaluation approach for its three new programs, the Appliance Recycle, LINP, and Home Energy Solutions program in AJO Attachment 1. Id.

[28] Casey Mather Testimony at 5 (July 20, 2011).

[29] See, for example, AEP Ohio's assessment of its Program (Case name here), and FirstEnergy's assessment of its program here.

[30] Duke's benchmark case to be cited here.

[31] Timothy Duff Testimony at 13 (July 20, 2011).

but additional programs will be needed and could provide important new sources of energy bill savings for customers. Some possible sources of new savings are described below. The pilot program process will help to get Collaborative-vetted ideas into Duke's service territory for testing.

G. Commercial and Industrial Lighting Programs

Duke's current commercial and industrial lighting program is providing incentives chiefly for high-bay lighting The Company should explore opportunities to save more energy by retrofitting and de-lamping inefficient T12 fixtures, and other lighting opportunities.

H. Additional Pilots Recommended for Development

As noted above, OCEA recommends the exploration of additional pilot programs, within the expedited process as proposed by Duke, to evaluate other opportunities to capture energy savings:

- A Commercial server program targeting data centers and small server rooms and server closets. The average server in the United States only runs at 5-15% capacity while using 60-90% of its maximum power.[32] Virtualization and other practices can significantly reduce the amount of energy a business uses running servers, consolidating several servers onto one machine.
- A Commercial/industrial energy management program pairing executive-level commitment to energy savings with a detailed facility audit to produce a pipeline of savings. This could be an expansion of the existing *SmartSaver Energy Assessment* program.

[32] NRDC: *Is There A Ghost In Your Closet?* See Attachment 1.

- A commercial retro commissioning program should be investigated. Achieving operational savings through commercial building diagnostics, retro-commissioning and continuous commissioning can be complementary and additive to efficiency retrofit programs. Instrumented commissioning is typically not considered cost-effective in buildings smaller than about 100,000 ft^2, although bundling commissioning into programs for efficiency retrofits, demand response, or thermal storage could significantly lower this threshold.
- A program to target consumer electronics and plug loads. Electronics and other plug loads typically represent 20% of commercial and residential consumption, but no measures are included in Duke's current prescriptive program or residential program.
- A lighting program for residential customers that includes more than 60W-equivalent CFLs. The current program should be expanded to include several options that would address different types of lighting and provide an opportunity to place an efficient light bulb in more types of fixtures.

As stated, these programs could be discussed and approved in Duke's proposed expedited process. They could also be forwarded through a supplemental RDR filing, and/or included in the Company's next EE/PDR plan.

III. CONCLUSION

For the foregoing reasons, the undersigned members of OCEA respectfully request that these Comments be considered and the recommended actions taken by the Commission in its consideration of Duke's Application.

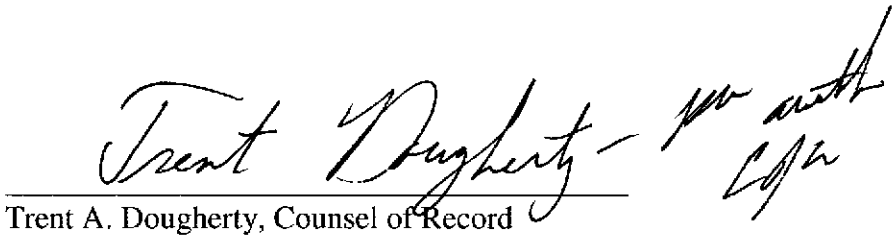
Respectfully submitted,

Christopher J. Allwein, Counsel of Record (0084914)
Williams, Allwein and Moser, LLC
1373 Grandview Ave., Suite 212
Columbus, Ohio 43212
Telephone: (614) 429-3092
Fax: (614) 670-8896
E-mail: callwein@williamsandmoser.com

Attorney for the Natural Resources Defense Council

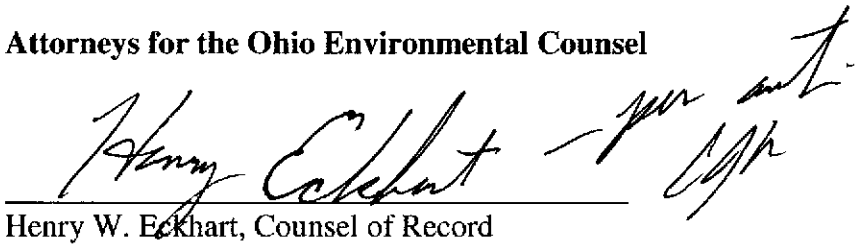
JANINE L. MIGDEN-OSTRANDER
CONSUMERS' COUNSEL

Jeffrey L. Small, Counsel of Record
Melissa R. Yost
Assistant Consumers' Counsel
Office of the Ohio Consumers' Counsel
10 West Broad Street, Suite 1800
Columbus, Ohio 43215-3485
614-466-8574 (Telephone)
small@occ.state.oh.us
yost@occ.state.oh.us



Trent A. Dougherty, Counsel of Record
Nolan Moser
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212-3449
(614) 487-7506 - Telephone
(614) 487-7510-Fax
trent@theOec.org
nolan@theoec.org

Attorneys for the Ohio Environmental Counsel

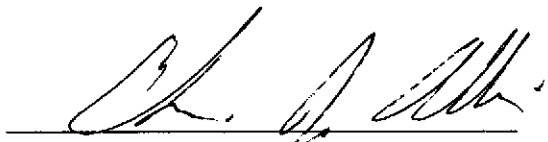


Henry W. Eckhart, Counsel of Record
1200 Chambers Road, Suite 106
Columbus OH 43212-1703
Phone: (614) 461-0984
Fax: (614) 485-9487
henryeckhart@aol.com

Attorney for the Sierra Club

CERTIFICATE OF SERVICE

I hereby certify that a true and accurate copy of the foregoing *Comments by Members of the Consumer and Environmental Advocates* has been filed with the Public Utilities Commission of Ohio and has been served upon the following parties via regular U.S. Mail, postage prepaid, on September 21, 2011.



Christopher J. Allwein

DUKE ENERGY OHIO, INC

Elizabeth H. Watts (0031092)
Associate General Counsel
Amy B. Spiller (0047277)
Deputy General Counsel
Duke Energy Shared Services, Inc.
155 East Broad Street, 21st Fl.
Columbus, Ohio 43215
Phone:614-222-1330
Fax: 513-419-1846
Elizabeth.Watts@duke-energy.com
Amy.Spiller@duke-energy.com

OHIO ATTORNEY GENERAL

William Wright
Attorney General's Office
Public Utilities Commission of Ohio
180 E. Broad St., 6th Fl.
Columbus, OH 43215
William.wright@puc.state.oh.us

PEOPLE WORKING COOPERATIVELY, INC.

Mary Christensen
Christensen & Christensen LLP
8760 Orion Place, Suite 300
Columbus, OH 43240
Mchristensen@columbuslaw.org

JANINE L. MIGDEN-OSTRANDER
CONSUMERS' COUNSEL
OFFICE OF THE OHIO CONSUMER'S COUNSEL

Jeffrey L. Small
Melissa R. Yost
10 West Broad Street, Suite 1800
Columbus, Ohio 43215-3485
614-466-8574 (Telephone)
small@occ.state.oh.us
yost@occ.state.oh.us

OHIO ENERGY GROUP

David F. Boehm, Esq.
Michael L. Kurtz, Esq.
Jody M. Kyler, Esq.
BOEHM, KURTZ & LOWRY
36 East Seventh Street, Suite 1510
Cincinnati, Ohio 45202
Ph: (513)421-2255 Fax: (513)421-2764
dboehm@BKLlawfirm.com
mkurtz@BKLlawfirm.com
jkyler@BKLlawfirm.com

OHIO PARTNERS FOR AFFORDABLE ENERGY

Colleen L, Mooney
231 West Lima Street
Findlay, OH 45839-1793
Telephone: (419) 425-8860
FAX: (419) 425-8862
cmooney2@columbus.rr.com

ENVIRONMENTAL LAW & POLICY CENTER

Tara C. Santarelli (0084255)
Environmental Law & Policy Center
1207 Grandview Ave., Suite 201
Columbus, Ohio 43212
T: 614-732-0966; F: 614-487-7510
tsantarelli@elpc.org

OHIO ENVIRONMENTAL COUNSEL

Trent A. Dougherty, Counsel of Record
Nolan Moser
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212-3449
(614) 487-7506 - Telephone
(614) 487-7510-Fax
trent@theoec.org
nolan@theoec.org

BOTTOMLINE RESOURCE TECHNOLOGIES, LLC

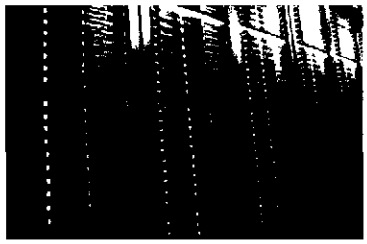
Samuel C. Randazzo (Counsel of Record)
Frank P. Darr
Joseph E. Oliker
MCNEES WALLACE & NURICK LLC
21 East State Street, 17th Floor
Columbus. OH 43215
Telephone: (614)469-8000
Telecopier: (614)469-4653
sam@mwncmh.com
fdarr@mwncmh.com
joliker@mwncmh.com

VECTREN RETAIL, LLC

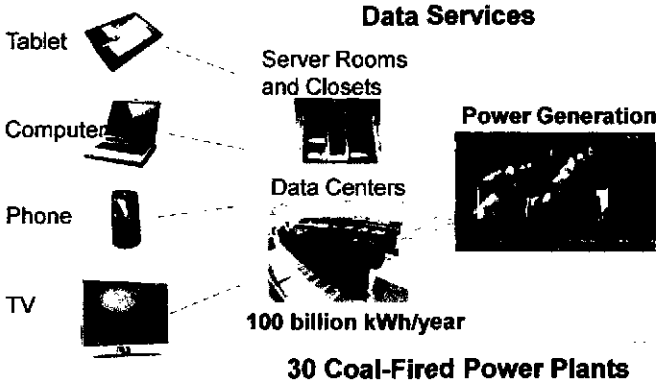
Joseph M. Clark (Counsel of Record)
6641 North High Street, Suite 200
Worthington, OH 43085
Telephone: (614)781-1896
Telecopier: (812)492-9275
jmclark@vectren.com

SIERRA CLUB

Henry W. Eckhart, Counsel of Record
1200 Chambers Road, Suite 106
Columbus OH 43212-1703
Phone: (614)461-0984
Fax: (614) 485-9487
henryeckhart@aol.com



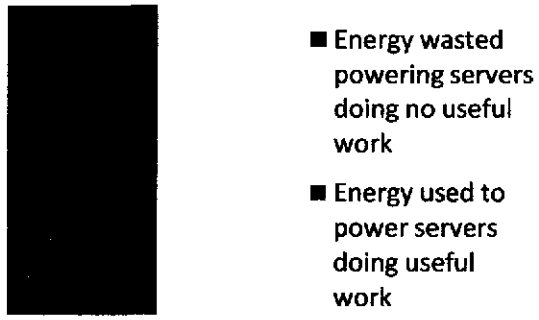
Computer servers and the facilities that house them, from the server closet in your office, to the warehouse-scale data center in a business park, are the hidden half of your digital life. When talking on your cell phone, tweeting or chatting with friends on social networking sites, shopping and banking online, emailing at work or at home, you are using a web of servers located all over the internet.



This fast growing army of servers is powering the digital economy, enriching people's lives, creating jobs and supporting economic growth. But they are also responsible for rapidly growing cost and pollution through the massive amount of energy they use. All US data centers together are estimated to consume over 100 billion kWh, the equivalent output of 30 medium size coal-fired power plants[1].

Most of Data Center Energy is Wasted Powering Servers Doing no Useful Work

Can you believe it? The average US server only runs at 5-15% capacity, while using 60-90% of its maximum power[1]. Servers draw a lot of power simply by being on. We could get the same amount of work done with much fewer servers, just by loading each server to 50% capacity or more.



Most of the energy used to power the nation's servers is wasted doing no useful work. NRDC estimates that this wasted energy represents the equivalent output of 20 power plants! This not only costs consumers money through more expensive products and services, but it also generates unnecessary atmospheric pollution, and increases the cost of doing business making our economy less competitive and impacting jobs.

This situation is already the subject of intense focus by the IT industry and utility companies in large data centers, because of their high concentration of IT equipment and resulting high power consumption. However, the opportunities for savings in smaller server rooms and closets are overlooked. Together, server rooms and closets account for over 30% of data center energy use in the US[1]. Small server rooms can be found in many small and medium organizations, such as office-based private businesses, local government agencies, non-profits etc, but also in larger organizations which still have small server rooms and closets scattered in their buildings in addition to large corporate data centers. These small and large organizations are often unaware of how much of their electricity bill is due to their server room. NRDC's research indicates many office-based organizations spend in the range of 30% to 70% of their entire office electricity use on powering and cooling always-on servers.

Low server utilization levels are typically due to the common practice of deploying each new application on its own server: it's simpler than trying to share an existing server, and it provides plenty of margin for growth and peak load performance (far more than necessary!). In practice this margin for growth is rarely utilized, as most businesses find it easier to buy new servers, resulting in a situation where computing resources are vastly over-provisioned relative to needs, and the nation's server fleet and power supply are used very inefficiently.

How to estimate the energy consumption of a server room

There are many ways to estimate the energy use of a server room in an office building, here's a simple approach that will work in most cases:

1. Most UPS (Uninterruptible Power Supplies) have a load indicator. Multiply your UPS load factor by the UPS rating you can find on the web, this will give you a rough estimate of the IT load for that UPS
2. Have a professional electrician install a logging meter on the circuit breakers for the server room A/C on the electrical panel.
3. Add the IT load and server room A/C load to estimate your server overall energy use.

How To Optimize The Energy Footprint of Your Server Room?

Fortunately, there are plenty of proven, cost-effective solutions to reduce the energy footprint of your servers:

1. Measure or Estimate the Energy Consumption of Your Server Room

This is the first step before you do anything else: determine your current electricity usage to serve as a baseline against which to evaluate the cost-effectiveness of candidate energy efficiency projects, and evaluate your progress. The baseline will also help you raise awareness and attention to the problem, and garner internal support for action.

2. Switch Off Unused Servers, and Set Others to Go into Low Power State When Inactive

There are many servers doing absolutely nothing in server rooms of all sizes. After the application they hosted was decommissioned or no longer used, these "ghost" servers continued to run around the clock unused. In large data centers, keeping track of hundreds or thousands of servers can be tricky and many ghost servers fall through the cracks of asset management processes. Even in small server rooms NRDC has found unused or very infrequently used servers that could just be switched off without impacting anyone.

Some servers are used but only for short periods of time, for example a backup server might run just 2

hours per day. The server can be put in a low-power mode which uses a fraction of the power in idle mode, while still being able to respond to any service requests.

3. Optimize Server Utilization Through Consolidation and Virtualization

Once the above basic measures have been taken, turn your focus on the utilization level of your server assets. "What gets measured gets managed" goes the old saying, so here too, start by measuring your server utilization. Server hardware vendors offer software solutions that allow server room operators to track utilization over time. This will provide you with your second baseline, to plan and evaluate your server utilization optimization efforts.

Perhaps the single most important savings opportunity is to consolidate multiple applications from under-utilized servers onto a single "right-sized" server. This saves a lot of energy because a single server, even heavily loaded, uses far less energy than multiple lightly loaded servers. Virtualization is basically a more sophisticated solution to consolidate applications by running them in "virtual machines" that can be moved from one physical server to another depending on load conditions. The use of virtualization has taken off considerably over the past few years, although there is still a large remaining opportunity: As of August 2010, only 16% of data center loads are virtualized (Gartner)[3]. Virtualization commonly enables consolidation ratios of 10:1 or even 15:1, meaning 10 to 15 servers can be consolidated down to a single one. While virtualized host servers are bigger and use more energy than a standard single server, the consolidation can yield overall energy savings of the order of 50% or higher.

Consolidating servers not only saves server energy, it also reduces cooling needs, therefore saving on cooling energy use and costs. Virtualization also provides significant benefits in terms of operational and capital costs savings; it is a highly cost-effective project even in small server rooms.

4. Move Some Applications to the Cloud

Every IT trade magazine talks of Cloud computing these days, due to its many cost and flexibility benefits. Yet few organizations look at Cloud computing as an opportunity to reduce their energy and carbon footprint. Cloud computing can be defined as internet-based computing whereby shared servers provide computing resources to multiple customers. Email, office applications, data backup, and customer relationship management, to name but a few, all have significant cloud-based offerings.

How Green is the Cloud?

- While most cloud service providers tend to optimize the efficiency of their data centers, some are better than others. Unfortunately cloud service providers do not yet report their footprint, making it difficult for customers to compare different providers.
- An efficient data center does not mean a low-carbon data center: cloud services powered by coal-generated electricity have a much higher carbon footprint that those that use clean energy.
- Ask your cloud service provider for transparent reporting of the carbon footprint of their services.

Moving an application to the Cloud does not just outsource your server footprint to an external service provider, in most cases it also significantly reduces the overall energy and carbon footprint of your computing. Cloud computing is generally greener than in-house computing thanks to better sharing of server resources, and a natural market incentive for cloud service providers to invest in efficiency. A recent Microsoft-Accenture-WSP[2] report estimates that cloud can reduce the carbon footprint of applications by 30 percent of more. However, some clouds are greener than others, and most can become even greener (see the "How Green is the Cloud" insert). Be sure to ask vendors about the environmental attributes of their cloud

services before making a decision.

5. How About Facilities and Hardware Efficiency?

The primary focus of this article is server utilization, because it is arguably the largest opportunity for energy savings in server rooms. Significant opportunities also exist to reduce energy use in server rooms from cooling and hardware energy efficiency:

- Server room facilities efficiency: this is about optimizing the efficiency of cooling, power distribution, lighting and other electrical loads that are necessary to run the data center on top of the IT load itself. For example raising the server room temperature up to 81F per ASHRAE recommendations[4], requires 3-5% less cooling energy for every degree F the thermostat is raised.

- Hardware efficiency: increasing the efficiency of the IT hardware itself can also reduce energy use. Over the past few years hardware manufacturers have developed servers that are much more energy efficient than their predecessors, customers can save significant energy by purchasing the most energy efficient servers in their class.

Opportunity To Save Money and Energy

Businesses that implement virtualization today do it not just to save energy, but also to save money from electric bills and IT costs, to increase the reliability and performance of their IT environment. For example, an organization with 10 under-utilized servers can save over $100,000 over 5 years[5] in energy, hardware, software and consulting costs by implementing a fully virtualized environment.

Unfortunately there are a number of barriers that prevent this opportunity from being fully realized in the market: most businesses do not have a sub-meter for their server room and are not aware that it represents such a large portion of their organization's energy use, nor that solutions exist to cut that energy use in half or more. Moreover when aware of the opportunity, small and medium businesses may not have the cash to invest in this type of project, even if it pays back in less than 2 years.

This is where energy efficiency programs by local utility companies are key to raise awareness and help server room operators implement utilization optimization projects that will save them money and will help make them more competitive.

Conclusion

Small server rooms and closets of small and large organizations represent a significant and often overlooked energy savings opportunity. There are many opportunities to reduce server room energy use, from power management to virtualization, facilities retrofit and hardware efficiency. Server room energy savings are very cost-effective, saving businesses and consumers money, reducing pollution and making the US economy more competitive. Utility programs are needed to overcome market barriers and fully realize this opportunity.

Notes and References

[1] US EPA report to Congress, August 2007.
[2] http://www.microsoft.com/environment/cloud.aspx
[3] Information Week, August 23, 2010
[4] http://www1.eere.energy.gov/femp/pdfs/eedatacenterbestpractices.pdf
[5] NRDC analysis

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