STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

Commonwealth Edison Company	)	
	)	
	)	
	)	**ICC Docket No. 17-0049**
	)	
Revenue Neutral Tariff Changes	)	
Related to Rate Design	)	
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DIRECT TESTIMONY OF EDWARD C. BODMER

On Behalf of

THE CITY OF CHICAGO

(City Exhibit 1.0)

March 15, 2017

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<u>DIRECT TESTIMONY OF EDWARD C. BODMER</u>

<u>QUALIFICATIONS</u>

Q. What is your name and on whose behalf are you testifying?

A. My name is Edward C. Bodmer. I am testifying on behalf of the City of Chicago ("City").

Q. Have you previously testified before the Illinois Commerce Commission (the "Commission")?

A. Yes. I have provided analyses and testimony in Commission cases over a period spanning more than three and a half decades. Currently, the majority of my professional activity is no longer associated with providing testimony in utility proceedings. However, I have been involved in a variety of Commonwealth Edison Company ("ComEd" or the "Company") rate and rate design matters (on almost a continual basis) since beginning my career. My experience with regulated utility issues began as a member of the Commission Staff, when Jimmy Carter was president of the U.S. I have testified before this Commission on behalf of Staff, as a consultant for the City of Chicago and other consumer representatives, and once – many years ago –in support of a major ComEd initiative.

I have appeared as a rate design expert on behalf of the City of Chicago in all of the ComEd rate cases, special rate design cases and the RDI cases since the mid-1990s. You can see the City's stamp on many cost of service issues in the current ComEd cost of service study. Our Commission-accepted adjustments include: revisions to ComEd's allocation of secondary street lighting cost; allocation of uncollectible expenses on a percent of revenues basis; removal of transformers from the railroad class; allocation of DSM costs on the basis of demand rather than the number of customers; use of CP rather than NCP allocations for primary distribution (also supported by the ICC Staff); investigation of the costs of service for low-users; rejection of SFV rate designs (also supported by other parties); and other rate design items.

In my current area of activity, my 643-page textbook <u>Corporate and Project Finance Modeling: Theory and Practice</u> was published by Wiley Finance in 2014. Finally, I am proud of the fact that my financial modelling website generally has a high Google ranking in searches for project finance modelling or solar project finance modelling. Though I do not do any search engine optimization, the site sometimes gets more than 3,000 hits per day.

<u>INTRODUCTION AND SUMMARY</u>

Q. What topic areas do you address in your direct testimony?

A. I have separated my testimony into two parts. In the first part, I have responded to ComEd's latest in a long series of attempts to impose Non-Coincident Peak (NCP) allocations for primary distribution equipment. I address several aspects of ComEd's NCP method, including the method's inherent bias, its disconnect from cost causation, the unfair impacts, and the absence of changed circumstances that compel discarding the Coincident Peak (CP) allocations that ComEd has applied to primary distribution facilities for nearly all of the last three decades.

In the second part, I include three brief sections that make recommendations related to issues that the City has raised in previous cases. The first of these subjects is regional cost of service differences that ComEd has now acknowledged and selectively applied, but refuses to recognize uniformly. The second topic is ComEd's peak load measurements for residential consumers, especially low use apartment dwellers. The third subject is the cost allocation/rate treatment for ComEd's AMI meters.

Q. What are the main conclusions the Commission should take from your investigation?

A. The Commission's decisions on the issues in this case must take account of the following conclusions from my testimony.

NCP Allocations

- Purely as a matter of mathematics, ComEd's proposed[1] NCP calculations and allocations are biased against certain ratepayer classes. Where the members of a ratepayer class have similar usage, the NCP method over-allocates costs to that class. My analysis of the class-by-class impacts of ComEd's proposed change from the current CP cost allocation method confirms that bias.
- ComEd builds distribution facilities to meet long-term expected local/regional coincident demand, and its engineering decisions take account of anticipated load diversity. The NCP method ignores this cost causation reality.
- Though ComEd portrays NCP cost allocations as a regulatory norm, it is a historical anomaly in Illinois, and for ComEd.
- ComEd's principal support for its proposal to reverse existing Commission allocation determinations is a poorly designed and irrelevant feeder study. The study suggests

[1] Although ComEd's Mr. Lieck says ComEd is not proposing a change in allocation methods (ComEd Ex. 2.0, p 27), the Company selected and chose to present (ComEd DRR CTA 2.07) evidence supporting only its NCP allocation alternative, no others. I consider that a proposal.

that some distribution lines, in unspecified local/regional locations, have local annual peaks at surprising times (e.g., 5:00 AM or the odd month of April). My review of the study demonstrates that it is seriously flawed and cannot be used for any policy decision. Its design does not conform to real utility cost causing decisions; it does not track relevant peak load data by class; and, its results are not consistent with ComEd's PJM published system-wide load data.

- This case does not offer a choice between valid allocation methods. One (NCP) is highly biased, while the other (CP) is not. While CP allocations may not be perfect, that does not make NCP allocations a reasonable or correct alternative.

Other Recurring Rate Design Issues

- In this case, ComEd has made cost study adjustments -- selectively -- to reflect local/regional differences in its costs of service. Such regional cost of service measurements should be recognized uniformly.
- ComEd's load factors for the multi-family non-space heat class have changed dramatically over the years, with no clear explanation. Because of questionable sampling, ComEd should use allocations consistent with Docket 14-0384 and apply all available AMI data when constructing its load research.
- In past cases, the Commission has ordered ComEd to allocate demand management expenses as demand-related cost rather than a customer cost. In this case the Commission must assure that the added cost of new demand-related AMI meter functionalities, e.g., demand metering and time of day metering, are not allocated as customer costs.

Q. Are you sponsoring any exhibits as part of your testimony?

A. Yes, as part of my testimony I present the exhibits listed below. To limit the length of this testimony, I have included information and arguments on topics I discuss from my testimony in prior cases. (Do not worry about the number of pages in this document, there are a lot of pictures).

City Ex. 1.1	Needle-Peak Analysis Showing Bias in ComEd's Feeder Study
City Ex. 1.2	Prior Testimony Discussing the NCP Method and the NARUC Manual
City Ex. 1.3	Prior Testimony Discussing the Need for Regional Costs
City Ex. 1.4	Selected Discovery Responses Supporting the Testimony

NON-COINCIDENT PEAK (NCP) COST ALLOCATIONS

Q. What is the central point of your testimony related to the issue of NCP?

A. The issue of NCP allocations has been addressed in Commission orders and probably thousands of pages of testimony over almost a decade because of the nearly continuous efforts by ComEd and others to have it accepted by the Commission. (See the exhibits described above.) Because of all the earlier examinations of NCP, I have tried to do more than simply re-hash old (but still applicable) arguments. Much of my testimony in this case is about explaining a critical distortion in the NCP method -- a distortion that is not present in other allocation methods. This fundamental methodological flaw has not been presented in a clear manner in past cases (at least, not by me). Using simple illustrations, I explain why the NCP method ComEd proposes has an inherent bias in favor of classes (like the 400-1000 kW commercial class) that have diverse members and heterogeneous load profiles. This distortion produces biases that cause commensurate harm to homogeneous classes (like the street lighting and railroad classes), where the adverse impacts fall on just a few individual ratepayers. No other allocation approach

-- not coincident peak allocation, not billing demand allocation, not energy allocation, and not the number of consumers allocation -- has this bias.

The NCP bias I will describe is not a minor rounding issue, but a flaw that can cause allocated costs to swing by more than 30%. Worst of all, this bias in ComEd's NCP method has nothing to do with cost causation, coincidence of peak, or any technical factor related to how common costs should be shared. It results instead from the basic mathematics of the way ComEd calculates class NCPs and defines its rate classes.

My testimony shows that NCP is not some sophisticated concept derived objectively from advanced economic or technical engineering principles (though it is often presented as such by smart engineers using confusing language). Instead, the NCP allocation method is a prime example of arcane concepts that end up favoring certain groups, at the expense of the general population.

Q. How have you organized your response to ComEd's proposal to change from the CP allocation method to the NCP allocation method for primary distribution facilities?

A. I have split my discussion of problems with ComEd's NCP proposal into the five sections listed below. In addition to listing the sections, I provide a little summary of the conclusion from each section.

1. NCP's Unique Mathematical Bias and Vulnerability to Class Definitions Make It Inherently Worse Than Other Allocation Methods

The proposal to change from CP to NCP allocations is **not** about comparing two imperfect methods. ComEd's NCP method has an inherent bias that favors heterogeneous classes (with members that experience peak loads at different times). It is uniquely biased against rate classes with less variation of loads among consumers in the class (homogeneous load profiles), including the railroad class and the street lighting class. While the CP method may have some measurement problems attributable to differences between system-wide peaks and regional peaks, it does not have this crucial NCP bias, or the resulting discriminatory cost allocations. NCP allocations also are vulnerable to distortion from how rate classes are defined, and do not reflect true causation of the utility's distribution costs.

2. ComEd's Understanding of Fundamental Cost Allocation Principles Seems to Have Regressed, and ComEd's Arbitrarily Adjusted NCP Allocations Do Not Produce Valid or Fair Results

In this second NCP section, I contrast ComEd's past (correct) understanding of economic cost and cost causation principles with its statements in this case. I provide a review of the fundamentals of how capacity costs should be allocated (i.e. that capacity used by off-peak load served is a by-product of capacity required to meet peak demand). I also examine ComEd's proposal,[2] which combines flawed NCP allocations with arbitrary adjustments from its feeder study. My examination shows that ComEd's approach does not produce results that are anywhere near the allocations that would result from fair and efficient allocations. (ComEd DRR WRJ-5.01).

3. Class Rate Impacts of Switching from CP to NCP Allocations Confirm the Bias in ComEd's NCP

The third section examines monetary impacts of ComEd's proposed switch to NCP, which confirm the mathematical bias in favor of heterogeneous classes that is the subject of the first section. The primary beneficiaries of that bias are heterogeneous commercial classes that have numerous members with varying usage patterns from consumer to consumer. With NCP, cost allocations increase to other classes (like street

[2] This combination of flawed allocation and arbitrary adjustments is what I refer to as ComEd's proposal.

lighting) that have homogeneous usage within the class. The rate increases resulting from ComEd's proposed switch to NCP that I discuss have nothing to do with cost causation, but are due solely to the bias in the NCP methodology.

4. Use of NCP Allocations Is Historically Anomalous in Illinois, Particularly in ComEd Cost of Service Studies

The fourth section reviews the history of NCP and CP allocations for ComEd's primary distribution facilities. That review shows that (with the Commission's approval) ComEd has applied the CP method, not NCP, for most of the past thirty years. Because the issues and evidence in ComEd's cases have been different from those in other Illinois utility cases, results in other utilities' cases are not a basis for ComEd's proposed change.

5. ComEd's Feeder Study Is Poorly-Designed, Biased, and an Inadequate Basis for Changing Current Rate Design Policy

In its Order in ComEd's 2010 rate case, the Commission commented on ComEd's improper cost allocations to street lighting classes:

> ComEd continues to argue that the conclusions reached on this issue in that docket were incorrect. While the Commission acknowledges that, in the appropriate circumstance, such as a change in the applicable law, a matter should be revisited, that is not the situation here."

A similar history repeats itself in this case. ComEd continues to argue for NCP allocations, even though it has not shown any changed circumstances. This section demonstrates that ComEd's main support for its proposed switch from CP to NCP allocations, the feeder study discussed in the testimony of John Leick, (ComEd Exhibit 2.0), is deeply flawed. The study's defects include its design (no connection between volatile annual loads and long-term expected loads that cause ComEd's capacity costs), the irrelevance of its data (counting feeders, not tracking demand on a class by class basis), its potential bias and lack of verification, (dramatic unexplained inconsistencies with other verified data), and inappropriate application of data from the study mixed with biased NCP measurements. The analysis and conclusions of that study do not come close to proving an "appropriate circumstance" for changing the Commission's earlier rejections of other NCP allocations.

6. There Are Constructive Approaches to Addressing Any Imperfections in System-Wide CP Allocations That ComEd Does Not Propose

The final section of my testimony on NCP describes possible, constructive approaches to investigate improvements to current allocations based on system-wide CP, if the Commission finds CP imperfections that require attention. The Commission could examine modifications in CP allocations to reflect regional cost differences, or to incorporate regional CP and costs directly. The highly flawed NCP is no answer. (I emphasize, again, that the issue is not comparing two imperfect methods. The NCP is highly biased, unfounded in any economic, engineering or regulatory theory, and unreasonably favors certain rate classes.)

1. NCP's Unique Mathematical Bias and Vulnerability to Class Definition Distortions Make It Inherently Worse Than Other Allocation Methods

Q. What is your general approach in discussing the issues related to ComEd's proposed change to NCP cost of service allocations?

A. I try to avoid the unnecessarily confusing jargon that usually surrounds such proposals, and instead keep things simple and understandable. The language ComEd excerpted from the Commission Order in an Ameren proceeding -- parties' restatements of their arguments (not Commission determinations) -- is a good example of confusion that can surround NCP. Consider the following statement quoted (ComEd Ex. 2.0, 76:1296 -1338) by ComEd's witness:

> IIEC opines that the illustration, involving two local circuits, provided by witness Schonhoff explains both the difference between the NCP and CP

> demands and provides a persuasive explanation as to how, in the example, NCP provides a better recognition of load diversity and cost causation since distribution circuits often operate independently of each other and each is designed on an individual circuit basis.

In reviewing this quote, the confusion just oozes out (try reading it aloud). If I had to make a decision from this kind of confusing testimony, I would think it would be almost impossible without some kind of background in electrical engineering. I have now studied the NCP issue for a few years, and I must say that I feel the pain of ALJs and Commissioners trying to make decisions on testimony that purports to be so technical that it requires experience in electricity distribution engineering to question it.

To cut through that fog, I hope to present instructive examples using two or three individual ratepayers that show NCP's deficiencies in a way that does not require a master's degree in engineering. I show that the allocation task is simply to put costs in different buckets. Complexity and confusion hinder recognition that the CP method is fundamentally illogical and cloud decision making about its use. ComEd is not presenting a complicated choice between two imperfect allocation methods. The issue is actually much simpler. ComEd is proposing to displace a reasonable allocation method (CP) method with an inherently biased method (NCP).

Q. Can you start by explaining how the NCP cost allocator is computed?

A. Making sense of the term "non-coincident peak" is not easy. That fact alone should make you suspicious. First, let's discard the notion that NCP is a logical concept plainly related to utility cost causation. When you hear the term "non-coincident peak," you might correctly infer that it means the maximum peak load that an individual ratepayer experiences, regardless of when it occurs. You also might think that you could add up the annual peaks of all ratepayers in a group and come up with the non-coincident peak for that group or "class", a class peak. For example, if Consumer 1 experiences a peak of 100 kW (in winter) and Consumer 2 experiences a peak of

200 kW (in summer), you might think the non-coincident peak for that two-member group is 300 kW. Under the NCP method, this is not so.

The sum of individual class member peaks and the class NCPs ComEd would use are very different quantities. ComEd states that the class non-coincident peak represents "a delivery class' highest kW demand at any time during the year." The Company measures the highest sum of simultaneous class member loads during the year. ComEd further explains that the allocator actually used to compute the class' cost responsibility (a ratio) is calculated as the class peak (determined as above) "relative to the sum of all delivery classes' highest kW demands." (ComEd Exhibit 2.0, LL 1224-1225).

Q. It would be helpful if you could unravel ComEd's definition, beginning with how ComEd would determine the class NCP. What are the mathematics fundamentals that cause the proposed NCP method to be uniquely biased?

A. Class NCP is a calculated system wide peak load value attributed to the entire class at any time of day, during a year. It is not the load of the class at the coincident peak, and it is not the sum of the individual peak loads of individual members of the class. This leads to the most fundamental problem with NCP allocations, which is the following mathematical inequality: the sum of a series of maximum values is not equal to the maximum of the sums of values

$$\sum (\text{Max}) \neq \text{Max} (\sum)$$

The (A) sum of class members' maximum (peak) non-coincident demands is not the same as the (B) maximum of the sums of simultaneous demands of class members, which ComEd's NCP would use. The simplest example I can use to illustrate this is a case of two consumers and two rate periods. The little table below shows that the two individual consumers have different levels of consumption or demand in the two periods.

TABLE 1 - INDIVIDUAL AND CLASS NCP

	Period 1	Period 2
Consumer 1 Peak Demand	200	0
Consumer 2 Peak Demand	0	100
Class Demand	200	100

In this table, the sum of the maximum peak demands is the demand of 200 for Consumer 1 plus the demand of 100 for Consumer 2, or 300:

$$\sum (\text{Max}) = 300$$

On the other hand, if the class is aggregated and then the maximum simultaneous class demand is computed (ComEd's NCP proposal), the maximum of the sums of members' simultaneous demands is 200:

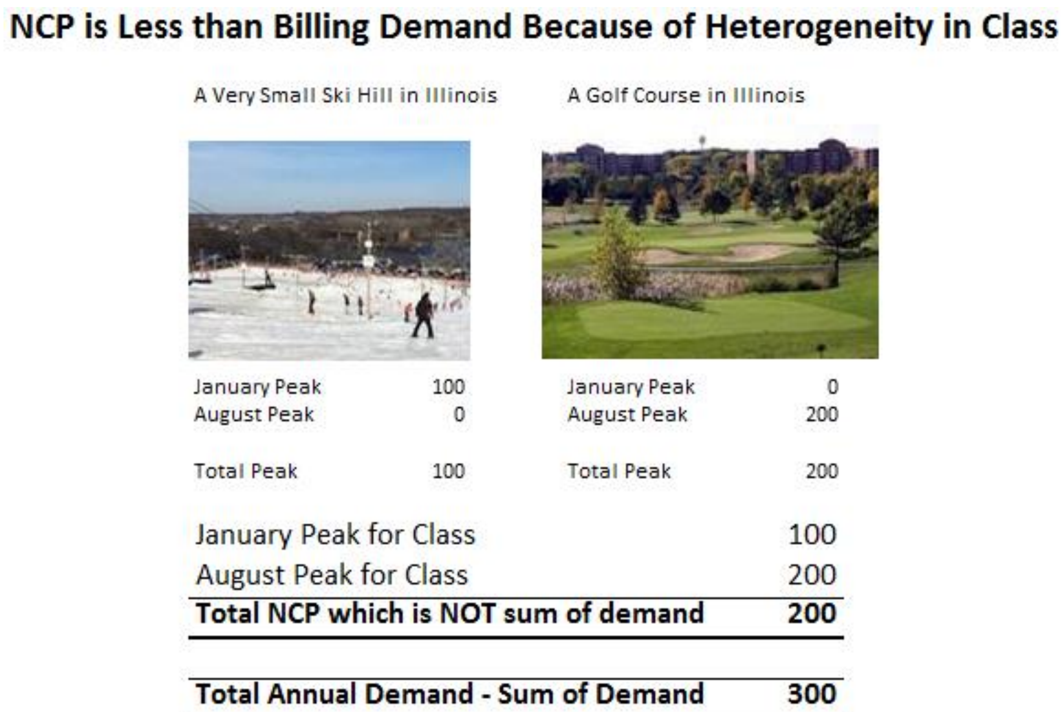
$$\text{Max} (\sum) = 200$$

This basic mathematical fact creates a big distortion in NCP measurement that is not present in any of the other allocation methods that are used to allocate utility costs.

Q. Can you provide an illustration of that distortion?

A. To clarify the computations, let's look at a hypothetical example (starting with the same numbers we just looked at). Say Consumer 1 with the wintertime peak demand of 100 kW is a ski hill. (There is a ski hill in the Chicago area, and it even has a lodge.) Consumer 2, with the summertime 200 kW peak demand is a golf course on the other side of town. The golf course has no load in the winter, while the ski hill has no load in the summer. The ski hill and the golf course are assumed to be part of the same class (which could easily be the case using ComEd's commercial rate classifications). Applying the NCP method's class peak determination process, you end up with 200 kW as the class NCP as shown in FIGURE 1.

FIGURE 1 - ∑ (MAX) ≠ MAX (∑)

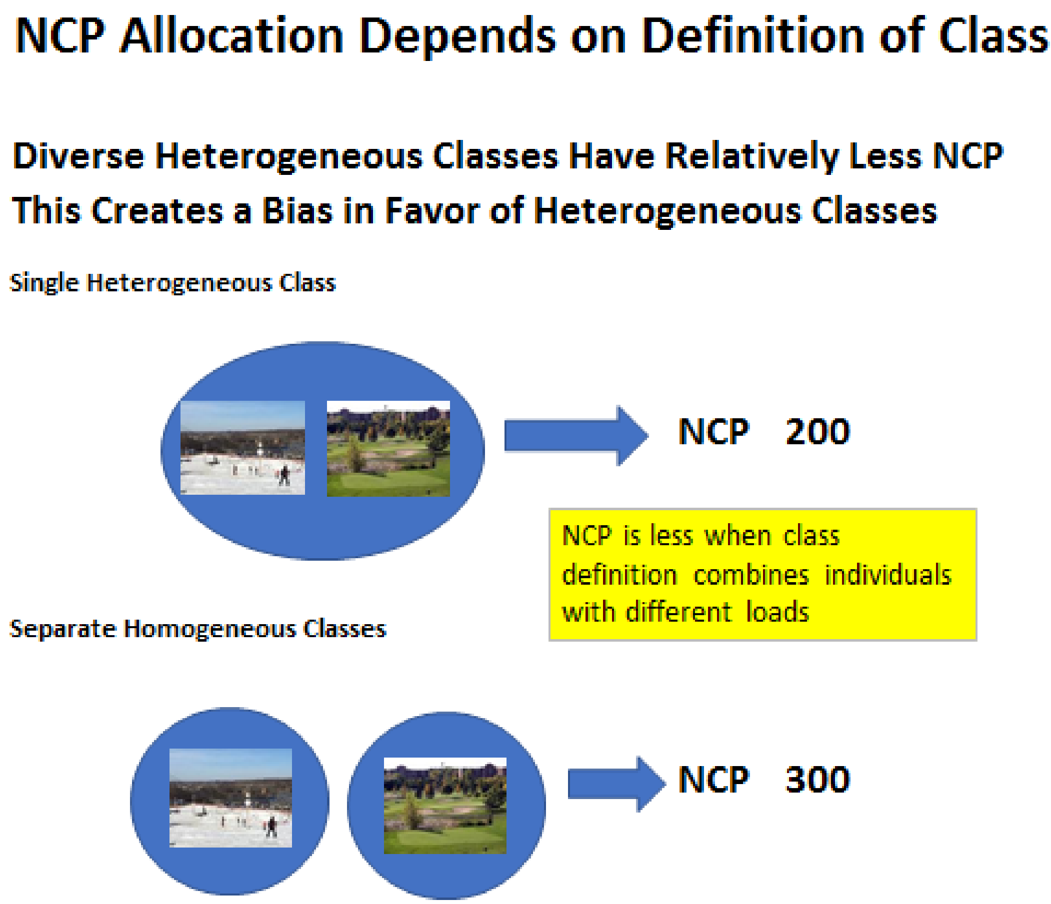


The number at the bottom of the picture shows that the sum of peak loads for the two facilities is 300 kW. This quantity, "annual billing demand," is distinct from class NCP demand, and "annual billing demand" is the quantity reported on and used to compute ComEd's bills. The difference between ComEd's billing demand and ComEd's class NCP demand, across rate classes, is an indicator of the magnitude of the distortion that can be expected from the proposed NCP allocation.

Q. Continuing with your ski hill and golf course example, can you explain how ComEd's system-wide class NCP peak load and allocation factors are vulnerable to distortion by rate class definitions?

A. In TABLE 2, I assumed that both the ski hill and the golf course are part of the same ComEd rate class. When you combine these very different load profiles in a single group, the class non-coincident peak, and thereby the resulting allocation factor, are lower than the summed billing demand measures for the two individuals, if they were in separate classes. This result has nothing to do with regional peak loads, economic efficiency, or complex engineering processes. It is the result of the NCP method's bias. When the two individual consumers are in a single class, the NCP, computed as explained above, is 200 kW. In the second scenario, when the two individuals are in separate classes, their (combined) NCPs increase to 300 kW. The costs allocated to the same individuals increases solely because of a rate class definition. That makes no sense, and no amount of engineering jargon can justify this result. I illustrate this effect in FIGURE 2 below. This figure will be the starting point for illustrating the effects on homogeneous and heterogeneous classes in the remainder of this section.

FIGURE 2 - DISTORTING EFFECT OF CLASS DEFINITIONS



Q. Continuing with your simple two-individual example, explain how the NCP is unfair to homogeneous classes such as the street lighting class.

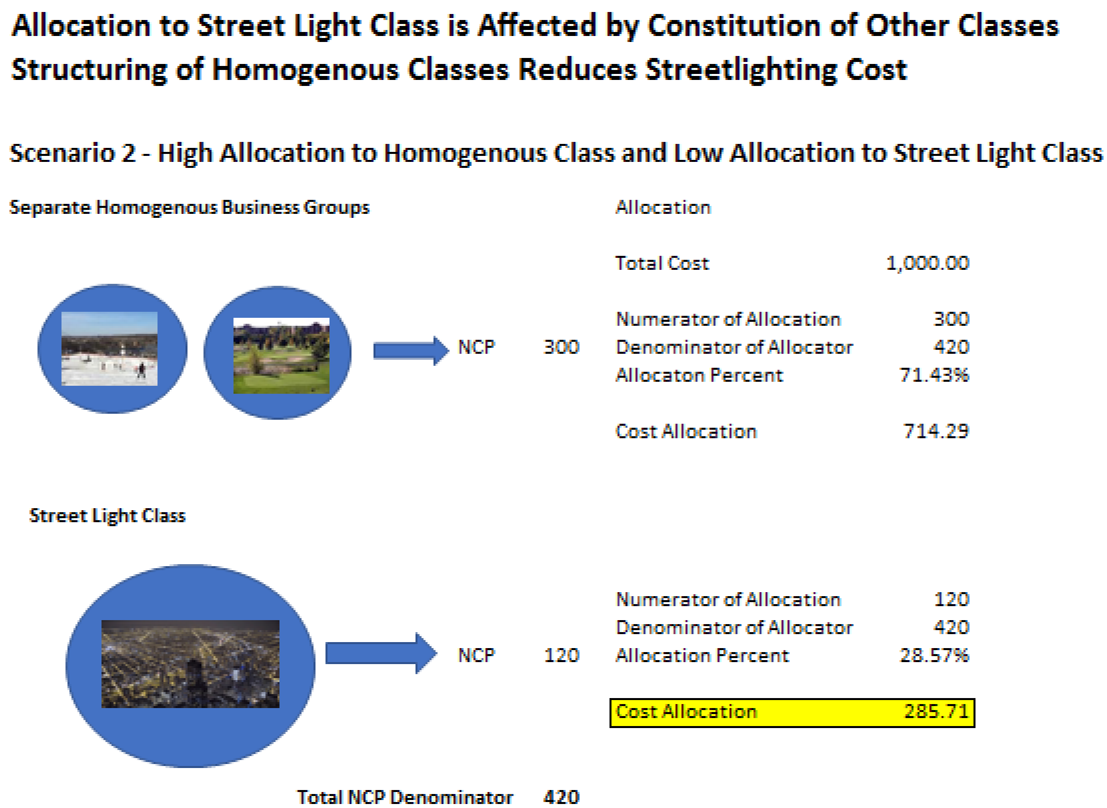
A. To illustrate why the NCP results in biased and unfair allocations, I will add another picture and rate class to the diagrams. This does not reflect any change in coincident peaks, economic diversity, or regional cost causation. For the new rate class, I add a representation of a set of street lighting consumers that have very homogeneous loads. (I will explain later why street lights probably have the most homogeneous load of any class.) I also assume for this illustration that the total cost to be allocated is a nice round number of $1,000. The street lights load (for simplicity, in both winter and summer) is assumed to be 120 kW.

To demonstrate the bias that is inherent in the NCP method, I have created two scenarios, with corresponding diagrams. The first diagram (FIGURE 3) assumes the non-street lighting load is represented by a single **heterogeneous** business class. The second scenario (FIGURE 4) assumes the non-street lighting load consists of two different **homogeneous** classes. One would think that the constitution of classes other than your own class would not affect the costs allocated to your own -- unchanged -- class. But this is not so with ComEd's NCP. Under ComEd's NCP allocations the street lighting class' cost of service **is** affected by how the other classes are defined. This has to be an unacceptable result in terms of any fairness standard.

Q. Describe your first scenario (FIGURE 3), which shows results of the NCP cost allocation to the hypothetical street lighting class in the presence of a separate, more heterogeneous class.

A. Figure 3 demonstrates that if the ski-hill and the golf course individuals are in a single class, the cost allocation to the street lights is $375. This allocation occurs because the total of all of the class' NCPs is 320 kW -- 120 kW from the street lighting class, and 200 kW from the heterogeneous combined golf course and ski hill. The streetlight allocation factor (per ComEd's description) is 120 kW/320 kW or 37.5%, resulting in the cost allocation of $1,000 x 0.375 or $375. The class we defined to be more heterogeneous is allocated $675 (200/320 x 1,000).

FIGURE 3 - NCP & HOMOGENEITY (3 CONSUMERS/3 CLASSES)

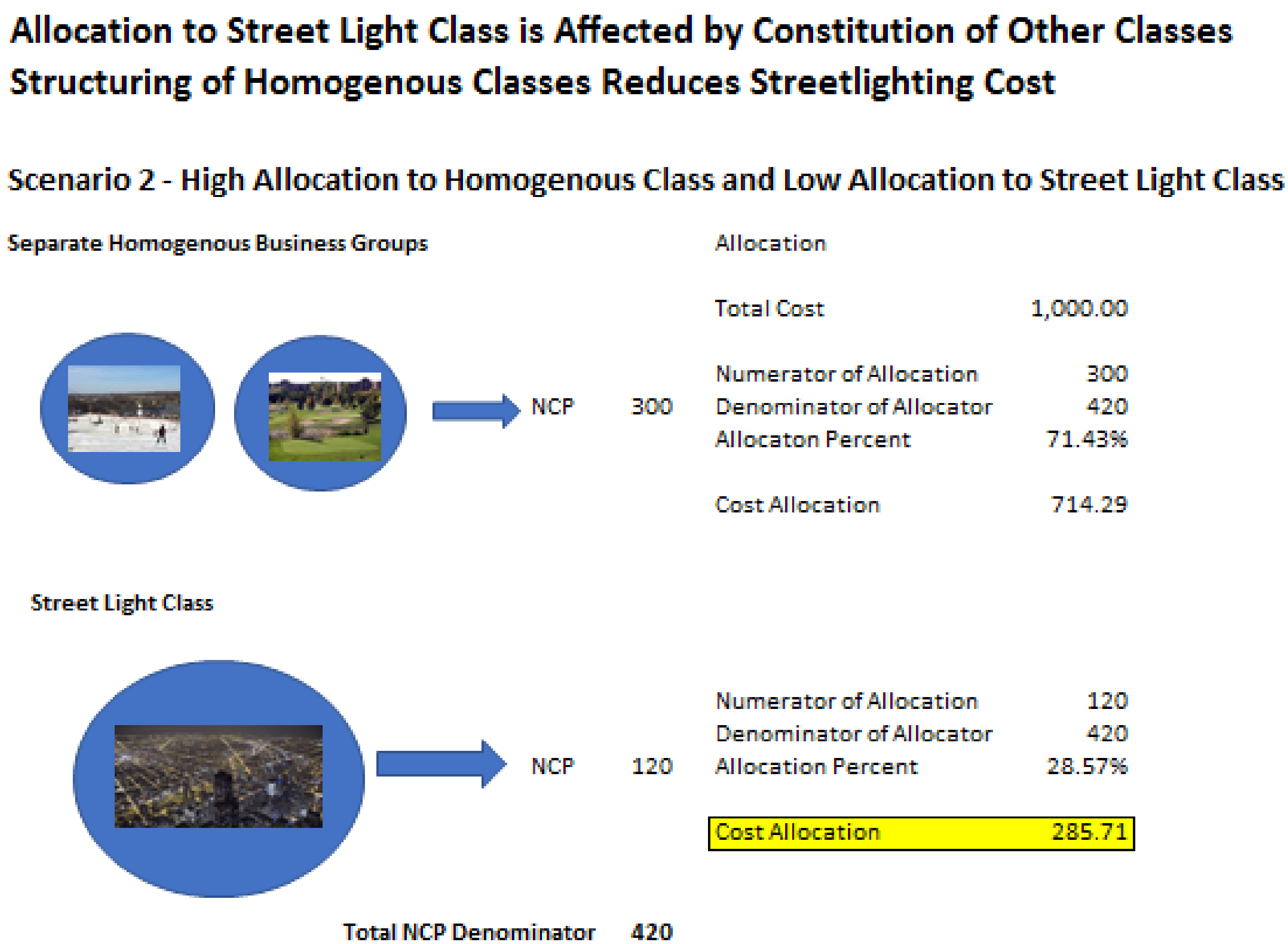


Q. Describe the second scenario (FIGURE 4), where the non-street lighting class consumers are assumed to be in two homogeneous classes, rather than one heterogeneous class.

A. Figure 4 shows the allocation that would occur if the ski hill and the golf course were considered two different classes. Intuitively, how other classes are defined should not affect your own class' cost allocation. And, that is what happens for every allocation method other than the NCP. But for the NCP this is not so. With the NCP allocation approach, the costs to our street lighting class change when the non-street lighting classes are defined differently.

In the presence of a similarly homogeneous class, the bias experienced by the street lights is reduced. However, the bias against homogeneous classes shows up as an increase to the business consumers when losing the advantage of a heterogeneous class. In this scenario, the total NCP across classes increases to 420 kW, even though the street lighting class does not have different usage. As 120/420 is less than 120/375, the cost allocation to our street lights decreases from $375 to $286. The allocation to the two now homogeneous business classes increases to $714.29 ([100+200]/420 x 1,000). Under ComEd's proposed change to NCP, the impacts of NCP allocations would be significant and adverse for ComEd's more homogeneous classes.

FIGURE 4 - NCP & HOMOGENEITY (3 CONSUMERS/2 CLASSES)



Q. Why aren't similar differences produced when allocations are based on Coincident Peak, billing demand, energy, or the number of consumers in a class?

A. The reason NCP allocations are uniquely biased is that the mathematical inequality at the core of NCP allocations is not incorporated in other allocation methods. For all except NCP allocation methods, that inequality does not apply. When using the CP method and other approaches, each consumer contributes the same amount (its individual demand at system peak) to the aggregate total denominator of the allocation formula, the CP on the date of the system peak. Instead, their calculations of the peaks used for allocations incorporate an equality.

For non-NCP Allocations: $\sum (\text{Max}) = \text{Max} (\sum)$

To demonstrate why the NCP is alone in causing this class definition bias I have expanded the example we have been using, with all the assumptions presented in TABLE 2. TABLE 2 demonstrates that other allocation methods do not have the same bias as the NCP method.

To explain more fully, I will walk through TABLE 2. The first two columns of the table repeat the assumptions that we presented in Figures 1 to 4. Because the golf course has a higher peak load than the ski hill, the peak load for the entire system occurs when the golf course hits its peak in the summer. (Conclusions would not be any different if the ski hill had a higher demand and the system peak was in the winter). In TABLE 2, I have also assumed that the street lighting peak demand occurs at the same time as either the golf course or ski hill demand, because this example does not address the separate problem of regional peaks. In the next two rows of the table, I show allocation results under the two class definition scenarios already used. In one row of the table, the golf course and ski hill are a single heterogeneous class. In the row below, they are two separate classes. The remaining rows and columns of the table show the calculations and results under various allocations, for comparison.

TABLE 2 - NO BIAS IN OTHER ALLOCATION METHODS

NCP is the Only Allocation Method with Bias for Heterogeneous Classes

Note that the Street Light Class Is Affected by Definition of Business Classes, with NCP
The Same Bias in Favor of Heterogeneous Business Classes Does Not Occur with Other Methods

	Winter	Summer	NCP	Billing Demand	CP	Energy	Number
Usage that Coincides with Peak Usage		320					
Peak Usage Reached in		Summer					
Ski-hill	100	0	100	100	0	438,000	1
Golf Course	0	200	200	200	200	876,000	1
Total Allocation - Heterogeneous			200	300	200	1,314,000	2
Total Allocation - Homogeneous			300	300	200	1,314,000	2
Street Lights	120	120	120	120	120	1,051,200	1
Total Aggregate Usage	220	320					
Allocation Denominator - Heterogeneous			320	420	320	2,365,200	3
Allocation to Business Class - Homogeneous			420	420	320	2,365,200	3
Allocation to Business Class - Heterogeneous			62.50%	71.43%	62.50%	55.56%	66.67%
Allocation to Business Class - Homogeneous			71.43%	71.43%	62.50%	55.56%	66.67%
Allocation to Street Light Class - Heterogeneous			37.50%	28.57%	37.50%	44.44%	33.33%
Allocation to Street Light Class - Homogeneous			28.57%	28.57%	37.50%	44.44%	33.33%
Total Cost to Allocate			1,000	1,000	1,000	1,000	1,000
Allocation to Street Light Class - Heterogeneous			375	286	375	444	333
Allocation to Street Light Class - Homogeneous			286	286	375	444	333
Percent Difference - Heterogeneous versus Homogeneous			31.25%	0.00%	0.00%	0.00%	0.00%

The first allocator shown is the NCP allocator I have discussed. The second allocator is annual billing demand. For this allocator, there is no change if classes are redefined in the scenarios. The sum of the ski hill and the golf course annual billing demands is 300, whether they are in two separate classes or one heterogeneous class. These results are shown in the column immediately to the right of the NCP column. In the row at the bottom of TABLE 2, I show the difference in allocations for our street lighting class, as a function of the class definition scenarios and allocation methods. For the NCP allocation method, as I discussed above, there is a big difference. For the billing demand allocator, there is no difference at all, because the billing and allocation demands for the golf course and the ski hill are the same in either grouping.

In the case of the CP allocation, the combined demands for the ski hill and the golf course are again the same whether they are one aggregate class or two separate classes. The total demand peak occurs when the golf course reaches its peak demand. The ski hill has no peak demand or demand allocation. This occurs whether the ski hill and the golf course are grouped together or separately. It would also occur if the ski hill for some reason had a bit of summer peak demand (in which case the group's demand would increase, and the ski hill, as a separate class, would have an individual demand allocation). Because the total allocated demand is independent of the grouping, there is no effect on the class (our street lighting class) from different groupings of other classes.

The final two columns simulate other allocation methods -- one uses an energy allocation and another allocates costs according to the number of ratepayers in the class. These allocations are similar to the annual billing demand, where the sum of the totals is the same as the total of the sums. The row at the bottom of the table shows that it is only the NCP method that has the bias and distorts cost allocations.

Q. Can you elaborate on why it is unfair that costs allocated to a particular class could change based on how other classes are defined?

A. Think about going to the liquor store to buy a six-pack of beer. The clerk who used to be your friend tells you that the cost of your beer just went up by 20%. He explained that a bunch of rich people from the golf course got together to form a beer cooperative with buying power, and they have been constantly pressuring the store owner for lower beer prices. Their golf coop succeeded in getting a lower price for their beer, and now you must pay more. You would rightfully be angry, as should individuals who are in **homogeneous** rate classes should be angry from any kind of NCP allocator that in our example would give an advantage to the people using the golf course and ski hill.

Before you think "Aha, NCP is then consistent with competitive markets", understand that there is a big difference between ComEd and the liquor store. ComEd does not operate in a competitive market. If the liquor store offers discounts to the favored golf groups , you and other customers could go to another liquor store. Eventually, the liquor store would lose all of its non-golf customers that it does not give discounts to. The store could well go bankrupt because of the favoritism. ComEd, on the other hand, can engage in the favoritism that is inherent in the NCP method and not lose ratepayers because of its monopoly position.

Q. Is the bias in favor of heterogeneous classes a minor detail, or is it a real problem with the NCP allocation method?

A. The bias in NCP is a big deal, not at all a minor detail. I demonstrate this in my analysis of impacts in the third section.

2. ComEd's Understanding of Fundamental Cost Allocation Principles Seems to Have Regressed, and ComEd's Arbitrarily Adjusted NCP Allocations Do Not Produce Valid or Fair Results

Q. ComEd has asserted that, because street lights use primary wires, street lights should be allocated capacity costs of primary wires. Do you agree with that position?

A. No, I do not. ComEd's testimony in this regard may seem intuitive, but it is dead wrong from cost causation and economic cost perspectives. If a consumer using facilities is not expected to have demands that coincide with the overall coincident peak load that must be served by the facilities' capacity, that consumer does not cause and should not be allocated capacity costs.

One of the better explanations of this cost causation principle that I have seen actually came from none other than a ComEd executive. The explanation was given at a time when ComEd seemed to understand the basics of shared facility cost allocations. Back in 2001, a man named Mr. Lawrence Alongi, a rates expert at ComEd, wrote the following:

> For each of the customer classes, two distribution capacity components were identified, the non-coincident class peak ("NCP") component and the coincident peak component. The NCP component . . . includes the costs for standard system elements that are ***likely to be sized*** to accommodate individual customers' maximum loads. . . . The coincident peak component, on the other hand, includes the costs for standard system elements necessary to serve a geographic area or larger group of customers that can be sized with consideration given to diversity between individual customers' loads. … [T]he investment costs of Transmission Distribution Centers ("TDCs"), 34 kV lines, Distribution Centers ("DC"), primary lines, and primary taps were included in the coincident peak component. Docket No. 01-0423, ComEd Ex. 13.0 at 16-17; LL 345-363. (emphasis added)

The ComEd expert's explanation is a correct statement of how non-coincident and coincident peaks relate to causation of the utility's distribution costs. Shared capacity costs are driven by the expected coincident peak demand for the capacity. Capacity to serve off-peak usage is a zero-cost by-product of installing the capacity required to meet peak requirements.

As far as I could determine from ComEd's testimony in this case, the Company has not identified any specific change since 2001, in the way it designs, sizes, and builds its distribution facilities, that would justify a switch to ComEd's proposed NCP allocation method. The only change seems to be the Company's unwillingness to accept that expected off-peak usage of shared capacity does not cause its capacity costs. This apparent loss of institutional memory is unfortunate.

Q. Can you illustrate how expected demand that occurs during off-peak periods does not cause costs of meeting peak demand and should not be allocated shared costs, on a cost-causation basis?

A. Yes, I believe I can. I was sitting in a café in Paris with a glass of wine, writing a summary of the economic theory on this off-peak/by-product question, when I had recalled a recent experience of my own that illustrates the principle. (The wine seemed necessary for another response to another ComEd attempt to increase costs allocated to City street lights.) The café is next door to a modest (€40 per night) hotel I stay at when I visit Paris. (I have included a picture of the Hôtel de Lorraine below.) I thought about my experience with morning showers in the Hôtel de Lorraine and about the same routine at a fancy expensive hotel like the Marriott.

FIGURE 5 - HÔTEL DE LORRAINE

Q. Please get to the cost allocation point.

A. Okay. I will explain cost causation and the NCP versus CP issue by looking at the hot shower capacity at different hotels. When I took a shower the previous morning at the Hôtel de Lorraine, the hot water quickly ran out because the hotel had not installed enough water heating capacity and other people must have been taking showers at the same time. The hotel seemed to have a needle peak for shower taking at around 7:30 AM. When I came back in the evening, there was no problem at all with taking a long shower, which was clearly off-peak usage (and felt good). Fancier hotels like the Marriott (which can cost €300 per night) do not have this problem, because they make sure the water heating capacity exceeds morning peak demand, so nobody will complain. Both the Hôtel de Lorraine and the Marriott must size their water heating equipment to meet the expected peak demand for showers, with some reserve margin. The Marriott doesn't size its capacity with a fundamentally different approach, it just installs more capacity (although its peak is probably later in the morning, because it is geared to a different clientele).

Here is the point of the story. Whether it happens that the installed capacity is enormous, with a large reserve (Marriott), is not sufficient to meet expected peak demand (Hôtel de Lorraine), or exactly matches peak demand, it is the **expected peak load** that is relevant to sizing hot water capacity for morning showers. The off-peak hot shower demand of hotel guests does not affect the sizing decision or cause the costs of the installed capacity. The ability to meet the demand of guests who take showers in the evening is a by-product of the capacity installed to meet peak demand. That off-peak demand does not **cause** any of either hotel's hot water capacity costs.

Q. Is off-peak usage related to cost causation at all in your hotel scenario?

A. No. Say that my Hôtel de Lorraine is refurbishing its water heaters to add capacity (which I hope it does). Also, say that I want to rent a permanent room in the hotel so I can work on NCP testimony for jurisdictions all over the U.S. and all the time (what a horror). Finally, suppose I commit to the owner of the Hôtel de Lorraine that I will never take a shower during the expected needle peak period. Instead I will always (very reliably) take my shower in the afternoon. The Hôtel de Lorraine could then build less water heating capacity, and I should negotiate a bit of a break on my room rate.[3] (I understand that I would have to pay for the energy used to heat the water and that this energy is distinct from capacity.) Whether the hotel

[3] Further, it does not matter how much surplus capacity is built into the system as a buffer to make sure nobody runs out of water. If the Hôtel de Lorraine is like the Marriott and installs a lot of surplus capacity, it is still the expected usage at the time of peak usage in the hotel that the capacity is designed to meet.

installs surplus capacity, insufficient capacity, or a perfect match, it is the morning peak that is the relevant benchmark and that drives the cost of the hot water capacity the hotel installs. And it is still the case that off-peak usage does not affect the amount that is paid for that capacity.

Q. Can you explain how this example relates to street lighting and off-peak usage of primary lines?

A. I hope the analogy is clear. The cost causation dynamic is the same for hotel water heating capacity and ComEd's shared distribution lines. If I always take showers in the afternoon I do, in fact, use the hotel's water heating capacity -- just as ComEd wrote that street lighting uses primary wires. It should be obvious also that just because I use the water heating capacity, it does not mean that I have caused any real capacity cost for the equipment. The hotel incurred no cost to meet my afternoon shower demand.

In addition, I hope the fact that I kept writing "expected" demand and never said "actual" demand was also apparent. If actual shower taking demand happens to be more in the evening for some periods, this does not mean that the fluctuating actual demand is changing the cost causation in any way. If the expected demand occurs at 7:30 AM it is that peak demand at the expected peak time that is driving the size and cost of the hotel's water heating capacity.

Q. In addition to suggesting that street lights should be allocated costs because they "use primary distribution facilities", ComEd appears to claim that its NCP method "mirrors engineering" (ComEd Ex. 2.0, LL. 1273-1274). Does ComEd's proposed NCP method "mirror" the engineering of its distribution facilities?

A. Given the extended explanation of ComEd's definition of NCP (including my simple hypothetical illustrations) and the design and installation of capacity (described in the water heating example), the absurdity of ComEd's suggestion should be clear. ComEd's computed system-wide class NCP (the basis of its proposed NCP allocations) is never used by an engineer in sizing the utility's local/regional facilities. ComEd's calculation of system-wide NCP would be analogous to finding the largest simultaneous peak demand when all the hotels in Paris combine their different levels of demand and the times of their clientele's peak shower usage (tourists at the Marriott probably take their showers later in the day). No hotel owners would use this irrelevant Paris-wide number to size water heating capacity in their own hotels. System-wide class NCP measurements have nothing to do with the local or regional demands (like individual hotels) that ComEd acknowledges drive its facilities costs.

ComEd suggests that NCP somehow "mirrors engineering," by excerpting (from an ICC order) arguments of business consumers made in support of NCP: "IIEC and the Commercial Group maintain that . . . costs allocated should mirror engineering concerns for NCP. (ComEd Ex. 2.0, LL. 1273-1274). Perhaps the most surprising thing about the excerpt ComEd selected, is that it actually points to a deficiency that supported the Commission's conclusion to not adopt NCP. The Commission stated in the same case: "No credible evidence has been proffered that the investments in question, distribution substations and primary lines, correlate to NCP-related investments." Excerpts from an ICC order's restatement of business consumers' **arguments** in support of NCP do not provide any evidence supporting a switch to NCP allocations.

Q. Turning to the specific NCP allocation method ComEd proposes in this case, does it have additional elements (other than the bias you have detailed) that are unusual?

A. When I skimmed ComEd's testimony, it seemed that the company had strongly recommended the NCP and then put in a couple of arbitrary moderating adjustments for street lights and residential space heating to mollify the affected consumers. My later, more careful review revealed that ComEd's proposal actually consists of a two-step process. ComEd's first step is to allocate all costs of primary equipment using its NCP method, instead of the current CP allocations. The second step is to reduce the dramatic negative effects on the Street Lighting and Residential Space Heating classes through adjustments loosely based on its crude feeder study. If the Commission accepts ComEd's proposal, I do not believe those moderating adjustments would remain in place for very long, before full (unmoderated) NCP allocations would be pursued (and possibly imposed). However, for purposes of evaluating whether ComEd's approach allocates costs appropriately, I have (for the moment) assumed the moderating adjustments would be in place.

Q. In performing that evaluation, how have you measured the appropriateness of ComEd's approach, in terms of cost causation?

A. I have used our ski hill/golf course/street lights example and extended it to consider different regions with distinct loads. The first step in my analysis was to divide the loads of the ski hill, the golf course, and the street lights (all single-member classes) into three regions, with a portion of each customer's load served by facilities in each region. I constructed the example so that one region peaks in the winter and the other two regions peak in the summer. To assess ComEd's proposal, I created four possible allocation techniques. The first is based on system-wide NCP, the second on system-wide CP, the third is a simulation of ComEd's NCP-based, allocation-plus-adjustment proposal. Finally, to gauge the efficacy of ComEd's NCP plus adjustments proposal, we need a benchmark that measures true cost causation. The benchmark is developed by using the expected regional peak load for each class (there is the word expected again), and costs are allocated based on this regional expected load. I have presented this benchmark as the final allocation technique.

I do not think it will shock anyone to hear that my evaluation showed that ComEd's NCP proposal does not produce satisfactory results, when tested against ComEd's acknowledgement that local/regional load drives its costs. This failure is due in large part to the fact that ComEd's approach is based on its NCP allocation, with all the distortions I have already discussed. Even with ComEd's adjustments, the distortions continue to exist.

Q. Explain your assumptions for different expected loads in different regions.

A. TABLE 3 illustrates my expected peak load assumptions. Total system-wide load of the ski hill and the golf course are the same as in the prior illustration, at 100 kW for the ski hill and 200 kW for the golf course. But this total system-wide expected load is now spread across three regions. For the first two regions, the golf course has more summer load than the winter load of the ski hill. To examine a winter peaking region, the third geographic region has more load from the ski hill (60 kW) than load from the golf course (10 kW). Unlike the previous scenarios, street lights now reach their demand peak only in the winter (to address the coincident peak issues).

TABLE 3 - REGIONAL EXPECTED PEAK LOAD ILLUSTRATION

Usage that Coincides with Peak Usage	70		120		80			
Peak Usage Reached in	Summer		Summer		Winter			
	Region 1		**Region 2**		**Region 3**		**Total System**	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Ski-hill	10	0	30	0	60	0	100	0
Golf Course	0	70	0	120	0	10	0	200
Street Lights	40	0	60	0	20	0	120	0
Total Aggregate Usage	50	70	90	120	80	10	220	200

To be sure the meaning of this table is clear, look at the data for Regions 2 and 3. The size and cost of facilities in Region 2 are determined by the expected summer regional peak load of 120 kW, all attributable to the golf course. Though the ski hill and the street lights have substantial expected winter load, they did not cause any Region 2 investment, because capacity is available from meeting the expected regional peak for the golf course. In Region 3, the expected regional peak is the result of the combined winter demands of the ski hill and the street lights. Each contributed to the peak demand that determined the facilities and costs in that region.

Q. Using this assumed expected regional data, how do the allocations of the methods compare with the regional demand peaks that ComEd has identified as the driver of its distribution costs?

A. TABLE 4 illustrates the allocation results from my assumed data. As with previous examples, the business consumers (golf course and ski hill) are assumed to be either (a) in a heterogeneous class or (b) separate homogeneous groups. The NCP method and the CP method results are computed as they were in TABLE 2, and the results are mostly the same. When comparing TABLE 4 with TABLE 2, a difference in the CP allocation for the street lights occurs, because the street lights are assumed now to peak only in the winter time, at night. This leads to a zero allocation for the street lights under the system-wide CP method (with other derivative effects shown below the allocation percentage).

Allocations in the rightmost two columns warrant a little more explanation. The third column titled ComEd NCP+ uses the NCP method, but then reduces the NCP allocation to street lights by 33% to reflect the ComEd approach that divides the number of regions that do not peak in the summer by the system total. In the example, one third of the systems peak in the winter. This is intended to be analogous to the manner by which ComEd reduced the NCP allocation according to counts in the feeder study that do not peak in the summer. The final column sums up the regional coincident peak for each region and for each class to determine allocation factors. If actual peak demand matched the expected demand used to size capacity, the ideal allocation would have been achieved. As can be seen at the bottom of TABLE 4, when the NCP is used and when there are heterogeneous classes, the ComEd result is completely wrong. The ComEd method produces an allocation of $167 of the $1,000 total to the street lighting class (using the heterogeneous assumption), when the true, cost-driven result is only $74.

TABLE 4 - REGIONAL ALLOCATIONS EVALUATION

NCP with Regional Allocation is Biased
Optimal method depends on region usage
Bias in the NCP is not solved by ComEd's method

Usage that Coincides with Peak Usage	Alternative Allocations			
	NCP	System CP	ComEd NCP +	Regional CP
Ski-hill	100	100	100	60
Golf Course	200	0	200	190
Street Lights	120	0	40	20
Allocation Denominator - Heterogenous	320	100	240	270
Allocation to Business Class - Homogenous	420	100	340	270
Allocation to Business Class - Heterogenous	62.50%	100.00%	83.33%	92.59%
Allocation to Business Class - Homogenous	71.43%	100.00%	88.24%	92.59%
Allocation to Street Light Class - Heterogenous	37.50%	0.00%	16.67%	7.41%
Allocation to Street Light Class - Homogenous	28.57%	0.00%	11.76%	7.41%
Total Cost to Allocate	1,000	1,000	1,000	1,000
Allocation to Street Light Class - Heterogenous	375	-	167	74
Allocation to Street Light Class - Homogenous	286	-	118	74
Percent Difference - Heterogenous versus Homogenou	31.25%	0.00%	41.67%	0.00%

Q. What conclusions do you draw from this analysis?

A. I understand that working through this evolving illustration can be exhausting, and I apologize for that. However, the simulation does demonstrate two key points, even if a few details are skipped. First, results of the regional load analysis are highly dependent on the load assumptions and cannot be derived from a count of the peaks. For example, if the regional load in the third region was changed only a little, the regional CP for street lights could easily go down to zero. Second, the ComEd method does not produce fair, consistent, or logical results, even at the regional level, where ComEd says cost causation happens.

Q. Could ComEd's feeder study be used to develop an alternative benchmark that would measure true regional CP expected peak demand, which (according to ComEd) really drives primary costs?

A. No. As will soon be apparent in my discussion below, ComEd's study does not come anywhere close to providing a good benchmark. The expected regional peak loads must be **measured**, which the ComEd study does not do. The study only counts numbers of feeders in various categories, none of which measure peak load in a way that tracks cost causation. In any case, ComEd's investments are based on expected peaks, not the actual peaks the study counts. ComEd's study does not even mention expected peak loads. Similarly, class expected peak loads must be determined, and that is not part of the study. Regional peak load must reflect cost causation of all equipment, which is not done by measuring feeders. And, finally, the class by class expected regional peak must be measured, which is not part of the study.

Q. ComEd's discussion of its NCP proposal focuses on the method's application to primary facilities. Are NCP allocations appropriate for the costs of secondary facilities?

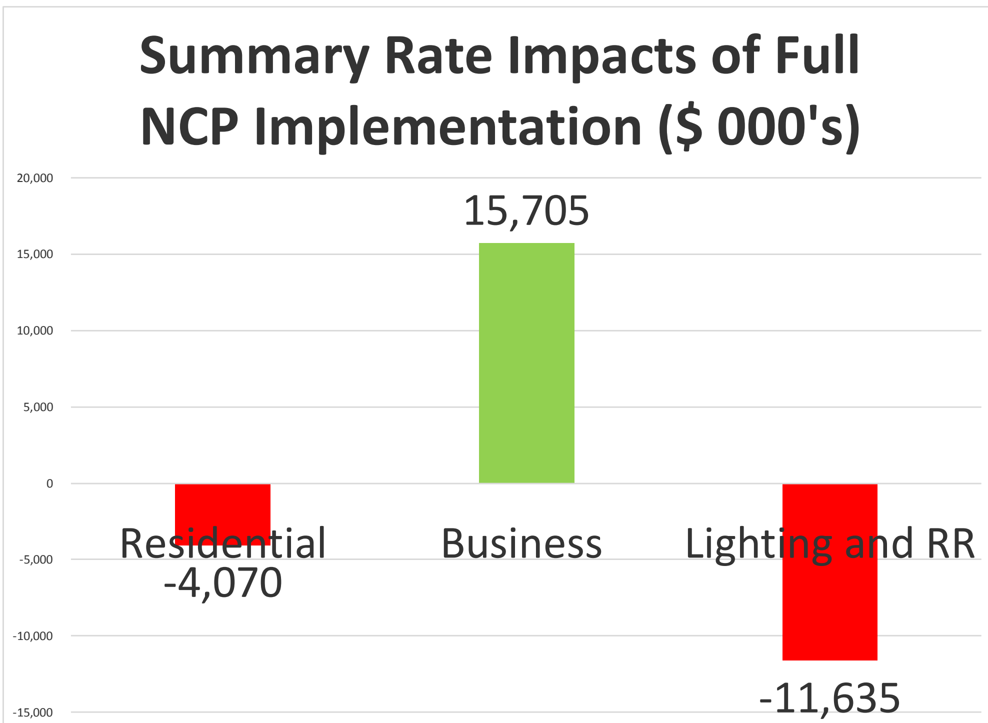
A. No. The bias I have described is inherent in all NCP allocations, including to secondary facilities. Annual billing demand, rather than NCP demand, should be used to allocate secondary facilities. It is the only way to avoid the bias in the mathematics of the NCP allocation method.

3. Class Rate Impacts of Switching from CP to NCP Allocations Confirm the Bias in ComEd's NCP

Q. Do NCP cost allocations have the same effect on all groups of consumers?

A. FIGURE 6 summarizes the effects of applying ComEd's proposal to allocate primary costs using NCP, but with no adjustment to moderate the effects to street lighting classes or residential space heat classes. FIGURE 6 shows that, in general, NCP transfers money from residential and government consumers, who lose (negative numbers), to the winning business classes (positive numbers).

FIGURE 6 - RATE IMPACTS (BUS, RES, GOV)



Q. **Do the numbers underlying this graph reflect ComEd's proposed adjustment to its NCP results?**

A. No, I excluded that adjustment from this impact analysis. I simply do not trust that it will remain in place if ComEd's NCP proposal is adopted. As time passes, things change, and people retire or get old. Soon the reasons why the arbitrary adjustment was made will fade or be forgotten. In subsequent cases, NCP advocates will continue to seek application of NCP allocations without a discount. One can reasonably expect that, at some point, ComEd will also seek to eliminate any discount. Eventually, if the City and other affected consumers cannot continually devote resources to re-arguing the issue, constant re-litigation by well-funded parties (or ratepayer-funded utilities) could see the Commission ceding to demands for un-discounted -- but still flawed -- NCP allocations.

Q. Can you provide a more detailed estimate of the cost allocation effects for each rate class that a change to NCP allocations would cause?

A. The table below (TABLE 5) demonstrates the impacts on other ratepayer groups of ComEd's proposed move to its NCP method. (It also excludes ComEd's adjustment.) Historically, ComEd's proposals have frequently benefitted commercial ratepayer classes, and this NCP proposal does just that. However, the proposed NCP method's beneficial effect on those ratepayers is small, when compared to the extreme (300+%) increase in the costs allocated to Dusk-to-Dawn street lighting ratepayers. Other classes harmed by ComEd's proposed switch to its NCP method are residential space heating ratepayers (40-50%) and electric railroad ratepayers (25+%). In general, benefitted classes would see small or modest gains, while the classes harmed would see dramatic adverse impacts.

In the table, negative percentage numbers represent a reduction in allocated costs (and rates) for the class. When the percentage is positive, there is a rate increase for the class. (The prevalence of negative numbers for business ratepayers likely explains why business consumers regularly support NCP allocations with such vigor.)

TABLE 5 - NCP'S CLASS ALLOCATION INCREASES

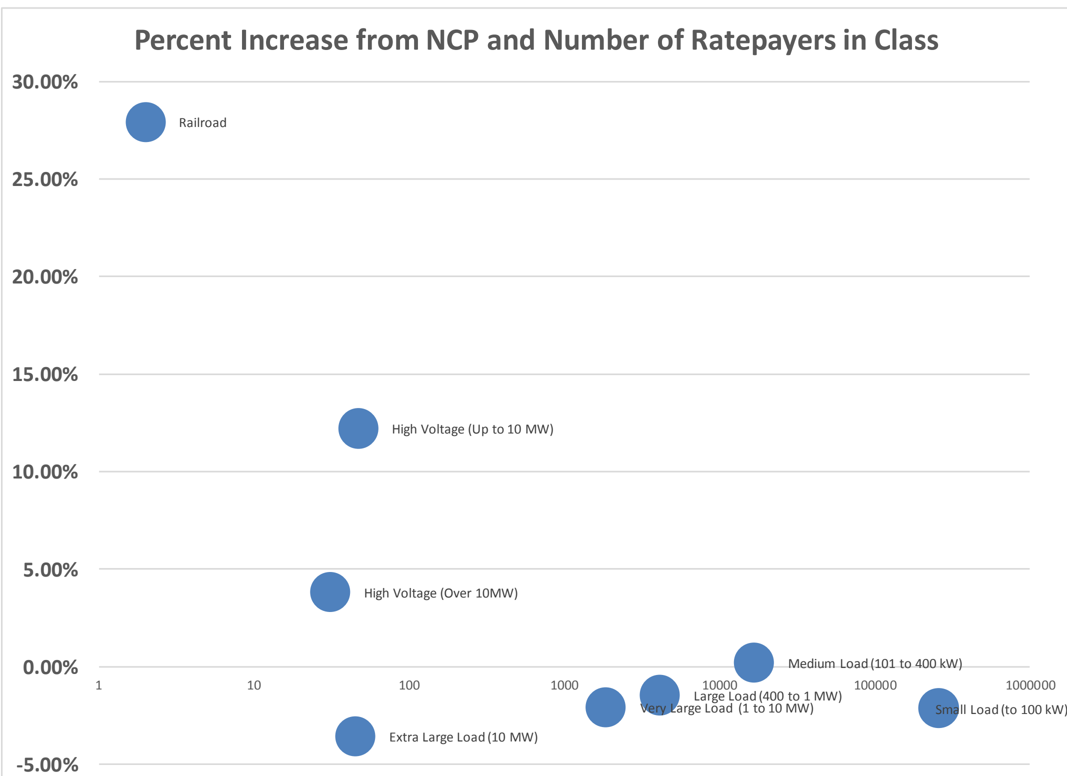
	Ratepayers	CP Cost	NCP Cost	Difference	Percent Difference
Single Family Without Electric Space Heat	2,281,965	1,143,297	1,113,176	-30,121	-2.63%
Multi Family Without Electric Space Heat	1,095,781	288,526	287,578	-948	-0.33%
Single Family With Electric Space Heat	35,568	20,491	32,003	11,512	56.18%
Multi Family With Electric Space Heat	164,462	54,196	77,823	23,627	43.60%
Residential	3,577,776	1,506,510	1,510,580	4,070	0.27%
Business Ratepayers					
Watt-Hour	88,015	25,019	25,711	692	2.76%
Small Load (0 to 100 kW)	258,662	349,355	341,881	-7,475	-2.14%
Medium Load (Over 100 to 400 kW)	16,734	207,894	208,334	440	0.21%
Large Load (Over 400 to 1,000 kW)	4,105	171,941	169,426	-2,515	-1.46%
Very Large Load (Over 1,000 to 10,000 kW)	1,851	290,383	284,332	-6,051	-2.08%
Extra Large Load (Over 10,000 kW)	45	51,790	49,945	-1,845	-3.56%
High Voltage (Up to 10,000 kW)	47	3,855	4,326	471	12.21%
High Voltage (Over 10,000 kW)	31	15,125	15,704	578	3.82%
Railroad	2	6,756	8,642	1,886	27.92%
Nonresidential (No Lighting)	369,492	1,122,119	1,108,299	-13,819	-1.23%
Fixture-Included Lighting		18,382	20,358	1,976	10.75%
Street Lighting - Non Alley Dusk to Dawn		4,361	11,155	6,793	155.77%
Street Lighting - Alley Dusk to Dawn		297	1,326	1,028	345.90%
Street Lighting - General Lighting		1,182	1,134	-49	-4.14%
Total Lighting		24,223	33,972	9,749	40.25%
Total		2,652,852	2,652,852	0	0.00%

Q. Does the table above show results that are consistent with your point about NCP favoring heterogeneous classes?

A. Yes. Consider the railroad class. With only two individual consumers in the class, both handling similarly timed commuter traffic, it is a very homogeneous class. Similarly, the Dusk-to-Dawn street lighting class is extremely **homogeneous,** all providing lighting on the same schedule. The effect of NCP allocations is negative for these ratepayers. The high voltage classes, with few ratepayers and probably **homogeneous** load, would experience a similar impact. Other commercial classes can be very heterogeneous, with entities that range from Walmart stores to factories to office buildings to churches and football stadiums. They benefit more from the bias favoring peak load diversity (within the class) attributable to class definitions.

To illustrate this effect I have made a scatter plot of the NCP impacts and the number of ratepayers in a class. (I have not included classes for which demand estimates come from load research; that includes watthour business ratepayers and residential ratepayers.) FIGURE 7 displays the plot. The x-axis of the chart (a log scale) represents the number of ratepayers. The y-axis shows the percent increase in total cost of service from switching to NCP allocations for primary facilities. The plot confirms that classes with lower numbers of consumers (suggesting lower in-class diversity) have the highest rate impacts. This is a mathematical effect of NCP methodology and has nothing at all to do with cost causation.

FIGURE 7 - INCREASES FROM NCP BY CLASS POPULATION



Q. Have you quantified the bias in favor of heterogeneous classes created by the NCP allocation method?

A. Yes. Any attempt to quantify the NCP method's inherent bias must begin with some sort of equation like the following:

Bias = [True Cost] – [Cost from NCP Allocation]

Such an equation highlights the fact that some benchmark of true cost of service must be established before the bias can be measured. The problem with trying to quantify the bias inherent in NCP allocations is that there are multiple drivers of the distortions. The first is the NCP's unique mathematical distortion and the effect of class definitions that have been the subject of the first section of my testimony. A second source of bias is the incorrect measure of cost causation, which I discussed in Section 2 of my NCP discussion. My discussion here isolates the effect of the NCP calculation among classes with varying degrees of peak demand heterogeneity.

I wanted to assure that my bias quantification was not distorted by incorrect measures of the local/regional expected peak load that drives ComEd's investments.[4] I have used annual billing demand -- which ComEd uses to compute consumers' bills and to recover its costs -- as the benchmark for true demand cost measurement. TABLE 6 below quantifies the bias in NCP allocations for classes with differences in load diversity. Numbers in TABLE 6 are about the bias that simply comes from how much heterogeneity there is in a class.

I have been forced to use data ComEd provided in the 2008 rate design case, as the company did not provide annual billing demand in response to a data request. In responding to our request, ComEd provided the usual lawyerly boilerplate and then only provided monthly billing demand. The company stated:

[4] Utility cost allocations traditionally use current load data, which may not match the expected loads that engineers use to design and build distribution facilities. I did not address that variance in this evaluation of an isolated factor.

> ComEd objects to this request in that it is vague and ambiguous and, depending on how the request is interpreted, may be unduly burdensome and not reasonably calculated to lead to the discovery of admissible evidence. Furthermore, ComEd objects to this data request to the extent it seeks analyses, or studies that ComEd has not conducted.

Using the data that ComEd provided in its 2008 rate design case to illustrate, the table compares the effects of the NCP method's mathematical bias on the Railroad class and various business classes. The final column of the table demonstrates how severely the heterogeneity in a class can distort cost allocations, when using the NCP method ComEd proposes. The Railroad class, which has only two individual ratepayers, is a very homogeneous class. This class would experience a 34% increase in its cost allocation, simply because of the NCP's mathematical bias favoring more heterogeneous business classes.

TABLE 6 - NCP-CLASS DEFINITION ALLOCATION DISTORTION

					Hypothetical Cost to Allocate			1,000.00
	NCP	Percent of Total	Billing Demand	Percent of Total	NCP Allocation	Bill Demand Allocation	Difference	Percent Difference
0-100 kW	2,921,029	24.03%	4,286,660	23.89%	240.29	238.90	1.39	0.58%
101-400 kW	2,663,481	21.91%	3,689,501	20.56%	219.11	205.62	13.49	6.56%
401-1000 kW	2,158,224	17.75%	3,488,439	19.44%	177.54	194.42	-16.87	-8.68%
1001-10,000 kW	3,475,295	28.59%	5,308,342	29.58%	285.89	295.84	-9.95	-3.36%
Over 10,000 kW	791,480	6.51%	1,008,243	5.62%	65.11	56.19	8.92	15.87%
Railroad	146,513	1.21%	162,006	0.90%	12.05	9.03	3.02	33.49%
Total	12,156,022	100.00%	17,943,191	100.00%	1,000.00	1,000.00	0.00	

To see how this measurement bias works, begin at the left-hand side of the table. The first column of the table lists the NCP load for each class (provided in the earlier case). The second column derives the associated allocation factor for the group, the class NCP divided by the total NCP across the classes. The third column shows the annual billing demand for the different classes (that ComEd would not provide in this case). The fourth column computes a second allocation factor that based on billing demand instead of NCP demand. (Note that the Railroad class allocation factor is 1.21% when using the NCP, and .90% when using billing demand.) Once the allocation factors are established, I allocate a hypothetical cost of $1,000 to show how much more or less the NCP method produced, compared with the billing demand benchmark. As TABLE 6 shows, the railroad class would receive a 33% increase with NCP allocations, simply because it is not a heterogeneous class.

Q. Is there a rate class even more homogeneous than Railroads?

A. Yes. The street lighting class is probably the most homogeneous of all ComEd rate classes, and it is most affected by the NCP's mathematical bias. Street lighting class members have an extremely homogeneous load profile. Sunset and the sunrise occur at just about the same time for all street lights on ComEd's system. There is no diversity at all between individual ratepayers in the Dusk-to-Dawn class. They all turn on at dusk and turn off at dawn. (If you are very technical you would know that northern parts of the service territory have a tiny bit more darkness in winter and a bit more light in the summer. Of course, ComEd's service territory does not extend from the North Pole to the equator, so this difference is very small.)

Because Dusk-to-Dawn street lights are turned on and off according to the times of sunset and sunrise, street lighting loads are extremely predictable, and they share a reliable, uniform load profile. In fact, street light ratepayers generally do not even have meters. TABLE 7 below shows the times of sunrise and sunset in Chicago for July. Note that this table has no years associated with it – the class' homogeneous load profile also does not even vary from one year to the next. (I could not show the effect of the annual billing demand versus NCP because I did not have data on the annual billing demand.)

TABLE 7 - STREET LIGHTING CLASS HOMOGENEITY

Chicago Sunrise and Sunset in July

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 Sunrise: 5:19am Sunset: 8:30pm	2 Sunrise: 5:19am Sunset: 8:29pm	3 Sunrise: 5:20am Sunset: 8:29pm
4 Sunrise: 5:20am Sunset: 8:29pm	5 Sunrise: 5:21am Sunset: 8:29pm	6 Sunrise: 5:22am Sunset: 8:29pm	7 Sunrise: 5:22am Sunset: 8:28pm	8 Sunrise: 5:23am Sunset: 8:28pm	9 Sunrise: 5:24am Sunset: 8:28pm	10 Sunrise: 5:24am Sunset: 8:27pm
11 Sunrise: 5:25am Sunset: 8:27pm	12 Sunrise: 5:26am Sunset: 8:26pm	13 Sunrise: 5:26am Sunset: 8:26pm	14 Sunrise: 5:27am Sunset: 8:25pm	15 Sunrise: 5:28am Sunset: 8:25pm	16 Sunrise: 5:29am Sunset: 8:24pm	17 Sunrise: 5:30am Sunset: 8:23pm
18 Sunrise: 5:31am Sunset: 8:23pm	19 Sunrise: 5:31am Sunset: 8:22pm	20 Sunrise: 5:32am Sunset: 8:21pm	21 Sunrise: 5:33am Sunset: 8:20pm	22 Sunrise: 5:34am Sunset: 8:20pm	23 Sunrise: 5:35am Sunset: 8:19pm	24 Sunrise: 5:36am Sunset: 8:18pm
25 Sunrise: 5:37am Sunset: 8:17pm	26 Sunrise: 5:38am Sunset: 8:16pm	27 Sunrise: 5:39am Sunset: 8:15pm	28 Sunrise: 5:40am Sunset: 8:14pm	29 Sunrise: 5:41am Sunset: 8:13pm	30 Sunrise: 5:42am Sunset: 8:12pm	31 Sunrise: 5:43am Sunset: 8:11pm

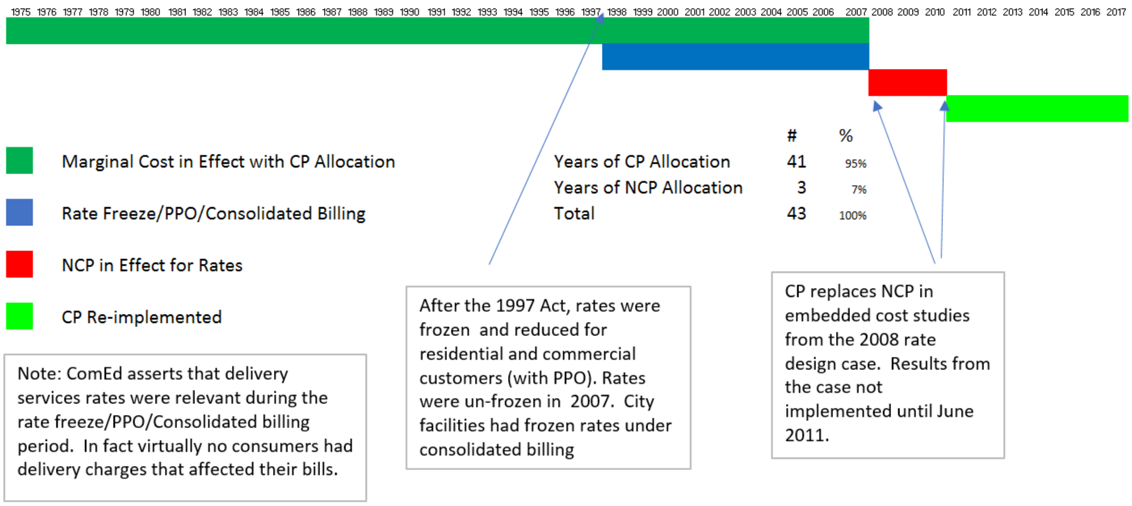
4. Use of the Proposed NCP Allocations Is Historically Anomalous in Illinois, Particularly in ComEd Cost of Service Studies

Q. Mr. Leick testifies "Currently ComEd allocates costs for its primary lines using a CP cost allocator. For many years the costs for primary lines were allocated by Illinois electric utilities on the basis of NCP cost allocators in their respective cost of service studies." (ComEd Exhibit 2.0, Lines, 1211-1213)." Is his statement consistent with the results of your review of Illinois cost regulation decisions?

A. Certainly for ComEd, the implication that NCP has been the prevalent method of allocation is not true. NCP has not been the prevalent method for allocating primary distribution for most of the past three decades. I have been involved in most (if not all) the rate cases where the NCP method was debated in testimony, as well as many cases when marginal cost was used to allocate cost. From the 1970s through most of the 1990s, ComEd's rates were determined from marginal costs. NCP allocations of primary wires, to set rates, were first introduced in ComEd's embedded cost of service studies around 2000. However, from 1998 to 2007, those distribution cost allocations were not the basis for ultimate retail rates, because of a statutory residential rate freeze and other rate relief mechanisms for non-residential consumers (like the PPO option for commercial and industrial consumers and the consolidated billing technique for certain governmental consumers). As late as its 2001 rates proceeding, ComEd proposed continued use of marginal cost studies, which applied the CP method for primary distribution equipment. (In the past ComEd has made the surprising argument that measuring the cost of wires in a case involving bundled generation and distribution is somehow different than measuring costs in a case that only involves distribution.) The Commission ordered instead limited use of a modified embedded cost of service study developed during the case (and across-the-board rate changes), but as I just stated, this was not consequential until after the rate freeze ended in 2007 because there were virtually no consumers who were not affected by either the PPO or the residential rate freeze. In ComEd's 2008 rate case, the Commission looked closely at the NCP issue. The Commission ordered ComEd to use the CP method in its ECOSS, which ComEd has done since that case.

When you put all of the history together, ComEd has used NCP allocations for primary distribution plant allocations and setting final rates only from 2007 to implementation of rates in the 2008 case. I have put this information together in the time line below (FIGURE 8) where the green colors represent years for which CP allocations of primary equipment were in place for rate determination. The little bit of red color represents years for which the inappropriate and biased NCP method was in use. The time line demonstrates that for only three years out of 43 years was NCP used to allocate primary distribution equipment for ratemaking. I would hardly call this the prevalent method.

FIGURE 8 - TIME LINE: CP VS. NCP ALLOCATION



Q. Given the deficiencies and biased impacts you describe, how could the NCP have become such a persistent issue in regulatory rate design and cost of service processes?

A. It is curious that the NCP method became an allocation procedure seriously considered by regulators, since (as I have explained) the NCP allocation method has blatant inherent biases and does not reflect anything about cost causation. But the NCP method does produce desirable results for members of heterogeneous rate classes. Often, they are consumers who can afford to push the idea in case after case, and they often have utility support.

Utility engineers and hired engineering consultants have told a consistent story about NCP -- that there are engineering and economic bases for NCP allocations, when in fact it is pure nonsense. Having the method mentioned in the NARUC Manual likely also helped. (ComEd Ex. 2, LL 1345). Advocates for classes harmed by NCP proposals were probably overwhelmed by the resources of NCP beneficiaries and of utilities, which can exploit a decisive information asymmetry (especially regarding utility data). In the end, NCP advocates and utilities can carry the day if their policies are treated as too dense and confusing to be challenged.

Q. You noted that the NARUC manual mentions NCP cost allocations. Do you agree that the NARUC manual supports the use of NCP?

A. No, I do not, and I am not certain that Mr. Leick believes that either. He does not make that claim in his testimony. He simply recounts that an Ameren witness in another case claimed it. ComEd Ex. 2.0 at 76:1345. I examined that interpretation of the NARUC Manual in detail in a prior case, and I do not want to make this testimony more boring than it must be by re-hashing the argument. So, I have simply provided my rebuttal to the claim (made in ComEd's 2010 rate case) as part of City Exhibit 1.2. Here, I will only state that the Manual did not recommend any particular method. The Manual simply tried to identify (and to summarize briefly) allocation methods that regulators might encounter.

Q. ComEd's testimony makes the simplistic argument that downstate utilities use NCP and they deliver electricity over primary lines. Is ComEd similar to those utilities with respect to these cost of service issues?

A. No, that argument is very much overly simplistic. ComEd is not like the downstate utilities. No other utility in the state has ComEd's unique demand issues and ratepayers.

For example, ComEd has a needle peaking characteristic that the Company has emphasized for decades. I look at data on **needle peaking** on the ComEd system in City Exhibit 1.1. In City Exhibit 1.1 I demonstrate that needle peaking is much more extreme for ComEd than for other more rural utilities. All you have to do is look at a graph of ComEd daily peaks compared to those of the more rural utility. If a utility has more needle peaks, the difference between off-peak load such as Street Lighting load and on-peak load is aggravated. For rural utilities, the difference between summer peaks and winter peaks is much less (see Part 1 of City Ex. 1.1). I hope my review of Paris hotels demonstrated the importance of differentiating peak usage from off-peak usage. Peak usage -- the driver of capacity costs -- is more important for ComEd than for other companies.

Second, the size of the lighting load is different and implies the issue is more important to ComEd. People who have taken a plane that lands at night at O'Hare should understand the difference between street lights in Chicago and street lights in Peoria, Illinois (a town that I think is served by Ameren). I have seen many tourists click their iPhones in arriving planes to take pictures of Chicago (like the one below, FIGURE 9). I recently listened to a speaker in Cote d'Ivoire describe Chicago as an amazing place where the lights at night are almost unimaginable. The sheer magnitude of street lighting in northern Illinois makes the issue far more important for ComEd, and for street lighting consumers. (But I hope nobody looks at the picture and falls into the simplistic trap that energy for the lights implies capacity costs should be imposed simply because "the lights use primary equipment." Even though there are a lot of lights, the lines that are used were built for meeting air conditioning use that occurs on hot summer days.)

FIGURE 9 - COMED TERRITORY/CONSUMERS UNIQUENESS

The more significant amounts at stake in ComEd cost allocations appear to concentrate interest far more than in other utility territories, especially for municipal street lighting consumers. In ComEd's testimony, there was no evidence that municipal interests participated in the cases of downstate utilities that ComEd cites. When advocates for affected consumers are not present to oppose proposals as obscure and arcane as NCP allocations, it is not shocking when the interests of those consumers do not prevail. Concerns about information and resource asymmetries are heightened when advocates for affected consumers are not even a part of the regulatory process. The Commission decisions in the Ameren and MidAmerican cases ComEd cites were made on heavily skewed presentations of evidence, without strong advocacy for the legitimate interests of street lighting ratepayers.

While the City does not participate in rate proceedings of utilities who do not serve Chicago, for years the City has been an interested and active participant on NCP issues in ComEd cases. Over the years, the City has presented persuasive evidence in ComEd cases that demonstrated the inappropriateness of NCP allocations for night time street lighting that uses otherwise idle capacity. This makes ComEd (or should I say the advocacy and evidence in its ratemaking cases) different. Still, City resources are challenged by the need to re-litigate this issue repeatedly, even in the absence of changed circumstances.

5. ComEd's Supporting Feeder Study Is Poorly Designed, Biased, and an Inadequate Basis for Changing Rate Design Policy

Q. Have you found sound reasons for ComEd to perform (or the Commission to consider) this particular study of feeder peaks?

A. No, I do not understand ComEd's reasons for undertaking this particular effort. There are many other cost of service issues -- like the multi-family load factor and dramatic differences in results from load research discussed below, regional analysis of costs or careful examination of true costs that should be in the customer charge -- that cry out for attention. It appears that ComEd had this item at the top of its agenda, and the Company jumped into this (ratepayer funded) data analysis without first specifying objectives, developing a testable theory, or thinking about (and conforming the study to) how distribution facilities are built. Why did executives at ComEd order the study? What staff designed and prepared details of the study? Why were the supporting data and documentation so difficult to analyze? Why has ComEd never made such a study before? These are all questions that bear on the true relevance of a feeder study to ComEd's system-wide cost of service study.

Q. Does ComEd's feeder study identify a change in relevant circumstances that justifies another re-examination of the Commission's decision on NCP cost of service allocations?

A. ComEd's feeder study does not come anywhere close to being a circumstance that should warrant revisiting the NCP issue. To make any study acceptable for policy analysis, there are criteria that the study must meet. They include the five I consider most relevant to ComEd's feeder study -- how the study should: (1) be structured so the analysis tests the appropriate policy objectives; (2) be available for detailed review by experts in the field; (3) use relevant data and statistics to evaluate or to inform the policy objectives; (4) be tested against other independent data to assure that the information is not biased, and; (5) produce results that are relevant for evaluating policy objectives.

If a study fails on any single one of these criteria, it cannot be used for making a policy decision. (ComEd's feeder study may not be a changed circumstance, even if it met all five criteria, since the study could have easily been made in earlier cases where NCP was advocated by ComEd.) But ComEd's feeder didn't violate just one of the criteria (which would make it invalid). It violates all of the criteria.

First, the ComEd study does not present objectives properly where the real-world cost causing expected peak load data used by actual staff is described in the context of the analysis. Second, ComEd has effectively limited interested parties in accessing the data for appropriate review. Third, the study uses the number of feeders that have peaks at different times rather than presenting the class by class actual annual peak demand at each of the feeders making the data irrelevant in the context of any cost causation objective. Fourth, the study is probably biased because it does not produce results consistent with ComEd's needle peaking characteristics that could have easily been tested through verifying that the sum or the regions equals the whole load. Fifth, the ComEd study has nothing at all to do with verifying use of system-wide NCP, making it irrelevant for assessing the fundamental issue at hand. Because of all of these problems, the ComEd feeder study in no way, shape, or form can be considered a changed circumstance that would warrant consideration of a change in policy with respect to NCP allocation. In the next few questions,I discuss each of the five necessary criteria for a study in the context of ComEd's feeder study. I present my findings in the order that I introduced the five criteria.

Q. What does the *first* criterion for an acceptable study, that the information presented must be consistent with an assessment of the policy objective, mean in this context?

A. Imagine the hypothetical study that attempts to refute Global Warming. Say the study only focuses on the ice age and asserts that changes in climate during this pre-history time before humans were engaging in industrial activity can allow us to conclude humans do not cause climate change. This study would at the outset need to explain why the ice age is relevant to current global warming. In the ComEd study, the feeder counts measured in the study must be consistent with true cost causation for the primary facilities being considered. ComEd did not explain why the feeder study's information on volatile observed counts of the number of feeders that experience peaks at different times has anything at all to do with the way primary distribution facilities are sized and costs incurred. In particular, there is no connection at all between the long-term expected peak loads used to build primary facilities (which may not be feeders) and the numbers that ComEd ordered its planning department to run off and collect.

ComEd has previously explained that it is expected peak load over the long-term that drives the sizing of capacity and cost causation. In Dkt. 10-0467, ComEd executive Ross C. Hemphill, Ph.D. (and my former business partner) testified:

> For example, when ComEd installs a new feeder, a new distribution substation, or even a customer's service drop, ComEd determines the capacity of that system component *based on the projected peak load* requirement over the long term. The system is thereby designed and sized to be able to serve all reasonable levels of demand and use. . . . For this reason, *once distribution equipment is installed*, ComEd does not need to go back and add or remove equipment based on period to period variations in use. Dkt. 10-0467, ComEd Ex. 14 at 10; LL 210-215, (emphasis added).

As I explained in my Paris hotel water heater example, if expected usage over the long-term occurs at off-peak times, this off-peak demand should not be allocated capacity cost. The data ComEd ran out and collected for the feeder study in 2014 and 2015 was data that has occurred long after the cost causing decisions to build capacity using expected demand levels were made. Further, as shown Exhibit 1.1, the chosen years are not good representations of the long-term. Perhaps ComEd has peak usage data rather than counts for regional peaks. Perhaps ComEd has data from more representative years. Perhaps ComEd's data has problems. ComEd's control of ratepayer funded data allows the company to select data and prepare statistics that do not measure anything relevant.

Q. What could ComEd have done to assure the feeder study is consistent with the policy objective?

A. Before deploying the planning department to go out and collect scads of data, ComEd should have considered whether the data that it was collecting are relevant. If the objective of the study was to determine what cost allocation method best assigns distribution costs on the basis of cost causation, ComEd should have designed the study to match its investment decision and engineering processes. Instead, ComEd engaged in what appears to be a mining of available "big data" to find support for the Company's NCP proposal. In terms of street lighting load, the real question is the one I raised in my discussion of water heaters in Paris hotels. Do the people who size distribution facilities (or water heaters) consider off-peak street light load (or afternoon showers) in their long-term forecasts. This is the real information the Commission needs to see and not some after the fact, undocumented, volatile data and statistics that measure nothing. ComEd's feeder study's first failure therefore is that it never explained how the study's *after-the-fact* determination of peak times on feeders in unspecified locations are relevant to (or used in) pre-construction distribution investment decisions.

A legitimate study would begin by providing actual examples of how projected peak load over the long-term is really determined and utilized. In the many years of discussing NCP, regional CP, and cost causation of primary facilities, ComEd has never provided such a real-world example of how its staff in fact uses regional long-term load *estimates* to construct new equipment.[5] Neither does ComEd introduce the study with a specification of what sort of regional peak estimates actually are used in designing and sizing its distribution facilities. It is simply not good enough for ComEd executives to order its staff (funded by ratepayers) to collect

[5] The City requested from ComEd (DR City 1.19) "reports that describe the need for new construction of distribution systems," and "a detailed description of how the load estimate is used to size the new facilities." The Company responded: "ComEd does not have an associated report." In response to a separate request (City DR 1.24) for "clear and simple explanations and examples of the documents and processes used in ComEd's feeder investment decision/construction process," ComEd summarily described a software-assisted engineering procedure that apparently produces and relies on numerous forms and documents -- no samples of which were produced.

a lot of data that is fully controlled by ComEd and can be presented in a case as authoritative because no one else has comparable access to the data.

Q. Assess ComEd's feeder study against the *second* test of an acceptability.

A. A study cannot be legitimately used in policy analysis if data gathered and used in the study cannot be examined in detail. That includes making relevant data and analysis available to other experts who may have contradictory data or conflicting positions. Pretend our anti-global warming study asserted that climate change was more rapid during the ice age than it is during recent times. Assume also that the data was not available to scientists who have contradictory data. Without the ability to have an appropriate review of the data, the study cannot be considered legitimate. In the case of ComEd's feeder study, ComEd continues to control data and limit realistic review. The company chose to make every element of the feeder study confidential (not just identifiable ratepayer or geographic information) and limit timely access to its work papers. [6]

Not only should the feeder study have been in public work papers, ComEd should have allowed the City and other Street Lighting class members that will be most directly affected by the proposed NCP allocation to review the data well before the case was filed. ComEd does this selectively with other rate classes. As a contrast to the feeder study, I remember sitting in a meeting with a City lawyer in the Sears Tower when there seemed to be fifty lawyers, engineers, and consultants representing commercial interests discussing the allocation of secondary wire. We were the only attendees who had an interest in residential and municipal ratepayers (another example of information/resource asymmetry). To sum up, the lack of real access to ComEd's data is the second fatal flaw with the feeder study.

[6] Accordingly, I must I reserve the option of supplementing my analysis after reviewing the data.

Q. Move to the *third* criterion that defines an acceptable study, that results of the study must be measured and presented in terms that are relevant to the policy being evaluated.

A. Assume the study of global warming measures the number of icebergs and then attributes this to the rapidity of global cooling that occurred during the ice age. The study would potentially not be useful because the data measured for the number of icebergs does not correspond to the central question of how fast temperature is changing (some icebergs may be bigger and combine with others for example). To evaluate whether ComEd used the kind of data required for a legitimate analysis of regional coincident peaks, recall the data in Figure 5, where I defined a benchmark that would measure true costs. For an unbiased and correct analysis of cost causing peak demand, the amount of the coincident peak demand in each local region and for each class is necessary. But instead of measuring the amount of usage during the peak periods by different classes, ComEd simply counted the number of places certain types of demand occurred -- feeders that supposedly peaked at different time periods. Crucially, the Company did not measure the amount of load by feeder. Worse, the coincident peak experienced by different classes was never presented. This means there is no real relevant information in the whole feeder study.

These data problems in ComEd's feeder study are compounded by other issues. For the fraction (feeder counts and not energy usage) of feeders with unusual peaks that drive the study's conclusions, ComEd did not relate its data to locations, the nature of consumers served, the feeder's load, or even whether the feeder is serving street lights, to make its data collection relevant to its proposed class cost allocations. As to street lighting in particular, the ComEd study does not document which feeders included street lighting loads nor how much street lighting peak load occurred on affected feeders. From what ComEd has presented, it is possible that none of the feeders relied on for the study's conclusions regarding street lighting allocations served any street lighting load at all (ComEd DRRs City 1.11, 1.15). We just don't know. In sum, the fact that the wrong data was used – number of counts; the fact that there was no specification of class by class load; the fact that street lightning feeders were not identified; and the fact that locations were not provided renders the study utterly useless for assessing allocation of primary facilities.

Q. Could ComEd have collected data that is actually relevant to the allocation question?

A. Yes, I believe so. I have found out that ComEd could have easily provided the usage by class for each feeder. I did not learn this from a ComEd data request. I learned this while having lunch with a utility engineer, a participant in my renewable energy class in Manila. He explained that load by class could be measured because there are meters at the end of the feeder from individual consumers and there are meters on transformation equipment. I mention this not only to point out that more relevant data are available, but also to emphasize just how selective ComEd is in providing information under its control, including in its work papers and data request responses.

Q. Continue with the *fourth* criterion for an acceptable study that you identified, data verification to assure no bias in the data.

A. When presenting data on how feeder peaks changed from year to year, ComEd seemed surprised and encouraged by the results (as if unexpected results would confound its critics). What the unintuitive results -- such as annual peak load occurring at 5:00 AM or annual peaks occurring in the month of April -- are probably saying is that the data contains some kind of bias. Instead of presenting the counter-intuitive results as confirmation that regional peaks do not occur on hot summer days, ComEd should have carefully examined exactly what consumption habits are changing at the questionable feeders and why the very odd results are occurring. This analysis of odd results must specify the locations of the counterintuitive feeders and the specific consumer behaviors that were causing the weird outcomes. ComEd should also have investigated whether there was a more basic flaw, a measurement problem. It is more likely that there is something wrong with the data than there is something wrong with the consumers.

Q. What could ComEd have done to verify data in the feeder study?

A. Things like peaks occurring at 5:00 AM, as shown in the ComEd data, and dramatic changes in usage from year to year cry out for verification tests of the data. The most obvious and basic check to assure that the data is not biased is to test the sum of the regional peaks with ComEd's overall aggregate peak. Consider another simple formula:

$$\sum \text{Feeder Peak} = \text{Aggregate ComEd Peak}$$

In terms of ComEd's aggregate peak, the company has over the years emphasized many times that it experiences extreme "needle peaks." Needle peaks are sharp demand increases, followed by equally precipitous drops. These needle peaks occur in the summer for ComEd. Given the weather in Chicago with relatively few really hot and humid days and the relatively low penetration of space heat, ComEd's needle peaking point is logical. When the needle peak load occurs in summer, street lights are not switched on. They only turn on after temperatures have cooled and air conditioners are not running full blast.

Results from the ComEd feeder study are inconsistent with summer needle peaks and suggest there are a whole lot of regions that peak at different times from when the overall peak occurs, for example in the shoulder months of April and October. Some annual peaks even occur at 5:00 AM and others at almost just as odd a time of 11:00 PM. ComEd presented this data simply as confirmation of ComEd's theory that a whole lot of regional peaks occur at counterintuitive times. What the company should have done is studied behavior of ratepayers who consume electricity over their lines at seemingly odd times and found out precisely what was occurring. Specific factories, extreme weather events or other circumstances may have been part of the explanation rather than a simple graph assumed to be a valid determiner of allocations for the system.

Given the fact that the ComEd system has a strong needle peak, there can only be two explanations of the differences between the individual regions and the overall system:

1. ComEd's feeder data is wrong and somehow biased, or
2. Count data in the feeder study is correct, and the usage volumes for many feeders have even more aggravated needle peaks than the system average (if some peaks occur at 5:00 AM in April, then the rest of the system must have an even more aggravated summer daytime peaks because the sum of the parts must equal the whole).

In City Exhibit 1.1 I have used system-wide data that ComEd provides to PJM to evaluate the feeder study. The data in City Exhibit 1.1 demonstrates that ComEd indeed does have more aggravated system needle peaks in summer than other utility companies . The data also show that 2014 and 2015 had higher load factors and less aggravated needle peaks then other years. The final section of City Exhibit 1.1 demonstrates that if some regions do not reach the system peak at the overall time of the system peak, the remaining regions must, as a matter of simple math (the whole equals the sum of the parts) have an even more pronounced summer time peak. The regions with the more pronounced summer peak are areas where street lights do not contribute to the system peak. When the regional peaks are summed across regions, the allocation denominator increases because of this reconciliation issue. As the street lights are not allocated costs from the more aggravated remaining summer peaking loads, the allocation to street lights is reduced. I demonstrated this with a simulation in the last part of City Exhibit 1.1 and I have not burdened non-expert readers with the details. This necessity to reconcile regions with the system total reduces street lighting allocation by 26% in the example that I created.

Q. Discuss the *fifth* and final *criterion* for an acceptable study, that results should be appropriate to the issue at hand.

The final issue with the feeder study is that, even if it were correctly performed, it would in no way justify the NCP-based allocation that ComEd recommends. Even if the feeder study was not biased; even if it measured regional usage by class rather than feeder counts; and, even if it was fully available for review, it would still not present any new information on the measure that ComEd says drives its distribution costs. That critical causation factor is the expected long-term peak load forecast that is the true driver of engineering decisions and costs. Supposing some sort of analysis that reasonably simulated peak demand studies used to size distribution capacity could be achieved, the correct approach would be to determine historic expected coincident peak by region and by class. Then the expected class regional peaks could be summed to come up with allocation factors as is illustrated in Table 5 where I compared ComEd's NCP method with alternative methods.

6. There Are Constructive Approaches to Addressing Any Imperfections in System-Wide CP Allocations That ComEd Does Not Propose

Q. Are you suggesting that there is no room for improvement in cost allocations for ComEd distribution costs?

A. No, it is possible that current allocations could be made more accurate and reliable while retaining the cost causation basis. My point is that ComEd's proposal is not an improvement. A good cost of service study that actually tracks how investment decisions are made and facilities installed might show that system-wide CP is not a perfect allocator. ComEd has not even presented that hypothetical, good study in this case.

The data and analyses I have presented in response to ComEd's claims demonstrate, first, that ComEd's flawed proposal for NCP allocations should not displace the Commission's current directives simply because CP allocations are not perfect. ComEd acknowledges that the usual cost allocation methods are surrogates for studies of the regional or local costs of service ComEd does not wish to pursue. My testimony also shows that ComEd has not demonstrated that NCP allocations are superior in any way to CP allocations. In fact, the preliminary analyses I have been able to undertake show that NCP allocations would be significantly worse in allocating costs according to cost causation.

Q. Are there alternatives other than NCP that could be investigated?

A. Yes. The data on expected regional peaks that drive construction of primary facilities is all in ComEd's possession, and the Company has shown no inclination to examine it. I recommend that the Commission order ComEd to work on a joint study with parties that have a strong interest in the subject, to design a good approach for identifying disparate regional costs, and then to devise appropriate cost allocation methods.

Such an effort must address what really constitutes expected local demand for purposes of constructing regional distribution equipment. Second, the study must address all the problematic allocations issues I discussed above. All this should be done with coordination of input from different parties. Third, if a real study can be made of retrospective expected regional demands that are relevant for constructing new facilities, the Commission should order ComEd to allocate costs according to aggregation of local demand, not according to the NCP nonsense. I emphasize that such an allocation would not be a determination of cost of service in various regional areas. It would just allocate existing costs, based on the way ComEd says they are caused, namely on local/regional coincident demand. The study could examine regional costs allocated by class (for example all street lights across all regions) to establish allocators. But until a reasonable study is made of local/regional demand, the system-wide CP method must be maintained.

OTHER RECURRING RATE DESIGN ISSUES

1. Regional Cost of Service Differences Should Be Recognized Uniformly in ComEd's Cost Studies

Q. You have discussed regional peak loads and cost causation driven by regional expected peak load. Is the regional peak load issue that you discuss in this section the same as the regional studies in the context of your NCP discussion?

A. No. The regional cost allocation in this section involves measuring the actual of cost of different facilities by region instead of measuring costs across the whole system. Once costs by region are identified, the loads that occur in the different areas (for example coincident peak load where the coincidence is measured against the entire system-wide peak) can also be tabulated. This means that if one region has less peak load relative to the number of ratepayers, the cost per ratepayer would be less. The regional costs and the regional peaks can then be used to determine each classes' regional cost of service. Given ComEd's technology including AMI meters (paid for by ratepayers) this can be done for small or large regions in the territory. The regional cost allocation is distinct from the analysis of regional peak load for measuring CP discussed above.

Q. Have you recommended recognizing regional cost of service differences in previous ComEd proceedings?

A. I have, on many occasions. Discussion of tracing costs by region began when disputes about franchise fees and free service arose in the 1990s. Later, I made efforts to correct ComEd's marginal cost study in measuring regional density and undergrounding. In Docket 07-0566, regional cost of service was the central proposition of my testimony after ComEd asked for large rate increases associated with suburban sprawl. In other cases, I have discussed the local/regional differences in load factors, ratepayer density, age of facilities and equipment, and overhead/underground construction as factors that create important (and significant in magnitude) regional cost of service differences. I have emphasized that these regional differences are harmful to low income areas and more favorable to suburbs where people seem to need to build large palaces that consume huge quantities of energy. I will not repeat the details of such a method in this testimony. I have attached segments of the testimony I referenced as City Exhibit 1.3. It recounts the instances the City and I have urged the Commission to consider seriously the improvement in cost allocation accuracy that regional studies would provide.

Q. Were there any parts of ComEd's cost of service testimony that surprised you?

A. When I first scanned the railroad study ComEd was required to provide, it seemed to be a very dense piece focused on things like flow to traction facilities that were only relevant to the CTA and Metra. When I read the testimony a second time, I noticed that a big reason railroad costs and rates were being lowered was the regional quantification of its costs of service. I was stunned. This is a remarkable -- but appropriate -- change in the way costs are allocated.

Q. Did ComEd recognize that it had opened a can of worms it has fought to keep closed?

A. Yes. ComEd's witness stated: "ComEd has concerns that studies like the RRGAS will lead to requests for further studies and possibly requests for regional rates, if customers in one region believe the costs within a specific region are lower than costs in other regions. (ComEd Ex. 2.0, LL 997-1001). I have been begging ComEd to investigate such regional costs in high consumer density areas like most City neighborhoods for years and years. My request has been made in testimony, in data requests, and in meetings with ComEd executives. Even though ComEd could perform this study with the (ratepayer funded) data in its possession, it has not.

Chicago's history is unique in terms of differences in housing stock. The amount of available land surrounding Chicago also differs from other world class cities. This land has allowed wealthy people to build palaces and high quality schools in areas far away from the center of the City. All of this history has also resulted in very different electricity distribution configurations. It is imperative that cost of service and load difference be accounted for in future rate cases.

Q. Are you suggesting that ComEd should apply the same approach to other identifiable regions with disparate costs?

A. There is absolutely no reason to apply the approach only selectively. To the extent that facilities like City police stations, City Schools, and to be sure City Street Lights operate inside a region with disparate costs, they should be allocated costs particular to that region. From my analysis of regional cost differences in the past, I suspect the cost differences for facilities within City of Chicago boundaries will be even more pronounced than the Cook and Will County cost differences the railroad study reveals. The same argument can be made for residential ratepayers in in densely populated areas of the City and older suburbs that do not have expensive underground facilities.

Q. Why is it so unfair to apply regional cost of service measurement selectively?

A.

In more than one case, ComEd has rejected the City's requests for a determination of regional cost differences that affect City ratepayers. After repeated instances of addressing such cost differences, I hope the Commission is ready to determine ratepayers' actual costs of service (even if they are not all the same), instead of what makes a convenient cost study for ComEd or preferred outcomes. There is ample support in this record for the Commission to initiate an investigation of regional cost differences.

2. ComEd Should Apply Load Research Data That Appropriately Reflects Usage Characteristics Of Low Use Consumers

Q. Why have you argued for reduced costs and tariffs for low-use residential consumers in past cases?

A. ComEd's residential rates continue to be particularly regressive, in that the price per kWh is much higher for low use consumers and the price is much lower for high use consumers, as compared to other utility companies in the U.S. and around the world. I have demonstrated this in case after case, and I do not repeat all of the graphs and analyses here. Furthermore, I have shown on many occasions that low use consumers tend to be low income families, with a strong positive correlation between income and usage. Finally, low use is a distinctive usage characteristic of City of Chicago ratepayers because of the large portion of housing stock that is multi-family or small single-family bungalow homes and because of population density. It is no wonder that the City has fought for decades to reduce rates for small users who live in apartments and small houses.

Q. What is your concern in ComEd's latest cost of service study with respect to the allocation of costs for the multi-family residential class?

A. In Docket 14-0384, "the low use case", ComEd's load analysis demonstrated that the multi-family non-space heat class as a whole should be allocated 17% lower distribution costs than in the 2013 RDI case according to load data it had recently collected from AMI smart meters. I demonstrate this in Table 8, where the distribution capacity costs from the low use case are compared to distribution costs from the 2013 RDI case. Table 8 also contrasts AMI data from the low use case with the load research data used in the 2013 RDI case that I demonstrated was highly flawed. The 17% reduction in cost of service difference that I explain below was entirely the result of a better load factor for the non-space heat multi-family low use group.

In this case, ComEd has not mentioned one word about load research, data from AMI meters or changes in measured load profiles for low use consumers even though the data had such a dramatic effect on cost of service measurement. Further, because of a lower load factor, much of the cost advantage to the low-use multi-family group that was present in Docket 14-0384 has mysteriously disappeared -- without an explanation from ComEd of the sudden change.

Q. Given the importance of the load factor in allocating costs, explain how you have computed the load factor for the multi-family class?

A. The load factor can be computed in two steps. First, the average energy used throughout the year is computed. This step is illustrated below by using an excerpt from the ComEd cost study where the energy is defined as "KWH-ALL". The KWH-ALL data is divided by 8766 (the hours in a year including leap years) to establish the average hourly energy use in kWh over the year. The second step is dividing this average energy use per hour by the coincident peak (measured in kW). I used the line in the allocation section of ComEd's ECOSS labeled "CP 69kV and below" to get a measure of the peak load. Dividing the average energy by the peak load results in the load factor. If the average use is the same throughout the year, the load factor is equal to 1.0. If much more electricity is used at the peak time, the load factor is far below 1.0. A higher load factor means less costs are allocated to group.

That process is used to determine a class' average use and coincident peak, and to compute its load factor. As I noted, the load factor affects the costs allocated to the class. For example, if a class' load factor is 40% instead of 20%, then half as many capacity costs would be attributed to the class to get the same amount of electricity that turns on your lights. This means your rate to have your kitchen lights on would be cut in half.

Q. Using the allocation data for KWH-ALL and CP<69KV, explain what has happened to load factors for the multi-family class since the 1990s?

A. In the 2013 RDI case, when commenting on problems with the load research, I noted how the load factors have changed dramatically and inexplicably over the years. In the 1994 case for example, the multi-family load factor was 54%. I then jump all the way to the 2013 RDI case where the load factor fell all the way down to 30.67%. My work in the 2013 RDI case demonstrated many problems with the sampling and large holes in the data. More recently ComEd's allocation ratios for apartment buildings (the multi-family non-space heat class) have dramatically changed with no clear explanation of what happened. The AMI data used in Docket 14-0384 contained a load factor of 40.22% for the multi-family non-space heating class, suggesting that ComEd has historically overestimated the costs for a group that tends to be vulnerable and is very important to the City – apartment dwellers without space heat. Sources for the table, documented in my work papers, show how I have computed the pro-forma load factors for non-residential groups using data from the low-use case.

Q. Explain how you have computed the effects of AMI data on different groups in Table 8

A. The right-hand side of Table 8 shows that if AMI data from Docket 14-0384 were used instead of ComEd's 2013 RDI case load research, rates for commercial groups would increase, while lower residential class rates would reflect the better load factor. The entire residential non-space heating group has also experienced odd and unexplained swings in load factors. In Docket 14-0384 the load factor for the entire non-space heat residential segment was 34.79%. This contrasts to the load factor of 29.9% for the residential class in the 2013 RDI case. In this case the load factor has returned back down to 28.7%. This difference in load factor implies a reduction in non-space heat residential rates of 9.91% for the low use case as compared to the 2013 RDI case. A comparison of the aggregate load factor is shown below:

TABLE 8 - DISTINCTIVE LOW-USE CONSUMER COSTS

	2013 RDI Load Factor	Current Case Load Factor	Low Use Case Load Factor	2013 RDI Allocator	Current Case Allocator	Low Use Case Allocator	2017 versus 2013 RDI	Low Use versus 2017 RDI	Low Use Versus 2013 RDI
Single Family w/o Space Heat	29.92%	28.68%	34.14%	36.89%	37.88%	34.49%	4.02%	-8.95%	-5.29%
Multi Family w/o Space Heat	30.67%	35.63%	40.19%	7.78%	6.71%	6.45%	-14.19%	-3.89%	-17.53%
Total Non Residential Space Hea	30.05%	29.72%	35.77%	44.68%	44.59%	40.17%	0.79%	-9.91%	-9.19%
Single Fam w/ Space Heat	72.88%	78.07%	87.59%	0.56%	0.49%	0.47%	-6.93%	-3.38%	-10.07%
Multi Fami w/ Space Heat	78.75%	76.09%	93.30%	1.09%	1.10%	0.97%	3.18%	-11.59%	-8.78%
Total Residential Space Heat	76.77%	76.70%	89.18%	1.65%	1.59%	1.48%	-0.21%	-6.76%	-6.96%
Watt-Hour	42.45%	51.84%	51.84%	0.58%	0.41%	0.44%	-18.36%	8.41%	-11.50%
Small Load 0-100 kw	46.03%	45.09%	45.09%	13.40%	13.91%	15.08%	1.79%	8.41%	10.35%
Medium Load 101-400 kw	51.32%	50.79%	50.79%	10.94%	10.90%	11.82%	0.73%	8.41%	9.20%
Large Load 401-1000 kw	55.28%	54.40%	54.40%	9.39%	9.31%	10.09%	1.30%	8.41%	9.82%
Very Large Load Over 1,000-10,0(	62.21%	61.58%	61.58%	15.68%	15.68%	17.00%	0.72%	8.41%	9.19%
Extra Large Load Over 10,000 kW	70.95%	68.09%	68.09%	2.96%	2.94%	3.18%	3.87%	8.41%	12.61%
High Voltage Up to 10,000 kW	457.26%	523.09%	523.09%	0.06%	0.06%	0.07%	-12.85%	8.41%	-5.52%
High Voltage Over 10,000 kW	1389.56%	2724.11%	2724.11%	0.20%	0.10%	0.11%	-49.15%	8.41%	-44.87%
Total Commercial	60.29%	59.53%	59.53%	53.18%	53.30%	57.78%	0.97%	8.41%	9.46%
Fixt. Incl. Ltg	3275.28%	3901.44%	3901.44%	0.00%	0.00%	0.00%	-16.31%	8.41%	-9.27%
Non Alley Dusk to Dawn	3272.99%	3893.23%	3893.23%	0.01%	0.01%	0.01%	-16.19%	8.41%	-9.14%
Alley Dusk to Dawn		3893.23%		0.00%	0.00%	0.00%			
General Lighting inc. Traffic Sign	92.07%	92.53%	92.53%	0.04%	0.05%	0.05%	-0.80%	8.41%	7.55%
Railroad	66.71%	58.60%	58.60%	0.45%	0.46%	0.50%	13.50%	8.41%	23.05%
Total Government	145.88%	141.23%	141.23%	0.50%	0.52%	0.56%	2.98%	8.41%	11.63%

Q. What is your recommendation with respect to load research, load factors and peak demand for the residential class?

A. When you look at TABLE 8 carefully, the problems of ComEd sampling and load research become clear. For classes where peak loads are not derived from load research, the difference between this case and the 2013 case is very small. Look at the left-hand columns of the table for the commercial classes, other than for the watthour class. Then look at classes where the load factor comes from load research – residential classes and the watthour class. For these classes, the changes are dramatic. ComEd has presented no evidence showing that there is much more volatility in residential and watthour usage, but that is not logical, and it is not explained. Given the problems with ComEd's load research, I recommend using load research and the associated load factors that were computed in Docket 14-0384, which lowers residential rates to reflect a reliable measure of load factor, though it implies an increase in non-residential rates .

A lot of new data is available from the hundreds of millions of dollars ComEd has spent on AMI meters. But the rest of us – that is other than ComEd – are left wondering whether ComEd has made the best use of the data made available from all of that money being spent. Even with precise data available from residential AMI meters, ComEd has continued to use sampling instead of comprehensive data (ComEd DRR City 1.05). It is incredible that ComEd would see fit to make such an effort in moving to the NCP method, but not mention one word about load research which is such a central issue in cost of service analysis.

3. Consistent With Past Practice, The Cost Of AMI Metering Equipment That Is Above The Cost Of Conventional Meters Must Not Be Included In Customer Charges

Q. What should be the rate treatment of expenditures the company has made for AMI meters?

A. ComEd states that the costs of AMI meters will be included in a meter rental charge that is essentially a fixed customer charge. The company has made large expenditures for meters that do a lot more than simply record the amount of energy that a consumer uses. I understand that the reason for the additional expenditures on meters has to do with incorporating functionalities like measuring demand and time of usage, to enable technical or rate mechanisms that assist controlling peak usage of electricity or incorporating distributed generation or demand side measures, and responding to generation outages. Each of these functions is related to reduction of capacity and energy costs. The additional cost of AMI meters has nothing to do with the basic function of sending a bill out to a ratepayer. Any cost of the AMI meters above and beyond the cost of a standard meter that can be used for billing must not be included in any customer charge. Instead, the manner of charging ratepayers must be consistent with the purposes of and benefits that are derived from the expenditures. The cost over and above the cost of a basic meter must therefore be treated as a capacity charge. For residential and watthour classes, the added cost must be an energy charge. For commercial ratepayers any added cost of AMI meters should be included in the demand charge.

Q. Is treating the added cost of AMI meters as demand costs consistent with prior Commission policy?

A. It is precisely consistent with Commission policy. ComEd has been ordered to treat some of its costs related to demand management that way. Before the 2008 rate design case, ComEd included demand management program costs as a customer charge. The Commission ordered ComEd to change this practice, recognizing that benefits of DSM expenditures are related to reductions in capacity and energy. In its order in the 2008 case, the Commission stated:

> The City informs us that ComEd also includes in this category of costs the following: technical services for ratepayers, City of Chicago College training, Exelon environmental strategy costs and Nature First costs. The City of Chicago College training provides a workforce equipped to operate distribution lines. City Ex. 1.0 (2nd Rev.) at 78. It is difficult to understand how this training cost varies based on the number of customers. City witness Bodmer provided a thorough analysis for why these costs should not be recovered based on the number of customers and why usage based rates are more appropriate. Accordingly, for this area of costs, the Commission adopts the City's proposal to recover these costs based on usage. (ICC Dkt. 08-0532, Order, p 77)

There is no difference at all between the demand-related function of demand side management program costs and the demand-related functionalities (and costs) of AMI meters, over and above the cost of a basic meter. Both DSM expenditures and new AMI function costs are rightfully classified as capacity costs because they are made with the objective of reducing capacity costs. The incremental cost of special functionality incorporated in AMI meters, e.g., demand metering and time metering, should be allocated on the basis of demand.