

**Responses to interrogatories on**  
**Dr. C.K. Woo's expert report on Hydro One**  
**Distribution's density-based rates**

Prepared for the School Energy Coalition (SEC)

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## **Hydro One Networks Inc.**

1. How is an Urban/Rural split based on Municipal Boundaries as recommended by Dr. Woo more cost reflective than Hydro One's current density definition?

### **Response**

Whether an urban/rural split is more cost reflective than a density-based split is an empirical issue that depends on the rate design choice. Adopting an urban/rural rate design requires a cost allocation that reflects an urban/rural split of customers. The resulting cost allocation can then be used to set the urban/rural rates, which in turn establish their respective revenue-cost ratios. If the urban/rural ratios are closer to unity than the density-based ratios, the urban/rural split is more cost reflective than the density-based split.

2. How would Dr. Woo define Urban for purposes of defining an Urban class?

**Response**

Based on Table 1 of my expert report (p.6), a starting point for defining an urban class may be customers located in incorporated cities, towns and villages with population over 2,000. Altering the population threshold will yield a different urban class definition. One may also consider the urban area definition used by Statistics Canada.<sup>1</sup> Varying the urban area definition will yield alternative urban/rural cost allocations and rates. An assessment of these alternative rates' performance (e.g., fair cost apportionment and customer bill impacts) will then help determine the final urban class definition.

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<sup>1</sup> "Area with a population of at least 1,000 and no fewer than 400 persons per square kilometre"  
(Source: <http://www12.statcan.gc.ca/census-recensement/2006/ref/dict/geo049-eng.cfm>)

3.

- a) Is Dr. Woo aware that in Ontario customers in the same municipality can be served either by Hydro One or another LDC?

**Response**

No.

- b) Given the question above, does Dr. Woo have any evidence to support the contention that customers can better understand municipal boundaries than Hydro One Residential customer classification, as stated at the bottom of page 7 of his report?

**Response**

I do not have empirical evidence (e.g., customer surveys) to support that customers can better understand municipal boundaries than Hydro One Residential customer classification. However, it is my belief that a customer can better understand a location definition based on the customer's service address than HOD's density criteria of 60 customers per km and a minimum critical mass of 3,000 contiguous customers. Moreover, an urban/rural definition is more stable for rate classification of a customer than a density-based definition because the customer's rate classification under an urban/rural definition is less likely affected by demand growth

and housing development than under a density-based definition.

4.

- a) Is Dr. Woo suggesting that customers within a municipal boundary should pay the same rates?

**Response**

If an urban/rural rate design is adopted for HOD, urban customers served by HOD would pay the same urban rates charged by HOD.

- b) Given the question above, is Dr. Woo suggesting that Hydro One rates should be the same as the other LDC rate serving that municipality regardless of differences in OEB approved Revenue Requirement?

**Response**

No. As stated in my response above, only urban customers served by HOD would pay the same urban rates charged by HOD. I have not done an analysis with respect to the rates for customers served by other LDCs.

5.

- a) Why is it appropriate to use other LDC's OM&A costs, as suggested by Dr. Woo, to allocate Hydro One's own OM&A costs between its Urban and Rural customers?

**Response**

If HOD has its own OM&A cost data by location for developing HOD's urban/rural cost allocation, it is unnecessary to use the benchmarking study of Lowry, Getachew and Fenrick (2008). But if HOD does not have such cost data, it is reasonable to use Lowry, Getachew and Fenrick (2008) as a practical alternative for estimating HOD's urban/rural allocation under the assumption that the regression model is a reasonable representation of HOD's OM&A expense data, as noted in p.16 of my expert report.

- b) Is Dr. Woo suggesting that as a matter of principle it is preferable to use generic cost based allocators rather than Hydro One specific allocators.

**Response**

No.

6. What level of effort and cost would Dr. Woo consider appropriate for Hydro

One to develop the cost information in a form that would be appropriate for implementing the methodology he is proposing?

**Response**

Assuming that HOD can provide the necessary data, an appropriate level of effort and cost would be a schedule of 2-4 months. If outside contract resources are required to do the work, an approximate budget would be C\$75K. But if HOD does not have the data, the project will likely take longer to complete at a higher cost. Without knowing HOD's data situation, I cannot provide any estimates of the time effort and cost that would be involved if the necessary data is not readily available.



## **Ontario Energy Board**

1. Would the process described on p. 15 be based on an analysis of Hydro One data alone? Alternatively, would the process be based on data from the larger number of distributors, including those that are clearly urban and perhaps others whose service area includes significant proportions of agricultural land, forestry, and undeveloped land?

### **Response**

The process would be based on an analysis of Hydro One data alone.

2. Is the process described in section 3.1 limited by its mathematical specification to two density zones, or could it be generalized to more than two zones (say, four zones as currently found in the Hydro One residential tariff)?

**Response**

The process could be generalized to more than two zones.

3. At p. 16 it is stated that Steps 1 – 3 split the data into urban and rural values.

OM&A costs do not appear to be included in any of those steps.

- i. If the data is for Hydro One only, does the completion of step 4 and step 5 require that Hydro One would divide its OM&A data into two parts, urban and rural, before applying the econometric model?

**Response**

Yes. Before applying the cost regression model, it is necessary to first develop the values for HOD of the regression's right-hand-side variables listed in Table 3 of my report (p.14). There will be two sets of values, one for HOD's urban customers and one for HOD's rural customers. The classification of urban/rural customers will follow the urban/rural definition based on the municipal boundaries assumed in Step 1. Step 4 will use the urban values and the regression's coefficient estimates to compute the natural log of OM&A cost for HOD's urban customers. Step 5 will use the rural values and the regression's coefficient estimates to compute the natural log of OM&A cost for HOD's rural customers.

- ii. If so, would the cost data divided in this way include administrative and general expenses or only costs that could be identified with particular operating zones within the organization?

**Response**

If data is available for the regression's right-hand-side variables for HOD's operating zones, one can use the same approach to develop a zonal allocation of HOD's OM&A costs. Since the regression is for OM&A costs, the approach applies to HOD's OM&A costs.

4. At p. 17, it appears that Step 7 may avoid the need to divide OM&A into urban and rural components, by estimating an Urban allocation  $R_U$  and a Rural allocation  $R_R$ . If step 7 avoids a division of operating cost accounts, please provide a more complete explanation of how this is accomplished.

**Response**

Step 4 of the process described in p.15 of my report estimates  $\ln Y_U$ , the natural log of total OM&A expenses for the urban area, by assigning the urban values to the right-hand-side variables of the model in Lowry, Getachew and Fenrick (2008, p.53, Table 3). An estimated level of urban OM&A expenses is  $Y_U = \exp(\ln Y_U)$ .

Step 5 repeats the estimation for  $\ln Y_R$ , the natural log of total OM&A expenses for the rural area, by assigning the rural values to the right-hand-side variables of the model in Lowry, Getachew and Fenrick (2008, p.53, Table 3). An estimated level of rural OM&A expenses is  $Y_R = \exp(\ln Y_R)$ . After obtaining  $Y_U$  and  $Y_R$ , Step 6 finds the urban/rural percent difference in OM&A costs:  $X = (Y_U / Y_R) - 1$ . Step 7 then uses this percent difference to allocate the total revenue requirement  $R$ , as described in p.17 of my report.

5. At p. 20, engineering analysis is identified as an alternative means of establishing a density-related cost differential, which could replace steps 4 – 6 in the process described in section 3.1.
- i. Please confirm that engineering analysis would not be limited to two density zones.

**Response**

Confirmed.

- ii. Does Dr. Woo have a recommendation on how many density categories could usefully be analyzed by this method in order to recommend a number and definition of density criteria?

**Response**

To the extent that rate simplification is a desirable goal, the number of density categories should not exceed the current level.

6. At p. 21, empirical comparison is identified as an alternative means of analyzing costs. Would the analysis in the referenced research paper<sup>2</sup> provide the basis for this comparison, or would new analysis of distributors other than Hydro One be necessary to make such a comparison?

**Response**

Since the referenced research paper is a recent benchmarking study, a new analysis is unnecessary.

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<sup>2</sup> Lowry, M.N., L Getachew and S. Fenrick “Benchmarking the Costs of Ontario Power Distributors”, Pacific Economics Group, 2008.

7. Further analysis based on sections 3.1 and 3.2:

- i. Does Dr. Woo recommend that analysis described in section 3.1 and/or section 3.2 be completed in the time frame of the present proceeding?

**Response**

Unless the necessary data is readily available, the analysis should be done for the next scheduled rate adjustment to ensure proper data collection and analysis.

- ii. Does Dr. Woo have an estimate of the amount of time it would take to complete such a cost allocation?

**Response**

Assuming that HOD can readily produce the necessary data, an appropriate level of effort and cost would be a schedule of 2-4 months. If external resources are required to perform the analysis, the analysis could have an approximate budget of C\$75K. If the necessary data is not readily available, the project will likely take longer to complete at a higher cost. Without knowing HOD's data situation, I cannot provide estimates for that scenario.



8. Would it be useful to augment the process described by Dr. Woo in section 3.1 to include an analysis of the bill impacts that might arise from implementing the results of such a study, and how would Dr. Woo recommend the study and results might be integrated or layered on the current harmonization plan (now in its second of four years)?

**Response**

Yes. It would be useful to augment the process in section 3.1 to include an analysis of the bill impacts that might arise from implementing the results of such a study.

Adopting an urban/rural rate design would reduce HOD's number of rate schedules.

Should the urban/rural cost difference be found to be negligible, the urban/rural rate differentiation would become unnecessary. This would further simplify HOD's rates.

## **PUBLIC INTEREST ADVOCACY CENTRE**

### **Question #1**

Reference: Pages 3, 4, 7 and 15

Preamble: Dr. C. K. Woo recommends that Hydro One Networks develop an urban/rural cost allocation and establish urban/rural rates if a sufficient cost difference is found. On page 15, Dr. Woo indicates that the urban/rural definition should be based on municipal boundaries.

a) In Ontario there are different types of municipalities as can be seen from the Ontario Ministry of Municipal Affairs and Housing's list of Ontario Municipalities (Source: <http://www.mah.gov.on.ca/Page1591.aspx> ). For purposes of establishing the urban/rural split what types of municipalities (e.g., cities, towns, townships, etc) should be considered as "urban" and why?

### **Response**

Based on Table 1 of my expert report (p.6), a starting point for defining an urban class may be customers located in incorporated cities, towns and villages with population over 2,000. Varying the urban class definition will lead to alternative urban/rural cost allocations and rates. The final choice of an appropriate definition will then be guided by an assessment of these alternative rates' performance (e.g., fair cost

apportionment and no disproportionately severe customer bill impacts). In short, the final definition choice should be based on rate design criteria such as Bonbright's.

b) Hydro One Networks serves a number of First Nation Communities from its grid-connected distribution system, which are typically not incorporated as "municipalities". Would Dr. Woo classify all of these communities as "rural"?

**Response**

Under an urban/rural definition of incorporated cities, towns and villages with population over 2,000, these communities might be classified as rural. As noted in my prior response, however, the final choice of an urban/rural definition and the adoption of urban/rural ratemaking should be determined based on rate design criteria such as Bonbright's. If replacing the existing density-based rates with a candidate set of urban/rural rates is found to cause disproportionately severe bill impacts on certain customer segments, revisions of those urban/rural rates should be explored. Without knowing HOD's urban/rural cost allocation, however, it is not possible at this time to determine the candidate urban/rural rates or their revisions.

## Question #2

Reference: Pages 4 and 9

Preamble: Dr. C. K. Woo recommends that Hydro One Networks develop an urban/rural cost allocation and establish urban/rural rates if a sufficient cost difference is found

a) Based on his experience, what is Dr. Woo's view as to the reasons why one would expect there to be "cost difference" between serving customers in urban versus rural areas (as defined by Dr. Woo)? Please list separately those reasons/factors that are likely to increase the cost of service in rural area and those that are likely to decrease the cost of service in rural areas relative to urban areas.

### **Response**

The factors include the following:

- An urban area tends to have higher cost of service than a rural area because of its more extensive use of underground lines and higher cost for facility sites.
- Urban areas tend to be provided with higher reliability than rural areas, which tend to increase costs.
- An urban area tends to have higher asset utilization, which despite higher absolute costs for the reasons discussed above, generally results in lower costs on a dollar per kWh basis for the urban areas.

- An urban area may have lower maintenance costs than a rural area because it is closer to the distribution company's service center.
- An urban area may have lower service restoration costs than a rural area because it may be less vulnerable to weather-related outages.
- An urban area may have lower service restoration costs because outages occur in closer proximity to utility crew locations.

b) Is it the fact that an area is incorporated as municipality that leads to a cost difference relative to other geographic areas or is the fact that "municipalities" generally have certain characteristics (such as being more densely populated) that are like to give rise to cost differences?

### **Response**

I concur that the urban/rural cost difference is due to the difference in electrical characteristics of the two areas (e.g., load density measured by kWh per customer, customer density measured by number of customers per line-km, and network configuration). However, customer density alone cannot fully explain the urban/rural cost difference, as noted in OEB's 01/29/2009 Staff Discussion Paper EB-2007-0031: *Rate Classification for Electricity Distribution Customers* (p.19): "Locational costs vary with other factors besides density ...".

c) If later, wouldn't a more direct approach to identifying areas with cost of service differences be to focus not on the urban/rural split but to directly distinguish areas based on the factors that give rise to such cost of service differences?

### **Response**

Whether density-based ratemaking is more appropriate than urban/rural ratemaking is an empirical issue that cannot be determined at this time for the following reasons:

- HOD has not provided a density-based cost allocation requested by the OEB, as indicated by HOD's response to SEC's Interrogatory #48 List 1: "Yes, Hydro One confirms that the study is not intended to be in full compliance with the Board's direction and further steps would be required."

- HOD has proposed to perform an urban/rural cost allocation study. HOD's Consultant states (ERA Report, p.4):

- "All things considered, it is my view that the most practical and cost effective approach is likely to be to use sample data to derive an estimate of the average cost (or cost differential) of serving urban and rural customers under the definitions that are approved for future use."
- "In the alternative, it may be appropriate to rely on engineering analysis to establish an appropriate rate differential between urban and rural

customers that isolates the density-related cost differential for urban and rural service."

Only after HOD's completion of the urban/rural cost allocation study, one can then meaningfully consider whether HOD's current density-based ratemaking should be replaced by urban/rural ratemaking.

Question #3

Reference: Pages 5-6

a) On page 5 Dr. Woo identifies three utilities with urban/rural rates. How does each of these utilities establish the rate differential between their urban and rural service areas?

**Response**

The sole purpose of Table 1 in my report (p.6) is to show that density-based ratemaking is not a common practice in Canada. As a result, I have not investigated how each of these utilities establishes the rate differential between their urban and rural service areas. That investigation, however, may be pursued, if HOD's proposed urban/rural allocation study shows a sufficiently large urban/rural cost difference that can justify urban/rural ratemaking.

b) If any of these utilities use their cost allocation methodology to establish this rate differential, how does their cost allocation methodology establish the cost of serving rural vs. urban areas?

**Response**

See above.



c) On page 6, it is noted that Maritime Electric and NB Power define “urban” as incorporated cities, towns and villages with population over 2,000. In each case, what was the rationale for selecting 2,000 as the cut off?

**Response**

The sole purpose of Table 1 in my report (p.6) is to show that density-based ratemaking is not a common practice in Canada. As a result, I have not investigated the rationale for selecting 2,000 as the cut off. That investigation, however, should be part of HOD’s analysis of alternative urban/rural allocations under different cut off assumptions.

Question #4

Reference: Page 7

a) Please provide any available evidence that would demonstrate that Hydro One Networks' customers have difficulty understanding its density based rate classification.

**Response**

I do not have empirical evidence (e.g., customer surveys) to support that customers can better understand municipal boundaries than Hydro One Residential customer classification. However, it is my belief that a customer can better understand a location definition based on the customer's service address than HOD's density criteria of 60 customers per km and a minimum critical mass of 3,000 contiguous customers. Moreover, an urban/rural definition is more stable for rate classification of a customer than a density-based definition because the customer's rate classification under an urban/rural definition is less likely affected by demand growth and housing development than under a density-based definition.

## Question #5

Reference: Pages 8 and 10

Preamble: As noted on page 10, one of the issues with Hydro One Networks' density-based rates was whether the current class definitions (in terms of number of and density of customers) provide the best demarcation of customer classes from a cost of service perspective. (See also ERB-2007-0681, SEC's Final Argument, paragraphs 7.7.24 to 7.7.26)

a) Why won't similar concerns arise with a definition of urban/rural based on municipal boundaries? For example, could issue be taken with the inclusion of very small municipalities and, alternatively with the basis for any arbitrary population cut-offs (such as used by Maritime Electric)? If not, why not?

## Response

If the urban/rural cost allocation is done for a single, arbitrarily chosen, urban class definition, similar concerns will arise. However, such concerns can be mitigated by an analysis that uses Table 1 of my expert report (p.6) as a starting point for defining an urban class (e.g., customers located in incorporated cities, towns and villages with population over 2,000). Varying the population threshold will yield different urban class definitions, leading to alternative urban/rural cost allocations, rates and revenue-cost ratios. An assessment of the alternative rates' performance (e.g., fair

cost apportionment and customer bill impacts) will then help determine the final urban class definition. For example, if the urban/rural rates based on a particular urban class definition are found to have disproportionately severe bill impacts on certain customer segments or unacceptable revenue-cost ratios, one may consider an alternative definition and its associated urban/rural cost allocation, rates and revenue-cost ratios. In short, the final choice of an urban class definition should be supported by its performance based on commonly accepted rate design criteria (e.g., reasonable cost reflection, fair cost apportionment, and no disproportionately severe customer bill impacts).

Question #6

Reference: Pages 13-15

Preamble: The Lowry, Getachew and Fenrick report states (page 54):

“Our research suggests that scale economies generally confer on the larger Ontario utilities a material unit cost advantage over smaller utilities. The potential of each company to realize scale economies should therefore be recognized in responsible benchmarking work.”

a) Assuming the “urban” area has higher volumes and customers than the rural area, the approach suggested on page 15 would incorporate the resulting cost reductions due to economies of scale into the OM&A expense differential. Is this an appropriate result and, if so, why?

**Response**

Economies scale is commonly found in electricity distribution, as shown in the cost studies referenced in Table 2 of my report (p.12). Thus, when determining an urban/rural cost allocation, it is reasonable to account for the potential OM&A expense differential that may be attributable to economies of scale.

b) In applying the model (per Step 4) would Dr. Woo include urban/rural differences for all the variables listed in Table 3? Please provide the rationale for including/excluding each variable.

**Response**

Table 3 in my report (p.14) is based on Lowry, M.N., L Getachew and S. Fenrick “Benchmarking the Costs of Ontario Power Distributors”, Pacific Economics Group, 2008, which contains the rationale for including/excluding each variable (pp.46-51).

My review of the study finds the rationale reasonable. In particular:

- A local distribution company’s (LDC’s) total OM&A cost should increase with the LDC’s total output, measured by the LDC’s total number of customers and total MWH volume.
- A LDC’s total OM&A cost should rise with the input price index that directly impacts the LDC’s total input cost.
- A LDC’s total OM&A cost should decline with the percent of distribution line underground because underground lines are less costly to maintain than overhead lines.
- Customer growth tends to reduce a LDC’s total OM&A cost because a fast growing LDC is likely to be more cost-efficient (e.g., using newer equipment that requires less maintenance) than a LDC with slow or no growth.

- A LDC with relatively more service area in a tough terrain (the Canadian Shield) tends to have higher cost than one with relatively less service area in the same terrain.

Question #7

Reference: Pages 18-19

Preamble: The Report suggests methods for allocating capital costs between urban and rural.

a) In the event that the same substation serves both urban and rural areas, how should the costs be allocated between urban and rural?

**Response**

My report (p.18) suggests that substation and transformer costs be allocated by installed capacity values by area. If the transformer banks can serve both urban and rural areas, the substation's installed capacity can be first allocated between the two areas by the total area-specific kW demands of the customers served by the substation. If the required kW demand data are unavailable, kW estimates can be made based on the available kWh data and load factor assumptions. Finally, if parts of the substation exclusively serve only the urban or rural area under both normal and emergency configurations, then the costs for those portions of the substation could be directly assigned, with the remainder allocated as discussed above.



b) In Dr. Woo's experience is the type of information required to undertake the "age-adjusted allocation" discussed on page 19 generally available? Is Dr. Woo aware of whether or not the information is available for Hydro One Networks?

**Response**

My experience indicates that a LDC's engineering data base typically contains a description of the installed facilities (e.g., substation, transformers, feeders, poles, and lines), which may include such information for each facility as location, size and year of installation. However, I do not know if HOD has a similar engineering data base.