Canadian Electricity Association

New Directions

Industry Response to Measurement Canada Consultation on Proposed New Directions in the Regulation of Electricity and Gas Measurement

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1. Summary

1.1 Closing the Loop

All across Canada the market place for electricity is changing. In some provinces change is driven by deregulation, in others provincial regulators are probing utility expenses and demanding that costs be reduced. And in all provinces, consumers are looking for better information about their consumption and more control over their electricity bills. At the national level, the Federal government has made international commitments and now looks to the electricity industry to reduce green house gas emissions.

Electricity metering alone cannot address these challenges but advanced solid state meters and improved transmission of consumption data are essential parts of the solution. If consumers are to respond appropriately, they need appropriate and timely information about their consumption. Consumers need to be able to observe the effect of changes they make on their bills. Advanced technology is needed to provide the information consumers require.

Another essential part of the solution is innovative electricity rates that provide the right incentives for consumers, rewarding appropriate changes in consumption pattern. With these elements in place, the loop will be closed. Advanced metering technology will provide the measurements and telemetering, advanced local display technology and the internet will provide the information consumers need to respond to price, demand and environmental signals. Consumers will be able to save money and help the electricity supply system and the environment, at the same time.

1.2 The Question at Hand

Driven by emerging market needs, metering and billing technology is advancing. New concepts are being introduced to electricity markets across Canada. And so the statutory requirements for electricity meters must also change.

The industry needs clear policy statements on the question of whether or not data transmission and bill calculation should be federally regulated. Lack of clarity on the scope of regulations will impede the introduction of new technology. Regulating the wrong things will add millions of dollars to the cost of electricity, with little or no benefit to consumers.

On May 23, Measurement Canada began to address some of these issues by posting a request for comment on proposed policy revisions.

The paper considers four major areas; some needing less regulation, others previously unregulated by Measurement Canada[1]:

a) the regulation of multi-rate register functions

b) the regulation of telemetering

c) requirements for the location of the display of measurement data and

d) the establishment and apportionment of legal units of measurement outside of an approved electricity and gas meter, including:

[1] Note that provincial market rules and fair trading requirements apply to computers, customer information and billing systems which are presently under strict utility control.

i) the use of interval metering functions when used as a multi-rate application and

ii) the use of load profile metering function when used to establish a quantity for time-related electricity demand

The Measurement Canada posting is available at:

http://strategis.ic.gc.ca/epic/internet/inmc-mc.nsf/vwGeneratedInterE/lm02960e.html

Measurement Canada is an independent operating agency of Industry Canada. It regulates electricity metering, drawing its authority from the Electricity and Gas Inspection Act[2]. The Act defines the scope and latitude afforded Measurement Canada in carrying out its responsibilities. The Act also defines obligations for the meter owner and the contractor who undertake the sale of electricity.

1.2.1 Meeting Environmental and Market Needs

The federal government would like to see the electricity industry make a strong contribution to the Kyoto Accord. Each province wishes to optimize its electricity system and maximize benefit for consumers. The utilities of Canada believe that both needs can be met through new incentive rates for consumers. New metering technology, capable of making the measurements and transporting the data required to meet these twin challenges, is needed today.

Measurement Canada has legislative, executive and judicial power over electricity metering, powers normally executed by separate branches of government. The structure and nature of the obligations placed on Measurement Canada results in a system that is sometimes challenged to keep up with rapidly changing environmental and market needs.

When new technology appears decisions need to be made such as the scope and application of the Act to the new product. New legal requirements and new performance criteria need to be specified. New testing methodology needs to be developed.

The CEA would suggest that cycle times could be shortened if industry and consumers played a real-time role in these activities. This could be achieved by use of the National Standards System which is another form of consultation that directly involves consumers and industry in the development of requirements.

Shortened cycle times would mean that technology, needed by the market places, would be available when it is required and could be delivered without loss of confidence in conformance to legal requirements or measurement accuracy.

In the consultation Measurement Canada asks for guidance regarding decisions it wishes to make regarding mandatory requirements for meters. The CEA would suggest that the development of such requirements would be best done through the National Standards System where the structured decision making process and balanced representation would ensure mandatory requirements meet market, environmental and legal requirements.

[2] Available at: http://laws.justice.gc.ca/en/E-4/text.html.

1.3 Industry Comment Summarized

This section summarizes the industry response to the proposals made by Measurement Canada. Detailed discussion is provided in section 3.

1.3.1 Terminology

Section 2 of the Measurement Canada paper provides definitions of the technical terms used. We remain unclear regarding some of the definitions:

a) Multi-rate register metering: We believe this definition would include interval metering which is widely deployed in time-of-use and real time pricing applications

b) Contractor: We believe this would include commercial generators who undertake sale of electricity, usually in deregulated markets

1.3.2 Multi-Rate Register Functions

In section 4 of its paper, Measurement Canada makes four policy proposals and asks two questions.

- Question 1: With minor qualifications, the CEA would support the four proposals because they formalize existing practice and will improve the clarity of notices of approval.
- Question 2: The CEA would not support regulation of switching mechanisms or the establishment of additional requirements since this may reduce the choice of technology that could be offered to consumers.

1.3.3 Regulation of Telemetering

In section 5 of its paper, Measurement Canada makes four policy proposals and asks two questions.

- Proposal 1: The CEA believes the present wording of the Act excludes devices and systems which acquire and transmit data measured and computed by the meter. Since the CEA believes such devices are already beyond the scope of the Act as presently worded there would seem to be limited need to re-word the Act.

  However, clear statements by Measurement Canada, would remove a long standing barrier to the implementation of automated meter reading systems which in turn reduces the number of estimated bills and improves consumer confidence in electricity metering.
- Proposal 2: Since they are not supplied with current and voltage, the CEA would suggest that telemetering devices cannot establish a legal unit or a time related demand, however if such a device were to come into existence we would support inclusion of the device within the scope of the Act.

The CEA believes that devices that measure current and voltage are included within the scope of the Act and that the Act excludes computation of energy from current and voltage since calculation is not measurement. We would recommend that certain portions of electricity meters, certain types of pulse recorders and all external telemetering, computers and billing systems need not be under strict metrological control. These transmission and computational processes are not a fundamental means of measurement.

However, the CEA would suggest, that as a practical matter, due to factors such as the lack of display showing current and voltage, certain portions of certain meters and pulse recorders may have to remain under metrological control even through this might exceed Measurement Canada's legal mandate.

- Proposal 3: The CEA would support the proposal that readings from telemetering devices should be considered a sound representation of consumption. This would maintain a status quo that has served the public well for many years.
- Proposal 4: The CEA would not support the proposal that on-board displays be made mandatory in the residential market. We believe specifying the location of the display may reduce consumer convenience and reduce access to information.

  The CEA would like to suggest that a policy statement to the effect that consumers must have access to consumption data would be sufficient: requirements specifying how this should be achieved would seem to go beyond the customary scope of regulatory authority.

  Further the CEA would suggest that the National Standards System be used to develop requirements for meters and displays.
- Question 2: The CEA would not support the proposal that Measurement Canada increase regulation of telemetering since these devices merely transmit information already established by a legal meter. If a bill were to be incorrect, the source meter would be the basis for resolution. Resolution of billing queries falls under provincial jurisdiction and is beyond the scope of the Act. Were the query to find the source meter to be the cause of an incorrect bill, Measurement Canada could be invited by one of the participants to resolve the meter dispute.

1.3.4 Display Registers

In section 6 of its paper, Measurement Canada makes two policy proposals.

- Proposal 1: The CEA does not support the proposal that on-board displays be made mandatory. We believe this requirement would reduce consumer access to information, reduce consumer convenience and would suggest that it could eventually become a barrier to trade.

  Again, the CEA would suggest a policy statement that consumers must have access to consumption data would be sufficient.

  And again the CEA would suggest use of the National Standards System to develop requirements and specifications for meters.

- Proposal 2: The CEA does not agree with the proposal that requirements for meters used in the commercial and industrial sectors be different. We would suggest that specifying the end-use at the time of type approval would prevent rapid response to unforeseeable market needs and limit consumer choice.
- Question 2: The CEA would not support distinguishing between trade sectors in establishing display, or any other meter requirements. We believe utilities need the maximum possible latitude to transfer technology from one market segment to another.

  The CEA does however recognize that the nature of the utility business relationship with industrial and commercial consumers is more complex than that with residential consumers. As a result the CEA would suggest utilities be allowed more scope to reprogram in-situ meters used to bill industrial and commercial customers. This can be accomplished using seals and without restricting the use of a meter to a particular customer type.

1.3.5 Calculations Outside the Meter

The CEA does not agree with several assumptions made in the title and introductory material of Section 7 of the Measurement Canada paper. See Section 3.4 below.

In Section 7 of its paper, Measurement Canada makes four policy proposals and asks three questions:

- Proposal 1: The CEA agrees with the proposal that devices which measure current and voltage should be approved by Measurement Canada. In some meters, those which can display only energy after calculating it from current and voltage, comparison the energy display to a reference meter is the only practical way to verify that measurement of current and voltage are accurate.

  The CEA would not agree that calculation of energy or demand from the product of current and voltage constitutes measurement and would suggest that any such post measurement processing is not a fundamental means of measurement. For the practical reasons outlined in the previous paragraph, strict metrological control up to the display of energy may be required for certain kinds of meters.

  The CEA would not agree that external computer systems establish legal units. Rather, we would suggest that the Act and Regulations[3] as currently written already limits the scope of application to devices that are a fundamental means of measurement leaving calculations outside the meter beyond the scope of the Act and under strict utility control.
- Proposal 2: The CEA does not agree with the proposal that external computers and billing systems be approved by Measurement Canada, sealed, verified and subsequently re-verified.

  As explained in Section 3.4 and Appendix 2, we do not believe that these devices carry out measurement functions nor do we believe them capable of establishing time related demand.

[3] http://laws.justice.gc.ca/en/E-4/SOR-86-131/text.html

Regulating these devices and placing them under strict metrological control would add in excess of $1.2 billion to the cost of electricity over the next 25 years while producing no additional benefit for consumers. See Appendix 4.

- Proposal 3: The CEA agrees with the proposal which adopts the status quo with respect to profiling methodologies presently used in Alberta and Ontario.
- Proposal 4: The CEA would not agree that a billing system is a meter and should therefore subject to strict metrological controls.

  We note that billing systems are part of provincial electricity markets which are regulated by provincial trading rules.

  For these, and additional reasons explained in Section 3.4.3, the CEA would not support the proposal that contractors be required to bring their "metering systems" into compliance with the Act.
- Question 2: The CEA would suggest that multi-rate, multi-register applications should not be placed under strict metrologically control whether within or outside of an approved device.
- Question 3: The CEA would not support modification of the Act or Regulations to include computer systems, inside or outside of the meter, in either the residential or industrial and commercial sector. We believe such computations are already excluded by the present wording of the Act.

2. Introduction

2.1 Preparation of CEA Paper

To facilitate preparation of a coordinated industry response to the Measurement Canada request for consultation, the CEA assembled the following task group:

Robert Heimann	Aquila Networks Canada
Norm Beaudoin	ATCO
Sid Mathur	ATCO
Brad Bishop	BC Hydro
Brent Hughes	BC Hydro
Gary Smith	ENMAX
Richard Caza	ENMAX
Roy Nesbitt	ENMAX
Kulwant Nanuan	EPCOR
Robert Henschel	Hamilton Hydro
Terry Court	Hamilton Hydro
Doug Currie	Hydro One
Victor Calvin	Hydro One
Owen Mahaffey	Hydro Ottawa
Serge Pettipas	Hydro-Québec
Guy Roy	Hydro-Québec
Jean Joly	Hydro-Québec
Rod Soviak	Manitoba Hydro
Darren Baxter	NB Power
Don Gallant	NB Power
Lorne Henderson	Newfoundland Power
Al Dube	Northwest Territories Power Corp
Lloyd Crookshanks	SaskPower
Bob Rossel	Toronto Hydro
Dave Wilson	Toronto Hydro
Peter Wong	Alberta ISO
Raymond Lee	Alberta ISO
Richard Zaworski	IMO
Clarence Batterink	Elster Metering
Jack Robertson	Elster Metering
Jeff Richardson	Elster Metering
Jean Pierre Leduc	General Electric
Bruce Orloff	Olameter
Scott Owen	SchlumbergerSema
Sheila Kee	SchlumbergerSema
Robert Foisy	Independent Consultant
Allen Stanbury	CEA

The task group held three conference calls and one face to face meeting during the development of this submission.

2.2 Electricity Industry in Canada

The electricity industry in Canada:

- Serves roughly 10.5 million residential consumers
- Serves 250,000 industrial and commercial consumers
- Generates and transmits over 580 TWh per year
- Sells $29 billion worth of electricity per year
- Represents 3% of the GDP
- Employs 275,000 people
- Has over 1750 computer systems producing more than 120 million electricity bills per year, totaling in excess of $50 billion in invoicing.

The nature of generation, transmission and distribution means the dollar value of bills computed by the industry each month is larger than the dollar volume sold to consumers. In Ontario for example, consumers buy $10 billion of electricity from utilities each year. The utilities buy that $10 billion worth of electricity from the power pool which pays the generators about $10 billion for electricity. Total value of invoices issued in Ontario each year: $30 billion.

Add to this international trading: Provincial power systems are interconnected to each other and to the United States. Transactions are settled on electricity meters regulated by Measurement Canada under rules established by international agreements and amount to many more millions per year.

International trading, transactions between utilities and sales to consumers are all computed based on data collected from meters approved by Measurement Canada, owned and maintained by utilities. Each meter is individually tested and sealed before it goes into service to confirm conformance to the approval. Meters are then placed into service by utilities and their performance is monitored by the utilities. At periods defined by Measurement Canada, the utilities sample a percentage of the meter population to confirm compliance with legal requirements. The sample size and test procedure are specified in detail by Measurement Canada and Measurement Canada audits the process of meter testing.

Sales to consumers are based on data collected by the utility from approved meters. Data collection can be done by hand written readings or on electronic media such as hand held readers, the telephone system and wireless or satellite communications.

Data collection can be automated in a central data collection system where readings are validated to ensure that the information:

- was not altered by the transmission process,
- that the source meter is operating normally and that
- consumption and other readings are reasonable

Even the smallest utility systems validate data. Some systems have as many as 50 different tests that can be applied in data validation, detection of meter and instrument transformer malfunction and tampering.

The billing system then computes a number of charges based on the rates assigned to the customer:

- For residential customers a declining block structure is common. Sometimes there is also minimum charge or separate charges for transportation of the energy.
- For industrial and commercial consumers there may be demand charges based on active power or 90% of apparent power. There are approximately 10 different types of demand charges in use. Industrial and commercial customers sometimes pay power factor penalties.
- For all customer classes there may be adjustments to account for concerns such as the meters being located in the incorrect side of the step down transformation or to recover costs for specific use of power system facilities. There will also be adjustments for date of meter reading, off cycle billing, estimated billing, special discounts, incentives and carryovers from the previous month.
- For generators there are payments for energy, voltage regulation, load following, spinning reserve, etc.

For typical consumer bills, see Appendix 3.

As a result a customer information and billing system is complex. Each installation is carefully verified to ensure that it works properly before being put into service. Software suppliers and utilities ensure that calculations remain accurate when upgrading to a newer version of the billing software.

All customer information and billing installations are managed systems with regular back ups, off-site storage of data, emergency restoration plans, and often off-site duplicate computer systems that can pick up the process when the main computer runs into trouble. All billing systems also have a trouble call system which notifies meter service staff when validation detects a malfunction on site or consumption figures are suspect.

Settlement time lines are short. In the Ontario wholesale market meter readings must be finalized within 6 days after the transaction. In other jurisdictions the elapsed time between meter reading and billing is as little as 48 hours. In all locations, using fixed billing cycles the computer systems must be up and running on the day that the billing is to be done, hence the need for rapid repairs or switching to an alternate system.

To meet these challenges the utilities of Canada have developed strict control systems for managing their bill calculation processes. In spite of the complexity involved, the utilities of Canada issue nearly 11 million invoices per month with a remarkably low error rate. And on the few occasions when invoices are found to be incorrect the root cause is almost never the meter, telemetering system or the computer system. Incorrect bills are almost always caused by the way data is input to the computer system such as errors in recording the customer account number etc. A frequent cause of billing queries is estimated consumption for interim billing.

The process from meter to bill is regulated by more than one jurisdiction. Measuring equipment is regulated by Measurement Canada. The provinces regulate utility rates and electricity markets. Consumers are protected by consumer protection legislation, common law and fair competition bureaus. While the regulations ensure equal opportunity and treatment for the consumer they do not relieve industry of any obligation to the consumer.

Utilities are, and always have been, fully accountable to the consumer for every aspect of fair and efficient delivery of electricity of which measurement is but one aspect. Accurate measurement is a responsibility of industry not the regulator who can only specify minimum requirements to ensure a level playing field for consumers. The CEA would suggest the time has come to recognize this accountability, empower industry and facilitate industry activities directed delivering on this accountability.

A central question for consumers is the jurisdictional boundary for each agency; what is its legitimate scope and latitude for action. The jurisdiction of Measurement Canada is defined by the *Electricity and Gas Inspection Act* and the *Weights and Measures Act*.

2.3 Legal Jurisdiction of Measurement Canada

2.3.1 Overview

Measurement Canada regulates two aspects of the sale of electricity:

a) the measurement of the electricity sold to a purchaser; and

b) the units of measure for the sale of electricity.

These are two distinct powers conferred on Measurement Canada. The first power allows Measurement Canada to ensure that the device/meter used to measure the quantity of electricity that will form the basis of the sale to the purchaser was measured in an accurate manner. The second power addresses the final sale of electricity to a purchaser, requiring that no matter how the electricity was processed, measured or otherwise dealt with prior to the sale, the purchaser can only be charged for a quantity of electricity in specific units of measurements.

In other words, with respect to a transaction for the sale of electricity, Measurement Canada's jurisdiction is limited to ensuring the accuracy of the apparatus used as a sensor to determine how much electricity is used and then ensuring the purchaser is charged for electricity in the approved units of measurement. The steps between measurement and charging the purchaser for the electricity do not fall within Measurement Canada's jurisdiction. For example, the transmission of a measurement from the measuring apparatus to another location (whether electronically or manually), the computation of billing charges, or the application of mathematical processes to the measurements taken by the apparatus, all fall outside Measurement Canada's jurisdiction. In many cases, such steps are regulated by provincial energy regulators. Importantly, the measurement accuracy portion of Measurement Canada's jurisdiction is not related to the concept of the "legal unit" of measure.

In the present context, Measurement Canada's jurisdiction is confined by statute to these two distinct areas and by the federal constitutional authority over weights and measures.

2.3.2 The Basics

For the most part, two federal statutes delineate Measurement Canada's authority: the *Weights and Measures Act* and the *Electricity and Gas Inspection Act*. The plain and ordinary meaning[4] of both statutes demonstrate that Measurement Canada lacks jurisdiction over any step between the physical measurement of electricity and the sale of the electricity in an approved unit of measure.

2.3.2.1 Approved Units for Use in Trade and Sale

The *Weights and Measures Act* provides that, "in trade", only the units of measurement set out in Schedule I and II to that act, or prescribed, may be used (s. 7). In situations other than "in trade", any unit of measurement may be used. The act defines "trade" as a number of forms of commercial transaction made on the basis of a measure (s.1). The statute does not address units of measure for a power utility's internal purposes. In practical terms, the unit of measure tendered to a purchaser on its account must use an approved unit of measure – nothing else.

Similarly, the *Electricity and Gas Inspection Act* requires that the unit of measure for the "sale" of electricity shall be those set out in the act (s. 3) or prescribed by regulations (s. 5 of SOR/86-131). This statute also does not address units of measure for a power utility's internal purposes – only for the actual sale to a purchaser.

2.3.2.2 Measurement

Under the *Weights and Measures Act*, the Minister has authority over "devices" for use in trade. A device is defined as,

> "any weight, weighing machine, static measure or measuring machine and includes any equipment and accessories attached to or used in conjunction with the device that have or can have an effect on the accuracy of the device".

As a result, Measurement Canada's jurisdiction under the act extends only to a "measuring machine" and equipment/accessories that affect accuracy of measurement.

Similarly, but using different terminology, the *Electricity and Gas Inspection Act* confers on Measurement Canada jurisdiction over meters. A meter is defined as,

> "an electric or gas meter and includes any apparatus used for the purpose of making measurements of, or obtaining the basis of a charge for, electricity or gas supplied to a purchaser"

Thus, only apparatus that takes measurements or obtains the basis of a charge can be regulated by Measurement Canada.

The device and meter form the foundation of Measurement Canada's jurisdiction over the apparatus used by power utilities. If a particular apparatus does not fall within the definition of a device or meter it cannot be regulated by Measurement Canada. The concept of a "legal unit" (often seen in Measurement Canada's informal material) has no application to Measurement Canada's authority over meters and devices.

[4] *Bell ExpressVu Limited Partnership v. Rex*, 2002 SCC 42 at paragraph 26 instructs that the plain and ordinary meaning of statutory language is the starting point for the analysis of a statute.

Common to both statutes is the concept of taking a measure. The *Oxford Canadian Dictionary* defines a measure as ascertaining "the extent or quantity of (a thing) by comparison with a fixed unit or with an object of known size". In other words, measuring involves the sensing of the extent or quantity of electricity. It involves physical sensing – not calculations based on sensory examination. This is consistent with the meaning of the phrase "obtaining the basis of a charge" in the definition of a meter in that refers to the lowest level assessment of the extent or quality of electricity.

As a result, in the electricity context, the "meter" or "device" regulated by Measurement Canada is only the sensory apparatus used to quantify electricity, with one caveat: A "device" regulated by Measurement Canada also includes any additional apparatus that impacts that accuracy of the measurement.

A traditional electricity meter (whether mechanical, electronic or otherwise) measures only two things: current and voltage. These are not calculated qualities. They are sensed by the meter. Energy is a calculated amount – not a measured quantity. For example, power described in watts of electricity is the product of current and voltage. Similarly, energy described in watt-hours is calculated from the product of current and voltage over time.

Thus, Measurement Canada's jurisdiction ends after the point where current and voltage are measured, unless the meter incorporates an additional element that affects the accuracy of the sensing of the current and voltage. In the case of electronic meters, none of the technology embedded in the meter impacts the accuracy of the measure. The additional technology merely applies mathematical processes to the measured qualities to calculate derived values. In contrast, certain traditional electro-mechanical meters incorporate technology that can affect the accuracy of the measurements of current and voltage, and properly fall within Measurement Canada's jurisdiction (metrological control).

Technology that does not fall within the definition of a meter or device is not subject to Measurement Canada's jurisdiction. As a result, the telecommunications portion of telemeter devices, computer billing systems, and in-the-meter calculation technology fall outside the scope of Measurement Canada's authority. These are all electronic technologies that do not impact the accurate sensing of current and voltage.

2.3.2.3 Parliamentary Intent

Specifically with respect the measurement of electricity, Parliament intended to regulate only the most fundamental measurement operation[5]. As much as possible was intended to be left industry and other regulators. A review of the Hansard[6] at the time of the enactment of the *Electricity and Gas Inspection Act* reveals that Parliament had in mind the following primary purposes for this legislation:

- **Modernization & Consolidation -** improve the existing legislation governing the accuracy of measuring electricity and gas, and recognize and reflect technological progress in the industry;

[5] Reference Re Firearms Act, *[2000] 1 S.C.R. 783 at 798, paragraph 20*

[6] See particularly the debate in the House of Commons on December 19, 1981 (second reading) and in the Senate on February 4 and 9, 1982 (second reading). Full cites

- **Privatization and Limited Interference -** increase the industry's responsibility for measurement accuracy, transfer some responsibility for meter inspection to the private sector, recognize the value of privatization, and recognise that the transfer of a portion of its meter inspection functions to the private sector will allow the federal government to cut expenses and enable the people in this branch of government to use their knowledge and training on more important features of the same general service; and
- **Accuracy -** continue to provide mechanisms to ensure the accuracy of measurement and the resolution, and where necessary the punishment, relating to any disputes with respect to measurement accuracy.

In light of Parliament's intent, the legislative scheme related to the measurement of electricity should be read together as limiting government's role with respect to meters, other than ensuring the accuracy of measurement (current and voltage).

2.3.3 Constitutional Considerations

Statutes and regulations, as well as administrative action are constitutionally limited. The *Constitution Act, 1867* divides all legal authority in Canada between the federal Parliament and the provincial legislatures[7].

Parliament's jurisdiction over weights and measures is set out in section 91(17) of the *Constitution Act 1867.* Provincial regulation of electricity generally falls under provincial jurisdiction over property and civil rights (s. 92(13)), municipal institutions (s. 92(8)), local works and undertakings (s. 92(10)), and electricity (s. 92A).

While legislation relating to weights and measures will inevitably impinge upon property and civil rights within the provinces, the legislation will only be valid so far as it interferences no more than is necessarily incidental to legislation which in pith and substance deals with weights and measures.[8]

The federal legislation, regulation and administrative action now being considered by Measurement Canada with respect to the telecommunications portion of telemeter devices, computer billing systems, and in-the-meter calculation technology would not relate – in pith and substance – to weights and measures. They do not relate to measurement, i.e. the sensing of the quantity or extent of electricity. Instead, the most important feature of the matters raised by Measurement Canada are consumer protection, commercial certainty and electricity regulation, all of which are matters of provincial jurisdiction[9].

[7] see Donald J.M. Brown, J.M. Evans, and Christine E. Deacon, *Judicial Review of Administrative Action in Canada* (Toronto, Ont.: Canvasback Pub., 1998) and *P.W. Hogg, Constitutional Law of Canada*, 4th ed. (Scarborough, Ont.: Carswell, 1997).

[8] See for example: *Regina v. Halpert et al.* (1984) 48 O.R. (2d) 249

[9] See *Global Securities Corp. v. British Columbia (Securities Commission)*, [2000] 1 S.C.R. 494 at 507, paragraph 22 for the meaning of "pith and substance".

2.3.4 Legal Conclusion

Measurement Canada has an important role in regulating the units in which electricity is sold to purchasers (that is, the amounts that appear on a purchaser's bill) and the measurement of the basic quantity and extent of the electricity (current and voltage) – but not all the steps in between. The legislative scheme under which Measurement Canada operates does not authorize the change in regulation it is contemplating with respect to the calculation of energy and power, nor would such regulation fall within Parliament's constitutional jurisdiction over weights and measures.

2.4 Meeting Market Needs

2.4.1 Expanded Role for National Standards System

With respect to electricity meters, Measurement Canada plays all three of the legislative, executive and judicial roles normally played by separate government agencies. In some instances, Measurement Canada may occasionally tend to set its own agenda based upon current objectives and its interpretation of its obligations under the Act.

Many of the proposals in the present consultation are intended to meet market needs. We would like to suggest that many of the proposals, such as the requirements for display registers proposed in Section 6, should be established by adoption of national standards under a structured process administered by an accredited standards development organization.

The use of the National Standards System would provide a consensus based approach with balanced representation; consumers, manufacturers, utilities and regulators participate in a structured decision making process. We would suggest that the outcome would:

- more reliably meet market needs than independent decisions by any one of the participating parties
- help shorten the development-of-requirements cycle since it and it directly involves industry and consumers in decision making

The resulting requirements would be part of the National Standards System; they would be visible and available to all manufactures and vendors wishing to bring product into Canada. And these requirements could be made mandatory by referring to them in technical specifications.

2.4.2 Expanded Role for Industry

We believe that the needs of electricity consumers would be more efficiently and effectively met if the industry and consumers were more directly involved in services presently delivered by Measurement Canada, all the while operating transparently under the oversight of Measurement Canada who would ensure conformance to legal requirements.

The present consultation provides an example. Many of the proposals relate to establishment of requirements for type approval as discussed above. However meters must be evaluated to determine conformance with predefined requirements. Approval of type is one of many possible areas where industry and consumers could fit in.

Approval of type is a process that declares a meter or metering device legal for use in electricity trading. Measurement Canada presently carries out this work itself, deciding what the requirements are, writing the test specifications then testing meters to make sure that requirements are met. In determining the requirements, Measurement Canada is empowered by the Act to focus only on accuracy. Industry takes on the responsibility of examining performance issues such as susceptibility to harmonics, unbalance and transients, conformance to international communication standards, etc.

The CEA believes that industry should be empowered to play a larger role in determining requirements and testing of electricity meters. We believe electricity consumers and the environment would be better off if industry & consumers played real-time roles in structured decision making with regard to requirements, and testing. Measurement Canada's participation is essential since it would carry the dual responsibilities of ensuring that polices and technical specifications comply with the legal requirements and of seeing that approved policies and specifications are adhered to.

2.4.3 Due Process

Such change is feasible. The Act provides extensive scope for Measurement Canada to empower industry, consumers and the National Standards System. We would suggest that such empowerment was the intention of parliament when the Act was last revised.

The CEA is pleased to participate in the current consultation. Many of the proposals are consistent with the intention and should be implemented as soon as reasonably possible.

We would like to suggest, however, that current regulatory policy be applied before implementation of any proposals made with respect to calculations outside the meter. When introducing new regulations, the Privy Council[10] requires that Measurement Canada work in partnership with industry and consumers and that:

- Canadians have an opportunity to participate in developing or modifying regulations and regulatory programs;
- The regulator demonstrate that a problem or risk exists, federal government intervention is justified and that regulation is the best alternative;
- Financial analysis demonstrate that the benefits outweigh the costs to Canadians, their governments and businesses.
- Adverse impacts on the capacity of the economy to generate wealth and employment are minimized and no unnecessary regulatory burden is imposed. In particular, regulatory authorities must ensure that:
  - ✧ information and administrative requirements are limited to what is absolutely necessary and that they impose the least possible cost;
  - ✧ parties proposing equivalent means to conform with regulatory requirements are given positive consideration.

[10] *Government Of Canada Regulatory Policy*, November 1999, Privy Council Office ,Government of Canada

3. Industry Comment in Detail

In this section the CEA responds to the questions of sections 4 through 7 of the consultation paper.

3.1 Multi-Rate Register Metering

In this section responds in detail to proposals and questions of section 4 through 7 of the consultation paper.

3.1.1 Response to Section 4.2.4 Question (1)

Do you generally agree with MC's proposed policy or would you agree in principle subject to additional modifications (indicate what modifications you would deem necessary)? (If no, please proceed to question 2)

3.1.1.1 Proposal 1

Measurement Canada will continue to approve and verify the performance and accuracy of multiple registers in an approved meter

The CEA would not agree with the proposal to approve and verify the accuracy of multiple registers during type approval. We believe this is beyond the intention of the Act since the registers do not measure. However, as a practical matter, for meters with no other means of determining the accuracy of current and voltage measurement, verification at the time of type approval may be unavoidable.

3.1.1.2 Proposal 2

Measurement Canada will not evaluate or approve the accuracy of the conditions that cause the meter to switch registers. If any switching condition can cause an error in the establishment of a legal unit then the switching condition will be approved and verified by Measurement Canada.

The CEA supports the proposal that Measurement Canada neither evaluate nor approve the accuracy of conditions that cause the meter to switch registers.

We have several reasons:

- If Measurement Canada were to carry out such evaluations it would greatly increase the cost of type approval since Measurement Canada would have to purchase new equipment and require significant injections of new capital. We believe test results and design details provided by the manufacturer should be sufficient for the type approval process.

- Inaccuracy in switching may not be possible from a design point of view. An example would be a meter that determines time by counting cycles of the power system. As long as the counter is working properly, and the line voltage is not interrupted, the time cannot deviate from true clock time by more than the very strictly controlled limits placed on the power system time by international trading rules. All interconnected utilities must conform to these requirements. The presence of the interconnection guarantees synchronism with the North American reference time.

  And in equipment where it can occur, inaccuracy in the time switching criteria is a second order effect with much less impact on the bill than the primary measurement. Appendix 1 shows that 5 minute[11] clock time error in a two rate time-of-use meter would cause the bill to be in the order of 0.14% low if the meter were installed in a typical provincial electricity market. The resulting error is much smaller than the 3% maximum error permitted for basic measurement.

- The CEA observes that, aside from temperature sensors used in Québec, the switching criteria have not been regulated by Measurement Canada before and during the many years that multi-rate meters have been in service across Canada, no significant problems have been identified by the public or industry.

- The proposal is consistent with the intentions of the Act.

The CEA would agree that the additional requirements for verification, where the switching criteria would affect measurement accuracy of current and voltage, and for certain meters the energy displayed, are reasonable.

3.1.1.3 Proposal 3

The notice of approval will clearly state that the rate switching function is not subject to Measurement Canada specifications and indicate any limitations on application of the meter.

The CEA supports clear statement of what has, and what has not been, verified by Measurement Canada during type approval.

3.1.1.4 Proposal 4

Security sealing of the metrological functions and parameters of an approved and verified meter shall not be compromised by the switching conditions, programming modifications meter or change of the TOU schedule.

The CEA supports the proposal for security of metrological functions. We understand these metrological factors to be those which determine the accuracy of current and voltage measurement.

[11] A five minute error is large by industry standards. Most utilities use automated processes to maintain clocks within ±1 minute.

3.1.2 Response to Section 4.2.4 Question (2)

Should MC regulate switching mechanisms and establish additional requirements for approval and verification in this regard? If yes, what legal metrology requirements or principles would you identify in support of this position?

The CEA does not support regulation of switching mechanisms, for the reasons discussed above in Section 3.1.1. We believe the proposal exceeds the intentions of the Act.

3.2 Regulation of Telemetering

In this section the CEA responds to the proposals and questions of section 5 of the Measurement Canada consultation paper.

3.2.1 Response to Section 5.3.5 Question (1)

Do you agree with MC's proposed policy on telemetering or would you agree in principle with some modifications (indicate what modifications you would like to see)? (If no, please proceed to question 2)

3.2.1.1 Proposal 1

For telemetering devices which are used by the contractor as a means to acquire and transmit measurement data that is already established by the source meter, MC will pursue an exemption from the provisions of the Act.

The CEA believes that the present wording of the Act excludes telemetering devices since they are not a fundamental means of measurement.

Since the CEA believes such devices are already beyond the scope of the Act as presently worded there would seem to be limited need to re-word the Act. We would suggest that the current regulatory requirements be withdrawn as soon as reasonable possible. It is our, possibly incorrect, impression that unclear requirements may have had a negative impact on the adoption of telemetering systems in the past.

3.2.1.2 Proposal 2

The exemption from the provisions of the Act will not apply to internal or external telemetering devices which are also used as the fundamental means for establishing the time-related demand for the sale of electricity.

Since it is not supplied with current and voltage, the CEA would suggest that a telemetering device cannot establish a legal unit or a time related demand, however if such a device came into existence we would support inclusion of the device within the scope of the Act.

3.2.1.3 Proposal 3

In principle, the meter readings provided by telemetering devices will be considered by MC as a sound representation of consumption for the purposes of billing.

The CEA would support the proposal that the readings provided by the telemetering devices are sound representation of consumption.

While we agree that the contractor has an obligation to ensure that data is not altered by the telemetering system, we do not agree that such an obligation arises from the Act. The Act refers only to the provision of less energy than purported but provision of more energy than purported is a concern for distributors and retailers who cannot recover the cost of this energy in sales to their customers. We believe the obligation arises from the customary obligation undertaken by any organization selling a product.

Industry is well aware of its obligation and has taken steps to ensure data transmission is reliable. Many commercial telemetering systems have automated processes in place for detecting alteration in the data during transmission. This includes cyclic redundancy checking of digital transmission, and comparison of energy computed from dial readings to energy computed from pulses for the same period. Some commercial products automate this process comparing energy-from-dial-readings to energy-from-pulse-count during every communication with the meter. In one Canadian market, two meters can operate in parallel. Comparison of the energy reported by each meter after separate interrogations provides monitoring of data transmission.

The CEA would not support insertion of such obligations into the Act since these obligations are well managed by utilities and are already regulated by the provinces. Alberta for example, fines the contractor $75 for every occurrence of an incorrect bill. The underlying cause for such error is rarely the metering or telemetering. The usual causes are estimating interim consumption, transcription errors on manually collected data, application of an incorrect rate, reading the meter on an incorrect date and billing the wrong customer.

We note that telemetering has not previously been regulated by Measurement Canada and that no large scale or widespread problem has been reported by the public or industry in the many years that telemetering systems have been in service.

The CEA would suggest that telemetering is outside the scope intended by the Act since it is not a fundamental means of measurement.

3.2.1.4 Proposal 4

In the residential electricity sector, MC will also require that the source meter incorporate an on-board mechanical or electronic storage and display register for the legal units of measurement established by the meter.

The CEA would not support the proposal to require the source meter to incorporate an on-board display.

We agree that some consumers will need measurement readings available to them without additional tools. For these consumers the traditional meter may be sufficient but we suggest that requiring a display on the meter would unnecessarily restrict customer choice, even for these customers:

- The proposed specification would require that meters remain forever mounted outside the residence, near the front door, when future technology might allow display at a more convenient location inside the house. Future displays might even be portable allowing the consumers to move the display within the dwelling as they please.
- The proposed specification would mandate continued expense for specialized and costly metering rooms in apartment buildings when displays in each apartment would be more convenient for the consumer.
- We believe future technology will allow displayless meters to be installed in the distribution or pad mount transformer. Portable remote display could be provided via wireless, PLC connection or some technology not yet contemplated.
- Installing residential meters at the distribution transformer would reduce the opportunity for theft of power and contribute to lower electricity costs for the honest consumer.
- The proposed requirement could prevent use of an in-home computer to collect meter data via the internet or over direct local connection to the meter since provision of both on-board display and internet connection may be too costly for the residential market where meters can cost as little as $35.
- In addition to being connected to the meter, home computers could also connect to equipment and appliances in the home, reducing demand when called upon or when price is high. Automated homes will be offered lower rates. The owners of these homes will be technically savvy and would already have computers or could justify purchasing one based on expected savings. The expense of mandatory on-board displays would be wasted on these consumers.

Our conclusion is that while a few customers may need access without additional equipment and their needs are easily met with existing technology, every consumer will not. Making on-board display mandatory would drive up costs for all consumers, even those who do not need displays and especially for those wanting to take advantage of special rates that will benefit the environment, reduce the demand for electricity supply and reduce the cost electricity.

The CEA would suggest a policy statement that the consumer must have access to the consumption data would be sufficient. To go beyond that to state how the requirement shall be met would appear to be in restraint of trade and to exceed the customary bounds of regulatory authority.

The CEA would like to suggest that consensus based processes administered by the National Standards System be used to develop requirements for meters and metering equipment. This would ensure direct input by consumers into the development of requirements process. See section 2.4.1.

3.2.2 Response to Section 5.3.5 Question (2)

Do you support the position that MC needs to maintain or increase the regulation of telemetering devices? If yes, what legal metrology requirements or principles would you identify in support of this position?

The CEA does not support the position that MC needs to maintain or increase the regulation of telemetering devices. The rational is provided in section 3.2.

3.3 Display Registers

In this section the CEA responds to questions posed in section 6.2.4 of the Measurement Canada consultation paper.

3.3.1 Response to 6.2.4 Question (1)

Do you agree with MC's proposed policy on the regulation of display registers or would you agree in principle with some modifications (indicate what modifications you would like to see)? If no, what requirements or principles would you like MC to establish?

3.3.1.1 Proposal 1

In the residential electricity and gas trade sectors, MC will require that meters used by contractors in this market incorporate an on-board display register capable of providing consumers with meter consumption data.

The CEA does not agree with the proposal that Measurement Canada require on-board displays for residential meters. As discussed in the previous section 3.2 such mandatory requirements would actually reduce future consumer access to information by ensuring the meter display remains outside home or apartment. It might also be in restraint of trade.

At the risk of repetition, we would suggest a requirement that the consumer must have access to the consumption data would be sufficient. This would treat all technologies equally.

It should be noted that a central focus of the European "Measuring Instruments Directive"(MID) is the development of performance based specifications for electricity meters: specifying essential performance criteria which must be met without stating how the performance is to be achieved. "The MID will be a 'new approach' directive, aimed at providing a level playing field for all measuring instruments subject to legal metrological control"[12].

We would suggest that the term "meter consumption data" be defined and limited in scope to replication of data currently available on electromechanical meters. This is consistent with past practice of not requiring meters to display interval data and which has created no widespread problems for consumers.

The high cost of mandatory on-board display of interval data may prevent use of interval meters in residential applications, unreasonably restricting provincial scope for optimization of their electricity markets and energy supply systems while depriving consumers of viable options for reducing their electricity costs.

[12] Roger Ford, "Barriers to Trade Crumble – The European Measuring Instruments Directive", Metering International, 2001, Issue 1

3.3.1.2 Proposal 2

In the commercial & industrial electricity and gas trade sector, measuring systems (i.e., meters and ancillary devices) shall incorporate an approved device capable of indicating printing, or storing the measurement results.

MC will not require the source meters used in measuring systems at the commercial & industrial trade sector level to incorporate an on-board display register.

The CEA does not agree with the proposal that regulatory requirements for meters used in the residential and commercial and industrial sectors be different. Meters should merely be legal for electricity trade or not.

The CEA would agree that the two sectors have different needs and should be regulated in different ways. Major power consumers will require different utility procedures than consumers would. Under the Electricity Trade Sector Review, utilities will be able to reprogram meters in-situ as long as they were careful with the metrological quantities, the client was aware of and has agreed to changes being made on-site and transactions take place under a contract that include a clause stating how disputes will be resolved.

Under the current regulations similar arrangements are not possible for residential consumers, nor are they required by the market, at this time. Even through the environments are different the meters need not be different and a utility should be free to use the same meter in both applications; strict utility control being exercised to ensure the correct procedures are followed. Hence our suggestion that metering hardware should merely be legal or not. There should be no prescription of the market sector of subsequent application the time of type approval.

Specifying the end-use at the time of type approval will:

- ✧ prevent rapid response to unforeseen market needs. Interval meters, for example, were once thought of as meters for the industrial and commercial consumers. The emergence of hourly markets in Alberta and Ontario has unexpectedly caused consumers and small IPPs (Independent Power Producers) to request interval meters for residential and generator applications, needs that could not be foreseen at the time of type approval.
- ✧ create a number of other minor issues such as:
  - the need for the end-use to be marked on the meter (to prevent application in the wrong sector and simplify enforcement)
  - introduction of penalties and fines for nonconformance.

  These unnecessary side effects could be avoided by requiring only that the meter to be approved by Measurement Canada and leaving the market to decide where the meters should be applied.

The CEA would also suggest that making data storage, indicating or printing requirements mandatory would be in restraint of trade and unreasonably limit future technology that could benefit industrial and commercial consumers.

Finally, we would suggest that National Standards System be used to develop requirements for meters. See section 2.4.1.

3.3.2 Response to 6.2.4 Question (2)

Do you think MC should distinguish between the trade sector levels in establishing requirements for displays in the proposed manner?

The CEA would not support distinguishing between trade sectors in establishing display requirements. Rational is provided above in section 3.3.

3.4 Calculations Outside the Meter

In this section the CEA responds to the proposals and questions of section 7 of the consultation paper.

3.4.1 Initial Considerations

The introductory text in section 7 of the Measurement Canada paper makes a number of assumptions which we believe to be incorrect:

- ✧ The title of section 7 of the Measurement Canada paper presupposes that legal units can and are being determined outside electricity meters.
- ✧ The first paragraph of section 7 incorrectly states that personal and main frame computers have made it possible to establish legal units of measurement for the sale of electricity.

We do however agree with the sense conveyed in paragraph two of section 7 of the Measurement Canada paper which conveys the magnitude of the challenge faced by regulation of customer information and billing systems.

3.4.2 Rational

The CEA would suggest that there are many reasons why computers, customer information and billing systems should neither be regulated nor placed under strict metrological control. Our rational has legal and economic threads but the most permanent might be that customers will have less choice, pay more for electricity and receive billing service of inferior quality.

Utilities currently maintain their metering and billing systems under strict control systems and consumers are protected by consumer protection laws, common law, provincial regulations and the competition bureau. The CEA would suggest that additional regulations proposed would add little in the way of consumer protection and would not relieve the utility of its existing obligations to consumers.

3.4.2.1 About Meters

The first commercial AC wattmeter went into service in 1895. This was an electromechanical meter, essentially a motor driven by the current and voltage being measured that turned a shaft that drove a register which counted the revolutions and indicated the amount of energy consumed. This technology is still in wide spread use and the majority of residences in Canada are metered using the electromechanical technology.

An electromechanical meter measures current and voltage. It computes energy. The meter is in fact an analog computer: the current and voltage are multiplied through the interaction of magnetic fields together and the result in disk velocity. The mathematical operation of integration is carried out counting the disk revolutions in a mechanical register which turns indicating hands on the meter dials. The computational portion of these meters requires metrological control because the accuracy of the computation process can be affected by time, wear, ambient temperature, materials used in manufacture, etc.

As utilities developed more complex rate options for industrial and commercial consumers, metering technology advanced to measure not only energy but to measure “demand” as well. (Demand is explained in section 3.4.2.2)

While the early demand meters measured several different kinds of demand, the technology used to measure was electromechanical. Current and voltage would pass through a heater coils to warm up a bi-metallic strip that caused the indicating needle to deflect up scale. In another type, disk revolutions were counted in a fixed period of time, often 15 minutes, and stored in a separate mechanical register that recorded the maximum such count. The demand register drove an indicating needle upscale to indicate the maximum average demand since the last reading.

The analog computer built into these meters which calculated demand could be affected by time, wear, ambient temperature, material used in manufacture, etc. The demand calculation portion of these meters again requires metrological control.

Over the years the technology for determining demand has evolved from electromechanical to solid-state electronic. In the solid-state meter only energy is computed from current and voltage. Demand is then calculated from energy recorded over fixed time intervals, often 15 minutes. The interval meter, for example, usually stores the computed energy for consecutive 15 minute periods for an entire month. These are transmitted to a central billing computer for processing. If demand charges apply, the billing computer calculates average demand from the interval energy readings.

The calculation of demand is easily replicated. The demand calculations can be reproduced by hand or on a pocket calculator, even if the meter is unavailable. As long as the energy readings reported are accurate the subsequently demand charge will be unaffected by time, wear, ambient temperature, etc. In some solid-state meters both energy and demand are calculated through a digital process. In others energy is still computed using analogue techniques. The analogue portions of these meters would require strict metrological control but the digital portion would not.

Where should the boundary be? Few meters display current and voltage. The cost of such display is too high forcing Measurement Canada to rely on the display of computed energy when verifying the accuracy of current and voltage measurement. For practical purposes the CEA would suggest that strict metrological control should end at the beginning of the first digital calculation process within the meter or at the meter boundary.

Metrological control adds value to the electricity market because it promotes consumer confidence in the accuracy of their consumption measurements. Utilities take great care to ensure that their meters remain under strict control. Many exceed minimum legal requirements while striving to meet customer expectations for accuracy. The CEA would support application of strict metrological control to the appropriate portions of the metering and telemetering devices.

Time-of-use and interval meters are based on the same concepts and often the same technology. Time-of-use meters usually have 2, 3 or 4 registers to record energy consumed during certain hours of the day. An on-board clock switches the energy consumed in from one register to the next based on the time of day. An interval meter typically uses 96 registers to store the energy consumed in 15 minute increments each day. An on-board clock switches the energy consumption from one register to the next based on the time of day. The time switching mechanism and data storage technology is the same for both time-of-use and interval meters. The only real difference is the number of registers receiving energy readings.

3.4.2.2 About Electricity

Energy is the eventual product sold by the utility and retailer. What is physically delivered is current and voltage. Energy consumption must be computed from the product of current, voltage and time at the point of delivery. Energy represents the volume of electricity purchased or sold in the same way that the number of gallons would represent the volume of water purchased supplied by a municipality.

Utilities rarely earn all of their revenue through the sale of energy. Some customers require that energy be delivered at a faster rate than others. These customers require larger capacity delivery systems that cost more to construct and finance. If the product were water, such a customer would require a larger and more expensive delivery pipe and investment higher capacity wells to meet the demand. The electricity industry uses a “demand” charge, based on the rate of energy consumption, to recover the extra costs from those customers who require that energy be delivered at a higher rate. The result is a conservation signal for larger consumers. But there is an even more important benefit: general consumers are not charged for capital costs they did not impose on the electric power system.

Other charges such as power factor penalty are billed to industrial and commercial customers who consume energy in a way that causes inefficiency in the upstream delivery system. The consumption of reactive power increases energy loss in the delivery system forcing the utility to burn more fuel to deliver the same volume of energy. Again, rather than ask the general consumer to pay these costs, utilities charge a power factor penalty to customers that cause the inefficiency. Industrial and commercial consumers can avoid these extra costs by installing power factor correction equipment which also reduces that customer’s impact on the environment.

In the future we may see new charges for introducing harmonics into the power system or for unbalanced consumption on three phase systems. Both of these drive up delivery system losses in the same way consumption of reactive power does. These side effects also limit the ability of the system to deliver energy and require installation of special equipment to correct the problem.

Most residential customers are charged only for energy. Additional demand and power factor charges are common for most industrial and commercial customers. The application of specialized rates helps prevent cross subsidization between customer classes but more importantly special rates reduce the impact on the environment.

3.4.2.3 About Measurement

Neither the Act nor Regulations provide the equations or mathematical algorithms to be used in computing energy. Rather the Act and Regulations rely upon standards developed by the electrical engineering profession. The AIEE, predecessor to the present IEEE, standardized the mathematical definition of electrical energy as the watt-hour at the turn of the last century. A direct application of physical principles, it has never changed and remains defined as the time integral of the product of current and voltage. Energy has always been computed from current, voltage and time.

Neither the Act nor Regulations provide the equations to be used for measuring demand. The IEEE standardized the mathematical definition of four types of instantaneous demand in 1930. These included active, reactive, apparent and fictitious power. The utilities adopted the first three type of demand but since the technology to measure fictitious power did not exist, utilities have never billed on fictitious power which would recover costs for harmonic content. The units of the common billing units are kW, kVAR and kVA as required by the regulations. In 2002, the IEEE approved new definitions of instantaneous demand in the presence of harmonics and unbalance. As metering technology advances we may see utilities develop penalties for these side effects of energy consumption.

3.4.2.4 About Rate Calculations

All consumers pay for energy consumption. What is physically delivered is current and voltage and together they produce energy which does the useful things that cause consumers to buy electricity. In most provinces the energy charge depends only on the volume, measured in kWh, consumed. In deregulated provinces the energy price varies hourly.

In addition to energy, industrial and commercial customers pay demand charges. Utilities have developed as many as ten different kinds of demand charge[13], each providing a slightly different incentive to the industrial and commercial consumer. All computations result in units specified in the regulations. Meters that compute from demand directly from current and voltage, leaving out the intermediate energy step, follow the IEEE definitions for kW, kVA and kVAR which are defined in terms of current and voltage - not energy.

The remaining 6 types of demand are all calculated, from energy previously established by an approved meter operating under strict metrological control. These derived charges are based on the rate of energy consumption in the hour which is established by adding up the energy reported by the meter in each 5 or 15 minute period making up the hour.

What the utility calculates is the average rate of energy consumption during the hour in units of kWh/h. Since the hours in the unit can be cancelled off most utilities report the billing determinant as kW which by coincidence has that same unit as one of those named in section 5 on the Regulations however it was arrived at through an entirely different process. Appendix 2 illustrates how utilities carry out average demand calculations.

Since other technology did not exist at the time, section 5 of the Regulations must have contemplated computation of demand directly from current and voltage as in thermal demand meters. But the process used by utilities is based on energy only. Customer information and billing systems have no access to current or voltage and cannot compute demand in the manner contemplated by the Regulations and the IEEE.

[13] These include instantaneous, average, exponentially weighted, vector, arithmetic, coincident, non-coincident, block interval, rolling block and fixed block demand charges

None of the Act, Regulations or the IEEE standards define how average power is to be calculated. However, the engineering profession universally applies the standard mathematical definition for the average of a continuous function of time. This turns out to be the energy in the period divided by the duration of the period. Knowing the energy in an interval entirely determines the average demand in the interval and vice versa, without further measurement.

Since utilities prefer to bill on average demand, rather than one of the instantaneous demands defined by the IEEE, there is little sense in transmitting a rate of consumption quantity to the billing system when it can be calculated from metrologically controlled energy.

Demand calculations are easily replicated and always produce the same result unlike analog demand determined directly from current and voltage which is subject to aging etc.

3.4.2.5 Legal Considerations

While the CEA supports regulation and strict metrological control of measuring devices and equipment that use analog techniques to compute energy and demand directly from current and voltage[14], we would suggest that calculation is not measurement and that calculation is outside the scope of the Act and Regulations. The CEA would suggest that devices outside the meter that calculate billing determinants should remain under strict utility control and remain beyond the scope regulation. Here are some of our considerations:

- Clearly the Act and Regulations contemplate measurement. Evaluating the average value of a quantity already established by a legal meter cannot be construed to be measurement. Customer information and billing systems should remain under strict utility control.
- A computer has no access to current or voltage. It cannot therefore determine demand as in the manner contemplated by the Regulations or the IEEE standards, both of which require current and voltage for this purpose. By definition billing systems would be beyond the scope of the Act & Regulations.
- The billing computer receives a time stamped energy value from the meter. Since the meter establishes both the energy and the time interval, we would suggest that the meter has already determined the demand, even before data is transmitted to the billing system.
- The down stream billing system merely uses the energy values already established by the meter to compute average consumption values. The customer information and billing systems is therefore not the fundamental device used to establish the basis of a charge.

We would suggest that meters that use analogue computation to compute energy or demand from current and voltage should continue to be placed under metrological control.

3.4.2.6 Implications of Strict Metrological Control

Regulation would mean that customer information and billing computers would need to be approved, verified and sealed by Measurement Canada. Strict metrological control would mean the computer systems would have to be reverified periodically and especially after replacement of components such as a CPU, motherboard, hard disk, tape back up or software upgrade. We note that utilities already have sufficient controls in place and produce a very high standard of accuracy in bill computation.

[14] Skipping the intermediate energy step

Bill processing will become less reliable. The cost of approving and verifying two systems may discourage utilities from maintaining the duplicate systems they presently use to ensure uninterrupted bill processing. And extended down time for frequent reverification would create new and unpredictable delays in billing.

New policies and structures to deliver approval and verification services would need to be put into place. To regulate customer information and billing systems, Measurement Canada would need to:

- Define requirements for approval
- Define testing procedure
- Develop requirements for initial verification
- Define requirements for subsequent re-verification
- Define criteria triggering re-verification
- Develop requirements for sealing
- Define criteria for accreditation of billing system verifiers
- Develop a process and system to accredit verifiers for billing systems
- Carry out approval testing
- Carry out initial verification
- Seal computer installations
- Carry out regular surveillance audits of accredited verifiers

3.4.2.7 Widespread Impact

Reduced latitude to respond promptly to computer upgrading or malfunction and extended periods of downtime for (re)verification will mean reduced quality of service for consumers. Consumers can expect irregular billing and extended billing days. The cash flow consequences for utilities would be enormous.

The provincial governments will have less scope to introduce new rates needed to control their electricity systems and respond to environmental needs.

Utilities will have less scope to introduce new rates:

- We observe the development of complex rates in the residential markets overseas. Similar trends could soon arrive in Canada. Here is the reason why: As the energy delivery systems of Canada become more and more stressed and energy costs escalate, provincial regulators will demand that all excess costs be driven out of their electricity systems and those that remain be minimized.

  To reduce costs, utilities will have to develop new incentives and new rates for residential consumers. Utilities and retailers will need the maximum possible latitude to flexibly develop rates and billing determinates.

- The industry must remain free to develop new cost recovery charges from industrial and commercial customers. An example might include cost recovery from those injecting harmonic pollution into the system and rewarding those who clean their end use applications up. Another might be to provide new incentives to reduce environmental impact of electricity consumption.

To minimize electricity prices, and reduce environmental impact, utilities must be able to flexibly switch industrial and commercial consumers from one type of charge to another. And this is best done in the customer information and billing system.

Confusion about scope and requirements for type approval would introduce additional delays and could even cause manufacturers and software vendors to decide not to bring needed solutions to Canada.

3.4.2.8 Limited Benefit

With respect to regulation of billing systems, we would like to suggest that the proposal would add little in the way of consumer protection:

- This area has been without Measurement Canada controls for many years and widespread problems have been not reported.
- The general level of concern over how bills are calculated is low, perhaps nonexistent.
- Measurement Canada would have to consult the engineering profession to tell it how the calculations should be done.

3.4.2.9 Increased Costs

Appendix 4 estimates the cost of regulating customer information and billing systems to be equivalent to $81 million per year which would be recovered for electricity consumers and tax payers. Reverification costs alone will add $54 million per year costs that utilities will have to be recovered from electricity consumers.

3.4.2.10 Provincially Regulated

Utility billing systems and trading arrangements are already regulated by the provinces. The provinces approve the utility rates and answer to the public when bills are not calculated properly. In the case of Alberta and Ontario the provincial governments explicitly define the equations to be used for billing calculations. Both provinces require that data be obtained from a Measurement Canada approved meter and both have dispute resolution systems in place to resolve the billing issues when they arise. Alberta even fines the utility or retailer $75 when a bill is incorrect.

The Alberta experience is that accuracy of data from the meter, or corruption during by the telemetering system, is almost never the cause of an incorrect bill. The most frequent causes are estimated interim billing, incorrect data exchange between the utility and the retailer leading to billing of the wrong customer or application of an incorrect rate.

3.4.2.11 Against the Trend

Let's step back for a moment and take a look at the overall trend of the proposals of Measurement Canada's paper:

a) For sound reasons, we see Measurement Canada moving away from regulating the non-non-measuring portions of the electricity meter.

b) We see Measurement Canada moving away from regulation of telemetering systems because such systems do not carry out a measurement function.

c) In light of the fact that computer systems cannot measure, would it make sense for Measurement Canada to regulate the even more remote customer information and billing system?

3.4.2.12 Recommendations

Given the enormous impact on consumers, provinces and environment and significant costs involved, we would suggest that electricity consumers would be best served by the status quo: computer billing systems should remain under strict utility control.

We note that no systemic or widespread bill calculation problem has arisen in the more than 100 year history in which demand calculations have been under strict utility control.

In previous sections of its paper, Measurement Canada has proposed that it move away from regulating multi-rate meters. We would suggest that energy data is stored exactly the same way inside an interval meter. While the number of registers is larger, the metrological principles are identical. We would suggest that interval meter be treated the same way as in multi-rate register meters.

As discussed in 3.4.2.1 the metrologically controlled portion of the source meter should remain the basis of the charge as required by the Act. The rest of the meter and billing system should remain under strict utility control. The provinces, utilities and retailers would then have maximum scope to offer consumers money saving incentives that will lower the cost of energy deliver, free up system capacity and contribute to the federal environmental initiatives.

3.4.3 Response to 7.2.4 Question (1)

Do you agree with MC's proposed policy or would agree in principle with some modifications (indicate what modifications you would like to see)? If no, what legal metrology requirements or principles would you identify in support of your position?

3.4.3.1 Proposal 1

As required by the Act, the establishment or apportionment of legal units of measurement shall be done only by devices which have been approved by MC.

The CEA agrees with the proposal provided the scope is properly stated. We would suggest that the Act and Regulations already limit the scope of application to the measurement of current and voltage from which energy and demand are subsequently calculated.

The digital portion of electricity meters, telemetering, data collection and billing systems should be specifically excluded from the purview of the Act and Regulations.

3.4.3.2 Proposal 2

With regard to the use of a meter's interval or load profile metering functions in association with telemetering devices in electricity measurement for the purpose of establishing a legal unit of measurement (i.e., time related electricity demand), such functions must be processed and recorded in approved devices, as indicated in clause 7.2.2 (1).

The CEA does not agree with the proposal. We believe that by time stamping the energy data, the interval meter establishes the demand before it is transmitted to the customer information and billing system. Rational is provided in section 3.4.2 and Appendix 2.

3.4.3.3 Proposal 3

Where telemetering devices are used to transmit electricity or gas measurement data from an approved meter which incorporates a single energy register, and this information is used for the purpose of allocating a unit cost to a specific measured quantity (i.e., time-of-use, real-time pricing rate application, etc.), MC proposes that this practice can be deemed to fall outside of the Agency's mandate and, as such, will not be subject to metrological control.

The CEA supports this proposal. It would allow continuation of the status quo to continue in Alberta and Ontario where profiling methodologies are used to compute weighted prices for the sale of electricity. Profiling results in savings for electricity consumers who would otherwise be forced to install more expensive metering at their residences. In fact meter replacement costs would be so high as to prevent implementation of hourly markets in either province.

3.4.3.4 Proposal 4

Contractors currently using interval or load-profile metering functions and microprocessor based software programs to establish or apportion legal units of measurement (i.e., time-related electricity demand) outside of an approved meter, will be requested to bring their metering systems into compliance with the Act.

The CEA does not agree with the proposal.

Nor does the CEA agree with the suggestion that a billing system is a meter. As shown in Appendix 2 and Section 3.4.2, the legal units calculated in interval and load-profile functions processed by software outside the meter, are established by the meter not by the computer system. The portion of the meter measuring current and voltage remains the fundamental basis for obtaining the charge.

The CEA would propose that the regulations be re-worded to specifically exclude microprocessor based software programs outside the meter, particularly customer information and billing systems.

3.4.4 Response to 7.2.4 Question (2)

Should multi-rate register applications be controlled regardless of whether they are used within or outside of an approved device?

The CEA would suggest that multi-rate register applications should not be metrologically controlled whether within or outside of the approved device. We have provided rational in section 3.4.2.

To avoid repetition we summarize that metrological control of such devices would increase the cost of electricity for consumers, decrease the quality of service to consumers and produce no increase in the confidence consumers have in their bills and in beyond the intention of the present Act.

3.4.5 Response to 7.2.5 Question (3)

In the long term, do you think MC should distinguish between the trade sector levels and consider making modifications to the Act that would allow, at the commercial and industry trade sector level, the use of microprocessor-based software (residing on personal or main frame computers) to establish legal units of measurement for the sale of electricity or gas?

The CEA believes that customer information and billing systems should remain under strict utility control. We would suggest that they do not carry out measurement functions and are therefore beyond the scope of the Act and Regulations.

We would not support modification of the Act or Regulations to include microprocessor-based software outside a metrologically controlled meter in either the residential or industrial and commercial sector.

Appendix 1: Clock Time Error

This appendix estimates the order of magnitude of clock error in typical time-of-use applications. The meter has two registers, one recording consumption during the off-peak period where the rate is 5¢/kWh and a second for the daytime period where the rate is 10¢/kWh.

The meter switches to the daytime rate 8 am in the morning and back to the off-peak rate at 8 pm. During the periods 00:00 to 8:00 am, 8:00am to 8:00pm and 8:00pm to 00:00 the rate of consumption is assumed to be 1.5, 3.0 and 1.5 kW respectively. The pattern assumed to be identical for the following day.

If the clock in the meter were accurate the bill for the day would be:

$$\text{True} = 8\cdot\text{hr}\cdot 1.5\cdot\text{kW}\cdot\frac{5\cdot¢}{\text{kWh}} + 12\cdot\text{hr}\cdot 3.0\cdot\text{kW}\cdot\frac{10\cdot¢}{\text{kWh}} + 4\cdot\text{hr}\cdot 1.5\cdot\text{kW}\cdot\frac{5\cdot¢}{\text{kWh}}$$

$$\text{True} = 450.000\,¢$$

If the clock were five minutes slow energy recorded in the off-peak register would be:

$$\text{OffPeak} = (7\cdot\text{hr} + 55\cdot\text{min})\cdot 1.5\cdot\text{kW} + 5\cdot\text{min}\cdot 3\cdot\text{kW} + (3\cdot\text{hr} + 55\cdot\text{min} + 5\cdot\text{min})\cdot 1.5\cdot\text{kW}$$

$$\text{OffPeak} = 18.13\,\text{kWh}$$

in which the last 5 minute period is from the following day. The daytime register would record:

$$\text{DayTime} = (11\cdot\text{hr} + 55\cdot\text{min})\cdot 3.0\cdot\text{kW} + 5\cdot\text{min}\cdot 1.5\cdot\text{kW} \qquad \text{DayTime} = 35.88\,\text{kWh}$$

The actual bill would be:

$$\text{Actual} = \text{OffPeak}\cdot\frac{5\cdot¢}{\text{kWh}} + \text{DayTime}\frac{10\cdot¢}{\text{kWh}} \qquad \text{Actual} = 449.375\,¢$$

leading to an error of:

$$\text{Error} = \frac{|\text{Actual} - \text{True}|}{\text{True}} \qquad \text{Error} = 0.14\,\%$$

The actual error is much smaller than the maximum error permitted in service under in clause 31 of the Regulations, i.e. 3%.

The 1.5 and 3 kW rates of consumption are typical for a large residence and the rates are typical of Canadian utilities.

The calculations demonstrate that primary measuring accuracy is much more important than clock time error. The CEA therefore supports Measurement Canada's to regulate accuracy of measurement but not accuracy of the criteria used to switch rate registers.

Appendix 2: Calculation of Demand

In section 7 of its position paper, Measurement Canada states that computer systems outside of the meter can establish legal units such as the time related demands referred to in section 5 of the Regulations. In this appendix, we demonstrate that establishment of average demand is done on a remote computer system by calculation not measurement.

Computation of time related demands outside of the meter is not equivalent to measurement of current and voltage and computation of demand inside the meter as contemplated by section 5 of the Regulations.

First let's start with the definition of power in a single phase circuit. The fundamental physics have been incorporated in to the engineering literature and formalized in standards developed by the IEEE and IEC. The power at any instant in time is universally defined as:

$$p(t) = v(t) \cdot i(t)$$

where:

p(t) is the instantaneous power

v(t) is the instantaneous voltage applied to the meter

i(t) is the instantaneous current supplied to the meter

Although not defined in any standard, average power during any time period T is universally understood to be the mathematical definition of the average of a continuous function of time:

$$P_{avg} = \frac{1}{T} \int_0^T v(t)\ i(t)\ dt$$

Now let's look at how the meter would compute the energy delivered over the same period of time:

$$W = \int_0^T v(t)\ i(t)\ dt$$

This definition is universal in the engineering literature and it too has been formalized in the IEEE standards. To avoid double measurement, meter manufacturers take advantage of the observation that:

$$P_{avg} = \frac{W}{T}$$

In other words the average demand is calculated from energy. Average demand is the result of a calculation not a measurement. If you know the energy in any interval of time you can determine the average demand without further measurement and vice versa. Knowledge of one completely determines the other.

Average demand however, is not the only type of demand calculation. There are at least 9 other variations, some of which cannot be computed a single meter. All result in units of kW or kVAR or kVA.

Under the technology available when the Act was promulgated and Regulations prepared, the computation of energy and demand was done inside the meter using analogue technology. In fact, many meters using electromechanical technology remain in service today. These analogue computers are subject wear, aging, quality of materials, etc. To ensure accurate computation such meters must be placed under strict metrological control which for practical reasons such as the lack of a current and voltage display, has been exercised by Measurement Canada.

But times have changed and computation technology that is free from the deleterious effects of wear, aging, quality of materials etc now exists. Digital computers, inside and outside of meters, are widely used to calculate average demand from energy reported by a remote meter. The use of a central billing computer:

- ✧ is efficient
- ✧ provides flexibility to switch customers from one rate to another
- ✧ enables rate offerings such as coincident demand that are not possible on a single meter

Accuracy of calculation made by a digital computer, whether inside the meter or not, is not affected by wear or aging. Digital computers should not be under strict metrological control.

Let's examine the way utility billing systems use energy to compute average demand. For example, many markets use hourly pricing. Charges for both energy and average demand must be computed for a 60 minute period. Meters used in these markets typically record data in 5 or 15 minutes intervals. Let's assume the use of 15 minute intervals.

The meter will transmit to the billing system a database that looks something like this:

End of Interval	Energy (kWh)
10:00	48
10:15	42
10:30	41
10:45	39
11:00	36
11:15	39
11:30	41
11:45	44
12:00	42
12:15	39
12:30	41

To arrive at the energy in the hour ending at 12:00, the computer adds up the four values from 11:15 to 12:00:

End of Interval	Energy (kWh)
10:00	48
10:15	42
10:30	41
10:45	39
11:00	36
11:15	39
11:30	41
11:45	44
12:00	42
12:15	39
12:30	41

Total energy for hour ending 12:00 is 166 kWh

Since the average demand is equal to the energy divided by one hour there is no need to actually divide by one. The average demand is determined by addition only. It is numerically equal to the energy in the hour and the computer never carries out the division.

Key observations:

- ✧ Average demand for any billing interval is determined by calculation, not measurement. And in the case of billing computers, the calculation is limited to addition.
- ✧ Computation of average demand is two steps removed from measurement of current and voltage since energy is computed before average demand.

The Ontario Retail Market requires that demand be computed as kWh/h since this more accurately describes the actual basis of the demand charge. Consumers then understand that they are being expressly billed for consuming an amount of energy in the hour.

We would suggest that some meters should remain under metrological control in entirety. These would include:

- ✧ meters using analogue techniques to compute calculate energy and average demand
- ✧ meters using analogue techniques to compute demand using thermal weighting

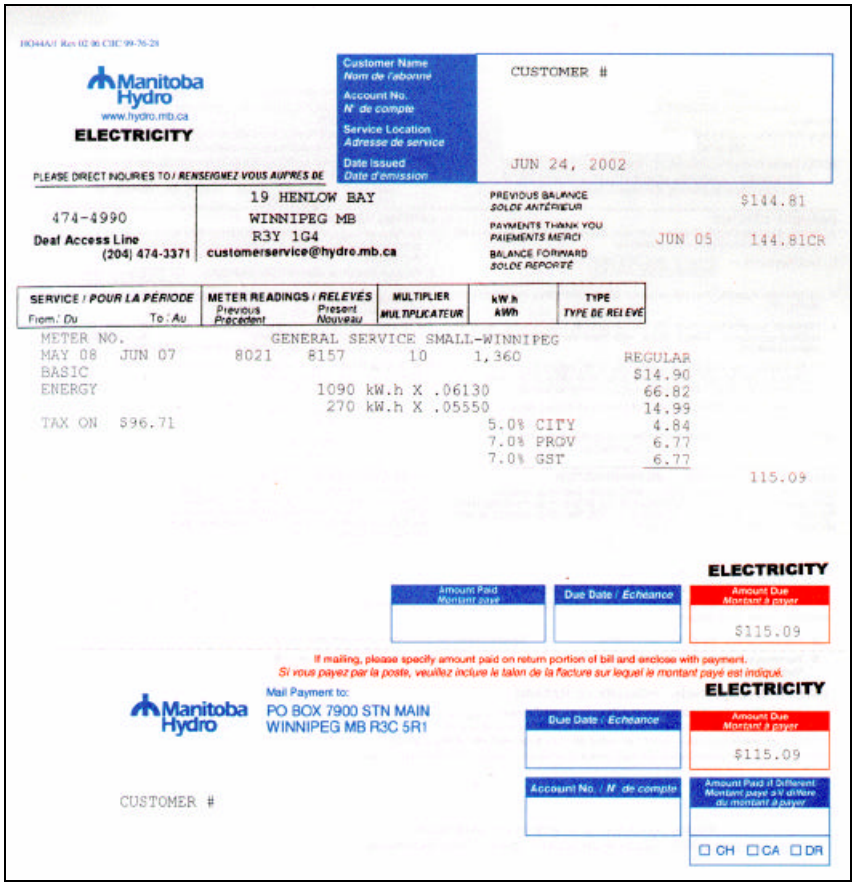
We would also suggest that the portion of an electronic meter that measures current and voltage should remain under strict metrological control. However the digital portion of the electronic meter that computes energy and demand need not be under strict metrological control. These meters display neither current nor voltage. To verify correct measurement of current and voltage, Measurement Canada must rely on the display of energy by the meter. Thus for practical reasons, we would suggest that strict metrological control of the measuring and energy computation portion of the electronic meter may need to remain under strict metrological control.

For calculations even further removed from measurement of current and voltage such as average demand, strict metrological control is not required. It will not improve the accuracy of the result and would infringe on the market by reducing customer choice and forcing cross subsidies between rate classes. With these reasons in mind we would suggest that strict metrological control of these stages in the meter and the even more remote computer billing systems would be detrimental. We note that both are already under strict utility control.

Appendix 3: Sample Consumer Bills

Shown below are typical bills prepared for residential, industrial and commercial customers of a Canadian Utility. The bills have been depersonalized and show typical calculations.

Figure 1 Residential Customer: There is a fixed charge and a charge for energy. The first block of 1090 kWh is sold at 6.13 cents/kWhr and the second block is sold at 5.55 cents/kWh. There is a carry over of $144.81 from the previous month.



Manitoba Hydro
www.hydro.mb.ca
ELECTRICITY

Customer Name / Nom de l'abonné
Account No. / N° de compte
Service Location / Adresse de service
Date Issued / Date d'émission

CUSTOMER #

JUN 24, 2002

PLEASE DIRECT INQUIRIES TO / RENSEIGNEZ VOUS AUPRÈS DE

474-4990
Deaf Access Line
(204) 474-3371

19 HENLOW BAY
WINNIPEG MB
R3Y 1G4
customerservice@hydro.mb.ca

PREVIOUS BALANCE / SOLDE ANTÉRIEUR $144.81
PAYMENTS THANK YOU / PAIEMENTS MERCI JUN 05 144.81CR
BALANCE FORWARD / SOLDE REPORTÉ

SERVICE / POUR LA PÉRIODE From: Du To: Au	METER READINGS / RELEVÉS Previous Précédent	Present Nouveau	MULTIPLIER MULTIPLICATEUR	kW.h kWh	TYPE TYPE DE RELEVÉ
METER NO.	GENERAL SERVICE SMALL-WINNIPEG				
MAY 08 JUN 07	8021	8157	10	1,360	REGULAR

BASIC		$14.90
ENERGY	1090 kW.h X .06130	66.82
	270 kW.h X .05550	14.99
TAX ON $96.71	5.0% CITY	4.84
	7.0% PROV	6.77
	7.0% GST	6.77
		115.09

ELECTRICITY

Amount Paid / Montant payé	Due Date / Échéance	Amount Due / Montant à payer
		$115.09

If mailing, please specify amount paid on return portion of bill and enclose with payment.
Si vous payez par la poste, veuillez inclure le talon de la facture sur lequel le montant payé est indiqué.

Manitoba Hydro
Mail Payment to:
PO BOX 7900 STN MAIN
WINNIPEG MB R3C 5R1

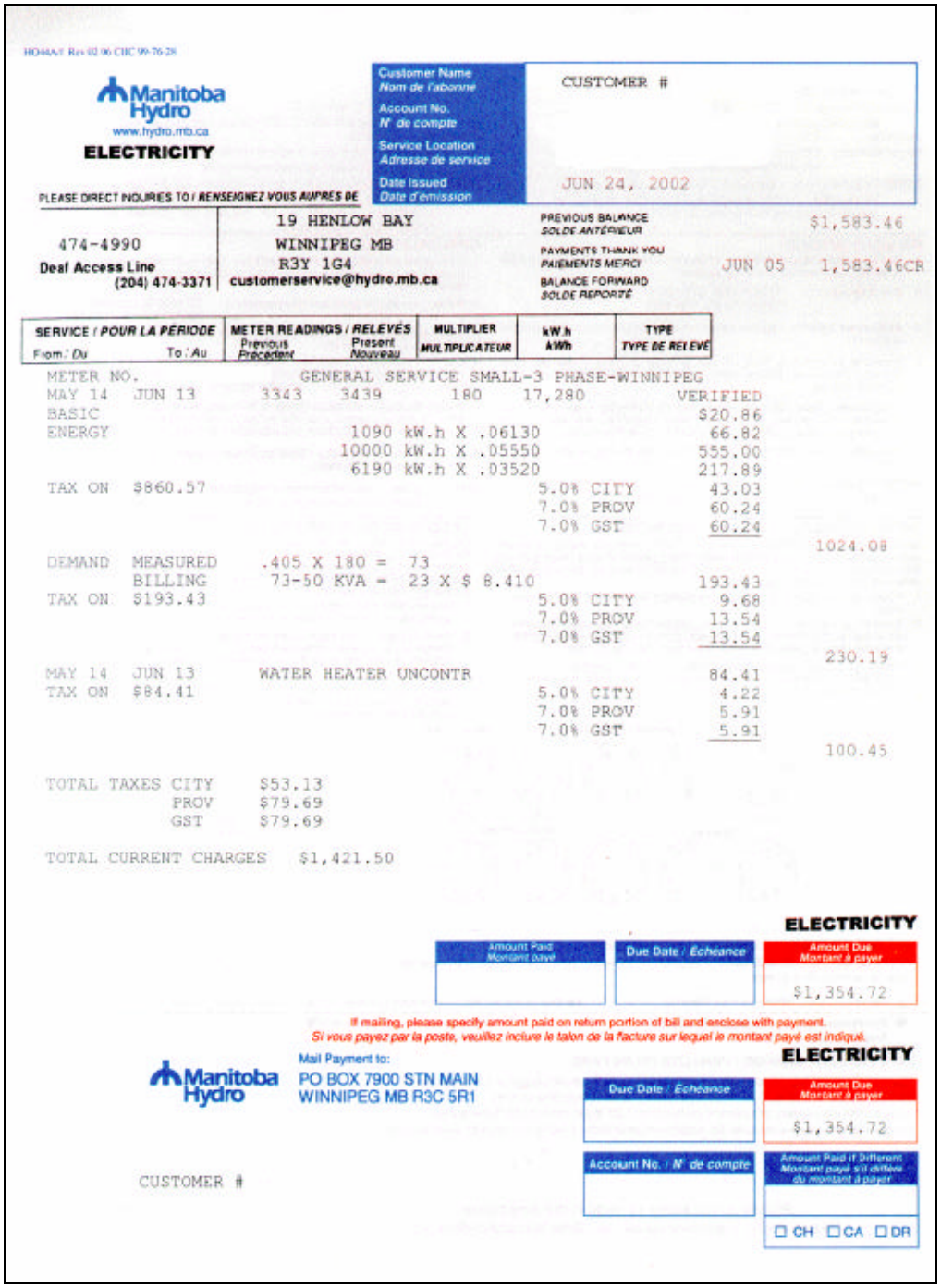
ELECTRICITY

Due Date / Échéance	Amount Due / Montant à payer
	$115.09

Account No. / N° de compte	Amount Paid if Different / Montant payé s'il diffère du montant à payer
	☐ CH ☐ CA ☐ DR

CUSTOMER #

Figure 2 Small Industrial and Commercial Consumer #1: This customer is billed for energy in a declining block structure. There is also a fixed charge. Each successive block sold at a lower price that the previous. Notice that the first 50 kVA of demand is free. Many utilities bill on 90% of the kVA demand.



Manitoba Hydro
www.hydro.mb.ca
ELECTRICITY

Customer Name / Nom de l'abonné
Account No. / N° de compte
Service Location / Adresse de service
Date Issued / Date d'émission

CUSTOMER #

JUN 24, 2002

PLEASE DIRECT INQUIRIES TO / RENSEIGNEZ VOUS AUPRES DE

474-4990
Deaf Access Line
(204) 474-3371

19 HENLOW BAY
WINNIPEG MB
R3Y 1G4
customerservice@hydro.mb.ca

PREVIOUS BALANCE / SOLDE ANTÉRIEUR $1,583.46
PAYMENTS THANK YOU / PAIEMENTS MERCI JUN 05 1,583.46CR
BALANCE FORWARD / SOLDE REPORTÉ

SERVICE / POUR LA PERIODE From: Du To: Au	METER READINGS / RELEVÉS Previous Précédent	Present Nouveau	MULTIPLIER MULTIPLICATEUR	kW.h kWh	TYPE TYPE DE RELEVÉ
METER NO.			GENERAL SERVICE SMALL-3 PHASE-WINNIPEG		
MAY 14 JUN 13	3343	3439	180	17,280	VERIFIED

BASIC			$20.86	
ENERGY	1090 kW.h X .06130		66.82	
	10000 kW.h X .05550		555.00	
	6190 kW.h X .03520		217.89	
TAX ON $860.57		5.0% CITY	43.03	
		7.0% PROV	60.24	
		7.0% GST	60.24	
				1024.08
DEMAND MEASURED	.405 X 180 = 73			
BILLING	73-50 KVA = 23 X $ 8.410		193.43	
TAX ON $193.43		5.0% CITY	9.68	
		7.0% PROV	13.54	
		7.0% GST	13.54	
				230.19
MAY 14 JUN 13	WATER HEATER UNCONTR		84.41	
TAX ON $84.41		5.0% CITY	4.22	
		7.0% PROV	5.91	
		7.0% GST	5.91	
				100.45

TOTAL TAXES CITY $53.13
PROV $79.69
GST $79.69

TOTAL CURRENT CHARGES $1,421.50

ELECTRICITY

Amount Paid / Montant payé	Due Date / Échéance	Amount Due / Montant à payer
		$1,354.72

If mailing, please specify amount paid on return portion of bill and enclose with payment.
Si vous payez par la poste, veuillez inclure le talon de la facture sur lequel le montant payé est indiqué.

ELECTRICITY

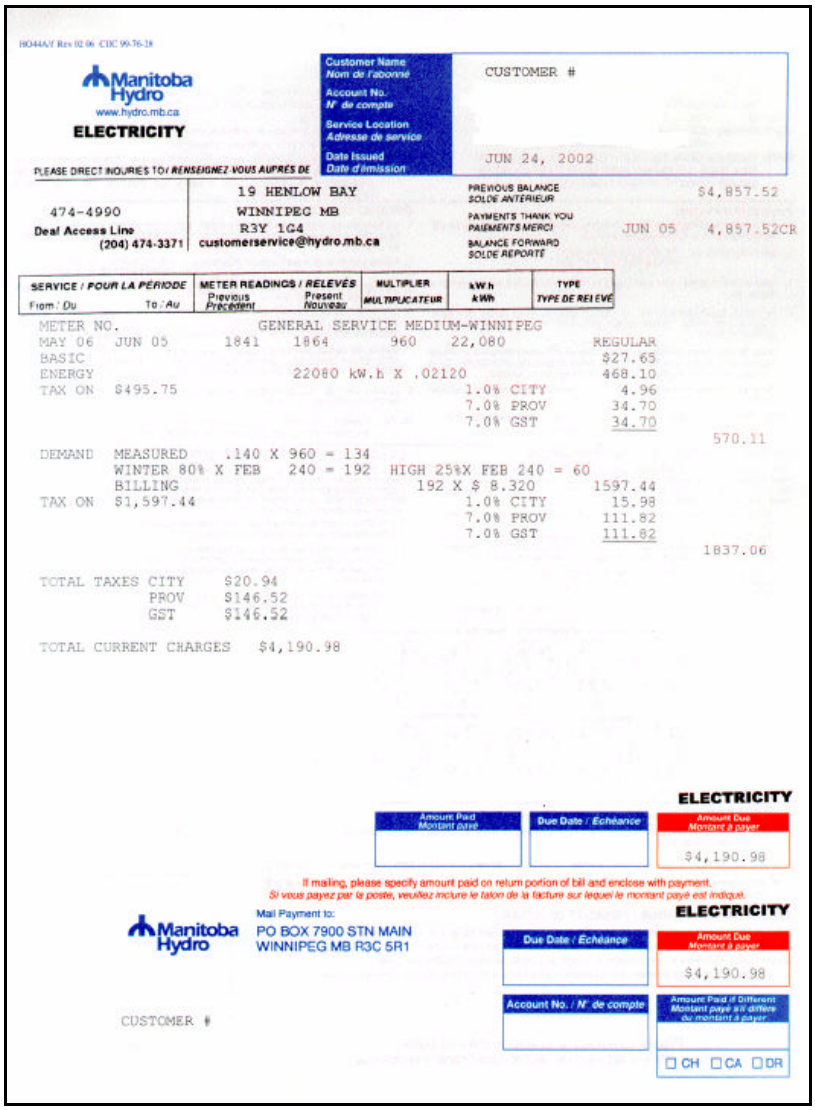
Manitoba Hydro
Mail Payment to:
PO BOX 7900 STN MAIN
WINNIPEG MB R3C 5R1

Due Date / Échéance	Amount Due / Montant à payer
	$1,354.72

CUSTOMER #

Account No. / N° de compte	Amount Paid if Different / Montant payé s'il diffère du montant à payer
	☐ CH ☐ CA ☐ DR

Figure 3 Commercial Customer #2: This customer is billed on energy, a minimum charge and for demand. The energy is sold at a fixed rate rather than in a declining block structure. The demand charge is billed at the greater of 80% of the winter demand or the current month's demand. This incentive rate provides signals aimed at reducing strain on the power system in the winter months.



Manitoba Hydro
www.hydro.mb.ca
ELECTRICITY

Customer Name / Nom de l'abonné: CUSTOMER #
Account No. / N° de compte:
Service Location / Adresse de service:
Date Issued / Date d'émission: JUN 24, 2002

PLEASE DIRECT INQUIRIES TO / RENSEIGNEZ VOUS AUPRÈS DE

19 HENLOW BAY
WINNIPEG MB
R3Y 1G4
customerservice@hydro.mb.ca

474-4990
Deal Access Line
(204) 474-3371

PREVIOUS BALANCE / SOLDE ANTÉRIEUR $4,857.52
PAYMENTS THANK YOU / PAIEMENTS MERCI JUN 05 4,857.52CR
BALANCE FORWARD / SOLDE REPORTÉ

SERVICE / POUR LA PÉRIODE From / Du	To / Au	METER READINGS / RELEVÉS Previous / Précédent	Present / Nouveau	MULTIPLIER / MULTIPLICATEUR	kWh / kWh	TYPE / TYPE DE RELEVÉ
METER NO.		GENERAL SERVICE MEDIUM-WINNIPEG				
MAY 06	JUN 05	1841	1864	960	22,080	REGULAR

BASIC $27.65
ENERGY 22080 kW.h X .02120 468.10
TAX ON $495.75 1.0% CITY 4.96
7.0% PROV 34.70
7.0% GST 34.70
570.11

DEMAND MEASURED .140 X 960 = 134
WINTER 80% X FEB 240 = 192 HIGH 25%X FEB 240 = 60
BILLING 192 X $ 8.320 1597.44
TAX ON $1,597.44 1.0% CITY 15.98
7.0% PROV 111.82
7.0% GST 111.82
1837.06

TOTAL TAXES CITY $20.94
PROV $146.52
GST $146.52

TOTAL CURRENT CHARGES $4,190.98

ELECTRICITY

Amount Paid / Montant payé	Due Date / Échéance	Amount Due / Montant à payer
		$4,190.98

If mailing, please specify amount paid on return portion of bill and enclose with payment.
Si vous payez par la poste, veuillez inclure le talon de la facture sur lequel le montant payé est indiqué.

ELECTRICITY

Manitoba Hydro
Mail Payment to:
PO BOX 7900 STN MAIN
WINNIPEG MB R3C 5R1

Due Date / Échéance	Amount Due / Montant à payer
	$4,190.98

Account No. / N° de compte	Amount Paid if Different / Montant payé s'il diffère du montant à payer
	☐ CH ☐ CA ☐ DR

CUSTOMER #

Appendix 4: Cost of Regulating Computer Systems

The utilities of Canada use 1750 different customer information and billing systems to invoice their customers. This section estimates the burden regulation of computer system would place on Measurement Canada and Industry. Industry costs would be recovered from electricity consumers. Measurement Canada costs would be covered by partly by federal tax revenues and mostly by utilities.

By far the largest portion of the Measurement Canada costs would be recovered from the utilities in terms of fees levied for the services Measurement Canada rendered. The cost of such fess would in turn be passed on to consumers increasing the price of electricity.

Work Item	Estimated Measurement Canada Labour (Hours)	Estimated Industry Labour (Hours)	Total
One Time Activities			
Define Requirements for Approval	320	160	
Define Testing Procedure	240	120	
Carry Out Approval Testing	320	160	
Develop requirements for Initial Verification	240	120	
Carry Out Initial Verification	320	320	
Develop Requirements for Sealing	320	160	
Seal Computer Installations	80	80	
Define Criteria Triggering Re-Verification	160	80	
Define Requirements for Subsequent Re-Verification	320	160	
	2,320	1,360	
Estimated One Time Cost at $65 per hour	$ 150,800	$ 88,400	
Ongoing Annual Costs			
Carry out Reverification (Est 4 per year)	320	160	
Estimated cost at $65 per hour	$ 20,800	$ 10,400	
Estimated One-time Cost for 1750 Systems:	$ 263,900,000	$ 154,700,000	**$ 418,600,000**
Estimated Annual Cost for 1750 Systems:	$ 36,400,000	$ 18,200,000	**$ 54,600,000**
Present Value over 25 Years at 4%:	$ 832,543,710	$ 439,021,855	**$ 1,271,565,565**
Uniform Annual Cost over 25 Years at 4%:	$ 53,292,757	$ 28,102,651	**$ 81,395,408**

The worksheet shows the one-time costs required to initially verify every billing system in Canada would exceed $418 million dollars. Ongoing costs can be expected to amount $54 million per year.

The net present value would exceed $1.2 billion over a 25 year period. If financed in equal payments over 25 years, the annual cost would exceed $81 million.