Transforming the Market for Efficient PC Power Supplies: Opportunities Assessment and Early Experience in Canada

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ABSTRACT

In 2005, Ecos Consulting and Natural Resources Canada joined forces to promote the 80 PLUS PC power supply efficiency program in Canada. The program is aimed at significantly reducing losses from power supplies in both desktop PCs and PC-derived servers.

In this paper, we begin by describing the program strategy. We then provide the results of a study assessing the Canadian PC market, the program's energy and environmental savings opportunity and its economic costs and benefits (including both the Total Resource Cost (TRC) and Utility Cost test results for both resource acquisition and market transformation scenarios). We proceed to describe steps taken over the past several months to engage the various stakeholders, upstream and downstream, reflecting on both successes and challenges to date. We go on to discuss required adaptations for success in the Canadian context. Finally, we conclude with a description of the steps that lie ahead.

Introduction

Research in the early-mid 2000s found that by simply improving the energy efficiency of power supplies – the devices common to all electronic products that convert AC to DC – significant energy savings can be achieved in a wide variety of electronics products (Calwell & Reeder, 2002; Calwell, Fulbright & Ghiasinejad, 2005). Of all product categories, desktop computers and desktop-derived servers (smaller servers that typically run 24/7 and are used for simple functions such as managing network traffic and routing e-mail) represent the "lowest-hanging fruit" because their power supplies waste about 30% to 40% of all the electricity that passes through them, converting the losses to heat (Calwell & May-Ostendorp, 2005). An opportunity for an efficient computer/server program emerged and the 80 PLUS program was born.

Program Strategy

The 80 PLUS program was initiated by Ecos Consulting (www.ecosconsulting.com), and is built around a very simple concept: recognize and reward the manufacturer for installing, in their computers and servers, power supplies that meet the following specifications: 80% efficiency or greater at 20%, 50% and 100% rated load, and a true power factor of 0.9 or greater at 100% load.

Through the program, 80 PLUS sponsors (electric utilities, state/provincial agencies and market transformation organizations) provide funding to Ecos Consulting to administer the program, while Natural Resources Canada (www.nrcan-rncan.gc.ca) provides supplemental program assistance. Most of this funding goes to financial incentives for computer manufacturers

and system integrators. This is referred to as an upstream buydown, and is meant to overcome the price barrier of premium power supplies to support market adoption.[1] The program comprises three distinct phases: Recruitment, Qualification and Implementation.

- **The Recruitment Phase**, led by Ecos, entails outreach to all potential participants. As a first step, Ecos presented the program to key utilities with a potential to join the effort in order to develop momentum. Next, Ecos solicited desktop computer and server component manufacturers, power supply designers and power supply manufacturers to encourage them to develop 80 PLUS qualified power supplies. This phase also involves direct outreach to computer manufacturers and system integrators to form a contractual agreement with Ecos to provide 80 PLUS qualified power supplies in participating utility service territories. Computer suppliers are also instructed on how to properly report sales to receive the incentive funds. In the final step of this phase, the program works with large commercial and institutional organizations to help them specify 80 PLUS qualified computers as their preferred procurement option to help pull the market along.
- **The Qualification Phase** focuses solely on the certification process, ensuring that power supplies earn the 80 PLUS label through rigorous testing using a standard test procedure developed by Ecos Consulting and EPRI Solutions. Power supply manufacturers send products to EPRI Solutions for testing, and results of power supplies that meet the 80 PLUS qualification are posted on the program Web site. Manufacturers of qualified power supplies can then affix the 80 PLUS label to their certified products and market them to computer manufacturers. At the time of this writing, there are over thirty certified models.
- **The Implementation Phase** begins when product is available in the market and may vary from one utility service territory to another. Typically, the utility or market transformation organization begins to actively market the program to customers, while Ecos works to engage PC manufacturers and system integrators, and assist them in integrating 80 PLUS into their marketing efforts. Ecos tracks sales and provides utility sponsors with monthly reports. The utility pays C$10.44 for every 80 PLUS qualified computer purchased in its territory (C$16.69 for every qualifying desktop-based server). Of that amount, Ecos pays the PC manufacturer C$6.25 per computer (C$12.50 per desktop-based server) to buy down the cost of the more efficient power supply, and uses the remaining C$4.19 to cover program administration, incentive processing, and marketing costs. A portion of this may also be used, at Ecos' discretion, to provide cooperative marketing dollars to select PC manufacturers and system integrators.

Additionally, Ecos has developed a three-tiered approach to quality control. First, it has adopted a challenge process through which third parties, including utilities and competing manufacturers, can ask that specific units be tested; if the test indicates failure to achieve the 80 PLUS standard, a series of steps provide opportunity for the manufacturer to bring the required changes or risk losing certification. Second, Natural Resources Canada (hereafter "NRCan") has indicated its intent to ensure random testing of market-ready units sold in Canada, with any negative results being fed into the Ecos challenge process. Third, Ecos provides interested

[1] The cost premium is believed to be in the range of approximately C$8 to C$15 per power supply.

utilities with sufficient sales information to allow them to carry out independent verification of PC manufacturers' claimed 80 PLUS sales.

Market Opportunities Study: Energy Savings, Emissions Reductions and Economic Costs and Benefits

In the Fall of 2005, NRCan commissioned *Dunsky Energy Consulting* (www.dunsky.ca) to conduct an assessment of the costs, benefits and opportunities for energy and environmental savings arising from the 80 PLUS program (Dunsky, 2006).

Canadian PC Market

Canadian PC market data was derived from two reports prepared for NRCan in the Fall of 2005 (SJR, 2005 and ERC, 2005).

In 2005, the Canadian market saw sales of some 4.3 million personal computers, including roughly 3 million desktop PCs and 170,000 PC servers.[2] Roughly half of these were sold to the business sector, while another 20% went to institutional customers and the remainder to individual consumers. Desktop and server PC growth is currently in the range of 6% annually. Distribution of PC sales across the country is similar to population distributions, although there is a somewhat stronger concentration in Ontario. PCs have an expected 4-year lifespan, followed by an additional 2 years in the refurbished market.

On the supply side, sales of PCs in Canada flow through a number of different channels. As illustrated in Figure 1 below, some 25% of PCs are sold directly from foreign "Tier 1" computer manufacturers (primarily Dell, also HP and Lenovo). Another 35% are assembled by foreign manufacturers and resold through domestic Canadian dealers. Finally, nearly 40% of PCs are assembled and sold by Canadian system integrators. These system integrators are located primarily in Ontario, but also have a strong presence in Québec and British Columbia.

Understanding the Canadian product flow is important to help define an appropriate market strategy *and* to assess potential market penetration in the early stages, as the program relies heavily on system integrator sales.

Opportunities for Energy Savings and Greenhouse Gas Reductions

Power supplies installed in a typical PC sold today are surprisingly inefficient. In fact, use of more efficient power supplies could reduce electricity consumption by over 100 kWh annually per PC (400 kWh in the case of PC-derived servers).[3] As a result, greenhouse gas (GHG) emissions could also be reduced, on the order of 340 kg of CO_2 equivalent (CO_2e) per PC.[4]

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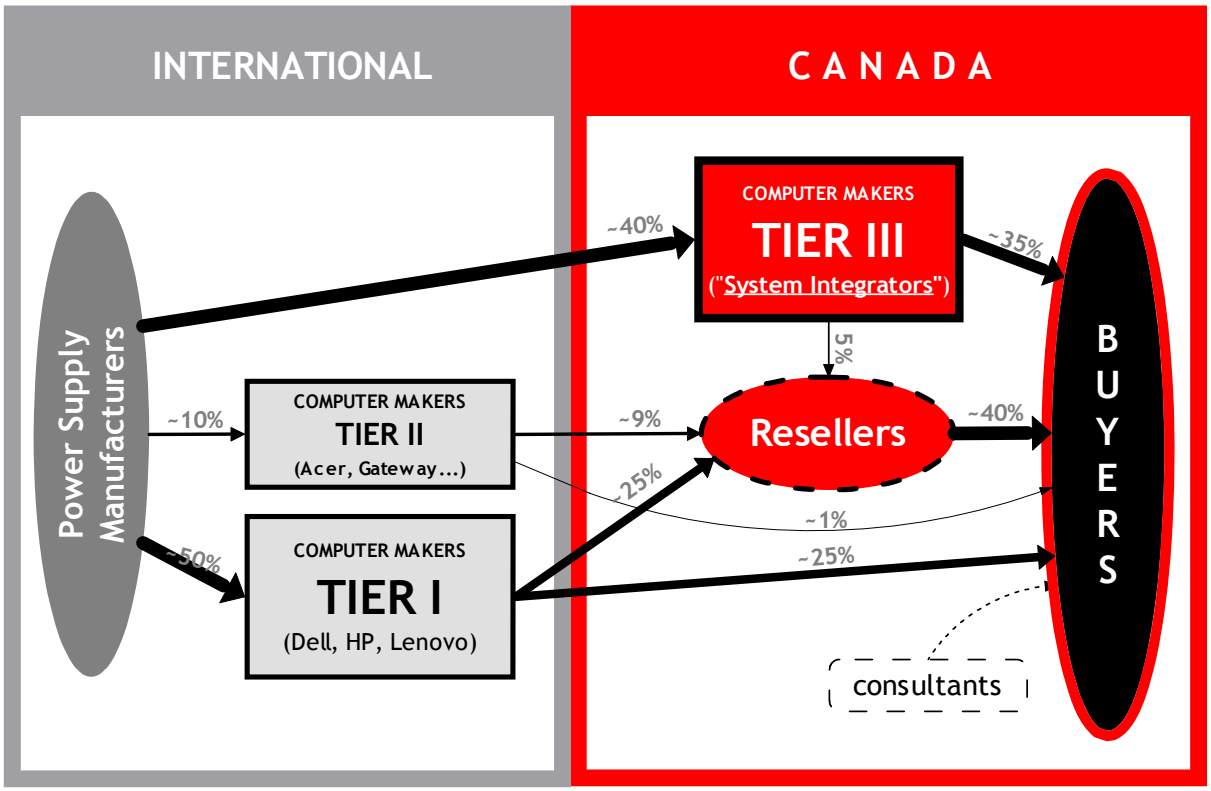
[2] The remainder, 1.15 million laptops is, at 27% of total sales, surprisingly low compared with U.S. market shares of roughly 50%.

[3] These savings account for both transformer heat loss (80% of savings) and additional reductions in wire losses (20% of savings) due to the program's insistence on a true power factor of 0.9 or greater.

[4] We assume that the marginal Canadian power plant is a combined-cycle gas turbine unit using natural gas as its fuel. The associated, life-cycle emissions rate is estimated to be 430 kg CO_2e per MWh.

Figure 1. Industry-Wide Product Flows Model



To assess the potential for Canada-wide savings, we built a model that could account for a host of factors including reasonable expected market penetration, free ridership, evolving efficiency levels and usage patterns, and a host of other factors. We further built a set of four market penetration scenarios:

- **"Direct RA (Resource Acquisition)":** This scenario provides for only direct, "resource acquisition" savings associated with a two-year run of the 80 PLUS program.
- **"High MT (Market Transformation)":** This scenario assumes that results of the initial 80 PLUS two-year program (2006-07) exceed expectations and, more importantly, accounts for possible market transformation effects in the years following (2008-20).
- **"Reference MT":** This scenario also allows for market transformation following 80 PLUS, but assumes that a follow-up initiative is required to this effect.
- **"Low MT":** This scenario also assumes that a follow-up initiative will be required but, partly in spite of this, assumes a disappointingly low rate of market adoption.

Our analysis found that the initial 80 PLUS program alone could result in some **68 GWh** of direct annual savings ("Direct RA") in the short run, and could provide some **2,342**

GWh/year over the long-run ("Reference MT" and "High MT" scenarios) throughout Canada. These values are net of free ridership and other factors.[5]

From an environmental standpoint, we have further evaluated the expected reduction in GHGs from each scenario. Our analysis found that the initial 80 PLUS program alone could directly result in some 24 kt of annual CO_2e savings and 160 kt of cumulative CO_2e savings ("Direct RA"). In the long-run ("Reference MT" and "High MT" scenarios), CO_2e savings could reach over **280 kt/year by 2012** and more than **800 kt/year by 2020**.

Cost-Benefit Analysis

We assessed the costs and benefits of our four scenarios according to industry-standard cost-effectiveness tests, including the *Total Resource Cost (TRC)* and *Utility Cost* tests.

Our analysis found that under all scenarios an initiative aimed at PC power supplies would be extremely cost effective. On a per-unit basis, our analysis suggests a direct TRC cost of some **1.3 ¢C/kWh** when *excluding* potential market transformation ("Direct RA" scenario). With market transformation, costs range from **0.1 to 0.6 ¢C/kWh**.

From an economic standpoint, these costs translate into high benefit/cost ratios. Again, limiting our analysis only to direct resource acquisition results, we find an expected TRC benefit/cost ratio of **more than 7:1** ("Direct RA" scenario). When accounting for market transformation, this ratio will range from **15:1 to 83:1**.[6]

It is worth noting that the unit cost of GHG reductions would amount to some C$30/t$CO_2e$ under the "Direct RA" scenario, and between C$2-9/t$CO_2e$ under the more realistic market transformation scenarios. At the time of writing, emissions reduction credits are trading in Europe at over €27 – or some C$37/t$CO_2e$.

All Results

Figure 2 below presents the results of our analysis for all scenarios and both primary tests.

As can be seen, the opportunities from the 80 PLUS program appear to be extremely cost-effective, while offering significant energy, capacity and GHG emissions savings.

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[5] *Dunsky Energy Consulting* developed an evolving net-to-gross (NTG) factor for the program based on assumptions regarding natural baseline efficiency improvements (initially at 1% *absolute* per year, falling to 0.25%/year by 2016) and natural increases in computing requirements (DC demand increasing initially at 5%/yr, falling to 1% by 2020). At the request of Natural Resources Canada, DEC assumed a static average efficiency level for 80 PLUS certified units (82% on average). The net result is a weighted-average NTG factor that ranges between 70-90% over the 15-year analysis period, meaning that initial unit savings were discounted by roughly one fifth throughout the assessment period.

[6] We've assumed a conservative average levelized avoided cost of 8.5¢C/kWh.

Figure 2. Summary Results (Four Scenarios)

	"80 Plus"	"Beyond 80 Plus"		
	Direct RA	*Reference MT*	High MT	Low MT
Savings				
GWh/yr (max.)	**68**	**2 342**	2 342	1 171
GWh (lifetime PV)	**343**	**11 806**	13 245	5 903
MW-yr (max.)	**11**	**454**	454	227
MW-yr (lifetime PV)	**57**	**2 281**	2 555	1 140
kt CO2e/yr (max.)	**24**	**836**	836	418
kt CO2e (lifetime)	**146**	**8 114**	8 856	4 057
Total Resource Cost Test (TRC)				
Levelized Cost of Saved Energy (¢/kWh)	**1,3 ¢**	**0,3 ¢**	0,1 ¢	0,6 ¢
Levelized Cost of Saved Capacity ($/kW-yr.)	**77 $**	**15 $**	6 $	32 $
Total Cost (PV)	**4 391 774 $**	**33 118 157 $**	14 377 397 $	36 456 460 $
Total Benefit (PV)	**30 964 948 $**	**1 066 745 541 $**	1 196 723 517 $	533 372 771 $
Net Present Value (NPV)	**26 573 175 $**	**1 033 627 385 $**	1 182 346 120 $	496 916 311 $
B/C Ratio	**7:1**	**32:1**	83:1	15:1
Cost of CO2e Reductions ($/tonne)	**30 $**	**4 $**	2 $	9 $
Utility Cost Test				
Levelized Cost of Saved Energy (¢/kWh)	**1,9 ¢**	**0,5 ¢**	0,1 ¢	1,2 ¢
Levelized Cost of Saved Capacity ($/kW-yr.)	**116 $**	**24 $**	4 $	60 $
Total Cost (PV)	**6 610 306 $**	**54 853 104 $**	9 811 941 $	68 741 795 $
Total Benefit (PV)	**30 964 948 $**	**1 066 745 541 $**	1 196 723 517 $	533 372 771 $
Net Present Value (NPV)	**24 354 642 $**	**1 011 892 437 $**	1 186 911 576 $	464 630 976 $
B/C Ratio	**5:1**	**19:1**	122:1	8:1
Cost of CO2e Reductions ($/tonne)	**45 $**	**7 $**	1 $	17 $

All monetary values in Canadian dollars and cents.

Electric Utility Value Proposition

Electric utilities and market transformation organizations became very interested in the turnkey 80 PLUS program for several key reasons:

- Significant energy savings per computer and server – roughly 100 kWh and 400 kWh savings per year, respectively – at a very low resource acquisition cost of 1.4¢C per kWh.
- A utility incentive program could overcome the primary market barrier: the incremental cost of more efficient power supplies.
- Consumers can participate by simply choosing 80 PLUS qualified PCs; the opportunity is therefore non-disruptive, no additional transaction costs are required and the program dovetails into the growing movement toward "green" procurement.
- The efficiency of a computer or server can be improved immediately by simply installing the more efficient model – no costly design changes at the manufacturing level are required.

- The opportunity to influence the current revision of the ENERGY STAR® desktop computer specification offers a significant opportunity for long-term market transformation.[7]
- Utilities could obtain considerable secondary benefits, including on-peak savings, reductions in cooling load and improvements in power quality

As in the U.S., many Canadian utilities are keenly interested in acquiring energy savings. Natural Resources Canada's (NRCan) Office of Energy Efficiency (OEE) is mandated to renew, strengthen and expand Canada's commitment to energy conservation and energy efficiency, with the objective of helping Canada reduce greenhouse gas emissions that contribute to climate change. Given the obvious advantages of the 80 PLUS program, NRCan adopted a multi-pronged strategy to encourage utility uptake of the program throughout Canada.

The Canadian Market

The Office of Energy Efficiency supports the 80 PLUS concept, and sees in it an opportunity to not only capture short-term GHG reductions and efficiency gains for PCs, but also to help prepare the market for an upcoming revision to the ENERGY STAR computer specifications, which it strongly supports. An in-depth analysis of the Canadian PC Market (Dunsky, 2006) confirmed the very positive cost-benefit ratios of the program. Two Canadian electric utilities were already interested in the project. Though the OEE does not have the budget to single-handedly sponsor 80 PLUS for the whole of Canada, there are a number of roles that it could play to ensure widespread uptake, the most important being that of facilitator.

As facilitator, the OEE hosted the first Canadian 80 PLUS Stakeholder Meeting in Toronto in September 2005 which assembled some of the country's major utilities, interested provincial agencies from Ontario (namely the Ontario Ministry of Energy and the Ontario Power Authority (OPA) Conservation Bureau), as well as the department of Public Works and Government Services Canada (PWGSC), the largest single purchaser of PCs in the country, in an effort to gain buy-in from these key stakeholders. For some, this was either a first introduction to 80 PLUS, while for others already familiar with the project, it was an opportunity to gain a better understanding of its mechanics. The meeting had two main outcomes: a number of utilities initiated a more in-depth analysis of the specifics of the program for their territory, and PWGSC agreed to include 80 PLUS specifications in its next Request for Standing Offer.

As in the US, utilities are viewed in Canada as key sponsors of 80 PLUS. However, the context under which Canadian utilities function differs somewhat from US-based utilities. One key difference is that most major Canadian utilities are publicly owned: indeed, provincial Crown corporations dominate electrical generation, transmission and distribution in all but two provinces.[8] As a result, most utilities face extremely close scrutiny from both their regulatory agencies and the media, resulting in a more risk-averse utility environment. As such, some of the utilities interested in 80 PLUS performed very thorough assessments before considering investing in the program, and have required extra actions be taken in order to satisfy their auditors (this resulted notably in the triple quality control mechanism described previously).

[7] See www.energystar.gov/index.cfm?c=revisions.computer_spec for more information.

[8] In both Alberta and Ontario (the latter being Canada's most populous province), electricity distribution is handled primarily by dozens of small, public and privately-owned municipal utilities.

Once Canadian utilities (or other entities) agree to sponsor the program (see later section), the OEE will work with Ecos and sponsors to organize three or four regional events in major markets (in Vancouver, Toronto, Montréal and, if needed Ottawa). These one-day mini-trade shows will bring together Ecos, utilities and their customer account representatives, and both system integrators and customers interested in the program. Also, to answer the very real market need for French as well as to abide by the Federal *Official Languages Act*, NRCan will be responsible for developing and hosting a bilingual Canadian 80 PLUS Web site (80plus.gc.ca) that will highlight participating Canadian sponsors and system integrators, while linking to Ecos' site (80plus.org) for some of the more technical elements of the program.

Early Results and Challenges

Setting a Higher Standard for Power Supply Manufacturers

At its outset, the 80 PLUS program issued a challenge to the power supply industry, based primarily in Taiwan but servicing the global computer market, to develop products that would perform to a higher energy efficiency standard. On average, the industry had been producing product that performed at around 65% efficiency with a power factor of ~0.6. However, 80 PLUS set an entirely new bar with its aggressive specifications, and initially there was some question as to whether power supply manufacturers could or would respond to the challenge. Those questions were answered quickly, as the response from manufacturers was immediate and positive.

Within a few short months of formal creation of the 80 PLUS initiative, power supply manufacturers began to submit product for testing and certification, a clear signal that the industry was prepared to embrace a new level of energy efficiency. Within months, the first power supplies had passed the rigorous testing requirements of the program and received 80 PLUS certification. By April 2006, more than three dozen power supplies had received certification, including units from the world's three largest power supply manufacturers.

Convincing PC Manufacturers of the Power of Energy Efficiency

The availability of more efficient power supplies was no assurance that they would be embraced by the computer industry, which has become increasingly price sensitive and risk averse in a fiercely competitive market. The second, and perhaps most important, phase of 80 PLUS was to convince computer makers that the time was right for the integration of more energy efficient power supplies. This was no easy task given that the new supplies carried a nominal price premium in the range of $8 to $15C. In a market climate where profit margins are extremely tight, manufacturers can be reluctant to incur even the smallest price increases.

However, while the idea of efficient power supplies was not accepted overnight, certain segments of the industry saw the immediate opportunities presented by the notion of a 'green computer'. Systems integrators, the smaller local and regional builders of computers that collectively represent about 45% of the North American market, saw efficient power supplies as a way to differentiate themselves from their larger competitors and meet a growing market demand for energy efficient product. Furthermore, 80 PLUS certified systems present maintenance savings as the reduction in in-box heat generation increases system reliability. Smaller and more nimble than large manufacturers, these smaller organizations integrated 80

PLUS quickly into their product offerings, and took advantage of the cooperative marketing dollars available through the 80 PLUS program. As the market began to respond and 80 PLUS product began to flow into the market, the large companies were forced to take notice. Combined with looming changes to the ENERGY STAR specification, the initial market push by innovative, forward thinking systems integrators was key in gaining the attention of the industry as a whole.

The Influence of ENERGY STAR®

While 80 PLUS and ENERGY STAR have shared the common goal of bringing greater energy efficiency to the computer industry, they are two separate and distinct initiatives. 80 PLUS, while considered to be a natural lead-in for a new ENERGY STAR specification, operates independently and seeks to unite utilities and market transformation organizations to create market incentives that will affect products offered by the computer industry. It is a voluntary, market driven approach that creates value for all stakeholders: utilities get cost effective energy savings, the computer industry gets incentives to help offset incremental costs, and consumers get more efficient and more reliable computers.

In parallel, ENERGY STAR is in the process of implementing the first official changes to its computer performance specifications in more than a decade. These specifications cover a variety of energy related topics, including power management, idle mode power consumption and power supply efficiency, all of which are likely to become *de facto* procurement guidelines for private and public organizations all over North America and beyond. Interestingly, the current draft specification has adopted the 80 PLUS performance criteria across the board, placing the initiatives in lockstep. The importance of this consistency cannot be understated, as it has made it clear to the computer industry that they must be prepared to adopt 80 PLUS performance requirements. It creates a simple question for the industry: do they wait for ENERGY STAR to make its specification official and take a reactive posture, or do they embrace the 80 PLUS program now and take advantage of market incentives and the ability to position themselves as an innovator in 'green' computing?

The Importance of Unity in International Specifications

Not only is consistency between ENERGY STAR and 80 PLUS itself creating motivation for the industry, but some of the world's biggest computer companies are finding additional motivation in the 'green labelling' programs found in other regions of the world. A prime example is 'Blue Angel', a labelling program in Europe that offers 'industry, trade and crafts companies the opportunity to document their environmental competence'. Many European organizations demand compliance with Blue Angel in their procurement documents, and computer manufacturers have long designed product to meet those specifications. While Blue Angel has yet to adopt the 80 PLUS specification verbatim, it has implemented requirements that approach those of 80 PLUS. For the large computer companies, this has proven to be a key element in their decision to move forward with the 80 PLUS program, as it has demonstrated that their largest markets in North America and Europe are proceeding with like mind toward policies that demand the integration of efficiency in computers.

The Canadian Situation to Date

NRCan has a long history of leading Canada's energy efficiency and conservation efforts. It launched the EnerGuide label in 1978 and established the OEE in 1998 as a center of excellence for energy conservation, energy efficiency and alternative fuels information. The Office plays a dynamic leadership role in helping Canadians save millions of dollars in energy costs at home, at work and on the road, while addressing the challenges of climate change. It achieves its goals in part through developing minimum energy efficiency legislation for energy-using equipment, and by partnering with key stakeholders on a wide range of initiatives and incentives, including the administration and promotion of the ENERGY STAR symbol. Introduced in Canada in 2001, the ENERGY STAR high efficiency program is enjoying significant success. Its notoriety and influence are growing, and utilities and other stakeholders throughout Canada are using ENERGY STAR as the basis for establishing incentive and rebate programs. The OEE has forged partnerships with a variety of organizations (industry, utilities, NGOs), and built solid credibility in the area of energy efficiency programs. The OEE now plans on expanding its reach by facilitating the adoption of 80 PLUS in Canada.

At the time of writing, Canada's three leading provincial utilities (from an energy efficiency standpoint) – Hydro-Québec, BC Hydro and Manitoba Hydro – seem poised to formally join the program. In Ontario, which is comprised of over 90 local distribution utilities, a collaborative of the six leading urban utilities has expressed strong interest in the program, as has the Ontario Power Authority's Conservation Bureau (an arms-length, para-governmental body). Together, these four provinces account for more than 80% of the Canadian PC market.

On the downstream side, there is already strong interest from system integrators, including from the country's three largest system integrators. They see the program as a potential competitive differentiator and would like to offer 80 PLUS equipped PCs their customer base.

Finally, there are positive developments on the procurement side as well. The federal government recently adopted a Green Procurement Policy across all departments, and made a commitment to consider the environmental performance of the goods and services that the Government of Canada will buy. Through this policy, the Government of Canada intends to make itself one of the greenest governments in the world. In response to this policy, Public Works and Government Services Canada, the procurement arm of the federal government, has announced its intent to include the 80 PLUS specification in its upcoming Request For Standing Offer for its National Master Standing Offers for computers, from which most departments draw.

Next Steps / Conclusion

Efforts in Canada are currently focused on the crucial phase of recruiting sponsors in the country's larger markets. The results of these efforts will dictate the scope and timing of the next steps. As mentioned earlier, a number of key utilities and other energy efficiency organizations have expressed interest in 80 PLUS; however, at the time of writing, signed contracts are still pending.

In preparation for the next steps, the development of a Canadian 80 PLUS Web site targeting primarily system integrators and computer purchasers has been initiated. Once sponsors have signed on, the next steps will be to actively work in the sponsor's territory to ensure uptake of the program: on the one hand recruiting system integrators to supply the demand for 80 PLUS

qualified PCs and servers while on the other hand working with the sponsor to actively promote 80 PLUS to the commercial and institutional market. One of the first activities to take place would be to organize a mini-trade show, as mentioned above, to bring together interested parties: Ecos, system integrators and potential buyers, not to mention utility sponsors and Natural Resources Canada.

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