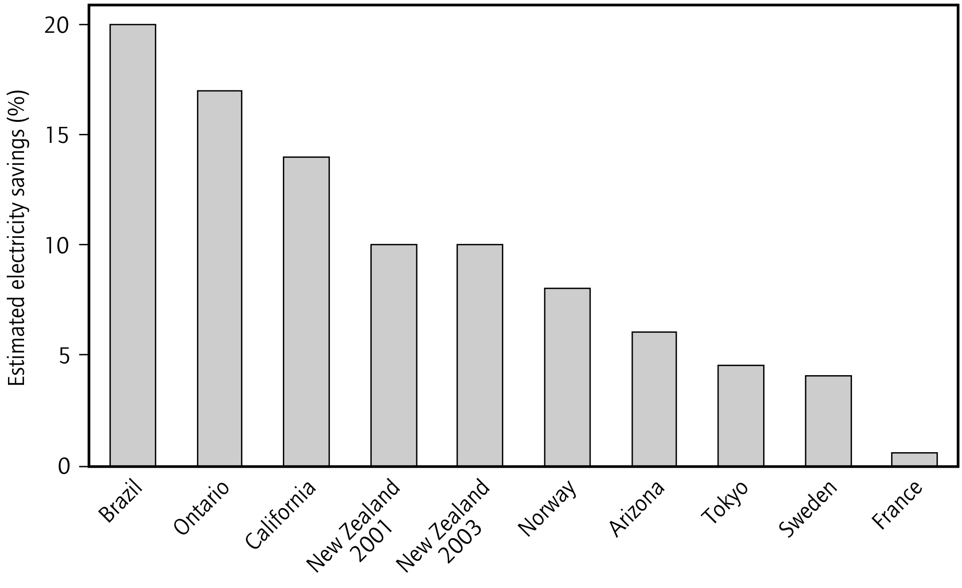
EXECUTIVE SUMMARY

Temporary shortfalls in electricity supply – ranging from one day to many months – have occurred at one time or another in almost every country. During these crises, the infrastructure to deliver electricity to the customer remains intact but the utility cannot supply as much power as consumers wish. Such shortfalls might occur as a result of a breakdown in a key power plant, a drought, a heat or cold wave, or partial loss of transmission capacity. The end of the crisis is generally known, that is, the power plant is repaired, the rains replenish the reservoirs, the heat wave abates, or full transmission capability is restored.

One response to these shortfalls is to fix the supply problem as quickly as possible, such as by connecting temporary facilities or importing power. But some shortfalls are so large that drastic curtailment appears to be the only feasible means of still providing some electricity while maintaining the integrity of the electrical system. This book describes the experiences of several countries that chose a strategy of "saving electricity in a hurry" rather than suffer curtailments, indiscriminate blackouts and other consequences

Figure ES-1

Summary of Estimated Savings Achieved in Regions through Programmes Designed to Save Electricity in a Hurry

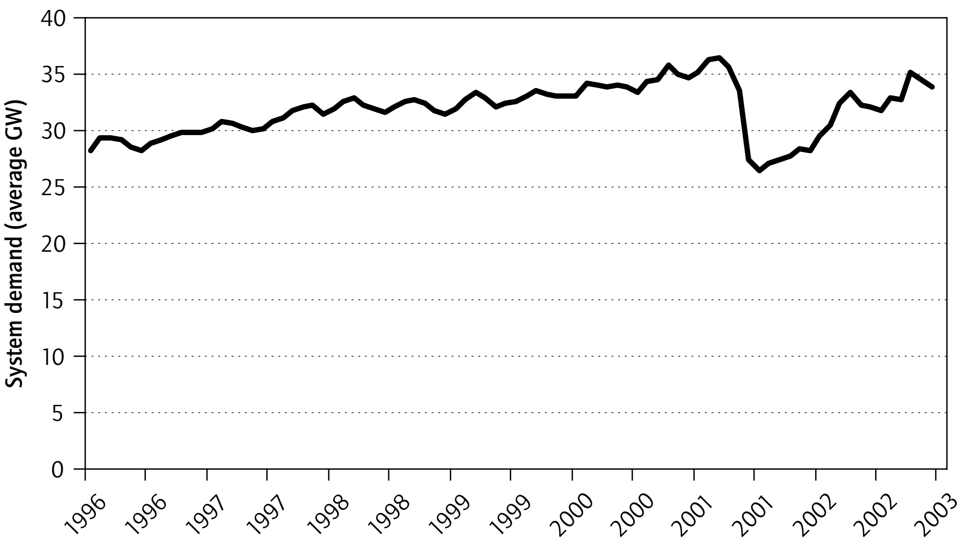


of electricity shortages. These countries include Sweden, Japan, Brazil, New Zealand and the United States. The shortfalls occurred in many different forms of electricity markets and for equally diverse reasons.

Countries have successfully cut electricity demand by 0.5 to 20% by saving electricity in a hurry (Figure ES-1). When confronted with a severe drought, Brazil cut its total electricity demand 20%, and sustained these savings for several months, without blackouts or causing major harm to the economy (Figure ES-2). Sweden cut its total electricity demand by about 4% for one day in anticipation of a cold wave that would have overwhelmed electricity generating capacity. In Arizona (United States), a fire at a key transformer facility cut available power; conservation actions sustained over six weeks reduced demand 6% and avoided blackouts.

Figure ES-2

Electricity Demand in Brazil Before and After its Shortfall in 2001



There are three major strategies to save electricity quickly:

- Raise electricity prices.
- Encourage behavioural changes.
- Introduce more energy efficient technologies.

The mix of the three strategies will depend on the time to prepare before the shortfall arrives, the anticipated duration of the shortfall, and the structure of the electricity markets. In fully liberalised electricity markets, the price mechanism will play the largest role in reducing electricity demand because experience has shown that higher electricity prices will stimulate conservation. A shortfall in a liberalised market is actually a "price crisis" which can be accommodated by normal market forces. In most current markets, however, there are administrative, political and technical obstacles to raising electricity prices quickly. The response in these countries must necessarily focus on behavioural and technical programmes to cut demand.

Programmes to reduce electricity demand quickly differ significantly from conventional energy efficiency programmes such as appliance efficiency standards, building codes and tax incentives (called "saving electricity slowly" in this book). First, the savings need only be temporary, that is, electricity use can return to traditional levels at the end of the shortfall. Second, it is acceptable to request consumers to make sacrifices and accept inconveniences for the duration of the shortfall. Finally, the shortfalls may appear and end so quickly that is impossible to draw on technical improvements in energy efficiency.

A mass media campaign can be surprisingly effective at quickly reducing electricity demand. Sophisticated media campaigns can be designed and launched in only a few days and reach a large number of consumers almost immediately. The messages must be carefully tailored not to blame the consumers for the problem and to convince them that individual actions will make a difference. Furthermore, the campaign must explain in simple terms to consumers which measures will save electricity (Figure ES-3). If the shortage occurs during peak hours, then the campaign must also explain *when* to save electricity. Sometimes consumers need to be educated before they can take actions. Many campaigns urged consumers to cut standby power use in homes and commercial buildings, but first they needed to explain what standby was and how it could be cut. Humour plays an unusually important role in encouraging consumers to conserve. Hundreds of measures have been used with success but nearly every campaign asked consumers to:

Figure ES-3

Example of Advertisement During New Zealand's 2003 Electricity Shortfall

- Re-set thermostats to reduce heating or cooling demand.
- Switch off non-essential lighting.
- Adjust schedules for the use of electricity-intensive equipment and industrial processes.
- Switch off office equipment or enable them to “sleep” in lower power modes.

These behavioural measures can be further encouraged by programmes that give consumers rebates for successful reductions in electricity bills. Each shortfall is unique so the appropriate actions depend on how electricity is used and when it must be saved. Regular collection of data related to energy consumption and savings will help a campaign focus on conservation measures that will save the most electricity.

When the shortfalls are expected to persist, technical improvements can supplement behavioural measures. The actions to raise technical efficiency often require an infrastructure to deliver or install. If an infrastructure already exists to “save electricity slowly”, then it may be harnessed to achieve the short-term goal, too. Some measures include:

- Installation of energy-efficient lighting (especially compact fluorescent bulbs).
- Replacement of old equipment (ranging from refrigerators to traffic signals) with new, efficient units.
- Audits and improvements of key electricity-consuming equipment (such as municipal pumping and industrial compressed air systems).

Technical improvements take longer to implement than changes in consumer behaviour but they provide more reliable electricity savings. In addition, the savings will persist after the crisis has ended.

Electricity shortfalls often take place in a politically charged environment where many institutions have lost credibility. Politicians and high executives have lost their jobs during these crises. At the same time, these crises disproportionately influence the shape of future electricity policies and market structures. Effective resolution of temporary electricity shortfalls may encourage implementation of more stable long-term solutions to the needs of the electricity market.

WHO NEEDS THIS BOOK AND WHEN?

Almost every part of the developed world has faced a temporary shortfall in electricity supply at one time or another. Such shortfalls might occur as a result of reduced hydroelectric supplies caused by a drought, a breakdown in a power plant, a heat wave, or partial loss of transmission or distribution capabilities. During these crises, the infrastructure to deliver electricity to the customer remains intact but the utility cannot supply as much power as consumers wish. The end of the crisis is generally known, that is, the rains replenish the reservoirs, the power plant is repaired, the heat wave abates, or full transmission capability is restored.

The traditional response to these shortfalls is to fix the supply problem as quickly as possible, often by bringing in or connecting temporary facilities. With enough advance warning – and good luck – a crisis will be averted. But some shortfalls are so large, or the temporary supply fixes so expensive, that the only outcome appears to be blackouts or unplanned curtailments.

It pays to avoid power shortages and even the threat of imminent blackouts. Even a single blackout can lead to deaths, injuries, and economic damage. The summer 2003 blackout in Ontario (and especially the mandatory reductions in electricity use in the weeks following it) led to a 0.7% reduction in Canada's total GDP during August (Statistics Canada, 2003). Continuing shortages, and the threats of blackouts, further undermine the economy by creating uncertainty and hidden costs of adaptation and preparation. At a personal level, people will become less productive in small ways; for example, they avoid using elevators (and may even refuse to visit upper floors of buildings). Companies will invest in expensive on-site electricity generation equipment, uninterruptible power supplies, and other mostly unproductive assets.

Many utility planners and government officials treat the demand for electricity as mostly fixed. When a shortfall occurs, the utility can disconnect some industries operating with interruptible contracts and perhaps wring additional reductions through Demand Response programmes. If the electricity market has been liberalised, drastically higher spot prices can be used to reduce demand. But what happens when these cuts are insufficient? For many planners and system operators, blackouts are the only solution. Is it possible to rapidly cut demand for electricity – at least temporarily – without causing lasting economic or environmental damage? This book examines the record, where regions encountered shortfalls and implemented rapid demand reduction programmes. The book's goal is to describe the extent to which electricity customers can also rescue an overwhelmed utility. Put another way, this books seeks to give the utility another tool with which to solve an electricity shortfall. This tool – rapid, short-term reductions in electricity demand – cannot be applied in every situation but it may be the best and cheapest tool, especially when combined with other strategies.

Who should read this book? Frankly, only a small group of specialists concerned with providing reliable electricity supplies and forecasting electricity demand should read this book immediately. But a second, larger group should skim through it and remember the book's primary conclusion – that it is feasible to cut electricity demand by as much as 20% in only a few months without destroying the economy – and then put this book in a safe place until a crisis arrives (when it should be read carefully). A second important conclusion of this book is that a modest amount of preparation can greatly accelerate the launching of a programme to save electricity quickly.

What Kind of Shortfalls are Covered in this Book?

It is important to understand the boundaries of the problem addressed by this book. Many electricity crises cannot be solved by saving electricity in a hurry (or would be more effectively addressed by other strategies). This book offers solutions when the crises have the following features:

The electricity supply infrastructure is basically intact. Put another way, electricity can reach customers, but not as much as they wish. Thus, the ice storm in Quebec and Ontario in 1998, where hundreds of transmission towers were toppled, is not a candidate for saving electricity in a hurry. Similarly, the great French windstorm ("tempête") of 1999, which seriously damaged large parts of the transmission and distribution network, could not easily benefit from rapid electricity conservation measures. System-wide blackouts, such as occurred in the north-east United States, Italy and Scandinavia during 2003 are other examples where saving electricity in a hurry would not have avoided the situation. On the other hand, some of these strategies may be useful while the system is being restored. This was the case in Ontario (see the vignette in Chapter 2) after its blackout in 2003 during the process of recovery and re-establishment of the grid.

An end to the shortfall is in sight. The shortfall will end when the seasonal rains begin, the heat wave abates, or a power plant comes back on line. For practical purposes, the duration of the shortfall covered in this book is from one day to one year. Many of the programmes proposed in this book, such as mobilising consumers by calling on their civic duty, cannot be sustained for long periods. Other strategies must be used.

The shortfall is larger or lasts longer than can be handled through the utility's standard Demand Response programmes. Many utilities offer certain customer categories low-cost power at lower reliability. From experience, the utility can estimate the extent to which customers will respond by cutting demand. About 5% of a utility's total demand will typically be responsive to these measures.

The shortfall may be a deficit in capacity (e.g., at the time of peak demand) or in total electricity consumption. Some shortfalls may first appear during periods of peak demand and then spread to total electricity consumption.

The concept of saving electricity in a hurry applies to a small number of events in a year. But these events have such large economic consequences that, like an accident at a nuclear power plant, advance planning is justified. Furthermore, these crises often disproportionately influence future policies, so their long-term impact may be great.

Developing Countries and Saving Electricity in Hurry

Rapidly-developing countries, for example China and India, suffer from chronic shortages of electricity when the electricity supply system struggles to keep pace with the country's growth. Saving electricity in a hurry does not apply directly to those situations because a clear end to the shortfall is not in sight, and the infrastructure is most likely not sufficient to deliver adequate amounts of power. Nevertheless, these countries may still benefit from many of the concepts described here, such as shifting municipal pumping operations to off-peak hours and scheduling vacations of staff in electricity-intensive factories to coincide with the weeks of peak electricity demand.

Security Applications of Saving Electricity in a Hurry

Actions by terrorists or criminals could also create shortfalls in electricity supplies identical to those covered in this book. Power plants, transformer stations and transmission lines are potential – and highly vulnerable – targets for terrorists. Oil and gas pipelines, oil storage tanks and other major facilities upstream of the electricity grid are also prime targets. (Indeed, several attempts have already been detected and thwarted in various parts of the world.) These actions could disrupt the supply chain for a few minutes or even many months because these facilities are unique and not easily replaced.

As soon as the authorities determine the extent of damage and probable length of the shortfall, a demand-reduction campaign would begin. The goal is identical to that of electricity shortfalls caused by a non-hostile act: reduce demand in such a way as to cause the least damage to the economy. Mobilising consumers would probably not be difficult because utilities and governments would find it easier to request conservation as a kind of civic duty or act of patriotism.

Reference

Statistics Canada (2003), "Canadian Economic Accounts", 28 November, www.statcan.ca.