

# ECONOMIC OUTLOOK

by Paul J. Scalise

## Three scenarios for economic impact

# Looming electricity crisis

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**D**espite the horrific human cost and property damage caused by the March 11 earthquake-tsunami-nuclear crisis, many economists argue that the devastation to the country's capital stock will have little impact GDP growth beyond a couple quarters. The argument is that the prefectures most damaged by the disaster are largely agrarian and that the Tohoku region contributes only 4-5% to Japan's GDP. Hence the impact of the national and global supply chain will be minimal.

Yet the conventional wisdom presupposes that the impact is localized. In reality, TEPCO and Tohoku Electric Power Co. distribute electricity across 45,963 square miles of northeastern Japan, servicing 33 million residential and 3 million industrial customers in 15 prefectures. Combined, these companies provide power to over 40% of the nation's electricity consumers who, in turn, produce 45% of national GDP. If the supply-demand imbalance is not resolved within the year, the spillover effects to economic activity could be much greater than commonly expected.

### Not just Fukushima

Aside from the nuclear crisis, the elephant in the room is the looming electricity crisis. Japan needs to restore capacity before the peak load summer months. Certainly the attempts to flood the Fukushima Dai-ichi reactors with seawater in an attempt to cool their radioactive cores (thereby permanently corroding them) have made this capacity useless moving forward.

What is less publicized is the amount of disabled capacity other than Fukushima Dai-ichi. On the nuclear front, 13 of TEPCO's 17 reactors (generating 12,396

megawatts, MW) and four of Tohoku's reactors (4,274 MW) are currently offline. 7 TEPCO reactors were automatically shut-down due to the earthquake on the eastern seaboard; 6 other reactors (3 at Fukushima Daiichi and 3 at Kashiwazaki-Kariwa) were already offline for regular inspection. The remaining Tohoku reactors at Onagawa and Tokai automatically shutdown after the earthquake, disabling 19% of each company's total nuclear capacity.

If history is any guide, these nuclear reactors will not come back online before August or indeed before the end of the year. After the July 2007 Chuetsu offshore earthquake (magnitude 6.6), extreme caution from both the regulator and the local government spurred numerous safety tests that delayed re-opening the undamaged reactors for 16 months—with some still being offline before the March 11 quake.

### New nuke plants unlikely

Further nuclear construction is also unlikely. Tohoku EPCO spokesman Sota Notsu indicated that the company has yet to review plans for two nuclear reactors (2,210 MW) as it is focusing on disaster recovery efforts for lost plant and equipment. Meanwhile, TEPCO already announced a halt to work on a 1,385 MW reactor at the Higashidori plant in Aomori, northern Japan, and suspended plans to build another 1,385 MW reactor at the same plant as well as two 1,380 MW units at the stricken Fukushima Dai-ichi plant.

This need to placate underlying NIMBY (not in my back yard) sentiments of the local communities places greater pressure on Tohoku and TEPCO to correct the supply-demand imbalance using con-

ventional thermal power plants. Unfortunately, acquiring additional thermal power fueled by oil, gas, and coal is where both utilities face the greatest challenge in avoiding rolling blackouts.

### Conventional power also hurt

At present, TEPCO and Tohoku have 18% (11,740 MW) and 33% (5,450 MW) of their respective conventional thermal power capacities disabled due to earthquake-related damage or regular inspection.

TEPCO acknowledges that three of its oil-fired units (2,200 MW) and two of its coal-fired units (1,600 MW) at Hirono Power Station are severely damaged. Units #3 (1 GW) might be salvaged by summer; the rest will likely be scrapped. Kashima Power Station, a large oil-fired site with four disabled units of 3,200 MW, and Hitachinaka Power Station, a coal-fired site with one 1,000 MW unit, were also severely damaged by the earthquake, but TEPCO flirts with the idea that repair is possible before the summer.

Purchasing power from neighboring power companies will not suffice. First, Japan's unique hertz (Hz) system—an accident of history—ensures that TEPCO's western counterparts cannot rescue them. From Okinawa to Chubu stands the 60 Hz system, a hold-over from the 19th century. On the eastern portion of Japan from Hokkaido to Tokyo spans the 50 Hz region inaugurated by Tokyo Electric Light Company (TELC) in 1883. Consequently, only 1,000 MW can be transferred today from Chubu Electric Power Co. to TEPCO through converters. Second, Tohoku—with 52% of its own total capacity currently disabled—faces even greater problems than TEPCO.

Nor will wholesale suppliers, new entrants, or self-generators likely be the blazing saddles of rescue. Wholesale suppliers (e.g., Japan Atomic Power Co. and Electric Power Development Co.) continue to sell power to TEPCO and Tohoku at maximum load. There is not much more than they can generate. Companies such as Diamond Power, Ennet and Marubeni also sell at the retail level in Japan's newly liberalized electricity market, but these 35 new entrants are small in capacity and limited in surplus power. This leaves some market watchers to place their faith in firms that generate their own electricity. The Kanto and Tohoku regions provide some 21,000

MW of self-generation to energy-intensive industries. How many generators can be purchased, redirected, or connected to the eastern grid system is debatable.

### Declining reserve margins

Historically, the frequency and duration of Japan's blackouts have been relatively few and modest. The average annual duration of forced outages in TEPCO's service area over the past decade, for example, records slightly over four minutes per household versus 69 minutes in the USA, 73 minutes in the UK, and 45 minutes in France.

Analyzing TEPCO's reserve margin—the amount of power it can generate beyond normal usage—reveals a more unsettling story. Energy economists agree that the optimal reserve margin is between 15-20%. Anything above that figure on an annual average is inefficient excess; anything below it sounds alert warnings. TEPCO's summer reserve margin—when air-conditioning use is at its height—fell as low 1.7% in 2007.

Part of the problem lies with simple forecasting error; both TEPCO and its regulator sometimes misjudged summer electricity demand. In addition to increased air-conditioning use from unforeseen heat waves, the demands of a post-modern industrial society lead to mounting usage of household electrical appliances, kitchen units, and heating systems. Trying to predict the erratic behavior of 13 million Tokyoites can never be easy.

But a more pervasive problem stems from what political scientist Daniel P. Aldrich calls “the site fights for public bads.” Local opposition, compensation negotiations, and media scrutiny in the siting, licensing, and construction of nuclear power plants and hydro-electric dams have resulted in protracted lead-times. Indeed, the building of conventional thermal power plants fueled by oil, natural gas, and coal are themselves constrained by stringent environmental regulations and zoning laws that protect against pollution, carbon emissions, and a negative impact on local wildlife. Consequently, lead-times range from three years for small 300 MW thermal plants to as high as 20 years for larger 1,000+ MW nuclear plants.

### Scenario analysis

Given these problems, TEPCO acknowledges that maintaining a stable supply of

power in 2011 is now “impossible.” But are extensive blackouts inevitable? On the most up-to-date information, three scenarios are calculated:

- *Worst-case:* TEPCO misjudges both peak demand and its ability to acquire supply before year-end. A 60 GW summer 2011 and 50 GW winter 2012 demand forecast for the Kanto region is consistent with historical growth trends. If TEPCO achieves only a quarter of its renewed supply projections, the estimated reserve margins in the -15% to -30% range will lead to extensive power outages until year-end (see figure)—most likely in sparsely populated rural areas where industrial (not urban residential) customers are prevalent.

- *Base-case:* TEPCO forecasts of supply and demand are correct. The nuclear crisis lingers for months alongside cooler weather patterns keeping demand below historical trends in the 46 GW (summer) and 35 GW (winter) range. Significant thermal supply is acquired but the damaged balance remains offline. A shortage of 8,500 MW leads to estimated 2011 reserve margins in the -8 to -10% range for summer 2011 with the possibility of a supply-demand rebalancing by winter 2012. Rolling blackouts would be limited to the summer, but short-timed.

- *Best-case:* TEPCO is too cautious in its estimates. The nuclear crisis is contained, with reduced electric power consumption keeping demand under trend growth. Supply sees damaged conventional plants back online, the regularly inspected nuclear plants in Kashiwazaki-Kariwa resume oper-

ation, and additional conventional plants are quickly erected—bypassing Japan's stringent environmental regulations—within 12 months. Estimated reserve margins would be in the 13% to 25% range in 2011-2012. Rolling blackouts are avoidable past late-April 2011.

### Economic impact

Tokyo Shoko Research reports that a survey of 1,597 firms conducted on 16 March 2011 tallies “power failure” as the fourth largest reason for industrial inactivity since the earthquake. That problem threatens to grow by summer.

Since the two oil shocks of the 1970s, energy intensive-industries such as chemicals, steel, aluminum, and machinery production have slowly moved away from the incumbent utilities to self-generation. They now account for 16% of total installed capacity and demand in the Kanto and Tohoku regions. Yet, it is the 3 million industrial customers that account for ¥3.2 trillion (\$40bn) in utility revenues, and which rely on a steady source of electric power from both TEPCO and Tohoku, that raise serious questions about regional GDP growth. Semiconductors, auto-parts, and breweries are just a few of the many probable casualties of 2011 blackouts.

Unlike the 1995 Great Hanshin Earthquake in Kobe, a growing number of economists now acknowledge these rolling blackouts could put considerable strain on economic activity. If either the worst-case or base-case scenarios prove correct, we can expect a deepening of the downturn.

