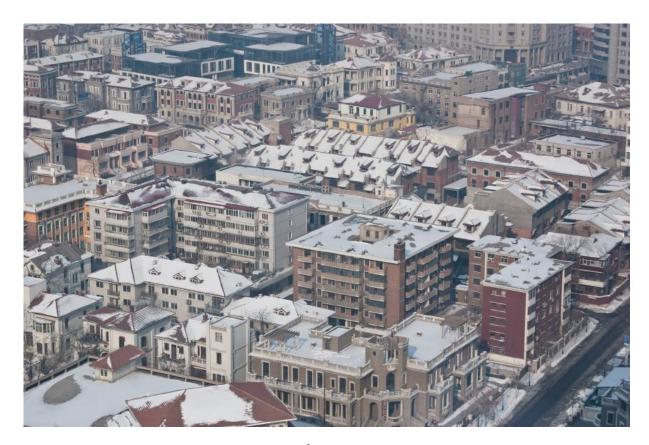
How a Chinese City Saved Millions in Energy Costs

Prepared for the CEO Council for Sustainable Urbanization October 2014



City of Tianjin





EXECUTIVE SUMMARY

China is designing and implementing new policies and programs to improve energy efficiency in its cities. Regulations and subsidies will provide Chinese businesses and utilities with the ability to reduce their power consumption and save money at the same

time. Think of the potential in China where the commercial and industrial sectors account for more than 75 percent of national energy use. Multiple studies have shown that the cheapest form of energy is that which is never used in the first

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One key technology that is now available in China is automated demand response (ADR) — which offers affordable ways to reduce the amount of electrical power that office buildings, labs, and factories consume while permitting them to continue to operate

at peak performance. A report by the China Electric Power Research Institute (CEPRI) estimates that if ADR systems were rolled out nationwide, they could save the equivalent of 40 one-gigawatt power plants by 2022. (A

one-gigawatt plant is roughly the size of a large nuclear reactor.)

Honeywell has already proven that ADR technology works in conjunction with China's grid while boosting energy efficiency. The company, working with the U.S. Trade and Development Agency (USTDA) and State Grid

Electric Power Research Institute (SGEPRI), successfully completed China's first smart grid pilot project in Tianjin as well as an accompanying feasibility study for managing energy use in commercial buildings in 2013.

"Residential and industrial electricity customers and grid operators are forming important new relationships across China. Honeywell has a proven track record of working with both utilities and their customers around the globe, giving it a unique perspective on how to quickly realize the

benefits of the evolving grid," commented Mr.
Shijie Xiao, president of the SGEPRI.
"Implementation of this pilot project will introduce us to the latest solutions and help identify the most suitable technologies for China."

For the half dozen buildings and factories involved in the pilot project, the city of Tianjin found that ADR reduced their heating, cooling, lighting and computing loads effectively and in line with the forecasted reductions of

approximately 15 percent for industrial and 20 percent for commercial facilities. The technology, designed and installed by Honeywell, is now being rolled out in 30 Shanghai buildings. "Cutting demand and consumption is the cheapest and cleanest

source of energy, and this project helps bridge the gap between the utility and its customers to make 'using less' easy and automatic, "said Stephen Shang, president of Honeywell China.

become more energy hungry as they purchase air conditioners, flat screen TVs and modern kitchen appliances. This means that the nation will need increasing amounts of energy —both to manufacture those products and to power them.

The key is for Chinese and American businesses to work together to share the latest in energy efficiency technology and to find ways to install, finance and maintain these systems in ways where all parties can prosper.

The challenge will be enormous. China is already the world's largest energy consumer. The U.S. Energy Information Administration predicts that the country will consume twice as much

energy as the United States by 2040. Building more power plants will be necessary, but that won't be enough to help China keep up with its skyrocketing energy demand. What's needed is a more efficient and technologically advanced grid system that will help businesses measure and actively manage energy usage.

While China has made significant progress in energy efficiency, it still requires about twice as much energy as the world's average energy

consumption to produce one unit of GDP. That must change if the nation wants to meet its future energy demand without power disruptions and dramatically rising prices. Other nations have already made great progress with efficiency. Consider that

since 1975 when the state of California implemented rigorous energy efficiency standards for buildings and appliances, businesses and individuals have saved more than \$75 billion in energy costs. At the same time, the total electricity use per person in

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The report that follows provides a detailed roadmap of how ADR has been effectively implemented in China. This technology has helped Chinese companies increase profits and benefit from a more reliable grid, and it

can help make China's cities cleaner and more sustainable by saving as much as 1.2 percent of China's total electricity consumption.

THE CHALLENGE:

More than half of China's 1.3 billion people live in

cities. According to the consultancy McKinsey & Co., by 2030 Chinese cities will have added an additional 350 million inhabitants, more than the entire population of the United States. As more Chinese become urbanized and join the middle class, their lifestyles will

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California has remained relatively stable over the past 30 years, while in the United States, nationwide electricity use has increased by almost 50 percent. vii

While ADR may be new to China, the technology, which simplifies decisionmaking and automates actions, has already saved money for businesses in the United

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States, Canada, Europe and other parts of Asia Pacific. With controls in 10 million buildings and thousands of industrial sites, and

utilities, to implement an ADR system for 700 of its commercial and industrial customers. Those businesses now save an impressive 82 megawatts of peak power every year, or 20 to

30 percent of their total consumption. Honeywell's technology and services help reduce both day-to-day and peak electricity consumption. On a global basis, Honeywell has helped give utilities reliable interaction with

more than 1 gigawatt of peak load, which is equivalent to the generation capacity of approximately 20 gas-fired peaking plants.

That's 20 power plants that the utilities didn't



Beijing Skyline

experience managing demand response and efficiency programs for more than 100 utilities, Honeywell has a long track record with ADR. In the United States, for example, Honeywell has worked with Southern California Edison, one of America's largest

have to build to meet increased demand.

The Chinese central government knows all too well the challenges involved in meeting the nation's growing energy needs. It also understands the environmental impact of additional fossil fuel power production on air

quality and climate change. With this in mind, Beijing is designing and implementing new policies and programs to improve energy efficiency throughout the country. These regulations and subsidies will provide Chinese businesses with the ability to reduce their

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power consumption and save money at the same time.

China, for example, has set national standards for annual reductions in energy intensity in every province, and the Central Government is supporting

municipal pilot programs for energy efficiency that will help corporations understand how this new exciting, technology works. In the future, energy efficiency will only become more of a priority for China. Says Deborah Lehr, a senior fellow at the Paulson Institute: "Tackling energy efficiency in the building sector will potentially generate the biggest bang in terms of emissions reduction, even when compared with efforts in the transport and industrial sectors."

THE OPPORTUNITY:
AFFORDABLE, RELIABLE
POWER

ADR systems represent one of the most important breakthroughs in smart grid technology. This integrated hardware and software

system allows a business and its local utility to work together to manage the consumption of electricity during periods of peak demand when electricity tends to be the most expensive, or sometimes, is not available at all. For example, a utility — with the

customer's approval — can automatically engage an office building or factory in order to reduce electricity consumption when demand is high to better balance the grid and avoid brownouts. At the same time, a business can reduce its electrical consumption without

interfering with its operations when market prices for electricity are highest, saving thousands or even millions of dollars over time.

process in which the operators of utilities have to track power usage and then telephone or email the business customer when power reductions are needed. By contrast, ADR technology allows a business to design customized, pre-approved energy reduction strategies for its facilities that utilities can automatically call into action when needed. Using ADR, utilities can quickly and reliably reduce overall energy consumption during peak-use periods, and

commercial customers can cut their energy use and costs without compromising critical operations. For example, an ADR system can automatically shut off non-essential lighting, turn down HVAC settings, and adjust settings on motors

and pumps, among other energy savings functions.

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One of the biggest benefits of ADR systems is that they can help make the grid more stable. With the recent pace of economic development in China, the demand for electricity has greatly increased, resulting in electrical power shortages — particularly during periods of peak demand in the summer, when energy use often strains the grid. In 2011, the disparity between generation and load was 30 gigawatts during

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critical peak times, and such serious power shortages are expected to continue. By installing a wide-scale demand response program, China can significantly reduce outages and create savings of 1 percent to 1.2 percent of China's annual electricity consumption. This amounts to avoiding the construction of 40 coal-fired power plants.

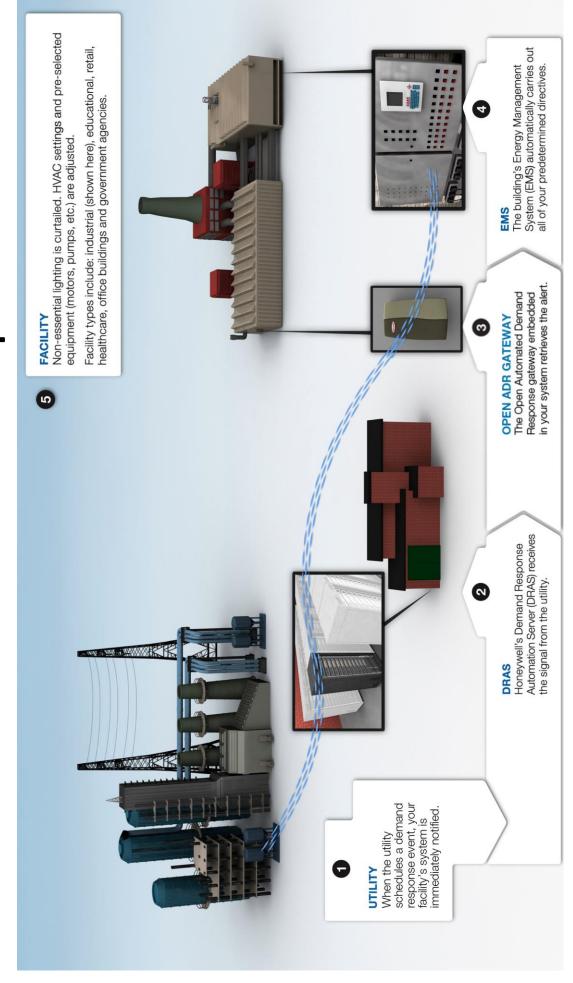
This should result in an increase in GDP as enterprises maintain production levels versus idling operations during power outages.

From the utility's perspective, ADR helps reduce greenhouse gas emissions and the need to run expensive "peak power" plants, which typically sit idle until customers require more electricity than the utility is able to provide using its base-load generators.

Deployment of ADR can effectively reduce peak loads by 15 to 30 percent and, when done at scale, create a "virtual power plant" that generates "negawatts" — or reduced demand — instead of megawatts.

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How Automated Demand Response Works



THE FRAMEWORK: A COORDINATED GAME PLAN

The road ahead is challenging. China will need to find a balance among businesses, utilities and power distributors to make sure all parties have access to the best technology available and receive the maximum benefit and the lowest costs when implementing ADR. This will require an evolution of the country's power regulations and pricing systems —both on the national and local levels.

Power in China is so inexpensive and subsidized that there's little motivation for businesses to invest in energy-saving technology. It is true that some large industries, such as steel and chemicals, must pay higher rates during peak demand in some parts of the country, but for the most part,

China does not have variable pricing.

To create incentives to invest in energy technologies such as ADR, central government agencies including the NDRC, the National Energy Administration (NEA) and CEPRI have become the primary drivers for the adoption of new grid technologies. They are analyzing system problems and are looking for the most cost effective technologies for China's specific needs. Once these technologies are identified and tested, utilities and businesses will be able to see the payback, and the technology will become more widely adopted. China is also offering financial support for energy efficiency and demand response with the

funding of the Demand Side Management City Initiative for 2013-2015.

At the same time, these agencies are encouraging individual cities to formulate strategies and to experiment with programs and regulations that would prove feasible for large-scale adoption. For example, in the case of Honeywell's Shanghai project, the local government is providing the financial support to insure smooth integration of the technology. State Grid is providing technicians

SGEPRI, TEDA and Honeywell participate in an ADR workshop – Beijing, September 2012

to help to make sure the ADR system works within the current grid system. The local businesses have no direct costs.

NDRC, CEPRI and others would also like local governments to experiment with

new forms of regulations that would hasten the adoption of ADR systems. For example, new construction regulations could require "smart grid-ready" buildings. Rules could also be designed to allow ADR gains to be counted toward meeting local and national greenhouse gas emissions targets. Appropriate incentive structures could be devised to increase participation of building owners.

Overall, the key to successful adoption is for local governments and state-owned utilities and distribution companies to work together to provide the financing and a consistent regulatory framework for ADR programs.

THE SOLUTION: ADR OFFERS FLEXIBILITY

CEPRI commissioned Honeywell, a leader in the building controls industry, and AECOM, an electrical engineering firm, to run The

Demand
Response
System Pilot
and Feasibility
Project in
Tianjin. The
project was
funded in part
by the USTDA
under a grant
agreement with
CEPRI.

Honeywell and AECOM also

TEDA AS PRINKFING AND ROBERTOR

TEDA helped spearhead Tianjin's pilot ADR project

Once all the major players

were on board, installing ADR

caused very little disruption.

contributed significant funding.

The Tianjin Economic Technological
Development Area (TEDA) and CEPRI provided
support to Honeywell in the identification of
and outreach to the pilot demonstration sites.
Honeywell implemented its ADR technology in
several settings, including two commercial
buildings, the TEDA Administration Building
and TEDA Library, as well as two industrial
buildings operated by Kumho Tire

Manufacturing and wind turbine maker Vestas. The idea was to demonstrate the feasibility of demand response solutions within China's grid infrastructure.

The project progressed on three tracks. First, State Grid needed to agree on a cloud-based architecture and ensure it would mesh with its power systems. The utility wanted to make sure that its grid employees could seamlessly communicate

with utility customers who would be using the ADR systems. State Grid found that ADR was compatible because it complies with international open software standards,

making it easy to integrate into almost any building control system.
Honeywell's ADR technology includes a demand response automation server that is deployed in the cloud and an Open ADR Gateway to intelligently connect with customer loads.

Next, Honeywell took steps to educate the managers who ran the building facilities. These managers needed to know how the system worked and what would happen once the system was activated. The city also needed the building owners to give written consent to have the system installed. Finally, the local distribution company, which controlled "the last mile" of power lines to the buildings taking part in the pilot project, also needed to be included.

Once all the major players were on board, installing ADR caused very little disruption. Honeywell says the entire process — from getting "buy-in," to installing the software and hardware — took

about three months, and most of that time was spent getting access to the key decision makers at the utility, the distribution business and the facilities. Strong local leadership played a critical role.

The building owners were primarily concerned that their offices or factories might be shut down while ADR was being installed, and that once installed, they would be handing over control of their operations to the utility.

notice, the Kumho Tire factory in Tianjin could move a shift around to save power when the utility needs a reduction.

Other building managers worried that there would be moments when the utility would ask

ADR Project Participants





Honeywell addressed this concern by explaining that the utility does not control the system, and that ADR could be installed without interrupting operations since the system works on the building's existing control system.

Once ADR is installed, the facility operators retain complete control over their building. The utility gives its customers at least 24 hours

of advance notice before reducing or shutting down power to a portion of the building. Under the current manual demand response system, a building manager usually only gets an hour or

so notice, and at that point, there's not much he can do. But a 24-hour window provides more flexibility. For example, with 24 hours' for help and they wouldn't be able to respond, because it would be too disruptive to the business to shut down a conveyor belt or turn off a line of robots. Honeywell assured them that any building can opt out of any specific request from a utility. Says Jay Sparling, Honeywell's Global Business Development Director: "When we told building managers that, there was a huge sigh of relief."

One lesson learned from this Tianjin pilot is that virtually any building with electrical equipment can be outfitted with current technology to enable demand response. All a utility must then do is

connect to the building via a central, automated dispatch system. And, in addition to helping facilitate demand response, ADR

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technology can be paired with energy efficiency systems. While energy efficiency and demand response programs have slightly different goals (overall consumption reduction, as opposed to peak load reduction), they typically generate greater results when they are combined.

THE OUTCOME: ADR WORKS

The Tianjin pilot exceeded the expectations of all parties. Now that the numbers are in, the NEA, the USTDA and the city of Tianjin believe that the money and effort have not only provided a handsome payback, but also have demonstrated that ADR is a technology that can be replicated in the rest of the city of Tianjin and throughout China.

The results for the Tianjin pilot project include:

- The industrial site's load reduction varied with production schedule. The site saw a reduction of 7.7 percent during full production periods. When not operating at full production, the site's demand response shed capacity increased more than 30 percent.
- The two commercial buildings provided a more stable and consistent load-shed response, shedding between 15 and 20 percent.
- The success of the TEDA project can contribute to the success of future ADR demonstration city projects. For example, Shanghai officially kicked off a 30-building pilot project with Honeywell technology support, and several other demonstration cities, such as Suzhou and Foshan, have expressed interest in using Honeywell technologies.

In the case of Honeywell's Shanghai project, the local government is providing the financial support to insure smooth integration of the technology. State Grid is providing technicians to help to make sure the ADR system works within the current grid system.

Overall, the city of Tianjin has achieved its short-term goal of implementing an ADR solution that works with China's grid. "The long-term goal," Honeywell's Sparling says, "is to achieve an optimal, real-time balance between electricity supply and demand through two-way information flow."

Lessons: The key lessons gleaned from the Tianjin pilot project for successfully replicating and scaling ADR technology include:

- ADR is a key technology that is already available today in China, and it offers affordable ways to reduce the amount of electrical power that facilities such as office buildings, labs and factories consume.
- Those companies that are among the first to move to ADR technology will have a competitive advantage over those companies that are slower to adopt. Thanks to technologies such as smart monitoring systems, cloud computing, demand response software and interactive controls, companies now possess ways to reduce costs, curb pollution and make their employees happier.

- Overall, the key to any successful technology program adoption is for local governments and state-owned utilities and distribution companies to work together to provide the financing and regulatory framework.
- integrate into almost any building control system.
- When implementing ADR, a city government should explain the system to the managers who run the building facilities. These building managers need to



Three Gorges Dam, one of the main sources of electricity in China

- Power in China is so inexpensive, and it's
 also subsidized, so there's little motivation
 for businesses to invest in energy-saving
 technology. As a result, the government
 must create more incentives for
 companies to invest.
- Honeywell's ADR technology allows a business to design customized energy reduction strategies for its facilities that utilities can automatically call into action when needed. Through ADR, utilities can quickly and reliably reduce overall energy consumption during peak-use periods, and commercial customers can cut their energy use and costs without losing control over critical operations.
- ADR complies with international open software standards, making it easy to

- know how the systems work and what happens once the systems are activated. The city also needs the building facilitators to give written consent to have the system installed. Finally, the local distribution company, which controls "the last mile" of power lines to the buildings taking part in the pilot project, needs to be brought into the loop.
- Once all the major players are on board, installing ADR causes very little disruption to anyone's business. Once ADR is installed, the facility operators retain complete control over their building. The utility gives its customer at least 24 hours advance notice before reducing or shutting down power to the building.

Endnotes

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