



Yogendra Patwardhan, 10 June 2016

ABB Power & Automation Solid Foundations for Smart Cities

Cities in the Global Context

Already play a significant role

All Cities

Cities today ...

- Home to 50% of the world's population
- Consume over 75% of natural resources
- Account for over 80% of global GDP

... by 2050

- 70% of the world's population
- 2.9 billion more people
- > 90% in emerging economies

Top 600 Cities

Contribution of emerging countries to top 600 cities by growth in GDP 2007 to 2025

- 70% of cities
- 90% of population growth
- 75% of GDP growth

- The top 600 cities
- Additional fast growing cities



Cities will become even more important to our global society, especially those in emerging countries

Key Challenges and Opportunities

As faced by cities to a greater or lesser extent



- **Growth**
 - Population growth
 - Economic growth
- **Competition**
 - Cities competing for investment and talented workforce
 - Citizen expectations for a high quality of life
- **Sustainability**
 - Local pollution and carbon reduction targets
 - Limitation of natural resources
- **Aging infrastructure**
 - Often beyond its intended life span

“Smart Cities” can help address these challenges and opportunities

Smart City Concept

A holistic concept that goes beyond just technology

ABB Smart City Definition

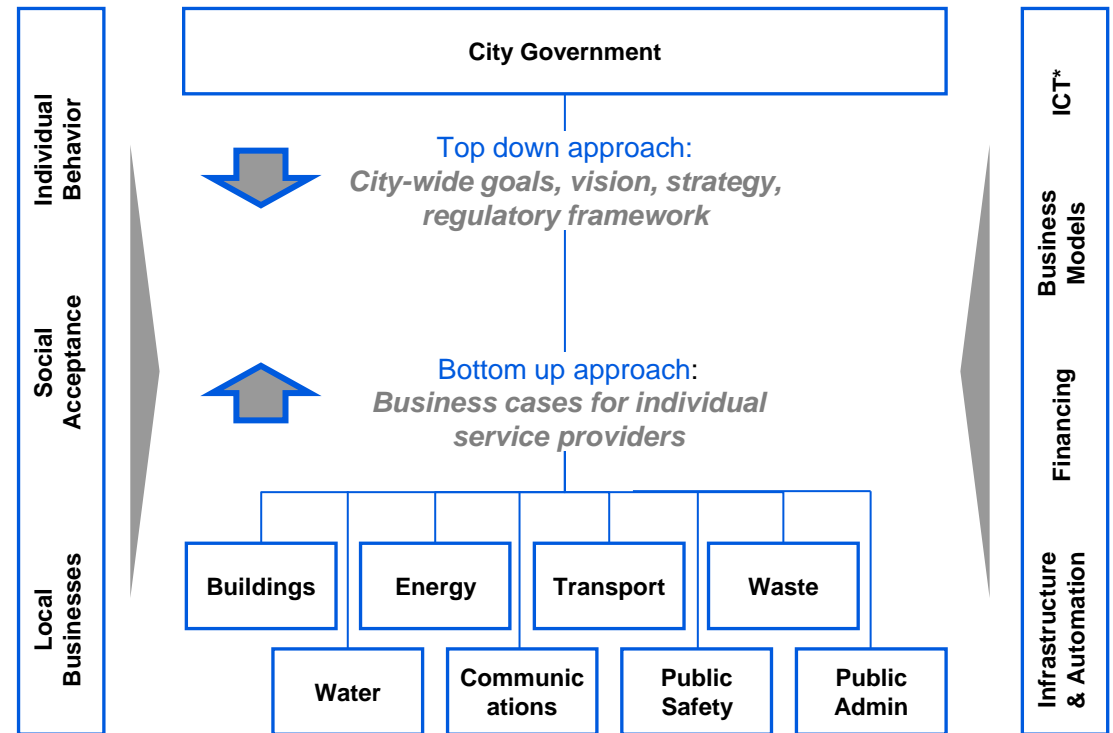
A Smart City optimizes quality of life and drives sustainability and economic growth by integrating and actively managing its infrastructure subsystems and engaging its citizens

Smart city development approach can be top down or bottom up

Citizens / Business

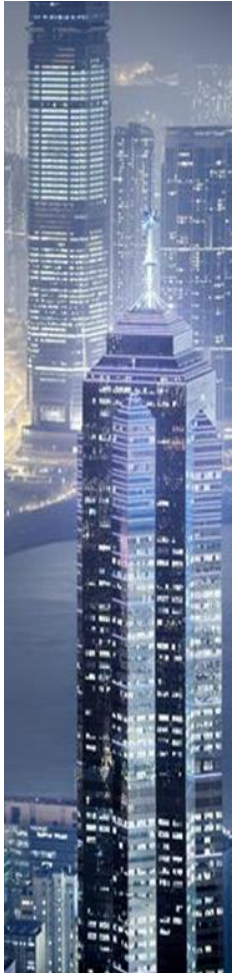
Government & Service Providers

Smart City Enablers



Smartness comes from sensors, automation, solutions that cross boundaries, but also from the right regulations, business models, financing and community engagement

How ABB's offering relates to Smart Cities



ABB's products and solutions are at the heart of a city's critical infrastructure, relied upon for everything from the supply of power, water and heat, to the automation of factories and the buildings we live and work in. Specifically, we offer intelligent solutions in:

- City Communication Platforms
- Electricity Grid
- Water
- Transport
- Buildings
- District Heating and Cooling

ABB Solutions

ABB's Smart City Offering: Power and Automation for critical city infrastructure



ABB Solution Areas:

Cross Cutting



By Segment

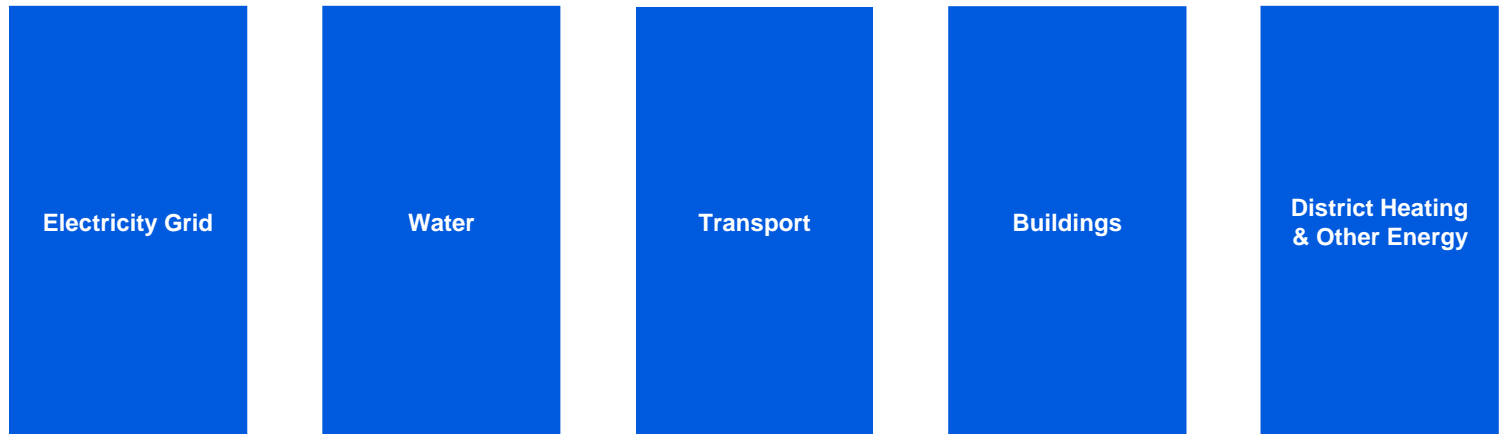


ABB Power & Automation Solution Components:

ABB IT/OT

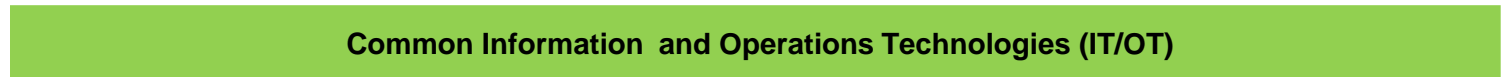


ABB Devices



ABB Services



ABB Solution Area: Communications Platform

High performance wireless network for multiple applications



ABB Tropos Wireless Communications for ...

Benefits

Municipal Workforce



- All services from fire, police ... to building, health inspectors ... to parking enforcement

Utilities
(Water, Gas, Electric)



- Distribution automation
- Advanced metering infrastructure

Intelligent Transportation



- Traffic signal management
- Variable message signs
- Red light enforcement cameras

Video & Public Internet



- Safety as well as crime prevention and prosecution
- Community broadband wireless

How: High Performance Network



- Secure, high availability, scalable network for multiple applications, static and on-the-go connection

- Enhanced public safety
 - Fast mobile connections
- Improved municipal services
 - Shortens time for building, health, fire inspection services
- Improved field worker productivity, reduced costs
 - Workers spend more time on job
- Reduced recurring communications costs
 - E.g., T-1 lines, cellular services
- Enhanced revenue streams
 - E.g., variable rate parking meters, online services
- Economic development
 - Broadband access for business and individuals

ABB Solution Area: Electricity Grid Solutions for evolving system demands*



Power & Automation for ...

Overview

Benefits

<p>Grid Automation</p>		<ul style="list-style-type: none"> ▪ New levels of monitoring, protection and control deeper into the distribution grid 	<ul style="list-style-type: none"> ▪ Improved capacity, efficiency, reliability, sustainability
<p>Demand Response</p>		<ul style="list-style-type: none"> ▪ Incent customers with supply side signals to change demand or feed in generation 	<ul style="list-style-type: none"> ▪ Reduced need to build new generation or grid capacity ▪ Reduced system costs
<p>Renewables Integration</p>		<ul style="list-style-type: none"> ▪ Cope with renewables using voltage regulation as well as distribution grid automation 	<ul style="list-style-type: none"> ▪ Improved reliability of supply ▪ Supports higher share of renewables
<p>Energy Storage</p>		<ul style="list-style-type: none"> ▪ Utilize batteries in the network to address capacity constraints and improve power quality 	<ul style="list-style-type: none"> ▪ Improved network stability, power quality and efficiency

* For example, volatile distributed generation (e.g. solar PV), new loads (e.g. electric vehicles), aging infrastructure, more frequent storms in some areas, regulatory requirements for higher reliability, ...

ABB Solution Area: Transport Infrastructure to effectively electrify transportation



Power & Automation for ...

Overview

Benefits





<p>Electric Vehicle Charging</p>		<ul style="list-style-type: none"> ▪ Charging infrastructure for 15-30 minute charges and longer 	<ul style="list-style-type: none"> ▪ Foster electric vehicle uptake ▪ Cut emissions in the city ▪ Help integrate renewables
<p>Electric Buses</p>		<ul style="list-style-type: none"> ▪ Ultra-fast charging for battery powered electric buses 	<ul style="list-style-type: none"> ▪ Clean, quiet public buses ▪ No overhead cables
<p>Electric Rail</p>		<ul style="list-style-type: none"> ▪ Recuperate braking energy in metro trains and trams 	<ul style="list-style-type: none"> ▪ Reduce energy costs by up to 30% ▪ Potentially sell services to grid
<p>Shore-to-Ship</p>		<ul style="list-style-type: none"> ▪ Infrastructure to power ships with electricity from the shore when berthed 	<ul style="list-style-type: none"> ▪ Eliminate 98% of emissions and all noise and vibration ▪ Improve quality of life near port

ABB Solution Area: District Heating, Other Energy

Advanced control for energy solutions



Power & Automation for ...

Overview

Benefits

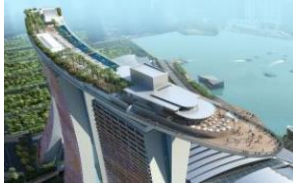
District Heating



- Control and optimize district heating systems

- Energy efficient, cost effective
- Fewer emissions
- Improved air quality

District Cooling



- Control and optimize district cooling systems

- Energy efficient, cost effective
- Fewer emissions
- Improved air quality

Waste to Energy



- Complete power plant systems including instrumentation, control and electrical equipment

- Renewable power
- Waste recycling
- Safe, reliable, economic

ABB Power and Automation Solution Components

Intelligent technologies with broad application



Solution Components

Purpose

Example Technologies

Operations
Technology (OT)



- Real-time control platforms for power networks and industrial electrical and production plant

- Advanced distribution management systems
- Process industry control platform

Information
Technology (IT)



- Monitor, forecast and schedule limited resources

- Workforce, asset management
- Energy, production management
- Virtual power plants

Devices



- Monitoring, control, protection
- Electricity transportation
- Efficiency improvements

- Intelligent electronic devices
- Building automation, motor drives
- Power electronics

ABB
Services



- Comprehensive range of services to support customers

- Engineering & consulting
- Installation & commissioning
- Maintenance outsourcing

ABB's Smart City Offering: Power and Automation for critical city infrastructure

ABB Solutions:

Communications



Key Segments

	Electricity Grid	Water Grid	Transport	Buildings	District Heating & Other Energy
	Reliable, efficient energy supply and management	Optimized water supply and treatment	Efficient and reliable transport infrastructure	Efficient energy management, use and control	Efficient, flexible gas, heating and cooling supply
ABB Solutions	<ul style="list-style-type: none"> ▪ Grid Automation ▪ Demand Response ▪ Renewable Integration ▪ Energy Storage 	<ul style="list-style-type: none"> ▪ Distribution ▪ Treatment ▪ Desalination 	<ul style="list-style-type: none"> ▪ EV Charging ▪ Shore to Ship ▪ Electric Buses ▪ Electric Rail 	<ul style="list-style-type: none"> ▪ Homes ▪ Commercial Buildings ▪ Industry ▪ Data Centers 	<ul style="list-style-type: none"> ▪ District Heating ▪ District Cooling ▪ Waste to Energy

ABB Power & Automation Solution Components:

ABB IT/OT

Common Information and Operations Technologies (IT/OT), typically deployed per application:
SCADA, Control Operations, Asset Management, Workforce Management, Business Analytics

ABB Devices

Common device types for Measurement and Control, deployed per application:
Sensors, Intelligent Electronic Devices (IEDs), LV and MV apparatus and switchgear, Batteries

ABB Services

Common services deployed per application

References

Wireless Communications – Oklahoma City, USA

High performance network for multiple applications



Customer

- Oklahoma City, Oklahoma, USA

Key objective

- Deliver a high performance network to securely support multiple applications for multiple customers, for both fixed and mobile use across 640 sq miles



ABB's Response

- A high performance Tropos wireless mesh network
- High bandwidth, low latency, resilient, secure, scalable, easy to manage
- Partitioned to meet the needs of various departments: Police, fire, security cameras, building inspectors, traffic controllers
- Currently >180 city applications use network
- Delivers efficiencies vs. individual networks

Wireless Communications – Rock Hill, USA

More efficient and cost effective municipal services



Customer

- City of Rock Hill, South Carolina, USA

Key objective

- Deliver a high performance network to enable
 - AMI meter reading (power and water)
 - Public safety
 - Mobile first responders
 - Video cameras
 - Public internet zones

ABB's response

- A high performance Tropos wireless mesh network
- High bandwidth, low latency, resilient, secure, scalable, easy to manage solution resulted in:
 - Increased meter reading accuracy
 - Increased operational efficiencies
 - 7-8 year payback, reduced OPEX
 - Additional applications

Distribution Management – Houston, USA

Improving power reliability in Houston, Texas



CenterPoint Energy is a domestic energy delivery company with more than 2 million metered customers and a long history of service.

Customer

CenterPoint Energy Inc., USA

Key objectives

- Improve reliability by up to 30% in areas with complete full smart grid functionality
- Deployment of initial smart grid to be completed in 2013

Smart grid scope

- Implement an Advanced Distribution Management System (DMS)
- Install remote monitoring equipment at 29 substations
- Install 579 automated field switching and monitoring devices on 226 distribution circuits
- Integrate components to accomplish stated improvements (reliability, monitoring)

Electric Buses – Geneva, Switzerland

An electric bus without overhead lines for Geneva



h e p i a

Haute école du paysage, d'ingénierie
et d'architecture de Genève



Main Partners

- The Geneva public transport authority and operator (TPG), the Office for the Promotion of Industries and Technologies (OPI), the state-owned electricity provider of the city of Geneva (SIG) and the Geneva plant of ABB Sécheron Ltd.
- Other local partners are Hepia school of technology, architecture and landscape and Palexpo conference center

Project Objectives

- Realize a full-scale demonstrator of the very first full electric high-capacity articulated bus running without overhead lines with feeding at bus stops

ABB's contribution

- ABB has developed a new technology that helps to power the world's first flash charging electric bus system. The battery on the bus is charged at selected stops and at the end of the line using fast charging

Shore-to-Ship Power – Rotterdam, The Netherlands

One of the world's largest turnkey shore-to-ship installations

The entire installation, both onshore and onboard the ships, was accomplished within a year and was activated at the Stena Line ferry terminal at the port of Rotterdam in June 2012.



Customer

- Stena Line B.V., a subsidiary of Stena AB, one of the world's largest ferry companies.

Key objectives

- Mitigate the negative impact of ferry operations on the local community and the environment.
- Cut fleet's fuel consumption. Reduce emissions by 98 percent and cut noise and vibrations in ports substantially by connecting ships to the port's electricity grid via shore-to-ship power connection.

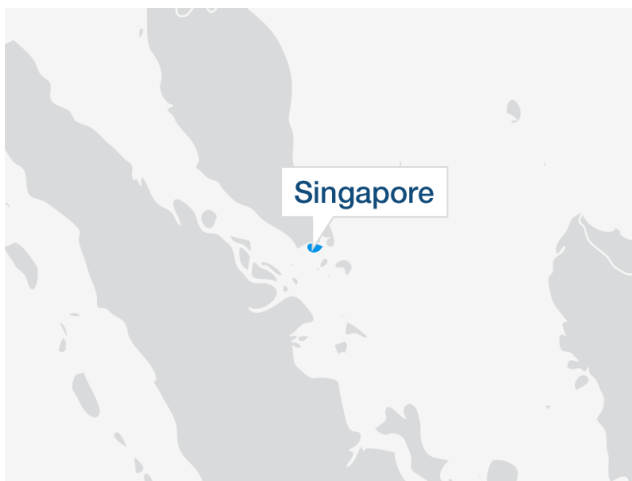
ABB's response – scope of supply

- Turnkey shore-to-ship power installation including design, engineering, project management, installation and commissioning.
- Complete substation and automation package based on PCS 6000 static frequency converters rated at 6 MVA.

District Cooling – Marina Bay, Singapore

The world's most ambitious district cooling project

The Marina Bay district cooling system provides cooling for buildings in the 360 hectare extension of Singapore's existing business district and downtown area.



Customer

Singapore District Cooling Pte Ltd

Key objectives

- Monitor and control 1.1 million square meters of accommodation with cool air via two chilled water production plants and a 5-km piping network
- Electricity prices determine when to produce cold water and store it in the ice-storage tank

ABB's response

- Complete electrical, control and instrumentation solution
- System 800xA, which monitors and controls the entire network of intake stations
- Providing the operators with real-time information on network and equipment performance to fine-tune production in line with demand and energy prices
- Install switchgear, transformers, motor control centers, drives and instrumentation for pressure, flow, temperature and energy metering

District Heating – Copenhagen, Denmark

Securing world class heating distribution

The central control room at CTR and Frederiksberg using ABB SCADA to transmit and distribute heat across 6 municipalities as well as control local heat production.



Customers

- Metropolitan Heating Transmission Company Copenhagen (CTR), Copenhagen Energy (KE) and Frederiksberg Utility

Key objectives

- Deliver cheap and environmental friendly heat to 98% of the citizens of Copenhagen
- Through the world's first heat stock exchange, all kinds of current and future renewable energy is traded. Delivered from the surrounding CHP's
- Storage capacity in insulated tanks at different production facilities, increases efficiency of heat delivery and is the battery that stores excess energy from solar and wind

ABB's response

- SCADA control and automation system, securing optimal heat delivery across the city
- A high degree of automation for reliable distribution that free up time for forecasting and planning

Smart City – Kalasatama, Finland

Building a smart city in the heart of Helsinki



Helsingin Energia is one of the largest energy companies in Finland, supplies electric energy to about 400,000 customers in Finland and covers more than 90% of heat demand of the capital city.

Customer

Helsingin Energia

Key objectives

- Develop a model area for a smart power grid in the new Kalasatama district
- Help to lower consumption and emissions with implementation of state-of-the-art energy, information and automation technology
- Provide 10,000 jobs and homes for about 18,000 residents in Helsinki's area by year 2030

Smart grid scope

- Demand Response Management
- Integration of renewable energy
- Integration of electric vehicles
- Energy storage
- House and building automation

Summary

Summary

Smart Cities

There are strong drivers to consider investing in intelligent city infrastructure:

- Rapid growth of urban populations in emerging economies
- Competition for business and talent in developed economies
- Sustainability for both

Smart cities can help to meet these goals by applying intelligence and automation in combination with the right regulations, business models and stakeholder engagement

ABB offers foundational technologies for Smart Cities, for everything from the supply of power, water and heat, to the automation of factories and the buildings we live and work in

ABB's heritage in power and automation is one of continued innovation and delivery on behalf of our customers, spanning over 125 years.

Power and productivity
for a better world™

