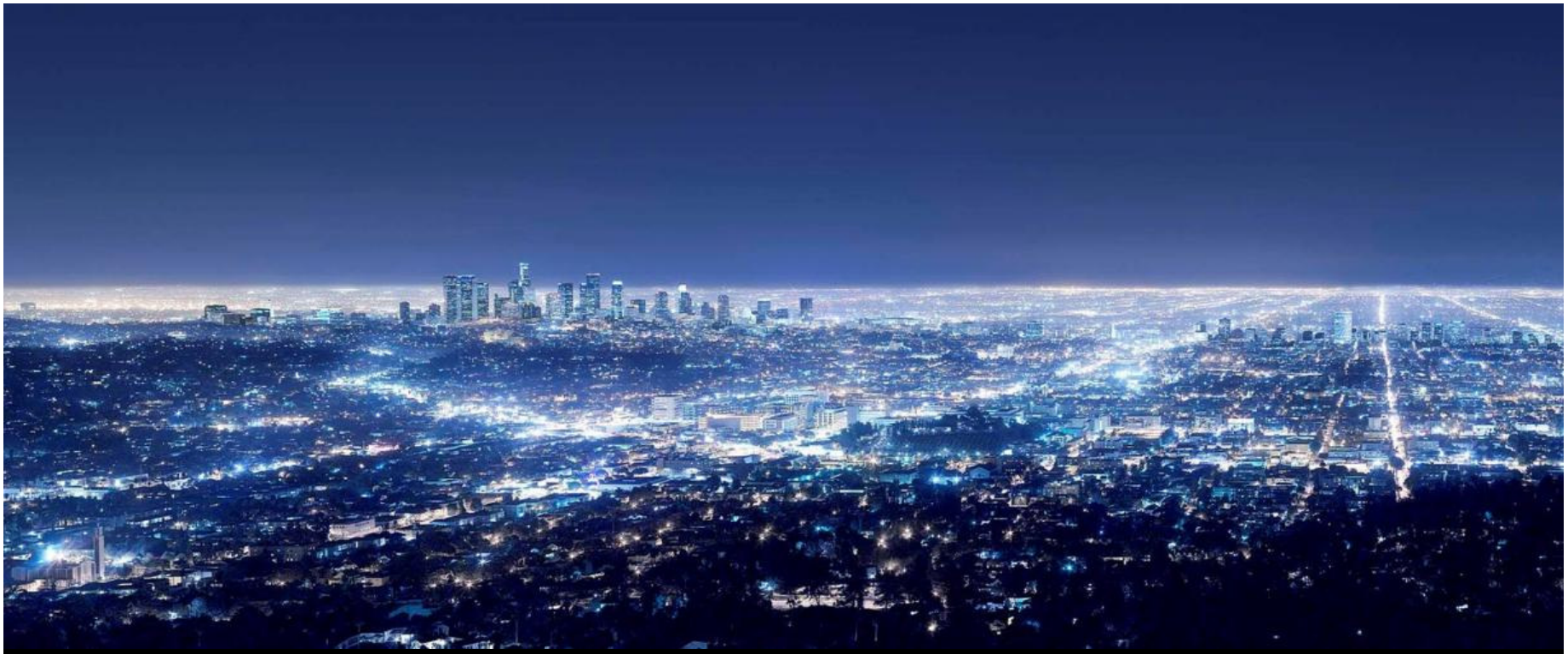


Smart City, August 2015 - Stresa

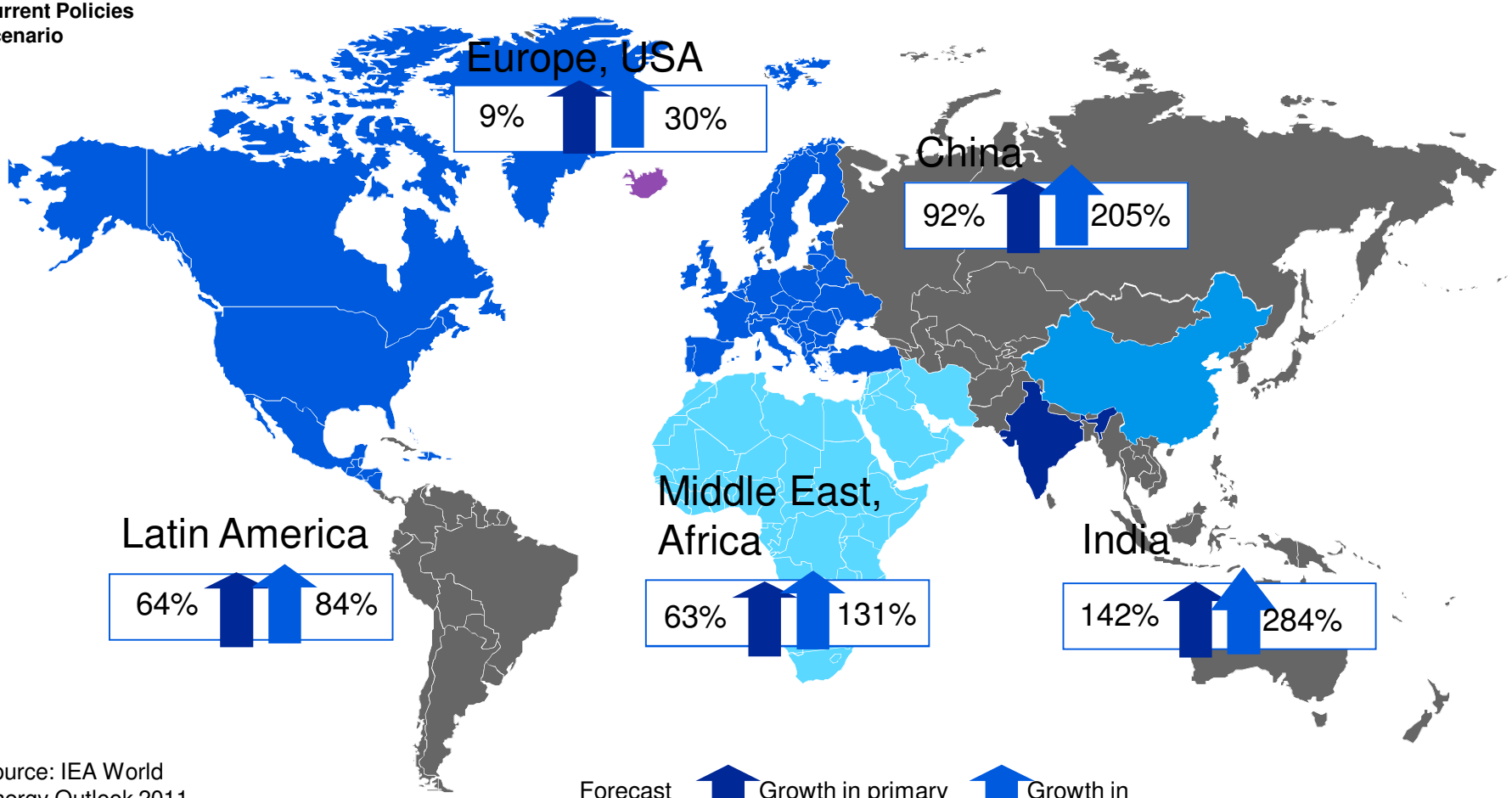
Smart Cities and Electric Power System

ABB makes cities smarter

Power and productivity
for a better world™

Today's energy challenge
Soaring demand; electricity growth greater than average

Current Policies Scenario



Source: IEA World Energy Outlook 2011

Forecast 2009-35: Growth in primary energy demand | Growth in electricity demand

Today's energy challenge
The evolving grid

- **Considering that:**
  - Electricity is the most versatile and widely used form of energy in the world, developed over the past one hundred years
  - More than 5 billion people have access to electrical energy
  - The electrical system ranges from power generation and transport to final consumption
- **Its evolution is ongoing but we urgently need to speed up the development**
  - To mitigate global climate change the electrical system needs to change quickly
  - We need a much better power system

Today's energy challenge
Cut link between growth, energy use and emissions

Meeting these challenges requires the world to:

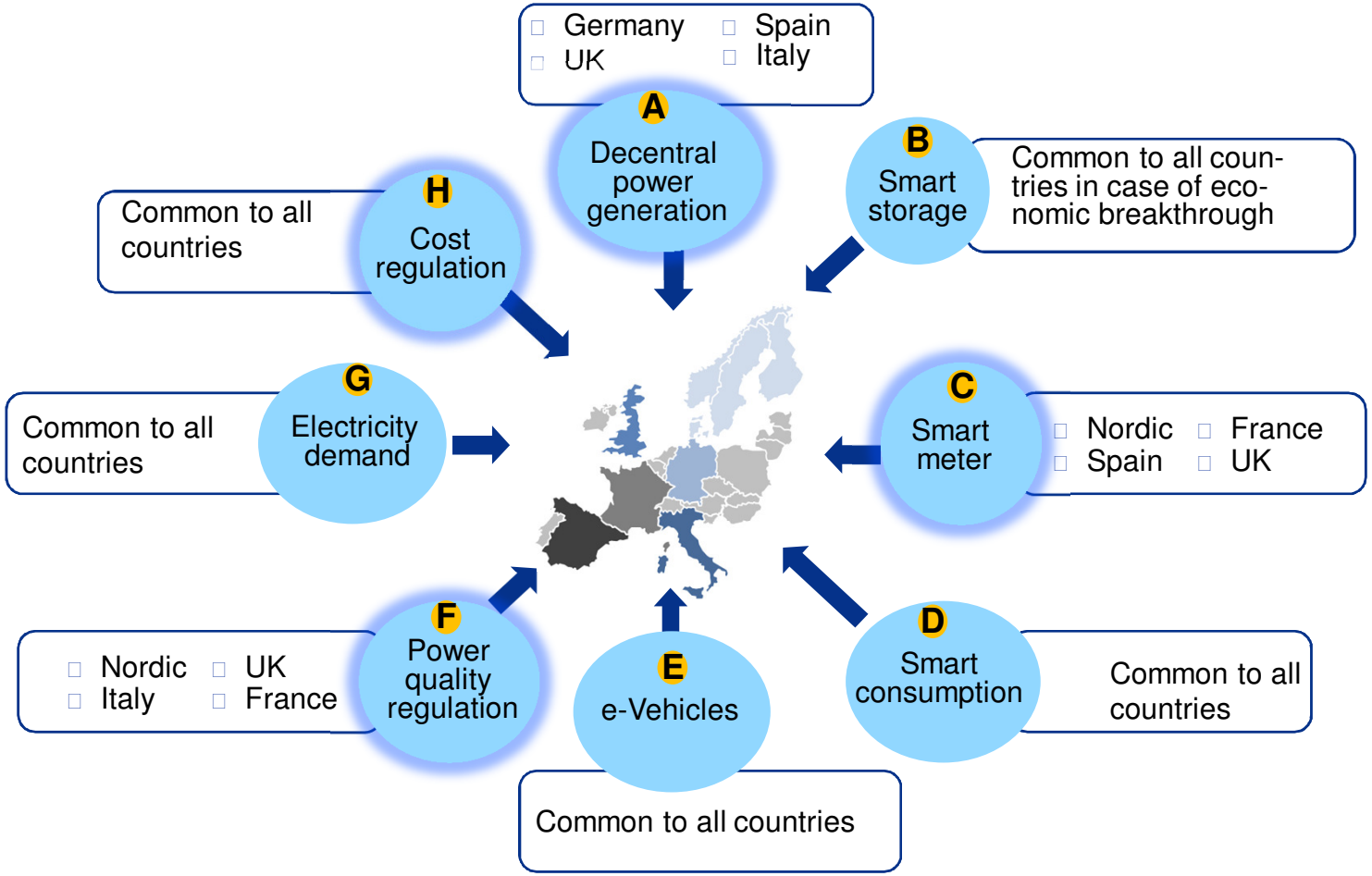
Reduce the correlation between economic growth and energy use

Reduce the correlation between energy use and emissions

Energy efficiency

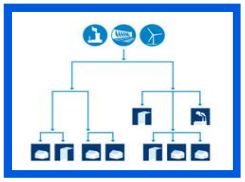
Renewable sources of energy

European Drivers of Grid Development



Consequences all over the value chain
The way becomes clearer

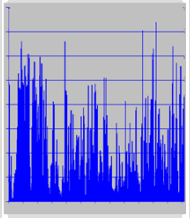
From Traditional grid



To smart grid

Driver	Consequences	
Strong growth of bulk, remote generation	Need of long-distance transmission capacity	overdue
Strong growth of distributed generation	New challenges for distribution networks - Voltage control - Capacity - Protection - Remote supervision, control	increasingly relevant now
Strong growth of volatile generation	Widely spread consequences - Mix of different sources ⇒ transmission capacity - Demand response - Storage	will be required 2015+
High generation peaks	Bulk storage	will be required 2020+

Strong drivers towards a new type of power systems
Consequences

Driver		Conv. generation	Transmission	Distribution	System operation	Application
Remote, bulk generation			Long dist. transmission Overlay grid/HVDC			
Distributed generation				Automation Voltage regulation	Communi-cation infra-structure Control	
Volatile generation		High efficiency all over the output range Flexibility	Trans-regional leveling Overlay grid/HVDC Bulk storage	Distributed storage	Demand response	Storage (in applications) Demand response
Cost pressure, ageing infrastructure			Asset health management	Automation Asset health management		Demand response
New loads (E-mobility)				Charging infrastructure	Demand response	

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

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

Source: McKinsey 2011, UNEP 2009, EIU 2012

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

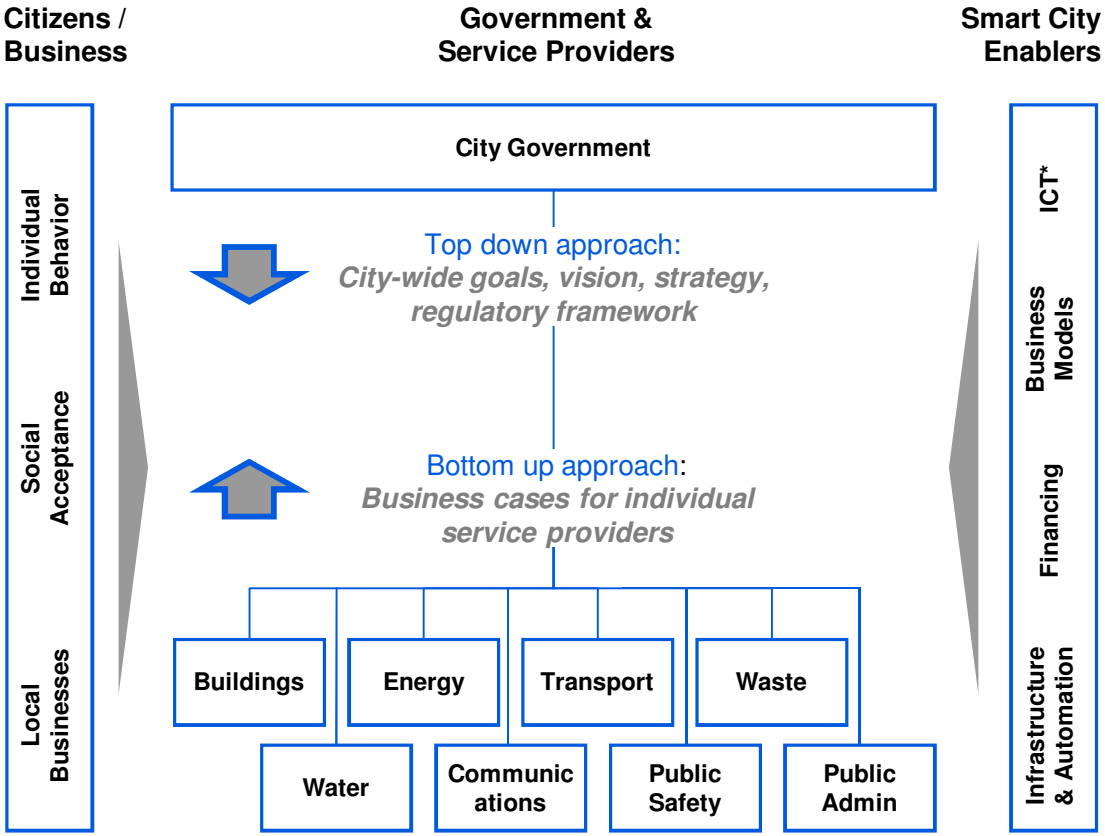
Cities and governments recognize these challenges by putting Smart Cities on their political agendas

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



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

* ICT = Information and Communications Technology

The visionary: Distribution Grid Modernization
Foundation is based on Five Objectives

Capacity	Upgrade/install capacity economically Provide additional infrastructure (PHEVs, Renewables)
Reliability	Stabilize the system and avoid outages Provide high quality power all the time
Efficiency	Improve efficiency of power generation Reduce losses in transport and consumption
Sustainability	Connect renewable energy to the grid Useful life of products as technology changes
Safety	Eliminate or reduce risk of harm or injury

How ABB's offering relates to Smart Cities/Smart Grid

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

ABB Solution Areas:

Cross Cutting — **Communications Platform**

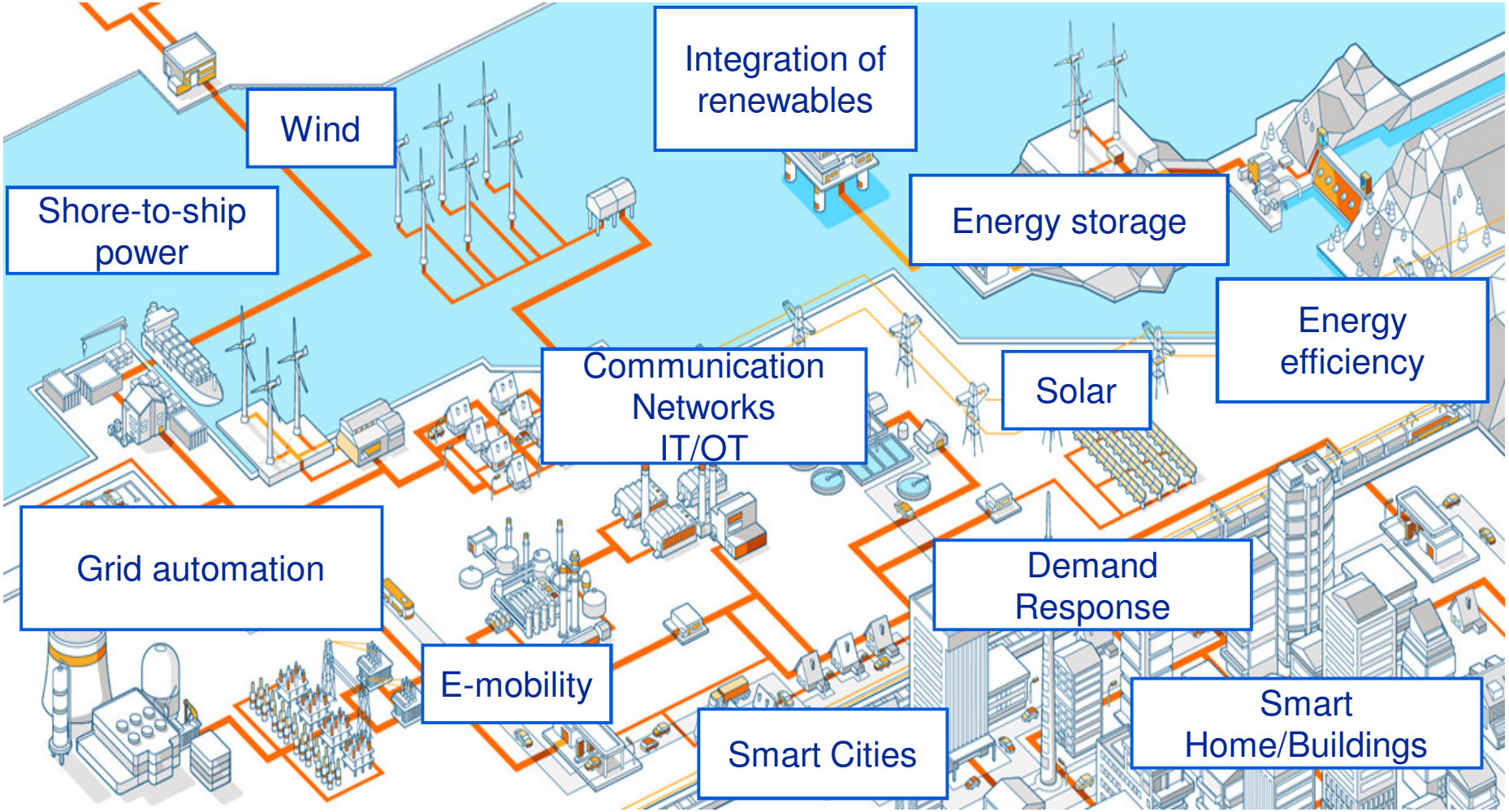
By Segment

- Electricity Grid
- Water
- Transport
- Buildings
- District Heating & Other Energy

ABB Power & Automation Solution Components:

ABB IT/OT	**Common Information and Operations Technologies (IT/OT)**
ABB Devices	**Common device types for Measurement and Control**
ABB Services	**Common services deployed per application**

The evolving grid
New intelligence



Collaboration accelerates smart grids understanding
Selective investments enhance the ABB portfolio

Acquisitions

Ventyx An ABB Company
epyon POWER
THOPOS networks
OBVIENT STRATEGIES
MINCOM
powercorp www.pcorp.com.au

Research initiatives

GM
North Carolina State University
MIT Massachusetts Institute of Technology
PURDUE UNIVERSITY
EPRI
eit European Institute of Innovation & Technology
Tianjin University (Peiyang University) 1895

Investments and strategic partnerships

Trilliant
POWER ASSURE
INDUSTRIAL DEFENDER®
Pentalum know your wind
AQUAMARINE POWER
ecotality
VIOLA systems
VALIDUS DC SYSTEMS, LLC

Combination of acquisition, investment, strategic partnership and research initiatives are expanding ABB market scope

Pilot projects enable smart grids understanding
Development in all relevant areas

Pilot projects help customers and suppliers understand the relationship of technology, economics and regulation

Diverse players planning projects

Smart grid projects address these areas

- Distributed generation
- e-Mobility
- Demand response
- Distribution grid automation
- Meters and communication
- Network management
- Energy storage
- Zone concept
- Substation automation
- Shore-to-ship power
- Projects covering all areas

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

Power & Automation for …		Overview	Benefits
Grid Automation		New levels of monitoring, protection and control deeper into the distribution grid	Improved capacity, efficiency, reliability, sustainability
Demand Response		Incent customers with supply side signals to change demand or feed in generation	Reduced need to build new generation or grid capacity Reduced system costs
Renewables Integration		Cope with renewables using voltage regulation as well as distribution grid automation	Improved reliability of supply Supports higher share of renewables
Energy Storage		Utilize batteries in the network to address capacity constraints and improve power quality	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's Smart City Offering:
Power and Automation for critical city infrastructure

ABB Solutions:

Communications

Communications Platform
Single, high performance wireless network supports hundreds of applications and facilitates integration

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	□Grid Automation □Demand Response □Renewable Integration □Energy Storage	□Distribution □Treatment □Desalination	□EV Charging □Shore to Ship □Electric Buses □Electric Rail	□Homes □Commercial Buildings □Industry □Data Centers	□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

… true smartness comes from integration across different solution area

ABB

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for a better world™

ABB