SMART CITIES: TECHNICAL AND SOCIETAL CHALLENGES

FROM A SILICON SAXONY PERSPECTIVE

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16.10.2014

Grand Societal Challenges

Urbanization

United Nations: By 2020, 60% of the world's population will live in cities, in 2050 it will be even 75%.

Picture: Shenzhen, China – 1979 0.03Mio → 2011 10.5Mio

Demographic Change

The world's population is constantly getting older: In 2050, 50% of Germans will be older than 50 years.

Picture from Infineon Technologies AG

Energy Resources

With limited fossil resources (coal, oil, gas) but a growing population we will need 50% more energy worldwide by 2030.

Picture from Infineon Technologies AG

Digitalization

The trend towards mobile use of the Internet and its services will add further considerable momentum to digital life

Picture from Infineon Technologies AG

Content

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Silicon Saxony Comprises Microelectronics and ICT in Saxony

SAXONY!
A Place in Motion

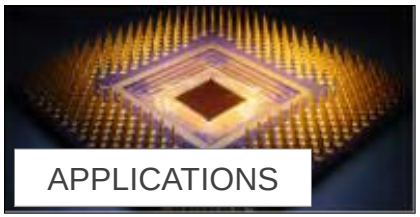
Facts:

- 2,100 companies
- 51,000 employees
- Turnover €11 billion

Silicon Saxony e.V. Is Structured into 6 Divisions

> 300 Member Companies

Divisions



Working Groups

- IC Design
- 450 mm
- RFID
- Cyber-physical Systems
- …

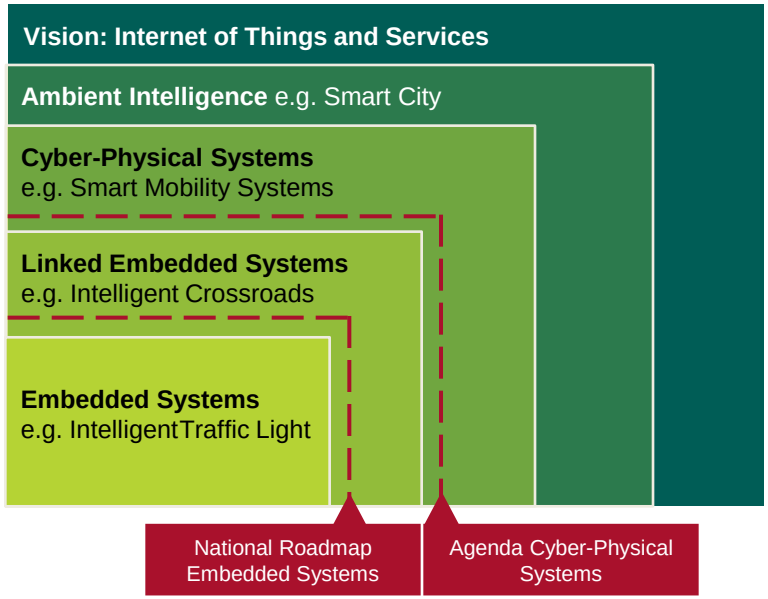
CPS Are a Global Key Technology

Powerful, autonomous microcomputers (embedded systems) are increasingly being wirelessly networked with each other and with the Internet. This is resulting in the convergence of the physical world and the virtual world (cyberspace) in the form of Cyber-Physical Systems.

Following the introduction of the new Internet protocol IPv62 in 2012, there are now sufficient addresses available to enable universal direct networking of smart objects via the Internet.

This means that for the first time ever it is now possible to network resources, information, objects and people to create the Internet of Things and Services.

Cyber-physical systems and the technologies behind have enormous economic potential for Germany.



Source: acatech, 2013

The AK CPS Provides a Platform for Collaboration

- The Working Group CPS has been established in 2012
- We meet 6 times per year
- We are grouped in active sub teams and maintain close collaboration with BITKOM AK CPS since 2014

- Vision
  - Silicon Saxony is a leading European center of excellence for cyber-physical systems
- Fields of Applications:
  - **Smart Cities**
  - Smart Factory (Industry 4.0)
  - Internet-of-Things

Members: 30+ companies and institutions with focus in Saxony, including:

Active Collaboration Resulted in the Initiative Smart City Dresden

Branchenverband Silicon Saxony diskutiert Modell „Smart City" – Chance und Herausforderung für Dresden

Smart City – Dresdens digitale Zukunft beginnt jetzt

Wirtschaft "Stadtentwicklung 2.0" - intelligent vernetzte Infrastrukturen waren ein Thema beim 8. Silicon Saxony Day

Von Ute Nitsche

Smart Cities heißen solche Städte, die über intelligent vernetzte Infrastrukturen verfügen, die den Einwohnern auf vielfältige Weise im Alltag begegnen - oft ohne dass sie überhaupt bemerkt werden. Sie dienen z. B. der Einsparung von Energie oder der Sicherheit. So können etwa Verkehrsströme erfasst werden, um Staus zu vermeiden und die Geschwindigkeit der einzelnen Autos auf die Ampelschaltung abzustimmen.

Anlässlich des 8. Silicon Saxony Day informierten kürzlich Vertreter des Silicon Saxony e.V. im Rathaus am Dr.-Külz-Ring über solche Technologien für die Stadt der Zukunft.

Die Grundlage dafür bilden sogenannten Cyber-physikalischen Systeme (CPS), für die Sachsen als Mikroelektronik-Standort die Schlüssel- und Querschnittstechnologien liefert. Damit habe der Freistaat einen

Beim 8. Silicon Saxony Day (v.l.n.r.) in Dresden: Heinz Martin Esser, Vorstand Silicon Saxony e.V., Markus Ulbig, Sächsischer Staatsminister des Inneren, Uwe Gäbler, Leiter Arbeitskreis "Cyber-physikalische Systeme" im Silicon Saxony e.V., und Dr. Wolfgang Sinn, Co-Leiter Arbeitskreis "Cyber-physikalische Systeme" im Silicon Saxony e.V

Foto: Ute Nitsche

Sächsische Zeitung
SZ-ONLINE.DE

Die Städte brauchen mehr Chips

Wenn die Autos der Zukunft miteinander sprechen, nutzen sie neueste Elektronik. Dresdner bereiten sie vor.

21.06.2013 Von Georg Moeritz

Zwei Räder und ein Lenkrad – nur eine Variante des Stadtflitzers der Zukunft. Über das Aussehen künftiger Fahrzeuge ist noch nicht entschieden, aber über eine wichtige Technik: Mikrochips und drahtlose Netze verbinden die Verkehrsteilnehmer. Foto: General Motors

Dresden. Ob das typische Familienauto in 20Jahren seine Energie nur aus Akkus bekommt, das steht noch nicht fest. Ob der Wagen der Zukunft ganz ohne Steuer auskommt oder das Selbstlenken zum Spaß noch erlaubt, auch das ist nicht entschieden. Aber eines wissen die Zukunftsforscher genau: Autos werden miteinander drahtlos kommunizieren, und auch mit Ampeln und Verkehrsschildern.

Dresden gehört zu den Städten, in denen ein Teil dieser Technik heute schon funktioniert. Und in Dresden stehen auch Fabriken und Softwarefirmen, die Produkte für den Verkehr und für die „Smart City" entwickeln, für die „intelligente" Stadt der Zukunft. Hans-Martin Esser als Vorsitzender des Vereins Silicon Saxony sagte am Freitag bei einem Pressegespräch, jetzt sei „die richtige Zeit", um die elektronische Vernetzung vorzubereiten. Am Montag treffen sich in Dresden 500 Experten auf Einladung des Vereins, der Sachsens Firmen und Forscher der Informations- und Kommunikationsbranche vertritt. Sie kennen auch Risiken der Chiptechnik.

Verkehr: Autos treten mit Schildern und Ampeln in Verbindung

Wer mit dem Auto nach Dresden hineinfährt, hat die Tafeln schon gesehen: Flüssiger Verkehr oder Stau werden angezeigt, freie Parkplätze, aber auch gesperrte Brücken. Das Elbe-Brücken-Informationssystem Ebis ist in Deutschland das erste seiner Art für Innenstädte. Ampeln an großen Kreuzungen geben Bussen die Vorfahrt, die Anzahl und Fahrtrichtung von Fahrrädern werden erfasst, um das Radwegenetz zu verbessern. Uwe Gäbler arbeitet für den Infineon-Konzern in Dresden und sieht in dieser Technik Exportchancen und „enormes wirtschaftliches Potenzial". Schließlich stellt Infineon in Dresden Mikrochips her, von denen immer mehr auch in Autos stecken. Gäbler weiß, dass teure Wagen heute schon Verkehrsschilder erkennen und aufs Tempolimit achten – doch das sei störanfällig. „Besser wäre es, wenn die Schilder eine Internetadresse hätten", sagt Gäbler. Autos und Verkehrszeichen treten bald elektronisch in Verbindung.

Fabriken: Automaten bestellen selbst den Warennachschub

Was im Verkehr bevorsteht, gibt es in modernen Fabriken schon: Gerade in den Chipfabriken von Infineon und Globalfoundries in Dresden steuert Elektronik einen Teil der Produktion. Da sausen Transportkisten an Deckenschienen durch die Hallen und setzen ihre Fracht exakt und zur rechten Sekunde ab. Silicon-Saxony-Chef Esser arbeitet für das Unternehmen Roth&Rau Ortner GmbH, das fahrerlose Transportsysteme für Fabriken entwickelt. Die Fabriken sollen nicht ohne Menschen auskommen – aber laut Esser mit asiatischer Billigproduktion mithalten.

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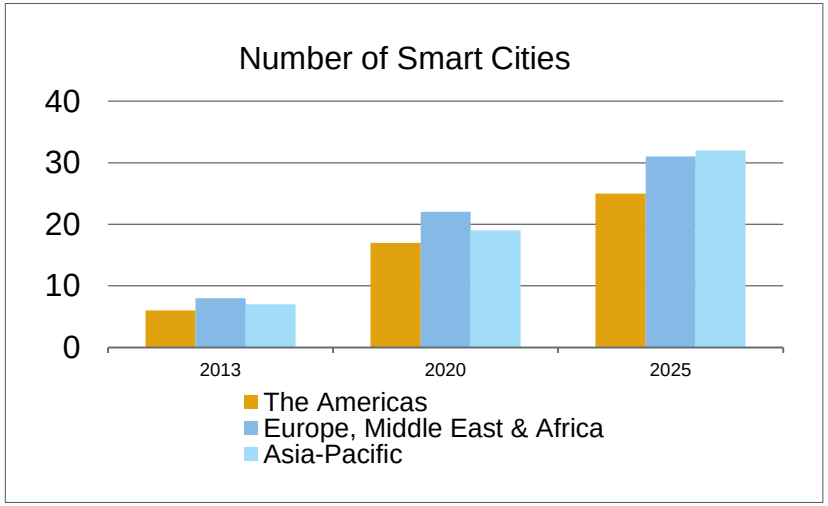
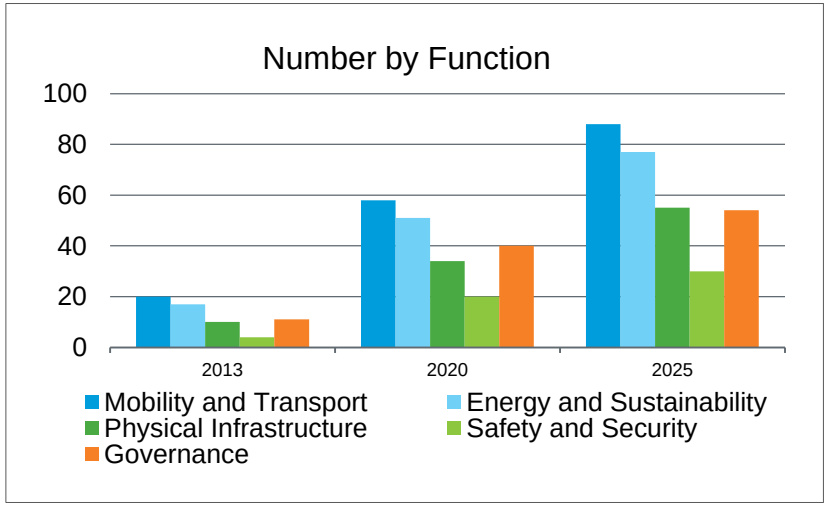
A Definition

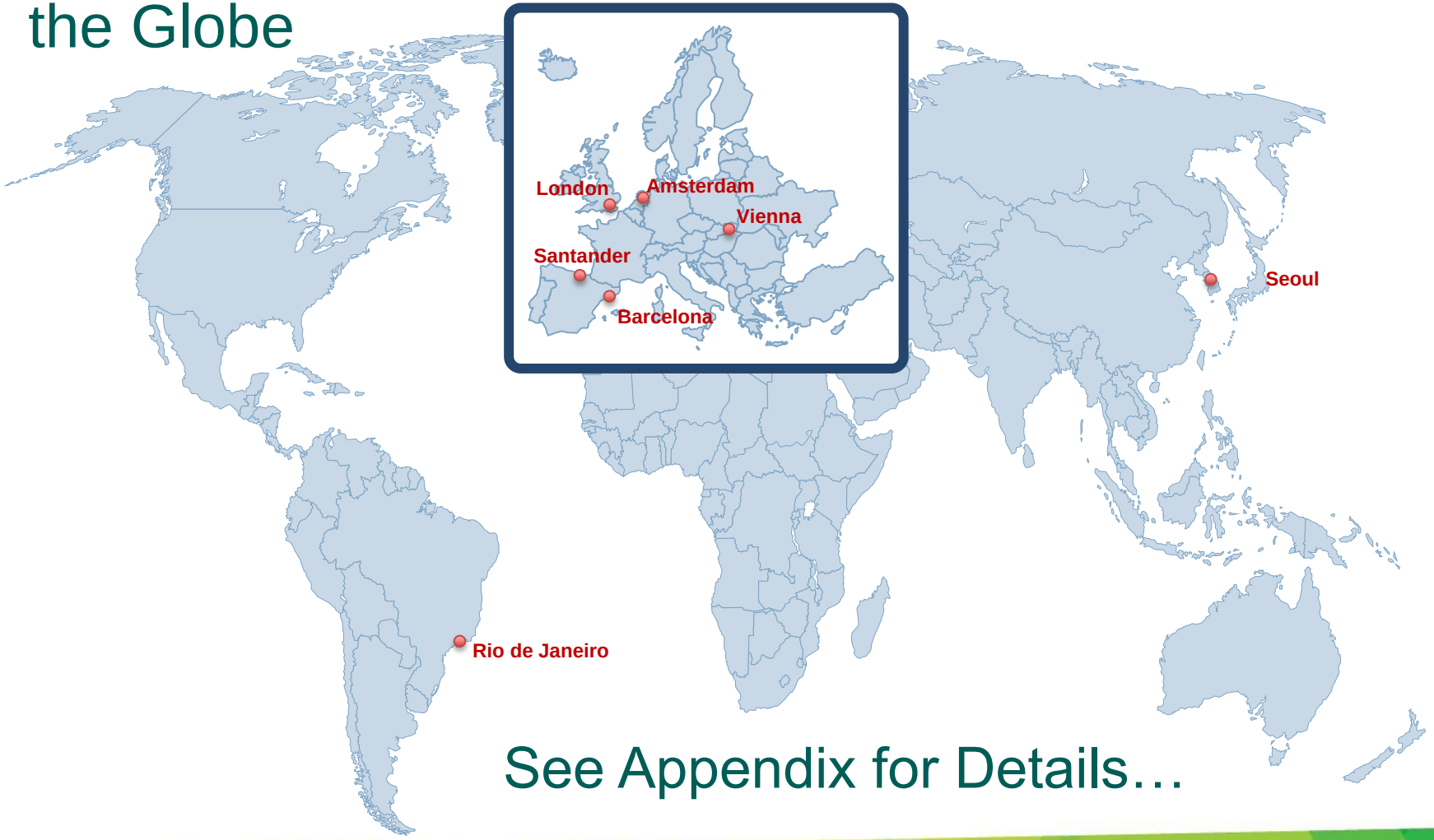
A Smart City is a developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas: Economy, Mobility, Environment, People, Living, and Government (IHS2014).





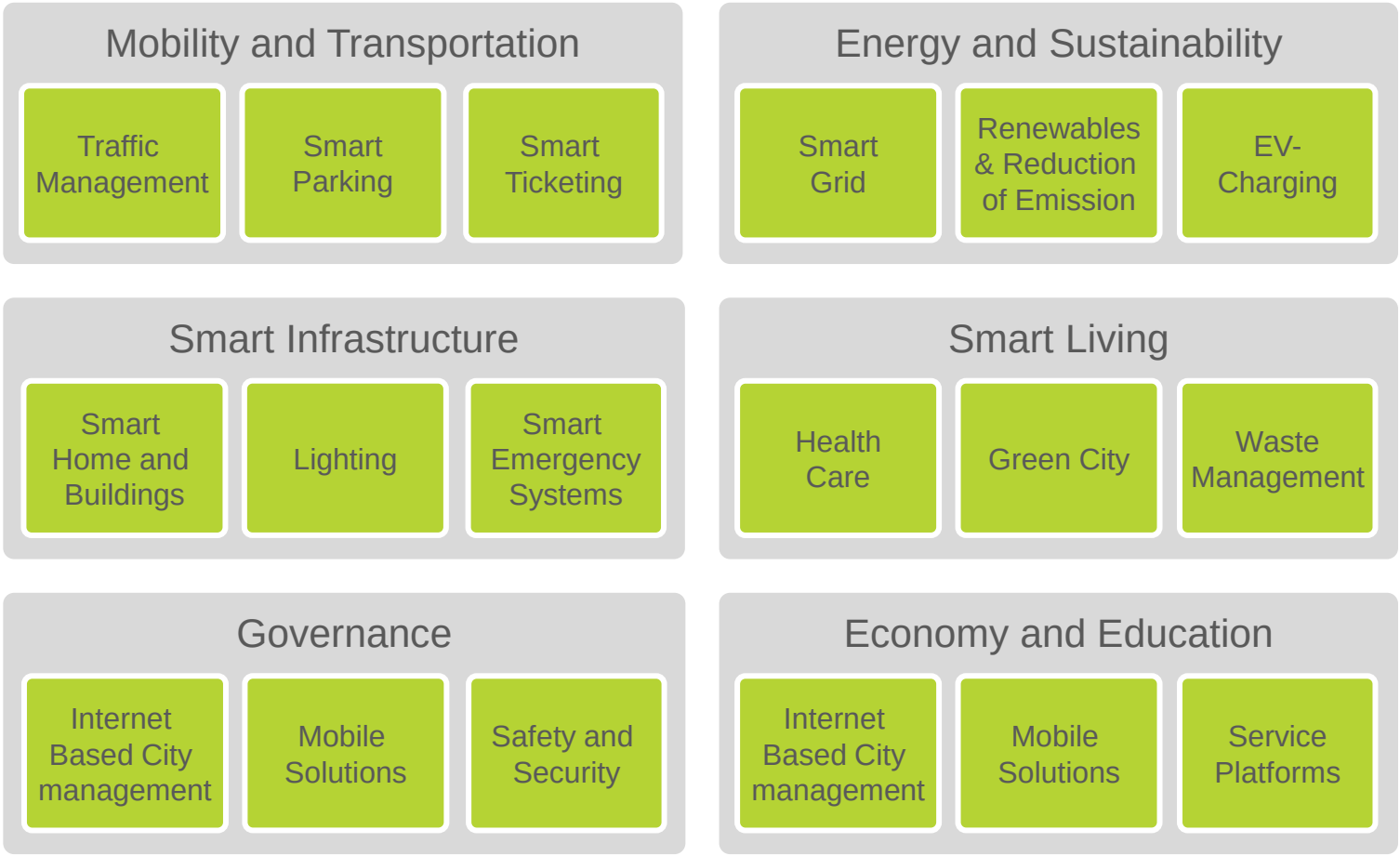
Source: IHS_Smart_Cities_Business_Models_Technologies_and_Existing_Projects_World_2014_Database

Smart City Case Studies Can Be Found Across the Globe

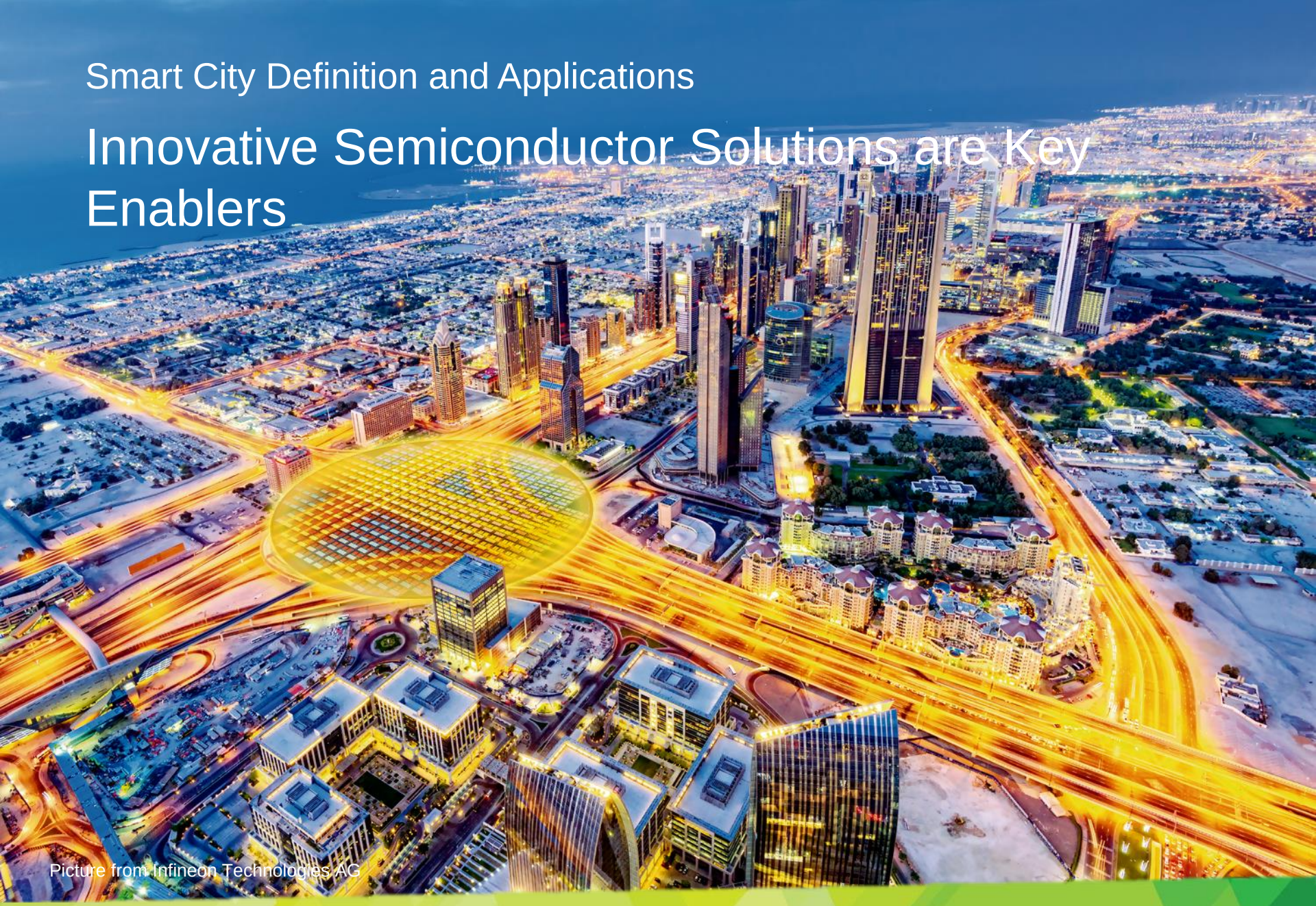


See Appendix for Details…

Applications Range From Mobility to Education



Innovative Semiconductor Solutions are Key Enablers



Picture from Infineon Technologies AG

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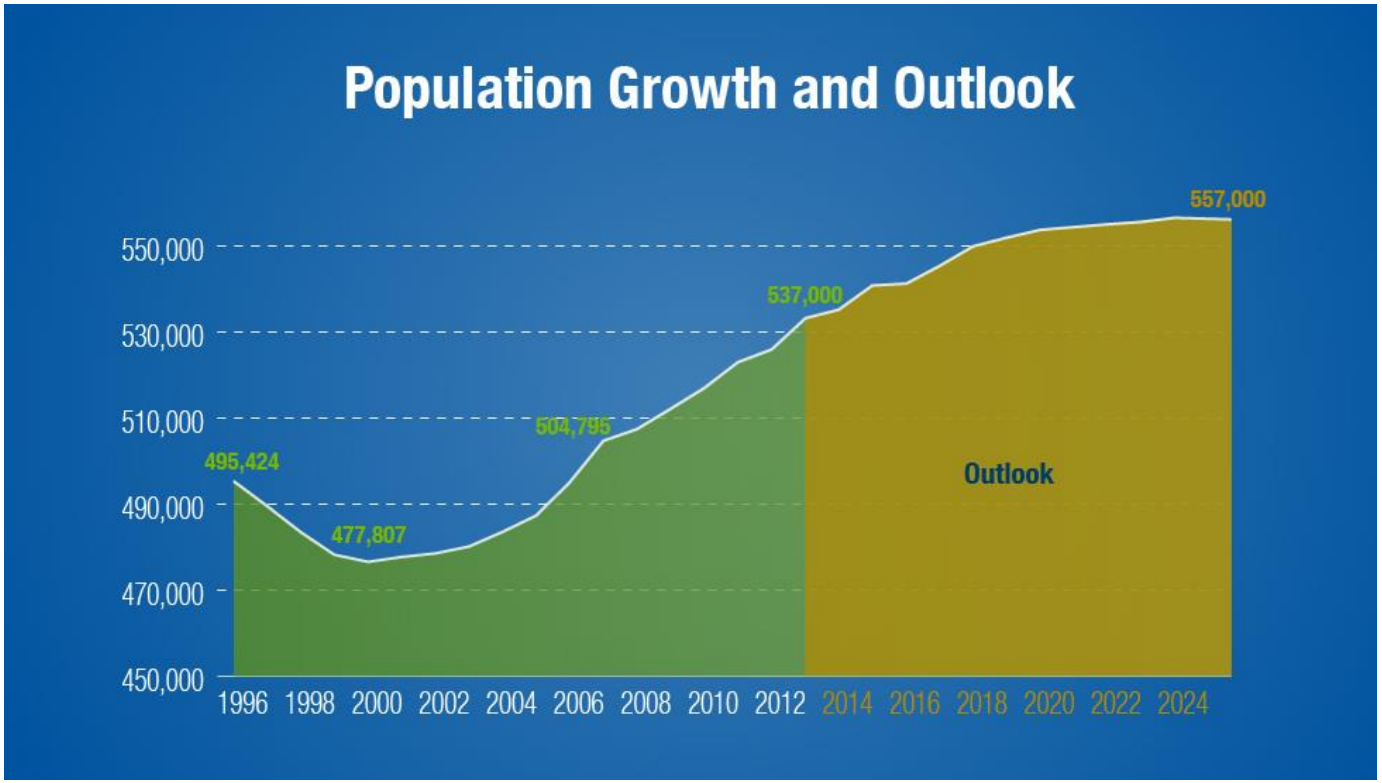
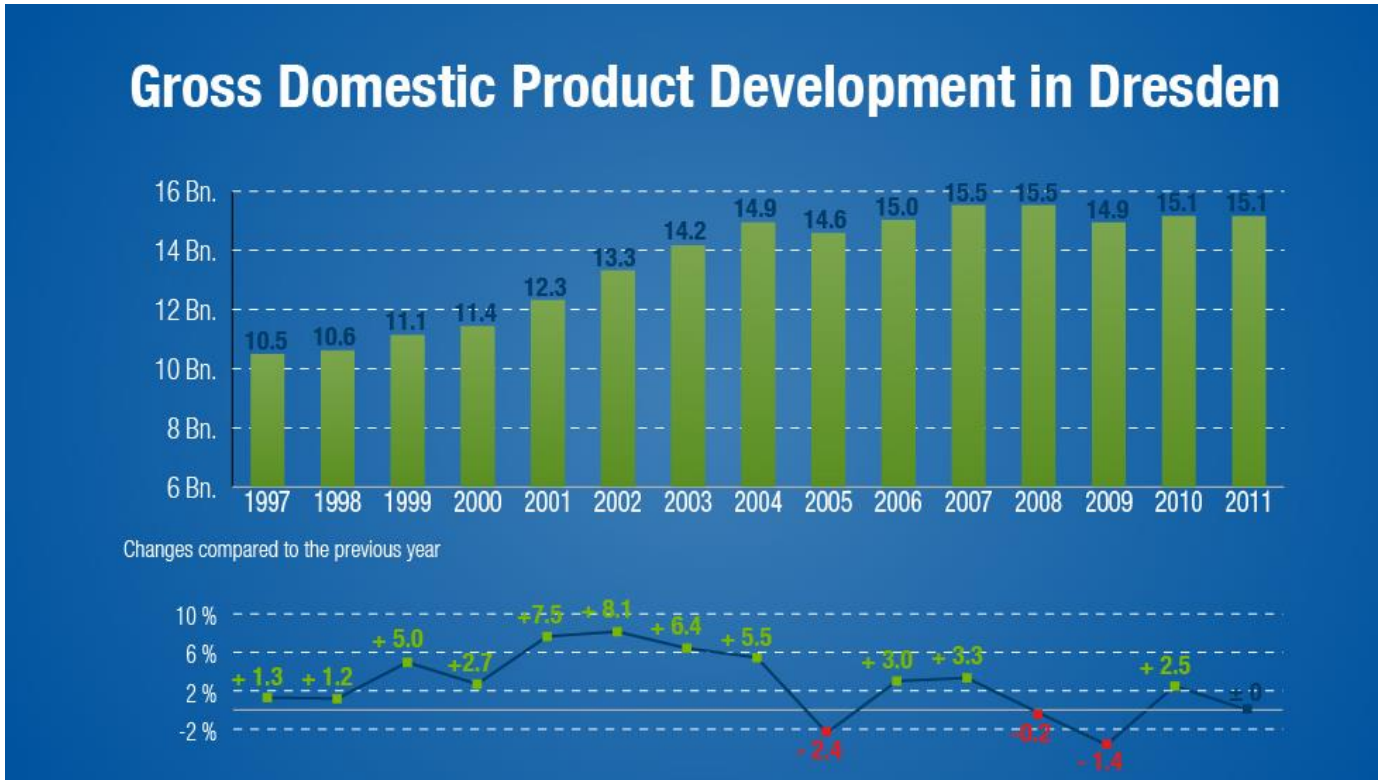
Is Dresden a Smart City Yet?

Dresden Is a Growing City



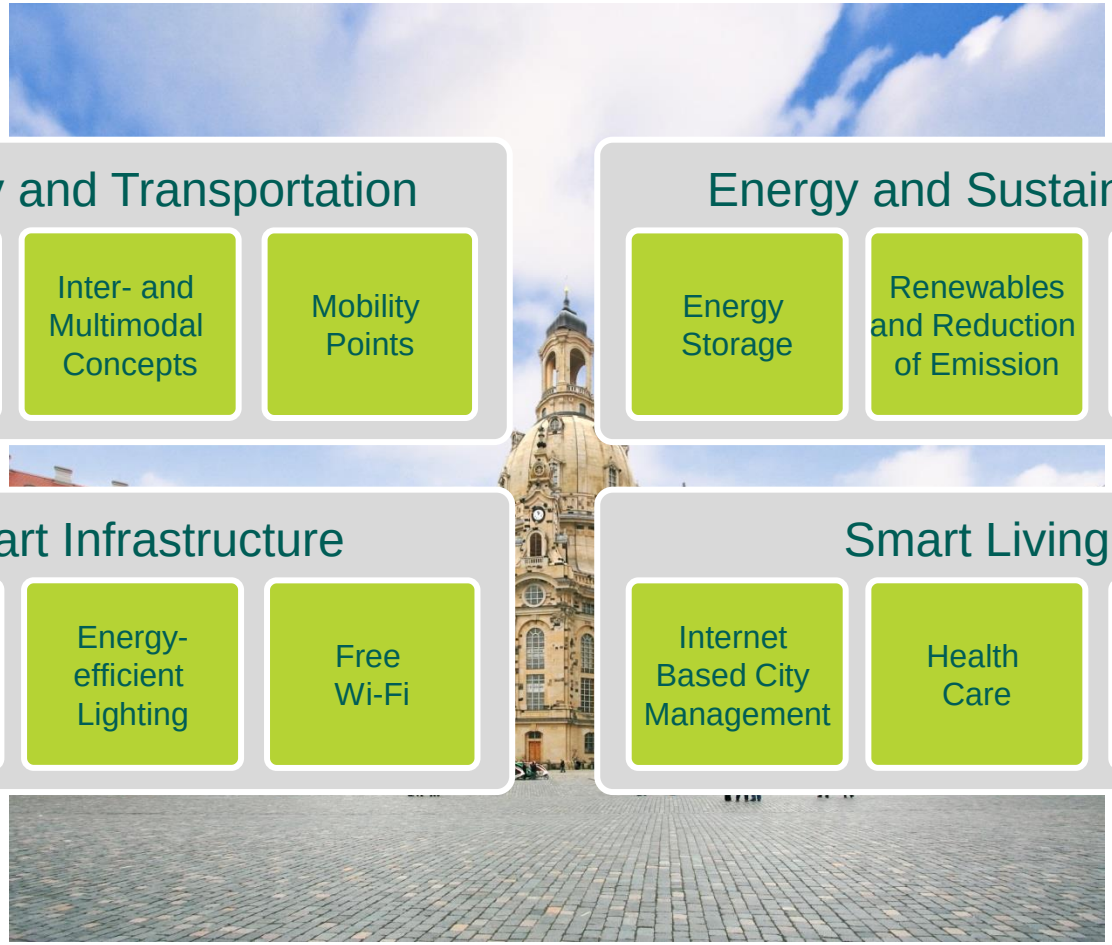
Source: Statistisches Bundesamt, Statistisches Landesamt Sachsen

Dresden's GDP Has Risen More Than 50% Since the Mid-90s



Source: Volkswirtschaftliche Gesamtrechnung der Länder

Dresden Is Engaged in Multiple Smart City Areas



Mobility and Transportation

- Smart Traffic Management
- Inter- and Multimodal Concepts
- Mobility Points

Energy and Sustainability

- Energy Storage
- Renewables and Reduction of Emission
- EV / E-Bike Charging

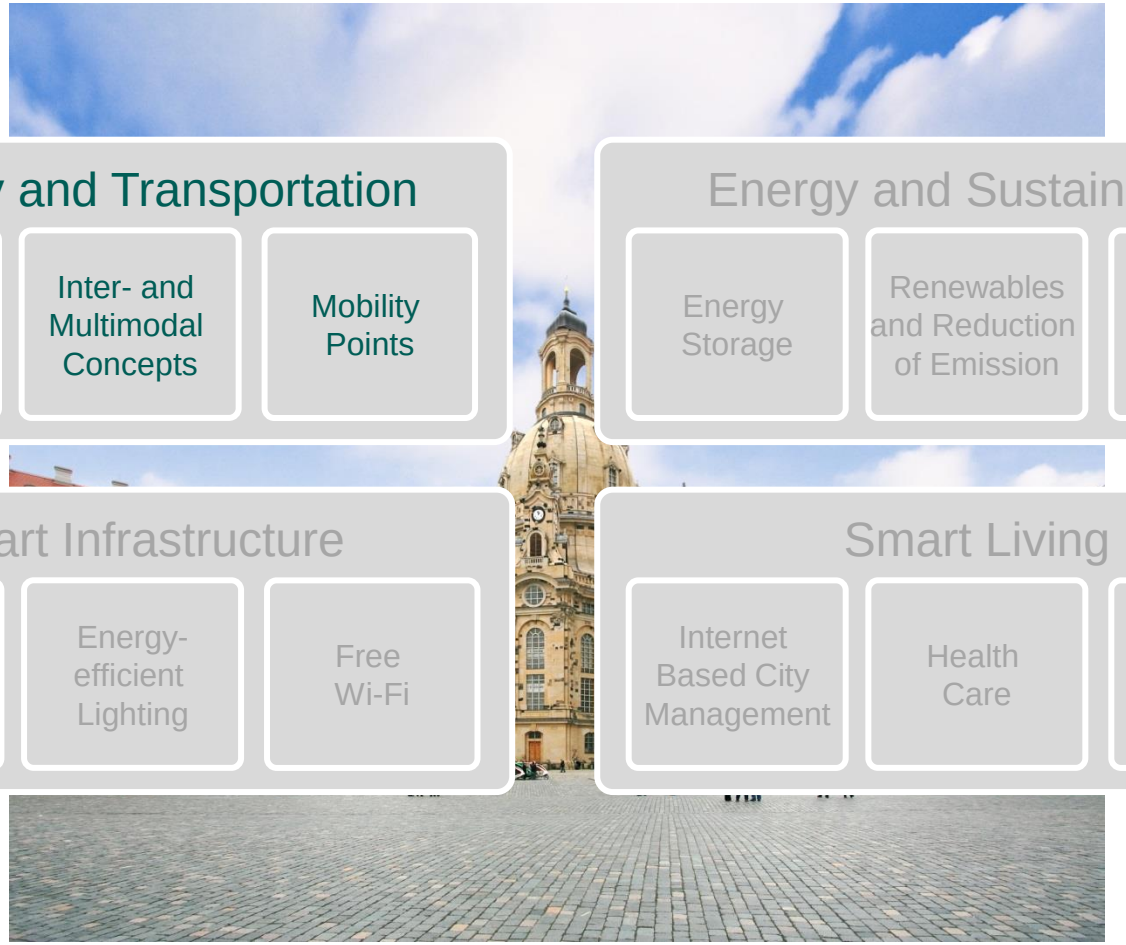
Smart Infrastructure

- Smart Home and Office
- Energy-efficient Lighting
- Free Wi-Fi

Smart Living

- Internet Based City Management
- Health Care
- Citizen Involvement (“Dresdner Debatte”)

Most Advanced is the Area of Traffic Management



Mobility and Transportation

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Energy and Sustainability

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Smart Infrastructure

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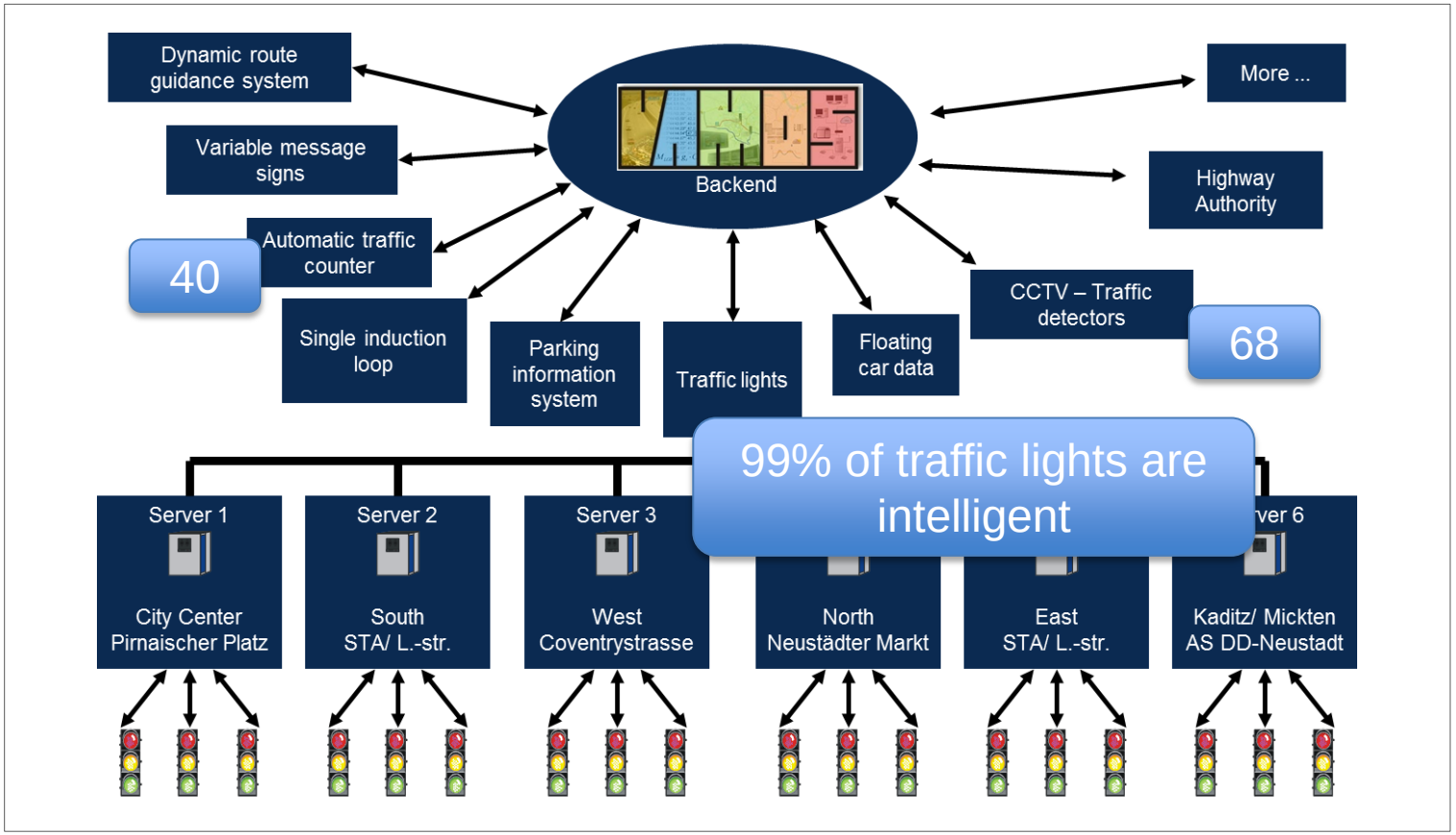
Verkehrs-Analyse-Management-Optimierungs-System

Goal: Smooth traffic flow and parking management



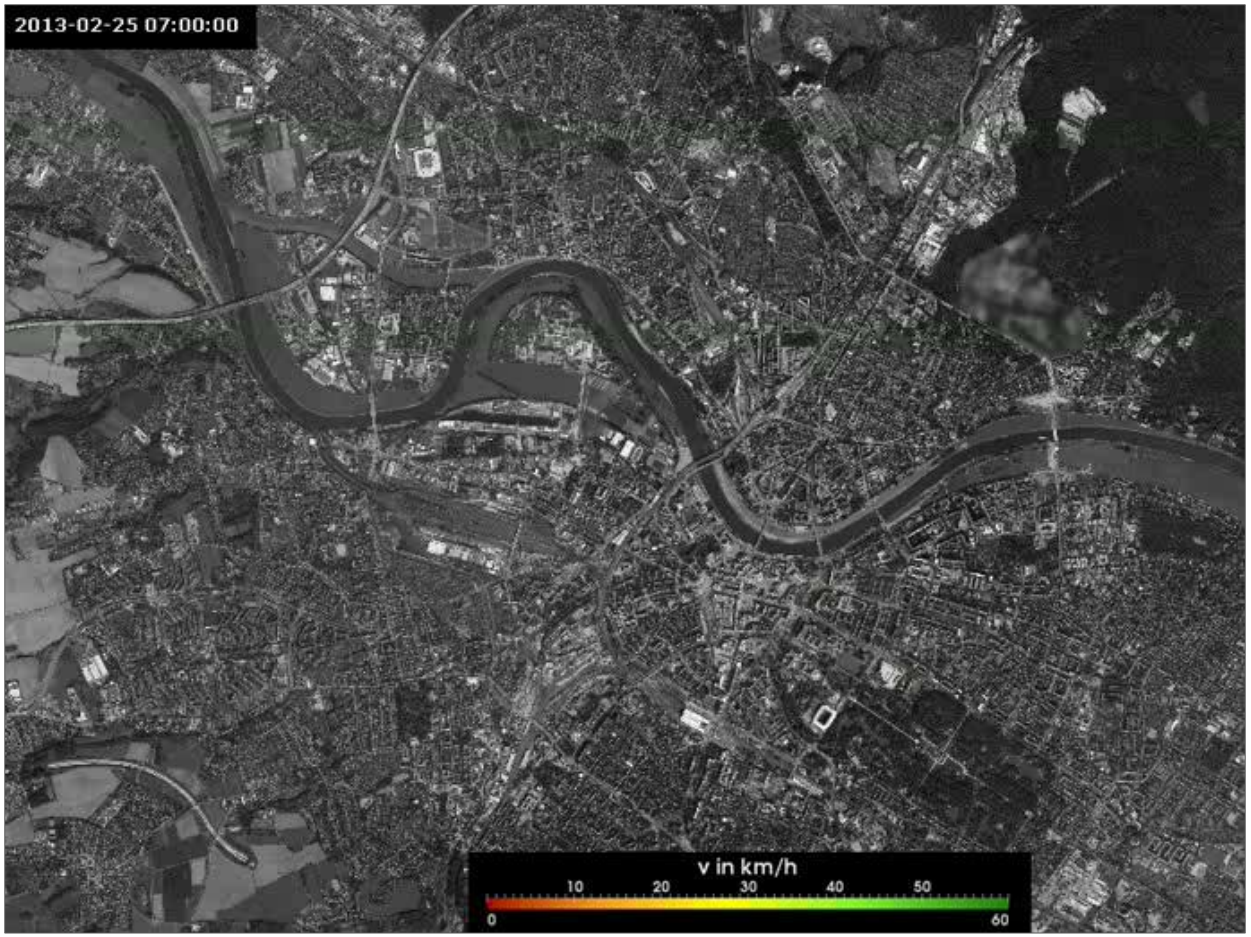
Automatic Changes of Road Signs Allows for Flexible Traffic Redirection

- Dynamic traffic guidance system for strategic routing
  - Dynamic change of route advisory based on various rules
  - Warning in cases of congestion or road works

500 Taxis Provide Data Each 5 Seconds

- Floating car data
  - Network-wide information about current traffic situation
  - 500 taxis transmit information every 5 sec about:
    - Position
    - Speed
    - Occupancy
    - Stop

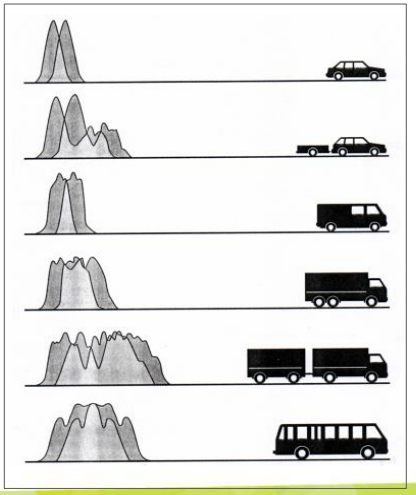
Video: Real-Time Taxi Movements



Source: Map by Bing

More Information Is Collected by Detectors and Traffic Counters

- Automatic traffic counters
  - Based on double induction loops
  - Classification of 8 different vehicle classes (specific fingerprints), or non-classified
  - Detected information: vehicle type, speed, time gap, vehicle length



- Future detectors and approaches
  - More TEU: Traffic Eye Universals (level of service, traffic volume)
  - Wimag detectors (magnetic field sensors for traffic volume, occupancy)
  - Bluetooth detectors (journey times and speed)
  - New approaches in the areas of
    - Big data
    - Cloud computing
    - Social networks
    - Car2Car and Car2X

Content

A Smart Parking Project is Close to Being Realized

Key targets

- Reduce time, search traffic and associated negative effects (CO_2 emissions etc.)
- Improve utilization of existing parking space

Facilitator for upcoming Smart City projects

- Critical aspects in terms of citizens' data collection and data security
- Strict legal rules for traffic and traffic space
- Technical solutions like sensors on street level must be robust, long-lasting and with none or very little maintenance effort
- Keep system access open for all user groups
- Find business model to refinance investment

The Project is managed in close cooperation between the City of Dresden, Office of Economic Development and Silicon Saxony, AK CPS members.

Smart City ICT Activities Are Part of Urban Planning

Approach:

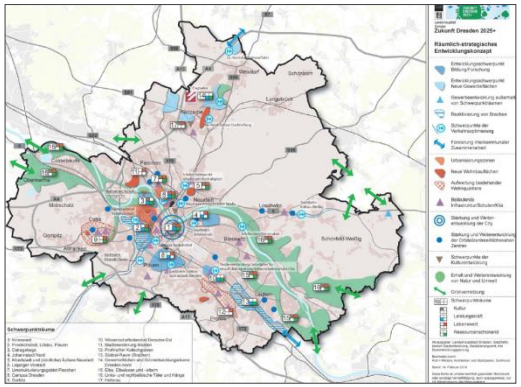
Identify and even re-label running projects as Smart City activities and translate it into strategic planning documents:

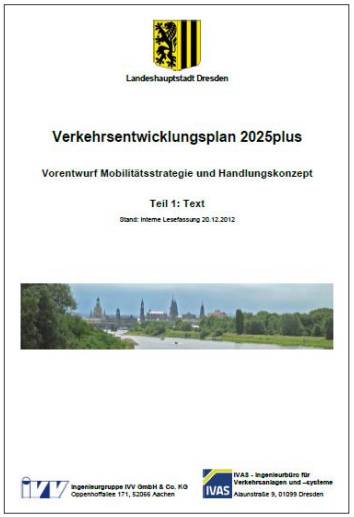
- Traffic Development Plan 2025+ with a definition of pilot projects
- Integrated City Development Concept 2025+ with 17 territory focuses

Challenge: Bridge ICT (chip design) and Smart City planning

Thematic focus areas in City Dev. Concept 2025+

1. City of culture in Europe
2. City of economic potential
3. Livable city for all citizens
4. Resource-saving city





For Further Action, It Will Be Crucial to Engage the Right Stakeholders

How much Smart City do Dresden's citizens really need and want?

- Initiate promotion of Smart City activities
  - Articles in local press
  - Online information material about latest activities, projects, etc.
  - Website Smart City and information videos
  - Conferences with key politicians
- Foster participation in Smart City platforms
  - Smart Cities and Communities platform (EU)
  - Smart City Forum (Germany)
  - EuroCities
- Attract citizen involvement and active feedback
  - e.g. from Facebook survey and future debate "Dresdner Debatte"

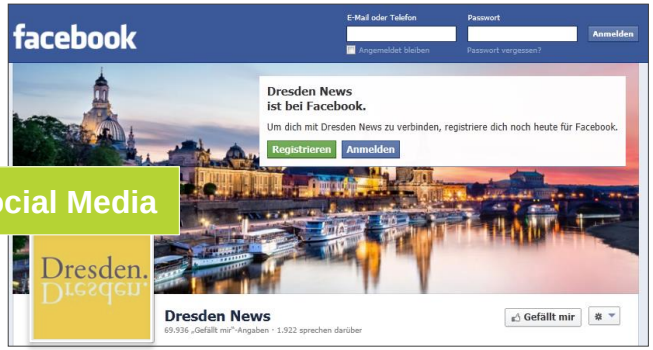
Challenge: Involve all stakeholders – online and off

Citizen Opinion Matters and Is Triggered by Use of Multiple Media

Online platform city debate

Newspaper

Website



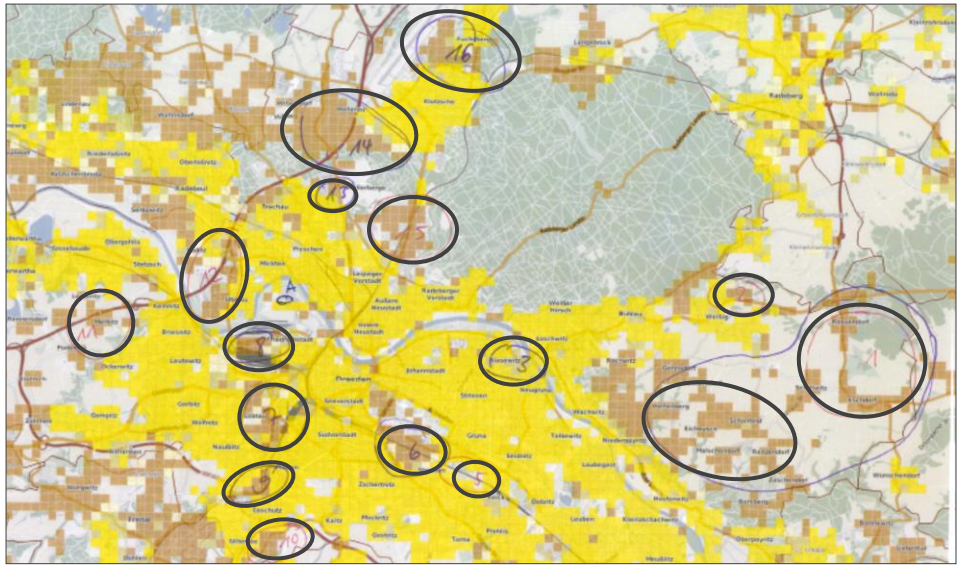
Social Media

F2F discussion

Infrastructure Needs Extension and Repair to Reach Smart City Goals

- Close gaps in the city with insufficient broadband capacity
- Meet new requirements for a digital infrastructure
- Start free wifi activities

Challenge: create appropriate infrastructure for a Smart City



Source: City of Dresden, research on 16Mbit connections (July 1, 2013)

What will happen in the near future?

- A **Large Scale Smart City Demonstration project** is planned under Horizon 2020 or ECSEL in 2015 coordinated by City of Dresden, Office of Economic Development:

- The **Involvement of stakeholders, experts and citizens** will be intensified: THINK Smart City will provide round tables

Summary

- A Smart City must be considered as an ongoing process of continuously developing and integrating new information and communication technologies (ICT) into existing infrastructures while considering constantly evolving demands.
- Smart Cities demand for intelligent technologies for efficient and networked infrastructures. Innovative semiconductor and software solutions, smart sensors and cyber-physical systems are key enablers. Silicon Saxony offers everything necessary: highly innovative Micro- and Nanoelectronics and Software.
- Becoming a Smart City requires continuous effort and synchronization of very different key actors: public authorities, industry, research and citizens, also a lot of “translation” work is required to define common objectives.

THANK YOU!

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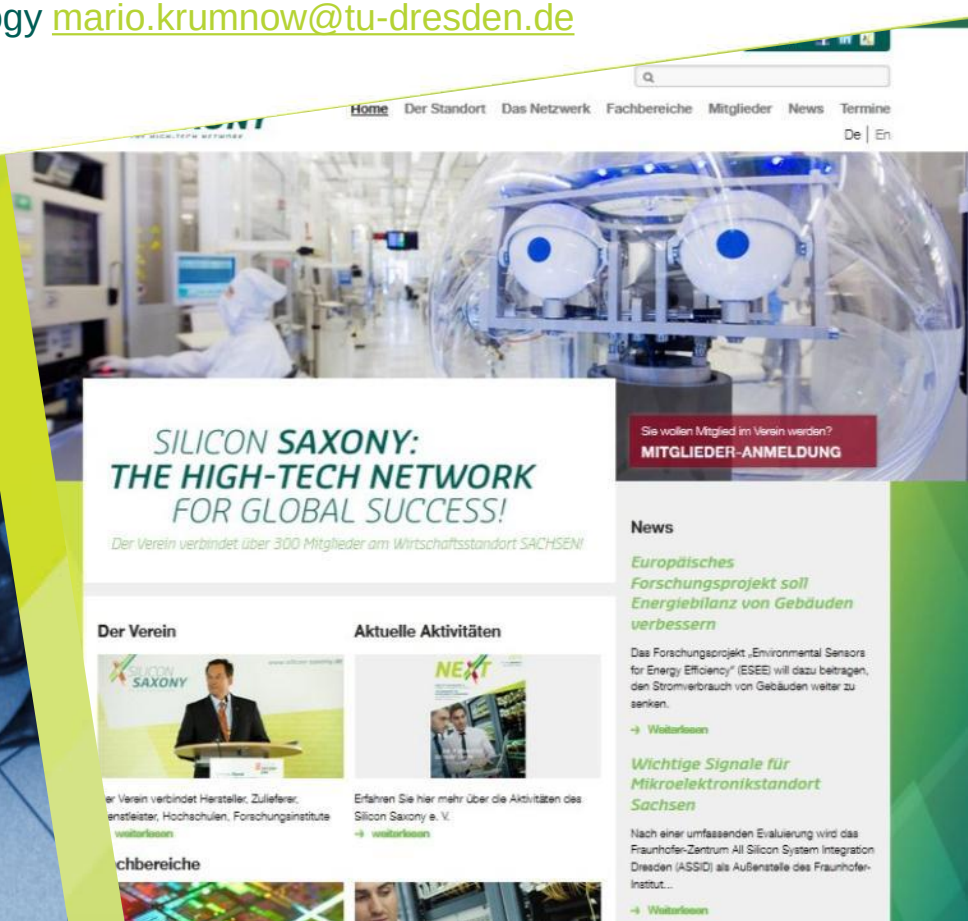


Appendix: Case Studies Worldwide

Smart City Case Studies Can Be Found Across the Globe

Smart City Case Studies

Vienna

Source: schreinerkastler.at

Vienna

Overview

Project themes involved

- Mobility & transport
- Energy & sustainability
- Physical infrastructure

Project goals defined

- Multi-functional urban lakeside district
- Improve quality of life
- Increase efficiency in renewables consumption
- Reduce carbon footprint
- Create 20,000 workspaces and apartments for 20,000 people

Highlights

- Car-free residential housing zones
- Community-funded solar power plants

Aspern Seestadt Wien 2002−2028

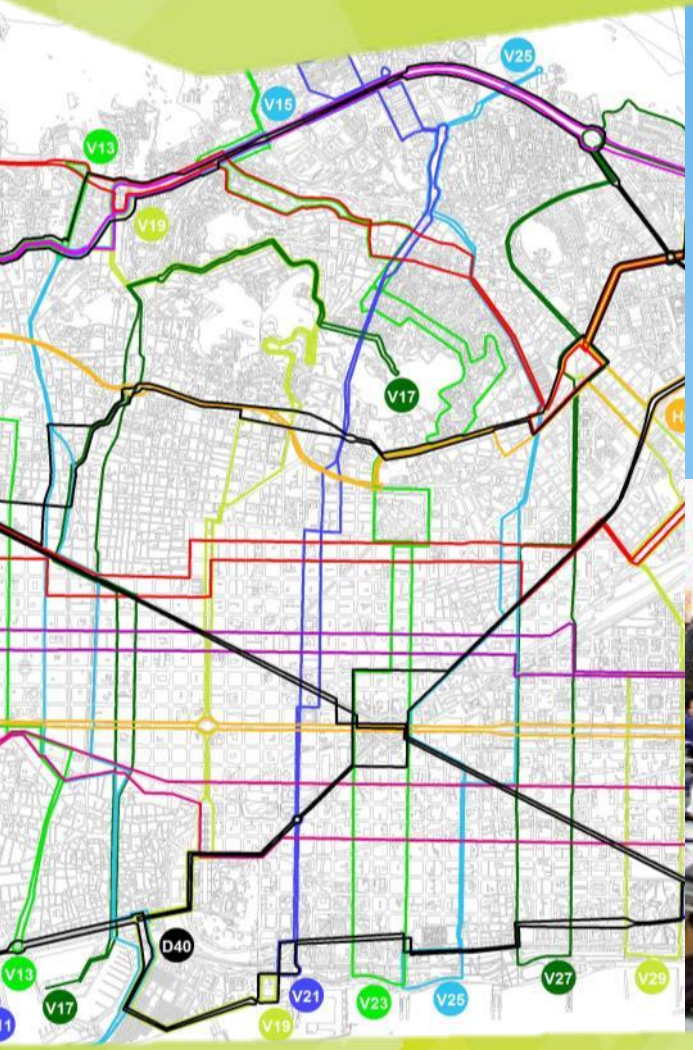
Selected activities

- Public **WLAN** services
- Intelligent traffic integration
- Decentralized power generation and modern storage technology
- Solar power plants
- **EcoTram** pilot with sensors and thermal heat pump to reduce or balance energy consumption

Sources: HIS Technology Smart Cities Report, smartcity.wien.at, wien.gv.at

Smart City Case Studies

Barcelona



Source: cityclimateleadershipawards.com

Barcelona

Overview

Project themes involved

- Energy & resource efficiency
- Comfort
- Safety & security

Project goals defined

- Merge urban planning, ecology and IT
- Citizen welfare and quality of life
- Build a zero-emission metropolis

Highlights

- 704 free wifi stations
- Remote irrigation control for parks
- Hybrid buses in an orthogonal bus network to improve reach, speed and frequency

Smart City Barcelona

Selected activities

- Connected bus stops with **WLAN** hotspots, information access and real-time traffic news
- App-based bike sharing **Bicing** via service access terminals (RFID)
- Waste management system with fill level **detection sensors** to cut costs by optimizing routes for garbage collection vehicles
- Environmental geolocation sensors by **Smart Citizen** to track temperature, noise level, dust, humidity, etc.
- Remote street lighting to save energy through motion sensors and adaptive **LED** intensity
- **App**-based smart **parking** through sensors set into the ground

Sources: T-Systems MMS Presentation J. Anke, vilaweb.cat, smartcitizen.me, bcnecologia.net, fastcoexist.com, smartcity.bcn.at

Smart City Case Studies

Seoul

Source: koreanair.bz

Seoul

Overview

Project themes involved

- Public ICT infrastructure
- Services & communication
- Smart users

Project goals defined

- Worldwide leadership in smart, urban technologies
- 80% smartphone coverage by 2015

Highlights

- 97.5% broadband coverage in households
- 1 Million second-hand devices given away to disadvantaged citizens
- Seoul leads eGovernment (acc. to UN survey)

Smart Seoul 2015

Selected activities

- **T-Money** and **Upass** smart cards for cash-free payment in stations, public transport and taxis
- **4G** and **Wi-Fi** in underground services and digital information terminals across stations; control points to check traffic card balance
- Bus stops with camera and meteorological sensor
- App-based steering of modern apartments, security systems with face recognition (planned)
- **Seoul Open Data Square** and free, public information hotlines
- No-driving campaigns
- Children safety guaranteed through **RFID** & CCTV
- IT industrial hub and network building **Digital Media City**

Sources: Avantgarde Labs presentation T. Hartmann, Yonsei University Seoul presentation J.-H. Lee, newsroom.cisco.com

Smart City Case Studies

Santander

Sources: media.npr.org, almanac-project.eu, mobileworldcapital.com, govtech.com

Santander

Overview

Project themes involved

- Mobility & transport
- Energy & sustainability
- Physical infrastructure

Project goals defined

- Improve mobility and quality of life
- Conduct efficiency improvement experiments (IoT test-bed facility)

Highlights

- Steady measurement of key environmental indicators through 2,000 IoT devices (sensor arrays)
- **Pace of the City** app for citizen engagement, e.g. to log a repair job

Project SmartSantander

Selected activities

- 20,000+ **sensors**, Meshliuum routers, actuators, cameras and screens to make useful information available to citizens
- **Smart parking**: 650 ferromagnetic parking sensors below ground, driver information panels
- **Smart lighting**: sensors identify failing lamps, presence detectors reduce light on empty roads
- **Smart waste management**: waste bin sensors for automatic collection alerts

Sources: HIS Technology Smart Cities Report, smartsantander.eu

London

Source: innovation.ukpowernetworks.co.uk

London

Overview

Project themes involved

- Energy & sustainability
- Customer adoption

Project goals defined

- Reduce carbon emissions
- Learning outcomes
- Generate low-carbon electricity
- Reduce CO_2 level by 60% by 2025 (from 1990)

Low Carbon London 2011−2015

Selected activities

- Installation and monitoring of more than 6,000 **smart meters**, electric vehicles, charging infrastructure, heat pumps, solar panels, combined heat and power plants
- Day-ahead price alerts for customers with smart meters to encourage a shift in electricity use to windy days
- Subsidy for **electric vehicle** leasing
- Testing prediction algorithms and capacity systems to estimate storage capacity based on demand profiles, temperature and season forecasts, battery lifespan etc.

Sources: HIS Technology Smart Cities Report, innovation.ukpowernetworks.co.uk, ofgem.gov.uk

Smart City Case Studies

Rio de Janeiro

Sources: cidadeolimpica.com.br, nbcnews.com

Rio de Janeiro

Overview

Project themes involved

- Mobility & transport
- Safety & security
- Energy & sustainability

Project goals defined

- Optimize emergency response management and day-to-day city functioning

Highlights

- City of Rio appoints Chief Digital Officer

Porto Maravilha Revitalization

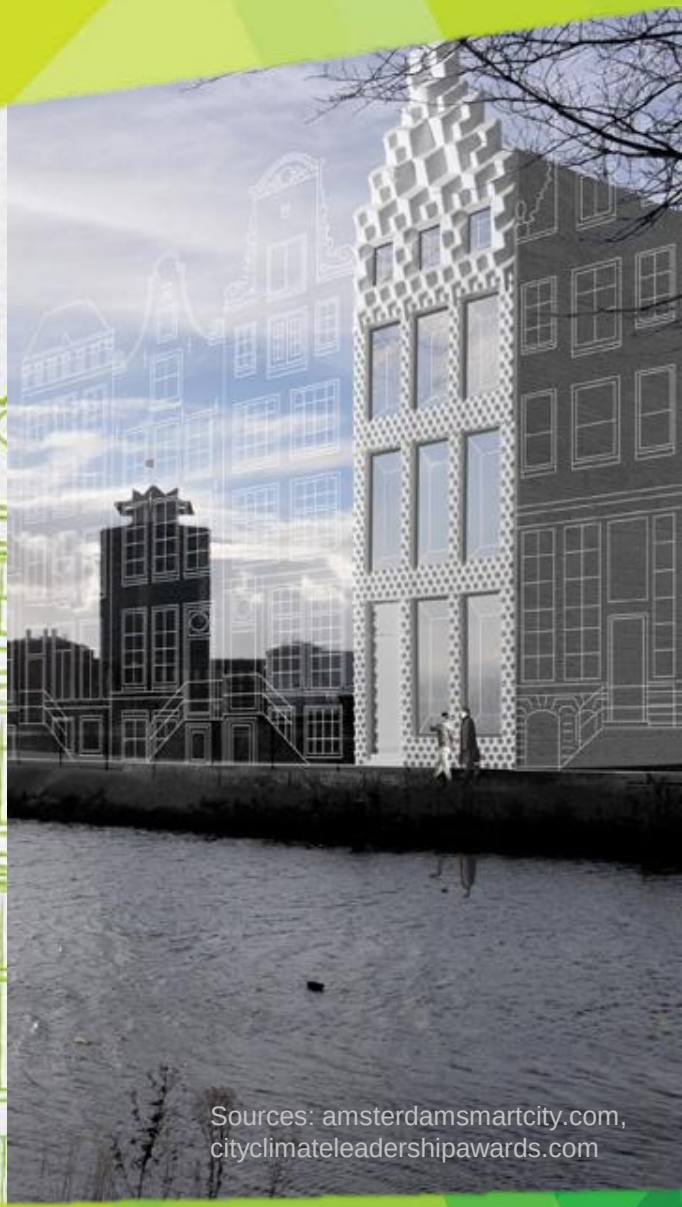
Selected activities

- Central monitoring system for 30 city parties (utilities, police, fire brigade, etc.) synthesizes data at the Rio **Operations Center** (with IBM hardware and analytics software) via 900+ street and traffic cameras, weather radar feeds, topographic surveys, warning sirens, to better coordinate the city's services
- **App**-based information system for citizens, also via Facebook or Twitter
- New bus rapid transit access, new sewer grids, waste water treatment plants, public lighting system with 5,000 **LEDs**

Sources: HIS Technology Smart Cities Report, people4smartercities.com

Smart City Case Studies

Amsterdam



Sources: amsterdamsmartcity.com, cityclimateleadershipawards.com

Amsterdam

Overview

Project themes involved

- Energy & sustainability
- Mobility & transport
- Open connectivity

Project goals defined

- Turn Amsterdam metropolitan area into an urban living lab
- Become one of the world's most sustainable cities by 2040
- Save 40% CO_2 and 20% in energy use by 2025 compared to 1990
- Create CO_2-neutral districts by 2015

Highlight

- Amsterdam wins Smart City World Congress Award

Amsterdam Smart City

Selected activities

- Dynamic traffic management: improved traffic flow through advisory **TrafficLink app**
- **Moet je Watt** project: residents-determined reuse and storage of locally produced energy
- **Vehicle2Grid** pilot to prevent battery over-charging
- **City-zen** smart grid in Niew West with improved computer and sensor technology at key notes
- Improved connectivity, free wifi and smart working centers for a whole city district through KPN's **Fiber-to-the-home** initiative
- One integrated street lighting network, increasingly LED-based

Sources: HIS Technology Smart Cities Report, amsterdamsmartcity.com