Panel on GREEN/SMART ACCESSIBILITY

Accessibility and Smart IoT-based Environments: Obstacles and Opportunities

Moderator
Erchin Serpedin, Texas A&M University, USA

Panelists
Lukas Smirek, Stuttgart-Media University, Germany
Bong Jun Choi, Stony Brook University / SUNY Korea, Republic of Korea
Kristin Skeide Fuglerud, NR–Norsk Regnesentral, Norway
Maxime Lefrancois, Mines Saint Etienne, France

Accessibility and Smart IoT-based Environments: Obstacles and Opportunities

Lukas:
“User needs and user requirements in Smart Environments? Frequently, developments in IOT and Smart Environments are driven by technical interests and not by the users’ needs."

Bong Jun:
"Consideration of user involvement in the smart IoT based energy network: Challenges and Opportunities."

Kristin:
"Multimodal interaction is essential to inclusive design. This is manageable when using a personal device, but how can it be solved in a IoT scenario, with multiple people and multiple devices?"

Maxime:
"How easily can we move from a Web accessible to machines (the Semantic Web), to a Web accessible to Smart IoT devices?“

Erchin:
“Green Communications: Opportunities and Challenges”

Why Green Communications?

- Motivations for Green Communications
- Green Solutions and Low and High traffic loads
- Heterogeneous Wireless Medium
- Green Uplink Multi-homing
- Green Downlink Multi-homing
- VLC-RF Internetworking
- Balanced Dynamic Planning
- Summary—Energy Efficient Communications

Panel: GREEN/SMART ACCESSIBILITY
Topic: Accessibility and Smart IoT-based Environments - Obstacles and Opportunities
Date/Time: July 25, 2016 17:40 - 19:40

David (Bong Jun) Choi

"Consideration of User Involvement in the Smart IoT based Energy Network: Challenges and Opportunities"

Smart Energy Lab
Department of Computer Science
The State University of New York Korea, Korea
& Stony Brook University, USA

SUNY Korea
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Modern Society

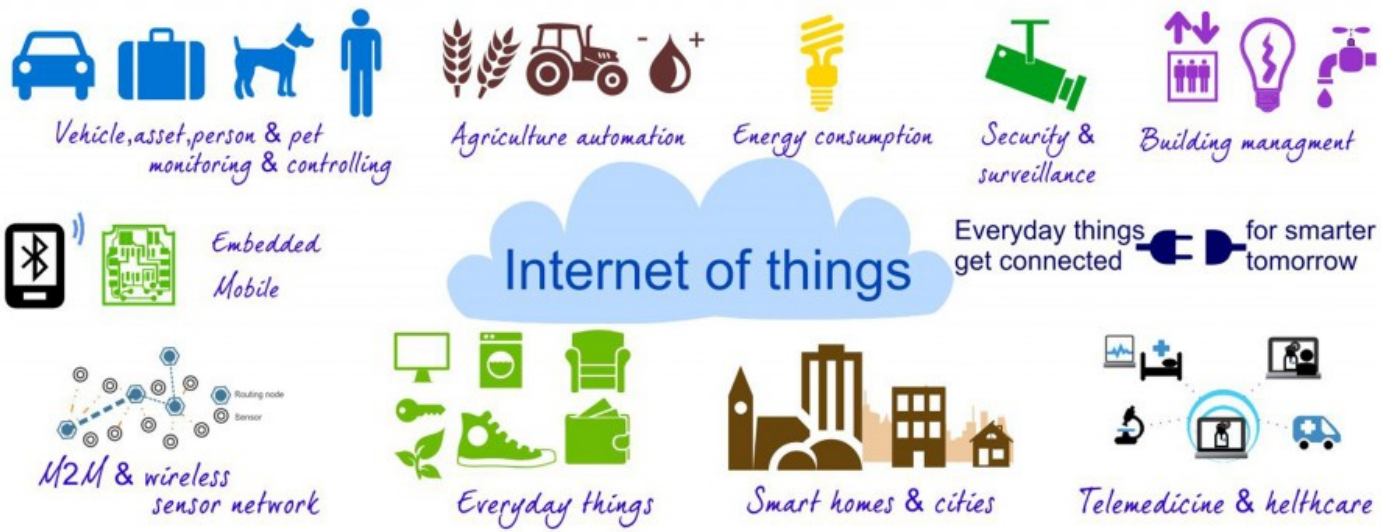
- **Personal**
  - Home, Appliances, Lights, Car, PC, Smart Phone
- **Industry / Business**
  - Factories, Offices, etc.
- **Government**
  - Critical Infrastructures
    - Life Support: Subways, Traffic System, Water System
    - Safety: Military, Surveillance System, and etc.

“All Sectors of Society are Fueled by Electrical Energy”

(e.g., Effect of Hurricane Sandy, Power Outages)

Future Society

- **Internet-of-Things (IoT) + Smart Cities**
  - Computers, Sensors, Equipments, Cars, and etc. powered by Electricity



"Increased Dependence on Reliable and High Quality Electrical Energy"

Image Source: http://www.satiztpm.it/

However, Can We Get There?

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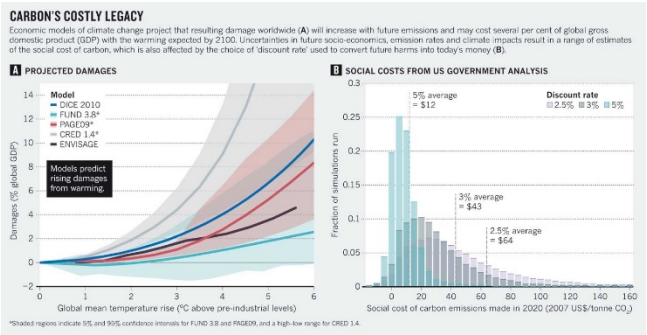
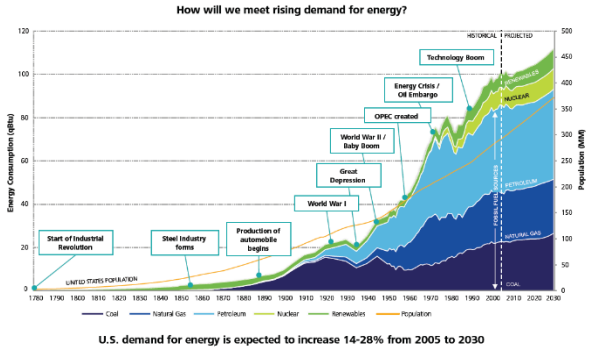
Economic Growth and Technology Advancement is Constrained by…

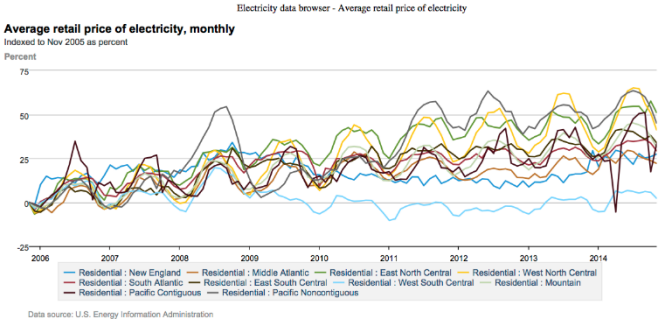
1. **Environmental Awareness (+ Cost of Climate Change)**



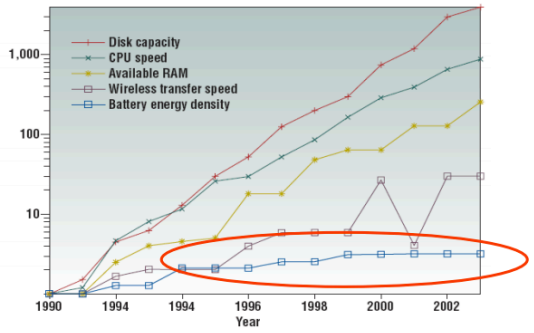
2. **Increasing Energy Demand**



3. **Rising/Unstable Energy Cost (Oil, Electricity)**



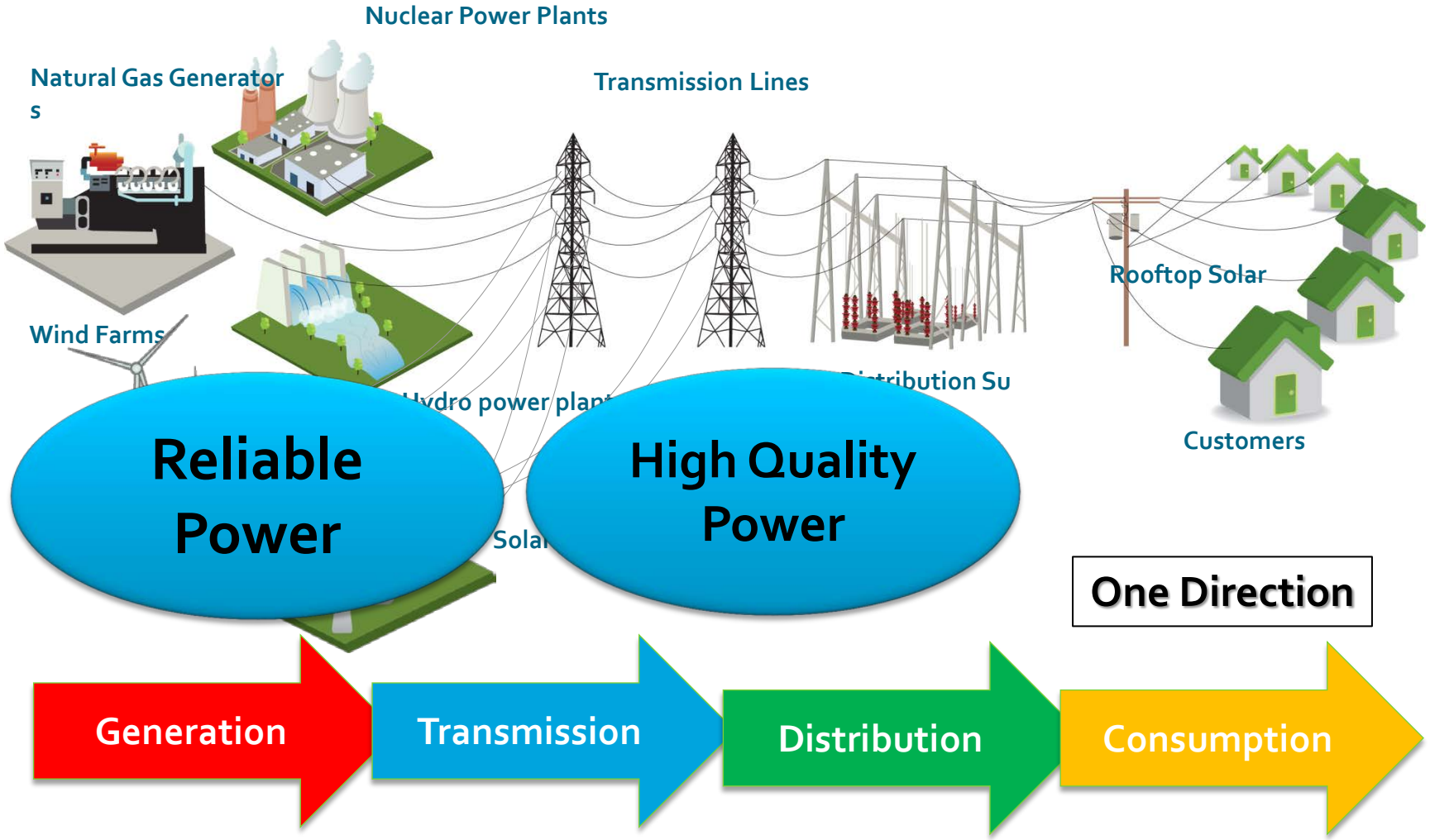
4. **Physical Limits of Energy Storage Capability**



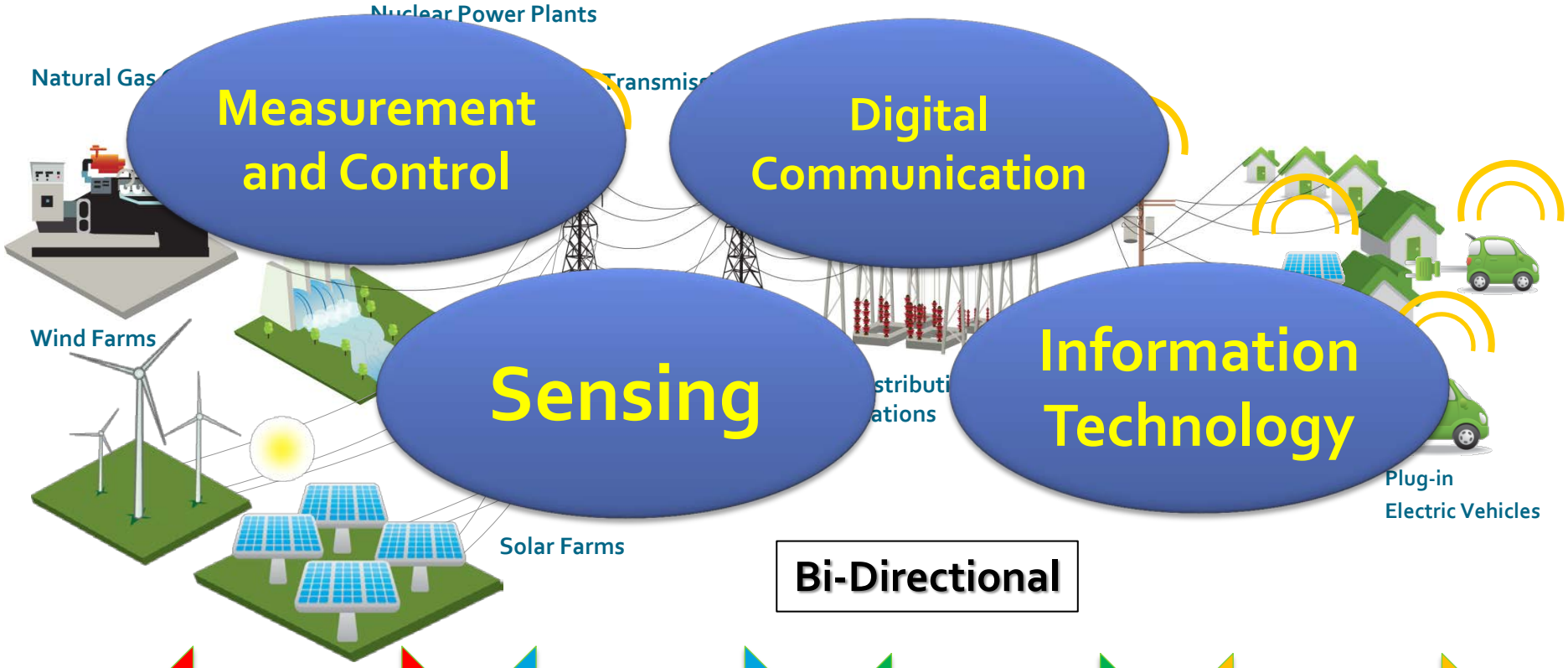
Mobile Computing Improvement – Paradiso, *et al.* Pervasive Computing, IEEE, 2005.

Source: Richard L. Revesz et al., "Global warming: Improve economic models of climate change", Nature, April 2014.
Thomas Sterner, "Economics: Higher costs of climate change," Nature, November 2015.
Source: Annual Energy Outlook, EIA (U.S. Energy Information Administration), 2008

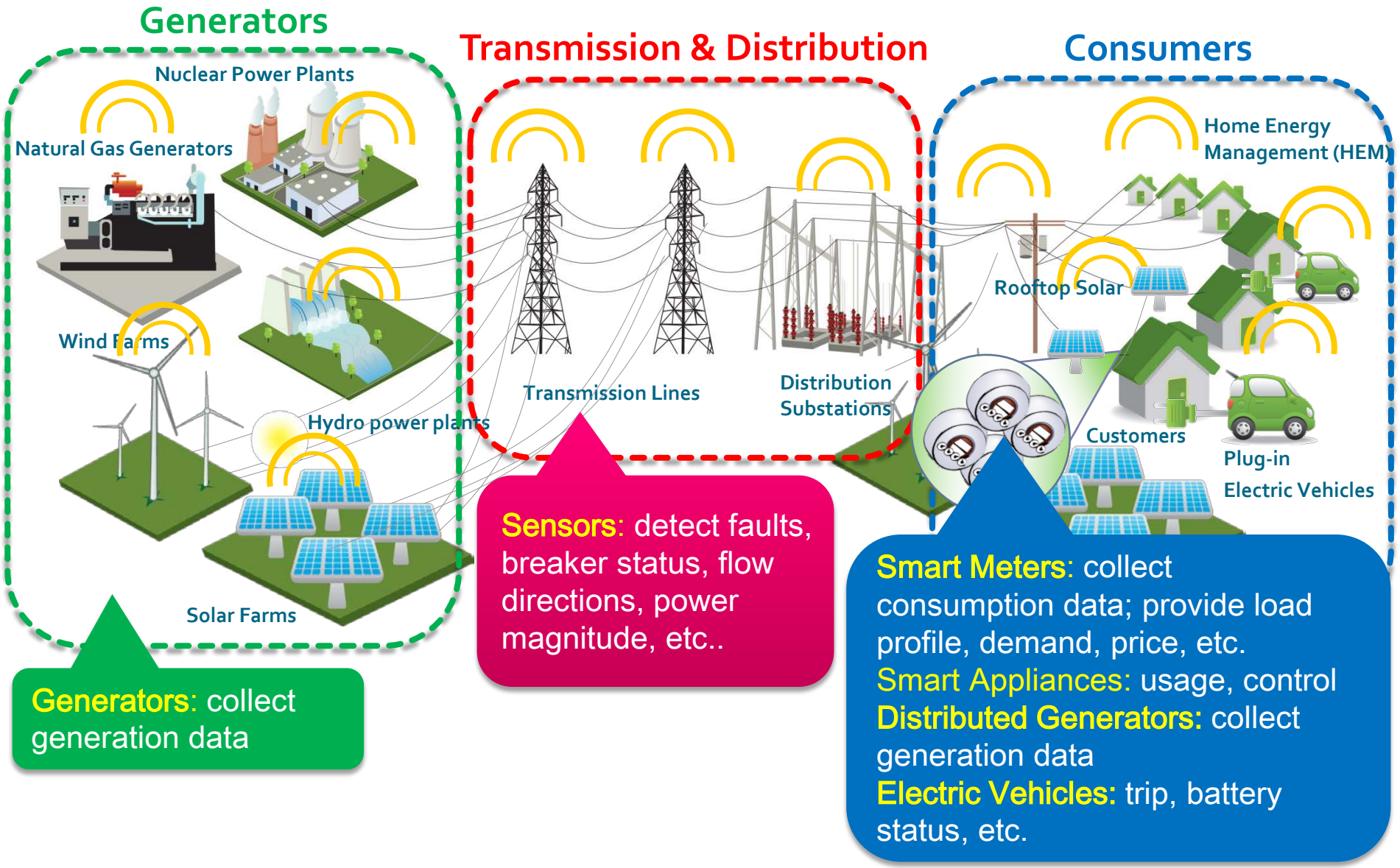
Current Power Grid



Smart Grid


Nuclear Power Plants
Natural Gas
Measurement and Control
Digital Communication
Sensing
Information Technology
Wind Farms
Solar Farms
Plug-in Electric Vehicles
Bi-Directional
Generation
Transmission
Distribution
Consumption

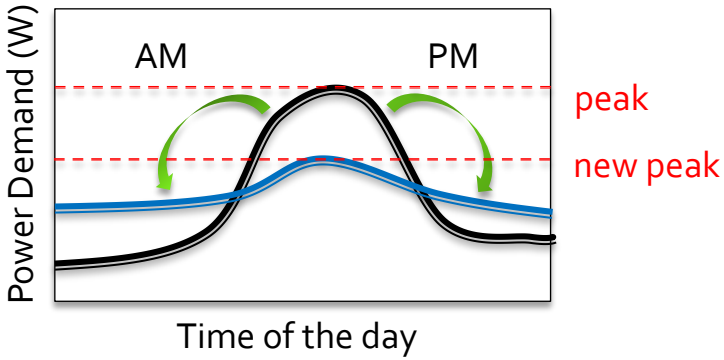
Demand Response



Demand Response

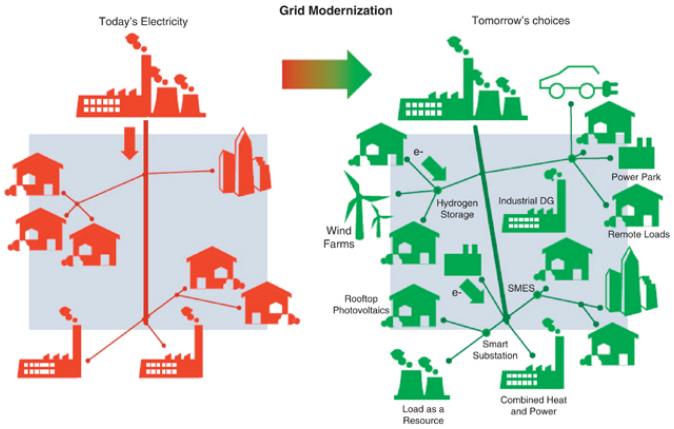
Generator

- Peak Shaving through Adaptive Control → Reduce number of generators



Transmission and Distribution

- Estimation along the line → Dynamic optimization of voltage levels and reactive power, fault detection
- Distributed generation (microgrid) → Increase reliability, reduce transmission loss (from resistance and heat)

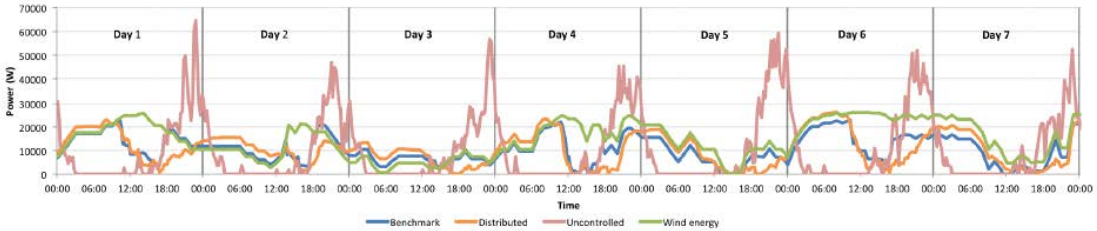


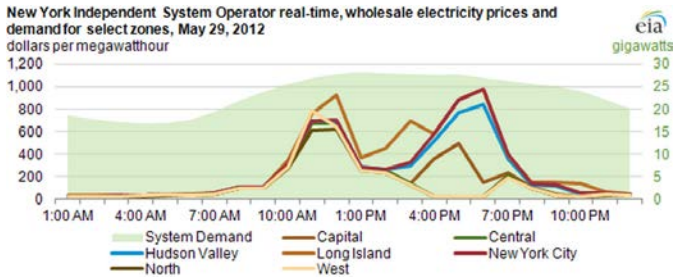
Consumers

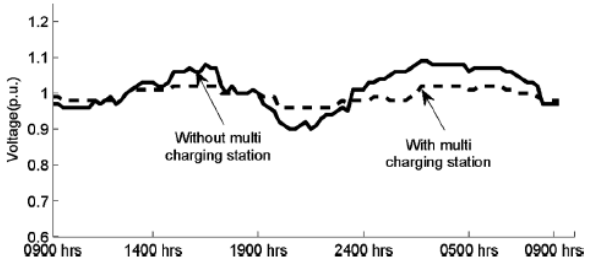
- Peak Shaving → Reduce electricity cost
- Distributed generation → Sell energy

Demand Response

- **Challenges:**
  - "Human Factor"
    - Electricity Usage/Cost
    - EV mobility
  - "Dynamic Nature" of Grid Components
    - Distributed generators, demand, price
  - System Constrains (for Stability)
    - Power Quality Control (Voltage/Frequency Stability)
    - Bi-directional electricity flow
    - Lower voltage from DGs
  - Communication Architecture
    - What communication architecture and technology to use?
- **Opportunities:**
  - Autonomous intelligent controllers mange energy grid through data analysis and control





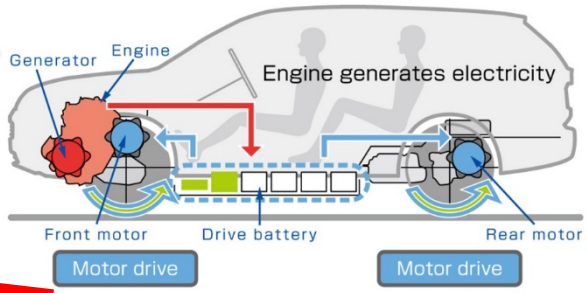


Electric Vehicles

- Reduce dependence on oil
- "idle capacity of electric power grid" = "70% energy cars and light trucks" (US Department of Energy)
- **Challenges:**
  - Adds another variable to the "Demand Response"
  - A large number of EVs → A large effect to the energy grid
  - Driving

Electrical Energy

Electrical Energy



Mechanical Energy

Transport

Fossil Fuel

Plug-In Hybrid Electric Vehicle (PHEV)

Data Analytics

- **Challenges:**
  - Large Amount of Data
    - 2020: 1 billion expected smart meters worldwide (= approx. 60% of all installed meters)
  - Large Number of Different Type of Devices
    - intelligent electronic devices located at substations, smart meters, sensors on transmission lines, electric vehicles, smart appliances
  - Different Processing and Communication Requirements
  - Various User Roles:
    - customers, operators, maintenance personnel, and etc.
- **Opportunities:**
  - Grid Operator Analytics:
    - Grid optimization, Asset Management, Power Flow Analytics, Crisis/Outage Management, Fault Detection
  - Consumer Analytics:
    - Cost Optimization, Behavioral Analytics, Building Energy Management

Source: [1] “Top Industries Predicts 2014”, Gartner Insight, Gartner, Inc., [2] www.sas.com

Data Analytics

- **Technical Challenges:**
  - Siloed systems prohibit easy data sharing
  - Complexity in systems integration
  - Unstructured data and no common platform
  - Prevention against non-intrusive data analysis
- **Research Opportunities:**
  - Predictive Analytics: For dynamic conditions (renewables, EVs, weather, personal)
  - Distributed Data Analytics: For improving latency, scalability, robustness
  - Security and Privacy-Preservation of Data

Security and Privacy

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- **Cyber security emerges to be a critical issue in Smart Energy Grid**
  - Millions of electronic devices are inter-connected via communication networks throughout critical power facilities
  - Has an immediate impact on reliability of such a widespread infrastructure.

- **Issues:**
  - System Failure (Outages), Power Flow Disruption
  - Consumer Data Privacy
  - Energy Theft or Hacking of Smart Meters

"Guidelines for Smart Grid Cybersecurity," NISTIR 7628 (Revision 1), NIST, Sept. 2014. URL: http://nvlpubs.nist.gov/nistpubs/ir/2014/NIST.IR.7628r1.pdf

Concluding Remarks

- **Discussed Topics in Smart Energy Network**
  - Demand Response
  - EV Charging and Discharging
  - Data Analytics and User Privacy

- **To Think About:**
  - Q1: How to design such systems where everyone (customers, service providers, system operators) is happy?
  - Q2: What IoT data should be shared and how should it be maintained and exchanged?
  - Q3: Maintenance of IoT devices (fixes and updates)

Thank You

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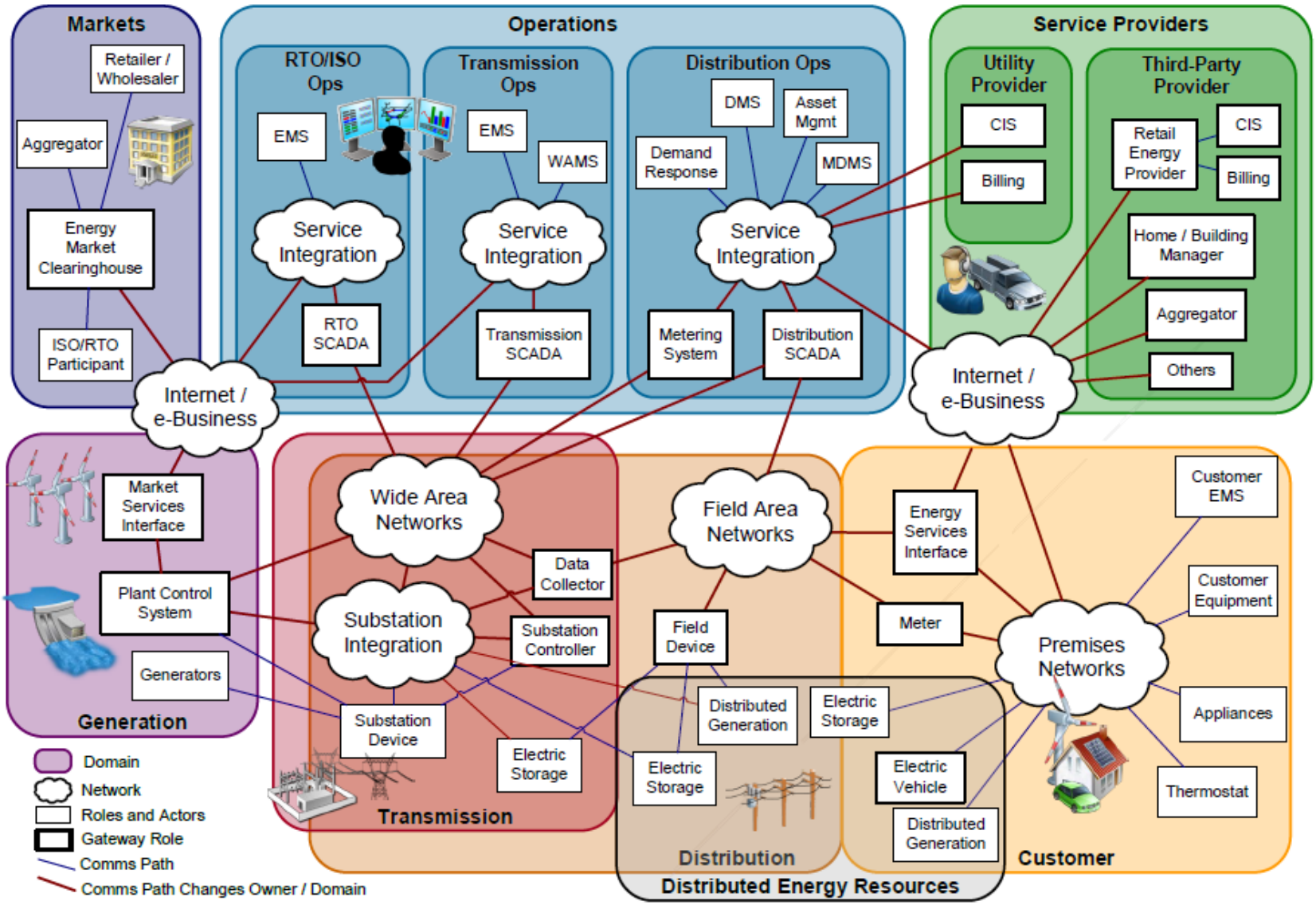
SG Information Network



Data Analytics

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FIGURE 1-1: UTILITIES' THREE PRIMARY DOMAINS FOR ANALYTICS

ENTERPRISE ANALYTICS

- Moving from Traditional, Historical Analytics to Real-Time Predictive Analytics
- Complete Situational Awareness
- Business Intelligence (BI)
- Trading with "live look" at the Grid Simulation/Visualization

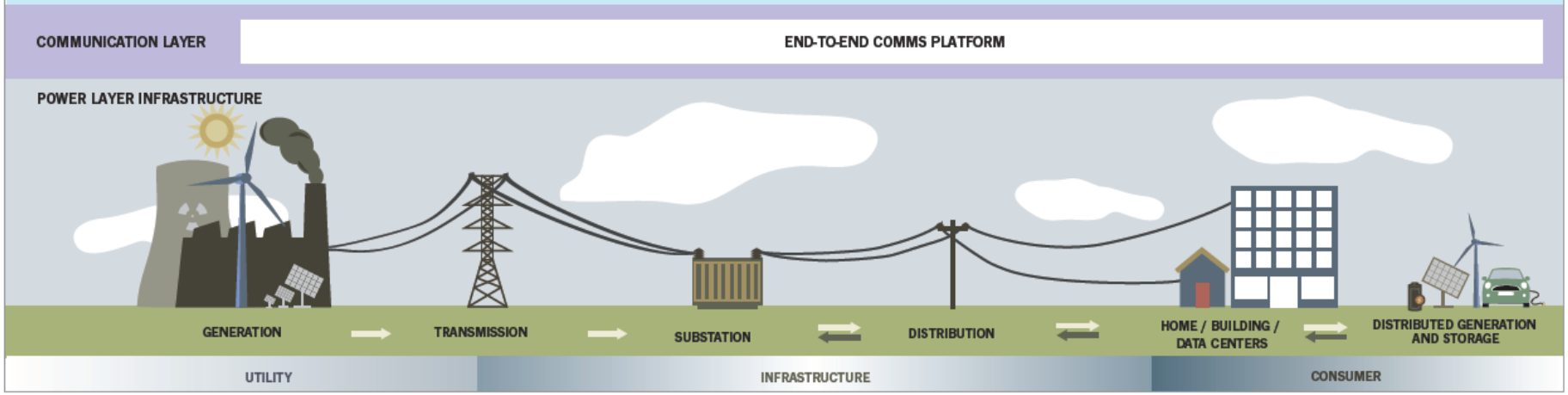
GRID OPERATIONS ANALYTICS

Grid Optimization and Operational Intelligence

- Asset Management Analytics
- Crisis Management Analytics
- DMS Analytics
- Outage Management Analytics/Fault Detection and Correction
- Weather/Location data
- Mobile Workforce Management
- Energy Theft

CONSUMER ANALYTICS

- Behavioral Analytics
- Tiered Pricing - Trading, Selling Megawatts (DR)
- Building Energy Management
- Power Analytics (Load Flow)
- Social Media Data Intergration
- DG/EV/Microgrid Analytics



SOURCE: GTM RESEARCH

Accessibility and Smart IoT-based Environments: Obstacles and Opportunities

Kristin Skeide Fuglerud, Head of e-Inclusion, NR

Smart Accessibility, Nice, France, July 2016

The need for inclusive and accessible smart environments

- **Goal:** full and effective participation for all people including people with disabilities, chronic illnesses and older people
- **Humanistic motivation:** creating equal opportunities, respect for inherent dignity and individual autonomy
- **Economic motivation:** if failing to think inclusive design when creating IoT-based environments, new barriers will inevitably emerge –> society will loose valuable resources

What do I envision?

- Enhancing the surroundings with ambient intelligence and digital interfaces so humans can interact according to their abilities and preferences.
- The human-environment interaction is guided by context, preferences, surrounding objects, history of use and appropriate modalities.

Obstacles and opportunities (1)

- Interoperability
  - including compatibility with assistive technology
- Meeting user needs
  - user involvement
- Profiling and privacy
  - security
  - tracking
  - trust

Obstacles and opportunities (2)

- Multimodal interaction
  - essential for accessibility
- Interaction translation
  - personal devices vs built in tech. in the environment
- Conflict resolutions - complexity
  - many to many devices and users

user needs and user requirements in Smart Environments – chances and challenges for accessibility

Lukas Smirek, Stuttgart Media University

Applications, chances and challenges of smart environments

- Entertainment
- Security features
- Energy efficiency
- Transportation services
- E-Health

- Support in every day life situations
- More participatory life for people with disabilities (social, educational, …)
- Longer independent life for elderly people
- Handling demographic change
- …

- But: Gap between expectations and reality!

Shneiderman‘s research agenda: Attaining universal usability for web- and other services (2000)

- Technology variety:
  - Support broad range of hardware, software, and network access
  - More users ➔ more difficult to replace technology ➔ more variety
  - pace of technology development
- User diversity:
  - Accommodating users with different skills, knowledge, age, gender, disabilities (visually impaired, motor impairments etc.) literacy, culture, income, …
  - disabling conditions (mobility, sunlight, noise),
- Gaps in user knowledge:
  - Bridging the gap between what users know and what they need to know.
  - how to begin, what to chose in dialogue boxes, how to handle system crashes,
  - or what to do about viruses
- Today:
  - Responsive design
  - Web Content Accessibility Guidelines (WCAG)
  - …

…and the future?

- technology variety:
  - Increasing number of interconnected devices
  - One user, many controllers to control many devices

    Solution: Device abstraction, semantic, middlewares
- User variety:
  - User group will reflect heterogenity of society

    Solution: personalized and Adaptive user interfaces
- Global availability:
  - Of user interfaces
  - Of user preferences

- Further issues:
  - Social aspects?
  - Technology should be developed for people

The Global Public Inclusive Infrastructure (GPII)