香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

PPOL DIVISION OF PUBLIC POLICY 公共政策學部

AI-Based Innovation to Tackle Climate Change: Technological Opportunities and Institutional Challenges in Smart Cities

YARIME Masaru 鎗目 雅

Division of Public Policy, Hong Kong University of Science and Technology

Science, Technology, and Innovation Governance (STIG), Graduate School of Public Policy, The University of Tokyo

Department of Science, Technology, Engineering & Public Policy, University College London

Japanese – German – French Conference

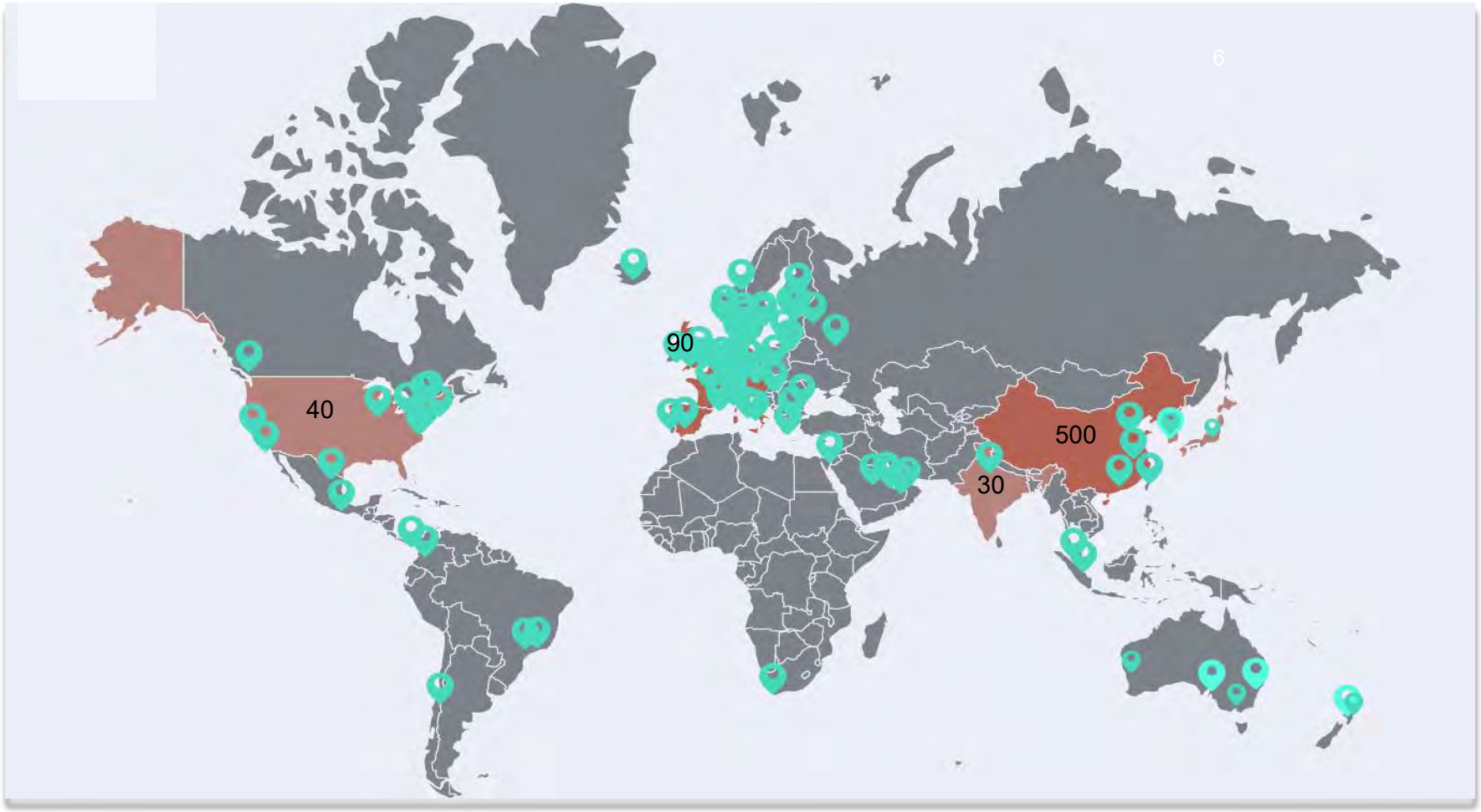
AI for SDGs – How Can AI Help Solve Environmental Challenges?

October 24, 2019, German Cultural Centre, Tokyo

東京大学 THE UNIVERSITY OF TOKYO

UCL

Development of Smart Cities in the World



Numbers of smart cities in construction and dispersion of top 100 smart cities around the world

Easypark group, deloitte report

European Innovation Partnership

Smart Cities & Communities

Invitation for Commitments

1 Smart Cities and Community a European Innovation Partnership

How to make our cities smarter?

The Partnership integrates the **ICT**, **energy** and **transport** sectors. It aims to apply innovative solutions to tackle issues such as **congestion**; **air pollution**; **high energy costs** and to achieve **better mobility**; **cleaner urban environment**; **energy efficiency**.

congestion

air pollution

high energy costs

better mobility

cleaner urban environment

energy efficiency

Resilient Human/Smart Infrastructure Collaboration

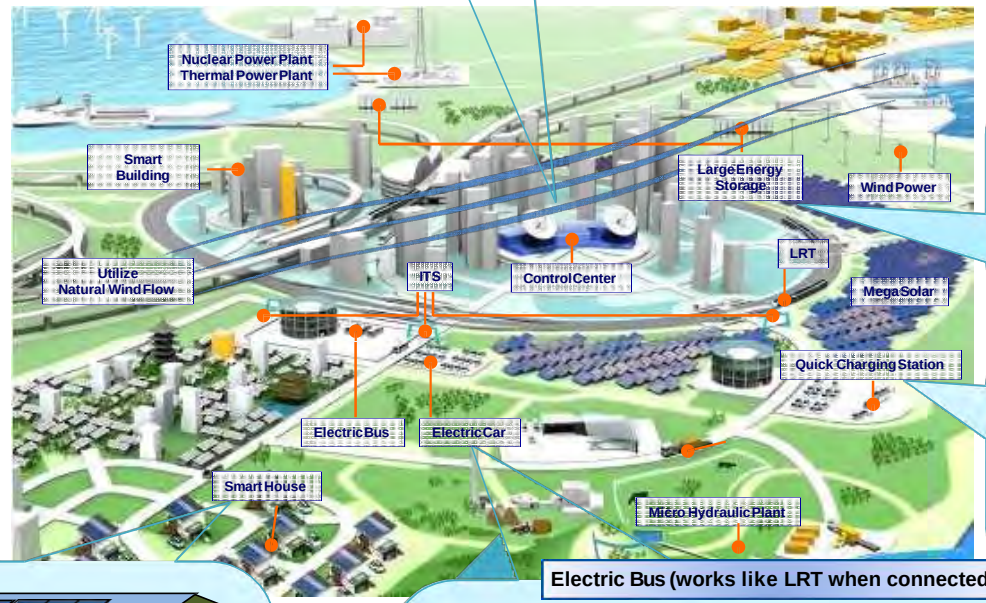
https://static.pexels.com/photos/327345/pexels-photo-327345.jpeg
https://unsplash.com/photos/8Z_vbHQZ8IY
https://static.pexels.com/photos/263210/pexels-photo-263210.jpeg
https://static.pexels.com/photos/303313/pexels-photo-303313.jpeg
https://static.pexels.com/photos/580117/pexels-photo-580117.png

FIWARE
Ministry of Science and ICT
NIST National Institute of Standards and Technology U.S. Department of Commerce
ETSI World Class Standards
ANSI
USGBC
ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
TIA ADVANCING GLOBAL COMMUNICATIONS
27

NIST (2017)

Smart Communities in Japan

Community Energy Management System for Optimizing Energy Supply and Demand

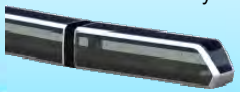


Power Line Free LRT

LRT with Battery

At the station: Charge to battery

Between stations: Move by battery



Quick Charging Station

80% charge in 30 minutes

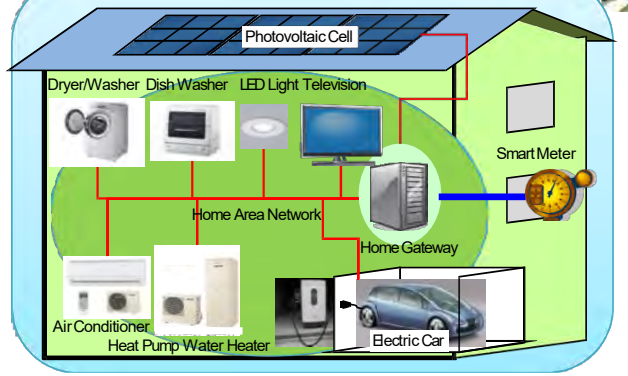
Utilize Electric Car

As a part of energy infrastructure

Shortage: EV→ House

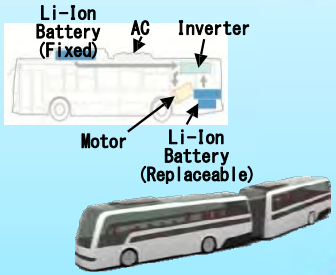
Excess: House → EV

Smart House



Electric Bus (works like LRT when connected)

Battery Replaceable Bus / Works like LRT by connecting multiple buses



Connected buses will operate like LRT

METI (2012)

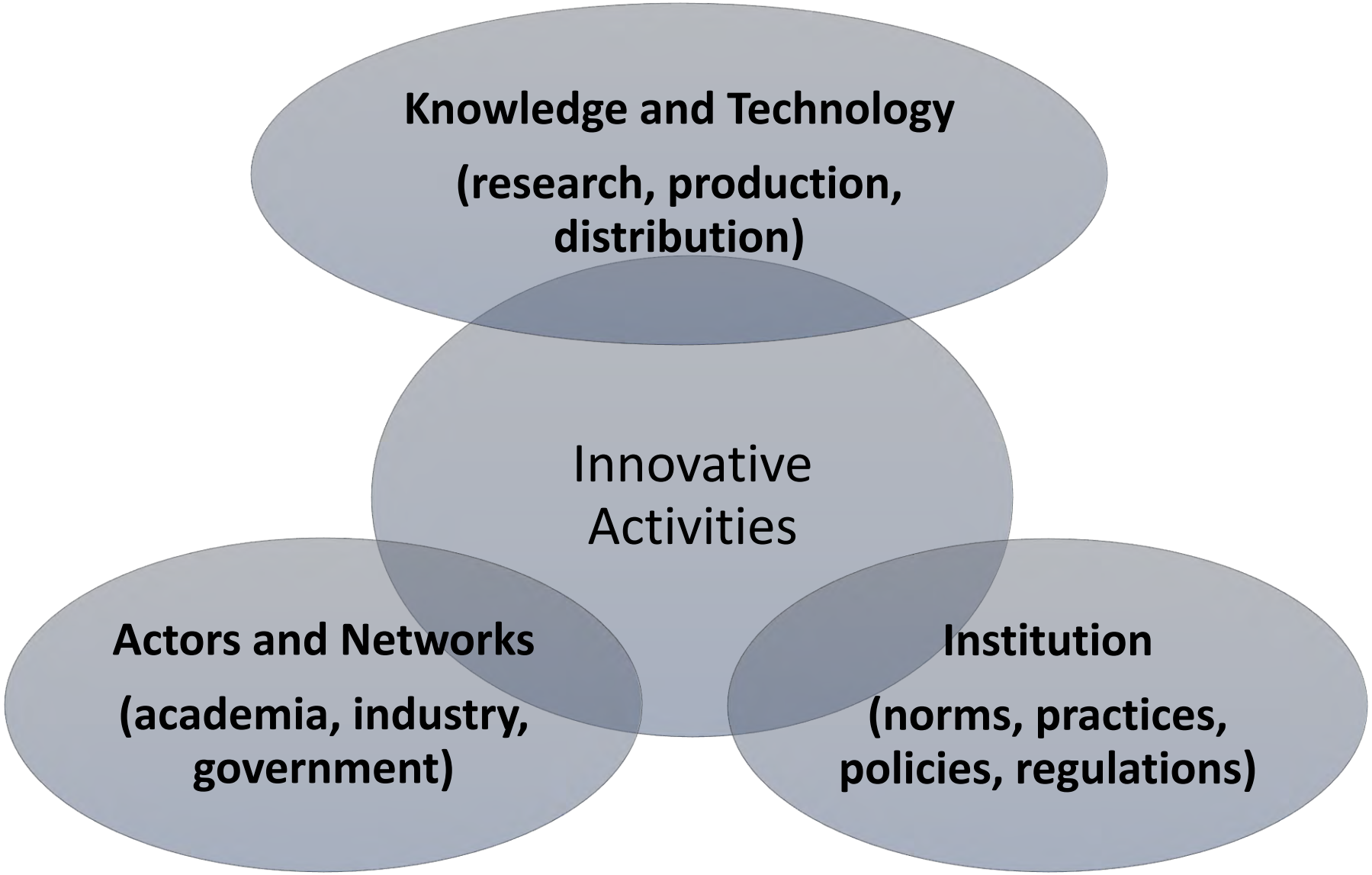
Addressing Sustainability Challenges in Smart Cities

- **Upgrading ageing and deteriorating infrastructure** for energy distribution
- **Reducing environmental burdens** (CO_2 emissions, air pollution) by increasing renewable energy sources and efficient energy usage
- **Strengthening the resilience** of the supply of energy and services against disruptions and disasters (earthquakes, typhoons)
- **Coping with cost pressure** to improve energy efficiency and to cut back its consumption during peak periods
- **Providing services to an ageing and declining population** in efficient, flexible and user-friendly ways

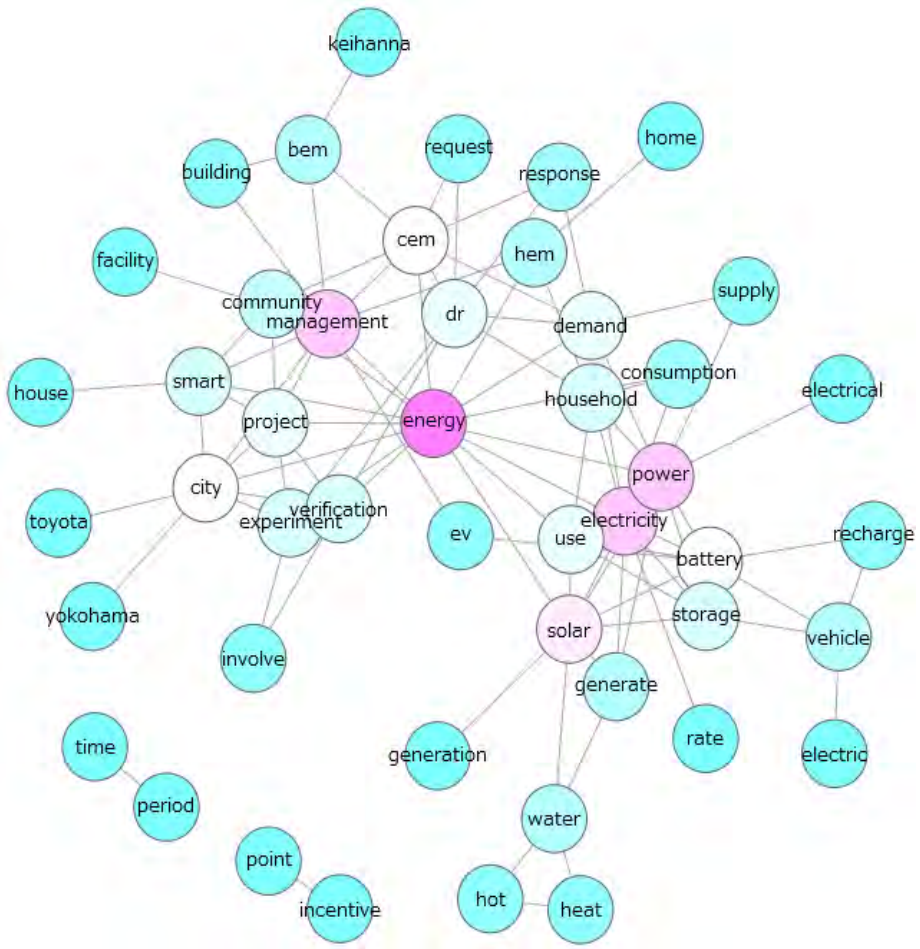
Research Questions

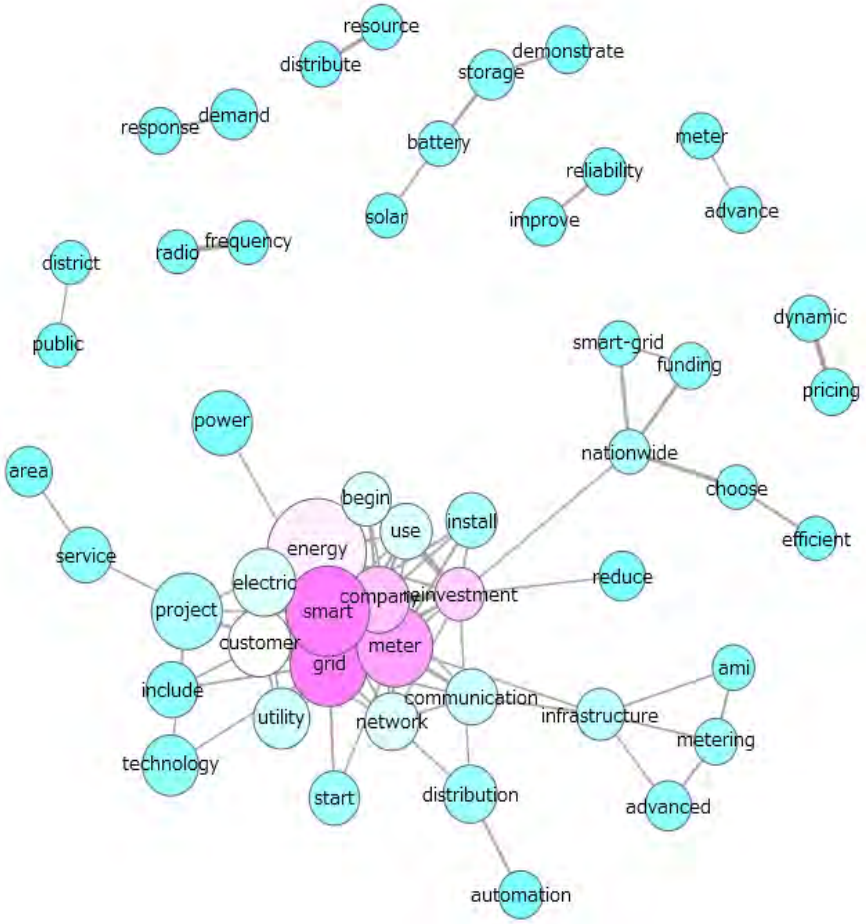
- What are the technological fields emphasized in innovative activities?
- Who are the main actors in innovative activities?
- What are the key drivers and obstacles in creating innovation?
- What are the effects of institutional conditions and environments on innovation?
- What are the implications for public policy and governance for data-driven-innovation?

Elements of Innovation Systems



Knowledge and Technology Domains in Smart Cities



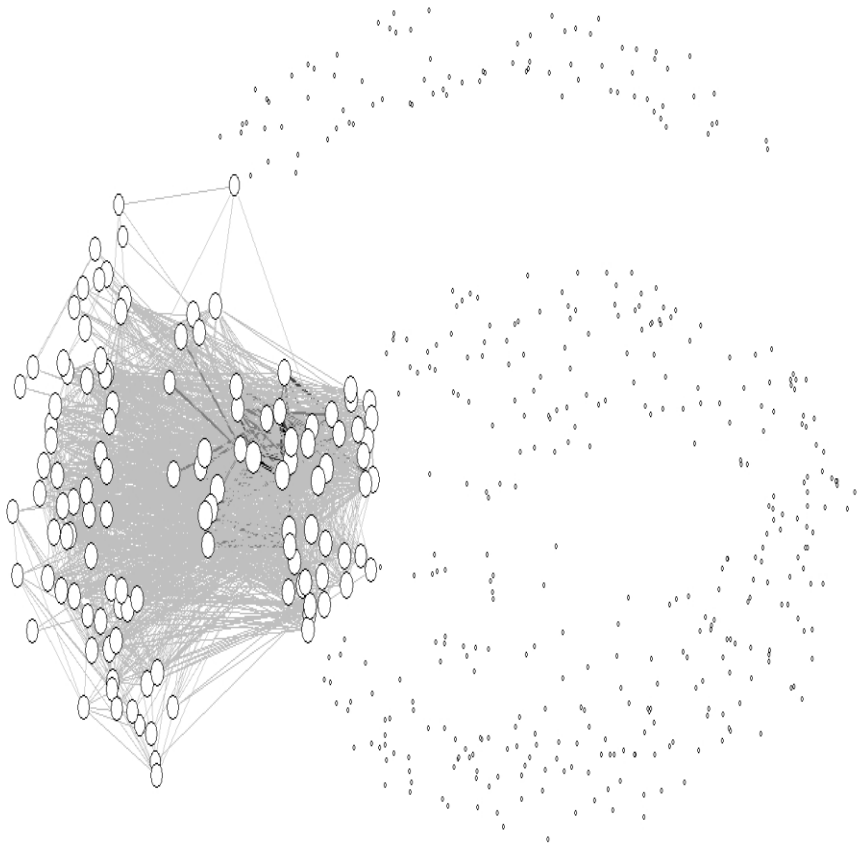


Japan: PVs, distributed energy, and energy storage, home appliances, electric vehicles, community energy management

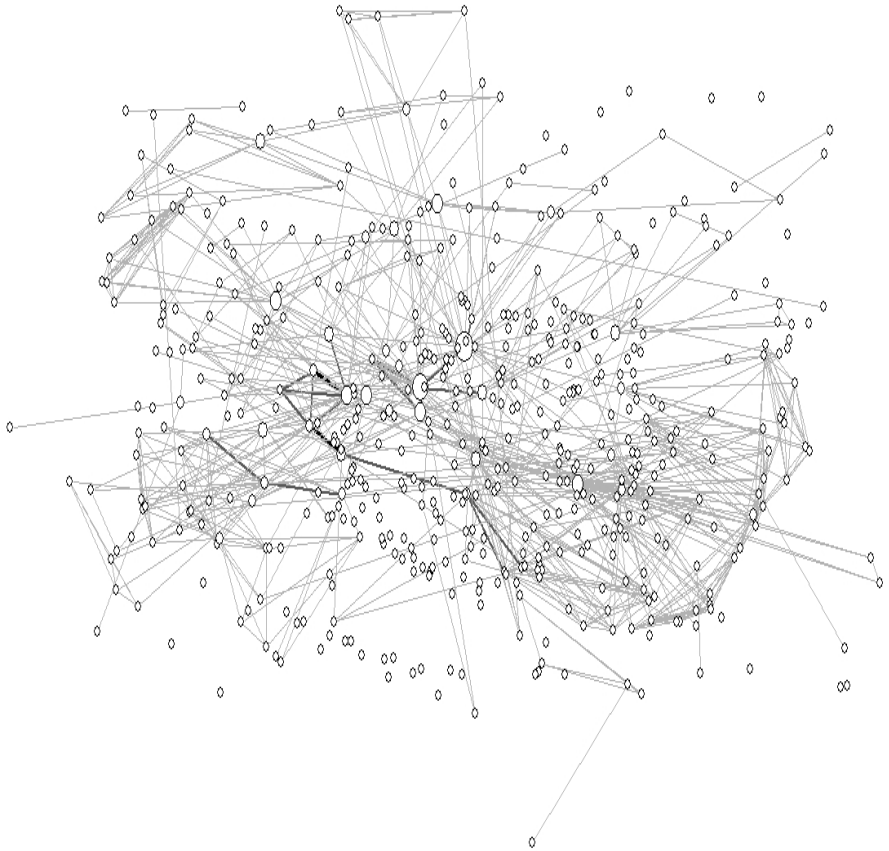
US: smart grid, smart meter technologies, communication network

Yarime and Karlsson (2018)

Network of Actors in Developing Smart Cities in Japan & US



Japan: concentrated structure dominated by a small number of large actors, e.g. energy & electric companies and public organizations



US: distributed structure with many actors, such as utilities and ICT companies including SMEs and start-ups

Yarime and Karlsson (2018)

Major Actors in Japanese Innovation System of Smart Cities

Organization	Type	Degree	Betweenness
Hitachi	Electronics company	74	5212.703
TOSHIBA	Electronics company	64	3735.588
Mitsubishi Corporation	Trading company	67	2908.344
NEDO	Governmental funding agency	28	2735.742
Sharp	Consumer electronics company	91	1603.521
Denso	Automotive component supplier	55	1567.229
Fuji Electric	Infrastructure vendor	53	1516.667
JX Nippon Oil & Energy	Petroleum company	55	1481.08
Panasonic	Electronics company	35	1276.681
Furukawa Electric	Infrastructure vendor	47	1187.081
University of Tokyo	University	13	1154.299
Sumitomo Electric Industries	Infrastructure vendor	55	1123.101
Urban Renaissance Agency	Real estate agency	47	960.8317
TOTO	White ware vendor	30	917.3737
IBM	Software vendor	30	917.3737
Omron	Automotive component supplier	24	770.785
Kansai Electric Power Co	Electric utility	24	770.785
Iwatani	Gas equipment vendor	29	658.7583
Nittetsu Elex	Infrastructure vendor	29	658.7583
Tokyo Gas	Gas utility	31	609.8406

Yarime and Karlsson (2018)

Innovation Systems of Smart Cities in Japan & US

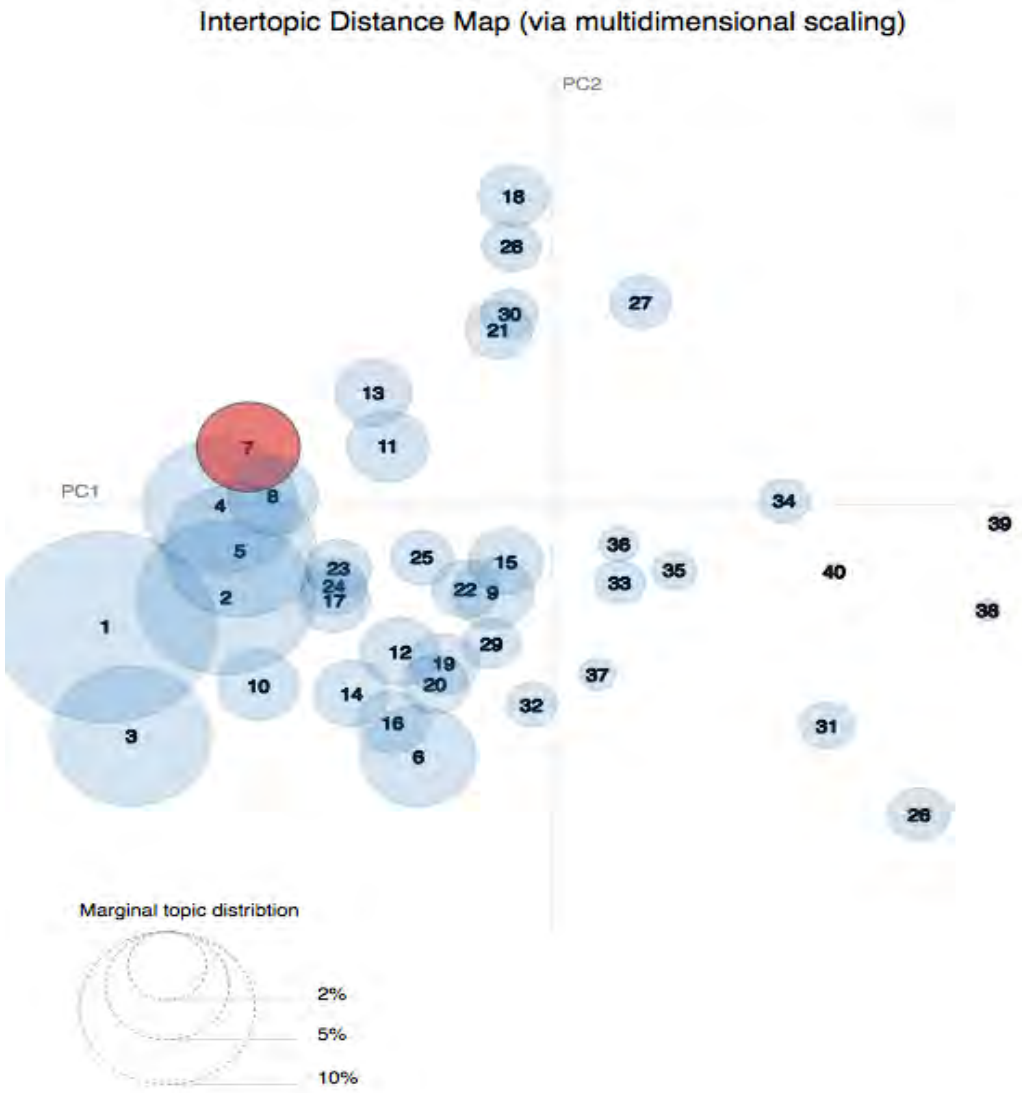
Japan

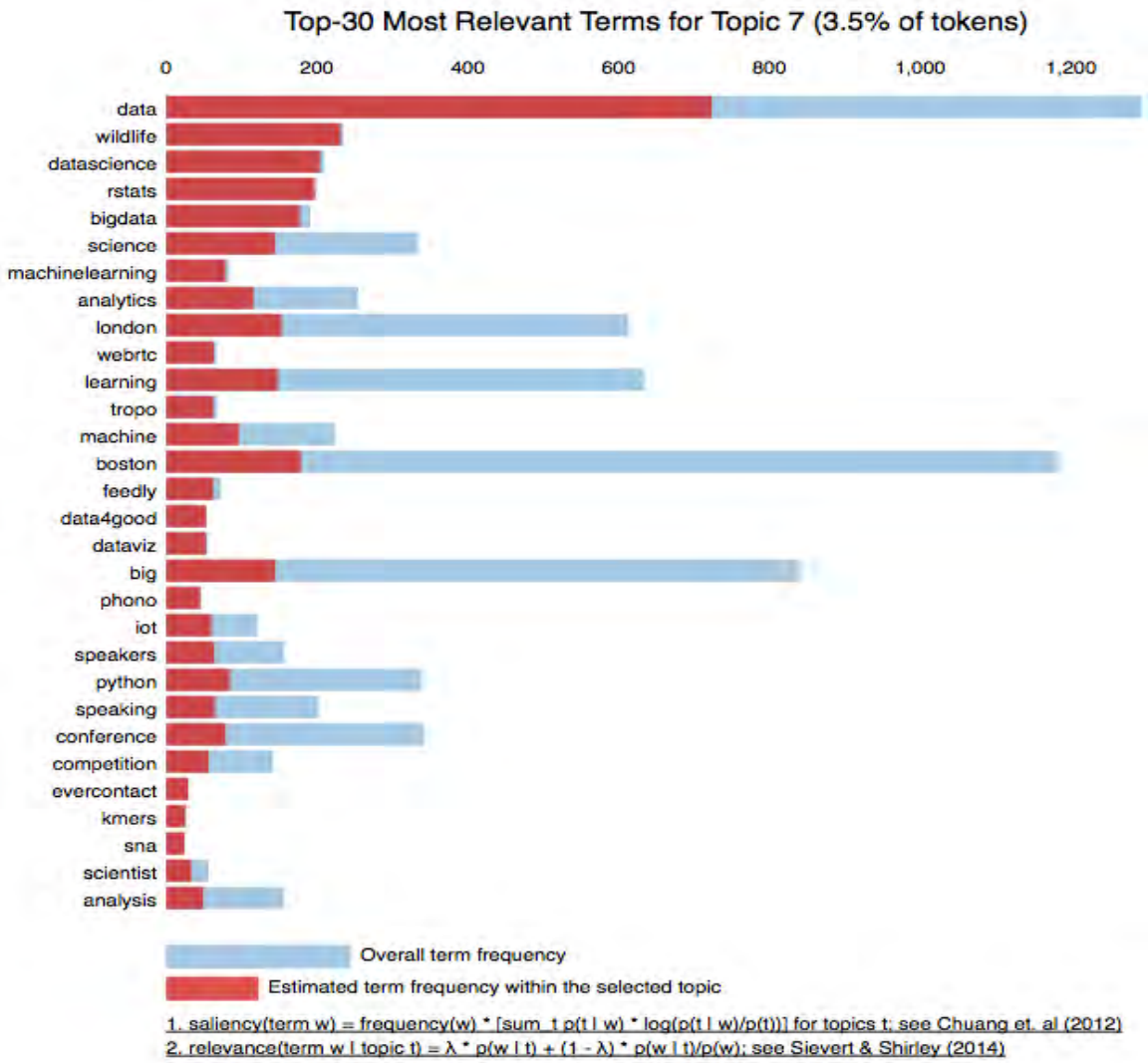
- Strong interest in resilience to natural disasters and distributed energy systems
- Focus on application technologies for home appliances and electric vehicles, energy storage, community management
- Concentrated structure dominated by a small number of large actors, including government organizations and electric & electronic companies
- Innovation system mainly driven by the energy sector

US

- Strong interest in resilience to physical and cyber attacks and cost reduction
- Focus on grid and smart meter technologies, communication, infrastructure network
- Distributed structure with many actors, such as utilities and smart meter manufacturers including SMEs and start-ups
- Innovation system mainly driven by the information and communication sector

Smart City Projects in China



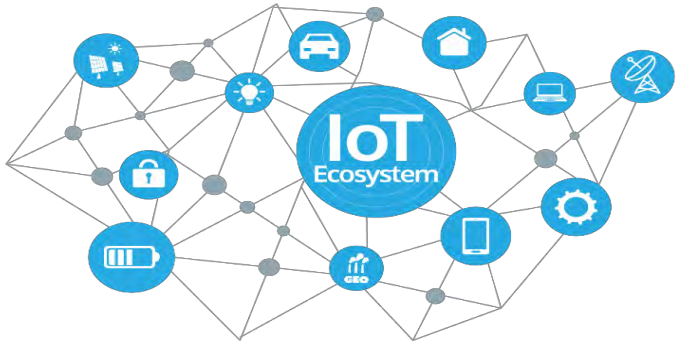


Characteristics of Smart City Projects in China

Topic	Key Contents
1 Data/information platform/system/management	**Health and medical care**, tourism, community,
2 Construction of the city	**Transportation, city management, infrastructure**, education, tourism, agriculture, information safety, and civic life, etc.
3 City improvement engineering projects	**Roads project, car park space, greening projects, and street lights**, etc.
4 Big data/information platform/management/system	**Access safety, operation surveillance, internet surveillance**, etc.
5 Big data/information platform/management/system	**Logistics system**, agricultural technology, and surveillance and analysis on agriculture and logistics.
6 Big data/information system/management	**Video surveillance, public safety**, and transportation.
7 Database and server room	

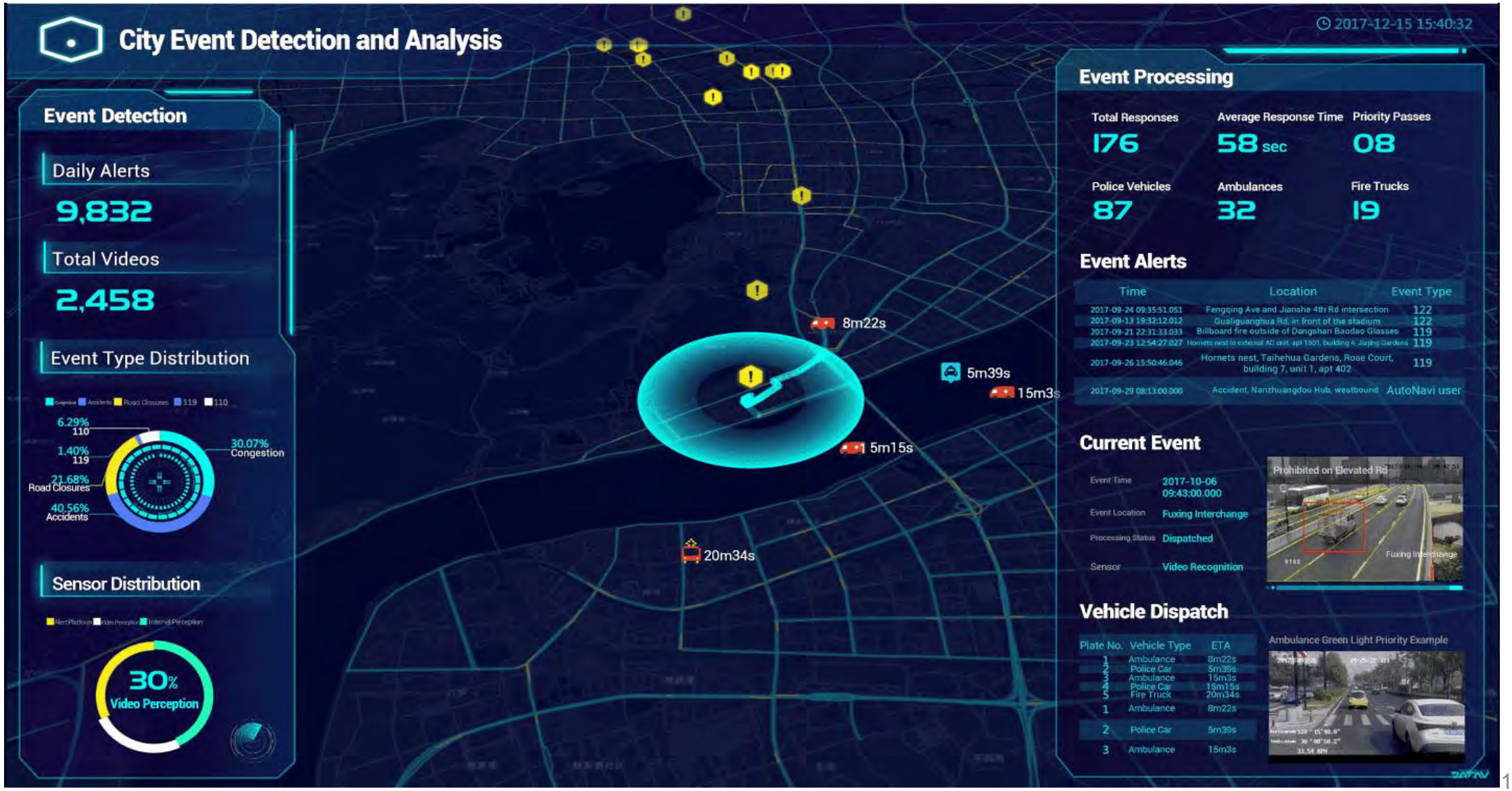
Data-Driven Innovation for Smart Cities

- Sophisticated systems of information and communication hardware and software
- Intelligent exchanges of information that flow between its many different subsystems
- Covering various types of products and services relevant to urban functions
- Exchange of information analyzed and translated into citizen and commercial services
- Acting on the information exchange to make urban ecosystem more resource-efficient and sustainable



Alphabet Sidewalk Toronto

Alibaba City Brain Hangzhou



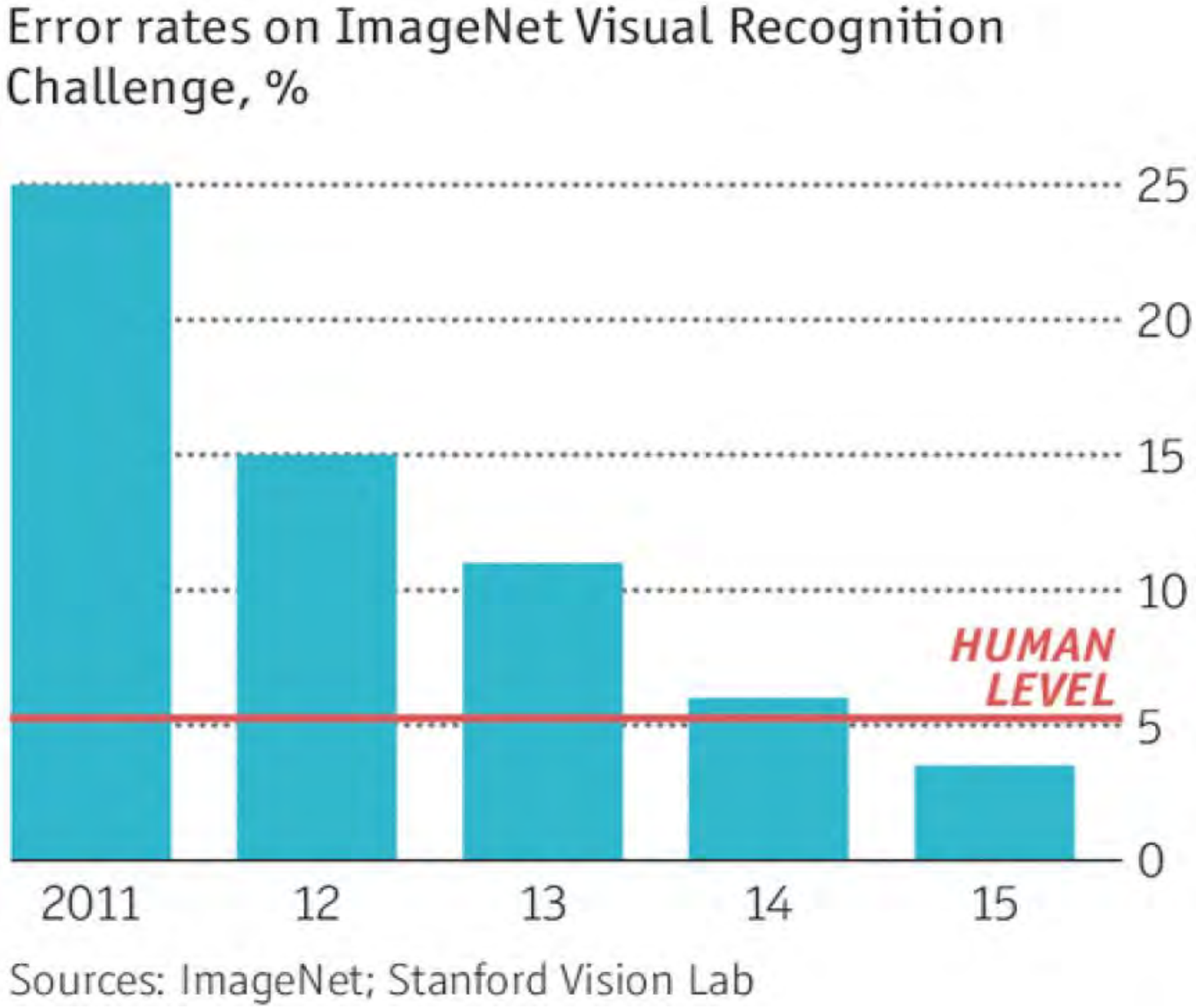
Data-Driven Innovation for Smart Cities

- Energy
  - Distributed energy systems with peer-to-peer exchange based on blockchain
  - SaaS – Solar as a Service
- Building and Housing
  - Smart meters and IoT
- Transportation
  - CASE - Connected, Autonomous, Sharing, and Electrified
  - MaaS – Mobility as a Service
- Health
  - Diagnosis of cancer based on image recognition
  - SaMD – Software as a Medical Device

Data, Data Science & Domain Expertise for Data-Driven Innovation

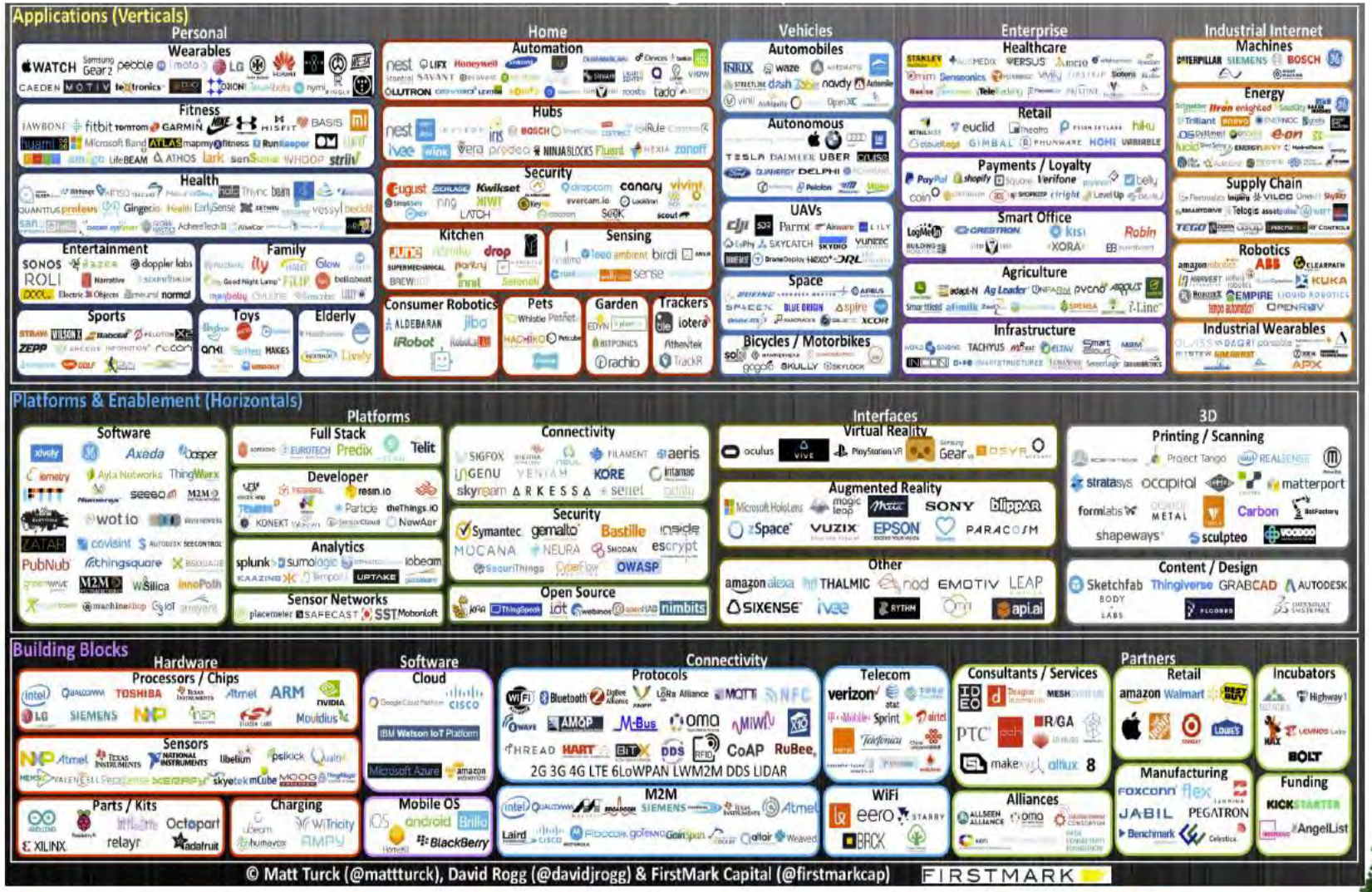
- **Data**
  - Availability and accessibility
  - Quantity and quality
  - Open data
  - Internet of Things (IoT)
  - Drones, satellite images
- **Data Science**
  - Big data
  - Data analytics
  - Artificial Intelligence (machine learning)
- **Domain Expertise**
  - Sector-specific knowledge
  - Cyber-physical systems
  - Manufacturing
  - Smart cities
  - Sustainability

Rapid Technological Progress of AI



Economist (2016)

Landscape of the Internet of Things



FIWARE

Ministry of Science and ICT

NIST National Institute of Standards and Technology U.S. Department of Commerce

ETSI World Class Standards

ANSI

USGBC

ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

TIA ADVANCING GLOBAL COMMUNICATIONS

Data-Driven Innovation

- Deriving new and important insights from the vast amount of data generated during the delivery of services every day
- Ability to learn from real-world use and experience
  - Training
- Capability to improve the performance
  - Adaptation

Challenges to Policy Makers in Facilitating Data-Driven Innovation

- Speed and direction of technological change
  - Rapid progress and significant uncertainty
  - Widening gap between technological and institutional changes - “Pacing Problem”
  - Difficult to explain or understand the process of technological improvement
- Interconnectedness of technologies
  - Cyber-physical systems such as smart cities
  - Coordination of policies in different fields and sectors
- Real-world use and experience
  - Stakeholder engagement and collaboration
  - Multi-stakeholder platform
  - Societal experimentation

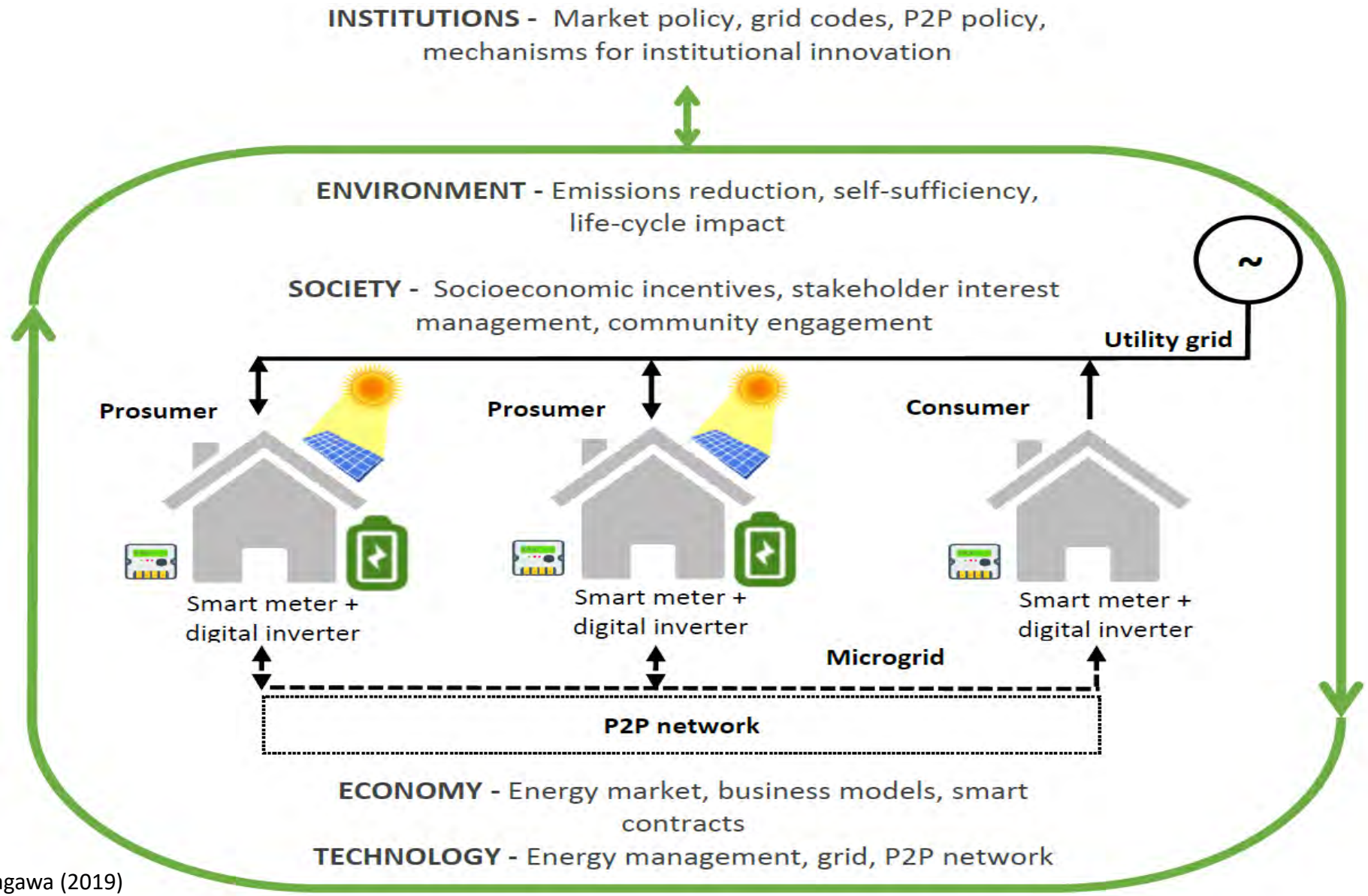
AI for Predicting Demand and Supply & Improving Market Efficiency

- Potential of AI to improve efficiency by predicting demand and supply, overcoming computational barriers, and reducing search frictions.
- AI will play a substantial role in the design and implementation of electricity markets.
- Machine learning could help predict human behavior in a variety of settings including bargaining, risky choice, and games, helping to verify or reject theory.
  - Provide insight into new ways to model biases in human decision-making.
- (Agrawal, Gans, and Goldfarb, 2019)

Distributed Energy Systems

- Proximity to the customer
  - Localisation of energy development
  - Reduction of T&D costs
  - Improved understanding of customer needs
- High energy efficiency
  - Multi-generation and cascading energy usage
  - Combination of complementary energy resources
  - Use of excess heat and residual pressure
- Utilising clean and low-carbon energy sources
  - Integration of VRE
  - Reduction of air pollutant emissions
  - Reduction of carbon emissions
  - Reduction of fossil fuel consumption
- (OECD/IEA, 2017)

Peer-to-Peer Distributed Energy Systems Based on Blockchain



Ahl, Yarime, Tanaka, Sagawa (2019)

Blockchain-Based Distributed Energy Systems

- Blockchain is rapidly gaining momentum as a platform
- Internet of Value
  - A distributed ledger leveraging consensus procedures and cryptographic security
- Emerging applications of blockchain are highly disruptive
  - Irreversibility
  - Incorruptibility
  - Aptitude to decentralize markets
- Benefits of decentralization
  - Fault tolerance
  - Attack resistance
  - Avoiding collusion and price cartels
- Internet of Energy (IoE)
  - enabling transparent, distributed prosumer markets.
- Can contribute to a shared energy economy with a platform
  - All people can produce, sell, and purchase energy.

Ahl, Yarime, Tanaka, Sagawa (2019)

Renewable and Sustainable Energy Reviews 107 (2019) 200–211

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Review of blockchain-based distributed energy: Implications for institutional development

Amanda Ahl[a,*], Masaru Yarime[b,c,d], Kenji Tanaka[e], Daishi Sagawa[e]

[a] Department of Innovation Science, School of Environment and Society, Tokyo Institute of Technology, 3-3-6 Shibaura, Minato, Tokyo 105-0023, Japan
[b] Division of Public Policy, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong
[c] Department of Science, Technology, Engineering and Public Policy, University College London, Gower St, Bloomsbury, London WC1E 6BT, United Kingdom
[d] Graduate School of Public Policy, The University of Tokyo, 7-3-1 Hongo, Bunkyō, Tokyo 113-8654, Japan
[e] Graduate School of Engineering, The University of Tokyo, 7-3-1 Hongo, Bunkyō, Tokyo 113-8654, Japan

ARTICLE INFO

Keywords:
Blockchain
Microgrid
Peer-to-peer
Renewable energy
Institutions

ABSTRACT

The future of energy is complex, with fluctuating renewable resources in increasingly distributed systems. It is suggested that blockchain technology is a timely innovation with potential to facilitate this future. Peer-to-peer (P2P) microgrids can support renewable energy as well as economically empower consumers and prosumers. However, the rapid development of blockchain and prospects for P2P energy networks is coupled with several grey areas in the institutional landscape. The purpose of this paper is to holistically explore potential challenges of blockchain-based P2P microgrids, and propose practical implications for institutional development as well as academia. An analytical framework for P2P microgrids is developed based on literature review as well as expert interviews. The framework incorporates 1) Technological, 2) Economic, 3) Social, 4) Environmental and 5) Institutional dimensions. Directions for future work in practical and academic contexts are identified. It is suggested that bridging the gap from technological to institutional readiness would require the incorporation of all dimensions as well as their inter-relatedness. Gradual institutional change leveraging community-building and regulatory sandbox approaches are proposed as potential pathways in incorporating this multi-dimensionality, reducing cross-sectoral silos, and facilitating interoperability between current and future systems. By offering insight through holistic conceptualization, this paper aims to contribute to expanding research in building the pillars of a more substantiated institutional arch for blockchain in the energy sector.

Technological, Economic, Social, Environmental, and Institutional Challenges in Distributed Energy Systems

Technological	Economic	Social	Environmental	Institutional
- **Energy management system:** automatic management of energy & bidding strategies [9, 11, 24, 34, 59], frequency and voltage control [9, 11], reliability [11, 12, 24, 32, 57] - **Power grid:** smart metering [9, 31, 57], energy storage [11, 12], O&M of microgrid [60, 62], virtual & physical grid connection [30, 34], P2P microgrid-utility grid interoperability [63] & islanding [11, 12, 31, 34, 57], power loss [64] - **P2P network system:** smart contracts & consensus mechanisms [9, 20, 24, 34], cybersecurity [48, 20], data storage [20, 24]	- **Energy market mechanisms:** competition [31, 57, 58], scheduling [24, 60], real-time pricing [24, 34, 35, 57] for frequent power fee settlements [24], ancillary service participation [32, 57] - **Prosumer business models:** selectivity & locality [32], value-tapping & participation willingness [59] - **Smart contracts:** business model support [19, 59] through automated purchase & selling strategies [19, 24], smart-utility contract interoperability [63]	- **Socioeconomic incentives:** local economy growth [33, 34, 50], income equality [59], reduced pollution [11, 32, 34, 60], energy security [11, 24, 32, 57], enhanced consumer/prosumer choice [7, 9, 34], sustainable behavior [1, 7] - **Stakeholder interest management** [12, 13, 32, 33, 35, 58, 59]: interests, concerns & acceptance [12, 13, 58], shifting roles [11, 30, 37], user friendliness [71-73] - **Community engagement:** communication [71], public acceptance [13, 34, 58], stakeholder skill development [20, 71, 74]	- **Emissions reduction:** energy management for emissions reduction [11, 57, 59, 60], emission regulations in smart contracts [57] - **Self-sufficiency:** higher renewable share, lower line losses [11, 57, 59] - **Life-cycle impact:** tracking microgrid equipment end-of-life impact and recycling [35]	- **Market policy:** liberalization [31, 32], microgrid ancillary service market [11, 32, 57], emission regulations [57] - **Grid codes:** for microgrid interconnection, islanding, metering [11, 31, 34, 57] - **P2P policy:** prosumer licenses [11, 63], ownership & sharing models for infrastructure & energy [31, 32, 62], blockchain governance [48] - **Institutional innovation mechanisms:** community-building & reduced silos [63, 66, 74], co-development [58, 74], regulatory sandbox [80, 87]

Ahl, Yarime, Tanaka, Sagawa (2019)

Renewable and Sustainable Energy Reviews 117 (2020) 109488

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: http://www.elsevier.com/locate/rser

Exploring blockchain for the energy transition: Opportunities and challenges based on a case study in Japan

A. Ahl [a,*], M. Yarime [b,e,f], M. Goto [a], Shauhrat S. Chopra [c], Nallapaneni Manoj. Kumar [c], K. Tanaka [d], D. Sagawa [d]

[a] Department of Innovation Science, Tokyo Institute of Technology, Tokyo, Japan
[b] Division of Public Policy, Hong Kong University of Science and Technology, Hong Kong
[c] School of Energy and Environment, City University of Hong Kong, Kowloon, Hong Kong
[d] Graduate School of Engineering, The University of Tokyo, Tokyo, Japan
[e] Department of Science, Technology, Engineering and Public Policy, University College London, United Kingdom
[f] Graduate School of Public Policy, The University of Tokyo, Japan

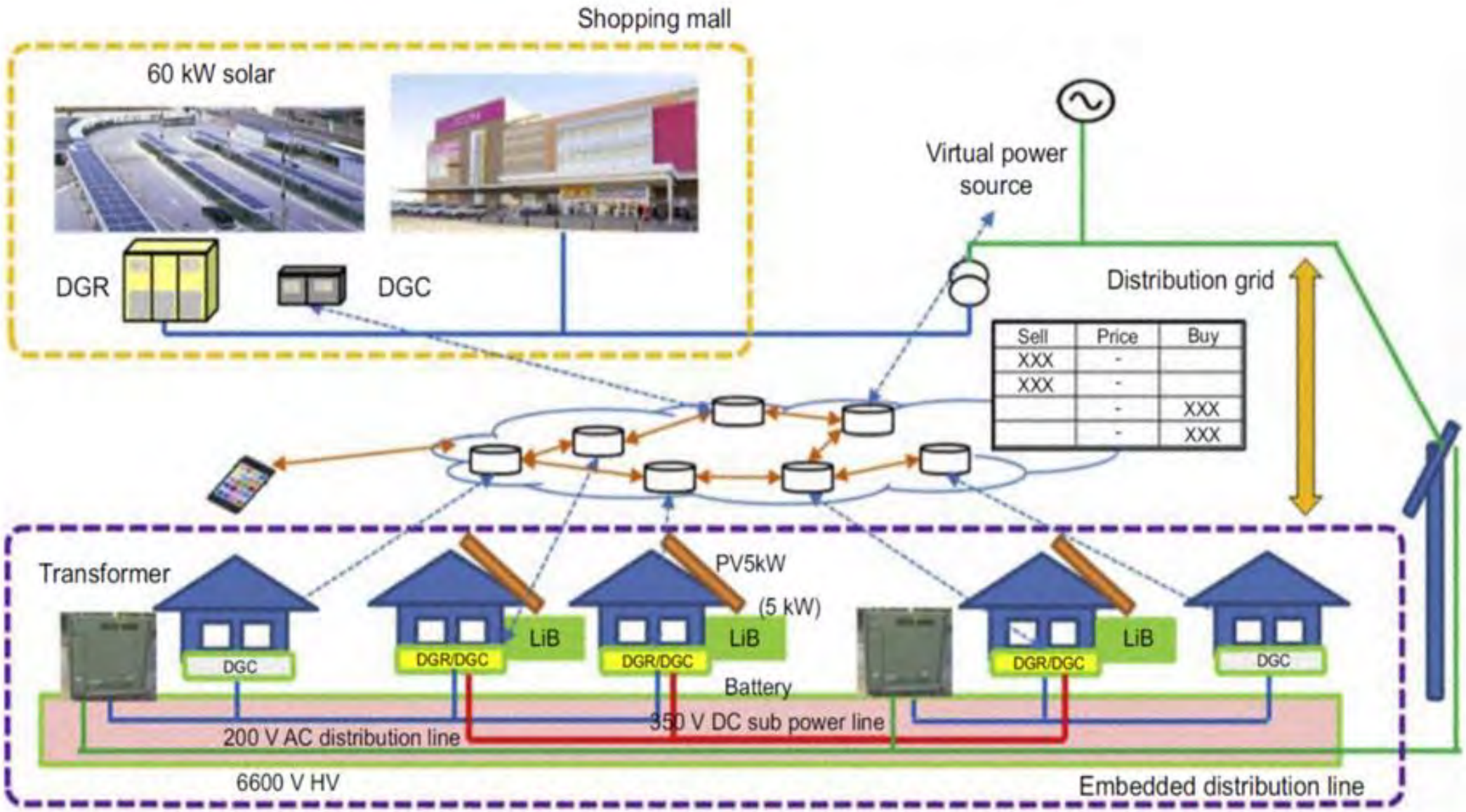
ARTICLE INFO

Keywords:
Blockchain
Energy transition
Energy internet
Smart grid
Energy-trading
Renewable energy
Prosumers
Innovation ecosystem

ABSTRACT

Under pressures to reach net zero emissions by 2050, there is an ongoing transition of energy decarbonization, decentralization and digitalization. Physical and information flows in energy systems are increasingly complex and distributed, leaving centralized structures inefficient. Blockchain technology is suggested as part of the next step in this transition. Blockchain has potential to facilitate distributed, peer-to-peer trading with reduced transaction costs, increased security via cryptography, and prosumer choice. However, there are as of yet multiple challenges to the expansion of blockchain in the energy sector. This paper argues that analysis of these challenges requires a multi-angled approach incorporating technological, economic, social, environmental, and institutional dimensions. First, each dimension is explored, substantiated based on a blockchain-based energy system case in Japan. Concrete challenges of scaling this case toward 2050 and potential opportunities in overcoming these challenges are discussed, leveraging extensive literature review. Finally, an overview of strategic indications is suggested. The findings of this paper present initial indications on challenges and opportunities to overcome them based on a multi-dimensional overview. It is suggested that the factors identified across the dimensions are interrelated. This would in turn call for coherent innovation management and multi-stakeholder innovation ecosystems. Living Labs and regulatory sandboxes are prospective foundations to support such ecosystems, and enable informed decision-making among both private and public sector actors. At large, it is suggested that a holistic and pragmatic approach can benefit the application and scalability of blockchain in the energy transition.

Blockchain-Based Distributed Energy System, Urawa-Misono, Saitama, Japan



Abe, Tanaka, Triet (2019)

Challenges and Opportunities in the Blockchain-Based Microgrid in Japan

- Technology
  - Throughput, latency, data storage, high speed connectivity, interoperability, cybersecurity
  - Consensus mechanism development, sharding, multichain communication, off-chain storage, state channels, 5G internet, CR, AI solutions, machine learning, smart meter blockchain integration (such as via light clients), IoT, M2M, privacy measures, quantum resilience.
- Economics
  - Subsidy-dependence, lacking market competition, contract interoperability, platform market growth
  - Business model innovation, market transparency, wholesale trading, pricing mechanism development, AI solutions, machine learning, DAO- and fee-based platforms for trading and infrastructure cost-sharing, EaaS.
- Society
  - Behavioral change, public acceptance, stakeholder management, skill development
  - Platform transparency and userfriendliness, digital platform company partnerships, convenience, user interaction, AI solutions, blockchain searchability, expanded consumer/prosumer choice, university blockchain training and programs.

Ahl, Yarime, Goto, et al. (2019)

Challenges and Opportunities in the Blockchain-Based Microgrid in Japan

- Environment
  - Emissions reduction scheme uncertainty, environmental regulation in smart contracts, grid equipment end-of-life management
  - Transparency and traceability in renewable energy trading, green wholesale market opportunities such as ancillary markets, emissions-tracking and trading, carbon taxation, validation of rights and meter data, environmental metric fraud prevention, end-to-end supply chain traceability, IoT, coherent technology management
- Institutions
  - Low renewable energy targets, uncertain stakeholder roles, tokenization, prosumer licenses, balancing obligations, grid interconnection codes, network consignment fees, smart meter measurement act, privacy protection, centralized decision making.
  - Market unbundling and competition, network consignment fee structure update, DNO and DSO role establishment, prosumer contract and license development, smart meter act and standard development for blockchain integration, smart meter security and data traceability, Living Labs, regulatory sandboxes, interdisciplinary teams.

Ahl, Yarime, Goto, et al. (2019)

The Regulatory Sandbox for Stimulating Innovation

- Allows firms to test innovative products, services and business models in a live market environment, while ensuring that appropriate safeguards are in place.
- Potential benefits
  - Reducing the time and the cost of getting innovative ideas to market
  - Enabling greater access to finance for innovators, by reducing regulatory uncertainty
  - Enabling more products to be tested and potentially introduced to the market
- Potential risks
  - Accidents, health, safety, environmental disasters, privacy, security
  - Responsibility

Applications of Regulatory Sandboxes

- Established by UK Financial Conduct Authority in early 2016
- Fintech Supervisory Sandbox launched by the Hong Kong Monetary Authority in September 2016
- Regulatory Sandbox to Encourage Energy Sector Innovations launched in Singapore in October 2017
- The Japanese government introduced a new framework for regulatory sandboxes in June 2018, covering financial services, healthcare industry, mobility and transportation
- Extending from Fintech to Cyber-Physical Systems

ICO opens Sandbox beta phase to enhance data protection and support innovation

Share

Date
29 March 2019

Type
News

The Information Commissioner's Office (ICO) has opened the beta phase of its Sandbox, a new service designed to support organisations using personal data to develop products and services that are innovative and have demonstrable public benefit.

The beta phase of the Sandbox, which is now open to applications, will enable participants to work through how they use personal data in their projects with the ICO's specialist staff to help ensure they comply with data protection rules. The Sandbox will also provide some comfort from enforcement action and, where feasible, increased public reassurance that innovative products and services are not in breach of data protection legislation.

The Sandbox beta phase offers a free, professional, fully functioning service for approximately 10 organisations, of varying types and sizes, across a number of sectors. The ICO will consider applications from start-ups, SMEs and large organisations, across private, public and voluntary sectors.

The ICO will assess applications on the basis of whether the product or service being developed is innovative and can provide a potential demonstrable benefit to the public. Public benefit will be determined in terms of both breadth – the amount of people benefitting – and depth – the extent to which they benefit.

The ICO expects that many of the products that will come into the Sandbox will be at the cutting edge of innovation and may be operating in particularly challenging areas of data protection where there is genuine uncertainty about what compliance looks like. As a result, Sandbox participants may become use-cases from which the ICO anticipates change and develops public guidance and resources on compliance.

GOV.UK

1. Home (https://www.gov.uk/)
2. Business and industry (https://www.gov.uk/business-and-industry)
3. Industrial strategy (https://www.gov.uk/business-and-industry/industrial-strategy)

Press release

Regulation rulebook rewritten to ensure UK leads tech revolution and empowers consumers

New measures will transform the UK's regulatory system to support innovation while empowering consumers.

Published 11 June 2019

From:

Department for Business, Energy & Industrial Strategy (https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy), Department for Digital, Culture, Media & Sport (https://www.gov.uk/government/organisations/department-for-digital-culture-media-sport), and The Rt Hon Greg Clark MP (https://www.gov.uk/government/people/greg-clark)

- government rewrites regulation rulebook to embrace technological change as part of its modern Industrial Strategy
- more support for businesses to launch new, transformative products to UK markets faster
- Smart Data Review to offer consumers greater control over their data to get better deals
- Vulnerable Consumer Challenge to ensure the most vulnerable and least digitally engaged customers are still able to enjoy the best deals

New measures announced today (11 June 2019) will free up businesses and innovators to test their ideas, make use of the latest technologies and get their products to market quicker – keeping the UK at the forefront of innovation.

Regulation for the Fourth Industrial Revolution

UK Smart Data Review: Proposals

- Accelerating the development of innovative data-driven services in consumer markets
  - The establishment of a new cross-sectoral Smart Data Function to oversee the delivery of smart data initiatives across multiple markets
  - Introducing an Open Communications initiative that will require communications businesses to provide consumers' data to third party providers at the consumer's request
- Using data and technology to help vulnerable consumers
  - Establishing a Vulnerable Consumer Challenge that will encourage data-driven innovation to improve outcomes for vulnerable consumers
  - Placing the needs of vulnerable consumers at the centre of Smart Data initiatives and the new Smart Data Function
  - Exploring ways regulators can utilise consumer data, subject to the right protections, to support vulnerable consumers
- Ensuring consumers and their data are protected
  - Building trust in innovative data-driven services by introducing strong data protection requirements on Third Party Providers accessing consumer data
  - A cross-sectoral approach to the regulation of Third Party Providers to minimise burdens on providers that operate across multiple markets

Alphabet's Sidewalk Toronto

- The company won a bid to redevelop 800 acres of Toronto's waterfront in October 2018
- Promises ubiquitous high-speed internet; intelligent traffic lights and curbs; smart awnings in public spaces; underground delivery robots; wooden homes; and a thermal energy grid.
  - Generates large quantities of data that can be used to optimize and improve services.
- Privacy challenges in building smart cities capable of tracking their inhabitants in unprecedented detail
- Citizen groups questioned Sidewalk's business objectives and have worried about the privacy implications.
  - Canadian Civil Liberties Association sued the city of Toronto in an effort to block the project.
- Master Innovation & Development Plan (MIDP) for Toronto released in June 2019
- Rebooting the smart-city concept through community engagement and understanding of local technology needs.
- Data governance plan
  - Data gathered through the project will be kept by an independent "civic data trust" and will not be sold, used for advertising, or shared without people's permission.

(MIT Technology Review, 2019)

POLITICS

Japan moves to grant consumer rights over personal data

Individuals would be able to bar companies from using identifying information

NOBUTAKA HIRAMOTO and KOSUKE TAKEUCHI, Nikkei staff writers
APRIL 03, 2019 02:44 JST

A Facebook data center. The abuse of data collected by companies has fueled a push for greater privacy protections. © Reuters

TOKYO -- Japan is considering giving individuals the right to stop companies from using their personal data, Nikkei learned Tuesday, as companies increasingly mine this virtual resource to build new businesses.

The idea will be a point of debate in discussions about revisions to the country's data protection law, which is scheduled for review in 2020.

Under the current law, individuals can stop companies from using their personal information only if it is improperly obtained or used for something other than its original purpose. The Personal Information Protection Commission would expand that right to allow people to designate how their information can be used.

Nikkei Asian Review (2019)

BUSINESS TRENDS

Japan's 'information banks' to let users cash in on personal data

Monetary and other rewards await consumers who allow sharing

JUNYA HEMMI, Nikkei staff writer
MAY 09, 2019 05:11 JST

People use smartphones outside an Apple Store in Tokyo. Information banks will not only give Japanese consumers greater control over their data, but also compensate them for it. © Reuters

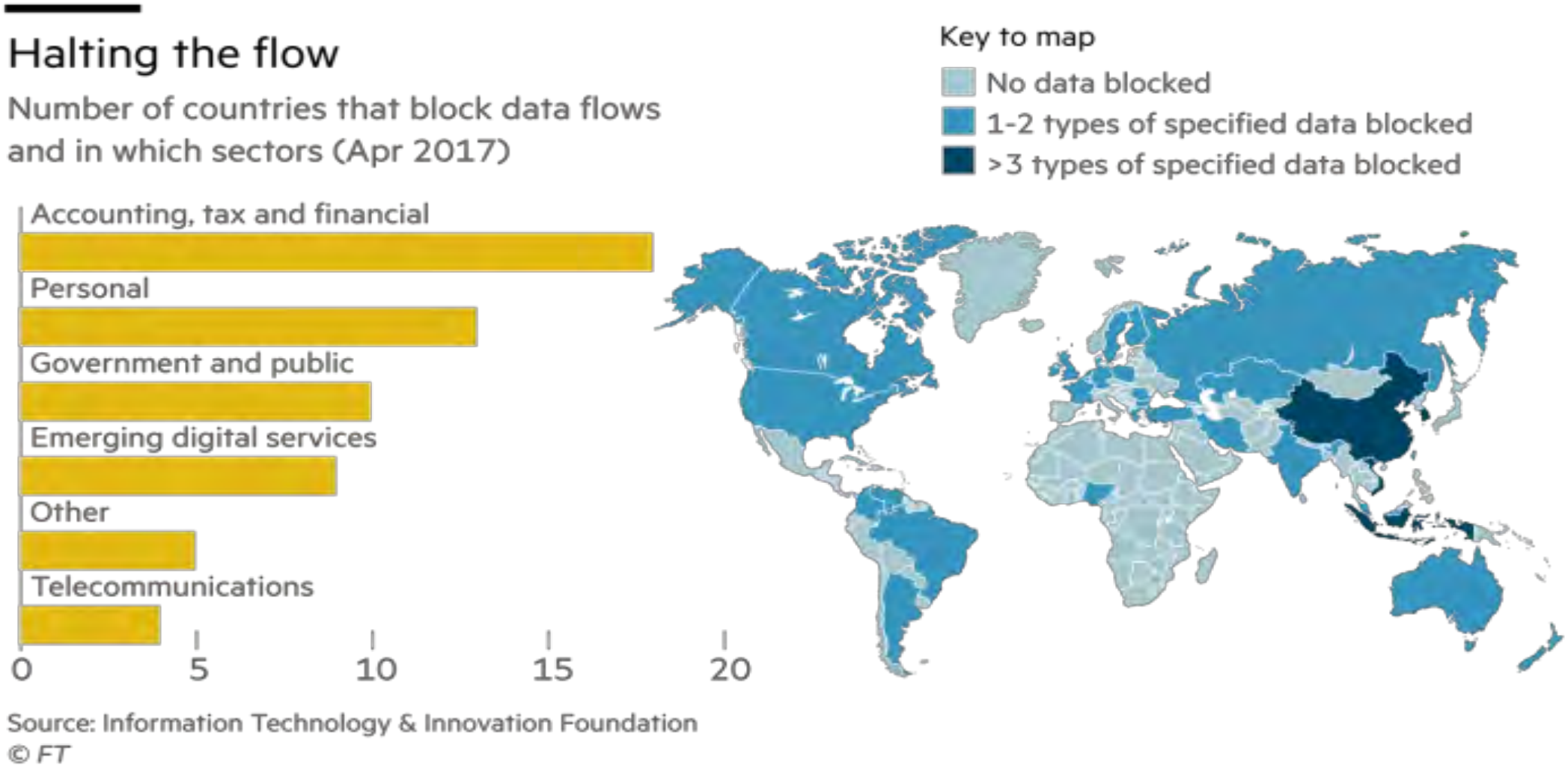
TOKYO -- As dissatisfaction grows with how technology giants use personal data, Japanese businesses are offering a solution in the form of "information banks" that compensate customers for providing it.

Satellite broadcaster **Sky Perfect JSAT Holdings** and personal loan provider J.Score are among the companies setting up these banks, which also give users greater control over data distribution.

Starting July, Sky Perfect customers will enjoy subscription discounts for allowing their viewing histories and interests to be shared with outside companies. They can save several hundred yen a pop, or several dollars. The data in turn would allow a sportswear store to buy advertising slots only targeting frequent sports viewers, for example.

Nikkei Asian Review (2019)

Rise of Data Protectionism?



Financial Times (2018)

European Commission adopts adequacy decision on Japan, creating the world's largest area of safe data flows

Brussels, 23 January 2019

The Commission has adopted today its adequacy decision on Japan, allowing personal data to flow freely between the two economies on the basis of strong protection guarantees.

This is the last step in the procedure launched in September 2018, which included the opinion of the European Data Protection Board (EDPB) and the agreement from a committee composed of representatives of the EU Member States. Together with its equivalent decision adopted today by Japan, it will start applying as of today.

Věra **Jourová**, Commissioner for Justice, Consumers and Gender Equality said: *"This adequacy decision creates the world's largest area of safe data flows. Europeans' data will benefit from high privacy standards when their data is transferred to Japan. Our companies will also benefit from a privileged access to a 127 million consumers' market. Investing in privacy pays off; this arrangement will serve as an example for future partnerships in this key area and help setting global standards."*

The G20 creates the Global Smart Cities Alliance to establish universal norms and guidelines for the implementation of technology

12 SEPTEMBER 2019 / DIGITAL TRANSFORMATION, INCLUSIVE & SHARING

Author | Patricia M. Llaneras

Global Smart Cities Alliance. This is the name given to the network established during this year's G20 summit to ensure the most important economies in the world work together to **establish norms and values for smart cities.**

The aim of this collaboration is to **unite municipal, regional and national governments** with allies in the private sectors and residents in cities worldwide with the ultimate aim of creating a series of principles to serve as a **guide for the deployment of technology** in smart cities, promoting principles including transparency, privacy and security.

Currently, there is no global framework in place for how sensor data collected in public spaces, such as by traffic cameras, should be used. This is one of the issues that this network of interconnected cities will aim to address, **fostering greater openness and trust** as well as establishing **standards for how this data is collected and used.** This is the first time the implementation of smart city technologies and global technology governance have been elevated to the agenda of world leaders.

The World Economic Forum will be the main stakeholder of this global alliance. **It will work in coordination with members of the G20 and the Urban 20 and Business 20 communities** for the responsible use of data and digital technologies in urban environments. There will also be an agency in charge of directing the group's work and to ensure the members of the coalition provide an account of their activities and initiatives. It will be the World Economic Forum's Centre for the Fourth Industrial Revolution, specifically the Internet of Things, Robotics and Smart Cities team.

Transparency, security and privacy

Challenges in Governing Data-Driven Innovation for Smart Cities

- Rapid progress and significant uncertainty in technological change
- Increasing integration of various sectors through data
- What incentives can be provided to various stakeholders for publishing, exchanging, and sharing data?
- Who owns the data and who can use it for what purposes?
- Who can have and how to control accessibility to data?
- How to control the quality of the data
- How to maintain data portability and interoperability
- How to valuate data and to distribute the value

Integrating Technologies and People in Smart Cities

	Smart City 1.0	Smart City 2.0
Focus of Vision	• Technology-driven, business-oriented	• People-centered
Role of Citizens	• Passive role as sensors, end-users/consumers	• Active role as co-creators or contributors to innovation, problem solving and planning
Objective of Technology and Experimentation	• Optimize infrastructures and services • Serve user demands and spur new business opportunities • Efficiency through ICT and big data	• Solve social challenges • Enhance citizen wellbeing and public services • Legitimacy through participation and transparency in decision making and consensus building
Approach	• Top-down, centralised	• Bottom-up, decentralised, inclusive to diverse stakeholders

Cf. Crowley, Nutter et al. (2016), Nomura (2017), Trencher (2017)

MASARU YARIME

Smart city test bed

Greater Bay Area can leverage its rich knowledge, human and financial resources to be pioneer

China's Guangdong-Hong Kong-Macao Greater Bay Area outline development plan has the potential to make the region a leader in smart cities.

With a population of 70 million, the Greater Bay Area is equivalent to more than 12 percent of China's GDP. It includes Guangdong's nine key cities, including Guangzhou, Shenzhen and Foshan, and the Hong Kong and Macao special administrative regions.

It is one of the most vibrant areas in the world and it has witnessed remarkable economic development in recent years.

To facilitate innovative activities in the region, technology parks have been established to attract corporate research and development and to encourage the entry of local high-technology companies in the manufacturing sector.

Utilizing the region's experience, accumulated by participating in the global supply chain for electronic products, many entrepreneurial companies have started to provide a variety of technologies and services.

With large technological companies already established in the region and new start-ups being created, the Greater Bay Area is transforming itself into a leading innovation cluster.

At the same time, the Greater Bay Area faces the serious challenge of achieving well-balanced progress in environmental, economic, and social aspects of sustainability.

A key question is how the region can make best use of its rich knowledge, human and financial resources to create sustainable smart cities.

For that, we need to understand and utilize the mechanisms involved in the innovation system for smart cities, with the lessons heeded for strategies in the future.

By establishing an international regulatory sandbox, the Greater Bay Area can become a global living laboratory in which entrepreneurs are encouraged to develop and experiment with novel technologies in close collaboration with stakeholders across the world.

It is particularly important to identify the knowledge and technological domains that have an advantage, key stakeholders in academia, industry and the public sector who can actively engage in innovation, and the institutional conditions and environments that facilitate cooperation and collaboration among them. Based on that, the Greater Bay Areas will be able to promote the drivers to stimulate innovative initiatives to form smart cities.

Data-driven innovation such as the internet of things and artificial intelligence derive significant insights from the vast amount of data generated during the use of technologies and delivery of services every day. Therefore, training, the ability to learn from real-world use and experience, and adaptation, the capability to improve performance, become critical in the advancement of data-driven innovation.

There is a great possibility that the Greater Bay Area will become a global open test bed for smart cities. As data-driven innovation is crucially dependent upon real-world uses and experiences, societal experimentation of technologies from an early stage of innovation plays a significant role.

Active engagement and close collaboration with relevant stakeholders in business, academia, government and civil society will be key to implementing living laboratories for novel technologies. The existence of strong entrepreneurship producing numerous start-ups, coupled with support for their market entrance, will enable the region to be an excellent place for open innovation for smart cities.

Data-driven innovation, which is advancing rapidly through trial and error, requires an appropriate governance system, as there are also growing concerns about safety, security and privacy.

The regulatory sandbox is an approach that allows companies to test innovative products, services and business models in a live market environment, while ensuring that appropriate safeguards are in place.

Potential benefits would include reducing the time and the cost of getting innovative ideas to market, enabling greater access to finance for innovators by reducing regulatory uncertainty, and allowing more products to be tested and potentially introduced to the market. As an increasing amount of various kinds of data is involved, it is of critical importance to manage open access, exchange, and sharing of data properly among stakeholders, while ensuring intellectual property rights receive fair protection.

By establishing an international regulatory sandbox, the Greater Bay Area can become a global living laboratory in which entrepreneurs are encouraged to develop and experiment with novel technologies in close collaboration with stakeholders across the world.

MA XUEJING / CHINA DAILY

The author is associate professor of the Division of Public Policy at the Hong Kong University of Science and Technology. The author contributed this article to China Watch, a think tank powered by China Daily. The views do not necessarily reflect those of China Daily.

China Daily, September 11, 2019