Road to Smart City

“From lamppost to multi-purpose smart public hub”

Bouwfonds Investment Management

Oktober 2017

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The investment opportunity

Summary and conclusions

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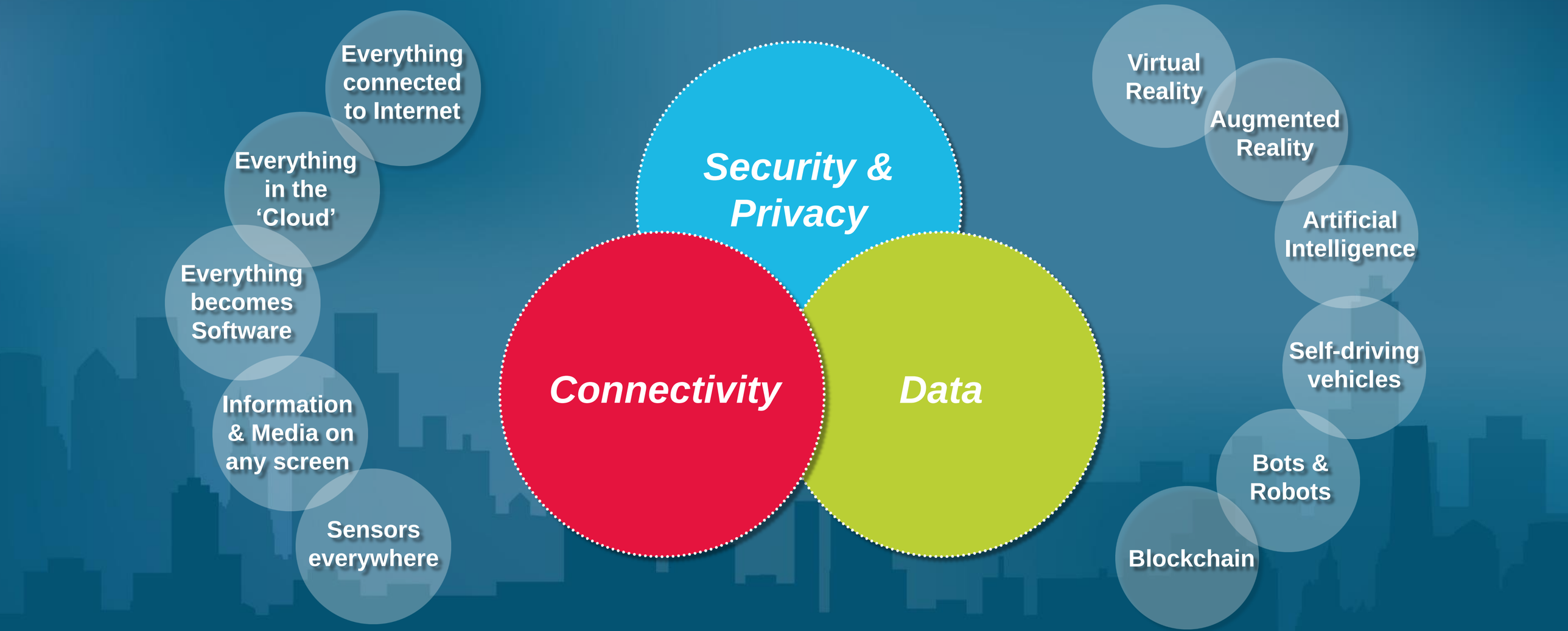
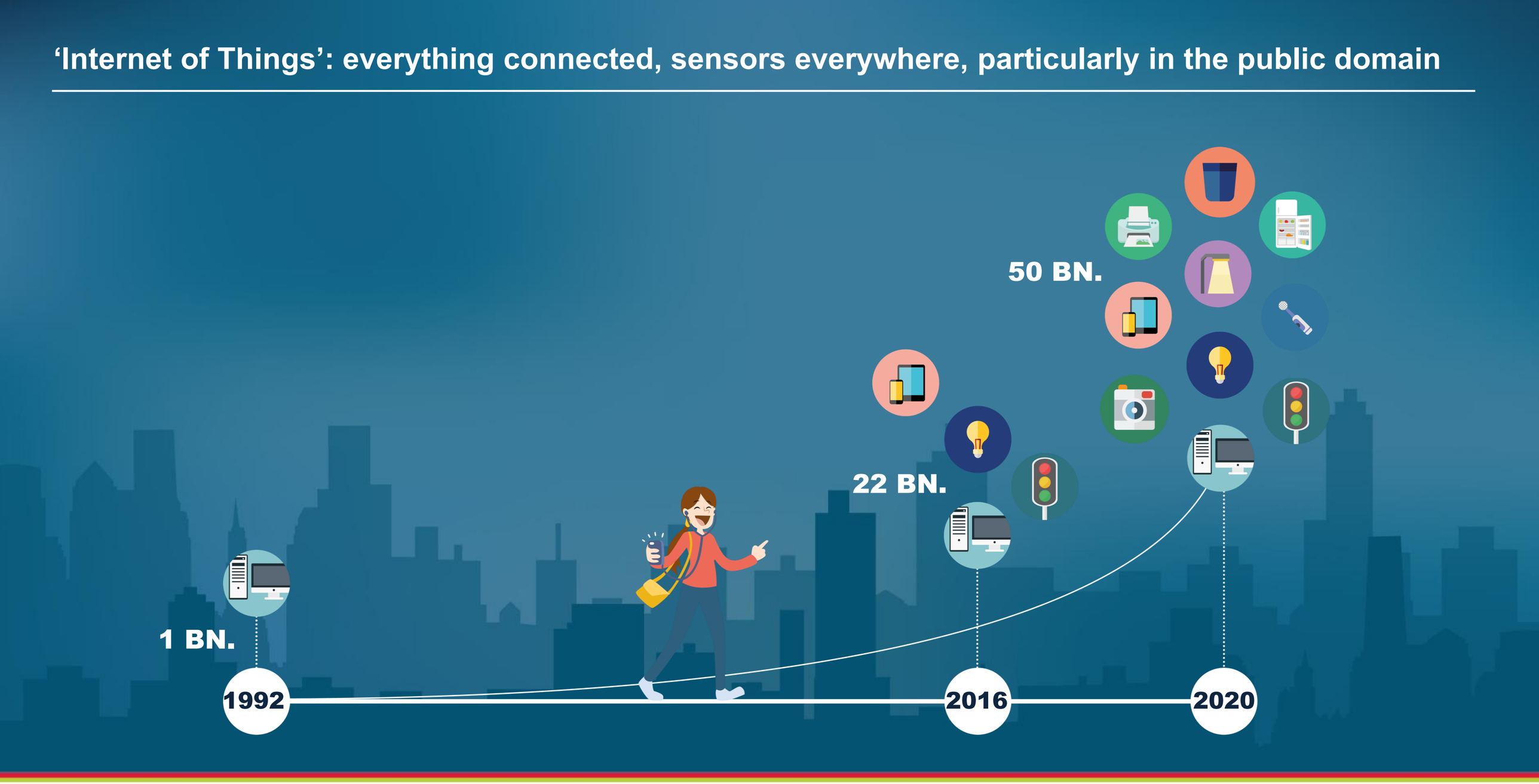
Technology Trends that (will) influence us all…



‘Internet of Things’: everything connected, sensors everywhere, particularly in the public domain



New technology: threats and opportunities

New technologies offer both **opportunities** (new markets, partnerships, efficiency gains, etc.) and **threats** (‘disruption’, new entrants, etc.)

A digital infrastructure (‘platform’) is required to be able to start innovating, build products and services, develop partnerships, etc.

What is a Smart City?

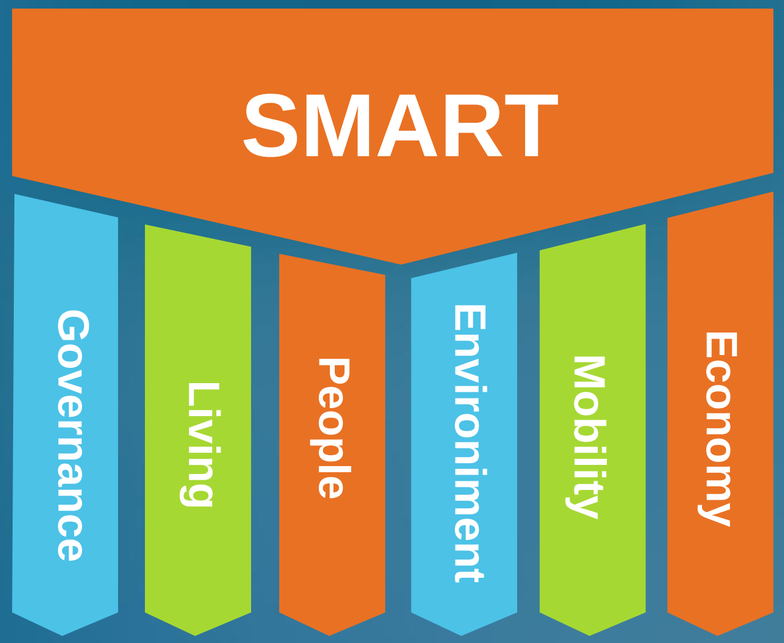
Those places that invest in human and social capital, as well as in traditional (transport) and modern (communication) infrastructure that fuels sustainable economic growth and a high quality of life, with wise management of natural resources through a participatory government.

What makes a City Smart?

SMART

Economy	Entrepreneurial, start-ups, cross overs, strong innovation
Mobility	Traffic and parking management
Environment	Climate neutral
People	Efficient processes & digital access
Living	Data management for safety and quality of living
Governance	Digital communication, great openness

The Smart City requires investments in a digital communication infrastructure



Open digital communication infrastructure

Open access:

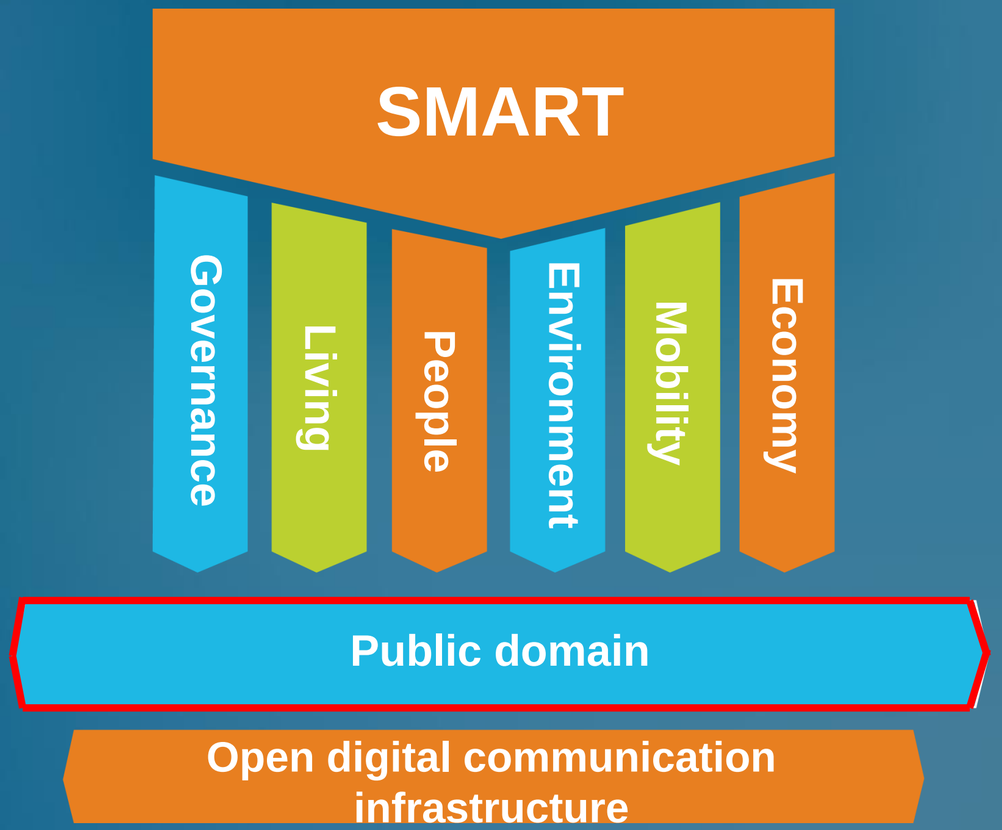
- The infrastructure ‘backbone’ for Smart City is open to develop services with and through multiple partners

+

‘Next generation’ hybrid communication infrastructure:

- **Fibre**: future proof & scalable ‘fixed’ network
- **Mobile: 4G/5G** and **WiFi** access points

Existing objects in the Dutch public domain play a crucial role



Smart Public Hub: multiple public assets are crucial as a ‘hub’ between the digital infrastructure and applications

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The lamppost as hub for the Smart City

Smart Public Hub: the lamppost as bearer of smart technology becomes the hub for the Smart City

- Density: 3,5 million lampposts in the Netherlands
- Accommodated with electricity
- Always close to communication infrastructure
- Elevation: makes it very suitable for antenna, camera and sensor placement
- Modularity: physically expandable with equipment, sensors, etc.

Smart City: opportunities in the public and private domain

The lamppost, now only with a single purpose light function, can be converted into a smart hub with multiple applications

This enables lots of new opportunities:

Smart Public Hub: benefits for all parties involved

1. New applications

- Mobility
- Safety
- Environment & sustainability
- Waste management

2. New partnerships

- Public *and* Private
- Established parties *and* Start-ups
- Short- *and* Long-term investors
- Infrastructure *and* Services providers

3. New business models

- From assets to services
- Shared earnings between the participants in the Smart City
- Business climate stimulates more innovation

4. Financial improvements

- Assets off-balance-sheet
- From one-off investments to predictable operational costs (CAPEX to OPEX)
- Growth of economic activity, employment an investments

1. New applications: value proposition street lighting

From single purpose lamppost used for street lighting, to smart public hub with multiple applications

< Fiber >

< Electricity transport network (3*25A) >

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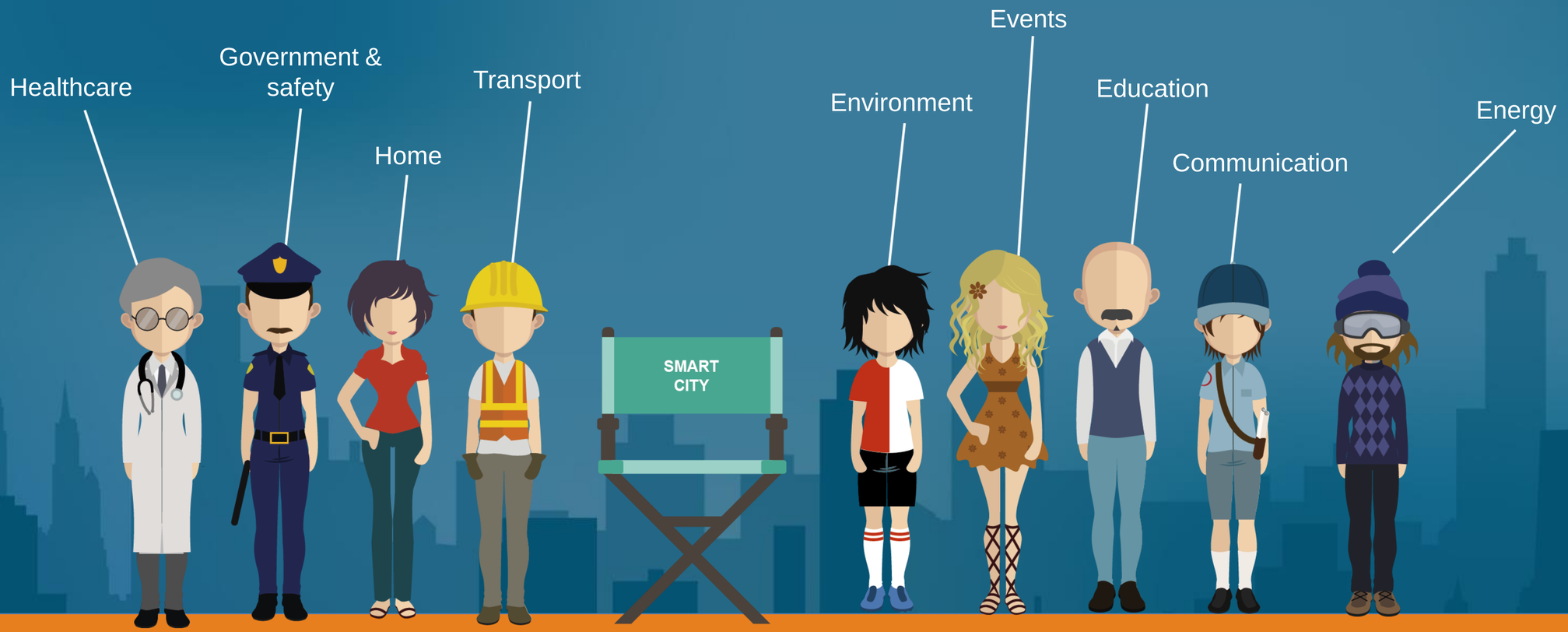
2. New partnerships: Smart Public Hub as binding factor

No single-purpose but multi-purpose solutions, based on public-private collaboration



Open digital communication infrastructure

3. New business models: Smart City partner framework

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- Long term public asset focus
- Access to capital markets
- Maximum utilisation based on open infrastructure
- Independent & neutral
- Shared earnings

Tenant agreements

Supplier/partner agreements

profit-sharing agreement

concessions

design-build-finance-maintain-operate agreement

Smart City

Public & Private tenants

- Multi-purpose: Smart lighting, Telecommunication, Electric vehicle charging, etc.
- Shared earnings

Technology & Service partners

- Infrastructure separated from services
- Best-in-class technology partners
- Shared earnings

- Open digital communication infrastructure
- From investing in assets to using services
- Shared earnings

4. Financial improvements

- Assets off-balance-sheet
- From CAPEX to OPEX
- Shared earnings
- Mutual interest to increase utilisation
- The city/region attracts more companies and citizens

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Vision & timing: the time is right for Cities to turn ‘Smart’

Our vision: Bouwfonds invests in the ‘platform’, our partners offer services using the lamppost as ‘Smart Public Hub’, in an open business model

Platform: lamppost + digital communication infrastructure

The time is right: replacement of lampposts is the ideal moment to make them ‘smart’

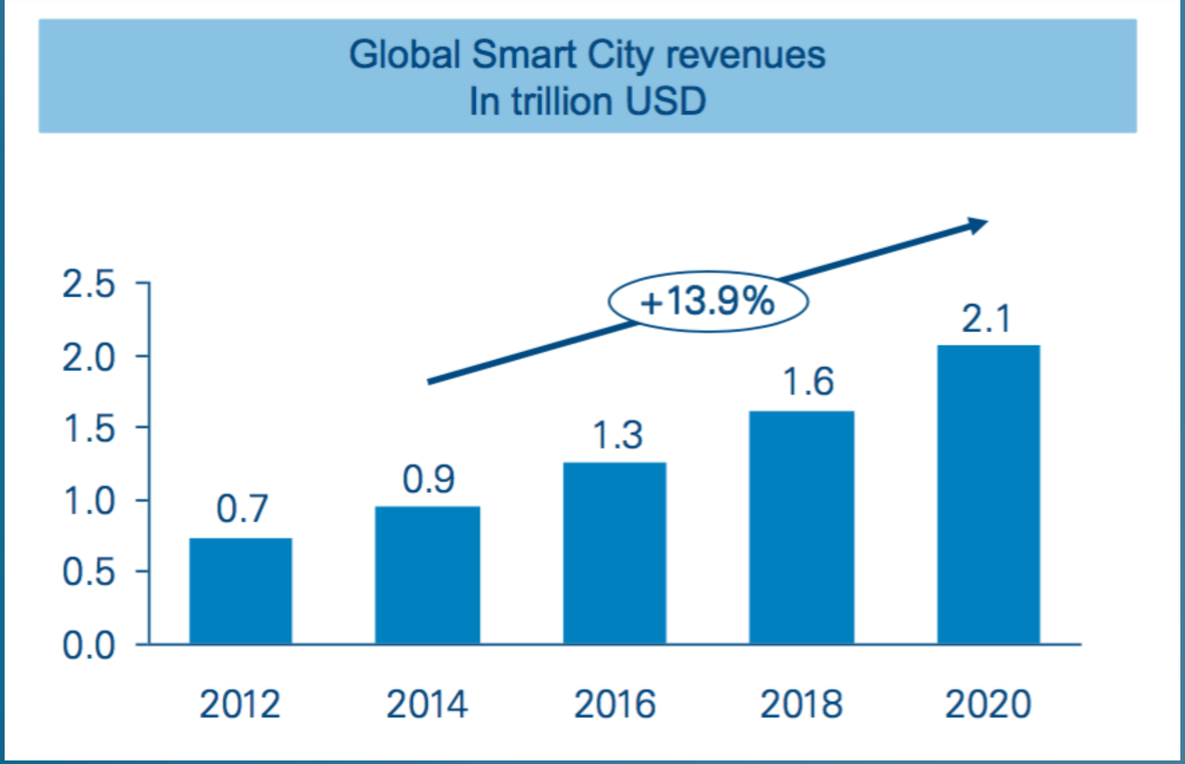
Cities are actively assessing, and planning for, the physical replacement of lampposts:

- **Climate treaty**: the Dutch Government and cities agreed a binding climate treaty with the objective that 20 percent of total energy consumption is from sustainable (renewable) sources by 2020
- **Smart City:** all cities are looking at ‘smart city’ strategies to make the city more attractive
- **End-of-life**: physical or economical end-of-life of the lamppost

Public domain: physical replacement of lampposts

Global Smart City market trends: high growth & significant value in the Telecom domain

More than 100 cities are implementing some kind of smart solution within their ecosystems: Europe, North America and Asia play pioneering roles in Smart City concept adoption



The global Smart City market will double according to Arthur D. Little*:

- from almost USD 1 trillion in 2014 to just over USD 2 trillion in 2020
- high growth rate: 13.9% CAGR
- main drivers: rapidly expanding population, speedy urbanization and industrialisation
- the potential for Telecom providers is huge: up to 50% of overall market value is in the ‘telecom’ domain

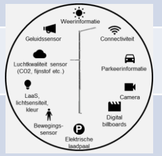
* *Source: ADL viewpoint ‘Connecting the dots, Telecom providers as enablers for smart cities’ (2015)*

The Dutch Smart City market is innovative and active but fragmented

Innovative & active ‘Smart City’ landscape in the Netherlands	• **Netherlands is in the leading group of countries*** in terms of Smart City initiatives • Smart City projects in Amsterdam and Eindhoven are globally used as reference cases • Most initiatives are in **pilot stage** and focussed on developing specific **vertical solutions**
Fragmentation & lack of financing delay upscale potential	• **Vertical fragmentation** leads to a lack scale and economically sustainable deployments • **The lack of financing** is the #1 reasons for Smart City initiatives to fail in the Netherlands, according to Cisco research**
Limited competition on the digital infrastructure layer	• **Operators**: KPN acts as fixed infrastructure provider and System Integrator. Vodafone acts as mobile infrastructure provider (no activity from Ziggo in the smart city domain) • **Dedicated IoT infrastructures**, such as LWPA and LoRa, can be considered alternatives for a Fiber-based digital communication infrastructure but they lack ability to provide high-speed scalable broadband connectivity, e.g. required for video applications

** Source: European Parliament study “Mapping smart cities in the EU (2014)”*
*** Source: Cisco and Smart Cities Council (http://www.cisco.com/assets/global/NL/tomorrow-starts-here/pdf/Smart_City_infographic_NL.pdf)*
**** Source: EC Smart Cities (https://ec.europa.eu/digital-single-market/en/smart-cities)*

Comparing Smart City initiatives: mainly vertical pilots, the first horizontal model in Rotterdam

	Copenhagen	Barcelona	Amsterdam	Eindhoven	Rotterdam
Integrated platform	V	V			V
Replicable	V	V			V
Open					V
Public space	V	V	V	V	V
Modular functionality			V		V
Scalable					
	 *'Lighting Metropole' is an integrated collaboration with 24 partners (LED on 20k lighting points).*	 *Limited use of existing public space. Smart lighting in a number of separated pilots.*	 *Wide variety of initiatives through partners. Limited integration.*	 *Existing public space well used, lampposts equipped with very limited functions.*	 *Modular lampposts, open to all applications and organisations: 'Living Lab' innovation. City as concessionaire .*

Business model: creating a ‘double-edged sword’ for a sustainable business case

Bouwfonds IM and partners are well positioned to take advantage of growth in the smart city space with a **sustainable business case:**

1. **Open Business Model:** long-term investments in open multi-functional infrastructures create a ‘platform’ for a wide variety of revenue generating activities, with the benefit of **cost-sharing** across them.
2. **The city as concessionaire and tenant for public functions:** the city is concessionaire to the consortium partners and tenant for public functions.
3. **Revenue sharing & common objective to maximise utilisation:** there is a natural an shared incentive for all parties to strive for maximum utilisation since this drives the **shared earnings** model.
4. **Operational strength:** in the proposed partnership framework, all partners (small or big, public or private) work from their strength, delivering and maintaining their specific part of the smart city eco-system.

- Cost sharing & Economies of Scale
- The city is concessionaire
- Incentive to maximise utilisation
- Operational strength & experience

Financials: indicative investment potential & returns

3.5 million lampposts in the Netherlands

Category:	Logic:				Potential:
1. Lamppost 'full smartization' investment potential	Average lifespan of a lamppost is 35 years	Replacement rate is 100.000 lampposts/year	20% 'Smartization' to 'Smart Public Hub' = 20.000 SPH/year	Average investment is EUR 4.500,- per lamppost	**EUR 90 mln / year**
2. Lamppost 'limited smartization' luminaire investments	Average lifespan of the light fitting (luminaire) is 20 years	Replacement rate is 175.000 luminaires/year	40% simple 'Smartization' with LED and/or sensor = 70.000 luminaires /year	Average investment is EUR 500,- per luminaire	**EUR 35 mln / year**
3. Fiber infrastructure investments	The 20% full-smart lampposts (SPH) need fixed broadband	Will be based on fibre backhaul	Connection rate is 20.000 SPH/year	Average investment is EUR 2.000,- per lamppost	**EUR 40 mln / year**

TOTAL EUR 165 mln / year

The total addressable market for institutional investment capital is EURO 165 mln per year with an IRR* of 5-6%

** Assumption: 40% guaranteed use of service by the government and 60% commercial operation*

The lamppost as smart public hub: an unique asset class

- Real assets with long investment cycles
- Physical assets connected through ‘next gen’ communications infrastructure technology
- Scalable proposition
- High entry barriers, limited infra competition
- Stable cash flow and returns
- Innovation readiness through partnerships & ‘Living Lab’ approach

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Why is this attractive to cities?

Cities

- **Multi-functional use of objects in the public domain**: benefitting the city, thereby becoming more relevant
- **From assets to services**: the city can make use of services, instead of having to invest, maintain and manage operationally
- **Improved quality of life and appeal of the city:** sophisticated Smart City infrastructure attracts companies and citizens
- **Sustainability:** new applications support achieving sustainability targets, e.g. in the field of energy saving and air quality
- **Control over the public domain:** the use of lampposts as technology bearer gives the city control over the public space and direct involvement in the possibilities that Smart City infrastructure offers

Why is this attractive to Bouwfonds and partners?

Bouwfonds IM and partners

- **Sustainable investments** that fit with the long-term horizon of pension funds
- **We innovate and learn together** with the cities and leading technology partners
- **Scale benefits** are achieved through the multi-functional use of objects in the public domain
- In an **open and neutral model** where all parties benefit from **maximum utilisation**

Why is this attractive to institutional investors?

Institutional investors

- Unique asset class
- Long term nature of investments / risk averse
- Market opportunity: timing for the Smart City is now due to 2020 climate treaty
- Investing in an open ‘horizontal’ infrastructure platform, creates economies of scale and cost sharing opportunities
- Common objective for all participants to maximise utilisation and benefit from shared earnings
- Bouwfonds IM has teamed-up with leading technology parties
- Investor IRR targets of 5-6%

Why do we want to make this happen?

Bouwfonds IM and partners can make ’Smart City’ benefits reality!

We would like to follow-up on this with you
and discuss how we could collaborate.

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“If you want to go fast, go alone,

If you want to go far go together”

https://www.youtube.com/watch?v=eydYEEhPRkg&feature=share