

An isometric, top-down view of a smart city. The city is composed of various buildings in shades of blue, white, and grey. A prominent feature is a large green square in the center, which contains a white wind turbine. The city is populated with small figures of people, cars, and a bus. Red and white concentric circles radiate from several points, representing wireless signals or data transmission. The overall scene is bright and modern, with a clean, geometric aesthetic.

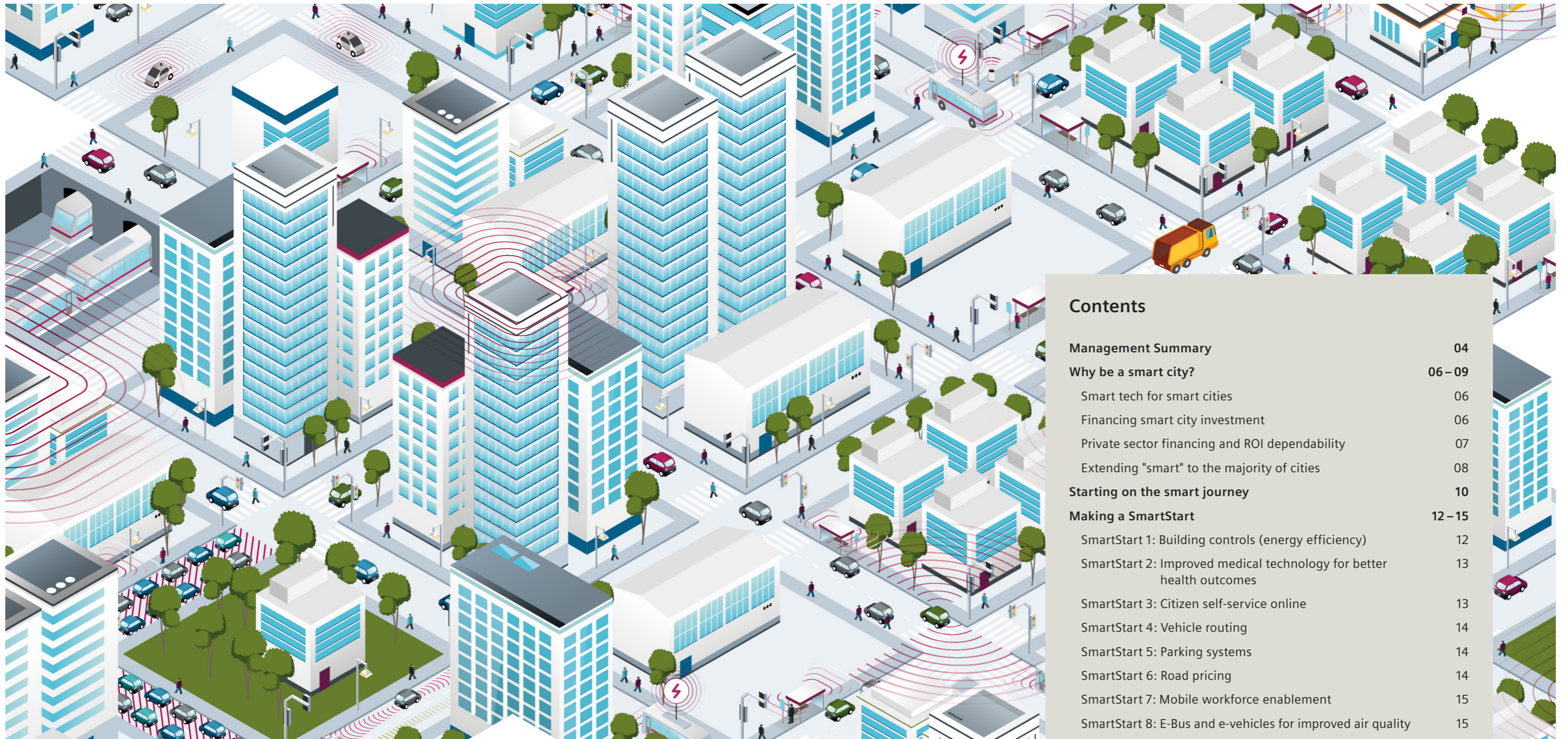
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# SmartStart

Modeling private sector finance  
adoption for SmartStart cities

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# Management Summary

To date, many smart city pioneers have embarked on large-scale, visionary city transformation projects requiring significant financial resources.

Now, a much wider selection of global cities – along with their commercial stakeholders – are looking to initiate smart projects and developments to improve the efficiency of local services, enhance sustainability, attract business and talent, and develop their competitiveness. This has been encouraged by more widespread government smart city initiatives and the availability of competitive private sector financing.

At the same time, there is a growing realization that public sector budgets are usually inadequate to fund smart city development, so raising funds from the private sector is becoming commonplace globally. This may be done directly by city authorities or by private sector participants and contributors like commercial building owners or private subcontractors providing services to the public sector.

Large-scale projects, or those where there are a complex set of variables governing return on investment (ROI), tend to be financed through public sector capital in combination with private sector finance in the form of either project finance or equity finance.

In contrast, a widening range of cities are now approaching smart transformation through a series of smaller smart

projects (a few thousand to a few million euros) – which offer highly dependable ROI, often to the extent of being self-financing – generating savings that effectively pay for the investment.

When aggregated together, these smaller smart projects often add up to considerable funding volumes, accessible from private sector finance.

These are better funded through some form of asset finance arrangement – techniques that are widely available, affordable, simple, easy and quick to arrange, and offer a high transparency for cost-benefit monitoring and analysis.

Such financing can often be self-funding through the savings they deliver, offering improvements to citizens' lives and other desired outcomes, while effectively paying for themselves.

These self-funding technology and equipment investments effectively unlock more finance availability for cities from financiers that intimately understand how such smart city technology applications work, and the benefits they produce. These financiers will use that understanding to unlock financing for private and public sector smart city stakeholders where generalist loan providers are unlikely to do so.

In order to understand how a wide range of cities benefits from these lower-risk, high-ROI-dependability smart investments, nine early stage smart initiatives have been identified, referred to collectively in this paper as SmartStart:

 <b>SmartStart 1:</b> Building controls (energy efficiency)	 <b>SmartStart 4:</b> Vehicle routing	 <b>SmartStart 7:</b> Mobile workforce enablement
 <b>SmartStart 2:</b> Improved medical technology	 <b>SmartStart 5:</b> Parking systems	 <b>SmartStart 8:</b> E-bus and e-vehicles
 <b>SmartStart 3:</b> Citizen self-service online	 <b>SmartStart 6:</b> Road pricing	 <b>SmartStart 9:</b> Low-energy street lighting

Investment in these nine early stage smart initiatives – which often pay for themselves through the savings or revenues they generate – is either made directly by the public sector, or by commercial city partners (for example landlords, subcontractors, managed services providers, etc.).

By constructing a model based on real-life experience and official statistics, this paper has estimated the amount of accessible funding for SmartStart investments that the top 40% of cities could be raising from private sector asset finance. This was done in 13 countries.

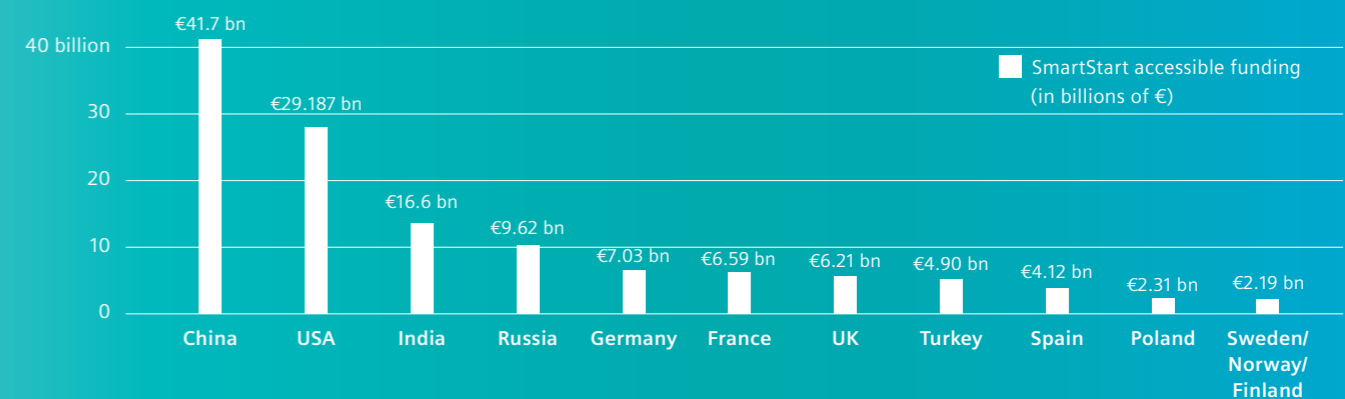
These SmartStart accessible funding estimates represent the capital investment in smart city development that can easily be raised from the private sector in the form of asset

finance. Using private sector finance frees up precious public sector capital budgets to be applied to smart initiatives with less dependable, less comprehensively proven ROI.

The SmartStart model is conservative, offering a picture of the minimum accessible finance for cities' smart investments, for instance by building in partial implementation rates ranging between 20% and 50%.

On average, the typical city covered in this report is estimated to be able – as a starting point – to access around 10% more investment capacity through private sector asset finance for SmartStart, compared with their capital budgets over a five-year period.

The SmartStart accessible funding estimates for the top 40% of cities (excluding capitals) in each country are:



In order to select the most appropriate financier for SmartStart projects, public sector financial managers point to four key defining factors:

**Diversity** – drawing on a wide range of financing sources – public and private sector – and applying each financing technique as appropriate to the relative dependability of ROI that the smart initiative will produce

**Ease and flexibility** – allowing cities to raise the finance they need, when they need it, on terms that make sense for their particular circumstances, supported by customer-focused processes

**Expertise, appropriateness and transparency** – from financiers who understand the public sector and its challenges and the role of equipment and technologies to address those challenges, and can therefore offer customized finance solutions, linked to desired outcomes that assist financial planning

**Reliability and sustainability** – from financing partners that have a track record with, and commitment to, the public sector and are looking to build long-term customer relationships

# Why be a smart city?

An increasing number of cities around the world have developed strategic initiatives to become "smart". Examples include: Shanghai (China)<sup>1</sup>, Indore (India)<sup>2</sup>, Kazan (Russia)<sup>3</sup>, Izmir (Turkey)<sup>4</sup>, Pila (Poland)<sup>5</sup>, Bremen (Germany)<sup>6</sup>, Lyon (France)<sup>7</sup>, Valencia (Spain)<sup>8</sup>, Bristol (UK)<sup>9</sup>, Stockholm (Sweden)<sup>10</sup>, Helsinki (Finland)<sup>11</sup>, Trondheim (Norway)<sup>12</sup>, and San Jose (USA)<sup>13</sup>.

To be a "smart city" is not an end in its own right; rather, it is driven by hard and practical outcomes. Consensus from a wide range of sources points to a handful of key objectives for smart city transformation:

- 
**More efficient public services**  
 Increased efficiency of, and access to, public services (efficient deployment of public funds)
- 
**Attract business**  
 Improved business services (telecoms, transport, facilities) to attract inward investment
- 
**Attract people and talent**  
 Enhanced "livability" to attract people and talent to support economic and business growth (transport, education, public spaces, etc.)
- 
**Meet environmental standards**  
 Improved environmental standards (water, air quality) and reduced pollution
- 
**Energy management**  
 Energy efficiency and energy dependability (harnessing renewable sources)
- 
**Improve security**  
 Improved security (from human and natural threats)

In essence, cities want to become smart in order to be more competitive and sustainable. They wish to attract business and talent, grow economically and culturally, and provide citizens with an enhanced quality of life, all using the most efficient possible deployment of funds and resources.

## Smart tech for smart cities

Most smart city improvements depend on the result of deploying smart technology, often including some element of **digitalization**. Wireless technology means that physical objects – machines, vehicles, streets, traffic lights, water plants, and so on – can be equipped with sensors that allow

them, their performance, or the environment around them to be remotely monitored and managed through the "Internet of Things" (IoT). Digitalization means that people, IT and objects can all be connected (often through smartphones<sup>14</sup>) in order to deliver better, quicker public services at a much reduced cost. Citizens can get their questions answered online, without having to interact with an (expensive) public sector employee. Furthermore, sensors installed around the city can help ease congestion, restrict pollution, improve service routing, and protect people and infrastructure against threats such as flooding, contamination, or even crime and terrorism. Yet digitalization is not the whole story. Reduction of vehicle use and conversion to hybrid or e-vehicles reduces pollution. Equally, electricity-efficient technologies reduce both pollution and costs. All are important.

## Financing smart city investment

Technology for transforming into a smart, competitive city requires investment. Yet cities seldom have enough funds to invest. Indeed, it requires considerably more capital investment than can be afforded from the public purse. There is broad recognition across the globe that taxation revenues are already overstretched simply to fund the public sector's **operational** expenditure.

Smart, competitive city development therefore requires access to private sector capital. This is a mature idea in the USA, where experts have written in-depth commentaries on the range of possible private sector financing techniques available for smart cities<sup>15</sup>. In Europe, various forms of public-private partnership arrangements exist to fund large projects (e.g. a business park, an airport, a school). It is also a fact that although substantial state funds have been injected into the Smart City Mission in India, and the Ministry of Housing and Urban/Rural Development (MOHURD) smart city program in China, state funds will not be enough to cover the desired smart city investment. The state funding program in India, for instance, equates to around €130 million per city; yet if key elements of infrastructure have to be constructed (water and sewage, for instance), funds will not stretch far enough. It is instructive that even in China, the 18<sup>th</sup> National Congress of the Communist Party of China (CPC) renewed its health policies and for the first time connected healthcare, financing and the private sector<sup>16</sup>.

## Private sector financing and ROI dependability

Private sector finance is keen to get involved with public sector investments – as well as those of commercial city stakeholders such as commercial landlords and outsource service providers. Yet the terms and structure of such financing arrangements are entirely predicated on the dependability of ROI). No smart city initiative would be put

in place if there were not a rigorous rationale and strong predicted benefits; yet the predictability of outcomes – and therefore the associated risk – varies from project to project.

Different financing arrangements are typically associated with different levels of ROI predictability.



### 1. Public and Private equity

Projects with a strong rationale, but a more speculative basis for ROI, are where scarce public sector capital is normally applied. The private sector may well get involved, but on an **equity** basis, where risk is shared with the state, but financial rewards can be high. A good example might be when building an airport. Theoretically, this should boost trade and tourism, but exactly how much, and how quickly, remains challenging to predict.

### 2. Project finance

Cities can also access private sector finance for large projects with a more widely proven ROI (such as improving an already overburdened rail network) on a **project finance** basis, often with a financing period of several decades. These kinds of public-private partnerships tend to be large and complex, involving a consortium of financiers, and fix the rate of return for the length of the project.

### 3. Asset finance

Smaller investments (from a few thousand euros to a few million) in "smart" improvements (such as energy-efficient buildings, a clean heating plant, a smart routing system, a smart parking system) are most easily financed with private sector capital. These investments have a clear, well-proven, widely testified, highly dependable ROI – sometimes as short as six months, sometimes a few years. The savings they generate can often pay for the investment through a financing arrangement, making them effectively zero-cost investments.

As such, specialist private sector financiers compete to offer asset finance packages with appropriate terms and highly affordable rates. Those financiers that best understand the technology and how it will be applied tend to offer financing packages that best fit the city's cash flow requirements. Awareness among city investors of these self-financing models, along with the availability of specialist asset finance is now growing, unlocking greater take-up of private sector finance.

## Extending "smart" to the majority of cities

A relatively small selection of cities around the world has publicly declared a large-scale smart strategy, with ambitious plans and targets requiring significant capital resources. Yet these visionaries – often led by an ambitious city CEO – remain just a handful. According to global researchers, there will be around 26 **fully fledged** "smart cities" in 2025, with more than 50% of them located in Europe and North America<sup>17</sup>. Each one is a vitally important icon of smart city progress and vision, but these pioneers do not in any way represent the majority of global cities. In contrast with very large-scale smart city projects, most cities around the world would like to benefit from **some** level of digitalization, introducing smart initiatives over time, taking each step once a clear benefit has been realized from the previous phase. National authorities are evidently starting to think this way as they earmark not a handful, but hundreds of cities for their countrywide smart city initiatives.

### Example – Improving Citizen Health:

An urban hospital group recognized that a portion of its diagnostic imaging equipment was out of date. This was resulting in suboptimal image quality for clinicians, meaning that diagnostic capabilities were being impaired. In addition, the age of the equipment meant that breakdowns were frequent, increasing maintenance costs and often making important diagnostic services unavailable. Using asset finance, the hospital replaced this portion with new-generation diagnostic imaging technology that delivered state-of-the-art image quality to clinicians in a fraction of previous scan times. As a result, patient outcomes improved, the hospital attracted greater patient volumes (along with their funds) and many expensive invasive treatments were avoided through early detection.

*"We have some cities moving in that [strategic, real-time big data] direction, but a lot more doing little one-offs."*

Former Mayor of Indianapolis, USA (2016)

*"Through a large number of projects with many different partners, we are laying the foundations for the intelligent smart city of the future – a city that uses technology to protect resources and get closer to its citizens."*

Mayor of Hamburg, Germany (2013)

*"What we're doing is giving companies more bandwidth than they know what to do with, creating the headroom for experimentation and innovation. ... Data is the real next city utility."*

Director of Futures, Bristol City Council, UK (2014)

*"One of the significant changes in building [a] new smart city in China is that the old government-driven model should be changed into [a] user-oriented and market-driven one."*

Director, China Center for Urban Development (2016)

*"People have already sent us about 400 different ideas [through the Santander City Brain App]. So [it's as though] the citizen is sitting with us, telling us 'I want to work to make this city better. I don't just want to complain.'"*

Mayor of Santander, Spain (2013)

# Starting on the smart journey

The question then, is how do a **majority** of cities across the globe start on the gradual journey toward becoming a smart, digitalized city? Where to start? What are the low-risk first moves they can make? Which investments in smart city technology will reliably retain the good opinion of a city's wide range of stakeholders?

The answer is to choose a selection of projects that can demonstrate a very clear and dependable ROI, and can be funded through easily accessed private sector asset financing arrangements (funding type No. 3 above). In addition, when a city has to reach certain regulatory targets, asset finance provides a way to spread the outlay and not tie up precious public sector capital. A good example is the requirement to reach mandatory air quality targets – something that is required by regulators across the USA, Europe, India and China<sup>18</sup>.

This paper has identified a selection of smart initiatives that fit this definition. As a group of financially dependable technology investments, we have given them the title **SmartStart**.

## Example – Electricity Backup:

In India, security of electricity supply is still a national problem. Many city facilities (hospitals, police, fire service) are now investing in local power generation plants, conforming to today's environmental standards. They use asset financing techniques to spread the cost of this investment and make it affordable out of operating budgets.

The following section first describes each SmartStart technology application – what it is and how it works. The paper then estimates the **SmartStart accessible funding potential** that the top 40% of cities in each of 13 countries could raise from the private sector. By employing asset finance from the private sector, cities wishing to start their smart development with investments in digitalization can reserve their own precious public sector capital for more experimental or visionary developments. The **SmartStart accessible funding estimates** in this paper therefore represent private sector funding that can easily be raised in addition to public sector budgets.

It should be noted that every effort has been made to ensure these SmartStart estimates are highly conservative. Technology implementation rates in most cases are limited

to between 20% and 50% of possible capacity. Software implementations – such as citizen self-service portals, are calculated for just one application, whereas recent experience has shown there are likely to be multiple ones.

## Example – District Heating:

In China, urban environments have communal heating plants known as "district heating" – providing a service for whole residential or commercial areas. Many of these plants are now in urgent need of renewal to less environmentally damaging alternatives. Many cities are harnessing the power of asset finance to renew district heating plants with more efficient, lower power consumption, cleaner, greener technology.

The result is a set of estimates for SmartStart finance, leveraged through private sector asset finance, that represents a starting point for this exercise. Cities that more vigorously pursue a SmartStart strategy are likely to find that the private sector financing they can leverage is far greater than the estimates in this paper.

As a broad finding, the average city covered in this report is estimated to be able – as a minimum – to access 10% more investment capacity through private sector asset finance for SmartStart, than they will typically spend through their capital budgets over a five-year period. It should also be noted, however, that this is a global average and amounts will vary in practice according to state policy, short-term infrastructure investment drives, regulation over private sector finance, etc. Nevertheless, SmartStart investments can often pay for themselves over the financing period through the savings or revenue they enable, making them effectively zero-net cost. In addition, once implemented, these SmartStart investments continue to generate returns long after the financing period ends.

## Example – Local Power Generation:

In countries with more remote regions, connecting cities to the developing national electricity grid may not always be the most economic option. Many remote cities are now opting to invest in local power generation, using asset financing techniques to fund the installation and maintenance of small turbine power.

"'Yes' to smart buildings ... only with their smartly planned surroundings ... taking traffic issues into consideration."

Mayor of Adana, Turkey (2014)

"Many more things are going to get connected between people, with and between objects, creating valuable interactions and processes ... Our ability as a city to harness this data is crucial to understanding what's going on in real-time and to enhance a multitude of services for city dwellers."

Mayor of Pila, Poland (2014)

"For me a smart city is, first of all, an effectively planned city, and secondly, a resource-efficient city that also offers its residents much more opportunities. The task is to use technology comprehensively, both in new estates and in already existing buildings."

Mayor of Krasnoyarsk, Russia (2015)

"In the past, Smart Cities were mainly explored by large cities that needed [large scale] solutions for growth. Now it's time for all city managers to make people feel they live in the cities they want to live in."

Mayor of Pila, Poland (2014)

"The Lucknow Municipal Corporation has improved in the fields of sanitation, road development and traffic management."

Mayor of Lucknow, India (2016)

# Making a SmartStart

Drawing on real-life experience from around the world, this study has assembled a selection of smart, competitive city technology initiatives that have a solid track record for delivering dependable ROI. The initiatives selected for this study are intended neither to be comprehensive, nor definitive. However, all of the tech investments described are currently being financed through asset-financing arrangements, and are therefore dependable (often self-financing) initiatives with which cities can raise finance from the private sector and conserve their precious tax-derived capital to be applied to more appropriate uses.

Of course, ROI periods vary across the globe, according to variations in technology sophistication (and therefore price), average cost of labor, existing road densities, level of established infrastructure, and so on. Other factors may also come into play. In the case of smart building controls, for instance, energy consumption is focused on heating in colder climates, but on air cooling in hotter climates. Yet whatever the country or regional circumstances, the technology investments chosen within SmartStart will all reliably deliver ROI, and often be self-financing through the savings they deliver. Local variations simply affect the **period** of ROI – and consequently, financing periods – which may vary between a few months and a few years.

Alongside each description of these high-ROI-dependability smart city investments, we have indicated key outcomes – in terms of recognized, tangible smart city benefits – that each enables.

## SmartStart 1: Building controls (energy efficiency)

Smart controls for buildings – whether public sector or commercial – give buildings a "central nervous system" that balances and reconciles competing interests such as energy minimization, occupant comfort, and grid stability. Today, things like fire protection, climate control, ventilation lighting, and video surveillance are usually still controlled separately. Modern, sophisticated management stations, on the other hand, allow all building systems to be integrated into a single platform. Of course, ROI from smart building controls – while dependable in all parts of the world – will vary, depending on external climate, cost of power, and other factors. This is demonstrated not only by the wealth of published case studies on the subject, but also the rise of "managed services" financing arrangements, which encompass service, product and maintenance. In these cases, the provider can offer a single fixed-fee financing arrangement because they are confident that energy savings will effectively pay for the technology investment over a relatively short period of time.



## SmartStart 2: Improved medical technology for better health outcomes



There is an international consensus that medical equipment over 10 years old is "in urgent need of replacement"<sup>19</sup>. Older medical equipment – especially in diagnostics – becomes expensive to maintain, fails more often, and impairs a hospital's ability to deliver high-quality patient outcomes. Moreover, medical technology is also going through a phase of digitalization that is transforming levels of efficiency and clinical effectiveness in healthcare systems around the world<sup>20</sup>. ROI from the new generation of diagnostic imaging technology has a well-proven pedigree, helping to reduce expensive invasive procedures, process patients more quickly and deliver more detailed and accurate diagnostic tools into the hands of clinicians. This paper confines itself to simply the replacement of technology more than 10 years old in medical institutions (almost always located in urban centers), which should in all events be urgently replaced. The paper's estimates confine themselves to current equipment implementation rates, even though many countries have low access to diagnostic imaging technology.



## SmartStart 3: Citizen self-service online



As populations, from the USA to China, are becoming increasingly digitalized (mainly through the smartphone), it has become possible to deliver many civic services through self-service online. Because these smart city initiatives effectively replace manual call handling, in-person appointments, postal communications, and so on with automated online services, the ROI is often rapid. Moreover, the service received by citizens is usually much improved – instant access to information, no query-handling bottlenecks, 24/7 availability, and little restriction to the amount of information that can be made available. Once a main application has been developed, additional capabilities such as extra services and extra departments can be added, improving ROI even further. In order to keep the SmartStart model focused on **minimum** estimates, this paper only allows for one citizen self-service portal per city, even though experience shows there tend to be multiple ones.



#### SmartStart 4: Vehicle routing

Geo-information systems are being installed across the globe to optimize the routing of services in order to deliver a better service with fewer assets (vehicles, people and equipment). Two such smart routing initiatives that are common to city authorities in all the 13 countries studied in this paper are waste collection and school transport. The investment cost for such routing systems, compared to the savings gained, can be rapidly recouped. Again, such ROI periods – reflected in equivalent financing periods – will vary according to the types of equipment used, local labor costs, and so on. This paper has (conservatively) accounted for one smart routing application in a typical sized city; however, as with citizen self-service, an initial investment can be upgraded to encompass more than one smart-routing initiative, further enhancing ROI. In fact, it is the powerful combination of smart technology with smart financing arrangements (which can be flexed to include vehicle retrofitting or fleet-size adjustments) that make SmartStart initiatives easily implementable.



#### SmartStart 5: Parking systems

Smart parking systems deliver a better service to citizens and visitors, while maximizing a city's potential parking charge revenue – a clear ROI model. They simplify driver decision-making with valuable information on parking availability, ultimately reducing congestion and frustration. Drivers are guided to their final parking destination along the shortest possible route via in-car navigation or with the help of programmable dynamic message signs (giving commuters the current occupancy levels of the surrounding parking zones). For the city administration, a clear picture of who's parking where feeds into a data warehouse, where detailed parking and violation information can then be accessed by routing and enforcement applications or city dashboards. The SmartStart model estimates accessible private sector funding for smart parking at just 20% to account for the wide variation in the state of public road infrastructures as well as the propensity of citizens to afford parking payments across the countries studied.



#### SmartStart 6: Road pricing

Smart road pricing systems reduce the traffic flow in congested urban and interurban areas while also raising revenue. The benefits are both economic and environmental. Reduced fuel usage means reduced pollutant emissions; reduced congestion creates a better driver experience; freer flowing, dynamically managed traffic attracts business and talent to the city; airport, rail and road transport are more efficiently linked; and congestion zones, low-emission zones or other road-charging schemes can be implemented. As revenue-generating technology, the ROI can be easily calculated, especially when structured into a financing arrangement that combines technology, installation and maintenance/support into a single monthly charge for the financing period.



#### SmartStart 7: Mobile workforce enablement

City surveyors, parks maintenance, inspectors, engineers, outreach health and social services: There are many categories of city employment that are essentially mobile, and where today's workflow management software, accessed through dedicated mobile devices, can greatly improve the efficiency of service delivery. Again, ROI is well-attested from such mobile workflow management (often also incorporating smart routing and scheduling), with typical efficiency savings of more than 10%<sup>21</sup> being reported. In most instances, implementing such technology, through digital mobile enablement, does not necessarily seek to reduce workforce headcount, but to do more with the same number of people. Most cities are seeing rising demand for public services and are aiming, through smart city technology, to fulfill that demand while avoiding sharply escalating costs. Taking into account the wide variation in software options pricing across the countries studied, the SmartStart model only account for equipping the relevant public workforce with mobile hardware. Nevertheless, asset finance arrangements will usually additionally embrace software requirements for mobile workforce enablement.



#### SmartStart 8: E-bus and e-vehicles for improved air quality

In some instances, cities have to meet mandatory targets. These targets can be factors that attract people and business to move to a smart city. A good example is required air quality compliance – a requirement that is common to all the countries studied in this paper. One of the key contributors to poor air quality is the use of public vehicles. This paper has incorporated one aspect of public transport – the bus fleet – into its model. Replacing diesel vehicles with hybrid or electric alternatives makes a disproportionately positive contribution to meeting air quality improvement targets. The inclusion of this factor demonstrates the role that asset finance can play, not only in investing in initiatives with a clear and relatively short-term financial return, but also to minimize the capital spending impact of reaching mandatory targets that are important to building a sustainable, attractive, competitive city. In the interests of realistic and conservative estimates, SmartStart has focused on hybrid and e-buses, and based estimates on a 30% implementation (to account for strong growth in clean vehicle technology in some US, European and Chinese cities).



#### SmartStart 9: Low-energy street lighting

LED lights reduce power consumption by over 60% compared to previous-generation lamps. Just as replacement in the typical home is gaining momentum, one easy win for SmartStart development is to replace streetlight lamps with an LED equivalent. LEDs are brighter than conventional light sources, have longer lifetimes and lower maintenance, and provide more safety and security in public spaces. Besides the safety aspect, energy consumption is also an important factor. To take one example, European streetlights alone use some 60 terawatt hours (60 billion kilowatt hours) of electricity every year – the equivalent of 2.5% of the entire EU consumption<sup>22</sup>.



# Getting the right blend of private and public sector finance

It should be recognized that most of the countries studied in this report have state lending facilities available for city investments. These low-cost borrowing schemes are suitable for certain kinds of investment. The reality is that cities need to access a blend of public and private sector finance to accelerate their smart initiatives in a timely way and benefit from the resulting savings, efficiency, quality and citizen service improvements as quickly as possible. As this paper has stressed, smart initiatives give a city competitive advantages, so the longer investment is delayed, the further behind a city falls in attracting business and people, along with the economic growth and increased taxation revenue they bring.

Governments across the globe have recognized the need for cities to access public and private sector funding sources. The US Secretary of Transportation has been quoted as saying that even in the "rosiest" political scenarios, there would not be enough public money (tax revenue or state-sponsored borrowing) to plug a \$1 trillion infrastructure funding gap through to the end of the decade<sup>23</sup>. On the other side of the world, the Chinese government announced its intention last year to promote a blend of public and private finance in certain sectors including transport, environmental protection and healthcare<sup>24</sup>. A World Bank study notes that, "In the past, infrastructure projects [in India] were typically financed from the limited resources of the public sector ... characterized by inadequate capacity addition and poor quality of service ... [and this situation has now undergone] a paradigm shift ... with greater emphasis on private participation."<sup>25</sup> Such official policy to attract private sector finance may be found in Turkey<sup>26</sup>, the UK<sup>27</sup>, Germany<sup>28</sup>, Poland<sup>29</sup> and elsewhere.

What are the reasons, then, why public sector bodies use private finance? First, there are limitations (in available volume) to state-sponsored loans, which is one reason why governments are encouraging appropriate use of private sector finance. A diverse range of funding sources allows a city to make the full range of technology investments it wants to – using a combination of public and private sector finance – in a timely fashion. Different financiers will be sourced for the different types of SmartStart technology investment. The sooner the smart investments are

implemented – especially those included in our SmartStart selection – the quicker the savings (or revenues, or inward investments) begin to accrue. To delay is to incur an opportunity cost. So, all sources of finance need to be deployed.

Notional interest rates **are** higher for private finance than for state-sponsored loans. However, cities are often regarded as good risks by the commercial finance sector (reducing interest rates levied) and there is much competition for this kind of financing business (making rates very competitive). Also, asset finance arrangements often take into account the "residual value" of the technology financed (where the technology "asset" is appropriate), which also affects the monthly charge. On another topic, some commentators have remarked that the use of private sector financing techniques can help increase transparency and improve governance, through their application processes and reporting structures<sup>30</sup>. Certainly, some governments around the world have become concerned about the soaring use of state-sponsored loans by cities<sup>31</sup>.

Most importantly, almost all of this paper's selection of SmartStart tech investments deliver savings that effectively make them self-financing, whatever financing method is used (public or private), and also take into account the cost of funds. Each generates a strong "net benefit". Again, this is a strong argument to deploy private sector finance on clearly self-financing smart projects, and perhaps reserve state-sponsored borrowing for projects where ROI does not have such a solid track record.

In short, this paper is not making an argument for private sector finance **as opposed to** state-derived or state-sponsored finance. In order to fund 100% of a SmartStart initiative plus other smart developments, a city will want to access private sector capital – both from local and international providers – as well as state-sponsored lenders where appropriate. Cities should access the full diverse range of financing sources in order to invest in smart technologies in a timely fashion, in order to start experiencing their efficiency, effectiveness and strategic attractiveness benefits as soon as possible.

# SmartStart: accessible funding estimates

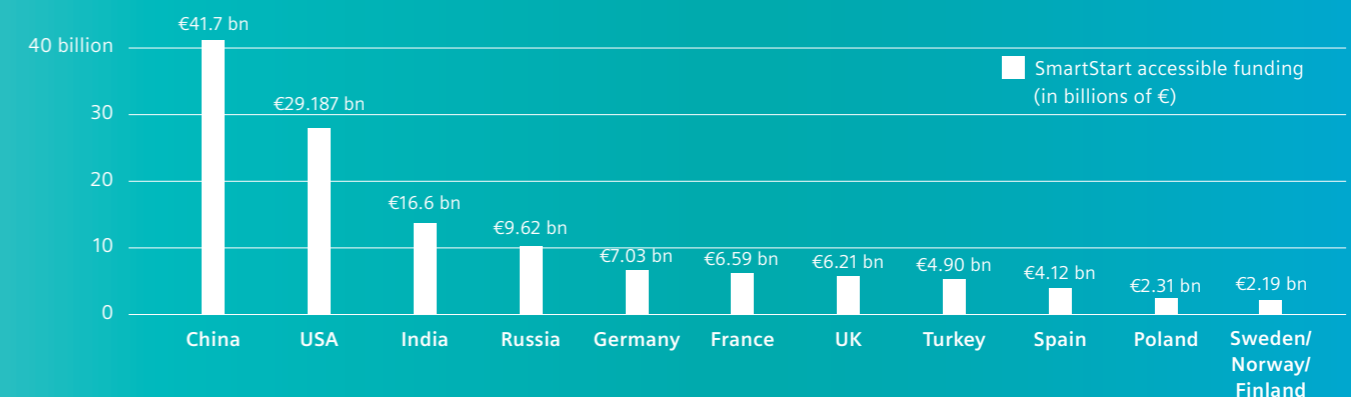
What, then, is the scale of impact that SmartStart might offer the typical city? In particular, how much asset financing could a typical city potentially access from private sector financiers – to invest in SmartStart, to improve citizens' health, safety and environment, to make cities more competitive/ attractive for business, and to enhance public service efficiency?

This paper has sought to answer this question in two ways. First, a SmartStart accessible funding estimate has been modeled at the country level. This indicates to policymakers the funding that SmartStart could leverage from the private sector across a country. Secondly, the same model has been applied at the city level – to indicate to city stakeholders

the funding volumes that a typical city of 500,000 inhabitants could access from the SmartStart selection of initiatives.

The importance of calculating SmartStart potential is to demonstrate the level to which asset finance – often self-financing and therefore effectively zero-net-cost investment – can contribute to improving citizen health, making public services more efficient and effective, attracting business and talent for economic growth, promoting sustainability (especially regarding energy consumption), and freeing hard-pressed public sector capital for more visionary and experimental smart city initiatives.

The SmartStart accessible funding estimates for the top 40% of cities (excluding capitals) in each country are:





## The typical SmartStart city

**Smart City No.1** is a fictitious city. The city authorities have decided to implement a **SmartStart** program to digitalize and improve a range of aspects of the city's public services, and to attract both businesses and talented job candidates to the city to generate economic growth.

The city aims to achieve implementation of its SmartStart program over the next 5-10 years.

- LED lamps are to be installed in streetlights on the city's roads.
- Traffic management systems will deliver enhanced revenues from parking and selective road charging, while easing congestion.
- The local hospital is to acquire new diagnostic imaging technology to replace the oldest proportion of its equipment, improving patient throughput and outcomes.

- A proportion of the city bus fleet will be upgraded to hybrid technology to meet air quality standards.
- Smart routing is expected to reduce the city's waste collection fleet by at least two vehicles.
- The city's commercial and public buildings are to be fitted with smart-building controls to radically reduce energy consumption.
- Finally, a new self-service portal will allow citizens to make queries and get information on local services on their mobile phone.

Various asset finance packages are being employed to finance these smart investments.

### Accessible SmartStart funding

USA

**€301 million**

Typical SmartStart city  
1,000,000 inhabitants

Germany

**€153 million**

Typical SmartStart city  
500,000 inhabitants

Russia

**€114 million**

Typical SmartStart city  
500,000 inhabitants

China

**€235 million**

Typical SmartStart city  
1,500,000 inhabitants

Spain

**€140 million**

Typical SmartStart city  
500,000 inhabitants

Turkey

**€98 million**

Typical SmartStart city  
500,000 inhabitants

France

**€167 million**

Typical SmartStart city  
500,000 inhabitants

UK

**€136 million**

Typical SmartStart city  
500,000 inhabitants

Nordic countries

**€86 million**

Typical SmartStart city  
250,000 inhabitants

India

**€157 million**

Typical SmartStart city  
1,500,000 inhabitants

Poland

**€128 million**

Typical SmartStart city  
500,000 inhabitants

# What does smart finance for smart cities look like?

Smart city development represents a major investment challenge, even at the level of SmartStart initiatives that have a highly dependable ROI. This study has already noted a widening range of financing sources to make those investments – not only accessing private sector finance in general, but also asset finance in particular for smaller (a few thousand to a few million), high-ROI-dependability technology projects.

Financing packages that intelligently flex to ensure that savings enabled by the technology investment accrue at the same rate as monthly payments are a relatively recent development, with a range of providers entering the market over the last 3-5 years. Hence the ability of cities to access SmartStart financing, along with awareness of the availability of such financing, is still at an early stage of its development.

What then, does this smart finance for SmartStart look like? What does it need to offer? And where does it come from? Evidence from qualitative interviews with city financial managers has revealed a number of key attributes of smart financing.

## Diversity

Cities are clear that they are drawing on a widening range of financing sources and techniques to maximize their access to finance and to find the most appropriate financing solution for their particular needs. Techniques cited by respondents cover asset finance, pay-per-use, managed services, project finance, equity engagements, loans, city bonds, and more. SmartStart initiatives tend to be funded through some form of asset finance.

## Ease and flexibility

Respondents highlighted the fact that traditional loans can often be a long and bureaucratic process. Also, governments are now encouraging cities to raise commercial finance rather than seek (inadequate) state funding. Therefore, they have an increasing requirement for financing techniques that are quick and straightforward to arrange. Such agile financing methods are increasingly valued by respondents as separate lines of finance, offering the flexibility to fit the city's precise needs, and allowing them to incrementally build their new-generation, smart technology base.

## Expertise, appropriateness and transparency

City financial managers also underline the benefits of obtaining finance from expert financiers who understand both technology and city applications and are able to offer customized packages that flex to fit the city's particular circumstances and cash flow needs. These packages can be made comprehensive, embracing equipment acquisition, service, maintenance and even software upgrades. Moreover, tailored asset financing packages make it easy for financial managers to understand total lifetime costs and therefore calculate a dependable ROI – a significant advantage for transparent financial planning and managing the good opinion of city stakeholders.

## Reliability and sustainability

Finally, finance providers specializing in urban technology applications tend to remain committed to serving the sectors, even when economic circumstances tighten. This is important for long-term city business planning – knowing there is a dependable financing partner who will be prepared to finance technology needs over time, and who will not abandon the market when times get tough. Financial managers often also cite the advantages of dealing with long-term, specialist financing partners who will often create finance approaches that make it easier for cities to embrace additional technology acquisitions without having to go through a separate, detailed financing application every time.

## Country examples of SmartStart asset finance



### €11.8m "green bus" deal in China

Asset finance from SFS helps a Chinese state-run bus company invest in hybrid and electric buses

Siemens Financial Services (SFS) strengthened its relationship with green bus vendor Zhongtong Bus & Holding Co., Ltd. with an €11.8 million finance solution to enable a state-run bus company in the Shandong Province to acquire 111 hybrid buses and 20 electric buses.

Environmental protection is a priority for China's local governments, with large cities such as Beijing and Nanjing announcing plans to "blue the sky". The deal ensures the state-run company remains on track to replace all current diesel buses with 1,200 green buses over the next three years, thereby meeting the local government's environmental and emission-reduction targets.



### A breath of fresh air for the Gewandhaus Concert Hall in Leipzig, Germany

Home to one of Europe's most famous symphony orchestras, the Gewandhaus Concert

Hall in Leipzig was lagging behind other venues in its use of the latest energy efficiency technology. Siemens Building Technologies (BT) was therefore asked to revamp the concert hall's ventilation and heating systems and modernize the lighting in the foyer. Both the organizational and financial framework requirements were demanding: The venue is fully booked during the concert season, so the project had to be completed during the one-month summer break. The concert hall's owner and operator also insisted on an off-balance financing solution.

Siemens BT was able to successfully deliver the project, thanks to close collaboration with SFS. The integrated solution provided a "One Siemens" energy performance contract, which cut energy and operating costs for Gewandhaus through modernization and energy optimization and enabled the investment to be paid for with the savings. For Gewandhaus, the approach worked perfectly even though the investment was substantial – almost €1 million. The project did not require Gewandhaus to initially invest from its cash reserves, and the savings achieved from the state-of-the-art ventilation, heating and lighting more than covered the monthly payments. As for the installation work, it was all completed during the summer break. Flawless implementation and execution that brought more than a breath of fresh air to Leipzig's prestigious concert hall.



### Princeton Radiology, USA

To serve its patients more efficiently, adhere to new guidelines on radiation dose standards and preserve reimbursement rates, Princeton

Radiology decided to replace a 16-slice SOMATOM Emotion CT scanner with a new 64-slice SOMATOM Perspective CT

scanner. The only way the investment in the scanner could be made within budget was with an affordable financing package.

SFS provided a seven-year, fair market value lease solution for Princeton Radiology to acquire the new scanner. Coupled with the outlay for monthly service, the total cost of the new equipment was equal to the monthly operating expense of the organization's existing scanner. Since the solution addressed so many needs and could be purchased affordably, Princeton Radiology decided to negotiate a multiple-equipment transaction to upgrade five other scanners at its other locations.

The new equipment enabled Princeton Radiology to increase its clinical capabilities, improve workflows, retain reimbursement rates and provide higher standards of care to its patients. The combination of equipment and financing from Siemens meant the organization could achieve this while managing budget limits.

### Road building in Russia

A significant road builder in Russia deployed tailored financing to support an extension of its region's transport network. The company, a key supplier partner for civil development in the region, wanted to find a financier to help support a direct import contract to acquire concreting equipment from an Italian manufacturer. SFS created a bespoke financing scheme for the company's precise requirements, and also provided strong support negotiating the most convenient payment and delivery terms with the equipment manufacturer.

By acquiring this equipment, the company was able to more than double its production volumes, cut costs by 10% and reduce production time by 40%. All this was achieved while also improving environmental impact, as the equipment was selected from the new generation of low-emission models.

### Street cleaning in Spain

A micro-vehicle supplier was chosen as equipment supplier for street cleaning in Spain. To fulfill this task, the supplier needed a tailored financing solution so that they could provide a full package to the city – both equipment and service. A special financing package for four street sweeping micro-vehicles was constructed by SFS that matched the supplier's and the city's cash flow requirements across a three year-period. The vehicles are also making a contribution to clean air and energy efficiency in the city. With a wide sweep, the vehicles achieve optimal work performance. They offer a top rating in official EU tests to deliver the highest reduction of dust particulates, and maintain a clean environment. In addition, the vehicles have low fuel consumption and emissions.

### Energy efficiency at school in Bytom, Poland

Bytom is a city in Silesia, Poland, near Katowice. The city has long been concerned about energy overspending in its local schools, covering some 17 institutions. In a specially constructed arrangement, Siemens guaranteed to reduce electricity consumption by 20% and reduce thermal energy generated by 48% through the modernization of heating and energy control systems. This energy performance contracting arrangement was enabled through SFS, and allowed the city to engage the service across a fifteen-year period. The project has had a positive ecological impact on the local environment, as well as making the educational experience more attractive. Thanks to financing from Siemens, the city did not have to invest capital or increase debt.



### Flexible financing enables London bus operator to acquire new low-emission fleet

An established London bus operator was awarded three Transport for London routes for a five-year term, on the proviso they would deploy a range of new low-emission single-deck buses. The operator was therefore looking to acquire a new fleet of fuel efficient buses. The company needed a financing solution that would facilitate the investment without locking down its capital on a single expensive purchase.

SFS demonstrated its service commitment and financing expertise through the provision of a flexible, customized solution. The bus operator was able to service its new routes with environmentally friendly buses. The vehicles not only helped generate substantial fuel savings, but also enabled lower operating costs.



### Hybrid vehicles for cleaner air in Scandinavia

In a rapidly growing city in southern Scandinavia, an increasing population is putting greater demands on the public transport network. Concerned about how this public demand could adversely affect sustainability and impact environmental measures in the city, the authorities decided to invest in a different profile of vehicle in its bus fleet. The solution chosen is based on hybrid technology combining biogas with electricity, and comprises double articulated 24-meter buses. By cooperating with SFS, the supplier was able to

offer the city an attractive financing solution, without affecting any of their other lines of credit. The solution has helped preserve and enhance a sustainable environment in the city, allowing a significantly increased public transport capacity, yet at the same time reducing emissions.



### Energy-efficient traffic lights in Freiburg, Germany

The city of Freiburg in southwest Germany decided to equip a proportion of its traffic lights with cost-saving LED technology. At the same time, the associated control units were modernized. The project was valued at €1.7 million. Financing was provided by SFS. Compared to incandescent bulbs, LEDs require considerably less energy and have a much longer useful life. This reduces maintenance and energy costs. Over 15 years, the city of Freiburg will pay annual installments that are lower than the savings that the city makes with respect to power consumption and maintenance. The combination of 40 volt LED signal heads and the C840V, a controller specially developed for this application, needs much less energy than traffic lamps that use incandescent bulbs. As a result, power consumption can be reduced by 350,000 kilowatt hours. The long useful life of the LEDs also lowers maintenance costs, removing the need to regularly replace lights.

### A leading super-specialty hospital in Aurangabad region, India



United CIIGMA is a super-specialty hospital that provides comprehensive care to patients within 10 districts in the Marathwada region. When setting up, the hospital required funding for a range of healthcare equipment. Because it was a new hospital, the repayment terms needed to step up only once the hospital became more established in the region. These conditions could not be supported by its bankers. This equipment was critical to the hospital since without it, it would be unable to provide patient care. The customized financing solution from Siemens consisted of a moratorium of six months, after which a step-up plan was provided based on estimated cash flows – keeping in mind that the hospital needed to establish itself. The asset finance arrangement required minimum documentation, implemented complex transactions smoothly, and enabled doctors and hospitals to gain access to financing without any collateral security.



### Building technologies improve security and energy-efficiency in southeast France

The regional headquarters of a national French bank was looking to improve its energy-efficiency footprint, while also upgrading its security and fire systems to be more intelligent and sophisticated. The bank's brand is strongly associated with low carbon footprint ambitions, and a buildings automation upgrade was seen as an important way to boost brand values while also saving money – all without impairing the working environment at the bank for staff and visitors. The bank is a major employer in the city and is therefore a significant private sector stakeholder in the city's development. It

would prove difficult, however, for the bank to raise the necessary capital internally – certainly at the speed and on the terms required to match the project's schedule. Accordingly, the bank chose a solution with an embedded, tailored financing solution from Siemens. As a result, energy management, security and fire risk management were all improved within the bank's buildings in the city, in an arrangement that significantly subsidized monthly payments with parallel energy savings.



### The drive to healthcare digitalization in western Turkey

A major university hospital in a city in western Turkey was looking to move a wide variety of its clinical and diagnostic equipment to new-generation, digital technology. The result of this wholesale digitalization would be several-fold. Take the field of diagnostic imaging as an example. More sophisticated diagnostics would deliver higher-resolution imaging, leading to more accurate diagnoses and therefore better patient outcomes. Earlier diagnosis would also help reduce the need for major (expensive) surgical interventions, with their longer recovery times. Faster throughput times would improve the productivity rates that the technology could deliver and thereby enhance the technology's ROI. Scores of different technology providers were involved in different aspects of the digitalization upgrade, and so a financing arrangement was needed that could embrace a wide variety of suppliers, as well as a staggered implementation schedule, and the opportunity to add extra technology investments at a later date. Siemens structured an asset finance framework agreement that fulfilled all these criteria, as well as tailoring finance periods to reflect the hospital's cash flow needs.



# Appendix: The SmartStart model – methodology

The SmartStart model estimates the volume of accessible private sector finance that a city can draw upon to fund its investments in the nine "application" areas described earlier in this paper. In each case, case studies and supplier research were assembled, along with asset and urban population densities, to estimate per capita investment costs. The resulting data was then used to estimate country SmartStart accessible funding volumes at both a country level, and for a fictitious "typical city" of 500,000 inhabitants. The key data pieces in the SmartStart model are listed below.

Interviews were also conducted with nine city financial managers in the USA, Europe, China and India to validate the estimates in this report, along with the methodology employed to calculate those estimates.

SmartStart application	Key data components	Qualifiers
1. Building controls (energy efficiency)	Average investment per m <sup>2</sup> Public buildings (m <sup>2</sup> ) per country Commercial buildings (m <sup>2</sup> ) per country	1. Regions defined as USA, Europe, India, China.
2. Improved medical technology	% diagnostic imaging equipment 10+ years old Diagnostic imaging market per country	2. Implementation rates in all cases calculated between 20 and 50% – estimated conservative target for 5-10 year SmartStart investment program
3. Citizen self-service online	Average investment per 1,000 people	3. Representative SmartStart city population sample calculated as top 40% of cities per country, minus capital/very large cities
4. Vehicle routing	Average investment per 1,000 people	
5. Parking systems	Average investment per 1,000 people	
6. Road pricing	Average investment per km <sup>2</sup> Average urban density per country (minus capital/very large cities)	
7. Mobile workforce enablement	Average investment per device per region Average device penetration – mobile workforce Public mobile workforce size	
8. E-bus and e-vehicles	Average fleet per 1,000 people per region Average investment per hybrid vehicle per region	
9. Low-energy street lighting	Average investment per km Average urban road density per region	

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Siemens Financial Services  
80200 Munich, Germany

For more information:

Phone: +49 89 636 40019

E-mail: [communications.sfs@siemens.com](mailto:communications.sfs@siemens.com)

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