Senate Department for
Urban Development and the Environment

Smart City Strategy Berlin

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I. Strategic Framework for Smart City Berlin

Berlin is growing. By the year 2030, there will be 250,000 more people living in the city than there are today.[1] This will bring with it an increase in the demand for housing as well as in requirements for mobility, the adaptation of infrastructures and the availability of resources such as water, energy, data and building land. Like many major urban centres around the world, this means that Berlin is also facing a wide variety of challenges for the future: the growing city, the aging city or the city in the midst of structural change all require inter-disciplinary and inter-departmental approaches if solutions are to be found. The Smart City approach aims to find solutions to the ecological, social, economic and cultural challenges faced by Berlin through the use of intelligent technology. Berlin wishes to preserve – and as far as possible enhance – its appeal and its quality of life.[2]

The "BerlinStrategy | Urban Development Concept Berlin 2030" represents the city's own cutting-edge mission statement. The Smart City Strategy Berlin, submitted within this framework, sets out an innovative strategic policy approach aimed at serving the common good by expanding and ensuring the future sustainability of Berlin.

I.1 Berlin's Understanding of the Smart City Concept

Smart City as a global trend

An increasing number of cities and metropolitan areas around the world are embracing the "Smart City" concept. This trend has been set in motion by the rapid development and widespread proliferation of increasingly powerful digital information and communication technologies (ICT). Today, these technologies have opened up what seems to be an almost endless array of technical possibilities for using sensors to automatically gather information about processes and events within the urban environment and for converting this information into digital data. This data can then be analysed and, within a fraction of a second ("in real time"), converted into control information which can be used to formulate appropriate responses to events. These technologies have already been used to manage many urban infrastructure systems for many years – in telecommunications, energy supply, traffic systems and also increasingly in water and waste cycle management. The utilisation of ICT in these areas makes a vital contribution towards enabling infrastructure service providers to maintain their performance capabilities even in the face of increasing or changing demands, to improve the quality of their services for their customers and to achieve a sustainable reduction in their consumption of resources.

The relatively inexpensive availability of technologically more powerful and increasingly miniaturised sensors, processors and actuators[3], together with rapid advances in the capabilities, transmission

[1] On the population forecast findings, see (in German): http://www.stadtentwicklung.berlin.de/planen/bevoelkerungsprognose/download/bevprog_2011_2030_kurzfassung.pdf.

[2] On the individual challenges, see (in German) the status report on the Urban Development Concept Berlin 2030: http://www.stadtentwicklung.berlin.de/planen/stadtentwicklungskonzept/download/status/StEK2030_Status_kompakt_bf.pdf.

[3] Actuators are drive elements which transform electrical stimuli into mechanical motion or other physical properties.

speeds and reaction times of wired and wireless communications channels, mass data storage devices and mainframe computers, not only allows a largely automated control of individual processes and process sequences now and in the future. It also means that, in the long term, complex interdependencies such as traffic flows and the levels of use of different modes of transport within a city can be managed in real time by means of “intelligent” technical systems.

The dramatic advances in digital technologies and their widespread proliferation and use in the public and especially private spheres (smartphones, computers, telecommunications devices, and household appliances and private cars equipped with sensors and computer capabilities) has meant that there is hardly an area or application left within cities in which data about technology use isn’t constantly being generated in digital form and sent over mainly publicly accessible communications channels, where it can in principle be collected, analysed, linked together and used for the development of innovative, cross-sector ICT applications and services.

Today, this “big data”, as it is called, is primarily used by commercial manufacturers and operators of ICT technologies and applications in order to offer additional services to their customers. Various new business models have also emerged on the basis of “big data” analyses, such as sharing platforms and car pooling services. Furthermore, for decades there has been much discussion at a local government level as to how far cities and their municipal agencies should themselves make use of the possibilities opened up by modern ICT applications above and beyond improving the quality of their services, e.g. as a means of increasing safety in public places and infrastructures.

In both public ICT applications and the newly emerging business models, it is clear that, apart from the benefits which can be expected from the introduction of ICT applications, there are always going to be negative side-effects as well, which policy discourse and decision-making must keep in check. A Smart City concept, therefore, does not only give a boost to a city’s profile on the international stage as regards urbanisation, globalisation and digitalisation.[4] It must also improve the bases of information on which local government decisions are made about the stance cities should adopt and the action they should take as far as new technological developments are concerned.

In 2050, approximately 70% of the world’s population will be living in cities.[5] This will place an even greater strain on public infrastructures and basic services. Faced with these challenges, the aim of Smart City concepts is to point out the possibilities which are available to create cities and metropolitan areas which, through the use of modern technologies, ensure a sustainably good quality of life and are viable for the future. At the same time, this opens up a potential market for specific solutions and technologies.

The European Commission reacted to the international Smart City movement in 2012 by setting up the European Innovation Partnership on Smart Cities and Communities (also known as the Smart Cities Initiative).[6] The aim of this initiative is to encourage and support European industry, science and research in international collaborations to develop possible solutions for efficient energy production and supply, urban mobility and intelligent networks in cities using modern information and communication technologies.[7] Berlin sees this as an incentive to initiate European projects in the

[4] See: JPI Urban Europe: Megatrends Report (Joint Programming Initiative Urban Europe, 2014).
[5] See: State of the World's Cities 2010/2011: Bridging the urban divide (UN Habitat, 2011), 13.
[6] See: http://ec.europa.eu/eip/smartcities/.
[7] See: Smart Cities and Communities – European Innovation Partnership (European Commission, 2012): (COM (2012) 4701).

Smart City field and to participate in international competitions within Europe and further afield.[8] Synergies for securing funding from the EU and elsewhere are being sought for this.

In Germany, the federal government has invited experts in the field to debate the future sustainability and viability of German cities as part of the National Platform for the City of the Future and used the launch of the Science Year 2015 to present a research and innovation agenda for the city of the future.[9] In addition, a wide range of networks and initiatives exist which are dedicated to the Smart City concept within the federal states and larger cities.

The Berlin discourse on Smart City

As a global trend, "Smart City" has given rise to a discourse on urban policy which Berlin is constructively and critically involved in and which it contributes to with its own projects and ideas.[10] Berlin follows this discourse with great interest and also helps to shape it. At the same time, it evaluates the arguments and measures this discourse sets out in relation to the common good and the needs of its citizens. A vital precondition for this is the close collaboration of public administration, private enterprise and science. Berlin has over 300 research groups and research-based companies working on theories and projects for the city of the future. Smart City research expertise can be found in almost all of the faculties of Berlin's universities and higher education institutes, as well as in other independent research institutes in the city. In Berlin, results are regularly produced which have a high transfer potential. Spin-off companies from the state-run universities and start-ups are already a strong feature of Berlin's innovation landscape.

Smartness within the urban context

But what actually makes cities "smart" and therefore viable for the future? As Berlin sees it, cities which are viable are those which achieve a significantly higher or stable quality of life while using the same or a lower level of resources. This can only be achieved by means of an urban management which, by using innovative information and communication technologies,

- links up various sources of information, thus allowing the creation and use of synergies,
- achieves a significant increase in efficiency and a conservation of resources through integrated approaches, and which,
- in so doing, involves both citizens and investors in the shaping of the city to make it attractive, viable for the future, resilient and dedicated to the common good, thus increasing the quality of life.

Smart Berlin is, therefore, both a place to live and an economic area which develops sustainably through the systematic and inter-modal deployment of innovative technologies, materials and services. This comprises production processes, services and technologies as well as infrastructures which, by means of the new, "intelligent" information and communication technologies, only become viable at all because they are integrated, networked and mutually supportive.

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[8] This is also reflected in the Berlin Operational Programme for the European Regional Development Fund 2014 – 2020. See (in German): http://www.berlin.de/sen/strukturfonds/strukturfonds_2014.html#p7d.
[9] See: http://www.nationale-plattform-zukunftsstadt.de/index.php.
[10] For an initial comprehensive survey (in German), see the Appendix and TSB Technologiestiftung Berlin (ed.), Smart City Berlin, Urbane Technologien für Metropolen, Berlin 2014: http://www.technologiestiftung-berlin.de/fileadmin/daten/media/publikationen/140213_Studie_SmartCity.pdf.

Inter-departmental thinking and action

In order to be able to develop and deal with these approaches and problems, it is necessary to continue and further improve the interaction between public administration, urban society, business, science and research in a way that transcends the borders between the European Union, national government, the federal states and local authorities. To ensure the future viability of the city, life-defining areas of urban society like housing, the economy, public administration, mobility, utilities infrastructure, health and public safety have to be taken into account in a way that is properly balanced. This means that they become policy areas in which developments, problems and challenges have to be dealt with integratively, inter-departmentally and with a view to long-term objectives. At the centre of these policy areas lies the preservation and further improvement of the quality of urban life of each and every native Berliner as well as of people who move to the city from elsewhere.

The fundamental societal questions and inter-disciplinary issues of demographic change, social integration, resource efficiency and digitalisation make such an approach inevitable. In tackling these issues, it is important not to consider the areas of action separately from one other, but rather to focus on the points at which they overlap and intersect. Because information in a Smart City is increasingly linked up so as to enable the city to act more efficiently, the city's public and private players have to coordinate their actions and synchronise them at an early stage. However, in the dialogue between urban society, politics and public administration, it is necessary to develop clear objectives, agree upon responsibilities, provide leadership and carry out regular reviews of the progress made so that potential mistakes and problems with implementation and their causes can be detected in good time and amended as part of an "error management culture" within the urban policy dialogue.

The goals of Smart City Berlin

As one of Europe's major cities and a growing urban centre, Berlin has set itself the following goals in its Smart City strategy with the basic premise of serving the common good:

- A reduction in the use of finite resources; the establishment of the use of renewable energies; an increase in resource efficiency and the climate neutrality of Berlin by the year 2050
- A minimisation of the negative side-effects of living in a densely populated urban environment, such as environmental pollution, stress-related illnesses or a diminished feeling of personal safety
- The further development of the international competitiveness of the capital city region of Berlin-Brandenburg; an increase in economic strength and the creation of jobs
- The creation of a lead market for innovative applications
- Further networking on a regional, national and international level
- A strengthening of the resilience of urban infrastructures
- The long-term securing and optimising of public services through public administration, municipal enterprises and social bodies
- The strengthening of a transparent decision-making culture in public administration

- An increase in the quality of life and location
- An increase in opportunities for greater social participation [11]

I.2 The Role of Technology

The safeguarding of the inviolability and freedom of each and every citizen is the number one priority of Berlin's Smart City strategy. Smart City Berlin is in no way overly technocentric. Instead, available technologies are deployed in such a way as to get the most use out of them while at the same time keeping them within the control of providers and consumers.

ICT as a key technology

Data and ICT infrastructures are the technological backbone of a Smart City. Large pools of data and their analysis (Aggregate Analytics) form the other basis and starting point of ICT to ensure the functioning and performance capability of a Smart City. This means that data capture, processing, transfer, analysis and security lie at the very heart of digitalisation activities.

A great variety of information and communication technologies is available for all the city-related areas of application in Berlin – mobile Internet, LTE, RFID, NFC, WLAN[12] and a wide range of communication hardware, actuators and sensors. A high-performance wireless and wired broadband infrastructure with comprehensive coverage is a precondition for Berlin to be able to function as a Smart City.

The deployment of ICT as a cross-sector technology is central to the development of a Smart City; when it is used, actuators, segments and processes can be interconnected and information exchanged.

ICT for the city

Digitalisation – the capturing of the active and passive features of analogue processes of everyday life by means of suitable sensors and their transfer into digital information which can be further processed by electronic means – pervades almost all areas of urban life and already plays a prominent role in public administration (e.g. the federal government's Digital Agenda or Berlin's e-Government Strategy[13]). This process will be continued and intensified in Berlin over the next few years.

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[11] On this, see (in German): VDE Verband der Elektrotechnik Elektronik Informationstechnik e. V. als Träger der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (ed.) *(Association for Electrical Engineering, Electronics and Information Technology as the supporting organisation of the German Commission for Electrical Engineering, Electronics and Information Technology)*, Die Deutsche Normungs-Roadmap Smart City, April 2014, p. 8f, at: http://www.dke.de/de/std/documents/nr_smart%20city_de_version%201.0.pdf.

[12] LTE – Long Term Evolution, a 4th generation mobile communications standard; RFID – Radio-Frequency Identification, identification using electromagnetic waves; NFC – Near Field Communication, an international transmission standard for the contactless exchange of data via radio technology over short distances of a few centimetres; WLAN – Wireless Local Area Network

[13] See (in German): http://www.digitale-agenda.de, http://www.berlin.de/projektzukunft/ikt-wirtschaft/e-government/ and www.berlin.de/projektzukunft/ikt-wirtschaft/e-government/.

By digitalising processes which have up to now been analogue, industry, public administration and the general public will be spared time, effort and money. This will free up resources which can be used for dealing with other important tasks. Internet-based services in the leisure sector, production processes, transport and public administration will increasingly complement or entirely replace analogue services. Sensors and environment recognition systems are already increasingly taking on an intermediary role in the interaction between human beings and their environment (e.g. autonomous parking[14]).

The networking of pools of data and information systems opens up new lifestyle possibilities. By developing new communication media or refining existing ones, access to digital information in the future will be simpler, cheaper and more efficient. This will also mean improved possibilities for productive exchanges both between citizens themselves and between citizens and public administration. The technological basis required to reach a broad section of the general population is the multi-channel capability of the processed and communicated information.

Examples of the efficiency-enhancing deployment of ICT

There is, therefore, a wide range of smart applications For example:

- Through the development and widespread proliferation of mobile end devices such as smartphones, the technological precondition for many different forms of support has already been fulfilled. Intelligent electronic assistance systems can link real-time data from the city's networked information systems to citizens' enquiries in a wide range of application areas. This process also works the other way round – citizens can use their smartphones to collect data and make it available to other members of the public, e.g. in IT-supported complaint and issue management.[15]

- Berlin's roads are already home to a wide range of "intelligent" vehicles which share their positional and operational data with other vehicles or service provider companies.[16] This Car2X communication[17] makes it possible for other road users to anticipate dangerous situations or other dynamic events more effectively and quickly. This data can be combined with data platforms and made accessible to all road users. Information about traffic jams, free parking spaces or public transport alternatives to driving, which is provided in this way, speeds up the flow of traffic.

- Satellite-based navigation systems are nowadays already capable of achieving accuracy to within less than 10 metres. The Open Service offered by the European GNSS[18] (GALILEO)

[14] For example, BMW has developed an autonomous parking assistant: http://www.bmw.de/de/topics/faszination-bmw/connecteddrive/fahrer-assistenz/intelligentes-parken.html. As part of the AUTONOMOS project at Berlin's Free University, a completely driverless car has also been developed: http://www.autonomos-labs.com/vehicles/spirit-of-berlin/.
[15] For examples (in German), see: http://www.service.brandenburg.de/de/anliegenmanagement_in_deutschland/303443.
[16] For example, it is possible to access the positional data of vehicles offered by the car-sharing provider Car2Go via Berlin Public Transport's "FahrInfo Plus" app. See (in German): http://www.bvg.de/de/Fahrinfo/Jederzeit-mobil.
[17] Car2x communication is intelligent communication between vehicles. In Berlin, for example, the Heinrich Hertz Institute is developing car-to-car technologies. See: http://www.hhi.fraunhofer.de/de/kompetenzfelder/drahtlose-kommunikation-und-netzwerke/projekte/enabling-technologies-for-future-wireless-applications/car2x.html.
[18] GNSS – Global Navigation Satellite System

boasts a precision of just a few metres. GALILEO[19] has its own separate tiers for both security-critical and government applications with higher resolutions and guaranteed availability. Navigation in areas which are inaccessible for satellites (buildings, tunnels), unmapped objects and non-map-based autonomous navigation will be used in Berlin to meet challenges faced in the field of public safety.

- Intelligent electricity meters (or smart meters, as they are also known) make it possible to monitor actual energy consumption in real time. There are similar intelligent meters for gas, water and heat consumption. They help to optimise energy consumption and use infrastructures to the best of their capacity.

- Industry 4.0, the "digital factory", represents a new paradigm in industrial production and its logistical processes.[20] It involves a networked (self-) organisation of production and a transformation of the working environment. The organisation of production made possible by this in the urban environment will also be considered as a development option for Smart City Berlin. The application of innovative manufacturing processes and the use of new materials will go towards providing a further boost to industrial production in Berlin.[21]

- Over the next few years, a decisive role will be played by intelligent networks known as Smart Grids. Using new components and systems from the fields of energy, data and communication technology, it will be possible to integrate electricity grids and decentralised accumulators (electric vehicles, battery banks, power-to-heat systems). The possibility of incorporating short-term and long-term storage into energy management is becoming increasingly important, particularly as a result of the expansion of renewable, and therefore fluctuating, energy production.

- Recyclable material from household waste and waste packaging will no longer be collected separately in Berlin but in a combined recycling bin. The separation into different recyclable materials will be carried out in highly efficient, sensor-controlled plants. In modern waste incineration plants, the unrecyclable residual waste is burnt[22] to produce heat and electricity. Similarly, biogas is obtained from the accumulated organic waste. These technologies are constantly being refined and are becoming cleaner and more efficient. Smart City Berlin aims to recycle waste to generate usable materials and also heat and electricity as much as possible.

- The development of LEDs[23] has made a generation of efficient and controllable light fittings available which can be used together with sensor and control technology to fulfil all the preconditions required for the widespread deployment of intelligent lighting systems in public places by the year 2020. The function of lighting systems can also be expanded to include their use as WLAN nodes or in anomaly detection.

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[19] For more details, see: http://www.esa.int/Our_Activities/Navigation/The_future_-_Galileo/What_is_Galileo.
[20] For more details on this (in German), see: Promotorengruppe Kommunikation der Forschungsunion Wirtschaft-Wissenschaft, acatech - Deutsche Akademie der Technikwissenschaften e.V. *(National Academy of Science and Engineering)*, Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0. Abschlussbericht des Arbeitskreises Industrie 4.0 *(Implementation Recommendations for the Project "Industry 4.0". Final Report of Working Group "Industry 4.0")*, Frankfurt/Main, Munich, Berlin 2013, p.16, at: http://www.bmbf.de/pubRD/Umsetzungsempfehlungen_Industrie4_0.pdf.
[21] For information (in German) on Industry 4.0 in Berlin, see: http://www.berlin.de/industriestadt/industrie-4-0/.
[22] For example, in the waste-to-energy plant in Berlin's Ruhleben district run by the city's waste management agency BSR: http://www.bsr.de/8668.html.
[23] LED – light-emitting diode

- Another issue which will also become increasingly important will be that of open data, i.e. the free availability and modification of private and public pools of data for the provision of new services.[24] To this end, Berlin has set up basic infrastructures and ensured that data can be processed electronically. The readily available (non-personal) data will also be made available in digital form free of charge.[25]

Data security and data protection

At a time of increasing public awareness and concern, the need to ensure personal data protection and all the aspects associated with it such as data autonomy or data minimisation may constitute a real long-term advantage for Berlin. Although a change in values as regards data protection cannot be ruled out even for Berlin, the desire for the integrity and authenticity of data – i.e. the prevention of an unauthorised modification of information or a guarantee of its reliability – remains important.

The Berlin Senate attaches great importance to its citizens' right to self-determination as regards information; data protection is a fundamental right and therefore one of the foundations of a free and democratic society.[26] Thus, when introducing ICT-based measures and projects, it is always necessary to ensure that usage complies with data protection laws so that those affected retain control over their own personal data.

In a smart city, it must also continue to be possible for people to remain anonymous when moving around the city, i.e. without data about their movements being captured and passed on to an indefinite number of private-sector or state agencies. Should the collection of personal data for specific functions such as navigation services be necessary, it must be ensured that this data is only used for that specific purpose and subsequently erased or anonymised.

This also applies to other areas such as smart homes.[27] Here, a wide range of personal data accrues which allows precise inferences to be made about the living habits of the residents. For example, it may be possible to determine which rooms people spend their time in, whether they sleep in separate rooms or which television programmes they watch. It is also necessary here to ensure that the people who are affected retain personal control over the data which accrues in their homes and are themselves able to decide which agencies should receive this data.

The deployment of technological solutions which have a high standard of data protection will ensure that personal data is only collected when this is absolutely necessary and that this data does not find its way into the public domain or end up in the hands of unauthorised persons. Digital services are

[24] On this, see (in German): Both, Wolfgang und Schieferdecker, Ina (eds.), Berliner Open Data Strategie, Berlin 2012, p. 19f.
[25] For further information (in German) on the Open Data Strategy, see: http://www.berlin.de/projektzukunft/ikt-wirtschaft/e-government/berlins-open-data-strategie/.
[26] On this, see (in German): Berliner Beauftragter für Datenschutz und Informationsfreiheit *(Berlin Officer for Data Protection and Freedom of Information)* (ed.), Berliner Informationsfreiheitsgesetz, Berlin 2012, p. 3; for further information on freedom of information and self-determination with regard to information in Berlin, see: http://www.datenschutz-berlin.de/content/informationsfreiheit.
[27] A smart home is a private home (e.g. a privately-owned house or rented accommodation) in which the various home automation devices (e.g. heating, lighting, air conditioning), household appliances (e.g. refrigerator, washing machine), consumer electronics and communication equipment become intelligent devices dedicated to fulfilling the residents' needs. By connecting these devices together to create a network, it is possible to place new support functions and services at the residents' disposal and generate an added value which goes beyond the individual uses of the applications available in the particular home. For more information (in German), see: Strese, Hartmut; Seidel, Uwe; Knape, Thorsten; Botthof, Alfons; Smart Home in Deutschland, 2012, Berlin: Institute for Innovation and Technology (iit).

subject to the same sets of values, the same perception of the democratic state and the same perception of fundamental rights as analogue ones.

Meeting the demands for data minimisation, secure data storage, data transparency, data sovereignty or data security will play a decisive role in determining the acceptance of Smart City Berlin. If, for example, data misuse is suspected after the energy-efficient refurbishment of a rental property, technologies such as smart meters will be left unused. As a result, there is a risk that the intended economic and ecological effects will not come to pass.

I.3 Areas of Action

The fundamental requirements of the growing city of Berlin can be broken down into these areas of action: smart administration and urban society, smart housing, smart economy, smart mobility, smart infrastructure and public safety. These areas of action are subject to challenges arising from the cross-sector issues of demographic change, social integration, resource efficiency, innovation orientation and digitalisation. In tackling these issues, it is important not to consider the areas of action as separate silos, but rather to focus on the points at which they overlap and intersect.

I.3.1 Smart administration and urban society

Modern administration

In seeking to create a Smart City, it is absolutely vital to establish new administrative structures and modes of participation. This involves taking into account all aspects related to administration, from the core services provided by local citizens' offices to health care and public safety. Nowadays, this means that a modern state offers its services first and foremost online. Modern administration is no longer conceivable without the use of the latest information and communication technology.

Speeding up and simplifying administrative processes

IT support makes it possible to speed up administrative processes and allows new services to be offered with a greater level of transparency and citizen-friendliness. Processes become noticeably simpler and faster, and the use of electronic processing throughout saves time and money. Measures are put in place to deal with recurring administrative services in order to be able to carry out processes with optimum efficiency (e.g. an automated alert sent out when an identity document expires). Process optimisation and automated control in closed systems of administration support human decision-making. Smart services are, thanks to unified and standardised operating concepts, simple to use, familiar, easy to find, secure and certified.

The result is a visible reduction in the effort required of citizens and businesses. To name but two examples, it becomes possible to lodge appeals against official decisions via email or to file lawsuits using qualified electronic signatures.[28] Berlin is well aware that, as a rule, extremely sensitive processes and data are involved here. For this reason, the Berlin Senate places particular emphasis on data protection and security.

[28] For more details (in German), see: http://www.berlin.de/vergabeplattform/registrierung/qualifizierte-signatur/.

Political challenges

The progressive digitalisation of business processes

Many tasks (e.g. the opening of a café or restaurant) have to involve more than one of Berlin's administration departments and therefore require complex organisation. The aim of the progressive digitalisation and networking of business processes within or between authorities is to minimise the amount of effort involved in joining up official processes. It should be the data which is sent from one place to another, not the public. The use and interconnection of available pools of data in administration should lead to clients and businesses being relieved of the burden of having to prove their identity each time. The harmonisation and optimisation of data standards, IT procedures and business processes are the basis for this. Corresponding measures already form part of the Berlin e-Government Strategy.[29] This strategy creates a framework for the further development of e-government within Berlin's administration for the years 2015 – 2017.

E-Government

Berlin is getting its own e-government law. The law aims to establish basic e-government norms which will be able to help overcome the major obstacles created by the formal requirements of administrative law. It thus opens up the possibility of carrying out all business processes entirely electronically and offering these processes to the public and business in an easier, simpler and more cost-effective way.

The law takes previous experiences with e-government projects in Berlin into consideration. It sets out to create the preconditions required to link up all application procedures (such as for planning permission) in advance more quickly and efficiently and to design the electronic processing of each step in the process, from the submission, receipt and processing of the application data to the final decision and notification of the applicant. All of this should involve close collaboration between the administration and applicants' representatives, such as chambers of commerce and industry, in order to achieve a high level of acceptance of the new electronic procedure on the part of both the client and the city's administration.

In order to make smart administration a reality, the Berlin Senate, independently of the legislative proposal, has passed a resolution to adapt federal state law with respect to e-government.[30] The aim of this resolution is to adapt the formal requirements in the legal norms of Berlin state law to the conditions of e-government, thereby laying the foundations for the provision of smart administration services. Any obstacles to an increase in online service provision and any new technological hurdles which may arise will have to be overcome to ensure that an extension of smart administration activity is achieved.

The (online) participation of urban society

In addition to application procedures, the participation of urban society plays a crucial role in the development of Berlin. Under the e-government law, participation will be supported and extended electronically. The new platform mein.berlin.de is going online in 2015, bringing together the online-supported participation procedures of all of Berlin's administration departments in one place. The

[29] Berlin e-Government Strategy, Senate Administration for Internal Affairs and Sport, Berlin, Senate Resolution No. S-76/2015 of 03.02.2015.
[30] Senate Resolution No. S-45/2015 of 06.01.2015.

platform makes a large number of tools available which can be used in participation processes. For instance, it is possible for users to create a profile which they can then use to follow a wide range of procedures, to keep themselves informed about the progress of a debate on a particular issue or to take part in the debate themselves. In a local context this applies to such things as monitoring the use of public money that has been set aside for local expenditure or commenting on a draft planning application which is open to public scrutiny. In a city-wide context it applies, for example, to participating in the planning for the use of the land of the former Tempelhof airport or for a climate-neutral city.

The challenge lies in further developing the discourse processes in order to build as broad a consensus as possible without hindering progress. The use of open data can support the participation of urban society. Nevertheless, care must be taken that these new forms of urban discourse-building do not undercut or devalue the democratic decision-making and voting processes which are guaranteed under constitutional law.

Unifying points of contact

On 26.02.2013, the Berlin Senate officially approved the "One Stop City Berlin 2016" programme, which sets out how the relevant guidelines for government policy are to be implemented.[31] These include combining services thematically, harmonising business processes and increasing the number of ways to access administrative services based on a specific issue in order to create unified points of contact for citizens and business. The services can be accessed in person, by post, over the telephone or via the Internet. Areas in which these approaches have been initially successful include contact points in Berlin's local administrative and regulatory offices, points of single contact for businesses and the 115 citizens' hotline. All administrative services are offered, combined and processed centrally. Successfully operating portals are being expanded. These smart services are highly individualised.

115 Citizens' hotline

The introduction of the 115 citizens' hotline in Berlin is part of a national initiative to establish 115 as the one-stop telephone number to reach administration agencies. The central concept behind 115 is to provide citizens with a single telephone number which they can use to access reliable information about public administration services. If a caller cannot be given immediate assistance, the matter is passed on to the relevant authority by telephone or email. In Berlin, the 115 citizens' hotline is becoming increasingly popular. In 2014, the number of calls received in a month again doubled to more than 100,000 in comparison to the year before. The 115 citizens' hotline has thus developed into an important factor in achieving modern, efficient and citizen-friendly administration. It is a shining example of how a citizen-friendly administration can be achieved.[32]

[31] For more information (in German) about One Stop City Berlin 2016, see: http://www.berlin.de/sen/inneres/buerger-und-staat/buergerdienste/one-stop-city-berlin-2016-und-buergerzentren/artikel.32048.php.

[32] The service guarantee of 115 pledges that at least 75 per cent of calls will be answered within 30 seconds. Furthermore, it sets out to achieve an overall call acceptance rate of over 90 per cent and to deal with more than two-thirds of enquiries to the caller's satisfaction. The 115 citizens' hotline achieved all of this in the year 2013 – 95 per cent of calls were answered and it was possible to deal with 80 per cent of enquiries directly. The remaining 20 per cent were passed on to the relevant authorities.

The modernisation programme "ServiceCity Berlin 2016"

With its modernisation programme "ServiceCity Berlin 2016", the Berlin Senate has committed itself to achieving the goal of making Berlin's administration more business- and citizen-friendly, transparent, participatory and efficient.[33] The programme is being implemented in a number of citywide projects which are being promoted by various public authorities. It provides flexible financial support for internal modernisation efforts in administration carried out as part of an overall strategy. The central priorities are IT and e-government projects, including the associated changes in structures and processes. One example of a project which has been funded in the course of the current legislative period is the service portal service.berlin.de.[34] This is being expanded to include functions which can be used to personalise access – the aim being to enable users to use the electronic identity functions of the new identity cards to process personal matters completely online. The online channel will also increasingly offer citizens electronic transactions and information about the status of a procedure. The service portal is also available as an app.

Electronic files

A single, standardised document management system with viewable electronic files is a precondition for the functioning of e-government. Berlin's administration has begun a phased introduction of the e-file with the aim of creating a modern, efficient and networked working environment for all Berlin administration staff in the future.[35]

Open data

A further element of a modern, citizen-friendly administration is free access to selected data held by Berlin's public authorities (open data). Access to data and information held by Berlin's administration and their further use is provided centrally via a portal (www.daten.berlin.de) in which over 800 data sets are already currently available. For example, a large amount of geographical data relating to the Federal State of Berlin has been made available online free of charge and unconditionally since October 2013 (Geoportal Berlin[36]). Data protection is guaranteed just as it is for official statistics. This enables new business and service ideas to be developed by combining the available data. A phased extension of the disclosure of public and commercial pools of data in digital form is a fundamental precondition for Smart City Berlin. Incidentally, smart administration is also present in the form of open WLANs in all public administration buildings.[37]

Smart leadership and smart staff

A functioning digital administration relies on inter-departmental action and therefore requires a change in the way that all those involved think.

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[33] For more information (in German), see: Modernisierungsprogramm ServiceStadt Berlin 2016, Stand 2012 (version 2012):
http://www.berlin.de/sen/inneres/moderne-verwaltung/servicestadtberlin/auftrag/modernisierungsprogramm_servicestadt_berlin_2016.pdf.
[34] See: http://www.service.berlin.de.
[35] In accordance with Senate Resolution S-3831/2011 on the electronic file in Berlin's administration. For more information (in German) on the e-file in Berlin's administration, see: http://www.berlin.de/sen/inneres/moderne-verwaltung/prozesse-und-organisation/projekte/e-akte/.
[36] See (in German): http://www.stadtentwicklung.berlin.de/geoinformation/.
[37] For an overview of public WLANs in Berlin, see:
http://www.berlin.de/projektzukunft/standortinformationen/offene-wlan-hotspots-berlin/.

Smart administration depends on highly qualified, motivated employees. Using demographic change as a basis, it develops and makes use of new ways to attract and recruit staff. In its role as an employer, the Federal State of Berlin is expanding its career portal http://www.berlin.de/karriereportal/. Smart staff recruitment is based on the principles of diversity, gender equality and non-discrimination, and can be carried out entirely electronically.

Social integration

Social integration is another fundamental challenge faced by smart Berlin. The integration of newcomers to Berlin in particular is both a challenge and an opportunity for public administration and urban society. As a result of the increasing individualisation of citizens, a growing number of different interests are coming together and making their presence felt in public discourse. Skilful and intelligent urban management and the inclusion of stakeholder groups can ensure the social participation of everyone. Berlin is a melting pot of the most diverse range of cultures, religions, ethnic groups and age groups. The city fosters and preserves the potential which lies in this diversity, and is constantly evolving. Innovative services will be beneficial and accessible barrier-free to all people, irrespective of their level of education, income or age.

IT professionals and the teaching of ICT skills

This participation can, however, only be fully guaranteed if the general population has the necessary wherewithal to make use of the new technical possibilities. Education and training in digital Berlin must therefore meet the latest technological standards and provide in-depth ICT skills. The equipment available in schools is of central importance to determining the use of new media in everyday life. As well as providing the relevant technical equipment, qualifying learners in the use of the new technological solutions must become a part of both school education and vocational training. Any efforts in this direction will have an immediate relevance for the job market. Indeed, according to the latest findings, Germany will need approximately 1.2 million IT specialists by the year 2020. Berlin can lead the way in this. In order to be successful in this, Berlin will need to provide good training locally and attract qualified specialists from outside.

Art and culture

Art and culture enrich the daily lives of every Berliner. Art has a socially integrating effect and brings cultures together. Access to cultural assets and content will be made possible and freely accessible to all. The digitalisation of cultural assets such as the collections held in the Berlin Natural History Museum will represent a major step in this direction. [38]

I.3.2 Smart housing

Housing in Berlin has particular qualities. All the boroughs of the city offer diverse neighbourhoods with a wide variety of building types, residential areas and housing standards, not to forget an excellent range of public and private infrastructures and services. No matter whether people have lived in their local neighbourhood for years, have just moved there from somewhere else in the city or have come from other parts of the world, they are quickly accepted and made to feel welcome.

[38] For more information (in German), see: http://www.naturkundemuseum-berlin.de/presse/pressemitteilungen-2014/2014/digitalisierungsstrasse/ and http://eos.naturkundemuseum-berlin.de/digitization.

Various demands concerning housing and surrounding area

Accordingly, the demands that people in Berlin have concerning their flat and its surrounding area are many and varied. Housing must be affordable and meet the individual wishes and income levels of people of all ages and from all sections of society. Individual flats should provide enough rooms and space to meet all the requirements of daily use. They should have a workable layout, functioning fixtures and fittings, and they should provide a living space with an atmosphere that is both comfortable and healthy. Finally, they should provide safety, security and peace and quiet for their occupants at all stages in their lives and they should guarantee the right to privacy.[39]

The nearby provision of a network of green and open spaces, social facilities, public and private services, jobs, self-help opportunities and community activities in the neighbourhood raises the housing standard and the quality of life in the area. To maintain and further develop residential areas with a social and demographic mix is one of the key challenges for the future to which residents, the housing industry, private service providers, social service providers, associations and neighbourhood initiatives together with politicians and administrators make important contributions.[40]

Political challenges

Rising rents

The continuing influx of newcomers to the city has caused new-letting rents, building land prices and property prices to rise. The Senate has deployed a range of housing policy measures[41] in its efforts to ensure that housing in Berlin continues to be attractive and affordable for all people. According to the Urban Development Plan 2025[42], around 137,000 new flats (this means around 10,000 flats a year or around 7% of the existing housing stock of approximately 1.9 million flats) will have to be built in order to cover the housing needs of this growing city. In addition, extensive investment in the maintenance of existing housing, in improvements to its energy-efficiency and in modifications to meet the needs of an aging population will be necessary in order to retain the social diversity and functional mix of neighbourhoods and to ensure that the city can further develop in a balanced way in terms of urban design and ecology.

New building

In order to achieve the goal of 10,000 new flats a year that are ready to move into, it is necessary to develop sufficient land for building and to slow down the upward pressure on prices for new builds.[43] The following are helping to contribute solutions to this problem:

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[39] For statistical information (in German) about housing in Berlin, see: Statistical Office for Berlin-Brandenburg, census 2011 – buildings and housing and living conditions of private households, https://www.statistik-berlin-brandenburg.de/zensus/gdb/gwz/be/11_Berlin_gwz.pdf; Investitionsbank Berlin, Housing Market Report 2014

[40] For details (in German) on this, see: Senate Department for Urban Development, Manual for social environment planning. Basis of an integrated urban and local district development in Berlin, hhtp://www.standtenticklung.berlin.de/Wohnen/wohnungspolitik/de/ueberblick/index.shtml.

[41] See (in German): Overview of Rent and House Building Policy Berlin, http://www.stadtentwicklung.berlin.de/wohnen/wohnungspolitik/de/ueberblick/index.shtml.

[42] Senate Department for Urban Development and the Environment: Stadtentwicklungsplan Wohnen 2025. Grundlagen für Berlins Wohnungsbaupolitik *(Urban Development Plan for Housing 2025. Basis for Berlin's housing policy)*, Berlin, August 2014 (in German)

[43] See (in German), for example: Dietmar Walberg, CEO of ARGE-SH Arbeitsgemeinschaft für zeitgemäßes Bauen GmbH, Kiel, Baukostenentwicklung im Wohnungsbau – Stand und Ausblick *(The Development of Construction Costs in House-Building – Current Situation and Future Prospects)*, in: Immobilien & Finanzierung 2014, p. 766ff.

- Since the end of 2013 a building land information system has been built up under the overall control of the Senate Department for Urban Development and the Environment and with the participation of all 12 boroughs. It is the basis for the successful management of new building land. It is planned to make relevant data and information accessible to investors – on the Internet as well - about building plots that will be available in the short and medium term.

- The geographical data portal FIS Broker[44], which is run by the Senate Department for Urban Development and the Environment, contains an extensive catalogue of geographical data. This catalogue is constantly updated and expanded and offers maps, plans and other geographical data from Berlin and Brandenburg which, for example, enable the user to make an online assessment of the quality of particular building plots. Searches are possible according to location (e.g. addresses) and content (e.g. key words). Maps can be viewed, overlaid and linked to other technical data. With the help of the dossier function it is possible to quickly obtain a wide range of information about a plot of land.

- The development of new residential areas requires integrated planning procedures to ensure the sustainable development of the space involved (type and dimensions of the buildings, green and open spaces, technical and social infrastructures).[45] The people whose homes adjoin these areas, and all interested individuals and groups, should be involved in this planning process by means of participation procedures that are adapted to the circumstances of the particular location.[46] There is considerable potential for the development and application of smart solutions in the 3-D visualisation of different planning solutions (e.g. the appearance of the area, the light conditions, barrier-free access), in the simulation of urban planning effects (e.g. sound propagation, urban climate, use of solar power) and in the case of platforms for electronic participation[47] that are easy to use and that encourage the user to become involved.

- Methods of "Building Information Modelling" [48] (the digital modelling of buildings in the phases of planning, construction and building use) in the pre-fabrication of housing[49] should be tried out to explore their potential for improving efficiency and reducing costs in the planning and construction of buildings and for optimising operating and maintenance costs once the buildings have been built. At the same time, given that overall ecological building concepts for new builds are being further developed and increasingly applied as a key element in climate protection and climate change adaptation[50], it needs to be made clear that there does not

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[44] See (in German): http://www.stadtenticklung.berlin.de/geoinformation/fis-broker/.
[45] See (in German), for example, an overview by Bernd Streich, Stadtplanung in der Wissensgesellschaft *(Urban Planning in the Knowledge Society)*, 2nd ed., Wiesbaden 2011
[46] For examples of participation processes and procedures, see (in German): Senate Department for Urban Development and the Environment, Handbuch Partizipation, 2nd ed., Berlin 2012
[47] For an overview (in German) of the e-participation procedures that have been run or are being run by the Senate Department for Urban Development and the Environment, see: http://www.stadtentwicklung.berlin.de/wir_ueber_uns/fokus/partizipation/index.shtml.
[48] See (in German), for example: Ingrid Strohe, BBSR, BIM-Leitfaden für Deutschland *(BIM Guideline for Germany)*, in the Bundesbaublatt *(Federal Building Gazette)*, no. 11, 2014, p. 64f.
[49] See (in German), for example: Andrea Gill, Julia Benze, Saskia Herbert, subsolar* Architektur und Stadtforschung, Berlin, Serieller Wohnungsbau. Standardisierung der Vielfalt *(Pre-fabricated Housing – the Standardisation of Variety)*, study and project research for the IBA 2020 Berlin, commissioned by the Senate Department for Urban Development and the Environment, Berlin 2013, http://www.stadtentwicklung.berlin.de/staedtebau/baukultur/iba/download/studien/IBA-Studie_Serieller_Wohnungsbau.pdf.
[50] See (in German): the exhibition panels with example projects at: http://www.stadtentwicklung.berlin.de/bauen/oekologisches_bauen/de/gebaeudekonzepte/index.shtml.

necessarily need to be a conflict between reducing building costs and building sustainably. In the end, it is important to make greater efforts to investigate and to make full use of the potential of new materials[51], like adaptive materials, in the area of house building.

Development of existing housing stock

Residential buildings are long-term assets and can be used for much longer than 100 years if they are regularly maintained and, through modernisation measures[52], adapted[53] to changing needs. Despite the great importance of new builds, the even greater potential for developing and using smart solutions is to be found within existing housing stock. Such solutions have to offer clearly identifiable advantages, above all in the form of higher living comfort and savings in time and costs. Moreover, they must be easy to use. There is considerable market potential – not least for development companies, manufacturers and service providers in Berlin – particularly in the areas outlined below:

Smart homes

Because of the widespread availability of PCs (from desktops to tablets), smartphones, and, in future, "wearables", i.e. watches, jewellery or clothing with digital technology, and because of the ready availability of affordable and powerful micro-electronic and micro-mechanical components, there is already a wide range of sensors, actuators and software which technically-minded users can use to equip fixtures or furnishings in their flat with their "own intelligence" and then to create networks. Equally, it is possible to buy domestic appliances with these features. In this way, routine household tasks in the home are automated and/or controlled by the user from outside the home[54] – via mobile signal or broadband and with the corresponding security risks and need for technical precautions.

In addition to the potential for applications that depend exclusively or almost exclusively on the interests, preferences and options of individual members of a household – like, for example, controlling lighting, the music system and the television, or vacuum cleaning using a robot – ICT solutions also offer a variety of applications, which it is in the public interest to disseminate as quickly as possible.

Ambient Assisted Living

Technical assistance systems (Ambient Assisted Living) provide people with disabilities and with age-related physical restrictions to their mobility additional ways of increasing the quality of their accommodation and their quality of life so that they can be well catered for and stay in the surroundings they are familiar with. In future, this area of application will probably be further

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[51] See (in German): http://isc.fraunhofer.de/branchenloesungen-und-referenzen/umwelt/bauwerkstoffe/.

[52] The distinction between maintenance, i.e. measures to maintain the contractually required condition of a rental property, and modernisation, i.e. measures which sustainably enhance the utilisation value of the rental property, is of particular importance in Berlin (where around 85% of inhabitants are tenants and 15% owner-occupiers) because, according to tenancy law, the costs for maintenance have to be borne by the landlord whilst the costs for modernisation can be added to the rent pursuant to the standards and procedures set out in the tenancy law provisions of the German Civil Code.

[53] In 2012 the breakdown of existing housing stock in Berlin according to its year of construction was as follows: approx. 522,000 flats (27% of housing stock) were built before 1919; approx. 283,000 flats (15%) were built between 1919 and 1948; approx. 1.1 million flats have been built since 1949. For details, see (in German): Investitionsbank Berlin, IBB Wohnungsmarktbericht *(Housing Market Report)* 2013, p. 39.

[54] See (in German), for example: http://www.smarthome-deutschland.de/smarte-orte.html.

developed[55] particularly in health care provision (tele-care, tele-rehabilitation and tele-medicine). The fundamental characteristic and critical factor in the success of these two areas of application will be an appropriate combination of ICT and personal services.[56]

Security for flats and buildings

In addition to the installation of smoke detectors, the use of which in residential accommodation is also prescribed in Berlin, there are many ICT solutions which can increase the security of flats against breaking and entering.[57] On the basis of an extensive analysis carried out by the German Forum for Crime Prevention *(Stiftung Deutsches Forum für Kriminalprävention)* on the options and limits regarding the prevention of break-ins, and on the recommendation of the Interior Ministers' Conference, the KfW banking group has included[58] support for measures that prevent break-ins in its programmes, "Energy-efficient refurbishment" and "Age-appropriate modernisation", both of which are used by tenants and property owners in Berlin.

Tele-jobs

The fact that homes are equipped with high-performance computers and ICT terminal devices and have high-speed broadband connections confers an entirely new quality on the idea of working from home. Basically, it is true even today that everywhere in the city the preconditions exist for providing data processing and ICT services independently of one's work station in the office. On the one hand, this means that additional, skilled jobs can be created in households where, for example, flexible working hours are necessary without journeys between home and work because of the need to look after children or family members who require nursing care. On the other hand, the transfer of jobs from the office to home can become associated with negative aspects (e.g. reduced personal communication with team members, insufficient data security and restrictions in terms of employment law and pay and conditions). Consequently, the future prospects for this particular application of smart systems need to be investigated more fully.

Energy and resource efficiency

In addition to having an ICT connection via cable and/or mobile signal, all flats in Berlin are networked – in part with each other – via the electricity grid and water supply system with supply and disposal facilities in the city's infrastructure. Moreover, most flats are also networked in similar ways via the waste water disposal system, very many via the gas supply system and a large number via the central district heating system. The obligatory refuse disposal as well as collection and delivery services from logistics companies also represent a form of comprehensive networking with service providers. In all the networked areas of local services there are opportunities for developing smart solutions using ICT applications, both on the part of individual households (e.g. smart electricity and

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[55] See, for an overview (in German) of the areas of application and of providers and developers in Berlin, Anne-Caroline Erbstößer, Smart Home Berlin – Von der Komfortzone zum Gesundheitsstandort, Technologiestiftung Berlin, Report 2015.

[56] A successful example of this is the emergency call service SOPHIA Berlin and Brandenburg, which is funded and run by the city housing associations DEGEWO, STADT UND LAND and Wildauer Wohnungsbaugesellschaft, as well as by the housing cooperatives Hellersdorfer Kiez, Marzahner Tor and Neues Berlin. This system combines emergency call technology (a security arm band) with voluntary support for elderly people in the neighbourhood. See: http://www.sophia-berlin.de/index.php.

[57] The police crime statistics show that the number of reported cases of burglary has increased from approx. 6,000 (2005) to approx. 12,000 (2014). See (in German): https://www.berlin.de/sen/inneres/sicherheit/polizei/kriminalstatistiken-und-lagebilder/2014/artikel.266888.php.

[58] See (in German): https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/Einbruchschutz/.

water metering) and on the part of service providers (e.g. remote electricity and water meter reading). These opportunities can and must be used to reduce costs and to improve energy and resource efficiency.

In its appendix, the feasibility study "Carbon-neutral Berlin 2050"[59] contains differentiated and detailed calculations and estimates concerning the structure, the supply of energy and the energy efficiency of Berlin's housing stock and also concerning the potential use of residential properties as platforms for technology that can be deployed in cities for using renewable sources of energy – in particular, photovoltaic cells and thermal solar energy. According to the study's calculations, the heat requirements of Berlin's housing stock could be reduced from 150 PJ (petajoules) a year (2010) by 59% to 61 PJ a year by 2050. In order to achieve this, it will be necessary to use established technology and insulating material as well as more developed technology when insulating the building shells and improving the internal heating systems.

Barrier-free access

According to estimates by the Kuratorium Deutsche Altershilfe (KDA) *(a foundation that helps the aged)*[60], approximately 69,000 flats in Berlin are barrier-free. A further 41,000 flats would have to be modified by means of appropriate building measures[61] in order to meet the need of particularly elderly people for living space that is barrier-free or as barrier-free as possible. In addition to what are often small-scale modifications within the flats themselves, the single weightiest financial factor is above all the fitting out of existing buildings with lifts and, where necessary, ramps and staircase platform lifts in the entrance area. Because there is a conflict between the desire for barrier-free housing and the financial resources of households with a limited pension income, more developed technical solutions are necessary here.

Neighbourhood development

With its support programmes for the repair and modernisation[62] of the pre-fabricated housing stock put up in the eastern part of the city (in total, around 270,000 flats) and with its work on improving the general surroundings of these residential areas and on strengthening the neighbourhood centres there, Berlin has set high standards since reunification.[63] The experience gained in the course of this work is being used in Berlin by the housing association GESOBAU[64] in carrying out an energy-efficient refurbishment of the residential estate, Märkisches Viertel, and by the housing association degewo[65] in its work on developing the Mariengrün Quarter. Energy-efficient refurbishment comprises

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[59] See (in German): http:// www.stadtentwicklung.berlin.de/umwelt/klimaschutz/studie_klimaneutrales_berlin/.
[60] Kuratorium Deutsche Altershilfe und Wüstenrot Stiftung *(two charities concerned with help for elederly people)*, Wohnatlas, Rahmenbedingungen der Bundesländer beim Wohnen im Alter *(Accommodation Atlas: Living Conditions for the Elderly in the federal states)*, Cologne/Ludwigsburg 2014
[61] For examples and costs, see (in German): Senate Department for Urban Development and the network agency Generationen Wohnen, Wohnungsanpassung – keine Frage des Alters *(Adaptation of Flats – Not a Question of Age)*, Berlin 2011.
[62] For further information (in German) on the programme "Stadtumbau Ost" run by the Senate Department for Urban Development and the Environment, see: http://www.stadtentwicklung.berlin.de/staedtebau/foerderprogramme/stadtumbau/Stadtumbau-Ost.1554.0.html.
[63] The Kompetenzzentrum Großsiedlungen, http://www.gross-siedlungen.de/de/20_Startseite.htm is active in this topic area as a knowledge transfer agency. The approach of BEEN Baltic Energy Efficiency Network, http://www.been-online.net/ was and is the impulse for the refurbishment of pre-fabricated buildings, primarily in Eastern Europe and China.
[64] See: http:// www.stadtentwicklung.berlin.de/staedtebau/foerderprogramme/stadtumbau/Das-Foerdergebiet-Maerkisches-Viertel.4221.0.html.
[65] See (in German): Degewo, Quartier Mariengrün. Eine Großsiedlung erfindet sich neu *(A Large Estate Re-invents Itself),* Berlin 2014.

not only improving the energy-efficiency of the building, but also modernising the heating technology and/or the energy supply. All the projects mentioned above are characterised by an essentially homogeneous building design, whereby the buildings are owned by one or just a few landlords. The challenges in the case of the energy-efficient modernisation of residential areas with a mix of building designs and a large number of mainly private owners with different investment cycles and possibilities are considerably greater. Because the potential for improving energy-efficiency in large estates with a small number of owners has to a large extent already been realised, the major task in the future will be to develop effective and affordable solutions for tenants and owners in mixed residential areas.

Green and free spaces

It is important to use and to further develop the large amount of green spaces and free spaces in Berlin (approximately 44% of the surface area of the city) in order to maintain quality of life and to support the process of adjusting to climate change despite the need for further house building in the city. Improved resource efficiency aims primarily at avoiding or reducing climate-relevant emissions. This means, when it comes to climate adjustment measures, tackling the anticipated negative impacts of global warming in city-centre areas by supporting suitable measures like unsealing areas of ground, improving evaporation, greening and the supply and circulation of fresh air. Berlin has presented such ideas[66] in its urban development plan "Klima"[67] *(climate)*.

Neighbourhood management

Neighbourhood management[68] draws on a wealth of experience to provide suitable activities to strengthen the social cohesion of city neighbourhoods by means of self-help activities, charitable commitment, the involvement of independent charitable agencies and other "strong partners in the neighbourhood" (e.g. clubs, local businesses, housing companies and cooperatives). In addition to offering meeting centres in the neighbourhood and other locations (e.g. in schools and religious communities), there is great potential in ICT solutions ("Kiez-App" – *neighbourhood app*). Such solutions aim to match the demand for self-help activities to the available supply and to communicate the provision of low-threshold services.

There is also a great need for investment and for technical development when it comes to making these residential estates barrier-free, designing their surroundings and providing energy-efficient lighting for public spaces as a way of making them more attractive and helping the residents to feel more secure.

I.3.3 Smart economy

Consistent with the high-tech strategy of the federal government[69], Berlin wishes to make its contribution to helping Germany on the way to becoming an established place for innovation in Europe and the world. The ability to innovate is indispensable - not just for Berlin's job market. After all, economic growth and value creation mean prosperity and have a positive influence on the quality of life of citizens and on the appeal of the city. In all of this, Berlin's industry is particularly important. The process of development of Berlin as a city of industry has been supported for years by

[66] See: "No Regrets" Charter, compiled as part of the Metropolis initiative "Integrated Urban Governance" at: http://www.metropolis.org/news/metropolis-initiative-launches-char.
[67] See (in German): http://www.stadtentwicklung.berlin.de/planen/stadtentwicklungsplanung/de/klima/ and http://www.kompetenz-wasser.de/.
[68] See (in German): http:// www.stadtentwicklung.berlin.de/wohnen/quartiersmanagement/.
[69] For details (in German) on this high-tech strategy, see: http://www.hightech-strategie.de/.

companies, unions and the city's administration working collaboratively to identify fields of action and to establish specific implementation strategies. The document that sets out the direction of this policy is the master plan for the city of industry, Berlin, which is available in version 2.0.[70]

Interface innovation

Smart Berlin offers many opportunities to drive cooperation between research institutes, universities and business. Successful innovation can best emerge when it is cross-disciplinary, particularly at the interfaces between ICT, energy technology, health and transport/mobility. A targeted policy of grants and subsidies is intended to bring together sectors and companies that don't normally work together but which benefit from cooperation. This is the way in which various domains become smartly linked.

Demand for innovation

In order to further develop Berlin as a location for industry and innovation, it is necessary that innovative products, processes and local services are developed in the city and are also used here. In this way, it can be possible to meet new social demands in a growing city and to establish Berlin as a leading Smart City. Berlin can contribute[71] to this with a targeted deployment of the EUR 4 to 5 billion that is estimated to be the city's current volume of investment and procurement. With the help of the technology platform www.berlin-innovation.de, it is intended to support the use of innovative technologies by making this a criterion in public tendering and procurement processes.

Start-ups

A very dynamic start-up scene in Berlin has access to an infrastructure that supports the conversion of ideas into viable business models.[72] The linking of established and start-up companies and the strengthening of a technology-based start-up scene enable Berlin to compete more effectively nationally and internationally.

Science and research

In order to make Berlin smart, it is important to bundle the skills of the excellent science and research community in Berlin, to create synergies and to realise joint project concepts in a way that has appeal. Political support in the form of project sponsorship, the organisation of competitions or of product-oriented workshops is intended to make the transfer of research findings into specific applications easier. This also helps to enhance Berlin's competitiveness. The increased financial involvement of companies in cooperation projects in addition to the very high level of third-party-financed research of central government and the EU is a further measure that is necessary if this goal is to be achieved. Even today, Berlin is very successful in securing third-party funds from the research framework programmes of the EU, and, with EUR 585 million in funds from the 7th Framework Programme for Research, holds fourth place in Germany.[73]

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[70] For the master plan for the city of industry, Berlin, see (in German): http://www.berlin.de/industriestadt/dokumente/masterplan_industrie_100622_web.pdf.
[71] See: press release (in German) of the Senate Chancellery, Berlin of 10th February 2015 at: http://www.berlin.de/rbmskz/aktuelles/pressemitteilungen/2015/pressemitteilung.263914.php.
[72] See (in German): McKinsey Berlin, Berlin gründet – fünf Initiativen für die Start-up-Metropole *(Berlin – Five Initiatives for the Start-up City)*, Berlin 2013, at http://www.mckinsey.de/2013-10-07/berlin-gruendet-fuenf-initiativen-fuer-die-start-metropole-europas.
[73] Evaluation of the EU office of the BMBF, based on the ECORDA database (status – February 2014)

Electromobility

Intelligent mobility and logistics are areas of key importance for Berlin, so the goal "electromobility as an economic factor" is being broadened in scope. New technologies, particularly with regard to resource efficiency and inter-modality, will continue to be given funding.

Since April 2012 the metropolitan region of Berlin has been one of four showcases for electromobility in Germany, with funding from the federal government and the federal states of Berlin and Brandenburg, and with contributions from industry.[74] The overall integrated scheme, which is being coordinated by the Berlin Agency for Electromobility (eMO)[75]*(Agentur für Elektomobilität)*, comprises 30 core projects with a total volume of up to EUR 85 million, covering all the relevant areas of action in the field of electromobility. What particularly finds expression here is the interplay between transport and energy systems, involving innovative ICT solutions and advanced vehicle technology.

The commitment to electromobility by the Federal States of Berlin and Brandenburg, as well as by companies, the scientific community and professional associations in the region, is strengthened by the "Programme of Action for Electromobility 2020".[76] The programme makes clear the goals of Berlin's electromobility strategy: on the one hand, to improve the quality of life for citizens by consistently electrifying mobility that uses conventional energy sources; on the other hand, to generate value creation for Berlin's economy using electro-mobile systems, components and business processes.

Skilled workers

A smart city is important for skilled workers, who represent a significant economic factor for Berlin. Processes ranging from planning to construction and the installation of technology with the use of new materials, including the networking of these processes, offer great potential for the development and integration of smart solutions. Innovative skilled work also means using the method of "Building Information Modelling". This method involves modelling information in the early planning stages in such a way that subsequent planning processes can be structured more efficiently. Measures for implementing Berlin's smart city strategy, e.g. the funding programme for increasing energy efficiency and for the use of renewable energies in companies, form an important part of the Programme of Action for Skilled Work 2015-2017 *(Aktionsprogramm Handwerk 2015-2017)*.[77]

Locations for the future in Berlin

Locations for the future are sites with development potential in which science-based network structures between business and science already exist locally or are intended to be created, and where these networks promote the innovativeness and competitiveness of the local economy.

In the Federal State of Berlin there is a wide range of sites that have the potential to become locations for the future. The size and profile of these sites and the extent to which they are equipped and developed vary enormously. It is intended to further strengthen Berlin as a location for future

[74] See (in German): http://www.schaufenster-elektromobilitaet.org/de/content/index.html
[75] For further information (in German) about the Berlin Agency for Electromobility (eMO), see: http://www.emo-berlin.de/de/.
[76] See (in German): http://www.e-mo-berlin.de/news/presseinformation-aktionsprogramm-%E2%80%9Eelektromobilitaet-berlin-2020%E2%80%9D-berlin-elektrisiert.
[77] See (in German): Aktionsprogramm Handwerk *(Programme of Action for Skilled Work)* 2015-2017, p. 20: http://www.berlin.de/sen/wirtschaft-und-technologie/branchen/handwerk/artikel.103016.php.

industries and technologies. Such locations for the future, with their attractive spaces that offer technology-based and knowledge-based companies room for ideas and creativity, are an important building block in this strategy. Consequently, the aim is to further raise the profile of locations for the future as places for creating links between business, science and research, and, where necessary, to improve the infrastructure, to optimise the provision of utilities to these areas and to create new opportunities for start-ups and established companies.[78]

Accordingly, when developing these locations for the future, it is intended to extend the digital infrastructure (a data transmission speed of at least 50 Mbit/s in all areas) and to make use of the latest building technologies and innovative mobility and networking solutions. This will ensure the emergence of model projects which will demonstrate what smart Berlin is all about. Even today, high-tech projects are being presented in Adlershof, the Clean Tech Park in Marzahn-Hellersdorf and on the EUREF campus in Schöneberg. With the Urban Tech Republic in Tegel, a further location will be created – in this case, concerned with the subsequent utilisation of the airport – in which Industry 4.0 processes can be tried out and made usable for Berlin.[79]

Smart forums

It is intended in the long-term to position Berlin internationally as a testing and model location for urban technology and innovation in the field of research, development and applications. From 2015 the largest smart city congress in the world, Metropolitan Solutions, will be held in the capital city every year. At this congress, innovations in the areas of mobility, energy supply, water quality and supply through to building technology and urban safety and security will be presented. At the same time symposiums on the innovative development of cities and their infrastructures will take place. Decision-makers in politics will meet innovative developers and companies that offer solutions to urban problems. Other excellent forums in the context of Berlin's smart city strategy are the CKI Conference[80] for students, administrators and companies, the Berlin Business Conference *(Berliner Wirtschaftskonferenz)*, the Smart City Summit, the Asia-Pacific Weeks and the City Architecture Congress.[81]

Internationalisation

International networks are important for the further development of Berlin as a smart city. To learn from one another saves resources, and is both innovative and efficient. In an exchange about successful and less successful projects and strategies, unusual ideas can emerge. Moreover, interesting markets are opening up worldwide for Berlin's smart city products. Even if the starting point varies enormously between cities, they are home to a great many innovative solutions because the pressure to act is especially great in cities. In competition with other regions in Germany and Europe, the German capital can present and market its specific competencies in the field of urban infrastructure.

[78] See (in German): http://berlin.de/sen/wirtschaft/wirtschaft-und-technologie/technologiezentren-zukunftsorte-smart-city/zukunftsorte/artikel.109346.php
[79] See (in German): http://www.berlintxl.de/.
[80] See http://www.cki.tu-berlin.de/konferenz2014/
[81] For the Metropolitan Solutions trade fair, see: http://www.metropolitansolutions.de/. For the other conferences mentioned, see: http://www.berliner-wirtschaftskonferenz.de/; http://www.businesslocationcenter.de/smart-city-summit; http://apwberlin.de/.

International cooperation

Cities, companies and institutes for science and research benefit from the close international collaboration between Berlin and its partner cities, from city networks like Eurocities and Metropolis, bilateral and multilateral projects, delegations of experts and international events.[82]

The close network of embassies and national and international players in the capital city provides excellent general conditions for cooperation. Berlin is a model city for smart city projects. The many international delegations that visit Berlin get to know the intelligent urban solutions in the German capital by viewing projects and buildings and by just being in the city.

The combination of the metropolis Berlin with the Metropolitan Solutions Trade Fair and the events that form part of the Asia-Pacific Weeks is a very attractive one for international delegations. After all, these forums provide opportunities to present innovative ideas, to discuss solutions and to position Berlin's model projects. Moreover, important trips abroad during the past few years by the Governing Mayor and the other members of the Senate, e.g. to China, Japan, South Africa, India, Russia, Turkey and the Gulf region, were devoted to the export of Berlin's solutions in the area of urban infrastructure (mobility, energy, the green economy). It can be seen clearly in Berlin that smart cities are learning systems.

New tools like the interactive Policy Transfer Platform[83], which was developed as part of a Metropolis initiative, make dialogue between experts possible, depict innovative urban development projects from all over the world and enable cities to network.

Political challenges

Digitalisation and structural change

Digitalisation has accelerated the structural change that is being generated by technological developments and globalisation. Small-scale company structures concentrate on niche markets or particular target groups. Local economic structures, e.g. for electricity, the Sharing Economy or exchange forums, are on the increase. People are increasingly becoming involved in producing things themselves, e.g. electricity or additive manufacturing, and are changing from being just consumers to being active players in the economy, so-called prosumers.[84]

Exemplary projects have already been created by private groups or through public funding, for example in the areas of mobility, energy and housing. These projects have a signal effect in addition to their actual purpose, but they are still isolated in the city. The aim is to create analogue and digital networks in Berlin and, by so doing, to integrate residential, industrial and business spaces and to develop the city and its infrastructure within a cooperative matrix.

Industry 4.0

For Berlin to be able to compete as a location for 4th generation industries, it is important that it develops its own profile in this field and that it builds links between the areas of research, science, IT,

[82] See (in German): http://www.berlin.de/rbmskz/internationales/staedtepartnerschaften/.
[83] See (in German): http://stadtentwicklung.berlin.de/internationales_eu/staedte_regionen/de/metropolis/2014.shtml#lernplattform.
[84] "prosumer" is an artificial word made up of consumer and producer.

and industry.[85] As an analysis of potential[86], which was commissioned in 2014 by the Senate Department for Economic Affairs, Technology and Research has shown, a number of companies and research institutes would be suitable as centres of competence. The development of a competence network, the launch of specific application projects and the planned Urban Tech Republic in Tegel will contribute to making the city economically viable for the future. Moreover, the fact that there are major partners here from business and industry shows that Berlin has considerable potential in this area.

Start-up scene

A challenge for a networked Berlin is to establish connections between the traditional economy and drivers of innovation. Even today, numerous major German and also international companies like Deutsche Telekom, Bertelsmann, Springer, ProSiebenSat.1, Otto Group, Daimler, Microsoft, Google, Siemens, BMW and Bombardier Transportation are significant driving forces in the city. To create links between established structures in production and service provision on the one hand and new, unconventional ideas on the other hand promotes innovation. There is great willingness in the start-up scene in Berlin to discuss ideas with partners in industry and to develop new forms of cooperation. Such cooperative ventures are part of what makes up the appeal of Berlin, and they have to be made possible and supported by the city administration.

For this reason, event formats like the CKI Conference[87] or the Smart City Summit for public and private investors and technology suppliers are being developed as part of Berlin's smart city strategy. At these events, companies, research institutes and administrators identify possible projects at the interfaces between the areas of mobility, the economy, housing, administration and industry. On the basis of these possible projects they then develop options for implementation and define areas of responsibility.

Health industry

Berlin and the surrounding region will have to deal with significant demographic challenges. Moreover, further improvements in preventive medicine, health care and follow-up care are necessary. Help is provided here by e-health solutions. The master plan for the health industry identifies a number of measures in this area, like web-based services for prevention and health promotion, technological development aimed at applications and healthcare delivery by networking all players, support for the further inter-linking of out-patient, in-patient and rehabilitative healthcare by deploying e-health technology and the development of innovative e-health products for the regional and global market.

Financing innovation

All over the world new financing models are being tried out, and Berlin can benefit from an analysis of these models. For example, the procurement of venture capital worldwide or crowd-funding models provide additional options that enable innovative entrepreneurs to put their ideas into practice. In Berlin, the first crowd-funding platforms have been created and represent a new format for project co-financing and citizen involvement.[88] For more than 10 years there have been venture capital funds in Berlin (VC Fonds Berlin, VC Fonds Technologie, VC Fonds Kreativwirtschaft) that are financed by

[85] See (in German): http://stadtentwicklung.berlin.de/internationales_eu/staedte_regionen/de/metropolis/2014.shtml#lernplattform.
[86] See (in German): http://berlin.de/industriestadt/dokumente/potenzialanalyse-i4-0-vortragipk.pdf.
[87] See (in German): https://www.cki.tu-berlin.de/konferenz2014/
[88] See, for example: www.crowdfunding-berlin.com

funds from the federal state and from the European Fund for Regional Development (EFRE) with a view to supporting small and medium-sized companies in technology and the creative industries. The investments of these venture capital funds attract a significantly higher level of third-party financing, which creates substantial leverage effects in the financing of innovation. In addition, there is the support tool Pro FIT *(Programm zur Förderung von Forschung, Innovationen und Technologien)*, a programme for supporting research, innovation and technology, which is specially designed for the areas of early-phase financing and project support in research and development (R&D) and which provides subsidies and loans to young, innovative companies in Berlin.

Such financing models can help to create a great deal of dynamism in the start-up development process. However, for the potential here to be realised completely, further political activity is needed in order to make the legal and fiscal framework conditions for crowd-funding and venture capital stable and internationally competitive. This will make Germany more attractive as an investment location for venture capital.

Broadband infrastructure

A precondition for a smart economy is an effective broadband infrastructure for all areas which is based on mobile signals and landlines. This infrastructure is necessary in order to be able to make use of ICT as an economic factor. In order to be able to build a smart technical infrastructure out of the building blocks that are broadband infrastructure, IT security, generic software solutions (databases, search machines, customer management systems, merchandise management systems), cloud computing, the Internet of Things, digital management and control systems or Big Data Analytics, it is necessary to have a cross-segment exchange on the basis of open standards and interfaces. In addition, it is important to provide public WLAN covering as great an area as possible and to make public and private-industry data available in digital form.

Innovation-oriented procurement

The smart city implementation strategy for Berlin involves establishing an innovation-oriented approach in the city administration, particularly in the case of construction and infrastructure projects. It is important to have regard for the best available technology when it comes to measures related to the growth of the city, e.g. the modernisation of existing housing and buildings, the construction of new buildings, or infrastructure projects. The technology platform www.berlin-innovation.de provides some useful guidance on this point. Examples are energy efficiency technology, new materials for new-build or refurbishment projects, security technology when planning new residential estates or traffic management systems in the case of mobility concepts.

Energy efficiency

With regard to energy efficiency technology, it is important to continue to develop the profile of the smart city of Berlin as a model of competence in energy systems. The importance of such systems will not only increase as the city grows: the systems themselves will make a substantial contribution to achieving the energy transition as well.

The energy transition provides Berlin's companies with new opportunities in the future market that is an economy built on the conservation of resources and renewable energy. The development and promotion of the intelligent electricity grid, "Smart Grid", are important technological challenges which Berlin, with its inter-linking of science, research and industry, is especially able to cope with.

I.3.4 Smart mobility

Mobility is a precondition for social participation. The people in a city are dependent on being able to make journeys in their working and private lives with as little disruption as possible. For companies, the reliable and efficient provision of goods and the disposal of industrial waste and recycling materials are of central importance.
Consequently, ensuring mobility has particular significance in Berlin. It means that the largest city in Germany can enjoy spatial and social cohesion and it is the basis for maintaining and strengthening the economic performance of Berlin and the metropolitan region of Berlin.

Increase in traffic – disproportionate in terms of eco-mobility

In the last 25 years Berlin has undergone considerable change, which can also be seen in changes to traffic as well. The overcoming of the division of the city, rising visitor numbers, the rising population, urbanisation, and the expansion of the European internal market are just some of the factors that are having an influence on traffic levels. However, this development has meant an increase in factors that put a strain on the environment and our health, e.g. noise, air pollution and emissions of greenhouse gases, accidents and increased land usage.[89]

An active, integrated transport policy has been able to contribute to breaking the trend of growing motorisation. More and more journeys are completed using public transport, by bicycle or on foot.[90] Moreover, electric motors are on the increase in cars, lorries and buses.

Short distances

It is the task of an intelligent and sustainable transport policy to satisfy the mobility needs of people and companies in the city in a way that is socially just, in line with ecological and economic circumstances and viable for the future. A basis for this is to maintain and strengthen the compact spaces with little traffic that generate short-distance journeys in the poly-centred structure of Berlin.

Urban Development Plan for Transport 2025

The Urban Development Plan for Transport 2025 was developed in a participative process involving all interested parties in Berlin as a kind of timetable for the city's transport policy. It takes into consideration the developments and overall conditions relating to transport and mobility in Berlin and, based on this, it then identifies transport planning and transport policy needs.[91] Important areas are improving accessibility, transport quality, transport safety and the reliability of transport providers. The assessment of the effectiveness of measures that have already been adopted was made – as far as possible – in relation to the financial expense that the implementation of the measure involved. Berlin's smart city strategy is taking up the goals of the Urban Development Plan for Transport 2025 and is trying to support and drive the achievement of these goals through the use of innovative mobility technology.

[89] See (in German): http://www.berlin.de/umwelt/themen/.
[90] For further details on this, see (in German): http://www.stadtentwicklung.berlin.de/verkehr/politik_planung/zahlen_fakten/entwicklung/index.shtml.
[91] See (in German): http://www.stadtentwicklung.berlin.de/verkehr/politik_planung/step_verkehr/download/Stadtentwicklungsplan_Verkehr_Berlin_gesamt.pdf.

More efficient mobility through "sharing economy" offers

Increasing digital networks and the trend to a "sharing economy" can make the most of mobility offers but can also contribute to the avoidance of high levels of traffic. People in Berlin are using new forms of mobility which improve the use of existing vehicles and infrastructure (e.g. car sharing, public bike hire system), which increase safety and which contribute to a reduction in environmental impacts by being resource-efficient (e.g. individualised transport information). For the economy, this means new opportunities for jobs, for adding value and for more efficient, city-compatible transport logistics.

Unified transport concept

A unified transport concept integrates individual, public and business transport with cross-system transport management and with inter-modal transport information. Tests and initial applications can be introduced on a pilot basis in individual areas or across the whole city in order to achieve the best possible combination of the strengths of the various transport providers.

Electromobility and its integration into the electricity grid

With its numerous research and development plans and projects, Berlin is one of the leading locations in Europe for electromobility. The network of the Berlin Agency for Electromobility (eMO) bundles these projects and is the central point of contact in the region for developments in this field. It supports the goal of increasing the share of electromobility in the city. In addition to their positive impact on the environment, noise levels and the climate, electric cars, lorries and buses can make an important contribution in terms of energy by serving as mobile and decentralised storage units. An aim of renewable energy policy is to stabilise the naturally fluctuating inflows of wind and solar energy into the electricity grid and, in so doing, to support the load management capability of the grid. For this reason, it is absolutely necessary for the electrification of means of transport that a supply of energy is generated from renewables and that this load structure is integrated intelligently into the grid. Berlin is also one of the leading locations in Europe when it comes to the area of electromobility with hydrogen and regenerative fuel cells for vehicle fleets and the service station infrastructure. However, this technology is only sustainable if the hydrogen is generated by excess wind energy or excess solar power.

Even today, electromobility forms part of Berlin's systematic approach to achieving sustainable mobility. The necessary networking of vehicles, transport systems and energy has to be integrated seamlessly into the wider mobility and energy requirements of a smart city. The mobility concepts that have already been initiated, like the mobility platform and map for combining public and individual transport, the stations of the future and smart grid storage units mean that electromobility is being integrated more fully into the areas of transport and energy. It is intended that electromobility should achieve greater industrial added value in Berlin, expand technical know-how, create new jobs and achieve a higher quality of life in the city.[92] The new project of eMO, "Smart e-mobility", is pursuing these goals. It is intended that Berlin's reputation as a laboratory and good example in the area of smart e-mobility should be further extended as part of Smart City Berlin. This will be achieved by giving targeted support to local companies and R&D facilities, by developing and testing innovative projects and products and by holding on to or attracting (international) companies and talents to Berlin.

[92] See (in German): http://www.berlin.de/rbmskzl/aktuelles/pressemitteilungen/2011/pressemitteilung.53147.php.

Political challenges

Innovation and securing existing infrastructure

A decisive factor in the implementation of ambitious, innovative approaches is the development of public spending or of the investment and expenditure capacity of the state. In all of this, the priority is to secure the existing infrastructure. Against the background of the continuing strain on public finances in the city, this is a matter of economic common sense. To attach particular importance to highly efficient measures when making necessary investments in the maintenance and modernisation of the road and rail infrastructure, and to strive for synergy effects is the expression of a modern transport policy and a financial necessity.

The structure of the population and the working population is undergoing massive changes. So, it is necessary to shape transport policy in order to cope both today and in the future with the challenges that result from the changes in the structure of the population and the economic development of Berlin and the surrounding region.

Design and organisation of transport processes

By designing and organising transport processes, it is intended to increase the quality of life in the city and that of the environment as well. This is achieved, for example, by reorganising road space in favour of eco-mobility (transport safety programme for Berlin, pedestrian and cycling strategy) and by using the potential of alternative motors and fuels. In this way, less strain is put on the environment and the local surroundings, and transport safety is increased.[93]

Traffic management and safety

Innovations in the ICT sector are driving new solutions in traffic control and management. These solutions will in future be complemented by an improvement in active safety (accident avoidance). The systematic introduction of “cooperative systems” in which vehicles communicate with each other and with the infrastructure and in which driving can even be automated promises significant improvements in road safety, above all in the complex traffic systems of cities. The trend towards the automation of motorised vehicles is only possible because of high-performance ICT and sensor technology, but it makes new demands on IT security, the stability of technical systems and the design of the interaction between human beings and machines. In this context, measures like the design of roads and the areas around them, the lighting of public spaces and the availability (multi-lingual) sources of information also play an important role. Furthermore, campaigns for greater consideration on the roads, traffic monitoring aimed at putting more pressure on road users to respect the rules of the road, and the pursuit of infringements of these rules all support efforts to improve the safety of all road-users.

Independent mobility

The possibility of being and staying mobile independently is a key precondition for participation and quality of life – especially for people with mobility restrictions. Barriers in buildings, social barriers and barriers created by a lack of information limit participation – a situation that requires action, particularly in Berlin, which is undergoing demographic change. This also requires that housing and mobility, as well as communication and participation, are viewed holistically. In addition to structural

[93] See (in German): http://www.berlin.de/rbmskzl/aktuelles/pressemitteilungen/2014/pressemitteilung.60753.php.

improvements (e.g. the installation of lifts in the public transport system), intelligent solutions using ICT can also make a contribution (individualised route-planning, taking into consideration, for example, the availability of lifts for wheelchair-users).[94] In the context of Ambient Assisted Living, it is possible, for example, to use innovative products and services which enable people with mobility restrictions to be independently mobile for longer.

Mobility and resource efficiency

With intelligent transport planning, Berlin contributes to improved energy and resource efficiency in the transport of people and goods and, thereby, to the avoidance and reduction of greenhouse emissions. An advantage for Berlin is the trend to more pedestrians and to a greater use of public transport and of the bicycle. Two thirds of journeys made by people across the area of the entire city are completed in this way. By making further improvements in the infrastructure (e.g. extending the network of cycle paths[95]), by launching model projects (e.g. pedestrian priority zones[96]), by promoting inter-modality[97] and by creating links between public transport and car sharing schemes, it is possible to shift the use of different modes of transport towards greater eco-mobility. The levels of noise and the emissions of NO_x[98] and CO_2 caused by traffic, as well as the emission of fine particles in city areas are all reduced by these measures. The use of innovative motor technology, e.g. electric motors, hydrogen and regenerative fuel cells, but also the use of biogas in the transport of people and goods can also make important contributions to the protection of the climate, of health and of the environment in city areas.

Logistics in the city

Modern urban logistics have to react intelligently to changes in the volume and structure of deliveries. In so doing, they implement, as far as possible, solutions which are compatible with climate protection[99] and which observe the applicable limits in the area of air pollution (e.g. NO_2, PM10) or traffic noise. This means that smart solutions in urban logistics are not only good for the global climate, but they also reduce the number of people who are affected locally by negative impacts. Approaches are, for example, new distribution concepts that make sensible use of all transport providers and the (tri-modal) distribution centres in the city, the use of alternative motors or, on the last mile of the journey, the use of delivery bicycles. Whether it is a matter of these “small solutions” or the problem of large-scale goods transportation, it is important to find approaches that make sensible use of the existing infrastructure, that keep and promote economic activity and industrial manufacturing in the city area and that, at the same time, take into consideration the general conditions that constrain a densely populated and built-up city in Europe.

The strategic approaches and specific measures of the City Development Plan for Transport have been adapted and also widened in scope as part of the Smart City strategy.

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[94] See (in German): http://www.bvg.de/de/Service/Service-fuer-unterwegs/Mobilitaetshilfen; for examples from other cities, see http://library.its.berkeley.edu/taxonomy/term/80.
[95] For further details (in German), see: http://www.stadtentwicklung.berlin.de/verkehr/mobil/fahrrad/radrouten/download/ausbau_fahrradroutennetz.pdf.
[96] For further details (in German), see: http://www.stadtentwicklung.berlin.de/verkehr/politik_planung/fussgaenger/strategie/de/begegnungszonen.shtml.
[97] Inter-modality describes the distribution of road users across various modes of transport.
[98] An abbreviation for nitrogen oxide and nitrous oxide as well nitrogen dioxide, which is particularly harmful to health
[99] See, for example, the aim in the EU White Paper on Transport of “urban logistics that are essentially CO_2-free in major city centres by 2030” at: http://eur-lex.europa.eu/LexUriServ.do?uri=COM:2011:0144:FIN:DE:PDF.

I.3.5 Smart infrastructures

Intelligently designed utilities infrastructures form the backbone of Smart City Berlin. The combination of and greater interplay between different infrastructure elements make intelligent, cross-system solutions possible. Berlin is in the process of putting this into practice. It will take into consideration the potential for smart energy infrastructures in all necessary areas of planning and policy and, in so doing, will develop in the next few years to become the leading city in the development of such infrastructures. At the same time, modern supply and disposal networks and infrastructures always have to reconcile the greatest possible safety with economic efficiency, and to strike a balance between the greatest resource efficiency and being environmentally compatible and consumer-friendly, particularly considering the wish of many people for convenience. In addition to networking its utilities functions, Smart City Berlin will guarantee a high level of network stability and the safety of its inhabitants.

Development of sustainable systems

In the course of developing smart solutions, a transformation of the structures for supplying electricity, gas and hot water, and for the supply of water and the disposal of waste water, and the disposal of household refuse is necessary. These systems have to become sustainable, and recycling systems have to emerge. In this way, Berlin can become carbon-neutral by 2050[100]. It is a matter of harmonising the built environment of the city with its network infrastructures - with their focus on a sustainable and carbon-neutral city - and optimising these infrastructures both economically and ecologically. In order to regulate the overall system, it is necessary to define interfaces for the interplay of individual infrastructure elements.

Recycling management

Smart supply and disposal means making the transition from a throw-away system to a resource-optimised recycling system and recycling society. A whole range of systems for the supply of resources and the disposal of waste are involved here. With the help of innovative approaches and new urban technologies in recycling (waste utilisation), upcycling (the creative reuse of waste) and urban mining (the reclaiming of compounds from waste), these systems can be developed for the purpose of reclaiming energy, hot water or raw materials.

Sustainable and climate-compatible energy supply

One of the challenges for cities is the question as to a sustainable and climate-compatible supply, distribution and use of energy. Berlin is on the way to achieving energy production that is socially responsible, ecological and innovative and that understands intelligent, smart infrastructures to be an important element in this process. This is why, in the area of basic utilities, the Berlin Senate has set itself the goal of exerting significantly greater influence on the operation and development of energy supply networks – specifically the electricity and gas distribution networks.[101] Furthermore, it is intended that the public utilities company that was set up in the summer of 2014 will make a contribution to climate-friendly energy supply as part of its remit to generate and sell renewable energy. Finally, the Berlin Energy and Climate Protection Programme is currently being compiled in a

[100] On the basis of the feasibility study “Carbon-neutral Berlin 2050”, the intention is that the Berlin Energy and Climate Protection Programme should be used to create a central and holistic tool for achieving the energy and climate goals of the city. For background on this, see (in German): http://www.stadtentwicklung.berlin.de/umwelt/klimaschutz/bek_berlin/index.shtml.

[101] See (in German): http://www.berlin.derbmskz/regierender-buergermeister/senat/richtlinien-der-politik/.

broad consultation process. This programme will determine specific measures and implementation strategies for achieving a sustainable energy supply that is also on the basis of renewable energies. These efforts are supported by a not inconsiderable section of Berlin's population.

Uncoupling higher performance and higher energy consumption in technology

As volumes of data, and also the speed and storage capacity of computers grow, so too does the consumption of energy in technology. Today, ICT devices and applications consume 10% of the energy we produce. For this reason, one of the tasks to be performed in the course of digitalisation (Green IT[102]) is the uncoupling of higher performance and higher energy consumption. At the same time, new business models and distribution channels are indirectly causing increases in energy consumption, e.g. through the growing transactions for goods that are increasingly ordered online.

Political challenges

Smart grids

The energy supply of the future needs an intelligent grid that links up energy consumers and producers with the help of digital information technology and that continuously evaluates information about energy consumption habits and energy availability in order to be able to react automatically to fluctuations in energy supply or consumption. In all of this, the security of personal user data must always be taken into consideration. The development of smart grids and virtual power stations is necessary to meet the requirements of having a stable grid and a secure supply whilst at the same time supporting the inclusion of the fluctuating production of decentralised, renewable energies, of energy storage devices and combined heat and power plants.

Anyone who uses energy at home should be able to modify their consumer behaviour. However, this requires improved public education, transparent information about peaks in consumption and production, and the opportunity for consumers to understand their own consumption patterns. And it also requires innovative services, for example tariff offers that support variable electricity consumption. Added to this is the need to take into consideration "new electricity consumers" on the basis of increases in electrification. Energy and transport systems should be regarded to a greater extent than has been the case to date as a single entity, for example for the development and operation of the necessary charging infrastructure in both the public and the private sphere.

Energy goals of the federal government and the Federal State of Berlin

The city of the future will achieve a high level of energy and resource efficiency by using new technologies. Through the efficient use of energy, the streamlined conversion of energy and a supply that is increasingly based on renewable energies, Berlin will make a contribution to achieving the energy goals of the federal government and its own climate protection goals as well.

Efficient heat generation and use

Heat is the form of energy that is used most in cities. So, the greatest energy-saving potential is to be found here as well. This potential is already being realised in Berlin in the form of heat efficiency measures in buildings, measures affecting the supply infrastructures of entire neighbourhoods, and

[102] This term refers to the environment-friendly and resource-efficient use of ICT. See on this point (in German): http://www.bitkom.org/de/themen/51049.aspx.

the increasingly decentralised and local generation of electricity and heat. The heating supply network of the future will expand these measures and, in particular, strengthen the use of renewable energies and other technical options, e.g. combined heat and power plants or the use of residual heat.

The existing infrastructures already meet the right requirements for storing and continuing to use the so-called surplus electricity from renewable sources. With the involvement of tenants, e.g. in the form of tenant associations, of property owners and suppliers (utilities companies and industrial suppliers of residual heat), it is possible to use smart systems to achieve new forms of heat supply that bring economic benefits to all the parties involved. The basis for combining infrastructures is innovative measuring and control technology and smart networking systems using ICT structures.

Sustainable water management

Berlin is not just modernising its water and waste water infrastructure. There are also discussions about innovative approaches (the collection of rain water, the reuse of grey water, the recovery of energy from cooling water, dealing with sewage sludge) with a view to achieving smart utilities provision in the water industry. Sustainable water management attaches importance to the ecological management of resources and includes topics like energy, urban development, the planning of open spaces, road building, ICT and education in a dialogue about water.

Pilot projects and breaking new ground

In addition to maintaining and ensuring the technical reliability of what has proved its worth for decades, it is also important to aim to achieve in the long term an upgrade of the central infrastructure systems in the city. Particularly with a view to the inter-dependence of the areas of water and energy, as well as energy and transport, it is necessary to break new ground in selected areas of the city and to try out decentralised solutions in pilot projects. Local approaches can serve as a model for the problems and challenges that have to be dealt with on an international scale.

I.3.6 Public safety

The term public safety in Smart City Berlin includes both protection against intentionally caused damage and protection against natural disasters. The new information and communication technologies and the megatrend towards digitalisation offer chances, but also risks. These risks have to be met with new security concepts.

New opportunities for the involvement of the public

Public safety is one of the key responsibilities that are particularly important to the Berlin Senate. However, safety is always a challenge for society as well, and this challenge cannot be met solely in the form of the security responsibilities exercised by the authorities and other organisations. The entire process has to enjoy the active support of the local population. Smart City Berlin opens up new forms of involvement that will help to achieve a qualitatively new (smart) safety culture for the people of the city. The possibilities range from active, personal involvement, warnings about severe weather and natural disasters, e.g. with the help of the “Internetwache Polizei Berlin”[103] *(a web-based police station)* or the warning app “Katwarn”[104] *(an app providing warnings about severe weather conditions)* which also gives advice about safe behaviour in severe weather conditions, to the use of street

[103] See (in German): https://www.internetwache-polizei-berlin.de/.
[104] See http://193.174.152.169/.

furniture and lighting as a form of crime prevention, and to a new understanding of informed cooperation between the public and the authorities.

In all of this, it is important to remember that technology is and remains an aid and is not a substitute for the exercise of judgement. For example, automatic analysis systems for evaluating cameras in public spaces can provide valuable indications of what to focus on and where action is needed, but the decision on what action to take is not made by technology.

Data infrastructure, smart grids and cyber security

The availability of an Internet infrastructure in all areas of the city is one of the preconditions of having a Smart City Berlin. Key security aspects are the integrity and authenticity of data, and the availability of data even at times of crisis. These aspects have to be considered from the perspective of the public, providers, the authorities and also organisations entrusted with security responsibilities. A dysfunctional data infrastructure that is prone to problems can cause differing degrees of disruption to other areas of life, for example an impairment of the individual's sense of personal safety, or disruption to networked devices in the home or to the connection with the electricity supply (as a consumer, producer and/or storage device).

All of these aspects mentioned above are a precondition for the core business, i.e. the responsibility to supply, of the energy suppliers. This is all the more the case because the remote control of decentralised units, e.g. electricity sub-stations, pump stations, is already state-of-the-art technology today. Whereas suppliers used their own communication systems with separate hardware in the past, today it is mostly public communication systems that are used. This is economically beneficial, but makes the suppliers susceptible to cyber-attacks.

The disruption-free operation of the electricity grid represents even today an enormous challenge of technical management and control. The increase in volatile energy sources that cannot cover primary load capacity could lead to the fact that control over the higher levels of the grid (the high voltage level) is no longer sufficient to maintain network stability. Precisely because electricity supply is the Achilles heel of every modern society, particular attention has to be paid to this problem. Without correspondingly integrated security and data protection concepts at all levels, a smart grid is exposed to significant risks in terms of acceptance and operational management.

Political challenges

Networks and systemic risks

In Berlin, too, the dependence of a modern, urban society on its infrastructures is growing. Power failures for period of several hours are enough to fundamentally call into question the functionality of existing systems. Cyber-attacks are on the increase all over the world. The growing use of networks – for sensitive areas too – which is implied by the technical concept of the smart city increases the vulnerability of, in particular, critical processes and structures. Accordingly, the protection of critical infrastructures is a central challenge which Smart City Berlin must meet effectively. To deal with this challenge successfully is the basis for all further steps in the smart city process.

For this reason, particular demands are made of the systems and applied concepts of Smart City Berlin for guaranteeing safety in the urban context. Networks mean an increase in mutual dependencies. If individual elements fail, neighbouring elements must have sufficient reserves to be able to absorb the given demand/load. This means that in Smart City Berlin only those solutions can be successful that contribute to the safe and robust supply of the city and its people with information,

services and resources. These solutions have to be able to cope with disruptions of whatever kind, to regenerate themselves after a possible serious incident and to adapt themselves to a changing environment and changing conditions of deployment.[105]

For supply infrastructures and public safety in Berlin, this means in practice that the relevant requirements have to be taken into consideration in the early planning phases. In addition to the provision of water supply and waste water disposal systems, electricity, heat and refuse disposal, other key aspects like ease of access for emergency services, crime prevention, disaster control and fire safety, as well as barrier-free accessibility and the impact of demographic change, will have to be given much greater consideration in the city's planning permission procedures.

The smart city as a safe city

Smart City Berlin has to be a safe city in order to limit the vulnerability (of the entire system and not just a single element or node) which can arise as a result of increasingly integrated networks. However, the city can only fulfil this requirement if the risks at every logical and organisational level of the smart city architecture are taken into consideration as well, and if corresponding security concepts are designed and then applied. For example, firewalls have to be erected in order to avoid the risk of infection spreading to the entire system, or partial shutdowns have to be possible that do not impair the operational capability of other parts of the system. An IT security system that is properly staffed and equipped to the highest possible standard has to be something that is a matter of course and the starting point for any smart city project. Only on this basis can the desired horizontal inter-linking of various part-systems (e.g. mobility and energy in the context of Vehicle2grid[106]) represent added value both for the overall economy and for the individual. Smart City Berlin must put in place the conditions that are a precondition for its success.

[105] These efforts are given decisive support by the bill on increasing the security of IT systems *(Erhöhung der Sicherheit informationstechnischer Systeme)*, which was presented by the federal government on 17th December 2014. Denial-of service attacks or other cyber-attacks must in future be reported to the authorities by those affected.

[106] Vehicle2grid refers to the intelligent storage and discharge of electricity, whereby electric cars function as electricity storage units and, when they are not in use, not only charge electricity but discharge it as well.

II. Ways of Implementing the Smart City Strategy Berlin

II.1 The Next Steps

The continuous transformation of Berlin and further developments in technologies will mean that the Smart City Strategy will constantly have to address the latest issues and set itself new objectives. Berlin's Smart City Strategy is dynamic and both a living and learning process in which information is prepared and shared transparently between actors, and the relevant conclusions drawn. The planning and implementation activities are adapted to changing parameters. The goal is to create an on-going dialogue in the course of which urban projects are developed, carried out and evaluated.

By the middle of 2015, an implementation plan will have been worked out in collaboration with representatives from the worlds of business and research which sets out the projects of Smart City Berlin, including the relevant milestones and responsibilities and the partners who are to be involved. The Smart Cities Unit at Berlin Partner für Wirtschaft und Technologie GmbH (Berlin Partners for Business and Technology) is the central point of contact for companies and science and research institutes and is, therefore, the interface to business-related actors and the first port of call particularly with respect to funding plans and the initiation of individual, business-oriented Smart City projects.

As a next step towards making Smart City Berlin a reality, in May 2015, the Berlin Senate will be taking part in the Smart City Call of the European Commission (SCC 2015-1) and submitting a tender as part of the Federal Ministry for Economic Affairs and Energy's "Intelligent Energy Showcase".

II.2 Public Relations and Marketing

Communication strategy

It is the citizens who decide whether innovative technologies can be successfully deployed in a city. They need to be convinced of the specific benefit that new products and services will bring to the common good. This requires a long-term communication strategy which is based on credibility and which makes the meaningfulness of the Smart City approach clear to the general public. Smart City Berlin must be given a real profile. To achieve this, Berlin is making use of modern communication media to inform and involve the public. All current activities, events, outcomes and agendas are published.[107]

National and international experts

As well as among the city's population, it is equally important to raise awareness of Smart City Berlin and inspire enthusiasm for Berlin amongst experts at a national and international level. The opportunity to show off Berlin's innovations, hold roundtable discussions with global experts and present model projects will arise when Berlin hosts the international Metropolitan Solutions Congress from 2015. Further important national and international events such as the Smart Cities World Expo Barcelona, the Metropolis World Congress or the Berlin Economic Forum will guarantee national and international awareness. The Smart City theme was incorporated into the Capital City Marketing division of Berlin Partner für Wirtschaft und Technologie GmbH and will be integrated into current and future communication and marketing campaigns.[108]

[107] See (in German): http://www.sei.berlin.de/presse/digital-capital.
[108] See (in German): http://www.berlin-partner.de/standort-berlin/smart-city-berlin/.

International networks

An exchange with other cities and regions is of particular significance because internationally it is important to learn from each other and pave the way for Berlin's Smart City applications in other markets. Berlin aims to use its pioneering role in urban technologies to become more competitive, to increase its economic strength and to create new jobs. Berlin's city partnerships, its membership of relevant, leading networks such as Eurocities, Metropolis, the C40 Climate Leadership Group, the Oder-Partnership and the EU's Committee of the Regions play a key role in this. Berlin is keen to find especially smart projects and products and enter into cooperative partnerships with especially innovative regions around the world.[109]

II.3 Smart City Partners

The further design of Smart City Berlin is a task of city-wide significance. It can only succeed if the actors from the worlds of politics, business, science, administration and urban society work together at an inter-disciplinary and inter-departmental level and bring their own respective core competences and resources into the process.

Policy Board

The Policy Board is Smart City's most senior committee and is responsible for laying down policy guidelines. The Policy Board has the following tasks:

- Leadership
- Priority-setting
- Integration of the Smart City Berlin concept into adjoining policy areas
- Networking and promoting of the Berlin location
- Promotion of cooperative partnerships with other urban centres

Smart City Berlin Service Unit at Berlin Partners

Smart Cities is a cross-sector, inter-disciplinary matter which is brought together at Berlin Partners in its own dedicated Smart City Unit. This unit is the central point of contact for actors from the worlds of business, science and research and the first port of call particularly as regards applications for funding from Berlin actors. Berlin aims to develop into an innovation centre for smart technologies in Europe.

Smart City Berlin Network

The Smart City Berlin Network has been set up to stimulate pilot projects in Berlin and to make Berlin a showcase for Smart City applications. It is coordinated by Berlin Partners and represents a cross-section of companies, science and research institutes, relevant networks, start-ups and financial institutions. It is open to new members. [110]

The network is committed to helping Berlin to become a place of the future for citizens, businesspeople and administrators alike, who come together in a new, intelligent urban culture to

[109] See: http://www.eurocities.eu/; http://www.metropolis.org/; http://www.c40.org/; http://www.oder-partnerschaft.eu/; http://www.europa.eu/about-eu/institutions-bodies/cor/index_de.htm.
[110] See (in German): http://www.berlin-partner.de/standort-berlin/smart-city-berlin/netzwerk-smart-city-berlin/.

make the city into an innovation leader at a national and international level. The network is an ambassador and discussion forum for policy and helps to drive development forward. This includes developing and implementing project ideas by exploiting the inter-disciplinary composition of the network. The other strategic partners in the city are state-owned enterprises, commercial and industrial chambers, societies, unions and associations. They are important in reaching a wider audience and can increase their members' awareness of the Smart City concept and win them over to it.

The most important partners are, however, the Berliners themselves because the overriding goal of Smart City Berlin is to further increase the quality of life of the Berlin population and the liveability of their city. Therefore, appropriate possibilities for participation are being used to invite Berliners to get involved and suggest their own ideas for the further design of the Smart City.

Appendix

Strategy Development Methodology

A. Smart City interdepartmental working group

The Smart City Strategy Berlin was developed inter-departmentally and with a high level of public participation.

An initial strategy paper was drafted by the inter-ministerial working group Smart City, consisting of five administration departments under the leadership of the Senate Administration for Urban Development and the Environment on the basis of the report on the cornerstones for Smart City Berlin. This included a definition of what the Berlin state understood by Smart City Berlin, which primary and secondary strategic goals it should pursue, which areas of action and inter-disciplinary issues were to be considered from the point of view of the Federal State of Berlin, and which structures were necessary to make Berlin one of the smartest cities in Europe.

B. Workshops, Expert Consultations, Interviews

To support the strategic process of Smart City, a series of workshops and round-table discussions involving experts were held in autumn 2014. In addition, the know-how of various urban society groups was also brought in through a series of expert interviews conducted both in person and in writing. The wide-ranging expertise and creative and strategic thinking of these many actors as well as the deep commitment of everyone involved made for fruitful discussions of the themes facing Berlin in the future.

The results of this information process and the suggestions made by participants have been incorporated into the present Smart City Strategy Berlin. The participation process for urban society will be launched in a range of further events. The presentation of the strategy and the consideration of concrete suggestions from the general public will contribute to the acceptance and design of the implementation process and to the creation of Smart City Berlin.

C. Experts

We would like to thank all those who took part in expert consultations, workshops and interviews:

Expert consultations on business and mobility

Dr Edgar **Göll**, Head of Research in Future Studies and Participation, Institute for Future Studies and Technology Assessment
Susanne **Henckel**, Managing Director, VBB Transport Federation Berlin-Brandenburg
Gernot **Lobenberg**, Director, Berlin Agency for Electromobility eMO, Berlin Partner für Wirtschaft und Technologie GmbH
Silke **Richter**, Sector Coordinator for Industry, Berlin Chamber of Commerce and Industry
Manfred **Schubert**, Managing Director, Berlin State Working Group for Nature Conservation

Expert consultations on housing and mobility

Dr Philipp **Bouteiller**, Managing Director, Tegel Projekt GmbH
Ulrich **Frieser**, Head of Development Program e-Mobility, Vattenfall GmbH
Dr Jochen **Hucke**, Berlin Senate Administration for Urban Development and the Environment

Ulrich **Jursch**, Head of Central Inventory Management, degewo Aktiengesellschaft
Birgit **Kahland**, Project Leader, City Partnership, VE Wärme AG
Tim **Lange**, Chairman, casenio AG
Prof. Dr Elke **Pahl-Weber**, Head of Faculty, Institute for Urban and Regional Planning, Technical University Berlin

Expert consultations on housing and business

Min-Ku **Chung**, Head of Project Communication for Power Plant New-Builds, Vattenfall Europe Wärme AG
Dr Johannes **Danckert**, Managing Director, Vivantes – Netzwerk für Gesundheit GmbH
Anja **Gothan**, Head of Marketing, Berlin/Brandenburg Regional Association of the Johanniter-Unfall-Hilfe e. V. (St. John's Accident Assistance)
Jochen **Kellermann**, GESOBAU AG
Dr Martin **Peters**, Environmental Consultant, Berlin Chamber of Crafts and Trades
Stefan **Preidt**, Head of Sales and Business Management, VE Wärme AG

Workshop on basic public services and public safety

Wolfgang **Both**, Berlin Senate Administration for Economic Affairs, Technology and Research
Albrecht **Broemme**, President, Federal Agency for Technical Relief
Lilly **Creed,** State-owned enterprise, Berlin Energie
Regina **Gnirß**, Head of Research and Development, Berlin Water Authority
Wilfried **Gräfling**, Director of the Berlin State Fire Service
Britta **Havemann**, Berlin Senate Administration for Economic Affairs, Technology and Research
Christian **Herzog**, Head of Division, Digital Business/Service Industries, Berlin Partner für Wirtschaft und Technologie GmbH
Lorenz **Kummert**, Berlin Senate Administration for Urban Development and the Environment
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Friederike **Rohde**, Research Assistant, Institute for Sustainability
Thomas **Schneider**, Stromnetz Berlin GmbH
Rainer **Tepasse**, Managing Director, Degas – ATD (German Association for Plant Safety and Project Management)
Wibke **Werner**, Member of the Board of Management, Berliner Mieterverein e. V. Landesverband Berlin im Deutschen Mieterbund (Berlin Tenants' Association, Berlin Regional Branch of the German Tenants' Association)
Jürgen **Wituschek**, Berlin Senate Administration for Economic Affairs, Technology and Research
Sönke **Zornig**, Bayer Pharma AG
Klaus **Zuch**, Departmental Head of Public Safety, Berlin Senate Administration for Internal Affairs and Sport

Workshop on administration and urban society

Katharina **Bober**, Berlin Senate Administration for Urban Development and the Environment
Rainer **Bohne**, Managing Director, SRL – Vereinigung für Stadt-, Regional- und Landesplanung e. V. (Association for Town, Regional and State Planning)
Britta **Havemann**, Industry Affairs/Smart City Berlin, Berlin Senate Administration for Economic Affairs, Technology and Research
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Dr Thomas Alexander **Letz**, Head of Policy and Planning, Berlin Senate Chancellery
Karl-Heinz **Löper**
Dr Pablo **Mentzinis**, Head of Division, Public Sector, BITKOM e. V.

Dirk **Meyer-Claassen**, Special Advisor, state-wide e-government, Berlin Senate Administration for Internal Affairs and Sport
Peter **Siebert**, Berlin Partner für Wirtschaft und Technologie GmbH
Dirk **Stocksmeier**, Executive Chairman,]init[Aktiengesellschaft für digitale Kommunikation
Christian **Vogel**, Head of the Innovations Department, Wall Aktiengesellschaft
Holger **Vogel**, Managing Director, IQ wireless GmbH

Interviews conducted in person

Prof. Dr-Ing. Christine **Ahrend**, First Vice-President, Technical University Berlin
State Secretary Guido **Beermann**, Berlin Senate Administration for Economic Affairs, Technology and Research
Jochen **Brückmann**, Head of Division, Infrastructure and Urban Development, Berlin Chamber of Commerce and Industry
Andreas **Buchwald**, Trade Union Secretary, IG Metall
Andreas **Dannebaum**, Berlin Police
Udo **Dittfurth**, Executive Director of the planning association Kohlbrenner eG
Anne-Caroline **Erbstößer**, Research Assistant, Technology Foundation
Permanent Secretary Christian **Gaebler**, Transport and Environment, Berlin Senate Administration for Urban Development and the Environment
Prof. Dr Dirk **Heinrichs**, German Centre for Aeronautics and Space Research
Norman **Heise**, Executive Chairman, Berlin State Parental Committee of the Berlin Senate Administration for Education, Youth and Science
Tilmann **Heuser**, Managing Director, BUND (Friends of the Earth Germany)
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Prof Dr Andreas **Knie**, Managing Director, InnoZ – Innovation Centre for Mobility and Societal Change
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Norbert **Kopp**, District Mayor of Steglitz-Zehlendorf, Steglitz-Zehlendorf District Office, Berlin
Permanent Secretary Bernd **Krömer**, Internal Affairs, Berlin Senate Administration for Internal Affairs and Sport
Dr Hans-Ulrich **Litzner**, Spokesman, Working Group “Building, Housing and Living Environment”, Berlin State Senior Citizens’ Advisory Board
Martin **Mahn**, Managing Director, Humboldt-Innovation GmbH
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Hartmut **Mertens**, Investitionsbank Berlin
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Dr Sigrid Evelyn **Nikutta**, CEO of the Berliner Verkehrsbetriebe (Berlin Transport Authority)
Maxim **Nohroudi**, Managing Director, Waymate
Permanent Secretary Tim **Renner**, Berlin Senate Chancellery of the Governing Mayor of Berlin – Cultural Affairs
Burkhard **Rhein**, Deputy Departmental Head, Economic Policy, Federation of Business Associations in Berlin and Brandenburg
Simon **Schäfer**, CEO, Factory
Prof. Dr Jochen **Schiller**, Head, Working Group “Technical Informatics”, Free University Berlin
Dr Jürgen **Schneider**, State Commissioner for People with Disabilities
Joachim **Schonowski**, Deutsche Telekom AG Laboratories
Axel **Schultz**, Head, Region Ost, Building Technologies Division, Siemens AG
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Christian **Vogel**, Head of Innovation, Wall Aktiengesellschaft
Petra **Waram**, Berlin Police
Patrick **Wenz**, Solution Sales Manager Public, IBM Deutschland GmbH
Gabriel **Wetzel**, Bosch Software Innovations GmbH
Klaus **Zuch**, Head of Department for Public Safety and Public Order, Berlin Senate Administration for Internal Affairs and Sport

Interviews conducted in writing

Dr Alexander **Dix**, Berlin Commissioner for Data Protection and Freedom of Information
Dr Mathis **Gruber**, DexLeChem GmbH c/o CoLaborator
Dr Jörg **Lipper**, BBU Berlin-Brandenburg Federation of Housing Associations
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Günther **Ohland**, Executive Chairman, SmartHome Initiative Deutschland e.V.
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