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Smart community infrastructures — Review of existing activities relevant to metrics

Infrastructures communautaires intelligentes — Revue des activités existantes applicables à la métrique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 268/SC 1, *Sustainable development in communities*.

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Introduction

Community infrastructures – energy, water, transportation, waste, information and communications technology (ICT), etc. – support the operations and activities of communities and have a significant impact on economic and social development. They are a means towards ensuring the delivery of goods and services that promote economic prosperity and growth, and contribute to the quality of life. Insufficient, inadequate community infrastructures can create obstacles to achieving a change in the distribution of relative incomes through the growth process to favour the poor (pro-poor growth). Furthermore, the demand for community infrastructures, as scalable and integrable products, will continue to expand significantly in the decades ahead, driven by major factors of change, such as population growth and urbanization.

It has long been argued that human activity is surpassing the capacity of the Earth. Community infrastructures developing in line with global population growth sometimes have less desirable consequences to sustainability. This is because the imperative for further infrastructure (i.e. accelerated population growth) conflicts with a path to sustainability. As a result, there is a need for community infrastructures to play a role in sustainable development to balance economic, social and environmental aspects and to meet the needs of communities more effectively and efficiently.

This indicates an urgent need to develop and implement more effective and efficient technological solutions in terms of environmental impact, economic efficiency and quality of life. Such solutions are often referred to as "smart." A number of plans and projects to build "smart cities" are currently underway. In addition, there are increases in international trade for community infrastructure products and services.

In planning and procuring community infrastructures to contribute to sustainable development, a wide range of evaluation concepts and metrics are available or under consideration. Some of these evaluation methods are not publicly available. Though they are helpful, their complexity, redundancy and lack of transparency make it difficult for public and private buyers (e.g. governments, city planners, investors, operators of community infrastructures) to evaluate multiple proposals or plans consistently and fairly, thereby increasing the burden of decision making. Different concepts and metrics are creating uncertainty in which infrastructure vendors have difficulty in developing new technology without an appropriate International Standard.

The purpose of standardization in the field of smart community infrastructures is to promote the international trade of community infrastructure products and services and disseminate information about leading-edge technologies to improve sustainability in communities by establishing harmonized product standards to evaluate their technical performances contributing to sustainability of communities. The users and associated benefits of these metrics are illustrated in Figure 1.

In this Technical Report, the concept of smartness is addressed in terms of performance relevant to technologically implementable solutions, in accordance with sustainable development and resilience of communities as defined in ISO/TC 268.

This Technical Report reviews existing activities relevant to metrics for "smart" community infrastructures and provides directions for further standardization. This Technical Report discusses metrics which is designed to help buyers to evaluate technical performances of community infrastructure products and services for procurement and, through the development of future technical standards in this area, may additionally be used in real-time monitoring for the operation of an existing community infrastructure. The users and associated benefits of these metrics are illustrated in Figure 1.

It is expected that this Technical Report will be useful to the following individuals/groups:

— national and local governments;

— regional organizations;

— community planners;

— developers;

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— community infrastructure operators (e.g in the field of energy, water, waste, transportation, ICT);

— community infrastructure vendors (e.g. constructors, engineering firms, system integrators or component manufacturers);

— non-governmental organizations (e.g.. consumer groups).

This Technical Report uses a model of the community functions in Table 1 and reviews activities relevant to metrics for community infrastructures.

Table 1 — Layers of a community

Layers	Examples of functions
Community services	Education, healthcare, safety and security, tourism, etc.
Community facilities	Residences, commercial buildings, office buildings, factories, hospitals, schools, recreation facilities, etc.
Community infrastructures	Energy, water, transportation, waste, ICT, etc.
NOTE "Water" includes sewage and wastewater as well as drinking water.	

Contribution

As illustrated in Table 1:

— Functions of community infrastructures are fundamental to support the other two layers;

— Products and services of community infrastructures are more technology-oriented, more internationally-tradable than those in other layers and therefore appropriate for international standardization.

NOTE 1 This compilation of existing activities is indicative only.

This Technical Report is intended to be used in the following ways:

— as a reference document

— to analyze the commonalities and gaps in existing activities relevant to metrics on smart community infrastructures

— to review the value of deploying smart community infrastructures

— as a basis for future standardization

— to assist stakeholders to have a better understanding of state-of-the-art smart community infrastructures around the world

NOTE 2 The environmental, social and economic subsystems of the global system interact and are interdependent. They are often referred to with phrases such as the three dimensions or pillars of sustainability. [SOURCE: ISO/DGuide 82:2013 3.1].

NOTE 3 OECD states that a pace and pattern of economic growth that helps poor women and men to participate in, contribute to and benefit from it is in short pro poor growth.

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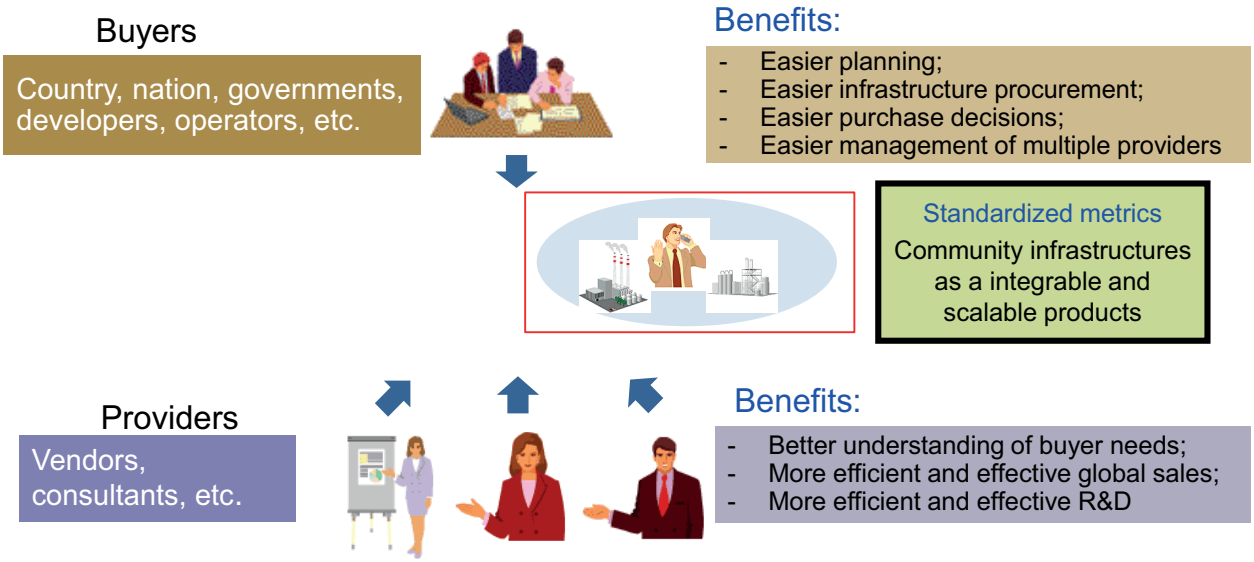

Figure 1 — Users of the metrics and associated benefits

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Smart community infrastructures — Review of existing activities relevant to metrics

1 Scope

This Technical Report provides a review of existing activities relevant to metrics for smart community infrastructures.

In this Technical Report, the concept of smartness is addressed in terms of performance relevant to technologically implementable solutions, in accordance with sustainable development and resilience of communities, as defined in ISO/TC 268.

This Technical Report addresses community infrastructures such as energy, water, transportation, waste and information and communications technology (ICT). It focuses on the technical aspects of existing activities which have been published, implemented or discussed. Economic, political or societal aspects are not analyzed in this Technical Report.

NOTE This Technical Report is not a recommendation document for best practices. Although sustainability objectives have been considered, the main subject of this Technical Report is the analysis of existing methodologies for smart community infrastructures.

2 Normative references

There are no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
buyer
person who aims to get possession of a good, service and/or right through providing an acceptable equivalent value, usually in money, to the person providing such a good, service and/or right

[SOURCE: ISO/IEC 15944-1:2002, 3.8]

3.2
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects

[SOURCE: ISO 14001:2004, 3.7]

3.3
interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

[SOURCE: ISO 21007-1:2005, 2.30]

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3.4
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal

[SOURCE: ISO 14044:2006, 3.1]

3.5
metric
the defined measurement method and the measurement scale

[SOURCE: ISO/IEC 14598-1:1999, 4.20, modified — Note 1 and Note 2 have been removed.]

3.6
pro-poor growth
stimulate economic growth for the benefit of poor people (primarily in the economic sense of poverty)

[SOURCE: OECD, 2008]

Note 1 to entry: Pro-poor growth can be defined as absolute, where the benefits from overall growth in the economy, or relative, which refers to targeted efforts to increase the growth specifically among poor people.

EXAMPLE A pace and pattern of economic growth that helps poor women and men to participate in, contribute to and benefit from.

3.7
provider
person or organization involved in or associated with the delivery of products and/or services

[SOURCE: ISO/TR 12773-1:2009, 2.40, modified]

3.8
snapshot
capture of the status of a data resource at a given moment in time

[SOURCE: ISO 12620:2009, 3.6.2]

3.9
sustainable development
development that meets the needs of the present without compromising the ability of future generations to meet their own needs

[SOURCE: The U.N. Brundtland Commission, 1987]

4 General

4.1 Overview for developing this Technical Report

In order to propose the directions of future standardization in the field of smart community infrastructures, this Technical Report collects and analyzes existing activities relevant to metrics. This Technical Report also describes desirable features of the community infrastructure metrics suitable to improve the sustainability of the community (4.2.2). In addition, this Technical Report identifies gaps between these desirable features and the reviewed activities and proposes future directions for standardization in the field of smart community infrastructures.

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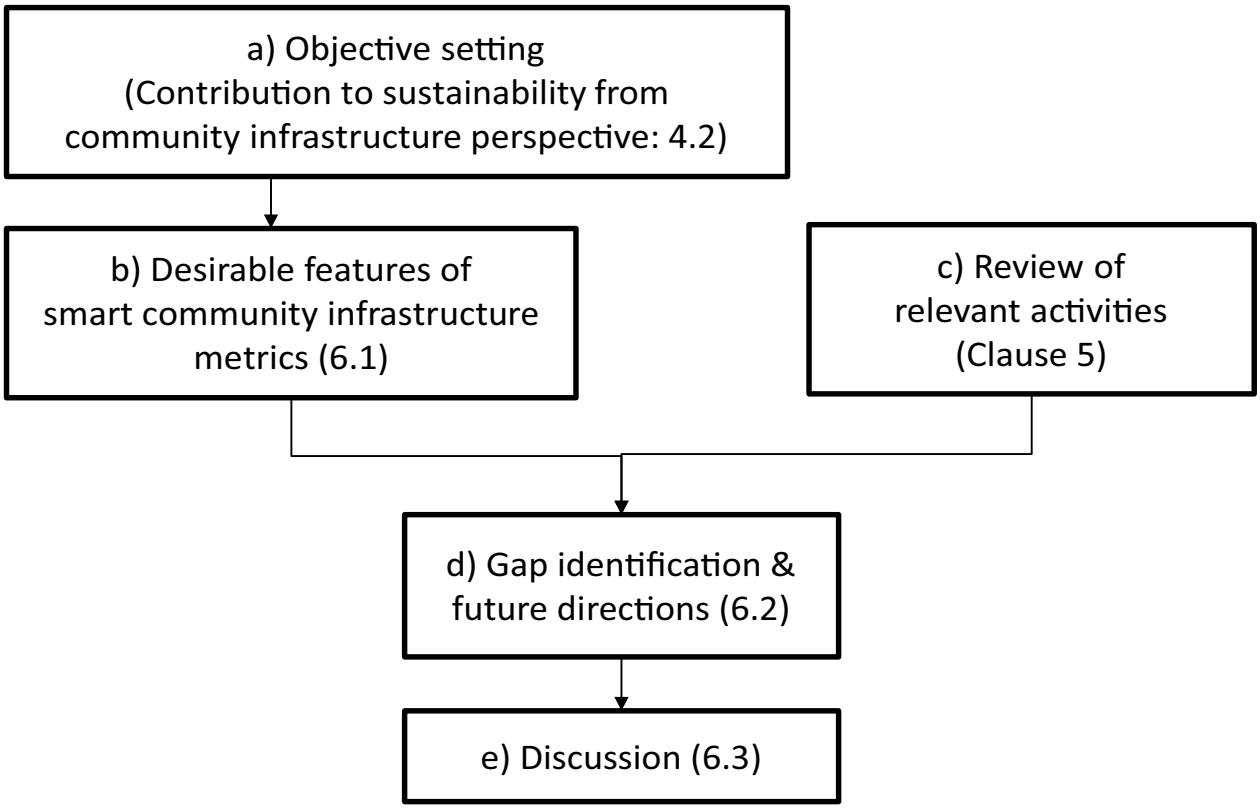

Figure 2 — Approach for developing this Technical Report

a) The objectives of this Technical Report are to create a non-exhaustive repository of information and documents and to provide directions for future standardization (See 4.2).

b) By considering lessons from existing relevant activities with regard to metrics, this Technical Report describes desirable features of smart community infrastructure metrics necessary to contribute to sustainability (See 6.1).

c) This Technical Report collects and reviews the following two types of activities relevant to community infrastructure metrics (See 5.1):

   1) International Standards, concepts and theoretical frameworks; and,

   2) projects.

d) This Technical Report identifies gaps between the existing relevant activities and the desirable features by mapping c) onto b) above. Taking the identified gaps into account, this Technical Report proposed future directions for standardization in the field of smart community infrastructure metrics (See 6.2).

e) This Technical Report discusses future possible areas of standardization related to the field of smart community infrastructure metrics.

4.2 Objectives

4.2.1 Background

In line with the concept of sustainable development and promoting pro-poor growth (as emphasized by OECD), enabling a pace and pattern of growth that enhances the ability of poor women and men to participate in, contribute to and benefit from growth will be critical in achieving a sustainable trajectory out of poverty and meeting the Millennium Development Goals (MDGs). All 193 United Nations member

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states and at least 23 international organizations have agreed to achieve these goals by 2015. Although a number of countries have demonstrated that progress in achieving the MDGs is possible, efforts need to be intensified in order to make this a reality.

As the OECD-DAC Guidelines on Poverty Reduction show, poverty has multiple and interlinked causes and dimensions: economic, human, political, socio-cultural and protective/security.[7] It is further recognized that insufficient, inadequate community infrastructure is among the most pressing obstacles to achieving pro-poor growth.[7] By raising labour productivity and lowering production and transaction costs, community infrastructures – energy, water, transportation, ICT, etc. – enhance economic activities and so contribute to growth, which is essential for poverty reduction.

Community infrastructures are a priority on the international development agenda. Investment in community infrastructures is an important enabler of communities and nations in achieving the MDGs, of which there are eight international development goals: 1) eradicating extreme poverty and hunger; 2) achieving universal primary education; 3) promoting gender equality and empowering women; 4) reducing child mortality rates; 5) improving maternal health; 6) combating HIV/AIDS, malaria, and other diseases; 7) ensuring environmental sustainability; and, 8) developing a global partnership for development. Table 2 outlines links between community infrastructures and seven of the eight MDGs listed above.

It has long been argued that the activity of human being is surpassing the capacity of the Earth. Community infrastructures are increasingly developing and operating in line with global population growth. This can have less desirable consequences. For example, turning the spotlight firmly on the inherent tensions between the imperative for further community infrastructures (i.e. growth) and sustainability. As a result, there is a need for community infrastructures to play a role in sustainable development to balance economic, social and environmental aspects and to meet the needs of communities more effectively and efficiently.

That situation indicates an urgent need to develop and share more effective and efficient solutions in terms of environmental impacts and the quality of life. Such solutions are often referred to as “smart.” A number of plans and projects to build “smart cities” are currently underway and the international trade of community infrastructures has become more common than before.

In general, International Standardization helps facilitate international trade by reducing technical barriers among the countries. However, there are currently no International Standards in the field of smart community infrastructures, e.g. harmonized metrics to evaluate them as integrable and scalable products.

4.2.2 Objective of this Technical Report

Taking into account the background information described in 4.2.1, the objectives of this Technical Report are:

— to create a non-exhaustive repository of information that will enable the creation of a future International Standard for community infrastructures;

— to provide directions for future standardization to improve the sustainability of communities by providing a common language for and access to knowledge about smart community infrastructures to support market activity.

NOTE This Technical Report acknowledges the necessity of consistency among related existing International Standards, work items under development (e.g. ISO/WD 37101 and ISO/WD 37120) and the technical standard for community infrastructures.

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Table 2 — Links between community infrastructures and the Millennium Development Goals (MDGs)

Infrastructure sector	Millennium Development Goals (MDGs)				
	Poverty and hunger (MDG 1)	**Primary education** (MDG 2)	**Gender equality and women's empowerment** (MDG 3)	**Health** (MDG 4, 5, 6)	**Environmental sustainability** (MDG 7)
Energy	- modern energy services increase productivity of human labour, while enabling enterprise development and income - energy can increase productivity and help reduce post-harvest losses - more efficient energy use (i.e. cooking, lighting) reduces expenditures on less efficient energy resources - improved cooking can reduce fuel and related labour demands	- electricity and lighting allows studying and educational tools and services in schools (computers, projectors, etc.) and promotes teacher retention - more efficient cooking can reduce time spent fetching wood and give more time for studying	- improved cooking can reduce time/labour burden and reduce indoor air pollution - street lighting improves women's safety	- permits cold chain for vaccines, reagents, sterilization, operation of essential laboratory equipment and operating theatres - modern energy can be safer (i.e. less accidents) - electricity enables pumped clean water and purification - increases hours of facility operation/ night-time services - helps retain qualified staff	- efficient cooking and switch to modern fuels (LPG) can reduce demand for charcoal or other biomass sources reducing pressure on local ecosystems from fuel collection - more efficient agriculture (including fertilizer, mechanization) can reduce need for additional land clearing - improved cooking can reduce greenhouse gas emissions and black carbon
Transport	- facilitates market access and reduces costs of trade, inputs prices, and monopoly power of agricultural middlemen - reduces social/ family travel costs	- can improve students' access to school, reducing drop-out rates, particularly for girls	- reduces time and transport burden and eases independent movement for women - Can save time, and increase access to health services for women	- increases access to health facilities - reduces emergency response times - improved roads can be safer for drivers and pedestrians	- improved public transport services reduces overall environmental impact

[SOURCE: Freeman, K.: Infrastructure from the Bottom Up, 2011, modified.[16]]

NOTE This report documented progress and lessons learned from the first five years of the Millennium Village Project (MVP) with a focus on investments made in infrastructure and services related to energy, transportation, communications and piped water supply.[16]

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Table 2 *(continued)*

Infrastructure sector	Millennium Development Goals (MDGs)				
	Poverty and hunger (MDG 1)	**Primary education** (MDG 2)	**Gender equality and women's empowerment** (MDG 3)	**Health** (MDG 4, 5, 6)	**Environmental sustainability** (MDG 7)
Information and communications technology (ICT)	- increases access to weather, market and income-related information - enables extension, outreach and other training for increased incomes (agriculture, business)	- enables distance learning, access to educational media and communications - aids in teacher retention - improves record-keeping and school management	- reduces isolation of working at home - enables education at home - enables emergency communication and reporting of violence	- increases access to emergency care - supports improved medical information systems (ChildCount), 'distance medicine', and access to health education media - improves access to and quality of public and community health systems	- improves natural resource information gathering, mapping and monitoring
Water and Sanitation	-irrigation (combining improved water access and energy) can dramatically raise agricultural productivity	- rainwater harvesting can reduce water gathering labour for schools by children - reduced water-borne disease, improves school attendance	- improved/piped water sources or systems reduces women's time/ labour burden of fetching water	- clean water is essential for health services - cleaner drinking water reduces water-borne diseases - safe disposal of medical waste prevents spread of disease	- increased availability of water and sanitation can improve local environments

[SOURCE: Freeman, K.: Infrastructure from the Bottom Up, 2011, modified.[16]]

NOTE This report documented progress and lessons learned from the first five years of the Millennium Village Project (MVP) with a focus on investments made in infrastructure and services related to energy, transportation, communications and piped water supply.[16]

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5 Review of existing activities relevant to metrics

5.1 Review method

5.1.1 Collect information on existing activities relevant to metrics

5.1.1.1 Points of consideration

This Technical Report is intended to discuss metrics to evaluate technical performances of community infrastructures on a community-wide basis. There are several views of "smartness" and "infrastructures." Those who are responsible for this document, ISO TC 268/SC 1/WG 1 therefore applied a wide scope in sampling the existing relevant activities with regard to metrics in order to avoid specific biases.

In order to take various needs in the world into account and respect global relevance when collecting information for this Technical Report on existing activities relevant to metrics, the following points were taken into consideration:

— geographical diversity, representing major continents and climate zones;

— economic diversity, representing both developed and developing countries;

— type of development of community infrastructures including both green fields and brown fields;

NOTE Greenfield sites are areas which are unbuilt land, mostly previously used for agricultural purposes. Brownfield sites are areas which:

— have been affected by former uses of the site or surrounding land;

— are derelict or underused;

— are mainly in fully or partly developed urban areas;

— require intervention to bring them back to beneficial use; and

— may have real or perceived contamination problems

— diversity of lead organizations (proposers), both public and private;

— diversity of development stages: planning, implementation, construction, operation and monitoring.

5.1.1.2 Collection process

a) Questionnaires

A survey was conducted by experts on existing relevant activities with regard to metrics in each region, country or organization.

NOTE Results of the questionnaire are included in Annex B.

b) Literature and internet surveys

Literature and internet surveys were conducted to collect existing activities relevant to the development or improvement of community infrastructures to supplement the work in a) above.

In accordance with the objective of providing future directions for standardization in the field of smart community infrastructures, the following profiles were considered in these surveys:

— International Standards, concepts, theoretical frameworks and indicators, including: those which can be directly referred to in the trade of products and services of smart community infrastructures.

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— Projects, including: those to develop specific communities, which are anticipated to include consideration of procurement of products and services of community infrastructures.

5.1.2 Perspectives for analysis

a) Relevance to community infrastructures

This Technical Report analyzes the relevance of collected activities to community infrastructures with regard to:

— relevance to particular types of community infrastructures, including:

  — community infrastructures as a main target or purpose of improvement;

  — community infrastructures as a means to improve other types of community infrastructures (e.g. ICT to improve energy);

— relevance to interoperability among multiple community infrastructures

b) Relevance to smartness

This Technical Report analyzes the relevance of collected activities to smartness with regard to:

— Contribution to sustainable development: sustainability issues and indicators for a community are relevant to community infrastructures although they are not usually in a direct relationship with community infrastructures. These are usually grouped into economic, environmental and social issues and indicators, in accordance with the framework of sustainability defined by the UN.[11] [12]

— Innovative features: features of relevant activities regarded as contributing to effectively or efficiently providing technical solutions.

c) Relevance to evaluation of technical performance

In order to analyze relevance to evaluation of technical performance of community infrastructures, this review categorizes indicators into:

— Community outcome indicators: the review identifies community outcome indicators for service provision and/or quality of life.

— Technical performance indicators for community infrastructures: the review identifies indicators for technical performance of community infrastructures which avoid discussion of specific technologies or organizational procedures.

5.2 Summary of review

5.2.1 Overview of activities relevant to metrics

5.2.1.1 General

This Technical Report identifies the following existing activities relevant to metrics although they are not exhaustive:

— 28 International Standards, concepts and indicators;

— 124 projects.

NOTE Annex A includes a list of identified activities, Annex B includes details of examples of the selected activities and Annex D includes a detailed review result.

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5.2.1.2 Geographical diversity

The majority of the identified International Standards, concepts and indicators are either published by international organizations or originated in Asia or Europe. Identified projects are geographically dispersed across regions.

5.2.1.3 Economic diversity

A half of the identified International Standards, concepts and indicators are made by international organizations. And in the other half, those in developed countries account for a larger part than those in developing countries.

With regard to the identified projects, those implemented in developed countries account for a larger part in a total number of projects, compared to those in developing countries. The majority of the identified projects are brown field projects.

5.2.2 Coverage of sustainability issues

In the identified relevant activities, this Technical Report identifies a wide range of sustainability issues that a community faces, as well as, a broad range of community outcome indicators across all regions.

Major specific issues are categorized into three categories of sustainability issues: economic, social and environmental. Other issues were identified and considered representatives but could not be grouped into the pre-mentioned three main categories and analyzed.

In identified International Standards, concepts and indicators, environmental issues were the most widely covered, with economic and social issues following it with the same coverage rate. Most of them covered more than one category.

A majority of the identified projects covers more than one category for issues. In most cases, an economic issue was most commonly covered and an environmental issue followed it. In comparison between developed and developing countries, both groups show a similar trend: an economic issue was the most widely covered, followed by an environmental issue, and a social issue was the least covered. The most prominent difference between the two groups was that a social issue was covered more frequently in developing countries. In comparison of the number of issue categories covered in identified projects between the two groups, the rate of projects covering all three issue categories is higher in developing countries while the rate of those focusing on only one issue category is also higher.

Compared to the result of the identified International Standards, concepts and indicators, the rate of those projects covering three issues is far less and the majority of projects are dealing with two issue categories only.

5.2.3 Relevance to community infrastructures

In the review of community infrastructures covered in the identified International Standards, concepts and indicators, as well as projects, coverage on a total of five community infrastructures, i.e. energy, water, transportation, waste and ICT, was analyzed.

Among the five types of community infrastructures mentioned above, energy is the most commonly covered by the identified International Standards, concepts and indicators. All five community infrastructures are set as both a main purpose of development and a means to improve other types of community infrastructures.

In the identified projects, a large part of them covers energy and ICT. A number of projects cover energy as a purpose of development and a vast majority of them set ICT as a means to improve it. Meanwhile, there are projects which use other community infrastructures, such as transportation, water, and waste as a means to achieve a purpose of energy.

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In comparison of developed and developing countries, the prominent difference is that energy is more widely covered in developed countries. Water, transportation and waste are more commonly dealt with in projects within developing countries, although energy is still a factor as a purpose or a means.

For example, as a means to achieve a purpose of energy, ICT is the most commonly set as a means, followed by transportation, water and waste. This seems to be due to the fact that many of the identified projects place the establishment of smart grid systems as a main aim.

5.2.4 Relevance to evaluation of technical performances

Various indicators are identified in the review. According to their properties, they can be categorized into the following groups and sub-groups:

a) community outcome indicators which are relevant to the community itself rather than community infrastructures;

b) indicators relevant to community infrastructures, including:

   1) status-quo of a specific design of each community infrastructure in a community;

   2) output or technical performance indicators of community infrastructure.

For sub-group 2), indicators for various particular types of community infrastructures are identified, while no single indicator commonly applicable to multiple community infrastructures was identified.

5.2.5 Innovative features

This Technical Report identifies qualitative features unique to individual activities, which are not suitable to be tallied and summarized in a graph. Examples of such features include: project implementation from a life cycle perspective (B-DASH, see B.1.2), consideration of synergies and trade-offs among multiple issues (Sustainable development of urbanization and smart city in China (see B.1.8) and CASBEE for Cities[21]) application to diverse geographical areas (The Green City Index series, see B.1.5), Interoperability of systems (BSI – A Standard Strategy for Smart Cities, see B.1.3), consideration of the synergies and trade-offs between infrastructures and buildings sites (INTEGRATION, see B.2.5).

6 Discussion on possible future directions

6.1 Desirable features of smart community infrastructure metrics

6.1.1 General

To contribute to sustainable development, smart community infrastructure metrics should:

— be harmonized;

— include items useful for as many stakeholders as possible involved in trades of community infrastructure products and services (e.g. local governments, developers, suppliers, investors);

— facilitate evaluation of the technical performance of community infrastructures, contributing to sustainability and resilience of communities;

— be applicable to different stages of the development of communities and community infrastructures;

— reflect the dynamic properties of the community infrastructures.

Harmonized metrics allow buyers (e.g. community planners, governments, operators of community infrastructures) to compare proposals for the introduction or renovation of community infrastructures introduced by multiple suppliers with the same criteria, thereby contributing to the creation of a fair competitive market.

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It is one of the core ideals of sustainable development to consider the benefit for future generations. Accordingly, it is desirable that the metrics are designed to enable evaluation and decision-making in the trade of community infrastructure products and services in the long term, e.g. taking different stages of the development of communities and the benefit of community infrastructures throughout their lifecycle into account.

It should be noted that the metrics under discussion change with time and tend to be time-related measurements, such as flows, gradients, graphs and, therefore, are dynamic.

6.1.2 Smart

Smart community infrastructure metrics in aggregate should:

— be selected with consideration for the synergies and trade-offs of multiple issues or aspects that a community faces, such as environmental impacts and quality of community services. Only addressing a single issue or aspect might not be considered smart;

— focus on advanced features of community infrastructures such as interoperability and efficiency rather than the status-quo.

Sometimes sustainability claims are made for a specific activity using indicators which cover only a single aspect, such as carbon dioxide (CO_2) emission reduction. However, it is desirable that metrics to evaluate technical performances of community infrastructures take social, economic and environmental sustainability into account (sustainable development).

Advanced technological features are also essential to resolve trade-offs between multiple aspects of sustainability, as well as, to achieve efficient coordination between multiple infrastructure services.

6.1.3 Community

Smart community infrastructure metrics should:

— be applicable to a diverse range of communities (e.g. geographical location, sizes, economic structures, levels of economic development, stages of infrastructure development).

6.1.4 Infrastructure

Smart community infrastructure metrics should allow:

— consideration of multiple community infrastructures (e.g. energy, water, transportation, waste, ICT) that support the operations and activities of communities;

— technologically implementable solutions;

— a holistic perspective of multiple community infrastructures. (More specifically, to consider an integrated system which includes the interaction and coordination of multiple community infrastructures).

Five types of community infrastructures (energy, water, transportation, waste and ICT) have already been recognized as key elements that support the operations and activities of communities now and in the future.

In general, solutions can be not only technological but also social or cultural (e.g. governmental policies, life style). However, the societal or cultural diversity of communities should be respected as traits of each community. Thus, it is desirable that the metrics are designed to focus on evaluating the technical aspects of community infrastructures, rather than societal or cultural aspects.

As the five and associated services are mutually inter-related through the activities of a community, sub-optimizations in only one type of infrastructures do not always lead to the desirable solution for sustainability of the community as a whole. Accordingly, it is desirable that metrics be designed to allow a holistic perspective across community infrastructures.

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6.1.5 Metrics

Smart community infrastructure metrics should:

— allow evaluation of the technical performance (e.g. efficiency, effectiveness) of community infrastructures rather than characteristics of specific technologies;

— be based on transparent and scientific logics.

Metrics based on performance will enhance innovative development of smart community infrastructure technologies.

EXAMPLE CO_2 emission per passenger kilometer as a metric, instead of the number of electric vehicle technologies, is an example of such an approach.

Scientific and transparent logics are required for metrics to be internationally accepted and widely used.

6.1.6 Smart community infrastructure metrics

Smart community infrastructure metrics are a measurement or quantification method and scale of the technical performance of community infrastructures which:

— allow a holistic perspective of multiple infrastructures in communities;

— have dynamic properties;

— take into account the long-term aspects of communities;

— enable understanding of the diversity of communities.

NOTE 1 Infrastructures such as those for energy supply, water supply and treatment, transportation means, waste control, and ICT are all responding to the dynamics of the activities in a community.

NOTE 2 A smart community infrastructure metric might:

— be a measurement or quantification of the dynamic flows and operations of systems within communities

— be a measurement or quantification at a point in time, leading to multiple measurements over time

— consist of flows, movements, levels or volumes that can be used as inputs to systems dynamics modelling or can be used for understanding community infrastructures and their strategic planning and management.

6.2 Identified gaps and possible future directions for smart community infrastructure metrics

Identified gaps between the desirable features and the activities relevant to metrics and consequently suggested future directions of standardization are summarized in Table 3.

Table 3 — Identified gaps and future directions

Desirable features	Identified gaps and future directions
General	
Be harmonized.	A lack in an overall comprehensive evaluation framework for technical performance of community infrastructures was identified. Therefore, it is worthwhile to develop smart community infrastructure metrics as a series of International Standards and other deliverables.

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Table 3 *(continued)*

Desirable features	Identified gaps and future directions
Include items useful for as many stakeholders as possible involved in trades of community infrastructure products and services (e.g. local governments, developers, suppliers, investors).	Because of the lack of information, it is generally difficult to judge from a literature survey whether an identified relevant activity has this feature or not. However, this feature is important and should be fully considered in developing smart community infrastructure metrics.
Facilitate evaluation of the technical performance of community infrastructures contributing to sustainability and resilience of communities	Because of the lack of information, it is generally difficult to judge from a literature survey whether an identified relevant activity has this feature or not. However, this feature is important and should be fully considered in developing smart community infrastructure metrics.
Be applicable to different stages of the development of communities and community infrastructures.	In general, identified relevant activities do not explicitly claim to either have this feature or limit their applicability to a specific development stage. However, this feature is important and should be fully considered in developing smart community infrastructure metrics.
Reflect the dynamic properties of the community infrastructures.	Some relevant concepts highlight dynamics (e.g. TAHI) and life cycle perspectives of community infrastructures (e.g. B-DASH). Accordingly, dynamic properties should be fully considered in developing smart community infrastructure metrics.
Smart	
Be selected with consideration for the synergies and trade-offs of multiple issues or aspects that a community faces, such as environmental impacts and quality of community service. Only addressing a single issue or aspect might not be considered smart.	Most of the relevant activities address multiple issues. Some of them point out the synergies and trade-offs among them (e.g. the sustainable development of urbanization and smart city in China). A few of them further quantify the synergies and trade-offs though they are intended for cities themselves rather than exactly for community infrastructures (e.g. CASBEE for cities). Accordingly, aspects such as trade-offs between environmental impacts and quality of community should be fully considered in developing smart community infrastructures.
Focus on advanced features of community infrastructures such as interoperability and efficiency rather than the status-quo.	In terms of community infrastructures, many of the relevant indicators address their status-quo, such as the prevalence rate of particular types of community infrastructures in a community, etc. On the other hand, some of the relevant concepts and projects (e.g. BSI and Smart Cities) indicate advanced features of community infrastructures such as interoperability and efficiency. Accordingly, in developing smart community infrastructure metrics, such advanced features should be fully considered.
Community	
Be applicable to a diverse range of communities (e.g. geographical location, sizes, economic structures, level of economic development, stages of infrastructure development).	Some of the relevant activities (e.g. Siemens Green City Index series) include both a general framework and its application to specific geographical regions. Accordingly, such a combination of general frameworks and applications should be fully considered in developing smart community infrastructure metrics.
Infrastructure	
Allow consideration of multiple community infrastructures (e.g. energy, water, transportation, waste, ICT) that support the operations and activities of communities.	Some concepts address multiple community infrastructures. Thus, these concepts might be helpful to identify the boundary of each community infrastructure to be measured (e.g. energy, water, transportation, waste, ICT).

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Table 3 *(continued)*

Desirable features	Identified gaps and future directions
Allow technologically implementable solutions.	In terms of solutions, most of the relevant activities discuss a variety of social solutions (e.g. governmental policies, life styles) or designs of specific technologies relevant to community infrastructures (e.g. smart grids, electric vehicles). However, the development of smart community infrastructure metrics should focus on the performances of technologically implementable solutions of the community infrastructure layer.
Allow a holistic perspective of multiple community infrastructures.	Most identified activities cover multiple indicators for each particular community infrastructure individually. Therefore they do not have a community-wide holistic perspective. Some relevant concepts and projects (e.g. BSI and Smart Cities, INTEGRATION) suggest interoperability, synergies and trade-offs among multiple infrastructures. Accordingly, learning from these activities should be considered in developing smart community infrastructure metrics.
Metrics	
Allow evaluation of technical performance (e.g. efficiency, effectiveness) of community infrastructures rather than characteristics of specific technologies.	Most of the identified indicators address the prevalence rate of specific technological designs (e.g. renewable energies, non-stop commercial flights) rather than technical performances of community infrastructures. Accordingly, smart community infrastructure metrics should be developed to address technical performances of community infrastructures on a community-wide basis. NOTE On a particular community infrastructure such as water and wastewater, there are some performance indicators (e.g. ISO 24510, ISO 24511, ISO 24512)., These indicators are normally applicable to the entire community, but can, at the needs of the organization be calculated on individual service sectors within the community. For example, water loss indicators can be calculated on individual sectors of the distribution system infrastructure as a means of prioritizing maintenance activities.
Be based on transparent and scientific logics.	Evaluation methods of relevant activities are not always publicly available and therefore it is difficult to judge whether they are based on scientific logics. Then, smart community infrastructure metrics should be developed based on scientific logic. International standardization in this field will secure the transparency of the evaluation methods.

Since there is no existing activity meeting all the desirable features, this Technical Report recommends a newly developed general principles and requirements of smart community infrastructure metrics, taking into consideration the lessons learned from relevant activities.

6.3 Discussion

6.3.1 Overview

6.3.1 discusses possible areas of standardization, related to the field of smart community infrastructure metrics and the roadmap.

Table 4 shows the overall structure of possible development of smart community infrastructure metrics.

Area A in Table 4 illustrates one of the desirable features of smart community infrastructure metrics given in this Technical Report: consideration of synergies and trade-offs among multiple perspectives

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(i.e. residents, community managers and environment). The three perspectives are the projection of the three areas of sustainability issues (social, economic and environmental) to the field of community infrastructures.

Following this Technical Report, a subsequent deliverable will be developed to address more detailed evaluation of the generic and overall technical performance of community infrastructures (as illustrated in Area B in Table 4). The deliverable will define the general principles and requirements of technical performance metrics that are relatively independent of particular types of community infrastructures or communities (for more details, see 6.3.2).

After the completion of the deliverable for general principles and requirements, their applications to particular types of communities or particular types of community infrastructures and an operational metrics having dynamic properties (as illustrated in Area C of Table 4) may be considered (For details, see 6.3.3). There are existing International Standards covering particular types of community infrastructures and some of their provisions can be applied to this area.

Table 4 — Possible development of a series of smart community infrastructure metrics

Community Infrastructures / Performances: (to be technically improved)		Energy	Water		Waste	ICT	Others
		Electricity Gas Fuel ……	Water supply reuse Waste water ……	Road, Railroad Air	Waste Recycle ……	Telecom ……	
Area B: General principles Area A: Residents perspective	Reliability	Apply		•……		•……	
	-						
		•……					
Trade-off Synergy Community manager perspective	ıal	•……					
Environmental perspective TR 37150	emissions				•……		
		Collaboration with assistance of existing sector committees					
TS 37151							

Area C: Applications of General principles to diverse types of infrastructures and communities

NOTE Items in Table 4 are indicative examples.

6.3.2 General principles and requirements of smart community infrastructure metrics

As suggested in 6.3.1, none of the relevant activities, as far as identified in the review, has all of the desirable features of smart community infrastructure metrics. Thus, development of new general principles and requirements of the metrics is required. This development should take into account some useful features of relevant activities. Incorporation of these features may not be a simplistic exercise of just importing or combining the specific details or documents from relevant activities.

The general principles and requirements should be developed to define the basic concept of the metrics in the community level and be generic (neutral) against particular types of communities or particular types of community infrastructures. They should be developed based on a scientific logic so as to minimize the arbitrariness resulting from commercial or political interests of specific entities.

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The general principles and requirements should be developed first and may be followed by their applications to particular types of communities and particular types of community infrastructures.

The possible beneficiaries of the general principles and requirements include e.g. community planners, governments, urban consultants, constructors, facility and manufactures.

The use of general principles and requirements might include:

— to provide a common language among multiple stakeholders, including buyers and providers of community infrastructure products and services, when they discuss the issue of the community and the introduction or improvement of community infrastructures;

— to compare multiple proposals of the introduction or improvement of community infrastructure products and services from multiple providers;

— to prioritize the area of the improvement among the multiple community infrastructures, providing the basis for estimating the effect of the introduction or improvement of community infrastructures;

— to monitor the performance of community infrastructures on a community-wide basis.

NOTE It is left to the users of the whether setting targets or not when applying general principles and requirements.

6.3.3 Application of metrics

6.3.3.1 Application to diverse types of communities

In order to apply the general principles and requirements to diverse communities, it is useful to develop guidance on the practical use of the framework in some typical categories of communities. It is also expected to develop some supplemental metrics that are more detailed and tailored to each category.

The typical categories of communities might be defined by:

— economic structure or major industry (manufacturing, commercial, tourism, etc.);

— population (large, medium, small, etc.);

— climate zone (tropic, subarctic, arid, etc.); and

— developed and developing countries.

NOTE Those typical categories are indicative and not exhaustive.

6.3.3.2 Application to particular types of community infrastructures

After the development of general principles and requirements, the discussion on the applications to particular types of community infrastructures follow (as illustrated in Area C of Table 4), whereby metrics of particular types of community infrastructures (e.g. energy, water, transportation, waste, ICT) share the same general principles and requirements and enable to measure technical performances of the community infrastructures as a whole.

As the first step, energy, water, transportation, waste and ICT should be the area of application.

In the development in this area, the utilization of existing International Standards and cooperation with other existing ISO/IEC committees is crucial.

6.3.3.3 Application to something other than the five types of community infrastructures.

There is also a possibility that general principles and requirements are additionally applicable to something other than the five types mentioned before (energy, water, transportation, waste and ICT).

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For example, public facilities such as libraries could be considered after application to the five initial types.

6.4 Discussion on related areas and actions

6.4.1 Overview

Subclause 6.4 includes discussions on possible standardization areas and possible action items to develop standards in relation with smart community infrastructure metrics.

6.4.2 Possible related areas

Table 5 outlines possible areas of standardization that ISO/TC 268/SC 1 should be responsible for in the future standardization process. This list is non-exhaustive. The actual standardization works for those areas will start only if there is a sufficient support from stakeholders.

Table 5 — Possible related areas

Possible related areas	Rationales
Measurement, reporting and verification (MRV)	In the operation of smart community infrastructure metrics, it is essential to develop a method to determine the value of technical performances of community infrastructures, e.g. greenhouse gas emissions reduction achieved by the introduction of the community infrastructure. It is also necessary to communicate related information with the intended users without misinterpretation and to confirm that specified requirements have been fulfilled. From this viewpoint, related standardization areas are specifications for measurement, reporting and verification. Additionally, specifications for real-time monitoring of actual dynamic technical performances of existing community infrastructures would be useful for responsive operation of community infrastructures. Learning from existing International Standards and other documents (e.g. international performance measurement and verification protocol) would be useful for standardization.
Use of smart community infrastructure metrics in multiple types of operation schemes (e.g. performance contracts)	Community infrastructures currently involve multiple types of operation schemes. For example, types of schemes between public authorities and private parties include, for example: concession; build, operate and transfer (BOT); and, privatization. There are also multiple types of contracts, such as performance contracts which relate the contracting payment to performance against measured performance of community infrastructures. Because smart community infrastructure metrics can be used in these different schemes, it is useful to provide specifications for application to different schemes. Such specifications might include guidance to illustrate savings and benefits of community infrastructures for cities and citizens.
Handling of a large volume of information data”	Data infrastructures are essential as a basis for city management. For example, in order to govern and operate community infrastructures with a holistic viewpoint in a community, it is necessary to handle and utilize massive amounts and various types of data across systems (e.g. technical performances of community infrastructures, demands for their outputs and geographical data), ensuring security and transparency.

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Table 5 *(continued)*

Possible related areas	Rationales
Safety (e.g. functional safety)	Because community infrastructures support operations and activities of communities, their safety is an essential point of consideration. In particular, it is important to design community infrastructures to prevent dangerous failures or to control them when they arise. From this viewpoint, a related standardization area might be functional safety (as indicated by IEC/SC 65A, *System aspects*), which is the detection of potentially dangerous conditions resulting in the activation of a protective or corrective device or mechanism to prevent hazardous events arising or providing mitigation to reduce the fight consequence of the hazardous event.
Terminology	Although certain terms and definitions relevant to particular types of community infrastructures already exist, ones intended for community infrastructures in community levels and generic (neutral) against the particular types are lacking. In order to promote communication and standardization in this field, harmonized terminology is essential.
Best practices for implementing smart city projects	Because the development of smart community infrastructures requires a wide range of considerations, including trade-off of multiple issues and having a holistic viewpoint across multiple community infrastructures in a community, it would be useful to collect best practices for implementing smart city projects.

6.4.3 Possible related actions

Table 6 outlines possible related actions that should be considered in the future standardization process. This list is non-exhaustive and includes the possible standardization areas mentioned in 6.4.2.

Table 6 — Possible related actions

Possible related actions	Rationales
Use of the deliverables for education	In general, International Standards are an important source of technological know-how. For example, International Standards provide access to advanced knowledge for users in areas where they may lack expertise and/or resources. The series of International Standards and other deliverables in the field, mentioned in this Technical Report, can be used for capacity building in the field of smart community infrastructures. Using the International Standards and other deliverables as educative tools for community administrative staff can improve their knowledge in the field and promote positive decision making when considering implementing or starting a project with a concept of community infrastructures that contributes to sustainability.

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Table 6 *(continued)*

Possible related actions	Rationales
Pilot testing of the general principles and requirements of smart community infrastructure metrics by communities for feedback	To engage potential relevant stakeholders in International Standardization (see the next action item) and to gather practical feedback for the deliverables in this field, it is recommended putting the future deliverable of general principles and requirements in pilot testing by actual communities to confirm their suitability for users' needs and to derive lessons learnt for further work.
Involving relevant stakeholders in standardization	Because there are various types of stakeholders involved in and affected by planning, financing, developing and operating community infrastructures, it is desirable to engage them in the International Standardization process to assure the practicality and relevance of future deliverables to them. Possible stakeholders might include: — international organizations (e.g. UN, OECD) — communities or cities (e.g. top management, those involved in water services); — industries of buyers (e.g. international industrial organizations) and vendors of community infrastructures (e.g. manufacturers); — financial and insurance institutions; — consumers (e.g. consumer associations).

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Annex A
(informative)

Identified relevant activities

A.1 General

This Annex contains non-exhaustive lists of possible activities relevant to metrics to evaluate technical performance of community infrastructures identified through the development of this Technical Report.

The objective of these lists is to widely identify the possible relevant activities without discrepancy, as much as possible (i.e. in terms of geographical locations, etc.). By listing these activities and examples of work in the field, this information was reviewed in this Technical Report.

A.2 List of identified International Standards, concepts, theoretical frameworks and indicators

The following list gives examples of identified International Standards, concepts, theoretical frameworks and indicators relevant to smart community infrastructures. These include:

— ISO 24510 series:

  — ISO 24510:2007, *Activities relating to drinking water and wastewater services — Guidelines for the assessment and for the improvement of the service to users*

  — ISO 24511:2007, *Activities relating to drinking water and wastewater services — Guidelines for the management of wastewater utilities and for the assessment of wastewater services*

  — ISO 24512:2007, *Activities relating to drinking water and wastewater services — Guidelines for the management of drinking water utilities and for the assessment of drinking water services*

— ISO 50001, *Energy management systems – Requirements with guidance for use*

— Aalborg commitment

— Blue book of urban competitiveness

— Breakthrough by dynamic approach in sewage high technology project

— British Standards Institution (BSI), A standards strategy for smart cities

— Comprehensive Assessment System for Built Environment Efficiency (CASBEE) City

— China city informanization evaluation index

— Cities of opportunity, Business-readiness indicators for the 21st century

— City biodiversity index (or Singapore index)

— European green capital

— European smart cities

— Global city indicators Facility

— Global power city index

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— International Council for Local Environmental Initiatives' (ICLEI)

— Information marketplaces: The new economics of cities

— Intelligent community awards

— Leadership in Energy and Environmental Design (LEED)

— Livability ranking

— RFSC/Sustainable city project

— Smart city framework

— Smart city realized by ICT (Fujitsu)

— Smart community by Toshiba

— Smarter cities

— Sustainable development of urbanization and smart city in China

— Sustainable smart town concept

— The green city index series

— The urban sustainability index

A.3 List of identified projects

Table A.1 gives examples of identified projects relevant to smart community infrastructures. These include:

Table A.1 — List of identified projects

Region, country or organization of main proposer or owner	Title of projects
Afghanistan	Kabul Metropolitan Areas Development Program in Afghanistan
Australia	Smart Grid, Smart City project
Australia	Solar Flagship Program
Brazil	Rio Operations Center
China	Changxindian Eco-city
China	Chongming Dongtan Eco-city
China	Comprehensive Operation Platform of Smart Lecong
China	Dezhou Sun-city
China	Liaoyuan Smart Card
China	Shangsha, Zhuzhou, Xiangtan, Two-oriented Society
China	Shenzhen Guangming Eco-city
China	Sino-Singapore Guangzhou Knowledge City
China	Sino-Singapore Tianjin Eco-city project
China	Smart Changzhou
China	Smart Chongqing
China	Smart City Projects of MOHURD in China

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Table A.1 *(continued)*

Region, country or organization of main proposer or owner	Title of projects
China	Smart Dezhou
China	Smart Hun Nan District, Shenyang
China	Smart Jiyuan
China	Smart Liaoyuan
China	Smart Luohe
China	Smart Tongling
China	Smart Wanning
China	Smart Wenjiang
China	Smart Zhenhai District
China	Tangshan Caofeidian Eco-city
China	Wanzhuang, Langfang Eco-city
Denmark	EDISON (Electric vehicles in a Distributed and Integrated market using Sustainable energy and Open Networks) Smart Grid Project
Denmark	Lolland Island Smart Grid
Denmark	zero emission mobility
Eastern Europe. Middle East	Smart community business study PJ
Europe	CONCERTO
Europe	Greening European Transportation Infrastructure for Electric Vehicles
Europe	Grid for Vehicles (G4V)
Europe	North Seas Countries Offshore Grid Initiative (NSCOGI)
Europe	Reference Framework for European Sustainable Cities (RFSC)/ Sustainable city project
Europe	Smart cities in Europe
Europe/Middle East/ Africa	DESERTEC
France	Linky project & pilot
France	Smart Community Demonstration Project in Lyon
Germany	E-Energy
Germany	E-mobility (Electric Mobility)
Germany	E-mobility Berlin
Germany	Hamburg-Harburg project
Germany	T-City
Iceland	Geothermal Energies utilization
Indonesia	Enhancement of Urban Development Management in the Mamminasata Metropolitan Area
Indonesia	Indonesia Economic Development Corridor (IEDC)
Indonesia	Metropolitan Priority Area (MPA)
Indonesia	Smart Community FS in Indonesia Jawa Island's industrial park
Indonesia	Spatial Plan and Urban Development Program for GKS Zone in East Java Province
Indonesia	Surabaya Urban Development Project

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Table A.1 *(continued)*

Region, country or organization of main proposer or owner	Title of projects
Italy	Telegestore
Japan	Aizuwakamatsu Area Smart Community Deployment Project.
Japan	B-DASH (Breakthrough by Dynamic Approach in Sewerage High Technology)
Japan	Breakthrough by Dynamic Approach in Sewage High Technology Project: Kobe green sweets project
Japan	Hachinohe Microgrid Demonstration Project
Japan	Yokohama Smart City Project
Korea	Smart Grid Test-bed in Jeju Island
Korea	U-City (Ubiquitous city) Project /New Songdo Green City
Malawi	Urban Development Master Plan for Lilongwe in Malawi
Malaysia	Iskandar Malaysia Project
Malaysia	The Multimedia Super Corridor (MSC) Project
Malta	Smart Grid Utility
Middle East & North Africa	collaborative smart communities project in MODON's industrial areas
Mongolia	Urban Development in Ulaanbaatar City
Netherlands	Amsterdam Smart City (ASC)
Philippine	Intelligent Operations Center in Davao City
Portugal	PlanIT Valley
Russia	Moscow
Singapore	CleanTech Park
Singapore	EV Taskforce(Electric Vehicles (EVs) Test-Bedding Programme)
Singapore	Intelligent Energy Systems (IES)
Singapore	Pulau Ubin Project
Singapore	Punggol Eco-Town
South America	INTEGRATION - Integrated Urban Development in Latin America
Spain	Smartcity Malaga/Spain Intelligent Community Practical Business
Sweden	Stockholm Royal Seaport
Thailand	Smart City in Nakhon Nayok Province
United Arab Emirates	Masdar City
U.S.	20MW Flywheel Frequency Regulation Plant
U.S.	Arizona Public Service (APS) Community Power Project
U.S.	Avista Utilities Smart Grid Project
U.S.	Baltimore Gas and Electric Company Smart Grid Project
U.S.	CenterPoint Energy Smart Grid Project
U.S.	Consolidated Edison Company of New York, Inc. Smart Grid Project
U.S.	Detroit Edison Company Smart Grid Project
U.S.	Duke Energy Business Services LLC Smart Grid Project
U.S.	EV project
U.S.	Florida Power & Light Company Smart Grid Project

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Table A.1 *(continued)*

Region, country or organization of main proposer or owner	Title of projects
U.S.	gridSMART SM Demonstration Project
U.S.	Hawaii Electric Co. Inc. Smart Grid Project
U.S.	Japan-US Collaborative Smart Grid demonstration project in Albuquerque
U.S.	Japan-US Collaborative Smart Grid demonstration project in Los Alamos
U.S.	KCP&L Green Impact Zone SmartGrid Demonstration
U.S.	Long Island Smart Energy Corridor
U.S.	Madison Gas and Electric Company Smart Grid Project
U.S.	NV Energy, Inc. Smart Grid Project
U.S.	Pacific Northwest Smart Grid Demonstration
U.S.	Pecan Street Smart Grid Demonstration Project
U.S.	PECO Energy Company Smart Grid Project
U.S.	Potomac Electric Power Company Smart Grid Project
U.S.	Progress Energy Service Company, LLC Smart Grid Project
U.S.	Sacramento Municipal Utility District Smart Grid Project
U.S.	SDG&E Grid Communication System
U.S.	Secure Interoperable Open Smart Grid Demonstration Project
U.S.	Smart Grid Demonstration Project
U.S.	Smart Grid Program
U.S.	Smart Grid Regional Demonstration
U.S.	SmartGridCity project
U.S.	Southern California Edison Company Smart Grid Regional Demonstration Project
U.S.	Southern Company Services, Inc. Smart Grid Project
U.S.	Sustainable Dubuque
U.S.	Technology Solutions for Wind Integration
U.S.	Urban Grid Monitoring and Renewables Integration
U.S.	Vineyard Energy Project
UK	Orkney Smart Grid
UK	Smart Cities
UK	Smart Metering Implementation Programme
UK	Sustainability Appraisal (SA
Vietnam	Comprehensive Urban Development Program in Hanoi Capital City
Vietnam	Golden Hills
Vietnam	Hoa Lac High-Tech Park
Vietnam	Hong Ha Eco City

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Annex B
(informative)

Examples of identified relevant activities

B.1 Summary of relevant concepts or theoretical frameworks

B.1.1 Aalborg Commitments

Title	Aalborg Commitments
Proposer	European Sustainable Cities and Towns Campaign/City of Aalborg
Purpose and scope	For European local governments to accelerate their efforts towards local sustainable development aiming at translating a common vision for sustainable urban futures into tangible sustainability targets and action at local level. The Aalborg Commitments are a resource from which local governments' select priorities appropriate to their local situations and needs, taking into account the global impact of their activities. It commits local governments to initiate a local, participatory process to identify specific targets and time frames to monitor progress towards achieving them.
Key aspects relevant to "smartness"	The Aalborg Commitments are one of the most important tools available for local governments to address sustainable development (in Europe).
Indicators or criteria	There are 50 overall objectives (qualitative indicators). For more information see: http://www.aalborgplus10.dk/media/pdf2004/finaldraftaalborgcommitments.pdf
Time frame	None
Application results	To date, 665 local governments have signed.
URL	www.aalborgplus10.dk
Additional description	

B.1.2 Breakthrough by dynamic approach in sewage high technology project

Title	Breakthrough by dynamic approach in sewage high technology project
Proposer	Kobelco Eco-Solutions and Kobe City (in cooperation with Osaka Gas)
Purpose and scope	Co-digestion of regional biomass and sewage sludge Low life cycle cost (LCC), highly functional steel digestion tank system Low LCC new biogas upgrading system
Key aspects relevant to "smartness"	Drastically reduce greenhouse gas emissions Reduce the construction costs based on high efficiency sewage treatment and sewage energy extraction
Indicators or criteria	Reduction of greenhouse gas emissions by ground breaking technology Reduction of construction costs by ground breaking technology
Time frame	2011, 2012

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Application results	Regional biomass intake facilities: - Food biomass: 11t/day; - Wood biomass: 4t/day(proposed). Digestion tank and heating facilities: - Steel digestion tank: 220m3; - High efficiency heat pump: 266kW. Biogas upgrading system gas holder: - Biogas upgrading capacity: 300m3/h; - Cylindrical medium-pressure gas holder: 60m3x3units
URL	
Additional description	The project aims to verify and promote the introduction of ground-breaking technology designed to drastically reduce greenhouse gas emission and construction costs based on high-efficiency sewage treatment and sewage energy extraction. The project began in 2011 under commission from the Nation Institute for Land Infrastructure Management (Ministry of Land, Infrastructure, Transportation and Tourism).

B.1.3 BSI Smart Cities consultation document

Title	BSI Smart Cities consultation document
Proposer	BSI
Purpose and scope	Establishing the conceptual framework for smart infrastructure projects
Key aspects relevant to "smartness"	Conceptual basis Responsively matching supply & demand within the city (incl. resilience) Reducing waste of infrastructure supply Interoperability of systems Interoperability ecosystem (in ITU meaning) Using one datum to supply other channels Delivery channels and horizontal integration & complementarity BSI Rubik cube
Indicators or criteria	Level of interoperability
Time frame	Not applicable (historic document)
Application results	Used for consultation with smart cities stakeholders in the UK and as the basis of BSI strategy for smart cities standardization
URL	http://shop.bsigroup.com/en/Browse-By-Subject/Smart-Cities/?t=r
Additional description	

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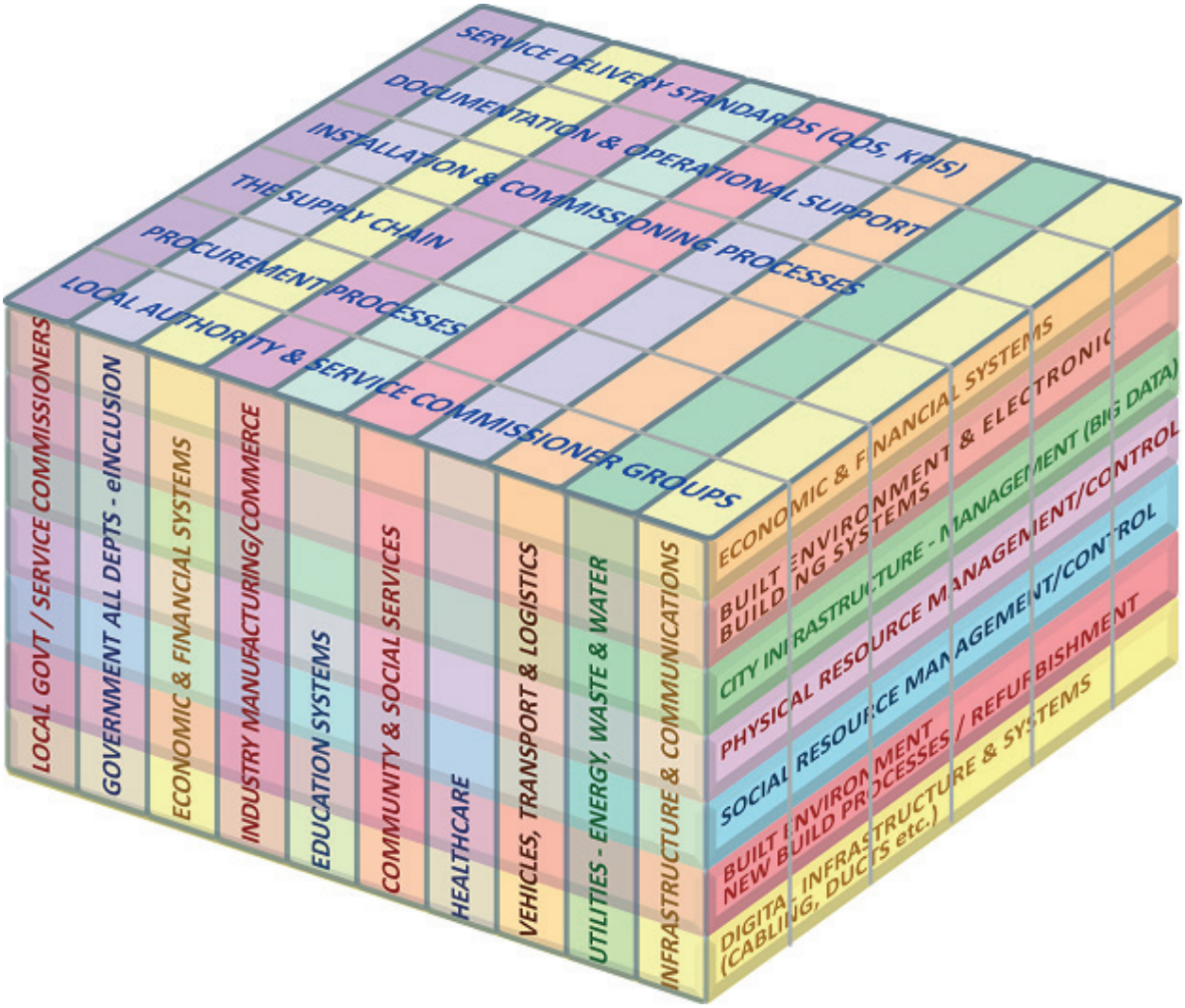

Figure B.1 — BSI Rubik Cube

B.1.4 Global City Indicators

Title	Global City Indicators
Proposer	Global City Indicators Facility (GCIF)
Purpose and scope	The Global City Indicators Facility responds to the urgent need for a globally standardized set of city indicators. The GCIF hosts a network of over 240 cities (and growing) and provides a globally standardized system for data collection that allows for comparative knowledge and learning across cities globally.
Key aspect relevant to "smartness" [a]	The Global City Indicators are designed to assist cities in monitoring their performance of city services and quality of life by providing a framework to facilitate the collection of city indicators. The GCIF includes a set of indicators that are standardized, consistent, and comparable over time and across cities. This standardization enhances the ability of cities to observe trends and to facilitate comparisons with other cities.

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Indicators or criteria	Standardized set of indicators across two broad categories of city services and quality of life. There are over 120 indicators across 20 themes and this current set is still evolving as it is being developed as an International Standard. Examples of city service indicators include: education, energy, finance, recreation, fire emergency, response, governance, health, safety, solid waste, transportation, urban planning, waste water and water. Examples of quality of life indicators include: civic engagement, culture, economy, environment, shelter, social equity, and technology and innovation The indicators under each of the themes were selected on the basis of the following criteria: - answer important questions and tell a story about the city; - available, up to date and able to report against them annually; - readily comparable among cities globally; - relevant for public policy-making and/or linked to established goals (e.g. UN MDGs); - cost effective to collect; - meaningful to cities across the globe regardless of geography, culture, affluence, size, or political structure; - understandable and not over complex; - clear as to whether changes in the indicator are good or bad.
Time frame	Over 240 cities have been reporting on this set of indicator since 2008. This set of indicators is currently being established as an International Standard (ISO 37120 under development by TC 268/WG 2). The scheduled publication date is summer 2013.
Actual application results	Cities use global city indicators for the evaluation of city service and aspects of quality of life in order to ensure better management and planning practices.
URL	www.cityindicators.org
Additional description	

B.1.5 The Green City Index series

Title	The Green City Index series
Proposer	Conducted by the Economist Intelligence Unit Sponsored by Siemens AG, Munich, Germany
Purpose and scope	To focus attention on the critical issue of urban environmental sustainability by creating a unique tool that helps cities benchmark their performance, share best practices, and learn from each other.
Key aspect relevant to "smartness", if any [a]	The Green City Index helps cities to become smarter in a sense that they can minimize their environmental footprint while at the same time accommodating population growth and promoting economic opportunity for their inhabitants.

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