
**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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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;

- 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.	

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.

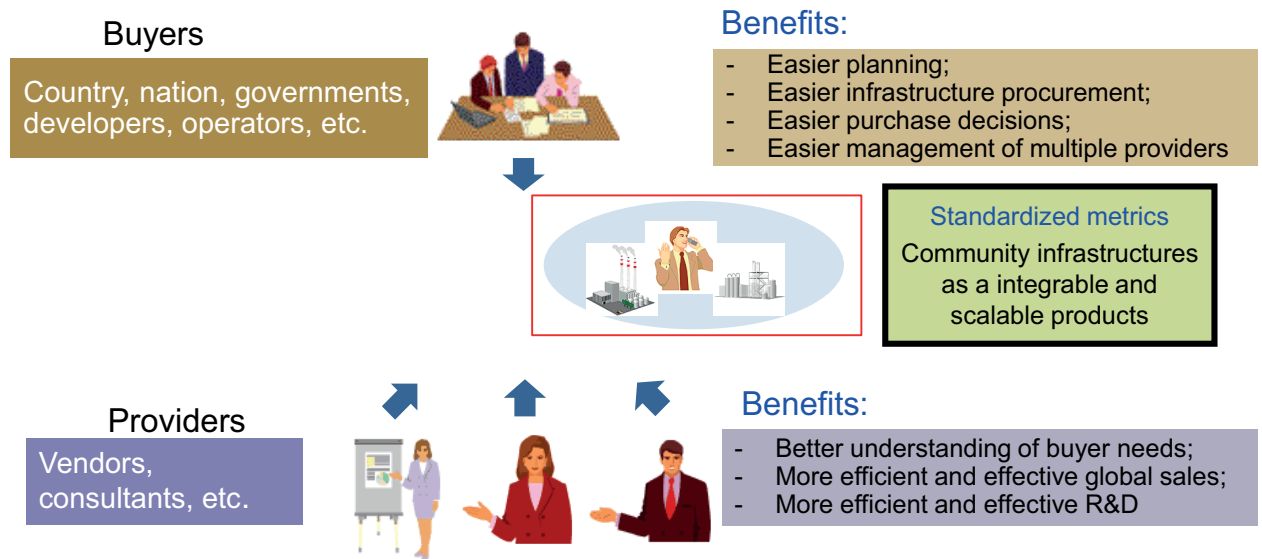


Figure 1 — Users of the metrics and associated benefits

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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]

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.

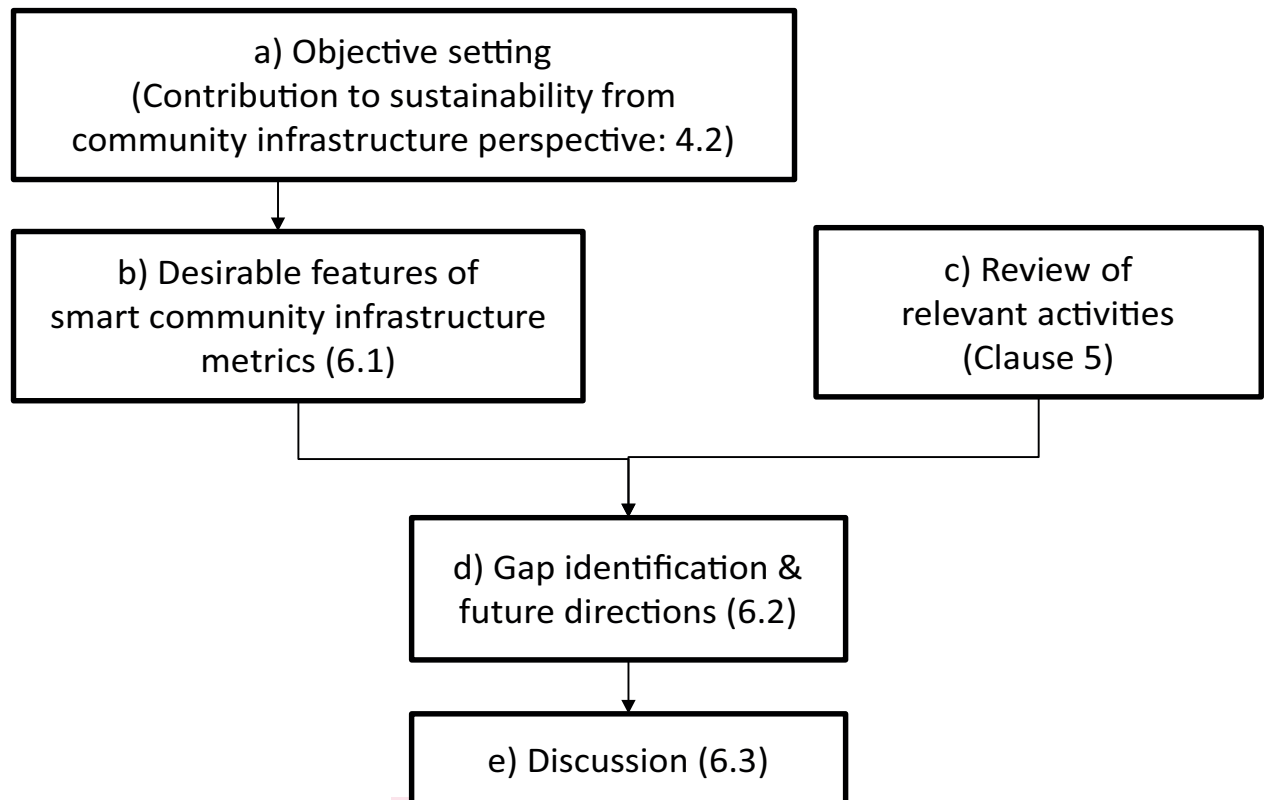


Figure 2 — Approach for developing this Technical Report

- 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

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.

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]					

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]					

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.