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THINK GLOBAL CERTIFY LOCAL

global comparability and regional adaptation for community certification systems exemplified by the water infrastructural components in the community

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DECLARATION
I certify that except where due acknowledgment has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; andany editorial work, paid or unpaid, carried out by a third party is acknowledged.

Anke Jurleit
Hamburg, 2013

Pic. 00-1: Towndevelopment in Hyderabad India - view from Golconda Fort into Hyderabad, 2013 Anke Jurleit

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“Everything is simpler than you think
and at the same time more complex than you imagine.“
(Johann Wolfgang von Goethe)

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ABSTRACT

This dissertation discusses certification systems (CS) for communities and their structure and choice of indicators and methodologies for sustainable water management. An important component of this work includes an investigation of commonly understood best practices for community scale water management and their comparability at an international level, as well as adaptability to different regional settings.

Certification systems are planning tools to foster sustainability by providing evaluation criteria and benchmarks. Historically, certification systems applied to the single building scale; however, as of 2006, these systems have expanded to encompass the certification of entire communities. In order to transition from the building to the neighborhood scale, new criteria and indicators were added to include relevant community scale aspects such as infrastructure and traffic planning, landscape architecture and social criteria.

Despite recent advances in community scale planning, the development of evaluation criteria for sustainable communities on a global level is easier said than done. At present, a variety of countries have developed their own CS with unique evaluation criteria and indicators. This dissertation identified over 20 different methodologies to assess sustainability at the water cycle management level in the community. The lack of common metrics and evaluation methods reveal that the international certification systems sector is far from being standardized. This raises three questions:

Firstly, whether current CS select, integrate and foster commonly understood best practices for water management; Secondly, the applicability of a single international CS to varying geographic, climatic and socio-economic communities; finally, the integration of relevant indicators for the documentation of sustainability progress. Sustainability indicators comprise an essential component in the overall assessment of progress towards sustainable development. (McLaren and Simonovic 1999) Based on commonly established indicators and best practices for community water quality and quantity management, a core framework will be developed. This framework will focus on the necessary steps CS must undergo for successful development on the international and regional scale, including:

- Following a standardized procedure
- Striving for international comparability based on appropriate indicator selection
- Catering to regional adaptation
- Deriving data from indicators and enabling documentation of sustainability progress
- Providing comparable data for monitoring, proofing and revising measures, which in turn justifies CS credibility

The developed framework constitutes a common procedure in order to achieve best practice for community water quality and quantity management, a selection of globally accepted core and secondary indicators and a three step process for adaption to regional settings.

A case study of Hyderabad, India, will describe the application to a certain regional settings.

The results of the case study show that it is important to first have an understanding of commonly understood best practices, and that a set of comparative indicators can provide valuable input when it comes to comparing best practices as well as monitoring their progress. The case study also shows the associated restrictions and uncertainties when it comes to the assessment of sustainability at a global level. Ultimately, a core framework with common methodologies and shared data sets across different regions will help to make informed decisions, monitor progress for possible revision making and justifies the further existence of CS themselves.

keywords:
Certification systems, sustainable communities, water infrastructure planning for sustainable communities, Ecoblock, key performance indicator, water budgeting

Summary

This paper discusses the practice of community certification systems (CS) at an international level towards gaining a best practice understanding of their ability to perform at a regional level. Certification systems are planning tools to foster sustainability by providing evaluation criteria and benchmarks. Historically, certification systems applied to the single building scale; however, as of 2006, these systems have expanded to encompass the certification of entire communities. In order to transition from the building to the neighborhood scale, new criteria and indicators were added to include relevant community scale aspects such as infrastructure and traffic planning, landscape architecture and social criteria.

Despite recent advances in community scale planning, the development of evaluation criteria for sustainable communities on a global level is easier said than done. At present, a variety of countries have developed their own certification systems with unique evaluation criteria and indicators. This dissertation identified over 20 different methodologies to assess sustainability at the water cycle management level in the community. The lack of common metrics and evaluation methods reveal that the international certification systems sector is far from being standardized.

The main objective of the dissertation was the development of a *Best Practice framework of key planning steps* for water cycle planning in communities with relevant *Key performance indicators* (KPI) and the integration of both tools into certification. Both tools attempt to create a common ground of understanding at a global level and therefore reduce complexities associated with the different approaches apparent in certifying. Different approaches show the comparative analysis of selected CS (cf. chapter 3.3). Stemming from the variety of national backgrounds, the lack of a common understanding raised the question of whether the systems operate towards best practices and their original purpose of:

• being able to compare across places and situations
• assessing conditions and trends in relation to targets
• providing early warning information
• anticipating future conditions and trends
(Gallopin, 1997, p.15)

Critics describing this problem see one of the main reasons in the brisk development of CS fueled by rapid urbanization and point out “signs of cracks and fissures (...) ranging from concerns about the quality of multiple new services, to larger issues about maintaining environmental and scientific integrity.” (Baker, p.2, 2004).

Consequently the following hypothesis with research questions were developed:

“Certification systems (CS) have neither the necessary structure nor the appropriate sustainability criteria to be comparable at an international level nor are they applicable at regional scales.”

Leading research questions therefor are:

» How are commonly understood best practice standards and procedures for sustainable water cycle management in the community described? Can a global common denominator for best practice in sustainable water cycle plan ning be defined?
» Do the criteria and indicators given in the CS conform with commonly understood best practice standards and procedures for sustainable water cycle management in the community?
» What structure and criteria would be necessary for CS to be applicable at an international level and adaptable for regional use? What are existing strategies for international comparability and regional adaptation and how can they be optimized?
» Is a core structure and criteria for international comparability possible, and what are uncertainties and objections of this concept?

Since this paper considers CS as a tool to enable "comparability across places and situations" and "providing a common ground for discussion." (cf. Gallopin), the initial step was the development of a *Best Practice framework of key planning steps* in order to speak the "same language and ask the same questions." (Dickhaut,personal conversation,2013) The developed framework was based on global key policy questions, commonly understood responses at planning and policy levels, and what Trinius points out as an important part in sustainability standardization: to relate to existing approaches and based on known and established sustainability indicators. (UNEP, OECD)

Commonly understood responses to the question of *"Is there a common denominator worldwide for best practice in sustainable water cycle management in the community?*" were formulated as followed:

With the current environmental and anthropogenic pressures of fast rates of urbanization, accordant missing or aging infrastructure as well as the consequences of climate change and extreme weather events, there is a common ground and global understanding for action to reduce, reuse, recycle and recharge our water resources (subchapters 2.1.3, 2.1.4, 2.1.6). As ".. it is becoming increasingly apparent that centralized systems are vulnerable where there are social factors such as high population density and high levels of water demand, and environmental factors such as water stress and flooding. […] A decentralized approach to water management to supplement the centralized system is becoming increasingly attractive, creating a society where water is also managed at a local scale to incorporate the three universal actions for sustainability: Reduce, reuse, recycle" (Wand, 2010, p.2)
This trend towards decentralization and downscaling to guarantee system success on a technical level is introduced as the ECOBLOCK (subchapter 2.1.5), a concept of "an integrated combination of centralized and decentralized management technologies with emphasis on reuse." (Burian et.al, p.58, 2000).
With this planning concept, neighbourhoods can become their own micro-utilities, supplying most if not all of their resources while treating and recycling their water and waste.

While the ECOBLOCK represents an appropriate tool at the urban and project planning level, on a policy level, indicators are the response to the above question.
Organizations in several sectors have developed *Key performance Indicators* (KPI) already, leaving out the community scale. As Gallopin (1997) defines indicators as „variables which represent operational attributes, such as quality and characteristics of a system", they also become a management tool. While describing complex system characteristics in a quantitative way, they help define and measure progress toward system goals. As indicators tend to bridge the gap between complex systems and decision making (Gallopin, 1997), they enable comparative analysis, benchmarking efforts and the support of decision makers.
Key performance Indicators in this paper were defined as tools to be able to monitor success of sustainable water cycle systems in new communities and a total of nine indicators were derived from existing and similar models (cf. ch.2.1.7.1)

In a next step, the *Best Practice framework of key planning steps* and nine *Key performance Indicators* served as a backbone for CS comparability analysis and responding to the question:

„Do the criteria and indicators given in the CS conform with commonly understood best practice standards and procedures for sustainable water cycle management in the community?"

The initial analysis of the CS at first compared the systems amongst each other and revealed, that each system had their own approach. Although a core system structure for certification could be identified, (cf. Fig. 03-10) each system chooses different categories, criteria and indicators to rate. Point distribution and rating mechanisms differ significantly from each other due to weighting, priority, and benchmark setting.

When comparing selected community CS with the *Best Practice framework of key planning steps*, it was revealed that oftentimes 'not all questions according to the framework were asked.' Criteria often stand separate from each other despite coherencies and necessary feedback loops are missing; this ‚linear approach' was identified as not representative of the complexity of sustainability (see 3.2.3 for example and FIG. 03-11 for overall systemstructure).

When comparing the CS with the nine identified KPI, it showed that they were not explicitly represented in most systems; however, often the computations formed part of the certifying process that would eventually feed into the KPI. Comparability is given at the level of defined Key Performance Indicators (KPI, cf. ch.3.2.3). This meant that CS at this point already provide the information necessary to be able to compare performance through KPI.

The additional instrumental value of KPI measuring progress towards defined benchmarks through the PSR cycle (cf. subchapter 3.1.4) was not installed in most CS. This cycle of setting benchmarks and revising them throughout the performance of a project is seen as a major contributing factor to make CS themselves credible (cf. chapter 4.4)
As Lang and others note the difficulties of the choosing and weighting of indicators as a subjective act, it becomes clear, that standards must be subjected to permanent revision. They become credible by continuously being believably observed, measured and reported upon. A lot of the documented CS have already gone through several rounds of revisions. However, the necessary flexibility and adaptability of the standards revision through the PSR cycle (cf. subchapter 3.1.4) for many CS is not yet in place. Doing so would guarantee the credibility of the standards set. (also refer to Point 3: credibility of the CS itself, cf. to subchapters 2.1.3 and 2.1.3 Benchmarking - the first step to rating in particular)

Based on this analysis the following was defined as steps CS must undergo for successful development on the international and regional scale:

- Follow a standardized procedure (*Best Practice framework of key planning steps*, cf. chapter 2.2)
- guarantee international comparability by incorporating appropriate indicator selection (cf. *Key performance indicators*, ch. 2.1.7.1)
- Follow regional identified adaptation mechanisms through adding impact factors, weight, and benchmarks according to local understanding and conditions (cf. casestudy, ch. 4.2.1, Fig. 04-7)
- based on the PSR cycle derive data from indicators, enabling documentation of sustainability progress (cf. 2.1.7, Fig.02-11)
- Provide comparable data to international umbrella organisatin (WorldGBC) for monitoring, proofing and revising measures, which in turn justifies CS credibility (cf. casestudy, ch. 4.2, 4.3, Fig. 04-6)

The visit to Hyderabad allowed for the examination of contextual building and certification alike. Several interviews with green building staff and various other stake- and shareholders gave insight into the status of community water cycle planning at large, as well as at the township level. Visited sites gave a picture of how certification impacted the planning, construction, and maintenance of the projects. Taking the status of the township CS into account, conclusions could be drawn towards international comparability and regional operational capacity. Green building staff gave much insight into the further regional actions necessary to "make the case of certifying in its entirety successful." (Anand ,personal conversation, 2013)

Together with IGBC staff steps to elevate the IGBC community CS to an international level were discussed and in addition to the above steps a cohesive roadmap for overall regional success in building "green" was developed.

This step described as ‚total regional success' involves the broad spectrum of necessary stake- and shareholders. One interviewee pointed out the importance of Post occupancy evaluation (POE) and the involvement of residents as a checkpoint of how green the project really is: „Another very important aspect missing in the CS is to set actual benchmarks for consumption. However, it is not enough to require low flush toilets in the certification systems when you later on realize that residents demand up to 200 l per person per day." (Anand, personal conversation, 2013). „This aspect is just one of many reasons to put Post occupancy evaluation (POE) on the top of our priority list for green building activity and rating. We need to make sure even more, that green building is an economical success by involving and educating residents and associated project developers."(Anand, personal conversation, 2013). ‚Educating green' is well described in a network Australia news article on ‚India's youth': „The quality of higher education in India is poor. Accreditation for universities and colleges is voluntary, and a bill to regulate them has spent the past three years caught up in a parliamentary logjam." (Australia network, 2013), which ultimately leads to students „not learning what the new technologies and market is about". (Australia network, 2013) IGBC's broad and widely recognized student initiatives are a response to this gap. Only a three month stay in Hyderabad allowed to extensivley discuss IGBC's ‚Roadmap to total regional success' gathering the important aspects which are key for an overall regional implementation of green building and certification alike. Council business segments and various other layers, such as involving partner from academia and research, industry and planning, were put into context for a capacity building strategy (cf. ch. 4.3, Fig. 04-7)

As discussions and talks confirmed the need for cohesive data and indicator computation, one major hurdle of the visit to Hyderabad was to immediateley test developed KPI and proposed CS adjustments. The KPI developed in this paper could only partially be tested due to limited data availability: townships were either in planning or pre-certification state and not all components of the *Best Practice framework of key planning steps* were taken into account. In interviews, however, there was no apparent hesitation to provide such data in the future. Older townships in operation could not provide data because accordant metering devices for results reporting were not installed yet.

This become the ultimate crux of the case. As different sets and initiatives of performance measurement and monitoring have been defined in India, the process itself turns out to be rudimentary.
Jane Henley, CEO of the World Green Building Council and widely recognized thought leader in the green building industry, points out the necessity of data retrieval: “Capturing more data on how spaces perform and impact people is the next step in understanding the value of green building.”(McGraw, 2013, p.60) And in the handbook Service Level Benchmarking, the Urban Ministry of India describes the limitations to this aspect, mainly due to the lack of performance monitoring not having been institutionalized: „Every sector has a few key performance indicators that are understood by most stakeholders in that sector. Similarly, in the urban sector too, there have been a number of performance indicators related to urban management and service delivery that have been defined, measured and reported. However, most initiatives in performance management so far have been observed to have some key limitations:

- Different sets of performance indicators have been defined under different initiatives;
- The definition or the assessment method may vary for the same performance indicator, thus inhibiting inter-city or intra-city comparisons;
- Most measurement exercises have been externally driven (by agencies external to the agency responsible for delivery against those performance parameters), leading to the key issue of ownership of performance reports.“

(cf. Handbook of service level benchmarking, Ministry of Urban Development Government of India, 2010)

The indicator approach is easy as long as a particular aspect is measurable (e.g. water consumption l/day/capita). However, when it comes to rating aspects which are not easily measurable, such as cultural and social aspects, Lang says ” The complexity of sustainability, the integration of the different dimensions (environmental, socio, economic) and the open and diffusing content structure of it is the main hurdle for developing a comprehensive indicator set. She later on claims: „indicators are (...) only truly useful if they are ‚owned‘ by the local community and measure issues of relevance locally.“ (The local government management board 1995, p.5) and points out the importance of a multifactoral strategy for building and certifying green.

The Casestudy of Hyderabad showed, that any rating system or indicator system should never be a finished product. In fact, it needs to be a flexible system, open to changes and opportunities for optimization and further methodological development. It also needs the involvement of people - system developers and green building residents alike, not mentioning the various stake- and shareholders of the green building industry to make the entire case of building green communities successful.

The paper concludes, that

Measuring alone will not lead to success

In 2007, a report for the U.S. Environmental Protection Agency stated: “While much discussion and effort has gone into sustainability indicators, none of the resulting systems clearly tells us whether our society is sustainable. At best, they can tell us that we are heading in the wrong direction, or that our current activities are not sustainable. More often, they simply draw our attention to the existence of problems, doing little to tell us the origin of those problems and nothing to tell us how to solve them.” (Hecht, 2007, p. 12)
Under the guiding principles of sustainability, in most cases a more detailed examination is necessary, which goes beyond the complementary indicators. “It is absolutely essential to describe, document and explain the interdependencies of complementary and opposing aspects. This documentation rarely happens.” (Birkmann, 1999, p. 104)
Birkmann points out, what has been described earlier and what is an ongoing discussion in urban sustainability assessment. “most currently available methods still fail to demonstrate sufficient understanding of the interrelations and interdependencies of social, economic and environmental considerations. Many reports on sustainability assessment methods point to the absence of truly integrated urban sustainability assessment methods.”(Adinyira et. Al, 2007, p.6)

This paper suggests a framework and KPI as a first step towards an agreed-upon platform for discussion. However, to make the entire case successful, a range of complex steps is necessary

How can the KPI proposed in this paper feed into or more complex sustainabillity understanding, taking into account water-related sustainability complexities, such as the water - energy nexus, as well as a social and economic understanding?

What else beside the role suggested in this paper can strengthen an international umbrella organisation, such as the WorldGBC, under the influence of more or less competing national green building councils and other larger organisations?

How can the long-term effects of CS be measured and how are they situated among the various other planningtools, regulations and policies? Which policies are supporting of and which are decreasing the effectiveness of CS?

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ABBREVIATIONS

BHW	Basic Human Water Indicator (by Gleick)
BMP	Best management practices (refer to ‚common terminologies‘)
BP	Best Practice
BRE	British Research Establishment
BREEAM	British Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CS	Certifiaction System(s)
CSE	Center for Science and Environment, India
DGNB	Deutsche Gesellschaft für Nachhaltiges Bauen
EEA	European Environment Agency
ESTIDAMA	Arabic word for sustainability
GBC	Green Building Council
GBCA	Green Building Council of Australia
GBI	Green Building Index
IGBC	Indian Green Building Council
IN 1	Indicator 1 / WAI - Water availability Index
IN 2	Indicator 2/ WA ratio - Internal vx. external available resources
IN 3	Indicator 3 / W prod - total waterproduction of recycled resources indicator
IN 4	Indicator 4 / D ratio - demand against Gleick Indicator
IN 5	Indicator 5 / D ratio - demand coverage ratio
IN 6	Indicator 6 / RW share - Rainwater use
IN 7	Indicator 7 / WW prod - % of treated water for re-use
IN 8	Indicator 8 / WW cov - wastewater to demand coverage
IN 9	Indicator 9 / WW treat - wastewater treatment quality index
ISO	International Organization for Standardization
KPI	Key Performance Indicator(s)

ABBREVIATIONS - cont.

LEED	Leadership in Energy and Environmental Design
LEED-ND	Leadership in Energy and Environmental Design - Neighborhood Development
LID	Low impact design (refer to ‚common terminologies')
OECD	Organisation for Economic Co-operation and Development
POE	Post occupancy evaluation
PSR	Pressure-State-Response
SI	Sustainability indicator
TAG	Technical Advisory Group
UNEP	United Nations Environmental Protection agency
USGBC	United States Green Building Council
WGBC	World Green Building Council

COMMON TERMINOLOGIES

What is a Sustainable Community?

There are many definitions for what constitutes a sustainable community, but the Sustainable Community Roundtable of Olympia, Washington explains a sustainable community most succinctly as a place where "resource consumption is balanced by resources assimilated by the ecosystem" (Sustainable Community Roundtable, Olympia, Washington, 2012). Beyond prudently balancing resources, sustainable communities strive to achieve social equity and cohesion, protect and enhance existing ecosystems, and provide for sustainable economic growth (Bonham-Carter, 2010). "To 'green' their own operations," sustainable communities often practice sustainable development and aim to reduce the carbon footprint of its residents, business, buildings, and vehicles through capital projects, and community outreach and education (Nolon, 2009, p. 4).

Why a community focus? Community, township, neighborhood discussion

For this dissertation the word "community" has been chosen to refer to a residential grouping of homes, local businesses, and other amenities that provide the basic physical, social, and economic needs for individuals living there. The term community is popular among authors and researchers (e.g. Patrick Condon, Woodrow W. Clark II, and Claire Bonham-Carter), who are looking at sustainability on this scale. Other sources such as the Indian Green Building Council (IGBC) refer to these mixed-use residential areas as "townships," but in addition to the consensus around the term "community" a township instills the idea of governance and administration over several village or community areas. Alternatively some sources refer to mixed-use residential areas as neighborhoods, like the USGBC in their LEED Neighborhood Design rating system (U.S. Green Building Council, 2009). Since the scale of communities described in this dissertation comes from the ECOBLOCK notion of a residential are that can be largely self-sustaining in energy and water, the neighborhood scale of "400-10,000 units of housing," has the potential to be too large to accurately meet these closed loop goals (Fraker, 2013).

Ecoblock

The Ecoblock concept was developed by a research team at UC Berkeley's College of Environmental Design under Harrison Fraker. The concept revolves around the idea of self-sufficiency, or semi-sufficiency in energy and water needs for a mixed-use residential area. The size of this residential area is largely dependant on the level of resource and energy self-sufficiency the residential area can achieve, and will be the scale of community development referred to throughout this dissertation (Fraker, 2013).

Water infrastructure

Traditionally, the term water infrastructure refers to man-made systems that are responsible for water supply, and wastewater and stormwater disposal (Aspen Institute, 2009). However, sustainable water management / infrastructure must also include the natural infrastructure with rivers and lakes, groundwater aquifers, wetlands etc. because they are affected by the humans' water use.
For the definition of what makes water management sustainable, numerous terms and key words can be found, varying in the diff erent world regions. The most common ones are listed next.

Reduce, Reuse, and Recycle (RRR) / Reduce, Reuse, Recycle, and Recharge (RRRR)

Reduce, Reuse, and Recycle, otherwise known as the three R's or in this dissertation RRR, are commonly referenced when talking about sustainability. The ultimate goals of the RRR concept are to reduce or eliminate waste, energy consumption, and material and resource use. Reduce refers to lowering material and resource consumption and waste through improved efficiency or demand; Reuse refers to having the material or resource remain useful beyond its initial usage for its original or a related purpose; and Recycle refers to reclaiming the components of a material for use with a different purpose (Calkins, 2009). Often the process of reuse and recycling will require treatment of the material to increase its quality; and for recycling this can entail chemically or physically altering the material. Additionally, as this dissertation focuses on the resource of water, a fourth "R" that of "Recharge" will be added to the RRR concept as to close the hydrologic loop, sufficient recharging of natural water storing bodies (e.g. aquifers, lakes, rivers…), is needed. While the "R" of "Recharge" contains elements of recycling water back into the natural ecosystem, and reusing water for urban hydrologic features such as man-made ponds, the ultimate end of the water is the natural hydrologic system.

Carbon Neutral

Carbon neutrality refers to the net elimination of carbon emissions as provided through a reduction of emissions, the generation of energy through renewable non-emitting sources, and the purchasing of offsets for remaining emissions (Vandenbergh et al., 2007).

Water Neutral

Water neutrality refers to a closed loop water cycle where the water consumed is no greater then the renewable water resources available through precipitation, and surface and groundwater recharge (Williams, 2007).

Green infrastructure

is a soil and vegetation-based approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies (US EPA)

Greywater

Greywater is defined as domestic wastewater excluding water from the toilet, and generally includes wastewaters from baths, showers, hand basins, washing machines, dishwashers and kitchen sinks. However, at small scale the heavily polluted sources such as washing machines, dishwashers and kitchen sinks tend to be excluded whereas at larger scale all sources are used to maximize water savings. The most common application for greywater reuse is toilet flushing which can reduce water demand within dwellings by up to 30% (Karpiscak et al., 1990). However, other applications such as irrigation of parks, school yards, cemeteries and golf courses, vehicle washing, fire protection and air conditioning are practiced (Pidou, M. et al, 2008,p.71)

Urban stormwater
Urban stormwater is rainfall and snowmelt that seeps into the ground or runs off the land into storm sewers, streams and lakes. It may also include runoff from activities such as watering lawns, washing cars and draining pools.
(Ontario Ministry of Environment , 2003)

Stormwater
Stormwater is rain, melted snow or any other form of precipitation that has come into contact with the ground or any other surface. This water either seeps into the ground, is absorbed by vegetation, evaporates or runs off the land into storm sewers, streams and lakes. Stormwater can come from any type of land – residential, industrial, commercial or institutional.
(Ontario Ministry of the Environment , 2010)

Rain water
Drops of fresh water that fall as precipitation from clouds.
(City of Edmonton, 2011)

Black water
Wastewater from the toilet, which contains heavy fecal contamination and most of the nitrogen in sewage.
(The World Bank Group, 2013)

Yellow water
an isolated waste stream consisting of urine collected from specific fixtures and not contaminated by feces or diluted by graywater sources; see also urine separating device.
(University of Minnesota Onsite Sewage Treatment Program, 2011)

Primary (mechanical) wastewater treatment
is designed to remove gross, suspended and floating solids from raw sewage. It includes screening to trap solid objects and sedimentation by gravity to remove suspended solids. This level is sometimes referred to as “mechanical treatment”, although chemicals are often used to accelerate the sedimentation process. Primary treatment can reduce the BOD of the incoming wastewater by 20-30% and the total suspended solids by some 50-60%. Primary treatment is usually the first stage of wastewater treatment. Many advanced wastewater treatment plants in industrialized countries have started with primary treatment, and have then added other treatment stages as wastewater load has grown, as the need for treatment has increased, and as resources have become available.

Secondary (biological) wastewater treatment
removes the dissolved organic matter that escapes primary treatment. This is achieved by microbes consuming the organic matter as food, and converting it to carbon dioxide, water, and energy for their own growth and reproduction. The biological process is then followed by additional settling tanks (“secondary sedimentation“, see photo) to remove more of the suspended solids. About 85% of the suspended solids and BOD can be removed by a well running plant with secondary treatment. Secondary treatment technologies include the basic activated sludge process, the variants of pond and constructed wetland systems, trickling filters and other forms of treatment which use biological activity to break down organic matter.

Tertiary wastewater treatment
is simply additional treatment beyond secondary! Tertiary treatment can remove more than 99 percent of all the impurities from sewage, producing an effluent of almost drinking-water quality. The related technology can be very expensive, requiring a high level of technical know-how and well trained treatment plant operators, a steady energy supply, and chemicals and specific equipment which may not be readily available. An example of a typical tertiary treatment process is the modification of a conventional secondary treatment plant to remove additional phosphorus and nitrogen.Disinfection, typically with chlorine, can be the final step before discharge of the effluent. However, some environmental authorities are concerned that chlorine residuals in the effluent can be a problem in their own right, and have moved away from this process. Disinfection is frequently built into treatment plant design, but not effectively practiced, because of the high cost of chlorine, or the reduced effectiveness of ultraviolet radiation where the water is not sufficiently clear or free of particles.
(The World Bank Group, 2013)

Best Management Practice (BMP)
a recommended technique shown to be effective and practical in preventing or limiting harmful impacts to the environment. Best Management Practices include any program, technology, process, siting criteria, operating method, measure, or device that controls, prevents, removes, or reduces pollution. A practice, or combination of practices, that are determined to be the most technologically and economically feasible means of preventing or managing potential impacts.
(British Columbia Ministry of Environment , 2013)

LID - Low impact development
is a site design strategy with a goal of maintaining or replicating the predevelopment hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic landscape. Hydrologic functions of storage, infiltration, and ground water recharge, as well as the volume and frequency of discharges are maintained through the use of integrated and distributed micro-scale stormwater retention and detention areas, reduction of impervious surfaces, and the lengthening of flow paths and runoff time (Coffman, 2000). Other strategies include the preservation/protection of environmentally sensitive site features such as riparian buffers, wetlands, steep slopes, valuable (mature) trees, flood plains, woodlands and highly permeable soils.
(United States Environmental Protection Agency, 2000)

Smart Source Mix
The term is introduced when outlining Best Practice in watercycle planning. When considering wastewater treatment options and afterall the re-using of wastewater, the following aspects shall be the base for deciding which water-/ wastewaterquality appropriate for which use. If all aspects are met at manageable levels, one can speak of a Smart Source mix:
1. Reduced overall capital and operating costs
2. Long system life and system performance
3. Reliability
4. Appropriate wastewater qualities for defined use
5. Energy efficiency

COMMON TERMINOLOGIES - cont.

Waterbalance modeling

„The IWAN model is based on the coupling of the deterministic distributed hydrological model WASIM-ETH (Niehoff, 2002; Schulla, 1997) with the numerical, finite difference based groundwater model MODFLOW (Chiang, 2001; Harbaugh, 1996a, b). WASIM-ETH is used for the simulation of runoff generation as well as water balance within the unsaturated zone whereas MODFLOW simulates the lateral groundwater flow and the interaction with the surface water. The water balance routines of the IWAN model were calibrated and successfully validated for several subcatchments within the Lower Havel floodplain (Krause, 2004a, b). The applicability of the model was tested by event based simulations as well as by perennial simulations of water balance including the simulation of landuse change scenarios (Krause, 2004b, c).“ (Krause, Geophysical Research Abstracts, Vol. 7, 00098, 2005)

WiseWater is a Microsoft ExcelTM based spreadsheet application for projecting reductions in Water Consumption Patterns after application of Environmentally Sound Technologies (ESTs). WiseWater was developed and funded by the UNEP and is designed to understand and experience application of ESTs for conservation of water by reducing consumption at household as well as at property level. It also incorporates a rainwater harvesting technology option at the Property level and a separate component to appreciate city level potential for rainwater harvesting.

Green building council

GBCs by definition are „transparent, consensus-based, not-for-profit coalition-based organizations with no private ownership and diverse and integrated representation from all sectors of the property industry;“ and their overarching goal is promote a transformation of the built environment towards one that is sustainable (WGBC, 2013)

Certification system (CS)

A [...] rating tool sets standards and benchmarks for green building, and enables an objective assessment to be made as to how „green“ a building is. The rating system sets out a „menu“ of all the green measures that can be incorporated into a building to make it green. Points are awarded to a building according to which measures have been incorporated, and, after appropriate weighting, a total score is arrived at, which determines the rating. [Definition by: Green building council South Africa]

Measures

in CSs measures are usually based on a broad intent which are often attached to a quantitative value (e.g.: design property to withstand a 500-year flood)

Conceptual framework

in qualitative research is a written or visual presentation that, "explains either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables and the presumed relationship among them". (Miles and Huberman, 1994, p.18).

Indicator or Kep performance indicator

Key Performance Indicators, also known as KPI , help define and measure progress toward organizational goals. Once an organization has analyzed its mission, and defined its goals, it needs a way to measure progress toward those goals. Key Performance Indicators are those measurements.„In general terms, an indicator is a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (e.g. of a country) in a given area. When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time.“ (OECD, 2008, p.13)

Normalization

In Indicator development normalization is a procedure to make results comparable.

Post occupancy evaluation

„is an „evaluation of buildings in a systematic andrigorous manner after they have been built and occupied"(Preiser 1995). It is a system of analysis which monitors andmeasures the performance of a building using data gatheredfrom environmental, social and energy monitoring. The method includes the use of surveys and questionnaires aswell as technical monitoring to understand the reality of the buildings' performance once occupied.“ (Kansara, T. Ridley, I., p.2, 2010)

Triple Bottom Line

The phrase "the triple bottom line" was first coined in 1994 by John Elkington, the founder of a British consultancy called SustainAbility. His argument was that companies should be preparing three different (and quite separate) bottom lines. One is the traditional measure of corporate profit—the "bottom line" of the profit and loss account. The second is the bottom line of a company's "people account"—a measure in some shape or form of how socially responsible an organisation has been throughout its operations. The third is the bottom line of the company's "planet" account—a measure of how environmentally responsible it has been. The triple bottom line (TBL) thus consists of three Ps: profit, people and planet. It aims to measure the financial, social and environmental performance of the corporation over a period of time. Only a company that produces a TBL is taking account of the full cost involved in doing business. (The economist, 2009)

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Chapter 1.0
Introduction

1.1 The broader context
1.2 Research design and methodology

In 2030,
47% of world population will be living in areas of high water stress

By 2030 the number of urban dwellers is expected to be about 1.8 billion more than in 2005 and to constitute about 60% of the world's population. As the ***urban population increases***, many major cities have had to draw freshwater from increasingly distant watersheds, as local surface and groundwater sources no longer meet the demand for water, or as they become depleted or polluted

Water withdrawals are predicted to increase by 50 percent by 2025 in developing countries, and 18 per cent in developed countries

new forms of planning instruments and governance are needed to quickly react towards such drastic changes

FIG. 01-1:
Facts about water by the Stockholm Institute ((The Stockholm International Water Institute, SIWI, 2013)

Pic 01-1 Hussain Sagar Lake in Hyderabad, India
Jurleit, 2013

1.1 The broader context

In the face of the 21st century's pressures of accelerated population growth - mainly in developing countries - climate change, and often-unplanned urban growth, represent major challenges to the planning community. (SIWI, 2013; UNEP, 2013)

Such challenges need to be resolved on many levels. Community and infrastructure planning require new planning and technical concepts. In order to carry these out, policies, regulations and planning instruments need to be enforced. Research is needed to form the basis for political action, and new forms of multidisciplinary cooperation between public and private stakeholders will have to exist in order to respond in a timely manner. (Booz Allen, 2007, p.17)

Certification systems (CS) were developed in the 1990s in response to these increasing urban pressures to fulfill mainly two goals: to provide a compact guideline on sustainability aspects for planners while simultaneously serving as a marketing tool for project investors. Amidst copious planning tools, CS are referred to as the most current system of implementation, due to their constant revisions when it comes to implementing sustainable and resource-efficient measures for their projects. Because of their self-declared flexible structure, they are marketed as an agile tool of best practice standards to react quickly to globally occurring changes to the built urban environment.

In the US, the US Green Building Council (USGBC) helped drive the integration of sustainable criteria in the built urban environment. The USGBC's website states the certification system for communities "… is expected to improve energy and water efficiency of projects and to revitalize existing urban areas, reduce land consumption, reduce automobile dependence, promote pedestrian activity, improve air quality […] and build more livable, sustainable communities for people of all income." (USGBC, 2007)

Different countries developed their own CS with their own evaluation criteria and indicators. The analysis of the various international certification systems identified over 20 different methodologies to assess sustainability at the water cycle management scale in the community. The lack of common metrics and evaluation methods reveal that the CS sector is far from being standardized. It raises the question of whether CS allow for the comparison of commonly understood best practices. The various methodologies that stem from different national settings raise the concern of the applicability of such systems to different regional settings.

1.2 Research design and methodology

Based on this result, this dissertation will identify a way to make CS comparable under commonly understood best practices, as well as create a framework based on common indicators, which allow for comparability and the further monitoring and evaluation of results.

Thematic focus and case study approach

The focus of this dissertation concentrates on CS for sustainable communities. Since communities take some of the largest part in consuming resources while at the same time producing substantial portions of CO_2, to make them sustainable (Condon, 2010) will have a larger impact than creating one single sustainable building. In addition, the author's own experience in community planning and the increasing demand for community certification explains the focus of this dissertation.

Furthermore, CS are analyzed through the water related aspects, representative of all sustainability aspects in the systems. CS were picked based on their comprehensive thematic approach to water cycle planning in communities and also availability of data and staff/ interviewees.

The case study of the city of Hyderabad, India, is used to elaborate the topic of regional adaptation of CS and their internationalization. It also exemplifies the dynamics of the major urban transitions in this century. The challenge of rapid urbanization, a phenomenon many cities in particular in developing countries are facing, is often expressed in the building of large communities. With the Indian Green building council (IGBC) headquartered in Hyderabad, the impact of CS as means to foster sustainability in community building can be put into context in one place.

Research design

The research design consists of three major parts.

The first step (Analysis I) in this process will be to define what is commonly understood as best practice for water cycle management. Chapter two will include the following:

• Identification of current pressures related to community water cycle planning
• Collection of relevant responses at the policy and planning level
• Establishment of a clear set of goals and values based on pressures and responses – the four Rs and the Eco-block concept

Hypothesis

"The certification systems (CS) have neither the necessary structure nor the appropriate sustainability criteria to be comparable at an international level nor are they applicable at regional scales."

Leading research questions:

- *How are commonly understood best practice standards and procedures for sustainable water cycle management in the community described? Can a global common denominator for best practice in sustainable water cycle planning be defined?*
- *Do the criteria and indicators given in the CS conform with commonly understood best practice standards and procedures for sustainable water cycle management in the community?*
- *What structure and criteria would be necessary for CS to be applicable at an international level and adaptable for regional use? What are existing strategies for international comparability and regional adaptation and how can they be optimized?*
- *Is a core structure and criteria for international comparability possible, and what are uncertainties and objections of this concept?*

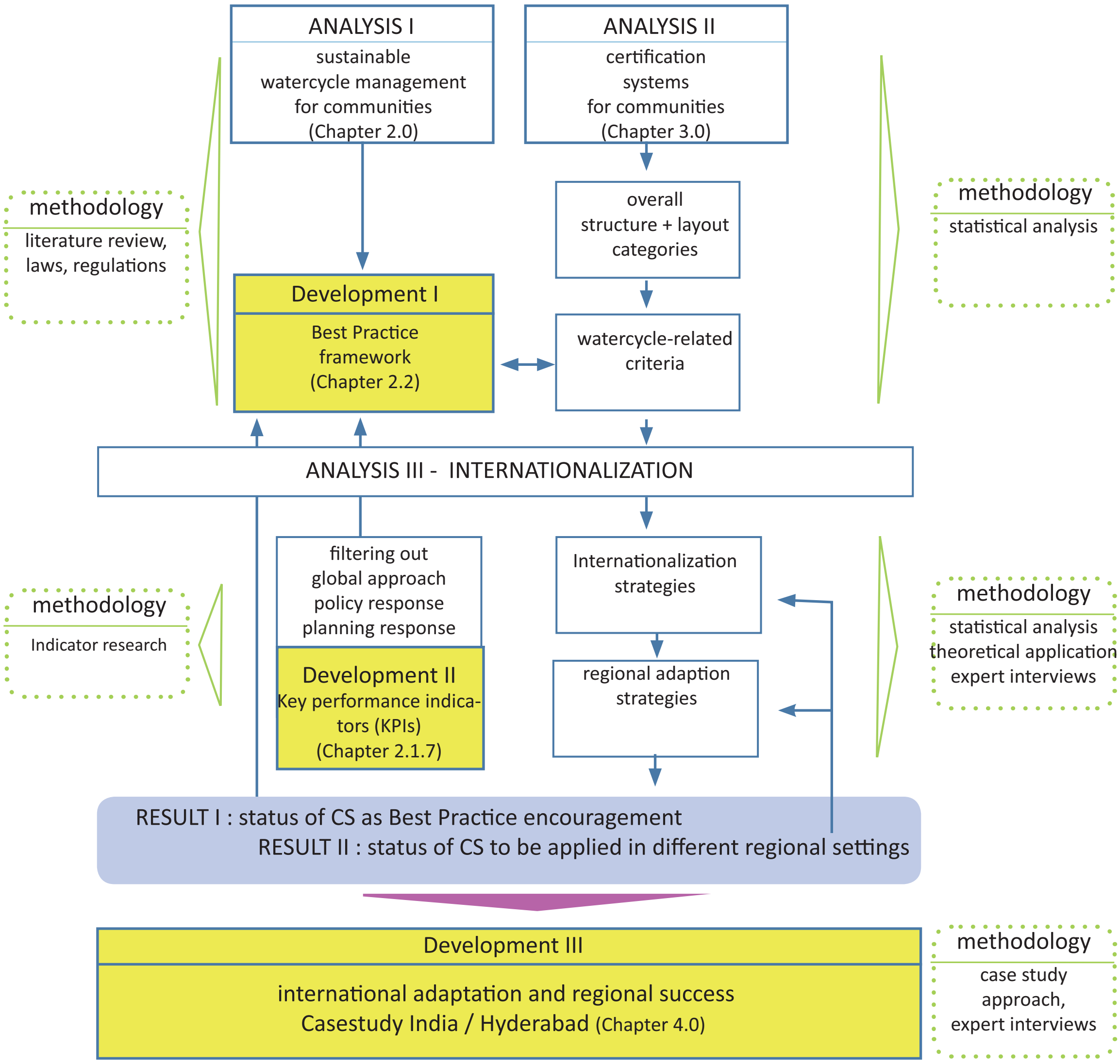

FIG. 01-2:
Research design and methodolgy

•Description of a framework of planning steps for water cycle management in the community that are likely to meet the goals
•Creation of a system that will help monitor outcome and evaluate monitoring outcomes in order to adjust goals
•Presentation of a framework of planning steps as a platform, in order to ask the same questions and identify KPIs so as to provide an avenue for industry collaboration toward a uniform set of metrics that are comparable and agreed upon

The design of a *Best Practice framework of key planning steps* and accordant *Key Performance Indicators* (KPI) towards best practice water cycle management in the community will be the backbone of this dissertation in order to compare selected CS systems against each other. Chapter three (Analysis II) will depict the differences in methodologies and the overall incongruence of the current CS. In particular the following will be explored:
•Does the structure follow a best practice procedure, respect interdependencies, and necessary feedback loops in the planning process?
•Do the CS provide quantitative results that are measurable, comparable and can assess conditions in relation to targets?
•Does the CS process allow for monitoring and re-evaluating success?
•How are CS set up for international comparability as well as regional adaptation?
•How do the CS stand at an international level and how are they regionally adapted?

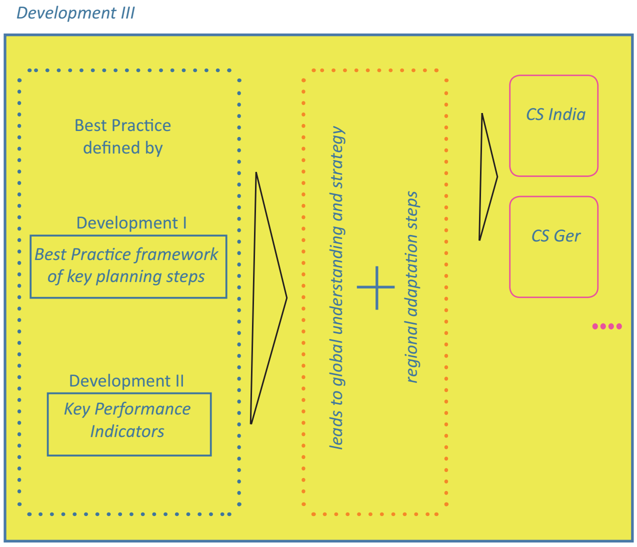

FIG. 01-4:
Development III: Based on Development I and II determine global strategy and regional adaptation and rating steps

The chapter concludes by describing challenges and hurdles in CS development and their applicability at an international level thus far and develops thoughts for catering to a best practice understanding and the ability for international comparability.

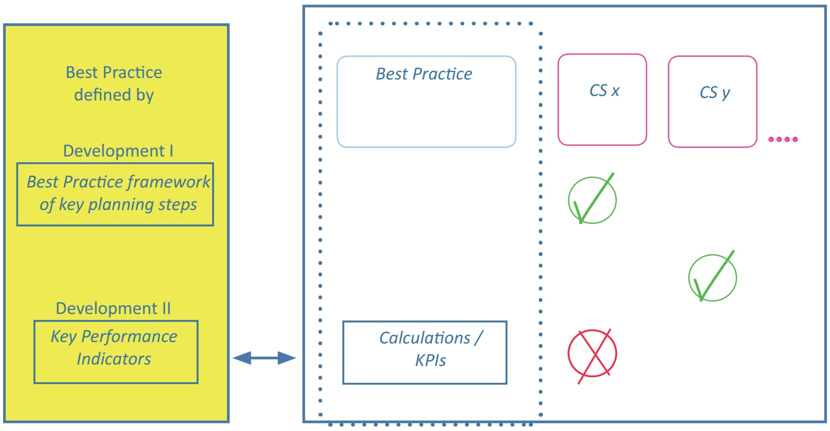

FIG. 01-3:
Development I of a Best Practice framework and Development II KPI for watercycle management in new communites - KPI's are compared with the CSs for Best Practice understanding in CS

In Chapter 4 (Development III), research is put in context and allows for the verification of developed tools and the identification of uncertainties. The two terms 'Internationalization' and 'Regionalization' are clearly defined in this chapter and associated measures for adaptation are described. The Indian context puts the proposed measures into reality and will therefore allow for an examination of the proposed scope.

The conclusion of the dissertation will respond to the formulated research questions and describes recommendations for further action.

Methodology

The methodology used in this study is triangulation, which refers to the use of more than one method to examine the research questions to improve confidence levels of the findings. (Bryman, 2004, p.21) In the case of the dissertation, triangulation consists of an extensive literature and data review, the conducting of interviews, and the case study approach.

» *literature and data review*

The main purpose of a literature review was to assist the study through previous work and knowledge. A review of relevant publications has been conducted over the last 3 years in order to identify current opinions and trends in the field of sustainable community planning, waterinfrastructure planning, certification systems and specifically these research topics in relation to Hyderabad, India. Research and publications are limited to the past 10 years mainly, as the topic is fairly new in research. Literature is referenced to hold up and validate own findings as well as to develop one's own opinion by synthesising with previous work. For the casestudy, data of community projects were asked for.

» *Interviews*

A total of over 30 interviews were held during a period of one year and a stay in Hyderabad in February and March 2013. Interviewees ranged from IGBC professionals to representatives from regional water management agencies, city agencies, and local newspapers. The interviews reflect the participants' views on Hyderabad's approach to water infrastructure management and its evolution in terms of planning new townships, decision making, important institutional and political relationships in the city, and future water management challenges facing the city. However, government and planning reports, news articles, and historical research were also used to supplement the information and insights from the interviews. The interviews were transcribed and coded.

» *Case study + Site visits*

Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Researchers have used the case study research method for many years across a variety of disciplines. Social scientists, in particular, have made wide use of this qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods. Researcher Robert K. Yin defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used (Yin, 1984, p. 23). In the case of this dissertation the Indian Green building council and the City of Hyderabad was taken as a case study to exemplify the findings of this work.

Site visits were conducted and interviews held with staff on site, including project developers, operations and maintenance staff, as well as residents. Three of four visited townships were in full operation, of which two of them were certified. The fourth project was in its construction phase with move in dates planned for the end of 2014.

» *Research limitations*

Research limitations are mainly due to the lack of data availability of associated CS. This also accounts for the community projects (townships) visited in Hyderabad. Chapter 4.4 depicts on this issue.

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Chapter 2.0:
Best practice attempt for sustainable water cycle management in new communities

The UN World Commission on the Environment and Development defines Sustainable development as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Sustainable Community Roundtable, Olympia, Washington says:

> *In a sustainable community, resource consumption is balanced by resources assimilated by the ecosystem. The sustainability of a community is largely determined by the web of resources providing its food, fiber, water, and energy needs and by the ability of natural systems to process its wastes. A community is unsustainable if it consumes resources faster than they can be renewed, produces more wastes than natural systems can process or relies upon distant sources for its basic needs.*
> *(„Sustainable Community |Green Communities | US EPA," para.3)*

Our motto has been one building at a time, and this philosophy has provided a good foundation. However, we recognize that the building by building approach needs to be scaled up. How we green our neighborhoods and districts is the next great challenge (Jane Hanley, CEO, WGBC in World Green building trends 2013, McGraw Hill)

Green buildings and infrastructure, working in concert, save energy and reduce waste on a neighborhood scale. Plugging buildings into surrounding infrastructure, such as tree-lined streets, stormwater treatment systems, and on-site renewable energy sources, creates greater sustainability than green buildings alone can achieve. (From the Neighborhoods Go Green! Exhibition A Curated Exhibit by Chicago Architecture Foundation (CAF))

Pic 02-0 water in the community (Jurleit)

PIC: 02-1:
one of the open water bodies in Hyderabad, India / © 2013, Jurleit

2.0 *Introduction and main objectives of the chapter*

Climate change and increasing urbanization continue to exude significant strain on urban infrastructure systems, demanding a high level of technical and political engagement to ensure adequate infrastructure systems meet present and future demand.
In order to discuss the current status of community water cycle management and where it is headed, it is necessary to understand the technological and political path it has already traversed. This first chapter (2.1.1) provides a historical overview of community water management, followed by an introduction to the current pressures shaping water cycle planning and management today. (2.1.2-2.1.4)
Following, subchapter 2.1.5 and 2.1.6 outline global best practices in community water cycle planning, including a detailed overview of the Ecoblock concept and the four Rs: Reduce, Reuse, Recycle and Recharge.
Subsequently, a foundation of best practices in community water cycle planning at both the global and regional level with focus on India will be presented, along with a *Best Practice framework of key planning steps* and discussion of *Key Performance Indicators* (KPI, cf. common terminologies chapter). The framework and KPI have been developed based upon the following stages below:

- Identification of today‘s relevant pressures influencing community water cycle planning (Ch. 2.1)
- Identification of key responses to pressures at the policy and planning level
- Response and goal based development of standardized *Best Practice framework of key planning steps* (Ch. 2.2)
- Integration of quantitative and qualitative measurements through KPI (Ch. 2.1.7)

The framework serves as a common ground for the analysis of community CS in Chapter 3 and a platform for analogous system development and collaboration toward a uniform set of standards and KPI which are comparable in application, as discussed further in Chapter 4.

The main results of this chapter are:
RESPONSE to research question
“Is there a common denominator worldwide for best practice in sustainable water cycle management in the community?”

With the current environmental and anthropogenic pressures, there is a common ground and global understanding for action to **reduce, reuse, recycle and recharge** our water resources (subchapters 2.1.3, 2.1.4, 2.1.6)

Based on the current pressures of aging or lacking infrastructure, the **trend towards decentralization** and downscaling to guarantee system success on a technical and political level is evident (subchapter 2.1.5)

A common denominator, which can be derived from current pressures, will lead to key policy questions and global responses and is expressed through a standardized **Best Practice framework of key planning steps** with **key performance indicators** for measuring success. Organizations in several sectors have developed KPIs already, leaving out the community scale. KPIs for monitoring success of sustainable water cycle systems in new communities are developed based on existing and similar models. (Subchapters 2.1.7, 2.2)

2.1 Sustainable water cycle management for new communities

2.1.1 Background: the sustainability journey in water infrastructure planning

In his work ‚Water centric Sustainable Communities´ (Novotny et al. 2010, p.6/7) Novotny et al. describes the water sector as a technologically nuanced historical journey comprised of five paradigms:

1. Basic water supply (until 1600s)
2. Engineered water supply and runoff conveyance (until industrial revolution)
3. Fast conveyance with no minimum treatment (until second half of 20th century)
4. Fast conveyance with end of pipe treatment

5. The future and fifth paradigm will consist of “decentralized cluster-based water management [….].”(Novotny et al. 2010, p.98) and will be discussed in detail in subchapter 2.1.5 and 2.1.6

Others rather than looking solely to the technical foundations, such as Brown (see Fig. 02-01), describe the transitions based on cumulative socio-political drivers. Kärrman confirms, the history of urban water systems and particularly wastewater management tells us that efforts have been made to solve one problem at a time (Karrman, 2000 as cited in Lundin, 2003, p.2), which has often led to unexpected effects. This includes solving the sanitation problem in cities through installation of sewers to remove wastewater, thereby causing eutrophication in rivers and lakes, or the construction of end-of-pipe measures in order to reduce emissions causing increasing resource requirements. The majority of these problems are common features all urban water systems face, including increasing water use, pressure on resources, ageing infrastructure and a deterioration of water quality that contaminate sludge and complicates the recycling of plant nutrients. (Lundin, 2003, p.2)

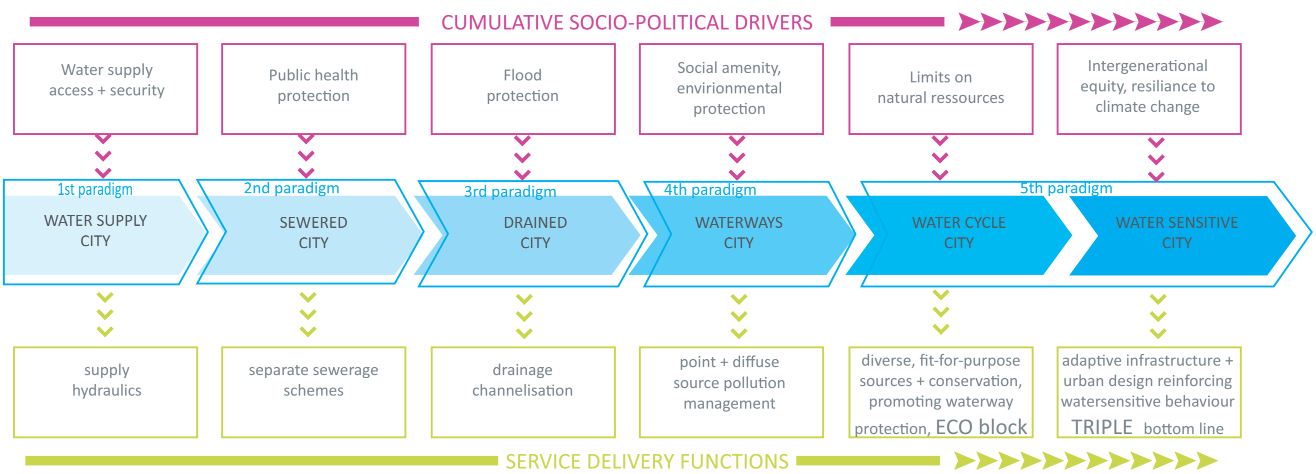

FIG. 02-1:
Urban water management - transition over time from functional to water cycle to water sensitive City (based on Rebecca Brown, 2012)

2.1.2 Pressures - environmental and social-economic

The following subchapter outlines the current environmental and social-economic pressures as they pertain to community planning and waterinfrastructure status quo and future considerations. The focus of India is already taken into consideration.

State of Infrastructure

As we are entering the fifth paradigm in water infrastructure planning (see Fig. 02-1) the formerly positive effect of draining waste and stormwater as quickly as possible, is becoming increasingly associated with problems. Centralized systems do not allow for groundwater recharge and therefore limit available drinking water. Such systems also disturb the smaller water cycles which naturally occur and create a certain microclimate (see paragraph Urban Water cycle) . With heavier rainfalls (see paragraph climate change) the dimensioning of centralized systems is often beyond holding capacities, which results in sewage overflow and flooding.
In India, the city of Hyderabad is facing a widening gap where demand is continuously outstripping supply, regardless of expansions to the supply network (Centre for Science and Environment, 2012). Officially, the city misplaces 30-40 percent of its water through distribution losses, and although "around 60-70 percent of households have metered connections, most are non-functional" (Centre for Science and Environment, 2012, p. 332). Within the city, water is only supplied for two hours every other day, and only one hour in surrounding areas.
In Hyderabad, thousands of kilometers of pipelines carry water from the sources, to the treatment plant (Centre for Science and Environment, 2012). City records reveal "there are over 678 water bodies within a 30-km radius of the city," which have been "encroached upon for land or simply covered up with sewage" (Centre for Science and Environment, 2012, p. 333). The outcome of this includes traces of excreta found in the drinking water (Centre for Science and Environment, 2012). Developing countries, where water infrastructure is often still lacking, are not alone in facing significant hurdles. According to a recent study by Booz and Allen, within the next 25 years, 40 Billion dollars will be spent in developed countries to restore and upgrade existing water infrastructure systems. In established cities with existing infrastructure, municipal planners are faced with falling water tables, aging pipes and leakage, for example „London's current leakage rate is 33%." (Siemens Sustainable Infrastructure report, 2008, p.12).

Urbanization

Within the past decade water has become an increasingly global issue. International institutions such as the United Nations have placed the spotlight on water management proclaiming the period of 2005-2015 as the decade for Action 'Water for Life', and dedicated 2011 in particular to water and the urban challenge.
In 'Triumph of the City', author Edward Glaeser says that in the foreseeable future, the world's population will continue to urbanize and with increasing tendency. While urbanization undoubtedly has significant benefits, such as reducing per capita environmental impacts, urbanization also brings with it significant challenges. These challenges include, providing large, dense, and growing populations with clean water.
On June 1st, 2013 in the state of Goa, India, the town and country planning department announced by 2021 there would be 72 cities and urban areas in the State, and as a whole, by 2030 India will grow from 7,935 urban areas (Chandramouli, 2011) to "36,000 cities and urban areas" (The Times of India). Hardoy, Mitlin, and Satterthwaite note, „the unplanned and uncontrolled physical expansion of cities" creates needs that cannot be met by available resources (2001, p. 175).

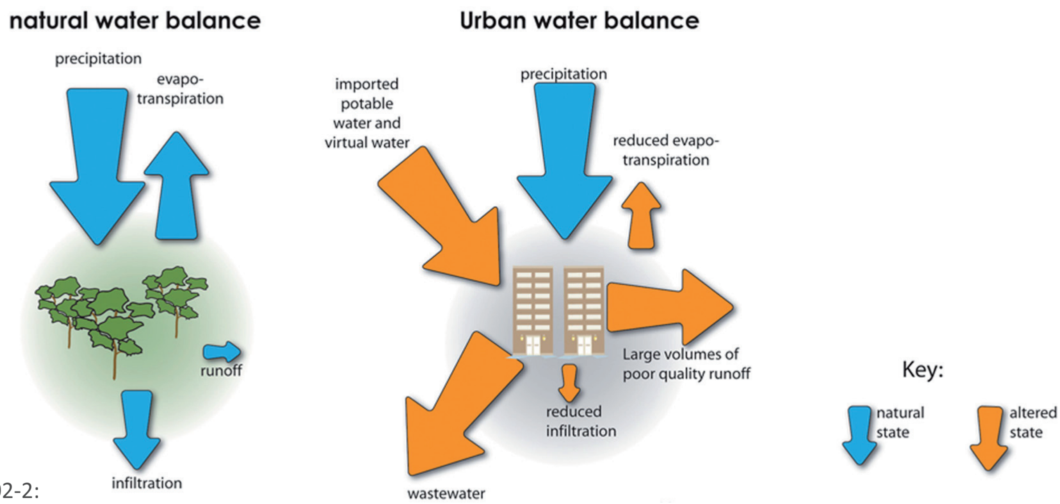

FIG. 02-2:
The urban water balance is an altered state of the natural water balance (based on Hoban & Wong, 2006)

Pressure on resources / increasing water demand

Population growth coupled with industrialization and urbanization increases the demand of water and energy. Over the past century, “water use has been growing at more than twice the rate of population” (United Nations Water, 2006, p. 2). With a population growth of around 80 million people per year, this implies an annual increase in demand of 64 billion cubic meters (Hinrichsen, Robey, & Upadhyay, 1998).

According to the Stockholm Institute, for many cities this will mean drawing freshwater from increasingly distant watersheds, as local surface and groundwater sources no longer meet the demand for water, or as they become depleted or polluted. By 2025, developing countries are predicted to draw 50% more water than today, and 18 % of all developed countries (World Water Assessment Programme, 2006). Currently 60 % of European cities larger than 100,000 people use groundwater faster than it can be replenished (European Environment Agency, 1995). If the entire global population adopted the unsustainable water consumption rates of Europe and North America, 3.5 Earths would be required to satiate demand (United Nations Water, 2013b). This volume of consumption severely contrasts the UN suggestion of 20-50 liters of water per day per capita to meet the basic needs of drinking, cooking and cleaning (United Nations Water, 2013a).

In India, where water demand consistently exceeds available supply, the significant groundwater extraction rates in the region of Hyderabad are unsustainable (Tiwari et al., 2009; Perveen et al., 2012). The extensive growth of cities and irrigated intensive agriculture lead to an ever increasing demand for water that needs to be sought further and further outside of the city.

In Hyderabad, like other parts of the country, ground water levels have plunged due to irrigation use and increasing water demand. The result of this includes bore wells being dug up to 1000 feet (Giri, personal conversation, 2013). In Chittoor the problem is similar, some farmers in desperation are drilling wells up to 700 feet deep in search for water, but to no avail; only few decades ago could be found at 30 to 50 feet (Mander, 2013). While many view the primary issue surrounding water to be its availability, other opinions view negligence in water use as the major culprit (Ranjith V, personal conversation, 2013). The pressures of negligence on water resources stem from the creation of illegal water connections, many in slums, as well as the irresponsible and inefficient operation of private bore wells (Kumar, 2013; Staff Reporter, 2013).

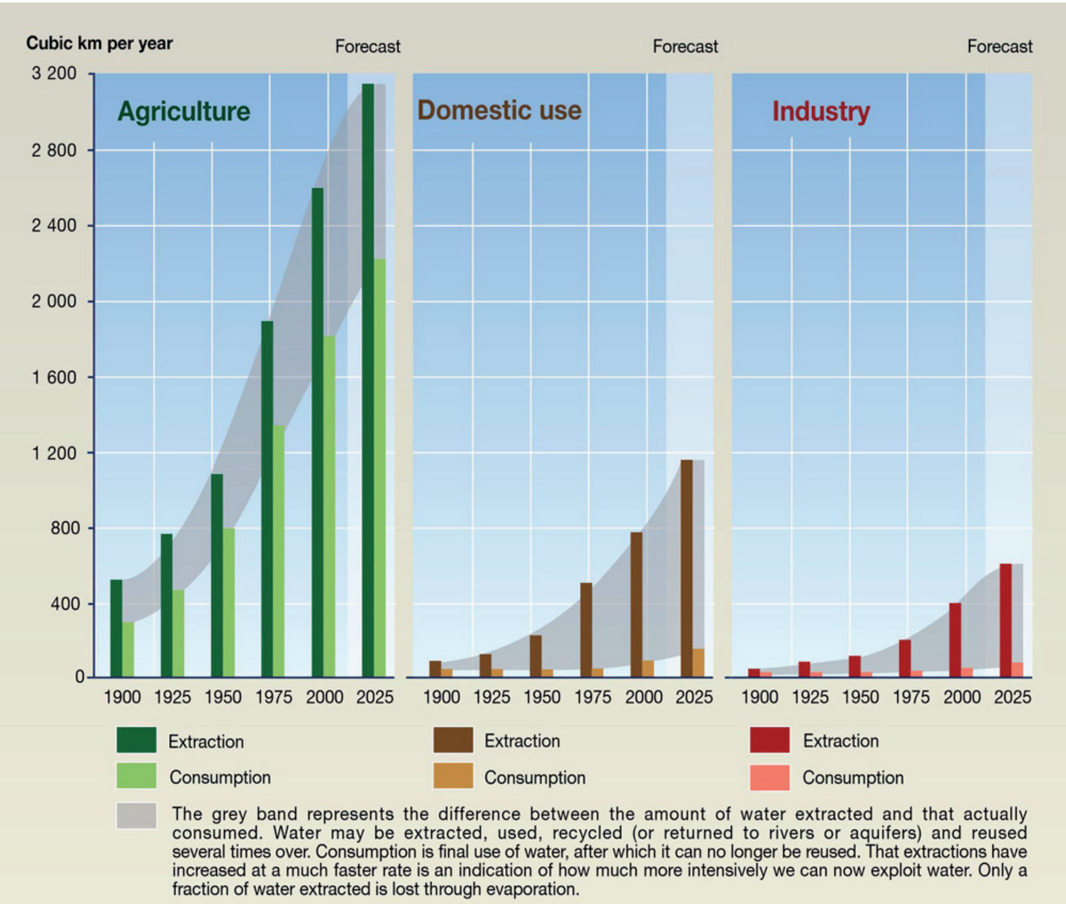

FIG. 02-3: Trends in World Water Use from 1900 to 2000 and projected to 2025. For each water major use category, including trends for agriculture, domestic use, and industry. Darker colored bar represents total water extracted for that use category and lighter colored bar represents water consumed (i.e., water that is not quickly returned to surface water or groundwater system) for that use category. Source: Igor A. Shiklomanow, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris, 1999)

Urban water cycle

The urban water cycle can be described as an altered natural water cycle, defined through human development. Water is usually abstracted from groundwater or reservoirs such as lakes or rivers, then processed to drinking water quality and finally distributed to the various end-users in the community. The drinking water, depending on the use, becomes wastewater of different qualities. In most cases, all wastewater including stormwater from impervious surfaces such as roofs and roads will leave the community through a combined sewage network system. Centralized treatment plants treat the wastewater in order to be able to discharge effluents into receiving waters such as rivers and lakes.

Through the anthropogenic interventions, the natural pattern of infiltration and evaporation is disturbed and communities consequently become warmer and dryer compared to the surroundings (see Fig. 02-2).

Climate change

The consequences of climate change are predicted to increase the variability of available water throughout the world. This manifests itself as longer drought periods coupled with heavy rainfall events. The frequency and severity of these phenomena will hinder the proper recharge rate of groundwater, and disrupt "ecosystems water quality" (United Nations Water, 2013a).

Climate models have predicted that global temperature increases will result in more frequent irregularities in India's monsoon season over the next two centuries (Schewe & Levermann, 2012). Climate change induced drought and flooding will likely result in glacial melting and crop failure (Zens et al., 2011). Additionally, core samples from Himalayan glaciers, which feed into India's major rivers, are suggesting that there has been no net accumulation of ice since at least 1950 (Kehrwald et al., 2008). These factors present serious water resource scarcities in India's future, especially at a time of agricultural growth, industrialization and urbanization.

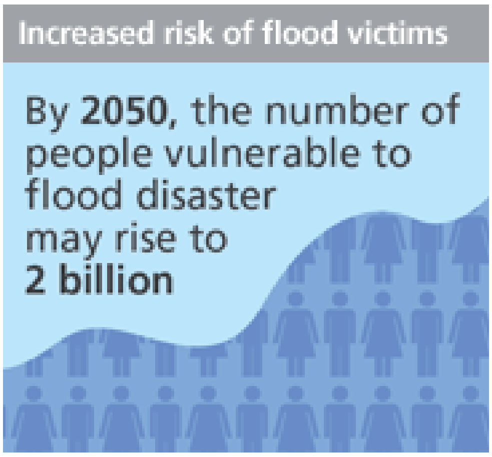

FIG. 02-4:
United Nations Water (2013). Increased risk of flood victims [graphic], Retrieved July 18, 2013, from: http://www.unwater.org/statistics.html

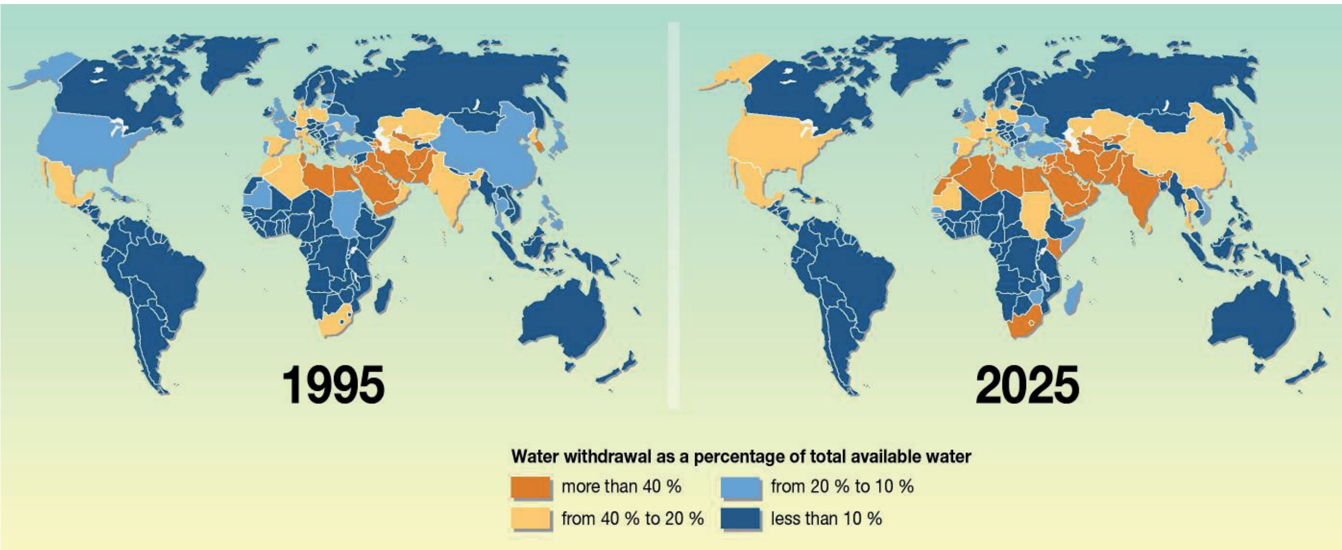

FIG. 02-5:
Countries facing Water Stress in 1995 and projected in 2025. Water stress is defined as having a high percentage of water withdrawal compared to total available water in the area. Source: Philippe Rekacewicz (Le Monde diplomatique), February 2006 and
United Nations Water. (2013). Water scarcity growth [graphic], Retrieved July 18, 2013, from: http://www.unwater.org/statistics.html

2.1.3 Responses - global policies and guiding principles

In 1992, the United Nations conference on environment and development produced 'Agenda 21' a compilation of sustainable actions urban areas are encouraged to pursue over the next decade. Agenda 21 specifically focuses on water through two of its sections, the first being 'Conservation and Management of Resources for Development', the latter through 'Protection of the Quality & Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management & Use of Water Resources' (Section 2, Chapter 18).
Since 1995, conferences on climate change have transpired on an annual basis. In 1997 an important outcome of the third COP (Conference of the Parties) included the Kyoto Protocol which set concrete targets for reducing green house gas emissions to decelerate climate change. In terms of water, that meant prioritizing resource protection, especially in light of water shortages and flooding induced by global warming in many regions through rising sea levels.

It was in 2002, ten years from the Rio Declaration, when the World Summit on Sustainable Development in Johannesburg determined the intermediate results of Agenda 21 and set future goals with the Plan of Implementation. Important driver for climate change activities has been the Intergovernmental Panel on Climate Change (IPCC), a scientific body, with its first report in 1990 and three following releases with the next one underway (IPCC 2011). The first report of 1990 addresses the topic of water in chapter 2.3: 'Hydrology and water resources', giving hints to possible global hydrological changes – in areas with increased precipitation, soil moisture and water storage, and also water availability and impact on agriculture.

According to the report IPCC 1990 (Section 2.3.1), „Future design in water resource engineering will need to take possible impacts into account when considering structures with a life span to the end of the next century. Where precipitation increases, water management practices, such as urban storm drainage systems, may require upgrading in capacity. Change in drought risk represents potentially the most serious impact of climate change on agriculture at both regional and global levels."

In addition, effects on water are discussed in section 2.4.2: „Global warming can be expected to affect the availability of water resources and biomass, affects coastal zones and oceans, and has negative impact on water quality with rising water temperature."(IPCC, 1990).

The United Nations (UN) also influence the international development: The UN set Millennium Development Goals (MDG) to which all 193 UN member states agreed to achieve by 2015.

Goal 7 deals with water issues:

- 7A: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources
- 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss, e.g. proportion of fish stocks within safe biological limits, proportion of total water resources used
- 7C: , Decrease half ofthe proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015
- Proportion of population with sustainable access to an improved water source, urban and rural
- Proportion of urban population with access to improved sanitation

(UNDP n.d.)

The United Nations declared the first UN Water Decade 1990 to 2000 to lay the focus on safe access to clean drinking water and sanitation as it is lacking, especially in developing countries: „However, growth and rapid urbanization, together with the low level of public awareness about health, has drastically reduced many countries' abilities to keep up with need; and today, there are still almost 1.1 billion people who have inadequate access to water and 2.4 billion without appropriate sanitation." (Global Development Research Center, n.d.). The second UN Water Decade from 2005 to 2015 *Water for Life* intends to protect the water resources, and call attention to sustainable water usage (United Nations, 2011).

As the United Nations set global goals, other organizations contribute to the future of water management through the creation of guidelines.

The ISO, International Standardization Organization, committed to providing standardized solutions and guidelines to various industries, created ISO technical committee ISO/TC 224 in the late 1990s. Since then ISO/TC 224 has been developing standards, providing guidelines for service activities relating to drinking water supply systems and wastewater sewerage systems. „Such standards are designed to help water authorities and their operators to achieve a level of quality that best meets the expectations of consumers and the principles of sustainable development." (ISO, 2012)

Originally established to address drinking water and wastewater services, the scope has now expanded to address other pressing water management issues.

The ISO International workshop on water in July 2012 in Japan approached sustainability of water and communities,in particular the ISO aimed to

• Raise awareness of water-related standardization, and its potential to disseminate technology, share knowledge and best practices, and diffuse needed solutions on a global basis
• Propose and examine standardization initiatives to address the global water challenge
• Promote„Stewardship and water management system approaches which consider environmental, social and economic aspects (life cycle assessment — water footprint)

The recently held 3rd European Water Conference in Brussels echoed the key messages addressed by the ISO in July 2012: common methodologies and shared data sets across EU will help to make informed decisions across Europe and bring policies forward.

Among the action items for a revised water policy the following was pointed out:

• Water saving: A significant proportion of EU basins are currently water scarce and this proportion will increase by 2030. The status of groundwater is also worrying. There is a need to maximize Europe's water saving potential and innovation and research can play a fundamental role in this respect.
• Water economy: Economic incentives for more efficient water resources management are needed.
Water pricing should be accompanied by education and awareness-raising related to water demand management.
• Water reuse: Some stakeholders support the development of EU standards for water reuse, underlining the need to have common quality parameters for the reuse of water at EU level.

The Flagship initiative under the Europe 2020 Strategy summarizes this as

, (....) needs a water policy that makes water saving measures and increasing water efficiency a priority, in order to ensure that water is available in sufficient quantities, is of appropriate quality, is used sustainably and with minimum resource input, and is ultimately returned to the environment with acceptable quality.
(EU flagship initiative, 2011)

2.1.4 Responses - global policies and guiding principles in India

In India, the importance of water is known, and the policies of federal and local governments reflect this importance. In practice however, these policies have not been fulfilled to their fullest extent and solutions are often bandages that address the symptoms and effects of water related crises, but avoid confronting the underlying problems full out. As per The Constitution of India, the discharge of wastewater to land or surface water is a violation of the fundamental Right to Clean Environment (Center for Science and the Environment, 2011b). However, this right has largely been ignored across India. In a 2008 report by the Government of India's Ministry of Urban Development, it was reported that, "indiscriminate discharge of untreated domestic/ municipal wastewater has resulted in contamination of 75% of all surface water across" the country (p. 2).

A solution that according to one M. S. Thapar of ADAPT Hyderabad, has been discussed for 30 years, and is in fact mandated in The Constitution of India is decentralization of water supplies and treatment of wastes (M. S. Thapar, personal communication, February 26, 2013). Constitutional reforms of the 73rd and 74th amendments were designed to decentralize the planning, design and implementation of water services to local bodies and townships. Currently there has been little decentralization of infrastructure planning below the state level. Cities where water or sewage infrastructure is proposed or planned are largely unable to act. In an interview, Suresh Kumar Rohilla of the Centre for Science and Environment stated that in this situation state technical experts dominate infrastructure planning, often with a single-minded centralized-planning focus. This methodology is ambivalent to whether townships would be able to operate, maintain, plan, design and implement these projects (Suresh Kumar Rohilla, personal communication, March 7, 2013).

Another response to the mismanaged centralized solutions is the just recently published handbook on `Service Level Benchmarking´ published by the Ministry of Urban Development. It says in the foreword by Dr. Ramachandran: "Recognizing the growing importance of improving efficiency in delivery of basic services in our cities, the Government of India has launched a series of initiatives aimed at enabling urban local bodies (ULB) to meet the (..) challenges." However, the handbook of "a standardized framework for performance monitoring" (MofUD, 2010, p.9) will only succeed, if the "most important stakeholder, the ULBs will sustain this initiative through their capacities and acceptance" (MofUD, 2010, p.9). The lack of decentralized projects in India according to Jasveen Jairrath, a Hyderabad for betterment in water supply activist and water policy researcher, is that water planning authorities are uncomfortable with unconventional technologies, misinformed about the expenses associated with decentralized systems and water recycling, and fearful of planning for future urbanization. An example of these failures can be seen in disappearance of Hyderabad's many lakes and tanks (J. Jairrath, personal communication, March 12, 2013). The city of Hyderabad was originally home to thousands of lakes and water bodies, but now just a fraction of those remain. The lakes of Hyderabad were a very well constructed decentralized system of water storage and predicted and controlled overflow and outflow. Development and the conversion of these areas into land for building have disrupted their effectiveness and capacity (Jasveen Jairrath, personal communication, March 12, 2013). Between 1973 and 1996, 100 lakes were lost due to urbanization and infill, and water sources sought from farther and farther away (CSE, 2012).

The story of Hyderabad's lakes is also one of a newfound appreciation for decentralization. Beginning in 1993, members of the city began to fight to save its lakes, and the city in turn has supported the protection of runoff and recharge for the lakes and tanks (CSE, 2012). In 1996 "Dangerous zone[s]" within 10km of the full tank level were declared, prohibiting development and pollution sources within the area. Residential areas are required to keep at least 60 percent of their area as open green space. The government was required to further protect the lakes and tanks through not hindering stream flow, and in 1997 as per the high courts, to "deny permission for lake, tank, and pond conversion in the state for any purpose" (CSE, 2012, p. 343). The Hyderabad Urban Development Authority affirmed the 1996 and 1997 decrees in 2000, and proposed a buffer area to surround the lakes. In 2002, the boundaries of the water bodies were permanently demarked by the Andhra Pradesh Water, Land and Trees Act. This act also enabled the state agencies to take protective steps against encroachment and conversion (CSE, 2012). Even with the strides in protecting its lakes and tanks, Hyderabad still largely overlooks these water bodies as integral to its water security. Instead "the City Development Plan prepared under the Jawaharlal Nehru National Urban Renewal Mission" (JNNURM) looks instead toward "new sources of water, the Krishna and Godavari," to fulfill its needs (CSE, 2012, p. 343).
There are additional flaws in the JNNURM, which does have reforms in place to provide for decentralization; however the reforms are not at the appropriate scale.

"The JNNURM … which make it compulsory that there should be rainwater harvesting should [promote] reuse and recycle, but the scale of the centralization is the big issue. We need to decentralize but this doesn't mean that we have to do it at the building level; we can do it at neighborhood level or a sector or for 5,000 population"
(Suresh Kumar Rohilla, personal communication, March 7, 2013).

One successful decentralization of water resource management has stemmed from the 1997 Andhra Pradesh Water Resources Development Corporation Act. The act created a corporation to promote the harnessing of river water for irrigation, drinking water, tourism, water recreation, and industrial activities, and also to ensure flood control (Andhra Pradesh Legislative Assembly, 1997). The corporation was given a wide-range of powers to manage the use of water, including the ability to levy water charges. The main success of the act however was in distributing the responsibility for canal maintenance and water management to the Water User Associations across Andhra Pradesh. It was recognized that these associations were able to more efficiently maintain and use the facilities of the Andhra Pradesh Water Resources Development Corporation (Andhra Pradesh Legislative Assembly, 1997).

With the rapid urbanization the Hyderabad Urban Agglomeration is facing, the population is expected to reach 13.6 million by 2021 (Department of Engineering Geology and Hydrogeology of the RWTH, Aachen University, 2011). The swelling population of the city is already too large to meet the water infrastructure needs through centralized systems. Within the city, water is only supplied for two hours every other day, and in surrounding areas for only one hour (CSE, 2012, p. 332). The cities sewage network only covers around 60 percent of its inhabitants, and only some 20 percent of sewage is treated by sewage treatment plants (CSE, 2012). With increasing population, come an increasing volume of water consumption, and an increasing volume of sewage. As the gap between water supply and demand is predicted to increase, it can be assumed that the gap between wastewater generated and wastewater treated will increase as well (CSE, 2012). As Hyderabad struggles to manage its potable and wastewater through centralized systems, decentralized works in the city are showing their merit in small ways.

Decentralization of urban water infrastructure management is already showing its benefits in Hyderabad's Rasoolpura slum. Water line pipe corrosion and sewage influx, as well as other chemical contamination has degraded water quality. With the help of Bhumi, a local NGO, Rasoolpura is grooming leaders to develop and realize solutions to the community's problems of water-sanitation and health, among other issues (Hoffmann, J-H., 2013). By testing three sequential taps along water lines, residents and volunteers are locating areas of corrosion and other contamination. By communicating sources of contamination to responsible authorities, community members are working to update their infrastructure piece by piece. Through these improvements and heightened awareness of contamination sources, the Rasoolpura health situation has improved between 20 and 25 percent since testing began (Hoffmann, J-H., 2013). The ongoing efforts in Rasoolpura verifies the assertion of M. S. Thapar of ADAPT Hyderabad that thinking "city is too big [might lead one to believe] we need big organization to take care of water exclusively to support it, but in contradiction it becomes inefficient to maintain; due to the combination of governance, management, planning, people, affordability and available of resources" (M. S. Thapar, personal communication, February 26, 2013).

2.1.5 Responses at the project planning and design level - the Ecoblock concept Forging the path towards sustainable water cycle management at the community scale through decentralization

The Ecoblock represents what was mentioned as the 5th paradigm in subchapter 2.1.1 and described as decentralized clusters. In a recently in Los Angeles held Symposium on Urban Sustainability, neighborhoods are the right scale to tackle sustainability because they allow for a larger potential to balance loads and match the intermittent supply of resources (Fraker, 2013). Condon reinforces this concept in his book 'Seven rules for sustainable communities', where he cites the opportunities laden at the community level to save resources. He argues, because communities take a large part in consuming resources and at the same time producing substantial portions of CO_2, guaranteeing sustainability entails planning for efficiency as well as social and economical balance (Condon, 2010, p.10).

According to Fraker, a whole new form of sustainable development is possible at the level of 'Neighbourhood scale development´ (from 400 to 10,000 units of housing). At the moment this form of development is relatively typical, both for private real estate developers, but also for cities pursuing urban renewal on underused or `brownfield´ industrial sites all over the world. As a result of this trend, Fraker and others believe neighbourhoods can become their own micro-utilities, supplying most if not all of their energy while treating and recycling their water and waste. "In doing so, the cost and loss of efficiency in distribution infrastructure and transport can be avoided". (Fraker, 2013)

The Ecoblock concept represents a solution to this demand. First developed by a research team at UC Berkeley's College of Environmental Design under Harrison Fraker, it "is self-sustained generating its own energy from renewable sources, harvests rainwater, produces its own water and processes and reclaims its used water". It is replicable on a mass scale, economically viable, resource self-sufficient for water, waste and energy, recycles 100% wastewater on site, reduces 75%+ of potable water demand and generates all renewable energy to 100% on-site.

The Ecoblock concept of being self-sustained or semi-sustained with water needs in particular, shall be the community scale this dissertation defines as the optimal size for a community. The size of a community is determined by, amongst other factors, the percentage of resource self-sufficiency. As most often administrative boundaries control the size of the community, the 'hydrological ecoblock system' is consequently a result of a certain input of external resources with a comparable percentage of internal water sources as shown in Fig. 02-8.

The figure shows the Ecoblock theme at three different detail degrees. (Fig. 02-8.1 - Fig. 02-8.3) Fig. 02-8.1 shows the Ecoblock as a blackbox with an initial input of various possible sources, which according to Ecoblock waterbalance components are external primary and secondary. External primary sources are sources coming from outside of the Ecoblock boundaries and are pure and never treated watersources such as groundwater, surface waterbodies, rivers and stormwater. Secondary external sources are considered treated or recycled waters, such as treated gray- and wastewater. (cf. Ch. 2.1.7.1 Indicators and 2.2 Framework of planning

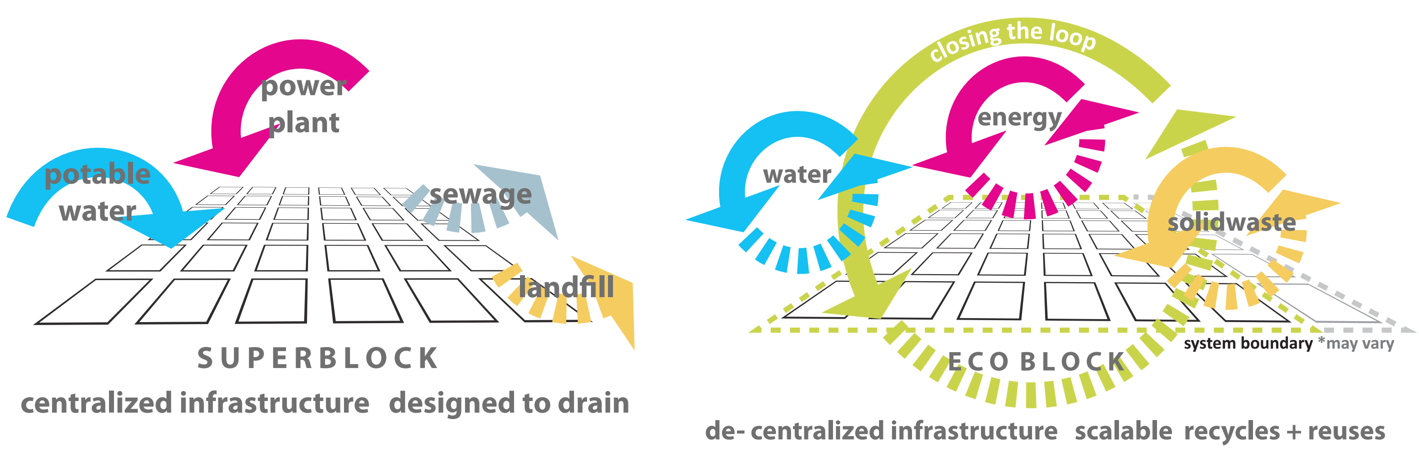

FIG.02-6:
Superblock vs. Ecoblock in community planning

steps). The final output is defined as a summary of discharge and loss leaving the Ecoblock's boundaries. Fig. 02-8.2 details the Ecoblock within defined community boundaries and an internal forward and feedback path. Community boundaries are defined as an overlay of administrative, natural and technical watershed boundaries and may impact the input factor significantly. In addition the initial input path is fed by an internal feedback path substituting necessary external resources (indicated by the + sign). The internal feedback path consists of waterbalance components internal primary and internal secondary. An internal primary source could be a community freshwater lake, internal secondary could be recycled graywater from households.
Fig. 02-8.3 is looking closer at the waterbalance components as they relate to various community subareas. In order to estimate water demands and interdependencies, community areas are divided into a number of classes of water use. This method is called disaggregate estimation of water use. The disaggregate water uses within some homogenous sectors are less variable than the aggregate water use, and a more accurate estimation of water use can therefore be obtained. Therefor interdependencies amongst subareas can be better determined as well. Examplary subareas are:
S1 - Residential housing / people per household / water use purpose
S2 - Commercial and small businesses
S 3 - Institutional
S 4 - Open space
Each subarea will have a sum of demands, a certain loss, storage and discharge. A park for example may have demand for irrigation, losses through evaporation, storage capacity by a lake and discharge of wastewater of a sportsfacility. These components can directly serve other community subareas and serves the concept of Decentralization, further explained in chapter 2.1.6.

Burion et al. describe the Ecoblock concept as "an integrated combination of centralized and decentralized management technologies with emphasis on reuse." (Burian et.al, p.58, 2000), which will have to be re-adjusted according to "population growth and distribution trends, changing development patterns, technological innovations, and many of the other societal factors that have influenced [waste]water management in the past, thatare influencing it today, and that will continue to influence it in the future." (Burian et.al, p.58, 2000)

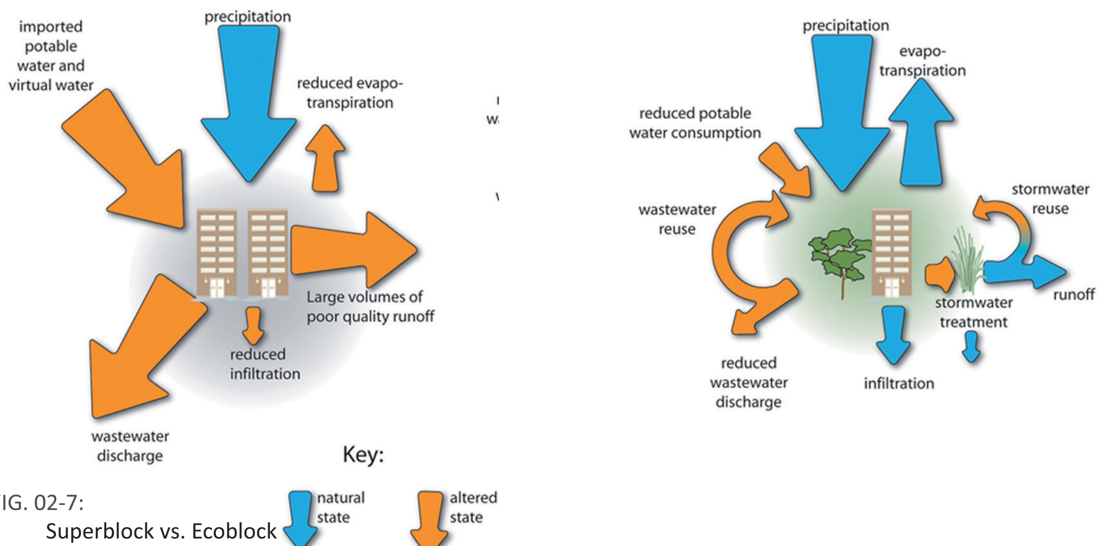

FIG. 02-7:
Superblock vs. Ecoblock in community water cycle planning (based on Hoban & Wong, 2006)

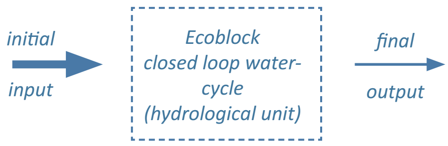

Fig. 02-8.1

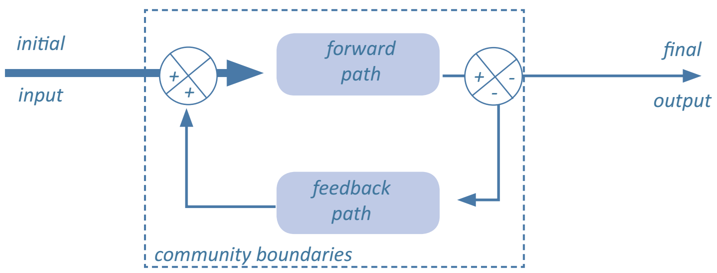

Fig. 02-8.2

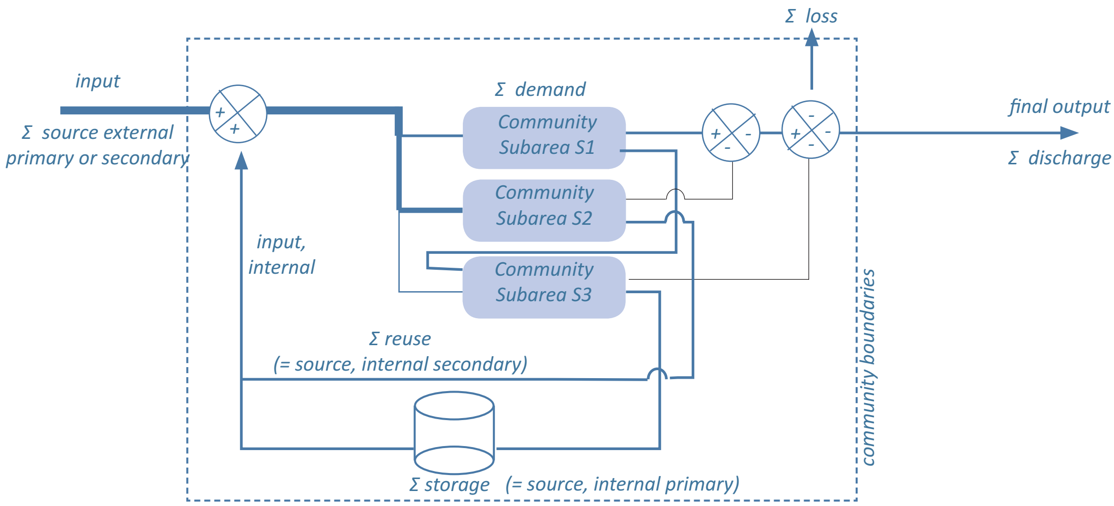

Fig. 02-8.3

COMMUNITY WATER BALANCE COMPONENTS:

Σ sources:
Σ external primary (e.g. freshwater lake , river)
Σ external secondary (e.g.recycled industrial wastewater)
Σ internal primary (e.g. freshwater lake , river, groundwater, rainwater)
Σ internal secondary (e.g.recycled residential wastewater)

Σ demand:
Σ per capita / houshold
(Primary and seconday resources)
Σ public realm
(Primary and seconday resources)
Σ commercial
(Primary and seconday resources)

Σ loss:
Σ evatransporation
Σ infiltration
Σ leakage

Σ storage:
Σ groundwater
Σ retention

Σ discharge:
Σ wastewater
Σ run-off

Fig. 02-8: Ecoblock scheme: dependency of resources within a certain immediate or further environment (input / output), loops within Ecoblock system boundaries as well as the interdepenencies of various subareas

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At the Ecoblock scale, there is little or no waste, and all energy is generated on site. The community becomes essentially a self-sufficient unit, a circular system. It does not require the construction of expensive new power plants, new sewage treatment and water supply outside the system.

The Ecoblock concept visualized: water demand through human use is covered by local internal water sources as well as external water sources (infrastructure)Recharge is only partially possible because of impervious surfaces. Drinking water demand can be significantly at the building level. Here water efficient applicances reduce the flowrate in showers and toilets. In addition, grey- and rainwater can be stored and treated inhouse for toiletflushing or the washing-machine.

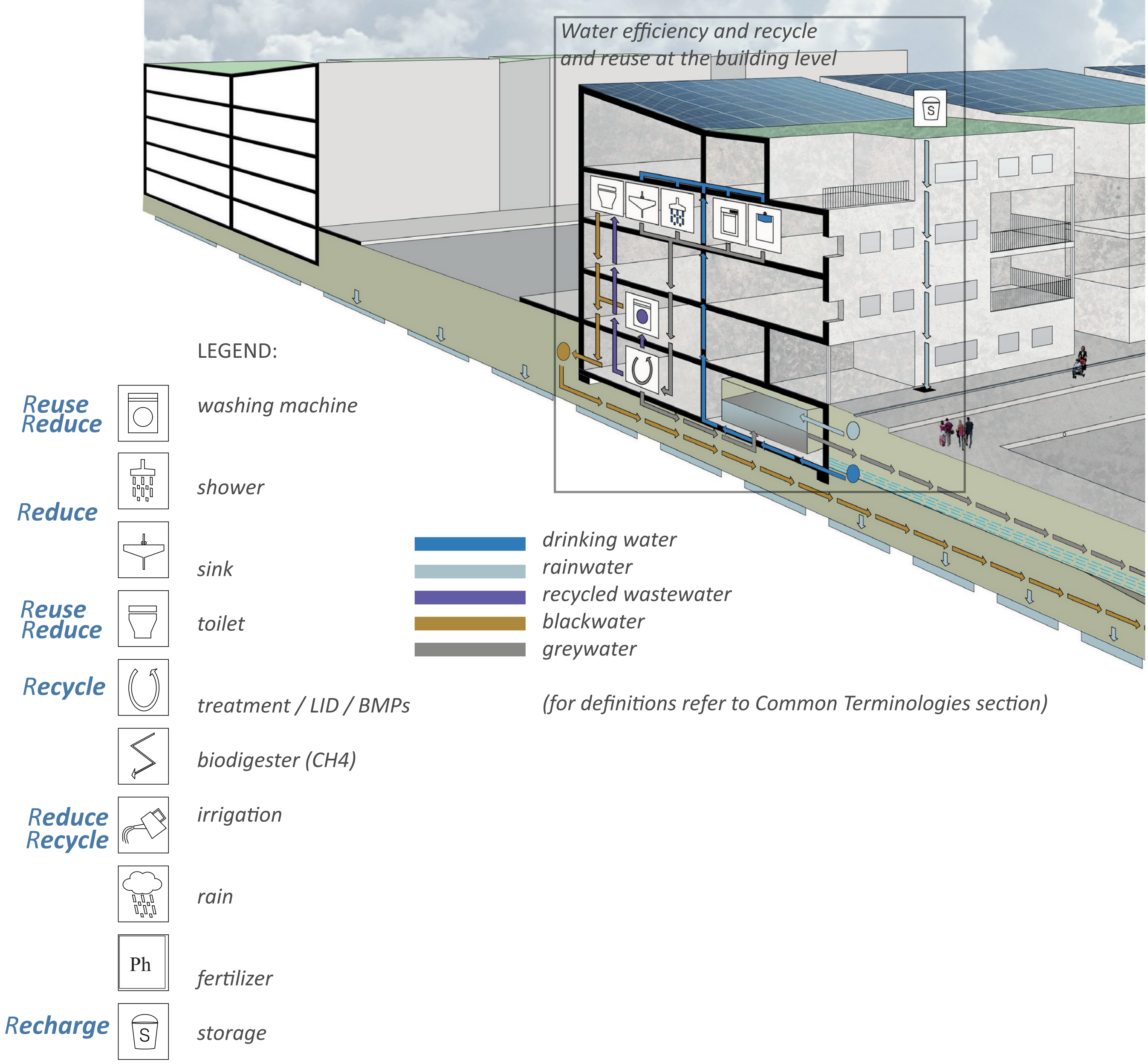
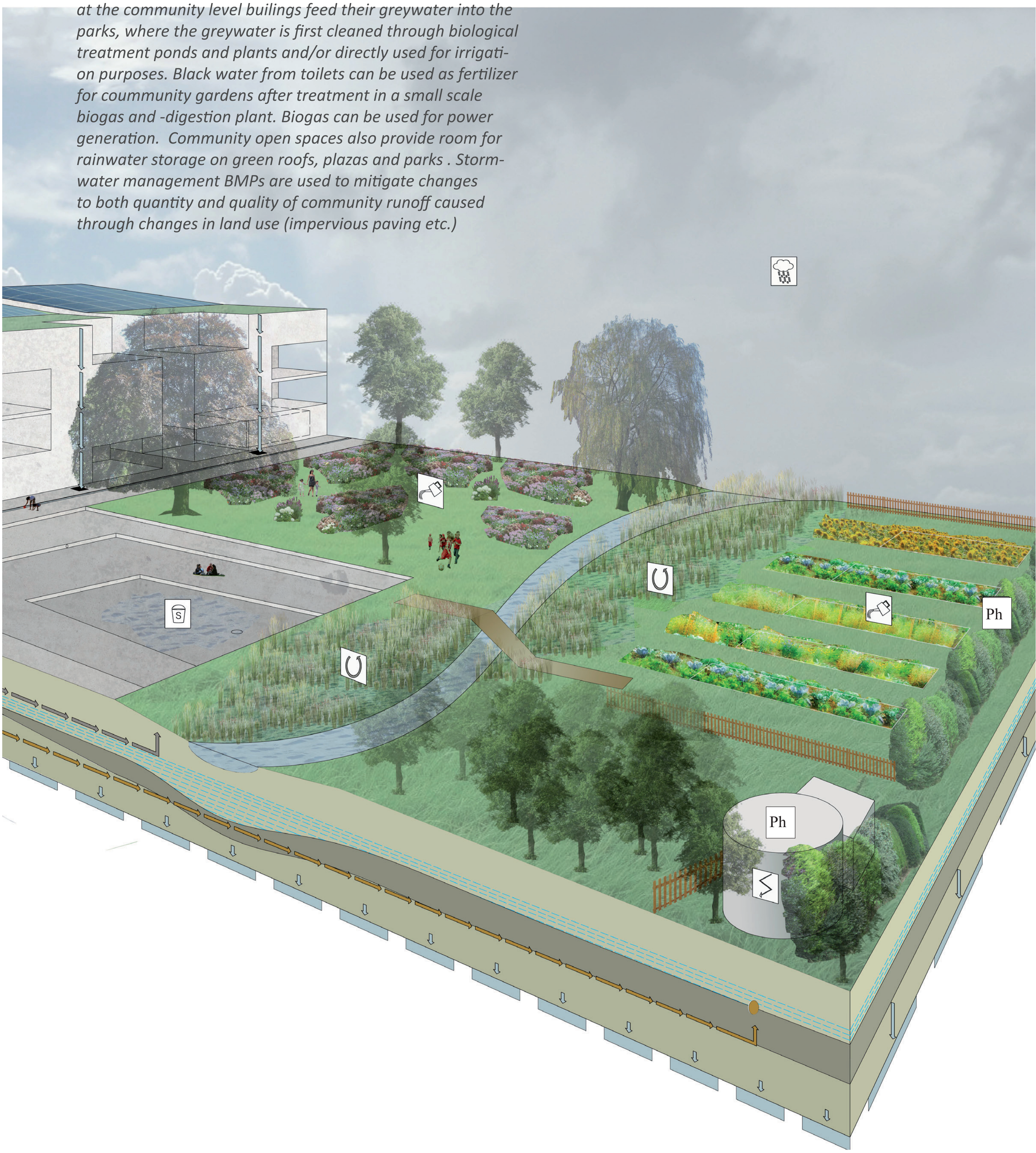


FIG. 02-9:
Community water cycles concept based on 4 RRRRs and decentralization from the natural water cycle because of human intervention

The Ecoblock concept visualized:
at the community level builings feed their greywater into the parks, where the greywater is first cleaned through biological treatment ponds and plants and/or directly used for irrigation purposes. Black water from toilets can be used as fertilizer for coummunity gardens after treatment in a small scale biogas and -digestion plant. Biogas can be used for power generation. Community open spaces also provide room for rainwater storage on green roofs, plazas and parks . Stormwater management BMPs are used to mitigate changes to both quantity and quality of community runoff caused through changes in land use (impervious paving etc.)



2.1.6 Responses at the project planning and design level - Decentralization and the 4 RRRRs

''However, it is becoming increasingly apparent that such centralized system is vulnerable where there are social factors such as high population density and high levels of water demand, and environmental factors such as water stress and flooding. [...] A decentralized approach to water management to supplement the centralized system is becoming increasingly attractive, creating a society where water is also managed at a local scale to incorporate the three universal actions for sustainability: Reduce, reuse, recycle" (Wand, 2010, p.2)

The new water management (5th paradigm, see chapter beginning) will make a switch from strictly engineered systems such as those above to ecological systems including rain gardens, wetlands, ponds, green roofs and ecosanitation. The future of municipal stormwater and sewage management is expected to be decentralized into clusters rather than regionalized.
As a byproduct, water will shift towards being managed in interlocking ways. It will be used, re-used, re-cycled repeatedly in small water cycles. Nutrients from yellow water will be used as fertilizer, rainwater captured and used for irrigation and service water purposes, the heat from wastewater can be put into biodigesters to recover energy. The various different water qualities produced and treated for re-use can significantly diminish the demand for drinking water. Water in the community is not distinguished in drinking water and wastewater, but drinkingwater, rainwater, stormwater, greywater, yellow water, blackwater and others (for terminology and definition refer to Common Terminologies section).

Central components of a sustainable water cycle community are (cf. Novotny, UNESCO-IHP, Grigg, Fraker, Wand et.al):

Reduce +
Reuse + Recycle

In this context according to the author a 4th R needs to be introduced to the equation as water withdrawal often times exceed availabilty (cf. Section pressures). If the environmental need of groundwater and resource recharge are not taken into consideration, the imbalance of supply and demand will harden even more.
Kumar points out that „Recharge is one of the key hydrological parameters for assessment, budgeting, management, and modelling of ground water resources.“ (Kumar et.al., p. 959, 2012) and therefore a functioning community water cycle. The fourth R is called:

Recharge

Decentralization important in developing countries - Particular challenges in developing countries

"As most industrialized countries have invested in major hydraulic infrastructure, many developing countries have as little as 1/100th as much hydraulic infrastructure as do developed countries with comparable climatic variability" (UN report, 2011), in developing countries often times water infrastructure is completely missing. When it comes to developing countries, most are confronted with two major water resources challenges:

- developing the laws, regulations and institutions required for managing water resources
- developing and maintaining an appropriate stock of water infrastructure

In a 2011 UN report on Eco-efficient Water Infrastructure Development in developing countries it says:
"In many countries in Asia, water resources planning and decision-making processes have been dominated by the elites located in capitals. Numerous cases show that such central planning system in water management has caused a deterioration of water supply and sanitation service levels and inefficient flood control measures in local areas. The virtue of decentralization in the water sector lies in the fact that the devolution of the managerial, administrative, and financial power to local areas can promote developmental policies and strategies appropriate for local social, economic and environmental conditions." (UN Mongolia report, 2011)
These failures of centralized water systems can be seen in India as well. In Hyderabad, not only are infrastructure networks insufficient to meet the city's demands, they have also been neglected, leading to waste and contamination. The original sewage network in Hyderabad was built over 80 years ago for a population of 0.4 million (CSE, 2012). Despite being updated in 1985, roughly 40 percent of the population still is not connected to the system (CSE, 2012). Only 133 MLD are treated by the city's five sewage-treatment-plants out of the estimated 600 MLD generated, though that number may in reality be as high as 1000 MLD (CSE, 2012). Corroded water pipes, that often remain empty, allow for bacteria and sewage contamination polluting drinking water (Hoffmann, J-H., 2013). The failure to decentralize responsibility for water supply and sanitation within the municipality has lead to inefficiencies and widening gaps in supply and quality.

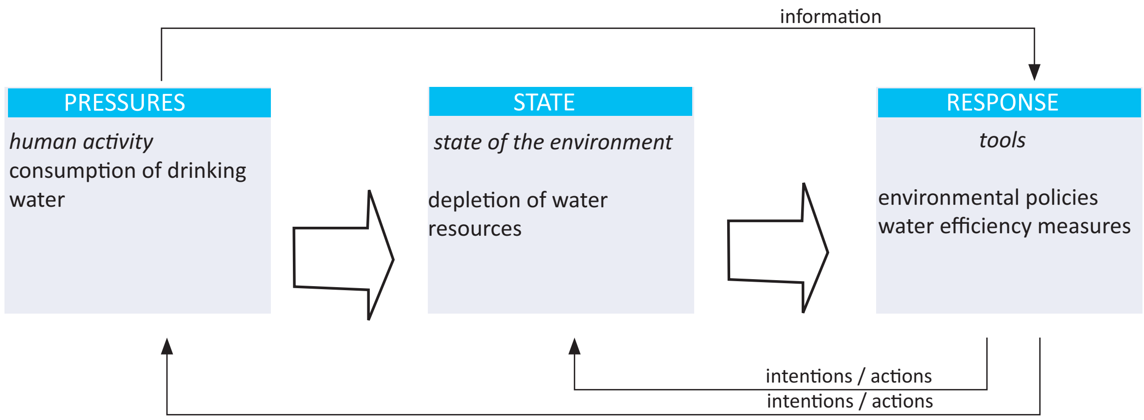
2.1.7 Responses - indicators for measuring progress

Sustainability indicators are seen as an essential component in the overall assessment of progress towards sustainable development. They are useful for monitoring and measuring the state of the environment by considering a manageable number of variables or characteristics (McLaren and Simonovic 1999). Once a concept has been defined the next step is to operationalise "... the process of converting concepts into their empirical measurements or of quantifying variables for the purpose of measuring their occurrence, strength and frequency" (Sarantakos 1993, p.46).

This subchapter summarizes the relevant global indicators by known organisations such as the OECD, UNEP and EEA. In order to measure the effectiveness of general goals and global principles Sustainabilty Indicators (SIs) have become popular. The OECD has been active in the field of environmental information dissemination for several decades, with regular publications on the state of the environment (1979, 1985, 1991), environmental data (since 1984, biennial since 1985) and environmental indicators (since 1991). Initially efforts were concentrated towards producing a first generation of environmental data and establishing state of the environment reports. This was further consolidated and enhanced during the 1980s, when the state of environment reporting became increasingly frequent at national and international levels. The OECD developed a handbook on using the Pressure-State-Response model to develop indicators of sustainabilty in light of "a further need to monitor and assess environmental conditions and trends in order to increase countries' accountability and their capacity to evaluate how well they are meeting their domestic objectives and international commitments. In this context, environmental indicators serve as cost effective and valuable tools." (OECD, 2011, p.2)

Based on the Pressure-State-Response methodology, indicator frameworks in various sectors can be developed." "Pressure" indicators describe environmental pressures from human activities, which influence the environment through emissions and the use of natural resources. "State" refers to the state of the environment, the quality or quantity of natural resources, and provides an overview of the situation in the environment. "Response", describes the extent to which society is responding to environmental changes and concerns." (Lundin, p8, 2003).

The PSR methodology provides an important role in organizing data and information as well as guiding the selection of indicators needed to answer certain questions. Through this process of considering issues in a systematic way, they ensure important considerations will not be overlooked.
Fig. 02-10 and 02-11 show the PSR framework applied to water cycle management in communities and corresponding relevant indicators. Through this model of documenting, monitoring and evaluating project data during planning, building and managing of community watercycles in operations, the often missing normative-actual value comparison in CS would be possible. (compare with Chapter 3.1.4)



The PSR model considers that: human activities exert pressures on the environment and affect its quality and the quantity of natural resources (" state"); society responds to these changes through environmental, general economic and sectoral policies and through changes in awareness and behaviour (" societal response"). (OECD, p.6, 2011)

FIG. 02-10:
Basic model of PSR by OECD, adapted from OECD environment monographs no. 83, Paris 1993 - example drinking water consumption

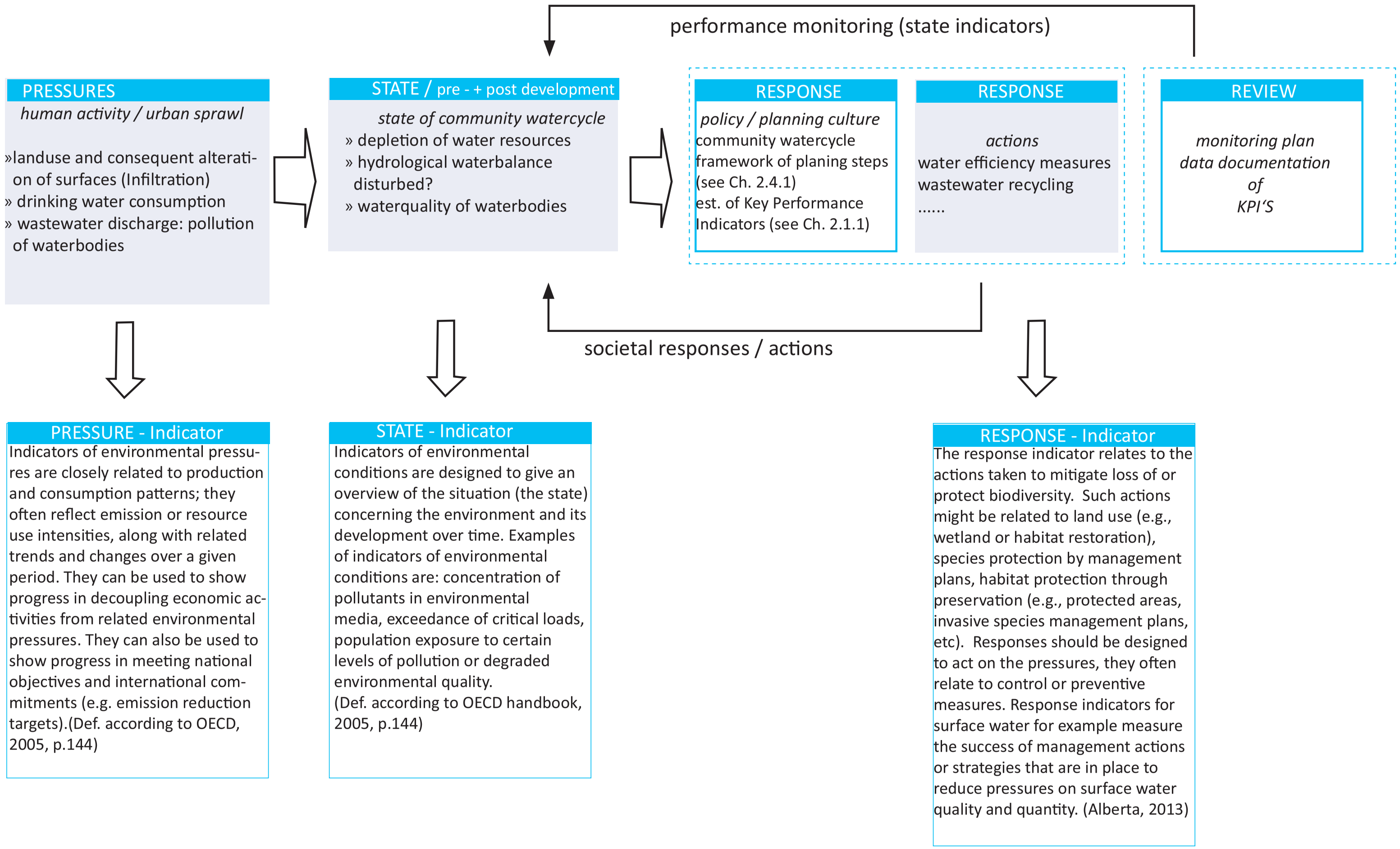


FIG. 02-11:
Basic PSR model by OECD , adapted from OECD environment monographs no. 83, Paris 1993 - to represent community watercycle associated indicators within that framework

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Normalisation of data

"Avoid adding up apples and oranges" (OECD, 2008, p.27)

Normalisation is required prior to any data aggregation as the indicators in a data set often have different measurement units. A number of normalisation methods exist (Freudenberg, 2003; Jacobs et al., 2004 as cited in OECD, 2008,p.27). For this dissertation the min-max range of -1 to +1 is chosen for comparabilty reasons and visual representation.
The OECD points out uncertainties for this method for extreme values: "Min-Max normalises indicators to have an identical range [0, 1] by subtracting the minimum value and dividing by the range of the indicator values. However, extreme values/or outliers could distort the transformed indicator. On the other hand, Min-Max normalisation could widen the range of indicators lying within a small interval, increasing the effect on the composite indicator more than the z-score transformation." (OECD, 2008, p.28)

$$I_{qc}^{t} = \frac{x_{qc}^{t} - \min_c(x_q^{t_0})}{\max_c(x_q^{t_0}) - \min_c(x_q^{t_0})}.$$

Note: x_{qc}^{t} is the value of indicator q for country c at time t. $\bar{c}$ is the reference country.

note: generic formula chosen for Min-Max normalisation, Indicators 1-3 were normalized according to this formula

CRITERION	EXPLANATION
Ease of availability	The indicator itself, or the information from which it is calculated, should already be available, or can be made available easily and cheaply
Ease of understanding	The indicator should be relatively easy to understand
Measurability	To be relevant, the indicator must relate to a measurable entity rather than a concept Readily available or made availabe at a reasonable cost/benefit ratio Adequateley documented and of known quality Updated at regular intervals in accordance with reliable procedures
Significance	The indicator should measure something believed to be important, or should reflect or represent something of significance
Speed of availability	There should be little delay between the element being measured and the availability of the data on this
Pattern of incidence	The indicator should be able to utilise spatial and social information so that a picture of relative incidence rather than simply aggregate impacts is available
Comparability	Ideally, international comparisons should be possible through the use of appropriate indicators, but those chosen should not be selected purely to simplify international comparisons at the expense of other objectives
Policy relevance and utility for users	The indicator should provide a representative picture of environmental conditions, pressures on the environment or society's responses Be simple, easy to interpret and able to show trends over time Be responsive to changes in the environment and related human activities
Analytical soundness	The indicator should be theoretically well founded in technical and scientific terms Be based on international standards and consesus Lend itself to bring linked to economic models, forecasting and information systems

FIG. 02-12:
based on ‚**Seven criteria for selecting 'good indicators**' (Anderson 1991, pp.49-51)
extract from environmental indicators for environmental performance reviews, OECD, 1993
These criteria describe the ‚ideal' indicator , not all of them will be met in practice

2.1.7.1 Overview: resources, main criteria and approach to choosing and designing KPI‘s for community water cycle management

For the following TABLE 02-01 `Selection of Indicators relevant for water cycle planning in the community‘ the below sources were chosen :

- WHO
- UN CSD (comission for sustainable development) Work Programme on INDICATORS OF SUSTAINABLE DEVELOPMENT
- OECD Environmental indicators
- Ministry of Urban development India: Handbook on Service Level Benchmarking
- European Environmental Agency (EEA) - Sustainability Development Indicators (SDIs)
- White Paper of arabian league for proposed water indicators Possible Indicators for SOW Report, Fifth Draft Nov. 10, 2011
- FAO, World Water Council
- ISO
- research paper

The original indicators were taken and checked for thematic and CS relevance based on principles shown in FIG. 02-11 *Seven criteria for selecting ‘good indicators’* (Anderson 1991, pp.49-51) and an extract from environmental indicators for environmental performance reviews, OECD, 1993. These criteria describe the ‚ideal‘ indicator , not all of them are relevant for Certificationsystems and will be met in practice. Therefor the following relevant points were choosing and indicators reformulated according to the purpose of this dissertation:

o Indicator addresses key policy questions, ecoblock and RRRR concept (Policy relevance / cf.: chapter 2.1.5 and 2.1.6)
o Purpose and usefulness of the indicator for monitoring, evaluating for community water cycle planning (Policy relevance)
o Methodologies including calculations and unit of measure guarantee measureability and comparabilty (Analytical soundness, Comparabilty)

How to read
TABLE 02-01 ‚Selection of Indicators relevant for water-cycle planning in the community‘ :

In the `Theme‘ column, each indicator is allocated to one of the four R‘s - Recharge, Reduce, Reuse and Recycle. The column called `Indicator‘ shows the original as well as reformulated indicator, the original indicators show reference and spatial scale in the same called column. Green and red checkmarks show the relevance of the particular indicator to the use in community water cycle planning and CSs. A green checkmark means that the indicator in its original form can be used. A red checkmark shows that the original indicator needs to be re-formulated in order to be applied.
In the `Comments‘ column each indicator is discussed in terms of content, variables to be calculated as well as applicability. Here also, each variable is associated with one of the planning steps in community water cycle planning. These planning steps are developed and discussed in subchapter 2.2.

LEGEND TABLE 02-01 `Selection of Indicators relevant for water cycle planning in the community‘

✓ (green) relevant for CS
✓ (red) relevant with alterations
PS 1.1 - 1.3 — planning step, see subchapter 2.2
original indicator
reformulated to
new indicator

FIG. 02-13:
Overview: resources, main criteria and approach to choosing and designing KPI‘s for water cycle managment in communities

Theme	Indicator	reference / spatial scale

Recharge

Indicator 1 / IN 1

WAI

Water availabilty Index (WAI)

Meigh et al. (1999)
region

$$WAI = \frac{R+G-D}{R+G+D}$$

Index is normalized to the range -1 to +1

-1 = high demand, therefor no wateravailabilty
+1 = no demand, therefor highest possible wateravailabilty

with
R= surface run off
G= groundwater resources
D= sum of demands of all sectors

Total actual renewable water resources (TARWR)

UNESCO-IHP*
global, country

The sum of:

- External water resources entering the country
- Surface water runoff (SWAR) volumes generated in the country
- Ground water recharge (GAR) taking place in the country

TARWR (in km3/yr) =
(External inflows + Surface water runoff + Groundwater Recharge)
- (Overlap +Treaty obligations)

reformulated to

Indicator 2 / IN 2

WA ratio

Internal vs. external available resources (WA ratio)

$$WA_{ratio} = \frac{WA_i - WA_{ex}}{WA_i + WA_{ex}}$$

Index is normalized to the range -1 to +1
-1 = only external watersources
+1 = internal watersources

with
WA_i = internal resources / primary and secondary
WA_{ex} = external resources are inflows into the ecoblock boundary / primary and secondary

Index of water scarcity

$$R_{ws} = \frac{W-S}{Q}$$

Heap et al. (1998)
country region

with
W = annual freshwater abstr.
S = desalinated water resources
Q = annual available water

reformulated to

Indicator 3 / IN 3

W prod

Total waterproduction of recycled resources indicator (W prod)

$$W_{prod} = \frac{W_{fresh} - W_{rec}}{W_{fresh} + W_{rec}}$$

Index is normalized to the range -1 to +1
-1 = no freshwater abstraction, only recycled water
+1 = only freshwater is used to cover demand

with
W_{fresh} = freshwater abstraction
$W_{rec.}$ = recycled resources produced

rec. = recycled resources with
rec. = WW rec Q 1 = treated stormwater
WW rec Q 2 = treated greywater
WW rec Q 4 = treated blackwater
WW rec Q 5 = treated agricultural wastewater
WW rec Q 7 = treated industrial wastewater

TABLE 02-1:
Selection of Indicators relevant for water cycle community

relevance	relevance to Community CS / comments
✓	relevant, R= surface run off is surface water availabiltiy calculated as reliable run off G= groundwater resources is groundwater availabilty calculated as potential recharge calculated from the monthly surface water balance or potential aquifer yield variables are calculated and discussed in: PS 1.1 - 1.3 PS 2.3
✓	relevant, with alterations, this indicator sums up internal and external watersources at the country level by using absolute numbers (km3/yr) The concept of documenting the ratio of internal and external watersources at the Ecoblock level is very relevant and indicator is altered accordingly The specific determinants required are: (1) Actual/natural: indicates whether it corresponds to a natural situation, i.e. a measure of the water balance without human influence, or an actual situation,i.e. the conditions at a given time taking into account human influence eitherthrough uptake abstraction of water or through agreements or treaties. Natural conditions are considered stable over time while actual situations may vary with time and refer to a given period. (FAO, 2003, p xi.) (2) Renewable water resources: Total resources that are offered by the average annual natural inflow and runoff that feed each hydro system (catchment area or aquifer). (FAO, 2003, p xi.) (3) Internal renewable water resources (km3/year): Average annual flow of rivers and recharge of aquifers generated from (endogenous) precipitation that originates within the countries borders. (FAO, 2003, p xi) (4) External renewable water resources (km3/year): That part of the country's renewable water resources which is not generated in the country which includes inflows from upstream countries (groundwater and surface water), and part ofthe water of border lakes or rivers. (FAO, 2003)
	WAi: primary internal watersources are groundwater, surface waterbodies, rivers and stormwater within Ecoblock boundaries secondary internal watersources is recycled grey- and wastewater within Ecoblock WAex: primary external watersources are groundwater, surface waterbodies, rivers and stormwater outside of Ecoblock boundaries secondary external watersources is recycled grey- and wastewater outside of Ecoblock variables are calculated and discussed in: PS 1.1 - 1.4 PS 3.3 - 3.5
✓	relevant, with alteriations, the Index of Waterscarcity is too specific to a certain country level applicaton. However the concept of documenting the ratio of freshwater against alternative resources is relevant at the ecoblock level. Calculation is reformulated to express ratio of recycled watersources over freshwater abstraction. recycled resources are: desalinated seawater, treated graywater, treated wastewater

fresh = freshwater
The definition of freshwater is water containing less than 1000 milligrams per liter of dissolved solids, most often salt. The global distribution of freshwater resources varies greatly from region to region (see Figure 1). An ‚inventory' of Earth's waters shows that approximately 97% of the global water supply is found in the oceans, which are saline. A very small amount of salty water is also located in saline lakes (e.g., the Caspian Sea). The remaining water inventory (3%) is ‚freshwater'. Permanent ice (e.g., continental and mountain glaciers) is the largest freshwater storage on Earth, accounting for about 2% of the total global supply - or nearly 69% of the total freshwater supply. Freshwater is also found beneath the Earth's surface as groundwater (approximately 30% of the total freshwater supply) and in surface water storages such as lakes, streams, swamps and marshes. Minute amounts of freshwater are also stored in the soil, the atmosphere and in biological organisms. (U.S. Geological Survey (USGS), 2006)

variables are calculated and discussed in:

PS 1.1 PS 1.4 PS 3.3 - 3.5

comment:
Indicators in RECHARGE are most difficult because the Ecoblock will in most cases likely be defined by administrative boundaries and not watershed boundaries. Recharge calculations should therefor always be based on a natural recharge rate for the actual property site leaving alone larger occuring inflow and outflow rates. For detailed commentary and modeling options refer to Planning steps 1.1 - 1.4

Theme	Indicator	reference / spatial scale
Reduce Indicator 4 / IN 4 D ratio (Gleick)	**projected / actual demand per person per day** **Basic Human Water Indicator (BHW)** $D_{ratio\ (Gleick)} = \frac{D\ projected\ /\ D\ actual}{50 \frac{l}{d}/person}\ x\ 100\ \%$ minimum drinking water:5 liters/per day/per person required for sanitation: 20 liters/perday/per person required for bathing/hygiene: 15 liters/per day/per person basic requirement for food preparation: 10 liters/day/person *total demand:* 50 liters per person/per day per Gleick BHW Indicator	Gleick (1996) global
Indicator 5 / IN 5 D ratio	**Demand coverage (D ratio)** $D_{ratio} = \frac{D\ projected}{D\ actual}\ x\ 100\ \%$ with D = demand	WSM - DSS Approach community
Reuse ***Recycle***	**% of rainwater use against total demand** Total Rainwater use for all sectors (km3) / Total volume of precipitation (km3)	African Water & Sanitation M & E
	reformulated to	
Indicator 6 / IN 6 RW share	**rainwateruse (RW share)** $RW_{use} = \frac{RW}{D}\ x\ 100\ \%$ with RW = rainwater as % of reliable run-off D = demand	
	Volume Wastewater produced million m3/yr	SOW Report, Fifth Draft Nov. 10, 2011 FAO country
	reformulated to	
Indicator 7 / IN 7 WW prod	**% treated urban water for re-use (WW prod)** $WW_{prod} = \frac{WW\ Qx}{WW\ total}\ x\ 100\ \%$	WW Q 1 = untreated stormwater WW Q 2 = greywater WW Q 3 = yellow water WW Q 4 = blackwater WW Q 5 = agricultural wastewater WW Q 7 = industrial wastewater
Indicator 8 / IN 8 WW cov	**Wastewater to Demand coverage (WW cov)** $WW_{cov} = \frac{WW\ Qx}{D}\ x\ 100\ \%$	
Indicator 9 / IN 9 WW treat	**Wastewater treatment Quality Index (WW treat)** $\frac{WW\ treat}{WW\ total} = \left(\frac{WW\ treat\ 1}{WW\ treat} + \frac{WW\ treat\ 2}{WW\ treat} + \frac{WW\ treat\ 3}{WW\ treat}\right)\ x\ 100\ \%$	EPI - Yale Yale Centre for Environmental Performance

TABLE 02-1 cont.:
Selection of Indicators relevant for water cycle community

relevance	relevance to CS / comments
✓	proposed minimum of 50 liters per day per person is based on demand instead of availabilty. Availabilty may differ significantly based on climate, technology and culture. waterquality is not taken into account, feedback with alternative watersources such as rainwater for bathing may be considered data required: » number of inhabitants » projected demand per person
✓	projected demands are calculated through disaggregation of wateruses established demand models such as WISEwater or IWAN (for more information cf. common terminologies section) should be taken into account for modeling demand method of disaggregation widely accepted and recommended by International Hydrological Programme (IHP) / UNESCO data required » projected demand per community subarea » demand should be based on a montly time series » monitoring system for actual demand variables are calculated and discussed in: *PS 2.1 - 2.3*
✓	refer to *PS 1.2* rainwater use indicator by African Water & Sanitation M& E reformulated to include reliable run-off without disrespecting environmental demands. rainwater use calculated as percentage to total demand in order to understand substitution value
✓	"Annual quantity of wastewater generated in the country, in other words, the quantity of water that has been polluted by adding waste. The origin can be domestic use (used water from bathing, sanitary, cooking, etc.) or industrial wastewater routed to the wastewater treatment plant. It does not include agricultural drainage water, which is the water withdrawn for agriculture but not consumed and returned to the system" (http://www.fao.org/nr/water/aquastat/wastewater/index.stm) relevant, with alterations: the indicator is changed to represent the various community wastewater qualities. The computation of wastewater related indicators 7-9 will assist in determining possibilities for recycling and re-use. Indicators 7-9 are important because they documents the volume and share of wastewater which is treated at the appropriate levels of treatment. This is in particular important within ecoblock boundaries where primary and secondary treatments will become more important as advanced tertiary treatments for cost reasons mainly. Requirement for qualified statement of this indicator is the calculation of 1. wastewater volumes produced (e.g. greywater production through household uses such as washingmachine) - Indicator 7 2. appropriate wastewater qualities used to cover demand (e.g. greywater for irrigation) - Indicator 8 3. wastewater treated to appropriate quality accoding to intended purpose (greywater treated for toilet flushing) - Indicator 9 refer to *PS 3.1* to *PS 3.7*
	Treatments are defined as follows: WW treat 1 = primary treatment WW treat 2 = secondary treatment WW treat 3 = tertiary treatment (Cf. Grigg, p.44, 2012)

PIC: 02-1:
Water surface in historic watertanks in Golconda Fort Hyderabad, India / © 2013, Jurleit

2.2 Best Practice framework of key planning steps and indicator development

2.2.1 Overview - conceptual framework of key planning steps for community water cycle management

The following pages describe a conceptual framework of planning steps which need to be considered in water-cycle community planning. Planning steps are based on the following overall goals:

- *to follow identified key policy questions and provide a list of planning steps based on the ecoblock and 4 RRRRs concept*
- *to include calculations for Indicator computation*
- *to present a framework of planning steps as a platform `to ask the same questions' and therefor:*
- *provide an avenue for industry collaboration toward a uniform set of metrics that are comparable and agreed upon*

The order of steps in based on the four Rs and Eco-block concept and follows guiding questions below:

- What sources are available? Distinguished are internal and external primary sources and internal and external secondary sources (cf. ch. 2.1.5)?
- What is the projected demand (m3) for the different community areas and quality per use?
- If there is a Delta in Demand coverage? What alternative sources can be used?

Recharge

with key policy question

Is the abstraction of water sustainable within a given `community hydrological unit'

and therefor

» ensures environmental demands for ground water recharge are met

» seeks a hydrological balance which is integrated into the urban hydrological cycle to mimic natural conditions

Reduce

with key policy question

How efficient is the water use?

and therefor

» provides inhabitants with sufficient supply based on water availability and demand

» promotes water efficiency and conservation

» reduces energy expenditures for wastewater treatment and water transportation

Reuse + Recycle

with key policy question

Are there alternative sources at appropriate quality? Is discharge into the receiving waters at an acceptable quality?

and therefore

» Provides inhabitants with appropriate water qualities for mixed uses (smart source mix, cf. common terminologies, ch. 2.2.4)

» Reclaims and treats polluted flows at appropriate treatment levels

» ensures any discharge to the environment is of proper quality

LEGEND:

Planning step	PS 1.1
Feedback loop	
Result	R2

note:

» ‚Indicator result summary' at the end of each step summarizes the results / variables obtained for indicator computation

» each formular in the calculations column is detailed out in the formulary in the Appendix and should be at hand in order to read the table

FIG. 02-14:
Overview: conceptual framework of key planning steps for community water cycle management

2.2.2 Step ONE - Recharge

Step ONE - **Recharge** *determine smart sources for water cycle community*

key policy question — *Is the abstraction rate of water sustainable?*

key response — The goal is to only use the amount of available primary water sources which will be fully recharged.If primary waterresources, distinguished in internal and external, are not sufficient in quantity, secondary sources can be considered according to regional practices.

Planning Steps		Intent	Calculations	uncertainties comments
PRIMARY SOURCES				
PS 1.1	Determine availabe primary internal resources within community watershed	Primary resources are to be prioritized as they are readiliy available with minimal energy consumption for purification	N/A refer to: **Difficulties in determining and calculating available volume of resources**	primary resources are groundwater, surface waterbodies, rivers and stormwater within community boundary. Community watershed to be defined as Ecoblock with a ratio of internal and external primary sources resources to be prioritized according to technical and energy expenditure
PS 1.2	groundwater extraction possible at guaranteed groundwater recharge?	availabiltiy needs to respect environmental demand and to be substracted from total run off. (see Hoekstra, 2009)	available volume WAenviro = P - R - Ret (G+E) where P: average annual precipitation level R: run off Ret: retention, G: Groundwater recharge E: evaporation	according to WAI groundwater availability is estimated either as the potential recharge that is calculated from monthly surface balance, or as the potential aquifer yield. uncertainty: determination of groundwater recharge rate within community watershed
PS 1.3	stormwater harvesting possible at guaranteed groundwater recharge?			
(R1)	available volume of primary internal resources	availabilty of primary internal resources should influence demand calculations	N/A	
	determine Delta based on demand	brutto demand projections shall be revised based on actual availabilties of primary internal resources	$D\,cov. = WA\,int. - \sum_{x=1}^{x=n} D\,Sx \;\; in\; f(t)$	feedback with *PS 2.2* *PS 3.3 - 3.5*
PS 1.4	determine and prioritize external water sources (hook up to centralized system, lake, river)	external resources are to be prioritized according to energy consumption for purification and transport		uncertainty: according to the ecoblock theme, the hook up to a centralized system is an external source
(R2)	available volume of primary external resources			sustainable abstraction from primary external resources needs to be defined

Indicator result summary

Result	Indicator	indicator variables determined
(R1)	WAI	R= surface run off G= groundwater resources
(R1)	WA ratio	pre- result for WAi, , primary resouces only, efficiency factor c (refer to PS 2.3) not taken into account
(R1)	RW share	R: run off
(R2)	WA ratio	pre- result for WA ex, , primary resources only, efficiency factor c (refer to PS 2.3) not taken into account
(R1) (R2)	W prod	W fresh

comment: (R1) (R2) to be prioritized and synchronized according to cost/benefit, local Best Practice, economic and ecological demands

Step ONE - Recharge *determine smart sources* -comments

The right choice of sources is essential for a community. Depending on the location, climate, precipation and groundwater table, the most sustainable choice will need to be taken into consideration.
When determining the smart source mix, the main concern here is to only substract as much drinking water as the environment is able to recharge in a timely manner. (Hoekstra, 2009)

In the UNESCO International Hydrological Programme IHP it says:
"Urban demands on water supplies are continually increasing as a result of growing urban populations and higher standards of living. When demands exceed the available water, shortages result, with significant social, political and economic implications.
Conjunctive use of surface water and groundwater can sometimes offer an attractive and economical means of solving water supply problems where the exploitation of either resource is approaching or exceeding its optimum yield. The volumes of groundwater naturally replaced each year are relatively small because of the slow rates of groundwater movement and the limited rate of infiltration. However, artificial recharge can be used to reduce adverse groundwater conditions such as progressive lowering of water levels or saline water intrusion. Rainwater harvesting is a supplementary or even primary water source at the household or small community level, especially in places with relatively high rainfall and limited surface waters (e.g. small islands) and in developing countries." (UNESCO, 2013)

Therefore questions to ask are:

- What are available resources?
- Groundwater extraction volume is to what extent possible?
- What is the necessary recharge rate?
- What is the rainwater harvesting potential?

The planning steps for planning a water cycle community want to create results which feed informatiion into commonly described indicators. Although concerns of common errors made in previously developed indices are taken care of the following uncertainties need to be pointed out:

Difficulties in determining and calculating available volume of resources

Reliable Run-off:
The actual physical processes that convert rainfall to runoff are both complex and highly variable. As such, these processes cannot be replicated mathematically with exact certainty. However, through the use of simplifying assumptions and empirical data, there are several mathematical models and equations that can simulate these processes and predict resultant runoff volumes and rates with acceptable accuracy. (New Jersey Stormwater Best Management Practices Manual, 2004,p.1)
Simple methods, such as the Rational or Modified Rational Methods, require limited rainfall and drainage area data, while other, more sophisticated methods have extensive data needs, including long-term rainfall and temperature data as well as drainage area soils, subsoil, and ground cover information. In general, the more data-intensive models can produce more comprehensive runoff predictions.(New Jersey Stormwater Best Management Practices Manual, 2004, p.5)

Groundwater recharge
„Groundwater is a renewable resource subjected to periodic replenishment primarily through precipitation. Recharge is one of the key hydrological parameters for assessment, budgeting, management, and modelling of groundwater resources. Although information and data regarding recharge rate is vital for recharge assessment of any region, determination of this parameter is neither easy nor straightforward."(Kumar et.al., 2012, p. 959) Modeling of groundwater recharge-potential principally aims at water-resource evaluation. Various techniques are available to assess recharge-potential, and their capability in estimating recharge for the quantitative estimation of recharge, few can be applied successfully in the field. All are characterized by major uncertainties (Germann PF et.al, 1985; 21(7):p.990–996). When estimating groundwater recharge it is essential to proceed from a good conceptualization of different recharge mechanisms and their importance in the study area (Kinzelbach W et.al.,2004; 4,p.125-131) . Besides this conceptualization the objectives of the study, available data and resources, and possibilities of obtaining supplementary data should guide the choice of recharge-estimation methods (Molden D et.al., 1999; 15(1 & 2),p.55–71).

Distinguishing primary internal and external warer-resources:
According to the ecoblock concept the community size is dertermined by its independency from the grid. Obviously in a lot of situations it may not be possible or necessary to be completely independent of the grid. The ratio of internal and external resources will vary significantly and the following factors should be taken into consideration when prioritizing the resources: economic concerns in constructing infrastructure, technology expenses and embodied energy (carbon footprint).

Determining recharge rate in a given community:
Here the necessary monthly aquifer yield within the ecoblock relative to the overall watershed recharge necessity. The UNESCO IHP report suggests for well supply to neither tap into static groundwater level nor should the specific capacity of the wells decrease. These values should be constant over a period of five years except for minor variations that correct themselves within a week. (UNESCO, 2008,p.25)

Step TWO - **Reduce** *determine demand*

key policy question *How efficient is the use of water?*

key response The goal is to conserve as much drinking water as possible by reducing the demand

Planning Steps		Intent	Calculations	uncertainties comments
DEMAND				
PS 2.1	Determine community subareas (S1, S2,...)	the goal is to create comparable community subareas	number of users area of subarea	
PS 2.2	Determine total water demand per subarea + per use		$\text{D total} = \sum_{x=1}^{x=n} \text{D Sx in f (t, Q)}$	here, the waterquality needs for distinguished uses to be part of the projected summarized demand
PS 2.3	Determine total water demand after waterefficiency measures per subarea		$\text{D total red.} = \sum_{x=1}^{x=n} \text{D Sx x CSx in f (t, Q)}$	where C= efficiency factor
R3	Delta D cov. based on availability of internal and external primary sources		$\text{D cov.} = \text{WA i prime} + \text{WA e prime} - \sum_{x=1}^{x=n} \text{D Sx in f (t, Q)}$	if external WA needs to be taken into account to cover demand, alternative sources need to be considered on the basis of economy (see comments
DEMAND + resulting OUTPUT				
PS 2.4	determine and document total wastewaterquality Dis Q output per subarea	replace external watersources with local graywater	$\text{WW total} = \sum_{x=1}^{x=n} \text{WW Sx in f (t, Q)}$	it may be economically more viable to use graywater from the community itself than depend on external watersources.

Indicator result summary

Result	Indicator	indicator variables determined
PS 2.3	WAI	demand projections after efficiency measures
R1	WA ratio	pre- result for WA int., , primary resouces only, Conservation C not taken into account
R2	WA ratio	pre- result for WA ext., , primary resouces only

Step TWO - Reduce determine demand - comments

In many large cities around the world, water demand has exceeded the total water resources in the basin in which the city is located. In such cases, one of the approaches to water supply management is to develop new inter-basin water transfer schemes in order to keep ahead of the ever increasing requirements of the growing population and improved standards of living. (cf. IHP - UNESCO). A different approach is referred to as demand side management, in which water conservation is practised to the maximum practical extent to reduce demands on the water supply and manage the needs for infrastructure expansion. (cf.Butler and Memon, 2005) Both goals are represented in the ecoblock equation.

The basis for this approach is taken from known demand modeling programs such as IWAN and Wisewater (for more information cf. common terminologies section). Good estimates of municipal water demands can be obtained by disaggregating the total delivery of water to urban areas into a number of classes of water use and determining separate average rates of water use for each class. This method is called disaggregate estimation of water use. The disaggregate water uses within some homogenous sectors are less variable than the aggregate water use, and a more accurate estimation of water use can therefore be obtained.

The project area is divided into homogenous sub-areas called S (x), interdependencies amongst subareas shall be roughly determined,

Subareas are:
S1 - Residential housing / people per household / water use purpose
S2 - Commercial and small businesses
S 3 - Institutional
S 4 - Open space

Therefore a demand equation shall be :

$$\text{D total red.} = \sum_{x=1}^{x=n} \text{D Sx} \quad \text{x} \quad \text{CSx} \quad \text{in f}(t, Q)$$

D= Demand
S= Sector
t= Time (daily, seasonal)
C: Conservation
Q: Quality

The development of water use in households varies considerably. On average a quarter of European water abstraction is for use in the `domestic sector', which includes households and small businesses. The future water demand of this sector is highly uncertain and will depend on a wide range of factors, including the incomes and sizes of households (water use per person usually increases with income and with fewer people per household), the age distribution of the population (water use varies considerably between different age groups), tourism and water pricing (high water prices reduce the demand for water in households, but the relationship between prices and use is highly variable). Another important factor is technological change, which generally increases the water-use efficiency of household appliances, and thus reduces total water withdrawals.

It is this uncertainty factor which backs up the proposed process of monitoring obtained data (cf. Fig. 02-11 and Indicator 5 D ratio - projected vs. actual demand).

2.2.4 Step THREE - Reuse and Recycle

Step THREE **Reuse + Recycle** *Smart source mix and discharge management*

key policy question *Are there alternative sources at appropriate quality?*

key response The goal is to firstly reuse untreated and then treat and recycle wastewater for reuse at appropriate qualities for various uses at reduced overall cost, guaranteed system longevity and energy efficiency

Planning Steps		Intent	Calculations	uncertainties comments
demand exceeds resources				
PS 3.1	determine possible smart source mix per subarea per use	based on the different uses in x subareas, identify the possible various waterqualities in order to reduce drinking water demand	$D\ total = \sum_{x=1}^{x=n} D\ Sx \quad in\ f(t, Q)$	
PS 3.2	Determine community subareas (S1, S2,...) interdependencies	identifying subareas spacially connected to each other for efficient water exchange		
	determine Delta based on demand	netto demand projections shall be revised based on actual availabilties of primary internal and external resources as well as internal secondary resources		feedback with *PS 2.2*
SECONDARY SOURCES / prioritized				
PS 3.3	determine the volume of greywater produced for each subarea	secondary sources can account to minimize the demand for freshwater	$WW\ total = \sum_{x=1}^{x=n} WW\ Sx \quad in\ f(t, Q)$	
PS 3.4	determine the volume of recycled wastewater produced for each subarea			
PS 3.5	determine the volume of desalinated seawater produced			
R4	Determine community subareas (S1, S2,...) smart source demand mix based on smart source availability	$D\ total = \sum_{x=1}^{x=n} D\ Sx \quad in\ f(t, Q)$ $D\ cov. = WA\ i\ prime + WA\ i\ second. + WA\ e\ prime. - D\ total\ red.$		feedback with *PS 2.4*
WASTEWATER				
PS 3.6	Determine wastewater production per subarea + per use	Volume produced	$WW\ total = \sum_{x=1}^{x=n} WW\ Sx \quad in\ f(t, Q)$	
PS 3.7	Determine % wastewater level of treatment primary, secondary, tertiary	in order to guarantee proper return to the environment and/ or a secundary use	$\frac{WW\ treat}{WW\ total} = \left(\frac{WW\ treat\ 1}{WW\ treat} + \frac{WW\ treat\ 2}{WW\ treat} + \frac{WW\ treat\ 3}{WW\ treat}\right) x\ 100\ \%$	

Step THREE **Reuse + Recycle** *Smart source mix and discharge management*

Technologies to treat wastewater are now well established and are capable of producing almost any degree of purification. Wastewater is typically treated in three stages: primary, secondary, tertiary otherwise described as mechanical, biological and biochemical treatment. (Grigg, 2012, p.44) The choice of treatment for the most appropriate and applicable technology is the particular social, political and economic environment, but also climate and environmental concerns. Burian et. al. add: „The reasons for a particular preference are based on a combination of cost, urban development patterns, accepted scientific theories, tradition, religious attitudes, prevailing public opinion on sanitation, the contemporary political environment, and many other factors.“ (Burian et.al, 2000, p.33)

When considering wastewater treatment options, the following aspects shall be the base for a decision-making process. If all aspects are met at manageable levels, one can speak of a ***Smart Source mix***:

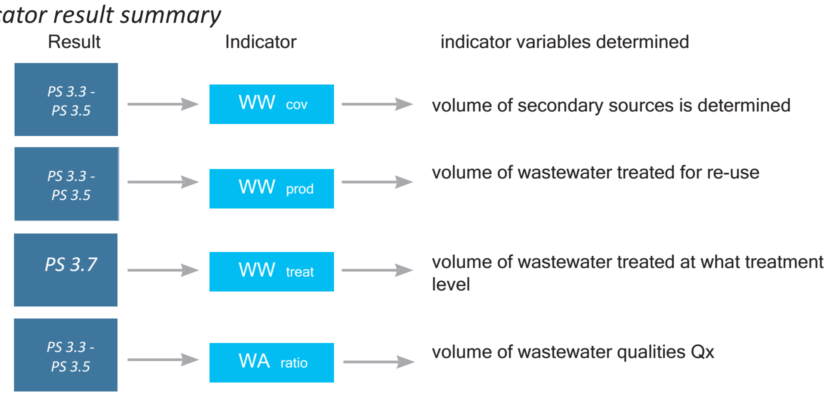
1. Reduced overall capital and operating costs
2. Long system life and system performance
3. Reliability
4. Appropriate wastewater qualities
5. Energy efficiency

The first step would be the assessment of associated costs including intial capital cost for investment and installment and later on operations and maintenance of the system. Studies show, that wastewater treatment represents a wide range of costs. In UNEP’s Guide to the Use of Water Quality Management the principles and planning steps of this chapter are confirmed: „If nonconventional options can be used, it may be possible to cut these costs by at least half. Promising low-cost treatment approaches, especially for small and intermediate cities, range from natural treatment systems (such as engineered wetlands systems, to decentralised treatment systems), to new treatment processes (for example anaerobic treatment processes such as the upflow anaerobic sludge blanket (UASB)’.“(UNEP, 1997,p.20) The report cleary states, that system longevity and cost for operation and maintenance need to be part of the overall equation (see above aspect 2. and 3.) Only recently the aspect of energy efficiency is being raised by many institutions: According to a publication by ACEEE, „wastewater plants and drinking water systems can account for up to one-third of a municipality’s total energy bill.(EPA 2009a) These facilities represent a significant portion of controllable energy usage and offer opportunities for cost-effective investments in energy-efficient technologies.“ (ACEEE, 2013) Taken into account are the installment of energy-efficient equipment and also the adoption of improved processes. „Pumping requires much of the energy used for treating and delivering water. (...) Energy is embedded not only in water facilities, but throughout pipe systems as well, since leaking pipes for drinking water requires the use of more energy to deliver water to the end user. The inefficient use of water also has energy implications. Projects to fix leaky pipes and improve end-use efficiency can be promoted as both water and energy saving investments.“ (ACEEE, 2013).

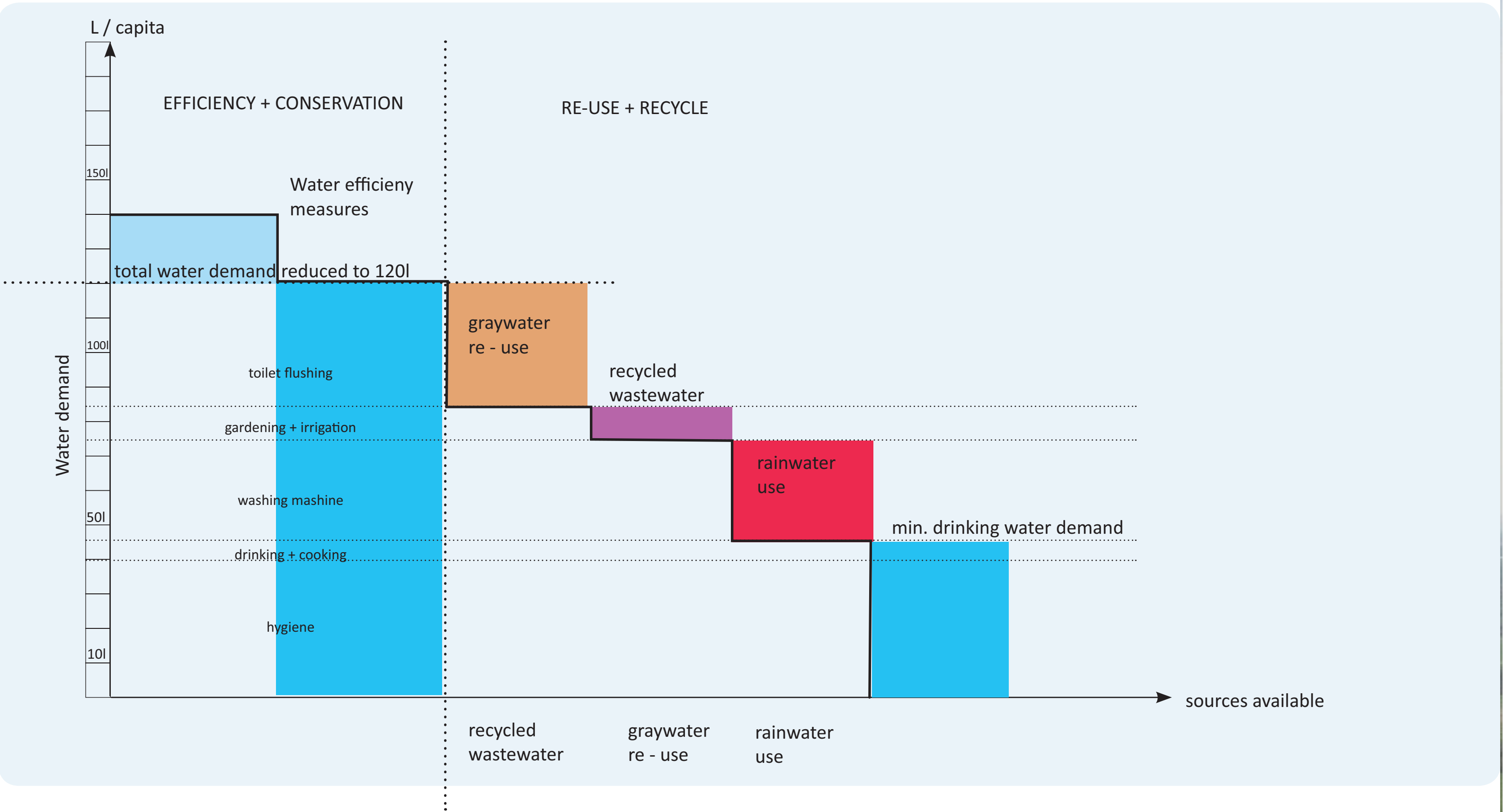
Ensuring water quality

Depending on the receiving component (e.g. a river) and use in the community water quality needs to be ensured. „The 2010 EPI Water Quality Index (WQI) uses three parameters measuring nutrient levels (Dissolved Oxygen, Total Nitrogen, and Total Phosphorus) and two parameters measuring water chemistry (pH and Conductivity). These parameters were selected because they cover issues of global relevance (eutrophication, nutrient pollution, acidification, and salinization) and because they are the most consistently reported.” (EPI, Yale, 2010)

Indicator result summary



Example of using a combination of efficiency measures and smart source mix approach



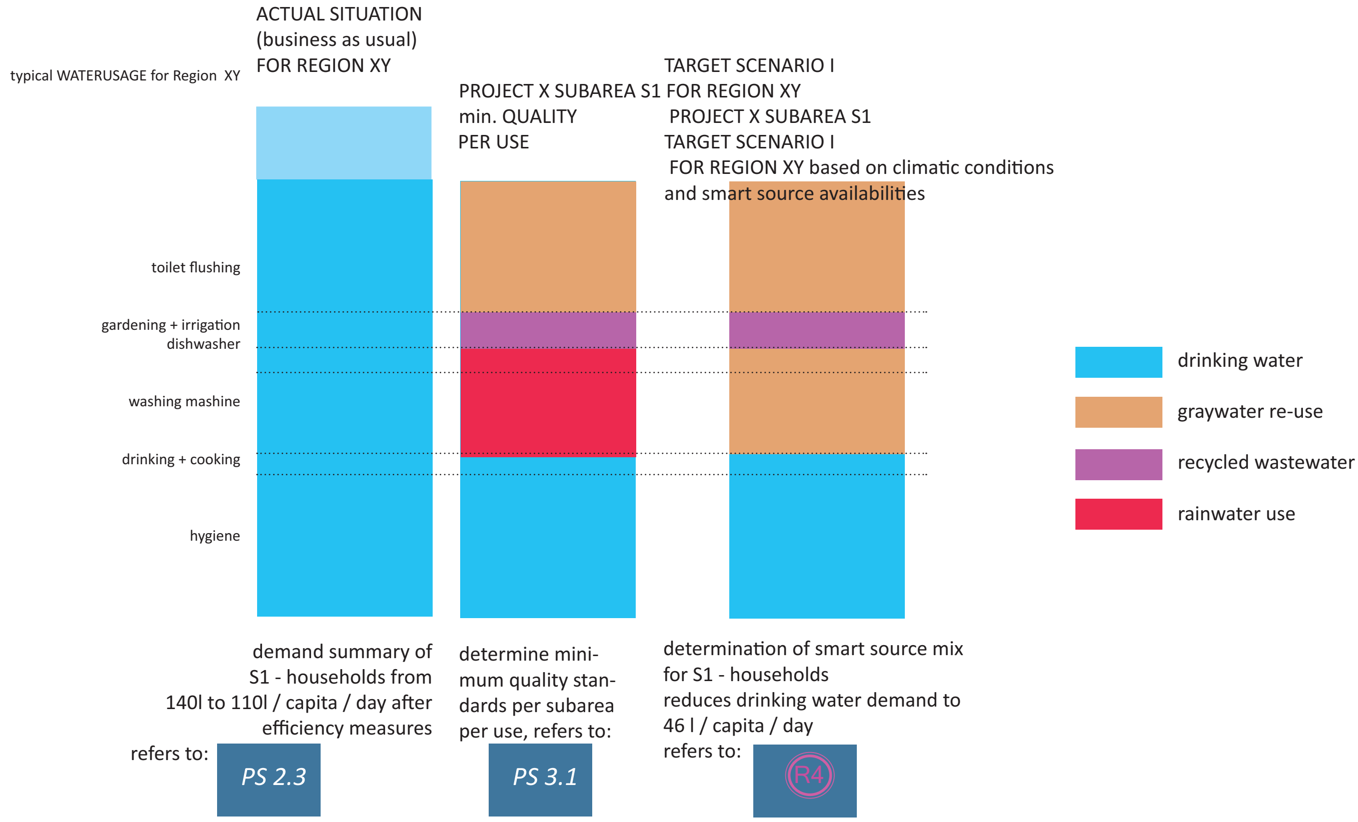


FIG. 02-15:
Example of using a combination of efficiency measures and a smart source mix approach

PIC: 02-3:
new township development with depleting waterbodies in the background
in Hyderabad, India / © 2013, Jurleit

Chapter 3.0:
Certification systems for communities

3.0 Certification systems for communities

Certification systems seek to ensure that products meet a set of agreed-upon standards. These programmes can be designed to encourage compliance with national and international environmental laws, or to go "beyond compliance" and to protect the environment more than the law requires. Many certification programmes are voluntary, market-driven mechanisms that use independent third-party verifiers to ensure that the certified goods adhere to the certification criteria.

[Definition by: United Nations Environment Programme environment for development]

A [...] rating tool sets standards and benchmarks for green building, and enables an objective assessment to be made as to how „green" a building is. The rating system sets out a „menu" of all the green measures that can be incorporated into a building to make it green. Points are awarded to a building according to which measures have been incorporated, and, after appropriate weighting, a total score is arrived at, which determines the rating.

[Definition by: Green building council South Africa]

PIC: 03-1:
Main entrance area at headquarters of the Indian Green building Council in Hyderabad, India,
LEED certified with Platinum in 2003 / 2013, Jurleit

3.0 introduction and main objectives of the chapter

Research centered on community Certification systems (CS) is very young, and there is very little documented on their effectiveness. The following chapter is based on the author's own findings via the analysis of existing CS, as well as work experience as a Technical Advisor for the development of the DGNB NSQ system.

This chapter will provide a brief introduction to the history of CS development, outlining the main aspects of what CS have achieved as well as where they fall under criticism. In particular, the water related aspects of the CS are analyzed based on overall structure and quantitative and qualitative requirements.

The comparative analysis identifies common challenges when certifying, and recommends solutions for the effective application of such systems at both the global and regional level.

Main results of this chapter:
Response to research question-
Do the criteria and indicators given in the CS conform to commonly understood best practice standards and procedures for sustainable water cycle management in the community?
What structure and criteria would be necessary for CS to be applicable at an international level and adaptable for regional use?

The initial analysis shows: Certification systems are currently not comparable with each other at achievement levels: Pearls cannot be compared with medals

Although a core system structure for certification could be identified, (cf. Fig. 03-11) each system chooses different categories, criteria and indicators to rate. Point distribution and rating mechanisms differ significantly from each other due to weighting, priority, and benchmark setting.

The choice of methodologies to measure sustainability differs. Over 20 different approaches were identified. When compared with a best practice procedure, (cf. chapter 2.2) results show the neglect of important interdependencies and necessary feedback loops in order to represent complex systems.

Although some attempts are being made, in most cases certification ends with project completion. Post occupancy evaluations (POEs) would significantly ensure that certification success be kept on track against set targets and benchmarks. (cf. chapter 2.1.7, Fig. 02-11)

Key Performance Indicators (KPIs, refer to subchapter 2.1.7.1) ensure comparability across chosen certification systems: CS did not explicitly request KPIs, but the KPI variables were part of the calculations.

According to the author, the terms 'Internationalization' and 'Regional adaptation' are not clearly distinguished in current practices. Roles and tasks should be distinctly separated from one another

3.1. Background

Certification has emerged over the past 15 years as a way to differentiate environmentally or socially conscious products and services from their conventional alternatives.
What started with eco-labels like Germany's *Blue Angel* label in 1978, has become a large business within the building industry. As the term eco-label implies, it was developed to communicate a product or service's ‚environmentally friendly' characteristics. Since the 1990s, green building labels standardize what is considered to be environmentally friendly and energy-efficient building. As the term green building evolved over the years, more labels entered the market, distinguishing between building types and different national settings. After the first Certification System for sustainable communities entered the market in 2006, several followed soon after. Some of them were clearly designed for national settings, such as Casbee, whereas others like LEED-ND and the DGNB system were meant to operate on an international level. Ultimately the goal of all labels is to convey information, promote environmental performance transparency, ensure quality standards and to empower consumers.
Here, a distinction between the two terms ‚Label' and ‚Certification system' needs to be introduced, described in Kira Matus' paper on *Standardization, Certification, and Labeling: A Background Paper for the Roundtable on Sustainability*:
"While the label is a symbol indicating compliance with certain standards, and often is the last, or "customer-facing" element of a certification system, the certification system itself, by contrast, spans the market from producer to end consumer, involves continual interactions among these various stakeholders in the value chain, and entails numerous processes that are not easily communicated by a consumer label." (Matus, 2010, p.5)

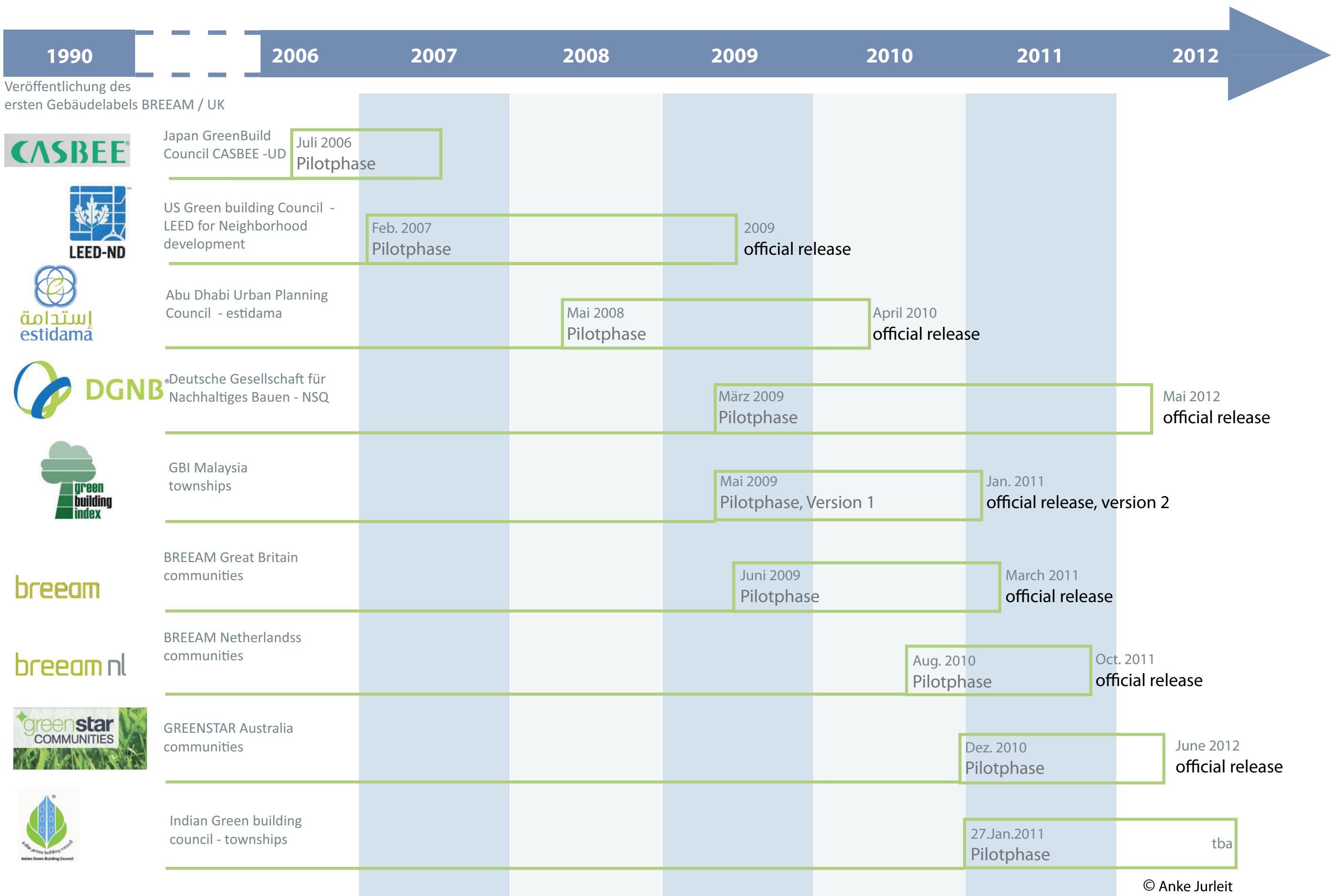


FIG. 03-1:

timeline: Community Certification systems: After the introduction of building labels in the 1990, CASBEE in 2006 came out with the first CS for communities

FIG. XY:

3.1.1 Certification - a popular tool

In her paper, Matus describes in detail why Certification systems (CS) have become so popular in the past few decades. The trend for CS "reflects both a lack of confidence in the public sector's willingness or capacity to require and enforce higher standards and a belief, that voluntary and market-based methods promote innovation, cost less, and protect free enterprise from unwarranted intrusion." (Matus, 2010, p.10)
The increase in the case of the green building sector, was due impart by the strong environmental interest and political agenda to encourage a much needed sustainable planning culture. In cases where government regulation may move at a slower pace, CS provide authorities with compact guidelines for sustainability measures. LEED, for example, has moved in advance of government in setting building codes and standards. According to Matus,"In the United States, most building regulation is promulgated, monitored, and enforced on a state and local level, it was far less costly for stakeholders to develop a single, voluntary LEED standard, which was then available for local regulators to use, either as the basis for their own codes, or whole cloth as a part of their own regulatory schemes." (Matus, 2010, p.17)

As planning authorities implement the system requirements into the overall legislation, it is stated just recently, „In a remarkably short period, LEED™ has gone from the fringe to a national brand, and is now well on its way to becoming standard practice. Cities and other agencies through the state are mandating LEED." (APA, 2011)
Several other factors explain the growing interest in certification as a tool, including the above described ineffectiveness of many governmental and intergovernmental processes. „It is also due to the rapid pace of economic globalization and a general interest in pursuing innovative ‚smart regulation' to address adverse environmental and social impacts." (Auld et al., 2008).
In the green building industry, the following reasons may be relevant for firms pursuing certification of a building or community (according to Matus):

1. Firms may engage in voluntary regulatory programs in anticipation of future regulation
The green building industry in recent years has undergone rapid changes when it comes to building and infrastructure regulations. Reasons for that are the CS themselves, but also a tight political agenda to combat climate change and resource depletion.

FIG. 03-2:
overview: Community Certification systems worldwide, distinguished between national and international approach

2. Firms may engage in voluntary regulatory programs to gain exposure to practices that improve operations Architects and planners as well as governmental bodies instrumentalize CS to keep up to date with the latest practice.

3. Firms may engage in voluntary regulatory programs as a signal to consumers and/or business partners For developers the achieved result, a gold plaque for instance, serves as a marketing tool.
For example:
Project development firm Drees & Sommer, which is heavily involved in the certification business summarizes the benefits of green building certificates for all stakeholders and therefore markets itself (Fig. 03-04)

In the recently published ‚*World Green building trends*‘, McGraw points out, that "doing the right thing was the primary trigger, (...) however green building is increasingly seen as a business opportunity. With client and market demand being the main forces, branding and public relations, an aspect Matus pointed out, is confirmed in the report, as well as green buildings' lower operational costs." (McGraw, 2012, p.15).
However, the involvement in the green building market increases confusion as more certification systems enter the market.

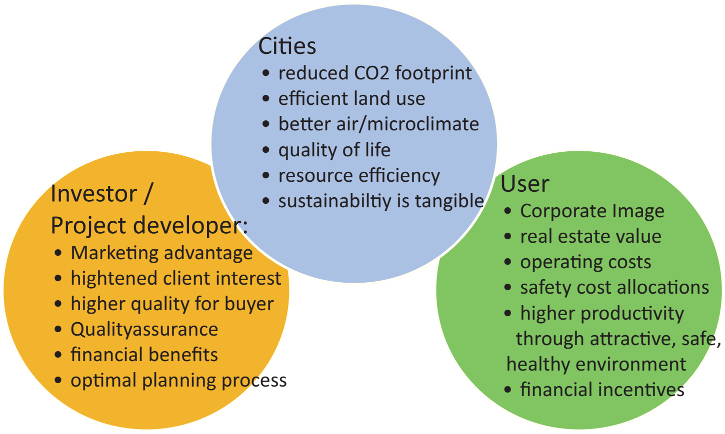


FIG. 03-4:
marketing the benefits of certifying buildings (according to Drees & Sommer)

3.1.2 The challenge - green noise and market confusion

As the green building market grows, the green building CS business grows alongside it. Between 2009 – 2011, seven additional labels for community certification entered the market. This can create confusion and lead to the question *Which system is the right one?*
Fig. 03-03 depicts none of the CSs are uniform when it comes to their achievement levels "nor are they immune to competing and sometimes false claims which contribute to green noise and consumer fatigue." (Matus, 2010,p.3)

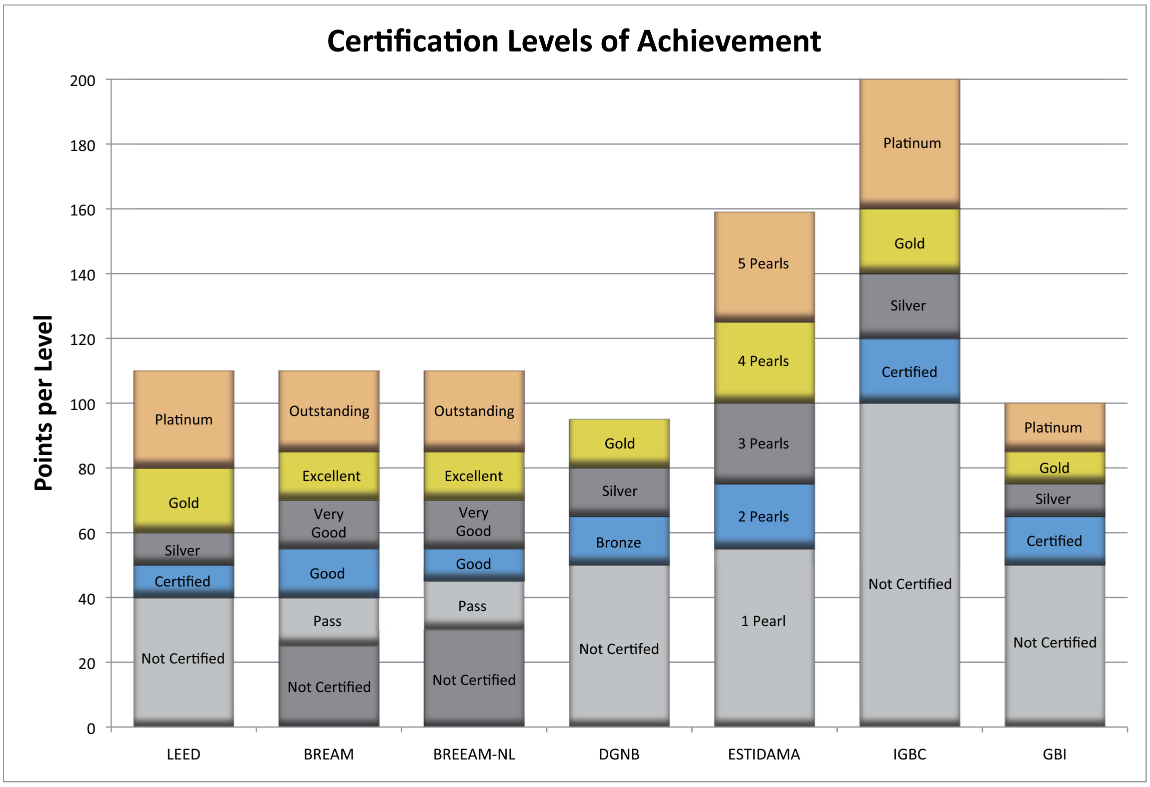


FIG. 03-3:
Community Certificationsystems - Comparison of Level of achievements differing approaches can lead to market confustion

As the CS will be broken down further throughout this chapter, their incomparability will be evidently revealed.
This finding is ultimately the opposite of what was described in the last paragraph: CS are amongst other functions to be a tool for comparison. Matus (2010) says: „Currently no precise set of sustainability standards exist. Instead as the field matures and advances, there is increasing evidence from practitioners of what works and why, and where there is room for improvement." (p.3)
In fact, often times competing labels were developed as a response to a certain perceived weakness in another system. Matus' perceptions are echoed by Mösle (2010) who says: "At this point there is no CS on the market which is according to international standards and at the same time applicable to different regional settings". (p.14). The green noise of having no comparative values even at the superficial of achievement levels (pearls versus metals and points, see Fig.03-3), the following chapter will look at the CS in more detail.

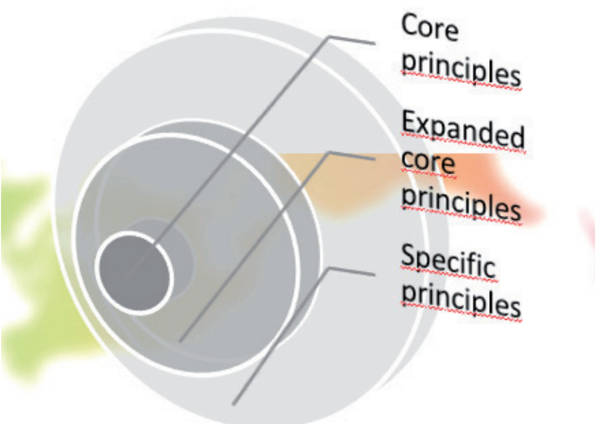
3.1.3 The goal of certification and associated difficulties - making sustainabilty measurable

One of the main goals of Certification systems is to make sustainability tangible and measurable.
„This counteracts the often heard criticism of developing broad principles which are then not supported by concrete measures." (Keiner, 2006, p. 32)
CS attempt to systematically simplify the complex issues of sustainability, while maintaining and understanding the often times overlapping factors in sustainability.
One can imagine, the trade-off between accuracy and simplification is a sensitive decision-making process. On one hand the theoretical, often very complex linkages must be depicted and on the other hand the number of indicators and sub-indicators should be low, in order to keep the system understandable and traceable for decision makers.

Gallopin outlines as the most important functions of certification:
• To be able to compare across places and situations
• To assess conditions and trends in relation to targets
• To provide early warning information
• To anticipate future conditions and trends
(Gallopin, 1997, p.15)

However, without measurable indicators, these functions are difficult to attain. Gallopin (1997) defines indicators as „variables (not values) which represent operational attributes, such as quality and characteristics of a system." Indicators are therefore a management tool, which describes and operationalizes complex system characteristics in a quantitative way. As indicator frameworks tend to bridge the gap between theoretical concepts of complex systems and decision making (Gallopin, 1997), they enable comparative analysis, benchmarking and the support of decision makers in complex decision situations.

The indicator approach is easy as long as a particular aspect is measurable (e.g. water consumption l/day/capita). However, when it comes to rating aspects which are not easily measurable, such as cultural and social aspects, Lang says " The complexity of sustainability, the integration of the different dimensions (environmental, socio, economic) and the open and diffusing content structure of it is the main hurdle for developing a comprehensive indicator set. She later on claims: „indicators are (...) only truly useful if they are ‚owned' by the local community and measure issues of relevance locally." (The local government management board 1995, p.5).



Core principles: internationally applicable
expanded core principles: more detailed, steering and political indicators
Specific indicators: problem or project specific

FIG. 03-5:
Structure of Indicatorsystems
(Birkmann 19999,p62 as cited in Lang)

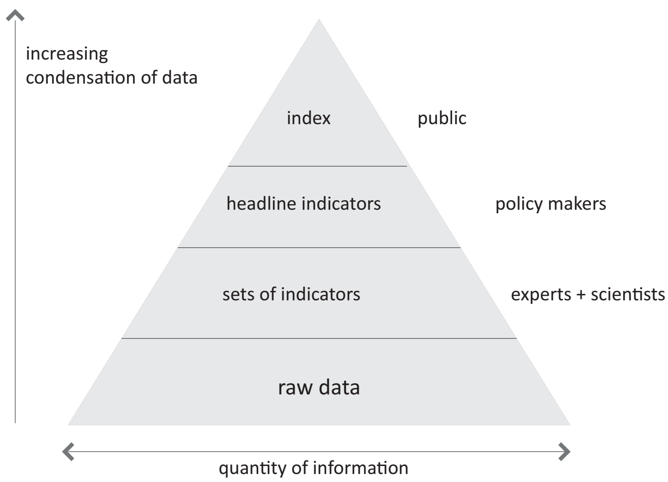


FIG. 03-6:
The information pyramid (Braat, 1991)

She therefore recommends a general framework, which was formerly developed by Birkmann, for structuring an indicator system (Lang, 2003, p.138), see Fig.03-6.
This framework of indicators is representative of what Braat illustrates in his information pyramid of indicators and how they relate to distinguished target groups, such as experts, policy-makers and the public.
According to Braat (1991), scientists are most interested in raw data that can be analyzed statistically. Policy-makers prefer data related to policy objectives and reference values, while the general public prefers a simple index of information. (as cited in Lundin, 2003, p.6)

Quantitative or qualitative indicators are important to fulfill what certification systems intend to provide (according to Spangenberg/Bonniot 1998, p.5 as cited in Lang):

- Comparison
- Political tool
- Communication:
    1. Provide grounds for decision making
    2. Outline target values
    3. Comprehension
    4. Raise awarenes

3.1.4 Certification as the final step...and then what?

The regulation and operation of the CS process and development is done by Green building councils. GBCs by definition are „transparent, consensus-based, not-for-profit coalition-based organizations with no private ownership and diverse and integrated representation from all sectors of the property industry;“ and their overarching goal is to „promote a transformation of the built environment towards one that is sustainable with buildings and cities that are environmentally sensitive, economically viable, socially just and culturally significant.“ (WGBC, 2013).
Fig. 03-7 shows a typical set up of a Green building council and associated players and business segments.

Fig. 03-9 compares the CS process of different organisations against an ideal CS process:
The ideal CS process is based on and derived from the PSR model in subchapter 2.1.7. It would start with a catalogue of design benchmarks, defined parameters and goals (cf. CS overall structure see subchapter 3.2 ff.), which would then be continuously monitored.

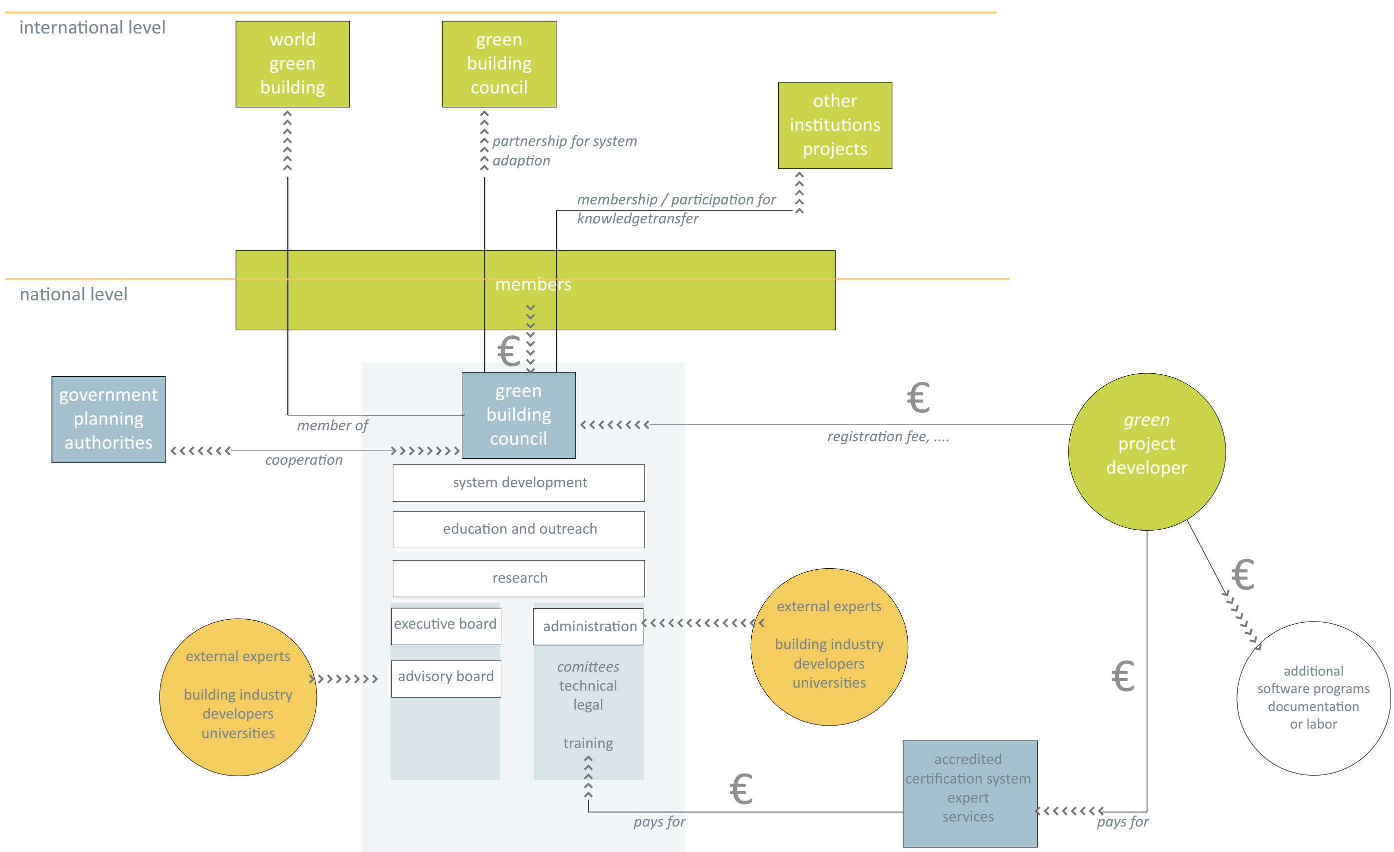


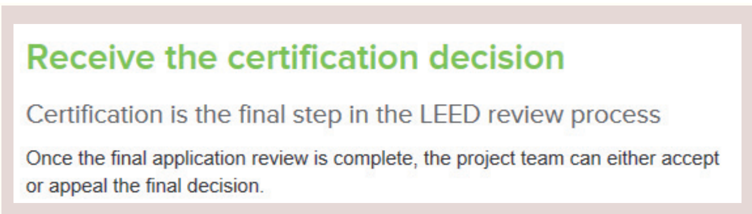
FIG. 03-7: *Overview Green building council operations: standards, codes and rating systems are developed and the certification process is administered*

At first, projects would register with an associated Green building Council. Designs would be drawn up by the project team and submitted to the CS agency for assessment and review, and a design rating awarded for ability of the anticipated project to meet design benchmarks (cf. subchapter 3.2.4). After the design stage, construction would commence and either periodically or upon the completion of construction, a construction submittal by the project team, and the CS agency would perform an assessment and review of the project and whether design benchmarks had been met. At this point a final construction rating would be determined and awarded for the project. As the project becomes operational, performance data would continue to be monitored and collected, and periodic operational reviews would take place by the CS agency accompanied by the awarding of operation ratings. Based on the operational performance relative to the original design benchmarks, and ongoing CS requirements and updates, a feedback loop of data gathering for documenting, monitoring and evaluating progress would be created.

While all of the CS processes analyzed include a registration step, a design and construction review, and an awarding of a certificate or rating upon project completion, each is different, and many steps of what would make for an ideal CS process are overlooked. LEED Neighborhood Development does not include the issuance of a design award and clearly state the certification of the built project as the final step of the agency‘s review process. (Fig. 03-8)

BREEAM-NL Area Development will issue certifications not just for fully completed communities, but also for partial completion. DGNB and the IGBC both issue certificates upon project completion in parts. For DGNB the first certificate is issued upon the community's completion of 25% of its buildings and 25% of its infrastructure. The second certificate, the urban quarter certificate, is issued upon the completion of 75% of both its buildings and infrastructure. For IGBC's Green Townships CS, the first certificate is issued when 50% of infrastructure has been built. When 75% of infrastructure has been built and 25% of the residences the second certificate is issued. The final certificate is issued upon 100% completion of the project. Estidama offers an operational rating for its communities, and separate certification systems for "In Use" and "Existing Area" are being developed for BREEAM and BREEAM-NL respectively. Green Star communities comes the closest to meeting the ideal community CS process by requiring a three year assessment of the projects development every five years, followed by recertification.

Within each CS are embedded indicators for measuring the sustainability. These indicators, in particular when documented beyond the last review process post construction, can create a transparency of what a CS award represents and inform and educate the public about the benefits derived from CS. Indicators such as water availability; quality; quantity; the energy of extraction, purification, and transportation; etc. provide the opportunity to monitor progress. Additionally, the data collected by monitoring indicators during the design, construction, and operation of a community can



(© USGBC website, 2013)

(© DGNB website, 2013)

FIG. 03-8: *Certification process as operated by the DGNB, the certificate has unlimited validity with completion of 75% buildings, public space and highways (DGNB website, 2013)* provide developers with a means to compare performance against design benchmarks. Benchmarks can be modified by incrementally advancing indicators from their original baseline, or by defining indicators that meet long-term sustainability goals. In this way, indicators can be used to update CS. The importance of monitoring and going beyond what's built into the O&M (Operations and Maintenance) phase of a project is just recently confirmed by the National Institute of Building Sciences : „ No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Ensure operation and maintenance personnel are part of the project planning and development process, including the establishing of commissioning criteria at the onset of a project." (WBDG, 2013) The council uses the example of toxic cleaning products which can deteriote indoor air quality or the operation of installed waste recycling and separation systems . An adequate feedback installment as part of the CS ongoing process would alleviate or at least document this aspect as something which needs to be addressed. Subchapter 4.4 describes the difficulties and inconsistencies in data-gathering and compiling with cohesive results visualization as one of the most challenging tasks in sustainabilty assessment.

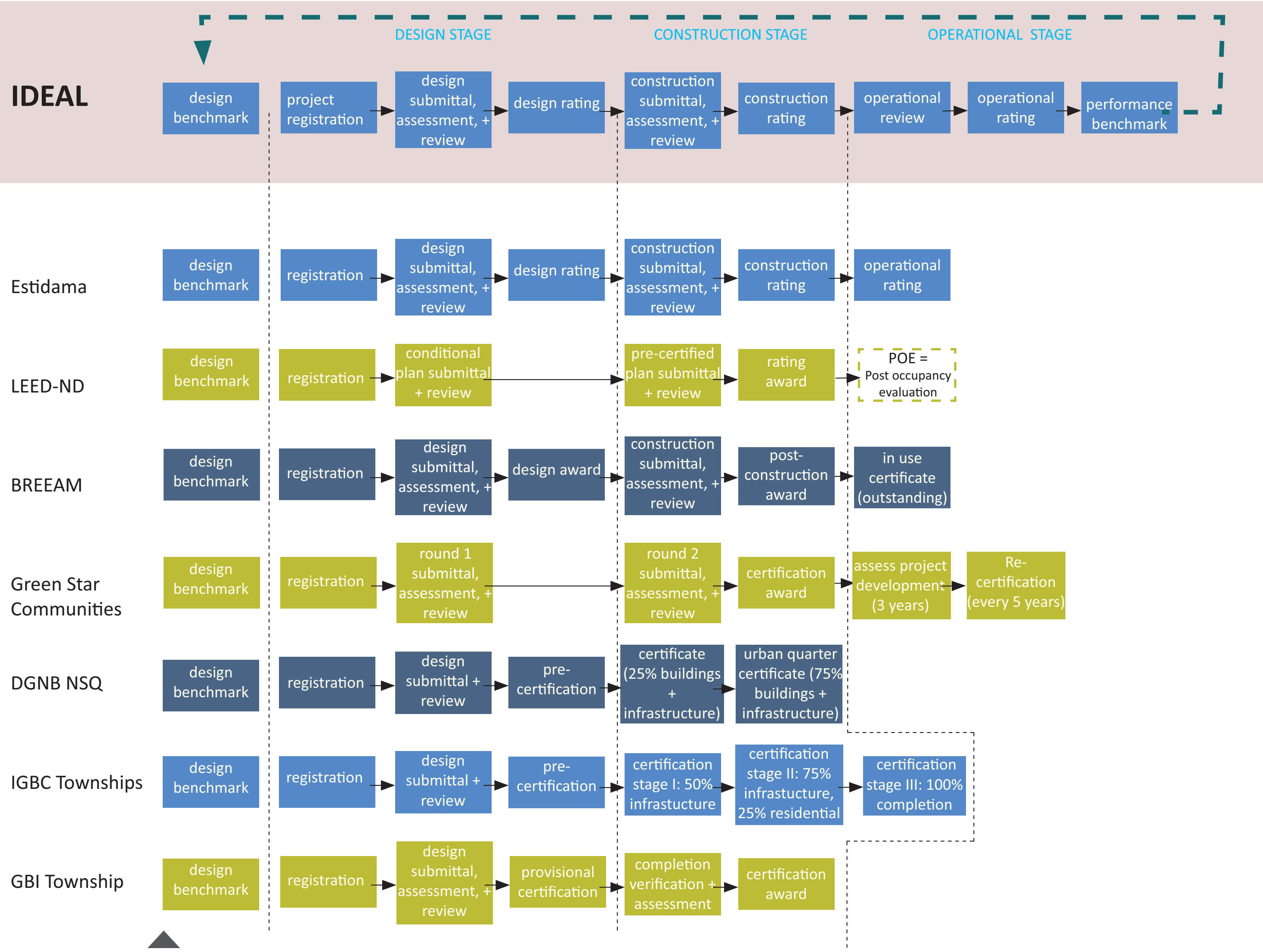


FIG. 03-9: *Certification process: comparing the stages of certification of selected CS against an ideal process*

PIC: 03-1:
Often, the ceremony of handing over the ‚Label' is the final part of the certification process once the project is completed

3.2 System development / system structure

3.2.1 Critical assessment of system development process

FIG.03-10:
Certification systems - general development of the system approach

When system development starts, it often times comes out of a political, industry-driven and/ or civil urge to change things. In the case of the green building industry, it was the necessity to foster the construction of energy and resource-efficient buildings and communities beyond of what was regulated by law.
The initial stage in system development usually includes the establishment of an overall framework formulating a desired outcome. This framework may be in response to global guiding principles (UNO, ISO etc.) as well as an immediate political need for action. In the case of LEED, it was the response to a deficit in America's planning culture: urban sprawl and auto-dependency.
In Germany, it was the urge to define higher quality beyond legislation: The Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) of Germany attests certification systems in the building sector guarantee a widely accepted definition of quality and therefore creating transparency.
Although reasons for introducing a CS may differ, all CS follow a similar deductive reasoning method by assuming an overall framework and breaking it into measurable system components. This is where one major hurdle in system development arises. How can complexity be broken down into singular aspects without compromising the whole systems philosophy of sustainability? In her dissertation Lang says the act of assessing will lead to the aggregation of aspects and therefore to the reduction of complexity, however shall not lead to loss of content.(Lang, 2003)

CS have become more complex over time. Fig. 03-10 shows that CS often times started as simple pass/fail systems. Participants making the grade receive a certified seal, and those who do not meet the requirements are left out. The comparison of both values will indicate a success or failure.
Having realized this approach forbids tiered qualities, the tiered approach was introduced. The LEED standard for green buildings is an example of a tiered approach, offering a performance baseline, and three ascending levels of compliance (silver, gold, and platinum). Within this system, projects receive points in several categories, and the total score determines their level of achievement. Tiered approaches within a scheme can therefore provide a pathway to sustainability with a robust consensus building at the bottom, in order to bring as many on board as feasible. At the same time, there is still room for improvement. In most cases CS followed the tiered approach with a system set up which allowed for category and criteria weighting as well as indicator introduction. This general system set up is represented in Fig. 03-11 and still accounts for many systems.
Taking this approach raises four primary red flags questioning this system set up for the following reasons:

- criteria often stand separate from each other despite coherencies, necessary feedback loops are missing; this ‚linear approach' is not representative of the complexity of sustainability (see 3.2.3 for example and FIG. 03-11 for overall systemstructure)
- criteria are often prescriptive rather than performance based. By the term ‚performance-based' a situation is described, in which regulations are written in terms of the required outcome rather than by prescribing the process by which the specified outcome can be achieved. (IRCC 2004b p.2 ;compare subchapter 3.2.3)
- the main focus of CS is still too focused on environmental and enviro-efficiency aspects (see Fig. 03-12)

When the next steps in system set up and development are discussed, the term Lifecycle approach (LCA) and Coroprate Social responsibility (CSR) needs to be introduced.
LCA has been critical in identifying some important features, such as embedded energy, or downstream pollution effects following disposal of a product. The term is a well-described, following an internationally standardized structure (ISO 14040, 1997) and represents the conceptual idea of regarding the entire supply chain of a product or system. However, LCA addresses mainly the environmental effects in a system, CSR will cover the social and economic side of sustainability.
Certification in the green building industry so far was widely used to communicate a product was built with environmentally friendly products and with limited impact on the environment.
This does not automatically imply, that materials were not produced with child labor, or that the producer received a legal minimum wage. Less consideration has gone into how and where certification could be used to also advance workers' rights, or support the interests of small-scale ventures. In short, certification systems are not currently being employed to address all of the sustainability challenges associated with a given sector.

Matus (2009) says: „The complexity and systemic nature of these challenges requires a range of interventions rather than a silver bullet, but existing certification programs have rarely sought to integrate themselves into more holistic efforts." (p.51)
There are recent instances of converging interests. On the DGNB website it says: The DGNB Certification System is a second-generation system compared to other international certification systems: Assessment revolves not only around ecological aspects but also includes a holistic examination of the entire life cycle of a building or urban district.
This reflects what was also discussed during the NRC workshop ‚Certifyable sustainable?' „(...) that a certification is a tool, and that to make it more effective, or to ‚optimize' it, one must take a more holistic look at the system within which it is meant to operate."
However, in the green building industry, the greening of supply chains as a whole, the monitoring of the social impacts of certification regimes are not being adressed yet.

Another point which was already addressed in subchapter 3.1.4 is the lifecycle of the Certification itself. In order for CSs to justify their existence a more or less permanent structure or at least continuous attention needs to be in place. As „the institution (is) to bring benefit to participants and society" (Matus, 2009, p.96), an undermining of that would question their existence siginficantly. CSs are relatively new policy tools and one question to be disccused in the coming years of system development is to „improve our understanding of how and when they are effective."(Matus, 2009, p.101)

3.2.2 Comparison of system structure of community certification systems

CS for communities are compared in terms of their overall system structure, categories and indicator settings. With regard to water-related aspects in the systems, systems studied are based on data availability and relevance to research questions.
CASBEE was the first CS, has a very complex structure and is designed for a very particular market and therefore not relevant for further study.
LEED-ND was the first certification system for communities and took its overall structure from the building systems. Additional categories applying relevant Best Practice standards for communities were added.
Abu Dhabi's ESTIDAMA followed a similar path, yet it clearly set priorities based on national standards.
The GBCSA stated „that it does not wish to 'recreate', 're-do' or 'reinvent' Best Practice standards during the tool development stage of Green Star – Communities". (GBCSA, personal conversation, 2013). „It is the aspiration for Green Star - Communities to build upon the information and lessons learnt from others who have followed similar paths."(GBCSA, personal conversation, 2013)
Consequently the general structure of the systems is quite similar. It can be separated into four different levels, as seen in Fig. 03-11. The first level depicts the broad goal of the certification system, a scope of the final objective of the end project. These goals are often classified into environmental, social, economic and accessibility parameters. From these goals, the certification system is fragmented into various categories within the goal, which summarize multiple criteria. Categories contain multiple specific criteria, in which points are assigned to associated indicators.
A point system tallies points based upon a predetermined scoring system and percentage weighting, a ranking is given to the project.
As previously mentioned, although similarities occur due to commonly understood best practice ideals and copying other systems variations occur as the system developers gear towards national standards and technicalities, climatic and cultural issues (e.g. water scarcity in Abu Dhabi) or other pressing matters such as lacking infrastructure in India.
The variations in category choice and water-related criteria in the different systems are graphically shown in the following charts.
Fig. 03-12 shows the point distribution by core category. Although it can be seen, that they cover often similar goals of sustainabiltiy, such as environment, categories differ in percentage weighting and number of categories. LEED-ND for example puts a major emphasis on Smart location and linkage, which can be seen as „a direct response to what is america's biggest post-war problem: urban sprawl and auto-dependency" (Jurleit, 2012,P.16).

By demanding projects to be in smart locations, the CS counteracts what has established itself as a problem in america's planning culture
The IGBC's heaviest weighted category is ‚Infrastructure', which is in response to India's daring need to build functioning infrastructure systems. While these two first generation CS directly respond to some of the country's current planning needs, the DGNB system as a second generation system, responds to the critique, that systems often times focus not only on their immediate national planning needs but also focus too much on environmental and planning issues. The DGNB developed a system with a ‚harmonized and holistic approach' covering all aspects of sustainabilty: environment, but also economy, society and technology as well as process design.

When further investigating the core categories with focus on the water related aspects, one sees, that the choice and weighting are different in each system.

Here choice of criterion, weighting and point distribution, calculation methodologies and benchmarks need to be distinguished. Often times the goals of the criteria are similar: water efficiency, rainwater harvesting, wastewater reuse are all mentioned. Fig. 03-14 shows how these criteria are integrated into the overall system-structures of each system. Some systems have a long list of prerequisites which need to be fullfilled before a project can be registerd for further certification and which are related to waterinfrastructure in the community. For example requires LEED-ND a minimum building water efficiency and the preservation of all wetland and waterbodies of the project. IGBC new townships doesn't have that requirement, although encroachement into waterbodies is a well known problem in township development. Instead, rainwaterharvesting is a prerequisite for all new townships. By making certain criteria mandatory, the direction of a new development is already given a certain weight and direction. The following water-related criteria and points which are more or less voluntarily, will have an impact through their point and percentage weight as well as benchmark setting. (cf. Fig. 03-14)

Goal:
Definition: In the CS a goal is usually defined by a principle national idea for future community development
For example: environmental

Prerequisite:
Definitions: something that is necessary to an end or to the carrying out of a function
minimum characteristics that a project must possess to be eligible for certification

For example: locate the project on a site served by existing water and wastewater infrastructure

Categories:
Definition: generic term for the following criteria
For example: Precious Water

Criterion, often called Credit:
Definition: a rule or principle for evaluating or testing something
For example: Stormwater management

Indicators:
Definition: description of the status quo, can be quantitative and qualitative
Indicators are usually simplifications of the phenomena which they seek to measure, since many of these phenomena are complex and are often not fully understood (MOFA, 1982; Nagel, 1984) They thus represent a compromise between scientific accuracy and the demand for concise information to inform policy and guide decision making (Meyers, 1987)

For example:
qualitative: use of Best management practices to achieve performance goal
Quantitative: volume of rainwater to be managed

Weighting:
In the CS Categories and Criteria are applied a certain % weight
For example:

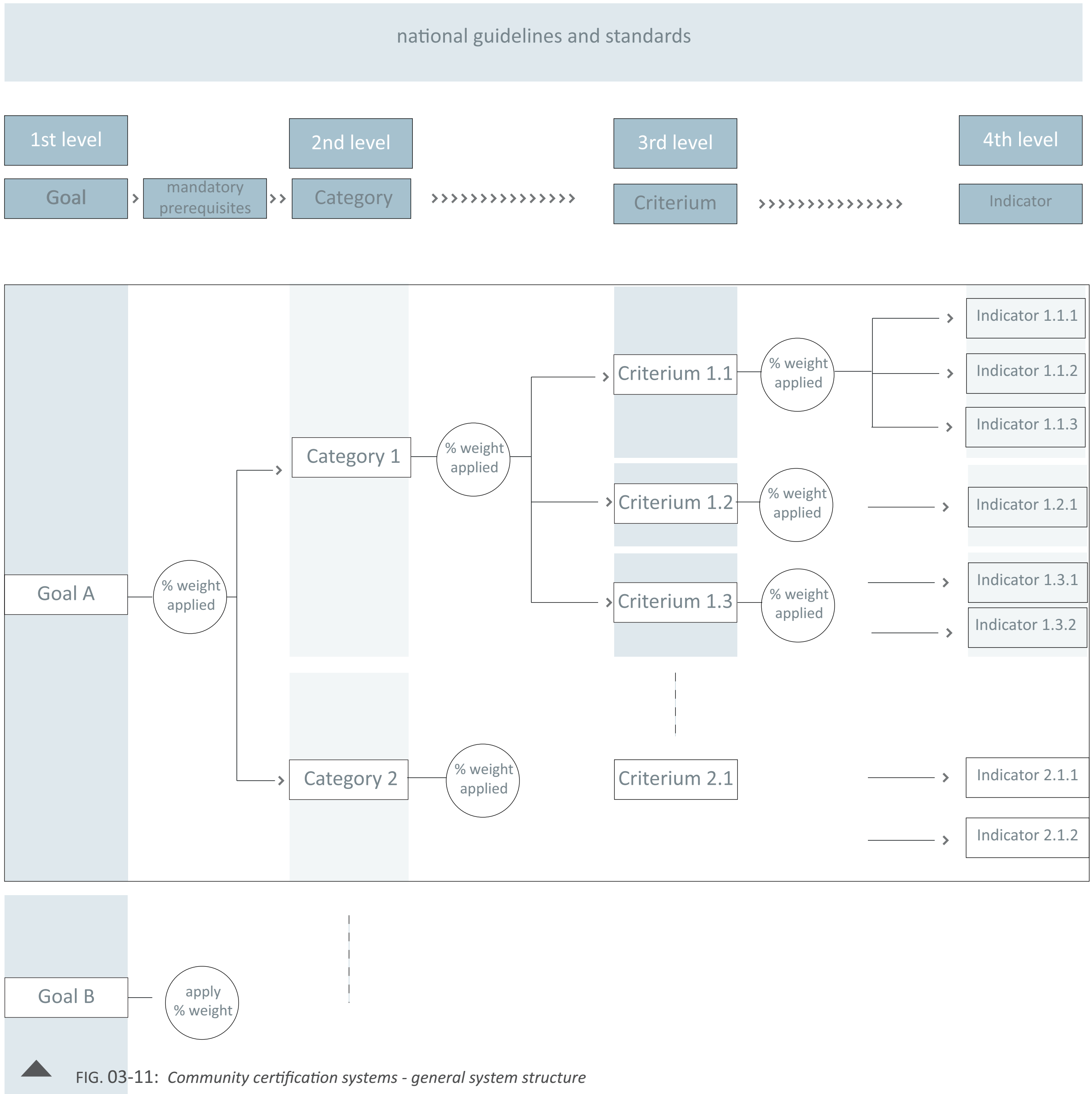
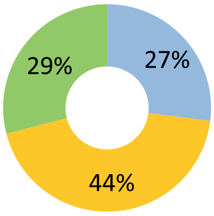


FIG. 03-11: *Community certification systems - general system structure*

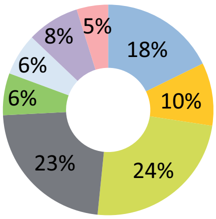
Point Distribution by Core Category

LEED Neighborhood Development



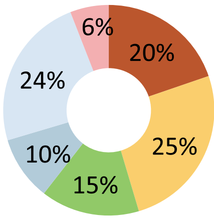
Smart Location and Linkage	3	4	4
Neighbourhood Pattern and Design	0	1	1
Green Infrastructure and Buildings	3	6	14
Innovation and Design Process	-	-	-
Regional Priority Credit	-	-	-

BREEAM Communities



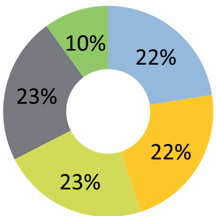
Climate & Energy	2	4	12
Place Making	0	2	6
Community	0	0	0
Transport	0	0	0
Ecology	0	0	0
Resources	0	1	3
Business	0	0	0
Buildings	2	3	9

BREEAM Netherlands



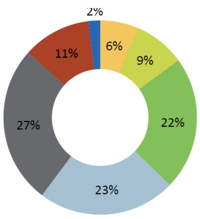
Synergy	1	1	7
Resources	0	1	3
Spatial Development	1	2	8
Well-being	0	0	0
Area Climate	0	1	4
Management	0	0	0

DGNB



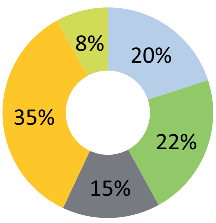
Environmental Quality	2	2
Economical Quality	-	2
Sociocultural and Functional Quality	x	4
Technical Quality	x	3
Process Quality	x	3

Pearl Community Rating System for ESTIDAMA



Integrated Development Process	1	1	2
Natural Systems	3	1	6
Livable Communities	1	2	13
Precious Water	3	5	37
Resourceful Energy	0	0	0
Stewarding Materials	0	1	1
Innovating Practice	-	-	-

IGBC Townships



Site Selection & Planning	1	1	6
Land Use Planning	0	1	12
Transportation Planning	0	0	0
Infrastructure Resource Management	1	3	18
Innovation in Design & Technology	-	-	-

FIG. 03-12:
Community certification systems - main categories of relevant CS

New urban districts, version 2012

Quality Sections	Evaluation Topics	Nr.	Criteria	Weighting	Share of Overall Score
Environmental Quality (ENV)	Global and Local Environmental Impact (ENV10)	ENV1.1	Life Cycle Assessment	3	2,7
		ENV1.2	Water and Soil Protection	2	1,8
		ENV1.3	Changing Urban Microclimate	3	2,7
		ENV1.4	Biodiversity and Interlinking Habitats	2	1,8
		ENV1.5	Considering Possible Impacts on the Environment	2	1,8
	Resource Consumption and Waste Generation (ENV20)	ENV2.1	Land Use	3	2,7
		ENV2.2	Total Primary Energy Demand and Renewable Primary Energy Share	3	2,7
		ENV2.3	Energy-efficient Development Layout	2	1,8
		ENV2.4	Resource-efficient Infrastructure, Earthworks Management	2	1,8
		ENV2.5	Local Food Production	1	0,9
		ENV2.6	Water Circulation Systems	2	1,8
Economic Quality (ECO)	Life Cycle Costs (ECO10)	ECO1.1	Life Cycle Costs	3	6,8
		ECO1.2	Fiscal Effects on the Municipality	2	4,5
	Value Development (ECO20)	ECO2.1	Value Stability	2	4,5
		ECO2.2	Efficient Land Use	3	6,8
Sociocultural and Functional Quality (SOC)	Social Qualities (SOC10)	SOC1.1	Social and Functional Mix	2	1,8
		SOC1.2	Social and Commercial Infrastructure	2	1,8
	Health, Comfort and User-friendliness (SOC20)	SOC2.1	Objective / Subjective Safety	2	1,8
		SOC2.2	Public Space Amenity Value	2	1,8
		SOC2.3	Noise Protection and Sound Insulation	2	1,8
	Functionality (SOC30)	SOC3.1	Open Space Offer	3	2,7
		SOC3.2	Inclusive Access	2	1,8
		SOC3.3	Development Layout and Flexible Use	2	1,8
	Aesthetic Quality (SOC40)	SOC4.1	Urban Integration	3	2,7
		SOC4.2	Urban Design	2	1,8
		SOC4.3	Use of Existing Structures	2	1,8
		SOC4.4	Art in Public Space	1	0,9
Technical Quality (TEC)	Technical Infrastructure (TEC10)	TEC1.1	Energy Technology	2	2,6
		TEC1.2	Efficient Waste Management	2	2,6
		TEC1.3	Rain Water Management	3	4,0
		TEC1.4	Information and Telecomunication Management	1	1,3
	Technical Quality (TEC20)	TEC2.1	Maintenance, Upkeep and Cleaning	2	2,6
	Transport, Mobility (TEC30)	TEC3.1	Quality of Transport Systems	3	4,0
		TEC3.2	Quality of Motor Transport Infrastructure	1	1,3
		TEC3.3	Quality of Public Transport Infrastructure	1	1,3
		TEC3.4	Quality of Bicycle Infrastructure	1	1,3
		TEC3.5	Quality of Pedestrian Infrastructure	1	1,3
Process Quality (PRO)	Participation (PRO10)	PRO1.1	Participation	3	1,7
	Quality of Planning (PRO20)	PRO2.1	Concept Development Process	2	1,1
		PRO2.2	Integrated Planning	3	1,7
		PRO2.3	Municipal Involvement	2	1,1
	Quality of the Management and Construction (PRO30)	PRO3.1	Management	2	1,1
		PRO3.2	Construction Site and Construction Process	2	1,1
		PRO3.3	Marketing	2	1,1
		PRO3.4	Quality Assurance and Monitoring	2	1,1

FIG. 03-13:
Community certification systems - general system structure and point distribution of DGNB system (© DGNB, 2013)

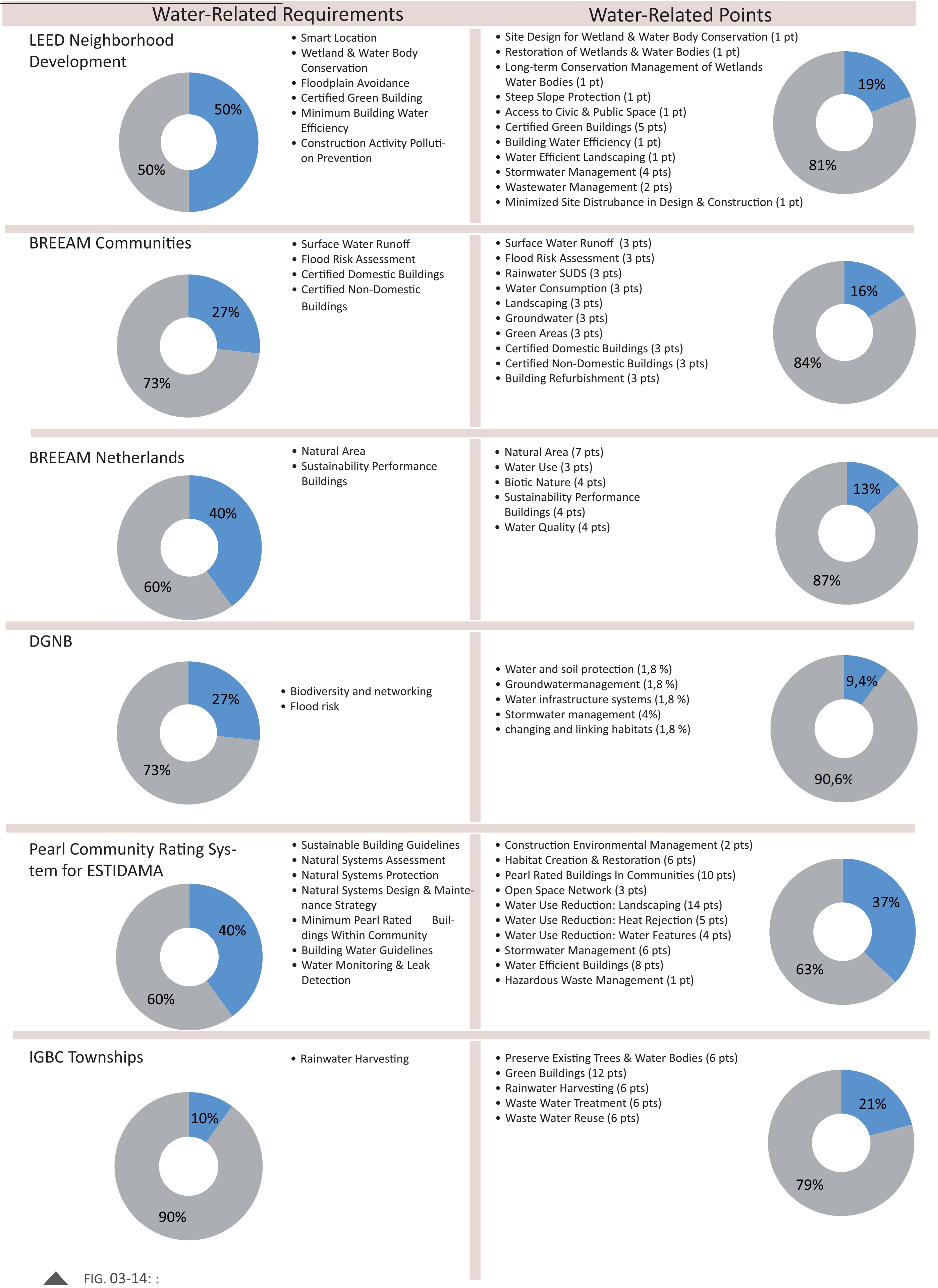


FIG. 03-14: :
Community certification systems -
water-related percentages compared to total score; the separation of required versus related points adds to the incomparability of systems

3.2.3 Criterium (Credit) and Indicators

Finding the balance:
qualitative vs. quantitative and
prescribtive vs. performance based rating

„All research ultimately has
a qualitative grounding“
- Donald Campbell
(as cited in Mile & Huberman, 1994, p. 40)

„There‘s no such thing as qualitative data.
Everything is either 1 or 0“
- Fred Kerlinger
(as cited in Mile & Huberman, 1994, p. 40)

To find the balance between quantitative and qualitative rating parameters and wether these should be checked through prescriptive measures or else a performance based assessment, is an everarising challenge. Within the CS many of the technical requirements are quantified (e.g. energy consumption), whereas social aspects are often confirmed in a checklist format of qualitative questions.
Within the aspect of water, both qualitative as well as quantitative approaches are applied. Usually the quantitative requirements are backed up by a qualitative mission statement.
For example, in LEED-ND’s most recent Pilot credit manual, the *‘Rainwater management’ credit says: „*Intent is to restore or maintain the natural hydrology and water balance on site based on historical conditions and undeveloped ecosystems in the region. Requirement: In a manner best replicating natural site hydrology processes, manage onsite run off from the developed site for the percentile of regional or local rainfall events listed using Low Impact Development and green infrastructure.“ (USGBC, 2013)
The paragraph already assumes many technical measures through its use of certain terminology such as LID and green infrastructure (cf. common terminologies). Point distribution occurs through the percent of total volume to be retained during a rainfall event.
Even though certain technologies are required to ‘reach the points’, points are ultimately distributed based on the quantities controlled, which leaves out a lot of other points important to the hydrology process (such as evatransporation). These points are formulated in the ‚Documentation guidance‘ section of the credit, but are not part of the rating and point distribution process: „prepare a stormwater management plan that addresses infiltration, evaporation, or reuse.“ (LEED-ND, 2009, p.388).
Another approach with a similarly broad intent, but different calculation methods have the DGNB and Estidama. The DGNB Rainwatermanagement criterion requires the calculation of an area waterbalance with the components ‚average annual precipiation‘, , average annual groundwater recharge‘ and ‚average annual potential evaporation level‘. The deviation of the project‘s waterbalance against the waterbalance at undeveloped project state makes 50 % of the rating points. The other 50 % consist of the assessment of Best management practices in a checklist format. ESTIDAMA, national CS of the UAE is the one CS in which water plays a very important role. With a 27 % category weighting for ‚Precious water‘and several water related requirements and additional credits it outweighs other systems by number of criteria and complexity. Since rainwater is extremely scarce in the UAE, the intent of the rainwater criterion states: „To minimize peak stormwater discharge and protect the stormwater drainage system and receiving water bodies from pollutant loading during and after storm events.“ (Estidama, 2010, p.104)
The credit requires quantity and quality control of a peak run-off rate of a design storm.
All of the above examples show the ever arising challenge of balancing between qualitative and quantitative and prescribtive and performance based rating requirements. Especially the trend from prescriptive (e.g. install a green roof for rainwater retention) to performance rating (e.g. retain rainwater on site) is becoming wideley accepted and leaves much more room for innovation as confirmed by the IRCC: „ By the term ‚performance-based‘ we are describing the situation in which regulations are written in terms of the required outcome rather than by prescribing the process by which the specified outcome can be achieved. The adoption of this approach opens up the possibility of new and innovative solutions to the construction process.“ (IRCC, 2004, p.2). Still, as the examples show, the picking of a particular ‚performance‘ in a complex environmental process, such as the watercycle, will partially diminish the representation of the overall complexity of the process.

This phenomenon of having to condense complexity to a single rating parameter becomes very evident in the criteria section of the CSs (cf. chapter 3.1.3)

Stated Intent vs. Actual rating parameter:
condensing complexity to a single rating parameter

For instance: In LEED-ND each credit category begins with a brief sentence or two, providing a broad purpose of the criteria‘s ‚Intent‘. From there, the document delves into the details of the criterion. Oftentimes, the original intent isn’t well reflected in the methodologies and awarded points. This can cause confusion in interpreting the credit because the true purpose of the credit becomes blurred. One major reason to explain this occurrence is because no community concern exists in isolation, especially with regard to environmental issues, which are all interconnected and rely on an organized synergy of methods.

An example of deviation from stated intent can be found within LEED's rainwater management. LEED's intent is "To reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions." (USGBC, 2013)
Based solely on the intent, one might perceive the category awards credits for projects which minimize pollution and increase water quality, based on certain indicators. Instead, credits are awarded for percentile rainfall events retained on-site. It is true rainfall retention will have a significant effect on pollution from stormwater and will improve water quality, however there are other consequences of retaining rainwater as well. One major benefit that is overlooked until the Implementation section of the document is on-site rainwater reuse. This is a major potential benefit, and is mentioned in the LEED-ND category on Stormwater Management, however it is unclear whether the category actually promotes it. No credits are earned directly for rainwater reuse, although it is mentioned as a best practice and is involved in the calculation section as well.

Another example is the IGBC's focus in community watercycle management on rainwater harvesting. Here the overall intent is described as:
„Harvest rainwater to enhance the groundwater table and reduce municipal water demand." (IGBC, IRM Credit 1)

More points are distributed the more rainwater is captured either to recharge groundwater or to capture it in order to minimize drinking water demand, ultimateley two opposing goals.

For a certification system to be truly successful, it must ensure each category (e.g. watercycle management) is cohesive. This means it must either be focused solely on one issue, or be general enough to encompass the array of potential benefits. Systems which have not yet found this balance and try to integrate both ideas in each category will have far more difficulty in applicaton and adaptation. *Otherwise,* the stated intent reflecting the complexity and different dimensions of the hydro-

CS	rainwater management intent	calculations / quantification / documentationof performance
LEED-ND	'Rainwater management' credit: ‚To reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions..'	volume of rain to be retained on site based on impervious surfaces and performed through Best management practices (quantitative volume-based / calculation)
DGNB-NSQ	The objective is to promote concepts that provide decentralised rain water management in order to prevent flooding and to improve the local climate. In so doing, measures should be developed which correspond as closely as possible to the natural, site-specific water balance of rain water volume, evaporation and surface drainage and associated ground water recharge. (DGNB Criterion TEC1.3)	» change in water balance pre- and postdevelopment status (Quantification / calculation) » implementation of Best management practices (Checklist format)
IGBC	‚Harvest rainwater to enhance the groundwater table and reduce municipal water demand' (IGBC, IRM Credit 1)	» provide details on the rainwater harvesting system specifying storage capacity and volume of water captured (quantitative volume-based / calculation) » provide calculations to show that rainwater harvesting system captures X% of the design storm » provide stormwater management plan highlighting location of all harvesting pits
Estidama	To minimize peak stormwater discharge and protect the stormwater drainage system and receiving water bodies from pollutant loading during and after storm events. (Estidama, PW-2: Stormwater Management)	» calculations describing and quantifying the stormwater management strategies, specifically addressing the pre-development and postdevelopment peak runoff rate and quantity; » Drawings showing locations of components of the stormwater management » Extracts from specifications and product data sheets describing the components specified, confirming that the system is capable of collecting 90%of stormwater and is able to treat to the required quality standards

FIG. 03-15: :
Community Certification Systems - rainwater management criterion: goals, methodologies and calculations differ in the four chosen and representative systems

logical cycle in the community gets diminished through the necessity of having to choose a parameter for rating purposes.
The example of the IGBC Townships rating system is a blatant example where the intent demands two opposing actions and consequently a clear goal is skewed.

It is in particular within the criteria where the difficulties of operationalisation the complexities of sustainablity become evident. Some CS have addressed this issue by pointing out other criteria in each criterion, which influence or relate to one given indicator. True feedback loops to make a project better are not installed though.
LEED-ND puts, what could be considered an overall and accepted approach to watercycle planning in the community in the wastewater section: in LEED-ND Credit 14 Wastewater management under 5. Timeline and Team it is suggested: „A waterbudget enables comparison of trade-offs for water conservation strategies and evaluation of the impact of water infrastructure on other systems. (...) Estimate the feasibility and cost of different reuse and treatment strategies and compare environmental effects of on-site with off-site watersupply." (USGBC, 2013)
The complexity and cohesion of the various aspects in watercycle management in the community need to be presented not only by clearly defined goals and their linkages, it also needs to be represented in the point distribution. Point distribution according to logical consecutive linkages needs to be carefully considered and is often not transparently shown in the CS:
LEED-ND misses that rainwater may be worth points for being re-used. Altough mentioned in the category wastewater, 0 points are given. Instead 4 pts are given if the rainwater is managed onsite (see table). This may lead to a decisionmaking process which is not based on project needs but point distribution.
The DGNB system gives 20 points total if rainwater is re-used to reduce drinking water demand and also 20 points if the rainwater remains within the community and is managed according to the natural hydrological cycle. Both actions may cancel each other out, however here an informed decision for the project and not rating benefit can be made.

All of the above mentioned difficulties and various approaches of compound and interlocking effects which need to be taken into consideration when creating a CS, show the challenge of simplifying complexity to an acceptable degree.

3.2.4 Setting benchmarks - another first step to set the bar

„A [...] rating tool sets standards and benchmarks for green building, and enables an objective assessment to be made as to how ‚green' a building is. (SAGBC, 2012) Aside of setting out , a ‚menu' of all the green measures that can be incorporated into a (...) project to make it green" (SAGBC, 2012), benchmarks are determined as desirable target values. The sensitve act of creating a menu of measures, weighted categories and criteria and benchmarks is ultimately the first step to determining what's best in class.

Benchmarking, as a concept, began in the hands of early land surveyors, used to classify a fixed point of reference to which all other measurements are made. Benchmarking has existed since the 1950s, however quickly took flight in the 1970's and by the 1990s was implemented by numerous governments, non-profit and private companies by to exemplify "the systematic process of searching for best practices, innovative ideas and highly effective operating procedures that lead to superior performance". (Blakeman, 2002) . A Benchmark is therefor by definition a point of reference to compare to other points.
Choosing and defining a benchmark is a sensitive act of balancing various steering powers (see Fig. below) and in the case of CS an important step to determine what's best.
In a Scandinavian international comparison of benchmarking in the building sector, Porkka concludes that benchmarking is still lacking in transparency and the inclusion of end-users. (Porkka, et al., 2010). Where organizations like the VDI (The Association of German engineers) have a long history of benchmarking and making the process transparent and available to the public, Porkka et al. conclude in their assessment of 28 case studies throughout North Europe, that benchmarking in the building sector is still a fragmented process. They mention, that „front runner companies have their own key performance indicators, sometimes even several indicator systems used by different organizational units in different process phases. There seems to be a demand for a uniform." (Porkka, et al., 2010), however they urge for „a commonly accepted standardized set of global or European Key Performance Indicators" (Porkka, et al., 2010), because of the general trend of market growth in the rated building sector .
Whereas Mieldazys concedes in her study, that performance-based building codes offer important prescriptive codes to necessitate international CS, however is weary as to whether standard benchmarking is culturally sensitive and its transference in various international environments effective, claiming benchmarking values generally vary from country to country. (Mieldazys, 2004)
These findings are confirmed by the author's own experience in systemdevelopment itself as well as the analysis of the various chosen CS show how different benchmarks are set.
The debate surrounding how high benchmarks should be set can be shown through the example of floodrisk management in CSs. For example, BREEAM communities demands to control surface run-off to 1:500 year event for highest marks. The question arises: Is this too sufficient and therefore leads to disproportional project costs? Would the community in the end be technically over-designed? Choosing appropriate benchmarks is a question answered differently in each system. This is also apparent when it comes to the Water Efficiency category. For water efficiency, the DGNB proposes a reduction from 120l/person/day to 60l/person/day and is very concrete with this determination, BREEAM targets 80l/person/day. Other systems are less precise and call out for water-saving fixtures, such as low-flush toilets in order to reduce drinking water demand.(cf. LEED-ND)
In a just recently held interview series in the UAE on benchmarks set in Estidama, Khater summarizes

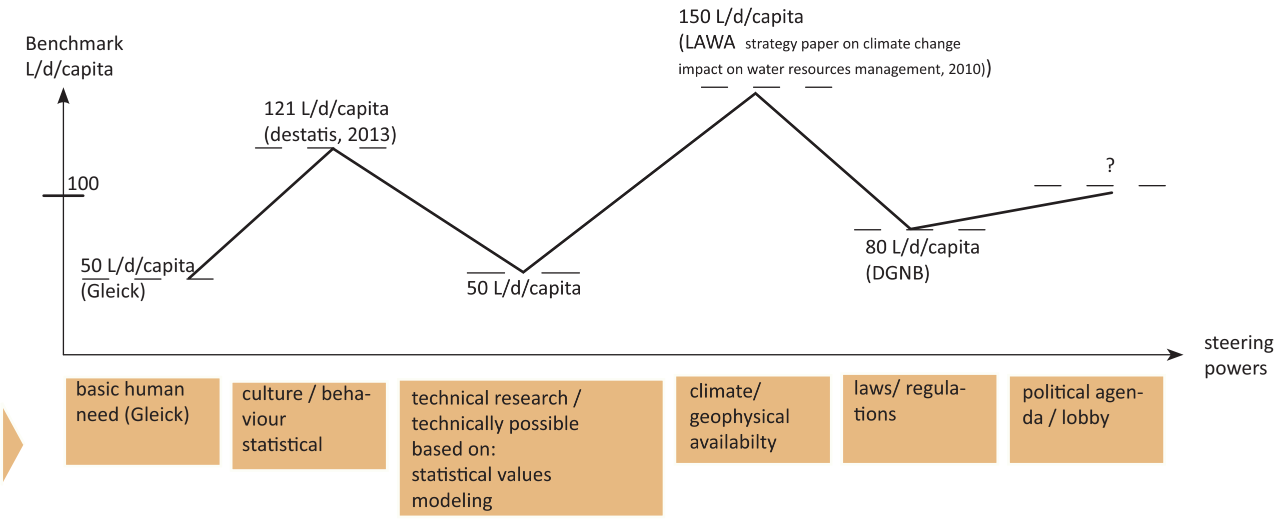


FIG. 03-16: :
setting a benchmark is the first step to rating -
internal and external steering powers with different agendas may influence the benchmarking process

"current benchmarks are perceived to be generally below average and more stringent ones are wished for" (Khater, 2013, p.82), however the often politically enforced values are often beyond what is simply doable and therefore questionable.
As benchmarking is a relatively new phenomenon in the case of the building sector, little information is available regarding its efficiency and effectiveness. Nevertheless, benchmarking for CS has come under criticism between the various political, social and economic steering powers, which shape it.
For instance, the American High-Performance Buildings Coalition recently argued LEED lacks transparency, "shuts out stakeholders" and is not built on consensus. (Badger, 2013) There has been political and economic contention surrounding LEED point acquisition to locally sourced materials, particularly wood. If timber is FSC certified and accounts for half of the buildings used timber, 1 point is awarded out of 100. If, however, timber is sourced locally at although perhaps through less sustainable activities, 2 points are awarded. (Badger, 2013) As Badger points out, although such differences represent minute variations, such point determination can place an entire rating system in jeopardy.
Lobbying from the timber, plastics and chemical industries in their tireless attempts to ban building codes in certain states, represents a political "heavyweight" according to Badger, once again, underlying the importance of public and private steering powers in the debate.
According to the USGBC, support of benchmarking is crucial to the future of the building energy sector. „Without benchmarking, those low and no-cost opportunities to save energy will never be found. We have the free tools available to start making benchmarking part of standard building operation" (Pearce, 2012). Weingart summarizes what will always have to be taken into consideration in the decision making process of setting benchmarks:

The integration of benchmarking and benchmark / target value setting based on scientific evidence and its inclusion in policy, will continue to undergo a process of mutual transference, known as the scientification of policy, and the politicization of science, bound to follow cyclical processes of delegitimization from media, policy and economic interest groups in its quest for accountability and institutionalization. (Weingart, 1999)

How to read
TABLE. 03-1: Overview of key indicators and their representation in selected Certificationsystems :

The left column lists each indicator with the question whether the indicator is explicitly requested as part of the water-related criteria and calculations of the selected CSs. If the indicator is not documented as part of the certification process, the variables of the indicators are checked. For quick visual results presentation, the following symbols were chosen:

✓ indicator is not requested

✗ indicator is not requested as part of the certification process

✗ ▸ ✓ indicator is not requested as part of the certification process, however variables of indicator are computed

the result summary at the end of the table condenses the overall emphasis and calculation of the four chosen CSs.

PIC: 03-3:
rainwater harvesting pit at Malaysian township in Hyderabad, India / 2013, Jurleit

3.3 Comparative analysis: comparing selected certification systems with best practice

Analysis Methodology

The methodology for conducting an analysis of community certification systems was developed based on the four R's: Recharge, Reuse + Recycle, and Reduce. Each of these water cycle components relate to key policy questions communities should consider: Is the community water extraction rate sustainable; are their alternative water sources available, or appropriate uses for used water; and how efficient is water being used? For these aspects, a framework of planning steps was developed. Also considered was, that parts of the framework will feed into computing the KPI developed in chapter 2. With this framework as ideal-scenario guidelines (cf. Chapter 2), selected certification systems were analyzed to whether they provided the information needed to feed into the KPI.
The CS were selected where representative validity was to be expected. Estidama is a CS weights the water category the most and has some very advanced methodologies, such as a community watercalculator. LEED-ND was chosen, because it is one of the most known and wideley spread CS, also information and USGBC feedback was easily available. The DGNB system was chosen because of the author's involvement as a technical advisor during CS development and lastley IGBC was chosen as a casestudy.

The result summary for each certification system is shown in table 03-1 .
In general it can be said, that the chosen CS represent the overall impression that most indicators are not asked for in the systems in particular, however the necessary variables of the indicators are often part of the CS' necessary calculations.
One factor which was not presented in the CS is the question of what kind of waterresources were available to a community, distinguished in internal and external according to the ecoblock concept. Also, the aspect of waterquality for wastewater as well as treatment possibilities is mostly not explicitly discussed. Instead terms like ‚recycled wastewater', ‚potable' versus ‚non-potable' water are being used .

The Framework and accordant KPI's in Chapter 2 was developed on the basis of general and consensus-based Best Practice procedures (Chapter 2.2) and relates to accepted standards (UNEP; EEA; OECD) and policies (Chapter 2.1). In this chapter it is used as the backbone for CS analysis.

Indicator	Indicator name	calculations with variables	variables
Indicator 1 WAI	Water availabilty	$WAI = \frac{R + G - D}{R + G + D}$	R= surface run off G= groundwater resources D= sum of demands of all sectors
Indicator 2 WA_{ratio}	internal vs. external resources	$WA_{ratio} = \frac{WA\,i - WA\,ex}{WA\,i + WA\,ex}$	WA i = internal resources are groundwater and surface run off WA ex = external resources are inflows into the ecoblock boundary
Indicator 3 W_{prod}	freshwater vs. recycled water resources	$W_{prod} = \frac{W\,fresh - W\,rec}{W\,fresh + W\,rec}$	W_{fresh} = freshwater abstraction $W_{rec.}$ = recycled resources
Indicator 4 $D_{ratio\ (Gleick)}$	projected demand vs. basic human water demand	$D_{ratio\ (Gleick)} = \frac{D\,projected\ /\ D\,actual}{50\frac{l}{d}/person}\ x\ 100\ \%$	projected demand of community residents against Gleick BHW Indicator of 50 liters per person/per day per
Indicator 5 D_{ratio}	projected vs. actual demand	$D_{ratio} = \frac{D\,projected}{D\,actual}\ x\ 100\ \%$	projected demand of community disaggregated subareas (refer to P.S. 2.1)
Indicator 6 RW_{share}	rainwater usage against demand	$RW_{use} = \frac{RW}{D}\ x\ 100\ \%$	RW = rainwater as % of reliable run-off
Indicator 7 WW_{prod}	wastewater to demand coverage	$WW_{prod} = \frac{WW\,Qx}{WW\,total}\ x\ 100\ \%$	WW Q 1 = untreated stormwater WW Q 2 = greywater WW Q 3 = yellow water WW Q 4 = blackwater WW Q 5 = agricultural wastewater WW Q 7 = industrial wastewater
Indicator 8 WW_{cov}	wastewater for re-use	$WW_{cov} = \frac{WW\,Qx}{D}\ x\ 100\ \%$	
Indicator 9 WW_{treat}	Wastewater treatment quality	$\frac{WW\,treat}{WW\,total} = \left(\frac{WW\,treat\,1}{WW\,treat} + \frac{WW\,treat\,2}{WW\,treat} + \frac{WW\,treat\,3}{WW\,treat}\right)\ x\ 100\ \%$	WW treat 1: share of primary treatment WW treat 2: share of secondary treatment WW treat 3: share of tertiary treatment

FIG. 03-17: Overview of key indicators (for more details refer to formulary in Appendix)

TABLE. 03-1: Overview of KPI‘s and their representation in selected Certification systems

	LEED-ND	DGNB - NSQ

Indicator 1
WAI
explicitly requested?
if no:
variables of indicator are part of CS calculations / documentation?
if yes:
which ones?
which ones are missing?
	✗
	D= sum of demands is calculated in:
	GIB Credit 3- building water efficiency
	GIB Credit 4 - water efficient landscaping
	R= surface run-off:
	GIB Credit 8 - stormwater management as volume of rainwater which must be retained
	G= available groundwater resources is not requested as part of the CS calculations
		✗
		D= sum of demands is calculated in:
		Criterion: ENV 2.6: drinking water consumption by calculating residential gross floor area and non-residential gross floor area; water efficiency measures are assumed
		R= surface run-off is calculated in TEC 1.3 as part of area water balance
		note: surface run-off not calculated as available surface run off for re-use, taking into account environmental demands (*refer to PS 1.2*)
		G= available groundwater resources is not requested as part of the CS calculations

Indicator 2
WA ratio
explicitly requested?
if no:
variables of indicator are part of CS calculations / documentation?
if yes:
which ones?
which ones are missing?
	✗
	no distinction between internal and external water resources is made
	Ecoblock concept not conveyed in CS
		✗
		no distinction between internal and external water resources is made
		Ecoblock concept not conveyed in CS

Indicator 3
W prod
explicitly requested?
if no:
variables of indicator are part of CS calculations / documentation?
if yes:
which ones?
which ones are missing?
	✗ → ✓
	W rec.:
	GIB credit 14 - wastewater management
	‚This Credit requires calculating the percentage of average annual wastewater generated for potential re-use‘
	W fresh:
	freshwater abstraction volume is not mentioned
		✗ → ✓
		W rec.:
		Criterion: ENV 2.6 - watercirculation systems
		requires a schematic water balance in which rainwater, grey-water and blackwater usage are rated. rating is prescriptive (e.g.: separation of grey and blackwater) and not volume based;
		W fresh:
		freshwater abstraction volume is not mentioned

Indicator 4
D ratio (Gleick)
Indicator 5
D ratio
explicitly requested?
if no:
variables of indicator are part of CS calculations / documentation?
if yes:
which ones?
which ones are missing?
	✗ → ✓
	✗ → ✓
	projected demand:
	D= sum of demands is calculated in:
	GIB Credit 3- building water efficiency
	demand calculated based on fixture efficiencies
	GIB Credit 4 - water efficient landscaping
	demand calculated based on landscape coefficient consisting of species, density and microclimate factor
	note: baseline determined by available technologies and landscape co-efficients
	actual demand:
	monitoring of actual consumption (actual demand) post-occupancy is not determined in CS
		✗ → ✓
		✗ → ✓
		projected demand:
		D= sum of demands is calculated in:
		Criterion: ENV 2.6 - watercirculation systems
		demand calculated in proportion to GFA (gross floor area)
		note: baseline for demand calculations defined as: weighted average (baseline for residential: 130 lites per person per day and the need of 45 m2 living area; baseline for non-residential: 50 l per person per day and 25m2 office space)
		actual demand:
		monitoring of actual consumption (actual demand) post-occupancy is not determined in CS

Estidama

D= sum of demands is calculated in:
Criterion: PW-R1 community water strategy
Using the Community, Building and Villa Water Calculators, establish the community's overall water demand and determine the community-wide water balance between the available building wastewater and public realm irrigation, heat rejection and water feature demands.

$$CWB = \sum B_W x E_M - L_W - DC_W - WF_W$$

The Community Water Balance, CWB, is determined as follows:
BW = Building Water Consumption (determined using Building/Villa Water Calculator)
EM = Municipal Recycled Water Efficiency
LW = Irrigation Demand of all community landscaping
DCW = Water make-up requirements of all community district cooling schemes
WFW = Water make-up requirements of all community based water features

R= surface run-off is addressed in *Criterion: PW-2 stormwater management*
peak stormwater discharge to be minimized, post-development peak runoff rate not to exceed pre-development runoff-rate
note: surface run-off not calculated as available surface run off for re-use, taking into account environmental demands (*refer to PS 1.2*)

G= available groundwater resources is not requested as part of the CS calculations
NOTE: Community water balance more demand reduction oriented rather than availabilty oriented

‚The aim is to ensure that the non-recoverable community water demand associated with irrigation, heat rejection and water features does not overburden the available building wastewater.The community water balance is determined based on the difference between the available building wastewater and the exterior water demand for irrigation, heat rejection and water features.'

no distinction between internal and external water resources is made; Ecoblock concept not conveyed in CS

W rec:
Recycled Water addressed in
Criterion: PW-1.1: Community Water Use Reduction: Landscaping

Completed Community Water Calculator confirming the percentage of the irrigation demand that can be served using the Exterior Water Allowance.
The Exterior Water Allowance, EWA, that is available to serve the community's exterior water demand is determined based on the values used within PW-R1 Community Water Strategy as follows:

$$E_{WA} = \sum B_W x E_M$$

BW = Building Water Consumption
EM = Municipal Recycled Water Efficiency
note: wastewaterqualities are not distinguished

W fresh:
freshwater abstraction volume is not mentioned

projected demand is calculated in:
Criterion: PW-R1 community water strategy
Using the Community, Building and Villa Water Calculators, establish the community's overall water demand and determine the community-wide water balance between the available building wastewater and public realm irrigation, heat rejection and water feature demands.

$$CWB = \sum B_W x E_M - L_W - DC_W - WF_W$$

landscape demand targets in PW-1.1
building demand targets in PW-R1: Minimum Interior Water Use Reduction
‚Interior water use is defined as the water demand that relates solely to fixtures, fittings, and appliances.Efficiency measures are all measures which reduce the overall demand for water from the baseline requirement. Reductions in potable water cannot be claimed through the use of any recycled water within this prerequisite. Calculations are based on building occupancy and include all interior water use relating to fixtures, fittings and appliances.'
actual demand:
monitoring of actual consumption (actual demand) post-occupancy is part of the operational rating scheme

IGBC- townships

D= sum of demands is calculated in:
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚Provide water balance calculations indicating the water requirements for potable use, domestic use, landscaping and all other non-potable uses'
R= surface run-off:
IRM mandatory requirement and IRM Credit 1 rainwater harvesting
‚provide rainwater harvesting system to capture at least 50 % run-off'
note: environmental demand (*refer to PS 1.2*) is not taken into account in both credits
G= available groundwater resources is not requested as part of the CS calculations

no distinction between internal and external water resources is made
Ecoblock concept not conveyed in CS, however encouragement of wastewter and rainwater reuse conveys the impression of a decentralized approach

W rec:
IRM Credit 3: Infrastructure Resource management - waste water re-use
provide calculations to demonstrate the percentage of wastewater reused on site

W fresh:
freshwater abstraction volume is not mentioned

projected demand:
D= sum of demands is calculated in: *Criterion:*
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚Provide water balance calculations indicating the water requirements for potable use, domestic use, landscaping and all other non-potable uses'

note: no baseline / orientation is determined for demand calculation

actual demand:
monitoring of actual consumption (actual demand) post-occupancy is not determined in CS

	LEED-ND	DGNB - NSQ

Indicator 6
RW share — explicitly requested?
 	
if no:
variables of indicator are part of CS calculations / documentation?
 	
if yes:
which ones?
which ones are missing?
	GIB credit 8 - stormwater management
	‚This Credit requires calculating the amount of rainfall infil-trated, reused or evapotranspired, considering necessary drawdown rate‘
		Criterion: TEC 1.3 stormwater management requires a waterbalance for the community calculating average annual precipitation, surface run-off and required retention
		
		note: TEC 1.3 requires water balance equation to be close to undeveloped state. Availabe reliable surface run-off for re-use without environmental compromi-ses is not specifically calculated.

Indicator 7
WW prod — explicitly requested?
 	
if no:
variables of indicator are part of CS calculations / documentation?
 	
if yes:
which ones?
which ones are missing?
	GIB credit 14 - wastewater management
	‚This Credit requires calculating the percentage of average annual wastewater generated for potential re-use‘
	
	D= sum of demands is calculated in:
	GIB Credit 3- building water efficiency
	GIB Credit 4 - water efficient landscaping
	
	GIB credit 14 also requires: ‚A waterbudget enables comparison of trade offs for water conservation strategies and evaluation of the impact of waterinfrastructure on other systems..(...)determine the area required for wastewater harvesting and treatment to meet specific end-use demands.‘
		Documentation requires: , An estimated water balance in which the amounts of the various water fractions are listed. Representation of all visible components of the water supply and disposal concept.‘
		
		note: water balance components are not specifically described in the CS. It is assumed that the volume of wastewater produced for re-use must be part of it

Indicator 8
WW cov — explicitly requested?
 	
if no:
variables of indicator are part of CS calculations / documentation?
 	
if yes:
which ones?
which ones are missing?
	GIB credit 14 - wastewater management
	‚This Credit requires calculating the percentage of average annual wastewater generated for potential re-use‘
	
	D= sum of demands is calculated in:
	GIB Credit 3- building water efficiency
	GIB Credit 4 - water efficient landscaping
	
	GIB credit 14 also requires: ‚A waterbudget enables comparison of trade offs for water conservation strategies and evaluation of the impact of waterinfrastructure on other systems..(...)determine the area required for wastewater harvesting and treatment to meet specific end-use demands.‘
		D= sum of demands is calculated in:
		Criterion: ENV 2.6 - watercirculation systems
		demand calculated in proportion to GFA (gross floor area)
		
		Documentation requires: , An estimated water balance in which the amounts of the various water fractions are listed. Representation of all visible components of the water supply and disposal concept.‘

Indicator 9
WW treat — explicitly requested?
 	
if no:
variables of indicator are part of CS calculations / documentation?
 	
if yes:
which ones?
which ones are missing?
	GIB credit 14 - wastewater management
	‚This Credit requires calculating the percentage of average annual wastewater generated for potential re-use‘
	Waterbudget to include estimated volumes for end uses of nonpotable water‘
	water qualities are not specifically called out as well as share of primary, secondary and tertiary treatment volume
		Criterion: ENV 2.6 - watercirculation systems
		
		documentation requires a wastewater concept

	result summary: » focus on demand management / water conservation measures » based on point distribution big focus on stormwater management to emulate natural waterbalance availabilty » wastewater and rainwater re-use is encouraged as well as decentralized management practices, but is not as heavily weighted to the CS to be added: wateravailabilty concept and variables based on different demands and waterqualities could be more refined (smart source mix per area per use, cf. to PS 3.1) treatment options and levels of wastewater for appro-priate uses and return to the environment (this will be addressed in LEED-NDv4, to be published in 2013)	**result summary:** » focus is on rainwatermanagement soley because of share of overall score (cf. to Fig. 03-10) with rainwater management to emulate natural hydrological conditions, pre-development state » wastewater and rainwater re-use is encouraged as well as decentralized management practices to the CS to be added: wateravailabilty concept and variables based on different demands and waterqualities could be more refined (smart source mix per area per use, cf. to PS 3.1) treatment options and levels of wastewater for appropriate uses and return to the environment

TABLE. 3-01: Overview of KPI‘s and their repre-sentation in selected Certification systems

Estidama

R= reliable surface run-off:
is addressed in PW-2 stormwater management
peak stormwater discharge to be minimized, post-development peak runoff rate not to exceed pre-development runoff-rate

note: surface run-off not calculated as available surface run off for re-use, taking into account environmental demands (*refer to PS 1.2*), also rainwaterharvesting is not mentioned as a meaningful practice (question of sensibility in this climate of almost no rainfall and desalinated seawater as the main source)

IGBC- townships

R= reliable surface run-off:
IRM mandatory requirement and IRM Credit 1 rainwater harvesting
‚provide rainwater harvesting system to capture at least 50 % run-off'
note: environmental demand (*refer to PS 1.2*) is not taken into account in both credits

---

WW Q1 = wastewater quality n to total WW production is calculated in:
community waterbalance as EM = Municipal Recycled Water Efficiency (see indicator 3)

note: wastewaterqualities are distinguished as potable and non-potable

total WW production: is calculated in Building watercalculator as m³/year, wastewaterqualities are distinguished as potable and non-potable

WW Q1 = wastewater quality n to total WW production is calculated in:
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚Provide calculations to demonstrate the percentage of wastewater reused on-site'

---

projected demand is calculated in:
PW-R1 community water strategy
Using the Community, Building and Villa Water Calculators, establish the community's overall water demand and determine the community-wide water balance between the available building wastewater and public realm irrigation, heat rejection and water feature demands.

$$CWB = \sum B_W x E_M - L_W - DC_W - WF_W$$

WW Q1 = wastewater quality n is calculated in: community waterbalance as EM = Municipal Recycled Water Efficiency (see indicator 3)

note: wastewaterqualities are distinguished as potable and non-potable

D= sum of demands is calculated in:
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚Provide water balance calculations indicating the water requirements for potable use, domestic use, landscaping and all other non-potable uses'

WW Q1 = wastewater quality n is calculated in:
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚Provide calculations to demonstrate the percentage of wastewater reused on-site'

WW treat = wastewater treatment level to total WW production is calculated in:
community waterbalance as EM = Municipal Recycled Water Efficiency (see indicator 3)

note: wastewaterqualities are distinguished as potable and non-potable

total WW production: is calculated in Building watercalculator as m³/year, wastewaterqualities are distinguished as potable and non-potable

WW treat = wastewater treatment level to total WW production is calculated in:
IRM Credit 3: Infrastructure Resource management - waste water re-use
‚In case the treated wastewater is used for construction purpose, provide documentationto show that the treated wastewater conforms to the required quality standards'
‚In case the treated wastewater is conveyed outside the boundary, provide calculations to show the percentage of wastewater conveyed'

result summary:

» focus clearly on demand management rather than availabilty
» waterqualities are not distinguished much, only non-potable and potable

to the CS to be added:
wateravailabilty concept and variables (internal, external, primary, secondary)
different waterqualities for different uses (smart source mix per area per use, cf. to PS 3.1) should be addressed
distinguish treatment levels and various wastewaterqualities for appropriate uses and return to the environment

result summary:

» focus is clearly on rainwater harvesting for rainwater re-use and groundwater recharge.
» the use of recycled water is strongly encouraged.
» Wastewater treatment and return at appropriate quality level is addressed. clear focus on decentralization and re-use.
» waterqualities are not distinguished much, only non-potable and potable

to the CS to be added:
wateravailabilty concept and variables (internal, external, primary, secondary) against demand
distinguish treatment levels for appropriate uses and return to the environment

3.4 Certification systems - performance at an international level and regional adaptation strategies - status quo

From the analysis of the certification systems (CS) it can be seen, that all CS were originally developed within their own national context. As „the market for green building rating systems has become increasingly competitive“ (GBI, 2007), and the ambition to gain market recognition became increasingly larger over time, the respected national green building councils stepped out of their national onto an international level.
LEED and BREEAM first entered the international market through adapting their systems to different countries. Although internationalization strategies were in place, critiques say, that the originally organic and paced development of the industry became to rapid and „signs of cracks and fissures (...), ranging from concerns about the quality of multiple new services, to larger issues about maintaining environmental and scientific integrity.“ (Baker, 2004, p.2) were expressed.
In order to analyze the status quo of the performance of CS at an international level and their strategies to be adapted to different national settings, a series of interviews were conducted. Many interviewees from a broad range of Green building councils were open about sharing their insights.

Three main approaches could be distinguished as relevant components in internationalizing a CS :

- Strategic market penetration + global knowledge transfer
- Administrative support in systemadaptation
- System-related adaptation strategies

Strategic approach

The strategic approach is described as identifying attractive markets and fostering knowledge exchange at an international level. Market entry typically parallels with the ever growing green building market in countries which have booming construction activity. LEED, for example, entered the chinese market at a very early point in time to establish its label against others. Another example is the contractual agreement between the USGBC and the Canadian Green building council as a natural transition into securing markets, which „had no labels at the time, and was a country with fairly similar standards.“ (USGBC, personal communication, June 3rd 2012). In South America, the Green Building Council of Brazil chose to „disseminate on the market of the LEED rating system as the most known and adapt it to Brazilian reality.“ (BGBC, personal communication, June 12, 2012)

GLOBE ALLIANCE
GLOBAL LEADERSHIP IN OUR BUILT ENVIRONMENT

Partners
American Institute of Architects
American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
Association of Climate Change Officers
Building Codes Assistance Program (BCAP)
Building Owners and Managers Association of Canada (BOMA Canada)
Carboun
Center for American Progress
Dow Corning
Deloitte Real Estate Advisory France
Earth Council Alliance
Earth Day Network
Econstruccion
Ecotech International
Enterprise Community Partners
Global Environment & Technology Foundation
Global Green

Green Consult Asia
Green Factory
Green For All
ICLEI USA - Local Governments for Sustainability
Ingersoll Rand
Institute for Market Transformation
Institute for Transportation and Development Policy
Johnson Controls
Kids vs. Global Warming
Lend Lease
MBO, Inc
Miron Construction
National Home Performance Council
National Institute of Building Sciences
Natural Resources Defense Council
Philippine Green Building Council
United Nations Foundation
United Technologies Corporation
Urban Land Institute
World Business Council on Sustainable Development
World Green Building Council
World Green Building Council Members
Argentina Green Building Council
Canada Green Building Council
Chinese-Taipei Green Building Council
Colombia Green Building Council
France Green Building Council
GBC Brasil
GBC España
Green Building Council of Croatia
Guatemala Green Building Council
Jordan Green Building Council
Mexico Green Building Council
Peru Green Building Council
Philippine Green Building Council
Polish Green Building Council
Romania Green Building Council
Turkish Green Building Association
U.S. Green Building Council

FIG. 03-18: *CS - Internationalization: One strategic approach to Internationalization is to institutionalize knowledge exchange and transfer. One example for this is GLOBE, which is led by the US Green building council*

The DGNB developed a system to mostly cater the European market. „It is our main goal to be the market leader in Europe. Our system is based on Europe's highest standards and aspirations for the green building industry." (DGNB, personal conversation, July 1st 2012). It also works the other way around. After the UN Green Building Rating Tool Conference in Nairobi in 2010, the South African Green Building Council used Australia's GreenStar rating tool as a base for developing their own system for South Africa and its associated regional African network. The GBCSA stated „that it does not wish to 'recreate', 're-do' or 'reinvent' Best Practice standards during the tool development stage of Green Star – Communities". (GBCSA, personal conversation, June 12th 2013). „It is the aspiration for Green Star - Communities to build upon the information and lessons learnt from others who have followed similar paths."(GBCSA, personal conversation, June 12th 2013). Only few markets exist where systems stand in direct competition. Both LEED and DGNB compete in the chinese market. Russia lists LEED, BREEAM and the DGNB system as validated rating tools. Other parts of Asia have their own national rating systems such as Malaysia and Japan.
In order for the CS to be internationally understood, another main pillar constitutes the international exchange of knowledge . One example is GLOBE, which discusses standards while overcoming and integrating cultural, social and technical challenges. The Global Leadership in Our Built Environment Alliance (GLOBE) – led in partnership by the U.S. Green Building Council together with the World Green Building Council (including its members, environmental organizations, and businesses)- „share a commitment to advocating for sustainable building practices as a key strategy for combating climate change."(Globe, 2011)
GLOBE and their partners work on „influencing national and international policies to increase green building and energy efficiency measures." (Globe, 2011) and therefor creates one of many platforms for Green building councils to review their work at an international scale.
GLOBE stands representative for what is one result in Accenture's recent *New era of sustainability* report: „that partnerships and collaboration are now a critical element of their approach to sustainability issues. Businesses realize that today's global challenges are too broad and too complex to go at it alone." (Accenture, 2010, p.11). The consequent spring-up of various collaboration platforms leaves a cluttered notion and questions whether in the case of the Green building industry the steering and governing power of the World Green Building Council (WorldGBC) as the umbrella organization may be undermined by too many other similar organizations with similar ideas.
The WorldGBC by definition „fosters and supports new and emerging Green Building Councils by providing them with the tools and strategies to establish strong organisations and leadership positions in their countries. Since our establishment in 2002, we have been working closely with councils to promote local green building actions and address global issues such as climate change. By driving collaboration and increasing the profile of the green building market, the WorldGBC works with its member councils to ensure that green buildings are a part of any comprehensive strategy to deliver carbon emission reductions." (WorldGBC, 2013)

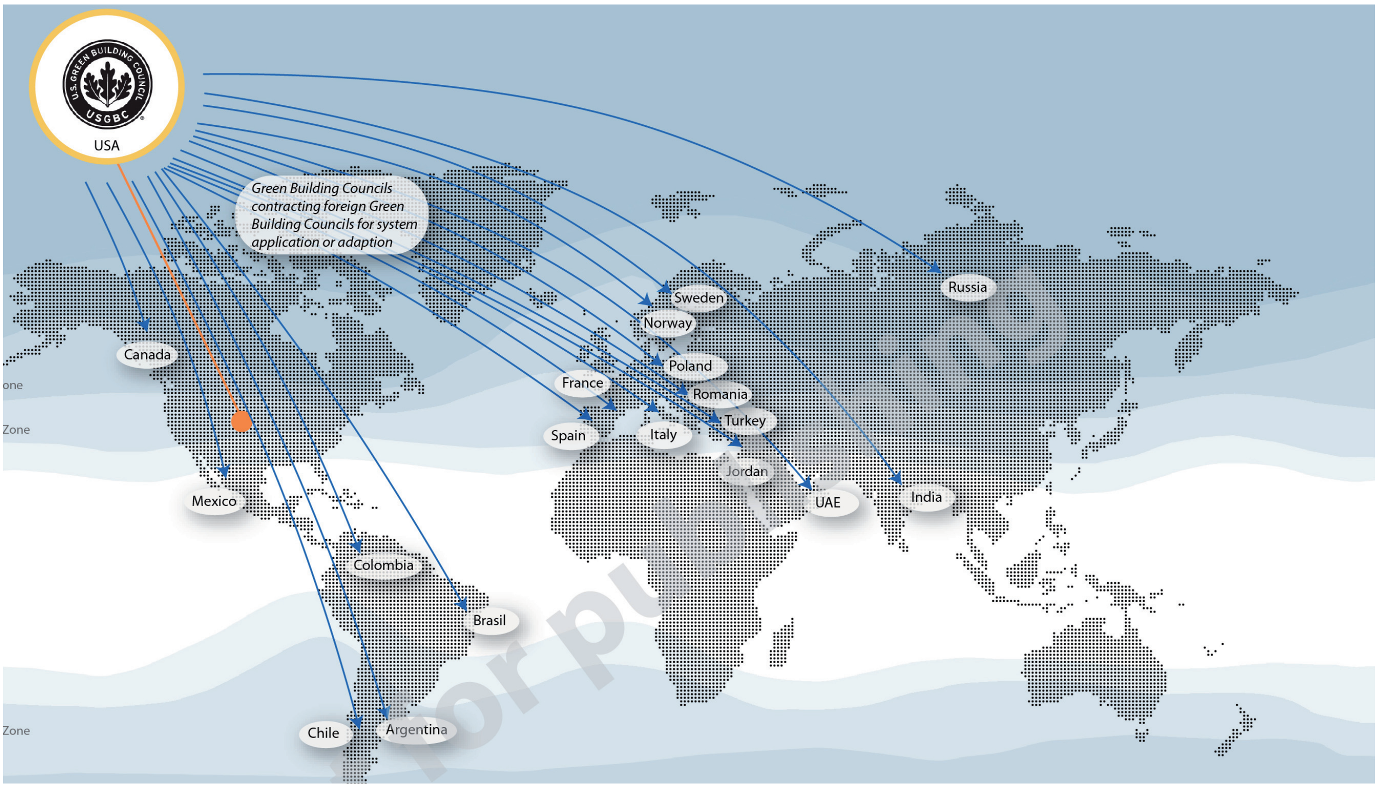


FIG. 03-19: The United States Green building Council (USGBC) and its large network of international Council partners

Administrative approach

To kick-off collaboration, National Green Building Councils often sign a Memorandum of Understanding or cooperation agreement with a foreign partner organization. This contract underlines the intent that both councils will work together in establishing common goals, helping to build a knowledge base and a nationally tailored system for CS. The receiving party will then appropriate the system as a base. Technical advisory groups of the receiving country, respected industry experts, then adopt the system to their national, cultural and climatic standards. (cf. FIG.03-7 Green Building Council operations)
In the case of LEED, LEED professionals claim to „[....] have found many innovative ways to adapt LEED locally. Built on *lessons learnt*, LEED emphasizes global consistency at its core' through past experience.“ (USGBC, personal communitcation, June 22nd 2011)
The past experience was described in a recent personal conversation with a USGBC representative: „Many years ago we licensed LEED to three countries: Italy, India and Canada. Over the years, we worked with them to develop country specific versions of the rating system. However, this process, though a great learning experience, proved to not be a sustainable method. It is very resource intensive for both organizations and creates market confusion. Thus, we are not doing country-specific rating systems anymore. The current country specific ones will eventually merge with LEED so that everything is one cohesive system. In order to address the needs of international LEED users, we have developed the alternative compliance paths. Our International Roundtable helps us evaluate and strategize how LEED will continue to develop regarding the international market.“ (USGBC, personal communitcation, June 22nd 2011)

As the USGBC states, the adaptation of a CS cannot be carried out by providing staff alone. A clear strategic roadmap to adaptation which is system-related needs to add to the adaptation process. (cf. Fig.03-21: system adaptation approach by DGNB and LEED)

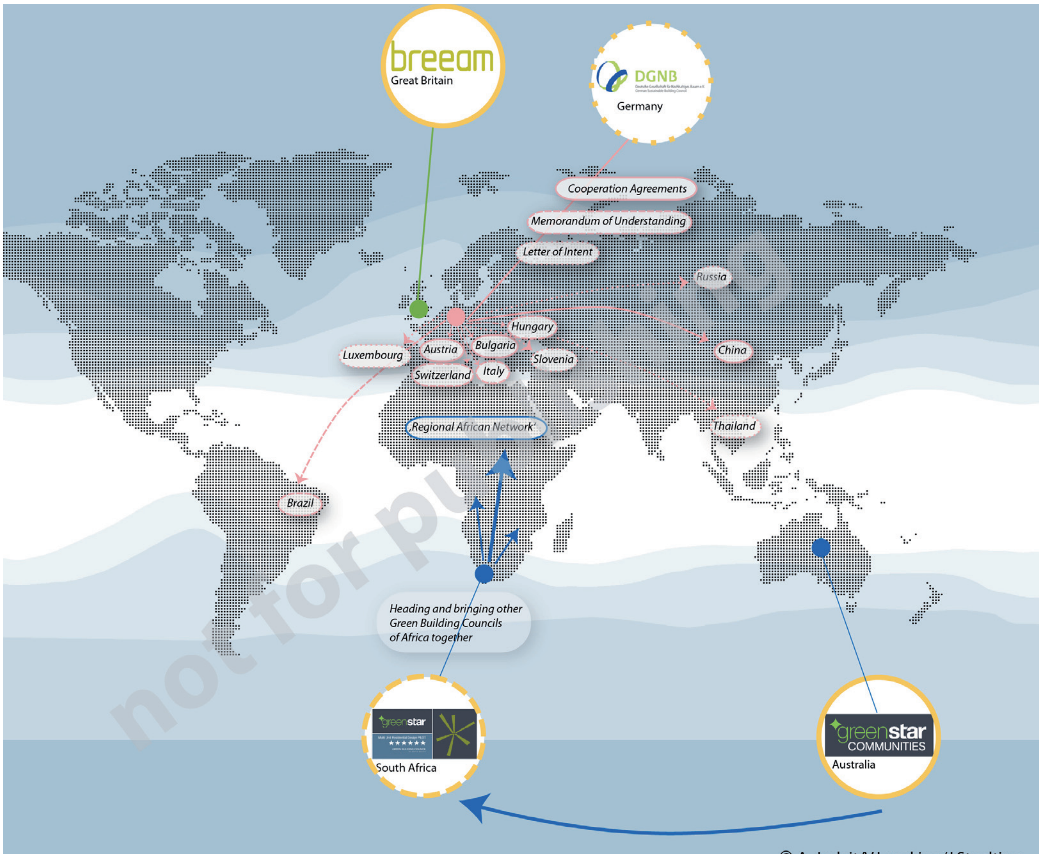


FIG. 03-20: DGNB international network and Australian with African regional network

System – related approach

In order for the systems to be adaptable to different regions a system-related approach is necessary and described in the following paragraphs.

The DGNB provides a so called 'core system', which is based on European standards. To regionally adapt a CS means in this case to dock the national standards of each country on the core system (see Fig. 03-21). Through this concept the DGNB system is the only one which truly addresses the first step to providing a consensus-based framework for regional adaptation. Although based on European standards, the 'coresystem' clearly defines what needs to happen at a trans-national (european level) and through modular additive action to the coresystem, the second step of regional adaptation is circumscribed.
According to the DGNB this approach leads to two ways of applying the DGNB system:
Direct application of the DGNB System, because the „DGNB provides an international version of its system (the coresystem) based on current European norms and standards. This enables (...) to directly certify buildings and districts anywhere in the world." (DGNB, 2013).
The second way of applying the DGNB system is through a local partner organisation, contracted as a DGNB system partner. In this process the system adaptation is based on the coresystem, which will be supplemented by additional local criteria.

LEED bases its regional system adaption on the systems developed and based in the US.

LEED offers so-called 'Regional Priority Credits', which allow for extra points based on regional particularities. Out of 100 points an additional 10 points can be earned for regional differences within as well as outside the US. However, according to the USGBC's website:

„These credits are an interim solution as USGBC works towards a long-term strategy for identifying the myriad of regional environmental priorities across the globe." (USGBC, 2011)" This more project-based approach to awarding regional differences was a relatively simple way .

A country specific adaption of LEED has been carried out in Italy, India and Brazil so far. During this process, the original version of LEED , based on US standards and priorities, was taken as a basis and tailored to country specific conditions by taking components out of the original version and adding country-specific values. (see Fig. 03-21). This approach can be perceived as more administrative than system-related.

The Jordan Green building Council adapted the LEED system to their own regional conditions by following a standardized procedure: The so called LEED Gap analysis (cf. Fig. 03-22). In the development of a regional adaptation of LEED, the JordanGBC, established a thorough five step process to ensure the "compatibility of international green building practices with local requirements" (JordanGBC, 2011, p. 10). The first step was for the JordanGBC Technical Committee to perform a preliminary gap analysis of what the Jordanian market provided at the time of review and determine the LEED certification system's applicability. The gap analysis examined existing codes, market conditions, technical expertise, and the roles of key stakeholders in the building and construction field. LEED credits and prerequisites were categorized based on regional applicability, and whether or not they needed additional action on the behalf of stakeholders for their execution or fulfillment of original intent.

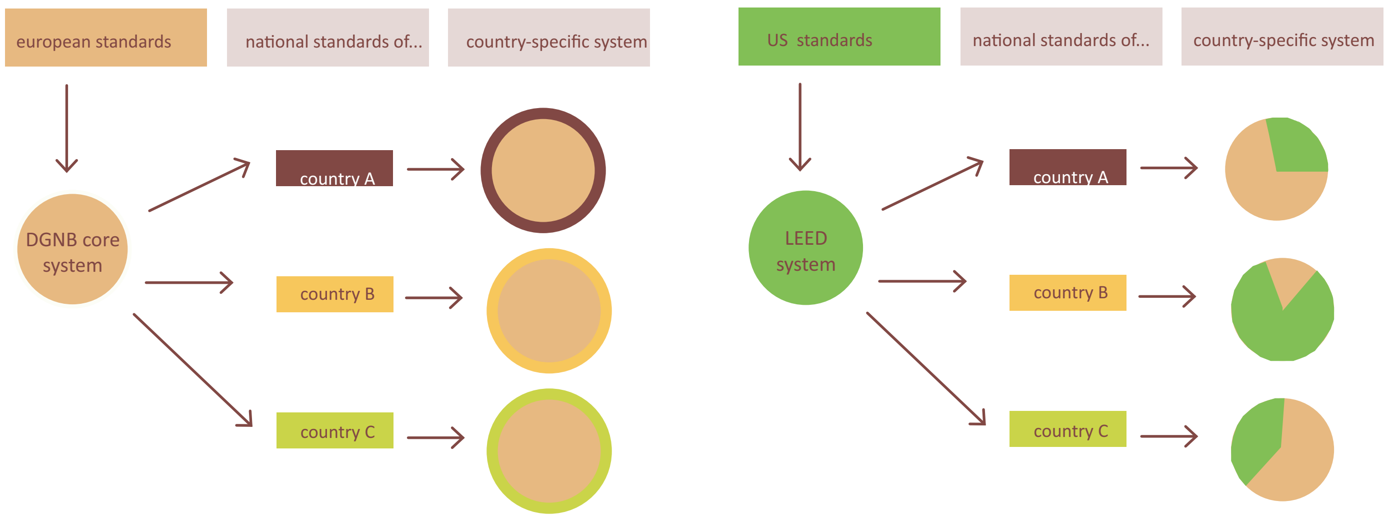


FIG. 03-21: DGNB concept of CS adaptation to different countries through coresystem vs. USGBC approach

The gap analysis indicated which credits were of a higher priority, and the next step was to quantify this. The technical committee evaluated each credit based on economic feasibility, cost, ease of accomplishment, and how common the credit's implementation currently was in Jordanian building practice. With a scale from 1 to 5 (hard to easy, or costly to cheap), the credits were ranked. This process highlighted 'low-hanging fruit' as well as more "challenging environmental issues like water efficiency" (JordanGBC, 2011, p. 10). It was determined that higher ranked credits would be favored in the initial development of the localized rating system.

Upon credit prioritization, an international LEED consultant was called upon to review the results of the gap analysis to ensure alignment with the overall objectives of the rating system and offer additional recommendations. After step three, the Technical Committee sought the input and feedback of field professionals, and so developed an online survey for distribution to over 100 professionals and practitioners. The major findings of the survey were that almost half of professionals agreed a local rating system for Jordan was very important, and that long-term feasibility be most important criterion considered. Water was deemed the "most important sustainable design category, followed by energy, and indoor environmental quality" (JordanGBC, 2011, p. 11). This professional feedback led to the final step of revised credit weighting, ultimately placing greater value on water and energy efficiency. (cf. Fig.03-22)

The analysis of the current international market performance with regional adaptian shows a blurred distinction of the two terms internationalization and regionalization.
If 'internationalization' is defined as a process of standardization or harmonization in order to establish a common ground for discussion, this step has not been refined at this point. In this context internationalization is rather driven by securing markets „leaving cracks and fissures....of scientific integrity.." (Baker, 2004, p.2). Subchapter 4.2 debates the distinction between ‚Internationalization' versus ‚regional adaptation' and according to the author attainable tasks and roles at both levels.

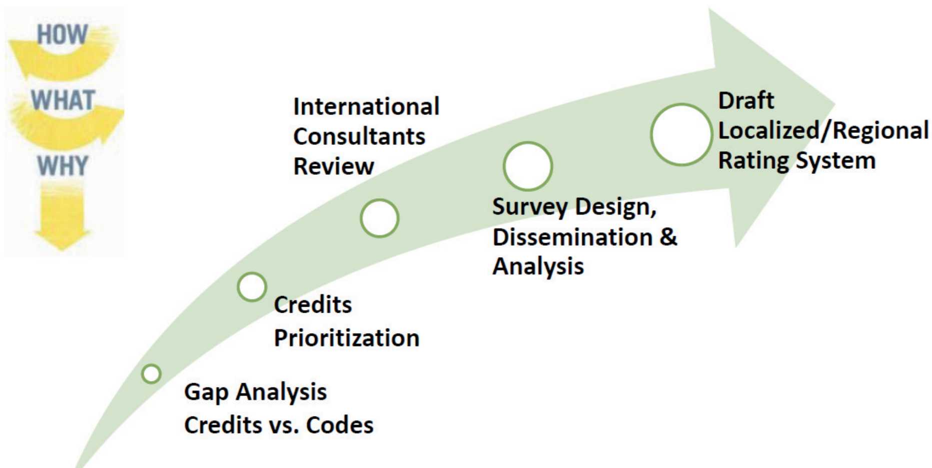


FIG. 03-22: LEED Gap analysis applied by the Jordan Green building council for system adaptation to national conditions

3.5 Conclusions and guiding thoughts for casestudy approach

Defining Best Practice through Certification systems: a sensible process

When developing a certification system (CS), there is an initial shared conception of the specific problem that brings participants together. However, the process of setting goals turns out to be a more difficult process than initially imagined. „This is where the theory gives way to the messiness of the real world." (Matus, 2010,p.98). Ideally, goals are set according to solid scientific and technical knowledge and formulated in such a way that leads to an outcome, which then addresses the original problem at hand. „This is complicated by the fact that different stakeholders have different conceptions of the exact nature of the problem as well as very different interests, and that there may be significant differences in desired goals that will need to be negotiated." (Matus, 2010, p.98)
A correlation between the rating party and the rated object may therefore compromise the objectivity of results as an outcome. Lang distinguishes three phases where subjectivity comes into play: the reproduction of a reality, the development of a value system, and the decision-making process within this system.
Beyond setting the goal itself, a goal needs to be weighted among others. Here, an imbalanced representation of stakeholders can significantly impact the overall outcome of a system. A balanced and scientifically solid foundation helps to distribute the correct shares among chosen categories.
In the case of setting benchmarks, committees usually stick to the defined goal of CS: to go "beyond compliance" and [....] more than the law requires. (UNEP)

The decision-making process of choosing a particular criterion, and consequently an indicator, which represent a stated goal is often not only a research-based process, it is also a political one. Lang notes that the choosing and weighting of indicators is already a subjective act. Since standards must be credible, in that they can be believably observed, measured and reported upon, they must be subjected to permanent revision. A lot of the documented CS have already gone through several rounds of revisions. However, the necessary flexibility and adaptability of the standards revision through the PSR cycle (cf. subchapter 3.1.4) for many CS is not yet in place. Doing so would guarantee the credibility of the standards set. (Also refer to Point 3: credibility of the CS itself, cf. to subchapters 2.1.3 and 2.1.3 Benchmarking - the first step to rating in particular)

Based on this knowledge, it comes as no surprise that a comparative analysis of CS showed that they are far from being harmonized. Although they often have a common environmental aim and comparable system structure overall (see Fig. 03.11), there are significant differences in the details of their methodologies, scopes and emphases on assessment metrics, (cf. 3.2.3 Criteria and Indicators) as well as between the certification processes themselves. (cf. subchapter 3.1.4 Certification as the final step ...and then what?)

The analysis suggests that the high degree of variation in the CS is partly attributable to each system being developed based on national regulatory standards and goals. The detailed analysis of the water-related aspects in selected CS identified over 20 different methodologies to measure sustainability. The question arises whether the most important functions of CS, as achieved as of this point, enable:

- Objective assessment for what is considered best practice
- Comparison across places and situations
- Assessment of conditions and trends in relation to targets
- The monitoring and providing of early warning information
- Anticipation of future conditions and trends

The analysis of the current international market performance with regional adaption showed a blurred distinction of the two terms 'internationalization' and 'regional adaptation.' Due to rapid market expansion, some integrity and solid scientific foundation in the robust progression of CS development and implementation may have been compromised. However, ongoing discussion, in particular through the WGBC and various other knowledge transfer institutions, show the need for the institutionalization of a common language in order to compare CS amongst each other.
Comparability is given at the level of defined Key Performance Indicators (KPI, cf. ch.3.2.3). When analyzed with the calculations and methodologies in selected CS, none of the KPIs were specifically requested; however, indicator variables were computed in almost all examples. This means that the CS provide the information necessary to be able to compare the performance of projects through KPI.

Chapter 4 will deliberate further on the following questions:

- How can CS be internationally comparable, and how can this be institutionalized?
- What exactly is the meaning of internationalization in this context?
- Based on a common and global understanding, how does a regionalization strategy look like?

Chapter 4.0:
Case Study

4.0 Case Study

We can conclude that „decentralized water and wastewater management will be the key for sustainable water management in the future given the rate of rapid urbanization in the country. The need for capacity building programmes to further train and strengthen the relevant government authorities was stressed upon. The role of [CSE] in training government officials with relevant tools, techniques and providing a platform for deliberations and exposure to new ideas was identified" (Center for Science and Environment , 2013 - workshop on 'Sustainable Water and Sanitation: Best management Practices' in Uttar Pradesh on May 1, 2013)

Pic. 04- 1: © DEEcann - Hyderabad's overall cityboundaries and waterinfrastructure set up with ‚Hussain Sagar' as the central lake of the city and sewage treatment plants outside of the city

Pic. 04- 2: © Service level benchmarking Handbook, MofUP, India

4.0 Introduction and main objectives of the chapter

A visit to Hyderabad served the purpose of studying current city development activities, visiting typical township sites, and getting an overall understanding of water infrastructure planning for such townships within the context of Hyderabad's overall water infrastructure situation.
A stay at the Indian Green Building Council (IGBC) offered insight into the status quo of CS development and associated green building activities as a rapidly developing business sector trying to keep up with the pace of urbanization.
The introduction to the chapter provides an explanation of the selection of Hyderabad as a case study. Hyderabad, India, represents the global phenomena of urbanization and its particular challenges in developing countries.

Subchapter 4.1.3 outlines IGBC's activities and describes prototypical township planning and construction within the context of implementing "green measures." The subchapter "Internationalization" clearly separates strategies and activities at an international level for comparability reasons, and sets apart steps towards an overall regional success when certifying projects.
The chapter concludes with a reflection on possible hurdles and objections when it comes to forging new approaches to measuring sustainability at an international level.

Main results of this chapter are:
RESPONSE to research question-
What structure and criteria for international comparability are possible and what are uncertainties and objections of this concept?

Site visits showed: The wide gap between project marketing, set target values in the planning and pre-certification stage and projects in operations show the indispensible need for post occupancy evaluations (POE) and accordant data collection and target value re-evaluation process. (cf. subchapter 2.1.7 – Indicators for measuring progress)

A concise definition of 'Internationalization' and 'regional adaptation' is necessary to distinguish doable tasks at both the international stage and regional level.

Internationalization means finding a common language through '**asking the same questions**' (Dickhaut, personal conversation, 2013)

Regional adaption consists of **three** main **steps**:
1. Aligning local CS with *Best Practice framework of key planning steps* and *Key Performance Indicators (KPI)* to be able to act on the international stage
2. Adding impact factors, weight, and benchmarks according to local understanding and conditions
3. Defining a cohesive roadmap for overall regional success in building "green."

The need for cohesive data and indicator computation is agreed on; in India, different sets and initiatives of performance measurement and monitoring have been defined. However, if the process is not embraced by all stakeholders involved, this effort is likely to fail.

Developed KPIs will need to be tested towards data availability and compilation; models for verification as well as methodological and statistical infrastructure need to be established.

4.1 Case study of Hyderabad India - signifying rapid urbanization in developing countries

Rapid urban development and increasing land use due to brisk population and economic growth is the phenomena of the 21st century and can be observed in particular in India.
Hyderabad is India's sixth largest city and a metropolis with an estimated population of 7 million, compared to 4.3 million in 1991. „It is expected that the Hyderabad Urban Agglomeration, which comprises the Core City Area and the quickly urbanizing surrounding municipalities, will reach a population of 13.6 million by 2021."(Hoffmann, 2013) „The growth was pushed by economic reforms that promoted foreign and national investments in order to transform Hyderabad from traditional manufacturing towards a knowledge-based economy. More than 500 IT companies are located in Hyderabad and from 2004 to 2008 the economy grew at an average rate of 8.73%." (Hoffmann, 2013)

As in all megacities in India, Hyderabad faces severe environmental challenges like air pollution, the generation of solid waste, as well as the overexploitation and pollution of water resources.

The accelerated urbanization resulted in unplanned and uncontrolled growth and has had dramatic negative effects on the environment and humans themselves. „Cities like Hyderabad are facing serious shortages of power, water, sewage treatment, developable land, housing, and transportation combined with dramatic pollution, poor public health/educational standards, unemployment and poverty." (Teubenbock et al., 2008, p.1)

TABLE: WIDENING GAP
Demand will keep outstripping supply

	Total demand (MLD)	Net supply (MLD)*	Deficit (MLD)	Deficit (%)
2006	1,325	931	394	30
2011	1,732	1,267	465	27
2016	1,833	1,435	398	22
2021	1,933	1,603	330	17
2031	2,188	1,955	585	27

Source: Camp Dresser and McKee International Inc 2005, *The Hyderabad Wastewater Recycling Project*, for the US Trade and Development Agency and the Hyderabad Metropolitan Water Supply and Sewerage Board, Hyderabad
Notes: *After accounting for 18 per cent leakage (technical loss); MLD: million litre daily

FIG. 04-1:
the widening gap between drinking water demand and supply

„Although provisions have been made towards favouring compact mixed use development within a masterplan context, the main form of urban development in Hyderabad can be considered as uncontrolled and individualized without appealing to masterplan provisions. This led to limited open space, encroachment on existing lakes, wetlands and parks, as well as building densities beyond legal restrictions." (personal conversation with Hyderabad Urban Development Authority, 2013)

In reaction to the increasing severity of depleting water bodies, activist groups have developed a network of experts.
In one of the interviews conducted for this study, Dr. Jasveen Jairath , founding member of SOUL (Save our Urban Lakes), stresses the correlation between corruptive land developers ignoring building regulations and government institutions not doing anything about it. The often practiced building of a project before providing infrastructure has led her to believe, that a decentralized approach to technology provision as well as policy implementation with a strong community empowerment factor needs to be in place. Jairath's opinion is widely called for (cf. CSE, policy papers), but may take time to implement as the speed of urbanization is increasing. „The content of the rights discourse needs to incorporate issues of equity, sustainability and inclusiveness, alongside socio-political concerns of effective decentralization and substantive empowerment of all water users." (Madhav,2007,p.19)
As „stories of encroachment of water bodies by the real estate agents keep on appearing in the local press quite frequently." (Ramachandraiah,2004,p.16) and water bodies are disappearing, the call for a comprehensive enforceable masterplan is undoubtly needed. „The National Commission on Urbanization has also observed that we should be developing water bodies within city areas to feed reservoirs and/or permit groundwater recharge, instead of constantly searching for new and distant sources of water" (Ramachandraiah,2004,p.23)

4.1.1 Hyderabad and its water sources - depleting and polluted

Hyderabad is the capital and largest city of the southern Indian state of Andhra Pradesh. At an average altitude of 542 metres, much of Hyderabad is situated on hilly terrain surrounding artificial lakes, such as Hussain Sagar—predating the city's founding—north of the city centre. According to Köppen Hyderabad has a tropical wet and dry climate (Rubel and Kottek, 2010), bordering on a hot semi-arid climate. (Rubel and Kottek, 2010)The annual mean temperature is 26 °C; monthly mean temperatures are 21–32 °C. Summers (March–June) are hot and humid, with average highs in the mid 30s °C; maximum temperatures often exceed 40 °C between April and June. Winter lasts for only about 2 1⁄2 months, during which the lowest temperature occasionally dips to 10 °C (50 °F) in December and January. (IMD, 2013).
According to the India Meteorological Department

THE CITY	
Municipal area	707 sq km
Total area (Hyderabad Metropolitan Area)	1,905 sq km
Population (2005)	7 million
Population (2011), as projected in 2005-06	8.2 million
THE WATER	
Demand	
Total water demand as per city agency (HMWSSB)	1,300 MLD
Per capita water demand as per HMWSSB	187 LPCD
Total water demand as per CPHEEO @ 175 LPCD	1,216 MLD
Sources and supply	
Water sources	Surface* and groundwater
Water sourced from surface sources	88%
Water sourced from groundwater	12%
Total water supplied	930 MLD
Per capita supply	134 LPCD
Leakage loss	40%
Actual supply (after deducting leakage losses)	558 MLD
Per capita supply (after leakage losses)	80 LPCD
Population served by water supply system	70%
Per capita supply in the served area	114 LPCD
Demand-supply gap (after leakage losses)	742 MLD
Treatment	
Number of WTPs	5
Total treatment capacity	967 MLD
Actual treatment	967 MLD
Future demand and supply	
Demand (2011), as projected in 2005-06	1,833 MLD
Augmentation needed to meet the demand	903 MLD
Required increase in supply	97%
THE SEWAGE	
Generation	
Sewage generated as per CPCB	605 MLD
Sewage generated as per city agency	600 MLD
Collection	
Length of sewerage network	2,400 km
Population covered by sewerage network	63%
Area covered by sewerage network	70%
Treatment	
Number of STPs	2
Total treatment capacity	133 MLD
Actual sewage treated	133 MLD
Disposal	Musi river

FIG. 04-2:
Water / Excreta Survey, 2005-06, (CSE, 2006 as cited in Deccan, 2012)

(2013) , heavy rain occurs from the south-west summer monsoon and falls between June and September, supplying Hyderabad with most of its annual rainfall (812.5 mm (32 in)). The highest total monthly rainfall, 181.5 mm (7 in), occurs in September .The heaviest rainfall recorded in a 24-hour period was 241 mm (9 in) on 24 August 2000. (IMD, 2013)
Hyderabad lies close to the edge of the Krishna–Godavari basin boundary, north of the Musi river, which is a minor tributary of the Krishna river (cf. Fig. 04-1 and Fig. 04-4). The upper catchment of the Musi river has been regulated by two dams, Osman Sagar and Himayat Sagar, which provide water to the city. Downstream from Hyderbad the Musi has become a wastewater river, and otherwise has little natural flow. (see Pic. 04-3)

„Over the years, these waterbodies became cesspools of waste from Hyderabad, while the city's search for water took it further and further away. Today, Hyderabad draws its water from the distant Nagarjuna Sagar Dam, over 100 km away, and has to fight for it: farmers dependent on the reservoir are angry at the city for taking away what they see as theirs. With costs of water supply increasing and sewage choking its waterways, Hyderabad is desperately searching for answers.“ (Deccan, 2012, p. 334)

„As per the Bureau of Indian Standards, IS:1172-1993, a minimum water supply of 200 litres per capita per day (lpcd) should be provided for domestic consumption in cities with full flushing systems. In the Tenth Plan (2002-07), for megacities like Hyderbad with planned sewerage systems, the recommended minimum water supply level is 150 lpcd.“(Wakode, 2011). „However according to the data collected from field surveys, the domestic water consumption per capita per day is 96.2 lt.“ (Shaban, 2008). „The quantity of water consumed in most Indian cities is not determined by demand, but the supply. The water supply in Hyderabad is a mix of adequacies and inadequacies, with multiple agencies pitching in to meet the needs. The municipal corporation supplies water to the majority of households one in every two days. Water tankers and bore-wells compensate for the deficiency of municipal water in the city. Approximately 11% of households in Hyderabad are dependent on tankers (water reservoirs) for their water supply, and of this, 46% are dependent on private tankers.“ (Shaban, 2008 as cited in Wakode, 2011)

4.1.2 Wastewater management

The sewerage of the city and its new growth areas is a story of neglect and disrepair. (cf. subchapter 4.1.1)

„The original sewerage network was built in 1931 to serve an area of about 54 sq km and a population of about 0.4 million. The system was connected to two main intercepting sewers – on the south and north of the Musi river. In 1985, it was remodelled, say city administrators, to add five more sewers to the same system. Its network of sewers is large – spread across the sprawling metropolis over almost 2,400 km. However by the city's own admission, its coverage is completely inadequate; large parts of the city are not even reached by the sewerage network." (Deccan, 2012)

Hyderabad's plans for drinkingwater supply and wastewatermanangement are accordant to India's Servicelevel benchmarks: In the case of drinkingwater, the goal is to extend coverage 100 per cent by 2016 with a volume of supply at 160 litres per capita daily. Until then the duration of supply will incrementally increase from four hours a day in 2011 to eight hours a day by 2016 and achieve 24 hour water supply by 2021.

Hyderabad's location in a semi-arid region has historically determined that life is sustained not by a river, but from wells, tanks and lakes. The loss of these water bodies due to urban sprawl is a critical factor in the depleting watertable and the resultant water crisis faced by many localities within the city.
The drying up of the lakes has had an adverse impact on the recharge of groundwater, with the water table dropping sharply in recent years. Further compounding this issue is the continued pollution of the remaining lakes. It is crucial for local water levels that any master plan created for Hyderabad should focus on the lakes, rock formations and hills that are such important elements of its natural environment.

Ramachandraiah points out in his paper „ (...) the fact that when the lakes of Hyderabad were common property of the locals they were conserved, however with growing statisation and privatization, these water bodies have been lost." In conclusion (...) he emphasizes „(...) an urgent need to get out of the reductionist approach to water bodies - which first destroys them for profit, creating a crisis which is resolved by drawing up grand plans to bring drinking water miles away from the river Krishna. Therefore it becomes imperative for the urban planning bodies to include the sustainability of the physical environment along with the planning of the built environment." (Ramachandraiah,2004,p.23)

Many of the interviews confirmed Ramachandraiah's findings about Hyderabad's waterinfrastructural state. As townships are being built to provide necessary housing for a rising middle-class, water boards are not keeping up with the pace and don't provide the necessary basic infrastructure.
One solution, which is well described in the Indian Green Building Council's certificationsystem for communities, is the decentralization of waterinfrastructure to the community level, with focus on rainwater harvesting and the reusing and recycling of wastewater within community boundaries. (cf. ch. 2.1.5 Ecoblock)

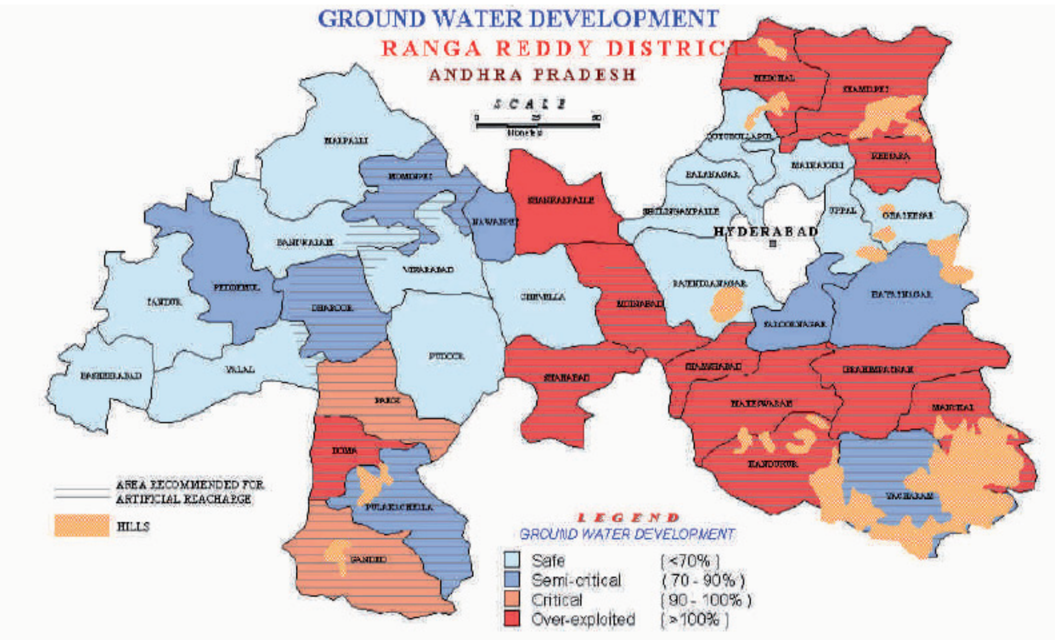
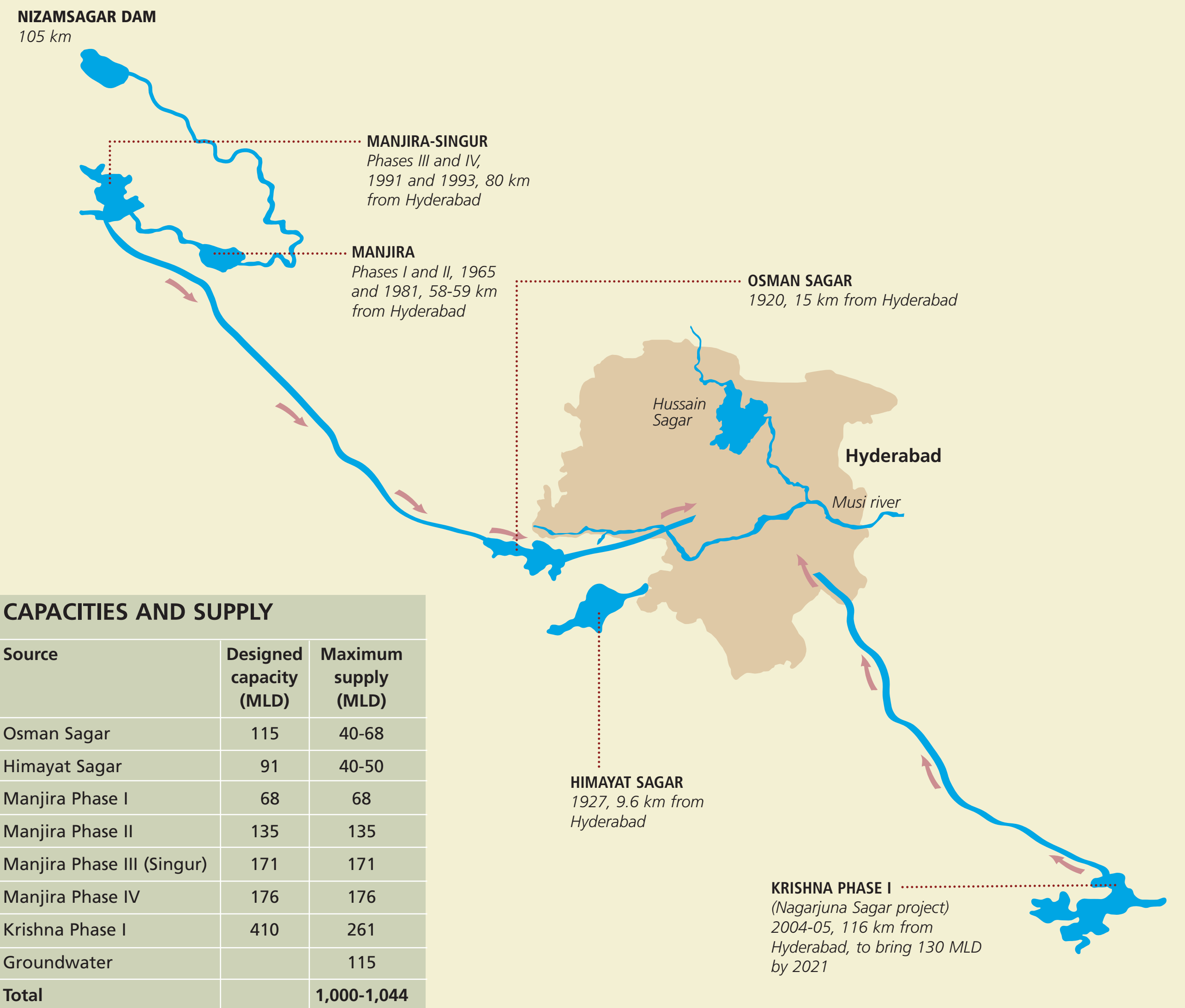


FIG. 04 - 3:
Groundwater depletion in and around Hyderabad, CGWB, Government of India, 2007

HYDERABAD'S WATER SOURCES

The city is travelling afar in its search for water – from 15 km to 116 km – and tapping a variety of sources



CAPACITIES AND SUPPLY

Source	Designed capacity (MLD)	Maximum supply (MLD)
Osman Sagar	115	40-68
Himayat Sagar	91	40-50
Manjira Phase I	68	68
Manjira Phase II	135	135
Manjira Phase III (Singur)	171	171
Manjira Phase IV	176	176
Krishna Phase I	410	261
Groundwater		115
Total		**1,000-1,044**

WHERE THE WATER CAME FROM OVER TIME

Source	Osman Sagar	Himayat Sagar	Manjira-I	Manjira-II	Manjira/ Singur-III	Manjira/ Singur-IV	Krishna
Year of commissioning	1920	1927	1965	1981	1991	1993	2004
River	Musi	Esi	Manjira	Manjira	Manjira	Manjira	Krishna
Reservoir	Osman Sagar	Himayat Sagar	Manjira Barrage	Manjira Barrage	Singur Dam	Singur Dam	Nagarjuna Sagar
Distance from Hyderabad (km)	15	9.6	58	59	80	80	116

Sources: Anon 2006, *Hyderabad City Development Plan*, JNNURM and Ramachandraiah Chigurupati and Vedakumar Manikonda 2007, *Hyderabad's water issues and the Musi river: Need for integrated solutions*, paper presented at the International Water Conference, Berlin, September 12-14

FIG. 04 - 4:
Hyderabad's water sources, 2007

PIC: 04-3:
Mursi river in Hyderabad, India / 2013, Jurleit

4.1.3 The Indian Green Building Council in Hyderabad and typical townships

The Indian Green Building Council (IGBC) was formed by the CII (Confederation of Indian Industry) in 2001 and is spearheading the green building movement in India. CII is an all India Apex Industry Association, formed over 118 years ago.
The IGBC headquarters in Hyderabad is housed at CII – Sohrabji Godrej Green Business Centre and has partnered with the Government of Andhra Pradesh in constructing its Green Business Centre building. With the CII as a strong lead partner, various other stakeholders from the construction industry such as builders, developers, architects, engineers, consultants, and students are part of IGBC's initiatives.
At the outset, one of the main IGBC initiatives was the launching of various rating programmes to suit different types of construction such as government buildings, airports, banks, corporate offices, educational institutions, factories, residential complexes, SEZ's, townships, etc. As a founding Member of the World Green Building Council (WorldGBC) and MoU partner with the US Green Building Council (USGBC), most of the rating systems, including the CS for communities, were taken from the USGBC and adapted to regional conditions. „With 1642 members and 1200 accredited green professionals, 35 student chapters as well as being 'widely supported by various Government Bodies (ex. Ministry of Urban Development, Ministry of Environment & Forests, Ministry of New and Renewable Energy, Hyderabad Metropolitan Development Authority (HMDA), Delhi Development Authority), the IGBC can be defined as 'a success in the context of the vast amount of construction activity happening across India…[…] demonstrating that 'going green' is not only ecologically beneficial but economically attractive.' „ (IGBC, 2013)

Hyderabad is one of the rapidly urbanizing cities in India, with new township developments currently in both the planning and construction stages. Various sites of such typical development typology (cf. ch. 2.1.5) in and around Hyderabad were visited during the author's stay at IGBC.

The projects were visited to get an understanding of township development and the approach to watercycle management of such townships. A total of 4 projects in different phases were visited. 3 projects were already in operation with two of them being certified. One site was registered to get certified and was in construction. In discussions with project developers, engineers as well as operations and maintenance (O&M) teams a best practice understanding was amplified and obvious or potential shortcomings in the execution of it discussed.

One IGBC platinum pre-certified township known as Alien Space station was also visited. Alien space station is a larger development a few minutes outside of Hyderabad, the project markets itself as an 'intelligent living space' where a healthy and green lifestyle is guaranteed through the pre-certification by the IGBC. A total number of 2182 apartments ranging from 1122 sft to 7674 sft. are accommodated in 83 towers, allowing for 80% open space in close proximity to a natural lake.
The project checklist by the IGBC reveals that the project completes 11 out of 18 possible points under the water efficiency category (Fig. 04-5). Mandatory requirements for rain water harvesting and water efficient plumbing fixtures are met. In addition, part of the landscaped area was designed to be water efficient with an irrigation system installed. Treatment and reuse of wastewater as well as water metering are two of the possible criteria of the certification system, but were not applied.
According to a discussion with the development team, the water demand of the community is to be met by 1 connection to Mandala damn, 22 bore wells on site, the natural lake next to the project site, as well as greywater-recycling. At this point in time, it was not clear whether accordant treatment options for various wastewater qualities were in place to meet the average water demand target of 200l/d/person.

Taking into consideration the overall circumstances of Hyderabad's water shortage situation and insufficient infrastructure, this project takes few alternatives into consideration to try and meet the high target of providing 200l/d/person of drinking water to its habitants.

As this project will get into its operational phase in 2014, target values and measures may have to be readjusted. Other townships have already gone through the experience of having to re-adjust significantly due to the reality in Hyderabad. Another township, Raintree Park (RTP), was visited, and an interview with the O&M engineering team revealed that the provision of an average of 150 l/d/p had to be met by private watertrucks. This situation was confirmed in several community board postings complaining about the „ … promise of uninterrupted water supply not being met." (Rain Tree Park Messsage Board, 2013)

„Residents were given the impression that there is an agreement between Sitco and Huda for water supply. However, the residents are facing a severe shortage of water and are forced to pay private agencies for supply. There is no proper planning of lifts, water sumps and bores, as well as no swimming pool maintenance. The seepage problems have not been rectified […] and water treatment plants are not working." (Rain Tree Park Messsage Board, 2013)
This is a typical situation in Hyderabad in the recent years as newspaper articles confirm. „The pitfall of residents using private watertrucks to guarantee their watersupply is the inability to estimate the true waterdemand, not only at the township level, but also municipal level." (The Hindu, 2013)
Interviewees pointed out that the fragmentation of the various watersources makes it hard to keep track of a cohesive picture of necessary intake and output.

PIC: 04-4:
Raintree park by Malaysion township developemt:
township in operation in Hyderabad, India / 2013, Jurleit

RTP community mentioned in the interviews that the next steps for the township would be the installment of watersaving appliances with metering devices.
This situation tells two very important points:
Any certified project without a well informed O&M is likely to fail, because new technologies need proper training of staff. The second point is the residents themselves: If they are not aware of benchmarks and technologies, any system will ultimately fail over the long run, as studies show „that behavior account for 51%,37%, and 11% of the variance in heat, electricity, and water consumption.“ (Gill et al 2010) Deuble and de Dear point out „that ‚greenoccupants‘ who have a predisposition towards environmental issues, will be more forgiving and tolerant attitude to the performance of a building.“ (Deuble and de Dear, 2010).
As „the culture of wasting water in these communities needs to be seriously addressed“ (Giri, personal conversation, 2013), the culture of marketing new developments as having the necessary infrastructure to allow for high water consumption, coupled with lush irrigated greenery and swimming pools does not accurately reflect the current conditions. These projects are a blatant example of cases where the feedback loops in planning for Best Practice Water Infrastructure are not yet considered during the planning and/or certifying process. A community water budget that does not take into account Planning Steps P.S 1.1 – 1.4 (cf. subchapter 2.2 conceptual framework of key planning steps for community water cycle management) will not be able to provide the necessary long term water supply. The wide gap between project marketing, set target values during planning and pre-certification stage, and projects in operation show the indispensible need for data collection and consequent target value re-evaluation process. (cf. subchapter 2.1.7 – Indicators for measuring progress)

In general, site visits gave an impression of the overall status quo in building green and the efficiency of certification systems. Data was available on a limited basis due to confidentiality agreements and sensitivity of data as well as the rather short stay in India. Actual data retrieved was too fragmented to be able to verify KPI computation (cf. Table 04-01). So far, data was produced based on a local understanding of best practice and what was requested in the CS. The cycle of target value

Project type *prototypical Community / township ,* Alien space station

Project location: Hyderabad / India

++++PLANNED++++++ **VS.** **++++IN OPERATION+++++**

PLANNED

waterdemand 200l/d/person

infrastructure / watersupply

- 1 hook up to Mandala damn
- 22 borewells / groundwater
- natural lake
- groundwater
- greywater recycling, biotreatment pond
- sewage 100 % recycled

IN OPERATION

waterdemand 200l/d/person with interrupted supply
supply gap covered by private water tankers

infrastructure / watersupply

- 1 hook up to Mandala damn - leakage rate 40 %
- 22 borewells / groundwater - only 11 bore wells are working
- natural lake - encroached and polluted, no capacity during dry season
- greywater recycling, biotreatment pond - in operation, blooming, low waterlevel
- sewage 100 % recycled

‚extract from the marketing brochure‘:

Rain water harvesting thereby increasing ground water table

100% waste water treatment

treated water for flushing, gardening etc. (through sewage treatment plant), thereby decreasing the consumption of fresh water and to prevent water crisis

Reverse osmosis and UV treated water for drinking and water softener to prevent scaling and for healthy hair and skin

Separate plumbing lines for fresh water and treated water takes care of hygienic factor

WATER EFFICIENCY			
WE Mandatory Requirement 1	Rainwater Harvesting, Roof & Non-roof, 25%	Required	Required
WE Mandatory Requirement 2	Water Efficient Plumbing Fixture	Required	Required
WE Credit 1	Landscape Design: 20%, 40%	2	4
WE Credit 2	Management of Irrigation System	1	1
WE Credit 3	Rainwater Harvesting, Roof & Non-roof, 50%, 75%	4	4
WE Credit 4	Water Efficient Plumbing Fixture: 25%, 35%	4	4
WE Credit 5	Waste Water Treatment and Reuse: 100% & 50%, 95%	NA	4
WE Credit 6	Water Metering	NA	1
		11	18

FIG. 04 - 5:
typical township - planned (ex.: Alien space station) and in operation (Raintree Park)

against measured value evaluation was not possible at this point in time for the four visited sites.

The difficulties of obtaining data are extensively confirmed and discussed by other PhD students (Kansara, T. Ridley, I. ,2010 - Post Occupancy Evaluation of Building in a Zero Carbon City. GCREEDER, Jordan) and are also well described in the just recently published handbook for Service level benchmarking, Ministry of Urban development, India.

4.2 Internationalization - finding a common language for comparabilty

The term internationalization is not yet clearly defined. Subchapter 3.4 showed that the term was mainly used when it came to describing the market expansion of certification systems and their overall global presence. Only the DGNB clearly distinguishes between international and regional levels. International meant to provide a so-called core CS as a basis for regional adaptation. (cf. Fig 3-21)

In a broader sense internationalization can be seen as a common ground or language in order to allow for global discussion on global issues.
A discussion spearheaded by the WorldGBC, lots of thought has been brought into the topic. What the WorldGBC manifested in its mission statement as an instrument for a better understanding when it comes to sustainability, has been pondered about by many respected leaders in the field:

Mohammad Asfour of the Green building council in Jordan states in one of the interviews conducted: “Regarding a common language, we were also part of something called the Unit Sustainable Buildings and Climate Initiative (USBCI). This is an initiative based in Paris, and I used to chair the advocacy committee. We met a few years ago, and we were thinking of finding a way through which a rating system could be translated into another. Meaning what a silver in LEED means in BREEAM, for example. As a consequence USBCI developed something called *common carbon metric*. We were thinking of how we could link a rating tool to carbon emissions and if you could do that, then you could translate it into any other rating tool. We had expectations, but this did not go through. You could use carbon as a common language, but then again, green buildings aren’t limited to emissions, there are different aspects. Again, because a lot of the people who worked on developing rating systems concentrated more on the emission perspective, you’ll find that a lot of rating tools miss important things such as the biodiversity component. So if the common language is carbon, it’s not enough. Even if it was possible, it’s not enough.” (Asfour, personal conversation, 2012) Asfour describes two phenomena: one to be able to compare factual information globally and trying to find an equivalent for it (CO2 footprint) and the other to compare different ratings amongst each other (best in class in India vs. best in class in Germany).

What Ricaurte calls „strange equivalents in sustainability reporting“ (Ricaurte, 2011) Kather in his thesis confirms, that measurements in sustainability need to be understandable. Where rating systems just like carbon foot printing can be quite alienating when it comes to communicating achievements, he suggests to use more tangible numbers (e.g. liters per day per person): “At present the conveyed information used to inform the public and users [...] is a single number of pearls. For someone who has no understanding of the benchmarks used this number would not be meaningful, as it is not transferrable to generally known and used indicators.” (Khater, 2013, p.83) He therefor suggests adding more data to better convey helpful information beyond the level of rating achieved.

In his dissertation, Mösle describes internationalization as “the necessity to compare national reference and target values against each other and rate their relative utilization of potential against one another and therefor provide international comparability.” (Mösle, 2010, p.67)
Even if it is possible to compare the utilization of potential against reference and target values in a given CS, the question arises what conclusions can be drawn from such results and what further proceeding derived from it. For example: the drinking water consumption in an American goes down from 200 to 150 l/p/d, resulting in an absolute utilization of 50l/d/p and a relative utilization of 25% against the target value of 150l/p/d. In an African state, drinking water consumption needs to be reduced from 30l to 20l/p/d, equaling an absolute of 10l/d/p and a relative utilization of potential of 33%. The utilization of potential in the African example is higher than in the American example, and should therefor be rated higher. However the percentage difference does not represent the necessary adaptation based on absolute values just yet. Here, Mösle suggests the coupling of adaptation variables in order to represent the true complexity of the effort for the sake of meeting the target value. Even if after adaption of the % weight, the African example may get a 66% utilization of potential, as the impact and expenditure to reach the new target is much higher than in the US example, the true relevance of this result is questioned.

What Asfour described as awkward trials to compare and others as rather alienating procedures for the sake of comparing, leads to two main conclusions:

•Consistency and relate-ability amongst means of measuring sustainability is a key component that is often lacking. Therefore, stick to tangible data for information dissimilation and comparability
•Leave the layer of rating target achievements at a regional or comparable multinational level, where circumstances are actually comparable with each other

Internationalization consequently has to standardize or harmonize, as strategically defined by the following steps as presented by Trinius in a CEN workshop for ISOs sustainability standardization strategies:

-Relates to other standards (ISO)and directives or policies (CEN)
-Harmonizes existing approaches
-Is a consensus-building process
-Is a participatory process stakeholders
-Is performance based rather than prescriptive

Under this premise, the paper seeks to help create an easily understandable and tangible measurement scheme for common comparison, and provides two tools:

- *Best Practice framework of key planning steps* (cf. subchapter 2.1.5 and 2.1.6)
- *Key Performance Indicators* (c.f. subchapter 2.1.7.1)

The framework developed in chapter 2 provides the ground for a common language by 'asking the same questions' (Dickhaut, personal conversation, 2013). KPIs derived from that framework are the tools in order to promote, monitor and report on sustainable development progress.

Equipping national GBCs with these tools (KPI and best practice planning framework, cf. subchapters 2.1 and 2.2) enables them to set their targets and national agendas within an aligned global understanding. They:

• Help to identify main trends in selected sectors (water cycle planning) with global relevance
• Facilitate the preparation and monitoring of plans and data (PSR, cf. subchapter 2.2)
• Facilitate reporting on the state of sustainable development to decision-makers and the general public, both domestically and internationally;
• Identify national and appropriate cross-country dialogue
• Help to assess the fulfillment of governmental goals and targets, and in the revision of set goals and targets

4.2.1 Regionalization

If 'Internationalization' is defined as a process of harmonization in order to establish a common ground for discussion, it can be seen as a first step towards regional adaptation. Through internationalization, a product is designed in a way that it can perform properly when it is modified for the use in different locales. Internationalization then refers to the process of adapting in order to simplify and optimize the localization process.

Regional adaptation is therefore based on the *Best Practice framework of key planning steps* and agreed upon *Key Performance Indicators*. The actual adaptation process means adjusting targets to different national reference standards as well as local strategies and conditions such as:

– Environmental, economic and social preconditions
– Legal and regulatory framework
– Societal demands
– Political priorities
– Cultural context
– General development perspectives

Regional adaptation towards globally agreed upon Best Practice understanding and international comparability is outlined in the following steps:

STEP ONE -
towards international comparability

- Align / add / reformulate local CS with *Best Practice framework of key planning steps* in order to be able to act on an international stage ("asking the same questions")

- Cater CS and computations towards feeding results into globally agreed upon *Key Performance Indicators*

- Install monitoring and evaluation mechanisms to report back to the international platform

- Define appropriate Cross Country Cluster dialogue partners to accomodate global knowledge exchange

STEP TWO -
regional adaptation of certification system

Regional adaptation towards successful regional implementation is a second step, and relates to what Mösle describes in his scheme for regional adaptation (Mösle, 2012, p.91):
- After national CS is aligned with BP framework, factor in national conditions and define mandatory criteria for national CS
- Set impact factor for each criterion / weight criteria against each other according to regional/national conditions
- Set benchmarks and target values according to regional priorities

This paper does not consider Mösle's concept 'procedure of regional target value relative to global target for comparability reasons'. (cf. Mösle, 2010, p.67)

STEP THREE -
roadmap towards total regional success

The last step towards 'regional success' is considering the various influencing factors of sucessful CS implementation.
This roadmap takes into account the various associated stake- and shareholders in the process and identifies the necessary business segments important in the capacity building process. Examples of the Indian case study are described in the following subchapter and shown in Fig. 04-6 and 04-7.

4.3 Case Study Indian Green building Council - Hyderabad, India: steps to elevate to the international level and guarantee ‚regional success‘

Based on the three steps described in subchapter 4.2.1, IGBC'S new township rating system shall perform the following adjustments:

At first missing planning steps according the *Best Practice framework of key planning steps* should be added. The analysis of the certification systems in general and IGBC's in particular show, that criteria often stand separate from each other despite coherencies, necessary feedback loops are missing; this ‚linear approach' is not representative of the complexity of sustainability (see 3.2.3 for example and FIG. 03-13 for overall system structure). Credit 1 ‚Harvest rainwater to enhance the groundwater table and reduce municipal water demand' (IGBC, IRM Credit 1) was used as an example, where a criterion intent demands two opposing actions and consequently a clear goal is skewed. The results summary (cf. Table 03-1) of the analysis recommends to add the following points to the system in order to cater to *Best Practice framework of key planning steps* :

• wateravailabilty concept with described variables (internal, external, primary, secondary) against demand benchmarks
• distinguished treatment levels for appropriate uses and return to the environment

These findings are confirmed by interviews taken during the stay at the Indian Green building council (IGBC). In a talk with IGBC staff it was said, that „ here it is important to rate the actual water supply source" (Giri, personal conversation, 2013) Planning steps 1.1 through 1.4 suggest to identify available internal and external water sources and prioritize them according to ‚a ratio of internal and external primary sources, with the resources to be prioritized according to technical and energy expenditure.' „ One of the most important challenges to tackle is the water shortage problem we are facing. Rainwater harvesting will have to be a mandatory requirement with a significant impact factor in the certifying process. This coupled with rigid benchmarks for water consumption will effectively help save our very limited freshwater resources." (Giri, personal conversation, 2013)

Another step of CS adaptation towards international comparability is oriented along 9 identified *Key Performance Indicators (KPI)* for watercycle community planning. The analysis of the CS showed that most calculations in the CS computed the necessary variables in order to serve the KPIs. (cf. subchapter 3.3).

A procedure however, to obtain, collect and interpret data however is not established yet and is seen as an essential part for continuous success (cf. chapter 2.1.7, Fig. 02-11, Fig. 04-8)
In addition, the reporting to a higher / umbrella organization such as the WorldGBC is a necessary installment to continue the discussion at a global level (cf. chapter 4.2, Fig. 04-6)

The third step is described as ‚total regional success' and involves the broad spectrum of necessary stake- and shareholders.
One interviewee pointed out the importance of Post occupancy evaluation (POE) and the involvement of residents as a checkpoint of how green the project really is: „Another very important aspect missing in the CS is to set actual benchmarks for consumption. However, it is not enough to require low flush toilets in the certification systems when you later on realize that residents demand up to 200 l per person per day." (Anand, personal conversation, 2013). „This aspect is just one of many reasons to put Post occupancy evaluation (POE) on the top of our priority list for green building activity and rating. We need to make sure even more, that green building is an economical success by involving and educating residents and associated project developers." (Anand, personal conversation, 2013).

‚Educating green' is well described in a network Australia news article on ‚India's youth': „The quality of higher education in India is poor. Accreditation for universities and colleges is voluntary, and a bill to regulate them has spent the past three years caught up in a parliamentary logjam." (Australia network, 2013), which ultimately leads to students „not learning what the new technologies and market is about". (Australia network, 2013) IGBC's broad and widely recognized student initiatives are a response to this gap.

As described in subchapter 4.1.3 IGBC's association with the Indian government and planning authorities is a formal act and basis of a mutual understanding, however „ We have a long way to effectively work with each other ahead of us: If you are familiar, which you are, with the green building movement all around the world, there's a lot of politics associated with the issue because there are different players. There are organizations like us, which are membership-based, there are government entities, which have authority, and then there are these engineering syndicates, etc. So, ensuring that everyone is on the same page might be difficult to achieve. In our case, when we started we faced many challenges and problems because they felt that we were intruding into areas that weren't our areas. So the engineering syndicate that has something like 100,000 members felt that it was their responsibili-

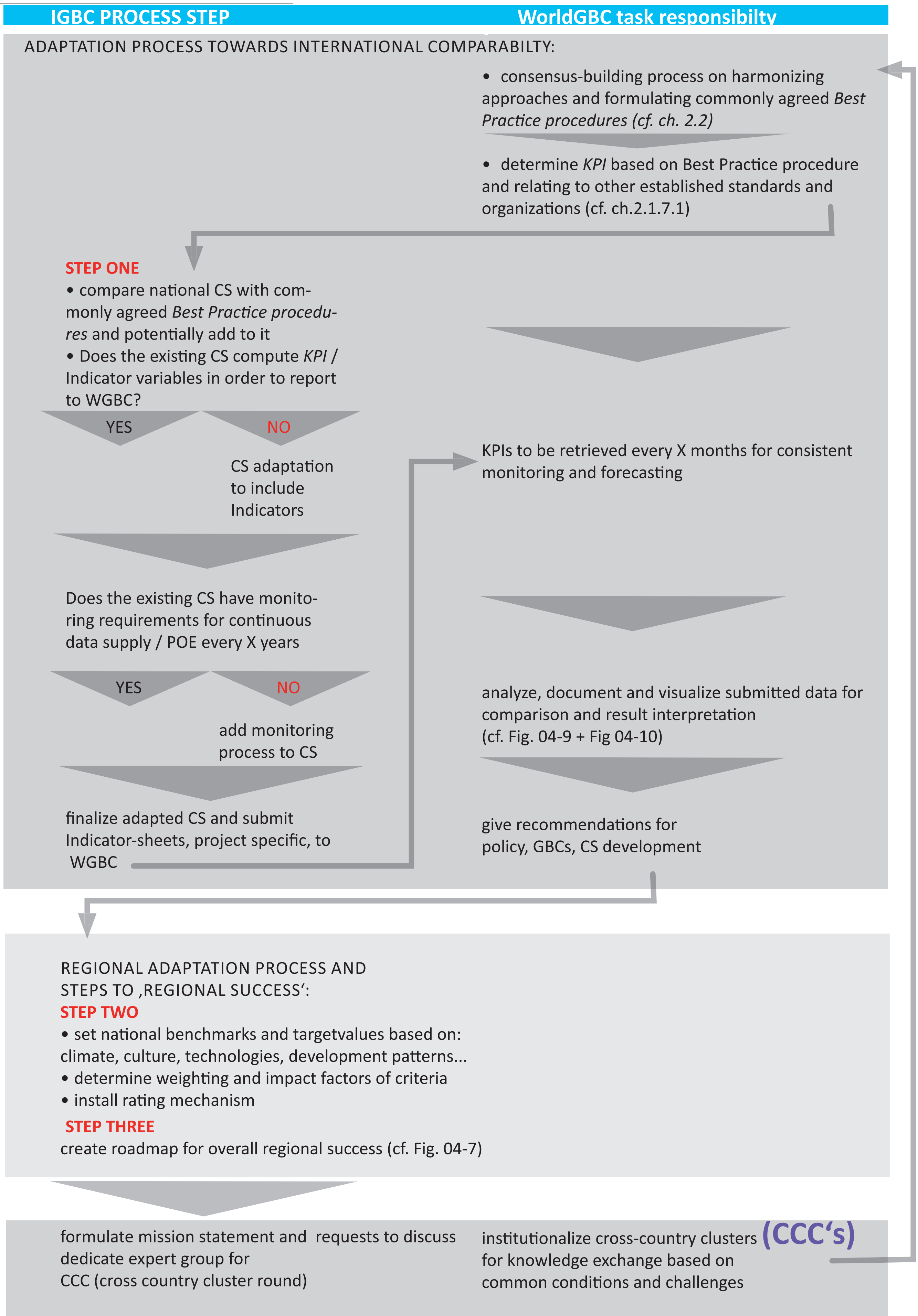


FIG. 04 - 6:
Steps towards international comparabilty

ty. The main government R&D facility in the country felt it was their responsibility. The national building council, which issues building codes, felt that it was their responsibility. So there were several organizations that felt it was their responsibility. There's a certain philosophy that everybody in this field I assume would understand, which is that when you mention the word green, it does not just have to do with the relation between you and materials, between air and water, etc. It's also about establishing harmony with your human surroundings. So part of our guiding principles was to work with everybody, not just to take sides. When we started there was lots of resistance because all these parties should be involved. Then gradually, one organization by the other, they became more aware of what we were doing and less aggressive." (Anand, personal conversation, 2013)
The following two Figures graphically show the implementation of the described three steps. Fig. 04-06 ‚Towards international comparabilty' concentrates mainly on step one and outlines necessary steps national GBC's must undergo in order to be able to report back to the WorldGBC. At the same time, WorldGBC's tasks and responsibilities are outlined. Fig. 04-7 ‚Roadmap to total regional success' gathers the important aspects which are key for an overall regional implementation of the green building and certification aspect. Here, GBC business segments and the various other layers, such as involving partner from academia and research, industry and planning, are put into context for successful capacity building. The proposed process framework is back up by quotations and sources of indian partners and interviews.

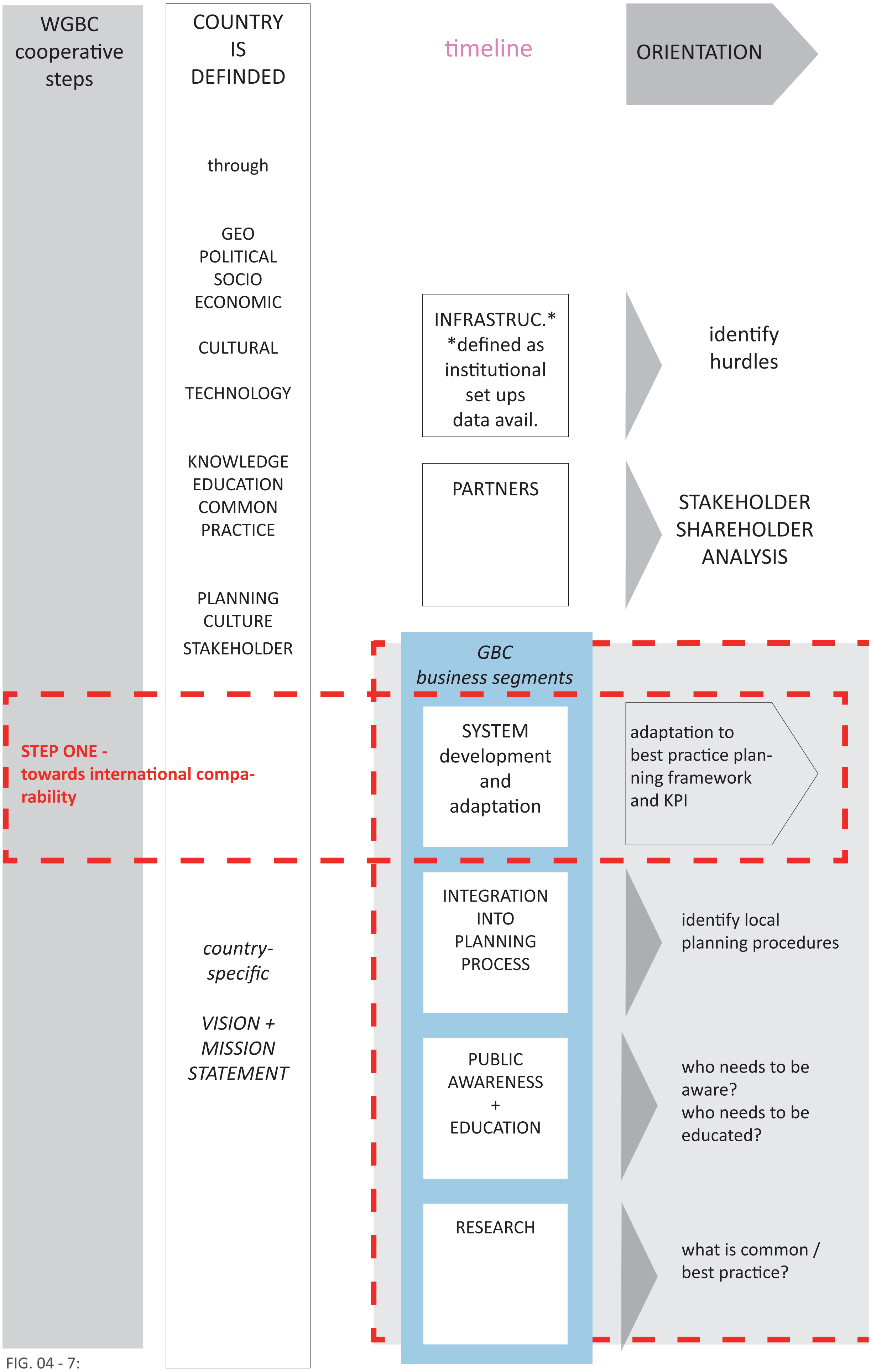
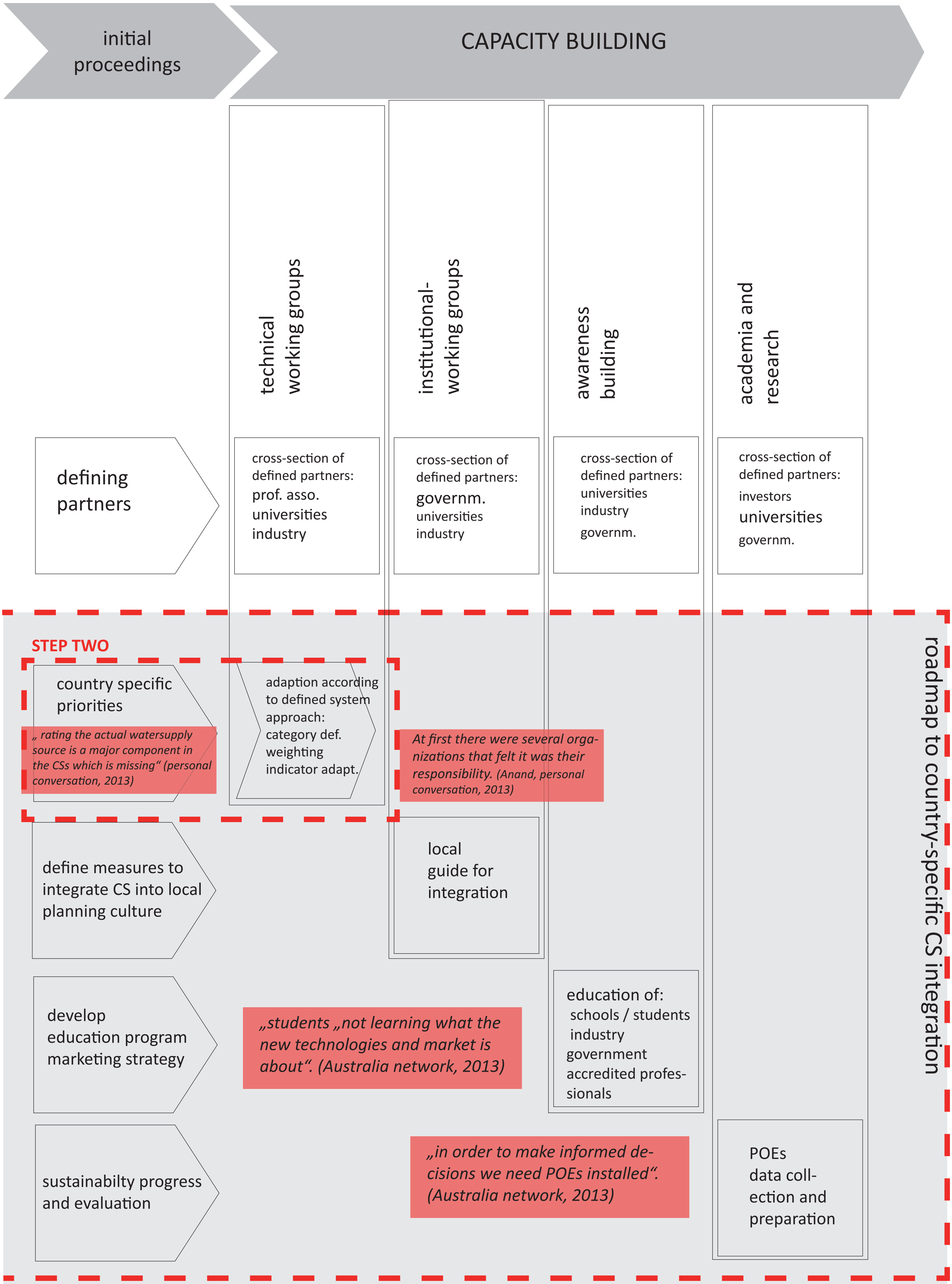


FIG. 04 - 7:
roadmap to regional success, based on discussions at IGBC



initial proceedings
CAPACITY BUILDING
technical working groups
institutional-working groups
awareness building
academia and research
defining partners
cross-section of defined partners: prof. asso. universities industry
cross-section of defined partners: governm. universities industry
cross-section of defined partners: universities industry governm.
cross-section of defined partners: investors universities governm.
STEP TWO
country specific priorities
„ rating the actual watersupply source is a major component in the CSs which is missing“ (personal conversation, 2013)
adaption according to defined system approach: category def. weighting indicator adapt.
At first there were several orga-nizations that felt it was their responsibility. (Anand, personal conversation, 2013)
define measures to integrate CS into local planning culture
local guide for integration
develop education program marketing strategy
„students „not learning what the new technologies and market is about“. (Australia network, 2013)
education of: schools / students industry government accredited profes-sionals
sustainabilty progress and evaluation
„in order to make informed de-cisions we need POEs installed“. (Australia network, 2013)
POEs data coll-ection and preparation
STEP THREE
roadmap to country-specific CS integration

4.4 Institutionalizing Internationalization - keeping targets and strategy on track through KPI

A difficult exercise in sustainability assessment is the collection and processing of data. At this point no CS has a refined procedure to collect data, nor is there a set of agreed upon indicators for performance measuring and reporting.

In the Indian handbook of benchmarking the need to institutionalize this effort is described, otherwise " good means will get lost eventually". The challenge of the acceptance and capacity of such an undertaking at all levels is questioned in the book, as such an "initiative will only sustain through the understanding and willingness of all stakeholders to participate." (Handbook benchmarking, 2012, p.19). The necessity is clear: not only do projects themselves tell their own story, the handbook points out that the process of performance monitoring and evaluation against agreed targets is essential to understand the dynamics of the industry.

What was mentioned in Facilities Net Magazine's article 'Using Post-Occupancy Evaluations to Fine Tune Green Design' is the next step to be undertaken in sustainability assessment: "With the critical mass of (...) certified projects that have now been built, the million dollar question is, how well are they working?" (facilitiesnet, 2013)
The site visits in India showed, that set target values will have to eventually get measured against real data derived from POEs. As described in subchapter 3.1.4, at this point no POEs seem to be installed as a larger revision cycle, although the necessity is clearly confirmed with interviewees at IGBC. Some individual efforts have been made by the USGBC which initiated a POE campaign "to connect building design, management and use to achieve the best performance possible. The initiative will include feedback mechanisms for building managers, owners and occupants so they can address gaps between predicted vs. actual building performance." (facilitiesnet, 2013)

Such individual efforts may be a good start and in subchapter 3.1.1 it was already mentioned, that "green building is increasingly seen as a business opportunity" (McGraw, 2012, p.15) because of lower operating costs. It also says in the same article, "despite the importance of business benefits for making the case for green building investment, more than a third of global firms are not using any metric to track their building performance" (McGraw, 2012, p.47). Results reveal "the endemic problem due to a lack of consistent measurement and available tools" (McGraw, 2012, p.47) and show the necessity of what the UN calls as the most important in sustainability assessment and Sustainability Indicator development: "Indicators and data collection must be built using harmonized, recognized international recommendations and guidelines, where they exist, as benchmarks, and new recommendations and guidelines developed where needed, to ensure general harmonization and consistency among the indicators, international comparability and reliability over time to assess trends. These methodologies and best practices, comprising data sources, methods of computation, treatment of missing values, regional estimates, and so on, must be fully documented and readily available."(UN, 2013,p.21)

The problem of scattered indicator and performance collection has been described well in reports by the Ministry of Urban government, India. The following challenges are repeatedly pointed out and strengthen the argument for an umbrella organization that formally coordinates activities and pools resources, in the case of green building this would be the World Green Building Council. Different sets of performance indicators have been defined under different initiatives. The definition or the assessment method may vary for the same performance indicator, thus inhibiting inter-city or intra-city comparisons. Most measurement exercises have been externally driven (by agencies external to the agency responsible for delivery against those performance parameters), leading to the key issue of ownership of performance reports. Most performance measurement initiatives have not been institutionalized, limiting the benefits of monitoring trends in performance over time; and the process of performance measurement has not been taken forward into performance management. (points based on comments by MofUD, India, 2012)

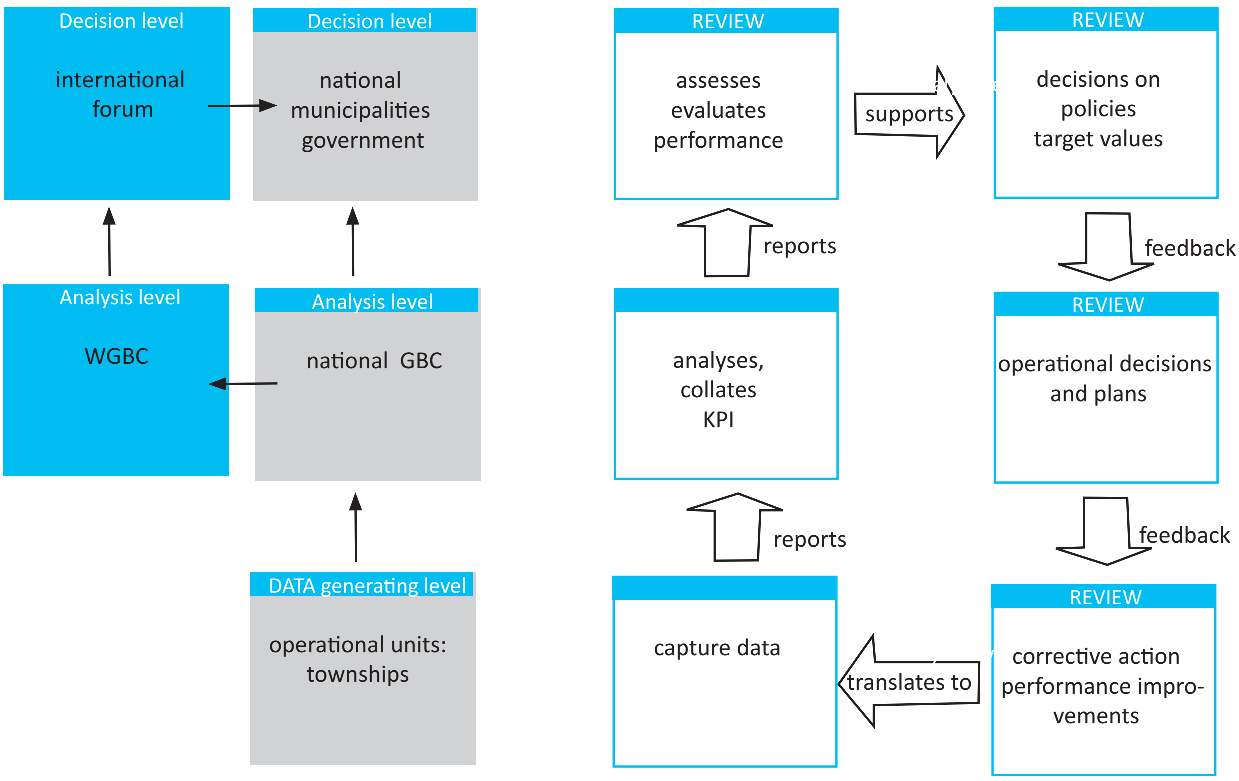
POEs can only be an effective tool if resources and data are cohesively pooled together. They initiate the discussion on "how buildings impact our world by working to find more innovative ways to increase the partnership between designer, owner, manager and occupant." (facilitiesnet, 2013) Their results will also allow for informed decisions in target value re-evaluation, best practice understanding and certification itself.

KPI management necessary steps "will be sustainable (...) if disclosure, reporting, monitoring and performance management feedback, incentives and disincentives are also brought into the cycle.(p.16,2012) (...) and if all stakeholders are taking part." (Handbook benchmarking, 2012 ,p.19,) Fig. 04-8 shows the three levels in KPI management: data generating, analysis and decision. At the data generating level, the operational units, in this case townships, collect and generate raw data then pass it on to the national GBC. At the analysis level national GBCs analyze the raw data and collate this into KPI sheets, which are forwarded on to the WGBC. At the decision level, the WBGC analyze and evaluate KPI, cross-reference this information with associated country members and collate the information in a dashboard format, supporting policy and decision making

at all levels of government. This feeds back down to the analysis level as the resulting operational policies and plans are established. Finally the loop is completed as corrective action performance improvements are undertaken back at the data generating level, creating more data that will then restart the loop.
With the WorldGBC being a potential umbrella organization for KPI management, it falls under their responsibility to create a reporting system including the following tasks:

• KPI progress reporting towards targets
• KPI change management over time report
• KPI comparable charts– regional/project comparison

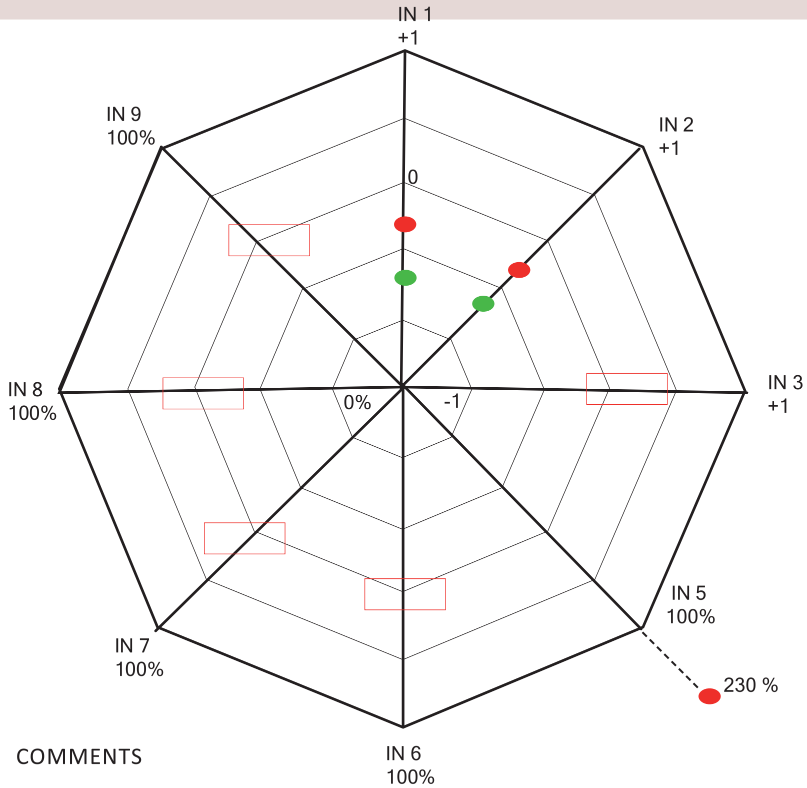
The difficulties of this proposal became evident during the stay in Hyderabad where the attempt to test proposed KPI and datasets at this point in time and under described circumstances pretty much failed (cf. table 04-1). None of the pre-certified projects nor projects in operation was able to provide data.
However, the exercise of retrieving and collecting data is considered to be important as much as the visualization of it is a crucial duty for informed decision making processes. Two examples of a KPI web and a dashboard are shown in the following figures: Fig.04-9 shows one way to illustrate all nine KPI in a web format with indicators normalized to a range between +1 and -1. This allows to see at one glance how a community has performed in its watercycle management. The example in Fig. 04-9 shows a community with targetvalues set in red and values in operation in green. Onother possibilty is to compare communities with each other. Here, it is important to stick to communities which are comparable based on the project quick facts shown in the figure. Also, as pointed out in the subchapter on Indicators, a comments / description section is necessary to provide proper understanding of indicator result.
Another important tool for intelligently conveying information is a KPI dashboard (Fig.04-10) showing progress towards a target and change management over time. With the visualization of raw data collection and massing at first, an understanding of measuring devices, methodologies and frequency is at hand. Both figures do not claim to be complete, they are examples only.



Performance management will be sustainable only if disclosure, reporting, monitoring and performance management feedback, incentives and disincentives are also brought into the cycle. (p.16,2012)

FIG. 04 - 8:
KPI management system, based on HANDBOOK OF SERVICE LEVEL BENCHMARKING, ministry of urban development, government of India

Indicator		Dimension	Co1-plan	Co1- operational
IN 1	Water availabilty -1 = high demand, therefor no wateravailabilty +1 = no demand, therefor highest possible wateravailabilty	-1 / +1		
IN 2	internal vs. external resources -1 = only external watersources +1 = internal watersources	-1 / +1		
IN 3	freshwater vs. recycled water resources +1 = only freshwater is used to cover demand -1 = no freshwater abstraction, only recycled water	-1 / +1		
IN 5	projected vs. actual demand	%		
IN 6	rainwater usage against demand	%		
IN 7	wastewater to demand coverage	%		
IN 8	wastewater for re-use	%		
IN 9	Wastewater treatment quality	%		



PROJECT QUICK FACTS

Project type township
Project location Hyderabad

no. of residents
land use allocations
residential (m2)
commercial (m2)
open space (m2)

infrastructure
hook up to exisiting
none
community wide

climatic conditions
rainfall data
groundwater
surface water

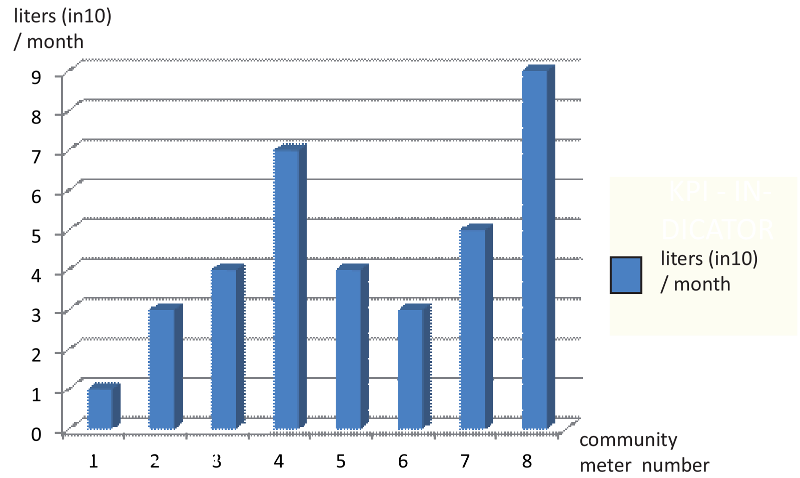
COMMENTS

for comments and explanation of Indicator results refer to comment sheet attached.
note: as mentioned in subchapter 4.1.3, data availability was dependend technical, documentation and political circumstances

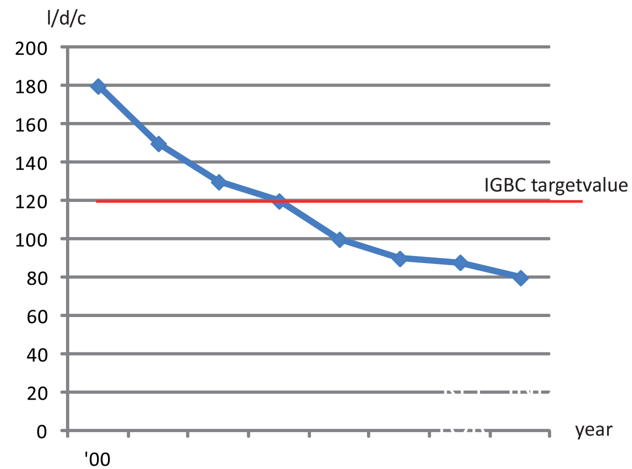
FIG. 04 - 9:
EXAMPLE ONLY of a proposed chart layout - NO REAL DATA
KPI spider for 9 water-related Indicators in community planning - target compared operational values

KPI - INDICATOR		Co-IGBC-WCM-KPI- IN 5	
EVALUATION SECTION		COMMUNITIES / WATERCYCLE MANAGEMENT	
DATA SUBMITTED BY PROJECT ID		Indian Green building Council	
RESULTS			
goal	raw data collection (1)	progress towards target (2)	change management (2)
sources of data	metering at field level, O&M		
frequency	monthly		

visualization



(1) data retrieved from field meters



(2) community water demand per person per day against target value of 120 l/d/c

FIG. 04 - 10:
EXAMPLE ONLY of a proposed chart layout - NO REAL DATA
KPI dashboard showing raw data accumulation and actual versus target values over time

Indicator	Indicator name	calculations with variables	variables
Indicator 1 WAI	Water availabilty	$WAI = \frac{R + G - D}{R + G + D}$	R= surface run off G= groundwater resources D= sum of demands of all sectors
Indicator 2 WA ratio	internal vs. external resources	$WA_{ratio} = \frac{WA\,i - WA\,ex}{WA\,i + WA\,ex}$	WA i = internal resources are groundwater and surface run off WA ex = external resources are inflows into the ecoblock boundary
Indicator 3 W prod	freshwater vs. recycled water resources	$W_{prod} = \frac{W\,fresh - W\,rec}{W\,fresh + W\,rec}$	Wfresh = freshwater abstraction Wrec. = recycled resources
Indicator 4 D ratio (Gleick)	projected demand vs. basic human water demand	$D_{ratio\,(Gleick)} = \frac{D\,projected\ /\ D\,actual}{50\frac{1}{d}/person}\ x\ 100\ \%$	projected demand of community residents against Gleick BHW Indicator of 50 liters per person/per day per
Indicator 5 D ratio	projected vs. actual demand	$D_{ratio} = \frac{D\,projected}{D\,actual}\ x\ 100\ \%$	projected demand of community disaggregated subareas (refer to P.S. 2.1)
Indicator 6 RW share	rainwater usage against demand	$RW_{use} = \frac{RW}{D}\ x\ 100\ \%$	RW = rainwater as % of reliable run-off
Indicator 7 WW prod	wastewater to demand coverage	$WW_{prod} = \frac{WW\,Qx}{WW\,total}\ x\ 100\ \%$	WW Q 1 = untreated stormwater WW Q 2 = greywater WW Q 3 = yellow water WW Q 4 = blackwater WW Q 5 = agricultural wastewater WW Q 7 = industrial wastewater
Indicator 8 WW cov	wastewater for re-use	$WW_{cov} = \frac{WW\,Qx}{D}\ x\ 100\ \%$	
Indicator 9 WW treat	Wastewater treatment quality	$\frac{WW\,treat}{WW\,total} = \left(\frac{WW\,treat\,1}{WW\,treat} + \frac{WW\,treat\,2}{WW\,treat} + \frac{WW\,treat\,3}{WW\,treat}\right)\ x\ 100\ \%$	WW treat 1: share of primary treatment WW treat 2: share of secondary treatment WW treat 3: share of tertiary treatment

DATA collection and computation for *township Alien Space station Hyderabad* .
based on disclosed documents and data conveyed in interviews / sitevisits

Indicator 1
WAI

target value: -0,3 / operational value: - 0,7

-1 = high demand, therefor no wateravailabilty
+1 = no demand, therefor highest possible wateravailabilty
comment: wateravailabilty based on groundwater and available stormwater run off was planned at - 0,3 with high demand at relatively low availabilty, availabilty adjustment planned through damn connection as external source. After project is in operation, availabilty goes down to -0,7 due to groundwater depletion and borewells not being operational
note: indicator varies significantly with dry and wet season, it is recommended to compute indicator on a monthly basis

Indicator 2
WA ratio

target value: -0,3 / operational value: - 0,7

comment:
-1 = only external watersources ; +1 = internal watersources
waterresources were planned to be 75 % external through a damn connection and centralized infrastructure ad 25 % through rainwater harvesting. Project in operation is relying more so on external watersources to close the demand / supply gap. Watertrucks deliver drinking water on a regular basis to fill up installed rainwaterharvesting tanks. Centralized infrastructure provides 3 hours of watersupply on average per day.

Indicator 3
W prod

N/A

comment:
-1 = no freshwater abstraction, only recycled water; +1 = only freshwater is used to cover demand
This indicator attests the potential use of recycled resources to substitute freshwater.
Because the use of recycled resources is very much encouraged in Hyderabad and also the CS for new townships, target value was set at ???. Later on, in operation, the greywater recycling plant was not operational, however rainwater harvesting could be accounted towards substituting freshwater.

TABLE. 04 - 1:
KPI computation of township development Alienspace station in Hyderabad

DATA collection and computation for *township Hyderabad* - cont.
based on official government documents and data conveyed in interviews / sitevisits

Indicator 4
D ratio (Gleick)

$$\frac{D\ proj.}{D\ actual} = \frac{220\ l/d}{50\ l/d}\ x\ 100\% = 440\ \%$$

Indicator 5
D ratio

$$\frac{D\ proj.}{D\ actual} = \frac{220\ l/d}{96\ \ l/d}\ x\ 100\% = 230\ \%$$

100 % = project target equals actual average drinking water demand
0% = theoretical value, where project would not need any drinking water
comment: Indicator is at 230% and is therefor much higher than the average drinking water demand, or else in India often daily availabilty
here, the ratio between an actual demand against the project demand is calculation. The average drinkingwater consumption per person per day in Hyderabad is at 150 liter (Govt. of India, 2002). Typical townships set their target values usually a lot higher, in this case to 220 liter. In operation, drinkingwater supply per day goes down to 96 liter due to lacking operations.
„ The quantity of water consumed in most indian cities is not determined by demand, but by supply." (Shaban, 2008)

Indicator 6
RW share

N/A

100 % = high volume of rainwater used in order to cover the demand
0% = low volume of rainwater used in order to cover the demand
comment: This indicator will vary significantly based on seasonal changes in wet and dry season as well as installed harvesting tank capacities. Tank capacities do not take into account reliable run-off computations and therefor account to indicator on a limited basis only

Indicator 7
WW prod

N/A

100 % = wastewater quality Qx makes x% of the entire wastewater volume
0% = wastewater quality Qx has no share in total wastewater volume
comment: Indicator is at 64% for Q2/greywater and at 35% for Q4/blackwater
the indicator distinguishes a total of 7 wastewater qualities. Wastewater qualities WW Q 1 = untreated stormwater, WW Q 2 = greywater WW Q 3 = yellow water and WW Q 4 = blackwater ;

Indicator 8
WW cov

N/A

100 % = wastewater quality Qx makes x% against overall demand
0% = wastewater quality Qx has no share
comment: this indicator shows the potential of wastewater qualities to be used for freshwater demand reduction;
the indicator distinguishes a total of 7 wastewater qualities. Wastewater qualities WW Q 1 = untreated stormwater, WW Q 2 = greywater WW Q 3 = yellow water and WW Q 4 = blackwater.; IGBC new township CS encourages wastewater recycling to substitute against overall freshwater demand (cf. page 03-30; CS analysis), therefore Indicator for certified projects shall be in the higher range. Site visits showed technologies installed, however in operation they failed

Indicator 9
WW treat

N/A

100 % = wastewater treatment quality WW treat 1 against total wastewater treated
0% = wastewater quality Qx
comment: Indicator is at x%
distinguished treatment facilities at various treatment levels were shown in one project including one greywater treatment plant and rainwaterharvesting tanks connected to a bio retention pond. Data should be easily obtained by technology volume capacity installed, however could not be computed at this point in time According to CSE survey, 2006, 70 % of Hyderabad area is covered with sewerage connections at a total of 2 central sewage treatment plants, capacity at 133 MLD). This indicator is important for India, because of lacking sewage connection coverage and release of raw sewage in natural waterbodies (Musi river)

Chapter 5.0
Conclusion

'Statistics determine our world view. We measure what we treasure. So statistics, however objective and accurate, are never value free but focus on what various societies deem to be important goals and values.' (van Dieren, 1995 Club of Rome p., 157)

This paper discusses the practice of community certification systems at an international level towards gaining a best practice understanding of their ability to perform at a regional level. The main objective of the dissertation was the development of a *Best Practice framework of key planning steps* for water cycle planning in communities with relevant *Key Performance Indicators (KPI)* and the integration of both tools into certification. The framework and KPI attempt to create a common ground of understanding at a global level and therefore reduce complexities associated with the different approaches apparent in certifying. Different approaches show the comparative analysis of selected CS. Critics, describing the brisk development of CS as fueled by rapid urbanization, point out "signs of cracks and fissures (...) ranging from concerns about the quality of multiple new services, to larger issues about maintaining environmental and scientific integrity." (Baker, 2004 ,p.2) One of the "cracks and fissures" of the selected CS is the lack of the applicability of the systems at an international level.

The initial analysis of CS identified different methodologies to assess sustainability at the water cycle management level in the community. Stemming from the variety of national backgrounds, the lack of common metrics and evaluation methods revealed, that the international certification systems sector is far from being standardized. This raises the question of whether the systems operate towards commonly understood best practices.

The status quo on internationalization showed that efforts have been made to cater to the international market; however, without clearly distinguishing between international and regional strategy concepts. Only the DGNB developed a so-called core system based on European standards, which is used as a base for regional adaptation.

This paper considers CS as a tool to enable "comparability across places and situations" and "provide a common ground for discussion." (cf. Gallopin) A *Best Practice framework of key planning steps* was developed in order to speak the "same language and ask the same questions." (personal conversation, Dickhaut, 2013) and working towards the goal of being able to compare certification systems internationally.

The framework was based on global key policy questions, commonly understood responses at planning and policy levels, and what Trinius points out as an important part in sustainability standardization: to relate to existing approaches and based on known and established sustainability indicators. (UNEP 1997, OECD 2008)

A total of nine KPI were derived from this framework as tools to show, monitor and evaluate progress over time. When comparing selected CS with the best practice framework of key planning steps, it was revealed that oftentimes 'not all questions according to the framework were asked.' Also, KPI were not explicitly represented in most CS; however, oftentimes the computations formed part of the certifying process that would eventually feed into the KPI.

As such, frameworks and KPIs can be a valuable avenue for industry collaboration and, ultimately, a platform of agreed-upon metrics providing transparency. A total of three steps towards international comparability and regional success for CS were defined:

1.Catering to commonly agreed-upon best practice planning procedures and the installment of KPI; institutionalizing a continuous performance revision cycle with an umbrella organization.
2.The addressing of national and region specific conditions and policies.
3.The design of a roadmap for total regional success.

A visit to Hyderabad allowed for the examination of contextual building and certification alike. Several interviews with green building staff and various other stake- and shareholders gave insight into the status of community water cycle planning at large, as well as at the township level. Visited sites gave a picture of how certification impacted the planning, construction, and maintenance of the projects. Taking the status of the township CS into account (derived from the American system), conclusions could be drawn towards international comparability and operational capacity. Green building staff gave much insight into the further regional actions necessary to "make the case of certifying in its entirety successful." (Anand,personal conversation, 2013)
While sustainability aspirations and targets were often set high, projects often failed to perform during their operational phase. This phenomenon showed what has been described in chapters 3.1.4, 4.1.3 and 4.4.: that CS are missing the installment of post occupancy evaluations (POE) for the ongoing evaluation of KPI and targets set.
The KPI developed in this paper could only partially be tested because of limited data availability (cf. table 04-1): townships were either in planning or pre-certification state and not all components of the best practice framework were taken into account. In interviews, however, there was no apparent hesitation to provide such data in the future. Older townships in operation could not provide data because accordant metering devices for results reporting were not installed yet.
The suggested KPIs were seen as positive installments to further progress; however, the difficulty of institutionalization was pointed out as well. This is also confirmed by the just-recently published Handbook for Service level Benchmarks for water supply and wastewater treatment: "Systems for capturing key data elements identified for Service Level Benchmarking are not present in many cases at the field level." (GoI MofUD, 2012, p. 16)

Outlook - Fostering credibility of the systems

The act of reducing complexity is not only necessary for the ones using the system; it is essential for communicating results to the public. In order for the layperson to comprehend results, information may have to be condensed yet further. The credibility of the system may be compromised if the entire process of aggregating information is not rendered transparent and comprehensible. The responsibility towards the public is one major aspect which can impact the systems' right to exist.

CS, at this point in their process, are following a regular planning procedure and final certification process. Some CS may demand a post-occupancy certification for verification. The meaning of the data produced during the CS process is left unexplored. Data is not prepared in a way to communicate a certain outcome and or progress.

In any case, for the standard and certification to be effective, continual attention is required. Like other policy institutions, the organizations that create and certify standards need to be able to learn and adapt. Technical standards need to be adjusted to take into account advances in science and technology. There must be a way to deal with any issues of credibility or legitimacy that arise, as well as negative impacts. Additionally, it is paramount that there be a way to adapt to changes in the problem itself.

One of the fundamental challenges of these programs is measuring impact. At best, most programs are focused on obtaining an increasing share of the market. Several interviewees pointed out that this may be used as a proxy for environmental improvements, but without more work to connect these programs to measureable, on-the-ground changes, market share alone is an imperfect metric.

In the recently published McGraw Hill World Green building trends report, it notes in the chapter titled "Metrics used to measure benefits of green building" that "Despite the importance of business benefits for making the case for green building investments, more than a third of global firms are not using any metric to track performance from green building. (...) These results reveal an endemic problem due to a lack of consistent measurement and availability of tools and expertise to help firms be able to make the full case for green." (McGraw, 2013,p.13)

Jane Henley, CEO of the World Green building Council and widely recognized thought leader in the green building industry, confirms: "Capturing more data on how spaces perform and impact people is the next step in understanding the value of green building."(McGraw, 2013, p.60)

In the handbook Service Level Benchmarking, the Urban Ministry of India points out similar limitations, mainly due to the lack of performance monitoring not having been institutionalized:

„Every sector has a few key performance indicators that are understood by most stakeholders in that sector. Similarly, in the urban sector too, there have been a number of performance indicators related to urban management and service delivery that have been defined, measured and reported. However, most initiatives in performance management so far have been observed to have some key limitations:
•Different sets of performance indicators have been defined under different initiatives;
•The definition or the assessment method may vary for the same performance indicator, thus inhibiting inter-city or intra-city comparisons;
•Most measurement exercises have been externally driven (by agencies external to the agency responsible for delivery against those performance parameters), leading to the key issue of ownership of performance reports.“
(GoI MofUD, India, 2012)

The function of an indicator is to compare current conditions with set target values. The comparison of both values will indicate a success or failure. When deciding on an indicator, one main concern should be the amount of data collection with respect to availability. Indicators that require an amount and effort of data collecting which is beyond conventional methods consequently will be dropped. Indicators also need to be legible, up-to-date, concise and easily ascertained.

Any rating system or indicator system should never be a finished product. In fact, it needs to be a flexible system, open to changes and opportunities for optimization and further methodogical development. A global set of indicators must, by definition, incorporate the capacity to integrate different countries' interests and circumstances. (Lang,2007, p.119)

Ultimately, the credibility vis-à-vis sustainability of the program is fundamentally impacted by the ability of the institution to bring benefit to participants and society. The installment of continuous revision cycles and flexibility will confer the necessary credibility of the systems.

Water scarcity is one of the defining issues of the 21st century. In its Global Risks 2013 report, the World Economic Forum identified water supply crises as one of the highest impact and most likely risks facing the planet.
This issue, directly coupled with global accelerated urbanisation, needs to be addressed on various levels. As CS have become powerful tools to encourage 'green building' over the last years, they can have a direct impact on designing future 'smart' urban water networks – when used properly. This necessitates that CS contain set targets, collect data, and monitor results in an intelligent and continuous cycle of revisiting and re-evaluations methods and tools to help us better understand and quantify progress towards sustainability. With a global issue needing global attention, an umbrella organization institutionalizing this task needs to be coupled with informed and sensible cross country partnerships for knowledge exchange to guarantee overall success, because "… partnerships and collaboration are now a critical element of their approach to sustainability issues. Businesses realize that today's global challenges are too broad and too complex to go at it alone." (Accenture, p.11, 2010)

Further research:

The Indian case study shows that the first step to making CS international is fairly easy. Later steps included the adaptation of the system to include all best practice planning steps, and the ability to cater to the defined KPIs. The following steps, which are not part of this paper, would have to be the testing of proposed measures and relation to the list of "good indicators," as pointed out in subchapter 2.1.7:
• Data availability - the challenge of compilation of existing evidence / data (cf. table 04-1)
• provision of models for data collection
• The comparison of results and the identification of reasons for differences in results; in particular, methodological and statistical differences and measuring units
• Drawing up lessons for future studies to improve comparability and to ensure that results are meaningful.

Pilot projects are needed, and must be supported with necessary resources to both test new indicators and data collection methods and ensure that their methods and results be fully documented. As the UNICEF points out in their vast study on indicator development, „Most developing countries have limited internal resources, human or financial, to support compilation and analysis of indicators, or of innovative studies, but are keen to take advantage of innovations that have been proven effective." (UN, 2013,p.21) These resource limitations clearly conflict with the necessity of collecting data in order to be able to make informed decisions at a global level.

A sensitivity and stability analysis should be an integral part of any solution methodology and would be a next step in testing the proposed measures. Sensitivity analysis (SA), broadly defined, is the investigation of these potential changes and errors and their impacts on conclusions to be drawn from the model. (e.g. Baird, 1989)

Measuring alone will not lead to success

In 2007, a report for the U.S. Environmental Protection Agency stated: “While much discussion and effort has gone into sustainability indicators, none of the resulting systems clearly tells us whether our society is sustainable. At best, they can tell us that we are heading in the wrong direction, or that our current activities are not sustainable. More often, they simply draw our attention to the existence of problems, doing little to tell us the origin of those problems and nothing to tell us how to solve them.” (Hecht, 2007,p.12)
Under the guiding principles of sustainability, in most cases a more detailed examination is necessary, which goes beyond the complementary indicators. “It is absolutely essential to describe, document and explain the interdependencies of complementary and opposing aspects. This documentation rarely happens.” (Birkmann, 1999, p.104)
Birkmann points out, what is an ongoing discussion in urban sustainability assessment. “most currently available methods still fail to demonstrate sufficient understanding of the interrelations and interdependencies of social, economic and environmental considerations. Many reports on sustainability assessment methods point to the absence of truly integrated urban sustainability assessment methods.”(Adinyira et. Al, p.6,2007)

This paper suggests a *Best Practice framework of key planning steps* and *KPI* as a first step towards an agreed-upon platform for discussion. However, to make the entire case successful, a range of complex steps is necessary.

This leads to research questions such as:

How can the KPI proposed in this paper feed into or more complex sustainabillity understanding, taking into account the water - energy nexus, as well as a social and economic understanding?

What else beside the role suggested in this paper can strengthen an international umbrella organisation, such as the WGBC, under the influence of more or less competing national green building councils and other larger organisations?

How can the long-term effects of CS be measured and how are they situated among the various other planningtools, regulations and policies? Which policies are supporting of and which are decreasing the effectiveness of CS?

Sources and Appendices
Bibliography and references
APPENDIX A Overview Community Certification systems
APPENDIX B formulary
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APPENDIX D LIST OF CONTACTS + INTERVIEWEES

Forum for a sustainable Hyderabd - Dr. Bhawa's library

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A	LEED-ND	BREEAM Communities	DGNB Stadtquartiere	CASBEE-UD
GENERAL INFORMATION				
Certification system	Leadership in Energy and Environmental Design for Neighborhood Development Rating System	Building Research Establishment's Environmental Assessment Method	Deutsches Gütesiegel für Nachhaltiges Bauen	Comprehensive Assessment System for Building Environmental Efficiency
System classification	International	International	National	National
Logo				
Country of Origin	United States of America	Great Britain	Germany	Japan
Founding Institution	U.S. Green Building Council (USGBC), Congress for the New Urbanism, Natural Resources Defense Council	Building Research Establishment (BRE) Global	Deutsche Gesellschaft für Nachhaltiges Bauen (German Sustainable Building Council)	Japan GreenBuild Council (JaGBC)
Sponsorship: private/state	independent, non-government	State	independent, coop /w government	State
Founding year	2009	2009	2007	2007
Pilot phase	2008	2008	2009	-
Website	www.usgbc.org/DisplayPage.aspx?CMSPageID=148	http://www.breeam.org/communities	http://www.dgnb.de/_en/index.php	http://www.ibec.or.jp/CASBEE/english/download.htm
Contact	Jeffrey Lovshin email: jlovshin@usgbc.org	tel: +44 (0)1923 664462 email: breeam@bre.co.uk	Stephan Anders tel: +49 (0)711 722322-45 email: s.anders@dgnb.de	Nobufusa Yoshizawa (Mr.) tel: +81-3-3222-6728 email: yoshizawa@ibec.or.jp
Contact for water related issues	...	...	Prof. Wolfgang Dickhaut / HCU Hamburg, Anja Schumann / H2O Consult, Ulm	...
PROPERTIES OF CERTIFICATE				
Certification process	3 Stages: - Preliminary assessment of the certification potential before permit planning (optional) - Pre-certification (max. 75% completion of project) - Certification (buildings and infrastructure are completed)	3 Stages: - Registration - Optional pre-certification to assess the preplanning phase - Certification: Submission of the required documents before commencement of approval procedure	3 phases: - Pre-certification: planning (master plan, valid to 5 years) - Certificate: local public infrastructure (min. 75% of infrastructure, valid to 5 years) - Certificate: quarter (min. 75% building contruction (in perpetuity)	4 Steps: 1) Main Sheet - Basic information 2) Score Entry Sheet 3) Score Sheet 4) Assessment Results Sheet Basic information,
Evaluation through	LEED Accredited Assessor	BREEAM Accredited Assessor	...	CASBEE Accredited Assessor(s)
Evaluation method	Credit-point system Max 110 credits (100 plus 10 bonus credits)	Weighted credit-point system Max 107% (119 plus 7 bonus points)	Credit-point system, Check List Points (CLP)	Letter-grade system - Matrix comparison of averaged, weighted scores from core categories for grade
Rating benchmarks	Certification (40-49 points) Silver (50-59 points) Gold (60-79 points) Platinum (≥ 80 points)	Pass (30% - 44% points) Good (45% - 54% points) Very Good (55%-69% points) Excellent (70% - 84% points) Outstanding (≥ 85% points)	Bronze (>50% points) Silver (>65% points) Gold (>80% points)	Poor (C) Fairy Poor (B-) Good (B+) Very Good (A) Excellent (S)
Structure of the certificate	- 3 Core Categories - 12 prerequisities - 41 sub-categories -10 bonus credits for innovation & regional priority - Points earned are summed for a total score	- 5 Core Categories - 12 mandatory credits - 40 sub-categories - 7 bonus percentages for innovation - Points earned are weighted catagorically, then summed for a total score	- 5 Core Categories - 46 sub-categories	- 2 Sections, with 3 Core Categories each - 82 sub-categories - Points earned are weighted individually, then again in small groups. Points from each Section are compared on a matrix for a letter grade

PCRS Estidama	Green Star Australia	BREEAM-NL	Indian Green Building Council	Green Building Index
The Pearl Community Rating System for Estidama	Green Star Communities	BREEAM-NL Area Development	Indian Green Building Council - Townships	Green Building Index for Township
National	National	National	National	National
				Logo
Abu Dhabi	Australia	Netherlands	India	Malaysia
Abu Dhabi Building Council	Green Building Council of Australia	Dutch Green Building Concil	Indian Green Building Council	Greenbuildingindex SDN BHD
State	State	independent, membership based	State	State
-	-	August 2012	January 2011	September 2011
2010	June 2012		November 2010	Pilot Phase
http://www.estidama.org/pearl-rating-system-v10/pearl-community-rating-system.aspx?lang=en-US	http://www.gbca.org.au/green-star/green-star-communities/	http://www.breeam.nl/gebied/breeam_gebied	http://www.igbc.in/site/igbc/testigbc.jsp?desc=267002&event=267001	www.greenbuildingindex.org
...	Termeh Hezareh tel: +612 8239 6227 email: Termeh.Hezareh@gbca.org.au	Martin Springer tel: +31 (0)10 30 32 777 email: helpdesk@dgbc.nl	Rohith Ravula Executive - Green Buildings Tel: +91 90001 23299	tel: +603 2283 2566 email: info@greenbuildingindex.org
...	...	...	...	...
- Pearl Rating System Preparation Step 1: Register Development Step 2: Appoint Qualified Professional Step 3: Conduct Workshops - Pearl Design Rating Step DR4 - Review & Update Step DR5 - Issue Design Submission Step DR6 - Review by Assessor Step DR7 - Achieve Design Rating - Pearl Construction Rating Step CR4 - Review & Update Step CR5 - Issue Construction Sumission Step CR6 - Review by Assessor Step CR7 - Achieve Construction Rating	...	...	3 Stages: Stage I: 50% of total infrastructure development Stage II: 75% of infrastructure and 25 % of residential development Stage III: 100% infrastructure & residential development	4 Stages: Stage 1: Application & Registration Stage 2: Planning Assessment (PA) Stage 3: Final Planning Assessment (FPA) Stage 4: Completion & Verification Assessment
ESTIDAMA - Pearl Qualified Professional	...	BREEAM-NL Acknowledged Assessor	Indian Green Building Council - Green Townships	GBI Certifier
Credit-point system Max 162 credits (159 plus 3 inovation credits)	Credit-point system Max 110 (100 plus 10 innovation points)	Weighted credit-point system Max 110% (163 plus 10 bonus points)	Point System - 200 Points (incl. mandatory credits)	Point System - 100 Points
1 Pearl (<55 points) 2 Pearls (55-74 points) 3 Pearls (75-99 points) 4 Pearls (100-124 points) 5 Pearls (125+ points)	4 Star (45-59 points) 5 Star (60-74 points) 6 Star (75+ points)	1 Star (30% - 44% points) 2 Stars (45% - 54% points) 3 Stars (55%-69% points) 4 Stars (70% - 84% points) 5 Stars (≥ 85% points)	Certified (100-119 points) Silver (120-139 points) Gold (140-159 points) Platinum (160-200 points)	Certified (50-65 points) Silver (66-75 points) Gold (76-85 points) Platinum (>85 points)
- 7 Core Categories - 20 required credit catagories - 44 credit categories - Points earned are summed for a total score	- 6 Core Categories - 20 required credit catagories - 44 credit categories - Points earned are summed for a total score		- 5 Core Categories - 10 mandatory credit catagories - 29 sub-categories - Points earned are summed for a total score	- 6 Core Categories - 45 sub-categories - Points earned are summed for a total score

A	LEED-ND	BREEAM communities	DGNB Stadtquartiere	CASBEE-UD
PROPERTIES OF CERTIFICATE				
Context within the planning system	Voluntary Although LEED certifcation system provides guidelines to planning authoritys on new sustainable/green buildings and communities	Voluntary	Voluntary	Voluntary
PROPERTIES OF PROJECT				
Size of site / project	≥ 2 residential buildings ≤ 320 acres, if > 320 acres site is divided into subunits	Moderate or large mixed-use developement	Min. 1 hectar gross building land with building ensemble and public spaces	No requirements
Application area	New developments, redevelopment of brownfield sites, existing neighborhoods	New developments and for renewal or redevelopment of existing communities	New developments	Can be applied to new development areas, and to existing neighbourhoods
Uses	Mixed used, basic requirement: connection to an existing quarter	Mixed use	Mixed use, 15-85% residential public spaces	Mixed use
ADAPTABILITY				
Regional Adaptability	Regional adaptability is given, In terms of water related issues, different climatic conditions, the measures applied might be completely different depending on the local climate.	Is partly taken into account, local climate is more or less neglected	...	CASBEE has a high adaptability for the region of Japan, due to the climate factors being excluded and being very general and qualitative in the scoring of the system.
International Adaptability	The LEED-ND certificate is applicable with restrictions on an international level. In some points like in the case of stormwater management local precipitation data is required. The way the data is recorded might differ to other national standards that might be very complicated to be translated to the American system. Furthermore, the measuring system might be different as well (gallons to liters etc.). The conversion from one measuring system to the other would mean additional time and effort for the planners but not a severe handicap in the application of the rating system.	Internationally applicable with some restrictions, European and British norms as basis. Upon examination of the BRE Global Website and the BREEAM manual, it appears that the BREEAM certification system has been adapted for other country part of the UK and Ireland. The BREEAM system seems to rely on various Environmental Agencies within the UK as a benchmark for a standard or criteria. Therefore unless similar agencies and regulations are in existence internationally, BREEAM would have to be adapted for each individual country and/or State. Although measurements are in the Metric systems, allowing for the quantitative values to be used in Mainland Europe.	The DGNB Stadtquartiere is still in its pilot phase and not yet implemented. It will allow adaptations for international application, as it integrates all requirements from European legislation and engineering standards.	,,The Internation Organization for Standardization (ISO) is also working on the development of the international standard on the method of assessing environmental performance of building "TC59/SC17"" CASBEE if it complies with the international standard, may be used internationally in the future. No current international projects are underway.
contact: regional adaption	Chris Marshall, LEED® AP ND LEED® Technical Development cmarshall@usgbc.org Direct 202.609.7158		Michael Dax DGNB Internationalisierung M.Dax@dgnb.de Direct:	

Estidama	Green Star Australia	BREEAM-NL	Indian Green Building Council	Green Building Index
Required - „Estidama ...is a mandatory system that must be applied for any new project in the Emirate of Abu Dhabi.“ Emirates Green Building Council office@emiratesgbc.org	Voluntary	...	Voluntary	Voluntary
≥ 1000 residential population, if > 20,000-30,000 people the project must be divided into	≥ 4 buildings, of class 1-19 structures (except class 4), as classified under the Building Code of Australia.	...	A unspecific size of a mixture of commercial, industrail, and residential. At least 25% must be zoned commercial.	...
Estidama is focused on the rapidly changing built environment.	Clear site boundary and development plan managed by government, private, or community-owned development entity. Meaningful result.	Applicant is free to define the physical boundaries of the area.	The rating system is designed to address large developments and it is mandatory to include residential development as part of the township.	For Project Teams, Building owners, Contractors, Government, Design & Build Contractors and other Developers
In the design and construction of low impact developments on the community scale. After 2 years of building being operational and has a occupancy of 80% , a Pearl Operational Rating can be given	Mixed use	All area developments: greenfields, brownfields, combinations of greenfields and brownfields,and projects that are less plan-oriented and integrated in design, such as temporary transformations or adaptive reuse.	The rating system is designed to address large developments and it is mandatory to include residential development as part of the township.	Used for site, community and environmental planning for townships.
This program was designed to be used specificly in the emeriate of Abu Dhabi. Through correspondance with the Emirates BC that ESTIDAMA is a base requirement for any new community developments.	...	...	Green Townships were designed specifically for Indian towns. The credits available have the very little weight on the water aspect of the design.	The Green Building Index is developed specifically for the Malaysian tropical weather, environmental and developmental context, cultural and social needs.
The international adaptability of this program is undetermined. This program was designed for the climate in the UAE, which heavily relies on the reduction and conservation of water. I believe adjustments could be made to allow for a more international certification system to be made, but as the certifcation system is designed right now, it is more focused on communities situated in a desert climate. The certification references many ISO standards for the criteria credit rating.	...	...	Through my reading, I have not noticed any attempt to adapt this rating system internationally. I believe due to the specifically design and the adaptation of the rating system into the existing Indian infrastructure.	The Green Building Index is developed specifically for the Malaysian tropical weather, environmental and developmental context, cultural and social needs.

	LEED-ND	BREEAM communities	DGNB Stadtquartiere	CASBEE-UD
WATER ASPECTS				
Water related touchstones - qualitative	- Smart location (req) - Wetland and water body conservation (req.) - Floodplain avoidance (req.) - Steep slope protection (1point) - Site design for habitat or wetland and water body conservation (1 point) - Restoration of habitat or wetlands and water bodies (1 point) - Long-term conservation management of habitat or wetlands and water bodies (1 point) - Certified green buildings (req.) - Indoor water use reduction (req.) - Construction activity pollution prevention (req.) - Certified green buildings (5 points) - Indoor water use reduction (1 point) - Outdoor water use reduction (2 points) - Minimized site disturbance (1 point) - Rainwater management (4 points) - Wastewater management (2 points) -Access to civic and public space (1 point) - Compact development (req) - Compact development (6 points) - Reduced parkinglot footprint (1 point) - Tree-lined and shaded streetscapes (2 points) -Local food production (1 point) -Agricultural land conservation (req)	- Flood risk assessment (req.) - Water strategy (req.) - Land use (req.) - Utilities - Adapting to climate change - Flood risk management - Water pollution - Landscape - Sustainable buildings - Rainwater harvesting	- Life Cycle Assessment - Water and Soil Protection - Biodiversity and Interlinked Habitats - Considering Possible Impacts on the Environment - Land Use - Local Food Production - Water Circulation Systems - Efficient Land Use - Concept Development Process - Construction Site and Construction Process - Quality Assurance and Monitoring - Public Space Amenity Value - Open Space Offer - Information and Telecommunication Infrastructure - Rainwater Management	- Conservation and creation of habitat - Consideration and conservation of microclimates in pedestrian space in summer - Consideration and conservation of water environment - Environmentally responsible construction management - Mitigation of impact on geologic features outside the designated area - Monitoring and management system - Performance of supply and treatment systems - Reduction of mains water supply (load) - Reduction of rainwater discharge load - Reduction of the treatment load from sewage and graywater •Reduction of the thermal impact on the environment outside the designated area in Summer
Water related touchstones - quantitative	- 8 of 12 prerequisites are water-related - 22 of 41 credit categories are water-related - 30 of 100 available points are water-related	- 3 of 12 mandatory credits are water-related - 10 of 40 credit categories are water-related	...	- 17 of 82 credit categories are water-related - 52 of 283 available points (before individual weighting) are water-related
ASSESSMENT				
Core Category Breakdown	Smart Location and Linkage - 28 points Neighbourhood Pattern and Design - 41 points Green Infrastructure and Buildings - 31 points Innovation & Design Process/ Regional Priority Credit - 10 points	Governance - 9.3% Local economy - 14.8% Social wellbeing - 17.1% Environmental conditions - 10.8% Resource and energy - 21.6% Land use and ecology - 12.6% Transportation and movement - 13.8%	Ecological quality - 22,5% Economical quality - 22,5% Sociocultural and functional quality - 22,5% Technical quality - 22,5% Process quality - 10%	Natural Environment Service functions for the designated area Contribution to the local community Environmental impact on microcliates, facade and landscape Social infrastructure Management of the local environment
Overall emphasis or Main Points	...	...	...	...
User-friendliness	The manual and the procedure to the certification is clear and traceable. The application of the required aspects seems to be manageable for the involved planners.	Overall, BREEAM seems to be very user-friendly. The criteria are outlined in a manner in which each credit that is possible is clearly defined. The structure of the manual seems to be easy to browse and categorized in various criteria. The customer service staff is very difficult to get any information from.	...	The manual gives very little or no quantitative analysis, it is describes as opinion or points are awarded if a system is present. I personally found CASBEE very complicated to understand. They did very little to simpify it for wide spread use among various firms.
Sample projects	Refer to LEED-ND Case Study 2011 pdf	MediaCity UK, Manchester, UK Masthusen, Malmö, Sweden Sheffield Housing Company, Sheffield, UK	13 model projects in Germany and European countries	IBEC-C0001-UD

Estidama	Green Star Australia	BREEAM-NL	Indian Green Building Council	Green Building Index
- Sustainable Building Guidelines (req.) - Community-Dedicated Infra-structure Basic Commissioning (req.) - Construction Environmental Management - Natural Systems Assessment (req.) - Natural Systems Protection (req.) - Natural Systems Design and Management Stategy (req.) - Habitat Creation and Resto-ration - Minimum Pearl Rated Buildings (req.) - Open Space Network - Pearl Rated Buildings Within Communities - Community Water Strategy (req.) - Building Water Guidelines (req,) - Water Monitoring & Leak Detec-tion (req,) - Community Water Use Reduc-tion: Landscaping - Community Water Use Reduc-tion: Heat Rejection - Community Water Use Reduc-tion: Water Features - Stormwater Management - Water Efficient Buildings - Hazardous Waste Management	- Environmental Management - Adaptation and Resiliance - Site Selection - Site and Context Analysis - Access to Fresh Food - Site Sensitivity - Ecological Enhancement - Green Buildings - Potable Water Consuumption - Stormwater	- Characteristics of the area - Water usage - Food - Land use - Soil contamination - Urban programme - Abiotic structures - Ecological values - Underground infrastructure - Sustainability performance of buildings - Flood risks - Rainwater management - Social cohesion - Perception of surroundings - Water quality	- Avoid Development of Inna-propriate Sites (req.) - Soil Erosion Control Plan (req.) - Preserve Existing Trees & Water Bodies - Retain Natural Topography - Public Landscape Areas - Local Fruits and Vegetables - Land Use Optimization (req.) - Green Buildings - Rainwater Harvesting 50% (req.) - Rainwater Harvesting, 75%, 95% - Waste Water Treatment, 100% - Waste Water Reuse, 75%, 95%	- Reduced Water Use - Reduction in Water Use by Wastewater Treatment - Biodiversity Conservation - Land Reuse - Flood Management and Avoidance - Wetland and Water Body Conservation - Agricultural Land Preserve - Hill Slope Development - Sustainable Stormwater Design and Management - Proximity To Existing Infra-structure -Services Infrastructure Provision - Green Spaces - Compact Development - Health in Design - Site Sedimentation and Pollu-tion Control - Sustainable Construction Practice - GBI Certified Building
- 9 of 20 required catagories are water-related - 10 of 42 credit categories are water-related. - 59 of 159 avaiable points are water-related	- 10 of 37 credit catagories are water-related - 19 of 100 available points are water-related	- 15 of 46 credit catagories are water-related - 52 of 163 available points are water-related	- 4 of10 mandatory credits are water-related - 8 of 29 credit categories are water-related - 56 of 200 available points are water-related	- 17 of 45 credit categories are water-related - 34 of100 available points are water-related
Integrated Development Process - 10 points Natural Systems - 14 points Livable Communities - 38 points Precious Water - 37 points Resourceful Energy - 42 points Stewarding Materials - 18 points Innovating Practices - 3 points	Governanace - 21 points Design - 11 points Liveability -23 points Economic Prosperity - 19 points Environment - 26 points Innovation - 10 points	Management - 18% Synergy - 18% Sources - 17% Spatial Development - 20% Welfare & Prosperity - 12% Area climate - 15% Innovation - 10%	Site Selection & Planning - 40 Pts Land Use Planning - 44 Pts Transportation Planning - 30 Pts Infrastructure Resource Ma-nagement - 70 Pts Innovation in Design & Techno-logy - 16 Pts	Climate, Energy & Water - 20 pts Environment & Ecology - 15 pts Community Planning & Design - 26 pts Transportation & Connectivity - 14 pts Building & Resources - 15 pts Business & Innovation - 10 pts
...	...	...	...	...
I found this manual very user-friendly; it shared many characteristics with the LEED-program. It was very well laid out and organized.	...	...	The certification system is very basic and is very easy to use	Readily available for use by any interested party. Clear and precise point categories, and intentions.
...	...	...	...	...

Indicator 7 – WW $_{prod}$ Production of different wastewater qualities compared to total wastewater volume	$WW_{prod} = \frac{WW\ Qx}{WW\ total} x\ 100\ \%$	WW Q 1 = untreated stormwater WW Q 2 = greywater WW Q 3 = yellow water WW Q 4 = blackwater WW Q 5 = agricultural wastewater WW Q 7 = industrial wastewater
Indicator 8 – WW $_{cov}$ wastewater qualities used to cover total demand	$WW_{cov} = \frac{WW\ Qx}{D} x\ 100\ \%$	
Indicator 9 – WW $_{treat}$ Share of primary, secondary and tertiary treatment against total wastewater volume and total wastewater treated	$\frac{WW\ treat}{WW\ total} x\ 100\% = \left(\frac{WW\ treat\ 1}{WW\ treat} + \frac{WW\ treat\ 2}{WW\ treat} + \frac{WW\ treat\ 3}{WW\ treat}\right) x\ 100\ \%$	WW treat 1 = primary treatment WW treat 2 = secondary treatment WW treat 3 = tertiary treatment
Planning step	Formular	
P.S. 1.2 + 1.3 Available internal primary resources, groundwater and reliable run-off only	$WA_{enviro} = P - R - Ret\ (G+E)$	P: average annual precipitation level R: run off Ret: retention, G: Groundwater recharge E: evaporation
R 1 brutto demand coverage based on availabilities of primary internal resources	$D\ cov. = WA\ i\ prime - \sum_{x=1}^{x=n} D\ Sx\ \ in\ f\ (t)$	
P.S. 2.2 total water demand per subarea + per use with waterquality share	$D\ total = \sum_{x=1}^{x=n} D\ Sx\ \ in\ f\ (t, Q)$	D cov = community demand coverage D total= community BRUTTO demand D total red = total NETTO community demand after efficiency measures D Sx= demand of Subarea X CSx = Conservation coefficient of subarea x
P.S. 2.3 total water demand per subarea + per use with waterquality share after efficiency measures	$D\ total\ red. = \sum_{x=1}^{x=n} D\ Sx\ \ x\ \ CSx\ \ in\ f\ (t, Q)$	

Indicator	Formular		
Indicator 1- WAI Water availability index	WAI = $\frac{R+G-D}{R+G+D}$	Index is normalized to the range -1 to +1 -1 = high demand, therefor no wateravailabilty +1 = no demand, therefor highest possible wateravailabilty	R= surface run off G= groundwater resources D= sum of demands of all sectors
Indicator 2- WA ratio Internal vs. external available water resources	$WA_{ratio} = \frac{WA\,i - WA\,ex}{WA\,i + WA\,ex}$	Index is normalized to the range -1 to +1 -1 = only external watersources +1 = internal watersources	WA i = internal resources / primary and secondary WA ex = external resources are inflows into the ecoblock boundary / primary and secondary
Indicator 3- WA prod Total production of recycled resources against freshwater abstraction	$W_{prod} = \frac{W\,fresh - W\,rec}{W\,fresh + W\,rec}$	Index is normalized to the range -1 to +1 -1 = no freshwater abstraction, only recycled water +1 = only freshwater is used to cover demand	W fresh = freshwater abstraction W rec. = recycled resources produced
Indicator 4 – D ratio (Gleick) Projected/actual demand per person per day against Gleick Basic Human Water indicator	$D_{ratio\,(Gleick)} = \frac{D\,projected\ /\ D\,actual}{50\frac{l}{d}/person}\ x\ 100\ \%$		D projected = planned project demand D actual = project demand in project operation
Indicator 5 – D ratio Projected against actual demand	$D_{ratio} = \frac{D\,projected}{D\,actual}\ x\ 100\ \%$		D projected = planned project demand D actual = project demand in project operation
Indicator 6 – RW share Share of rainwater use against total demand	$RW_{share} = \frac{RW}{D}\ x\ 100\ \%$		RW = rainwater as % of reliable run-off D = total demand

resources after efficiency measures	$D\ cov. = WA\ i\ prime + WA\ i\ second. + WA\ e\ prime. - D\ total\ red.$	
P.S. 3.6 Quality of Wastewater produced per subarea + per use	$' WW\ total = \sum_{x=1}^{x=n} WW\ Sx\ \ in\ f\ (t, Q)$	
P.S. 3.7 Share of primary, secondary and tertiary treatment against total wastewater volume and total wastewater treated	$\frac{WW\ treat}{WW\ total} = \left(\frac{WW\ treat\ 1}{WW\ treat} + \frac{WW\ treat\ 2}{WW\ treat} + \frac{WW\ treat\ 3}{WW\ treat}\right) x\ 100\ \%$	

R 3 brutto demand coverage based on availabilities of primary internal and external resources	$D\ cov. = WA\ i\ prime + WA\ e\ prime - \sum_{x=1}^{x=n} D\ Sx \ \ in\ f\ (t, Q)$	WA I prime = internal and primary water resources WA e prime = exernal and primary water resources WW total = total wastewater volume WW Sx = wastewater volume of Subarea X WW Qx = wastewater quality X WW treat 1 = primary treatment WW treat 2 = secondary treatment WW treat 3 = tertiary treatment Ideal scenario versus actual availabilities
demand coverage based on availabilities of primary internal and external resources after efficiency measures	$D\ cov. = WA\ i\ prime + WA\ e\ prime. - D\ total\ red.$	
P.S. 2.4 total wastewaterquality output per subarea	$WW\ total = \sum_{x=1}^{x=n} WW\ Sx \ \ in\ f\ (t, Q)$	
	$WW\ S1 = \sum_{x=1}^{x=n} WW\ Qx \ \ in\ f\ (t)$	
P.S. 3.1 Smart source mix ideal scenario: total water demand per subarea + per use with waterquality share	$D\ total = \sum_{x=1}^{x=n} D\ Sx \ \ in\ f\ (t, Q)$	
P.S. 3.3 – P.S 3.5	$WW\ total = \sum_{x=1}^{x=n} WW\ Sx \ \ in\ f\ (t, Q)$	
R 4 demand coverage based on availabilities of primary and secondary internal and external	$D\ total = \sum_{x=1}^{x=n} D\ Sx \ \ in\ f\ (t, Q)$	

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What is kindly requested from you?

Basically, to facilitate and support my research as much as you are willing to. Anything which may answer the thesis questions and hypothesis in both qualitative and quantitative ways is highly appreciated; therefore there is a need for:

1. General information from the communication department
2. Studies conducted within your organization relevant to the thesis
3. Interviews with staff members
4. continued communication in case of questions or clarifications
5. Interview type: qualitative
6. Time: the lengths of the interviews are from 45 to 60 minutes (according to your availability).
7. Language: all interviews are to be conducted in the English language.
8. Data recording: all interviews are to be tape recorded as well as notes taken. Upon your permission, a picture of your face will be taken to be associated with your biography.
9. Interview structure: the interview topics/questions are to be shared with the interviewee by myself prior the time of the interview (for preparation and adjustment if needed). Unconfined questions may occur to clarify the participants' answers.

Interviews will be divided as following:

- Introduction to the general aims of the study and the information given in the invitation letter will be repeated
- Consent form to be signed
- General individual queries (name, position, background, etc.)
- Questions about the organization, scope of work, plans and vision
- Organization questions (collaboration and integration with others)
- Opportunities and challenges with consumers/developers, government agencies and consultancies
- Some technical questions about sustainable materials, energy and water
- Personal opinions
- At the end of the interview participants will be asked if they have something else they would like to say or share. This is to assure that aspects they thought important are not left out

Consent form

You are being requested to participate in a qualitative interview conducted by Anke Jurleit who is a phd candidate at HafenCity University, Hamburg. The interview is for her doctoral thesis entitled: "Think global, certify local - a regional implementation strategy for community CS in India - examplary shown by the waterinfrastructural components in the community".

Purpose: The objective of the thesis is to develop an understanding of the impact, challenges and opportunities of the certification system requirements.

Selection: You have been chosen for the nature of your work, your work experience as well as the nature of your project locations.

Participation: Your participation in this study is voluntary. This means that your decision will be respected, whether or not you want to be in the study. If you decide to join the study now, you can still change your mind during the study.

Risks: No risks or discomforts have been identified for this interview. If you feel stressed during the study you may stop at any time, and you may skip any questions that you feel uncomfortable answering.

Procedure: The procedure is having the interview questions sent to you via email for reviewing first. Then, you could identify any questions you wish to eliminate, or you could decide to do so during the interview. Additions to the interview that you see helpful are welcomed.

Payment and Benefits: there is no monetary payment associated to this interview. Although this study is not designed to help you personally, the information you contribute will help answering the hypothesis and connect your experience with the objective of the study.

Time and Location: interviews are to be conducted within your facilities for your convenience at a mutually suitable time.

Confidentiality: Your contribution in the form of an audio recorded interview will be written in the annex of the thesis, with an acknowledgement of the speakers (identified by name, biography and a picture of your face which will be next to the biography). While this is the case, this interview is intended for the sole purpose of the thesis specified above, and will not be published by any external media or used for revenue. All audio files will be deleted after the thesis writing is completed or within 6 months (whichever comes first).

I give permission to be interviewed by the researcher	☐ Yes	☐ No
I give permission to have my picture taken	☐ Yes	☐ No
I agree to have the interview audio recorded	☐ Yes	☐ No

Your signature below indicates that you have decided to participate voluntarily to this study and that you have read and understood the information provided above. You will be given a copy of this form to keep.

Participant's Name and Signature : ______________________________

Interviewer's Name and Signature: ______________________________

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Interview questions:
Best practice waterinfrastructure planning

1. Personal Data:

- Name:
- Position:
- Country of origin:
- Scope of work:
- Tell me briefly about yourself:

2. General Questions:

- What do you consider India's Best Practice in community waterinfrastructure planning?
- If you needed to summarize, what are the three main concepts in sustainable community waterinfrastructure planning?
- Which documents or guidelines do you refer to? (state water policy, national documents etc.)
- What are the main sources for Best practice standard?
- What in your opinion are the most pressing issues when talking about sustainable waterinfrastructure?
- What in your opinion are the main reforms which need to be undertaken?

3. Global principles / regional Best practice:

- In your opinion, the global principles introduced to you, would you agree with them
- Which of the principles do you find most pressing?
- What are the regional differences in Andra Padresh, which don't apply globally
- Can you tell me about a Best Practice project in the Hyderabad area?

4. Certificationsystems:

- In your opinion, can CS help to creat Best Practice? Why?
- Which indicators would you find important to use?
- Would you say the input/output approach would be something which could be used for any community in order to assess the performance of a community waterinfrastructure system?
- What would in your opinion need to happen to successfully implement CS?

Interview questions:
Certification system development, adaption and benchmarking

1. Personal Data:

- Name:
- Position:
- Country of origin:
- Scope of work:
- Tell me briefly about yourself:

2. General Questions:

- What do you consider India's Best Practice in community waterinfrastructure planning?
- If you needed to summarize, what are the three main concepts in sustainable community waterinfrastructure planning?
- How is this represented in the Green townships CS?
- In your opinion, do there have to be adaptions being made depending on the region in India?

3. Certificationsystem development:

- Most CS focus on environmental efficiency. Would you agree with this?
- Which sources for waterinfrastructure planning did you use when developing the CS?

4. Certificationsystem adaption:

- Most CS focus on environmental efficiency. Would you agree with this?
- Which sources for waterinfrastructure planning did you use when developing the CS?
- What is your experience with adapting a different system to the Indian Conditions?
- How was it done?
- How do you imagine a benchmark revision process?
- What is it based on?
- Would you say that there could be a global benchmarking tool like the input/output approach in order to make CS comparable

APPENDIX D
LIST OF CONTACTS + INTERVIEWEES

Indian Contacts

institution Adapt Technologies
address Adapt Technologies & Consultancy Services India Pvt. Ltd.
133/A, First Floor
Gunrock Enclave, Phase I
Secunderabad 500009
Andhra Pradesh, India

name Maheep Singh Thapar
designation Managing Director & Principal Consultant

institution Aliens Group / Alien Space station
address Vittal Rao Nagar
Hitech City, Hyderabad, AP 500032, India
name Mr. Naveen Mypalla
designation Director, founding partner

institution ASCI Hyderabad
address ASCI – Bella Vista campus
Raj Bhavan Road
Hyderabad – 500082, (AP)

name Sirinivasa Chary Vedala
designation Dean, research and management studies + Director, centre for energy, environment, urban governance and infrastructure development

name Vaibhav Purandare Subaamanyan
designation Project supervisor, Centre for Urban Governance

institution Biome Environmental Solutions Pvt. Ltd, environmental planning and water sustainability solutions
address 1022, 6th Block, 1st Floor, HMT Layout
Vidyaranyapura Main Road
Vidyaranyapura, Bangalore 560 097 INDIA

name Chitra Vishwanath
designation Principal Architect and Managing Director

institution CEPT University (PAS Project)
address Kasturbhai Lalbhai Campus,
University Road, Navarangpura,
Ahmedabad-380009,
Gujarat, INDIA.

name Prof. Dinesh Mehta and Meera Mehta
designation Dept. of architecture

institution Confederation of Indian Industry (CII): Triveni Water Institute
address CII Sohrabji Godrej Green Business Centre
Survey No. 64, Kothaguda Post, Near HITEC City, Ranga Reddy Dist., Hyderabad - 500 084, India

name KS Ventkatagiri
designation Principal Counselor of Water Institute

name C Sripati
designation Senior Counselor of Water Institute

name Ajay Ranjith V
designation Senior Counselor / Civil eng.

institution CSE - India's leading environmental NGO
address CSE - Centre for Science and Environment
41, Tughlakabad Institutional Area
New Delhi-110062, India

name Suresh Kumar Rohilla
designation Programme Director – Urban Water Management

institution ECI Engineering & Construction Co. Ltd.
address Plot No. A-12-13,
Panchavati Township,
Manikonda, Hyderabad - 500 089,
Andhra Pradesh, India

name Nama Ramesh
designation Executive Director

Indian contacts

institution Forum For A Better Hyderabad
address „CHANDRAM“ 490, Street No. 11
Himayatnagar, Hyderabad-500 029
Andhra Pradesh. India

name Dr. Vasant Kumar Bawa
designation Founder of the Forum, First Chairman of HUDA and instrumental in institutionalizing urban planning

name Omim Maneckshaw Debara
designation General secretary, Urban management

institution Hyderabad Metropolitan Development Authority
address Block 'A', District Commercial Complex,
Tarnaka, Secunderabad - 500017.
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Towndevelopment in Hyderabad India
2013 Anke Jurleit

Anke Jurleit has 10 years of experience in sustainable community planning and water sensitive urban design. Her passion lies in the mix of practice, teaching and researching the challenges of our cities and communities. Her international background and multidisciplinary approach to problem-solving allowed her to travel the world and see from a global perspective. Anke's work spans climate mitigation and adaptation plans for cities, to sustainability guidelines for communities to working on certification systems. She says her calling is to 'save this world as much as it is in my capacity'.