Urbanization and Climate Co-Benefits

Implementation of win–win interventions in cities

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10 Decision-support tools for climate co-benefits governance

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Introduction

Addressing local environmental challenges typically requires the steering of a range of actors who manage the necessary resources in a coordinated fashion for improved environmental outcomes. The concept of sustainability calls for problem definitions that recognise the complex interdependencies in socio-ecological systems and adequate interventions embracing this complexity via coordinated action. The transition from simple disjoint solutions to integrated long-term ones is not solely a technical matter as much as an organisational, institutional and political challenge that includes the careful consideration of opportunities, burdens and the trade-offs between them. There is an increasing attention to the role of various decision-support tools to assist steering the transition towards sustainability by providing insights into the nature of these complex policy challenges. Since the late 1990s, a number of theoretical studies have been carried out to actively steer governance processes at different levels of administration, including the international, national and sub-national/local levels. In particular, the local level of governance is recognised as a potentially influential intervention point to generate tangible changes necessary for achieving not just local but higher level environmental goals. The underlying assumption is that in many countries, local governments tend to have direct control over many of the resources and systems that have environmental implications. These include land use, building decisions, local transport planning, energy management and solid waste management (Bulkeley and Betsill 2003). Accordingly, building capacity and understanding in local government may be a critical success factor in transforming towards sustainability.

Relatively little is known about the potential of tools specifically designed to support the integration of environmental aspects into decision-making and development processes at the local level of governance. Recently, attempts have been made to explore quantitative tools aiming to assess certain environmental attributes. There is a broad range of quantitative sustainability tools available to address local environmental features (Bhagavatula *et al.* 2013; GIZ-ICLEI 2014). As presented in the previous chapter, the tools for transport, energy and waste sectors[1] are also obvious examples of tools focusing on

quantification of co-benefits. At present, however, there is an absence of published tools that help with the often overlooked, more qualitative or hard-to-capture aspects of adopting potential interventions in practice. Certain solutions may be desirable from a stylised outcome point of view, but very challenging to implement due to local financial, organisational and political limitations. The limited number of tools to capture the non-technical aspects of local development probably reflects the relative interest that the co-benefits and local governance literature has spent on synthesising our understanding of institutional capacity requirements of various local co-benefit policies. Building on such a synthesis, qualitative analytical tools would ideally help identify how different local institutions can and should develop the transitional path to manage the organisational and institutional changes required to deliver the local environmental co-benefits.

A comprehensive institutional analysis would have a particular value in diagnosing capacity gaps and navigating the local governance to properly implement co-benefits policies and achieve desired outcomes. Against this backdrop, this chapter proposes an approach to assess the capacity and readiness of institutions to adopt co-benefits-oriented measures into their policy processes. This chapter takes the viewpoint that to achieve environmental co-benefits, it is worth recognising the levels of human factors and potential that would accumulatively support vital organisational change for better local environmental governance. A grading instrument, using a fundamental mathematical concept, the Analytic Hierarchy Process (AHP), is demonstrated to guide data collection and populate the tool. Thereafter, the importance and role of systematic tools to support co-benefits governance are discussed.

Addressing co-benefits at city level

The co-benefits approach here refers to the development and implementation of policies and strategies that simultaneously contribute to tackling climate change and solving local environmental and developmental problems. With respect to climate change, co-benefits can emerge in two major forms. On the one hand, there are local environmental and development co-benefits of climate change-related actions, like pollution control, improved health conditions, poverty reduction, etc. On the other hand, there are global climate change co-benefits like reduction in greenhouse gas (GHG) emissions and an increase in adaptation capacities.

The co-benefits approach thus explicitly connects the global and local scopes. As the academic and political discourse on the unsustainable nature of current economies and their global environmental impacts has unfolded during the past decades, micro-level perspectives have been strengthened, relative to national and international perspectives. The role of cities, in particular, has been highly emphasised in both creating many of the pressures leading to climate change as well as offering opportunities for laying down the foundations of an economy that may reduce climate change impacts.

One reason why cities are especially suitable entry points in tackling environmental issues is because the scope of cities as administrative units neatly coincides with the spatially concentrated human activities we know as cities. Despite variations from country to country, cities can typically enjoy a reasonable level of control over critical urban systems such as transport, energy, buildings and waste (Bulkeley and Betsill 2003). They have the ability and the experience to directly influence these systems, which makes them powerful actors to shape how patterns of human activity in cities emerge. For this reason, city-level investments, regulations and policy decisions regarding transport, energy, waste and other systems are often considered to have high potential in reshaping local development paths, also yielding benefits beyond individual cities (IPCC 2014).

Although cities may be recognised for their potential contribution to creating more sustainable societies, in practice, such goals may not necessarily be a top priority or even a relevant aspect in some local-level decision-making processes. In running critical urban systems, decision-makers typically face a range of simultaneous objectives often derived from private benefits, such as economic efficiency, affordability or accessibility. When considering venues for improvement, options are often evaluated and compared on the basis of their respective costs and benefits. Such comparison, however, is highly dependent on the scope of analysis (what costs and benefits are included) and valuation approach (how costs and benefits are measured in monetary or other hard terms that facilitate comparison). These two aspects are in close interplay.

By disregarding co-benefits, cities may miss many intervention options that could offer win–win solutions to the community as a whole. Moreover, as suggested by OECD (2010, p. 82), city-level policies are also the least-cost CO_2 mitigation strategies to pursue macro (national) level reduction targets, arguing that trade-offs between economic growth and environmental priorities are lower at the urban level due to complementarities of policies only observable at the local scale. Co-benefits, however, are challenging to integrate into decision-making processes because they are often societal and/or non-monetary benefits that are more difficult to measure compared to other benefits and cost. They may look too elusive and difficult to defend in political debates. Despite these challenges, there is some evidence that suggests that cities are becoming more willing to take the political risk and venture into new policies (and spending) with potential co-benefits even in the absence of exact valuations. Kousky and Schneider (2003) found that, in addition to rational economic choice (e.g. evident cost savings), perceived co-benefits were named as an important factor of implementing urban climate policies. This suggests that often the idea of co-benefits itself can sensitise local decision-making to environmental and climate change concerns. Of course, systematic indicators and tools to capture and plan for these societal and often non-monetary co-benefits will earn even more credibility and make it easier for such aspects to be seriously considered in decision-making.

Tools to support co-benefits governance

A number of efforts have been made to develop quantitative and qualitative indicators and tools to assist the evaluation of plans, projects, programmes or policies in terms of their environmental, societal and economic impacts. In recent decades, sustainability indicators have been widely applied to monitor sustainable development in a given area, assess progress against a set of goals and objectives set in terms of desired environmental outcomes as well as socio-political aspects, such as desired political and behaviour changes, public participation and communication (Moreno Pires *et al*. 2014).

Sustainability indicators (SIs) sometimes face the criticism of trying to capture natural and social complexities by applying a static quantitative measurement approach, while incapable of triggering change in strategic processes or building governance capacity that would enable the development and implementation of effective policies (Holden 2013). In the SI community, there is a growing number of examples of SIs being applied at the city (urban) level. These initiatives range from international rating of cities, the compilation of best practices, to city self-evaluations through indicators (Moreno Pires *et al*. 2014). There is, however, still a niche for indicators to benchmark specifically the capacity of a city to develop and implement effective policies, and to identify the potential to generate such capacity at the local government level to achieve co-benefits.

Recognising this gap, the urban administration literature has been investigating institutional enablers and barriers to climate action, and the importance of climate change governance on the municipal decision-making process (Leck and Roberts 2015). Governance in the context of climate change should be a system of dynamic and interactive institutional processes resting on the awareness that 'the complexity of cities as dynamic, open systems often means there are linkages and interactions between different components of the urban system' (Bai *et al*. 2010). It is important to better understand governance potentials that can steer the co-evolutionary process of urban environmental problems and urban policy.

Holden (2013) argued that the existing SIs are 'currently hitting the limits in terms of promoting the social and political change, necessary for a sustainable shift'. The use of indicators has been generally restricted to linear methodology to monitor and evaluate progress towards the specific goals and targets. The instrumental indicators are seen to be of little value to incubate policy changes, as they overlook the governance dynamics that actually enable any progress ever to be measured. A next generation of tools that would manage to more successfully address the interplay between the *softer* aspects of the policy context and the *harder* aspects of urban systems could potentially lead to more effective local governance for co-benefits.

Many of the decisions related to climate co-benefits may require the restructuring of city-wide systems, which often have substantial technological and infrastructural components. Such decisions are strategic in the sense that both

their implementation and their anticipated benefits (and *co*-benefits) will typically occur in the longer run. They also often need larger scale investment in terms of resources (human capital, capital goods, etc.), which requires long-term commitment in the form of path dependency. Also, such decisions are often rendered more complex by the underlying relationship between policy alternatives, such as mutual exclusivity, complementarity and preconditions.

A degree of uncertainty in expert or scientific knowledge can be coupled with competing interests (political uncertainty), which makes these decisions related to climate or health co-benefits quite *wicked* as policy problems. Decision support tools can be helpful in structuring the process of co-benefits-oriented policy formulation by highlighting potential advantages, disadvantages, burdens and opportunities. Formal decision-making models and tools have long been used in production and service providing industries providing managers (decision-makers) attitudinal, management and technical support in solving business-related problems (Gonzalez *et al.* 2015). Similarly, urban decision-makers need models, solution approaches and tools to make decisions on a strategic level, not just on a tactical and operational level, and also to ensure that economic, environmental, societal and ethical aspects are balanced early on in the policy process.

Indicators may play a conducive role when applied in the assessment and building of institutional capacity. They would support:

> learning, understanding and structuring the definition of policy problems and interpretation of trends and solutions in fostering change readiness through learning to think about policy problems and sustainable trends from different perspectives suggested by interpretations and relations offered within the indicator system.
>
> (Holden 2013)

These indicators may play the valuable role of creating a dynamic platform to benchmark the capacity of different actors within an administrative system, and to steer collective efforts that produce conditions for change by matching goals with the engagement of policy makers, administrative structures, enforcement activities and human and financial resources.

Developing a qualitative tool for local energy governance

To illustrate how governance aspects could be included in the design and development of decision-support tools for city-level decision-making, we will now use local energy governance as an example. First, we briefly provide some context to local energy issues and then we discuss the conceptual underpinnings of a specific set of evaluation tools created for local energy climate co-benefits with a special emphasis on the qualitative or *governance* aspects of co-benefits-oriented interventions.

Background to local energy governance

Historically, energy networks have been largely owned and operated by utility companies (typically electricity and gas) in most of the industrial and industrialising countries. The utilities may be state-owned or private, and different in their scales depending on the national context. Most of them, however, have been highly influential over energy decisions. In contrast, local authorities have been fairly weak to let their preferences be reflected in the utilities' choices.

The global imperative for the low-carbon transition and the recognition of the significance of renewables in the local energy supply portfolio have made the global energy context become quite different from what it used to be. Moreover, the surge of the energy decentralisation and liberalisation movement created awareness of the importance of local energy governance. Over time, the recognition has grown that monopolistic or laissez-faire energy systems are unsustainable and require fundamental restructuring. This triggered substantial interest in academic research to analyse the performance of socio-technical systems organised around energy and to explore the role of energy governance that would enable the low-carbon transition (Bolton and Foxon 2015).

The traditional view that utility companies have to be the sole institutions that plan and operate all the energy production, transmission and distribution infrastructure is becoming more and more challenged. An increasing number of initiatives have been taking place to establish municipal utilities, as opposed to national and private ones, and to create the conditions for the low-carbon energy transition in some developed countries (Blanchet 2015). Even where such tangible local energy ownership is yet to be established, especially in developing countries, local energy governance is already becoming instrumental in integrating sustainability considerations into local energy policy in contrast to the exclusively economic criteria often pursued by utility companies. Municipal energy policy has long been to ensure adequate service (electricity, heating) that meets energy demand at a reasonable service cost to its residents. Conventional energy policy typically tries to juggle such objectives based on operational efficiency (being economical by minimising costs, maximising service quality), affordability (e.g. service fees) and access (availability).

Energy use in cities, however, can be a substantial direct and indirect driver of GHG emissions and local air pollution. For this reason, contemporary thinking suggests that municipal energy planners also need to consider the demand side effects and should seek improvements in the urban energy system by adding potential climate and air pollution co-benefits to their palette of decision criteria. Such climate and pollution related objectives are often perceived to go against achieving regular energy objectives. In fact, climate co-benefits are not difficult to align with other benefits of energy system improvements if challenges in providing energy for the city are approached from a systemic point of view, where the overarching goal is to make the system viable in the long-run both from a local community and from an environmental perspective. For instance, being able to introduce energy-saving practices in a city is not only good for the

environment, but may also lower the operating costs of the urban energy system, putting less burden on the taxpayers. On the other hand, being able to recover energy from the municipal waste, while creating climate co-benefits, may at the same time improve the community's energy self-reliance.

A successful urban energy transition rests on viable local energy governance that recognises institutional resources and burdens while steering strategic cooperation to overcome potential conflicts. At the same time, viable energy governance is also mindful of the nexus between energy and other sectors, especially those related to transport and waste spheres. The volume of fuel consumption and types of fuel choice inevitably affect the energy profile of a city. The energy profile of a city is also influenced by the methods of waste treatment – for example, energy recovery from waste and biomass content in waste-to-energy recovery. There is a need to demonstrate a framework that strategically manages energy transition over cross-sectional boundaries, through understanding institutional context and capacity.

From quantitative to qualitative tools for local energy governance

Climate co-benefit reductions in GHG emissions and local air pollutants are largely the result of a combination of two factors: (1) a shift in behaviour that generates energy consumption and (2) a shift in technologies used at the supply and/or demand side. Both energy-related behaviour (e.g. patterns of energy demand) and technology (e.g. what building materials, appliances, electric devices are used, what energy infrastructure is put in place, what sources of energy are used) are manifestations of choices made by individuals (citizens) and organisations (local authorities, organisations, businesses) that add up to create city-level patterns. In order to achieve societal (community) objectives, municipal energy policy should intend to shape these patterns of choices and in doing so they should rely on an array of strategies and corresponding policy measures that range from regulations, various forms of economic incentives, spending on infrastructure and technology, and the provision of information. These actions implemented by local authorities and stakeholders must rely on an understanding of what major driving factors affect energy-related behaviours and technology choices and how they may respond to various interventions. These conceptual links are depicted in Figure 10.1. The framework emphasises a practical policy logic in that it assumes, as a point of departure, that a range of policy options (measures) applicable to local-level energy policy can be identified as targeting various driving factors (leverage or intervention points) which will result in behavioural and technological changes and thus climate co-benefits.

Generally speaking, the purpose of decision-support tools in a framework like this is to offer practical models of these conceptual links. The practical models embodied in the tools translate the conceptual links into more concrete relationships so that decision-makers can evaluate how changes in one sub-system relate to potential changes in other sub-systems. Certainly, the conceptual links identified in Figure 10.1 – among them, targeted interventions, driving factors,

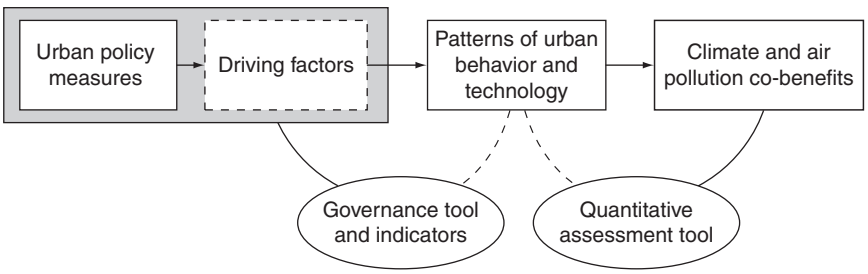

Figure 10.1 The co-benefits evaluation toolkit and the conceptual links.

behaviour, technology adoption and co-benefits – are a simplified model of the manifold complex interrelationships characterising the reality of these socio-technical systems. Decision-support tools as models of these links will always focus on a limited number of aspects of these relationships and thus will always need to be accepted as incomplete. Users will have to use their judgement in determining whether a particular tool and its underlying assumptions provide relevant answers to the scale and scope of the problem decision-makers face.

A further challenge in addition to the incompleteness of decision-support tools is that some relationships can be more readily captured in a practical model than others. The processes and dynamics of physical systems, for instance, can be translated into numerical terms using a range of equations specifying the relationships between the variables of interest. These specifications are typically based on empirical evidence established through research. Although parameters may change as the result of new discoveries and continuous refinement, the fundamental structure of the relationships are typically quite stable. Take, for instance, the calculation of the combined emissions from a changing mix of energy sources used in a city. If one has the adequate emission factors associated with each energy source and the proportion of the total energy supplied from each source, the differential emissions resulting from shifting around the proportions in the mix can be readily calculated (approximated).

In our simple framework of the local energy sector, quantitative decision-support tools, such as climate co-benefit calculators, are connecting the right-most two elements as diagnostic tools. Climate co-benefits as outcomes are measured through a set of well-defined, quantifiable indicators, such as tonnes of emissions. The quantitative tool relates these outcomes to quantifiable input variables describing energy-related behaviour and technology. Scenarios assuming different levels of these input variables can be easily built and tested to see how co-benefit outcomes respond to these variations. The value of quantitative tools is two-fold. Not only do they offer a structured and thus replicable approach to approximate climate co-benefits, they also come pre-populated with some of the necessary data (in the form of parameters and options) for the convenience of users, sparing them from substantial research.

Unfortunately, quantitative tools cannot completely eliminate the burden of user input. While many physical model parameters may be adequate across a range of user contexts, input variables tapping into energy-related behaviour and technology are most certainly place specific. The relevance and quality of results will greatly depend on the accuracy of the user input. In other words, quantitative tools are very much prone to 'garbage in, garbage out'. In addition to data quality challenges, decision-makers relying on quantitative tools also need to face another, probably even trickier challenge. Quantitative tools are usually built to simply quantify the implications of changes in input parameters, such as aspects of energy-related behaviour or technology choices. They take those changes for granted and leave it to the user/modeller to understand what processes or interventions could trigger such changes in the model input parameters. Speaking in terms of our simple framework of the local energy sector, quantitative tools rarely model policy inputs and how they relate to driving factors but they rely on assumed policy outcomes captured in the form of altered patterns of behaviour and technology choices. Decision-makers can develop an idea of climate co-benefit implications of a range of 'what-if' scenarios but little will a quantitative tool teach them about what interventions are more likely to bring about certain scenarios and what implications they would have from a policy implementation point of view.

In our framework, we conceived of the Governance Tool as a qualitative tool connecting policy to behaviours and technology. In its decision-support function it is complementary to the quantitative assessment of climate co-benefits. As such there are Governance Tools for each of the sectors covered by the quantitative tools in Chapter 9, namely transport, waste and urban energy. Each tool has essentially the same structure and mode of operation, the only difference being the policies that are contained in the tool are, of course, relevant to the sector and will have different sensitivities to the context criteria.

Its purpose is to extend the analysis backwards to the origin of the estimated climate co-benefits and to help answer what interventions could/should be taken in order to achieve the desired level of co-benefits. Policy interventions can fundamentally differ in what makes them effective and applicable in a given urban setting. There is no single universal recipe for all city contexts. What intervention may very effectively work in one city can turn out to be a failure in another. This is because cities differ in many ways. Other than differences in geography, physical layout and structure, cities operate in different cultural, political, legislative, organisational and resource conditions. Policy measures are sensitive to these conditions, so evaluating the differential requirements of various policy options in a particular situation will help decision-makers better understand enabling factors and potential pain points in implementation. In this sense, the Governance Tool conceptually connects the policy domain to energy-related behaviour and technology patterns.

The structure of the Governance Tool

The current version of the Governance Tool contains data on 19 urban energy policy measures and their sensitivity to 12 aspects of the local policy context (or criteria), but the coverage of the tool can and should be expanded in both dimensions as new knowledge becomes available. The initial set of context criteria was chosen to represent the conditions that are critical to the successful implementation of urban energy measures. At the same time, however, their relevance may vary from city to city. For instance, in one city financial resources may be considered much more of a restrictive factor compared to creating political consensus, whereas in another city political consensus may be perceived more difficult to achieve compared to securing funding. Accordingly, the Governance Tool first requires that decision-makers assess how critical these criteria are relative to each other.

Based on this user input and following the method of the AHP, the tool calculates the weight of each criterion and these weights are then used to give various emphasis to the score the policy measures have on each of the 12 criteria. AHP is a structured technique to support decision-making in situations where options are evaluated on a range of criteria rather than a single criterion (Alonso and Lamata 2006). Multiple criteria often make it very difficult to choose an alternative that performs best in every aspect that decision-makers believe to be important for satisfying their overall goal(s). AHP decomposes the decision problem into a hierarchy of sub-problems (criteria), which can relate to any aspect of the decision problem regardless of whether it is precisely measurable or tentatively estimated. (In the case of our Governance Tool, AHP is structured to have 12 sub-problems which we label as context criteria or indicators, which represent qualitative judgements as to the sensitivity of decision alternatives [policy measures] to these conditions.)

After the hierarchy is set up, decision-makers evaluate the relative importance of each criterion, which leads to numerical weights or priorities. These weights are then used to assign a compound score to each decision alternative based on its relative ability to achieve the overall decision goal. These scores make it possible to compare alternatives in a single dimension and the Governance Tool then ranks policy measures based on their overall score, which reflects how challenging they may be to implement in the particular city. In addition to ranking policy measures, critical factors (context indicators) are highlighted. The Governance Tool also identifies which key energy variables are typically affected (targeted) by each policy measure and to what degree they are likely to change as a result of intervention.

The structure of the tool is depicted in Figure 10.2. White boxes represent parts of the tool which are visible to the user, either taking input or providing output. Grey boxes stand for the parts of the tool which are 'under the hood' and represent expert knowledge connecting user input to outputs.

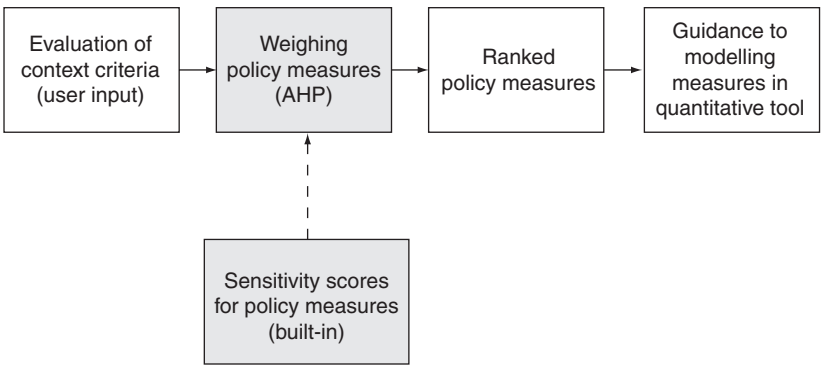

Figure 10.2 The structure of the Governance Tool.

Context criteria (context indicators)

The context criteria incorporated in the Governance Tool represent important local conditions for managing the energy system at the city level. In addition to their use as assessment criteria for planning a range of energy measures, they can also serve as context indicators during implementation providing feedback to decision-makers on changing conditions. In this latter usage, they can be developed into periodically measurable indicators. As criteria in the Governance Tool they are used in a qualitative way, only indicating whether a policy measure has low, medium or high sensitivity to a particular aspect of the local policy context. The 12 criteria were identified and chosen based on the existing literature relevant to the local governance and institution (Macário and Marques 2008; Bos and Brown 2014), and are briefly summarised below.

- **Lifestyle change.** Policy makers often focus on the most tangible aspects of taking action that are under their direct control – for instance, budget allocations, legislation and changing other formal rules of the game. It is easy to assume away the cultural and community context in which their strategies will be expected to work as intended. Some energy policy measures require that individuals (and organisations) embrace substantially different ways of organising their lives as it relates to using (and even generating) energy. If they are reluctant to change their attitudes, norms and routines, policy measures may not lead to satisfying outcomes (or at least not within the expected time frame). Understanding what factors of cultural dynamics play a role in changing the behaviour of the local community is crucial for policy measures that are especially dependent on cultural and lifestyle change. That understanding will help to identify complementary measures to make the transition happen as planned.

- **Public support and acceptance.** Decision-makers also need to consider whether a particular energy measure may create tension in the local community and hence require special attention to managing the introduction of the policy measure. Failing to make sure that the public accepts (and even supports) changes in energy system arrangements can have a substantial impact on whether intended outcomes are met or not. While the awareness-raising programmes may be typically welcomed by citizens, posing no special challenges to securing public support and acceptance, the collection of charges (or other fees and levies) may be a touchy issue in many locales.
- **Legal authority and legislation.** While our tool focuses on energy policy measures that can be typically implemented at the local level, there are certainly differences across cities as to which aspects of the energy sector (and connected domains) they have legal authority to rule and to what degree. For instance, in some cities their jurisdiction allows them to control the level of tax allowances and credits, while in some others it may be delegated to a higher level of government (state/country). Also, some energy policy measures may require extensive legislative action (e.g. formally passing new ordinances, council decisions), while others may require relatively little legal action. This context indicator shows how demanding a policy measure is in terms of legal authority and legislation.
- **Administrative structures and enforcement.** This criterion refers to the administrative and enforcement burden that a particular energy policy measure puts on local agencies (or stakeholders). For instance, introducing certain charges or subsidies may require setting up an administrative unit that keeps track of records and payment. Making sure that charges are actually paid moreover requires effective control and enforcement. On the other hand, an awareness-raising campaign about the benefits of solar PV, being an informational instrument, puts virtually no administrative or enforcement burden on authorities.
- **Openness and learning.** While policy measures may be more or less demanding in terms of necessary lifestyle change within the community, they also differ in the level of cultural change they require within the municipal administration (or more generally speaking the 'policy system'). Some policy measures may challenge generally agreed upon ideas, conventional thinking, norms and prevailing professional values (the status quo). Municipal administrations which are more open to such challenges and are willing and able to learn new ways of thinking will have a better chance at succeeding with such policy measures.
- **Expertise (management, planning and technical).** Putting policy measures into practice requires various forms (tacit and codified) and types of knowledge in several professional areas (e.g. planning, project management, engineering). This criterion focuses on one aspect very generally, that is, professional knowledge that can be acquired through formal training and education, and hence is believed to be relatively easy to transfer. Such

knowledge is embodied in people (staff), their working relationships (the organisation) and is also contained in documents (e.g. plans, technical files and specifications) and the databases holding them.

- **Human resources.** While expertise more explicitly refers to professional knowledge available in the municipality, human resources emphasises more the quantitative aspect of staffing requirements that policy measures generate within the municipal organisation. For instance, purchase decisions (e.g. buying durable, eco-friendly supplies) may require much less staff time and no additional hiring necessary at all, while running a successful awareness-raising programme may call for extra staff time and hiring adequately trained personnel may even be required.
- **Financial resources.** Every policy measure has an associated cost, although not all types of costs are easy to express in monetary terms. This aspect refers to direct financial costs related to various forms of investment (e.g. into infrastructure, equipment) related to the implementation of a policy measure. As an example, installing a new energy recovery facility typically requires significantly more financing than promoting energy-efficient light bulbs through campaigns. Of course, financial costs are some function of the scale of the project. Here, we simplify the issue by assuming away the role of scale and just give a general indication of costliness.
- **Technology and infrastructure.** This criterion refers to the extent to which a certain policy measure is sensitive to the availability of physical infrastructure and technology necessary to make the policy option work successfully in practice. Administrative measures or informational instruments typically do not require advanced technology or expensive infrastructure, while energy generation and transmission do.
- **Horizontal coordination.** This criterion reflects the relative amount of local coordination necessary among various municipal departments, local agencies, service delivery organisations and stakeholders in order to successfully implement a policy measure. For instance, several municipal departments may be involved in planning and implementing a renewable energy programme for the city, including the ones responsible for public works, urban planning and building and economic development. Coordination often needs to cross organisational boundaries and may involve an array of (more or less autonomous) actors. In many cases, facility operators may not be under the direct control of the local government, which adds to the challenge of coordinated action. Horizontal coordination, to a great degree, rests on mutual trust among institutions and effective governance mechanisms.
- **Vertical coordination.** In addition to horizontal coordination, policy measures may also require coordination across various tiers of government (regional, state and federal). This may stem, for instance, from funding arrangements, resource allocations or legislative requirements. For example, there may be very little need for vertical coordination regarding an awareness-raising programme, but a major infrastructural investment like

the setting up of a power plant usually involves actors higher up in the government hierarchy (e.g. special authorities and agencies).

- **Consensus and commitment.** The effective implementation of policy measures is also sensitive to the degree of political consensus and commitment that can be forged in support of the measure. Consensus may be difficult to reach for policy measures that involve, for instance, great financial investment, a large amount of additional resources, uncertain or distant improvements. Consensus and commitment is also relatively difficult to get when a variety of potentially conflicting stakeholder interests are involved.

Policy measures

The Governance Tool has data on an initial set of 19 policy measures related to the urban energy system which are generally applicable to a wide range of country and city settings. These measures were chosen to be representative of several intervention points we identified based on our typology (Figure 10.3). As mentioned earlier, the Governance Tool is built on the view that the conceptual framework for energy measures corresponds to the Avoid-Shift-Improve (A-S-I) framework upon which this book is based, generally applied to the transport studies (Schipper *et al.* 2000). The measures (and the intervention points) can be divided into three sets depending on whether they seek to avoid (reduce) energy demands, shift from non-renewables to renewables, or improve energy efficiency in the system (Comodi *et al.* 2012).

Measures in the first group are primarily aimed at users (demand side). In our urban energy system perspective, this means households (residents), businesses (e.g. retailers, hotels, offices) and institutions (including schools and universities,

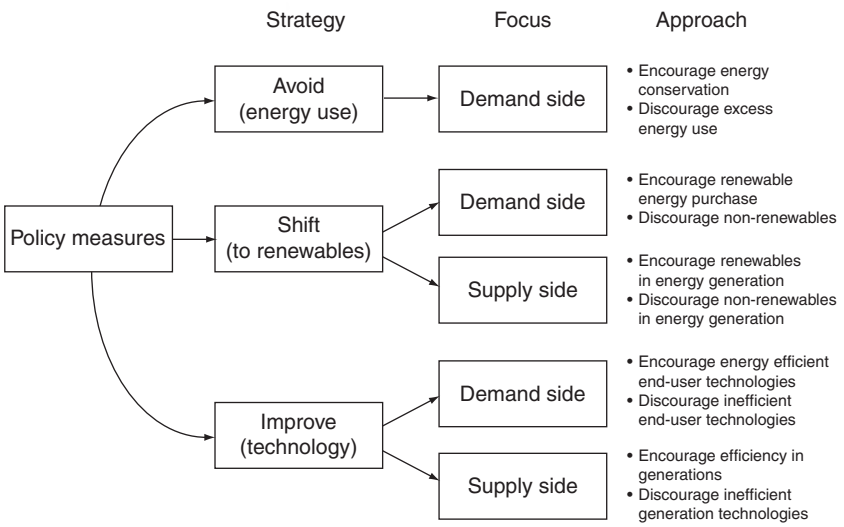

Figure 10.3 A typology of policy measures.

and organisations of the local government). The second set of measures is targeted at both supply and demand sides. This includes incentives to increase the reliance on renewable energy. The actors involved in these activities can be private entities and public entities under the control of the municipality or some level of government. The third group of measures intend to improve energy efficiency both at the user-end and generation.

The list of 19 measures currently representing the default set built into the Governance Tool is of course by no means exhaustive. While recognising this as a potential limitation, our purpose was to offer reasonable coverage by including several plausible alternative measures for each intervention point. These measures are not mutually exclusive; in fact, some of them may work best if combined. As for 'vertical' linkage, the measures included for different intervention points actually require combination (pairing) to yield reasonable policy packages and outcomes.

Evaluation of context and policy measures

Based on the above concept, we developed the methodologies and guidelines for a series of energy indicators for urban co-benefits, emphasising self-examination of capacity to bring changes in the local energy policies. The tools analysis is subject to the degree of ability and resources of a sub-national government and the nature of its required policy change in the multiple policy categories.

The evaluation of context criteria

As seen above, the Governance Tool's first component is 'Context Criteria'. This assessment allows the user to evaluate perceptions of how challenging the 12 context criteria are in the user's city. This assessment provides input to the calculation of weights that can be used in the comparison of policy alternatives. Of course, there is no universally applicable scale to measure the degree of challenge in these 12 domains; therefore, it must be stressed that this assessment exercise is strictly a matter of subjective judgement. The assessment of the context criteria can be done in one of two ways, currently implemented in two alternative versions of the Governance Tool. The first method is called ranking, while the second is pairwise comparison. While the former may be somewhat more intuitive, less cognitively demanding, the latter is reported to help users reflect and learn more about these initial conditions (Hajkowicz *et al.* 2010).

Ranking

In the rating version, the user is asked to rate on how much challenge each criterion poses to municipal energy management (Figure 10.4). As the users evaluate, the tool automatically calculates weights.

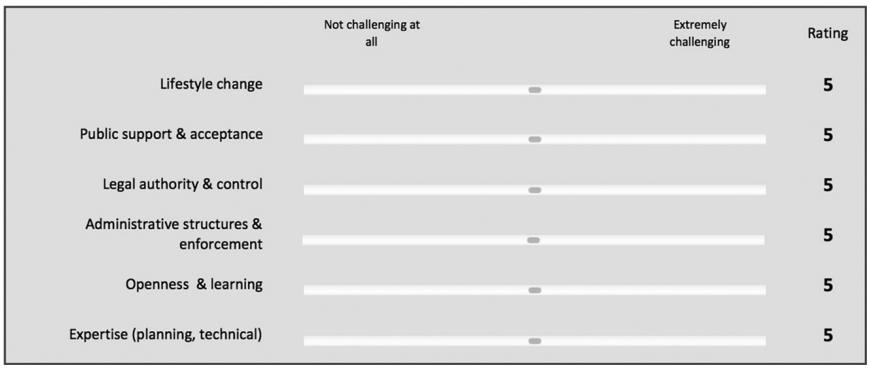

Figure 10.4 Sliders used for rating (partial screenshot of the Energy Governance Tool).

Pairwise comparison

In contrast to ranking, pairwise comparison expects users to make relative judgements as to which aspects of the local context would pose greater or lesser overall challenge to local energy policy development. Going pairwise means that each criterion has to be compared to all other criteria on a one-on-one basis. This is done in a matrix format (see Figure 10.5). Take an example where the user needs to compare 'lifestyle change' and 'public support & acceptance'. Which one is more challenging to control or improve in the city? Is one more challenging than the other? How much more? Users can evaluate these from the available judgement options.

	Lifestyle change	Public support & acceptance	Legal authority & control	Administrative structures & enforcement	Openness & learning
Public support & acceptance	↑				
Legal authority & control	↑↑	↑			
Administrative structures & enforcement	↑↑↑	↑↑	≈		
Openness & learning	←←	↑	←	↑	

Figure 10.5 The pairwise comparison matrix (partial screenshot of the Energy Governance Tool).

Having four levels to express differences in challenge makes it possible to capture subtleties and obtain more accurate relative prioritisation among the 12 criteria. At the same time, it puts much greater burden on the users when going through the pairwise judgements compared to simply specifying which criterion is more challenging than the other. Processing 61 pairwise comparisons is not only demanding (of both time and concentration) but may also lead to inconsistencies in judgement after a point. To offer some feedback regarding the overall integrity of judgements contained in the matrix, the consistency ratio is reported.

Sensitivity profiles

The sensitivity of certain policy measures to the 12 aspects of local conditions included in the tool of course may be markedly different in various settings. Cities share a lot in common regardless of their location, yet they also differ in so many important aspects that they cannot be accounted for completely. The sensitivity scores incorporated in the tool therefore should be seen only as a general approximation based on expert opinion and experience reported in the energy management literature.

The sensitivity scores for each policy measure across the 12 context criteria are contained in tabular format, expressed on a four-point scale: not sensitive, low, medium and high sensitivity. A portion of the sensitivity table is shown in Figure 10.6. The sensitivity table is hidden by default as sensitivities are not meant to be altered by the user under normal circumstances.

		Culture & community		Legal ar
	Measure	Lifestyle change	Public support & acceptance	Legal authority & cont
GENERATION	Tax on packaging materials (disposable plastic goods)	Low	Medium	High
	City procurement - Buy extended-life products (tires,	x	x	Medium
	City operations - Electronic document system, commu	x	x	Low
	City admin - Waste planning (targets, actions)	x	x	Low
	City admin - Waste monitoring and Reporting	x	x	Low
REUSE	Residental awareness-raising programs promoting reu	Medium	x	x
	Deposit/refund system for aluminium cans (Containei	High	Low	High
	Deposit/refund system for glass bottles (Container De	High	Low	High
	Deposit/refund system for PET bottles (Container Dep	High	Low	High
	Promoting reuse (e.g. flea market, community garage	Medium	Low	Low
	"Take it or leave it" areas	Medium	x	Low

Figure 10.6 Sensitivity table (partial screenshot of the Energy Governance Tool).

Interpreting ranked measures

After providing the self-evaluation across the context criteria, the users are presented with a list of 'Ranked Measures' in which the policy measures are ranked on the basis of the overall score they receive as a result of the AHP calculations – that is, the combined weighted 'performance' score on each criteria (Figure 10.7). Policy measures listed lower down in the list will tend to have more critical issues identified for implementation. In the example, 'Standards for new municipal facilities' appears before 'Subsidies/loans for retrofitting old buildings', although the latter has five *moderate* and one *great* challenge, while the former has one *moderate*, two *great* challenges and one *substantial* challenge. This is due to the fact that 'Standards for municipal facilities' as a measure may score well under the average in other (non-critical) aspects, which leads to an overall lower score in spite of the four critical issues.

Through the presentation of the ranked measures, the Governance Tool provides policy makers with insight as to their potential to materialise policy development. It offers a holistic understanding about whether the decision-makers have sufficient local resources to bring changes. Judgement and population of the data on the Governance Tool is inevitably subjective, but would give a representation of the current local capacity and decisions, in relation to the alternative energy development and the degree of energy efficiency.

Potential uses of Governance Tools

There is ongoing discussion on how to address development issues simultaneously with climate change mitigation. The co-benefits approach aims to produce several different benefits from one particular policy, and the approach has been acknowledged in its Fourth Assessment Report of the IPCC (IPCC 2007). Climate co-benefits can be the primary motivation for developing countries to participate in international climate change action.

The co-benefits approach, however, has yet to be widely mainstreamed in international and domestic climate mitigation policy frameworks. There are some activities to mainstream co-benefits in the international climate mitigation framework by integrating the concept in its GHG accounting methodologies (Fransen 2009; Cheng 2010; Winkelman *et al.* 2011). These movements, however, have not yet progressed to become the sufficient force to drive the local decision-makers to scientifically evaluate the degree of co-benefits they may gain, through what policies, and how they prepare capacity to implement the policies.

Governance Tools, such as the one presented above for the energy sector, provide a useful framework for the assessment of institutional trajectories for positive policy transition. Through applying the analytical procedure, based on the tools, institutional capacity would be evaluated to identify the gap between current conditions and the required change to pursue a certain policy agenda. The assessment is important, as it can contribute to the institution to develop

	Culture & Community		Legal and Institutions		Organization & Resources					Coordination		Political	
Measure	Lifestyle change	Public support & acceptance	Legal authority & control	Administrative structures & enforcement	Openness & learning	Expertise (planning, technical)	Human resources	Financial resources	Technology & infrastructure	Horizontal coordination	Vertical coordination (across tiers)	Consensus & commitment	Total Weighted Score
☐ Standards for new municipal facilities (energy performance standards)			***	*				***	**				1.415
☐ Subsidies/loans for retrofitting old buildings (to meet higher energy performance standards)			*	*		*		***	*			*	1.522
☐ Tax credits for renewable energy installations (e.g., property tax & solar, geothermal)			**	*		*		***	*		*		1.575
☐ Net-metering			**	*		***			***			*	1.593
☐ Feed-in tariff (FiT)			**	*		***			***			*	1.615

Figure 10.7 Ranked policy measures (partial screenshot of the Energy Governance Tool).

paths for sustainable courses. Understanding organisational and institutional capacity can create a baseline against which future changes in institutional development may be benchmarked (Bos and Brown 2014).

The Governance Tools should be mindful of steering institutional transitions by generating organisational dynamics for transformative processes. Since the Governance Tool does not belong to any particular policy sphere in multilevel governance, its boundary-crossing capacity may give them specific importance at identifying the gaps and commonalities between different policy scopes in terms of organising, interpreting and linking different views and perceptions. The tool may help to build a network of commonly shared visions and values among different actors.

The Governance Tool for the energy sector in our example hosts a core set of context indicators and a core set of policy measures covering renewable energy and energy-efficiency development. Combined together, these two dimensions provide views on how many resources they have and/or they need to have more of to make progress in changing the local energy portfolio. This qualitative assessment framework was designed to be applied in conjunction with a quantitative energy assessment tool explained in Chapter 9 (page **000**), but it can be a stand-alone self-assessment tool for local policy transition. Although the Governance Tool is meant to be used at the level of local government (city councils), it is not unfeasible to assess national level capacity and decisions through this framework.

In general, these tools help to identify co-benefit-oriented policy measures which are more likely to be easily implemented in a particular city. They also help to highlight critical factors of their implementation. This alone, however, does not say anything about their potential to generate climate co-benefits. A measure that turns out to be marginally challenging to implement may only provide modest co-benefits. At the same time, a measure that poses great challenges may be found desirable for the substantial co-benefits it is expected to generate. It should be pointed out that the Governance Tool is intended to provide only an indication of the level of challenges for a set of policy measures rather than single out a 'best option'. The policy measures included in the tool are not mutually exclusive. Indeed, they are typically used in combination to yield reasonable results. For instance, awareness-raising measures will rarely work very effectively without measures that are intended to provide reasonable alternatives and incentives for changing behaviour and making desirable choices in technology.

Using the tool in and for local governance will always face concurrent challenge of reliability and validity. There is substantial deviation in understanding contextual capacities, which is only evaluated subjectively. Therefore, the Governance Tool can be infinitely questioned on its validity, because no evaluation is agreed by all the members of an institution. Quick adoption of the tool may only produce a self-assessment of the institutional status quo, and the incubation and implementation of the new policy measures can be left behind as a forgotten agenda.

The approach to developing qualitative tools proposed here also presents the need to create demand for the tool to be used as a mechanism to drive changes. The absence of incentive for using the tools and indicators address a common shortcoming among them that the accumulated and proliferated indicators and tools developed so far are hanging on the walls and webs, with the lack of sufficient incentive for their use. 'Designing demand' for the indicators and tools is required, to incubate and deliver the changes in policy and practice. Addressing and implementing co-benefits policies is the final goal of the Governance Tool, and there should be sufficient international advocacy to identify environmental co-benefits policies and their effects, in order for the local actors to seriously seek for the solutions.

Concluding remarks

The co-benefits concept is an approach for mainstreaming climate change issues at the local level. Generally speaking, the concept attempts to strengthen the policy making process so that each measure can intentionally realise multiple impacts at both the local and the global scale. By attempting to address both issues together it can be seen as a more coherent form of policy making which could also prove to be financially beneficial for locals and globally in the long term. Moreover, it is essential to encourage the implementation of climate-friendly measures in developing cities which are not obliged to reduce their carbon emissions but where much progress can be effectively made. In the context of urban sustainability, there have been several studies documenting such innovative practices around the world. However, given that most of those practices are to be of an incremental nature, it is challenging to assess the degree of contribution they made in tackling larger environmental problems or whether they have the potential to scale-up and stimulate systemic change in urban development processes.

The extent to which such an approach creates a difference remains questionable and a method to evaluate the co-benefits in the early stages of a long-term climate change strategy is still lacking. From this starting point, we focus on two environmental benefits that can be gained from sustainable urban measures: local environmental quality improvement and GHG emission reductions. In particular, this chapter provides a review of the initiatives to improve urban sustainability in cities and their potential for co-benefit and, based on these initiatives, proposes a framework to explore how the co-benefits approach may be adopted in the energy sector.

Although they cover a good range of energy strategies, they should not be understood as a comprehensive set of available policy measures by any means. They are rather representatives (or examples) of typical approaches which may actually have many variants and incarnations being implemented throughout the world. Another important implication is that the Governance Tool does not consider interaction effects. This means that the tool is not capable of indicating the simultaneous effects of several policy measures on the context

criteria. Such a capability would involve working with substantially more assumptions and thus would potentially lead to even more uncertainty in estimates.

In addition, the Governance Tool assumes away the time dimension of implementing policy measures. Some measures may only lead to expected outcomes on longer timescales, while others can provide benefits in a relatively short term. Finally, the Governance Tool is based on qualitative data derived from expert judgements regarding the sensitivity of policy measures to selected local conditions and their potential impact on urban energy system variables. These expert judgements can, in principle, be justified and improved by supporting empirical data. However, such data may not be readily available for every policy measure and every criterion and for a particular geographical location.

In spite of all the limitations, the information offered by the Governance Tool can be useful in setting the direction of the urban energy sector and serve as a starting point for more elaborate analyses (with fewer limitations) of particular options, including more accurate estimates of costs and (co-)benefits. Existing frameworks and indicators exist for various aspects of local sustainability. While this chapter has demonstrated that these frameworks are useful for covering certain subjects related to national sustainability policies (see page 000), they are not intended to focus on the energy governance aspects that may bring benefits to local and global communities. Existing guidelines are present to quantitatively assess the degree of renewable energy penetration and energy efficiency, but these are not intending to connect contextual potential and energy policy development.

The focus of the Governance Tool for the energy sector is to analyse institutional capacity for designing and implementing energy co-benefits policies through highlighting the variety of choices of energy governance at the local level. Energy issues in the urban context cannot simply be seen as just a matter of energy provision, meaning that urban energy policy is not separable from wider perspectives ranging from land-use planning, transport and waste management. This systematic view suggests local energy and the relevant politics are part of local development.

All these relevant dimensions have economic, social and environmental consequences which may have strong environmental and sustainability implications to cities. Thus they have to be considered in local energy policy making. By focusing on the specific challenges and tensions of governing energy on an urban scale, the Governance Tool intends to facilitate discourse among various interested parties not limited to academics and policy makers but especially local government so as to connect urban energy research more closely to the objectives and needs of local practitioners and policy makers to materialise co-benefits. Taken together, the Governance Tool here exhibits cities to be tangible locations of socio-technical change of energy systems, but also arenas of experimentation and learning around prospectus arrangement. It may be a way of learning and moving from the actual urban contexts worldwide to deliver environmental and sustainable outcomes.

Note

1 These tools were developed by the United Nations University Institute for Advanced Studies, available from http://urban.ias.unu.edu.

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