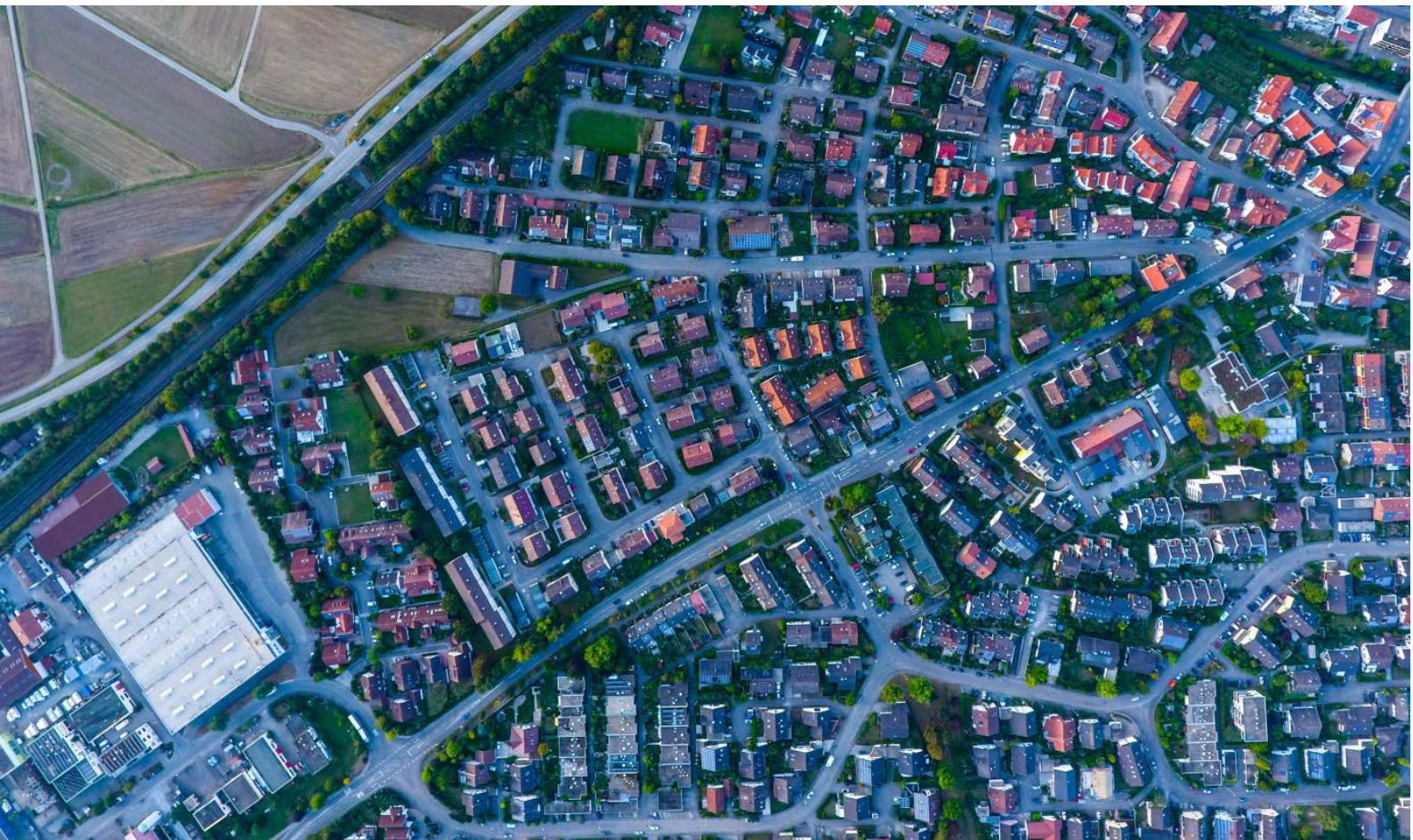


International Energy Agency

Implementation of Energy Strategies in Communities (Annex 63) Volume 5: Recommendations

Energy in Buildings and Communities Programme
October 2018



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Preface

THE INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. A basic aim of the IEA is to foster international co-operation among the 29 IEA participating countries and to increase energy security through energy research, development and demonstration in the fields of technologies for energy efficiency and renewable energy sources.

THE IEA ENERGY IN BUILDINGS AND COMMUNITIES PROGRAMME

The IEA co-ordinates international energy research and development (R&D) activities through a comprehensive portfolio of Technology Collaboration Programmes (TCP). The mission of the IEA Energy in Buildings and Communities (IEA EBC) Programme is to develop and facilitate the integration of technologies and processes for energy efficiency and conservation into healthy, low emission, and sustainable buildings and communities, through innovation and research. (Until March 2013, the IEA-EBC Programme was known as the IEA Energy Conservation in Buildings and Community Systems Programme, ECBCS.)

The R&D strategies of the IEA EBC Programme are derived from research drivers, national programmes within IEA countries, and the IEA Future Buildings Forum Think Tank Workshops. These R&D strategies aim to exploit technological opportunities to save energy in the buildings sector, and to remove technical obstacles to market penetration of new energy efficient technologies. The R&D strategies apply to residential, commercial, office buildings and community systems, and will impact the building industry in five areas of focus for R&D activities:

- Integrated planning and building design
- Building energy systems
- Building envelope
- Community scale methods
- Real building energy use

THE EXECUTIVE COMMITTEE

Overall control of the IEA EBC Programme is maintained by an Executive Committee, which not only monitors existing projects, but also identifies new strategic areas in which collaborative efforts may be beneficial. As the Programme is based on a contract with the IEA, the projects are legally established as Annexes to the IEA EBC Implementing Agreement. At the present time, the following projects have been initiated by the IEA EBC Executive Committee, with completed projects identified by (*)

and joint projects with the IEA Solar Heating and Cooling Technology Collaboration Programme by (☀):

- Annex 1: Load Energy Determination of Buildings (*)
- Annex 2: Ekistics and Advanced Community Energy Systems (*)
- Annex 3: Energy Conservation in Residential Buildings (*)
- Annex 4: Glasgow Commercial Building Monitoring (*)
- Annex 5: Air Infiltration and Ventilation Centre
- Annex 6: Energy Systems and Design of Communities (*)
- Annex 7: Local Government Energy Planning (*)
- Annex 8: Inhabitants Behaviour with Regard to Ventilation (*)
- Annex 9: Minimum Ventilation Rates (*)
- Annex 10: Building HVAC System Simulation (*)
- Annex 11: Energy Auditing (*)
- Annex 12: Windows and Fenestration (*)
- Annex 13: Energy Management in Hospitals (*)
- Annex 14: Condensation and Energy (*)
- Annex 15: Energy Efficiency in Schools (*)
- Annex 16: BEMS 1- User Interfaces and System Integration (*)
- Annex 17: BEMS 2- Evaluation and Emulation Techniques (*)
- Annex 18: Demand Controlled Ventilation Systems (*)
- Annex 19: Low Slope Roof Systems (*)
- Annex 20: Air Flow Patterns within Buildings (*)
- Annex 21: Thermal Modelling (*)
- Annex 22: Energy Efficient Communities (*)
- Annex 23: Multi Zone Air Flow Modelling (COMIS) (*)
- Annex 24: Heat, Air and Moisture Transfer in Envelopes (*)
- Annex 25: Real time HVAC Simulation (*)
- Annex 26: Energy Efficient Ventilation of Large Enclosures (*)
- Annex 27: Evaluation and Demonstration of Domestic Ventilation Systems (*)
- Annex 28: Low Energy Cooling Systems (*)
- Annex 29: ☀ Daylight in Buildings (*)
- Annex 30: Bringing Simulation to Application (*)
- Annex 31: Energy-Related Environmental Impact of Buildings (*)
- Annex 32: Integral Building Envelope Performance Assessment (*)
- Annex 33: Advanced Local Energy Planning (*)
- Annex 34: Computer-Aided Evaluation of HVAC System Performance (*)
- Annex 35: Design of Energy Efficient Hybrid Ventilation (HYBVENT) (*)
- Annex 36: Retrofitting of Educational Buildings (*)
- Annex 37: Low Exergy Systems for Heating and Cooling of Buildings (LowEx) (*)
- Annex 38: ☀ Solar Sustainable Housing (*)
- Annex 39: High Performance Insulation Systems (*)

- Annex 40: Building Commissioning to Improve Energy Performance (*)
- Annex 41: Whole Building Heat, Air and Moisture Response (MOIST-ENG) (*)
- Annex 42: The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (FC+COGEN-SIM) (*)
- Annex 43: ☀ Testing and Validation of Building Energy Simulation Tools (*)
- Annex 44: Integrating Environmentally Responsive Elements in Buildings (*)
- Annex 45: Energy Efficient Electric Lighting for Buildings (*)
- Annex 46: Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo) (*)
- Annex 47: Cost-Effective Commissioning for Existing and Low Energy Buildings (*)
- Annex 48: Heat Pumping and Reversible Air Conditioning (*)
- Annex 49: Low Exergy Systems for High Performance Buildings and Communities (*)
- Annex 50: Prefabricated Systems for Low Energy Renovation of Residential Buildings (*)
- Annex 51: Energy Efficient Communities (*)
- Annex 52: ☀ Towards Net Zero Energy Solar Buildings (*)
- Annex 53: Total Energy Use in Buildings: Analysis and Evaluation Methods (*)
- Annex 54: Integration of Micro-Generation and Related Energy Technologies in Buildings (*)
- Annex 55: Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost (RAP-RETRO) (*)
- Annex 56: Cost Effective Energy and CO₂ Emissions Optimization in Building Renovation (*)
- Annex 57: Evaluation of Embodied Energy and CO₂ Equivalent Emissions for Building Construction (*)
- Annex 58: Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements (*)
- Annex 59: High Temperature Cooling and Low Temperature Heating in Buildings (*)
- Annex 60: New Generation Computational Tools for Building and Community Energy Systems (*)
- Annex 61: Business and Technical Concepts for Deep Energy Retrofit of Public Buildings (*)
- Annex 62: Ventilative Cooling (*)
- Annex 63: Implementation of Energy Strategies in Communities
- Annex 64: LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles
- Annex 65: Long-Term Performance of Super-Insulating Materials in Building Components and Systems
- Annex 66: Definition and Simulation of Occupant Behavior in Buildings (*)
- Annex 67: Energy Flexible Buildings

- Annex 68: Indoor Air Quality Design and Control in Low Energy Residential Buildings
- Annex 69: Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings
- Annex 70: Energy Epidemiology: Analysis of Real Building Energy Use at Scale
- Annex 71: Building Energy Performance Assessment Based on In-situ Measurements
- Annex 72: Assessing Life Cycle Related Environmental Impacts Caused by Buildings
- Annex 73: Towards Net Zero Energy Public Communities
- Annex 74: Competition and Living Lab Platform
- Annex 75: Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewables
- Annex 76: ☀ Deep Renovation of Historic Buildings Towards Lowest Possible Energy Demand and CO₂ Emissions
- Annex 77: ☀ Integrated Solutions for Daylight and Electric Lighting
- Annex 78: Supplementing Ventilation with Gas-phase Air Cleaning, Implementation and Energy Implications
- Annex 79: Occupant Behaviour-Centric Building Design and Operation
- Annex 80: Resilient Cooling

Working Group - Energy Efficiency in Educational Buildings (*)

Working Group - Indicators of Energy Efficiency in Cold Climate Buildings (*)

Working Group - Annex 36 Extension: The Energy Concept Adviser (*)

Working Group - HVAC Energy Calculation Methodologies for Non-residential Buildings

Working Group - Cities and Communities

Project Overview

BACKGROUND

Energy Efficient Communities (IEA-EBC Annex 51) suggested that successful urban energy planning is only possible, if energy planning is integrated in the entire urban planning process. However, research in both Annex 51 and Annex 63 has found that in many countries consideration of energy issues is missing in urban planning processes. This is of great concern, since, with the growing challenge of climate change, municipalities and energy utilities are charged with implementing both measures that adapt to the present conditions and measures that mitigate against future impacts. Both parties, municipalities and energy utilities, must coordinate their actions and both need a comprehensive set of tools and strategies to manage their resources so as to minimise the generation of greenhouse gases.

The linkage between urban form, energy use and climate change has been recognised for many years yet there still remain significant barriers separating the goals of urban planning and those of efficient energy delivery. In current practices energy related issues are still isolated from virtually all other municipal services; building codes for example often limit their scope to building safety and ignore the impact of energy consumption. By integrating strategies about optimizing supply, delivery and consumption of energy with (municipal or utility) planning protocols both municipalities and utilities can deliver to their constituents a powerful set of strategies with which to address climate change.

A natural connection should exist between urban development and energy development. Historically, the separation of each field's priorities and practices has created an energy efficiency challenge that requires a new and improved set of planning tools and strategies.

CONTENT

IEA-EBC-Annex 63 aims to identify strategies that can unify urban and energy planning communities and allow both parties to engage in the process of change to reach long term targets. The research addresses key barriers that expand the scope of planning and lead to a more comprehensive understanding of the new, urban, low-carbon environment. The outcome of this project is that governments, urban decision makers, utilities and urban planning departments can develop a clearer understanding as to how they integrate energy issues into urban planning processes and what actions they must undertake and when, in order to be successful.

PARTICIPATING COUNTRIES

Following countries (represented by 19 organisations) have been participating in Annex 63: Austria, Canada, Denmark, France, Germany, Ireland, Japan, the Netherlands, Norway, Switzerland and the United States of America.

INVOLVED CITIES

Following cities were involved in Annex 63: Salzburg, Vienna (Austria), Burlington, Guelph, London (Ontario), Toronto (Canada), Egedal, Middelfart, Roskilde, Skive (Denmark), Lille, Strasbourg (France), Aachen, Ludwigsburg, Karlsruhe (Germany), Kitakyushu, Yokohama (Japan), Maastricht (the Netherlands), Oslo, Bergen (Norway), Basel (Switzerland), Minneapolis (USA). Also Graz (Austria), Ottawa, Pickering (Canada), Ballerup, Lyngby (Denmark), Bottrop (Germany), Amsterdam, Parkstad (the Netherlands) and Zürich (Switzerland) supported the project team with information and case studies.

METHODOLOGY

To better understand the composition of suitable energy strategies, the research program adopted the following approach:

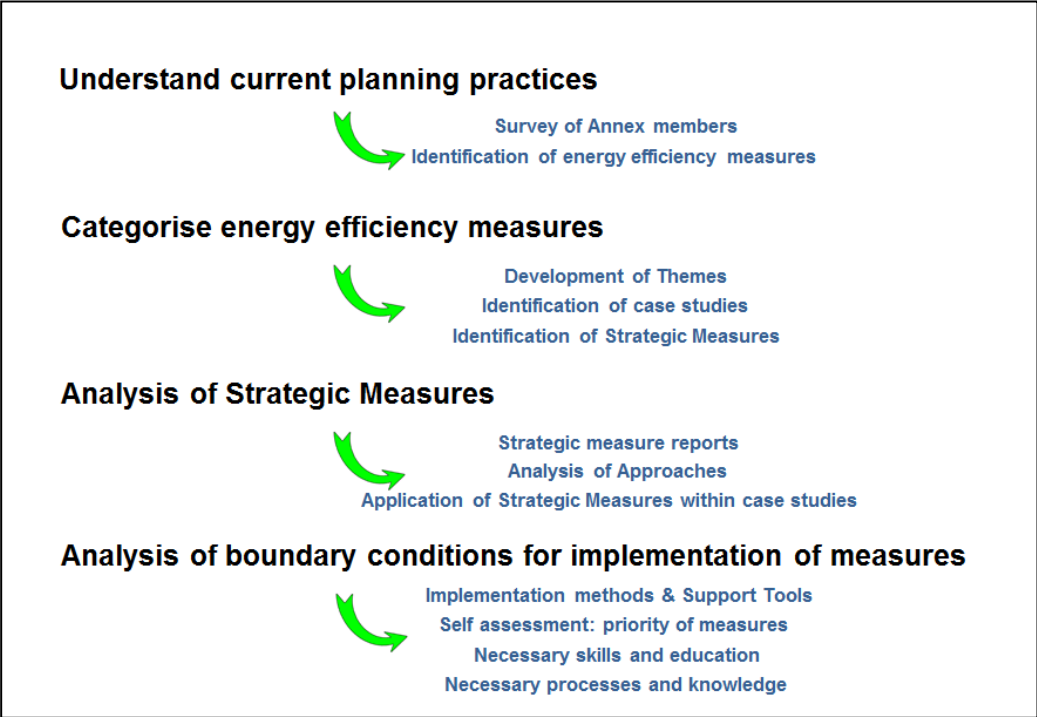


Figure A: Research Methodology (NRCan, 2017)

OUTPUTS

The results of Annex 63 (Implementation of Energy Strategies in Communities) are documented in six Volumes (sequenced according to the development progress). For orientation, the name and content of each Volume is described in the following overview:

Volume 0 – Documentation of workshops and involvement of cities: This report describes the information exchange and dissemination activities undertaken within this research. The information exchange activities were essential to get and understand all relevant information for answering the research question and to contribute to practical appropriability. In total 143 information exchange activities with 2,394 people were carried out.

Volume 1 – Inventory of measures: This report describes the existing national political framework conditions, energy and land-use planning processes, strategies for energy planning and existing national measures in the field of urban and energy planning. In this research, the term measure refers to any action, program, policy or other activity that can demonstrate or influence a change in process. Amongst other background information, 22 planning processes and 89 measures from 11 countries are described in detail in this report.

Volume 2 – Development of strategic measures: This report describes the further development of the analysed measures from Volume 1 into strategic measures. As with the term measure, a strategic measure refers to an essential measure in concept that can be used to develop individual implementation strategies on a local level for part or the whole life cycle of a project (from the first vision to monitoring of the implemented solution). The developed strategic measures deal with the following topics:

- Setting Vision and Targets
- Developing Renewable Energy Strategies
- Making Full use of Legal Frameworks
- Designing an Urban Competition Processes
- Making use of Tools Supporting the Decision Making Process
- Implementing Monitoring of Energy Consumption and GHG Emission practices
- Enhancing Stakeholder Engagement & Involvement
- Including Socio Economic Criteria
- Implementing Effective and Efficient Organisational Processes

The report includes both a summary of each strategic measure supported by nine appendices, each a detailed description of each strategic measure.

Volume 3 – Application of strategic measures: This report describes, for different scales (city, district and project level) and for 29 conceptualised case studies, how implementation champions can apply the strategic measures from Volume 2. Implementation champions are hereby understood as stakeholders in the city who take the initiative to lead and facilitate implementation processes.

Volume 4 – Stakeholder support materials: This report describes, in more detail, within the framework of Annex 63 elaborated stakeholder support materials and their application. The materials deal with the following topics:

- Municipality Self-Assessment tool
- Capacity building and skills
- Workshop format and procedures
- Informational slides for presentations
- Education materials

Volume 5 – Recommendations: This report contains central recommendations for different target groups (e.g. policy makers, researchers, planners), for implementation and for further investigation. Justifications and examples in the field of urban and energy planning are central elements of this report.

HOW TO READ

Depending on the interest of the reader whether the focus might be on the application of results or on the methodology of producing the results, figure B shows the sequence of how best to use the Volumes.

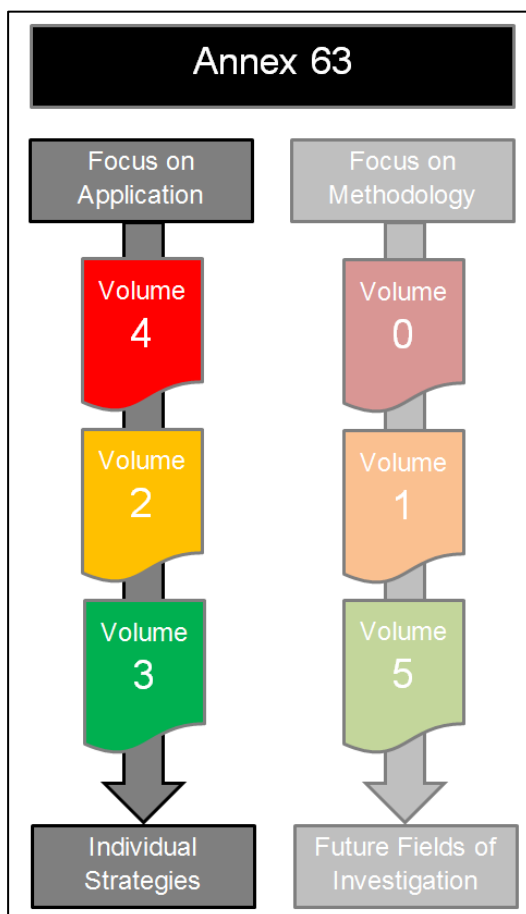


Figure B: How readers should apply the produced documents (SIR, 2017)

If the focus of the reader lies on the application of the elaborated results, the Volume 4 should be read first. The appendix of Volume 4 contains a municipality self-assessment tool that allows the reader to identify the strengths and weaknesses within the current municipal structure. Volume 4 also contains additional working materials (e.g. necessary capacities and skills, suitable workshop formats, informational slides for presentations and education materials) that support the implementation of strategic measures. Recommendations for the successful implementation of specific strategic measures can be found in appendix of Volume 2, leading to the application of different strategic measures as outlined in Volume 3. In this way, the reader gains from the three reports all relevant information for the development of individual implementation strategies.

If the reader is interested on methodological aspects of Annex 63, Volume 0 should be read first. Volume 0 contains the central information regarding the information exchange activities and input from the variety of annex stakeholders (cities, local stakeholder groups, project team, national and international networks, IEA Technology Collaboration Programmes). Principal output of this consultation process is also described in detail in Volume 1 (local framework conditions in 11 countries and 22

cities). Finally, all relevant recommendations for different target groups are summarised in Volume 5. Again, the reader gets in the three reports all the relevant information for further fields of investigation.

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1. Introduction

In chapter 2 step-by-step **recommendations for strategy** are inventoried and are based either on experience of the involved stakeholders in their various fields of expertise, discussions within the meetings of the Annex 63 and the participating communities and the actual state of science and technology for the topic of the Annex. In this way, the carried out workshops of Annex 63 enabled the group to identify common issues, useful approaches and innovative strategies, especially from the participating case studies and countries. The presented outputs and recommendations are exemplary and derived from the analysed best practise but should not be understood as the sole methodological approach to success. They aim to motivate other actors and stakeholders to initiate similar but not necessarily the same innovative processes. More information about the involved stakeholders and carried out workshops is listed in Volume 0.

In chapter 3, the **recommendations for operations** are based on an analysis of strategic measures within frontrunner cities which are supposed to be transferrable to other communities and of which the experts from the Annex 63 community experienced a need for strategical information from the stakeholders in their networks (see also Volume 2). Based on this framework, the project team was able to set up a self-assessment tool for municipalities for self-guidance in their needs towards recommendations and case studies which will be the most relevant and of highest priority for them (see Volume 4). At the mean time the project team realised that those recommendations are far from complete. In practice, the project team has collected many more experiences on a lower strategic level. E.g. although everybody is realizing that steering on long term goals, by getting feedback from monitoring results is a necessity for the implementation of climate goals, in practice it is hardly seen on a municipal level. So the need is not to know what to do, but how to transform organisations and cooperation's step by step in order to make such an approach possible.

Also the **target groups of these recommendations** might vary from country to country due to different administrative and organisational structures and different actors/stakeholders. While some of the recommendations are directly addressing communities others are focussing on intermediates, universities, public bodies on regional or national level which are e.g. creating framework conditions like developing research programs, etc. The project team has tried to follow this logic in the order of the enumerations – from communities to larger scale. It is intended that each reader can identify the recommendations relevant for his/her work.

2. Strategic level

The recommendations on the strategic level deal with the following topics:

- 1) Capacity building
- 2) Effective organizational structures in municipalities
- 3) Intergovernmental coordination & local to national linkage
- 4) Fully understand & utilize legal frameworks
- 5) Pilot projects – experimentation to advance innovation
- 6) Link community (social) goals to business case / private interests
- 7) Future research – including but not limited to IEA

2.1. Capacity building

Technology is part of the solution, but the people are a bigger part and thus capacity building is critical. Successful implementation of energy strategies in communities requires therefore engaged and skilled persons within cities' administration, in particular in urban planning departments, building permission offices, environmental permits offices, energy management of the public buildings institutions/offices, climate protection offices and so on. Knowledge, which has been provided by education, is often yet not sufficient when aspects of integrated planning or energy planning has not been introduced sufficiently. Additionally issues of energy planning will be or have in the past often been carried out by external organizations such as energy supply companies. These recommendations on the one hand focus on those who are in a position to provide the mentioned activities. On the other hand, staff members should be encouraged to demand and to participate in capacity building activities.

2.1.1. Recommendations

To push the topic capacity building it is necessary to:

- Conduct workshops across stakeholder groups (e.g. municipal employees, utilities, NGOs) to facilitate learning from each other and to build networks.
- Promote information exchange within communities and across groups.
- Create training programs for practitioners in order to increase the knowledge of the professionals who carry out these activities.
- Integrate energy planning into public employee training, including creating new programs if needed.
- Integrate energy planning training into urban planning education and urban planning training into engineering education.
- Introduce decision support tools and certification schemes – they can help to build capacities by breaking complex systems into their component parts – they can help to manage the complexity and provide an orientation to it.

- Network the champions to support capacity building, as well as ensure that innovative work is institutionalized.
- Organize visits to other cities/projects in order to build knowledge and create inspiration.
- Discussion of capacity building emphasizes that people make decisions and are the ones who will get us to innovation.

2.1.2. Justification

Modern planning approaches show an extensively growth of complexity. This fact turned out during workshops and discussions held within Annex 63 workshops as well as in several studies (e.g. Geertman & Stillwell, 2003) and other research projects (e.g. Urban Learning, 2017).

The identification of the nine strategic measures of Annex 63 (see also chapter 3) reflects these findings. Planners have to work strategically when linking regularly urban scale and project scale. While the identified strategic measures of vision and target setting and the development of renewable energy strategies are focussing especially on urban scale stakeholder involvement and operative planning procedures are linked to real on site projects. Some of the strategic measures such as those of supporting tools and monitoring are relevant at both levels (see Volume 2).

Thus, urban planners need to have knowledge and skills in the different roles they have. To fulfil the tasks they need to be experts for example of urban planning, building standards, energy supply and mobility as well as have soft-skills such as moderation, presentation and communication.

Typically big cities and energy suppliers have numerous employees in their planning departments. Capacity building activities thus should have in mind that all of them are the potential target group for learning and training activities. But not all cities are in this situation. A lot of communities don't have enough employees to work intensive on the huge variety of projects (see also chapter 2.2).

The better the staff members are familiar with all the required skills the better the new holistic planning procedures will be established in the city. Also the team and cross-thematic cooperation in the administration and the networking with local actors is a key to success (see also chapter 2.3).

2.1.3. Examples

See Volume 4 (Stakeholder support materials) for examples of capacity building and skills.

2.2. Effective organizational structures in municipalities

Cities face the pressure to transform their energy system but are challenged by a lack of authority, because energy has just recently become a field of duties for municipalities. Hence, in most countries there are no defined formal planning procedures for urban energy planning. Through new frameworks, the local administration will be enabled to develop and implement urban and energy planning concepts in collaboration with the relevant stakeholders. Since there are many actors on the local level involved in the field of urban development and energy planning, an effective and efficient organisation and process design (e.g. definition of roles/responsibilities) is of great importance. Stakeholder networks in the field of the transformation of the energy system with conflicting objectives, values or divergent tactics block a successful implementation of energy strategies equally as deviant temporal and spatial scales for operation of public administrations. The description of additional, organisational frameworks and methods to formally integrate energy planning issues and subsequently apply them on the community level is a core task for the municipality.

An important aspect of the integration of urban planning and energy planning in terms of organisation is its vertical and horizontal integration. Vertical means the integration and involvement of various stakeholders of the administration as well as non-governmental stakeholders relevant to urban and energy planning. Horizontal means integrating and coordinating the various sectoral policies and actions of the public and private sector within the city or the selected area. Therefore, an adequate organisation structure has to be installed to facilitate this process. Thus municipalities should create a climate protection coordinator position, that can coordinate cross-sectoral climate, energy, mobility, land use and housing issues etc. This position or administration unit can also act as a liaison to other municipalities, as well as to utilities, developers and other relevant parties.

2.2.1. Recommendations

To push the topic effective organizational structures in municipalities it is necessary to:

- Create a cross-sectoral unit within the administration to work in an integrated manner.
- Be aware of importance of legislation and room for experiments.
- Bring system thinking into the planning process (bringing findings together, searching for entry points).
- Create champions supporting programs including mapping to identify the right people and expanding network of implementation champions.
- Organize campaigns for influencing public opinion and gaining public support, including drivers, like facilitation of cooperatives.
- Re-organization of municipalities, including integration of departments and budgets.

- Checking consistency of decision making, especially short term activities towards long term goals.
- Organise public-private cooperation, since there is both a public and a private interest.
- Support the conceptual, designing phase for large scale implementation (trajectory funding).
- Organize the available knowledge and learning experiences.
- Find solutions which include social housing.
- Capacity building at both the demand and the supply side.
- Develop and steer on an agenda based on a roadmap, apply back-casting to ensure the realization of the long term goals.

2.2.2. Justification

One of the major bottlenecks with respect to large scale implementation is that the organizational structures and financial systems are not suited for these kind of integral approaches with shared responsibilities. In order to reach an ideal situation (transition arena, Loorbach et.al.), one could follow several trajectories: a step by step approach, organizing an internal task-force or a partly external facilitating board.

The same holds for companies like energy distribution companies which need to develop new business models. E.g. the momentary business models for storage systems are most of the time non profitable since they are competing with storage in the “free” grid. However, already at the moment the business models for energy storage on a district level could be profitable for the community itself. The energy suppliers in future could offer solutions like this as a service to the community.

2.2.3. Examples

See Volume 3 (Application of strategic measures) for examples of effective organizational structures in municipalities. Examples:

- 1.01 Minneapolis, USA
- 1.02 InnovationCity Ruhr, Bottrop, Germany
- 1.03 ProjectZero, Sønderborg, Denmark
- 1.08 Luzern, Switzerland
- 1.09 Strasbourg Metropolitan Region, France
- 2.03 Gnigl, Salzburg, Austria
- 2.04 Schlösslesfeld, Ludwigsburg, Germany
- 3.02 Minato Ward, Tokyo, Japan
- 3.03 PALET, Parkstad, the Netherlands
- 3.04 Jono, Kitakyushu, Japan
- 3.05 Minato Mirai 21, Yokohama, Japan

2.3. Intergovernmental coordination & local to national linkage

Since in the most state constitutions the local government acts independently of the national government, there is no natural connection between both levels of government. The local governments are responsible for local law enforcement. Local laws are statutory instruments made by local governments to regulate a broad range of issues within their communities (e.g. local taxes, public budget, land use and urban planning). Thus the national government has no direct statutory jurisdiction in local affairs. But the national level can contribute to the local policy by setting clear national targets and by developing national strategies how to reach these targets. It is recommended to adopt a clear national legislation for example on climate goals referring to the Paris Agreement.

The linkage between local level and national level should be a learning and transformation cycle that runs bottom up (i.e. learning from the various local best practise examples, scaling them up and standardising tools, measures and planning instruments) as well as top down (i.e. decentralising regulatory framework, targets and strategies from national level towards regions, municipalities networks and even neighbourhood areas). The strategic level – that is equal to the national level – rules and targets setting level should learn from the grassroots level and try to scale good solutions up. The operative level – that is equal to the local level – should implement national targets and strategies using local adaptable solutions and methods.

One option for the national level to influence the local policy anyway, is to offer national funding programs for specific topics, in order to motivate the local government to follow national requirements. It is important to underline the role of the municipalities for changing conditions. Consequently national programs are needed to empower municipalities to take action e.g. on integrated energy and urban planning. National programs have to consider the characteristics and needs of community projects in funding programs: On the one hand municipalities needing long concept and planning phases, but on the other hand there is also a need to be flexible to cope unforeseen project changes.

Through new frameworks, the local administration will be enabled to develop and implement urban and energy planning concepts in collaboration with the relevant stakeholders. Since there are many actors on the local level involved in the field of urban development and energy planning it is important to consider also other them as beneficiaries.

2.3.1. Recommendations

To push the topic intergovernmental coordination & local to national linkage it is necessary to:

- Initiate informal opportunities for an exchange of information to build trust amongst the involved agencies (e.g. by conferences, workshops, cooperation programmes and projects).
- Create formal mechanisms, processes, and agreements, which establish specific intergovernmental activities to occur on a systematic basis.
- Establish a process for intergovernmental coordination among the local government and other affected agencies on a regular basis regarding the provision of services as consistent with the comprehensive plan.
- Introduce funding programs for local pilot projects and make them visible for scaling up.
- Set planning regulations as a framework within local municipalities are allowed and encouraged to exercise new approaches and instruments.
- Break down national climate goals towards regional and local level and make sure that local contributions are manageable and operational.
- Create networks of municipalities to spread knowledge on best practise.
- Develop standardised tools and instruments that can be used by municipalities under various framework conditions.

2.3.2. Justifications

Coordination among the numerous public and private entities that affect land and energy planning in cities and communities is essential for efficiently meeting the needs of the citizens in the future. The sheer number of governmental entities affecting communities requires substantial efforts of coordination: district or regional level, state agencies, authorities as well as sectoral administrations such as water management, energy planning, climate and environment protection, waste management, business development etc. all make direct or indirect decisions influencing urban and energy planning. Thus, it is critical that communities create and maintain viable mechanisms to enhance close working relationships with these agencies. All should work together to avoid conflict and build cooperation, with the goal of improved and efficient service to the public. Conflicts invariably arise if there is lack of communication and interaction. Such conflicts can lead to a loss of trust among the various units of local government and, more, importantly, the public. Private entities such as energy providers, mobility services and housing companies have limited direct contact with the public administration regarding plan coordination. An intergovernmental coordination element could provide direction to develop appropriate strategies for coordination with the private stakeholders.

The local contributions towards energy efficiency and decarbonisation vary according to the local problems and options and national frameworks. Meanwhile a huge picture

of “best practice cases” on local level is available with a broad mix of instruments, strategies and tools. The challenge is to link these successful pilot projects and good government examples with national frameworks and to ensure scaling up towards almost all cities and communities.

2.3.3. Examples

See Volume 3 (Application of strategic measures) for examples of intergovernmental coordination & local to national linkage. Examples:

- 1.01 Minneapolis, USA
- 1.02 InnovationCity Ruhr, Bottrop, Germany
- 1.05 Guelph, Ontario, Canada
- 1.07 Aachen, Germany
- 1.08 Luzern, Switzerland
- 2.01 Erlenmatt West, Basel, Switzerland
- 2.02 Stenløse South, Stenløse, Denmark
- 2.03 Gnigl, Salzburg, Austria
- 2.05 Zero Village Bergen, Bergen, Norway
- 2.06 Furuset Forbildeprosjekt, Oslo, Norway
- 2.07 Nordhavn, Copenhagen, Denmark
- 3.01 Salzburg Lehen, Salzburg, Austria
- 3.02 Minato Ward, Tokyo, Japan
- 3.03 PALET, Parkstad, the Netherlands
- 3.05 Minato Mirai 21, Yokohama, Japan
- 3.06 Zanklhof, Graz, Austria

2.4. Fully understand & utilize legal frameworks

Planning processes are embedded in legal frameworks. As far as energy planning was not seen as a task for urban planning those specific legal frameworks (e.g. of spatial planning) have not been utilized for this purpose in many countries. Thus, having a look on the legislation with the eyes of energy planning might offer new opportunities of implementation of energy strategies. When barriers and bottlenecks can be overcome, communities can implement changes of the legal framework (if they are the legal body) or can initiate discussion of changes in the general frameworks (if it's about regional or national legislation and guidelines). In general it is essential to understand the basic purpose of legal frameworks and the structured composition to put the right regulations at the right place.

2.4.1. Recommendations

To push the topic fully understand & utilize legal frameworks it is necessary that:

- Communities should do some analytical work on their individual energy supply and distribution situation and on the options they have to implement better energy planning. It may be a good idea to develop a typology or framework for energy planning on municipal level and community level.
- Communities should try to find the best entry points for energy planning within their local planning processes.
- Initiate a mapping of existing and relevant legal frameworks for energy and urban planning.
- Utilize options of existing legal frameworks for linking energy and urban planning.
- Initiate, support capacity building in communities (knowledge on strategic measures and their implementation) by training, workshops, excursion trips and so on.
- Utilize incentives within authority that exists and varies in different municipal and national contexts.
- Encourage communities to get engaged in changing frameworks as needed.

2.4.2. Justification

Planning has to consider existing legal frameworks. Besides of some exceptions (e.g. Switzerland) many countries don't have specific legal frameworks supporting energy planning. Instead, legal frameworks e.g. on urban planning and buildings might be utilized in a limited way for energy planning purposes. On the other hand legislation also might offer counterproductive regulations. Thus, mapping typologies for energy planning and analyses of planning processes is an excellent basis for identification of entry points for energy planning and relevant legal frameworks – either to be utilized or to be considered as a barrier. Utilizing existing legal frameworks needs – besides the knowledge on the legislation - a strong commitment for going for new ways. Sometimes it will require the confiscation of external lawyers to find out how the legal framework

can be used in the best possible way. In addition, cities are stakeholders in legislative processes and can thus contribute significantly to improved legal framework conditions. Often, however, it will be necessary to involve other stakeholders through events, discussions and other formats, such as funders, investors and energy suppliers, and to create broader support for improved framework conditions. Only by a high attention for the topic energy planning as a municipal task the legal possibilities can be exhausted or the legal framework can be arranged.

2.4.3. Examples

See Volume 3 (Application of strategic measures) for examples of fully understand & utilize legal frameworks. Examples:

- 1.05 Guelph, Ontario, Canada
- 1.07 Aachen, Germany
- 2.01 Erlenmatt West, Basel, Switzerland
- 2.02 Stenløse South, Stenløse, Denmark
- 3.02 Minato Ward, Tokyo, Japan
- 3.04 Jono, Kitakyushu, Japan
- 3.05 Minato Mirai 21, Yokohama, Japan

2.5. Pilot projects – experimentation to advance innovation

Case studies discussed in Annex 63 in many ways set ambitious targets and develop Strategic Measures that are summarised in the previous reports. Among them, some of the projects tested novel approaches especially with regard to the organisational framework of the projects. The case studies InnovationCity Ruhr in Bottrop, Germany, the Strasbourg Metropolitan Area in France, the city of Guelph in Ontario, Canada as well as the project Dundalk 2020 in Ireland put a specific focus on connecting different stakeholder groups.

Other case studies demonstrate the feasibility of zero carbon developments at the scale of districts. Case studies included the Zero Village Bergen, Bergen, Norway, the Jono project site in Kitakyushu as well as Minato Ward, Tokyo, Japan.

With more interconnected energy services, the importance of scale plays a role in pilot projects: technical improvements can be demonstrated at building level, while e.g. heat networks require a larger scale, which increases the administrative complexity but also potential benefits from a larger participation.

2.5.1. Recommendations

To push the topic pilot projects it is necessary to:

- Try pilot projects - they offer opportunities for research, evaluation, and promotion of new ideas
 - Support initial, conceptual phase of existing districts – starting point for pilot projects
 - Create room for experiments
 - Innovative business models
- Ambitious targets and dedicated actions are necessary to demonstrate the feasibility of such concepts but also to identify possible technical or non-technical obstacles and success factors for a wider rollout.
- Innovation supporting the project can be found in technology concepts but more and more in the connection between stakeholders and their structured coordination.
- A well-structured organisation is necessary to follow up the process. A number of projects has shown, that the implementation of a dedicated project management entity – as a third party to take on the role for the municipality – has been a successful strategy to follow up such processes.
- Throughout the lifetime of the project, the level of exchange should be increased from broad agreements to involve partners to dedicated cooperation of individual stakeholders or participating groups to deliver tangible results.

2.5.2. Justification

Exchange between a wide range of actors is key to the success of nearly all urban development projects. A main benefit lies in gathering existing expertise in the region to improve the project. Animating the local stakeholders to start participating in a joint approach requires a shared vision and often is reached by a target with high relevance in the local context.

2.5.3. Examples

See Volume 3 (Application of strategic measures) for examples of pilot projects.
Examples:

- 1.02 InnovationCity Ruhr, Bottrop, Germany
- 1.05 Guelph, Ontario, Canada
- 1.09 Strasbourg Metropolitan Region, France
- 2.08 Dundalk 2020, Ireland
- 2.05 Zero Village Bergen, Bergen, Norway
- 3.02 Minato Ward, Tokyo, Japan
- 3.04 Jono, Kitakyushu, Japan

2.6. Link community (social) goals to business case / private interests

The main issue here is the balance between the bottom-up and the top-down process. The top-down process is important for commitment on the municipal level, taking advantage of regular municipal money flows, facilitation of knowledge-funds-legal issues, finding and convincing bigger investors and searching for a financial close within the municipal public-private boundaries. The bottom-up process is important for finding public support, taking into account the public needs and financing the implementation based on cooperative models, including the social weaker groups.

2.6.1. Recommendations

To push the topic link community (social) goals to business case / private interests, the following aspects are relevant:

- Since multiple stakeholders have the potential to experience multiple benefits, a stronger business case that engages public and private interests can be created.
- Each benefit should be monetised from the perspective of the recipient. Since multiple stakeholders will benefit from the multiple benefits, we are effectively creating a public-private business case.
- 4-step approach:
 1. Inventory of possible co-benefits (economical, environmental, social)
 2. Value and monetize the co-benefits and broaden the business-case
 3. Involve stakeholders, including the inhabitants, in the selection of the co-benefits for a specific district
 4. Ensure commitment of relevant stakeholders and investors to the broad business-case, including the added values of the co-benefits.
- To make the business case more robust one should consider several future scenario's (e.g. with respect to energy prices) and look at the sensitivity and variations for the outcomes of the integral business case.
- In the end one should make a breakdown of the business case for every stakeholder, in order to show the investments and the profits.
- From an analysis of the countries participating in Annex 63 the importance can be seen of the coordination in organizing the case for public-private business partnership. The coordinator of this effort must have a broad overview of both (or all) partners' aims and positions and present a more or less independent position. This role is most of the time played by governmental organisations and/or municipalities. Thus, the municipality or government should (at least in the initial phase) realise that they play an important role in the facilitation of this process, since they are the most independent stakeholder covering the public values.
- The more time is spent in the pre-phase / planning phase, committing stakeholders and bringing them together, the more profitable the business case gets on the long term.

- Communities should try to define and organize a broader business-case for the implementation of energy efficiency measures and renewable energy sources. This is necessary to combine goals of society and business and to make the implementation more feasible and more competitive to conventional methods and business. The Energy transition needs sustainable urban development and vice versa.

2.6.2. Justification

From the consumer's perspective, the transition challenge represents a change in value systems from one which priced development at its lowest cost to one that is more holistic and identifies a product's value by its impact on the environment.

Investments in energy efficiency can provide many different benefits to many different stakeholders which are often overlooked.

Since multiple stakeholders have the potential to experience multiple benefits, a stronger business case that engages public and private interests can be created.

It is often thought that there is always a cost to change but not to maintain the status quo. This reflects the lack of inclusiveness consistent with current financial thinking. What is forgotten (or ignored) is that the additional cost to change may be offset by the value of the benefits created by that change (avoided costs).

2.6.3. Examples

See Volume 3 (Application of strategic measures) for examples of link community (social) goals to business case / private interests. Examples:

- 1.01 Minneapolis, USA
- 1.02 InnovationCity Ruhr, Bottrop, Germany
- 1.03 ProjectZero, Sønderborg, Denmark
- 1.04 DACH Cooperation, Karlsruhe, Germany
- 2.02 Stenløse South, Stenløse, Denmark
- 2.06 Furuset Forbildeprosjekt, Oslo, Norway
- 3.01 Salzburg Lehen, Salzburg, Austria
- 3.02 Minato Ward, Tokyo, Japan
- 3.03 PALET, Parkstad, the Netherlands
- 3.05 Minato Mirai 21, Yokohama, Japan
- 3.06 Zanklhof, Graz, Austria
- 3.07 Stieglgründe, Salzburg, Austria

2.7. Future research – including but not limited to IEA

Annex 63 brought together experts from multiple disciplines including engineering, urban planning, and design. Drawing on their diverse expertise and representing researchers and practitioners, the Annex was able to define not only the challenges to working across energy planning and urban planning, but also approaches to meaningfully integrating the two. The outcomes of Annex 63 draw broadly from across multiple national contexts and addresses urban cases of integrated energy and urban planning from small and large communities. In the future, research can be deepened via applications to different economic conditions, varied climates, and ongoing changes in technology.

2.7.1. Recommendations

To push the topic future research it is necessary to:

- Apply, evaluate and refine the high level findings of Annex 63 at the national and community scales to further understand the importance of context in shaping the approach to and outcomes of integrated energy and urban planning
- Complementing work conducted in Annex 63, attention to cities and approaches in developing country and warmer climate contexts are especially important.
- Conduct additional research on the institutional and decision making structures that can be used to sustain integrated energy and urban planning.
- Further examine approaches to public and stakeholder engagement within the specific context of energy and urban planning, bringing in additional disciplinary perspectives to examine public and stakeholder perceptions and fully achieve the multi-stakeholder concept design and commitment.
- Explore intersections with public and private sector initiatives around smart communities, including related private/public relationships and responsibilities.
- Redefine system borders in regional and city planning, in particular responsibility for national roads and mobility, local energy resource management, inter-municipality energy assessments and energy sustainability linked to socioeconomic aspects.
- Further examine mechanisms for balancing social and environmental goals between public and private stakeholders.
- Identify methods for municipal capacity building for new technologies (e.g. management of electricity supply and demand accompanying large-scale dissemination of PV).

2.7.2. Justifications

For example, research in Norway has identified ten challenges on the way to emission-free areas in their case areas.:

1. Stakeholder collaboration and project management
2. Lack of knowledge
3. Legislation
4. Goal conflicts
5. Time and cost pressure
6. New energy technologies
7. System boundaries
8. Risks and uncertainties
9. Flexibility
10. Transferability

The conventional sequencing of private and public roles in the planning and implementation of plans is disadvantageous for integration of energy into planning. As the responsibility for holistic neighbourhoods must be more equally shared between private and public sector. This would need a balancing of risks and responsibilities. It could be beneficial to look into cross-sectoral and integrated project delivery models that balance regional and local perspectives, social and environmental goals, is key to achieve maximum impact of energy planning.

In order to realize a decarbonized society in the second half of the century, as required by the Paris Agreement, innovation in both, technology and planning procedures are necessary. Therefore, suitable formats are needed in which the exchange of technology- and process-oriented research can take place, in order to deduce suitable research questions.

2.7.3. Examples

Additional examples to this topic are integrated in Volume 1 to 4:

- Volume 1: Inventory of measures
- Volume 2: Development of strategic measures
- Volume 3: Application of strategic measures
- Volume 4: Stakeholder support materials

3. Operational level

The recommendations on the operational level deal with the following topics:

- 1) Set Vision and Targets
- 2) Develop Renewable Energy Strategies
- 3) Make Full Use of Legal Frameworks
- 4) Design of Urban Competition Processes
- 5) Make Use of Tools Supporting the Decision Making Process
- 6) Implement Monitoring of Energy Consumption and GHG Emissions
- 7) Stakeholder Engagement & Involvement
- 8) Include Socio Economic Criteria
- 9) Implement Effective and Efficient Organisational Processes

3.1. Set Vision and Targets

In order to enable the linkage between urban planning and energy planning, communities should develop a community-based vision identifying the main goal to reach and possible pathways to get there.

- This also holds the different actors together.
- The identification of concrete measures and actions helps to move towards the common goal.
- Setting realistic and measurable targets is of vital importance to ensure that the local actions are leading towards the common goals and progress can be accessed.

3.2. Develop Renewable Energy Strategies

Strategic energy plans can relate to all components of energy systems, including production, conversion, delivery and use of energy, as well as all scales from global down to single buildings and building components.

- Developing a renewable energy strategy should be considered as an iterative process, within which ongoing assessment allows for responses to changing conditions.
- Community-scale renewable energy strategies are typically more focused on spatial implications of energy demand and community energy infrastructure.

3.3. Make Full Use of Legal Frameworks

General laws, secondary regulations and more or less formal / informal guidelines and recommendations are supportive frameworks for the implementation of visions, targets and renewable energy strategies.

- Regulations on a regional or national level support a much broader approach of implementation as a legal duty to communities.
- Clear regulations increase the planning security for investors and building owners and ensure the optimal usage of synergies.
- Contracts are an third and flexible alternative to regulate energy planning. The success of this instrument depends on market conditions.

3.4. Design of Urban Competition Processes

Climate and energy-related issues could and should be part of competition process (sometimes called requests for proposals). The following measures support the integration:

- Define the person who is responsible for planning, organising and running the competition and occupy this role with a “sustainability expert” who is capable of objective approaching a competition and combine design quality with sustainability.
- Define the requirements for the competition program and include aspects of sustainability.
- Define the assessment rules in the request for proposal and consider energy and carbon requirements in the evaluation.
- The jury composition affects strongly the outcome for the sponsor and the sustainability strategy. Therefore: Bring in outside experts or designs of some renown to give importance to sustainable and visibility to the competition.

3.5. Make Use of Tools Supporting the Decision Making Process

The aim of this measure is to clarify how decision makers as well as urban and energy system planners can be supported by information tools. Information tools can help to collect, evaluate and communicate data. An important aspect is the appropriate “translation” of data into the language of the target group. The visualization of data, such as with maps and graphs, helps to share information targeted to a variety of users. In addition, the interpretation and usability of collected data is crucial for informing the best possible decisions.

- Cities should provide a centralized data management with flexible interfaces to enable simple data access and provide a platform to share and access data, such as the central building database of the Netherlands (<https://code.waag.org/buildings/>).
- Integrate local knowledge in the decision process (local experts, community associations, citizens).
- Get tool support as early as possible. Early decision support can save time and money in later phases.
- Use simple tools to integrate stakeholders, such as web browser access or mobile applications.
- Visualization can transform data into a form or language that can be more easily understood by the target audience. Due diligence: Account for data uncertainty. Interpret the data methods and findings. Integrate stakeholders to verify the data.
- Consider external support for expert tool knowledge, especially when detailed analyses are required.
- Communicate: To support both data management and the use of tools, report to stakeholders on their benefits, such as a better foundation for decision making or reduced time and effort for data gathering.

3.6. Implement Monitoring of Energy Consumption and GHG Emissions

The role of decentralized local structures will become increasingly important in the context of decarbonisation. This will also increase the need for decentralized databases, which must be able to collect and process information on urban areas - extending the depth of data gathering and setting up of monitoring systems to district and neighbourhood level. The precision of data collection is constantly being optimized at the local level. The trend towards smart cities and digitalization will lead to more accurate and comparable reporting standards, carbon inventory guidelines and tools. A major challenge remains the stakeholders' acceptance of the data gathering/monitoring, which is strongly linked to data security and privacy, but also to a clear communication of possible benefits.

- Implement monitoring strategies at affordable costs based on standardised and often already existing infrastructure.
- Monitoring strategies will be successful if they are based on the inclusion and participation of all relevant stakeholders.
- Monitoring energy consumption in housing stock/public buildings can be a strong trigger for consumers to reduce their costs either by reducing their consumption.
- Monitoring energy consumption and GHG emissions of local industries and trade will encourage technological solutions towards energy efficiency.
- Monitoring GHG emissions on municipal and community level will encourage local strategies towards decarbonisation via changes of behaviour.

3.7. Stakeholder Engagement & Involvement

Many studies show: Stakeholder engagement and stakeholder involvement are essential for the successful implementation of energy strategies in communities. The answers to the following questions should be a fundamental part of the overall planning process:

- Identify the lead person / organisation for the plan or project initiative.
- What are the driving principles and goals of the plan or project?
- What stakeholders share the project territory, have related expertise, have interests, and/or have power that can influence the outcomes?
- What impact could the project bring to each of the stakeholder groups and where are the contact points?
- In what ways can stakeholders and the public contribute expertise?
- What role will the stakeholders play in your project; what are the possible ways to interact with them and when should that interaction begin?
- How and when should ongoing interactions and results be documented and shared?

3.8. Include Socio Economic Criteria

Investments in energy efficiency can provide many different benefits to stakeholders. To make them visible it is necessary to

- Identify which stakeholders benefit from a broader business model.
- Invest in the pre-planning phase, gaining commitment from stakeholders and bringing them together.
- Identify a localised set of benefits that relate to the stakeholders' needs.
- Identify those stakeholders who will profit from the broader business model.
- Employ impact assessment models to assess the impact of transition options on the community.

3.9. Implement Effective and Efficient Organisational Processes

As energy planning is an issue that concerns multiple actors and stakeholders it is necessary to bring all relevant organisations together and approach the topic in an integrated fashion. Effective and efficient organisational structures can be characterized as follow:

- Strong ties to existing municipal structures.
- Secured financing.
- Involvement of energy suppliers and network providers.
- Monitoring process and cyclical thinking.
- Strong local involvement and impulse.
- Government requirements.
- Create exchange of knowledge.

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