GABC - Global Roadmap
towards low-GHG and resilient buildings

Recommendation for a classification of measures and policies related to local conditions

Leistung gemäß Rahmenvertrag zur Beratung der Abteilung II des BMWi

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Content

Background

Starting point

The Global Alliance for Buildings and Construction (GABC) defines a clear target: Developing the current building stock towards net zero energy in 2050. Energy supply should become low carbon and buildings highly efficient and resilient to the effects of climate change. The global roadmap, prepared by the GABC as draft version in 2016, provides the following sub-targets:

- Target 1: Set global goals and milestones
- Target 2: Support national decision makers to design nat. strategies and policies

Recommendations for an evolution of the global roadmap

As a starting point for a partial extension of the global roadmap, an analyses of the current activities of the GABC along the phases of the policy cycle was performed. The result is presented in Figure 1.

Figure 1: GABC activities according to the policy cycle

The cycle starts with evaluation. Within the current GABC activites the different phases of the policy cycle are covered as follows:

- ⇨ *evaluation* is addressed by means of the global status report
- ⇨ *targets* is addressed by embedding the activities of the GABC into the (well-below) 2°C target
- ⇨ *strategies* is addressed by means of the current draft global roadmap
- ⇨ *implementation* so far is not addressed

⇨ *enforcement* so far is only addressed by the insight that the global roadmap only gets effective when it will be adequately translated, implemented and enforced on a national level.

In this document we address strategies, implementation and enforcement.

As to strategies, we have two observations:

1) "Key Actions" of the roadmap should be understood as "Strategic Priorities" or core themes:
   a. Key Action 1 -> Strategic Priority "Sustainable urban planning"
   b. Key Action 2 -> Strategic Priority "Low carbon retrofit of existing buildings"
   c. Key Action 3 -> Strategic Priority "New net zero emission buildings"
   d. Key Action 4 -> Strategic Priority "Management of building performance"
   e. Key Action 5 -> Strategic Priority "Decarbonized energy"
   f. Key Action 6 -> Strategic Priority "Sustainable construction materials"
   g. Key Action 7 -> Strategic Priority "Efficient appliances"
   h. Key Action 8 -> Strategic Priority "Resilient buildings"

This will allow to clearly discern and systematically derive targets, measures and policies for each of the strategic priorities down to the national level. We propose that furthermore the global roadmap should feature two different toolboxes: a generic set of technologies per strategic priority and a generic set of wide-spread policies for actual implementation of needed technologies. This structure is illustrated in Table 1.

Strategic Priority	Sustainable urban planning	Low carbon retrofit	New NZEB	Management of buildings	Decarbonized energy	Sustainable construction	Efficient appliances	Resilient buildings
Targets	Specific targets per Strategic priority							
Technologies	Toolbox 1: Generic set of technologies per priority							
Policies	Toolbox 2: Generic set of policies across priorities							

Table 1: Strategic Priorities

2) The global roadmap, closely linked to insights from the global status report, should highlight major threats and/or trends and their allocation – which we call "hot spots". This information should be added to the strategy part.

As to implementation and enforcement we made another observation. So far guidance is missing to translate the global strategy into national policies – which is key to actually implement and enforce the global strategy: So far many developing and emerging countries have not been able to define a national building strategy or NDCs (Nationally Determined Contributions). Many countries who defined NDCs did not specify a strategy for buildings. Yet, the global roadmap for buildings and construction should play an important role to support countries in defining national targets and strategies for a low carbon building sector as intended by target 2 mentioned above “Support national decision makers to design national strategies and policies”. The global roadmap should introduce into the necessary steps for setting up such a building strategy.

Based on our observations and in line with the main targets for the global roadmap mentioned above we recommend, the global roadmap should have a main part called

- Roadmap Part I – Strategy and future global “hot spots” for action

  and an equally important part called

- Roadmap Part II – Implementation guidebook that provides guidance for the development of national building strategies.

In the following chapters these two parts will be explained further.

Part I - Strategy and future global “hot spots” for action

The roadmap is to describe global strategic priorities to steer the global development towards a low carbon building sector. For setting the priorities right, emerging future threats and/or trends should be highlighted within the global roadmap. Visualization of such threats and trends by means of global maps seems to be most appropriate for efficiently informing decision makers around the globe. As an example a global mapping of “person degree days” was elaborated for highlighting the regions with the highest priority for timely development of strategies, that mitigate the uptake of cooling demand.

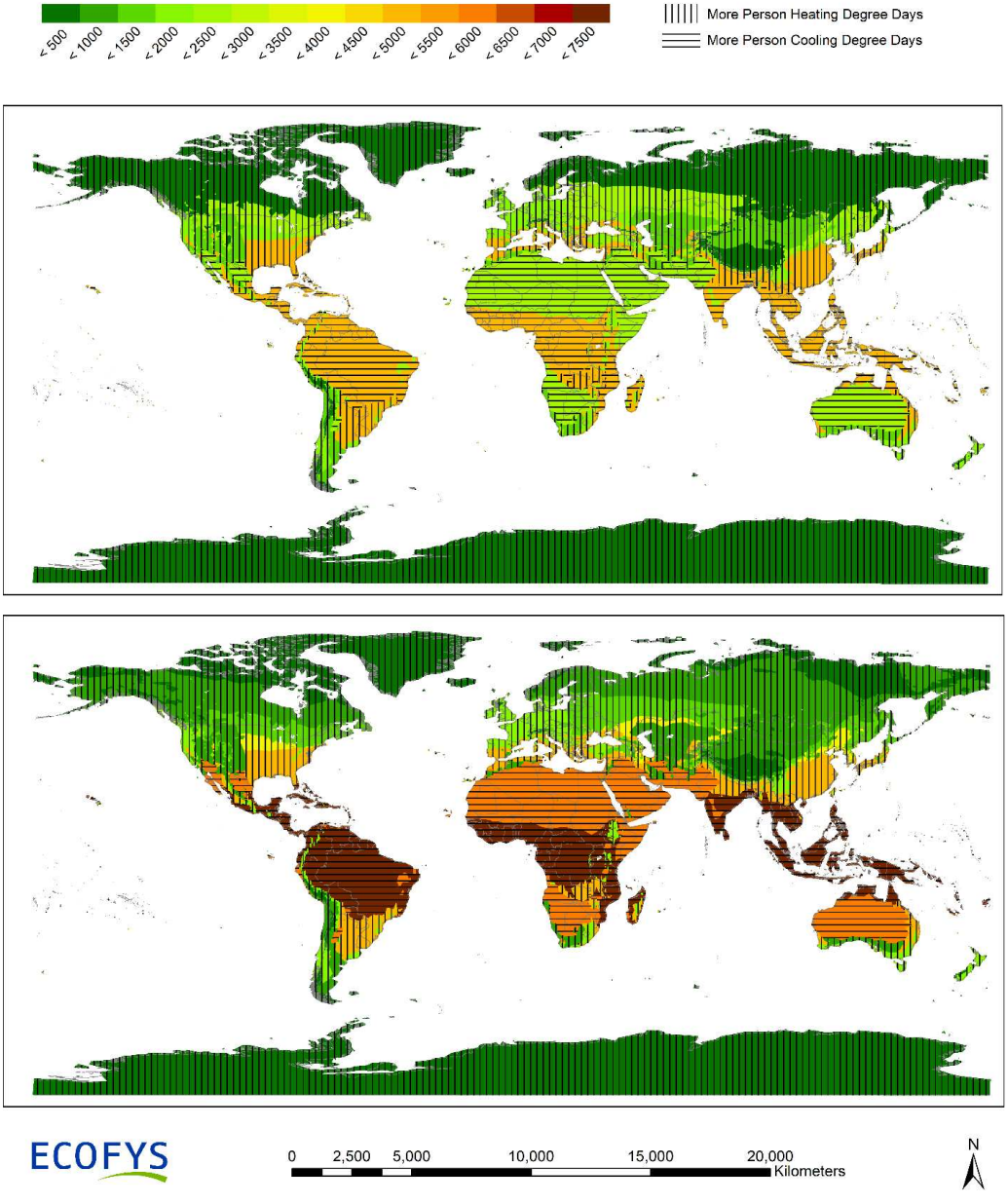

Figure 2: Comparison of person degree days in 2007 (top) and 2050 (bottom)

Multiplying the local heating and cooling degree days with the number of persons living in a specific (climate) region leads to a unit called *person heating degree days (PHDD) or person cooling degree days (PCDD)*. The sum of both can be expressed as *person degree days (PDD)*. This unit shows how many people are living in heating or cooling dominated regions. In 2007, the total *sum* of person degree days (PDD) was ~19,000. From these PDDs, 54% were person heating degree days (PHDD) and 46% person cooling degree days (PCDD) [Stein and Rullán Lemke, 2009].

The situation changes in 2050. According to population and climate forecasts, the PDDs will increase to roughly 26,000 while the split moves to 45% PHDD and 55% PCDD [Stein and Rullán Lemke, 2009]. This development is clearly shown in the lower figure. It clearly shows how hotspots of heating and cooling demand will move and/or aggravate within only a few decades. Heating dominated zones are marked by vertical lines) while cooling dominated zones are marked by horizontal lines.

This approach delivers a rough illustration of the development to come. It not only highlights the adequacy of this method for the purpose of setting up a global roadmap for buildings but it also shows the large regions deserving specific attention. Obviously for future analysis beyond this project the topics and granularity of such maps could be increased significantly.

Part II – Implementation Guidebook

General approach

Providing guidance for all countries that are still in an early phase of national building strategy design, the strategy and targets of the global roadmap need to be converted into country or region specific approaches, according to its particular context.
The major steps needed to do so are as follows:

- ⇨ Start with the strategic priorities given in the global roadmap
- ⇨ Define targets for each strategic priority on a global level and elaborate two toolboxes for generic technological measures and policies which are part of the global roadmap. This provides for a pool of generic technological measures and policies.
- ⇨ Generic measures need to be differentiated/translated into locally adequate technological measures and policies.
- ⇨ For this purpose the local context needs to be systematically analysed as to different aspects. The local context works as a filter to identify the most suitable technologies and policies.
- ⇨ As soon as the most suitable technologies and policies have been identified they will be further elaborated taking into consideration the local conditions.

Figure 3 provides an overview of this general approach underlying the implementation guidebook. It will be described in more detail in the following chapters. Its application in practice will be highlighted by means of two case studies for Tanzania and Indonesia.

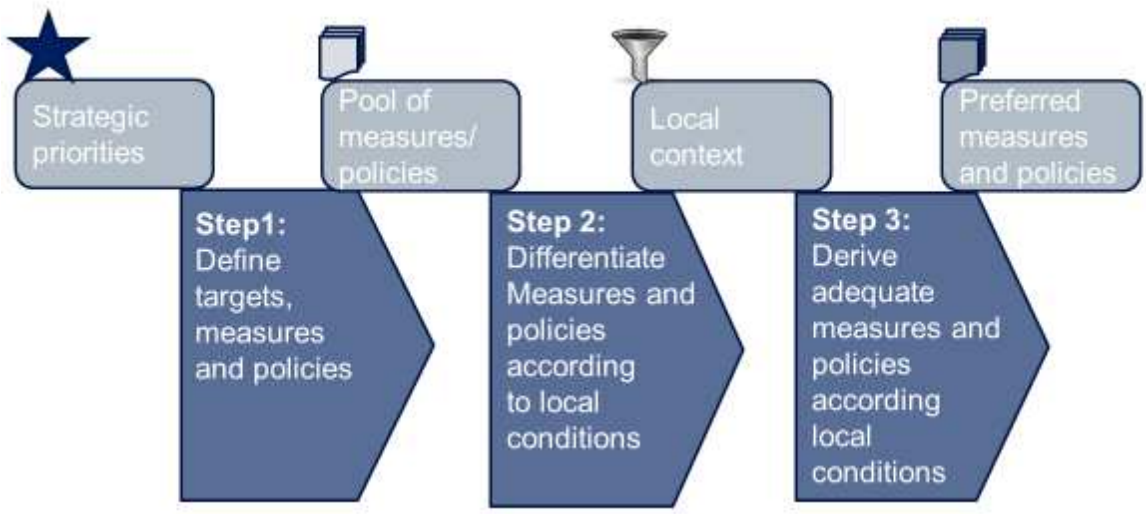

Figure 3 From global priorities to national strategies

Elements of the proposed methodology

Toolbox 1: Technologies

For each Strategic Priority a "pool" of generic technologies can be defined, including all relevant and most common technical measures, e.g.

- Reducing heating demand – building insulation, mechanical ventilation, efficient heating systems
- Reducing cooling demand – building insulation, shading and reflecting materials, efficient cooling systems
- Reducing the energy for ventilation – ventilation systems with heat/cold recovery
- Reducing energy for lighting – LEDs, daylight systems
- Reducing energy for heating water – solar thermal systems, efficient boilers
- Reducing energy for equipment and appliances – reducing standby-losses
- Improving persistence and monitoring of savings – building automation and control systems including energy management systems, continuous commissioning
- Reducing fossil fuels in energy supply system – Increase share of renewable energies for heating, cooling, power
- Climate proof construction – climate responsive / variable construction elements.

An elaborated version of such toolbox should group those generic technologies by strategic priority.

Toolbox 2: Policies

Across Strategic Priority a "pool" of generic policies can be defined, including all relevant and most common policy measures being applied in the buildings sector, which usually are structured within three buckets:

- Regulation: e.g. building codes, refurbishment obligations, RES-Heat obligations, energy management schemes, voluntary agreements like certifications or low carbon standards
- Information: labelling, capacity building, information campaigns, energy audits
- Promotions: product or project subsidies, fiscal incentives, low interest loans, grants

An elaborated version of such toolbox should include a complete typology of such generic policies.

Local context impacting the translation of generic technological measures into locally adapted technological measures

The following country specific information seems necessary to set national or regional priorities and to define most important technical measures and technologies matching the local situation:

- *Socio-demographic data:* Urbanization rate, population growth, (energy poverty): the focus of measures (e.g. new buildings vs. renovation) very much depends on whether a country is characterized by high/medium/low/stagnating urbanization and/or population growth. Figure 4 shows the very diverse global distribution of the annual urbanization rate (differentiated into

low, medium, high). Obviously a focus on new buildings and thus a high importance of urban planning can be expected in those regions with high urbanization rates.

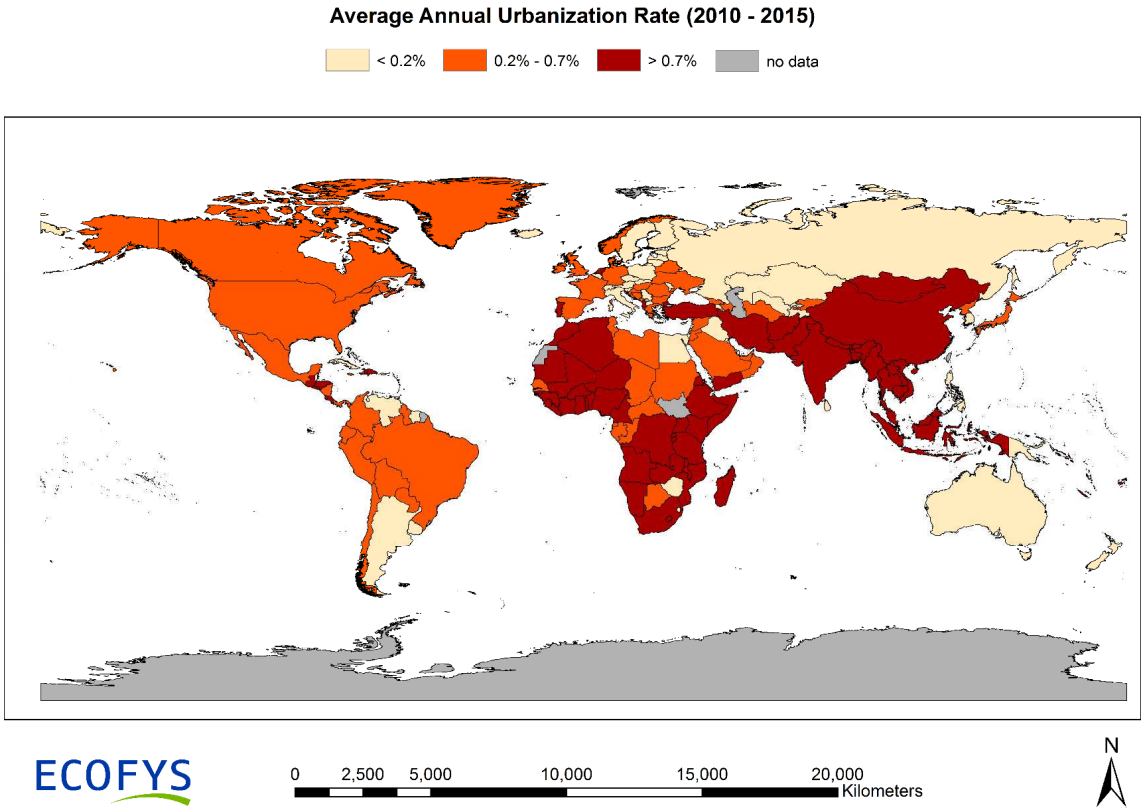

Figure 4: Annual urbanization rate (high, medium, low)

- *Economic data:* GDP per capita (income level), energy prices: this information determines the share of high /low cost investment measures and the marginal abatement cost curves vs. energy prices, which reveals the type and order of cost-effective measures.
- *Energy data:* Fuel type used, renewable energy resources available, access to energy: this information provides insight into the maturity and type of the energy system, which is decisive how future strategies for the transformation of the energy system look like and questions about the coupling of the demand and supply side should be approached in a specific context.
- *Building data:* Construction type (use of materials, historical construction technique, technologies available on the market, availability and cost of land): this type of information is decisive for setting priorities (residential, non-residential), the availability of space for new construction and relevant construction types / locally available construction materials and related cost. It will usually go hand in hand with economic, energy and climate data to determine cost optimal solutions for new buildings and renovation.
- *Climate data:* this information and also projections about its future development are decisive for judging the importance of heating, cooling, and dehumidification measures. These four cli-

mate zones seem to be sufficient to distinguish countries by climate and to select suitable technologies considering the previously mentioned factors: mainly cold, temperate, hot & dry,

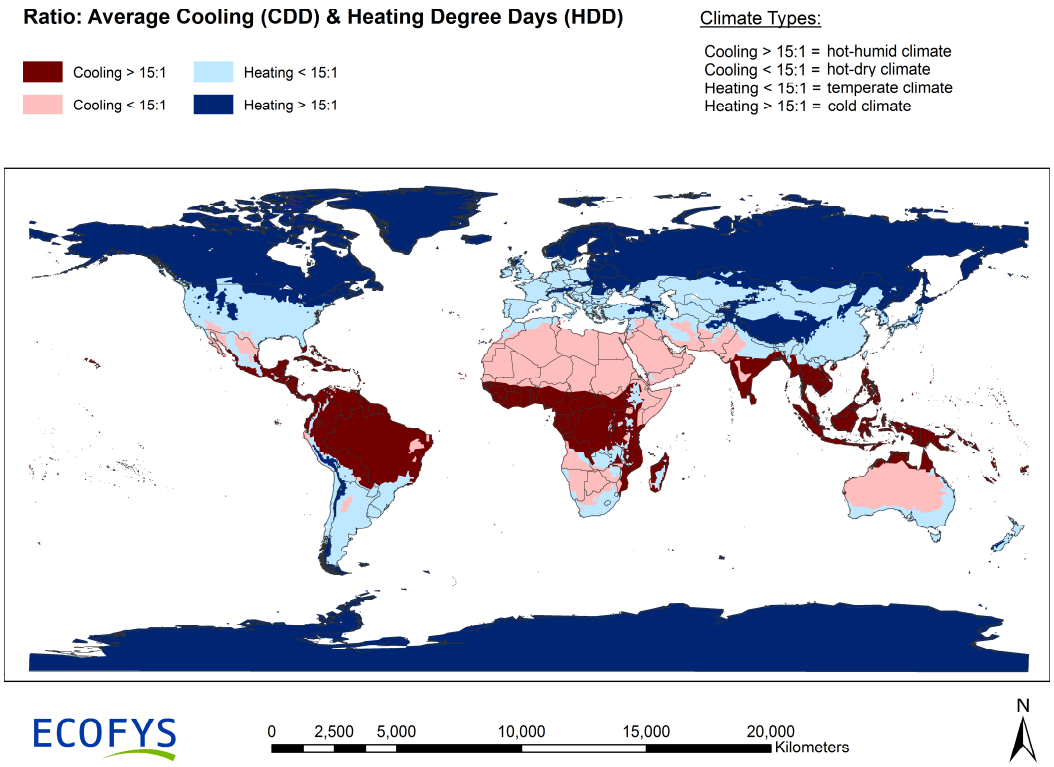

Figure 5: Climate zones (Cold, temperate, hot dry, hot humid)

hot & humid climate. The distribution of climates around the world is illustrated in Figure 5: Climate zones **(Cold, temperate, hot dry, hot humid)**

- *Policy context:* In addition, to further define national policy strategies and its implementation, the national state of policy development needs to be taken as a basis for an analysis of gaps and next steps to develop/complete the national strategy.

Steps for deriving locally preferred technical measures

Figure 6 illustrate the steps to derive the most adequate technical measures for a given local context.

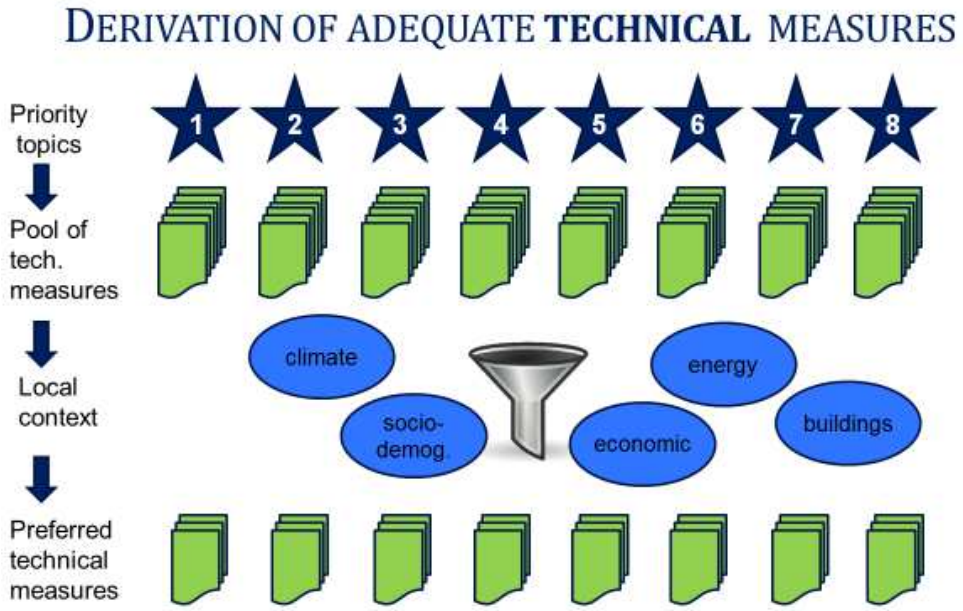

Figure 6: Steps to derive adequate technical measures

Starting with the roadmaps' strategic priorities and each priority's pool of technical measures the analysis of the local context is used to determine local strategic priorities and targets and to filter out the locally most relevant technical measures. The knowledge about the local context also underpins the elaboration of generic technical measures into concrete, locally adequate preferred technical measures.

Steps for deriving locally preferred policy measures

Figure 7 illustrates the steps to derive the most adequate policy measures for a given local context.

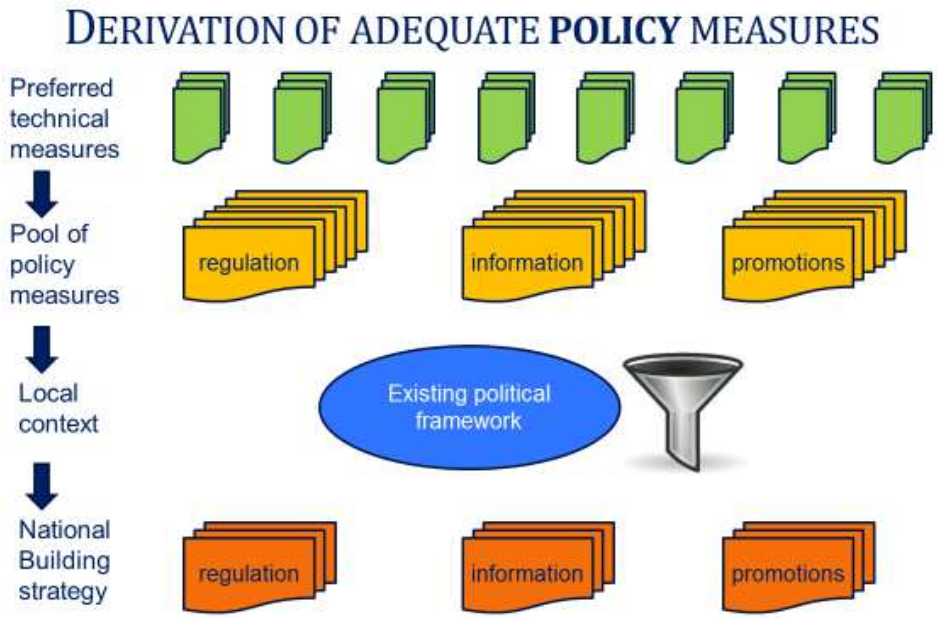

Figure 7: Steps of Policy Approach

Having determined the most suitable technical measures to reach the target of a carbon neutral building stock, the next step towards developing a national building strategy is to define a suitable set of policy measures which together with the technical measures will form the national building strategy.

This means the task is now to select the most suitable generic policy measures that can be found in the roadmap's pool of policy measures and adapt and specify them according to the local political framework.

Step 1: Asssessment of local political context

In order to do so, a crucial step is to thoroughly assess in detail the local context, i.e. a country's *existing political framework*. Where does the national government stand in the policy process? What are the main barriers and drivers? Who are the most important stakeholders to foster the development? How could a solid financing be organized?

Like in the analysis of technologies, the local policy context acts like a filter for determining the most suitable generic measures and to further elaborate and adapt them to the local context.

Again an assessment along the phases of the policy cycle (Figure 8), which defines the subsequent steps of policy making, helps to structure the process.

- Evaluation – status quo of political instruments

- Targets – key targets of strategic priority
- Strategy – setup of implementation framework (policy mix)
- Implementation – Institutional and legal framework
- Enforcement – enforcement strategy

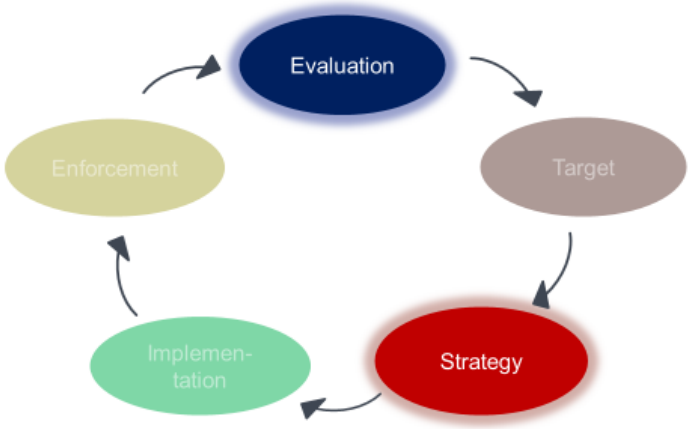

Figure 8: Policy Cycle Analysis

For each strategic priority the progress as to national target setting, strategy development, implementation and enforcement should be assessed.

The resulting overview of the current state of national building policy is used to select the most relevant building policies for the country based on existing gaps and those with the highest local impact.

Step 2: Defining specific elements of national building strategy

Based on the assessment of national priorities and gaps, the most relevant policies to implement within the national building strategy will be defined

- Target setting – key targets based on high priority technical measures
- Strategy development – policy framework supporting the achievement of national targets based on current state of policy background
- Implementation – institutional and legal setup to realize targets
- Enforcement - activities to increase compliance with requirements

The proposed approach is further exemplified with the help of two country case studies for “Tanzania” and “Indonesia”.

Conclusion

Technically we recommend for the further configuration of the roadmap to interpret Key Action as Strategic Priorities and clearly distinguish between targets, technologies and policies. We see an added value in using the „Policy Cycle“ to assess the national state of policy making to support national building strategies.

In general, we propose to create a stronger link between global status report and global roadmap, linking the current situation of the global building sector to a global low-carbon strategy. Future developments asking for immediate action or emerging threats in certain regions (hot spots) of the world need to be assessed and tied with targets and concrete action plans to avoid lock-in effects and exponential developments in the wrong direction.

We also recommend to include an Implementation Guidebook in the roadmap to translate Strategic Priorities into national strategies and to consider additional parameters on local context (filter) beyond climate to translate global targets, technical measures and policy approaches to the national level.

An advanced roadmap, including long-term global strategies (Part I) as well as the Implementation Guidebook (Part II), could be developed by the GABC to support the national policy making process in all countries, showing how the approach can lead to a future-proof, low-carbon and resilient building strategy and helping to set priorities based on a global overview of necessary actions as well as on the national requirements and needs.

Case study Indonesia

Indonesia serves as one of two case studies illustrating the approach for deriving national building policies that has been explained before. Indonesia and Tanzania will be taken as an example. Please note that the main purpose is to illustrate the approach. Actual development of building strategies for both countries needs further analysis. It is not the intention of the GABC to prescribe building strategies to countries, but to provide best possible guidance how this can be done systematically.

Derivation of preferred technical measures

Analysis of local context

Table 2. Analysis of local context for deriving suitable technical measures

Local context	**Indonesia**
Climate zone(s)	Equatorial
Population	255.4 million 1.21% annual population growth
Urbanization	1.47% annual urbanization rate (population: 134 million) (https://esa.un.org/unpd/wup/publications/files/wup2014-highlights.Pdf)
GDP per capita	3475.25 USD
Energy price	Average Electricity price 2012: 1271 IDR/kWh Gasoline: 90.5 US$/BOE, 2015 Avtur: 113.21, 2015 Avgas: 355.99, 2013 Kerosene: 34.6, 2013 ADO: 97.03, 2015 IDO: 119.78, 2008 Fuel Oil: 77.96, 2008 LPG (3 Kg): 0.041, 2013 LPG (12Kg): 0.061, 2013 LPG (50Kg): 0.129, 2013 Coal: 18.88, 2014 Electricity HH: 99.42, 2014 Industry: 128.22, 2014 Commercial: 149.44, 2014

Local context	Indonesia
Energy access	88.3% (Handbook of Energy & Economic Statistics of Indonesia 2016, Ministry of Energy and Mineral Resources Republic of Indonesia)
Fuel type used	Supply of Primary energy (2015) Oil: 38.35% Coal: 22.21% Gas: 17.03% Hydro: 2.15% Geo: 1.00% Biomass: 18.86% Biofuel: 0.41% (HANDBOOK OF ENERGY & ECONOMIC STATISTICS OF INDONESIA 2016, Ministry of Energy and Mineral Resources Republic of Indonesia)
RE resources available	Installed Capacity: 10,676 Hydro: 71% Biomass: 16% Geo: 12.5% Other: 0.5% (Energy Policies Beyond IEA Countries: Indonesia 2015, IEA)
Construction (use of materials, historical construction technique)	

Preferred technical measures by strategic priority

Table 3. Preferred technical measures according to local conditions

Strategic priorities	Technical measures
Urban planning	Optimization of urban fabric/structure for more efficient use of resources: (i) active use of solar energy (ii) include shading and urban ventilation aspects in structural plans Include green and blue infrastructure in urban landscape if sustainable Land use planning with focus on the smart use of resources should be in place from the very beginning of the urbanization process (green/smart city master plan) following certain standards Optimize urban form for the use of renewable energies and efficient energy distribution

Strategic priorities	Technical measures
	for heating/cooling/power
Retrofit existing buildings	Renovation measures to reduce cooling and dehumidification demand Insulation/exchange of parts of the building envelop Reduction of ventilation losses by improvement of air tightness + natural ventilation Exchange of existing/ old cooling system for more efficient cooling Installation of solar thermal systems for hot water generation Optimize external renovation (e.g. include external shades) to minimize solar gains
New net zero emission buildings	Optimization of the building codes to increase impact of architectural and passive measures - compactness, form and orientation of the building, shading, natural air ventilation Substantial reduction of cooling demand via high insulation of the building shell (roof, windows) Reflective materials Efficient cooling systems Efficient use of RE (solar thermal, PV, wind etc.) Natural ventilation – increase passive cooling capabilities of buildings Solar dehumidification
Building management	Information on energy savings through the implementation of energy management systems (ISO 50001) Improvement of behavioral aspects via trainings etc. Effective building operation and maintenance, user education, energy metering and information on consumption
Decarbonized energy	Construction of new buildings and urban infrastructure should follow high-density living methods (e.g. multifamily buildings, commercial buildings and urban infrastructure should be clustered to enable district cooling solutions that use clean energy sources Promote use of recycled materials as well as low energy intensity materials (e.g. bamboo, straw, clay) and traditional construction techniques through education curriculums of universities with architecture and civil engineering programs; For new buildings ensure that the building envelope is properly insulated and ventilated to avoid massive energy losses during intense heating periods

Strategic priorities	Technical measures
	Design buildings using green building design principles (e.g. passive solar, PV roof-tops, geothermal heating, shading, etc.)
Sustainable construction materials	In hot climates, as in any other climate, this Strategic Priority will be effective if new buildings are constructed with materials with low energy and carbon footprints With rapid urbanization rate, new buildings should use recycled materials and traditional techniques were low-energy-intense materials are used (e.g. bamboo, straw, clay); Promote traditional construction techniques and materials through education curriculums of universities with architecture and civil engineering programs as well as sustainable building practices for low-income households; Promote concept of circular economy in construction or renovation of buildings For new buildings ensure that the building envelope is properly insulated to avoid massive energy losses during cooling/heating periods
Efficient appliances	Effective building operation and maintenance, user education, energy metering and information on consumption Promote transition to energy efficiency appliances
Resilient buildings	Upgrade buildings and infrastructure for hurricane and storm protection (e.g. houses built on stilts, floating houses) Avoid flooding areas, climate proof construction Identify materials that are climate-proof but are at the same time low-energy intensity, and foster the use of these through the implementation of the strategy above

The following strategic priorities have been identified based on the evaluation of the local technical context:

- Sustainable urban planning: required to maximize future efficiency potential for rapidly growing cities (SP1)
- New buildings place increasingly high burden on electricity grid: measures required to limit the impact and increase building efficiency (SP3)
- Decarbonized energy: In regions where the urbanization rate is high, the total floor area will grow accordingly, increasing energy consumption (total/per capita) (SP5)
- Efficient appliances: Cooling and dehumidification are the major contributors to electricity consumption in new buildings - energy efficient appliances required to mitigate these effects (SP7)

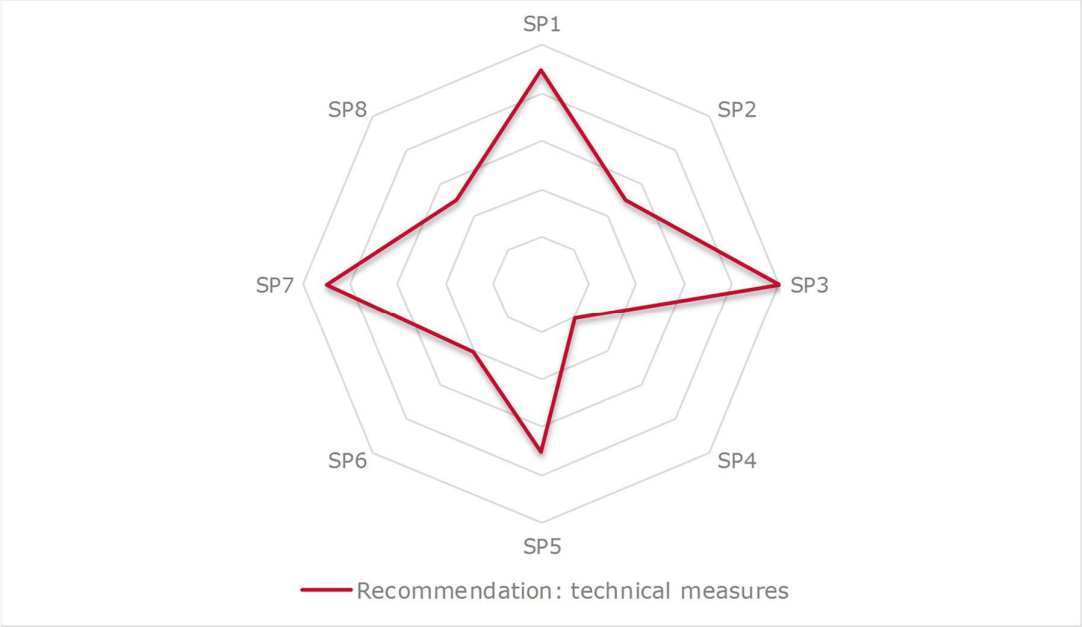

Figure 9: Mapping of the recommendations of technical measures - Indonesia

The priorities are qualitatively mapped in the spider net graph shown in Figure 9. The outer border means “should get very high priority”, while the recommended priority is declining towards the center of the graph.

The next step is to assess the current political context in order to be able to identify gaps between recommended strategic priorities and actual building policy priorities.

Derivation of preferred national policies

Analysis of existing national policies

Table 4: Overview of existing national policies

Local context - Policies[1]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
Urban planning	Integrating climate change adaptation efforts into urban spatial planning plans Quality management of sustainable urban environments	Preparation of maps of vulnerability to climate change for urban areas Preparation of spatial planning documents and management plans in urban areas The application of the concept and structure of the city and region based society and infrastructure vulnerability assessment Application of green urban development (Green Cities) Preparation of a strategy of urban settlements and infrastructure are integrated and in accordance with the direction of the development of the city as a "comprehensive" (including adaptation to climate change) and improving	InaSAFE (Indonesia Scenario Assessment for Emergencies): Software to assess vulnerability to disasters	n/a

[1] Source: • UNCC: Learn Pilot Project Indonesia: National Climate Change Learning Strategy • Indonesia: Helping Build Resilient Communities, World Bank 2014 • Indonesia Country Summary: IPEEC Building Energy Efficiency Taskgroup • First Nationally Determined Contribution Republic of Indonesia, 2016 • Summary of Indonesia's Energy Sector Assessment, 2015 • Indonesia climate change sectoral roadmap ICCSR, 2009 • Building Resilience in Eastern Indonesia – Effectiveness Review Full Technical Report, OXFAM 2012

Local context - Policies[1]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
		the quality of infrastructure in urban settlements Provision of urban drainage systems with environmental Provision of settlement with strong structures decent and affordable Reduction in the risk of disruption of the function which is based on the effects of flooding, sea level rise and other climate disasters Increase the capacity of urban communities associated with the threat of climate change issues Research and quality improvement information related to climate change in urban areas Increased public awareness about adaptation to climate change in urban areas Capacity building and research on the phenomenon of climate change impacts in urban areas		
Retrofit existing buildings	Certification of 50% of state-owned buildings	Education and capacity building programs that support code implementation	Energy Audits when feasible Energy Labelling Scheme	Refusal of Functional Feasibility Certificate Voluntary rating tool

Local context - Policies[1]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
New net zero-energy buildings	Certification of 50% of state-owned buildings	Education and capacity building programs that support code implementation	National (Law No. 36/2005; Government Regulation No. 36/2005) made it mandatory for eligible new buildings to consider energy conservation measures, but requirements for new buildings less than 500 m2 are voluntary Energy Labelling Scheme	Refusal of permission to occupy (in Jakarta new buildings) Voluntary rating tool
Building management				
Decarbonized energy	23% Primary energy mix by 2025	Government investment in transmission and distribution to ensure system growth and reliability: USD 1.5 billion/year 2013-2022 Promotional strategies from local/regional governments Indonesian Renewable Energy Society	Feed in tariffs Tax incentives	Indonesia does not have an independent electricity regulator or transmission system operator (TSO) for en-

Local context - Policies[1]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
		Indonesian Biodiesel Forum National Team for Biofuel development Indonesia Geothermal Association Energy Self Sufficient Village (ESSV), Solar Home System program aimed at electrifying isolated rural areas.		hanced technical monitoring of power sector operations
Sustainable construction materials	15% clinker usage reduction by 2030	Measurement, reporting and verification of GHG emissions data at a plant level from the cement industry Set new performance standards National Communication campaign to Increase governmental support for eco materials (lead by example) Eco-label Cement Products Government support for building local institutional capacity in policy development and program delivery for eco-efficiency, energy audits, energy services	n/a	Reward efforts to cut greenhouse emissions; removing subsidies for damaging activities Provision of fair export/import levy for waste products Facilitation and investment on a supply network

Local context - Policies[1]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
		Capacity-build Energy Services Companies (ESCO)s for servicing the cement and other heavy manufacturing industries National communications campaign to encourage the use of blended cements Award System for specific savings in GHG emissions across the (target) industries		system of waste to be used as alternative fuel in cement industry
Efficient appliances	n/a	Develop regulations Developing Minimum Energy Performance Standards Develop Energy Labelling for appliances Increase promotion because awareness is low	n/a	n/a
Resilient buildings	n/a	Pilot Project: Educate people on vulnerability n small villages to boost disaster awareness		

Recommendation for a national building strategy

Evaluation of current policies

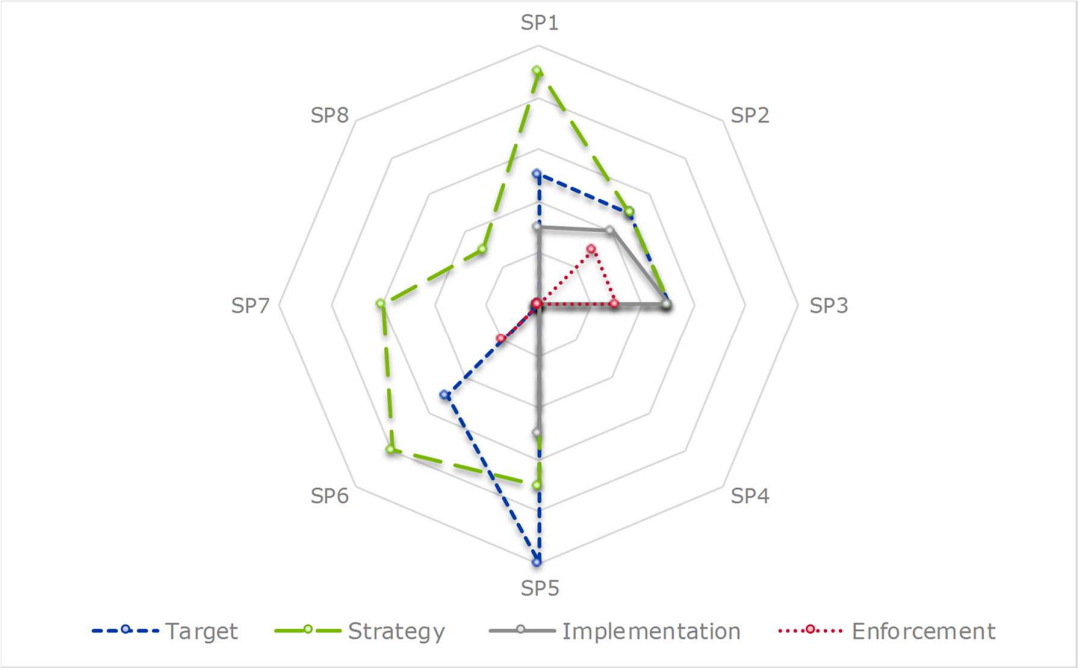

Figure 10: Mapping of status of national policies along the policy cycle

Legend:

Outer border: 10 = comprehensive approach across the sector, complete

Mid range: 5 = partial plan with potentially significant impact

Centre: 0 = nothing planned, or no information available

The mapping of the status of national policies in Figure 10 shows that requirements, incentives, information campaigns, and enforcement measures are lacking on a national scale. Additionally, specific targets are either absent for Strategic Priorities or will be insufficient to affect the necessary reductions in emissions.

As can be seen in Table 4, Indonesia currently has action plans to write policies regulating urban planning, building materials, and efficient appliances, which may increase the implementation of green city and energy efficiency building and renovation schemes. Current regulations exist mainly on a pilot scale and are either not enforced or are enforced but on a voluntary basis.

For the following Strategic Priorities, sufficient literature could not be gathered in the context of this project or they are not sufficiently addressed in available documents: SP1 urban planning, SP4 building management, SP7 efficient appliances, SP8 resilient buildings, i.e. the whole policy cycle needs to be applied to develop a common understanding of targets and a strategy which will accordingly be

implemented and enforced. Figure 11 illustrates the gap between recommended and current building policies. The blue line results as average of the results presented in Figure 10.

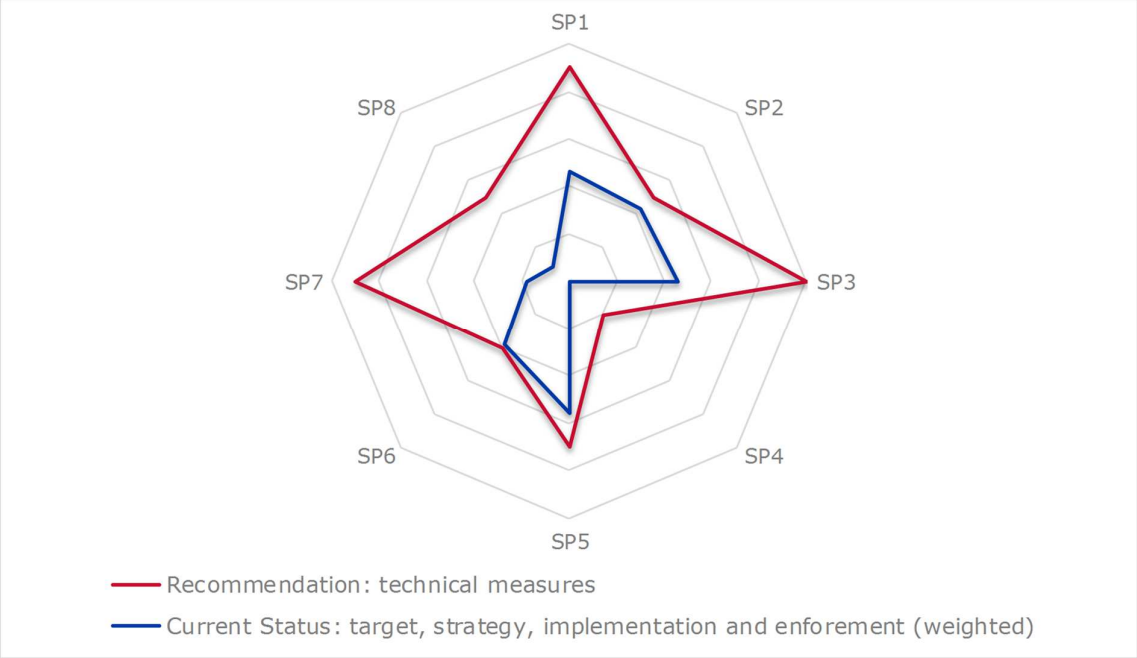

Figure 11, Mapping of gap between current and recommended policies

Recommendation for policy priorities

The comparison of technical recommendation and the status of national policies (Figure 11) reveals the strategic priorities showing the biggest gaps. These are the priority areas for national policies needing immediate implementation on the national level. In the following we look at the areas we recommended to rank highest on the political agenda. Some are already well addressed, others not.

Table 5. Proposed policy measures with regard to highly relevant strategic priorities

Strategic priorities	Policy measures
(1) Urban Planning	Implement intelligent urban planning policies to maximize future energy efficiency Define requirements for specific density, solar yield and coverage, blue and green infrastructure Define Requirements for the use of certain resources/RE; optimization and zoning of the urban structure accordingly
(3) New Buildings	Develop national education and capacity building programs Implement mandatory energy labelling schemes for new buildings

(5) Decarbonized Energy	The current policy status within Indonesia is close to the technical recommendations, and therefore SP5 is not an immediate priority
(7) Efficient Appliances	Develop minimum energy performance standards (MEPS) and labels for lighting and appliances (especially for cooling systems such as air conditioners, ventilation systems, fans, refrigerators and freezers); Implement throughout government buildings to show example and build efficient appliances industry

Recommendations for less relevant strategic priorities are summarized in the table below.

Table 6. Proposed policy measures with regard to less relevant strategic priorities

Strategic priorities	Policy measures
Retrofit existing buildings	Introduction of a Building Code including Energy Efficiency Increase energy productivity according to rising demand via more efficient buildings Provide financial support schemes to low-income social groups to allow access to energy efficient retrofit measures
Building management	Mandatory implementation of energy management systems and certification of building standards Requirements for demand-side management, flexible energy prices to steer energy demand, smart homes Internet of things requires new service providers and insurance of data security
Sustainable construction materials	For new buildings adopt regulations and enforce the use of materials with low energy and carbon footprints
Resilient buildings	Avoid flooding areas, climate proof construction Zonify the climate-change related risks and develop a strategy for renovation of standing buildings and implementation of new land use zones; Create financial schemes for low-income households to ensure their buildings are renovated to a climate-proof state Develop financial schemes that enable affected households to relocate without a financial burden

Case study Tanzania

Tanzania serves as one of two case studies illustrating the approach for deriving national building policies that has been explained before. Indonesia and Tanzania will be taken as an example. Please note that the main purpose is to illustrate the approach. Actual development of building strategies for both countries needs further analysis. It is not the intention of the GABC to prescribe building strategies to countries, but to provide best possible guidance how this can be done systematically.

Derivation of preferred technical measures

Analysis of local context

Table 7. Analysis of local context for deriving suitable technical measures

Local context	Tanzania
Climate zone(s)	Tropical with following regional variations: (i) Semi-temperate highland areas (ii) High lake regions (iii) Central plateau (iv) Coastal hinterland (v) Coastal area
Population	44.9 million
Urbanization	ca. 5% p.a. (Urbanization in Tanzania, 2014)
GDP per capita	879 USD 2673 USD PPP[2] (http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=TZ, 2015)
Energy price	Average Electricity price 2016 Residential: ca. 325 TZS/kWh (0.15 USD) Non-residential: ca. 200 TZS/kWh (0.9 USD) (http://144.76.33.232/wp-content/uploads/2016/04/TANESCO-ORDER-2016-ENGLISH.pdf, 2016)
Electrification rate	30% national electrification rate (urban: 57% and 18% rural) 96% Biomass (http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/ , 2016)

[2] Purchasing Power Parity

Local context	Tanzania
Fuel type used	Primary Energy Supply: 84.7% Biomass 10.7% Petroleum 3.1% Natural gas 0.9% Hydro 0.6% Coal
RE resources available	Installed Capacity: 594 MW (Total 1564 MW) Hydro 95% Other RE 5% (Renewable Energy in Africa: Tanzania Country Profile, 2015)
Construction (use of materials, historical construction technique)	Floor: Earth (59%) Cement (39%) Other (2%) Walls: Poles, branches, grass (1%) Mud and/or poles or stone (24%) Mud bricks (25%) Baked or burnt bricks (27%) Concrete, cement, stone (21%) Other (3%) Roof Grass, leaves, bamboo (28%) Mud& leaves (4%) Metal/ iron sheets (66%) Others (2%) (Household Budget Survey, Main Report 2011/ 2012)

Preferred technical measures by strategic priority

Table 8. Preferred technical measures according to local conditions, e.g. for coastal area

Strategic priorities	Technical measures
Urban planning	Optimization of urban fabric/structure for more efficient use of resources: (i) active use of solar energy (ii) include shading and urban ventilation aspects in structural plans Include green and blue infrastructure in urban landscape if sustainable Land use planning with focus on the smart use of resources should be in place from the very beginning of the urbanization process (green/smart city master plan) following certain standards Optimize urban form for the use of renewable energies and efficient energy distribution for heating/cooling/power
Retrofit existing buildings	Renovation measures to reduce cooling and dehumidification demand Insulation/exchange of parts of the building envelop Reduction of ventilation losses by improvement of air tightness + natural ventilation Exchange of existing/old cooling system for more efficient cooling Installation of solar thermal systems for hot water generation Optimize external renovation (e.g. include external shades) to minimize solar gains
New net zero emission buildings	Optimization of the building to increase impact of architectural and passive measures - compactness, form and orientation of the building, shading, natural air ventilation Substantial reduction of cooling demand via high insulation of the building shell (roof, windows) Reflective materials Efficient cooling systems Efficient use of RE (solar thermal, PV, wind etc.) Natural ventilation – increase passive cooling capabilities of buildings Solar dehumidification
Building management	Information on energy savings through the implementation of energy management systems (ISO 50001) Improvement of behavioral aspects via trainings etc.

Strategic priorities	Technical measures
	Effective building operation and maintenance, user education, energy metering and information on consumption
Decarbonized energy	Promote traditional construction techniques and materials through education curriculums of universities with architecture and civil engineering programs; For new buildings ensure that the building envelope is properly insulated and ventilated to avoid massive energy losses during intense heating periods For new buildings use recycled materials and traditional techniques were low-energy-intense materials are used (e.g. bamboo, straw, clay) Design buildings using green building design principles (e.g. passive solar, PV roof-tops, geothermal heating, shading, etc.)
Sustainable construction materials	In temperate climates, as in any other climate, this Strategic Priority will be effective if new buildings are constructed with materials with low energy and carbon footprints For new buildings use recycled materials and traditional techniques were low-energy-intense materials are used (e.g. bamboo, straw, clay); Promote traditional construction techniques and materials through education curriculums of universities with architecture and civil engineering programs; For new buildings ensure that the building envelope is properly insulated to avoid massive energy losses during heating periods
Efficient appliances	Effective building operation and maintenance, user education, energy metering and information on consumption
Resilient buildings	Upgrade buildings and infrastructure for hurricane and storm protection (e.g. houses built on stilts, floating houses) Avoid flooding areas, climate proof construction Identify materials that are climate-proof but are at the same time low-energy intensity, and foster the use of these through the implementation of the strategy above

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The Following strategic priorities have been identified based on evaluation of technical measures (see Figure 12)

- Sustainable urban planning: Optimization of urban structure and land use required to maximize future efficiency and renewable energy potential for rapidly growing cities (SP1)
- New buildings place increasingly high burden on electricity grid: Measures required to limit the impact and increase building efficiency (SP3)

- Decarbonized energy: In regions where the urbanization rate is high, the total floor area will grow accordingly, increasing energy consumption (total/per capita) (SP5)
- Efficient appliances: Cooling is the major contributor to electricity consumption in new buildings in hot-dry climates - energy efficient appliances (e.g. refrigerators and air conditioners) required to mitigate this effect (SP7)

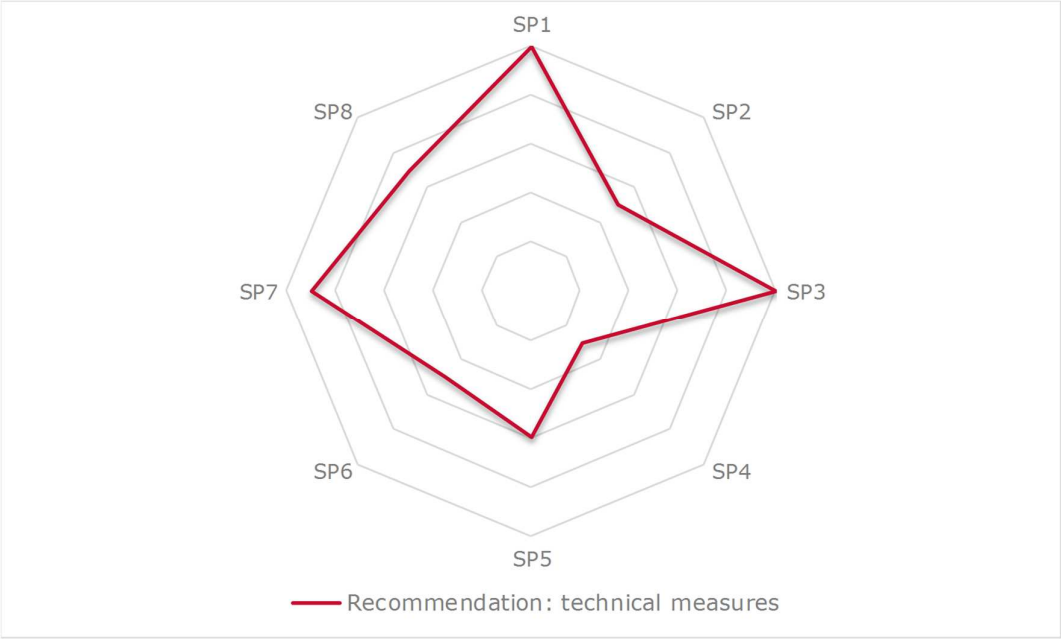

Figure 12: Mapping of the recommendations of technical measures – Tanzania

The priorities are qualitatively mapped in the spider net graph shown in Figure 12. The outer border means “should get very high priority”, while the recommended priority is declining towards the center of the graph.

The next step is to assess the current political context in order to be able to identify gaps between recommended strategic priorities and actual building policy priorities.

Derivation of preferred national policies

Analysis of existing national policies

Table 9: Overview of existing national policies

Local context - Policies[3]	Target	Strategy	Implementation (+ Monitoring)	Enforcement
Urban planning	Mainstream energy efficiency measures into housing policies Build necessary capacity Include sustainable land management systems and climate sensitive human settlement developments.	Enhancing awareness on the impacts of climate change in the context of human settlements. Promoting energy efficient technologies for supply, transmission/transportation and demand side as well as behavioral change in energy use.	Urban planning act No. 8 (2007) promotes sustainable development regarding density of buildings, of lands in urban areas, preserving and improving amenities.	Planning authorities enforces Urban Planning act No. 8
Retrofit existing buildings	Mainstream energy efficiency measures into housing policies Build necessary capacity	Develop General Building Codes Develop Energy Efficiency Building Code	Voluntary Energy Audits Voluntary labelling scheme for green buildings	Voluntary Energy Audits by various institutions, e.g. TIRDO

[3] Source: • Preparation of Energy Performance Certification of Larger Buildings: Current Legislative framework, gaps and recommendations on energy efficiency issues of the building sector, SE4All, 2016 according to (i) National Energy Policy, 2015, Tanzania, Ministry of Energy and Minerals, (ii) Preparation of National Energy Efficiency Programme for Tanzania & Institutional Capacity development – Project document , United Republic of Tanzania, Ministry of Energy and Minerals, April 2014 (iii) •National Indicative Programme for United Republic of Tanzania 20114-20120, United Republic of Tanzania – European Commission (iv) GIZ Sustainable Energy Program – Energy Efficiency Component, Energy Efficiency Kick of0f Workshop, May 2015 (v) Tanzania Country Report 2012 (vi) The Urban Planning Act No 8, 2007

	Develop energy performance standards	Develop energy performance standards Capacity building programs Promoting energy efficient technologies for supply, transmission/transportation and demand side as well as behavioral change in energy use. Promoting use of energy efficient technologies National Energy Efficiency Programme (under development)	Fiscal incentive for all solar products	Voluntary labelling scheme for green buildings provided from market actor such as Tanzania Green Building Council
New large buildings	Mainstream energy efficiency measures into housing policies Build necessary capacity	Develop General Building Codes Develop Energy Efficiency Building Code Develop energy performance standards Capacity building programs	Voluntary labelling scheme for green buildings Fiscal incentive for all solar products	Voluntary labelling scheme for green buildings provided from market actor such as Tanzania Green Building Council

		Promoting energy efficient technologies for supply, transmission/transportation and demand side as well as behavioral change in energy use. Promoting use of energy efficient technologies National Energy Efficiency Programme (under development)		
Building management				
Decarbonized energy	10-20% Green house gas reduction by 2030 relative to an BAU scenario of 138-153 Mio. tones of carbon dioxide equivalent	Reduction in electricity consumption by 20% in manufacturing industries and households by June, 2016. Reduction in petroleum consumption by 15% in industries, transport and households by June, 2016. Enhancing the use of renewable energy potential (hydro, solar, wind, biomass and geothermal). Promoting use of energy efficient technologies/ applianc-	Projects which qualify for carbon credit through clean development mechanism (CDM) window. Fiscal incentive for all solar products	EWURA has the power to establish and control Energy efficiency measure (supply side)

		es and behavior Promoting energy efficient technologies for supply, transmission/transportation and demand side as well as behavioral change in energy use. “Energy sector plan incl. a National Energy Efficiency Action Plan (NEEAP), including EE baseline, Indicators and target ,an EE monitoring and verification mechanism ,a stakeholder consultation mechanism, a concept for Energy Manager / Energy Auditor capacity building, Energy Managers guidelines for selected industries, Regulatory tools to promote investments in EE in water utilities, a concept for a communication platform / stakeholder consultation mechanism. incl. EE monitoring and verification mechanism”[4]		

[4] Preparation of Energy Performance Certification of Larger Buildings: Current Legislative framework, gaps and recommendations on energy efficiency issues of the building sector, SE4All, 2016

Sustainable construction materials				
Efficient appliances		Develop energy performance standards: introduction of minimum energy performance standards (MEPS) Promoting use of energy efficient technologies/ appliances and behavior. National Energy Efficiency Programme (under development) National Energy Efficiency Action Plan (on-going)	n/a	
Resilient buildings				

Recommendation for a national building strategy

Evaluation of current policies

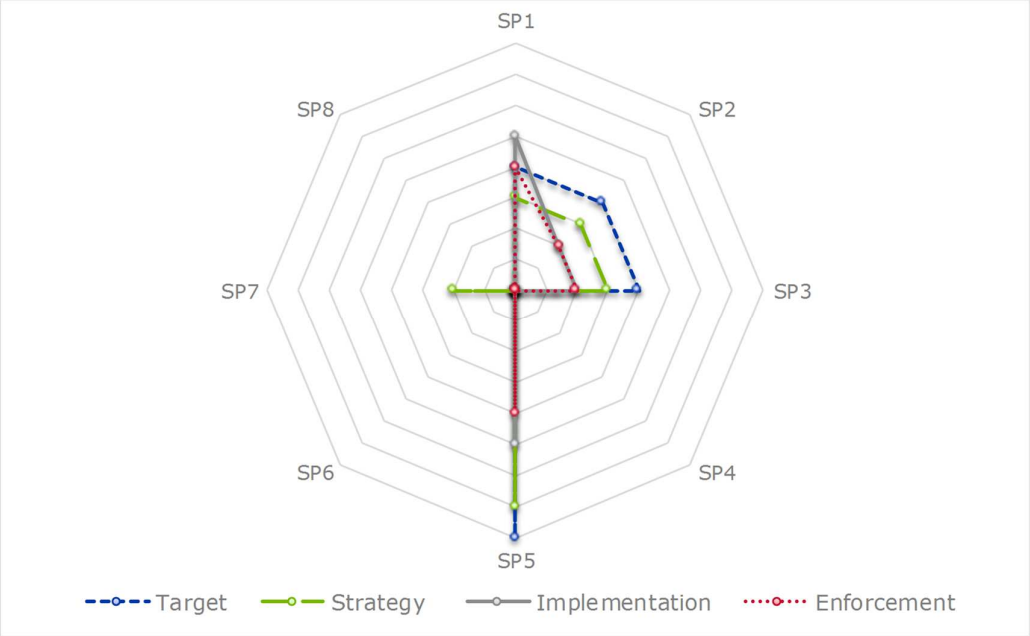

Figure 13. Mapping of status of national policies along the policy cycle

Legend:

Outer border: 10 = comprehensive approach across the sector, complete

Mid range: 5 = partial plan with potentially significant impact

Centre: 0 = nothing planned, or no information available

The mapping of the status of national policies in Figure 13 shows that requirements, incentives and information campaigns as well as specific targets for each of the key activities are largely missing.

However, Tanzania is currently preparing several strategies for energy efficiency policies in the building sector and appliances: among others a building code addressing energy efficiency, the national energy efficiency program, and a national energy efficiency action plan are under development. Few of these measures are implemented and mainly on a voluntary basis, i.e. energy audits and a green building scheme for green buildings.

For the following Strategic Priorities, sufficient literature could not be gathered in the context of this project or they are not sufficiently addressed in available documents: SP 4 building management, SP 6 sustainable construction materials and SP 8 resilient buildings, i.e. the whole policy cycle needs to be applied to develop a common understanding of targets and a strategy which will accordingly be implemented and enforced. Figure 14 illustrates the gap between recommended and current building policies. The blue line results as average of the results presented in Figure 13.

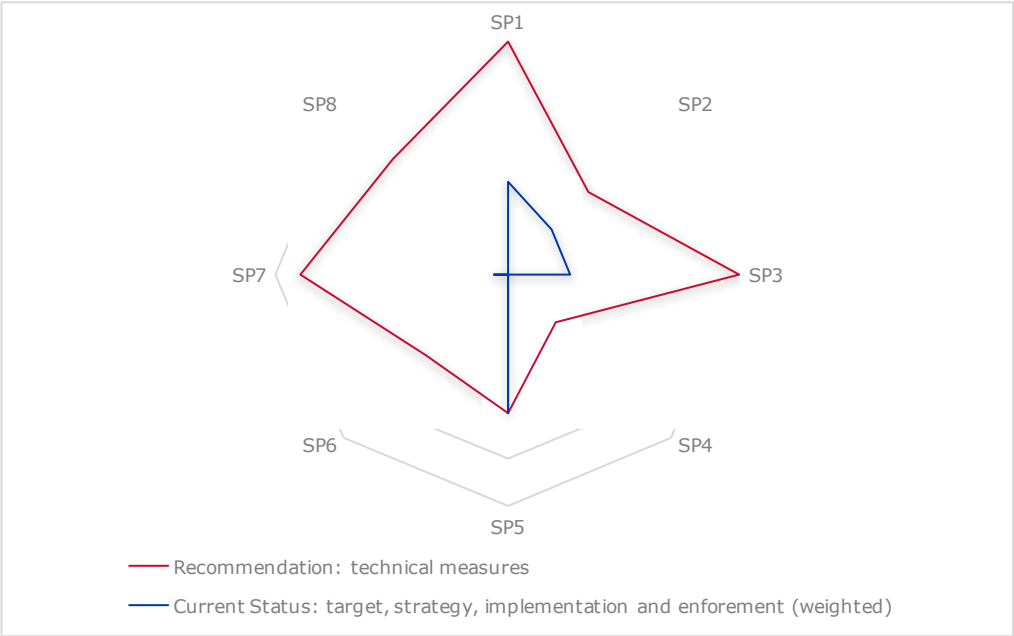

Figure 14 Technical recommendations and status of national policies

Recommendation for policy priorities

The comparison of technical recommendation and the status of national policies (Figure 14) reveals key recommendations for national policies which needs immediate implementation on national level.

Strategic priorities	Policy measures
(1) Urban Planning	Assessment of current and future conditions/options Implement intelligent urban planning policies to maximize energy efficiency
(3) New Buildings	Introduce building codes which include energy efficiency Define cost effective standard approach for NZEBs according to local conditions and energy prices
(5) Decarbonized Energy	The current policy status within Tanzania is close to the technical recommendations, and therefore SP5 is not an immediate priority
(7) Efficient Appliances	Develop minimum energy performance standards (MEPS) and energy labeling schemes for lighting and appliances (especially for cooling systems such as air conditioners, ventilation systems, fans, refrigerators and freezers) Implement throughout government buildings to show example and build efficient appliances industry

Recommendations for less relevant strategic priorities are summarized in the table below.

Table 10. Proposed policy measures with regard to less relevant strategic priorities

Strategic priorities	Policy measures
Retrofit existing buildings	Introduction of a Building Code including Energy Efficiency Increase energy productivity according to rising demand via more efficient buildings Provide financial support schemes to low-income social groups to allow access to energy efficient retrofit measures
Building manage-ment	Mandatory implementation of energy management systems and certification of building standards Requirements for demand-side management, flexible energy prices to steer energy demand, smart homes Internet of things requires new service providers and insurance of data security
Sustainable con-struction materials	For new buildings adopt regulations and enforce the use of materials with low energy and carbon footprints
Resilient buildings	Avoid flooding areas, climate proof construction Zonify the climate-change related risks and develop a strategy for renovation of standing buildings and implementation of new land use zones; Create financial schemes for low-income households to ensure their buildings are renovated to a climate-proof state Develop financial schemes that enable affected households to relocate without a financial burden