Participatory Scenario Development for Low-Carbon City Strategies: A case study of Krabi Municipality, Thailand

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Abstract

Under the global-social dynamics and urbanization over the past decade, the transition towards the sustainable city has received considerable attention worldwide as appeared in the preamble of the New Urban Agenda (NUA). In this context, a number of studies revealed that there is a growing recognition of cities to transform towards Low-Carbon City (LCC), which requires strategic long-term planning tools for making cities inclusive, safe, resilient, and sustainable from climate and disaster risks. This paper applied participatory foresight methodology to: (1) explore possible future scenarios and strategy options for LCC planning contexts in 2050; (2) initiate co-creation learning module with strategy building blocks encouraging the city's capability on low-carbon sustainable transition management. By using Krabi Municipality as a case study, 30 participants were selected through the purposive sampling including local administrators, key actors and representatives from government institutions, civil society, higher education institutions and private entrepreneurship networks. Data were collected through group semi-structured interviews, and participatory scenario workshops. Content analysis was used to analyze the data. Key results were found as; (1) Four plausible future scenarios covering 30-year time horizon, based on the combination of two axes of key driving forces. Consequently, a set of low-carbon strategy options were derived out of the scenarios; (2) Strategy building blocks containing six essential elements that could encourage effective LCC planning and implementations. The results provided an idea-driven approach that fulfills local government's gap of knowledge regarding the revision of strategies and management plans required for transitioning towards an LCC. This approach can be flexibly adapted to the specific needs of individual cities/local government and their inhabitants.

Introduction

Under the global-social dynamics and urbanization over the past decade, climate change is considered one of the most severe challenges humankind has to face (Milestad, Svenfelt & Dreborg, 2014). Cities are responsible for almost 60% – 80% of energy consumption and 70% greenhouse gas emissions (United Nations, 2016) due to their resources and energy demands for providing their functions and services. At the same time, cities are particularly vulnerable to shocks and stresses such as natural disasters because of the concentration of people and assets (Street, 1997). In this context, New Urban Agenda (NUA) has been adopted calling for sustainable urban development (UN-Habitat, 2012). Therefore, there is a growing recognition of cities around the world to transform towards Low-Carbon City (LCC) (Zhou, 2015).

In order to transform toward LCC in the long-range future, cities require holistic planning approach that could response to an increasingly complex and interdependent world. However, the limits of the learning and planning tools have been well critique. The conventional planning tools become inadequate due to the lack of collective visions or set of aspirations futures to work towards (Raskin & Kemp-Benedict, 2002). With this reason, scenario development, a systemic foresight methodology, could allow city planner to envision future pathways and account for critical uncertainties by widening perspectives and illuminating key issues that might otherwise be missed or dismissed (Kok, Biggs & Zurek, 2007; Lead, Raskin, & Monks, 2005). City also demands a concrete learning module as a strategy building blocks to continually improve their policy, strategy and implementation action plans in moving towards sustainability transition.

For Thailand, a number of policies have integrated the issues of climate change and its impacts into the core content (e.g. The 12th National development plan (2018 – 2021), the GHG reduction target for post-2020 is 20-25% compared to BAU level emission (ONEP, 2017). These policies indicated that Thailand is now moving towards an LCC. Krabi is the city in Thailand that is now continually faced with challenges from various context, due to the fact that there has been the development of all-in-one ecological, historical, artistic and cultural tourism. However, given their existing abilities to move towards LCC with their vision to become Quality City" (Q-City) in 2026 (Krabi Municipality Office, 2018), this paper recommend that strategy options should be developed.

Above mentioned, this paper presents the application of participatory foresight science methodology by using Krabi Municipality as a case study. The aim of this paper is to explore possible future scenarios and strategy options for LCC planning contexts in 2050 and initiate co-creation learning module with strategy building blocks encouraging the city's capability on low-carbon sustainable transition management.

Research objectives

1. To explore possible future scenarios and strategy options for low-carbon city planning contexts in 2050

2. To initiate co-creation learning module with strategy building blocks encouraging the city's capability on low-carbon sustainable transition management.

Literature review

Low-carbon City concept

Since the LCC movement started in the United Kingdom, this was the first country which began considering how to lower the production of Carbon dioxide (CO_2). The British Government published the "Energy White Paper" entitled "Our Future Energy: Creating a Low Carbon Economy" in 2003 (Department of Trade and Industry, 2003). Further, the original report proposed the concept of Low Carbon Economy. The aim was to achieve more economic output and high-quality living standards with less natural resource consumption and environmental pollution. This concept is profound and paramount ideas-driven of a Low Carbon Economy quickly found advocates around the world (Cales, 2014).

Low-Carbon City (LCC) development has recently attracted attention from various countries and researchers, which may give different interpretations on the concept (e.g. Ministry of the Environment, Japan, (2007); Skea and Nishioka (2008), Prime Minister's Office, Finland, (2009)). Based on the different understandings, it may draw the conclusion that LCS requires the low-carbonization of not only economic development but different aspects of a society such as life and culture. The fundamental characteristics of LCC are summarized as (Chen & Zhu, 2013; Li et al., 2012): 1) Aiming to reduce GHG emissions in the short term and to transition towards an LCS in the long term; 2) Applying a life cycle perspective to material flows, improving energy efficiency and reducing GHG emissions; and 3) Focusing on urban sectors such as building, transportation, waste, industry, and energy consumption.

Participatory scenario development as a tool to explore Low–Carbon City futures

Transformation towards LCC can poses significant methodological challenges. As the time horizon expands from years to decades, Conventional planning approaches such as trend analysis and mathematical modeling become inadequate. The long–range future cannot be extrapolated or predicted due to three types of indeterminacy – ignorance, surprise, and volition. First, insufficient information on both the current state of the system and on forces governing its dynamics lead to a classical statistical dispersion over possible future states. Second, even if precise information were available, complex systems are known to exhibit turbulent behavior, extreme sensitivity to initial conditions and branching behaviors at various thresholds – the possibilities for novelty, surprise and emergent phenomena make prediction impossible. Finally, the future is unknowable because it is subject to human choices that have not yet been made (Raskin & Kemp–Benedict, 2002).

In an era when traditional strategic planning is obsolete, a strategic action plan should have robustness and flexibility so that it can adapt to the still emerging needs, challenges and opportunities of a wide range of plausible, possible futures. With this reason, foresight studies have gained considerable importance in response to uncertainties and risks that threaten the pursuit of sustainability across world regions (Bina & Ricci, 2016). Scenario is stories about the future that can be expressed in words, numbers, maps, and/or graphics, offering an internally consistent and plausible explanation of how events unfold overtime (Heugens and van Oosterhout, 2001; Gallopín et al., 1997; Raskin et al., 2002). Rather than attempting to predict or forecast the future, it envisions several future pathways and accounting for critical uncertainties by widening perspectives and illuminating key issues that might otherwise be missed or dismissed (Raskin et al., 2002; Kok, Biggs, & Zurek, 2007). As such, scenario development is particularly appropriate for city planners and policy makers to grapple with uncertainties.

Although scenarios in early applications were developed by expert groups, combining such expert scenario approaches with participatory approaches has been gaining attention as a potentially powerful tool to engage a variety of stakeholders in discussion about preferred future actions and acceptable trade–offs (Bizikova et al., 2014), since scenario development requires creativity and ability to think outside the scope of the familiar and the present. Furthermore, it requires insight in dynamics, relationships, in synergies of systems and their environment and thus it requires a broad knowledge of the field involved. Therefore, scenarios development should take place in an interdisciplinary team.

Conceptual Framework

In this study, the conceptual framework is proposed as a core guideline of research methodology and method applied and detailed as follows (see also Figure 1). Grounded on the problem statement which requires framework that could provide solution options for local government to transform towards LCC, the study contexts were defined and reviewed to determine a research methodology concept and methodological framework for the study. This study employed foresight science methodology with participatory approach to explore future strategy options for LCC planning contexts in 2050. Consequently, the lesson learned from the study process contributes to the initiation of co-creation learning module with strategy building blocks which could fulfill the local government's gap of knowledge as a framework and mechanism encouraging the city's capability on low-carbon sustainable transition management under the complex and dynamic of social and environment while having the choice of their effective governance.
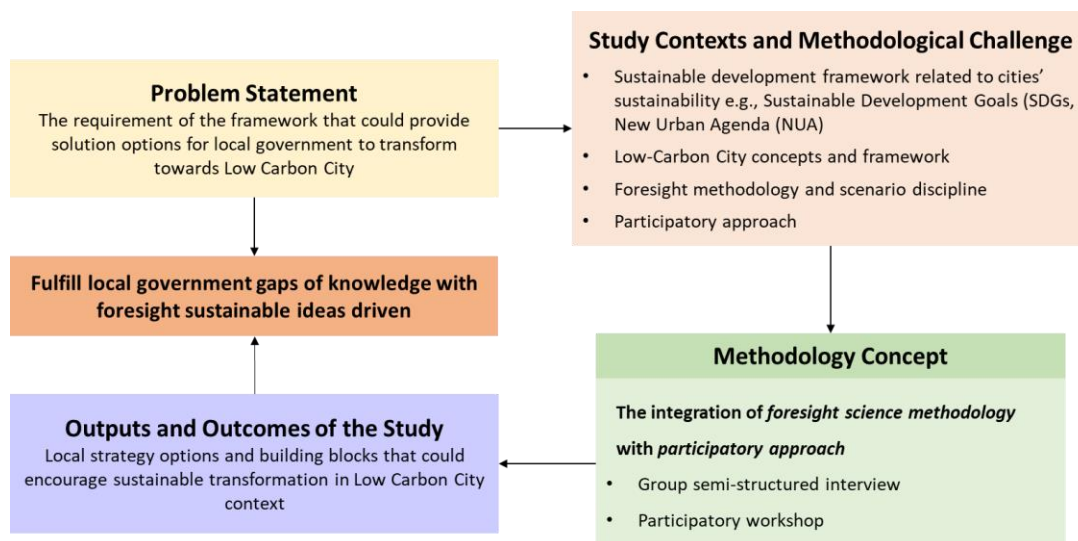

Figure 1 Conceptual Framework

Source: This study

Research Methodology

The methodology used in this study is the application of participatory scenario development to explore a set of low-carbon strategy options in city contexts.

Study area

The study was conducted in Mueang Krabi District, Krabi Province, with particular emphasis on Krabi Municipality as a unit of study. Krabi Municipality, located on the west coast of Southern

Thailand, covered an area of 19 km^2. It is one of Thailand's premier tourist destinations, famous for its scenic beauty, biodiversity, and unique history. Due to the fact that there has been the development of all-in-one ecological, historical, artistic and cultural tourism, Krabi Municipality is now continually faced with challenges such as, increased amount of wastes, decreased green areas and destroyed ecosystem etc. There are also global threats such as climate change and socio-economic development that could affect the city in the future. However, given the existing abilities to become an LCC, as seen from their vision to become "Quality City" (Q-City) in 2026 including six main strategies; Green city, Wealthy city, Healthy city, Clean city, Safety city, and Quality tourist destination city (Krabi Municipality Office, 2018). Additionally, they had participated in various sustainable city projects and initiatives e.g., the "ASEAN Environmentally Sustainable City (ASEAN ESC) Model Cities" launched by Institute for Global Environmental Strategies (IGES), and Thailand's Department of Environmental Quality Promotion (DEQP). Krabi Municipality is ideally suited to be the unit of study for exploring future low-carbon plausible pathways through co-creation process with their key related stakeholders.

Key participants and sample size

The key participants were selected through purposive sampling. The number of participants is determined to be 30 persons. The groups of possible participants in this study were the local administrators, key actors and representatives from the organizations who can influence city management policy and implementation and those who are affected by the decision making within the study area including:

1. Public organizations/institutions i.e. local government organization in the area of Krabi Municipality (Board executive, Division of Social Welfare, Division of Public health and Environment, Division of Education, Division of Technical Services and Planning), Provincial Offices of Natural Resources and Environment Krabi

2. Private and Civil organizations/institutions i.e., community networks, educational institution/ schools, and Business Enterprise/Young Entrepreneur Chamber of Commerce Group

Study Procedure

The study procedures, data collection and data analysis can be summarized into three main stages which are described in details as follows:

1. Identification of past and current situation of the unit of study. To obtain an overview understanding, relevant documents on the basic information of Krabi Municipality were reviewed. Then, group semi-structured interviews with key participants were performed to identify their perception and expectation of future development within the area. Doing so helps to understand

participants' attitudes towards LCC development, as well as areas of agreement and difference between the participants.

2. Scenario and strategy development process

Participatory scenario workshop with key participants was conducted to develop an explorative and normative scenario through foresight discipline (Börjeson et al., 2006). The process contains sub-steps as following (Schwartz, 1991; Voros, 2001). Sub-step 1-4 were done through plenary discussion and sub-step 5-6 were done through focus group discussions. The process is led by facilitator using a question guide.

2.1 Identify focal issue and key factors in the local environment – This step was to identify the target of the scenario (Rosenberg et al., 2014), which we have set out as the key question "How LCC could be reached in Krabi Municipality?" A 30-year timeframe were chosen, from year 2020-2050. Then, followed by creating the lists of the main factors that can influence the success or failure of these issues in the plenary session.

2.2 Identify driving forces – A "STEEP" analysis were used in this step to identify the driving forces that alter the future city development in significant ways (Barišić, 2016; Caille et al., 2007).

2.3 Rank importance and uncertainty – Participants were asked to rank and select the driving forces in order of importance and the degree of uncertainties (Barišić, 2016; Caille, et al., 2007). Driving forces that are not considered important were discarded.

2.4 Select scenario logics – The selected driving forces were used to generate two distinct alternative futures (i.e. extremes of the state), representing in two axes. By crossing those two axes, resulting in a 2x2 matrix of four quadrants that move the plot of a scenario (Pastor, 2009).

2.5 Generate plausible scenarios and storyline – Global Environmental Outlook Scenarios (GEO-3) (UNEP, 2002) are proposed in a broad outline as an initial set of 'prototype scenarios'. Then the participants were asked to develop a coherent and plausible storyline and underline the main characteristics of each quadrant up to the year 2050. A descriptive and catchy title were also created in each scenarios.

2.6 Explore the strategy options – The process focused on looking back at how the desirable future namely, Low-Carbon City in 2050, could be reached by using the back-casting approach (Dreborg, 1996). The participants were asked to develop the strategy options that investigate desirable pathways under each four plausible future scenarios developed before.

3. Initiate co-creation learning module with strategy building blocks. At the end of workshop, participants were ask to discuss on the lesson learned from the scenario development process lying on

the key question "What are the conditions and key factors that could encourage the city's capability on low-carbon sustainable transition management". This step was done through plenary discussion.

From stage 1-3, Audio and video recordings were made to collect the data during the process. The data were transcribed and then analyzed by using content analysis.

Research Results

1. Four possible future scenarios and strategy options for Low-carbon city planning contexts in 2050
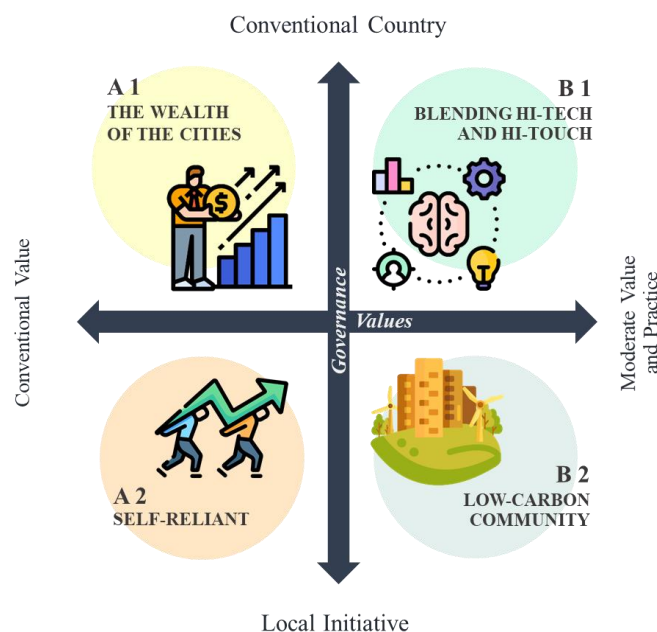

Figure 2 shows the scenario matrix highlighting four plausible alternative futures

Source: This study

Future scenarios were developed by crossing two spectrums of selected driving forces, i.e. 'Value' and 'Governance', presenting four quadrants (Figure 2) which are elaborated below.

In the first scenario, "The wealth of the cities", represents the world in which the economic development is rapid and successful which encourage the acquisition of goods and services in ever-increasing amounts, resulting in the increasing of the employment and the use of fossil fuels. Small local companies are replaced by larger-scale business and companies that are allowed to grow within the area of Krabi Municipality, resulting in the growth of urban areas and the expansion of mass tourism. The individual's idea and lifestyle are materialism and willingness to pay for welfare, but not of sustainable livelihood. Accordingly, there is high use of privately owned vehicles, less public transportation. The amount of wastes is arising relatively to GDP growth. The biodiversity are threatened.

In the second scenario, "Blending hi-tech and hi-touch", policy-making and new technologies are the main drivers that allow more sustainable consumption. Government strengthens low-carbon policy and measures in responses to environmental impacts. Therefore, they put more focus on resource and energy efficiency and pollution reduction which can reduce the material intensity and deal with market pressures. Tourism becomes more eco-friendly. Areas of ecological importance are restored, and biodiversity is maintained. Communities become more involved in environment management. The public transport system is well-maintained. Bicycle and walking friendly environment are created. These good conditions attract many immigrants and tourists. This leads to a challenge of urban design management.

The third scenario, "Self-reliant", is characterized by the trend towards overexploitation of natural resources and energy due to mainstream economic development. Production units are intensive (mainly in labor) and small in scale in order to produce as much as possible goods and products. As a result, biodiversity becomes more threatened and climate change becomes worse than expected. Consequently, tourism growth is decreasing. Local communities are fragmented since people focuses only on their survival. Government still focuses on short-term planning and cannot avoid these negative outcomes in spite of the implementation of monitoring and enforcement measures on resource use. Instead of waiting for the government, some local strategies are adjusted to the best practices and potential of each community in order to increase self-reliance and mitigate the impact of social and environmental crises.

In the fourth scenario, "Low-carbon community", a city of well-being and low consumption. The economy is growing in a self-sufficient system. Local communities become central to decision-making and have much greater responsibilities for the commons resources. Cultural and environmental learning centers are promoted, as well as ecotourism, thereby contributing to the preservation of the environment and the biodiversity site. The climate gradually stabilized but remains altered. The reduction on GHG emissions has been acted through the significant reduction in consumption of energy and materials. Krabi Municipality invests on more maintenance of existing transport infrastructure, improving bicycle and walking conditions and the conversion of older vehicles to electricity and bio-gas for local use.

Consequently, the result of the back-casting exercise offers a set of main strategic aspects and management actions proposed by the majority of participants for Krabi Municipality's for future planning in the LCC context, regarding the four future scenarios developed (see also Table 1). Related

local strategies (Q–city) were also identified in each aspect, so that local government could strengthen their existing strategies and increase the opportunities to reach the LCC in the future.

Table 1 Strategic objectives and main management actions proposed for Krabi Municipality related to their main strategies of city development

Aspect	Strategic objectives	Main actions proposed	Related strategies (Q–city)
Urban area management	Create functionally balanced urban design while maintaining existing biodiversity	1. Land use efficiency and energy–efficient buildings shall be prioritized. Well–connected transport system, the improvement of the safety, facilities, and pleasant environment, should also be integrated in urban design	Green city, Safety city, Healthy city
Knowledge Platform	To mainstream low–carbon issues into education and training	1. Improve learning platform regarding low–carbon issues through various channels such as learning centers, study courses, workshop etc. to raise public awareness on LCC development and sustainable lifestyle. 2. Improve accessible qualitative and quantitative database to monitor low–carbon actions of the cities	Wealthy city
Technologies	Promote clean and green technology	1. Technological developments in a matter of energy, transport system, waste management and manufacturing shall be supported from national and international organizations	Green city, Clean city
Tourisms	Promote environmentally friendly and eco–tourism	1. Collaborating with the private and business sectors to motivate eco– and conservative tourisms by initiate environmentally friendly goods or services that reduce GHG emissions	Wealthy city, Quality tourist destination city
Creating Resilience	Create a plan of risk management and resilience	1. Risks management plan should be revised in response to changing socio–ecological and driving forces that could affect the city 2. Investments in the resilience of necessities, including water, food, energy, and other services can help reduce losses, ensure operational continuity and save lives.	Healthy city, Safety city
Policy frameworks	Formulation of holistic policy frameworks addressing low–carbon actions	1. Policy framework addressing constraints in transitioning towards LCC shall be formulated. 2. Environmental standard and operational guidelines shall be revised. 3. The policy mechanisms like tax and import tariffs abolishment shall be encouraged.	Clean city, Green city

2. Learning module with strategy building blocks for the city's capability on low-carbon sustainable transition management.

At the end of workshop, participants were discussed and put on six strategy blocks that can encourage the city's capability on low-carbon sustainable transition management at city level as described below.

1) Institutional Arrangement – Local governments must Initiate a clear signal that LCC is a priority by setting concrete goals and coordinating interactions among government, public and private institutions in order to collaboratively support both technical skills and knowledge and practices.

2) Attracting the key agencies – to encourage key agencies investment in transition to an LCC, local government can utilize policies and instruments that reduce risk, increase return, and guarantee remuneration.

3) Enabling Environment – Creating a favorable, overarching context for LCC requires a creative economy, sustainable infrastructure, enforceable regulations, and competent knowledge-based society.

4) Data Requirements – collecting and managing data on level of achievement, low-carbon innovative data collection, and monitoring solutions which pool resources among sectors / Investment in information technology should develop, to facilitate the growth and transmission of low-carbon society in all sectors.

5) Assessing Co-Benefits – Identifying tangible ways that mitigation measures can contribute to environmental, economic, and social benefits, and clearly communicating these co-benefits can compel stakeholders—whether organizations or individuals, and from within the public or private sector—to act to help achieve city-wide low emission development goals.

6) Tracking emissions – Moving towards low-carbon city is often predicated upon the strategies and capabilities to properly measure, report, and verify (MRV) projects, while emissions are tracked through five sectors including: energy, waste, agriculture, waste, industrial process and LULUCF (Land Use, Land-Use Change and Forestry)
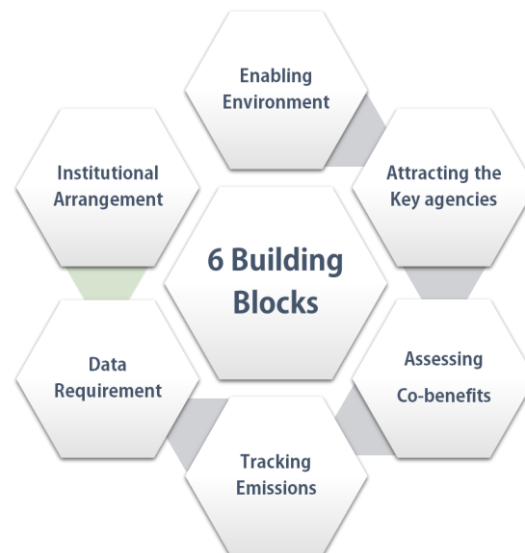
Figure 3 Six strategy building blocks

Source: This study

Discussions

       This paper sought to explore strategies for local government in Low–Carbon City contexts by the application of participatory foresight sciences methodology by using Krabi Municipality. Grounded on the research objectives stated above, the key results can be discussed as follows:

       1. Four plausible future scenarios were developed, covering 30–year time horizons from year 2020 to year 2050 based on the concepts of Global Environmental Outlook (GEO–3) scenario storylines framework as a solid starting point and helps shorten the workshop's time duration. It can be pointed out that the main drivers of the global and regional scale scenarios were quite accurately translated to Krabi Municipality scenarios, which is the combination of two axes of key driving forces namely, 'Value' and 'Governance'. In this sense, this avoids the risk that the local scenarios developed are biased and the risk of underestimating external drivers affecting the system (Enfors et al., 2008). All scenarios highlight the importance of the main issues affecting the implementation of the LCC in various contexts. In 'The wealth of the cities' scenario, changes in people's value are the key challenge. While in 'Blending hi–tech and hi–touch' scenario, a challenge of urban design management emerges. Moreover, in 'Self–reliant' scenario, the key challenge for local communities is fragmented community which can limit low–carbon implementation. In 'Low–carbon community' scenario, climate and environmental concerns and resource exploitation is still a challenge. Consequently, the back–casting process might also help to identify potential actions for enabling the transition to the LCC in 2050 that need further implementation and adaptation in Krabi Municipality's existing plan and strategies including six aspects: technologies, urban area management, tourism, policy frameworks,

knowledge platform, and creating resilience. Clearly, Krabi Municipality requires changes in technologies, infrastructure and lifestyles. Three fundamental characteristics of LCC (Chen & Zhu, 2013; Li et al., 2012) are incorporated into these strategy options;

2. This paper initiated and discussed on the learning module with strategy building blocks, which are provided as conditions and key factors that could encourage the city's capability on low-carbon sustainable transition management. It highlights the essential elements that local government needs to integrate as their knowledge platform, which can be pursued in any order or combination, e.g. how to attract key agencies to accelerate investment in low-carbon actions, or the enabling conditions that creating a favorable, overarching context of LCC.

Knowledge from Research

This research generates some new knowledge that provided an idea-driven approach that fulfills local government's gap of knowledge regarding the revision of strategies and management plans required for transitioning towards LCC. One of the most important findings is future scenarios in the year 2050 and a set of low-carbon strategy options developed from which envisions several future pathways to reach LCC and accounting for critical uncertainties and key issues that might influence the success or failure of local government management. Another new knowledge is six strategy building blocks which help strengthen the development and implementation of low-carbon actions, especially in local contexts, in order to meet the need of NUA framework.

Conclusion

Transforming towards LCC require holistic planning approach involving key agencies that could response to an increasingly complex and interdependent world. This paper has outlined a methodological framework of participatory foresight methodology to explore possible future scenarios and strategy options for LCC planning contexts in 2050 and initiate co-creation learning module with strategy building blocks encouraging the city's capability on low-carbon sustainable transition management by using Krabi Municipality as a case study. This paper highlights some key challenges and illustrates how the target of LCC could be reached. It can be pointed out that the scenario development method is useful and imperative for local government. It helps them to understand the problems, the current state, and improve the ability to discuss on how the target of LCC could be reached. Involving stakeholders in scenario development can bring significant benefits to both

stakeholders and researchers, leading to the development of more consistent and robust scenarios that can better prepare for the future.

Suggestions

1. Suggestions for the application of research results

This paper provided some potential strategies and main actions for transforming towards a Low-Carbon City (LCC). They are all possible solutions for fostering the LCC at the local government level. Furthermore, the six building blocks proposed in this paper would be useful as a blueprint of management mechanism to encourage the city's capability on low-carbon sustainable transition management. We believe that Krabi Municipality, as well as other key related organization, could apply these mechanisms to collaboratively explore plausible future development pathways in various challenges. The building blocks proposed is not finite or unchangeable, if necessary, local government can be flexibly adapted to the specific needs of individual cities and their inhabitants. We suggested that strong engagement with key stakeholders, sufficient finances, data and manpower, sustained program management, communication and the leadership could be the key success factors for implementing these tools and frameworks.

2. Suggestions for future studies

Since the proposed scenarios and strategy building blocks have not yet been implemented in local's practice in full-scales, future studies require a set of indicators to assess the implications of alternative futures on the focal issue. However, it is worth noting that there is no one-size-fit-all approach that can be applied to every problem or context. As the social dynamic and complex environments become more pressing, much greater effort is needed to build transformative systems that actively support and encourage significant change. The development of transformative learning mechanism should be considered in future research to initiate the transition process in local sustainable contexts.

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