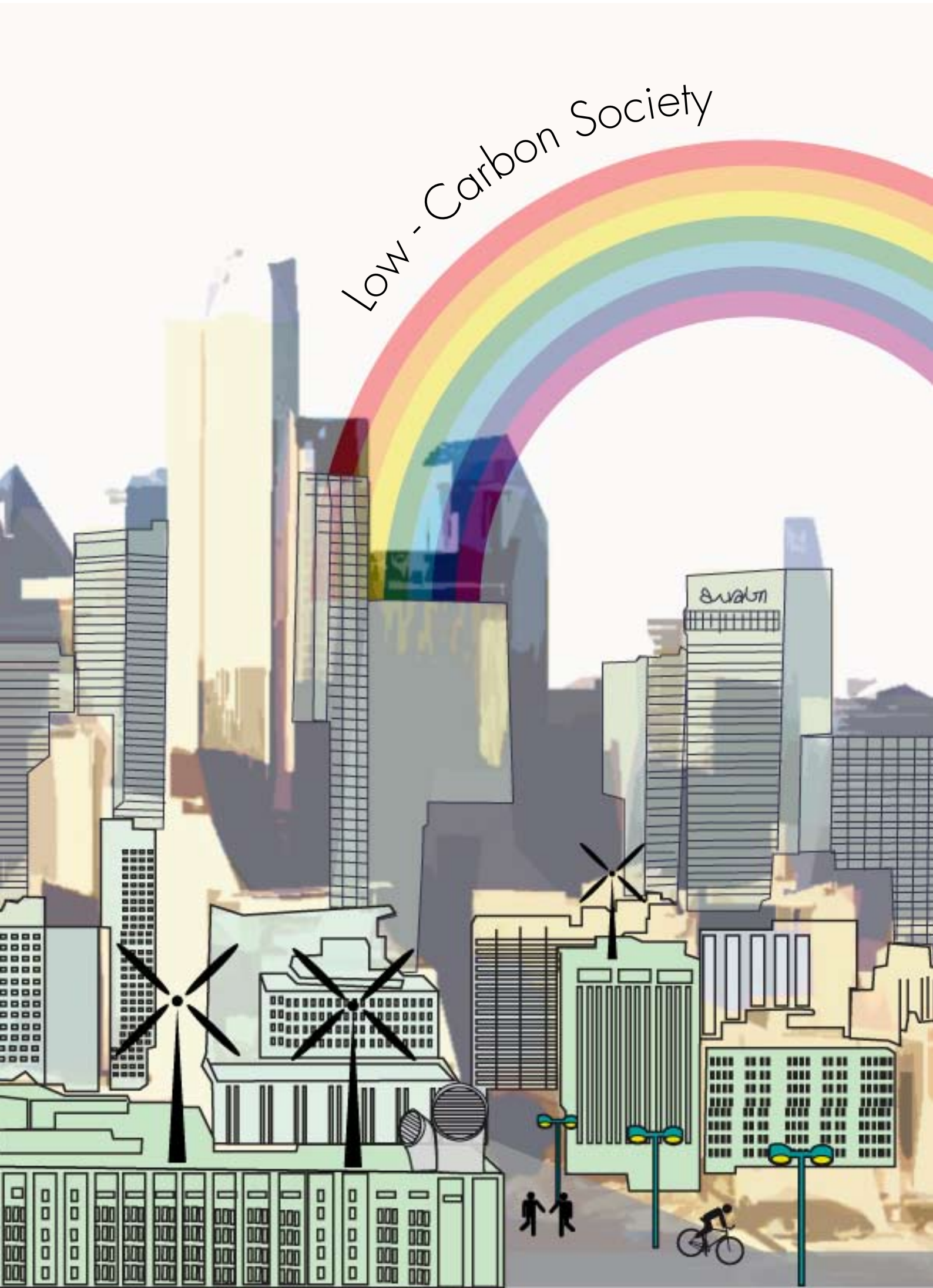
Low - Carbon Society



The Futures of Low-Carbon Society:
Climate Change and Strategy for
Economies in APEC Beyond 2050

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319 Chamchuri Square Building
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สวทน
WWW.STI.OR.TH

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Executive Summary

Over the last decade the APEC Center for Technology Foresight (APEC CTF) has utilized foresight techniques as a principle tool to address major cross-border issues including water, energy, and emerging diseases. In monitoring and studying technological shifts in these sectors, climate change increasingly emerged as a major driver behind all others. This is not surprising given that much of the Asia Pacific region is forecasted to receive a disproportionate share of the global impacts resulting from climate change. Whether it is the increased frequency of severe storm events compounded by sea level rise causing a greater number of natural disasters, longer dry seasons and declining river flows affecting agricultural productivity or unfamiliar weather patterns creating environments for new disease vectors and public health concerns, many new challenges await the region's policy makers.

In 2008, with some support from Thailand's Ministry of Foreign Affairs, the Research on the Futures of Low - Carbon Society: Climate Change and Strategies for Economies in APEC Beyond 2050 has worked to develop a common vision for new pathways for clean and sustainable development that has as a prerequisite the objective of a low - carbon society.

From May 2008 through January 2010, a five-part region-wide collaborative project was conducted to respond to the key question: what could bring about a society where a low-carbon economy and adaptive lifestyle are the principal drivers governing trade and development. The project's key components included:

- Scoping Workshop (in Hong Kong, China, August 2008) to review current knowledge and outline the project's main purpose and strategy.
- International Working Group Meeting (in Bangkok, October, 2008) to provide the critical input to form the structure and questions for a Real-Time Delphi (RT-Delphi) electronic survey.
- RT-Delphi survey (global, 15 June – 30 August 2009) to help distill a convergence of opinions with regard to trends, uncertainties and drivers related to climate change, its impact, threats and opportunities.
- Scenario Workshop (in Phuket, November 2009) to develop plausible scenarios for the Asia-Pacific region that illustrate social, economic and political dimensions that might frame a 2050 low - carbon society.
- Wrap-up Symposium (in Bangkok, January 2010) to conclude the research findings and identify policy recommendations including science, technology, and innovation options for future low - carbon society as well as adaptation strategies for APEC economies.

This project was designed and implemented from the bottom up - from a small circle of people who have been monitoring climate change and adaptation in the Asia Pacific for some time. Such participation was chosen to help advance the most informed ideas and recommendations to migrate upstream to ministerial levels. For many participants, the foresight process itself was unique, offering them valuable new tools for addressing the long-term climate change policies demand.

Core Issues Identified and Evaluated by RT-Delphi

Through the scoping and working group meetings a framework evolved for gathering input and discusingsocio-ecnomic mitigation and adaptation strategies for advancing low - carbon societies, including: personal lifestyles, social systems, international trade, economic systems, and effective governance. Core topics were identified, along with a set of predictive statements that were evaluated by international experts through the RT-Delphi survey process (see "Report of Delphi Analysis" in the package). These findings then formed the framework for the Low - Carbon Society Scenario Workshop.

The 2050 Low - Carbon Society Scenario and Its Challenges

The predictions of the core issues based on the RT-Delphi result were used as an input for the three-day scenario workshop. Experts from nine economies took part to envision what a 2050 low - carbon society might look like, and the steps necessary to attain it, through backcasting. Five groups were organized around the topics that framed the Delphi survey (see "The 2050 Scenarios"):

1 Climate change & its impacts:

Climate change will have adverse impacts. Doubts exist about the effectiveness and timeliness of technologies like carbon capture and storage, earth system modeling, and the effectiveness of international agreements.

2 Migration,rural life & natural resources:

Rising sea levels will force farmers to shift to higher altitudes despite coastal ecosystem management strategies. Impacts on eco-tourism and skilled imigration are only moderate. Water scarcity is a major concern. There are conflicting views whether well-educated people will undertake farming, and whether rural poor benefit from planting trees for carbon sequestration or cultivating energy crops.

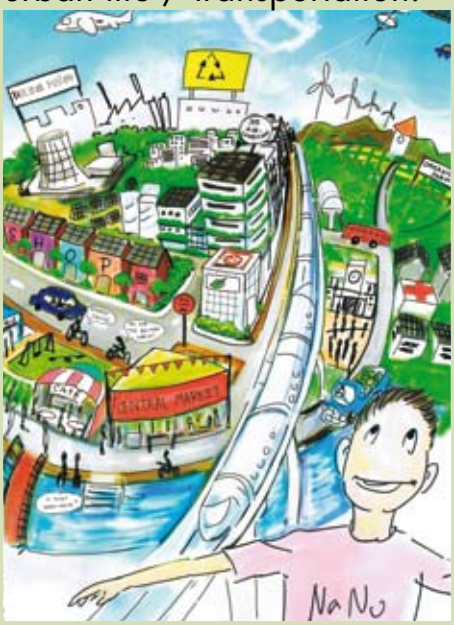
3 Society & health:

Technologies can improve the healthcare system. The low - carbon concept is spreading and some consumers are willing to pay more for green products.

4
Trade of goods & services:

Trade and services will be conducted with greater consideration for environmental costs and benefits. Carbon accounting becomes the norm and is regulated by the world's financial institutions.

5
Housing & construction / urban life / transportation:



Technologies will boost energy efficiency, public transportation, and renewable energy, but conventional fuels may not disappear quickly.

While the individual groups addressed their assigned topics, all groups also waded into the other four topics. So rather than developing five concise scenarios specific to each topic, a set of more general scenarios emerged. Taken in combination the output from these groups yielded a rather consistent vision, and plausible pathway, to a 2050 low - carbon society.

At first glance, their 2050 vision appeared rather positive relative to present day lifestyles and policies. However, the vision in many respects reflected an acceleration of trends that had already taken root in many parts of the world. Nonetheless, the scenario's creators pointed out that for their vision to be realized, significant challenges had to be overcome in many aspects of the future:

Public Sector Leadership

While national level leadership is critical in 2050, significant social and economic transformation supporting the low - carbon society occurs at sub-national levels through initiatives undertaken by individuals, communities, villages, businesses (small and medium) and even actions from the street.

Increased government leadership emerges as a result of the growing rate of climate change induced natural disasters and population pressures putting greater stress on natural resources. Preserving food security becomes a major driver for more stringent land use zoning, ensuring urban-migration and non-food crops do not compromise rural communities' competitive advantage for food production.

Public sector-led demand for new approaches, backed by financial incentives that encourage innovation and implementation, stimulates significant investment in research and commercial ventures advancing low - carbon lifestyles. Conversely, policy disincentives such as carbon taxes constrain those activities that contribute to greenhouse gas emissions and other externalities inconsistent with a low - carbon way of life.

Multilateral Cooperation

The difficult negotiating process undertaken by the United Nations Framework Convention on Climate Change during the century's first decade illustrates that such mechanisms are too slow to react to the myriad of changes brought on by climate change. Nonetheless, such agencies play a critical role in collecting and evaluating information and advancing knowledge sharing across borders to help accelerate the global adoption of effective low - carbon strategies. Additionally, these agencies also help establish valuable multilateral frameworks for specific policies such as facilitating a credible international carbon trading market and carbon currency.

Regional cooperation benefits from an Asian Parliament, whose representatives come from strong networks of community organizations. Carbon footprint reduction has been a key issue for the body since its inception, stimulating regional alliances that foster passion, creativity and innovation for low carbon development paths.

Technological Advancement

The world has become more "predictable" as advances in climate modeling technology provide greater certainty when projecting climate trends and their impacts. This has been aided by a significant upscaling of public investment for super computers dedicated to climate modeling.

Renewable energy's stake in global energy supplies has grown from 10 percent in 2010 to 70 percent in 2040, and ultimately reaches 90 percent in 2050. Geothermal technology becomes economically feasible in 2020, with a corresponding growth in algae technologies in the 2030s.

The "green industrial revolution" that got underway at the turn of the century, is fully integrated in 2050 aided by financial instruments such as shifting taxes from production to pollution. Zero-emission industries are now commonplace. The use of nano-technology for self-assembly manufacturing of personal goods like clothing, and for air and water filtration, has become widespread contributing to reductions in emissions related to transportation logistics.

Extensive transportation improvements materialize including: a dramatic increase in airliner fuel efficiency due to alternative fuels and advances in aeronautical engineering; improved battery storage and hydrogen fuel cells causing a complete phase out of fossil fuel land vehicles; further advances in teleconferencing and augmented reality technology reducing the need for business-related air travel, and growth in the use of robotics in delivery services.

More highly advanced communication technologies enable information to be accessible anywhere and at anytime, facilitating universal access to education.

Public Education Toward New Lifestyles

Lifestyles are significantly different than in 2010, largely the result of educational systems that stress sustainability values reinforcing low - carbon living behaviors. Societal values reflect a "back to the basics" environmentally friendly lifestyles due recognition of resource constraints brought on by population growth. The "consumption for happiness" lifestyle so popular earlier in the century is now seen as too difficult to sustain.

Most importantly, a much greater level of public resources are available for education, making learning more accessible to all. This helps inspire the creativity necessary to advance low - carbon lifestyles from villages to national levels.

The result are energy policies with virtually no reliance on fossil fuels, new materials that have made green buildings mainstream, a public more demanding of less polluted, less congested and more efficient urban environments.

Farmers in particular have benefited from improved access to information, leading to more efficient, more profitable and healthier food products. This in turn provides them increased revenue and lower public health costs for the society.

Representing an increasingly larger percentage of the population, the elderly have taken advantage of improved access to information to play a more active role in policy formation that help them enjoy higher living standards than their counterparts in 2010.

Carbon Accounting

Carbon trading is well established and regulated by the world's financial institutions. In 2050 spending on greenhouse gas mitigation accounts for 2.5 percent of world GDP, allowing for a 90 percent reduction in global CO2 emissions from the 1990 levels. Pricing system for carbon emission, along with taxes, subsidies and special legal instruments help sustain strong private sector investments in low - carbon technologies. Nonetheless, despite reductions in CO2 emissions, climate change adaptation strategies remain ongoing, accounting for five percent of global GDP.

Recommendations in Addressing the Challenges: The Path to Low Carbon Society

If APEC economies are to more aggressively take on the task of shifting to a low - carbon society, quick actions must be taken to lay the groundwork for the long-term transformation ahead. Key components of the policy frameworks at the national and regional level should include:

National Level:

Establish a permanent committee on climate impacts and environmental sustainability to develop, monitor, and implement policy recommendations related to human-environment relations. Reinforce the need for a holistic approach across all sectors: energy, transportation, housing, public health, finance, education and natural resources. Develop national policies in consort with local communities to ensure strong local support for their implementation.

Green planning, zoning and building regulations must be put in place at both urban and rural levels. These policies must work to ensure that cities become increasingly attractive and offer desirable lifestyle choices, while also assuring the more open and relaxed character of agricultural communities and small villages are retained.

Market mechanism such as a carbon pricing system must be developed. Financial and fiscal incentives to encourage investments in low - carbon technologies need to be established. Programs should endeavor to mobilize the private sector and academic researchers to work cooperatively to boost green technology development.

Special attention must be paid to low - carbon energy policies. A fundamental shift in energy planning must occur that makes low - carbon strategies the priority. Technology transfers, in particular, should be explored to help accelerate the transition away from fossil fuels in both the power and transportation sectors.

Public education systems must be infused with a low - carbon ideology. This must occur at all grade levels and across all disciplines. Moreover, investments must also be made in public outreach campaigns to consistently reinforce public sector leadership for the low - carbon transition. Immediate attention should be given to increase the number of climate scientists and support for more accurate climate forecasting systems. And finally, further investments in information technologies should occur to facilitate the growth and transmission of the low - carbon society knowledge base.

In order to ensure the emission reduction in country and benchmarking the Emission Inventory (EI) should be implemented in all cities with the collaboration from public and private.

Clean Development Mechanism (CDM) should be adopted to the project design processes as an incentive for both public and private projects.

None of the above will be of any value unless there is strong enforcement and monitoring to ensure policies are both adhered to, and benchmarks are either met or justification given for benchmark revisions.

APEC Regional Level:

Devise a roadmap with clear objectives on the steps the region should take to transition to low carbon societies. Mandate, and provide support for, the incorporation of international climate change mitigation and adaptation strategies into national development plans. To this end, the APEC Energy Working Group has announced in June 2010 a proposal "Low Carbon Paths to Energy Security" (see http://www.ewg.apec.org) and is to develop an APEC technology development roadmap for key energy technologies.

Establish international certification on green industries, and support investment strategies that encourage compliance. Set regional strategies which enhance international and regional cooperation in such areas as combating airborne pollution, trading in low - carbon products, enhancing public awareness, strengthening law enforcement and promoting environmentally sustainable practices.

Advance public education toward low - carbon societies by supporting regional knowledge sharing and exchanges through communications and networking among APEC members. Promote green values by supporting APEC--wide media campaigns that recruit participa tion from private sector actors that are furthering the low - carbon society transition.

Establish the APEC group for Climate Change for enhancing the North-South and South-South collaboration and negotiation among the international parties.

Embarking on the 2050 low - carbon society is neither technologically nor economically daunting. It is, however, socially challenging. The political will must be mobilized to put in place policies that can unite regulations and market forces with a commitment to more environmentally benign and healthier lifestyles in the Asia Pacific as a whole.

Final Report - Content

INTRODUCTION

Human societies have always been climate dependent, but we are only now coming to grips with the fact that our climate also depends on us. As the second decade of the 21st century gets underway, we now recognize that we are faced with two challenges created by our ever-increasing emissions of greenhouse gases. First, the atmosphere is warming, setting the stage for a host of problems from droughts, extreme weather events, coastal erosion and inundation, to which we have to adapt. And second, we must begin implementing strategies to slow down our greenhouse gas emissions to mitigate the scale of these impacts while putting in place corresponding adaptation measures.

These challenges are particularly problematic for countries and economies in the Asia Pacific. On the one hand, the region is slated to face some of the greatest climate related impacts relative to other regions of the world. On the other, developing economies in the region will see substantial expansions of their middle-classes and the greenhouse gas emissions their lifestyles generate.

Mitigation and adaptation are two sides of the same climate change coin, the size of which seems to grow by the day. There are still relatively few international leaders working aggressively on mitigation policies, causing people to question if any mitigation actions will be sufficient to fend off the serious problems, especially given the significant political and economic challenges. It is certain too that it will take decades to deploy new energy technologies on a global scale. Adaptation is also problematic as it covers many fields and must fit into an integrated system, but such systems are hardly being discussed, much less established. Moreover, changing conditions and extreme events play out most dramatically at the local level, making self-empowerment key. But resources and capacity at the local level are limited at best.

Regional actions are key to bridging both local and global gaps. With nine billion people expected to inhabit the planet in 2050, an unsustainable number should they all aspire to the current middle-class lifestyle, it is critical that changes be made across the globe. And with most of this increase occurring in the Asia Pacific, regional actions here will be pivotal to any successful global response. Conversely, local knowledge and constant monitoring is required to identify critical triggers in the climate system and anticipate their impacts. Regional modeling must unite the global climate change models with detailed local realities helping to better plan and forecast the changes likely to come.

The APEC CTF project "Research on the Futures of Low Carbon Society: Climate Change and Strategies for Economies in APEC Beyond 2050" was one of the first efforts of its kind to bring a strategic regional focus to climate change issues, as well as to link global science, technology and policy communities to local initiatives. Specifically, the project aimed to envision and describe a future society where a low carbon economy and adaptive lifestyle become the principle drivers governing trade and development, and to formulate short, middle, and long-term strategies for the region in terms of technological development.

The future scenario(s) aimed to illustrate how social, economical and political demand could be harnessed to move the Asia Pacific along a path toward putting far less carbon into the atmosphere by 2050. Science and technology development, including technology transfer, that respond to such demand was seen a key driver of this transition and thus was a major focus of the project. The future scenarios and policy recommendations developed from this project were meant to reflect the economic and social conditions among APEC economies and be consistent with their common but differentiated responsibilities and capabilities. While the project's main focus was on longer-term perspectives, recommendations were to be developed for APEC and member economies that spell out short-term actions that could be taken to more quickly reduce the region's carbon footprint.

The project was officially launched with a workshop that took place on 13-14 August, 2008 in Hong Kong in collaboration with Hong Kong University. The participating economies were China, Hong Kong-China, Japan, Republic of Korea, Malaysia, New Zealand, the Philippines, Chinese Taipei, Thailand, Vietnam, and Macao-China. The main purpose was to discuss the project's scope, and timeline. From the two-day discussion, it was agreed that "Low - Carbon Society (LCS)" would become the project's keyword, and that the focal point would be the socio - economic adaptation necessary to build such a society, including: underlining personal lifestyles, social systems, international trade, economic systems, and effective governance.

An international Working Group was formed and held its initial meeting in Bangkok, Thailand from 13- 14 October, 2008. The workshop aimed to gain valuable inputs from working group members on the direction and detailed structure of a Real-Time Delphi (RT-Delphi) survey, including Delphi statements and their questions. Since an extended APEC-wide network of experts was seen as crucial to the success of the survey, members of the Working Group were also requested to identify their local partners who should take part. A series of additional meetings were held in Bangkok with principally Thai participants to help further develop and refine the Delphi survey component.

From 15 June to 30 August, 2009 the Delphi Survey was conducted to gather

opinions from a wide range of experts in the APEC region to provide initial inputs for the development of future scenarios. The survey was "roundless", meaning participated experts could answer the questions as many times as they desired while following the answers and comments from other participants in real time. Anonymity was maintained in the sense that no one knew who else was participating and who gave which answers.

The Delphi survey results were then used to as a baseline for the development of future scenario(s) during the Low - Carbon Society Scenario Workshop held from 2 to 4 November, 2009 in Phuket, Thailand. Workshop participants from throughout the region set to the task of examining the main socio-economic drivers relevant to climate change, as well as those that would likely contribute to establishing low carbon societies. Their principle aim was to develop possible scenarios of adaptive lifestyle beyond 2050 that addressed the following themes:

1. Climate change & its impacts
2. Migration, rural life & natural resources
3. Society & health
4. Trade of goods & services
5. Housing & construction/urban life/ transportation.

The outputs from discussions on these five themes were then combined into a single scenario as a potential framework for the social, economic and technological solutions necessary to realize a low carbon society by mid-century. Recommendations for shot-term actions at both the national and regional level were also formulated.

The project's final component involved the Technology Foresight Symposium that took place from 27-28 January 2010 in Bangkok, Thailand. Regional researchers, policy makers and private sector investors and innovators discusses issues and findings from the 2050 Scenario Workshop for purposes of advancing a greater region-wide dialogue on action plans to more rapidly transition to low carbon societies.

Some Low - Carbon Society Guidelines

While the concept of "low - carbon" is fairly self-explanatory, the path toward developing a "society" around it is less so. Some of the basic elements planners see as critical to a low - carbon society are:

- Reducing energy demand.
- Moving away from carbon-intensive fossil fuels and GHG emissions.
- Meeting the development needs of all groups in society.
- Measuring energy security.

It's important to have visionary goals, not just targets. Such goals might include: carbon minimization in all sectors; a simpler lifestyle that realizes a richer quality of life; and coexistence with nature. This might require: rates of use of renewable resources below rates of regeneration; rates of use of non-renewable resources below the rate at which sustainable renewable substitutes are developed; and rates of polluting emissions, including GHGs, below the assimilative capacity of nature. With such goals in mind, then targets, both for the short and long-term can be set. It is important to have building blocks that work toward achieving specific targets, to help break the problem down and demonstrate intermediate success.

As many developing countries continue working to integrate low - carbon society strategies into sustainable development plans and the attainment of the millennium development goals, they need to find the right policy balance between development co-benefits and climate change mitigation and adaptation to reach the poverty reduction goals. This may require some countries to reconsider zero-growth pathways.

Some key elements of a low - carbon society strategy should include:

- Reduce energy demand in every sector: residential and commercial buildings, transportation and industry.
- Develop plans for the use of alternative energy: wind, wave, solar, geothermal, hydropower, and biomass are competitive now. Nuclear energy, hydrogen and biofuels may also play a role, but may need to overcome technological and/or political barriers prior to becoming major components of some countries' alternative energy portfolios.
- Promote co-benefits of climate change measures: rural electrification and distributed, renewable energy; community-based management of forests and carbon sequestration; flood prevention and mitigation and climate change adaptation; control of disease vectors, and livable cities and towns.
- Create green jobs for poverty reduction: renewable energy, green buildings, and recycling and forest management.
- Integrate climate change mitigation and action plans into all aspects of

policy making: enact enabling legislation that reinforces the need for sectors to achieve specific targets, incorporate climate change into national plans, sustainable development plans and socio economic plans at all levels of government.

Participants also kept in mind those barriers that impede the implementation of low - carbon society strategies.

• Political: lack of common vision, disagreement on goals and targets, uncertainty over modeling, emissions scenarios and technologic advances and transfers.
• Psychological and human nature: emotional denial, cannot overcome the tragedy of the commons and impacts on the consumer lifestyle.
• Economic and financial: carbon price; costs of inaction and delay, transaction costs of implementation and management; debate over carbon tax versus cap and trade emissions trading, and the viability of Reducing Emissions from Deforestation and Forest Degradation in developing countries (REDD).

Despite these challenges, it is critical that we urgently move to a war-like crash program toward low - carbon society, as further delay means failure. We need at least two plans, one that assumes we meet reasonable reductions in carbon dioxide by 2050, and another if we do not and/or science informs us that such targets may be too high and more drastic measures are needed.

Low - Carbon Society Underway in Asia

Japan

Japan's efforts to pursue LCS pathways began with a five-step process focusing on energy consumption. First, a vision for the country's social and economic conditions in 2050 was created. Energy service demand estimates to serve those conditions were derived. Innovations for meeting this demand were then explored. Carbon emissions associated with meeting this demand utilizing the proposed energy supply mix were then quantified. And finally, energy supply potentials were checked.

Two scenarios were formulated. One assumes more rapid economic growth through technological advances, and the other projects slower growth and more modest community-centered lifestyles.

Each scenario worked toward significant carbon emissions reduction in 2050 brought on by both increased energy efficiency to reduce demand, and increases in the use of biomass, wind and solar energy.

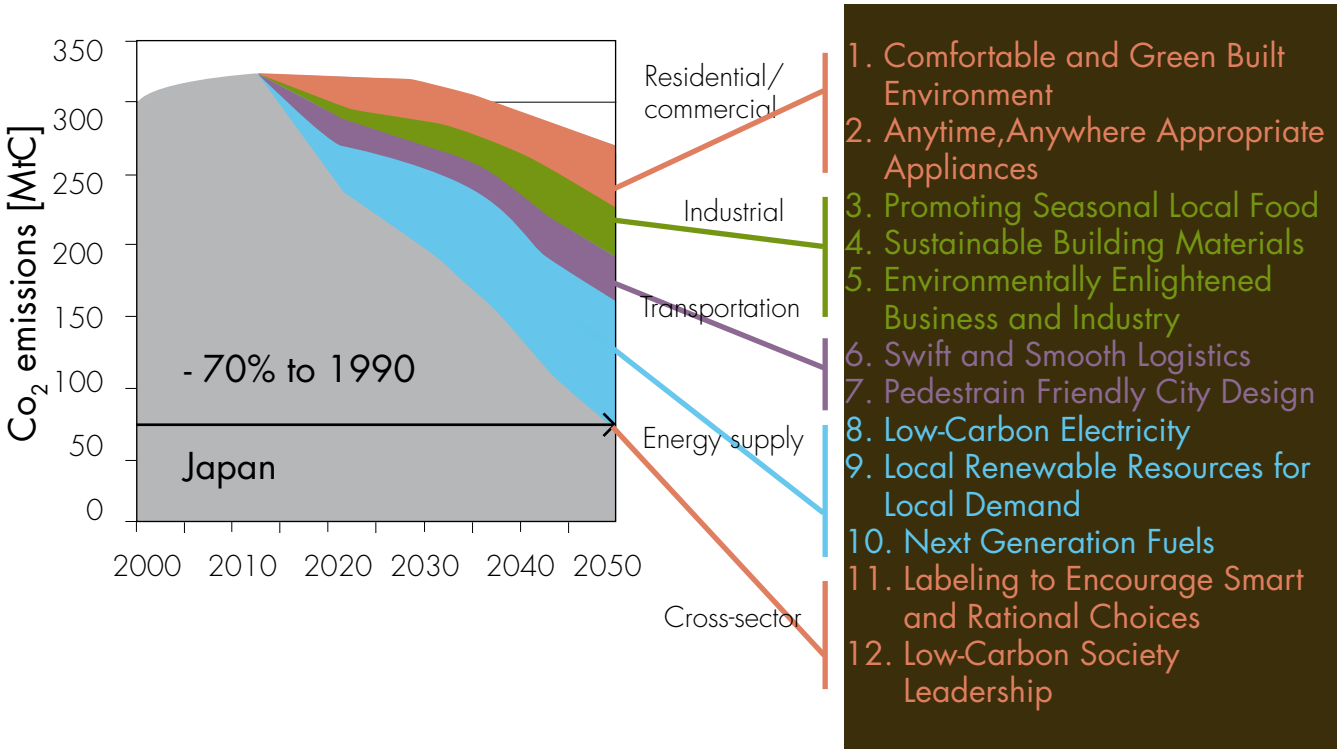
Backcasting was critical to the process. Planners took the social and economic vision for 2050, and then began backcasting in options that might be implemented over the 40-year period to achieve that vision. Time estimates were made for how long it would take for each of these options to be implemented and for them to achieve their intended results. Their feasibility and carbon cost trajectories were also examined.

A road map was then established that included: implementation polices, financing, assure sufficient technology and capacity are available to deliver the policies, and regulations to enforce the policies. All of these are seen as core steps in the implementation process, none of which can be neglected or skipped.

As depicted in Figure 1, ultimately a dozen actions were identified for how Japan might achieve a 70 percent reduction in carbon emissions.

CO_2 emission projections based on a dozen actions toward 70% reduction

AIM/LCS



Source: Kainuma, 2009

Thailand

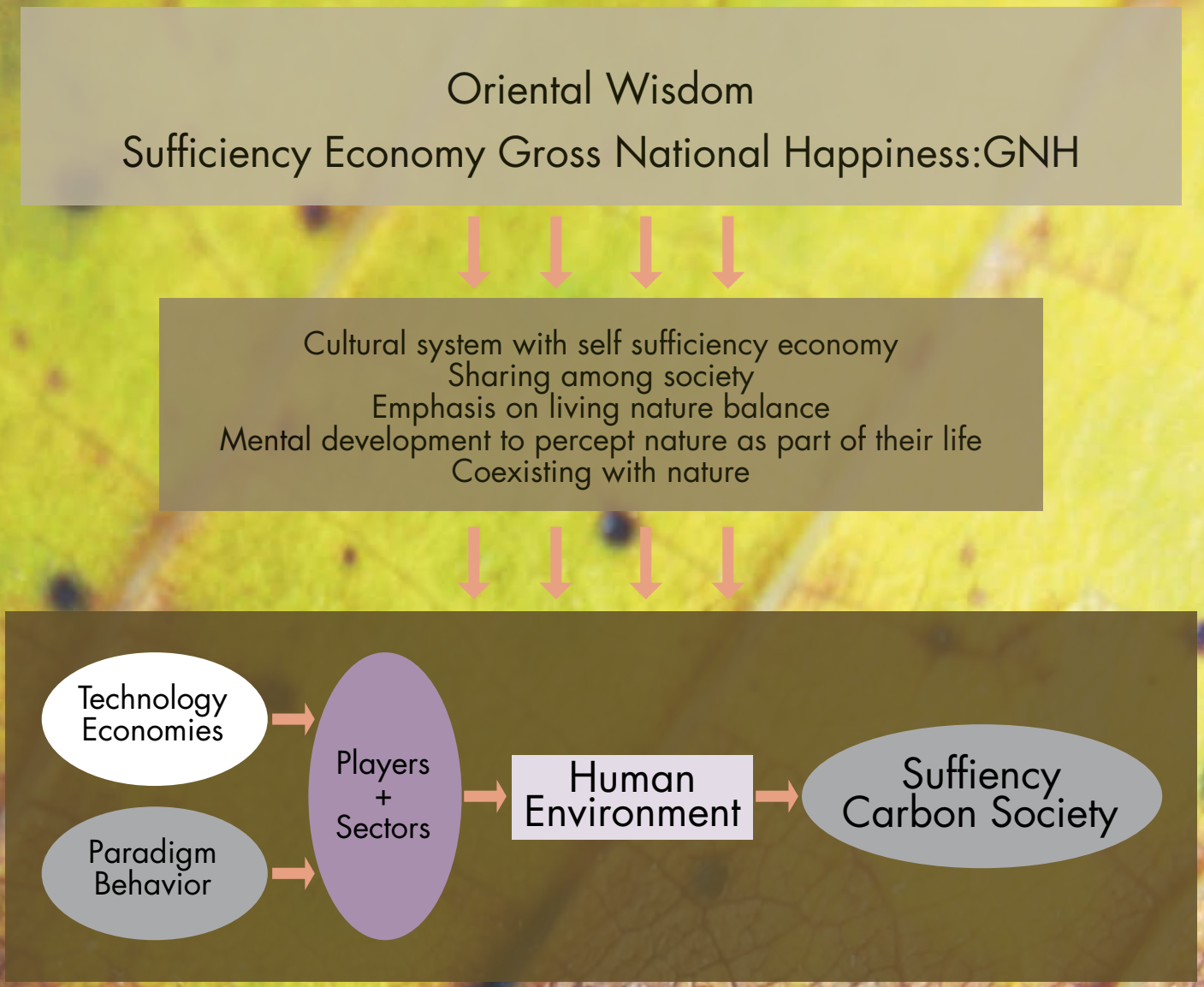
Low - carbon society is in harmony with a development philosophy unique to Thailand. The Sufficiency Economy, which has gained momentum in Thailand since the 1997 Asian financial crisis, stresses that the middle path (not too much, not too little) is the overriding principle for appropriate conduct by the populace at all levels. This also applies to the choice of a balanced development strategy so as to modernize in line with the forces of globalization while shielding against inevitable shocks and excesses that arise.

With such a principle in place, the steps to achieve a low - carbon society are driven as much by the publics overall awareness of the impact of their living practices as by any technological shifts.

Rural communities with sufficiency economic concerns are more likely to drive towards a low - carbon society due to their attitudes and consciousness than those in urban areas where technology plays a greater role in mitigation.

Such a strategy is also consistent with measures aimed toward increasing a country's Gross National Happiness. By reducing carbon emissions, a cleaner, simpler and richer quality of life can be achieved. Success with such attitudinal changes can bring about changes quickly, even independently, of technological advances as shown in Figure 2.

Figure 2



Source: Towprayoon, 2009

Delphi

A Real-Time Delphi Survey was used to gather opinions from a wide range of experts in the APEC region to provide initial inputs for framing the 2050 Low - Carbon scenarios. The Real-Time Delphi survey was "roundless", meaning participating experts answered the questions as many times as they liked upon review of the answers and comments from other participants. This was conducted in real time over an Internet html interface. Seventy-eight experts from five regions (Africa, the Americas, Asia, Europe, Asia and Oceania) were solicited to participate in the survey. Anonymity was maintained in the sense that no one knew who else was participating or their specific answers. The survey was carried out from 15 June - 30 August 2009.

The survey questions were informed by a scoping workshop that took place in Hong Kong in August 2008, and a working group meeting that took place in Bangkok two months later. The working group developed 34 statements for the Delphi survey, distributed across five categories: climate change & its impacts; migration, rural life & natural resources; society/health; trade of goods & services; and housing & construction/urban life/transportation. Five working group roundtable meetings were then held to further refine the Delphi statements and their questions. The survey results for each of the 34 statements were as follow:

Climate Change and Its Impacts

1) Anthropogenic greenhouse gas emissions are stabilized at 1990 levels. Results indicated this statement has a rather high level of impact and high level of desirability, but the level of feasibility was rather low. The median year of expected realization of this statement was 2050. Comments on this statement suggested that using 1990 as the level is artificial, and what's most important is establishing a discipline of reduction, as opposed to adherence to specific targets.

2) Carbon capture and storage (CCS) is effectively and fully implemented. Results indicated that this statement to have a rather high level of impact. However, there was wide dispersion of opinion among experts concerning the level of desirability and feasibility of such a technology. While some argued that in recent years there have been technological breakthroughs, and that some technologies might eventually prove useful, similar carbon reduction result could be achieved by shifting energy paths.

3) Technology and management enable forest plantations to act as the main carbon sink. Results indicated that this statement had a rather high level of both impact and desirability among the experts, but a more moderate level of feasibility, although there was a dispersion of opinions. The median year of expected realization of this statement was 2040. Experts noted that coral reefs and the ocean generally are greater carbon sinks than forests, and possibly future policies should be directed at those resources accordingly.

4) Global and regional earth system modeling (integrated assessment model) provides highly accurate results. Results indicate that this statement has a rather high level of impact, but only moderately feasible. The median year of expected realization of this statement was 2030. Experts noted that there are many different models, all of which have limitations. What is often learn each time a new model is created or refined is how very complex the real world is - and so reductionist models need to continuously become more agile and complex themselves.

5) Effective mechanisms are devised to cope with the direct impact of climate related events. Results indicate that this statement had both a rather high level of impact and desirability, although there was a wide dispersion of opinions on the level of desirability. Feasibility of the statement was found to be moderate. The median year of expected realization of this statement was 2030. Commentators noted that only some climatic disruption measures would prove to be amenable to human management; and while responses to change events have improved, they've been highly variable from country to country.

6) Food scarcity occurs as a result of a significant shift in land allocation from food to energy crops. This statement was seen as having a rather high level of impact, moderate level of feasibility, and low level of desirability. The median year of expected realization of this statement was 2030. One respondent noted, however, that while food scarcity was in fact occurring due to such competition it was by no means the only reason. It was felt that there should be more legislative efforts to protect future food sources.

Migration, Rural Life, and Natural Resources

7) Coastal ecosystem management becomes widespread and economically beneficial. Experts evaluated the impact of this statement as rather high, but felt it had moderate level of feasibility. The median year of expected realization of this statement was 2030. Experts expressed worries about the costs and other barriers for coastal ecosystem management.

8) Shift of farming land to higher altitude and colder areas cause major destruction to the most important carbon sink (forests). Experts found this statement to have a rather high level of impact, moderate level of feasibility, and low level of desirability. The median year of expected realization of this statement was 2040. While one expert felt that shifting of farming land would be a vicious cycle, another believed that there is a growing awareness about the tradeoffs between land cultivation and forest cover such that a balance could be reached.

9) Migration of people from coastal areas inland induces major conflicts over land and resources. Experts found this statement to have a rather high level of impact and moderate level of feasibility, while having a rather low level of desirability. The median year of expected realization of this statement was 2040. One expert noted that while this may be a rather predictable and foreseeable consequence, there is considerable variation in countries' circumstances, which will mitigate the severity of impact.

10) New generations of well-educated people choose new knowledge-intensive, agriculture-based industries that are more sustainable. Experts see this statement as having a rather high level of impact, feasibility and desirability. However, two comments felt that the majority of people will not be well-educated, and the impact of such changes will likely to be low.

11) High demand on carbon reduction creates sustainable income for poor rural people who plant trees and energy crops. Experts found this statement to have a rather high level of both impact and desirability, but with a moderate level of feasibility. There was also a wide dispersion of the opinion, with four experts commenting negatively about the prospects of rural poor benefiting from planting trees and energy crops. The median year of expected realization of this statement was 2040.

12) Ecotourism becomes dominant in the tourism industry. Experts viewed this statement as having a moderate level of impact and rather high levels of both desirability and feasibility. The median year of expected realization of this statement was 2030. Commenters noted that: ecotourism was unlikely to have a major impact since it was valued only by a few; greening of the tourism industry and economical benefits would no longer be the main issue in the future and tourism has always been more about transferring resources and income between economies than ecological improvement.

13) Algae technology capable of producing fuel (H2, oil, or ethanol) becomes commercially widespread. Experts evaluated the impact and desirability of this statement as rather high, while its feasibility as moderate with a wide dispersion of opinions. The median year of expected realization of this statement was 2030. One commenter added that the current R&D on algae technology looks promising.

14) Increase in, and acceptance of, skilled immigration. Experts evaluated the impact and desirability of this statement as moderate, while the level of feasibility was seen as rather high. The median year of expected realization of this statement was 2030. Three commenters agreed that skilled immigration would increase though it may create intolerance and calls for restrictions, but such restriction would unlikely succeed. Skilled people would have the choice to move, (migrate) to better environments.

15) Water scarcity becomes a cause of war. Experts felt the impact and feasibility of this statement was rather high, but not surprisingly rated its desirability as low. The median year of expected realization of this statement was 2030. It was noted that water scarcity is already a cause of conflicts in the Middle East, so will most certainly present similar problem in Asia as hydrologic patterns and demographics shift.

Society and Health

16) Technologies significantly improve the healthcare system to cope with new infectious diseases stimulated from global warming. Experts felt this statement had a rather high level of impact, feasibility and desirability. The median year of expected realization of this statement was 2030. It was noted by one expert that while technologies are improving rapidly, their deployment in areas where many diseases arise - e.g. Africa - is very uncertain.

17) Technological shifts toward producing food locally to serve societal demand while reducing carbon emission. Experts found this statement to have a rather high level of impact and desirability while the level of feasibility was moderate. The median year of expected realization of this statement was 2030. No additional commentary was offered.

18) A global regulatory framework of low - carbon is totally accepted. While the experts felt this statement had high levels of impact and desirability, the results showed they felt the feasibility was only moderate, and no real consensus. The median year of expected realization of this statement was 2040. It was noted that while the low - carbon concept may be spreading, there was not yet total acceptance.

19) Consumers are willing to pay more for low - carbon footprint products. Experts found this statement to have a rather high level impact and high level of desirability, while its feasibility was seen as moderate. The median year of expected realization of this statement was 2030. One commenter offered that some market segments are willing to pay more for low - carbon footprint products, but this will not have real impact unless forced by regulation. Another expert noted that the economics will no longer be an issue once most people feel the effects of global warming.

Trade of Goods and Services

20) Economies that were previously dominated by manufacturing industries /sectors have moved dramatically towards knowledge-based services. Experts indicated that this statement had a rather high level of both impact and desirability, while its level of feasibility was seen as moderate. The median year of expected realization of this statement was 2030. No additional comments were offered.

21) Environmentally friendly goods are now the dominant consumer goods in the global market. The results indicated that this statement had a rather high level of impact and high level of desirability. In contrast, the level of feasibility was found to be moderate, with a wide dispersion of the opinion. The median year of expected realization of this statement was 2030. No additional comments were offered.

22) Carbon accounting becomes mandatory globally. Experts found this statement to have a rather high level of both impact and desirability. In contrast there was a moderate level of feasibility, with a wide dispersion of the opinion. The median year of expected realization of this statement was 2030. It was noted that a global mandatory system is beset with many obstacles, and whether it works depends on the readiness of individual countries.

23) A low - carbon related SR (Social Responsibility) ISO Standard is considered the norm of any business practice. Experts found this statement to have a rather high level of impact and moderate level of feasibility. The median year of expected realization of this statement was 2030. No additional comments were offered.

24) Air freight shipments are down to 1990 level. The results indicated that this statement had a rather high level of impact and moderate level of desirability, while a level of feasibility was rather low. The median year of expected realization of this statement was 2030. It was noted, that while desirable, aviation is not a big contributor to carbon emissions, and air freight a subset thereof.

25) The Global IT network will reduce traveling to 1990 levels. The results indicated this statement to have a rather high level of desirability and moderate level of feasibility, although there was a dispersion of the opinion. The median year of expected realization of this statement was 2030. It was noted by some that such emissions reductions were unlikely to have a major impact.

26) Political instability and inter-regional conflicts due to climate change impacts lead to little interaction between the major economic powers. The results indicated that this statement had a rather high level of impact and moderate level of feasibility, while the level of desirability was rather low. The median year of expected realization of this statement was 2040. No additional comments were offered.

27) It is realized that emission trading has had little effect on reducing the global green house gas emission in 2050. The results indicated that this statement had a rather high level of impact, moderate level of feasibility, and low desirability. The median year of expected realization of this statement was 2040. One expert commented that emission
trading represents an important early measure, but after an initial flurry of activity may not deliver the results needed.

Housing and Construction, Urban Life and Transportation

28) Conventional fuels disappear completely from transportation sector. The results indicated that this statement had a high level of impact and rather high level of desirability. In contrast, only a moderate level of feasibility was found, with a wide dispersion of the opinions. The median year of expected realization of this statement was beyond 2050. No additional comments were offered.

29) Most existing commercial buildings are retrofitted to save 50% of energy use on average. The results indicated that this statement had a high level of both impact and desirability, while the level of feasibility was seen as rather high. The median year of expected realization of this statement was 2040. Retrofitting old buildings was seen as economical in the long term especially in regions of extreme climate. However, incentives would be needed to induce more retrofitting.

30) Energy efficiency of home and office appliances increases by 50%. The results indicate that this statement had a high level of both impact and desirability, and a rather high level of feasibility. The median year of expected realization of this statement was 2030. One expert felt consumers would be willing to buy more efficient products to save energy in the long run, while another felt regulations to mandate energy efficiencies in appliances is required because of the sizeable investment and long payback period.

31) 20% of electricity is generated by decentralized sources. The results indicated that this statement had a rather high impact, but with dispersion of opinions. Desirability and feasibility were also found to be rather high. The median year of expected realization of this statement was 2030. One expert noted that centralized energy supply and alternative energy sources are not compatible; energy self-sufficiency for individual communities will be the future.

32) The Majority of trips in daily life will be through efficient public transportation as opposed to the use of personal vehicles. The results indicated that this statement had high levels of both impact and desirability, and the level of feasibility was rather high. The median year of expected realization of this statement was 2030. One expert reinforced that efficient public transportation requires significant long - term investment.

33) Personal transportation, supplementing mass transportation, will mainly consist of shared, loaned or hired vehicles. The results indicated that this statement had a rather high level of both impact and desirability. In contrast, the level of feasibility was moderate, with a dispersion of the opinion. The median year of expected realization of this statement was beyond 2040. No other comments were offered.

34) Breakthroughs in battery storage technology make obsolete all other fuels including H2. The results indicated that this statement had a high level of impact and rather high level of desirability, though with some dispersion of opinion. However, experts found the statement to have a moderate level of feasibility. The median year of expected realization of this statement was 2050. One expert observed that batteries are not fuel. Another noted that there is a great deal of uncertainty about future energy systems, therefore we should only back a small number of options.

The key findings for each of the five core categories of questions were:

Summary of the Delphi Survey Results

• Climate change & its impacts: Climate change will have adverse impacts. Doubts exist about the effectiveness and timeliness of technologies like carbon capture and storage, earth system modeling, and the effectiveness of international agreements.

• Migration, rural life and natural resources: Rising sea levels will force farmers to shift to higher attitudes despite coastal ecosystem management strategies. Impacts on eco - tourism and skilled immigration are only moderate. Water scarcity is a major concern. There are conflicting views whether well-educated people will undertake farming, and whether rural poor benefitfrom planting trees for carbon sequestration or cultivating energy crops.

• Society & health : Experts are optimistic that technologies can improve the healthcare system. The low - carbon concept is spreading and some consumers are willing to pay more for green products.

• Trade of goods and services: Participants are generally positive regarding movement towards green trade and services despite some doubts about the effectiveness of policy implementations to support these activities.

• Housing and construction, urban life and transportation: Experts have faith in technologies to boost energy efficiency, public transportation, and renewable energy, but are unconvinced that conventional fuels will disappear quickly.

Key trends that the survey results suggest the region must prepare for include:

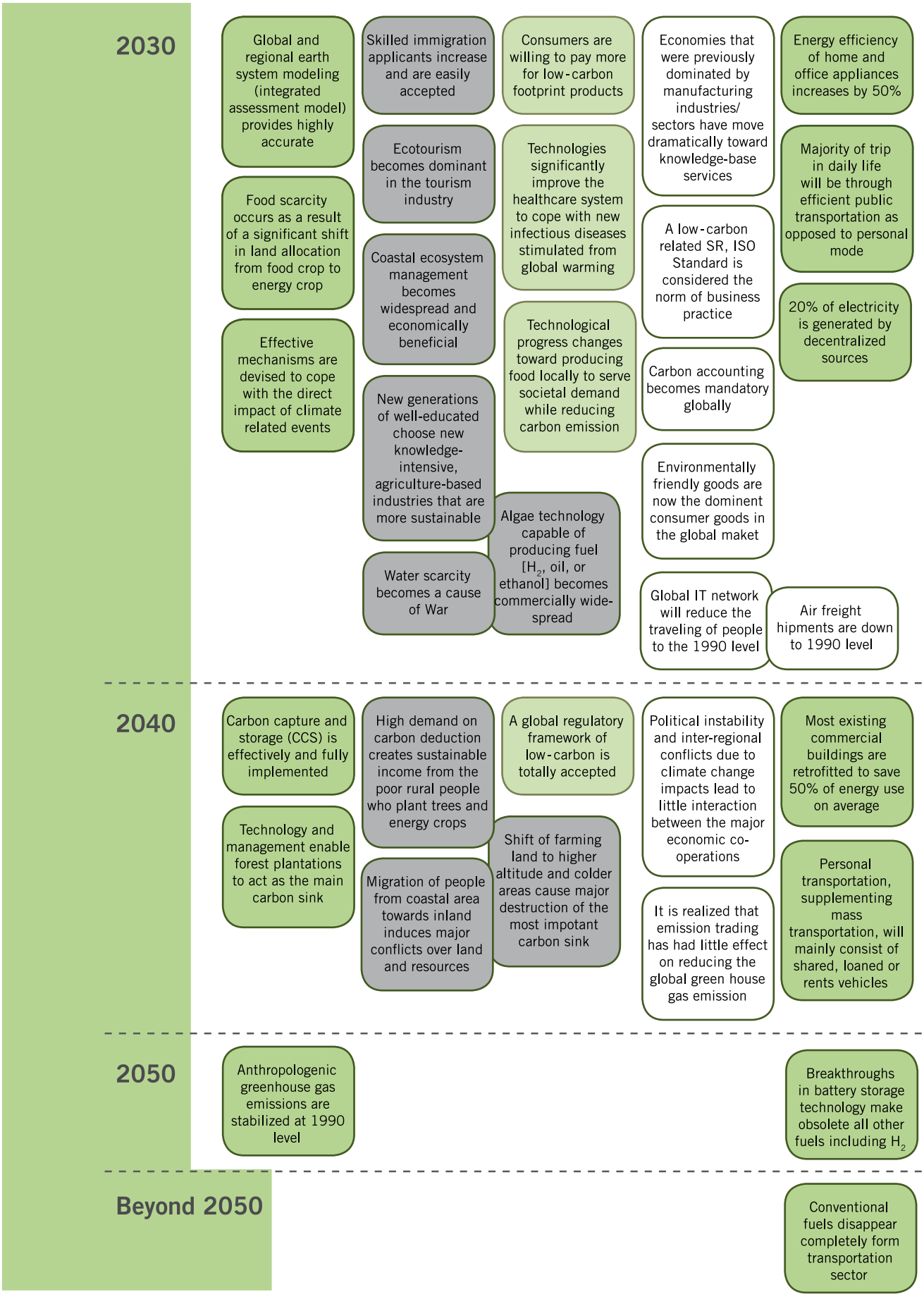
• Rising temperatures, more severe storms and extreme weather events.
• Greater water scarcity leading to changes in migration patterns and land use.
• Technological advances improving healthcare systems.
• Increased regulations on carbon emissions and individual carbon footprints.
• Greater energy efficiency to achieve gains in energy conservation.

Key uncertainties the survey highlighted included:

• The feasibility of carbon capture and storage
• Energy generation via algae farms.
• The viability of a global regulatory framework
• The impact information technology can have on reduced travel
• The role conventional fuel supplies will play in future transportation.

The analysis of Real-Time Delphi survey results illustrated by the LCS 2050 Chronology of Future Events was used as inputs to the Low - Carbon Society Scenario Workshop.

The LCS 2050
Chronology of Future Events



The 2050 Scenario

From 2 to 4 November 2009, a workshop was held in Thailand's resort town of Phuket to utilize the results of the Delphi survey to guide a foresight planning process. The workshop's objective was to construct a scenario for how a low - carbon society might be achieved in Asia Pacific by 2050, the steps that needed get and the challenges that would need to be overcome. Representatives from government ministries, NGOs, academia and independent research institutes from across the region participated, many of whom were involved in the Delphi survey and other earlier components of the program.

The task was broken down into five components, consistent with the main themes addressed by the Delphi survey: climate change and its impacts; housing and construction/urban life/ transportation; migration, rural life and natural resources; society and health; and trade of goods and services. In terms of the evolving a single scenario from these topics, the first, climate change and its impacts, provided a general overview of the direction climate and society might head, while the other four helped to filter out as well as clarify the details.

Visioning of LCS 2050

Every element shaping the five futures envisioned during the workshop is globally-driven by predicted changes, both incremental and radical over time. When encapsulating these potential futures into one future of a low-carbon society beyond 2050, such possibilities are best framed within the future envisioned under the theme Climate Change and its Impacts. The illustration above depicts this in a single plausible future, incorporating the other four main elements of the preferred futures envisioned during the workshop.

Participants worked in five teams to first formulate their desired low - carbon future for 2050, and then work backward (backcast) to identify what should happen in each decade from 2050 back to 2010 to realize that future. Participants were encouraged to embrace general brainstorming principles, by which every idea is good, to suspend judgment, and if desirable; shamelessly steal ideas from other groups for something that may have been overlooked.

Given that few participants had ever participated in such a long-range planning process, the precise description of the three-day exercise drew some nervous laughs. The task of imagining a future 40 years from now is seen as incredibly demanding by many. Half of the people in the room would not live long enough to see 2050. A quarter might still be alive, but barely. Intellectually, however, all recognized the importance of making choices now to minimize the problems handed down to the future generations, and that a low - carbon society in 2050 is unlikely to materialize unless key choices are identified and acted upon today.

In the end the groups generated quite a positive scenarios for the Asia Pacific in 2050. This result was not surprising given the normative scenario method employed for this workshop, which was designed to identify ways to overcome a negative force, the impacts of climate change.

As a whole, the groups saw the world achieving a dramatic reduction in global carbon emissions and, in doing so, taking advantage of ongoing opportunities to make major changes in how society was organized. Such actions, their findings concluded, would lead to less conflict, a dramatic reduction in poverty, greater access to health care, improved quality of life and greater independence in food production for each locality. These gains would come with an equally dramatic shift in accounting priorities away from currencies such as the US dollar standard to a greater emphasis on trade in carbon emissions.

Critical success drivers to realizing such a scenario included continued advances in technology, technology access for developing countries, stronger governance, education reform, open access to information, more equitable access to communication, and a dramatic shift away from fossil fuels toward alternative energy sources. While global leadership and cooperation would be critical, individual and community behavioral changes were seen as far more pivotal to realizing the forecasted outcomes, thus reinforcing the importance of assuring equitable access to information, participation in decision making and the public policy apparatus that supports this.

The key components of 2050 Low - Carbon Scenario included:

Public Sector Commitment

Strong governance with a commitment to planning will play a central role in lowering the region's carbon footprint. Public sector demand for new approaches with financial incentives to encourage innovation and implementation will result in viable commercial ventures that support low-carbon lifestyles. Conversely, disincentives such as carbon taxes to manage those activities that contribute to greenhouse gas emissions are major force discouraging extensive use of carbon-based inputs. Additionally, reforestation policies help to build and manage carbon sinks as central components to an overall mitigation strategy.

Increased attention is given to policies that reinforce sustainability, especially with regard to agriculture and food production. These policies are critical to managing the population increases placing greater pressure on agricultural land conversion, along with the increasing demand for plant-based products from fuels to plastics that compete for land resources with food producers.

Land use zoning therefore plays a more critical role to assure rural communities maintain a competitive land advantage for food production. The greatest threat to a more positive outlook for rural residents is migration from urban areas brought on by the potential failure of urban planners to manage their response to climate change and associated low - carbon growth opportunities. Permanent residences for urban migrants are expanding. Even well-managed urban areas, with green buildings, clean energy and efficient transport systems, can sometimes be of such densities that residents still seek the quality of life advantages offered in rural communities. Therefore, development policies must constantly work to reinforce the need to meet quality of life objectives by decoupling environment with development.

To protect the rural environment against the cumulative impacts of industrial pollution from both inside rural areas and migrating in from urban-based industry, strict controls are placed on the

emission of carbon and other pollutants. Physical or virtual domes are placed around factories and industrial estates to ensure through structural and/or policy barriers that no unwanted emissions or effluent enters the surrounding environment. The existence of such policy frameworks, and the regulatory apparatus to maintain them, also reinforces the importance good governance plays in this low - carbon society.

As evidenced by the challenges faced by the United Nations Framework Convention on Climate Change during the early part of the 21st century, national governments continue to have limited success in demonstrating an ability to react quickly and collectively to critical issues affecting the planet. Instead, significant social and economic transformation towards a low - carbon society occurs at sub-national levels because of initiatives undertaken by individuals, communities, villages, businesses (small and medium) and even actions from the street. Local level governments therefore must work to reinforce community networking and community-driven initiatives that can drive the changes the world requires in pursuit of a low - carbon development path.

Stronger political will toward well-designed decentralized administrative structures allows small communities in 2050 to be far more politically and economically liberated than their 2010 counterparts. Government assistance and market organizing are driven through community organization. Networking of communities, whether on-line or face-to-face, plays a major role in the achievement of development trajectories through cleaner energy paths, greener business and industrial practices, democratic access to technology, knowledge sharing, improved health care and education reform.

While national and local public sector leadership is vital, a greater level of regional collaboration within the Asia Pacific nonetheless occurs. The ASEAN blood bank and the European solar energy collaboration provided models for regional efforts that could quickly deliver benefits to communities. This regional teamwork is enhanced by an Asian Parliament made up of community representatives working to stimulate alliances that foster passion, creativity and innovation for low - carbon development paths. Key areas of collaboration that emerge across the Asia Pacific include epidemic control policies and targeted R&D investments for common societal needs such as green energy and food production.

Technological Advances

The world becomes more "predictable" as advances in climate modeling technology provide greater certainty when projecting climate trends and their impacts. By 2050, modeling accuracy has increased to 98-100 percent due to a 10,000-fold expansion in computer processing power, affording much more sophisticated real-time predictions of weather and climate. Of special concern to many in the region is the ability to more accurately forecast, and prepare for, extreme weather events. Weather prediction accuracy between 2020-2050 has increased since 2010. More accurate and reliable forecasting information allows policy makers and the public to better prepare for the longer-term changes caused by the changing climate.

There is a massive upscaling of public investment for both super computers dedicated to climate modeling, and building the capacity of climate scientists around the world to utilize these new computational resources. It is anticipated that such investment priorities will remain high beyond 2050.

Between 2010-2040 the world experiences a gradual transition in key technologies. Renewable energy sees its stake in global energy supplies grow from 10 percent in 2010 to 70 percent in 2040, and ultimately reaches 90 percent in 2050. Geothermal technology becomes economically feasible in 2020, with a corresponding growth in algae technologies in the 2030s. The common theme is the bridging of today's best technologies with something more efficient and less costly (economically, socially and environmentally) to come. By 2040, energy services become fully liberalized globally. The "green industrial revolution" that got underway at the turn of the century, is fully integrated in 2050 aided by financial instruments such as shifting taxes from production to pollution. Other regulations, incentives, institutions and production standards also come into play. In 2030 the Asia Pacific begins to see the emergence of zero-emission industries and the large-scale use of solar power. The private sector is instrumental in driving these positive changes, but the most fundamental change that occurs is society's change in thinking.

Technological advances are critical drivers to low - carbon solutions for urban areas. Technological innovation continues apace though 2040, and likely accelerates further as 2050 arrives. Artificial intelligence grows in importance allowing computers to manage a greater percentage of complex tasks. The use of nano-technology for self-assembly manufacturing of personal goods like clothing, and for air and water filtration, will become widespread contributing to reductions in emissions related to transportation logistics. Technological advances will also continue to fuel improved wellness and healthcare, and growth in personalized medicine.

Technology helps feed transportation improvements including: a dramatic increase in airliner fuel efficiency due to alternative fuels and advances in aeronautical engineering; improved battery storage and hydrogen fuel cells have led to the complete phase out of fossil fuel land vehicles; further advances in teleconferencing technology has

reduced the need for business-related air travel, and robots have taken over mail and parcel delivery to both homes and businesses.

Renewable energy including solar, wind, hydro and nuclear power are now prominent sources for electricity generation. Renewable energy sees its stake in global energy supplies grow from 10 percent in 2010 to 70 percent in 2040, and ultimately reaches 90 percent in 2050. Geothermal technology becomes economically feasible in 2020, with a corresponding growth in algae technologies in the 2030s. Urban high-rises are "wrapped" with PVs for self-electrification, while power generation gradually shifts to a less decentralized distribution system to afford greater supply options for rural areas. Demand side management is also key to success in reducing emissions from the energy sector.

The common theme is the bridging of today's best technologies with something more efficient and less costly (economically, socially and environmentally) to come. By 2040, energy services are fully liberalized globally. The "green industrial revolution" that got underway at the turn of the century, is fully integrated in 2050 aided by financial instruments such as shifting taxes from production to pollution. Other regulations, incentives, institutions and production standards also came into play. In 2030 the Asia Pacific sees the emergence of zero-emission industries and the large-scale use of solar power. The private sector is instrumental in driving these positive changes, but the most fundamental change that occurs is society's change in thinking aided by public sector leadership and education.

By 2030, food moves directly from farmers to consumers without intermediate handlers. More highly advanced communication technologies enable information to be accessible anywhere and at anytime, facilitating universal access to education. Improved educational opportunities increase interest in environmental protection. Manufacturing and consumption processes move toward zero waste, especially as any waste products serve as feed for electricity generation.

Public Education toward a new Lifestyle

Lifestyles are significantly different from 2010, largely the result of educational systems that stress sustainability values and that lead to behavioral changes that reinforce low - carbon living. Renewable energy, energy efficiency standards and mandated conservation practices are vital to the evolution of low - carbon lifestyles. Innovative housing and commercial building design parallel new materials' innovation to further lay the foundation for carbon neutral consumption practices. Support must be generated for sufficient mass transit to become the dominant mode of moving people to and from work in urban areas, and for advancing highly green and fuel-efficient technology that assures a clean flow of goods within and across national borders. A higher level of education among farmers, and their commitment to "computerized farming" and other technological advances. Absent a guaranteed supply of healthy food, a low - carbon future is difficult to foresee.

The 2010-2030 period is critical to the successful transformation to a low - carbon green growth society by 2050. Educational efforts will help bring about a major shift in mindset is achieved early in 2020s while the major structural shifts occur a decade later. The transformation during these two decades leads to more subtle changes on the path to 2050 and beyond. An acupuncture analogy is offered: when a needle is inserted at the right point, a wave of new energy is released that changes the state of the entire system.

The growth in natural disasters in the 2020s and cumulative population pressures in the 2030s represent "tipping points" that will stimulate greater incentive for behavioral changes to achieve low - carbon lifestyles. To take advantage of these stimuli low - carbon development strategies must be in place at the national level in all countries. And these plans must be accompanied by educational reforms that make learning free and accessible to all to inspire the creativity necessary to realize low carbon lifestyles.

The greatest challenge to realizing these changes is the quantity and quality of information for political leaders and the public to make sensible choices. Another crucial issue is the timeliness and accessibility of technological R&D for low - carbon development. The shift to greater information sharing for regional collaboration represents another hurdle that must be overcome to achieve the necessary low-carbon innovation across all sectors.

The public will better recognize that nine billion people will begin to be sharing this planet in 2050. Moreover, these people will be living longer, tripling of the 65 and older population from 2010. This will help to reinforce a more "back to the basics" environmentally friendly lifestyle gains popularity as resource constraints make the "consumption for happiness" lifestyle more difficult to sustain. Carbon footprints and green eco-accounting are firmly established in people's mindsets by 2040.

Carbon Culture

Not only must people exhale carbon, but we now must also "inhale" it, constituting a key element of the 2050 way of life. Carbon accounting has become commonplace, to the point where carbon replaces the US dollar as the dominant global currency. Carbon rights can be used as collateral for loans, and given as loans themselves through the International Monetary Fund. Global carbon trading is governed by an entity modeled after the World Trade Organization. Carbon clearinghouses allow almost everything to be accounted for in terms of carbon emissions.

In 2050, spending on greenhouse gas mitigation accounts for 2.5 percent of world GDP, allowing for a 90 percent reduction in global CO2 emissions from 1990 levels. Adaptation strategies necessary to combat climate change impacts account for another five percent share of global GDP.

Mitigation mechanisms include establishing a pricing system for carbon emission, along with taxes, subsidies and special legal instruments designed to provide incentives for the private sector to invest in low - carbon technologies. A global financing institution is established for carbon emissions' reduction.

Urban/ Rural

A key characteristic of the 2050 society is increased diversity in demography and cultures. Metropolitan and city planning is greatly improved, supported by vastly upgraded transportation infrastructure. 90 percent of urban commuters are able to take for granted an efficient and reliable mass transit system, leading to significant reductions in urban carbon emissions. The elderly represent a much greater percentage of urban residents, and enjoy increased mobility and a better quality of life as they too benefit from the greater emphasis placed on quality urban planning.

Rural life in 2050 grows in desirability as urban residents, especially retirees and the elderly, seek a cleaner environment and more relaxed lifestyle. Rural communities achieve greater and more egalitarian control of their natural resources, increasing opportunities for self-sufficiency relative to urban dwellers. Free education is the driving force, opening doors for rural residents to improve their livelihoods and quality of life. Rural poverty becomes a distant memory.

TECHNOOGY FORESIGHT SYMPOSIUM

The final stage of the Low - Carbon Society Beyond 2050 Project was the hosting a two-day symposium for regional researchers, policy makers, private sector investors and innovators. The focus was on strategies for utilizing the findings the 2050 Scenario Workshop to advance a greater region-wide dialogue and action plans to more rapidly transition to low - carbon societies. The symposium featured:

The Value of Foresight in the Changing World

Foresight is a valuable technique to help systematically explore the future. And if ever there was a time when such tools need to be deployed, it is in this era of climate change. While uncertainty remains about the scale of impacts societies and ecosystems may face as the atmosphere warms, few argue that an appropriate response from all people to reverse this trend is crucially needed. Foresight planning allows us to look decades down the road to the type of society that can bring about such a reversal, from which strategies then can be devised to realize this vision.

Without such tools, policy responses to climate change would be strictly reactive, and unlikely to successfully cope with the rapid changes ahead. More importantly, since the core policy responses must ultimately bring about fundamental changes in societal behavior to dramatically lower the collective carbon footprint, only by employing mechanism like foresight planning can the various conditions, obstacles and opportunities be explored to illustrate how, over time, such changes can actually occur. To achieve a low - carbon future, a new way of thinking must be adopted by the entire global population. Motivating such change is about learning what tools and strategies to deploy, or not, that can help both developed and developing countries to shift their priorities and expectations. Politics, political arrangements, economic priorities, population pressures, resource constraints and social system all must be assessed. Foresight allows the arrangement and rearrangement of all these variables to output a timeline, a roadmap, to a new world.

Practically, foresight is only an interface for charting a course through extreme conditions. Foresight itself has no power to motivate change. But with such options and visions clearly articulated to help guide policy discussions and societal decisions, foresight results help provide the clarity to reinforce that such change is entirely possible.

Challenges and Opportunities for Sustainable Development in the Asia Pacific Region

Climate change is a real urgency, and an issue of magnitude and complexity never tackled by the world's diverse political systems. The world's experience with the Kyoto Protocol illustrates how poorly equipped society is, as during its tenure the world actually experienced a dramatic increase in emissions far in excess of the most pessimistic forecasts when it was negotiated in 1997. Whereas collective intelligence urges the immediate deployment of smart technologies, a shift to clean energy, and the rapid phasing out of toxic products and practices, wisdom entreats us to pause, to shift the conversation in order to pose questions that are currently not part of the debate.

In the Asia Pacific, the threats and opportunities including adaptation option/strategy, underlying policy framework, and key constraints and opportunities to implementation in water, agriculture, infrastructure/settlement (including coastal zones), human health, transport, and energy are extensive. Carbon reduction opportunities including key mitigation technologies and practices are already commercially available and more are entering the pipeline every day. Meanwhile, policies, measures and instruments shown to be environmentally effective are discussed, along with strategies to address key constraints facing carbon reduction in energy, transport, and industrial sectors. While change is afoot, it is not yet at a level of conviction and focus commensurate with the challenges climate change has presented.

Meeting the climate challenge by shifting to a low - carbon economy is non-negotiable fact. While international agreements and frameworks have not yet proven to be as effective as hoped, examples of successful policies in Sweden, Germany and Denmark have illustrated that bridging mitigation and economy measures can indeed be achieved. Although the challenges facing developing countries are somewhat different, effective policies are in reach should societies choose to pursue them.

Adaptation and LCS Strategies for Asia Pacific

Climate change impacts can now be estimated more systematically for a range of potential scenarios. Some systems, sectors and locations will be especially affected by climate change while others less so. Mitigation strategies for developing countries should consider taking a regional approach to maximize co-benefits. The low-versus high–hanging fruit strategies will depend on national priorities along with financial and technological constraints.

The 21st century will witness a shift away from using fossil fuels for sustainable energy supplies. Nuclear and renewable energy are already appearing more attractive in many countries. Efforts are underway to reverse the flow of hydrocarbons, advance green energy and nano-based systems. Meanwhile, when addressing CO2 mitigation, poverty reduction needs must not be compromised.

Some key elements to achieving low - carbon societies are: 1) radical technological change, 2) technology dissemination, 3) increased energy technology investments, 4) synchronized climate policies and R&D strategies, and 5) recognition that technology alone is not the solution. Additionally, issues such as long-term vision, shifting from high resource-oriented to knowledge-oriented societies, poverty reduction, improved health care, and political leadership to motivate popular participation and support, also require consideration.

Adaptation strategies must be designed around coping, and building resilience. Vulnerable countries must address the challenge to balance development and adaptation needs. So far, support to aid poorer countries through the United Nations Framework Convention on Climate Change has yet to emerge. Nonetheless, these nations should continue to engage in international negotiations to seek partnerships that can help them to realize the co-benefits of development and climate change, address the economics of adaptation, bring forward technological options, and utilize humanware (especially social infrastructure) over hardware in mobilizing their response.

Market Opportunities in the Low - Carbon Society

Markets are exposed to many types of risks from climate change: resource constraints, natural disasters, rising insurance premiums and regulatory uncertainty among them. Nonetheless, opportunities exist as well. The Kyoto Protocol (2008 – 2012), for example, has three mechanisms: Emission Trading (ET), Joint Implementation (JI) and the Clean Development Mechanism (CDM) that utilize markets to address carbon reduction objectives. The CDM is particularly advantageous for entrepreneurs in developing countries as it promotes the creation of Certified Emission Reduction (CER) credits, each equivalent to one ton of CO2, which can be sold to polluters in participating developed countries. Moreover, private carbon markets, along with proposed post-Kyoto carbon offset strategies such as Reducing Emissions from Deforestation and Forest Degradation (REDD) signal additional growth potential in carbon markets for developing countries wishing to pursue low emission pathways.

As regulations and consumer awareness about climate change grow, companies must be prepared to demonstrate carbon reduction plans and the milestones they have been achieved. However, such strategies have significant practical benefits as well, since they can often lead to lower operating costs due to energy, materials, and waste management savings. Moreover, when such investments are made in developing countries they may be eligible for CDM certification, and thus provide new revenue streams. The number of CDM projects in the region is still quite small, but the market potential is quite large.

More directly, markets for new technologies such as carbon capture & storage (CCS), integrated gasification combined cycle (IGCC), solar cells, bio-fuels, fuel cells, efficient lighting and green building materials. These markets are all growing, and new ones are coming on line as demand for low - carbon anything continues to grow. The sooner companies adapt and respond to these changes the better prepared they will be to take advantage of new opportunities as the low carbon marketplace grows.

The Future of Global System and the Quest for the New Science Discipline

Dr. Suvit Maesincee, Director, Sasin Institute for Global Affairs

Nowadays, we are flooded with new challenges such as new markets, new competitors, new regulations, security concerns, disruptive technology, climate change etc. We need to develop a mental model to better understand the underlying forces behind them. From the science perspective, the liquid-phase modernity can be characterized by commonality, duality, uncertainty, and multiple realities.

Commonality: Globalization leads to a global common which reflect a higher level of interdependent. Many issues and economic crisis and pandemic diseases.

Duality: Nowadays, we can interconnect with other people and can be present in many places at a time. The liquid-phase modernity reduces the significance of 'something' (e.g. need to know the location of a commercial bank) whereas increases the significance of 'nothing' (e.g. do not need to know the location of credit card company).

Uncertainty: Human brain comprises two functions, i.e. cognitive function (understand the situation) and manipulative function (achieve the desired result). If we operate both functions simultaneously, it means that the present and past facts and intentions are mixed with expectations about the future. As a result, contingency or uncertainty is introduced into the course of events. The participant must introduce an element of judgment or bias into their decision-making. As a result, the outcomes are liable to divergence from expectation.

Multiple realities: In the past, environment, economy, and society have different entities. At present, we realize that they are completely interconnected. In the past, local, national and global boundaries are distinguishable but they are now interconnected. In science discipline, if there are two simultaneous observations from different points, there may be different expectations. Therefore, a change in perception of an individual may potentially result in alternative decision.

In a complex and uncertain situation, people have to 'predict the worst' but 'hope for the best'. This leads to 'hyper-choices'. When people do not know what is going to happen next, they live like there is no tomorrow. This leads to a so-called 'hyper-consumption' behavior. Hyper-choices and hyper-consumption are on the demand side whereas

hyper-competition is on the supply side. Such forces lead to 'hyper-capitalism' that is characterized by the excess of life in many dimensions. Liquid-phase modernity changes the pace of life so rapidly, creating a 'nano-second culture'. In liquid-phase modernity, people tend to choose short-term gain/long - term loss. Moreover, quick-win/hit & run mentality prevails over delayed gratification of the past. The more hyper-consumption and the more hyper-competition lead to greater possibility of high - carbon society. Hence, high vulnerability of crisis is possible.

In order to escape from the tragedy of the commons, one needs to consider the conceptual framework for remedy of the commons. In principle, sufficiency in combination with slowness leads to the sovereign society (i.e. people can live with self determination). The sovereign is the success condition in pursuit of sustainability. In practical, lower consumption and low competition result in low - carbon society, hence leads to low vulnerability to crisis.

Dr. Suvit Maesincee

A balanced development platform implies a balanced industry platform which comprises economic centric industries, environmental centric industries, human centric industries, and social centric industries (so-called WWW world or balanced development platform) is critical to achieving sustainable capitalism. Interactions amongst such clusters enhance value creation. Such interactions can be boosted by developing technology responsible for each cluster. Therefore transitioning from competitive science to collaborative science is needed in order to achieve maximum carrying capacity via positive collective action. People gradually shift from an industrial society ('make & sell' paradigm) to a knowledge-based society ('sense & response' paradigm) to a humanistic society ('care & share' paradigm). Collaborative science is a new science discipline. It is collaboration amongst people, disciplines, and sectors. It is also an optimal combination between science of matter and science of mind. When discussing the possible pathways, activities or actions that lead back to the solid society, there are four levels of knowledge: the philosophy, the perspective, the principle, and the practice. People agree that sustainability is new global governance. The symposium is an example of how we can collaborate to employ the state-of-the-art in solving one global commons' challenge: transitioning to a low - carbon society. The key success factors for such transformation are structural change (via policy options) and behavioral change. We have to adopt sufficiency economy and slowness concepts for the latter one.

Town Hall Meeting: Principles, Policy and Implication Towards LCS Cities

The continues expansion of cities consumes a vast amount of resources: open space to house new residents and infrastructure; materials to construct and maintain buildings and infrastructure; the water, energy and other inputs to meet daily needs of the residents and workers; and the management of waste disposal. While each of these represents fertile ground for exploring methods to reduce carbon inputs, the actual challenge of implementing low - carbon society policies to major cities requires taking several steps back.

Policy makers need to first understand the core pillars of LCS.
1. Takes actions that are compatible with the principles of sustainable development, ensuring that development needs of all groups within society are met.
2. Makes an equitable contribution towards the global effort to stabilize atmospheric concentrations of CO2 and other greenhouse gases at a level that will avoid climate change through deep cuts in global emissions
3. Adopts consistent patterns of consumption and behavior that are consistent with low levels of greenhouse gases emissions

And also, three key LCS principles:
1. Carbon minimized in all sectors.
2. Simpler life style that realize richer quality of living.
3. Co-existence with nature.
The application of these tenants must be through both top-down and bottom-up strategies including: policies & tools of the governments, innovation (on

energy, social system, life style) and action from citizens and the private sector. Top-down policy tolls might include: institutional infrastructures incentives, soft infrastructures, hard infrastructure and natural capitals. While the bottom-up strategies can be done through communications via experience sharing, exchanging ideas among countries, and international cooperation. San Francisco, which adopted its Eco City Declaration in 2008, subscribes to four principles: ecological security, ecological sanitation, ecoscape integrity, and ecological industrial metabolism.

A key element to creating LCS in cities is how to deploy resources efficiently to reduce greenhouse gas emission. To generate support for LCS, city residents are the critical factor. They will be asked to make lifestyle changes, that if they do not support, will compromise LCS aims. "Green thinking' must permeate throughout the city, especially amongst the private sector who will be relied on to make investments and support the transition to greener products and services. All stakeholders must understand that by moving in this direction, the living and working conditions will improve as policies work to unite the economic system and environment to create a healthier community for all. When considering LCS economic policies, it is necessary to identify the most important factors which support a nation's competitiveness as it moves along the LCS path. Apart from assessing institutional resources, infrastructure, human resources, investment capital and technological readiness, planners must also evaluate the potential to innovate new green products and services that better support the LSC lifestyle.

Building construction is a significant issue that the LCS policies must address. Housing, for example must be livable and affordable from the demand side, and the on the supply side they should comply the basic principles of: reduce, reuse, recycle, protect, eliminate, efficiency, life-cycle costing, and quality. All of these concerns must be integrated into every phase of construction, from planning, designing, construction to the building modification. From a broader perspective, urban planning must preserve a satisfactory environment and protect the city from natural disasters.

Initiative and Implementation Experiences of Bangkok Metropolitan Administration (BMA)

The BMA has had a strong intention to transform Bangkok to become a Low-Carbon City, where in migration continues along with traffic and other associated urban stresses. BMA views its core mission as assuring the happiness and well being of Bangkok residents, workers and visitors and sees its LCS strategy as an extension of this.

The LCS strategy operates on two scales: national policy-making and local implementation. The BMA is principally responsible for the local component. For example, green building design and green environment are issues which BMA is now engaged in. These represent the first attempt to begin establishing 'green thinking' among residents and workers. Attempting anything more substantial, such as biogas substitution, would be premature until these initial policies are solidified in people's consciousness.

The BMA employs extensive use of ICT as a communication tool to engage the public on LCS issues. For example, climate change is happening spontaneously in people's minds, but providing information about this natural phenomenon in conjunction with how LCS policies can help mitigate the impacts helps to strengthen public support.

The BMA would like to see the majority of Bangkokians work to make their buildings more efficient utilizing currently available technologies for lighting, insulation as well as investing in solar power where possible. It is understood, however that some of these green products are still quite expensive and are not affordable for the majority of Bangkokians. Therefore, BMA works to make sure that there are at least some choices for any group of people to reinforce equity in participation at least at a basic level.

The BMA is also working to reduce CO_2 emissions directly through a revised transportation and energy policies. The sector is responsible for 50 percent of the city's greenhouse gas emissions, followed by 35 percent for electricity use. The aim is to have five percent emissions' reduction within five years. The strategies to accomplish this include:

1. Improve mobility by expanding mass transit.
2. Promoting the use of renewable energy.
3. Efficiency in energy consumption by focusing on green building policies.
4. Improve solid-waste and water management.
5. Increase park areas.

Climate Change Resilience as part of LCS strategies

Preparing cities in the Asia Pacific to be more resilient to climate change impacts increases in importance with each passing year. Foresight, therefore, is very important in order to see what kind of natural disasters that could happen in the future, and the types of adaptation strategies and response mechanisms that planners may wish to attend to in advance. Such readiness is critical as the region has already experienced an increase in weather related natural disasters over the past decade.

In addition to understanding and preparing for such events, resources must be invested in advancing the public's acceptance of a new paradigm consistent with LCS principles. For example, people must respect new zoning laws or the development of preventative infrastructure as part of the larger effort to manage urban areas amidst these new threats. City administrators as well need to have both long-term vision and short-term action plans. To deal with the climate change, science community alone cannot solve the problems. Institutional commitment is also needed.

Another important issue is recognition that not all individuals view the challenges ahead with the same frame of reference. One's level of economic wellbeing, political influence and geographic proximity to the most vulnerable areas can greatly affect views on both resilience and LCS generally. Because of this, it is quite obvious that to solve the problems effectively, integration across all sectors of society must occur.

Moreover, there must be a strong balance between understanding resilience and the green building. There is not necessarily uniform understanding across all sectors. This reinforces the need for a holistic approach as cities embark on LCS strategies. Only thinking along one sector will miss the big picture. For example, it is not merely that the new building is "green", but also 'where' the building is located relative to the climate change impacts it may face.

Climate change resilience does not strictly refer to protection against natural disasters, but a city's ability to flexibly respond to the range of issues climate change may bring about, including: shortage of limited resources such as energy; food and water availability, or public health impacts. Here again, such impacts may not be viewed with the same level of concern depending one's social and economic frame of reference.

As a result, the Urban Climate Change Resilience Approach has been conceived this is both multi-sectoral (business and commerce, health, transportation, finance, public works, emergency response) as well as multi-scalar (metropolitan area, city, ward and neighborhood and individual housing). As a multi-sectoral and multi-scalar approach, developing both international and local organization partners is a significant strategy. Networking is the key success factor in city climate change resilience. By understanding the key issues of each partner, the proper engagement can be developed.

Asian Cities Climate Change Resilience Network (ACCCRN) Program is raised as an example. ACCCRN has an aim to catalyze attention, funding, and action on building climate change resilience for poor and vulnerable people by creating robust models and methodologies for assessing and addressing risk through active engagement and analysis of various cities. Although the program has been developed to fit with various countries, the understanding to the climate impact to each city is also necessary to get the most appropriate strategies for each city.

Effectiveness in developing networks on city climate change resilience requires identifying experienced partners. Partners can facilitate shared learning dialogues (SLDs) with the key stakeholders to help cities understand their vulnerability to climate change and how to create an urban climate change resilience action plan. In the near future the project aims to scale up and operate at a regional level, dissemination of information and adaptation frameworks, and leveraging additional funding sources for resilience building initiatives throughout the region.

Policy Recommendations

Many of the elements to the 2050 low - carbon society (LCS) envisioned in the above scenario are neither new, nor technologically challenging. They do, however, rely on policies to set them in motion. Participants often stressed that had such policies been pursued a decade ago, the trajectory to realizing their vision would be far less steep. Findings from the 2008 Stern Review on the Economics of Climate Change, and subsequent reports like it, were referenced to reinforce that steps need to be taken now, else risk a much greater burden should inaction persist. With that in mind a set of recommendations emerged to help frame policy-making agendas at both the national and regional levels for the Asia Pacific.

National Level:

Demonstrate Leadership

Establish a permanent committee on climate impacts and environmental sustainability to develop, monitor, and implement policies that advance a low - carbon trajectory. Such a committee should clearly articulate the nation's long-term, low - carbon goals and the strategies to achieve them. It should also reinforce a holistic approach across all sectors and ensure ministries work cooperatively to foster interrelationships that can accelerate the LCS transition. The committee must also assure the public that strict enforcement of new policies will be pursued and that free-riding and non-compliance will not be tolerated.

Immediate attention must be given to how, and at what rate, nations will reduce the amount of carbon dioxide emitted per unit of economic activity. Whether through efficiency gains, carbon-neutral energy generation or both, strategies must be articulated to illustrate that economic growth must rely less and less on carbon-based fuels. National governments must encourage and support research in energy savings, energy efficiency, alternative energy supplies and renewable energy to ensure their energy policies reflect the most current, viable options available. They should also explore greater decentralization of the energy supply infrastructure by offering incentives for small power producers. Transportation policies too must be revised to include improvements in public transit efficiency and support for alternative fuels that clearly demonstrate low carbon lifecycles.

Engage local stakeholders

Stronger political will at the top must be augmented by solid participation, support and innovation at local levels. Local governments should play a major role in policy formulation and planning and be afforded sufficient latitude for implementation specific to their needs and resources. Local governments too must be guided by strong public participation to better identify their needs and to advance public understanding about LCS.

Public participation is particularly important in helping to guide both urban planning and rural development strategies. City and town planning should begin to identify how carbon footprints will be lowered by better integrating land use, building codes and transportation planning.

For rural areas planners must work with local communities to ensure appropriate zoning is in place so that shifts toward low - carbon lifestyle preserve competitive land advantages for food production, and retains the more relaxed character associated with the rural quality of life.

National support should be made available to aid communities to network amongst themselves in designing and implementing low - carbon strategies to meet development objectives. Knowledge sharing of challenges and successes can greatly reduce the learning curve for local communities as a whole, while also supporting an atmosphere that stimulates innovation from the bottom up. This infrastructure should be backed by a data center and communication that facilitate essential information exchange in and among local communities and provide access to global information resources as well.

Invest in the Market

Governments should demonstrate interest in any strategy or product consistent with meeting its low - carbon objectives. Such open mindedness will foster an innovative atmosphere to bring more products to market. Tax and incentive programs should be pursued that bias low - carbon products and services meeting established standards and certification criteria. For example, national level carbon trading systems should be implemented to stimulate increased investment in low - carbon goods and services from both suppliers and consumers.

Public sector financial resources and investment capital should be made available to help spur innovation in low carbon research and development. This should be done through research grants and competitions, venture capital, and preferential procurement policies. Such public support should work to facilitate cooperation, communications and partnerships amongst research institutions, manufacturers and investors.

Investment priorities should include: energy generation and efficiency;

transportation products, services and infrastructure; and novel construction and building materials. Particular attention should be paid to investments in technologies that offer local communities a competitive advantage, such as renewable energy supplies that can be met through local, low-carbon fuels.

Invest in Education

An ongoing public relations program must be established that resolutely proclaims the government's commitment to developing an LCS. These should address the ecologic, economic and social benefits LCS delivers along with critical need to help mitigate the rise in CO2 emissions so as to help reduce the need for adaptation investments.

Most importantly, it should be stressed that shifts toward a low-carbon economy will not compromise, but are aimed to enhance economic growth. Overall, public sector messaging should work to stimulate support for green values and sustainability across all levels of society.

Within the formal education system LCS should be incorporated into all curricula, from primary school to university level coursework and research. The paradigm shift that LCS represents will span generations, thus the sooner students are brought into this process, the more quickly their generation can begin contributing new tools and ideas to the realization of LCS objectives. Immediate consideration should be given to train and support specialists in key disciplines such as climate science, architecture and renewable energy.

The LCS shift is nationwide in scope, thus the opportunities educational system afford should be available to all. Educational resources, especially technology and communications elements, must therefore be spread equally across the country's population. Moreover, given the increasingly rapid pace of change, much of it critical to the understanding of, and participating in, the LCS transition, educational ministries should encourage life-long education programs.

APEC Regional Level:

Support a Regional Policy Framework

APEC leaders should develop a roadmap that specifically states the region's commitment to an LCS transition and some initial objectives the region hopes to achieve. For example, APEC should:

- Encourage and support members to integrate climate change mitigation and adaptation strategies into their National Development Plans.
- Entertain opportunities to develop standards and certification procedures that can help to advance trade in LCS products and services.
- Obtain regional and global cooperation in pursuing eco taxes for non-green technologies and at the same time reducing import duties for green technologies.
- Support regional and global environmental laws and regulations toward green markets, emissions trading and carbon-trading system.
- Enhance international and regional cooperation to combat transboundary pollution, including haze pollution, through capacity building, enhancing public awareness, strengthening law enforcement, promoting environmentally sustainable practices, as well as encouraging trading of low carbon products.

Facilitate Collaboration

APEC should create an R&D consortium to help harness resources to advance key technologies beneficial to the LCS transition. It should sponsor awards for outstanding green product development especially for: energy efficiency advances, construction and building-related products, an energy technologies such as photovoltaic and biodiesel development.

APEC should look for opportunities to help spur collaboration on frontline research themes such as: projections on the financial and social costs of LCS transformation, estimate of the severity of climate impacts at the regional level, strategies to overcome obstacles toward more rapid expansion of renewable energy pathways and climate change impacts on food production.

APEC should help strengthen national and regional knowledge sharing through reliable network communication among APEC economies in order to pool more accurate data/information on all aspects of climate change science, adaptation and LCS strategies.

Amplify Voices

Support effective international, regional and national outreach programs that assist the public in understanding: climate change, the need to mitigating its human causes, adapting to its impacts and the role low - carbon strategies must now play in public policies, economic development and personal lifestyles. Such messaging should also reinforce that the public must be engaged at all levels: personal actions, policy making and enforcement.

APEC should utilize all facets of traditional and new media to advance these messages. As a start, APEC should take advantage of products such as the results of this workshop to illustrate the state of regional interest in LCS, and the specific actions some nations are already taking toward the LCS transition. This information could be augmented by publicizing leading edge efforts in terms of creative LCS policies, technologies and individual actions taking place within the region.

APEC should consider sponsoring communications' projects that encourage youth to develop outreach tools through literature, media and the arts that reflect low - carbon messages and strategies. An APEC children forum should be considered that focuses on a sustainable future. Partnerships with universities and research institutions should be developed to ensure LCS curricula are available across all disciplines, and creative competitions organized that encourage students to illustrate their generation's ideas toward furthering the LCS transition.

Refections on the Scenario Workshop Process

Following the 2050 Scenario Workshop a discussion was had with some of the participants to get their thoughts on the value of the workshop, foresight and efforts to work toward LCS generally. Here's what some of them had to say.

"This workshop is nothing like what I'm used to. We work hard but have fun at the same time," says participant Goay Peck Sim, General Manager of Techno-Economy and Commercialisation Centre, SIRIM Berhad, Malaysia.

Goay Peck Sim is no stranger to foresight gatherings, but most of the workshops she's attended have participants, mostly experts in the same fields, sitting stiffly in sterile meeting rooms awaiting a pre-appointed opportunity to offer their remarks.

Other participants join Goay Peck Sim in commending the workshop process as "exciting", "fresh", "fun" and "not-so-traditional", adding that they are looking forward to applying the techniques employed in Phuket to their work at home.

"I'm familiar with foresight and scenario-based planning, but we usually hire consultants to do it," says Dana Kartakusuma from Indonesia's Ministry of Environment. "This is the first time I've taken part in a real process and it's been a very thought-provoking exercise. I certainly want to introduce it to my colleagues at home."

One element, participants note, that makes the workshop different from others is that the organizers have invited a diversity of participants: climate change scientists, modelers, educators, meteorologists, epidemiologists, engineers, economists, industrialists, environmentalists, agriculturalists, technologists, government planners and foresight specialists.

They are asked to introduce themselves to other fellow participants by drawing their faces below their names on a large chart spread across a wall. They are also requested to offer their expectations and expected contributions to the workshop, and a short forecast of what they think they will be doing in 2050.

"Low - carbon society is not just an issue for some specialized scientists; everybody needs to get involved," says workshop architect and builder Nares Damrongchai. "That's why our participants represent a wide range of groups in society."

Climate scientist Anond Sanidvongs from Thailand couldn't agree more. He points out that a diverse field of social scientists has a much bigger role to play than a scientist like himself when it comes to dealing with the complexity of climate change impacts and adaptation problems facing our society.

While recognizing the challenges in putting people with such diverse backgrounds and interests at the same tables, foresight strategist Richard Hames, admits: "the most enjoyable part is meeting everybody". Future networking with people outside their own circles is another element most participants say they appreciate.

The "ice breaking" exercises to get participants to feel more comfortable with one another and the need to think differently receive high marks. Before sitting down at their assigned tables, for example, participants are asked to form a circle in front of the room to play a five minute game where they have to make strange sounds like "zouf", "boing" and "peeuw". Such activities precede each new discussion session throughout the three-day workshop. One morning begins with shoulder massage on the beach from fellow participants, generating relaxing smiles from everyone as they enter the meeting room.

"We get participants to do funny things not just to make people feel comfortable, but even more to reinforce it's acceptable for them to generate ideas that are strange, wild, far-fetched and creative," explains Ruben van der Laan, creativity trainer and facilitator from the organizing team. "Forty years is a long time; these activities will help them imagine a far off future."

Another technique to stimulate creativity is to remove participants from today's reality as much as possible, suggests Jack Smith, Chief of Staff (Science and Technology) Defence R&D Canada. "For example, get them to think of future fuel efficient cars with 100 miles to a gallon."

Such diversion strategies are especially important when it comes to working with a normative scenario. "You have a

very special activity. This is exclusively a normative scenario; it's not usual that a group creates a world that it wants and prefers and hopes will happen. That gives a special power to the community here to create a future that can be persuasive for people to see it will be reachable within our lifetime."

Participants are also encouraged to draw and cut pictures from magazines to aid them in expressing their ideas as pictures expand imagination. On Day 2, the five working groups illustrated their 2050 low - carbon society with diagrams consisting of intriguing images: the world's tallest tree, a shiny solar panel, high-tech buildings, futurist looking sport cars, a smiling elderly man wrapping his arm around a fashion model, and a muscular man looking proud of his health drink.

Such a process is also new for APEC CTF. Although the center has organized many foresight workshops, the approach this time is by far the most creative to date. Participant feedback seemed to reinforce the likelihood that the center might pursue similar methods in the future.

Future workshops might also make use of multimedia presentation devices for both audio and video and real time data and maps, adds Richard Hames, who's also an expert in cutting edge learning techniques. Complex systems like a 2050 low - carbon society are difficult to grasp and can therefore benefit from sophisticated techniques to help synthesize the information and ideas.

To Hames, building idea walls with post-it notes, a simple technique used in this workshop is a bit old school in today's foresight world. Workshop architect Nares welcomes his suggestions: "We hope our process provides learning opportunities for other people who wish to embark on similar workshops in the future. They can certainly consider techno-aids to create a different kind of dynamism for the discussion."

But eventually it is connecting the dots that matters, Nares states. "The year 2050 is so far away, we have no evidence nor accurate information to guide our decision making," he explains. "This scenario approach, designed for a group with disparate expertise, tried to extract maximum creativity from every participant in imagining living and flourishing under climate change, and the role science and technology will play in adapting our future lifestyles to a new climate regime. I think this workshop provides us the context and relevancy to embrace a low - carbon future, and complements well the results from the more systemic Delphi process."

List of Participants

Title	Name		Organization	Country	Events			
					Scoping Sc.	Int'	Scenario WS	Symposium
Mr.	Adam	Switzer	University of Hong Kong	China-Hong Kong	X	X		
Mr.	Alui	Bahari	Malaysia Meteorology Department	Malaysia	X	X		
Mr.	Amaret	Bhumiratana	Mahidol University	Thailand				X
Mr.	Amnat	Chidthaisong	The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi	Thailand		X	X	X
Ms.	Angkana	Chalermphong	Office of Natural Resources and Environmental Policy and planning (OEPP)	Thailand				X
Mr.	Anond	Snidvonges	Southeast Asia START, Global Change Regional Center	Thailand			X	X
Mr.	Apichai	Sunchindah	German Technical Cooperation (GTZ)	Thailand			X	X
Mr.	Athipong	Hiranraeng-chok	Competitiveness Development Office (CDO), Office of The National Economic and Social Development Board	Thailand		X		
Mr.	Bancha	Dokmai	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Bong-Geun	Song	APEC Climate Center National Pension Service Busan	Korea	X	X		X
Mr.	Boonlert	Archevarahu-prok	Thai Meteorological Department, Ministry of Information and Communication Technology	Thailand	X	X	X	X
Mr.	Boonya	Sirisakdi	Siam Cement Group (SCG) PCL	Thailand			X	X
Mr.	Buntoon	Sirisakdi	The Thai Chamber of Commerce, Board of Trade of Thailand	Thailand				X
Mr.	Chain-arong	Cherdchu	ational Institute of Metrology Thailand (NIMT)	Thailand				X
Mr.	Chaivat	Toskulkao	Office of Atoms for Peace (OAP)	Thailand				X
Mr.	Chaiyod	Bunyagidj	Thailand Environment Institute (TEI)	Thailand				X
Ms.	Chanathip	Pharino	Chulalongkorn University	Thailand			X	X
Mr.	Charit	Tingsabadh	Centre for European Studies at Chulalongkorn University	Thailand				X
Mr.	Charnwit	Udomsakdigoo	Alternative Energy Program (CPMO), National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology	Thailand				X
Mr.	Chatri	Sripaipan	National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology	Thailand		X	X	X
Ms.	Chintana	Leekijwatana	Departmet of Science Sevices (DSS)	Thailand				X
Ms.	Cholathorn	Dumrongsak	Siam Cement Group (PCL)	Thailand				X
Ms.	Chuleeporn	Boonyamalik	Agriculture, Natural Resource, and Environment Planning Office (ANEO), Office of The National Economic and Social Development Board	Thailand		X		X
Ms.	Chutinthorn	Praditpetch	Office of Transport and Traffic Policy and Planning, Ministry of Transport	Thailand	X	X	X	X
Mr.	Clarence	Tang	Siam Cement Group (PCL)					X
Mr.	Dana A.	Kartakusuma	Ministry of Environment	Indonesia			X	X
Ms.	Dawan	Wiwattana-date	Energy Research Institute, CU					X
Ms.	Edna L.	Juanillo	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) Weather Bureau	Philippines		X	X	X
Mr.	Eric	Raymundo	Raymunddo Environmental Management	Philippine		X	X	X
Ms.	Gina	V. Aljecera	National Economic and Development Authority (NEDA)	Philippines				X
Mr.	Glen	Apon Imbang	UP Technology Management Center	Philippines				
Mr.	Gregory	Thomassin	AFD Bangkok – French Development Agency	Thailand				X
Ms.	Helen	McNaught	Ministry of Research, Science and Technology	New Zealand	X			
Mr.	Jack	Edward Smith	Defence R&D Canada in Federal Foresight and Innovation Strategy	Canada			X	X
Mr.	Jon	Parke	Department for Business, Innovation and Skills, Government Administration industry	United Kingdom				X
Ms.	Josie	Close	University of Hong Kong	China-Hong Kong	X	X		
Mr.	Jung Won	LEE	Future S&T Strategy Center Science and Technology Policy Institute (STEPI)	Korea				X
Mr.	Kai Kim	Chiang	Stockholm Environmental Institute-Asia	Thailand				
Ms.	Kalaya	Sophonpanich	Ministry of Science and Technology	Thailand				X
Mr.	Kampanat	Deeudomchan	Geo-Informatics and Space Technology Development Agency (GISTDA)	Thailand				X

Ms.	Kanchana	Wanichkorn	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand				X
Mr.	Kanishka	Kaul	Emergent Ventures International Pte. Ltd.	Thailand				X
Mr.	Kasititorn	Pooparadai	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Khan	Ram-Indra	British Embassy	Thailand				X
Mr.	Kitti	Limskul	Faculty of Economics, Chulalongkorn University	Thailand				X
Mr.	Kopr	Kritayakirana	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Kornrawee	Phoorirak	Geo-Informatics and Space Technology Development Agency (GISTDA)	Thailand				X
Mr.	Krisada	Bamrungwong	National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Krizz	Chantijiraporn	Green Logistics Operations & Better Environment (GLOBE) SIG, Thai Logistics And Production Society (TLAPS)	Thailand				X
Ms.	Kulwarang	Suwanasri	National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Ms.	Kuniko	Urashima	Science and Technology Foresight Centre, National Institute of Science and Technology Policy (NISTEP)	Japan	X		X	X
Mr.	Lee	Tsz-cheung	Hong Kong Observatory	China-Hong Kong	X			
Mr.	Martin	Krause	United Nations (UN)	Germany			X	X
Mr.	Martin	Brechter	Thailand Greenhouse Gas Management Organization (Public Organization)	Thailand				X
Mr.	Marupong	Tansatcha	Town and Country Planning Engineering Bureau, Department of Public Works and Town & Country Planning, Ministry of Interior	Thailand	X	X	X	X
Mr.	Masahiko	Katagiri	National Institute for Materials Science (NIMS)	Japan			X	X
Mr.	Matha	Rattanussorn	Siam Cement Group (PCL)	Thailand				X
Ms.	Maxine	Levine	US Embassy	Thailand				X
Ms.	Melanie	Littlejohn	Political and Economic Section Australian Embassy	Thailand				X
Ms.	Metinee	Srivatanakul	Monsanto Co. Ltd.	Thailand			X	X
Ms.	Miranda	Yeap	Hong Kong Representative for APEC ISTWG	China-Hong Kong	X			
Mr.	Montri	Chulavatnatol	College of Management, Mahidol University	Thailand				X
Mr.	Nares	Damrongchai	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand	X		X	X
Ms.	Natalie	Goodkin	University of Hong Kong	China-Hong Kong	X			
Ms.	Natalie	Ward	Thailand Greenhouse Gas Management Organization (Public Organization)	Thailand				X
Ms.	Natarika	Vayuparb	Thailand Greenhouse Gas Management Organization (Public Organization)	Thailand	X	X		X
Ms.	Natcha	Petchdakul	College of Innovation, Thammasat University	Thailand				X
Ms.	Nattaporn	Poojumnong	Geo-Informatics and Space Technology Development Agency (GISTDA)	Thailand				X
Ms.	Nettip	Kookongviriyapan	Integrated Refinery Petrochemical Complex (IRPC)	Thailand				X
Mr.	Nguen	Duc Hien	National Economics University (NEU)	Vietnam			X	
Ms.	Ni	Cong Cong	Political and Economic Section Chinese Embassy	Thailand				X
Ms.	Noppan	Piboonvong	Thailand Environment Institute (TEI)	Thailand			X	X
Ms.	Parichatt	Krongkant	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Ms.	Pattranuch	Sornprasith	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Ms.	Pattraporn	Sooksopee	Dhurakij Pundit University International College (DPUIC)	Thailand				X
Mr.	Peter	N. King	Institute for Global Environmental Strategies (IGES)	Thailand			X	X
Mr.	Phoomsan	Seneewong Na Auydhaya	Ministry of Science and Technology	Thailand				X
Mr.	Pichet	Durongkaveroj	National Science, Technology and Innovation Policy Office (STI)	Thailand				X
Mr.	Pisuth	Paiboonrat	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Piyawut	Srichaikul	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Ms.	Pongmanee	Thongbai	School of Sciences, Mae Fah Luang University	Thailand				X
Mr.	Pongsak	Piboonsak	Thai Logistics and Production Society	Thailand				X

Ms.	Pongsuda	Pongtanya	Siam Cement Group (PCL)	Thailand				X
Ms.	Pongvipa	Lohsomboon	Thailand Greenhouse Gas Management Organization (Public Organization)	Thailand				X
Mr.	Pornsil	Patchrintanakul	The Thai Chamber of Commerce and Board of Trade of Thailand	Thailand				X
Mr.	Pramote	Dechaumphi	National Metals and Materials Technology Center (MTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Ms.	Prasertsuk	Chamornmarn	Thailand Greenhouse Gas Management Organization	Thailand	X	X		X
Mr.	Prateep	Chouykerd	Energy Research Institute Chulalongkorn University	Thailand			X	X
Mr.	Prayoon	Shiowattana	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Pun-arj	Chairatana	Noviscape Co., Ltd.	Thailand			X	X
Ms.	Quynh Hoa	Do	National Hydro - Meteorological Service of Viet Nam, Ministry of Science and Technology	Viet Nam		X		
Mr.	Rachaporn	Choochuey	Department of Architecture Faculty of Architecture, Chulalongkorn University	Thailand				X
Mr.	Ram	Rangsin	Phramongkutklao Hospital and College of Medicine	Thailand			X	X
Mr.	Rath	Ruangchotevit	Environmental Research and Training Centre	Thailand				X
Mr.	Ratirat	Sinweeruthai	National Institute of Metrology Thailand (NIMT), Ministry of Science and Technology	Thailand				X
Mr.	Reynaldo	V. Ebora	Philippine Council for Advanced Science & Technology Research and Development (PCASTRD)	Philippines	X			
Mr.	Richard	Walker	Kadoorie Institute	China-Hong Kong	X	X	X	
Mr.	Richard Stephen	Silberglitt	RAND Corporation	United State				X
Mr.	Ron	Sirivanasandha	Sasin Institute for Global Affairs (SIGA), Chulalongkorn University	Thailand				X
Mr.	Ron	Johnston	the Australian Centre for Innovation (ACIIC)	Australia				X
Mr.	Royol	Chitradon	Hydro and Agro Informatics Institute (HAII)	Thailand				X
Mr.	Ruben	Van Der Laan	Freelance Facilitator	Thailand				X
Mr.	Sakarindr	Bhumiratana	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Selma	Garrido	US Embassy	Thailand				X
Mr.	Shin Ru, George	Tang	Industrial Technology Research Institute	China-Taipei		X		
Mr.	Sirimet	leepakorn	Integrated Refinery Petrochemical Complex (IRPC)	Thailand				X
Ms.	Sirintorn-thep	Towprayoon	The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi	Thailand	X	X	X	X
Mr.	Sitanon	Jesdapipat	Southeast Asia START, Global Change Regional Center	Thailand		X	X	X
Mr.	Sittapong	Rattanakat	National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand	X	X		
Mr.	Siaw Kiang	Chou	Faculty of Engineering, National University of Singapore	Singapore				X
Mr.	Songsak	Saicheua	Office of Policy and Planning, Ministry of Foreign Affairs	Thailand				X
Ms.	Sooksiri	Chamsuk	United Nations Industrial Development Organization (UNIDO)	Thailand				X
Ms.	Sopida	Tongsopit	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand			X	X
Mr.	Sornthep	Vannarat	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Suchat	Udomsopagit	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand		X	X	X
Mr.	Suchin	Udomsomporn	Office of Atom for Peace (OAP)	Thailand				X
Ms.	Sudhiani	Pratiwi Sukarno	National Development Planning Agency (BAPPENAS)	Thailand				X
Ms.	Sumavasee	Salasuk	National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X
Mr.	Sun	Qijun	China Science and Technology Exchange Center	China	X			
Ms.	Supak	Virunhakarun	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand	X		X	X
Ms.	Supawan	Wongprayoon	Dept of Environmental Quality Promotion (DEQP), Ministry of Environment and Natural Resources	Thailand			X	
Mr.	Surachai	Sathitkunarat	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand	X		X	X
Mr.	Surajate	Boonya_aroon-net	Hydro and Agro Informatics Institute (HAII)	Thailand				X
Mr.	Suriyon	Thunkijjanukij	Office of the National Economic and Social Development Board	Thailand				X
Mr.	Suttirut	Pimpasut	United Nations Industrial Development Organization (UNIDO)	Thailand				X
Mr.	Suvit	Maesincee	Sasin Institute for Global Affairs (SIGA), Chulalongkorn University	Thailand				X
Mr.	Tanapoom	Chanprapri	Southeast Asia START, Global Change Regional Center	Thailand		X	X	X

Mr.	Tang-lu	Man	Macao Meteorological and Geophysical Bureau	China-Macao	X		X	X
Ms.	Tatiana	Selivanova	Far Eastern National Technical University	Russia		X		
Mr.	Tepwitoon	Thongsri	Departmet of Science Sevices (DSS), Ministry of Science and Technology	Thailand				X
Mr.	Thanakrit	Kasemsuk	Emergent Ventures International Pte. Ltd.	Thailand				X
Mr.	Thanh Binh	Le	International Cooperation, Ministry of Science and Technology	Vietnam	X	X	X	X
Mr.	Thanin	Pa-Em	National Economic & Social Development Board	Thailand				X
Mr.	Thutchai	Puengsupa	SRI (Siam Research and Innovation), Siam Cement Group (SCG) PCL	Thailand				X
Ms.	Tipwadee	Vimutisunthorn	Sasin Graduate Institute of Business Administration of Chulalongkorn University(SASIN)	Thailand			X	X
Mr.	Toshihiko	Nomi	National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology	Thailand			X	X
Ms.	Ubonthit	Jungtiyanont	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand	X		X	X
Ms.	Vassalisa	Traisutcha	APEC Center for Technology Foresight, National Science, Technology and Innovation Policy Office (STI)	Thailand	X		X	X
Mr.	Vincent	Cheung	Environmental Protection Department, Cross Boundary & International Group	China-Hong Kong	X			
Ms.	Waluree	Thongkam	National of Nanotechnology Center, Ministry of Science and Technology	Thailand				X
Mr.	Wang	Zhong-cheng	China Science and Technology Exchange Center	China	X			
Mr.	Wang	Yamin	College of Ocean, Shandong University-Weihai	China	X	X	X	X
Ms.	Wanida	Wanichpong-pan	Institute for Global Environmental Strategies (IGES)	Thailand			X	X
Ms.	Wikanda	Limthanapilak	Institute for Global Environmental Strategies (IGES)	Thailand			X	X
Mr.	William	T Lin	Center for Bilateral Taiwanese Strait Financial Research, Tamkang University	China-Taiwan	X			
Mr.	William	Wyn Ellis	entre for Small and Medium Enterprise Innovation System, Dept of Export Promotion, Ministry of Industry	Thailand			X	X
Ms.	Wiriya	Puntub	Center of research and training, Mahidol University	Thailand			X	X
Mr.	Wullop	Liwiwatha-napornchai	Department of Industrial Promotion (DIP), Ministry of Industry	Thailand				X
Ms.	Yada	Mukdapitak	National Science, Technology and Innovation Policy Office (STI)	Thailand				X
Mr.	Yen-Chuan	Chen	Industrial Technology Research Institute	China-Taipei		X		
Mr.	Yichung (Robert)	Lo	Industrial Technology Research Institute (ITRI) Industrial Economics & Knowledge Center (IEK)	China-Taiwan			X	X
Ms.	Yuwanan	Santitaweeroek	National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA),Ministry of Science and Technology	Thailand				X