**Final Report of Integrated Foresight for Sustainable Economic Development and Eco-Resilience in ASEAN Countries (January-October, 2013)**

This document provides the final report of the consultants in energy, food, and water, containing the overall results from the three regional workshops in Thailand, Indonesia, and Vietnam, the final symposium in Thailand, the real-time Delphi survey, the future development pathways and the plausible policy recommendations and actions. It includes scenarios for energy security, food security, and water management for ASEAN countries that are developing under constraints, especially impacts of climate change. The scenarios are based on a logic developed by focus groups at the regional workshops. Their analysis led to discussions at the final symposium of the energy-water-food nexus that illuminated the future development pathways and enabled the development of recommendations for policy strategies and actions aimed at sustainable economic development and eco-resilience in ASEAN countries over the coming decades.

**Executive Summary**

This integrated foresight, guided by the new paradigm for inclusive innovation of the ASEAN Krabi Initiative, was performed on several levels—background research and interactions of the APEC Center for Technology Foresight (CTF) staff with stakeholders and subject matter experts throughout the ASEAN countries; scenario-building workshops in three different ASEAN countries (Indonesia, Thailand, and Vietnam) using the Three Horizons foresight method with focus groups on energy security, water management, and food security (three of the eight Krabi Initiative tracks); a real-time Delphi survey with a broad cross-section of respondents throughout ASEAN; the leadership of three members of APEC CTF’s International Advisory Board with extensive experience and expertise who presented foresight methods and led the focus groups at each workshop, designed the questions for the real-time Delphi survey, and built energy, water, and food scenarios based on the focus group inputs; and a final symposium in which the scenarios were presented and discussed in breakout groups and all-participant sessions were devoted to the energy-water-food nexus.

While the problems and issues facing the energy, water, and food sectors differ somewhat in nature and context, the aspirations for efficient and sustainable use of resources, plus inclusiveness both at the local level and for the poor and underprivileged, and the recognition that ASEAN countries are developing under constraints, the most important of which (the impacts of climate change) may be outside their control, were consistent themes throughout the scenario workshops, the real-time Delphi survey, and the final symposium. As a result, the energy, water, and food scenarios that emerged from the focus groups all used one axis that reflected the effectiveness or ineffectiveness of actions to promote sustainability and a second axis that represented the strength of the constraints. Within this scenario logic, four extremes exist. The future which was consistent with the Third Horizon aspirations of all groups is one in which actions are effective and constraints are either weak or successfully mitigated. This future was called “Smooth Sailing” by all three groups, and recommended strategies and actions are aimed at pathways toward it. The future in which actions are effective, but constraints are too strong to be fully mitigated was called “Navigating Tough Conditions” by the energy and food groups and “Navigating Difficult Waters” by the water group. This future, while not as desirable as “Smooth Sailing,” does reflect positive efforts to minimize the effect of constraints, especially the impacts of climate change, by promoting sustainable and inclusive practices involving energy, water, and food. The water group saw it as the most likely outcome for ASEAN in the coming decade. The difficult and most undesirable future in which the constraints are strong and actions are ineffective was called simply “Constraint Domination” by the energy group, while the water and food groups adopted names that were more descriptive of their sectors, “Disaster,” and “Green is Mean (Tough World),” respectively. All participants agreed that this future is to be avoided, but some expressed fears that some ASEAN countries may be unable to avert it unless effective policies are enacted and implemented quickly. The fourth scenario, in which the constraints are weak and the actions are ineffective, was called “Future is Past” by the energy group, because this future is one in which policies and actions in the future are the same as those of the past, with little effort to address constraints that turn out to be weak. The water and food groups called this scenario “Water Waste” and “Sinking Slowly,” respectively, to reflect the negative impacts of continuing on this path. The water group argued that we are presently in this scenario and the most likely pathway if effective action is taken is to move diagonally to the “Navigating Difficult Waters” scenario.

The current and projected future position of ASEAN countries on this scenario logic was debated in all three workshops and in the final symposium. The outcome of these discussions was the firm conviction that the energy-water-food nexus must be addressed holistically, because of the strong interrelations between the sectors and the strong and potentially disastrous effects on each sector of independent activities in the other sectors. Examples include the energy and water requirements for food, the effects on the quality of water from its use to produce energy and food, and the effects of land use, irrigation, and biofuel production and use on all three sectors. Consistent with the results of the real-time Delphi survey, the final symposium participants recommended several strategies and actions to enable pathways leading to sustainable futures for ASEAN:

Improved governance that balances the use of resources for economic development with the needs of citizens and recognizes the opportunity costs associated with alternative uses of energy and water, including uses that support food production and distribution;

The need for a holistic approach to the energy-water-food nexus, recognizing that actions taken with respect to any one of these sectors will inevitably affect the others, and without careful evidence-based planning, is likely to be detrimental to one or more of them;

The recognition that achieving inclusiveness and promoting social equity will require the development and implementation of effective practices for community-based decision- making, as well as local capacity building that involves outreach, education and training, and investment;

An almost total reconsideration of the value of resources, most evident in the profligate use of water as if it had no value at all, but also for energy recognizing the economic and societal costs of energy production, conversion, distribution, and use.

The development of models and databases that will enable the proper valuation of energy and water to accomplish the holistic analysis of the energy-water-food nexus suggested above, as well as the type of integrated resource management and land-use practices that will make the best possible use of available resources. This, together with coordinated planning and implementation across provincial and national boundaries where required by resource constraints, will allow the identification and evaluation of truly sustainable pathways for a maximally resilient ASEAN.

# *Chapter 1 Background and Objectives*

The APEC Center for Technology Foresight (APEC-CTF) of the National Science Technology and Innovation Policy Office (STI) of Thailand, in partnership with the Rockefeller Foundation, organized this series of workshops to apply an integrated foresight approach coupled with sustainable economic and ecological choices to develop strategies and actions that advance science, technology and innovation for inclusive development of ASEAN countries. This project was conceived in agreement with the ASEAN Krabi Initiative’s vision of the ASEAN leaders in promoting “Science, Technology and Innovation for a Competitive, Sustainable and Inclusive ASEAN.” The results of the project are intended for use to formulate a new set of insights about what may be possible by 2020 after the completion of the ASEAN Community in 2015 in terms of stable, productive and innovative employment prospects in the emerging ASEAN economies.

The ASEAN Krabi Initiative was launched in December 2010 as an important policy framework and a strategic direction to move ASEAN forward using STI to raise competitiveness for a sustainable and inclusive ASEAN. It was fully supported by the ASEAN Committee on Science and Technology (ASEAN COST) and later endorsed by the ASEAN Science and Technology Ministers at the Sixth Informal ASEAN Ministerial Meeting on Science and Technology (IAMMST). Figure 1.1 shows the key characteristics of the ASEAN Krabi Initiative—its rationale, its thematic tracks, the paradigm shift that it entails, and its intended courses of action. The objective of this project was to give life to this paradigm shift through recommended strategies and actions based on the deliberations of a broad cross-section of ASEAN stakeholders using foresight to envision an ASEAN future that is inclusive in its use of science, technology, and innovation. This was accomplished by focusing on three of the Krabi Initiative’s eight tracks, energy security, water management, and food security, and integrating scenarios in each of these areas into an analysis of the energy-water-food nexus that takes into account the interrelationships between these sectors that must be recognized in developing successful policy strategies and actions. Both the scenarios and the nexus analysis indirectly address a fourth Krabi track, green technology.

**Figure 1.1 Key Characteristics of the ASEAN Krabi Initiative**



# *Chapter 2 Bringing the ASEAN Krabi Initiative Paradigm to Life*

This chapter describes the approach taken to achieve the project objective, the process used, and the important activities conducted along the way. The three consultants, members of the APEC CTF International Advisory Board (IAB), played a critical role by leading scenario focus groups on energy security, water management, and food security and developing the energy- water-food nexus analysis leading to the recommended policy strategies and actions described in this final report.

## Project Approach

There are profound challenges to continued economic development around the world. The paradigms, the processes, the institutions and the regulations that have arguably facilitated the greatest economic growth in human history do not appear to be appropriate or adequate to the new challenges emerging. New thinking and actions are required. This project embarks on such efforts, taking into account the following overarching trends that are driving challenges at the nexus of energy, water, and food.

The ***pressure of demographic growth*** demands ever increasing supply of the basic human needs, with the global population currently in excess of 7 billion ( a 350% increase in the current average lifetime) and projected to grow to 9-10 billion by 2050. Even more dramatic, and with greater consequences, is the growth of the urban population, with almost half the global population living in cities by that time, with the attendant special needs of intensive resource and service provision and management.

The threat, or reality of ***climate change***, requires radically new systems and structures to decarbonise our societies and economies as well as heroic measures to mitigate against influences on weather that are already apparent. Predicted impacts that are especially relevant to the ASEAN countries include rising sea level, changing seasons, and more severe storms.[[1]](#footnote-1)

Access to the ***fundamental resources for human life*** – air, water, food and energy, is under threat both from population growth and climate change, but also from the various processes of economic and industrial development, which deplete resources and pollute our environment.

The evidence of major ***threats to water security*** is now ell-established, with only limited opportunities for further increasing supply, and hence the need to dramatically advance the effectiveness of demand-side management of this precious resource. While water is correctly regarded as a universal human right, all too often its value, and even its price, is assumed to be at or near zero.

Constraints on water impact quality of life not only directly, but also indirectly through their consequences for food production and energy generation. Moreover, particularly in urban environments, there is a substantial energy requirement to provide adequate water supply, wastewater management and sanitation.

As stated in a recent Asian Development Bank report:[[2]](#footnote-2)

“The global debate is not about water security or water scarcity in isolation. Instead it is about the nexus … the links among food water and energy… Decision makers must acknowledge that:

1. food security will only worsen unless agricultural productivity is improved and the waste in the water used for agriculture is reduced;
2. food prices will continue to be subject to fluctuation, with causes on both the demand and supply side, including increasing frequency of weather shocks; and
3. poverty in rural and urban Asia will only worsen if strategic groundwater reserves continue to be mined and consumed, and if aquatic ecosystems continue to be destroyed, by failing to take into account their real value in stabilising and storage.

Old water economics has failed to protect the resource. Market mechanisms have failed. Non-renewable resources have been mined; water has been given away for free, often through blanket energy subsidies. Strategic future resources have been polluted as a cheap, convenient method of waste disposal.”

Clearly, addressing this energy-water-food nexus requires new approaches. Any plan, any program, any institution which addresses just one of these components is, or will be, manifestly inadequate. Competition between the development and implementation of each, as so often occurs, is simply disastrous. All governments face the challenge of profoundly restructuring their governance systems to address energy, water and food holistically. Business, as reflected in the emerging water security-focused analyses of their value and supply chains, need to adapt, and pursue the opportunities latent in such a major reconfiguration.

The proposed paradigm shifts identified in the ASEAN Krabi Initiative **also signal the need to develop and adopt new and different approaches**. These paradigm shifts are:

* STI Enculturation - mainstreaming STI into ASEAN citizens’ ways of lives;
* Bottom-of-the-Pyramid Focus - consideration must be accorded to the outcomes of STI addressing basic human needs such as food, habitat, health, and access to information and knowledge;
* Youth-Focused Innovation - emphasis must be given to the ASEAN youths by enriching their living and learning environment, with STI as an important foundation;
* STI for Green Society - appropriate technologies and green innovations are to be promoted among ASEAN member countries in order to become competitive and yet remain sustainable;
* Public-Private Partnership Platform - the ASEAN private sector has previously played only a limited role in STI and needs to be engaged through proactive programs.

Appropriate STI enculturation relies substantially on education, but that alone is not sufficient. Effective responses to the energy-water-food nexus challenges will require a transformation of decision-making processes and structures to emphasise the use of evidence-based approaches, and the accumulation of experience which is based on experimentation and testing. It also rests on a visible limitation of the arbitrary or self-interested application of power. Fundamental to addressing the nexus challenges will be a broad and deep understanding of the principles and practices of sustainability.

Shortcomings in addressing the challenges of the energy-water-food nexus are visited most strongly on those in the community with the least resources, including in addressing change – the so-called ‘Bottom of the Pyramid’:

“Environmental degradation and inequitable access to water, both in urban and rural settings, will always affect the poor and vulnerable first and worst, without access to affordable alternatives or cost-effective means of coping.”[[3]](#footnote-3)

Hence top-down approaches necessary to achieve the broad perspective necessary to address the nexus challenges need to be complemented by approaches that place responsibility and decision-making at the community level – a community that is sufficiently empowered and educated to take on such decisions.

Young people, given adequate education, are often leaders in the adoption of new innovations. There is an opportunity to enroll youth in a strong movement to address the major nexus-related challenges which threaten their community well-being.

It is apparent that adequate responses to the nexus challenge will necessarily place a great emphasis on sustainability. Indeed, little progress will be made on addressing the substantial issues of the energy-water-food nexus without the fundamental application of sustainable models and approaches.

Governments alone cannot address these major issues. There is a need and huge opportunities, in building complimentary alliances of government and industry to both address challenges and identify and pursue consequent new market needs.

**Another driver** **of the need to develop and adopt entirely new approaches emerges from the perspective of foresight**. The approach of foresight has been developed to address the recognition that the future is increasingly marked by rapid change, complexity and deep uncertainty. In such situations, redoubled efforts to improve prediction and remove surprises have little effect. Rather, what provides the capacity to address these uncertain futures is the ability to envisage and reflect upon a variety of possible futures, to consider the kind of actions that might be appropriate to prepare for these possible futures, and to systematically build the organizational and national strengths in resilience and agility that permit a rapid, but appropriate response as the future becomes more apparent.

While detailed technical and economic analysis is essential, as is the active development and application of STI to address and facilitate appropriate responses, these traditional tools alone are not enough. We need to adopt an approach that builds strongly on the non-deterministic and participatory features of foresight to address the scale, the complexity and the uncertainty of the challenges of the energy-water-food nexus.

**The key features of the approach adopted in this project are:**

* Recognition of the diversity of the ASEAN countries; strategies and actions will need to take account of the different demographic, economic, political and cultural context;
* A holistic conception and analysis of the energy-water-food nexus and the systems that underpin it;
* An approach that necessarily combines a systems perspective capable of comprehending the complex interactions of the components of the energy-water-food nexus with the necessity to base a significant part of analysis and implementation at the community level. This requires a radical reconstruction of the models of governance appropriate to such demands;
* The recognition of STI as a key facilitator, and generator of insights, but not the primary means for addressing the challenges of the energy-water-food nexus;
* An approach that acknowledges the fundamental uncertainty of the situations we are addressing, and places the emphasis on analysis through foresight, and the building of resilience and agility.

## Project Process and Activities

### Objectives

* To apply an integrated Foresight approach coupled with sustainable economic and ecological choices to develop policies, strategies and actions that advance science, technology and innovation for inclusive development of ASEAN countries in agreement with the ASEAN Krabi Initiative’s vision of the ASEAN leaders in promoting “Science, Technology and Innovation for a Competitive, Sustainable and Inclusive ASEAN”.
* To provide a demonstration of how foresight, coupled with sustainable economic and ecological choices, can create the basis for inclusive innovation, enhanced societal resilience to cope with systemic stress associated with management of scarce resources (energy, water and food), and identify new techno-economic opportunities.
* To increase the awareness among senior officials and decision-makers across the ASEAN nations about the nature and value of foresight-based approaches to planning for the future and to promoting sustainable development throughout the ASEAN member states.
* To formulate a new set of insights about what may be possible by 2020 after the completion of the ASEAN Economic Community in 2015 in terms of stable, productive and innovative employment prospects in the emerging ASEAN economies.
* To assist the ASEAN countries in addressing their future needs and opportunities in dealing with three of the most important grand challenges – energy, water, and food security and the crucial nexus between them.

### Methodology

The methodology had four major components:

1. *Pre-analysis* – a wide range of data and reports held by the APEC-CTF and the researchers was examined to build a strong knowledge base about approaches and barriers to energy, water, and food security in the ASEAN region.
2. *Participative Scenario Workshops -* three two-day workshops were held, one each in Bangkok, Jakarta and Hanoi between January and April 2013. The processes involved:

* Careful selection and invitation of a wide range of appropriate senior stakeholders representing government policy-makers, business managers, academics, researchers and non-government representatives with expertise and experience in at least one of the target fields of water, energy and food security. This selection was facilitated by the detailed knowledge and databases of the APEC-CTF of relevant participants, and the researchers’ extensive networks in the region. Each workshop was attended by 60-70 participants.
* Invitation of highly respected local experts in the fields of energy, water, and food security to make opening presentations about the important issues in their country and the region.
* A highly structured, but participative process to guide the deliberations of the participants. This involved a five-stage process built around the concept of “seeing in multiple horizons”[[4]](#footnote-4). This well-established foresight technique is based on a clear distinction between three different horizons of the future.

The first Horizon is based on projections from the present, which might be recognized largely as forecasting and trend/assumption extrapolation (i.e., largely ‘probable’ futures). The third Horizon is based on ideas about the future which are not realizable at the present, i.e., in foresight language it is the construction of possible futures. The second horizon is identified as an intermediate space in which the first and third Horizons collide – “a space of transition which is typically unstable” - “the space where change is fully engaged and one's assets are actively shifting to be able to realize opportunities and to adjust to new pressures”[[5]](#footnote-5).

The second Horizon might thus be considered as the space in which action-oriented foresight operates: understanding the drivers shaping the near future, imagining, by a variety of techniques, possible futures, and engaging the people and institutions involved in present-day decision-making to take into account these possible futures and their impacts. The particular feature of the ‘three horizons’ approach, which bears a strong similarity to the back-casting component of scenario planning, is its effectiveness as a metaphor to allow participants to bring their minds to bear on the possibilities in each of the Horizons, and to consider in a positive manner the types of pathways that would support effective practical means to address prevailing and possible uncertainty and risk.

Participants were successively led through the phases of identifying current issues (in energy, water, or food security), what might happen within the next twenty years, and then strategic initiatives which could encompass present realities and possible futures with all their associated uncertainties.

The fourth stage emphasized this project’s focus on inclusive approaches to benefit the ‘Bottom of the Pyramid’ (BOP). The ASEAN context of this foresight is focused on the need to identify how the application of technology can provide for an improved quality of life for all citizens while promoting social equity and creating productive employment, i.e., the type of jobs that encourage productive citizenship by reducing poverty and improving living conditions. For example, the availability of wireless Internet in rural areas could enable distance learning, thus educating and empowering a population sector that has heretofore been neglected.

The last stage was an application of the results of the first four stages to develop potential scenarios of possible and preferred futures, constructed around axes of the degree of external constraints and effectiveness of local capacity and responses. These scenarios provide a basis to consider appropriate actions at the national and ASEAN level.

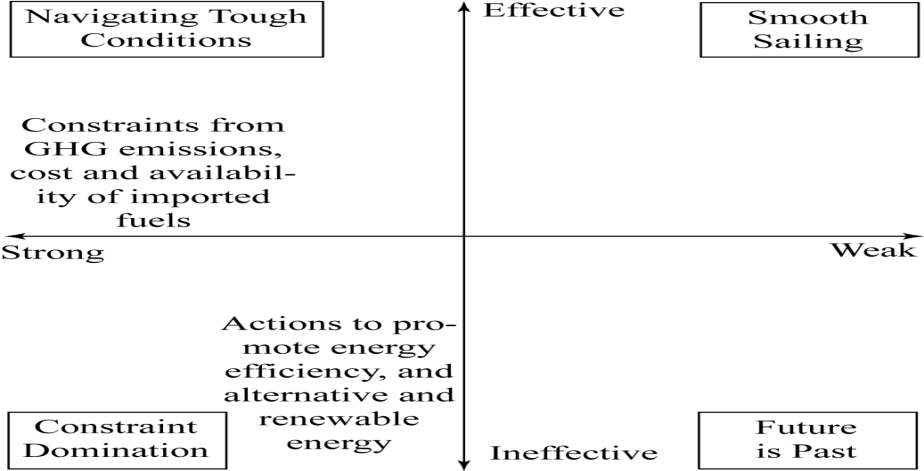
1. A final Symposium on 1-2 October in Bangkok, in which the findings of the project were presented, and the nexus between energy, water, and food and its implications for policy in the context of ASEAN 2015 were explored in detail, with senior representatives from the great majority of ASEAN nations, and with experts in energy, water and food policy and management.
2. *A Real-Time Delphi survey of participants across the ASEAN region* – on the basis of the findings of the three workshops, a Delphi instrument was constructed, largely by the staff of the APEC CTF, and distributed to a wide range of respondents across the ASEAN region.
3. *An Impact Evaluation exercise* which captured the perspectives and experiences of the participants at each meeting about the foresight processes used and their potential application.

# Chapter 3 Scenarios for Energy Sustainability

In the energy scenario focus groups in Thailand, Indonesia, and Vietnam, the participants began by developing a vision of a desired 3rd Horizon future. These visions shared several characteristics: the availability of energy to all citizens; increased energy efficiency; increased use of alternative and renewable energy; reduced environmental impact; improved social equity; effective use of local and indigenous resources. A variety of current (1st Horizon) energy sector characteristics suggest that reaching these visions will be challenging: ASEAN is a net oil importer; many citizens, especially in rural areas, do not have access to electricity; environmental impact of oil for transportation and coal for electrification is increasing. Achieving the 3rd Horizon visions will require resolving conflicts in the 2nd Horizon pathway associated with governance, availability of energy, environmental impact, and social equity. For this reason, the focus groups developed an energy scenario logic in which alternative scenarios are defined along the following dimensions: (1) the effectiveness of actions to support energy efficiency and renewable energy: and (2) the impact of constraints such as greenhouse gas (GHG) emissions and cost and availability of imported energy. When discussing and characterizing alternative scenarios, the focus groups also stressed the need to make sustainable energy available to currently underserved (e.g., rural, poor) citizens—the bottom-of-the-pyramid. Figure 3.1 shows this energy scenario logic. It envisions four extremes depending upon whether the actions to promote energy efficiency and alternative and renewable energy are effective or ineffective and whether the constraints such as those posed by GHG emissions and the availability and cost of imported fuels are strong or weak.

The future in which actions are effective and constraints are weak (a result that would likely depend on the effectiveness of global constraint mitigation policies and actions) is called **Smooth Sailing**. In this future, ASEAN benefits from greatly increased energy efficiency and alternative and renewable energy in its fuel mix. Social equity is improved, with high levels of electrification in both urban and rural areas.

**Figure 3.1 Energy Scenario Logic**



The future in which actions are effective, but constraints are strong, is called **Navigating Tough Conditions.** In this future, energy security in ASEAN is challenged by the lack of effective global action on GHG emissions and the absence of affordable imported oil. Despite effective actions to promote energy efficiency and renewable energy, continued reliance on coal for power generation and the expense of importing oil make improving social equity difficult and create challenges for mitigating environmental impact and improving air and water quality.

The future in which actions are ineffective, and constraints are strong, is called **Constraint Domination**. In this most undesirable future, all of the challenges of Navigating Tough Conditions exist, but the actions to counteract them are ineffective. Consequently, social equity becomes much worse, as does environmental impact and air and water quality. Only a small number of the elites of society will prosper in this future. It would require a combination of global failure to address GHG concerns, rising price of oil, and the absence or failure of policies to promote energy efficiency and renewable energy.

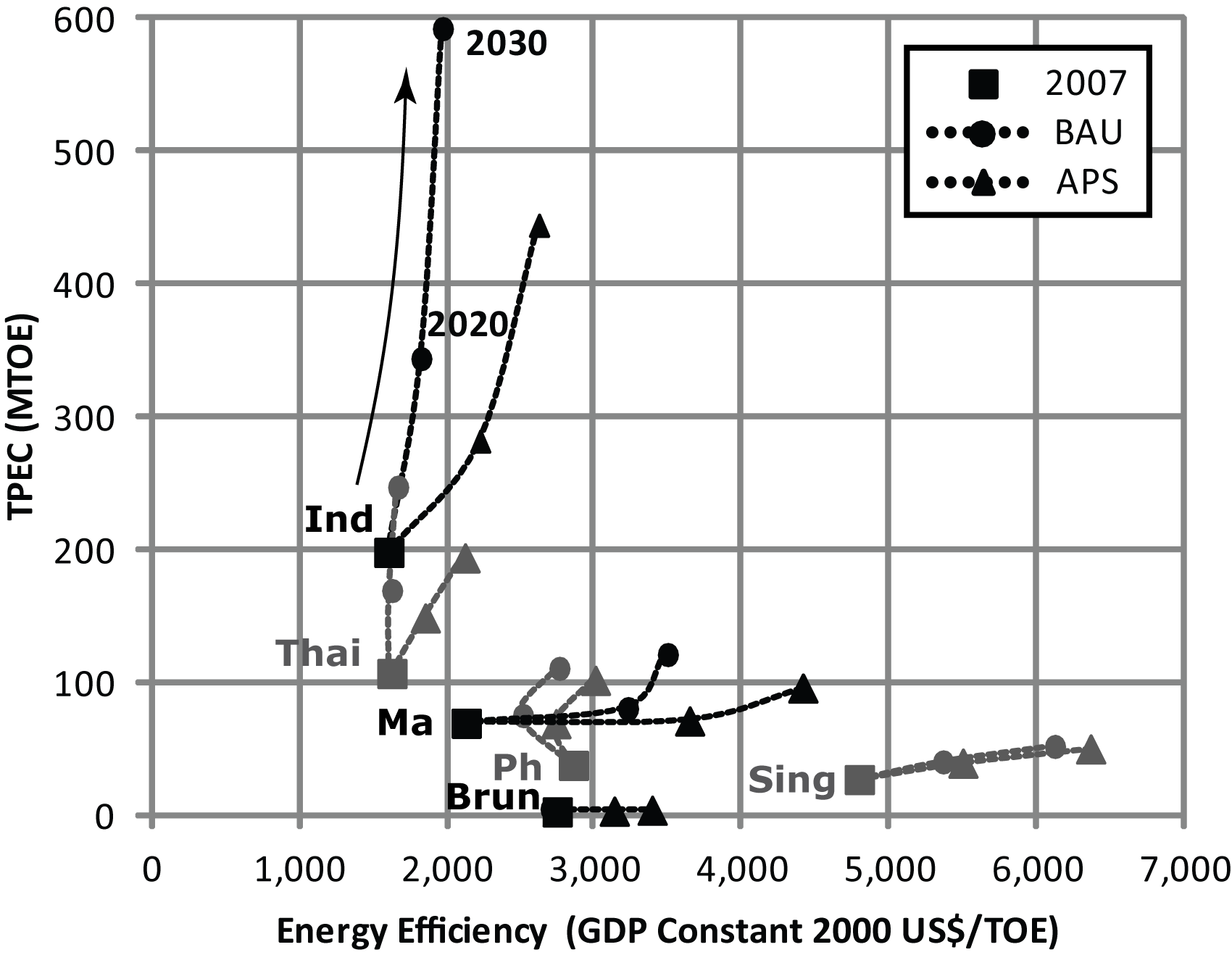
The future in which actions are ineffective, but constraints are weak, is called **Future is Past**. In this future, continued dependence on imported oil, coal for electrification, and subsidized fuel does not have serious consequences because global action mitigates GHG concerns and affordable fuel imports are widely available. Based on current trends toward increasing electrification, social equity would likely improve slightly, although most of the benefits of this future would likely be felt by the growing middle class.

Because of the diversity of ASEAN economies, each of these futures would affect citizens of different ASEAN countries in very different ways. Singapore, Brunei, Malaysia, and Thailand, as the most developed, might be most able to afford mitigation strategies. Indonesia, the Philippines, and Vietnam, as well as Brunei, might have the best chance to make use of their indigenous resources. The least developed economies, Cambodia, Laos, and Myanmar, would face the greatest difficulty in navigating a constraint-dominated future, although their food production capabilities, Laos’ hydropower potential, and Myanmar’s abundant resources could support some mitigation strategies.

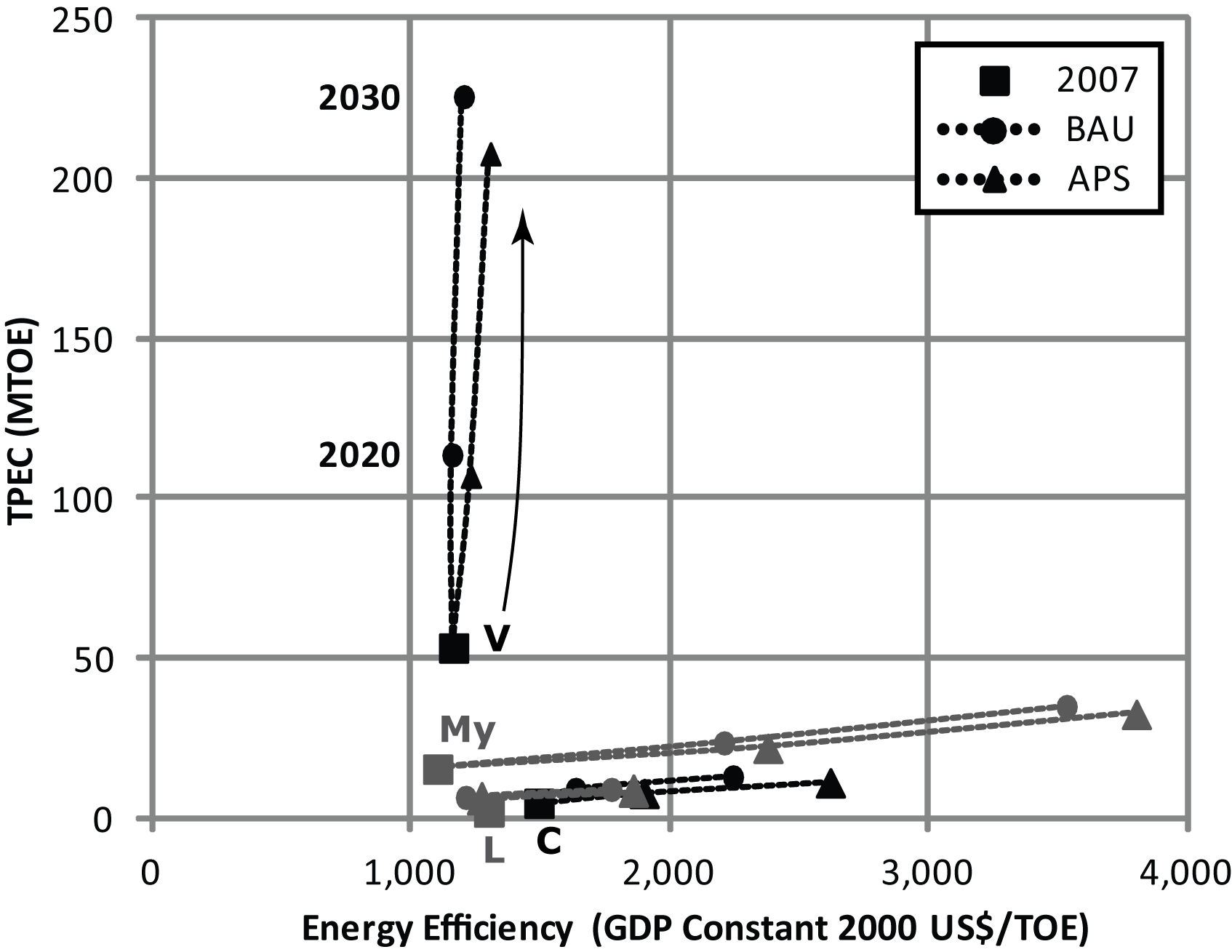
The energy focus groups discussed ASEAN futures qualitatively in terms of the likely characteristics of each of these scenarios according to such parameters as the level of energy efficiency, the amount of alternative and renewable energy in the fuel mix, the level of import reliance, and the level of social equity. The scenarios developed for the 3rd ASEAN Energy Outlook[[6]](#footnote-6) provided a quantitative means to compare energy projections for all of the ASEAN countries that allowed their placement on the scenario logic of Figure 3.1. The 3rd ASEAN Energy Outlook presents two scenarios for each of the 10 ASEAN member nations, a “Business as Usual (BAU)” scenario that projects current trends as identified by each nation, and an “Alternative Policy Scenario (APS)” that includes more aggressive policies aimed at increasing energy efficiency and the use of renewable energy, again identified by each nation. Figures 3.2 and 3.3 are plots of the total primary energy consumption (TPEC) of the ASEAN member nations versus energy efficiency showing points for 2007 (the year the 3rd outlook used as the basis for projections) and the BAU and APS scenarios for 2020 and 2030. The energy efficiencies are determined using World Bank GDP data for 2010 and the GDP growth assumptions of each scenario. The lines in the figures illustrate the trajectories. Because of their different values of TPEC and energy efficiency, the countries are separated into two groups, with Brunei, Indonesia, Malaysia, Philippines, Singapore, and Thailand (Group 1) in Figure 3.2, and Cambodia, Laos, Myanmar, and Vietnam (Group 2) in Figure 3.3.

The energy efficiency projections paint a picture of great diversity. The most developed ASEAN economies, Singapore, Brunei, and Malaysia, are projected on a high energy efficiency path, with the exception of Brunei’s BAU scenario and Malaysia’s BAU scenario between 2020-2030, both of which project little change in energy efficiency. The next most developed economies, Thailand and Indonesia, show significant differences between their BAU and APS scenarios, with their BAU scenarios showing little change in energy efficiency to 2020 for Thailand and between 2020 and 2030 for both countries. The Philippines is an intermediate case, showing decreased energy efficiency in 2020, but an increasing trend between 2020 and 2030 in both BAU and APS. While they show modest energy growth, Cambodia and Myanmar are projected for large increases in energy efficiency, while Laos remains about the same. Vietnam, however, is projected for strong energy growth with a very small increase in energy efficiency in both BAU and APS. This may reflect their projected moving from oil exporter to oil importer and the rapid increase in electrification fueled primarily by coal.

**Figure 3.2 Total primary energy consumption (TPEC) versus energy efficiency (EE) for ASEAN Group 1 - Brunei (Brun), Indonesia (Ind), Malaysia (Ma), Philippines (Ph), Singapore (S), and Thailand (Thai)**



**Figure 3.3 Total primary energy consumption (TPEC) versus energy efficiency (EE) for ASEAN Group 2 - Cambodia (C), Laos (L), Myanmar (My), and Vietnam (V)**



This analysis of energy consumption and energy efficiency provides information about projected energy trajectories for the ASEAN member nations, but does not provide insight into the political, social, and economic constraints faced by these projected visions of the ASEAN energy future. Such insight is provided by the Energy Sustainability Index published by the World Energy Council (WEC), a metric 75% based on energy security, social equity, and environmental impact mitigation, and 25% on political, social, and economic strength.[[7]](#footnote-7) Three of the ASEAN member nations: Indonesia, the Philippines, and Thailand, are included in this index, which is a ranking of 94 countries in which a higher ranking, corresponding to a lower number, is better. Indonesia is currently ranked 83rd, a decline from its 2011 ranking of 76th and its 2010 ranking of 71st. Within its GDP group, Indonesia is ranked 15th out of 24 countries. The Philippines is currently ranked 75th, a significant decline from its 2011 ranking of 57th and its 2010 ranking of 64th. Within its GDP group, the Philippines is ranked 10th out of 24 countries.

Thailand is currently ranked 63rd, a rise from its 2010 ranking of 72nd and its 2011 ranking of 67th. Within its GDP group, Thailand is ranked 15th out of 22 countries.

The WEC commentary on these rankings paints a useful picture of recent sustainability trends in these three countries. It attributes Indonesia’s decline to: (1) a decrease in the wholesale margin on gasoline (perhaps a result of fuel subsidies and increasing reliance on imported oil), (2) low social equity with only 65% of the population having access to electricity (a percentage projected for significant increase in both the BAU and APS scenarios), and (3) high emissions and low air and water quality (which may be addressed by projected increases in carbon efficiency in the APS scenario). However, the WEC commentary assesses that Indonesia currently “underperforms in mitigating its environmental footprint compared to other countries with similar levels of energy intensity per capita.” On the positive side, it assesses Indonesia as a country with political and societal strength “mostly stable” and with “strong economic performance.”

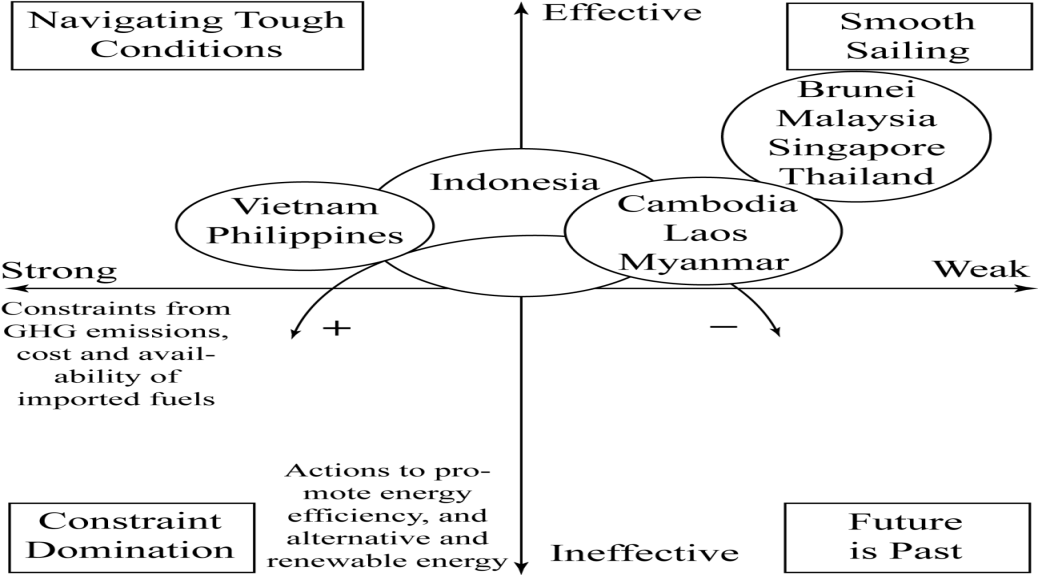
The WEC commentary attributes the Philippines’ significant decline in the rankings to problems across all ranked dimensions, including high emissions and poor air and water quality, and assesses that the Philippines “still struggle in social equity” and “underperform in mitigating its environmental footprint compared to countries with similar levels of energy intensity.” Moreover, ratings for political, social, and economic strength were all low due to assessments of low political stability, low control of corruption, and low availability of credit. The social equity and economic and political assessments suggest strong challenges ahead for sustainable development.

The WEC commentary attributes Thailand’s rise in the rankings to improvement in energy security because of lower growth rate in energy consumption, while its social equity “remains stable.” The commentary also assesses Thailand as “underperforming in mitigating its environmental footprint compared to peer countries with similar levels of energy intensity per capita,” and stronger in the economic than in the political and social dimensions. The 3rd outlook projects that Thailand will substantially decarbonize its fuel mix under both scenarios. This should go a long way toward improvement in mitigating environmental impact, thus addressing Thailand’s biggest sustainability challenge according to the Energy Sustainability Index.

The seven ASEAN member nations that were not ranked on the Energy Sustainability Index fall into two groups. Singapore, Brunei, and Malaysia, with the highest per capita GDP within ASEAN and projected for significant energy and carbon efficiency increases, should be best prepared to face sustainability challenges. Of the remaining group of four, Vietnam will be challenged in energy security as it relies more on imported oil, as well as in environmental impact mitigation as it increases electrification to improve social equity, relying primarily on coal. Cambodia, Laos, and Myanmar will need to pay close attention to the distribution of costs and access to energy and the carbon content of fuels used to electrify as their economies develop and they move away from extensive use of traditional biomass.

Combining the 3rd outlook projections of energy consumption and energy efficiency and the World Energy Council analysis of energy sustainability presented above allows the placement of the ASEAN countries on the scenario logic developed by the energy focus groups, as shown in Figure 3.4. For this purpose, the assumption is made that the constraints of GHG impacts and cost and availability of imported fuels are strong enough to have a significant influence, but moderate enough that the implementation of effective policies can mitigate their impact. Under this assumption, all of the ASEAN countries appear in the upper half of the figure. Brunei, Malaysia, Singapore, and Thailand appear to be the most aggressive in pursuing policies that would provide maximum flexibility to address constraints and move them on a pathway toward the desirable 3rd Horizon aspirations of the focus groups. Brunei, as an oil exporter, and Singapore, with the strongest economy, would be best able to withstand any constraints associated with the cost and availability of imported oil. Cambodia and Myanmar appear to be rapidly improving their energy efficiency as they develop, but their fuel mixes are becoming more dependent upon imported oil and on coal and their economic resources are limited, which puts them closer to the Navigating Tough Conditions quadrant. Laos is not improving in energy efficiency until after 2030, but is currently an exporter of energy derived from hydropower, which puts it in a similar position on the scenario logic. Indonesia appears to be at a crossroads, depending upon whether or not it actually implements its energy policies, while the Philippines and Vietnam are clearly in the most difficult position of all the ASEAN countries with respect to the constraints, the latter because of its increasing energy use without much increase in efficiency and the increasing carbon intensity of its fuel mix, and the Philippines because of its significant challenges in implementation of policies aimed at promoting energy efficiency and renewable energy. As indicated in the figure, should the contraints be stronger or weaker than assumed, all scenarios will shift counter-clockwise (if stronger), or clockwise (if weaker), which could change the quadrant in which they appear. The rationale for this rotation is that if constraints are stronger than assumed, policies will be less effective, while if constraints are weaker, there will be less support for implementation of the policies.

**Figure 3.4 Placement of the ASEAN Countries on the Scenario Logic of the Energy Focus Groups**



# Chapter 4 Scenarios for Water Sustainability

The following text describes the analysis carried out in the water focus groups using the 3 Horizons foresight approach, leading to the scenarios for water sustainability

## Three Horizons Analysis

The **Horizon 1** analysis (present and projected future) produced largely comparable responses from the Indonesian and Vietnamese participants:

**Box 4.1**

**Current issues of water supply and management**

**Water Supply Issues**

* Water yield is reducing
* Deforestation reducing natural water retention
* Not enough capture of rain water at household and community level
* Water imbalance - extreme fluctuation in supply over seasons
* Increased runoff because of changing land-use

**Water Quality and Management Issues**

* Increased water pollution of surface and ground water due to urbanization and industry development
* Increased runoff because of changing land-use
* Declining water quality – dry season polluted, wet season high turbidity
* Excessive groundwater extraction
* Poor maintenance of water infrastructure
* Leakage of water from the whole distribution system, including irrigation

**Water Governance Issues**

* Low public investment in water management
* Water regulations are not enforced
* Overlapping regulatory responsibilities (vertically and horizontally)
* Regional management of water does not align with water catchments

**Public Attitudes**

* Insufficient awareness of the importance of water

This list of issues, and the more general discussion at the workshops, conforms with the five key dimensions of national water security identified in the Asian Water Development Outlook 2013:[[8]](#footnote-8)

* Household water - piped clean water, sanitation
* Economic water –water for agriculture, industry and energy generation
* Urban water – water supply, wastewater treatment, drainage
* Environmental water – water resource development, watershed disturbance, pollution, biotic factors
* Resilience to water-related disasters – exposure, vulnerability, coping capacity (resilience)

The **Horizon 3** perspective addressed what might happen to water supply and management over the next twenty years in the countries being examined. Again, the views of those responsible for the management, research, regulation and governance of water supply and management from the three countries examined bore strong similarities.

**Box 4.2**

**Possible future state of water supply and management in 20 years**

* Natural (or climate change induced) disasters – regular floods and droughts
* Water supply declines
* Water demand greatly increased
* Conflicts over access to water
* Continuing problems in water management OR significant progress in water management through Government reorganization
* New technologies increase efficiency of capture, storage , distribution and usage of water
* The price of water is greatly increased
* Regional (super-national) water authority is able to manage water effectively across jurisdictions

One feature of interest in the discussion about Horizon 3 possibilities was the extent to which technology could assist in addressing the major challenges identified. Technologies identified as having a significant role to play were:

* Decision support systems that would make both long-term planning and day-to-day decision-making more effective and responsive to changes;
* Telemetry to provide real-time data about key water parameters;
* Transformed agricultural eco-systems relying on far less water;
* Early warning systems to detect major water movements;
* Nano/biotechnologies able to desalinate water (surface and ground)
* New technologies to greatly improve the effectiveness and efficiency of wastewater treatment.

This provides a target list for technology developments appropriate to the ASEAN region which need to be either developed or located and accessed.

**Horizon 2**

Horizon 2 was used to identify potential strategic initiatives built on a feasible evolution from present structures and circumstances capable of addressing the challenges identified through Horizon 3. The common threads to emerge are captured in Box 4.3:

**Box 4.3**

**Desirable strategic initiatives in water supply and management**

* Commitment to UN Rights to Water Charter which requires governments to deliver 60l/day of water to every member of their population – significant flow-on effects
* Water infrastructure and management becomes a major budget expenditure item
* Enforcement of laws and regulations governing water use and pollution
* Use ‘Water Day’ to inform and celebrate best practices in water management
* Establishment of local riverine communities to monitor and promote water management and river restoration
* Water catchment authorities manage the water supply including money transfer mechanisms upstream
* Draw on local knowledge of respect for and management of water
* Capacity building, focusing in policy makers and the communities particularly women and children
* Strengthen regional cooperation in water management (for example the Mekong River Agreement of 1995 is not yet fully realised)
* Promote development of national capacity to apply technology to improve water management

## Scenario Construction

The construction of the most appropriate axes for a 2x2 scenario exercise remains one of the less transparent elements of scenario construction. In this case, the three researchers explored and tested a range of options, before concluding with a set that seemed both to be readily understandable to the wide range of participants, and had a significant capacity to identify distinctly different futures.

The first axis is intended to reflect the extent to which the participants believe they can control the future, and is largely determined external to the ASEAN region. At one extreme, external events, natural and man-made, and powerful geo-political and commercial forces, combine to limit the influence of organizations and individuals in the ASEAN region. At the other extreme, nature is sufficiently benign, and the major players sufficiently cooperative, or so aligned, that a future can be imagined wherein ASEAN can expect to have a significant influence.

The second axis is a measure of the extent to which ASEAN stakeholders themselves can take effective action to achieve what is agreed to be important, i.e., it is largely internal to ASEAN. This axis reflects the capacity, and the investment in developing it through education, institutional building and other appropriate means.

Scenarios to populate the four quadrants were progressively developed through the three workshops, taking account of the different conditions in each country.

The bottom-right quadrant, where the world is relatively unconstrained but ASEAN action is ineffective, was labeled ‘**Water Waste**. With neither the drive nor the capacity to improve water supply and management, the targets for improved security are not met. The profligate use of water and the lack of cooperation between neighbouring countries lead to serious trans-border conflict over access to water resources. Without effective action, increasing pollution reduces the availability of fresh water, which flows on to increased prices and less availability of water to the poorer citizens.

In contrast, in the upper-right hand quadrant, the combination of effective action and an unconstrained world produces a positive ‘**Smooth Sailing’** scenario. Under these conditions, effective water management procedures are established and practiced, groundwater extraction is carefully regulated to ensure that aquifers are not depleted, pollution has been reduced to within best practice international levels, and the rural population have access to clean, affordable water.

In the far more challenging constrained world linked with ineffective ASEAN action and capacity, in the bottom-left quadrant, the scenario is ‘**Disaster’**. This scenario is marked by extreme variability in the weather from season to season, with raging floods during the monsoon and disastrous drought conditions in the dry period. Coastal communities are increasingly devastated by severe weather and saline intrusion into groundwater. The extensive riverine communities reel from flood to drought and there is a great loss of life. The unreliable and unmanageable water supply severely damages crop production, leading to widespread food shortages, which rapidly escalate into civil unrest.

Finally, in the top-left quadrant effective action is used to cope with the many challenges posed by the constrained world, in the form of ‘**Navigating Difficult Waters’**. By organizing effective water management policies and practices, food and water supply is maintained at adequate levels, though there is an unsatisfied demand for higher levels of investment in water management infrastructure. Adequate monitoring systems have been implemented to allow far more effective management of stocks and flows of water, and an early warning system based on mobile phones has been established to warn residents of oncoming floods. Effective wastewater management systems have pollution under control.

There was strong unanimity across the three workshops that the current position of each country with regard to water supply and management was in the bottom right hand quadrant, i.e., a situation of ‘Present Tense’ – there are only limited constraints imposed by outside forces, but the capacity to address challenges and opportunities effectively is limited.

When asked to identify their preferred future with regard to water supply and management in the context of ASEAN 2015 and the Krabi initiative, again there was unanimity for the top right quadrant – ‘Smooth Sailing’. However, it was agreed the far more likely future would be in the top left hand quadrant – “Navigating Difficult Waters’, in which the constraints had significantly increased due to climate change and competition for water, but initiatives taken by ASEAN members had substantially increased their capacity to make effective decisions and to implement them comprehensively.

## Inclusive Water Supply and Management

Participants readily engaged with identifying, within the framework of the three Horizons, what initiatives might be particularly appropriate to address the ASEAN Krabi Initiative Paradigm Shift towards supporting ‘Bottom of the Pyramid’ developments in water supply and management. The major initiatives identified are collected in Box 4.4:

**Box 4.4**

**Approaches to inclusive water security**

* Commitment to UN Water Charter which requires governments to deliver 60l/day of water to every member of their population
* Implement Water Resource Management Plan for all river basins based on detailed consultation with relevant communities
* Improve legal system with clear responsibilities of all stakeholders using participatory processes targeting the community level
* Comprehensive reviews of the legal system and stakeholders’ responsibilities and management in water system
* Provide more guidance at the provincial and city levels for improved water management
* Revise the water policy every 5 years
* Improve survey of the current demand and supply to improve water management
* Improve local human resource policy, both quality and quantity
* Current national programs to respond to the climate change and water use need to work together, inject climate change program into water management
* Improve data and information exchange
* Budget for national monitoring system and technology application
* On-going campaigns to increase the awareness of sound scientific basis for water policy making and management

## Comparative Water Security of ASEAN Nations

An assessment of the overall water security of the ASEAN member nations[[9]](#footnote-9) shows a collective strong performance on economic water security, moderate performance in household and environmental water security, and relatively poor performance in urban water security and resilience to water-related disasters. This suggests a major challenge at the ASEAN level, and in its member nations, is to raise the level of performance in these last two areas.

At the individual nation level, **Singapore** and **Brunei Darussalam** have relatively high overall water security, each for their own very specific context-based reasons, which means they provide limited guidance to the other ASEAN nations. However, it should be noted that Brunei Darussalam has a relatively poor performance in economic water security and resilience to water-related disasters, and Singapore also has a relatively poor performance in environmental water security.

**Malaysia** also has a relatively strong performance in overall water security, but has a relatively poor performance in the area of resilience to water-related disasters.

**Indonesia** and **Lao PRC** are the next best placed with regard to overall water security, but Indonesia has only a moderate performance in household, and urban water security, and in resilience to water-related disasters. Lao PRC has essentially the same capability, except for a very poor performance in resilience to water-related disasters.

**Myanmar**, the **Philippines** and **Thailand** compose the next level of water security going down the scale of performance. Myanmar is in a similar situation as Lao PRC with regard to specific water security. The Philippines scores poorly on all elements with the exception of economic water security, and is very weak in urban water security. Thailand has a poor performance in urban water security and in resilience to water-related disasters, but is weakest in environmental water.

**Vietnam** and **Cambodia** have the lowest levels of water security in ASEAN, reflecting the state of their economic development. Vietnam has a poor performance in environmental water security and in resilience to water-related disasters, and very poor in urban water security. Cambodia is very poor in household, urban water security, and in resilience to water-related disasters, and is poor in environmental water security.

With minor exceptions, participants in the various workshops acknowledged that these ratings were generally reflective of the state of water supply and management in their countries, and provided a useful guide on the kinds of policies and investments that were required to improve water performance.

## Recommended Policy Interventions

In the final symposium, participants in the water focus group were invited to identify the policy levers which were likely to be the most important and effective in addressing the range of challenges identified throughout the project. Their collective findings, assessed against the five components of water security adopted in this report, were:

### Household Water Security

Policy levers likely to have highest impact;

* Promotion of demand-side management through water-saving household technologies, industry regulations and recycle/re-use systems, accompanied by minimization of ‘non-revenue’ water.
* Package water supply, sanitation and wastewater treatment investments.
* Support community managed sources and services.

### Economic Water Security

* Evaluate current development strategies to ensure available water resources can sustain them.
* Support the development and effective implementation of basin-wide water allocation and management systems.
* Dramatically improve the water efficiency of irrigated agriculture.

### Urban Water Security

* Strengthen river basin organisations that will independently manage and regulate river water usage.
* Prioritise financing of water and wastewater infrastructure and integrated resource management to protect rivers in urban areas.
* Develop water allocation schemes that take account of both long-term sustainable supply and long-term environmental health.
* Develop integrated land use/water use planning.

### Environmental Water Security

* Expand community awareness and capacity to make behavioural changes to support and protect the rivers.
* Adopt comprehensive integrated water resource management to overcome governance competition and fragmentation.

**Box 4.5**

**A Model of Good Practice**

Chiangrai – municipal government has taken initiatives to manage their rivers, with involvement of the local university through capacity building and engaging the local community. Making green public spaces for exercise, which increases public ownership and responsibility. Too, often, water and sanitation problems are taken away, or hidden, from the people. A center has been established in the community where people can go to learn about the eco-system, e.g., what insects, plants grow there, and regularly check the quality of the water.

### Resilience to Water-Related Disasters

* Invest in monitoring, data storage, forecasting and warning systems.
* Raise awareness about disaster preparedness and collective and individual adaptation measures to increase resilience.
* Incorporate disaster risk management into national planning and budget processes.
* Land/water use planning and enforcement to prevent economic development in disaster-prone locations.

# Chapter 5 Food Scenarios for Sustainability

The food group used the scenario logic of Figure 5.1 in developing its food scenarios for sustainability:

Figure 5.1 Food Scenario Logic



## First Workshop – Thailand January 17-18, 2013

The keynote speaker on food, Mr. Prasit Boondoungprasert of CP-Meiji Co. Ltd., argued that there is a strong linkage between food, energy, and water. He also described the changing food needs resulting from an aging and more urbanized population. He explained that in the commercial sector the need is to accomplish food security and safety at a reasonable price. In Thailand, it is important also to increase productivity, because there was a recent rise in the minimum wage to 300 Baht, which he and his company supported.

In the discussion following the keynote addresses, the following important points were made:

* Need a sustainable business model, training for implementation, and supportive government policies for local development. This was noted for food, but seems to be applicable across the energy- water-food nexus (EWFN).
* Water resource management requires both a top-down and a bottom-up approach in coordinated fashion that can manage sub-basins, including those that traverse national borders.
* There is great potential for small scale energy development, with opportunity for local innovation, but this needs to be supported by government policy. Implementation appears to be a greater problem than technology development, and again this is applicable across the EWFN.
* As smartphone applications for more efficient usage tracking and management begin to emerge and spread across the region with respect to the nexus – new economic opportunities may be possible.

The breakout groups, each led by an IAB member, were charged with identifying current situation and possible future situations in energy, water, and food, and followed identical procedures. Starting with a brief statement by each participant, they then brainstormed to produce many different ideas concerning important problems to be addressed, drivers and barriers to potential solutions, and capacity development needs. These were clustered together and documented by STI staff, and then an in-depth discussion followed, aimed at developing a scenario framework for each area that could be used in the three workshops that will follow this one. Each group successfully accomplished its task, identifying problems, drivers, barriers, and capacity needs, and generating a scenario framework that was recorded by STI staff. There are important similarities and differences between the results of each group.

The most striking similarity is that all three groups used governance as one of the two scenario axes, and all concluded that government actions are critical to successful implementation of desirable scenarios. The greatest difference is that the water scenarios depend on global action on climate change, and the food scenarios depend on volatility of production and input resources, while the energy scenarios are based primarily on sustainable and acceptable technologies and actions to implement them.

In one dimension – locating the current position of the Thailand food system within the axes, the Food Group ventured further to explore various potential contingencies according to how the EWFN plays out over time, as indicated by the arrows, circles and movement lines in the scenario diagram below:

Figure 5.2 Food Scenarios of First Workshop



## Second Workshop – Indonesia April 1-2 2013

The keynote speaker on food, Prof. Dr. Endang Sukara, senior researcher at the Center for Biotechnology Research, Indonesian Institute of Sciences, and former Deputy Chairman of LIPI, noted Indonesia’s considerable advantages in the diversity of its native species of plants and animals, but it faces challenges of agricultural intensification, deforestation, freshwater extraction, and over-exploitation of fisheries. The world food summit goal to halve the number of hungry people by 2015 will not be achieved by present approaches. In the short-term, there is a need to improve soil condition and fertility and food quality and productivity. In the medium-term, research can lead to an increase in the high quality starch composition and nutrition of a range of plants. In the longer term, securing the national foodstock will require a reduction in dependence on rice, and the use of a range of different species.

The discussion that followed the keynote addresses focused on changes necessary in government structures and processes and societal attitudes and understanding, to address the intersecting challenges of food, energy and water supply and security.

The process designed to guide the breakout groups was a five-stage one built around the concept of “seeing in multiple horizons”[[10]](#footnote-10). The final stage was an application of the results of the first four stages to a scenario logic diagram, described below.

Figure 5.3 Food Scenarios of Second Workshop



## Third Workshop – Vietnam April 4-5 2013

The keynote speaker on food, Prof. Nguyen Van Bo, President Vietnam Academy of Agricultural Sciences, presented a comprehensive overview of the current food security and productivity profile of Vietnam and he identified several urgent concerns that will have to be engaged to ensure food system sustainability and enable more coherent linkages with water and energy issues. He first highlighted the enormous progress that had occurred over the past 30 years since the 1980s in shifting Vietnam from a net rice importer to the present where it exports over 5M T annually and manages to meet most of its own domestic food requirements as well. However as Prof Bo noted, such a strong reliance on rice (second highest consumption per capita in Asia after Myanmar; 45% higher than China and 100% higher than India or Japan) raises sustainability concerns and food security issues that include vulnerability to climate change and malnutrition for the approximately 10 M whose diets are almost exclusively rice dependent. He also identified the key areas of future pressure in meeting the food needs of a 90+M population that continues to grow over 1 M per year- e.g. decreasing amount of arable land for agriculture; exposure to climate change impacts (World Bank has listed Vietnam as one of the 5 most vulnerable countries); need to reduce agricultural emissions of GHG (higher than energy for Vietnam with rice cultivation accounting for almost 60%). In conclusion, Prof Bo suggested several topics that the workshop could pursue:

* How food security and sustainable agriculture can be integrated into regional and national policies;
* How to sustainably intensify food production while reducing GHG impacts by better crop selection and diversification;
* Measures to assist vulnerable populations cope with or anticipate climate change impacts;
* Reshape food access and consumption to improve sustainable eating patterns;
* Create better information systems for more ecological resources management and understanding of interfaces with energy and water issues;
* Consider strategies to reduce rice dependency, and to strengthen land use efficiency through community-based cooperative type production units for alternative crops;

The discussion that followed the keynote addresses focused on changes necessary in government structures and processes and societal attitudes and understanding, to address the intersecting challenges of food, with energy and water supply and security. The Three Horizons approach was then pursued, leading to the scenarios shown below.

The closing plenary confirmed that the Three Horizons foresight tool was seen as an effective way of addressing uncertainties and planning for the future. It facilitated the emergence of a common view that increasing national capacity to analyze and effectively address current problems in energy, water, and food supply could also lay the basis for increasing sustainability and resilience, and improving inclusiveness - which will help in addressing future challenges arising from conditions of great uncertainty.

The Food Group, following the lead of Professor Bo’s list of challenges ahead for Vietnam discussed them in the context of determining the current situation - Horizon 1- which was characterized as becoming ever more vulnerable to and eventually constrained by rising climate impacts, water shortages, pollution increases and negative global impacts and price uncertainties unless a range of actions to improve the sustainability and resilience of the food system could be developed and implemented: e.g.,

* Improve enabling factors for law, policy and regulations enforcement;
* Invest in Agriculture Infrastructure -e.g., GAPs, machinery; knowledge distribution;
* Financial support for RD plus Fairness in RD support allocations;
* Improve cooperative system, for the community;
* Develop / investment technology for animal feed;
* Design and create-- World-class products –i.e. Vietnam Branding;
* Identify ‘global positioning’ and prioritize products;
* Choose crops which fit to climate change;
* Consider biomass as crop, and manage its development as part of a sustainable food policy;
* Reduce rice dependencies by sensible diversification;
* Stimulate mindset to have ‘continuously learning and innovative’ like Japanese’s KAIZEN;
* Farmers need education and further thinking of business view;
* Decrease perception that imported food products are necessary or good.

The Food group then proceeded to explore what might be possible for Horizon 3 – 2020 and beyond. This vision consisted of: clear, stable and consistent policies, with integrated implementation across Ministries; better information for farmers regarding markets and supports for higher value product development; alternative crops that will have better climate resilience and require less water.

They then developed scenarios based on axes of uncertainty in market conditions (generally favorable, with low risk; or very volatile and high risk) and the context of a constrained or unconstrained world in terms of climate impacts in particular.

Four plausible scenarios were explored:

* ***Navigating Tough Conditions*** (high constraints and climate change impacts but also strong and stable markets and production capacity): major features were natural disasters, a low capacity to invest in things other than infrastructure; worsening environment, production costs manageable but rising, and increased vulnerability to climate change;
* ***Green is Mean /Tough World*** (high climate change, and high risk markets with highly volatile production inputs): major features were high social, economic and environmental uncertainty, competition and lack of coordination between institutions and policies, conflicted government;
* ***Sinking Slowly*** (low climate change, volatile production inputs): poorest bear the most risk; widening poverty/income gap, subsidies needed to sustain productivity ; reliance on imported fertilizers and pesticides adds to low flexibility;
* ***Smooth Sailing*** (low climate change, relatively unconstrained production capacity, stable markets and production inputs): major features are a good amount of innovation, increased yields and crops variance, micro cradle to cradle community eco-economies able to cope with climate impact, government is coordinated, aligned for support for food production, climate change readiness, implementation of effective Food , information and educational policies

In conclusion, the Food Group made the following observations regarding sustainability and how to strengthen or create inclusive innovation about each scenario as contributions – or pathways to policy - that decision makers could focus on going forward:

***Smooth Sailing***:

* Diversity In Investment;
* Emphasis on renewable energy;
* Agriculture infrastructure, high yield.
* Multifunctional uses of water resource.
* More food branded Cooperatives.
* Government loans to send the students to study and come back to their locality.
* Grass roots innovation and technology transfer.
* Alternative crops, more locally beneficial and unique crops for domestic income.
* IT, e.g., cell phones for sharing market information.
* High value added, special food products to replace restaurant food products.

***Navigating Tough Conditions:***

* Shift to low carbon society creates some barriers to developing countries, including trade in sustainability equipment.
* Government can still invest a lot of money on infrastructure, disaster relief and R&D.
* Sustainability can be enhanced by infrastructure improvement.
* Difficult to have inclusive innovation, when survival is the first priority.
* How inclusive can or should public investments for innovation be, when the government invests in infrastructure (e.g. highways, irrigation).

***Green is Mean: Tough World***

* Green products expensive, sustainability is jeopardized.
* Energy cost escalates – and pollution is high
* State may have to spend so much on climate change mitigation that there is no money for the farmers to get out of the vulnerability cycle.

***Sinking Slowly***

* Difficult for sustainability perspective, not too much on climate change.
* Increase urbanization rate, loss of agriculture land, difficult economy.
* Difficult for investor and farmers to innovate.
* Inclusive innovation is difficult.

Overall, the Food Group felt that these pathways could best be addressed at the national level, offering several suggestions to be carried forward to the Summary Final Workshop in Bangkok.

* Policy for the famers: material inputs, labor, trademarks (when we have good PPP policy, enterprise rather than government should identify the markets).
* Government will have to work with industrial enterprises to create innovation demands.
* Only when ASEAN combines together can we control prices, and design ASEAN to be globally competitive- while also maintaining transparency in price making.
* Take advantage – using what they have, in development for localities to create sustainable competitive advantage -e.g. by applying infrastructure R&D investment for sustainability and for inclusive innovation
* Policy needs to be driven toward or by business enterprise and the farmers should aim to harmonize agricultural production processing, and export and create Flagship programs

## Synthesis – Thailand October 1-2 2013

The main focus for the food group in the fourth (Synthesis) workshop was in deepening the analysis and elaborating the story lines of the four scenarios against two sets of criteria:

1. How the integrated nexus concept would be impacted by each scenario, particularly in the context of the third horizon time frame of 2020-2025;
2. According to the key filters – sub themes of food security; systemic sustainability; inclusive innovation and bottom of pyramid impacts and opportunities.

Because of the high constraints, and also a capacity to deal with recurring tough challenges, it is expected that food production and consumption will be continually challenged but mostly can be sustained though there will be considerable volatility in supply security and prices. To manage the required navigation, so that the food supply can withstand the expected severe buffering from climate change and other constraints, clearly at least a moderate degree of alignment with energy and water practices will be necessary.

The group also suggested that a type of institutional model similar to the European Commission might be required to support the continual navigation required, and to protect the most vulnerable segments of the ASEAN populations. With higher food prices there would likely arise more instances of poor production practices and food contamination so also more food security monitoring would be needed and ways to ensure that the potential for greater supply chain control by food conglomerates would not exacerbate or compromise overall food quality.

Within a more corporate controlled food value chain, small farmers would be looking to government to support them where possible for competitive guidance and innovation. The group also suggested that the nexus could enable a more competitive ASEAN, built around public-private partnerships in developing new food enterprises, but with a caveat that by the time of the Third Horizon, these new models for development would have to overcome the strong inertia which in the past differentiated ASEAN members in food production and aspirations.

In terms of the BOP – the greatest risks may be with the growth of the urban poor and the potential vulnerabilities associated with land use becoming more controlled by larger conglomerates. To ensure BOP resilience, it was thought that at both the national and ASEAN levels, interventions and measures to support regional and community level food enterprises – e.g. cooperatives, community development organizations etc. - which could be responsive to conditions and provide BOP income opportunities.

**Smooth Sailing**

This scenario is characterized by a thriving and secure food sector – supported by a resilient nexus of energy and water policies that have enabled export growth, crop diversification, higher yields, with ASEAN level governance providing both strategic direction and an inclusive innovation environment.

Similar efficiency and distributional dynamics are possible in food logistics – with supply and demand able to be well managed using state-of-the- art technology and education systems that promote ASEAN level entrepreneurship, social cohesion and resilience/sustainability values and practices.

**Sinking Slowly**

In this scenario, it becomes very difficult to use policy levers to counter the lack of opportunities presented by an increasingly daunting environment. Food security is possible, but barely so since there are numerous vulnerabilities – mostly derived from low public sector - governance capacity. At best this scenario leads to a sense of societal foreboding – that seems to cast the future as a continual muddling- along process – i.e., always waiting for the next shock, and a policy realm where resources are always in short supply to enable real coping or avoidance strategies. This scenario and its nexus interface characteristics demonstrate how central the capacity vector will be to developing what the group believes is a sufficient preparedness strategy for ASEAN, since essentially this scenario is regarded as a temporary state at best - upon which the potential for nexus solutions either improves through more concerted aligned ASEAN level action (while constraints are still low) or gets much worse, as in the Green is Mean scenario, when the constraints intensify.

**Green is Mean – Tough World**

In addressing this scenario- the most challenging of the four scenarios, the Food Group started by examining the various constraints affecting food availability (e.g. access, quality, variety, price volatility, supply uncertainty), concluding that food security would be relatively low for all but the rich and even they could at times experience situations where rich capacity in personal income terms might not be sufficient to guarantee food resilience, especially where energy and/or water costs and options are not conducive, because of non-viable nexus dynamics. In this scenario it is equally challenging to achieve sustainability – usually only possible when many constraints are removed.

Although the challenges posed here would be substantive in terms of ecological resilience, disease prevention and mitigation, and vulnerability of some regional crop monocultures – there nevertheless remain major opportunities for innovation and BOP improvements – because of the magnitude of challenge, (when times are tough, the tough get going) and despite a low regional effectiveness capacity, these could possibly inspire greater openness to innovations from external sources.

## Prospective Energy-Water-Food Nexus Pathways and Policy Levers

Finally, the Food Group discussed the following prospective policy levers and capacity developing measures, that if applied in a nexus context, could contribute to a strengthened ASEAN food system while also building national resilience and advancing the Krabi initiative:

* Create better information systems for more ecological resources management and understanding of interfaces with energy and water issues;
* Consider strategies to reduce rice dependency, and to strengthen land use efficiency through community-based cooperative type production units for alternative crops;
* Develop voluntary land use optimization guidelines for the ASEAN region, that could after some years of practice form the basis for a Nexus-based eventual ASEAN-wide standard;
* Consider ways to provide local incentives to small farmers to increase their ecological resilience and advance the conservation and renewable uses of both energy and water technologies along with associated socio-economic training-leasing strategies. (For example, adapting the Ontario, Canada model where government introduced a renewable energy development incentive aimed at rural villages and farmers who would be paid for renewable based power fed into the grid on a guaranteed fee –return basis from solar- wind etc. equipment leased to them by agent organizations based in the hinterland – creating new jobs for assembly, training, finance and servicing, while also supporting BOP objectives in the rural communities.);
* Consider measures (e.g., demonstration programs) that ASEAN and national governance authorities might adopt to encourage rural farming communities to develop local cooperative food enterprises that could become agents for Nexus implementation- e.g. more protein efficient, water conserving and energy – eco footprint -efficient.

# Chapter 6 The Energy-Water-Food Nexus

Managing the scarce resources of energy, water and food under conditions of significantly increasing demand is one of the most significant ‘grand challenges’ of our time. An adequate energy supply underpins both the economic growth of a nation and the quality of life of its citizens. Water is crucial to human survival, but its supply is relatively limited and negatively impacted by the use of water for agriculture, industry and waste disposal. Feeding its citizens is one of the central responsibilities of the state, but over 15% of the current world population are undernourished, and the rapidly growing population will require more.

There are many organisations tasked with addressing these issues, and an abundant literature and supporting research. But, as introduced in Chapter Two, it is the nexus between energy, water and food that represents perhaps both the greatest challenge, and offers the most significant opportunities for substantially improving the way we manage these scarce resources.

While it is apparent that the supply, management and use of energy, water and food are inextricably linked, an approach that may clarify problems and potential policy actions is to focus on the critical relationships between each of the pairs of the triad, followed by identification of activities in which all three elements are centrally involved.

## Energy-Water

**Generation of energy**, particularly the ubiquitous electricity, has very high water demands. Water that is allocated to and used for energy generation is not available for people to drink, for farmers to grow their crops, or for industry to use in manufacturing. All too frequently, under pressure to develop energy supply, the price of water has been subsidized, or in worst cases, i.e., set at zero. The consequence has been that there has been little incentive to use water efficiently, and there has been no effective market to manage the competing demands for water. A further consequence of the use of water in energy generation has been its return to the supply system polluted, both thermally and by foreign matter. More complex analyses are available that point to the water cost of the various materials used in the distribution of electricity.

To resolve the current problems of undervaluing of water resources and competition with other uses, data is needed on the quantity of water used per unit of electricity generated, the effect on water quality, and the end use of the electricity. Recommended actions are to monitor the source(s) of water used, determine the extent to which water waste is produced, water can be recycled, and the quality of water is reduced, and evaluate opportunity cost by defining the uses of water that have been ruled out by its use for electricity generation. These are actions that should be taken at the country level, but the development of standard practices throughout ASEAN would be helpful.

**Industrial processing** usually has a very high demand for water as a cheap cooling and transport medium, consuming energy for its movement. The commonly cheap price of water for this use has also led to high wastage and limited efficiency. Furthermore, there has been little incentive to use suitable lower grade water. Again, the processes typically seriously degrade the quality of the water returned to the system.

Many of the same arguments as for electricity generation apply. However, industry is a special case in that for many industrial processes lower quality of water may be sufficient, so analysis should be done to ensure that industrial users use the lowest possible quality of water required for their process. Production of water waste and pollution should be monitored and opportunity costs evaluated. The development of standard ASEAN practices would be helpful here as well.

The **supply and distribution of water and the processing of wastewater** all require substantial energy inputs. In a free market situation appropriate efficiencies could be pursued, but in the context of the delivery of an essential human service, largely by public utilities, such efficiencies may not be pursued, or even be pursuable. In this situation both water and energy may be under-priced. While there may be good public reasons for this arrangement, more transparent trade-offs may lead to more effective use and care.

Because these functions are typically performed by government agencies or utility companies, and the infrastructure used may be old and inefficient, it will be important to calculate the true cost of energy, including the mitigation of impacts, which will allow the comparison and prioritization of the assignment of energy for this use as compared to others.

## Food-Water

**Agricultural production** constitutes on average 70% of a nation’s water consumption. The usually simple processes of subsistence and small farming may be appropriate at the site, but collectively lead to high levels of wastage and inefficiency. Open channel irrigation has very high losses through seepage and evaporation. Only if water is scarce (e.g., through drought) or has a significant cost is innovation likely to occur. Effective action will be necessary at the community and family level, but needs to be guided and supported by simple schemes that increase the efficiency of water use. In addition, if fertilizers or pesticides are applied to increase production, run-off will pollute the remaining water sources, often to a destructive level.

Decisions on which crops to grow and how to irrigate the fields have implicit effects on the quantity and quality of water available for other uses. Recommended actions are to evaluate water needs in a holistic manner, taking into account the effects on other sectors. While the conditions are different in different countries, ASEAN could establish standard practices for performing the evaluations and provide models for comparative analysis.

**Food processing** is an intensive user of water, like all process industries. While food processing may require high quality water in some uses, in many lower grade water could be used. But without a regular supply, and differential pricing, there is little incentive to encourage its use. Again, a consequence of this usage can be further pollution, sometimes with dangerous chemicals. The promotion of closed cycle processing, as necessarily practiced in the petrochemical industries, could be one long-term approach.

Food processing, as an industrial use of water, should be held to the same standard as other industrial processing uses of water. Production of water waste and pollution should be monitored and opportunity costs evaluated. The development of standard ASEAN practices would be helpful.

## Energy-Food

**Agricultural production** uses energy, largely in the form of fuel for on-farm activities and transport to market. The availability of this energy in suitable form, time and place can act as a major facilitator, or constraint.

Recommended actions are to evaluate the energy efficiency of equipment and processes used for irrigation and fueling farm machinery and evaluate their cost-effectiveness and the potential for improvement taking into account the local context and available resources.

**Food processing** is an energy-intensive enterprise. There may be considerable scope in the design of foods and the operations of food processors to achieve significant efficiencies in energy consumption.

As for water, energy for food processing should be held to the same standard as energy for other industrial processes, while energy for food distribution likely uses existing commodity transportation infrastructure and supply chains, with refrigeration a special requirement. Recommended actions are to monitor and evaluate energy use to look for places where inefficiencies exist and can be eliminated.

## Energy-Food-Water

Some activities inherently involve all three sectors and highlight the tradeoffs and opportunities that need to be evaluated and addressed in a holistic manner. Here we briefly discuss three that were of special concern to participants in all three workshops and the final symposium: land use, irrigation, and biofuels. The key concerns in all three cases revolved around the importance of taking into account the local context in the development of policy strategies and actions and implementing practices that affect local communities. For land use, the key issue is how to ensure that local communities have a voice in decisions that determine whether land will be devoted to farming, energy production, commercial development, or other uses, and that these decisions are consistent with local culture and interests and advance social equity. For irrigation, there are tradeoffs between crop choices, yields, and irrigation methods that both determine requirements for energy and water and can have lasting effects on the life and livelihood of local farmers. For biofuels, there is a necessary tradeoff between crops for food and crops for energy, with water requirements in both cases, and the efficiency and social equity ramifications are different in different countries and localities, and must be transparently evaluated and discussed with the local community. Recommended actions in all three of these cases are to involve the local community in decisions and to provide detailed and transparent evaluations of the options for local decision-makers. Cooperation between ASEAN governments and non-governmental organizations in the development of data, models, and sustainability practices would be useful here.

# Chapter 7 Conclusions – Pathways to a Sustainable ASEAN

The nations of ASEAN are developing rapidly, but under constraints that threaten to impede the sustainable and inclusive growth consistent with the aspirations expressed during the performance of this integrated foresight activity and the inclusive innovation paradigm of the ASEAN Krabi Initiative. As described in the energy, water, and food scenarios of Chapters 3-5 and outlined in Chapter 6 on the energy-water-food nexus, effective actions will be needed to mitigate constraints and set ASEAN onto a sustainable pathway to the implementation of the ASEAN economic community in 2015, and to 2020, 2030 and beyond.

Considering the energy-water-food nexus, most of the ASEAN countries are challenged in one or more areas. While Brunei and Singapore are in a relatively good situation, they do not provide role models for the rest of ASEAN because of their small size in population and land area. Moreover, they do have potential vulnerabilities to shocks in the oil market (Brunei) and because of total reliance on imports (Singapore). In the water area, while they are ranked well overall, Brunei has relatively poor performance in two of the five water sectors described in Chapter 4 (economic and resilience to water-related disasters) and Singapore has relatively poor performance in one water sector (environmental). Malaysia and Thailand have relatively high energy and food security, but both have relatively poor performance in resilience to water-related disasters, and Thailand also has relatively poor performance in two other water sectors (urban and environmental). Indonesia has potential vulnerability in energy security if it does not follow through with its energy policies, has moderate performance in three water sectors (household, urban, and resilience to water-related disasters), and is ranked sixth out of the eight ASEAN countries ranked in the Global Food Security Index (GFSI).[[11]](#footnote-11)

Four of the remaining five ASEAN countries are challenged in two of the three areas of the energy-water-food nexus. The Philippines, which is ranked fifth among ASEAN in the GFSI, has low energy security based on the energy scenarios of the 3rd ASEAN Energy Outlook, has shown a dramatic decrease in the Energy Sustainability Index rankings, and has weak performance in all water sectors except economic. Vietnam, which is ranked fourth among ASEAN in the GFSI, has low energy security based on the energy scenarios of the 3rd ASEAN Energy Outlook, and has poor performance in three water sectors [environmental, resilience to water-related disasters, and urban (very poor)]. Vietnam, as a major rice exporter, also has vulnerability due to high water needs and dependence on monoculture. Cambodia and Myanmar, with moderate energy security, are ranked lowest among ASEAN in the GFSI, and both have poor performance on water-related disasters. Cambodia, which was ranked last among ASEAN in the GFSI, also has poor performance in the environmental water sector and very poor performance in the household and urban water sectors. Laos, with moderate energy security, has poor performance in resilience to water-related disasters. Laos was not ranked in the GFSI, but is most similar to Cambodia and Myanmar, the two countries ranked lowest among ASEAN.

The keynotes and other presentations, the focus groups in energy, water, and food, the real-time Delphi survey, and discussions at the final symposium all point toward several necessary features of pathways leading to sustainable futures for ASEAN:

Improved governance that balances the use of resources for economic development with the needs of citizens and recognizes the opportunity costs associated with alternative uses of energy and water, including uses that support food production and distribution;

The need for a holistic approach to the energy-water-food nexus, recognizing that actions taken with respect to any one of these sectors will inevitably affect the others, and without careful evidence-based planning, is likely to be detrimental to one or more of them;

The recognition that achieving inclusiveness and promoting social equity will require the development and implementation of effective practices for community-based decision- making, as well as local capacity building that involves outreach, education and training, and investment;

An almost total reconsideration of the value of resources, most evident in the profligate use of water as if it had no value at all, but also for energy recognizing the economic and societal costs of energy production, conversion, distribution, and use.

The development of models and databases that will enable the proper valuation of energy and water to accomplish the holistic analysis of the energy-water-food nexus suggested above, as well as the type of integrated resource management and land-use practices that will make the best possible use of available resources. This, together with coordinated planning and implementation across provincial and national boundaries where required by resource constraints, will allow the identification and evaluation of truly sustainable pathways for a maximally resilient ASEAN.

1. See the reports of the Intergovernmental Panel on Climate Change, available as of October 6, 2013 at <http://www.ipcc.ch>, and news reports such as, available as of October 6, 2013 at <http://www.cbsnews.com/8301-205_162-57604926/u.n-panel-says-its-extremely-likely-climate-change-is-predominantly-man-made/>. [↑](#footnote-ref-1)
2. *Thinking about Water Differently: Managing the Water-Food-Energy Nexus*, Asian Development Bank, 2013, pp. 6-7, available as of October 21, 2013 at <http://www.adb.org/sites/default/files/pub/2013/thinking-about-water-differently.pdf>. [↑](#footnote-ref-2)
3. *ibid*, p. vii [↑](#footnote-ref-3)
4. A. Curry and A. Hodgson, “Seeing in Multiple Horizons: Connecting Futures to Strategy”, *Journal of Futures Studies*, 13(1), 2008, 1-20. [↑](#footnote-ref-4)
5. J.E Smith, Presentation to the ASEAN project workshop, 2013. [↑](#footnote-ref-5)
6. Institute of Energy Economics, Japan and ASEAN Centre for Energy, *The 3rd ASEAN Energy Outlook*, February 2011, available as of July 22, 2013: <http://www.energycommunity.org/documents/ThirdASEANEnergyOutlook.pdf>. [↑](#footnote-ref-6)
7. World Energy Council, *World Energy Trilemma, 2012 Energy Sustainability Index*, available as of July 29, 2013 at <http://www.worldenergy.org/documents/2012_energy_sustainability_index_vol_ii.pdf>. [↑](#footnote-ref-7)
8. Asian Development Bank and Asia-Pacific Water Forum, *Asian Water Development Outlook 2013*, 2013 available as of October 21, 2013 at <http://www.adb.org/publications/asian-water-development-outlook-2013> . [↑](#footnote-ref-8)
9. *Ibid* [↑](#footnote-ref-9)
10. A. Curry and A. Hodgson, *op. cit*. [↑](#footnote-ref-10)
11. The Economist Intelligence Unit, *Global food security index 2013: An annual measure of the state of global food security*, 2013, available as of October 21, 2013 at <http://www.eiu.com/public/thankyou_download.aspx?activity=download&campaignid=FoodSecurity2013> . [↑](#footnote-ref-11)