Konrad Adenauer Stiftung

TOWARDS A GREEN ECONOMY

In Search of Sustainable Energy Policies for the Future

EDITED BY
ADNAN A. HEZRI
WILHELM HOFMEISTER

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Chapter 1

Energy Policy and the Transition to a Green Economy: An Introduction

Adnan A. Hezri and Wilhelm Hofmeister

Fossil fuel depletion and climate change are redefining policies on energy security. Evidence suggests that we cannot continue forever consuming carbon energy resources the way we have for a century (Crowley 2000). Because of rapid industrialization and population growth, carbon energy resources are depleting quickly, resulting in the fear of imminent 'peak oil' (Murphy and Hall 2011; Bentley 2002). Our voracious energy production and consumption has led to anthropogenic impacts of temperature rise which may lead to a catastrophic tipping point known as dangerous climate change (IPCC 2007).

Energy consumption and production connects numerous socioeconomic processes such as transportation, agriculture and industrialization, all directly related to CO_2 emissions. For these reasons, no government can ignore energy issues, whether they are about availability, accessibility or affordability. Increasingly, to address the challenge of climate change, issues of energy efficiency and sustainability have also entered the policy discourse by demanding a fundamental change in energy production and consumption. Be that as it may, despite countless efforts in formulating energy and climate change policies, in 2005, fossil fuels accounted for 85 per cent of the global primary energy mix, while hydroelectricity accounted for 3 per cent and modern renewables for less than 1 per cent (United Nations 2011). In other words, reducing our carbon dependency requires deeper structural changes in an economy and the way of life of its citizens. The twin crises of oil depletion and climate change have created a demand for a new overarching concept called the green economy. Moving towards a green economy means a shift to development strategies underpinned by the low carbon goal.

However, even when governments and societies accept that 'green' or 'clean' energy is desired, there is no agreement on how to transform from a fossil-powered economy to a green economy. A variety of technology and a variety of policy options are available, ranging from carbon cap, carbon market, renewable energy (wind, solar, geothermal, biomass, etc), feed-in tariffs, smart grids, energy conservation, green bonds, government procurement, etc. As a variety of policies have been implemented, few governments or the public are contented with their energy situation. The issue is complex and multiple: it concerns securing energy resources for a modern economy, meeting rising energy demand for development, mitigating the impact of climate change, and keeping the energy industries viable and profitable. Furthermore, not all countries face the same challenges: when facing the challenges of decarbonising electricity production and consumption, and securing energy supplies of all sorts, developed countries need to find ways to switch from dirty to clean energy sources without sacrificing living standards and hurting the economy in general. For many developing countries, an additional challenge of how to meet rising energy demands as they embark on industrialisation, urbanisation and modernisation means that they need to find ways to have 'green growth'.

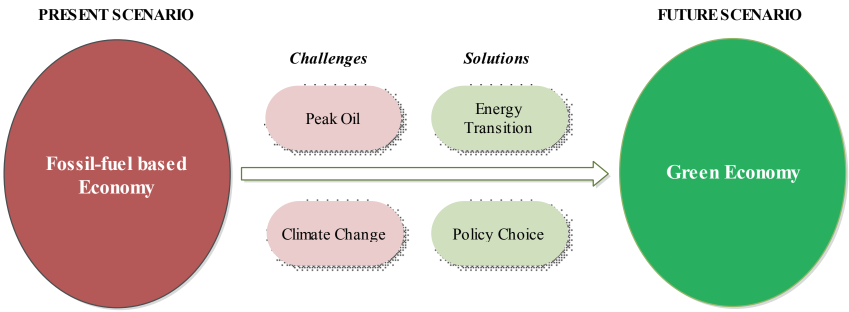
PURPOSE OF THIS BOOK

These debates have generated considerable heat, and, for the purpose of this book, at least some light. They have served to illustrate the major theme of the book: that the transition to clean energy is still at an embryonic stage. As this energy transition involves hard choices politically, economically, and technologically, countries can benefit from a comparative lesson-drawing across geographical divides. Further, the debates provide an opportunity to envision what a green economy should mean and look like, given that there are economic, political, and cultural variations across countries.

The general task of outlining the landscape of experiments with energy policies globally has thus served as a broad framework for an international conference entitled "Moving Towards a Green Economy: Energy Policies for the Future", organized by the Institute of Strategic and International Studies (ISIS) Malaysia and the Konrad-Adenauer-Stiftung, which took place in Kuala Lumpur on December 9 and 10 in 2011. At the outset, this project seeks to examine each of the policy instruments available to deal with the combination of energy-related challenges in each selected country, taking into consideration its economic, political and social development, as well as the availability of resources. It seeks to explain why governments decide to adopt a particular set of policies; how the public have responded to them; and, more importantly, who are the winners and losers in balancing priorities and interests. What is the role of the government? What are the options? What is the debate? Why are some options adopted but not others? The central idea is to understand the politics behind the policies and measures undertaken by the government to deal with these challenges. The conference particularly looked at successful stories as well as potential problems in racing towards a 'green economy'.

In what follows, as a preface to the remaining sections of the book, this chapter outlines three themes that will serve as the conceptual guide to anchor the different experiences surveyed in the nine countries presented in this book. These themes are—energy transition, policy choices and the green economy. They are at the core of the difficulties and opportunities in dealing with the intertwined challenges of peak oil and climate change (see Figure 1.1). The concept of energy transition recalls the salience of a long-term policy design to restructure energy systems for sustainability. Although transitions between energy sources have occurred historically, the 21st-century energy transition has to be rapid and well-planned. In this regard, the green economy goal serves as a carrot for such a transition to take place, given the opportunities available for businesses and governments alike. However, the transition demands of us to make some difficult policy choices because energy security is a 'wicked' policy problem. Not only is the energy policy domain complex, it is also ill-structured and intractable in character. Hence, in finding solutions to achieve a greener economy powered by cleaner energy sources, democratic political processes in mediating social conflicts will have to play a bigger role in the future.

Figure 1.1: A schematic of the Shift to a Green Economy



ENERGY TRANSITION FOR SUSTAINABILITY

To bring back human activities within ecological boundaries, our energy systems need to transform. At the very least, the transformation from a fossil fuel energy system to a non-fossil fuel based energy system is necessary. This entails a shift from a carbon emitting energy system to a low carbon energy system or a transition from a non-renewable energy system to a renewable energy system. These transformations are known as energy transition, involving the long-term reconfiguration of the production and consumption patterns in the energy sector and beyond. The Dutch Energy Transition Policy is a showcase of how the approach is used as a managerial strategy and given a central place in national policy making (Kern and Smith 2008).

For a large part of the developing world, urbanization and industrialization is causing rapid energy transition from biomass to modern energy sources for the benefit of their underprivileged population. Almost 2.7 billion people continue to rely on traditional biomass such as charcoal, wood and dung (United Nations 2011). The developed world had seen a transition from wood to fossil fuels by similar drivers (including innovation), but within a long period of 400 years (Solomon and Krishna 2011). Currently, both developed and developing countries are finding ways to accelerate the transition to more environmentally benign energy systems to avoid serious disruption of the earth's climate. To induce this systemic change will involve 'a shift in the dominant "rules of the game", a transformation of established technologies and societal practices, [and] movement from one dynamic equilibrium to another' (Meadowcroft 2009: 324). This process will typically stretch over several generations, involving 25–50 years at the very least, longer than the usual electoral or business cycle. The transition approach recognizes the merit of context-specific experimentation and learning in the deployment of policy instruments.

In the interim, sustainable energy transition will be constrained by path-dependency and technological lock-in. Put differently, our past choice energy matters and it will disincentive our move towards cleaner sources. The forthcoming chapters will highlight country-level efforts to break out from our technological 'lock in' in fossil fuel-based energy systems to carbon friendly alternatives. The discussions provide important insights into transition obstacles arising from the past and present vested interests, infrastructure network, behavioural pattern and market forces that underpin the fossil-fuel based economy.

DIFFICULT POLICY CHOICES

Energy-related issues often invoke emotional discussion and debates with little room for compromise, not only because countries do not often see their interests aligned, but also because policies tend to have unanticipated consequences. All involve trade-offs; all generate winners and losers; and, more importantly, the 'potential losers' of the energy-related structural change tend to be concentrated and immediate while the benefits are long-term and widespread. These confirm that decision-making on energy policy is messy and contingent. Therefore, in reconfiguring the current energy system, the political aspects of the transition cannot remain undeveloped conceptually and in practice.

Wind power, for example, may be clean in generating electricity. However, it occupies land, distorts scenery, and, more importantly, requires long-distance infrastructure to 'wire' electricity to where end-users are. Solar has similar trade-offs and many countries simply do not have the option. Biofuel may help address the issue of energy security and climate change; but it is blamed for rising food prices that threaten the lives of millions in poor countries. Nuclear may be free in green-house gas emissions; but its potential accidents have very long-term consequences. As carbon tax can encourage investment in renewable energy, it disrupts the 'normal' operation of traditional energy sectors. Some argue that, with the economic slowdown in developed countries, their governments should seize the opportunity of the 'green growth' which would create jobs, strengthen the national security, protect our planet, boost manufacturing and export-intensive industries and encourage innovation. Denmark is often used as an example not only because the wind capacity accounts to about 25 per cent of the country's electricity supply, but also because it is the largest exporter of wind technology and equipment. Their opposition argues with equal vehemence: 'green' would only replace, rather than add, jobs in other sectors; contribute less to economic growth than the status quo because of the costs for change; lead to higher energy prices and consequently higher costs of living; and create corruption as the government intervenes in the transition to the 'green economy'.

Hence, how to switch from carbon to other sources of energy while allowing economic and social development is a serious challenge to every government, citizen, business firm, and organisation. It is also important to note the market differentials between countries—some governments directly run their energy systems while others' are more liberalized. In both, however, while the governments' role in developing a complex mix of policy goals and tools and settings is still important, the energy transition requires us to acknowledge the possibilities of social learning through civic engagement in mediating conflicts, be they potential or actual. Clearly, institutional and political factors are relevant as they set the conditions for behavioural change for sustainability. Moving forward, policy choice or decision on energy is best tackled using new modes of governance which is deliberative, reflexive and informed by science.

GREEN ECONOMY AND ENERGY POLICY

The triple-F crises (fuel, food and finance) which struck the globe from 2006 to 2009 exposed the weaknesses of capitalist economies.[1] In responding to the crises and the ensuing global recession, some G20 countries had balanced their need to boost aggregate demand and growth with targeted expansionary policies incorporating green fiscal stimulus packages amounting to (approximately) $522 billion (Barbier 2011). Fundamentally, such a response follows the Keynesian logic of pumping money into the economy during a recession. This economic policy strategy is widely known as the Global Green New Deal (Barbier 2010), which aims to develop a win-win strategy for the economy and the environment, through finding economic opportunities in the response to climate change and the need for energy security.

As a result, a policy window emerged internationally between 2007 and 2009 involving international organizations and governments. The Organisation for Economic Co-operation and Development (OECD) promotes green growth, acknowledging that 'green and growth can go hand in hand' by 'fostering economic growth and development, while ensuring that natural assets continue

[1] This section draws heavily from Hezri and Ghazali (2011).

to provide the resources and environmental services on which our well-being relies' (OECD 2011:1,7). The OECD Green Growth Strategy provides an actionable framework to foster the necessary conditions for innovation, investment and competition that can give rise to new sources of economic growth. In a series of policy documents, the OECD outlined a central role market instruments should play in ensuring the diffusion of clean technologies and other environmental goods and services internationally (OECD 2009, 2010, 2011). This involves getting the price right, encouraging investments in green technologies, eliminating fossil fuel subsidies and introducing corrective taxation. The OECD approach to green growth has a social dimension to it. A greener growth is expected to address the social issue of high unemployment in OECD countries as a result of the 2008-2009 economic recessions.

Another important green economy formulation is spearheaded by the United Nations Environment Programme (UNEP). Its Green Economy Initiative (launched in October 2008) not only aimed at seizing the economic opportunities that this contemporary concept of a green economy has to offer, but also broadened the green problem framing to encompass social issues. The UNEP report Towards a Green Economy (UNEP 2011:2) presents a working definition of a green economy 'as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities'. For UNEP, a green economy is 'one which is low carbon, resource efficient and socially inclusive'. The report puts forth a macroeconomic case—output and job—for investing in sectors that produce environmentally enhancing products and services, while also guiding ways to boost pro-poor investments. However, not unlike the OECD policy prescription, UNEP also accords a strong emphasis on getting the market and prices right in creating the enabling conditions for a green economy (Bina and La Camera 2011). Economic growth that lowers quality of life or damages the biosphere will not lead to a greener economy. Highlighting a positive environment-economy nexus, UNEP economist Fulai Sheng (2010) argues that green growth does not refer to the standard definition of output growth. Rather, it embraces the broader notion of economic progress by emphasizing qualitative growth.

Energy policy is central to the debate on green economy. The fossil fuel price hike in 2008, coupled with the growing anthropogenic evidence of climate change, had rekindled strategic interest in developing renewable energy sources and energy efficient technologies. The process of developing a new energy system, built around a greatly expanded use of renewable energies, has the potential to create new relations, productions, exchange and livelihood. Differently put, greening the economy is clearly required to reverse the threat from global environmental deterioration. In other words, a sustainable economy needs social and economic revolution where greening is the focus, in the same way that Fordism was the basis for the first Industrial Revolution (Milani 2000).

The promotion of clean energy technologies and energy efficiency is frequently viewed by international policymakers as a complementary goal with green economy (Barbier 2011). The monetary reward in this transition is indisputable. HSBC Global Research forecasts that the global market for clean energy and energy efficiency investment opportunities will triple to US$2.2 trillion by 2020 (Robins et al. 2010). However, innovation and adoption of clean, renewable technology in different parts of the world is inter alia dependent on country-specific institutional arrangements and the market's competitive advantage (Green 2009). This is true for both first movers and late comers. Even countries that industrialize later in time may leap-frog over more advanced countries by using technologies that are newer and cleaner than those found in countries that industrialized previously. Therefore, investments (both public and private) in innovation, technology, infrastructure and institutions are necessary so that economies shift their course. For the energy sector and beyond, strategic long-term planning is essential to coordinate actions by many different actors in redesigning of markets by stimulating demand for clean, renewable energy.

A BRIEF OVERVIEW

The purpose of the book is to draw similarity and contrast between country-level policies in transitioning to sustainable energy systems. In thirteen chapters, the book documents the vagaries of problem framing and policy responses by nine countries, all of which are guided by recurrent themes of energy transition, policy choices and green economy. Chapters 3 to 4 demonstrate the struggles of major energy consumers such as United States, China, India and Brazil in switching to cleaner energy sources. The total primary energy supply for the United States was 95.18 quadrillion btu in 1998 and rose to 99.88 quadrillion btu in 2007. China recorded a staggering increase in consumption, from 37.04 quadrillion btu in 1997 to 77.81 quadrillion btu in 2007 (EIA 2009). India and Brazil also registered similar increases in total primary energy supply although comparatively much lower than China and the United States. Chapters 7 and 8 concentrate on the cases of Malaysia and Laos. These two Southeast Asian countries are currently at different stages of economic development but share the common trait of a rising energy demand and associated social issues. The last four chapters (9-12) of the book present innovative energy policies by pioneering states such as France, Germany and Australia.

The book's analytical scope goes well beyond the commonly addressed structural issue in energy policy to encompass innovation in processes, institutions and new policy instruments for sustainable energy systems. As evident in the forthcoming chapters, there are no one-size-fits-all energy policy. The subtitle of the book—in search of sustainable energy policies for the future—reflects the tentative nature of policy experiments undertaken so far.

In Chapter 2, **Xu Yi-chong** sets the scene for the country-level analysis by problematizing the 'trilemma' of energy, development, and climate change. Through cases of Southeast Asia, she points to the centrality and 'messiness' of political choice in energy policy decision-making. Balancing the preference for energy security is also difficult since what is economically feasible is not necessarily environmentally sound. A number of Asian countries experience technological 'lock-in' on coal, a problem also faced by other countries outside the region. The chapter emphasizes developing countries' rights to development space. Unless this is recognized, a true global dialogue to foster the energy transition remains uncertain.

Meredith Crafton and **Benjamin Sovacool** (in Chapter 3) provide an overview of the current status of renewable energy in the United States. The authors assess the potential of renewables such as biomass, geothermal, hydroelectric, ocean, solar and wind to meet US energy demand needs. The most significant policy mechanisms in the United States include Renewable Portfolio Standards, net metering and tax credits (production and investment). Despite the United States' reputation as international leaders in many technologies, private and public funding on renewable energy research has been on a steady decline since the 1970s. Recent years however recorded a reversal of this. Moving forward, the country is now improving its energy efficiency measures and adopting the feed-in-tariff mechanism.

In Chapter 4, **Qin Tianbao** and **Pi Liyang** explain China's energy challenges by focusing on the nuclear energy and other renewable source, given its status as a major GHG emitter. Although its policy choice regarding nuclear remains unchanged, China has strengthened its nuclear safety measures following the Fukushima nuclear meltdown, demonstrating a form of policy learning. As a matter of policy choice, the reasons why China insists on developing nuclear energy in comparison with fossil fuels and renewable energy are explored in detail. The authors also explain how China handles the relationship between nuclear energy development and nuclear safety from the perspectives of technology, policy and legal system. The chapter concludes with a reiteration of China's attitude towards nuclear energy development and provides the proposal for improvement.

Harsha Meenawat and **Nidhi Srivastava** detail India's planning and decision-making for its energy sector in Chapter 5. The authors describe the evolution of energy policy in the country and provide a detailed discussion on renewable energy policy. Energy governance in India reached a new height when the Ministry of New and Renewable Energy was established in 1992. Such an institutional response is one of its kind even by international standards. In addition, the energy sector is singled out as one of the main drivers of India's green economy vision. The chapter also describes the formation of institutions that are taking forward renewable energy in the country and the various options under implementation. In response to the energy challenges, India focuses its policy to ensure energy accessibility for all, as well securing options for the grid and enhancing demand management.

Brazil is widely known as a leader in biofuels. In Chapter 6, **Arnaldo Walter** and **Camila Ortolan Fernandes de Oliveira** analyse the role of the Brazilian federal government in setting policies, giving financial support and assuring coordination among the economic agents involved in the biofuel industry in Brazil. An overview about the production and consumption of biofuels in Brazil provides the context for understanding the evolution of biofuels policy since 1970s. Apart from the familiar Brazilian Alcohol Program (PROALCOOL) the authors describe some forward-looking policies such those aiming to control land use, reduce sugarcane burning and enhance science and technology policies. One of the main conclusions is that planning mistakes and uncoordinated action can cause negative impacts both on the supply and demand of biofuels, even in a country with a successful ethanol and biodiesel industry such as in Brazil.

In Chapter 7, **Endang Jati Mat Sahid**, **Adnan A. Hezri**, **Shahnaz Sharifuddin**, and **Leong Yow Peng** analyse the extent of energy consumption in Malaysia and the scenario in the forthcoming decades. By projecting Malaysia's recent energy demand trend up to year 2030, the authors point out that the big domestic demand and a depleting energy resource base constitute the country's major energy security challenges. The key implication of the rising energy demand on Malaysia's public policy is increasing dependence on energy imports and the near prospect for it to become a net energy importer. To truly move to a green economy, Malaysia needs a range of deeper policy options such as demand management and subsidy rationalization or even to consider alternative energy sources such as nuclear power.

Mattijs Smits elaborates on hydropower and the meaning of a green economy in Laos (Chapter 8). The chapter shows the disconnection between domestic access to electricity and hydropower development. Almost three-quarter of all current and future electricity generated in Laos is and will be exported to neighbouring countries such as Thailand, Vietnam and Cambodia. The government of Laos has to deal with a difficult policy choice to balance the at times conflicting three main goals for the energy sector: access to electricity, increasing revenues from private sector power production, and developing a regional electricity grid. By considering the benefits, costs and equity issues of hydropower in Laos, the author contends that the current practice is likely to increase inequality and 'greenwashing'. A true green economy for the future is possible by improving current hydropower practices and searching for renewable energy solutions which are more appropriate in the Lao context.

France is often touted as an exemplary case of energy transition from fossil fuels to nuclear power. In Chapter 9 **Marie-Helene Schwoob** describes the French energy policy innovations, challenges and the major stakes in moving towards a green economy. Unlike other major world economies, a notable feature of France is its stabilized total energy consumption. Nonetheless the challenge of heavy dependency on oil and gas imports remains, particularly for the transport sector. French energy policy innovations include commitment to the European Union's target of 20 per cent energy efficiency and the formulation of POPE Law aiming to reduce CO_2 emissions by 75 per cent for the year 2050. In 2007, a major institutional reform was also undertaken to enhance policy integration across sectors. The hitherto separate portfolios were combined into a supra-ministry called the Ministry of Ecology, Energy, Sustainable Development and Town and Country Planning. Future challenges include making policy choices over how to deal with the European smarter grid, tariff regulation issues and addressing post-Fukushima nuclear debates.

The greening of the German economy is the product of several decades of targeted policy design and implementation. The feed-in-tariff mechanism for instance was started in the 1990s with Renewable Energies Law passed in 2000. In Chapter 10 **Hartmut Grewe** distils recent developments in German energy policy with emphasis on renewable sources. The ambitious 2010 Energy Strategy sets national guidelines for energy transition by outlining the main strategic targets of Germany's energy and climate policy for the long term until 2050. For 2020 the national target for renewable energy's market share has been set with a minimum of 35 pre cent. Post-Fukushima, in 2011, Germany adopted decisions on accelerating the nuclear exit, encouraging greater energy efficiency and switching to renewable energies. These initiatives are expected to usher Germany into a new era of sustainable energy supply and demand.

Australia's steady growth in fossil fuel consumption has led to increased greenhouse gas emissions. In Chapter 11, **Hugh Saddler** explicates Australia's array of policies and programs intended to reduce GHGs emissions from the energy system and to restructure its energy industry. This includes the innovative use of a direct price on emissions called carbon trading. In November 2011 the Australian Parliament passed a legislation called the Clean Energy Future package, which will have the effect of imposing a price on GHGs emissions from most energy combustion activities, fugitive energy, industrial processes and waste. However, the author opines that the targeted reductions in energy related emissions amount to little more than marginal adjustments for Australia's energy system to make deep emissions cut to avoid dangerous climate change. Improved policy integration across sectors such as transportation is therefore necessary to enable a credible energy transition to happen.

Chapter 12 by **Joachim Elsaessser** diverges from the other chapters by highlighting a sub-national initiative in greening the economy. The State of Baden-Wuerttemberg (B-W), one of the most innovative regions of the European Union, is Germany's pioneer in the establishment of the first regional environmental technology cluster in the country. The B-W government develops environmental policy B-W Sustainability Strategy by fostering the trilateral dialog between government, economy and civil society. The Industry Association for German Federal State of Baden-Wuerttemberg (LVI) plays a significant importance in this strategy by managing the Environmental

Technology Cluster of B-W called "PU" which is a voluntary union of more than 130 individual companies, R&D institutions, universities and service providers dealing with environment-related products and services. Such a coalition building is a prerequisite in moving towards a green economy.

The book ends with Chapter 13, in which **Wan Portia Hamzah** outlines six main ingredients to achieve a reliable, affordable and efficiently clean energy system in sync with the green economy goal.

References

Barbier, E.B. 2011. The policy challenges for green economy and sustainable economic development. *Natural Resources Forum*, Vol. 35, pp. 233–245.

Barbier, E.B. 2010. A Global Green New Deal: Rethinking the Economic Recovery. Cambridge University Press, New York.

Bentley, R.W. 2002. Global oil and gas depletion: an overview. *Energy Policy*. Vol.30 (3): 189-205.

Bina, O. and F. La Camera. 2011. "Promise and shortcomings of a green turn in recent policy responses to the 'double crisis'." *Ecological Economics*, Vol.70, pp. 2308–2316.

Crowley, T.J. 2000. Causes of climate change over the past 1000 years. *Science*. Vol.289 (5477): 270-277.

EIA. 2009. EIA Annual Energy Review 2009. Energy Information Administration, New York.

Green, J. 2009. "The elusive green economy." *The Atlantic*. July/August. www.theatlantic.com/magazine/archive/2009/07/the-elusive-green-economy/7554, accessed on 3 October 2011.

IPCC, 2007: Climate Change 2007: *The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Hezri, A.A. and R. Ghazali. 2011. A Fair Green Economy? Studies of Agriculture, Energy and Waste Initiatives in Malaysia. Paper Two: UNRISD Occasional Papers on Green Economy and Sustainable Development. Geneva.

Kern, F. and A. Smith. 2008. Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. Energy Policy, Vol. 36: 4093– 4103.

Meadowcroft, J. 2009. What about the politics? Sustainable development, transition management, and long term energy transitions. Policy Sciences, Vol. 42: 323–340.

Milani, B. 2000. *Designing the Green Economy: The Postindustrial Alternative to Corporate Globalization*. Rowman and Littlefield, Lanham, Maryland.

Murphy, D.J. and C.A.S. Hall. 2011. Adjusting the economy to the new energy realities of the second half of the age of oil. *Ecological Modelling*. Vol 223(1): 67-71.

OECD (Organisation for Economic Co-operation and Development). 2011. *Towards Green Growth: A Summary for Policy Makers*. OECD, Paris.

OECD. 2010. *Interim Report of the Green Growth Strategy: Implementing Our Commitment for a Sustainable Future*. C/MIN(2010)5, 10 May OECD, Paris.

OECD. 2009. *Declaration on Green Growth*. Adopted at the Council Meeting at Ministerial Level on 24 June, C/MIN(2009)5/ADD1/FINAL. OECD, Paris.

Robins, N., Singh, S., Clover, R., Knight, Z., Magness, J., 2010. *Sizing the Climate Economy*. September 2010. HSBC Global Research, New York.

Sheng, F., 2010. *A Green Economy: Conceptual Issues*; United Nations Environment Programme. http://www.unep.org/civil-society/Portals/59/ Documents/GMGSF12-GEConceptual- Issues.pdf, accessed on 13 December 2011.

Solomon, B.D. and K. Krishna. 2011. The coming sustainable energy transition: History, strategies, and outlook. Energy Policy 39: 7422–7431.

UNEP (United Nations Environment Programme). 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, A Synthesis for Policy Makers*. www.unep.org/greeneconomy, accessed on 27 September 2011.

United Nations. 2011. World Economic and Social Survey 2011: The Great Green Technological Transformation. United Nations Department of Economic and Social Affairs, New York.

Chapter 2

Making Choices: Powering the Dream or Endangering the World

Xu Yi-chong

ABSTRACT

No country has ever developed without increasing its energy consumption; and no rising energy consumption has ever taken place without contributing to climate change. The other side of the same coin is that without "sustainable" energy production and consumption, there will never be long-term social and economic development. The inseparable relationship of energy, development and climate change poses one of the greatest challenges in modern world – how to develop policies aiming to achieve one objective without undermining the objectives of others. This "trilemma" also means that there is no perfect solution to any part of this interlocking challenge; therefore, there are no perfect policies for a country, individuals, or any particular group of people, all of whom pursue their distinct interests and consequently every choice will create winners and losers.

BACKGROUND

Securing energy supplies and curbing energy's contribution to climate change are the twin over-riding challenges for all countries. Developing countries face an additional challenge – providing their citizens with affordable and reliable access to modern energy, without which social and economic development cannot take place. Each challenge requires carefully designed policies that will not make other challenges worse. For example, an expansion of access to modern energy for the world's poor cannot be achieved without securing access to energy supplies and this has to be balanced by significant decarbonisation of the global energy system. It is therefore the greatest challenge of all – how to develop policies aiming to achieve one objective without undermining the objectives of others. Such win-win policies seem more in theory than in reality, and require governments to make hard choices. Given that energy is at the heart of the quality of life and drives economic prosperity too, those who have it are reluctant to reduce its consumption and those without it struggle to gain an access to it. This makes sustainable energy development extremely difficult. Yet, we need to remember what Churchill once said: "A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty".

The difficulty lies on the inseparable nature of energy and security, energy and development, and energy and climate change. No country has ever developed without increasing its energy consumption; and no rising energy consumption has ever taken place without contributing more greenhouse gas (GHG) emissions. The other side of the same coin is that without "sustainable" energy production and consumption, there will never be long-term social and economic development. It is this interlocking relationship of energy, development and climate change that presents the most difficult challenges to developing effective policies, based on which, many have argued, sustainable development has to take place. The challenges, known as "trilemma", also show that there is no perfect solution to any part of this interlocking problem and therefore there are no perfect policies for a country, individuals, or any particular group of people because every choice will create winners and losers. To complicate the difficult decision making is that their seemingly contradictory objectives are tied to political and economic interests. Well-organised groups usually have much more influence in policymaking but do not always pursue the agenda that can protect and promote the interests of the majority. Concentrated interests of energy companies, for example, usually have more weight in decision making process than dispersed interests of citizens as consumers or as beneficiaries of a clean environment.

Energy has two parallel stories – transport and electricity. This paper focuses its discussion on making choices around "electricity", which powers industrialisation and lights urbanisation – neither could take place without electricity. Electricity is also the most efficient way of using primary sources of energy – coal, oil, natural gas, uranium, solar, wind and many other forms of primary energy. In February 2000, Neil Armstrong, the first person to land on the moon, announced, on behalf of the American Academies of Engineering, the top 20 achievements of the 20th century that had the greatest impact on quality of life. At the top of the list is electrification – electrification changed economic development and gave the rural population the same opportunities and amenities as people in the cities. It provides the power for small appliances in the home, for computers in control rooms that route power and telecommunications, and for the machinery that produces capital goods and consumer products. "If anything shines as an example of how engineering has change the world during the 20th century, it is clearly the power that we use in our home and businesses".

ENERGY AND DEVELOPMENT

While people in developed countries take electricity for granted and seldom pay any attention to it, about 1.3 billion people (about 20% of the world population) still do not have access to electricity. Among ASEAN countries, over 160 million people have no access to electricity (Table 2.1).

Table 2.1: ASEAN Electricity Access by Country, 2008

	Population (million)	Electrification rate (%)	Rural Pop. Without elec. (million)	Urban Pop. Without elec. (million)
Brunei	0.4	100	0.0	0.0
Cambodia	14.7	24	10.1	1.1
Indonesia	228.3	65	74.0	7.1
Laos	6.0	55	2.4	0.3
Malaysia	27.0	99	0.2	0.0
Myanmar	49.2	13	29.8	13.0
Philippines	89.5	86	10.8	1.7
Singapore	4.7	100	0.0	0.0
Thailand	64.2	99	0.4	0.0
Vietnam	86.1	89	9.4	0.1
TOTAL	570.2	72	137.1	23.3

Source: International Energy Agency, *World Energy Outlook 2009*, Paris: OECD, p.561.

Electricity consumption per capita varies significantly across countries in the region too. In Singapore it is three times the world average while it is only 3.6% in Myanmar and 4.5% in Cambodia of the world average (Table 2.2).

Table 2.2: Electricity Consumption per Capita in ASEAN Countries, 2009

Country	Electricity consumption per capita (kwh)	% of world average	Country	Electricity consumption per capita (kwh)	% of world average
Brunei	8485	311	Cambodia	123	4.5
Indonesia	609	22.3	Laos	360	13.2
Malaysia	3677	135	Myanmar	99	3.6
Philippines	592	21.7	Singapore	7948	291
Thailand	2073	75.9	Viet Nam	904	33.1

Source: International Energy Agency, *2011 Key World Energy Statistics*, Paris: OECD.

In 2009, Thailand consumed the same amount of electricity as Indonesia, which has more than three times the population of Thailand. Since 2005, 27 million people in the region have gained access to electricity. This success can hardly hide the fact that over 137 million people in the region in 2008 were still without access to electricity. The electrification rate was as low as 13% in Myanmar and 24% in Cambodia. Even in relatively developed Indonesia, 74 million (35% of the total population) do not have access to electricity.

Energy is at the core of economic development. Most ASEAN countries have experienced a profound transformation which has led to much faster economic growth than in many regions and at least their past. This economic development has been supported by increases in energy consumption. Furthermore, energy consumption by urban citizens is at least four times that of rural residents. Urbanisation will drive up energy demand and as incomes rise, demand for modern energy surges. All recent socioeconomic development studies project major increases in energy demand, driven by demographic and economic growth in developing countries. It is estimated that the total final energy consumption among ASEAN countries will nearly triple from 343 million tonnes of oil equivalent (mtoe) in 2005 to 901 mtoe in 2030 and primary energy consumption per capita will double.

Buoyant economic growth in the past three decades in Asia has fuelled an insatiable thirst for energy and rising energy demands are driven by industrialisation, urbanisation and prosperity, all of which are part of a broader process of development that has lifted millions out of absolute poverty. "Globally, growth in electricity demand is highly correlated to GDP growth, with a coefficiency of close to one (i.e. every 1% increase in GDP is accompanied by a 1% increase in electricity demand)" (IEA 2011, 360). Because of this tie, developing countries that want to grow will have to ensure that their electricity demand is met. It is estimated that installed generation capacity among ASEAN countries would have to triple, from 138GW in 2007 to 390GW in 2030, some of which would replace existing capacity that is retired (IEA 2009, 557). This process will continue until the mid-21st century.

As demand for electricity in the whole region is rising rapidly under the pressure of population growth, industrialisation and urbanisation, providing electricity to people and economy is increasingly controversial and poses great challenges because of the concerns of energy security and climate change. Today, for example, developing countries face US$100 a barrel of oil in comparison with developed countries at the compatible development stage which paid $22 per barrel. World coal price quadrupled between 2005 and 2010. All fossil fuel resources are limited in reserves; they are allocated unevenly geographically; they are depleting fast, and their prices often fluctuate. More importantly, consumption of fossil fuels is the main contributor to CO_2 emissions. Generation of electricity and heat is by far the largest producer of CO_2 emissions and was responsible for 41% of world CO_2 emissions in 2009. In 1995-2010, total CO_2 emissions among ASEAN countries doubled from less than 0.5 giga-tonnes to a little over 1 Gt. In short, developing countries, ASEAN included, cannot provide their citizens with adequate and reliable supplies of modern energy the way developed countries did in the process of their industrialisation in the 19th century and first half of the 20th century. Nor can they stop the process of industrialisation and urbanisation. Economic growth, poverty eradication and climate protection have to be considered in a holistic and integrated manner.

While few OECD countries, which together consume half of the world's electricity, want to give up their way of life, those without modern energy desire to have it. We all face mountains of challenges. For Asian countries, especially developing ones, the stake is high, not only because the poor tend to be more vulnerable to climate change threats but also because their development depends on an adequate supply of modern energy. As each individual country faces the challenges of balancing “four competing objectives – sustain economic growth, increase energy access for the world’s poor, enhance energy security, and improve the environment – tall orders” (World Bank 2010b, 191), there is no easy way of achieving them. Instead, governments, industries and citizens have to make a series of difficult choices – choices over sources of energy, types of technology to convert energy, and prices for different type of energy we consume. Making choices affects interests and often involves balancing one set of interests against another. Who is in charge of making choices, how choices are made and whose interests are taken into consideration are at the core of politics.

CHOICES OF SOURCES OF ENERGY

Primary energy comes from coal, petroleum, natural gas, natural uranium, solar, wind, falling or flowing water, biomass (wood, agricultural residues or animal dung), and geothermal. Addressing climate change will require a transformation in how we source for energy. In 2010, 35% of world commercial primary energy use came from oil, 23% from natural gas, 26% from coal, 6% from nuclear and 10% from various renewable sources. For those who do not have access to electricity, non-commercial energy sources meet nearly all their energy consumption. Consuming traditional forms of energy, such as woods, crop residues, and animal dung, is labour intensive and has serious adverse consequences for health, economic development and environment. Even burning coal directly for cooking or heating is bad for health and environment and very inefficient in consuming energy. Converting them into modern energy – electricity and heat – is a necessary component for development and modernisation in these countries.

Coal powered industrialisation and urbanisation in the western world in the 18th, 19th and first half of the 20th century. It remains the backbone of global electricity generation, alone accounting for over 40% of electricity output in 2010 (IEA 2011, 354). Many developed countries still heavily depend on coal for their electricity generation. In Australia, for example, coal (both black and brown) accounts for over 83% of electricity generation. Many have argued that they did not and still do not have a choice to do things differently. Indeed, the share of coal in generating electricity in the world has increased despite its negative impacts on climate change because (a) countries may not have other energy resources available; (b) it is relatively fast and cheap to build coal-fired power plants rather than use other technologies; (c) it is too costly to replace the existing coal-fired power plants before they reach their retirement age;

and/or (d) coal industry often provides employment in concentrated areas and political pressures therefore are high on governments to keep supporting it.

From an energy security point of view, coal resources are abundant and widespread and they are also cheap. Solar power is the most abundant energy source on earth, but it is so costly that few developed countries are developing it. The cost of one kilowatt-hour (kwh) of electricity ranges from 15-225 cents for solar PV, 7-17 cents for offshore wind, 4-16 cents for onshore wind, 5-28 cents for hydro, 12-16 cents for oil, 3-12 cents for natural gas, 2-11 cents for coal and 4-12 cents for nuclear (IAEA 2009, 22). The wide ranges are due partly to different techno-economic assumptions behind the calculation, but more importantly, due to the local economic, social, and energy conditions. Coal is cheap; coal-fired thermal power plants are quick to build and technologies are mature and widely available. This includes supercritical power plants. Yet, coal is a carbon-intensive fuel and adverse environmental consequences of burning coal have long been recognised. That is the reason initially it was thought that coal would not be much of an option for most ASEAN countries, except Indonesia. The first decade of the 21st century wiped out this “dream” – in just a decade, the share of electricity production by coal-fire thermal power plants rose from 10% in 2000 to 30% in 2010 in Malaysia; in Indonesia, 45% of the electricity comes from coal-fired thermal plants in 2010 and it is expected to rise to 66% by 2016; in the Philippines and Vietnam, more than half of the new generation capacity is coal-fired ones; and the coal deposits in Myanmar, Cambodia and Laos will be utilised for their electricity expansion to supplement their hydro capacities and to meet their urgent rising base-load demands on electricity. The International Energy Agency (IEA), consequently, predicted that the share of coal in electricity generation among the 10 ASEAN countries would increase from 27% to 50% between 2007 and 2030.

Rising coal consumption raises at least two serious concerns – coal depletion and CO_2 emissions. With nearly 10% of the world population, Southeast Asia has only slightly over 1% of the world total coal reserves in total. The reserve-production ratios in the three countries in the region that have the largest share of coal reserves, Indonesia, Vietnam and Thailand, stand at 26 years, 76 years and 103 years respectively by current production standards. Given that Indonesia supplies much of the coal import demand for its neighbouring countries where coal consumptions are expected to rise, a sense of urgency in diversifying energy sources is spreading.

In principle, coal can be replaced by other fuels for generating electricity. Natural gas is among the better options because it is relatively cheap and quick to construct natural gas-fired power generation plants which can be used for both base-load and peak hour supplies; and it is clean with low CO_2 emissions. ASEAN is richer in natural gas reserves than in coal and the region’s proven reserves of natural gas is about 3.7% of the world’s total. The bulk of gas reserves are in Indonesia, Malaysia and Brunei. This has not calmed a sense of concern of fast depletion of natural gas in the region.

Take Malaysia for an example: 55% of the country's electricity was generated by gas-fired generation plants, a much larger share than the world average of 15%. This share is expected to reduce to 47% in 2015, 39% in 2018, followed by a rapid shrinking to 9% by 2020 and 4% by 2025. The current large share of gas generation capacity was the product of the four-fuel diversity policy adopted by the Malaysian government in 1981 – oil, hydro, natural gas and oil. The government then added nuclear energy as part of the energy diversification strategy in 2008 to "ensure adequate, secure and cost-effective supply of energy and to ensure factors pertaining to environmental protection are not neglected in production and utilisation of energy". The rationale behind it is that (a) Malaysia will become a net oil importer by 2014; (b) its gas fields will be depleted by 2027; (c) hydro can only supply in limited geographical areas; (d) renewables tend to be small, decentralised, less economic and difficult to meet large base-load demands; and (e) imported coal as a fuel for electricity generation will rise, but with adverse impacts on climate change.

According to the Malaysian government, nuclear is an option the country cannot avoid. Since it takes 10-15 years for countries to move from the decision-making stage to nuclear reality, Malaysia needed to start now to avoid a major interruption of electricity supplies. In other words, "we do not have other choice by engaging in a nuclear energy program". People outside Malaysia may not agree that this is the decision the country should adopt. We nonetheless have to understand the world as it is rather than what we wish it should be.

Indonesia, in comparison with other countries in the region, is rich in energy resources and has a variety of them. About 42% of its electricity is generated by coal-fired power plants; 22.8% by oil, 22.1% by natural gas, and 7.3% from hydro stations. While Indonesia may have the energy diversity, it faces the challenges of meeting the rising demand. Currently, over 80 million people in Indonesia still do not have access to electricity and electricity consumption per capita in Indonesia is less than 25% of the world's average and 7.6% of OECD average. The struggle to provide modern energy to its citizens and to protect the environment has forced the government to make choices among different sources of energy and different technologies too. With many islands, large scale supercritical coal-fired generation units may be suitable for some regions, but not many small islands where small hydro, geothermal or renewable projects may be more appropriate, yet with high costs involved. A balance of resources, demands and supplies, and urban and rural population has to be made. The government did exactly this. For example, in the early 2000s, the government in Indonesia did propose to start a nuclear energy program and a nuclear regulatory agency was put in place in preparation for nuclear development. In 2009, the government cancelled plans to build four nuclear power plants by 2025. The decision was made not only because of the current climate of tight credit but, more importantly, because of growing public opposition inside and outside the country. Diversifying energy sources is never easy.

Hydro power is another option, especially for the Southeast Asian region where there is plenty of sources. Building hydro stations is controversial for their large foot-print, human relocation, and impacts on fishery and agriculture. It is particularly controversial when rivers run across countries. Meanwhile, several large hydro projects elsewhere in the world are not as controversial as others, such as the Churchill Fall and La Grande in Canada and Hoover Dam and Dalles Dam in the US. Small hydro projects are considered as renewable projects now, but only 20 years ago, they were condemned for being inefficient in utilising resources and for local environmental problems. There are plenty of mini- and micro-hydro potentials in Indonesia, Malaysia, Cambodia, and the Philippines. Mini-hydro development is challenging because where hydro resources are is not necessarily where financial resources are available. External support is often needed.

The three countries that have the lowest access rates among ASEAN countries, Cambodia (24%), Laos (55%) and Myanmar (13%), all have rich hydro resources. According to a reported commissioned by the World Bank, they are all going to expand their installed hydro capacity significantly (Table 2.3).

Table 2.3: Current and Planned Installed Hydro Capacity, 2007 and 2020

MW	Cambodia	Laos	Myanmar
2007	13	673	803
2020	1,955	7,747	11,539

Source: Economic Consulting Associates Limited, 'The Potential of Regional Power Sector Integration: Greater Mekong Subregion Transmission & Trading Case Study', January 2010, Annex. At http://www.esmap.org/esmap/sites/esmap.org/files/BN004-10_REISP-CD_Greater%20Mekong%20Subregion-Transmission%20%26%20Trading.pdf.

The planned expansion of hydro projects has been motivated not only by the desire to expand access to electricity but to export electricity for national economic development. The Nam Theun 2 (NT 2) hydro project in Laos might be controversial to many environmentalists who are arguing that the project would change the whole eco-system in the Mekong region. It was welcomed and supported by the government in Laos, which argued that as a land-locked country, Laos did not have other options but to use its hydro resources for national development and indeed, the World Bank considered the export revenue from NT2 as a success for a low-income developing country like Laos. The planned hydro export projects in the region, however, have raised local and international concerns too. Moreover, it remains to be seen how financial constraints on government budgets for launching such large projects can be dealt with.

Renewable energy is preferred by all countries; yet, their development has been limited to only supplementing the fossil fuels rather than replacing them. Renewable energy accounted for about 27% of ASEAN total primary energy demand in 2007. In addition to traditional biomass use for household cooking and rural electrification, modern applications of renewable energy are developing quickly in Southeast Asia. In the Philippines, for example, geothermal energy already provides 27% of the total electricity production in the country. There it is cheaper to produce electricity by geothermal plants than those fuelled by gas or coal, and even hydro. Currently, Indonesia, Malaysia, Philippines, Thailand and Vietnam all have set targets for renewable energy development (Table 2.4):

Table 2.4: Renewable energy targets in ASEAN 5

Country	Renewable energy (RE) target
Indonesia	5% geothermal (2025) 5% biomass, hydro, solar and wind energy (2025) 5% biofuels (2025)
Malaysia	350MW grid-connected RE power (2010)
Philippines	100% increase RE capacity from 2005 level in 2015
Thailand	15.5% RE in 2011 19.1% RE in 2016 20.3% RE in 2022
Vietnam	3% RE in 2010 5% RE in 2020 11% RE in 2050

Source: *Deploying Renewables in Southeast Asia: Trends and Potentials*, Paris: OECD, 2010, p. 49.

It is important to note that the richest country in the region, Singapore, does not have any plan for renewable energy development due to "its small land area with a relatively low natural endowment of renewable". For other countries, it remains to be seen how renewables can be expanded as it remains much more costly to construct large-scale renewable projects, whether wind or solar. Denmark is often used as an example for "teaching" developing countries. Denmark is seen as a world leader in wind power, which contributes 18.5% of its electricity production. Its recently elected central-left government promises to phase out coal use by 2030 and completely phase out all fossil fuels by 2050. Coal currently accounts for 48.5% of its electricity production, oil 3.2% and natural gas 18.5% – an admirable ambition. The other side of the story is: the current electricity price in Denmark is 70% higher than the European Union average. GDP per capita (in current US$) in Denmark is $55,988 in 2010, in comparison with the world average $9216, Indonesia's $2945, and Cambodia's $802. Questions that emerge from these data are quite apparent – how can developing countries afford to give their citizens some access to modern energy by pursuing the policies promoted by Denmark; is it an option for countries like Indonesia with a population of 240 million (over 36% of them still do not have access to electricity) to do what Denmark did with a population of 5.5 million? And is there a moral ground for people to argue that countries with an average CO_2 emission per capita of 1.4 tonnes (as in Indonesia or 0.34 tonnes in Cambodia) should not have the development that countries like Denmark have had where the average CO_2 emission per capita (9.15 tonnes) is nine or ten times that of developing countries?

There are many renewable projects in Asian countries and these are often innovative projects. Yet, for now, the renewable capacity is limited. The potential for expanding renewable energy depends on the resources' availability and affordability. This is the conclusion drawn by the IEA and World Bank – "there is no technology that has a clear overall advantage globally or even regionally." Countries have to make choices based on the national political, economic and social development priorities.

Even though there are no existing nuclear power plants among ASEAN countries, several of them have developed serious plans to construct their first nuclear power plants in the next decade or so, Malaysia and Vietnam in particular. In 2006, the government in Vietnam announced that it would have two 1000MW nuclear reactors in operation by 2020. This was followed by the siting, feasibility studies and negotiations with international vendors. According to the World Nuclear Association, the first two reactors will start construction in 2015, with one from Russia and one from Japan. After a long planning phase, the government of Malaysia adopted a national nuclear policy in July 2010, which set the target of the first nuclear power plant in operation by 2021. Even the Singapore government has made it known that it has nuclear energy under consideration.

Nuclear is seen as an option by many Asian countries partly because of their limited energy endowments, as in the case of Japan, Korea and Taiwan. Both South Korea and Taiwan are nearly 98% dependent on energy imports and their governments have made conscious decisions to develop nuclear energy to deal with the twin issues of energy security and climate change. It is also due to concerns about the potential adverse impacts on climate change with their rising energy demands and fossil fuel consumption. Countries may also show interest in nuclear energy because they want to build a "nuclear hedge" – either for security reasons or for broader economic reasons – after all, nuclear energy programs have spill-over effects on manufacturing and high-tech industries. The decision to go with a nuclear energy program is often motivated by a combination of these factors, and it is never an easy decision for governments because of high costs involved, security and safety concerns and political acceptance. Finally, no matter how enthusiastic countries may be over nuclear energy development, it will only be developed in the near future as a supplement rather than a replacement for their fossil fuel consumption.

This enthusiasm is in great contrast to the strong scepticism in continental European countries for several reasons. First, there is a different perception of nuclear energy in Asia compared to Europe where people still remember vividly the disaster at Chernobyl, as some Germans explained, “we were only little kids then and had to stay indoors and were not allowed to play in sand-boxes outside in case of contamination”. In Asia, despite the bombing in Hiroshima and Nagasaki, nuclear power is more associated with electricity than disasters, and represents technological progress rather than the destructive forces. Finally, the accident at Japan’s Fukushima Daiichi nuclear power station may have shaken the public in Japan, Asia and around the world. Politicians in Tokyo, Seoul, Beijing and some capitals among ASEAN countries do not seem to see that they have other options but to engage and expand their nuclear energy expansion because the accident in Japan has not changed the challenges they are facing – shortages of energy endowment and serious adverse consequences of burning coal to meet rising electricity demand. Indeed, the shut-down of most reactors in Japan following the earthquake and tsunami resulted in heavy losses – black-out and brown-out, slow production of manufacturing industries and significant reduction of GDP at a time when the country was trying to recover from its ailing economy. “The realistic plan is,” explains one of the professor at Tohoku University, “to build several gas-fired generation plants to meet short-term demands and start planning and construction of new nuclear power plants with advanced designs and higher standards for safety”.

As IEA and the World Bank conclude, “there is no technology that has a clear overall advantage globally or even regionally.” There are advantages and disadvantages for developing every energy source, adopting each technology, and selecting each place for energy development. Hard choices have to be made based on local conditions. It is easy to criticise when other countries use coal, develop nuclear power plants, or build large hydro projects. Yet when countries concerned do not have a lot of energy endowment, they may not have other choices. As developing countries need modern energy, there will be consequences on resources depletion and climate change. While “it is ethically and politically unacceptable to deny the world’s poor the opportunity to ascend the income ladder simply because the rich reached the top first” (World Bank 2010b, 44), it is also impossible to meet the demand for modern energy in the same way that developed countries did. Renewable projects will have to expand, but we also need to be realistic that the new renewable and nuclear capacity will come on line only to supplement the development of fossil fuel capacity to meet the rising demands unless new low-carbon energy technologies are developed and made available to developing countries.

Within a country, public acceptance of energy projects is a great challenge too. No government can survive in the modern world without being accountable to the public one way or another. Energy projects are particularly controversial because while people demand safe, secure and reliable supplies of modern energy, few are willing to live next to large energy projects. This holds true not only for nuclear, hydro, coal-fired and other power stations, but also for grid expansion, carbon capture and storage projects, shale gas developments, wind power schemes and even energy efficiency programs, such as smart grids. Information about these conflicting objectives needs to be presented to the public and public acceptance must be obtained in energy policy making.

It is never easy to make choices on policies to achieve a bundle of desired objectives, including sustained economic growth, long-term development, clean environment, and energy security, because making choices is political and difficult; it affects interests and pits one source of energy, one type of technology, and one group of interests against another. Each industry or group pushes for the advancement of their interests – nuclear and natural gas, for example, argue that they are the interim or "bridging" solutions to the clean energy supply of the future; while renewables insist they are the only alternatives if the world wants to avoid climate calamity. Debates and conversations among different industries, different groups and different countries are often at cross purposes; and few want to listen to the other side. Yet, industries need a clear signal for them to transform and move forward. It is the government that ultimately is responsible to make difficult choices, based on local conditions. Meanwhile whatever the political system a country may have, its government has to be accountable to its citizens and no government can completely ignore the interests of the majority while surviving long. We therefore need to understand the political, economic and broader environment within which such decisions are made.

Fortunately, despite serious challenges, countries face ample opportunities too. First of all, international cooperation is available. Donor countries have shifted their resources to ensure sustainable low-carbon energy development. Companies have become increasingly global and would go where opportunities are and where they think policies are in favour of clean energy. The second opportunity is the potential of new technologies. Developing new low-carbon energy technologies is costly in the short-term but this is also where the opportunities are for reaping the long-term gains. Taking advantage of the current opportunities to develop low-carbon energy technologies will allow those countries to lead in the coming decade. It is true some of the technologies are much more expensive than traditional dirty fossil fuels. Waiting for the cost to come down may be an option, but the long-term cost may be even higher when others start leading the way. It is a choice governments have to make: paying now and benefitting later or controlling the costs and paying prices later. Making this choice needs leaders who can see beyond their current tenure and it is never easy. The third opportunity is that democracy has been spreading around the world. Public participation in planning for the future may counterbalance the short-term interests of politicians.

In sum, energy is indispensable for development. Improving people's living standard without undermining the sustainability of development is the main challenge for large swaths of the world. Without a paradigm shift in the global approach to energy, global GHG emissions will continue to rise.

References

IAEA. 2009. *Climate Change and Nuclear Power 2009,* Vienna: IAEA.

IEA. 2009. *World Energy Outlook 2009*, Paris: OECD.

IEA. 2011. *World Energy Outlook 2011*, Paris: OECD.

Nuclear Energy Agency. 2008. *Nuclear Energy Outlook 2008*, Paris: OECD.

World Bank. 2009. *South Asia: Shared Views on Development and Climate Change*. Washington, DC: The World Bank.

World Bank. 2010a. *Winds of Change: East Asia's Sustainable Energy Future*. Washington, DC: The World Bank.

World Bank. 2010b. *World Development Report 2010: Development and Climate Change*, Washington, DC: The World Bank.

Chapter 3

An Overview of U.S. Renewable Energy Policies

Meredith Crafton and Benjamin Sovacool

ABSTRACT

Much of the focus in United States energy policies over the years has been on expanding energy production rather than improving energy efficiency and integrating renewable energy sources. Most policies, regulations, government research and development funding still favour conventional fuels and technologies over renewable energy technologies. However, some areas of the country have demonstrated the potential of energy efficiency and conservation measures. This paper summarizes the current energy trends and the status of renewable energy in the United States and assesses the potential of renewables to meet U.S. energy needs. It then summarizes the most significant policy mechanisms used to date and provides a brief review of public and private funding for renewable energy research, development and deployment (RD&D). Energy efficiency measures and integration of renewables hold enormous potential and promise in the United States. The future of these technologies will depend on policymakers rallying the political will to enact bold policies that eliminate subsidies for conventional energy technologies and fuels, put a price on carbon, and minimize risk to investors.

INTRODUCTION

The United States is the world's largest energy consumer. With less than five percent of the global population, it accounts for 27 percent of primary energy use and consumes about one-fourth of the world's electricity. As of 2010, the country was home to 17,342 conventional power plants totalling 1,087,791 gigawatts (GW) of generating capacity, approximately 527,000 miles of high-voltage transmission lines, 21,688 power substations, 1,298 coal mines, and 125 nuclear waste storage facilities—making it the largest electric utility system on the planet. It also boasts 410 underground natural gas storage fields and 1.4 million miles of natural gas pipelines (Sovacool 2008, 15, 63; US EIA 2009). But, non-hydroelectric renewable resources represented only 5 percent of the nation's power production (US EIA 2010).

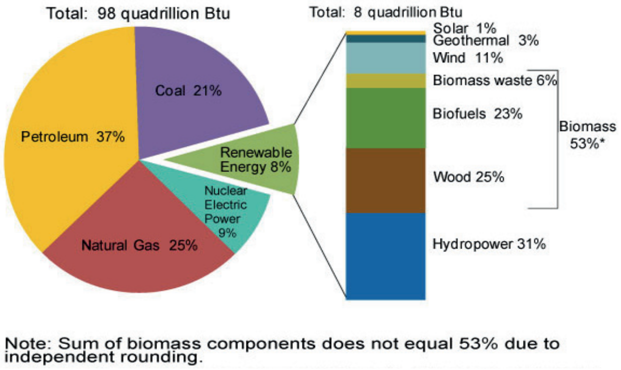
Although the use of non-hydropower renewable energy in the United States is minimal to date, concerns about energy security, volatile energy prices, climate change, and a call for the creation of vast numbers of "green jobs" are beginning to drive rapid growth of wind and solar power and other renewables. The country has some of the best renewable energy resources in the world and, with the right policies, could lead the world in the production and use of clean, renewable energy.

Most focus in the United States over the years has been on the development and diffusion of renewables for electricity generation, which is also the focus of this paper. This paper summarizes the current status of renewable energy in the United States, and goes on to assess the potential of renewables to meet U.S. energy needs. It then summarizes the most significant policy mechanisms used to date and provides a brief review of public and private funding for renewable energy research, development and deployment (RD&D). It concludes with some suggestions for future energy policy trends.

THE POTENTIAL FOR RENEWABLE ENERGY IN THE U.S.[1]

As of 2010, renewable energy resources provided only about 8 percent of U.S. electricity supply (See Figure 3.1). The country remains heavily dependent on fossil fuels, with coal and natural gas providing more than 70 percent of national electricity.

Figure 3.1: U.S. Primary Energy Consumption in the Electricity Sector by Source, 2010



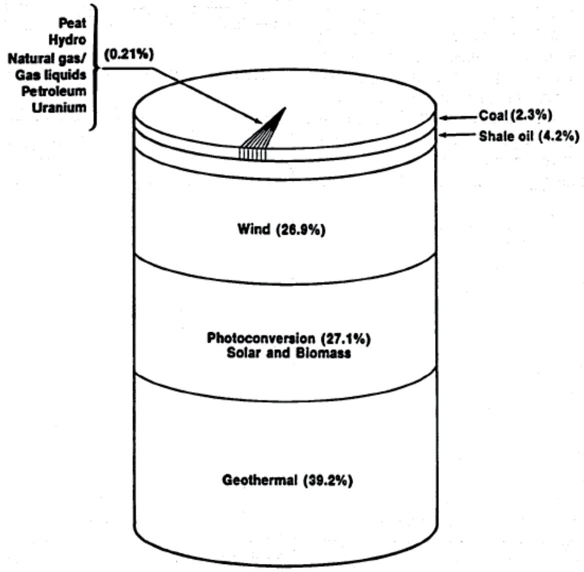
Source: U.S. Energy Information Adminsistration, Annual Energy Review 2010

The United States has enormous renewable energy resource potential. A comprehensive study undertaken by the U.S. Department of Energy (DOE) in 1989 estimated that 93.2 percent of all domestically available energy was in the form of wind, geothermal, solar, and biomass resources (See Figure 3.2). In other words, the amount of domestic renewable resources available on an annual basis then amounted to a total resource base equivalent to approximately 657,000 billion barrels of oil, more than 46,800 times the annual

[1] Much of the information for this paper was compiled in Sovacool and Sawin (2011).

national energy consumption for the 1980s and 1990s (US DOE 1989). (Since renewable technologies have advanced since then, today's current technical potential would be even greater). Researchers at the U.S. Geologic Survey, Oak Ridge National Laboratory, National Renewable Energy Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory, the Colorado School of Mines, and Pennsylvania State University also validated this research (US DOE 1989). Moreover, unlike the distribution of coal, natural gas, and uranium, which are heavily concentrated in some states, renewable resources exist in every state in the United States (although, admittedly, some states are more heavily endowed than others).

Figure 3.2: Domestic U.S. Energy Resources and Reserves



Source: Washington, DC: DOE/CE-0279, 1989

Biomass energy

The country's biomass resource potential comes in three forms: wastes, agricultural and forestry residues, and energy crops. Energy producers can use these resources to generate electricity, to heat water and space, and to produce first generation transportation fuels such as ethanol and biodiesel and second generation fuels such as cellulosic ethanol and algal fuels.

Many industrial and agricultural processes in the United States produce significant amounts of energy-useful byproducts, including tobacco residue, chicken carcasses, coffee-grounds, peach pits, sawdust, scrap wood, and rice-hulls, that energy producers can use to generate electricity, heat and/or biofuels. The Midwest possesses large reserves of biomass fuel in the form of crop residues and the potential for energy crops. The U.S. DOE recently determined that the nation's forests and agricultural lands could produce close to 1 billion tons of biomass while still meeting food, feed, and export demands (ORNL and US DOE 2005). Second generation fuels hold far more promise than first generation fuels such as corn ethanol (Sovacool 2007, 5505-5514). A study conducted by Sandia National Laboratory and General Motors predicted that 45 billion gallons of cellulosic biofuels could be produced by 2030 without accelerated technology deployment (SNL and GMRDC 2009).

Geothermal energy

More than 40 operational geothermal plants total nearly 3,000 MW of power capacity nationwide. But the nation's potential for water and space conditioning and electricity generation is far greater. The U.S. Geologic Survey estimates that the nine western states can provide more than 20 percent of national electricity needs (up to 150,000 MWh) using current geothermal technology (GEA 2006). Researchers at NREL project that the energy content of domestic geothermal resources to a depth of 3 kilometers is equivalent to a 30,000-year supply of energy using current rates of consumption (Green and Nix 2006). They also note that the United States could develop 2,800 MW of hydrothermal capacity using today's technology and 30,000 MW by 2050, and that the United States has more than 100,000 MW of geopressured potential and 130,000 MW of deep geothermal potential (Green and Nix 2006). An interdisciplinary study from the Massachusetts Institute of Technology concluded that commercialized enhanced geothermal systems could provide 100,000 MW of baseload power capacity by 2050 (MIT 2006). In addition, low-to-moderate geothermal heat resources can be tapped for a number of direct uses, including greenhouses, industrial processes, and space conditioning.

Hydroelectric energy

By far the most used and mature of all renewable energy technologies, hydroelectric facilities operate in 48 of the 50 U.S. states and generate slightly less than 7 percent of the nation's electricity. In principle, current U.S. electricity generation from hydropower could be increased significantly. Of the 80,000 dams around the country today, only an estimated 3 percent are actually used to produce electricity. The DOE estimates that by simply installing generators at the 97 percent dams that now lack them, and improving existing hydropower projects, the United States could add another 21,000 MW of capacity.[2] In total, the DOE estimates that hydropower could double its current capacity of more than 78,000 MW (Department of Energy cited in Consumer Energy Council of America, 2006).

Ocean energy

Although most forms of modern ocean energy systems are still in the early stages of development, they have the potential to meet a large share of U.S. energy needs at some future date. The Electric Power Research Institute estimates that the nation's near-shore wave resources alone could produce more than 8 times the annual output from U.S. hydropower plants, or some 2.3 trillion kWh per year (Aston 2006). Some coastal regions of the United States have significant ocean current and tidal power potential as well (Sawin et al. 2006, 32n108).

Solar energy

The sun's energy (heat and light) can be used to produce electricity as well as heat for water and space heating and for industrial purposes. Solar energy resources in the United States are vast. A Department of Energy study projects that the sun could meet 65-75 percent of U.S. water heating and about half of residential space heating needs.[3] The DOE also estimates that solar photovoltaics (PV) erected on just 7 percent of the country's available roofs, parking lots, highway walls, and buildings (without substantially altering appearances or requiring currently unused land), could supply every kWh of the nation's current electricity requirements (US DOE 2007, 5).

Wind energy

In 2008, the United States wind industry added 8,358 MW of new capacity, or an estimated 42 percent of all new generating capacity installed that year worldwide. The American Wind Energy Association calculates that the country

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[2] 21,000 MW from study by the U.S. Department of Energy, cited in National Hydropower Association, "Spotlight: Hydropower Research and Development," www.hydro.org/Hydro_Facts/Issue_Briefs/665.cfm, updated 1 March 2006; 97 percent from Linda Church Ciocci, Executive Director, National Hydropower Association, email to Michael Eckhart, American Council on Renewable Energy, both cited in Janet L. Sawin et al. (2006, 32).

[3] Lew Pratsch, U.S. Department of Energy, Energy Efficiency and Renewable Energy, communication with Janet Sawin, Worldwatch Institute, 30 September 2004, cited in Sawin et al. (2006, 32n108).

ended 2008 with 25,170 MW installed, or enough to meet the electricity needs of nearly 7 million U.S. households.[4] And yet, the full potential for U.S. wind generating capacity remains largely untapped. According to government-sponsored studies, the wind resources of Kansas, North Dakota and Texas alone are in principle sufficient to meet current national electricity demand (Sawin 2004). And the U.S. DOE estimates that, off the U.S. coast, more than 900,000 MW of wind generation capacity (roughly equivalent to the current amount of total installed electricity capacity for the entire United States) exists within 50 miles of the country's coasts (US DOE 2004, 6). Although much of this will remain untapped because of environmental concerns and competing uses, the potential is clearly enormous and much of it close to major urban centers.

THE MOST SIGNIFICANT U.S. POLICY MECHANISMS USED TO DATE

Regulators in the United States have relied on more than two dozen different policy mechanisms to promote renewable energy and energy efficiency, ranging from investment tax credits and RD&D subsidies to government procurement to low-cost financing. The most significant mechanisms for driving renewables in the United States in recent years have included three mechanisms: renewable energy/portfolio standards, net metering, and tax credits.

Renewable portfolio standards (RPS)

Renewable portfolio standards, sometimes called "renewable energy standards" or "sustainable energy portfolio standards," are mandates for utilities to source a specific amount of their electricity sales (or generating capacity) from renewable sources (Sovacool and Cooper 2008; Sovacool 2008b; Sovacool and Cooper 2007).

Efforts to mandate targets for renewable electricity generation at the federal level have been unsuccessful to date (as of printing). But, as noted above, more than half of U.S. states have enacted RPS laws. Iowa was the first U.S. state to pass such a policy in 1985, when legislation was enacted to "encourage the development of alternate energy production facilities and small hydro facilities in order to conserve our finite and expensive energy resources and to provide for their most cost effective use." (Moeller 2004, 91) The law mandated that utilities enter into power purchase agreements with renewable energy producers and it set the upper limit on aggregate purchases of renewable energy at 105 MW.

As with other renewable energy support mechanisms, policymakers meant for these regulations to correct three major failures of the existing market for

[4] http://www.renewableenergyworld.com/rea/news/story?id=54619.

electricity fuels: 1) electricity prices do not reflect the social costs of generating power; 2) energy subsidies have created an unfair market advantage for conventional fuels and technologies; and 3) renewable energy is a "common good" and thus is subject to a "free rider" problem, enabling society at large to benefit from the investments of individuals without paying for them.

RPS policies provide electric utilities with choices similar to the way emissions control strategies implemented in the 1970s and 1980s worked to reduce lead pollution from refineries and chlorofluorocarbons from aerosols. RPS allows generators to generate their own renewable energy, purchase renewable energy from others, or buy credits. It therefore blends the benefits of a "command and control" regulatory paradigm with a "free" market approach to environmental protection.

While RPS mandates have done much to stimulate a market for renewable resources and spur additional research, they are not without problems. Impacts have varied from state to state depending on policy design and implementation, including what share of the market is affected and the existence or level of penalties for non-compliance. In addition, uncertainty about the bidding process and the future value of renewable energy credits can increase risk for investors. Furthermore, RPS systems are best suited for large centralized plants, and they tend to promote the cheapest, most mature technologies (which is why some states have recently adopted solar "carve-outs").[5]

Net metering

Net metering enables energy providers to credit owners of grid-connected renewable electricity systems for the electricity that system owners supply to the grid. If the amount of electricity that a system owner supplies to the grid is greater than their demand then their meter actually spins in reverse. As of March 2009, net metering was available in 44 states plus Washington, DC.[6] Most states limit the aggregate capacity to a small percentage of a utilities' peak load. Also, in most states, producers are credited only up to the amount of electricity that they consume; any energy excess beyond the level of consumption goes to the utility. However, net metering has played a significant role in encouraging investment in distributed renewable energy systems. Under two of the most successful net-metering regimes, customers in California and New Jersey had installed more than 20,000 and 3,000 distributed solar systems, respectively, by early 2008. Net metering has been described as "providing the most significant boost of any policy tool at any level of government…to

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5 See for example Janet L. Sawin (2004).

6 http://www.dsireusa.org/library/includes/topic.cfm?TopicCategoryID=6&CurrentPageID=10&EE=0&RE=1. Note that four of these states have net metering programs that are offered voluntarily by one or more electric utilities.

decentralize and 'green' American energy sources." (NNEC 2007) By compensating customers for reducing demand and sharing excess electricity, net metering programs are powerful, market-based incentives that states have utilized to promote renewable energy.

One recent evaluation of state net metering programs found that the most successful programs did not set limits on maximum system capacity or restrictions on eligible renewable resources. These programs required that all utilities participate and included all classes of customers. They went hand-in-hand with interconnection standards and had little to no application fees, special charges, or tariffs (Haynes 2007). As expected, since not all net metering programs meet these requirements, their effectiveness varies from state to state.

Production and investment tax credits

At the federal level, most support for renewable energy has come in the form of investment and production tax credits. Investment tax credits provide a partial tax write-off to those who invest in a particular renewable energy technology. Production tax credits (PTC), by contrast, provide the investor or owner of a qualifying property with an annual tax credit based on the amount of electricity generated by the facility during the course of a year. In the United States, this credit has been available to eligible wind, hydropower, landfill gas, municipal solid waste, and biomass facilities (Beck and Martinot 2004, 32-34; Owens 2004, 32-34).

In 2008 the PTC reduced the price of renewable electricity by about 2 cents per kWh (the initial credit was 1.5 cents/kWh, inflation adjusted) on a 20-year basis, in order to make investments in renewable energy more attractive. To accomplish this incentive, however, the PTC also imposes a cost to U.S. taxpayers in the form of displaced tax revenue. PTC disbursements amounted to about $4 million in 1995 but more than $210 million in 2004, and wind projects accounted for about 90 percent of all PTC-related tax credits (Bolinger and Barbose 2007, 77-88). Despite these costs, researchers at Lawrence Berkeley National Laboratory calculated that the PTC was instrumental in attracting nearly $4 billion in wind energy investments in the United States in 2006; since the PTC began in 1994, it has helped incentivize an estimated $13 billion of investment in the renewable energy sector (Bolinger and Barbose 2007, 77-88). As perhaps counter-intuitive evidence of the importance of the PTC, wind capacity additions and installations have lagged significantly in years the PTC faced expiration: 2000, 2002, and 2004 (See Figure 3.1). Since it was first implemented, the PTC has been renewed and extended on seven occasions, but only four of the extensions occurred before the expiration of the tax credit, creating considerable boom and bust cycles in the renewable energy market (most recently being extended in 2008 until 2012). The PTC has had the greatest impact in states that have had their own incentives and mandates in place.

TRENDS IN PUBLIC AND PRIVATE ENERGY FUNDING AND INVESTMENT

Total government subsidies (including research and development) for renewable energy technologies in the United States reached their peak in late 1970s, and have declined sharply since then, from $1.9 billion in 1979 to $305 million in 2007 (US GAO 2007). As Kurt Yeager, former president of the Electric Power Research Institute, noted, "today the U.S. invests [in energy technologies] at a lower rate than [any of] its major international competitors." (Yeager 1998, 57) Further, although the coal, gas and nuclear energy industries are mature sectors (electricity has been produced from coal, for example, for more than a century), federal RD&D expenditures and other subsidies continue to favor these technologies. Between 2002 and 2007, U.S. RD&D expenditures on energy technologies totalled approximately $11.5 billion. But only 12 percent was directed to all renewable technologies; the vast majority of the total went to nuclear power and fossil fuels (Levesque 2007, 149). In fiscal year 2006, the federal government allotted $580 million in RD&D funds to fossil fuels and $221 million to nuclear. The wind industry, in contrast, received only $38.3 million (Levesque 2007).

Further, a review of U.S. Department of Treasury data indicates that the energy sector, excluding nuclear power, benefited from $18.2 billion in lost tax revenue—or federal subsidies—between 2002 and 2007. Fossil fuels received 75 percent of all energy related tax credits ($13.7 billion) while renewable power systems received just 15 percent ($2.8 billion) of the total.

In the private sector, restructuring of the electric utility industry and increased competition have reduced the incentive for large electric utilities and energy companies to invest in renewable energy research. Increased competition has meant that energy firms are likely to make investments only in short-term products that have better discount rates, lower risk, and perceived better financial return to the company's investors. During the late 1990s, for example, large utilities drastically cut RD&D spending on clean power technologies to prepare for restructuring and impending competition. In fact, a 1998 study conducted by the Government Accountability Office concluded that "increased competition from restructuring was cited as the primary reason for the biggest cutbacks in research to date by utilities in California, New York, and Florida."[7]

As a result, energy RD&D *intensity*—expenditures for energy RD&D as a percentage of an energy firm's total sales for one year—now averages less than three tenths of one percent in the energy sector, compared to an average industrial benchmark of 3.1 percent throughout most of the 1990s. Power companies conduct less RD&D as a share of total sales than manufacturers of

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7 Quoted in Yeager (1998, 97).

dog food (Munson 2005, 152). Furthermore, RD&D investments made by all energy companies declined 50 percent between 1991 and 2003 (Kammen and Nemet 2005, 84).

Despite the dearth of investment in the 1990s and early parts of 2000, the outlook has improved considerably over the past decade and is set to improve further. The fastest growth is occurring in the solar, wind, and biofuels sectors. Venture capitalists invested more than $1.5 billion into solar companies in the third quarter of 2008—more than the $1.05 billion investors put into solar companies for the entire 2007.[8] And while public sentiment toward biofuels was relatively negative through much of 2008, a number of companies—particularly those involved with second-generation technologies—were able to raise significant funds.[9]

Investment in new renewable energy manufacturing facilities and installed capacity has been increasing rapidly as well over the past several years. For example, over the 18-month period ending in September 2008, 41 facilities for production of wind turbine components were announced, opened or expanded (Wood 2008). The American Wind Energy Association estimates that the wind industry invested more than $15 billion in domestic wind farm construction during 2008 (AWEA 2008). And the Geothermal Energy Association estimates that new projects currently being planned or developed in the United States will result in the infusion of about $15 billion in capital investment in the western states.

EXPECTATIONS FOR THE FUTURE

To date, U.S. federal government policies have focused primarily on expanding energy production rather than improving energy efficiency, and policies, regulations and government research and development funding still favour conventional fuels and technologies over renewable energy technologies. However, some areas of the country have demonstrated the potential of energy efficiency and conservation measures. An examination of the change in per capita energy consumption in California (See Figure 3.3) and Vermont (See Figure 3.4) illustrates that government initiatives can halt the growth of energy demand.

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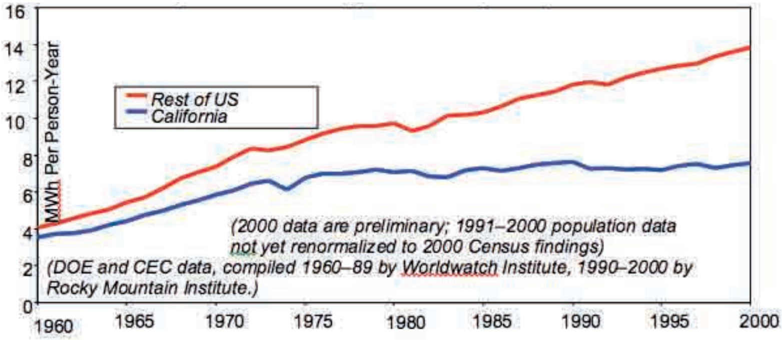
8 http://www.greentechmedia.com/articles/the-year-in-solar-a-mix-of-victories-and-woes-5428.html.

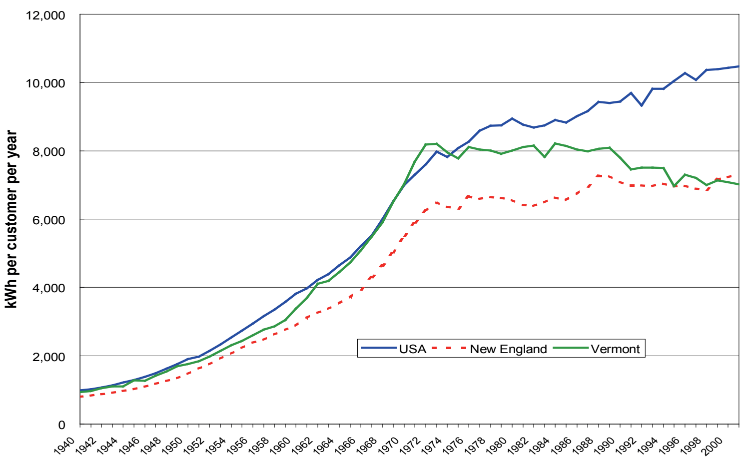
9 http://www.renewableenergyfocus.com/articles/general/news/080820_nef.html.

Figure 3.3: Per-Capita Electricity Consumption, 1960-2000



Implementing energy efficiency and conservation measures can not only assist the United States with a transition to cleaner domestic energy production, but can also reduce demand, thereby reducing the need for additional coal and nuclear power generation. Energy efficiency remains a significant energy resource for the United States and the world to tap. David Goldstein argues further that the United States could reduce energy demand by 30% simply by harvesting the low hanging fruits of energy efficiency (Goldstein 2009, 131).

Figure 3.4: Residential Electricity Use, 1940-2001 (kWh per customer per year)



Although it will take time to turn the United States onto a new course, there are positive signs that renewable energy will play an increasingly important role in the nation's future. President Obama made green jobs and clean energy a centerpiece of his election campaign. He has called for a doubling of U.S. energy from alternative sources within three years (Obama 2009) and aims for 10 percent of U.S. electricity to come from renewable sources by 2012 (and

25 percent by 2025) (AWEA 2008). He has also called for investment of $15 billion annually to develop clean energy technologies.[10] In addition, the economic stimulus packages of October 2008 and February 2009 both included significant incentives for renewable energy and the necessary energy infrastructure—including transmission expansion and smart grid technologies—for enabling renewable energy to play an increasingly important role.

At the federal and state levels, U.S. policy makers are also beginning to look to new policy options that, if well-designed and implemented, could dramatically expand renewable energy markets and manufacturing in the United States. One such policy is the feed-in tariff (FIT), exemplified by the Renewable Energy Law in Germany and now in place in some form in more than 40 nations, states and provinces around the world. During the summer of 2008, a national FIT bill was introduced in Congress. It called for technology-specific payments lasting 20 years, and covered projects of up to 20 MW in size. The Federal Energy Regulatory Commission would set payment rates, and costs would be covered through per kWh charges on electricity.[11] While this particular bill saw no progress, interest in such a policy is increasing on Capitol Hill.

The idea of FITs has also gained momentum at the state and municipal levels. In January 2009, Gainesville in Florida became the first U.S. municipality to approve a FIT for solar power. Beginning 1 March 2009, people who install new solar PV systems in Gainesville became eligible to receive 32 cents per kWh of electricity produced by the system over the next 20 years.[12] Several other municipalities as well as states have also begun considering FITs. By early 2009, FIT legislation had been introduced in at least five states, legislation had been drafted and was likely to be introduced in 5 more, and two other states were likely to enact FITs by legislative action.[13] As of the date of publication, the state of Hawaii planned to have a FIT in place by July 2009 as a result of an agreement between the Governor and the utility Hawaiian Electric Company (REF 2009).

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[10] For example, see Remarks of President Barack Obama—Address to Joint Session of Congress, Remarks of President Barack Obama—As Prepared for Delivery, Tuesday, February 24th, 2009. http://www.whitehouse.gov/the_press_office/Remarks-of-President-Barack-Obama-Address-to-Joint-Session-of-Congress/.

[11] House Bill 6401, introduced by Representative Jay Inslee of Washington state.

[12] http://www.gainesville.com/article/20090206/ARTICLES/902061014/1003/NEWS?Title=Commission_gives_its_approval_to_feed_in_tariff_for_solar_power.

[13] Paul Gipe, email message to Janet Sawin, February 16, 2009.

CONCLUSION

The challenges ahead will be great, particularly in uncertain economic times. However, energy efficiency measures and integration of renewables hold enormous potential and promise in the United States. The future of these technologies will depend on policymakers rallying the political will to enact bold policies that eliminate subsidies for conventional energy technologies and fuels, put a price on carbon, and minimize risk to investors.

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References

American Wind Energy Association (AWEA). 2008. "American Wind Energy Association Notes Top Wind Industry Accomplishments of 2008." Press release, Washington, DC, 22 December 2008.

Aston, Adam. 2006. "Here Comes Lunar Power." *Business Week*, 6 March 2006: 34.

Beck, Fredrick and Eric Martinot. 2004. "Renewable Energy Policies and Barriers." *Encyclopedia of Energy* 5: 365-383.

Bolinger, Ryan Mark and Galen Barbose. 2007. "Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States." *Electricity Journal* 20(9) (November, 2007).

Consumer Energy Council of America. 2006. "Fueling the Future: Better Ways to Use America's Fuel Options." Washington, DC.

Geothermal Energy Association (GEA). 2006. *Geothermal Energy: Estimates of Potential Use*. Washington, DC: GEA.

Goldstein, David. 2009. *Invisible Energy: Strategies to Rescue the Economy and Save the Planet.* Point Richmond, CA: Bay Tree Publishing.

Green, Bruce D. and R. Gerald Nix. 2006. *Geothermal— The Energy Under Our Feet*. Golden, CO: National Renewable Energy Technology, November, 2006, NREL/TP-840-40665.

Haynes, Rusty. 2007. "Not Your Mother's Net Metering: Recent Policy Evolution in U.S. States." Presentation to the Solar Power 2007 Conference in Long Beach, CA, September 25, 2007.

Kammen, Daniel M. and Gregory F. Nemet. 2005. "Reversing the Incredible Shrinking Energy RD&D Budget." *Issues in Science & Technology* (Fall, 2005).

Levesque, Carl. 2007. "In Energy Sector, Renewables Get Less Federal Support." RenewableEnergyWorld.com, 19 November 2007.

Levesque, C.. 2007. "What is the percentage of federal subsidies allotted for wind power?" *RenewableEnergyAccess*, April 10.

Massachusetts Institute of Technology (MIT). 2006. *The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems on the United States in the 21st Century*. Cambridge.

Moeller, James W. 2004. "Of Credits and Quotas: Federal Tax Incentives for Renewable Resources, State Renewable Portfolio Standards, and the Evolution of Proposals for a Federal Renewable Portfolio Standard." *Fordham Environmental Law Journal* 51 (Winter, 2004).

Munson, Richard. 2005. *From Edison to Enron: The Business of Power and What It Means for the Future of Electricity.* London: Praeger.

Network for New Energy Choices (NNEC). 2007. *Freeing the Grid 2007.* New York: Network for New Energy Choices.

Oak Ridge National Laboratory (ORNL) and U.S. Department of Energy (US DOE), *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: Technical Feasibility of a Billion-Ton Annual Supply.* Washington, DC: U.S. Department of Energy, 2005, DOE/GO-102995-2135.

Obama, Barack. 2009. "Remarks of President-Elect Barack Obama as Prepared for Delivery: American Recovery and Reinvestment." 8 January 2009, at http://www.whitehouse.gov/agenda/economy/.

Owens, Brandon. 2004. "Beyond the Production Tax Credit (PTC): Renewable Energy Support in the U.S." *ReFocus* (November/December, 2004).

Renewable Energy Focus (REF). 2009. "Hawaii feed-in tariff decision to open clean energy market." October 9, 2009, available at http://www.renewableenergyfocus.com/view/4329/hawaii-feedin-tariff-decision-to-open-clean-energy-market/.

Sandia National Laboratory (SNL) and General Motors Research and Development Center (GMRDC). 2009. *90-Billion Gallon Biofuel Deployment Study* (February 10, 2009).

Sawin, Janet L. 2004. "National Policy Instruments: Policy Lessons for the Advancement and Diffusion of Renewable Energy Technologies Around the World." Thematic background paper #3, prepared for the International Conference for Renewable Energies (Bonn 2004), January 2004.

Sawin, Janet L. et al. 2004. "Renewable Energy: Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities." *GAO Report to the Ranking Democratic Member, Committee on Agriculture, Nutrition, and Forestry, U.S. Senate.* Washington, DC: GAO.

Sawin, Janet L. et al. 2006. "American Energy: The Renewable Path to Energy Security." Washington, DC: Worldwatch Institute and Center for American Progress, September 2006.

Sovacool, Benjamin K. 2007. "Solving the Oil Independence Problem: Is it Possible?" *Energy Policy* 35(11) (November, 2007).

Sovacool, Benjamin K. 2008a. "Chapter One—The Big Four Energy Challenges." *The Dirty Energy Dilemma: What's Blocking Clean Power in the United States*. New York: Praegar.

Sovacool, Benjamin K. 2008b. "A Matter of Stability and Equity: The Case for Federal Action on Renewable Portfolio Standards in the U.S." *Energy & Environment* 19(2) (February, 2008): 241-261.

Sovacool, Benjamin K. and Christopher Cooper. 2007. "The Hidden Costs of State Renewable Portfolio Standards (RPS)." *Buffalo Environmental Law Journal* 15(1/2) (2007-2008): 1-41.

Sovacool, Benjamin K. and Christopher Cooper. 2008. "Congress Got it Wrong: The Case for a National Renewable Portfolio Standard (RPS) and Implications for Policy." *Environmental & Energy Law & Policy Journal* 3(1) (Summer, 2008): 85-148.

Sovacool, Benjamin K. and Janet L Sawin. 2011. "National Renewable Energy Support Schemes in the United States." In *European Union Energy Law: Renewable Energy in the European Union, edited by Doerte Fouquet.* Brussels: Claeys & Casteels, forthcoming 2011.

U.S. Department of Energy (US DOE). 1989. *Characterization of U.S. Energy Resources and Reserves*. Washington, DC: DOE/CE-0279, 1989.

U.S. Department of Energy (US DOE). 2004. "Wind and Hydropower Technologies Program: Wind Energy Multi Year Program Plan for 2005-2010." (November, 2004).

U.S. Department of Energy (US DOE). 2007. *Solar Energy Technologies Program: Applications*. Washington, DC: DOE.

U.S. Energy Information Administration (US EIA). 2009. "Existing Capacity by Energy Source." January 21, 2009, available at http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html

U.S. Energy Information Administration (US EIA). 2010. *Annual Energy Review*, 2010.

U.S. Government Accountability Office (US GAO). 2007. *Federal Electricity Subsidies: Information on Research Funding, Tax Expenditures, and Other Activities That Support Electricity Production*. Washington, DC: October, 2007, GAO-08-102.

Wood, Elisa. 2008. "High Winds for Texas: Lone Star State is Stepping Up." *Renewable Energy World,* Vol. 11, Issue 5, September/October 2008.

Yeager, Kurt E. 1998. *"Electricity Deregulation and Implications for RD&D and Renewables."* Hearing Before the Subcommittee on Energy and Environment of the House Committee on Science (March 31, 1998).

Chapter 4

Nuclear Energy and Renewable Energy: Which Way to Go for China?

Qin Tianbao and Pi Liyang

ABSTRACT

The Fukushima nuclear accident raised a fierce controversy over nuclear energy development. This paper examines China's options and response to the issue. The spectacular economic growth in China is accompanied by a huge surge in demand for energy. Since coal is the chief source of energy production, it is impossible for China to achieve a climate solution based on existing technology without a significant reliance on nuclear energy. Renewable energy at present is constrained by natural and technical conditions, so it cannot provide stable and substantial power. Therefore it is necessary for China to develop nuclear energy besides renewable energy. Nuclear energy will remain a component of China's energy mix to meet its energy needs and mitigate greenhouse gas emissions, with safety as a precondition. China advocates the safe and efficient development of nuclear energy, and has been devoting great effort to technological progress, policies and legal system to guarantee nuclear safety. Information disclosure and public participation needs to be improved to avoid panic stemming from ignorance and protect human rights.

INTRODUCTION

China has been developing nuclear energy for decades. Nuclear energy is considered as a clean and cost-effective alternative to fossil fuels. It barely produces greenhouse gases, and provides tremendous power with a small amount of uranium. However, the Fukushima disaster in 2011 brought back questions surrounding nuclear energy to the forefront of public debate. Should we give up nuclear energy? Can renewable energy replace nuclear energy? This paper provides China's answer.

There are five sections in the paper. Section two presents the background of the Fukushima nuclear accident and China's positive and prudent response. Section three explores the reasons why China insists on developing nuclear energy in comparison with fossil fuels and renewable energy. The analysis in section four explains how China handles the relationship between nuclear energy development and nuclear safety from the perspectives of technology, policy and legal system. The conclusion reiterates China's attitude towards nuclear energy development—safe and efficient development—and provides the proposal for improvement.

NUCLEAR PLANTS IN CHINA: MOVE ON OR SHUT DOWN?

Fukushima nuclear accident

A 9.0 magnitude earthquake hit Japan's northeastern Honshu Island on March 11, 2011, and a 6m tsunami warning was issued.[1] The earthquake and tsunami in Japan have caused unprecedented problems for the country's nuclear industry and the Fukushima power plant in particular (Froggatt 2011).

On April 12, the nuclear accident at Fukushima Daiichi was rated as a level 7 "Major Accident" on the IAEA (International Atomic Energy Agency) International Nuclear and Radiological Event Scale (INES) (IAEA 2011). Level 7 is the most serious level on INES, used to describe an event comprised of "A major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures" (IAEA 2011). The only other nuclear accident to have been rated a Level 7 event is the 1986 Chernobyl accident.

The Fukushima accident sparked debates and reflection on nuclear energy all over the world. One of the core issues is whether we should continue developing nuclear energy. Different countries gave their own answers.

China's response

The Chinese government responded right after the accident. On March 12, a day after Japan's earthquake and tsunami, Zhang Lijun, the Vice Minister of Environmental Protection, said at a press conference: "China will not change its determination and plan to develop nuclear energy."[2] He added, "Some lessons we learn from Japan will be considered in China's strategy of development of nuclear energy."[3]

At the executive meeting of the State Council on March 16, Chinese Premier Wen Jiabao discussed the Fukushima Nuclear Plant crisis, its impact on China, and measures that China will take regarding its own nuclear safety. He emphasized safety as the top priority in nuclear energy development. The meeting decided that China would suspend approval for all new nuclear power

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[1] "9.0 Magnitude Earthquake Rocks Japan". Available at http://english.cntv.cn/special/quakehitsjapan/homepage/ (accessed 20 November 2011).

[2] "Ministry of Environmental Protection: Japan's Nuclear Leak will not Change China's Arrangements of Nuclear Energy Development". Available at http://www.chinanews.com/ny/2011/03-12/2901566.shtml (accessed 20 November 2011).

[3] Id.

plants until the government can issue revised safety rules. The State Council also announced that the government would conduct safety checks at the country's existing nuclear facilities and those under construction.

WHY INSIST ON NUCLEAR ENERGY?

To cope with energy shortage and climate change

Pressure of energy supply

China is confronted with a serious energy shortage. The growing demand for energy continues to outpace supply. It is predicted that there will be an electricity shortage this year of 30 million kilowatts.[4]

Coal accounts for nearly 70% of China's energy supply. Nowadays China has become the largest importer of coal. Last year China's net imports of coal reached 170 million tons, accounting for 15% of global trade (Yu 2012, 17). The import costs have also risen more than doubled in the past five years (Yu 2012, 17). Similarly, more than 50% of petroleum consumption relies on import in China, not to mention the volatile petroleum prices. It is extremely detrimental to energy supply and energy security if China does not take measures to change the status quo.

Nuclear fission can provide tremendous amounts of energy. The energy 1 gram of uranium-235 releases during nuclear fission is equivalent to the energy 2.5 tons of coal or 1 ton of petroleum release during complete combustion (Wang and Hao 2011, 76-82). In addition, the cost of nuclear power is generally 20%-50% lower than the cost of coal-fire power (Wang and Hao 2011, 76-82). As a result, nuclear energy is an affordable source of energy that enhances the security and diversity of the energy supply.

Reduce greenhouse gas emissions

Developing nuclear energy is an important way to mitigate greenhouse gas emissions. China's energy supply has been over-reliant on fossil fuels, especially coal. In recent years, with the rapid growth of energy consumption, greenhouse gas emissions increased significantly. China's coal-based energy consumption mode has to be altered as it had vowed to reduce the intensity of carbon dioxide (CO2) emissions per unit of gross domestic product (GDP) by 40%-45% by the year 2020 from 2005 levels, while non-fossil fuels would account for 15% of primary energy consumption (He 2011).

As a cleaner alternative to coal, nuclear energy should be ramped up. The CO2 emission from a nuclear power plant is 1.6% of that from a coal-fire

[4] "CEC: the 2012 Country's Electricity Shortfall may Equal Last Year". Available at http://www.china-nea.cn/html/2012-01/21163.html (accessed 1 February 2012).

power plant of the same scale. Besides, the nuclear power plant produces no sulphur dioxide, nitrogen oxides or soot. All its gaseous and liquid effluents are discharged through rigorous treatment, well below the limits of radioactive emissions. Therefore it is necessary to develop nuclear energy to achieve the reduction targets of greenhouse gas emissions. It is considered as an alternative to fossil fuels in a large scale, markedly reducing greenhouse gas emissions.

Renewable energy: a poor substitute yet

Generally speaking, renewable energy is often confronted with two major problems. The first problem is that the uneven distribution of renewable energy resources directly leads to the divergence between production regions and consumption regions. Many renewable energy resources are concentrated in economically underdeveloped provinces such Tibet, Qinghai and other western provinces, while the power consumption is mainly concentrated in the economically developed eastern regions. This requires the long-distance transmission of electricity, which the current power grid is unable to do. The second problem is about grid connection. Renewable energy is restricted by natural conditions, and it is this poor stability that constrains renewable energy generation from large-scale grid connection. Peak shaving for grid connection and power quality is the key technical issues to be resolved.

Specifically speaking, renewable energy includes hydropower, wind energy, solar energy, biomass, and geothermal energy etc.

Hydropower is the most mature technologies among renewable energy. It is determined by the quantity of rainfall and the height of reservoirs above sea level. China's 12th Five Year Plan vigorously pushes hydropower development. If China gives up nuclear energy, it is too hard for hydropower to make up the gap left by nuclear power plants from its own development due to its difficult construction and limited potential. Environmental pollution and ecological damage have also been controversially caused by hydropower development.

Both wind energy and solar energy are vulnerable to changing climate conditions and restricted to geographical conditions. It is estimated that there are only 200,000 square kilometers suitable for wind farms, mainly in northern China, nearly half in Inner Mongolia (Chen 2011, 50-51). In the east, south or central part of China, there are no objective conditions for large-scale operation of wind energy. As to solar energy, Qinghai-Tibet Plateau is the best place for its utilization. Since they are unstable and intermittent, wind power and solar power have tough problems in grid connection because they are liable to shock the grid and destroy safe and stable power supply. They cannot be a major source until the technologies of energy storage improve significantly.

The problems of biomass are mainly in poor quality and inadequate resources. Considering the sustainability and costs of biomass supply, the Notice on Construction Management of Biomass Power Generation Project released by China's National Development and Reform Commission in August 2010 clearly stipulates: In principle, a biomass power plant should be arranged in a straw-rich area of the major grain-producing region, and there should be only one plant in each county or within a radius of 100 kilometers; considering the transportation of biomass, the capacity of the plant is generally no more than 30,000 kilowatts. Thus biomass hardly provides substantial power.

The technologies of geothermal energy are relatively immature, resulting in unknown cost with uncertain income during exploration.

In comparison with renewable energy, nuclear energy is almost unaffected by external factors such as natural conditions, so it can offer stable and substantial power. So it turns out that renewable energy cannot be a substitute for nuclear energy yet. China needs to develop nuclear energy together with renewable energy. Both have been the strategic emerging industry identified and promoted by the government.

Additionally, the cost of nuclear energy is cheaper than renewable energy and coal-fire power. Biogas power is 1.5 times the cost of coal-fire power, while wind power is 1.7 times, and photovoltaic power is 11-18 times at present (Chen 2011, 50-51). But the cost of nuclear power is generally 20%-50% lower than the cost of coal-fire power (Wang Hong and Hao Mei 2011). In summary, nuclear energy is considered as a clean and cost-effective alternative to fossil fuels in a substantial scale, which is crucial for modern China.

SAFETY VS. DEVELOPMENT: CONFLICT OR COMBINATION?

Since it is necessary for China to develop nuclear energy, the question turns to be "How to develop it?" Safety is always the top priority that people are concerned with at any time, and is also the focus of controversy after the Fukushima nuclear accident. There are 16 operational nuclear power reactors (Table 4.1) in China, and 26 under construction. Are they safe? How to ensure their safety under any circumstances? Could safety and development be coordinated or mutually exclusive? China endeavours to combine safety and development from the following dimensions and has achieved good results.

Table 4.1: Sixteen operational nuclear power reactors in China[5]

Name	Type	Location	Gross Capacity (MWe)	Date Connected
CEFR	FBR	Beijing	25	2011/07/21
GUANGDONG-1	PWR	Guangdong	984	1993/08/31
GUANGDONG-2	PWR	Guangdong	984	1994/02/07
LINGAO 1	PWR	Guangdong	990	2002/02/26
LINGAO 2	PWR	Guangdong	990	2002/12/15
LINGAO 3	PWR	Guangdong	1080	2010/07/15
LINGAO 4	PWR	Guangdong	1080	2011/05/03
QINSHAN 1	PWR	Zhejiang	310	1991/12/15
QINSHAN 2-1	PWR	Zhejiang	650	2002/02/06
QINSHAN 2-2	PWR	Zhejiang	650	2004/03/11
QINSHAN 2-3	PWR	Zhejiang	650	2010/08/01
QINSHAN 2-4	PWR	Zhejiang	650	2011/11/25
QINSHAN 3-1	PHWR	Zhejiang	700	2002/11/19
QINSHAN 3-2	PHWR	Zhejiang	700	2003/06/12
TIANWAN 1	PWR	Jiangsu	1000	2006/05/12
TIANWAN 2	PWR	Jiangsu	1000	2007/05/14

Advanced technology for security

Technology is a fundamental guarantee of safe performance for nuclear power reactors. The reactor in Beijing (as shown in Table 4.1 above) is an experimental fast reactor, utilizing a variety of security technologies. It has reached the security requirements of the fourth-generation nuclear energy system, which is the most advanced in the world. Fast reactor technology is expected to help

[5] This table is from IAEA Power Reactor Information System. Available at http://www.iaea.org/pris/ (accessed 1 February 2012).

China develop a sustainable nuclear power industry with an advanced fuel-recycling capability.[6]

The Fukushima nuclear power plant is an old plant constructed in 1960s with only an inside steel containment. It had experienced several accidents before 2011 without public knowledge (Nakamura and Kikuchi 2011, 893-899).

The nuclear power plants in China are equipped with four shields. The outermost explosion-proof containment is a 90-centimeter-thick solid concrete wall, equipped with radiation-proof metals inside. They are sufficient to ensure that there is no leakage of radioactive material under any condition.

GUANGDONG-1 with consecutive 10 years' safe operation in Daya Bay Nuclear Power Base ranks first among similar units in the world.[7]

The National Plan of Science and Technology Development posts a schedule for two national major projects of nuclear energy in the next five years. Both projects represent the most advanced technology of nuclear energy around the world, particularly in security and economy.

Policies: safe and efficient development

China's 12th Five Year Plan of National Economic and Social Development issued in March 2011 advocates the efficient development of nuclear energy based on safety. It also requires thorough investigation for inland nuclear power projects.

China's Policies and Actions on Climate Change (2011) issued on 22 November 2011 notes "the safe and efficient development of nuclear energy" in the next five years as well. China's 12th Five Year Plan of Environmental Protection issued in December 2011 considers "nuclear and radiation safety" as a key field to strengthen prevention and control of environmental risks. It requires improving the security of nuclear facilities, enhancing nuclear and radiation safety regulation, strengthening prevention and control of radioactive pollution, and so on. The Nuclear and Radiation Security Project is listed as one of the eight major projects in the Plan. The Project includes a system of regulations and standards for nuclear safety and radioactive pollution prevention, construction of security technology research base, environmental monitoring, capacity building of law enforcement, and intellectual training etc. The Plan also addresses safety information disclosure from nuclear power plants.

The Nuclear Safety Plan and the revised Long-term Development Plan for Nuclear Power have been proposed in the year 2011. The State Council will

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6 "The China Experimental Fast Reactor", *Nuclear News*, September 2011, p.38.

7 "China Guangdong Nuclear Power Group's Daya Bay Unit 1 Operates for Consecutive 10 years". Available at http://realtime.xmuenergy.com/newsdetail.aspx?newsid=103760 (accessed 1 February 2012).

soon hold a specialized conference for deliberation and work out a clear view of nuclear energy development.

Legal system to guarantee nuclear safety

China has established a pyramid framework of laws with regard to nuclear safety. The pyramid can be divided into three levels. On the top of the pyramid is the Law on Prevention and Control of Radioactive Pollution. It is the basic law in nuclear safety at present. Atomic Energy Law has been included in the legislative plan by the State Council. And it is now in the stage of drafting and research.[8] The Nuclear and Radiation Safety Center under the Environmental Protection Ministry is drafting a Nuclear Safety Law in order to promote legislation on nuclear safety.[9]

Regulations and rules are in the middle part of the pyramid, including administrative regulations and rules, and local regulations and rules. The State Council, the Ministry of Environmental Protection (the former State Environmental Protection Administration, SEPA) and the National Nuclear Safety Administration promulgated many regulations and rules about nuclear power plants, civilian nuclear facilities, nuclear material and radioactive material. After the Fukushima nuclear accident, the Ministry of Environmental Protection released the Regulations for Environmental Radiation Protection of Nuclear Power Plant on March 16, 2011, providing new requirements for the locations of nuclear power plants. A few local governments and standing committees of local people's congresses promulgated local regulations and rules on the issue, such as in Guangdong, Zhejiang and Tianjin.

Hundreds of standards and safety guides constitute the bottom of the pyramid, including radioactive environmental standards, standards of monitoring methods, and nuclear safety guides.

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[8] "Draft of Atomic Energy Law is Expected to Take Advice". Available at http://www.chinanews.com/gn/2011/04-25/2994134.shtml (accessed 20 November 2011); "Game of Interests Behind Atomic Energy Law". Available at http://www.legalinfo.gov.cn/pfkt/content/2011-04/20/content_2606717.htm?node=7908 (accessed 20 November 2011).

[9] "Policy and Regulation Institute Organized Internal Discussion on Draft of Nuclear Safety Act". Available at http://www.chinansc.cn/web/static/articles/catalog_262300/article_ff8080813078dc04013293f91e5c0228/ff8080813078dc04013293f91e5c0228.html (accessed 20 November 2011).

There are several major systems in the legal framework:

Licensing

Anyone who engages in activities likely to result in radioactive contamination shall go through prior examination and approval formalities in accordance with relevant regulations.

I. Nuclear facility license: The site for nuclear facilities shall be selected on the basis of scientific demonstration, and the formalities of examination and approval shall be gone through in accordance with relevant regulations. Before construction, fuel loading, operation or decommissioning of nuclear facilities, the entity that operates nuclear facilities shall apply for a license for construction and operation of nuclear facilities and go through the formalities of examination and approval for fuel loading and decommissioning. The entity that operates nuclear facilities shall, only after obtaining the relevant license or approval document, proceed to construct nuclear facilities, load fuel, operate or decommission such facilities accordingly.

II. License for use of nuclear technology: Any entity that produces sells or uses radioisotopes and radiation-emitting devices shall apply for a license and go through the formalities of registration. Any entity that transfers ownership of or imports radioisotopes and radiation-emitting devices and any entity that is equipped with radioisotope instruments shall go through the relevant formalities.

III. License for storage and disposal of radioactive solid waste: The establishment of a specialized entity for storage and disposal of solid radioactive waste shall be subject to examination and approval by the administrative department for environmental protection under the State Council before obtaining a license. Specific measures shall be formulated by the State Council. Engaging in activities for the storage or disposal of solid radioactive waste without a license or at variance with the relevant provisions of the license is prohibited.

Environmental Impact Assessment

Before going through the examination and approval formalities for selection of the site for nuclear installations, or before applying for a license for construction and operation of nuclear installations or going through the formalities of examination and approval for their decommissioning, an environmental impact report shall be prepared and submitted to the administrative department for environmental protection under the State Council for examination and approval; in the absence of such approval, the relevant department shall not issue the approval document or license.

Any entity that produces, sells and uses radioisotopes, accelerators, neutron generators and radiation-emitting devices containing radioactive sources shall, before applying for a license, draw up an environmental impact assessment document and submit it to the administrative department for environmental protection under the people's government of a province, autonomous region, or municipality directly under the Central Government for examination and approval; in the absence of such approval, the relevant department shall not issue the license.

Three Simultaneity

The facilities for prevention and control of radioactive pollution in support of nuclear facilities shall be designed, constructed and put into operation simultaneously with the main part of the project.

The facilities for prevention and control of radioactive pollution shall be checked and accepted simultaneously with the main part of the project; only after they are accepted as qualified may the main part of the project be put into production or operation.

Security and Supervision

The entity that operates nuclear facilities shall set up a sound security and safeguard system, enhance security and safeguard work, and accept supervision and guidance from public security departments.

Any entity that produces, sells, uses, or stores radioactive sources shall establish a sound security and safeguard system, designate a person to take charge, implement the security responsibility system, and formulate necessary contingency measures against accidents.

Emergency Preparedness and Response

The State establishes an emergency system for nuclear accidents. The department in charge of nuclear facilities, the administrative departments for environmental protection, for health and for public security and the other departments concerned shall, under the coordination and leadership of the people's government at the same level, in compliance with their respective duties and in accordance with law, cope with emergencies caused by nuclear accidents.

To be fully prepared for an emergency, the entity that operates nuclear facilities shall draw up an in-site emergency plan for nuclear accident in conformity with the size and nature of the nuclear facilities.

In the event of an instant nuclear accident, the entity that operates nuclear installations shall immediately take effective emergency measures to keep the accident under control and shall report the matter to the department in charge of nuclear facilities, the administrative departments for environmental protection, for health and for public security and to the other departments concerned.

CONCLUSION

The Fukushima nuclear accident undoubtedly provides us with a window of opportunity for better understanding the complexity of nuclear energy, as well as its potential effects (Wang 2011). Concerns of energy security and climate change are the major arguments for developing nuclear energy. Meeting energy needs indicates relying on a diverse set of energy sources that includes renewables and nuclear power (Broder 2011). Given existing technologies, renewable energy cannot replace nuclear energy to offer stable and substantial power. Therefore it is necessary for China to develop nuclear energy together with renewable energy. And nuclear safety is particularly noted as a top priority. The conclusion is that nuclear energy will remain a component of China's energy mix to help meet the energy demand and reduce greenhouse gas emissions, with safety as a precondition.

After examining the legal system with regard to nuclear safety, it can be found that the system seems dominated by the government and enterprises, and there is a lack of information disclosure and public participation. It is proposed to build an open platform for information exchange and industry transparency. An information disclosure system for nuclear facilities needs to be established to make clear the respective responsibility of government departments and operating entities. A long-term mechanism for nuclear safety education and publicity would meet the public demand for nuclear safety information, and enhance the understanding and confidence in nuclear energy. Improving information disclosure in the nuclear safety emergency and publishing authoritative and timely information will help clear up doubts, eliminate false information and misunderstanding. In addition, the public should be involved in decision-making on the site, construction, operation and decommissioning of nuclear reactors, as well as policy making and legislation on nuclear energy.

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References

Broder, J. M. 2011. "U.S. Nuclear Industry Faces New Uncertainty". *The New York Times*, 14 March 2011.

Chen Xiaojin. 2011. "Where do Global Nuclear Energy Go?". *World Affairs*, 2011, No.8.

Froggatt, Anthony. 2011. "What next for Chinese nuclear?". Available at http://www.chinadialogue.net/article/show/single/en/4168 (accessed 20 November 2011).

He Jiankun. 2011. "CO_2 Intensity Per Unit of GDP in 2020 will Decrease 40%". Available at http://www.chinadaily.com.cn/hqcj/zxqxb/2011-11-02/content_4244320.html (accessed 1 February 2012).

IAEA. 2011. "Fukushima Nuclear Accident Update Log: IAEA Update on Fukushima Nuclear Accident", April 12, 2011, 4:45. Available at http://www.iaea.org/newscenter/news/2011/fukushima120411.html (accessed 20 November 2011).

Nakamura, A and M. Kikuchi. 2011. "What we know, and what we have not yet learned: Triple disasters and the Fukushima nuclear fiasco in Japan". *Public Administration Review*, 2011.

Wang Hong and Hao Mei. 2011. "Rising Star in Energy—Nuclear Energy (I)". *China Three Gorges*, 2011, No.9.

Wang Yichao. 2011. "Nuclear Tension in Japan, Lesson for China". Available at http://www.chinadialogue.net/article/show/single/en/4160 (accessed 20 November 2011).

Yu Menglin. 2012. "China Continues to be the Net Importer of Coal". *China Energy News*, 19 January 2012.

Chapter 5

Planning for the Future: Decision-Making on Energy Policy in India

Harsha Meenawat and Nidhi Srivastava

ABSTRACT

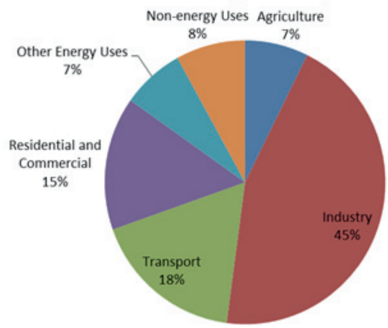
This article discusses the decision-making process in the Indian government with regard to providing sustainable energy solutions for its people. The article begins by describing the evolutions of energy policy through the years post the country's independence and the formulation of various institutions that play an important role in the renewable energy sector in India. It then discusses the main drivers of green economy in the country and the various responses of the government in the field of clean energy to secure energy access for the under-served, ensure energy security for the economy and manage the resulting demand and usage. Further, it elucidates on how the various energy related challenges have been responded to by policy interventions at the supply side and demand side. The article concludes with the importance of having a good mix of fossils and renewables for addressing the economic, social and environmental challenges collectively.

INTRODUCTION

As an emerging economy, with a significant population below poverty line, India faces the daunting challenge of pursuing economic growth. Balancing this priority requires that energy policy form an important component of the country's development planning process. During the course of the last decade, India has realized the three different yet complex challenges it faces regarding its energy future.

First, energy concerns in the 21st century have pertained largely to securing optimum energy supplies. India is a newly industrialized country and is undergoing rapid economic growth, experiencing equally rapid increase in modern energy consumption. The country has reported GDP growth rates of approximately 7-8% for the last 5 years but meeting the requirements of such a fast growing economy has resulted in the country becoming a net energy importer. Economic expansion in the last decade has resulted in the country becoming one of the largest consumers of oil (fourth largest in 2009) and importers of other fossil fuels such as liquefied natural gas. For economic development to continue energy demand will increase further and the country will need to utilize all available sources of energy. This could be tackled by using current supply efficiently to its maximum potential or exploring new sources within and beyond the country or developing and promoting the use of renewable energy.

Figure 5.1: Sectors of final energy consumption in India.



Source: TERI 2009

Second, the bigger challenge for policy makers in the country is tackling the equity issue for access to modern energy. As per 2009 statistics revealed by the government of India, 82.3% of the villages have been deemed electrified. As an overall figure, this is great progress in the last 5 years, from a figure of 74% in 2005; but electrification figures within the country show great disparity among states/provinces – for instance, Bihar having a rural electrification rate of 52.9% as compared to 100% in states like Punjab or Karnataka. One of the biggest concerns and now a key objective for the government of India is facilitating complete Rural Electrification providing actual access to electricity (and not just access to electricity infrastructure). The Integrated Energy Policy developed by the Planning commission in 2006 defines the vision for energy security as follows:

> "The broad vision behind the energy policy is to reliably meet the demand for energy services of all sectors including the lifeline energy needs of vulnerable households … with safe, clean and convenient energy at least cost … The goal of the energy policy is to provide energy security to all." (GoI 2006, ii)

Third, being an emerging economy and a developing country, India realizes that it would be very difficult if not impossible to fuel the aforementioned initiatives with domestic fossil fuels alone and there is only a limited supply that can be imported. Although India has maintained its position at climate negotiations that GHG emissions are a common but differentiated responsibility, and developing countries need to increase their share of emissions to meet developmental goals, yet on home ground policy makers understand that the country's absolute emissions are increasing at an unprecedented rate and alternative low carbon sources of energy will be the need of the hour very soon.

To confirm this stance, the government adopted the 'vision of sustainable development' under the National Action Plan on Climate Change (NAPCC).

In today's globalized world, domestic policy making processes play a reinforcing role for global trends and the way India plans its future energy policy would have an important role in shaping global energy governance. This commentary provides some perspectives on the decision making process within India for making affordable and sustainable energy accessible to its people. It commences with a short description of the evolution of energy policy in the country and a detailed discussion on renewable energy policy and institutions. The discussion then moves to the vision of the policymakers to tackle these challenges while moving away from a carbon intensive economic development path. The paper describes the formation of institutions that are taking forward renewable energy in the country and the various options under implementation.

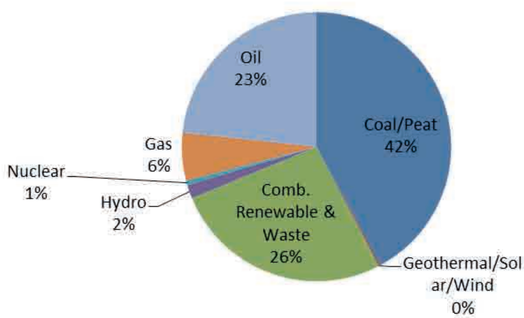
ENERGY POLICY EVOLUTION

To understand India's decision making on energy planning for the future, one should revisit the policy evolution through the years. Several reviews of energy policy making in India have concurred that historically this process has been dominated by national considerations rather than any external influence. Energy policy evolution in India has been largely focused on meeting the growing energy demand for supporting economic development in the country. The initiatives of the early post-independence governments saw energy policy as a part of national development policy targeted towards creating self-reliance in a country that had lost some important provinces. The process was largely governed by the Planning Commission and the three fuel specific ministries (Ministry of Coal, Ministry of Power and Ministry of Petroleum and Natural Gas later joined by the Department of Atomic Energy under the Prime Minister's Office).

Actual planning for energy and fuel options came only in the 1970s at the time of the oil crisis when emphasis shifted from oil to coal for electricity generation. India ranks fourth in the world for proven recoverable reserves for coal and as a legacy of decisions taken during that time, today the country ranks third in overall coal production. Historically, post-independence India's commercial energy sources have been dominated by coal (and the un-credited biomass that caters to the residential needs of the vast rural population of the country). The 1970s were also characterized by structural changes in institutions leading to the formation of large state-owned enterprises that implemented most of India's energy-related strategies by acting as monopolies. Being a largely agrarian society, the government in the late 1970s and continuing in the 1980s, took to subsidizing power for agricultural irrigation to increase food security and to appease the large populations that were involved in agriculture. On similar populist notes, this was followed by more subsidies for essential fuels like kerosene and domestic LPG, essentially making power subsidies commonplace within planning agendas.

Large subsidies without adequate government compensation led to the state-owned enterprises running huge losses. Subsidies became ingrained in the planning process and by 1989 formed almost a quarter of all government expenditure (Chhibber 1995). By the 1990s the practice of excessive state control had lived its life and the energy sector was reformed to integrate it better with global markets. As the country liberalized its way through the early 1990s the power sector also set out to attract private players as 'Independent Power Producers' and reduce the monopoly of state owned enterprises. After a few reform attempts, the coal sector saw limited reform (with Coal India still maintaining its monopoly by virtue of owning the majority of available coal blocks), the oil and gas sector liberalized for exploration resulting in the entry of new players, and the electricity sector saw reforms for privatization and regulation though spread over a longer period of time (Dubash 2011). Even after reforms within the energy sector leading to creation of markets, and the entry of new players and ongoing regulations to increase efficiency and transparency within the sector, the larger policy scenario had been fossil fuel oriented. The country's total primary energy supply in 2008 is presented in the following figure:

Figure 5.2: Share of total primary energy supply for India in 2008.



Source: OECD/IEA 2010.

RENEWABLE ENERGY POLICY IN INDIA

Initiatives to promote various forms of renewable energy in India also began soon after independence though such efforts were piecemeal and related to biomass only. The first improved biomass stoves were introduced in late 1940s followed by some research initiatives in subsequent years. However, not much progress or push was found in this sector, until the world was shaken by the first oil crisis and forced to relook at their energy policies. Research in the biomass sector began to gather steam only in the 1970s and early 1980s (Hansen and

Ballard-Tremeer 2010). After the oil crises of the 1970s, the government also started looking at other renewable sources as well as to keep the impact of such shocks low in future. Through most of the 1980s, efforts to promote different forms of renewable energy, such as wind, solar, biomass, and small hydro, were undertaken. A Commission for Additional Sources of Energy was established to formulate policies and programmes for renewable energy research and development in India. The next year a Department of Non-Conventional Energy Sources was set up under the Ministry of Energy, before it was split up. This was the first formal institutional step taken to promote renewable energy, much earlier than most other countries. In 1992, the department received the status of a separate ministry. India is probably the only country that has accorded a ministerial status at the federal level to renewable energy.

Institutionally, the main agencies that govern different aspects of renewable energy policy in India are: the Ministry of New and Renewable Energy (MNRE), Power and Energy and Rural energy divisions under the Planning Commission, and Central Electricity Authority. Large hydro, another renewable, is not covered under the mandate of MNRE and is dealt with by the Ministry of Power that governs power generation, transmission and distribution. These institutions have been in place for long but the approach of their policy is something new.

Recent policy trend is to adopt a more targeted approach as described below – for instance, the national Solar Mission and the MNRE Strategic Plan for 2011-2017. The mission mode makes the renewable energy policy actions more focused and target oriented. Linking these initiatives to National Action Plan on Climate Change (NAPCC) has provided them with additional support from the government. The NAPCC formulated by the Prime Minister's Office outlines the principles and approach for development while dealing with the challenges of climate change and these are articulated as eight national missions, namely

1. National Solar Mission
2. National Missions for Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission
5. National Mission for Sustaining the Himalayan Ecosystem
6. National Mission for a Green India
7. National Mission for Sustainable Agriculture
8. National Mission for Strategic Knowledge on Climate Change

DRIVERS OF GREEN ECONOMY

Green economy has been defined as 'one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities' (United Nations Environment Programme 2011). For developing countries, a green economy does not imply only a unidirectional focus on environmental aspects. It entails that due regard is given to the social aspect too as both green and brown are a part of the Green Economy of today and tomorrow (Chatterjee 2011). In the Indian context, the thrust has been on integrating energy security with green economy, while focusing on inclusive growth with renewable energy as one of the priority areas.

The Strategic Plan of the government for new and renewable energy sector envisions up-scaling and mainstreaming the use of renewables 'in furtherance of the national aim of energy security and energy independence, with attendant positive impact on local, national and global environment' (Ministry of New and Renewable Energy 2011). The Sixth Five Year Plan of India, which proposed an energy strategy that included 'exploitation of renewable sources of energy like energy forestry and bio-gas, especially to meet the energy requirements of rural communities', was largely a response to the oil shock of 1979. In order to maintain the balance between energy need and availability, the energy strategy was broadened to include efficient utilization and renewable energy technologies. A Commission for Additional Sources of Energy and an independent Department of Non-conventional Energy Sources were set up in quick succession to contribute to the energy requirements of the country and moving towards energy 'self-sufficiency'.

In the year 2000, a Committee was constituted to develop a Vision 2020 report for India that reflected people's aspirations, potentials of growth and development, and the efforts required to fulfil this vision. The Vision 2020 Report explicitly recognized the multifunctional role of renewable energy in India's energy policy. It took note of the fact that besides reducing India import dependence for fuel and strain on the environment, renewables hold promise for greater rural employment opportunities and higher rural incomes (Planning Commission 2002, 73). In its strategy and approach paper, the Ministry of New and Renewable Energy highlights the role of renewable energy in 'augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon developmental pathway' (Ministry of New and Renewable Energy 2010, 11).

RESPONSES TO ENERGY CHALLENGES

Securing energy for unserved

Given the concerns for security of supply and access to energy, the policy focus has been on enhancing and diversifying energy sources and working towards providing energy access to a vast section of population. Taking account of the shortage of energy resources in India, the Integrated Energy Policy emphasized on the importance of developing different energy sources, including renewable energy options (GoI, 2006, 92). In the Indian scenario, probably the greatest advantage that the renewable energy has over others is in terms of catering to those regions and populations which are not connected to the grid and where it is difficult to provide commercial energy. Thus, for a long time renewable energy projects and initiatives were dominated by subsidies to the users and with a supply orientation (Shukla, 1997).

Due to their geophysical characteristics, several parts of India get abundant supply of sunlight and are well suited to tap the solar energy potential. As compared to other renewables, solar technologies are more apt for being deployed at local levels outside the grid. Thrust on developing solar technologies has been going on since 1960s and 1970s. However, real progress was made mostly in usages such as cooking, heating etc. These usages have a great off grid potential and hence, have attracted a fair interest from policy makers. Under the National Solar Mission, a target of meeting 2000MW energy demand through off grid solar applications has been set for the year 2022. There are plans and targets to promote use of solar energy but the actual uptake is dependent on a range of factors and as MNRE comments, 'rising costs of oil and lowering of cost of solar' would be the catalyst for this shift (Ministry of New and Renewable Energy, 2010, 21).

Another form of renewable energy with a large off grid potential for India is biomass. Programmes and government initiatives for promoting biogas and improved cook stoves have been in place since the 1940s. In the 1970s, biomass was seen as an economically viable and sustainable energy source that needed to be developed to recover from the oil shock and the rural energy crisis of 1970s (Shukla 1997). The recent policy focus on biomass for off grid has been on promoting biomass gasifier to use biomass resources such as rice husk, corn cab, wood chips and agro-residues. This reflects how the target recipient of biomass applications is no longer restricted to certain rural households but has been broadened to include more industries as well.

Policy support for most off grid renewables has been provided in the form of subsidies, some R&D support, demonstration projects and awareness building exercises. The potential of off grid renewable to meet the energy needs of the unelectrified rural areas has long been realized but the potential is still far from being optimally utilized.

Securing options for the grid

Promotion of renewable energy through grid-connected utilities was led by the Electricity Act of 2003. The Act set the stage for pushing for a renewable mix in the grid by providing a broad framework that introduced mechanisms such as renewable purchase obligations and preferential tariffs for the first time in Indian electricity regulation. The Act mandates the regulatory commissions in different states to determine tariffs, keeping in view, inter alia, promotion of cogeneration and generation of electricity from renewable sources of energy. The Electricity Act, Electricity Policy and the Tariff policy together provide the basic framework for preferential tariffs, renewable purchase obligations, linked, Renewable Energy Certificates. A range of fiscal incentives such as generation-based incentives for wind, along with subsidies for solar and biomass are other incentives provided for uptake of renewable energy policy.

Of all the main renewable options available and feasible in the Indian context, the biggest contribution to grid comes from wind, amounting to almost three-fourth of the total grid installed renewable energy capacity. The 12,800MW of wind power contribution to grid is led by the private sector with support from the government in the form of accelerated depreciation and fiscal incentives.

In India, solar has traditionally been seen as a renewable energy solution for off grid and decentralized energy. However, in more recent times, the potential of solar for adding to the grid has been recognized. The Jawaharlal Nehru National Solar Mission aims to add 20,000MW of solar power to the grid by 2022. From an initial focus on development of solar thermal devices for end use, Indian solar energy policy has come a long way with the setting of an ambitious target of 20,000MW grid connected solar power. The Mission is still new and unfolding, but the initial response and performance has been positive and the high target may not be that difficult to achieve.

The focus of RE in grid on large power plants is also now beginning to shift towards smaller plants for the ease of transmission and logistics. These small plants based on solar PV and biomass are expected to contribute to the tail end of the grid to improve voltage and frequency while keeping transmission and distribution losses low.

Managing the demand and usage

Renewable energy policy has been supply-driven for long, with factors such as availability of the source, technology and capacity, both technical and financial, playing a role in deciding whether renewables have any contribution towards meeting the energy needs of the country or not. An energy conservation wing has existed in the Department of Power of Government of India since the 1985; however, its activities were more promotional in nature with little perceivable impact on actual energy conservation. The last two decades have witnessed a much greater and more active engagement from the government and academia with the issue of demand side management of energy to address the energy concerns of the country. Initiatives include standard setting and mandatory labelling of an array of end use products, rules to govern public procurement, technology programs to reduce transmission and distribution losses, energy conservation building code for new and existing buildings, ESCOs promotion and capacity building programmes. Realizing the 'Negawatt' potential, demand side management has emerged as an important policy focus for Indian energy sector.

Demand side management (DSM) has been planned through efficient usage, checking transmission and distribution losses, and soft options like incentives and disincentives to steer consumer behaviour, also including options such as renewable energy systems (Ministry of Power). For instance, the Market Transformation for Energy Efficiency (MTEE) under the National Mission for Enhanced Energy Efficiency (NMEEE) is a set of DSM measures, supported with CDM financing. The initiatives include charting a national CDM roadmap under which programmatic activities like the Bachat Lamp Yojana (distribution of incandescent lamps at a subsidized rate to grid connected households) and DSM schemes in the Agricultural, Municipal, SME, commercial transformer and commercial building sectors would be promoted (Bureau of Energy Efficiency (BEE) 2008).

CONCLUDING REMARKS

Although frameworks for green economy are still not in place, it is clear that the result of a green economy should be 'improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities' (UNEP 2010, 3). The concept of green economy captures the vulnerability of human welfare that springs from an unsustainable model of economic development (Bhandari 2011, 5). Therefore, a green economic growth does not preclude the social component in the process of linking economic growth to the achievement of environmental sustainability. This is an important facet to be remembered while embarking on a journey towards a green economy, especially for a developing country like India.

Energy choices have far-reaching implications on the economy, environment, as well as the society. As much as making energy accessible is important, the source from which this energy comes from is also crucial. Privileging of one energy source over another can create some losers or winners. However, in the Indian scenario, the trajectory of introducing renewables in the energy mix has not given rise to any losers as such. Historically, over-dependence on fossils may have locked India into a path-dependent situation but since a notable part of its energy need is still unfulfilled, the scope for a healthy energy mix does exist. Certain energy development activities undoubtedly result in greater externalities and therefore, higher environmental and social costs. To say that any one energy development is going to be completely devoid of any negative externality and best suited to address the manifold energy challenge would be untrue. This is due to two reasons; first, many of the greener options also run the risk of causing a stress on the socio-ecological situation, and second, the suitability of an energy choice has to be understood in a broader socio-economic context along with the history. A good mix of fossils and renewables, achieved in a responsible manner, can address economic, social and environmental challenges collectively, thereby avoiding creation of winners and losers amongst stakeholders.

Public response to any energy-related decision can be categorized under two broad heads – towards energy production and energy usage. The latter has more to do with respect to uptake and adoption of a new kind of energy source or device. In India, the uptake of greener practices in energy usage has not met with opposition but has not been very easy to get. This has been evident in the case of getting consumers to use CFLs instead of candescent lamps. After a few years of initial disregard, the use of CFLS has been received positively by the people. For most other technologies such as solar PV, the uptake has been slow mainly on account of high upfront costs.

Public response to energy generation is important and most vocal with respect to issues such as displacement and safety. In the past, public opposition to thermal and large hydro plants has been a common phenomenon. With respect to displacement, it is irrelevant whether it is fossil-based or renewable. However, when it comes to safety aspects, the public response is very much resource specific. For instance, concerns with coal have existed for long. Opposition to nuclear plants is also extreme, both from certain sections of civil society groups and the local population. Opposition to wind power installations are also there due to the interference with the ecology of that region. Concerns with respect to safety concerns emanating from disposal of CFLs and solar panels are still not perceived as a concern by the general public.

The developments discussed above and the space accorded to renewables in Indian energy policy were always driven by needs which were more to do with making energy available and not per se by the need or pressure to 'go green'. Although clean energy has become an integral aspect of the overall growth strategy and energy policy, it is still not the determining factor. The actions and decisions to diversify supply options or conservation and efficient utilization of energy are still driven by the concerns of energy access and security, but are resulting in making the energy mix greener.

References

Bhandari, M. P. 2011. *The conceptual problems of Green Economy and Sustainable Development.* Association for Protection of Environment and Culture (APEC-Nepal) and Atlantic States Legal Foundation (ASLF), Inc. (NGO), USA.

Bureau of Energy Efficiency (BEE). 2008. *Action Plan for Bureau of Energy Efficiency.* New Delhi: BEE, Ministry of power.

Chatterjee, T. 2011. Green Economy perspectives. *CII meet organized* . New Delhi: MoEF.

Chhibber, P. 1995. Political parties, electoral competition, government expenditures and economic reform in India. *Journal of Development Studies, 32*(1).

Dubash, N. K. 2011. From Norm Taker to Norm Maker? Indian Energy Governance in Global Context. *Global Policy, 2* (Special Issue on Global Energy Governance), 66-79.

GoI. 2006. *Integrated Energy Policy.* New Delhi: Government of India, Planning Commission.

Hansen , M., and Ballard-Tremeer, G. 2010. *Improved Cookstoves* . Retrieved 11 17, 2011, from http://www.hedon.info/Improvedcookstove. Accessed on December 28.

India, G. o. 2003. *Electricity Act.* Government of India.

Ministry of New and Renewable Energy. 2010. *Renewable Energy in India: Progress, Vision and Strategy.* New Delhi: MNRE, Government of India.

Ministry of New and Renewable Energy. 2011. *Strategic Plan for New and Renewable Energy Sector* . New Delhi: MNRE, Government of India.

Ministry of Power. n.d.. *Demand Side Management*. Retrieved November 16, 2011, from http://www.powermin.nic.in/distribution/demand_side_management.htm

OECD/IEA. 2010. *India Statistics.* IEA Energy Statistics: http://www.iea.org/stats/pdf_graphs/INTPESPI.pdf. Retrieved November 17, 2011.

Planning Commission. 2002. *Report of the Committee on India Vision 2020.* New Delhi: Planning Commission, Government of India.

Shukla, P. 1997. Biomass Energy in India: Transition from Traditional to Modern. *The Social Engineer*, Vol. 6 No. 2.

TERI. 2009. *TERI Energy Data Directory and Yearbook.* New Delhi: TERI Press.

UNEP. 2010. *GREEN economy: Driving a Green Economy Through Public Finance and Fiscal Policy Reform.* France: United Nations Environment Programme.

United Nations Environment Programme. 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. Arendal: UNEP.

Chapter 6

Biofuel Policies in Brazil: Experiences and Perspectives

Arnaldo Walter and Camila Ortolan Fernandes de Oliveira

ABSTRACT

Brazil is worldwide the second largest producer of both fuel ethanol (about 28 billion litres produced in 2010) and biodiesel (2.4 billion litres in the same year). In both cases the federal government has had an instrumental role, setting the policies, giving financial support and assuring coordination among the economic agents. This paper describes the policies and regulatory instruments used in Brazil for fostering the production and consumption of fuel ethanol and biodiesel, the perspectives for both biofuels and the challenges to be faced in the mid-term. One of the main conclusions is that mistakes on planning and lack of proper coordination can cause important negative impacts on both the supply and demand of biofuels, even in the case of the ethanol market in Brazil where its production is economically feasible vis-a-vis gasoline and the consumer can decide between both fuels at the moment of filling in the tank.

INTRODUCTION

Brazil has used fuel ethanol in a large-scale for partially displacing gasoline since the mid-1970s, and since 2005 there has been a program supporting biodiesel production. Currently, Brazil is the second largest producer in the world of both fuel ethanol (about 28 billion litres produced in 2010) and biodiesel (2.4 billion litres in the same year).

The Brazilian government has had an instrumental role in both cases, setting the policies and regulatory measures, defining mandatory blends for creating the market, giving financial support, controlling prices and giving subsidies (when necessary), and assuming a coordinating role, etc. A simple comparison between these experiences is senseless as there were different motivations for fostering ethanol and biodiesel production and there is a large divergence in the production capacities. Both cases are analyzed in this paper, but the focus is more on ethanol production and consumption, due to its current relevance and growing perspectives.

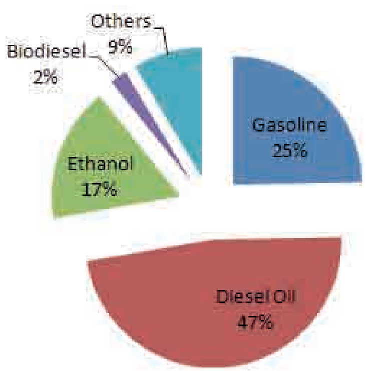
The paper is organized in five sections, besides this introduction. The second section is devoted to an overview about the production and consumption of biofuels in Brazil. In the third section the focus will be on the policies used for deploying the production and consumption of ethanol and biodiesel. In section four some specific policies are described, such as those aimed at controlling land use, reducing sugarcane burning prior to the harvest process, and science and technology policies. Perspectives regarding ethanol and biodiesel production are presented in the fifth section and, finally, final remarks are presented in section six.

BIOFUELS IN BRAZIL

An overview

In Brazil, road transport is very important within the transport sector both for freight and passengers. As a consequence, the bulk of the energy consumption in the transport sector is due to fuel use in diesel engines and in spark-ignition engines. By 2010, ethanol consumption represented 17% of the energy consumption in road transportation and 38% of the energy consumed by spark-ignition vehicles (69% of the gasoline consumption in energy basis). In Figure 6.1, "Others" correspond mostly to kerosene (consumed in jet engines) and natural gas (consumed in spark-ignition engines). Figure 6.1 shows the distribution of the energy consumption in the transport sector by 2010.

Figure 6.1: Final energy consumption in road transport sector by 2010



Source: EPE/MME (2011)

Ethanol

Large-scale production of fuel ethanol in Brazil started in 1976 but it has been since 1999, after the complete deregulation of the industry, that consumption has increased. Flex-fuel vehicles (FFVs)[1] have been the main driving force of the domestic consumption of ethanol. In Brazil, FFVs can run with any fuel

[1] The very first model was launched in March 2003.

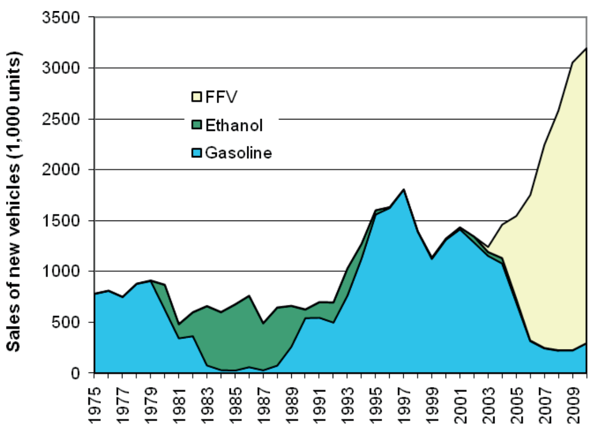
mix between gasohol (E18–E25) and pure hydrated ethanol (E100). The relatively low price of ethanol compared to gasoline, and also the good technology of FFVs, are the main reasons why currently they are a big sales success in Brazil (more than 90% of new cars). It is estimated that FFVs can reach 65% of the fleet of light vehicles by 2015 (Jank 2008).

Since the early 1980s, all fuel ethanol production in Brazil has been based on sugarcane. In addition to the favourable conditions for biofuels production, such as climate, rainfall and land availability, Brazil has taken advantage of its long-term experience with sugarcane production. It is also worthwhile to mention that for about 15-20 years (i.e., from 1975 to early 1990s) the Brazilian federal government offered very favourable conditions for fuel ethanol production (see section three).

Brazilian experience with ethanol blended to gasoline comes from the 1930s, but it was in 1975 that the Brazilian Alcohol Program (PROALCOOL) was created, aimed at partially displacing gasoline in individual transport. At that time the country was strongly dependent on imported oil and gasoline was the main oil derivative. In 1979, with the second oil shock, the Brazilian government decided to enlarge the Program, supporting large-scale production of hydrated ethanol to be used as neat fuel in modified engines.

On the other hand, during the 1990s, less support from the government and the lack of a positive attitude by the producers led the ethanol market to difficulties; a shortage of ethanol supply in 1989-1990 led to a strong drop in the sales of neat ethanol cars. The reduction of the neat ethanol fleet deeply impacted the consumption of hydrated ethanol during the 1990s and early 2000s. Figure 6.2 shows the total sales of new vehicles in the period 1975-2007, according to the fuel option; with the success of FFVs, sales of straight-ethanol vehicles vanished in 2006.

Figure 6.2: Annual sales of new vehicles from 1975 to 2010, according to the fuel option

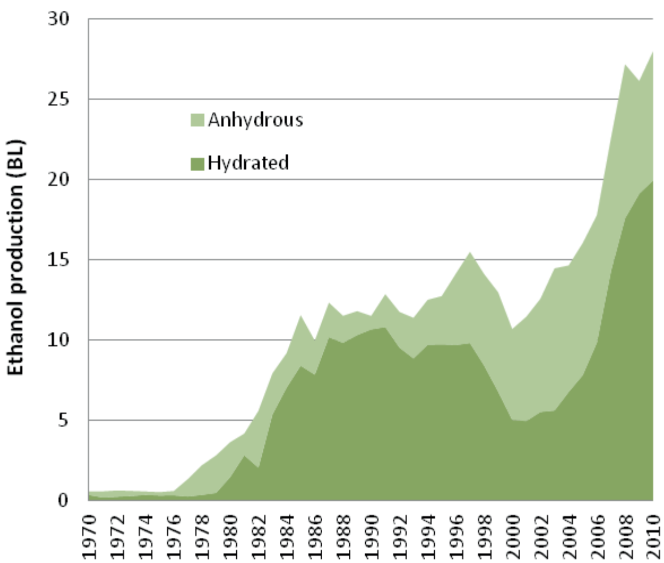


Source: ANFAVEA (2011)

The PROALCOOL, as initially conceived, finished during the 1990s as government support ceased. The main changes started in the early 1990s, first with the liberalization of fuel prices to consumers and, second, in the late 1990s, with the full deregulation of sugarcane industry. The positive results started to be noticed in 2001, when sales of neat ethanol cars increased due to a larger price difference between ethanol and gasoline. Due to the success of FFVs, it is predicted that the domestic market of ethanol shall reach 52.4 billion litres by 2020 (EPE 2011).

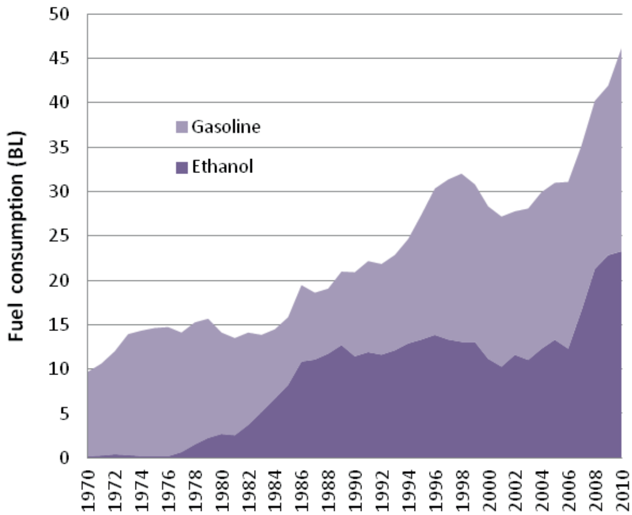
Figure 6.3 shows ethanol production in Brazil from 1970 to 2010. The production in the harvest season 2010-2011 was about 28 billion litres (BL), while the domestic consumption surpassed 23 BL in 2010. It can be seen in Figure 6.3 that since 2003 (i.e., after FFVs) the production of hydrated ethanol has increased continuously while the production of anhydrous ethanol (exported and domestically used in fuel blends) has been almost constant. Currently, the consumption of fuel ethanol in the transport sector is roughly equivalent to the consumption of pure gasoline, volume basis (Figure 6.4).

Figure 6.3: Evolution of fuel ethanol production in Brazil from 1970 to 2010



Source: EPE-MME (2011)

Figure 6.4: Evolution of automotive fuel consumption (ethanol and gasoline) from 1970 to 2010



Source: EPE-MME (2011)

There are about 440 industrial units under operation and some mills under construction. It is estimated that 70-80% of the total production is in the state of São Paulo and in the regions around it, in southeast Brazil. A small share of sugarcane production is in the north-northeast regions (13%, with more than 10% in the northeast region).

Recently (after 2009), ethanol production in Brazil was negatively affected by a set of factors, including the high sugarcane prices in the international market, unfavourable weather conditions and the lack of investments for sugarcane production. As a consequence, the annual growing rates of ethanol production were reduced and it is estimated that the production in 2011 was lower than in the previous year. The perspective is that ethanol production will recover its growth path from 2012 on.

A synthesis of information of fuel ethanol production in Brazil is presented in Table 6.1.

Table 6.1: Some information about ethanol production in Brazil in 2010

Raw material	Sugarcane (100%)
Production of sugarcane	624 million tonnes
Share of sugarcane for ethanol production	54%
Harvested area of sugarcane for ethanol production	4.35 million hectares
Number of mills under operation and producing ethanol	Around 420
Ethanol production	27.6 billion litres
Average combined yield	6,345 litres/hectare

Source: CONAB (2011)

Biodiesel

By the end of 2004, the Brazilian government had decided to implement the so-called National Program of Biodiesel Production and Use (PNPB). The declared targets of the program are generating jobs and income in rural areas and reducing regional inequalities. According to the government, two additional targets are the potential contribution to foreign-exchange savings and environment improvements.

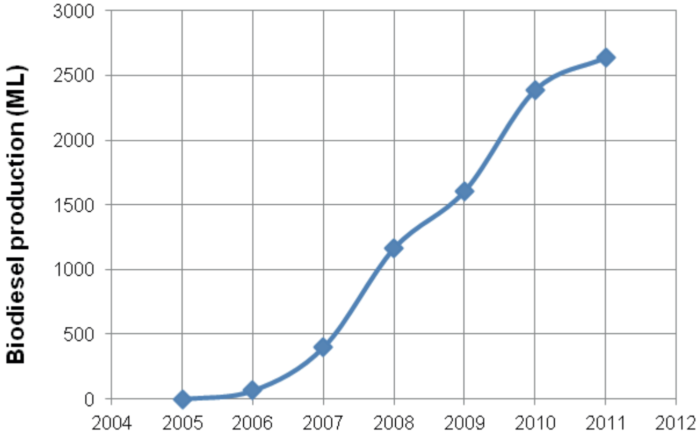
In 2004 it was defined by law that B2 blends would be mandatory countrywide starting January 2008, but the target changed to B3 blends in July 2008 and enlarged to B4 blends in July 2009. It was initially predicted that only in January 2013 would the mandatory mix reach 5% of biodiesel (B5), but the target was anticipated to 2010. Higher biodiesel blends or even B100 can be used, but only if authorized by the regulatory body (Petroleum, Natural Gas and Biofuels National Agency – ANP). From 2005 to 2007, the use of B2 blends was not mandatory.

The program was conceived in order to foster the production of biodiesel from different raw materials, such as palm oil and babassu in the north region, castor oil and cottonseed in the northeast region, sunflower and peanuts in the south and soybeans, residual oil and fats in the southeast and centre regions. However, the bulk of biodiesel production has been based on soy oil (about 82% in 2010; with approximately 13% produced from animal fats and 5% from other feedstocks) (ANP 2011).

The three main pillars of the PNPB are: (a) the so-called "Social Label", as specific policies were designed to support subsistence farming systems; (b) reduction of some federal taxes; and (c) biodiesel purchasing auction schemes (Amaral et al. 2008).

The production of biodiesel has been encouraged through purchase auctions organized by ANP. Twenty three auctions have taken place since 2007 while the total amount of biodiesel sold surpassed 8 BL. Only producers that hold the Social Label can participate in these auctions; PETROBRAS – the state-controlled Brazilian oil company – assures the purchase (Pousa et al. 2007). Figure 6.5 shows the biodiesel production from 2005 to 2011. In 2011 the production surpassed 2.5 BL and tends to grow about 10% per year in the following years.

Figure 6.5: Biodiesel production in Brazil (estimates for 2011)



Source: ANP (2011)

POLICIES FOR DEPLOYING BIOFUELS PRODUCTION AND CONSUMPTION

Ethanol[2]

During the first 15 years of the Brazilian ethanol program, supply and demand were both stimulated and adjusted through central coordination. Producers have accepted the Program positively since the very beginning as it was also created in order to minimize the difficulties frequently faced by the sugarcane sector due to the excess of sugar production and fluctuations of its international prices. In addition, the required investment was assured by credits given at low interest rates and risks were extremely reduced as sales were guaranteed and prices were controlled – both for sugarcane and ethanol. In fact, fixed prices for producers and consumers played an essential role in the general trust of the program (van den Wall Bake et al. 2008).

Also aiming at assuring the supply, during the 1970s and 1980s, the government has obliged PETROBRAS to provide and operate the required infrastructure of transport, storage, blending and distribution. Eventual losses during ethanol commercialisation were also assumed by PETROBRAS.

In parallel, in order to induce consumption, the government negotiated with the automobile industry[3] to introduce the required modifications in engines and parts. As the share of ethanol in the fuel blend is large, more

[2] Text based on Walter (2008): Bio-ethanol Development(s) in Brazil; in: Soetaert W. and Vandamme E. (Editors). Biofuels.

[3] At that time, four main companies were based in Brazil.

modifications are required[4] (Coelho et al. 2006). In the early 1980s, the automobile industry has agreed to give full warranties to the consumers. The R&D efforts regarding engines able to run with blends and straight ethanol started at a federal research centre (Aeronautics Research Centre) where the development of engines and tests were performed. The first neat ethanol engine was commercially available in 1979 and technology was quickly transferred to the automobile industry.

On the other hand, the ethanol market was induced by mandates. In 1975, a mandate for 20% anhydrous ethanol (E20 – volume basis) on fuel blend was established. However, by the early 1980s the share of ethanol in all gasoline commercialised reached 20%. The ethanol share was reduced to 13% between 1989 and 1993, during a (domestic) supply ethanol crisis, while in 1993 it was defined by law that the share of ethanol in fuel blend should be in the 15–25% range (now the range is defined as 18-25%), depending on the conditions of the ethanol market. Since then, the lowest level reached was 20%. In practice, this relatively wide range allows the shift of production to more sugar (when it is convenient), allowing the producer to maximize its earnings. By the end of 2011, the share of anhydrous ethanol in the fuel blend is 20%.

Moreover, over the years consumers were stimulated to buy neat-ethanol cars through lower taxes regarding those applied over gasoline vehicles. In addition, fuel prices were controlled until the mid-1990s and ethanol prices to consumers were kept close to 65% of gasoline prices (volume basis). Direct subsidies were completely eliminated with the deregulation process that finished in the early 2000s. However, a tax exemption policy is in place and part of the benefits received by ethanol consumers is due to lower taxes applied to ethanol regarding those paid by gasoline consumers. Anyhow, it should be noticed that in Brazil the taxation applied to diesel oil is even lower than the corresponding tax applied to ethanol (about 27 % in 2005, on average) (Cavalcanti 2006).

In Brazil, taxes have a strong impact over the consumer's fuel price. Six different taxes and contributions have been applied over automotive fuels, with just one equivalent to the value-added tax (VAT). Local (state) taxes vary along the country and ethanol producer states used to apply lower values: for instance, in the state of São Paulo (the largest producer and consumer of ethanol in Brazil), the taxation over hydrated ethanol is lower than the tax applied to gasoline. An additional advantage for ethanol consumers is the lower value of the annual license paid by owners of neat-ethanol vehicles (including FFVs).

[4] For instance, for 25–100% ethanol in the fuel blend, modifications include materials substitution (e.g., of the fuel tank, fuel pump, and electronic fuel injection system) and new calibration of devices (e.g., of ignition and electronic fuel injection systems).

Biodiesel

As mentioned in section 2.2, biodiesel production has been fostered by the Brazilian government. For assuring the market, a B5 mandate (5% biodiesel, volume basis) has been in place since 2010 and all diesel oil is in fact a blend. The supply is coordinated by a federal agency that promotes regular auctions with upper prices defined in accordance to the international prices of vegetable oils. The bulk of the production is bought by PETROBRAS, which promotes blending. Biodiesel quality is assured by the regulatory body (ANP).

The higher price of biodiesel vis-à-vis mineral diesel induces a higher price paid by the consumers, but this is small due to the amount of biodiesel blended. Financial incentives through special credits were conceived for the construction of the industrial facilities.

Despite the early priority given to the production of feedstocks by family farmers, mainly in the poorest regions of the country, over the years the production has been dominated by large corporations, such as soybean and soy oil producers and large processing meat industries. As previously mentioned, more than 80% of the production is based on soy oil and approximately 13% based on bovine tallow; just the balance is produced from feedstocks, considered the priority in the early stages of the program. This is a consequence of the fact that the government agreed to anticipate the mandate targets, pushed by the economic sectors that have an interest in diversifying its production.

The support given to the production of feedstocks by small farmers is still in place as a minimum share is required for participating in the auction processes. Biodiesel producers need to hold a certificate – called Social Label – that is issued by the Ministry of Agrarian Development (MDA). The bulk of production by small farmers has been of soybean, in south Brazil, where the production is much more organized than in the north and northeast regions.

SPECIFIC POLICIES RELATED TO BIOFUELS PRODUCTION

This section is devoted to the analysis of special policies related to biofuels production. The cases addressed correspond to actions for controlling land use for feedstock production (e.g., sugarcane), for fostering mechanised harvesting, and for inducing science and technology developments.

Control on land use

Land use and land use change are worldwide issues of special concern regarding the production of biofuels. Brazil is a special case, as land availability is huge in comparison to its population and economic activity, but even then specific regulations have been defined for reducing the negative impacts of feedstock production for biofuels.

The figures for 2009 are that forests and native vegetation covered 58% of total country area (498 Mha out of 851 Mha). The arable land that year was estimated at 338 Mha (about 40% of the total) and 55 Mha were occupied by different crops (c.a., 6.5%), 172 Mha by pastures (c.a., 20%) and 103 Mha were still available (c.a., 12%) (UNICA 2011). It is estimated that at least 40 Mha used as pasturelands correspond to degraded land, in different levels. The area cropped with sugarcane in 2010 (8.1 Mha) represented less than 1% of the total area and 2.4% of the arable land; the area cropped for ethanol production in 2010 represented 1.3% of the estimated arable land.

In a study released in 2008 (Miranda et al. 2008) it was concluded that the area legally available for agriculture and cattle herd is 209 Mha (i.e., 62% of the area considered arable, as presented above). In this estimate almost 230 Mha were excluded as they correspond to conservation areas and areas reserved for indigenean people (according to the law), and additionally 413 Mha were excluded because the natural vegetation in this area should be preserved according to the current Forest Code (about 144 Mha would be riparian areas and 269 Mha should be set aside for keeping natural vegetation). Thus, the cropped area with sugarcane for ethanol production in 2010 occupied 2% of the area legally available for agriculture and livestock.

In order to reduce the pressure over natural vegetation due to sugarcane expansion, the Brazilian government developed an Agro-Ecologic Zoning (AEZ) that was released in 2009 (EMBRAPA 2009). The AEZ is not a law and the regulatory action is based on financial constraints: no public credits can be given for companies that produce sugarcane in areas considered inadequate. Evaluating such adequate areas, first, the biomes Amazon and Pantanal were completely excluded and, second, topography and climatic constraints were considered, besides soil quality and water availability. In addition, areas already occupied with other crops were also not taken into account.

The results of Agro-Ecologic Zoning for sugarcane are shown in Figure 6.6. It is estimated that 63 Mha (total) are adequate for sugarcane cropping, with 36 Mha currently occupied with pasturelands; 18 Mha are considered with very high potential for sugarcane production (EMBRAPA 2009).

The estimated total production of ethanol in 2019 (64 BL) (EPE 2011) would require about 10 Mha cropped with sugarcane. Thus, the results of the Agro-Ecologic Zoning show that it would be possible to significantly enlarge the production without any (direct) serious environmental damage due to land use change.

Recently, the Brazilian government has decided to go for other specific agro-ecologic zonings. For instance, the results of the study for palm oil show that 30 Mha could be used for this purpose, with the bulk in areas already deforested at the Amazon region and in specific regions at the coast line, in the northeast and southeast (Marin 2011).

Figure 6.6: Results of the Agro-Ecologic zoning for sugarcane

Note: Green areas correspond to those adequate for new sugarcane production (dark green more adequate, light green less adequate) (red area = Amazon region; blue areas = Pantanal region)

Source: EMBRAPA (2009)

Inducing mechanised harvesting

In Brazil, a law forbids the open burning of agricultural residues as well as for cleaning the area prior to the harvest. However, the law's regulation varies among the different states of the country. In the state of São Paulo, where about 60% of the sugarcane production occurs, the regulation and a further agreement among the main players define that sugarcane burning will be completely forbidden in 2017. In 2011, in the state of São Paulo, about 65% of the sugarcane was harvested by machines. In some other states in the central and southeast regions similar regulations also exist.

As a consequence of the phasing-out of sugarcane burning, manual harvesting will vanish as well. In practice, without previous burning of the sugarcane field it is very difficult (due to biomass density) and unfeasible to go for manual harvesting. A single harvester displaces 80-100 men and jobs will be drastically reduced. On the other hand, as manual harvesting imposes very tough working conditions, mechanization is understood as beneficial, but the problem is that it would be necessary to create working opportunities for a large number of people with very low skills. In Brazil, currently, there are requalification programs for such workers but it is necessary to close monitor further developments. The phase-out of sugarcane burning is mainly due to environmental, agronomic and economic reasons; the potential positive social impacts are side effects.

With the mechanic harvesting of unburned cane, straw could be left on the ground or even recovered to be used at the mill site. Besides the potential use of this straw as feedstock for electricity generation, for instance, there are several agronomic benefits of the straw blanket left on the ground, such as soil protection against erosion, increase of soil organic carbon content, inhibition of weed growth, nutrient recycling, and reduction of soil water losses, to name a few. On the negative side, the potential main impacts seems to be the risk of fire in the cane field, delay of ratoon sprouting in some cane varieties, increase in pest types and populations, increase in NO_2 emissions, and the difficulty to perform some agronomic operations. The balance of the negative and positive impacts with the economic and energetic value of the straw indicates that there must be a range of values of the straw left on the ground, associated with the straw recovered for economic use, which could be considered optimal.

Fostering science and technology

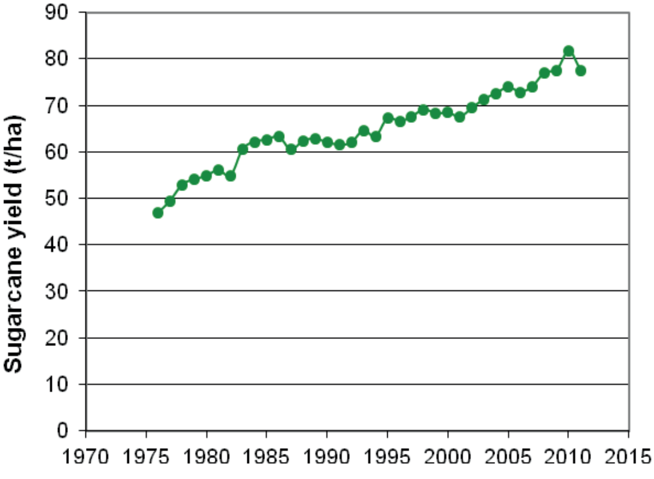
Brazil has the lowest production cost of ethanol and is so far the only country where biofuels are strictly competitive vis-à-vis oil derivatives. Figures about production costs of ethanol in Brazil vary due to set of mills and also according to the exchange ratio that is used. On average, ethanol production costs fell 3.2% per year in the south-south region since 1975 and about 1.9% per year in the northeast region (Walter 2008). In 2010, it was estimate that the production cost of hydrated ethanol would be in the range 320-380 US$/m^3, with sugarcane representing 60-65% of the total cost (Gouvello 2010). The production cost of anhydrous ethanol is about 5-10% higher than the cost of hydrated ethanol.

Since 1975, ethanol production costs have reduced, on average, down to 30% of the initial costs. Feedstock (sugarcane) cost reduction was mostly due to the development of new varieties of sugarcane with indirect impacts on costs of soil preparation, planting, stock maintenance and land rents. Industrial processing costs were reduced more due to economies of scale, with impacts on investments and on operation and maintenance costs. Furthermore, up-scaling led to vertical chain integration that indirectly allowed optimization of the production chain (van den Wall Bake et al. 2008).

Comparative advantages of ethanol production in Brazil are mostly due to the technological developments that have been conducted for many years in private companies, research centres and universities. More oriented R&D efforts started in the 1970s with adaptation and optimization of technologies from other sugar and ethanol producing countries, and further with the development of technologies more suited to the local conditions (Walter 2008). Figure 6.7 illustrates the evolution of the agricultural yields in Brazil (average values) from 1975 to 2010; in this period the growth was 65%, with an average annual rate of 1.4%. The lack of adequate investments during the last years explains the recent fall of productivity.

Due to the technological developments achieved both in the agriculture and industry sectors, average combined production yields have grown from 3,000 litres/ha/year (67 GJ/ha/yr) in the early 1980s to 6,640 litres/ha/year (148 GJ/ha/yr) in 2009 (in 2009, the average figure in the state of São Paulo was 7110 litres/ha/year, or 158 GJ/ha/yr). Best practices would allow yields higher than 8000 litres/ha/year even just with conventional production processes.

Figure 6.7: Average agricultural yields of sugarcane from 1975 to 2010



Sources: MAPA (2009) and CONAB (2011) for 2009 and 2010

Also regarding policies for supporting science and technology developments aimed at biofuels production, a good example is the creation in 2008 (inauguration of the facilities in 2010) of the Brazilian Bioethanol Science and Technology Laboratory (CTBE). CTBE is a national laboratory with focus on innovative and sustainable production of ethanol from sugarcane and has five research programs with focus on agriculture, industry, science, technology assessment and sustainability. The main targets up to 2016 are (a) the development of a new agricultural machine that will allow deep reduction of the compacted area and further introduction of no-tillage practices and (b) the development and the scaling-up of ethanol production process through hydrolysis of sugarcane bagasse and straw. Regarding sustainability, the aim is the assessment of the current and new technologies of sugarcane and ethanol production, both in conventional and new areas; the focus has been on assessing greenhouse gas emissions, impacts on water resources, impacts on biodiversity and socio-economic impacts (CTBE 2011).

PERSPECTIVES ON BIOFUELS PRODUCTION

The domestic consumption of fuel ethanol in Brazil was 23.3 BL in 2010 and it is predicted that it could reach 52.4 BL in 2019 (EPE 2011); that would correspond to an average annual growth rate of 9.4%. The average annual growth rate of the domestic consumption of fuel ethanol since the introduction of flex-fuel vehicles in Brazil was 11%, over seven years (2003-2010). The same study (EPE 2011) predicts that the ethanol exports could reach 9.9 BL in 2019; this figure seems conservative when compared with the exports in 2008 (more than 5 BL) but is too optimistic compared with recent net results of ethanol trade (1.8 BL in 2010 and less lower than 1 BL in 2011[5]).

The domestic market of fuel ethanol will depend on the competitiveness of ethanol vis-à-vis gasoline, and this will require continuous enlargement of ethanol production and reduction of the production costs. There is no reason to doubt the success of FFV's technology while other energy options for automobiles, such as electric and fuel cell vehicles, seem to be far from being economically feasible.

Regarding exports, about 10 BL is an achievable target depending on the policies of the main consumer markets – currently US and EU. However, considering that (a) the targets of domestic consumption in US, (b) Brazilian ethanol has been recognised in US as an advanced biofuel (due to saved GHG emissions higher than 50% vis-à-vis automotive gasoline), (c) import duties are no longer applied over ethanol in US (since January 2012) and (d) production costs are too high in Europe, the target seems feasible. Here the challenge is also the enlargement of the production with low costs, but also sustainability should be enhanced due to the existing initiatives, mainly in Europe.

In order to fulfil both targets it would be necessary to enlarge the production at an annual average rate of 9.6%, that is close to the result achieved from 2000 to 2010 (10.1% per year). The issue right now is that the enlargement of the production should be on less traditional production areas, mainly in the

[5] Exports totalled 1.96 BL while imports totalled 1.14 BL; imports of ethanol have been almost nil for about 10 years (MDIC 2011).

central part of Brazil. That would require large-scale production in an environment that is different compared with the state of São Paulo and neighbouring regions, where rainfall, climate and soil conditions are very adequate for sugarcane production. In addition, as the central part of Brazil is a region with less anthropogenic impacts, sustainability is an issue to be considered as a high priority.

It is also worthwhile to mention the efforts on developing technology for the production of second-generation ethanol from sugarcane residues (bagasse and straw), aimed at keeping advantage of the very adequate production conditions in southeast Brazil, and exploring synergies of co-production with conventional ethanol.

On the other hand, the perspectives regarding biodiesel production are much less ambitious than in the case of ethanol, both considering the consumption in mid-term and the innovations within the production chain. In order to keep the target of B5 blends it would be necessary to produce about 4.2 BL in 2019, which would represent a 5.9% average annual growth rate of the production during the period; this is a relatively modest target, considering that it is estimated that the production grew 10% in 2011. The target corresponds to the aim of producing biodiesel just for the domestic market, with no ambitions for exporting.

Considering the feedstocks, no important change is predicted up to 2019: according to an energy planning study with focus on 2019 (EPE 2011), the production that year would be mostly based on soy (78%) and bovine tallow (16%). Regarding technologies, it is also predicted that there will be no big changes in the following years.

These predictions correspond to the understanding that the most organized economic sectors will keep advantage of the existing biodiesel domestic market. The partial displacement of mineral diesel allows the reduction of its imports (e.g., 9 BL were imported in 2010) but this is not necessarily an economic advantage for Brazil.

From the point of view of sustainability, the production of biodiesel has been much less studied in Brazil than ethanol production. As long as part of the production has been based on bovine tallow and production based on soy oil has not caused additional production of soy beans (Cunha 2011), the environmental impacts could be considered reasonable. However, there is a lot to be studied for a definitive assessment, mainly because the enlargement of soy production has been blamed in Brazil (and abroad) for deforestation.

The final point to be addressed is regarding the importance of policies and regulatory actions as long as the deployment of biofuels production and consumption are considered. First, it is obvious that the market needs to be created through mandates, and that the higher initial production costs oblige financial and/or fiscal incentives. Second, the production chain of biofuels is much wider than those of conventional energy vectors, such oil and oil derivatives, and coordination is essential. This aspect is also related to the required infrastructure (e.g., existence of agricultural machines, the supply of fertilizers, required storage facilities, roads, etc.) and to the fact that activities based on agriculture are much less predictable than those based on mining. In this sense, it is important to notice that even in Brazil, with more than 35 years of experience on large-scale production of ethanol, the reliability on biofuels supply can be seriously impacted due to the lack of planning, as has been recently noticed.

CONCLUDING REMARKS

Brazil is an important producer of liquid biofuels in the world, being the second largest producer of both ethanol and biodiesel. The production of ethanol is more traditional than biodiesel; it is at least 10 times larger and the short- to mid-term aims are much more ambitious. Brazil has the potential of being a large exporter of ethanol even considering trade barriers imposed by the main markets and the requirement of sustainability initiatives. In the case of biodiesel, it is clear that the target for the following 10 years is supplying the domestic market that was created by a B5 mandate.

The production of biodiesel depends on the financial support of the federal government as the opportunity cost of vegetable oils is higher than the production cost of mineral diesel. The main arguments presented when the biodiesel program was launched are questionable, as currently the security of energy supply in Brazil does not seem to be a high priority; the environmental benefits have not been properly evaluated; and the benefits to small farmers have been tiny.

On the other hand, the ethanol production sector has been deregulated in a large extent for years and subsidies are no longer required. However, it is clear that the lack of coordination and of proper planning can impose drawbacks on the supply chain, as has been noticed since 2009. In addition, the challenges to be faced by the sugarcane and ethanol industries are much higher, as the production shall enlarge significantly in the mid-term, expansion must occur in less traditional areas, new technologies should be available in the market, and sustainability is a crucial issue both for the international and domestic markets.

References

Amaral, WAN et al. 2008. A Sustainability Analysis of the Brazilian Biodiesel. Report to the UK Embassy in Brasília and to UK Department for Environment, Food and Rural Affairs (DEFRA).

ANFAVEA – Brazilian Association of Automotive Industry. 2011. Data available at http://www.anfavea.com.br.

ANP – Agency of Oil, Natural Gas and Biofuels. 2011. Information available at www.anp.gov.br.

Cavalcanti, MCB. 2006. Análise dos Tributos Incidentes sobre os Combustíveis Automotivos no Brasil, Master Thesis, Federal University of Rio de Janeiro, Rio de Janeiro, p. 213.

Coelho, S, Walter, A, Goldemberg, J, Schiozer, D, Moreira, F, Tiago Filho, GL, Geller, H, Guardabassi, P, Schaeffer, R, Suslick, S. 2006. "Efficiencies and Infrastructure Brazil - a country profile on sustainable development", chapter 4 of *Indigenous Energy Technologies*, 1st ed. International Atomic Energy Agency, Vienna, p. 252.

CONAB – National Company of Food Supply. 2011. Sugarcane Crop Assessment 2011, December. Available at www.conab.gov.br

CTBE – Brazilian Bioethanol Science and Technology Laboratory. 2011. Information available at www.bioetanol.org.br.

Cunha, MP. 2011. Avaliação de impactos e indicadores socioeconômicos e ambientais de rotas de produção de biodiesel no Brasil, baseada em análise de insumo-produto. Ph.D. Thesis, University of Campinas (Unicamp), Campinas, p. 258.

EMBRAPA – Empresa Brasileira de Agropecuária. 2009. Zoneamento Agroecológico da Cana-de-Açúcar. EMBRAPA Solos. Documento 110. Rio de Janeiro.

EPE – Empresa de Pesquisa Energética. 2011. Plano Decenal de Expansão de Energia 2019. Brasília.

EPE/MME – Empresa de Pesquisa Energética/Ministério das Minas e Energia. 2011. Brazilian Energy Balance 2010. Brasília.

Gouvello, C. Estudo de Baixo carbono para o Brasil. 2010. Energy Sector Management Assistance Program. The World Bank. Washington

Jank, MS. 2008. Overview of the Brazilian ethanol market. IFA Technical Symposium – Food, Fuel and Climate: Challenges for the fertilizer industry. São Paulo. March. Available at www.unica.com.br.

MAPA – Ministério da Agricultura, Pecuária e Abastecimento. 2009. Anuário estatístico da agroenergia. Brasília, 160 p.

Marin, F. 2011. Agroecological Zoning for Biofuels: The Brazilian Experience. Embrapa Agriculture Informatics. Presentation available at www.bioenergytrade.org.

Miranda, EE, Oshiro, OT, Victoria, DC, Torresan, FE, Carvalho, CA. 2008. O alcance da legislação ambiental e territorial. Revista Agroanalysis. São Paulo, SP, p. 25-31.

MDIC – Ministério do Desenvolvimento, Indústria e Comércio. 2011. Information available at www.mdic.gov.br.

Pousa, GPAG, Santos, ALF, Suarez, PAZ. 2007. History and policy of biodiesel in Brazil. Energy Policy 35, pp. 5393–5398.

UNICA – Brazilian Sugarcane Industry Association. 2011. Presentation "Desafios do Crescimento e Competitividade do Setor Sucroenergético", by Jank, M. Available at www.unica.com.br.

van den Wall Bake. JD. 2006. Cane as key in Brazilian ethanol industry - understanding cost reductions through an experience curve approach. Master Thesis, Utrecht University, Utrecht, p. 82.

van den Wall Bake, JD, Junginger, M, Faaij, A, Poot, T, Walter, A. 2009. Explaining the experience curve: Cost reductions of Brazilian ethanol from sugarcane. Biomass and Bioenergy, 33(4), pp. 644-658.

Walter, A. 2008. Bio-ethanol Development(s) in Brazil. in: Soetaert W. and Vandamme E. (Editors). Chapter 4 of Biofuels. John Wiley & Sons, Ltd.

Chapter 7

Transition to Sustainability: Energy Demand and Supply in Malaysia

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ABSTRACT

Malaysia's rapid economic growth, increasing population and personal consumption is leading to an increasing energy demand which compounds the issues relating to sustainable development and national energy security. The total primary energy supply is projected to more than double its 2005 value, increasing from 66 Million Tons of Oil Equivalent (Mtoe) in 2005 to 130 Mtoe in 2030, where fossil fuel is expected to constitute more than 90% of the total primary supply. To meet the energy supply requirements and due to the country's depleting indigenous energy resources, the country's net energy export of 27 Mtoe in 2010 is expected to be overturned into a net energy import of 48 Mtoe in 2030. This study has identified two main issues that may affect sustainable development and energy security, namely over-dependence on fossil fuel and increasing energy consumption per capita contributing to global warming through the generation of green house gases. This paper will discuss the energy policy and recent energy demand trend and also analyze the energy demand projection up to 2030 and the expected challenges to achieve sustainable development.

BACKGROUND

In the past 50 years, Malaysia has shown remarkable economic and social progress. It has achieved the Millennium Development Goals' primary objective of halving poverty, whereby the aggregate figure fell from 17% in 1990 to less than 4% in 2009 (United Nations Country Team 2011). To a large extent, this success is made possible by an invariably high Gross Domestic Product (GDP) growth rate, which hovered above 9% before the hit of the Asian Financial Crisis in 1997. From 2000 to 2007, Malaysia registered a high growth rate at an average of 5.1% per annum to reach RM 506,341 million (2000 constant price) in 2007. After the sub-prime crisis in 2008 which led to the global economic crunch[1], Malaysia's economy has again posted a positive growth in 2010, amounting to RM 552,115 million (2000 constant price) (DOS 2011). In addition, Malaysia's GDP per capita rose 2.6 times from 1980 to 2010, to reach RM 19,000 in 2010 (DOS 2011).[2]

The increase in per capita income has brought an improvement in life-style and also economic activity which in turn spurred significant increases in demand for energy in industry, commercial and residential sectors (Ong et al. 2011; Chua and Oh 2010). The scenario of soaring energy demand may negatively affect sustainable development by diminishing the country's energy security in two ways. One, increasing dependence on energy imports and two, contributing to global warming through the generation of Green House Gases (GHG).

Malaysia's increasing per capita energy use, if prolonged, will result in overconsumption that will end its energy-exporting status. Malaysia's total final energy demand is expected to almost double between 2010 to 2030, from 47 Million Tons of Oil Equivalent (Mtoe) in 2010 to almost 93 Mtoe in 2030 (APERC 2009; KETTHA 2008). The total primary energy supply is projected to more than double its 2005 value, increasing from 66 Mtoe in 2005 to 130 Mtoe in 2030, where fossil fuel is expected to constitute more than 90% of the total primary supply.

Malaysia's over dependence on fossil fuels as the main source of energy is at odds with the recent global switch to renewable sources in response to the onset of global warming. The increasing energy demand is expected to cause an increase in Malaysia's emissions of anthropogenic GHG. The energy sector alone accounted for 66% of total emissions in 2000. The total GHG emissions are projected to increase from 223.1 $MtCO_2$ equivalent in 2000 to 375.4 $MtCO_2$ equivalent in 2020 (The Second National Communication 2010).

Against this background, this paper asks what is the extent of energy consumption in Malaysia and what will the scenario be in the forthcoming decades. By extension, it also seeks to answer what are the prospects for future energy policies towards global sustainability challenges. Section two provides an overview of Malaysia's energy resources profile particularly the recent energy demand trend and its projection up to year 2030. It points out that the voracious domestic demand and a depleting energy resource base constitute the major energy security challenges for Malaysia. Section three surveys the implications of the rising energy demand on Malaysia's public policy. Section four then reviews the development of policy responses by the Malaysian

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[1] Real GDP at 2000 constant price: for year 2007 (RM 506,341 million), 2008 (RM 530,181 million), 2009 (RM 291,095 million), 2010 (RM 552,115 million). The year on year growth rates were 4.7 %, -1.7% and 6.0 % respectively.

[2] The population of Malaysia increased at an average growth rate of 2.5% %per annum from 1980 to 2010, rising from merely 13.9 million in 1980 to 28.9 million in 2010 (DOS 2011).

government since the 1970s to ensure the continuity of energy supply for industrial development. Before concluding, section five examines a range of deeper policy options needed to ensure Malaysia's energy sector is placed on a sustainable trajectory.

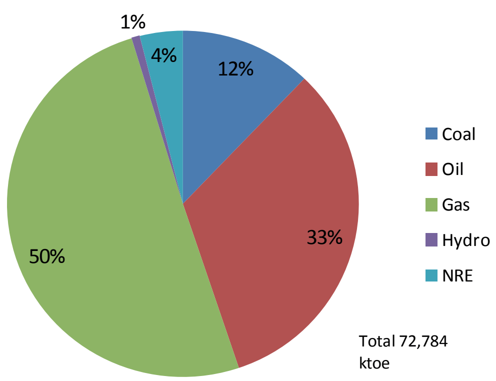
ENERGY DEMAND TREND AND OUTLOOK

Malaysia's economic growth has for the past two decades been strongly backed by the energy sector, particularly oil and gas exports. The increase in domestic production of oil and gas has allowed the population to enjoy a healthy increase in energy consumption, with primary energy supply per capita increasing 128% between 1990 and 2008. Plentiful and cheap energy has resulted in a highly inefficient mode of consumption, with 2009 primary energy intensity at 0.49 (toe per thousand 2000 USD GDP) compared to the world average of 0.31. The following subsections compare recent energy demand with the projection of demand for the year 2030.

Recent Energy Demand and Supply

Like most countries, Malaysia is still very much dependent on fossil fuels as a source of energy supply. Oil and gas have maintained a share of over 80% of primary energy supply from 1998 to 2007, although this has steadily decreased from 91% in 1998 to 83% share in 2007. The share of coal in primary energy supply, however, has experienced a slight increase from 3% in 1998 to 12% in 2007 (Figure 7.1) (IEA 2009). The dominance of fossil fuels is true even in electricity generation whereby 80% of installed capacity in 2005 was based on fossil fuels, 10% on large- and mini-hydro, and negligible capacity based on new and renewable energy (NRE).

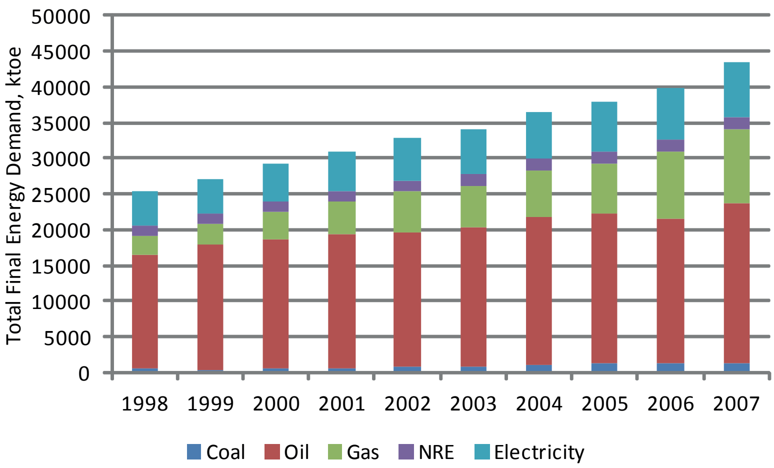
Figure 7.1: Malaysia's Primary Energy Supply in 2007



Source: IEA, 2009

As for final energy demand, oil accounted for the largest portion of final energy demand although that has reduced from 62% in 1998 to 51% in 2007[3] (Figure 7.2). The high percentage share of oil was mainly due to the transport sector which accounted for 51% of total oil demand in 1998 and 60% in 2007. The decreasing share of oil in the final energy mix, on the other hand, was mainly due to the switch from oil to gas in the industry sector. This also led to an increase in the share of gas in the final energy mix, from 11% in 1998 to 24% in 2007 (Figure 7.2). Industry accounted for the largest share in total final energy demand, ranging from 39% to 44% between 1998 and 2007, followed closely by the transport sector at around 32% to 31% in the same period.

Figure 7.2: Final Energy Demand by Sources from 1998 to 2007



Source: IEA, 2009

Energy Demand and Supply Outlook

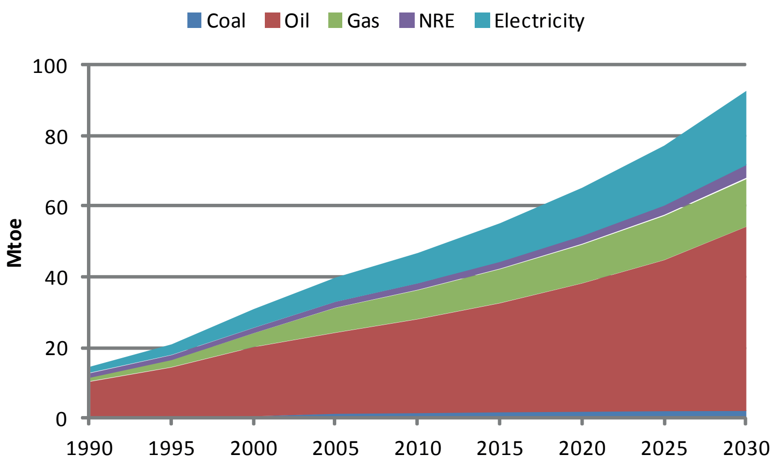
The Malaysian economy is projected to grow at an average annual growth rate of 4.5% annually between 2005 and 2030, with real GDP increasing from 300 billion USD in 2005 to 843 billion USD in 2030 (PPP at 2005 constant price) (APERC 2009). The increase is attributable to growth in both the industry and service sectors. Malaysia's population is expected to grow at a rate of 1.3% per annum during the same period, with population increasing from 26 million in 2005 to 35 million in 2030 (APERC 2009). The resulting increase in GDP per

[3] Oil demand increased at an average rate of 4.0% p.a. between 1995 and 2004.

capita[4], hence standard of living, is expected to lead to a substantial growth in energy demand from the transport, commercial and residential sectors.

The Final Energy Demand for Malaysia is expected to experience a fast growth of 3.4% p.a. between 2005 and 2030, increasing 2.3 times its 2005 value to reach about 93 Mtoe in 2030 from 39 Mtoe in 2005 (Figure 7.3) (APERC 2009). Oil is expected to remain the most consumed final energy-type – maintaining its share above 50% from 2005 through to 2030, albeit with a slight decrease from 58% in 2005 to 56% in 2030 (Figure 7.3). The bulk of oil demand will arise from the transport sector which is expected to show the fastest demand growth to become the biggest energy consuming sector (40% of total final energy), followed by industry (39% of total final energy).

Figure 7.3: Final Energy Demand by Sources, 1990 to 2030



Source: APERC, 2009

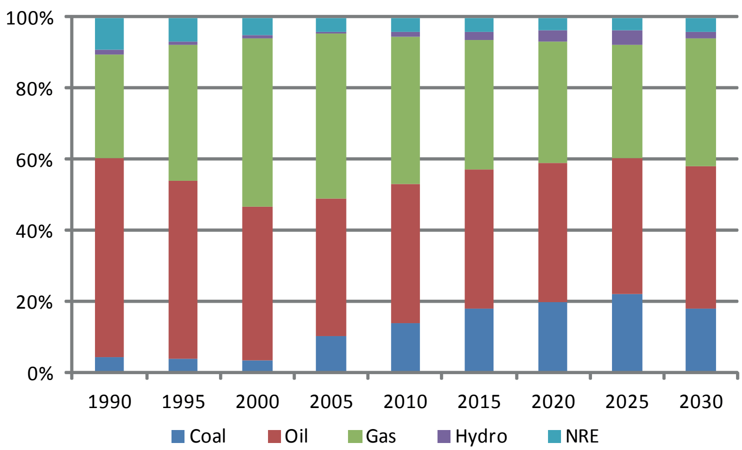
The share of gas is also expected to decrease slightly from 17% to 15% (Figure 7.3), with demand as a final energy arising mostly in industry (68.7%). The decreasing shares of oil and gas in the final energy mix are attributable to their displacement by electricity and NRE, which are the two fastest growing final energy-types at 4.5% p.a. and 3.5% p.a., respectively. The growth in electricity demand will be led by industry and other sectors to increase from its share from 17% to 23% of total final energy demand. The growth in demand from NRE, on the other hand, will be led by the transport sector although NRE's share in the final energy mix will remain very small at 4% (Figure 7.3). Coal

[4] GDP per capita is expected to more than double from USD 11,678 in 2005 to USD 23,973 (PPP at 2005 constant price) in 2030 (APERC 2009).

will maintain its share of the total final energy demand at around 3% from 2005 to 2030, with demand as a final energy arising mostly in industry.

Total Primary Energy Supply is expected to grow at a rate of 2.8% p.a. between 2005 and 2030, almost doubling from 66 Mtoe in 2005 to 130 Mtoe in 2030. Oil is projected to account for 39 to 40% of the total primary energy supply throughout the projection period, growing at rate of 2.9% p.a. Gas supply is expected to grow at a relatively slow rate of 1.8% p.a. with its share in total primary energy supply projected to decrease to 36% in 2030, down from 46% from 2005. On the other hand, coal supply is expected to increase fastest at a rate of 5.0% p.a., with a share increasing from 10% in 2005 to 18% in 2030 (Figure 7.4) (APERC 2009).

Figure 7.4: Primary Energy Supply in Malaysia, 1990-2030



Source: APERC, 2009

It is clear that a significant displacement of gas in the primary energy mix is expected due to an increasing dependency on coal in electricity generation and the expansion of hydropower capacity as the Bakun dam comes online (Figure 7.4). Coal is expected to show the fastest increase among all the primary energy-types at a rate of 5.0% p.a. Its consumption is split roughly 60:40 between industry and other sectors, with consumption in the former as a primary energy form and consumption in the latter in the form of electricity.

Oil is projected to constitute negligible amounts of input by 2015 as a result of government decision to reduce oil consumption in industry and electricity generation. However, oil is projected to maintain its share of energy input for industry, with absolute amounts increasing some 130% to 12.7 Mtoe in 2030. Further, primary oil supply will remain high due to the higher demand from the transport sector. This sector is projected to consume 35 Mtoe of oil in 2030 which roughly amounts to 27% of the total primary energy supply in the same year, compared to 5.5 Mtoe or 22% of total primary energy supply in 2005.

NRE is projected to remain a very small contributor to the total primary energy supply even as its supply expands 85%, from 2.8 Mtoe in 2005 to 5.2 Mtoe in 2030, with the expansion almost entirely due to the utilization of liquid biofuels in transport (which is set to become the biggest consumer of NRE by 2030).

IMPLICATIONS FOR POLICY AND SUSTAINABILITY

Energy issues occupy a central place in the debate on sustainable development (Najam and Cleveland 2003). On one hand, energy is a key motor of economic growth, which is desirable for developing countries to meet the basic needs of their present and future generations. On the other hand, since economic growth is a physical process of transforming materials into goods and services, the use of energy in this process has resulted in it becoming a key source of environmental stress at global and local levels. Together, the energy issue becomes a complex or 'wicked problem' for public policy to address as there are many trade-offs involved. The analysis in the foregoing section specifically points to at least three issues that relates to energy security and subsequently sustainable development. These are: overconsumption and dependence on fossil fuel; the economic growth-energy nexus; and the possibility of Malaysia becoming a net energy importer.

Overconsumption and Fossil-Fuel Overdependence

The share of fossil fuels in the primary energy supply is projected to be around 90%, increasing from about 63 Mtoe in 2005 to 123 Mtoe in 2030. The high and continuous demand for fossil fuels, coupled with the depleting domestic fossil fuel reserves, is expected to result in increasing the country's net import from -22 Mtoe in 2015 to almost 18 Mtoe in 2030 (APERC 2009). The trends of macroeconomics, energy demand and supply and energy intensity illustrated in Table 7.1 has confirmed that the primary fossil fuel dependence will be very high, that is, around 90% share of the total primary energy supply.

Final energy demand per capita is expected to increase steadily throughout the projection period; increasing from 1,535 toe per capita in 2005 to 2,654 toe per capita in 2030 in tandem with the increase in GDP per capita (Table 7.1). It is projected that the energy consumption per capita of 1,535 toe in 2005 will spike to 2,654 toe per capita in 2030. This is because the increase of the GDP per capita[5] will bring about a substantial increase of energy demand for the transport, commercial and residential sectors (Figure 7.5).

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[5] GDP per capita is expected to increase more than double from 11,678 USD PPP at 2005 Prices in 2005 to 23,973 USD PPP at 2005 Prices in 2030 (APERC 2009).

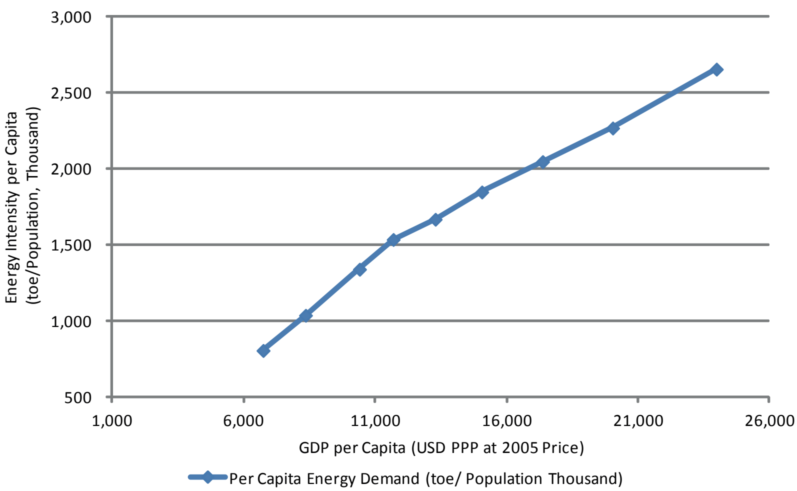
Table 7.1: Major Macroeconomic and Energy Indicators for Malaysia

	1990	1995	2000	2005	2010	2015	2020	2025	2030
MacroEconomics									
GDP (USD Billion PPP at 2005 Price)	122	172	242	300	369	451	554	681	843
Population (Million)	18	20	23	26	28	30	32	34	35
GDP Per Capita (USD PPP at 2005 Price)	6,727	8,343	10,396	11,678	13,277	15,048	17,360	20,028	23,973
Energy Demand and Supply									
Primary Energy Supply (Mtoe)	23	35	51	66	72	80	91	105	131
Fossil Fuel Dependency (%)	89%	90%	94%	95%	93%	93%	94%	95%	94%
Final Energy Demand (Mtoe)	15	21	31	40	47	55	65	77	93
Per Capita Final Energy Demand and Energy Intensity									
Per Capita Energy Demand (toe/ Population Thousand)	806	1,037	1,339	1,535	1,667	1,847	2,046	2,267	2,654
Energy Intensity, toe/GDP, USD Million	119	123	127	220	196	176	165	154	155

Note: Total Final Energy Demand (TFED), Total Primary Energy Supply (TPES).
Source: Adapted from APERC, 2009

However, primary energy intensity (GDP)[6] is expected to decrease steadily throughout the projection period; reducing from 220 toe per one million of GDP in 2005 to 155 toe per one million of GDP in 2030.

Figure 7.5: Final Energy Demand per Capita vs. GDP per Capita 1990-2030



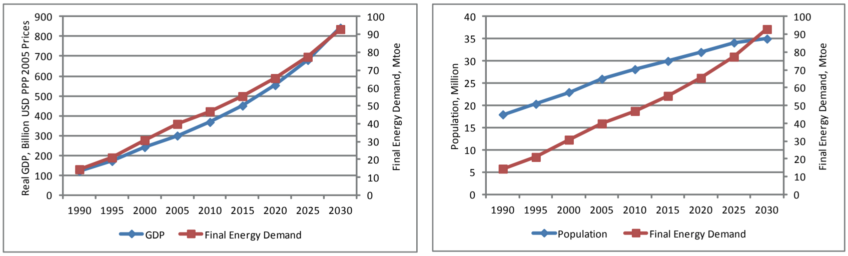
Energy and Economic Growth

Quantitative analysis on the projected energy demand and supply has been carried out to identify the issues and challenges related to sustainable development and energy security. The final energy demand is expected to increase in tandem with economic growth and increase in population (Figure 7.6). Econometric analysis by Chandran and collegues (2010) suggests that Malaysia is an energy-dependent country. Since energy is a principal ingredient of

[6] The amount of energy required to generate every RM1 million of GDP.

economic growth for Malaysia, 'any conservation policies or a shock to energy supply will have an adverse effect on economic growth' (Chandran et al. 2010). Consequently, Malaysia needs to install measures to encourage the decoupling of energy from economic growth.

Figure 7.6: Total Final Energy Demand versus GDP and Population Trend

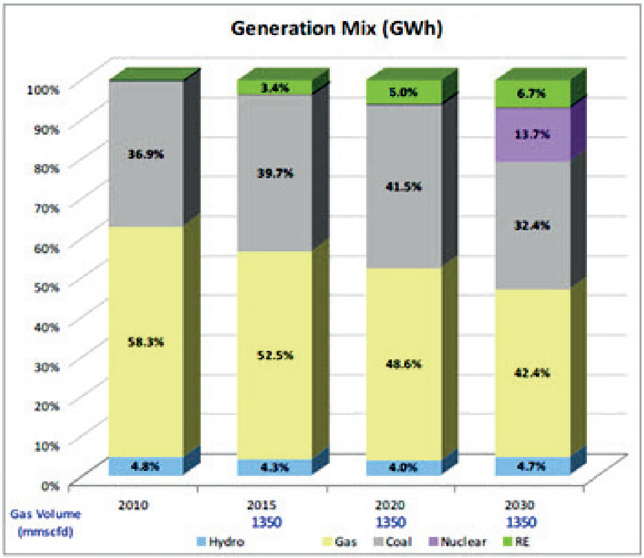


Dependence on Energy Imports

As of 1 Jan 2010, Malaysia has only 5.80 billion barrels of crude oil remaining, or no more than 24 years of current production. It also has 88.59 Tscf of natural gas remaining, equivalent to 38 years of current production. This indicates that Malaysia could become a net oil importer by 2022 and a net energy importer by 2026.

In 2005, Malaysia is a coal net importer at 6.4 Mtoe. Owing to the projected increase of coal utilization in power generation (Figure 7.7), coal net import is expected to increase further to 23 Mtoe in 2030. As for oil, in 2005 Malaysia is a net exporter at about 12 Mtoe; however, by 2030 the domestic demand is expected to exceed the domestic production, thus resulting in net import of 23 Mtoe in 2030. Fortunately, the domestic gas production is expected to meet the domestic demand, enabling the country to remain as a net gas exporter in 2030 (28 Mtoe) (APERC 2009).

Figure 7.7: Future Trend of Electricity Energy Generation Mix



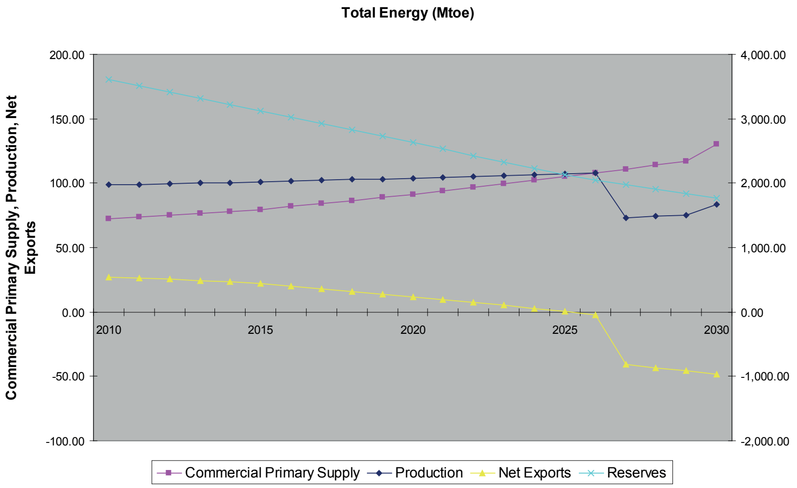
Peak Demand (MW)	15,072	17,963	21,227	25,817
Energy Generated (GWh)	100,991	119,902	142,254	173,008

Source: KETTHA, 2010

The total final energy demand is expected to almost double between 2010 to 2030, from 47 Mtoe in 2010 to almost 93 Mtoe in 2030,turning Malaysia from a net energy exporter into a net energy importer by 2026 (Figure 7.8) (APERC 2009; KETTHA 2008).

Malaysia's energy security could deteriorate significantly when it becomes a net energy importer. The risks arising from import dependency are most intense with respect to oil. This is because oil contracts typically allow for greater price volatility, with contract prices being more closely linked to the spot market prices. This subjects contract prices to greater degrees of geopolitical risks as the Middle East is expected to assume greater importance in world oil production. In addition, dwindling energy export profits threatens to unwind Malaysia energy subsidy 'system', thus directly exposing the population to the risks of price increases and volatility. The subsequent section reviews the development of energy policy in response to the changing meaning of energy security, driven as it were by the global energy scenario as well as the domestic trend of energy supply and demand.

Figure 7.8: Net Energy Export Position from 2010 to 2030



Sources: APERC, 2009; KETTHA, 2008
Note: The figure does not take into account new oil and gas reservoir discoveries.

POLICY RESPONSES FOR ENERGY SECURITY

Securing adequate supply of energy sources becomes a matter of strategic national interest for all nations including Malaysia. Fuelled by concerns over global warming, recent security thinking extends the traditional focus on energy security as mainly the questions of availability, accessibility and affordability to encompass newer concerns such as efficiency and sustainability (or environmental stewardship) (Sovacool & Brown 2010). As a net exporter of oil and gas, Malaysia has in the past gained a very large degree of security in terms of guaranteeing the availability of primary energy. With abundant energy resources, policy development from 1970s to 2000 had centred on the objective of energy availability, accessibility and affordability. From 2001 onwards, however, the security framework is broadened to include new objectives such as energy efficiency and sustainability. Like most countries, Malaysia's policy responses are an evolving agenda to suit the changing meaning of energy security.

First generation policies (1970s to 2000)

The earliest policy direction for the energy industry was formulated in 1975. The National Petroleum Policy was formulated with the objective of bringing about efficient utilization of petroleum resources for industrial development as well as ensuring national control over the management and operation of the petroleum industry.[7] The framework policy for energy, The National Energy Policy (1979), was formulated with three-pronged objectives:

- *Supply Objective*: To ensure the provision of adequate, secure and cost-effective energy supply by developing indigenous energy resources, both non-renewable and renewable, using least-cost options, and diversifying supply sources both within and outside the economy;
- *Utilisation Objective*: To promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption; and
- *Environmental Objective*: To minimize the negative impacts of energy production, transportation, conversion, utilization and consumption on the environment.

The National Depletion Policy of 1980 was formulated to prolong the life of the economy's oil and gas reserve. The policy, aimed at major oil fields of over 400 million barrels of oil initially in place (OIIP), restricted production to 1.75% of OIIP. However, the initial restriction proved too conservative, and in 1985, the ceiling was raised to 3% of OIIP. Due to this policy, total production of crude oil is limited to about 650,000 barrels per day. The National Depletion Policy was later extended from crude oil to include natural gas reserves. An upper limit of 56.6 MCM per day (2,000 million standard cubic feet per day) has been imposed in Peninsular Malaysia.

In the ensuing years, a series of policy statements were announced to diversify the country's fuel sources. The Four-Fuel Policy was adopted to complement the National Depletion Policy (1980) in ensuring the reliability and security of supply. This strategy was designed to reduce the country's dependence on oil, and its goal is to achieve an optimum mix of oil, gas, hydropower and coal in the supply of electricity. In addition to policy statements, suites of legislations were also promulgated. Key ones include during this period: Electricity Supply Act 1990 and Electricity Supply Act (Amended 2011); Electricity Supply (Successor Company Act 1990); and the Energy Commission Act 2000.

[7] The National Petroleum Policy (1975) goals are as follows: ensuring adequate energy supplies at reasonable prices to support national economic development objectives; promoting greater Malaysian ownership and providing a favorable investment climate, including creating opportunities for downstream industries; and developing oil and gas resources at a socially and economically optimal pace, while conserving these non-renewable assets and protecting the environment.

Second generation policies (2001- 2011)

The Five Fuel Policy was formulated under the 8th Malaysia Plan (2001-2005) to encourage the utilization of renewable resources such as biomass, solar, mini hydro, etc. as an additional source for electricity generation. This policy was introduced in 2001 to encourage the utilization of RE resources for power generation. To fast track the implementation of the Five-Fuel Policy, Small Renewable Energy Power Program (SREP) was introduced in the same year. Under this program, the utilisation of all types of RE sources including biomass, biogas, municipal solid waste, solar, mini hydro and wind are allowed. However low take-up rate[8] of the RE development under SREP, have led to the formulation of Renewable Energy Act 2010[9]. The Renewable Energy Act 2010 will provide for the establishment and implementation of a Feed-in-Tariff system to catalyse the generation of renewable energy. The Act envisages that about 3,484 MW of electricity, or 14% of total peak electricity demand, will be generated by RE resources by 2030.[10] The FiT scheme encourages adoption of RE sources by bridging the gap between the cost of fossil fuel and renewable sources. The Act ensures participants having a guaranteed access to the grid and through a long-term contract to sell electricity to the power distributors.

In 2009, the green technology portfolio was introduced into the rationalized Ministry of Energy, Green Technology, and Water. The National Green Technology Policy (2009) has five main objectives, one of which is directly relevant to the energy sector that is 'reducing the usage of energy while increasing economic growth'. The National Policy on Climate Change (2010) also highlights the Energy Efficiency in the supply and demand sector. Specifically it aims to consolidate the energy policy, incorporating management practices that enhances renewable energy (RE) and energy efficiency (EE) through: burden sharing between government and power producers; establishment of EE and RE targets/standards; inclusion of RE in generation mix by power producers; and promotion of RE generation by small and independent developers including local communities.

DEEPENING POLICY RESPONSES FOR SUSTAINABILITY

Managing the energy problems of a rapidly developing society like Malaysia will require changes in the structure and operations of its institutions. At the risk of stating the obvious, policy formulation alone will not help in prompting

[8] After almost nine years of its launching, only 10 SREP project is in operation amounting to 56.7 MW install capacity.

[9] Other legislation during this period include : The Efficient Management of Electrical Energy Regulation (2008); National Energy Efficiency Master Plan (in progress).

[10] National Renewable Energy Policy & Action Plan, 2010.

institutional change. It is imperative to move from articulation of policy statements to an implementation stage which is backed up by adequate resources. Apart from diversifying fuel mix to include alternative energy, Malaysia needs deeper policy responses that include improving demand management and rationalizing energy pricing and subsidy structure.

Alternative Energy

A diversification of energy mix, such as through widespread deployment of renewable energy technologies, has now passed pilot stage and is ready for full-fledged implementation. In addition, the government is also exploring alternative energy supplies. Malaysia is studying the option of adding 2 GW of nuclear capacity in the peninsula in 2021 or after. This amounts to less than 10% of the total generation capacity in 2008; as such they would not drastically improve the diversity measure at the national level. Nonetheless, they are almost equal to the total hydroelectric capacity in the peninsula (2.5 GW, including new additions of 0.6 GW). Therefore, nuclear power could make up 18% of CO2-free generating capacity in Malaysia by 2030 (2.6GW hydro in the peninsula, 5.8 hydro in East Malaysia, 0.9 GW solar PV, 2 GW nuclear). Furthermore, as nuclear power is calculated to have a lower levelized-cost than other fossil fuels, it has the potential to dampen electricity price increase when the gas pricing regime is liberalized, thereby having a positive influence on affordability. With respect to import dependency, Malaysia does not mine uranium and has no plan for an enrichment facility, meaning that it will be completely dependent on imports for nuclear fuel. However, this measure would overstate the risk of import dependency as the high energy density of nuclear fuel means that very little of it is required, and the long fuel-cycle of nuclear means that the importer can purchase fuel when the price is low.

Demand Management

There is a need to make major improvements in energy efficiency and conservation both in the supply and demand sectors. A study on the environmental impact of the Malaysia's Fuel Diversification Strategy showed a negative result of increasing amount of CO_2, SO_2 and NO_x emissions over the years (Jafar et al. 2008). To achieve environmental sustainability with the proposed fuel mix, greater emphasis must be given to improving the conversion efficiency of energy emissions. The National Energy Efficiency Master Plan (NEEMP) is established to achieve the Utilization Objective of the National Energy Policy (1979) to promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption.

Initiatives that have been undertaken to improve Energy Efficiency (EE) are categorized into three sectors, namely, Industry, Commercial and Residential. For the industry sector, the enforcement of *The Efficient Management of Electrical Energy Regulations* 2008 under the Electricity Supply Act will ensure that any installation which consumes more than 3 million units (kWh) of electricity over a period of six months will be required to engage an electrical energy manager responsible for efficient utilization of energy in the installation. As for the commercial sector, the government of Malaysia has taken several pro-active actions in promoting energy efficiency through the constructions and operations of several low-energy buildings, such as Low Energy Office (LEO) building of the Ministry of Energy, Green Technology and Water in 2004 and the Green Energy Office (GEO) of Malaysia Green Technology Corporation (MGTC) in 2008. A green building rating tool called the Green Building Index (GBI) has also been introduced for all types of buildings to encourage the construction of green buildings. The Code of Practice on the Use of Renewable Energy and Energy Efficiency in Non-Residential Buildings under MS 1525:2001 will be incorporated in the amendments to the Uniform Building By-Laws (UBBL) for all buildings in Malaysia. In the residential sector, the EE initiatives include the introduction of 'Star Labeling' in 2002, with five-stars products being the most efficient product and one-star being the least efficient products. Currently, four household appliances have been issued 'star labels', namely, television, refrigerators, domestic electric fans and air conditioners (split unit).

Subsidy Rationalization

One of the reasons for the high energy demand per capita is the subsidized fuel prices enjoyed by the consumer, resulting in inefficient utilisation of energy resources. The transport sector's gasoline price RON95 are sold at RM1.90/litre, as compared to the actual market price of RM2.75/litre which translates to a subsidy of RM0.85/litre or about 31% of the actual price. In addition, the subsidized gas price to the power sector, at RM13.70/mmbtu as compared to more than RM50/mmbtu at market price, has enabled Malaysians to enjoy a relatively low electricity tariff.

The Malaysian government seeks to mitigate demand growth by gradually moving towards market-pricing for oil and gas supply by 2016. According to a recent simulation, the liberalization of gas pricing would increase gas prices by 30% above the regulated price by 2020 and 4% higher by 2030; it would also reduce demand by 4% (compared to demand projection before price liberalization). The same simulation also calculates that removal of oil subsidies would increase prices by 8% above the subsidised prices by 2020 and 4% higher by 2030; it would also reduce demand by 2%. To mitigate the impact to energy security, the Malaysian government plans to provide assistance to low-income households and other vulnerable groups to ensure their accessibility to affordable energy.

CONCLUSION

This chapter has highlighted the key challenges facing developing countries like Malaysia who aspires to be among the league as an industrialized country. The path towards economic growth invariably resulted in higher consumption of energy which is very much dependent on fossil fuel. The turnaround from a net exporter to net importer of energy is a major challenge in maintaining a balance between economic growth, sustainability and conserving our environment. The fact remains that government policy towards green economy through alternative energy, greener sources in the energy mix, more efficient demand and supply side management and the varying wasteful consumption patterns of the entire population will have to be given more emphasis in order to ensure sustainable development for the benefit of future generations.

References

APERC. 2009. Asia Pacific Energy Research Centre, Japan (2009), *APEC Energy Demand and Supply Outlook 4th: Edition Economy Reviews 2009*, Asia Pacific Energy Research Centre.

APERC. 2010. Asia Pacific Energy Research Centre, Japan (2010), *APEC Energy Ovewview*, Asia Pacific Energy Research Centre.

Asia Pacific Energy Research Centre, Japan. 2007. *A Quest for Energy Security in the 21st Century: Resources and Constraints, 2007.* Asia Pacific Energy Research Centre.

Chandran, V.G.R., Sharma, S., and K. Madhavan. 2010. Electricity consumption–growth nexus: The case of Malaysia. *Energy Policy*. Vol.38: 606-612.

Chua, S. C. & T.H Oh. 2010. Review on Malaysia's national energy developments: Key policies, agencies, programmes and international involvements. *Renewable and Sustainable Energy Reviews*. Vol.14: 2916-2925.

C. S. Tan, Endang Jati Mat Sahid, Y.P. Leong. 2011. '*Energy Efficiency Initiatives in Malaysia*'/ In: 'Energy Audit for Energy Professionals in Developing Countries'. Mumbai, NAM S&T Centre).

C. S. Tan, Suhaida Sood, Y.P. Leong. 2011. '*Sustainable Development through Energy Efficiency Initiatives in Malaysia*', 15th International Conference on ISO & TQM 2011. Kajang, 26-28 July 2011.

DOS (2011), Department of Statistics. 2011. *Malaysia Economic Statistics - Time Series, 2011*. Putrajaya, Department of Statistics.

Department of Statistics. 2011. *The Malaysian Economy in Brief - December 2011*. Putrajaya, Department of Statistics.

Economic Transformation Programme - A Roadmap for Malaysia. Putrajaya, Prime Minister's Department.

Endang Jati Mat Sahid, Ahmad Rafdi Endut, Leong Yow Peng. 2011. '*Regulatory Requirements for Green Initiatives and Sustainable Development*', 15th International Conference on ISO & TQM 2011. Kajang, 26-28 July 2011.

Energy Commission. 2008. *The Efficient Management of Electrical Energy Regulations 2008*: <http://st.gov.my> (accessed on July 2011).

IEA. 2009. International Energy Agency (2009), *Energy Balance for Non-OECD Countries – 2009 Edition.* International Energy Agency.

Jafar, A.H., Al-Amin, A. and C. Siwar. 2008. Environmental impact of alternative fuel mix in electricity generation in Malaysia. Renewable Energy Vol. 33: 2229-2235.

KETTHA. 2010. Ministry of Energy, Green Technology and Water Analysis 2010.

Meng Yew Choong. 2011. *Power up, Cleanly*, The Star (2011): <http://www.thestar.com.my> (accessed 24 May 2011).

Ministry of Energy, Green Technology and Water. 2010. *National Renewable Energy Policy & Action Plan 2010.* Putrajaya, Kementerian Tenaga, Teknologi Hijau dan Air.

Ministry of Energy, Green Technology and Water. 2009. *The Final Report on National Renewable Energy Policy and Action Plan* (2009): <http://www.kettha.gov.my> (accessed on May 2011).

Ministry of Natural Resources and Environment. 2010. *The Second National Communication 2010.* Putrajaya, Ministry of Natural Resources and Environment.

Najam. A. and C.J. Cleveland. 2003. Energy and Sustainable Development at Global Environmental Summits: An Evolving Agenda. *Environment, Development and Sustainability*. Vol.5: 117-138.

Ong HC, Mahlia TMI, Masjuki HH. 2011. A review on energy scenario and sustainable energy in Malaysia. Renewable and Sustainable Energy Reviews, Vol.15(1):639-47.

S.C. Chua, T.H. Oh. 2011. "Green progress and prospect in Malaysia", *Renewable and Sustainable Energy Reviews* 15 (2011), pp 2850-2861.

Sovacool, B. and M.A. Brown. 2010. Competing Dimensions of Energy Security: An International Perspective. Annu. Rev. Environ. Resour. Vol. 35:77–108.

United Nations Environment Programme. 2011. *Towards Green Economy*: <http://www.unep.org>(accessed on June 2011).

Chapter 8

Hydropower and the Green Economy in Laos: Sustainable Developments?

Mattijs Smits

ABSTRACT

This paper discusses the surge of export-oriented large hydropower projects in Laos in the context of the green economy. It starts off with an overview of rural electrification in Laos and figures about the hydropower boom. While there were 85 hydropower projects in some stage of development in 2011, around 30% of the Lao population still does not have access to electricity. The paper then discusses the stakeholders involved in the hydropower sector, which shows that almost all the developers, financiers, and consultancy companies are foreign, as well as the designated markets for the electricity produced. Finally, the benefits, costs, and equity implications of large hydropower projects in Laos are discussed. While the economic benefits are generally large, the social and environmental costs are also large, as well as unpredictable in the long run and disproportionally affecting people in rural areas. The paper concludes that hydropower in Laos in its current form is not an example of a 'green economy' activity as long as it does not address the inherent shortcomings of a 'green' neoliberal economic approach to energy development. Furthermore, there are many forms of renewable energy possible in Laos that would better fit the label 'green economy' and could lead to more sustainable developments.

INTRODUCTION

In a Rio+20 Issues Brief, on "Trade and Green Economy", hydropower export in the Lao PDR is referred to as a "selected green sector with trade potentials". However a footnote mentions that *"with these hydropower projects, villages disappeared under the reservoir — and tens of thousands more living down-stream have been affected. Not everyone considers these exports sustainable without thorough environmental assessment as well as sufficient resettlement and adaptation support"* (UNCSD & UNCTAD 2011, 1).

This example shows in a nutshell the dilemma facing Laos[1] vis-à-vis hydropower and the green economy. It also raises questions such as: can hydropower actually be classified as a "green economy" activity? Who are the stakeholders involved in hydropower development in Laos and what markets

[1] The short name for Lao Peoples' Democratic Republic will be used from here on.

do they serve? What are the economic, social and environmental costs and benefits of hydropower and how are these distributed geographically? What are the alternative "green economy" activities in the energy sector?

This paper offers perspectives to each of these questions, opening up the debate about the linkages between hydropower and the green economy. While some of the issues in the paper are related to energy and development in Laos in general, the focus is on large hydropower. This is justified given the particular nature of large hydropower development and the large economic, social and environmental implications of current and future hydropower projects. Indeed, these projects might transform the face of one of the least populated (6.5 million) and developed (HDI of 122) countries in the world.[2] The mountainous and land-locked geography of Laos has long been perceived to restrain economic development (Pholsena and Banomyong 2006), but is ideal for the development of small and large-scale hydro-electric power generation.

The question about what the "green economy" is and what it means for Laos is of crucial importance. While the term has been widely used in the public discourse, its operationalisation is often messy and tends to diminish its value. All too often, the term "green economy" is used either very loosely or for purposes of "greenwashing". A good starting point to untangle what the green economy is about is Jacobs's (1991) widely cited book *The Green Economy: Environment, Sustainable Development and the Politics of the Future*. The starting point of the book is that there are two distinct and opposing "strands of thought" concerned with the environment, one from environmental (neoclassical) economics and one from green political ideology. The former strand argues for the incorporation of environmental values into current economic systems, whereas the latter aims to change neoliberal thinking and current modes of production and consumption. These two positions are useful as an analytical framework as it raises questions about putting values on the environment, whether and how to measure these values, whose values they are, and how they are distributed. Many of these issues are relevant for the discussion about hydropower and the green economy in Laos today. A narrow conceptualisation of the green economy as neoliberal economics with a green lining, reflecting Jacobs's first strand of thought, will lead to social and environmental inequity and ultimately unsustainable developments.

This paper starts off with an overview of the energy sector and hydropower in Laos, showing the disconnection between domestic access to electricity and hydropower development. It goes on to describe the large number of projects, the origin of the shareholders and markets for Lao hydropower and the key stakeholders in the Lao hydropower sector. This information is then used to reflect on the three main goals of the Government of Laos for the energy sector:

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[2] Population figure for July 2011 estimate from CIA World Factbook (2011) and Human Development Index (HDI) figure from UNDP (2011).

access to electricity, increasing revenues from private sector power production, and developing a regional electricity grid. It is argued that the policies supporting these goals are not always clear and sometimes in conflict with each other. The final section of this paper discusses these issues in the framework of the green economy. The benefits, costs and equity issues of hydropower in Laos are discussed, showing that current hydropower practices are likely to increase inequality as they are based on neoliberal principles and "green" rhetoric. Finally, two ways forward or "alternative" green economy approaches are discussed, improving current hydropower practices and searching for renewable energy solutions which are more appropriate in the Lao context.

ENERGY AND HYDROPOWER STATUS IN LAOS

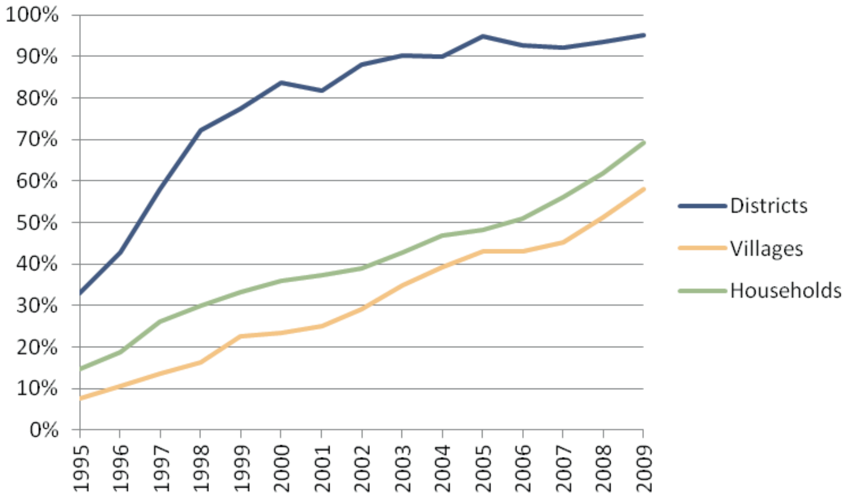
Access to electricity and hydropower

Access to electricity in Laos is not ubiquitous and is generally not related to hydropower developments in the country. Yet, a lot of progress has been made in terms of access to electricity and rural electrification in the last two decades. The electrification rate has increased from 15% to 69% of households in 2009 (see Figure 8.1) mainly through the expansion of the different "national grids".[3] Most of the district centres and denser populated areas along the main roads have now been electrified. However, one could argue that the "low hanging fruits" have now been picked and the villages further away from the main road are still unelectrified. These places are often harder to reach and will have a low load profile, making further grid expansion slower and more expensive.

Off-grid electrification occupies a small, but important segment of the electricity landscape in Laos. The most important forms of off-grid electrification are pico-hydropower, solar home systems (SHS), diesel generators and rechargeable car batteries. There are also several dozens of micro-hydropower systems, district diesel generators and solar or hybrid village grids in Laos (Susanto and Smits 2010). With the exception of SHS, which are supported by the World Bank under their Rural Electrification Projects (REP), most of the off-grid systems are market-driven and not supported by donors or the government. Pico-hydropower is an important example and there are an estimated 60,000 systems in the Laos, providing electricity to around 90,000 households (Smits and Bush 2010). In comparison, only around 16,000 SHS have been implemented in Laos, most of them fully funded by grants from the Global Environmental Facility.

[3] Laos does not have a centralised grid yet. Instead, there are three different grids: In the Central/North, Middle and South.

Figure 8.1: Percentage of districts, villages and households with access to electricity in Laos.



Adapted from statistics in EdL (2010b)

According to the official statistics (MEM 2008), 99.9% of the electricity in Laos is generated by large hydropower (classified as over 1 MW). However, the development of domestic rural electrification has very few links with the development of large hydropower projects, as most of the electricity is exported. Indeed, for some of the largest projects, the Lao grid has been bypassed entirely, transporting the electricity straight to Thailand. The main bottleneck of increased access to electricity is not generating more electricity, but increasing the number of connections through grid extension and better off-grid rural electrification programs.

The boom of large hydropower projects

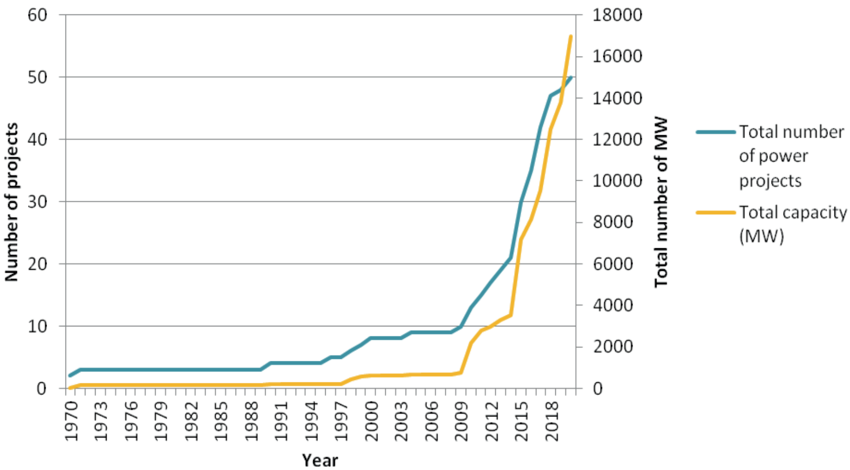
The number of large hydropower projects in Laos is set to increase dramatically in the next decades. This increase in hydropower is driven by high electricity demand in neighbouring countries (mainly Thailand and Vietnam), the opening of Laos's economy for outside investment since 1986 and the rise of regional banks and investors in Asia. In July 2011, there were 14 projects operational and 72 under construction, planning or feasibility stage in Laos (Table 8.1). All but one (the 1,878 MW Hongsa lignite plant) of these 86 projects are large hydropower projects. Figure 8.2 shows a graphical representation of the number of power projects, until 2020, excluding those in feasibility stage. The fact that the total capacity (in MW) rises more steeply shows that the projects tend to become bigger. Examples are the eight controversial dams planned in the Mekong mainstream in Laos and on the Lao-Thai border. The geography of these hydropower projects can be seen in Figure 8.7.

Table 8.1: Total number of power projects in Laos.

	Number	Capacity (MW)
Operational	14	2,548
Under construction	10	4,111
Planning stage	25	7,136
Feasibility stage	37	7,380
Total	86	21,175

Adapted from Government of Laos (2011a)

Figure 8.2: Total number and capacity (MW) of power projects realized, under construction and planned in Laos.

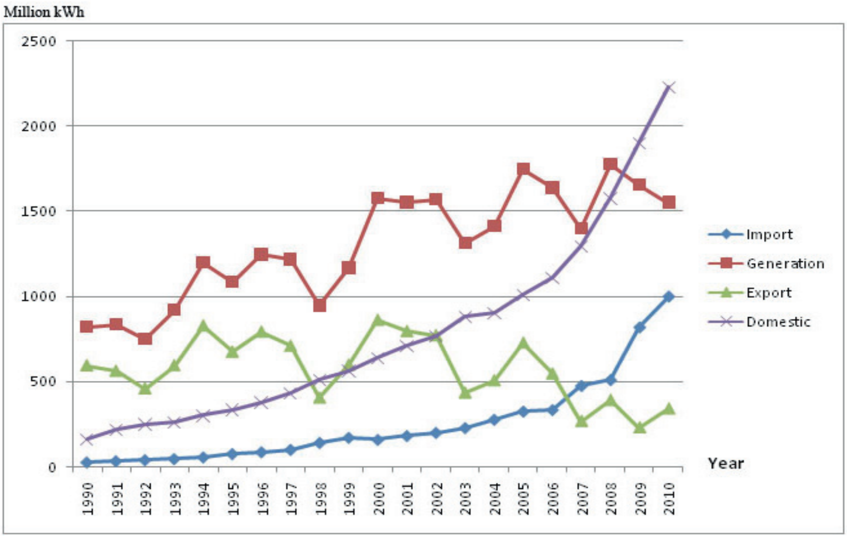


Source: Government of Laos (2011a)

Import and export of electricity

The majority of the electricity generated by large hydropower projects in Laos is designated for export. Laos currently has Memorandum of Understanding (MoU) with Thailand (7,000 MW), Vietnam (5,000 MW) and Cambodia (1,500 MW) to supply electricity till 2020 (Phomsoupha 2009). However, from 2006 to 2010, the amount of import of electricity in Laos was higher than the amount of export. This has mainly to do with the fact that the electricity grids in Laos are still very fragmented, as well as with water shortages in the dams. This means that Laos has to import a lot of electricity from Vietnam and Thailand in border regions and during the dry season. In addition, the tariffs for import of electricity from Thailand and Vietnam are significantly higher than the export tariff. The situation has changed since the Nam Theun 2 dam (1080 MW), the largest thus far in Laos, started operating in 2010. This and other completed power plants should boost the export numbers.

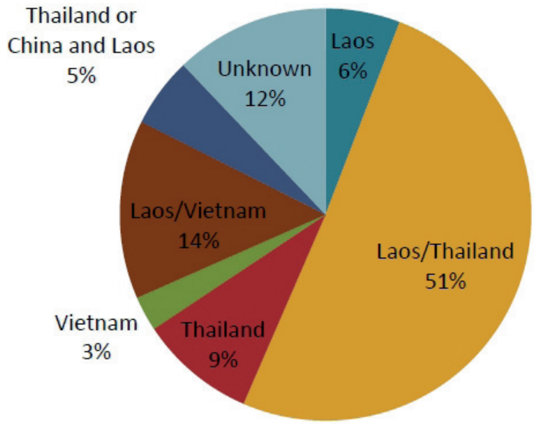
Figure 8.3: Generation, import, export and domestic use of electricity for 1990-2010.



Source: Government of Laos (2011d)

The markets for all the electricity produced by the projects realised, under construction, planned and in feasibility stage are mainly outside of Laos (Figure 8.4). Projects designated for Laos itself only cover 6% of the total amount of power which is and will be produced. The shares of "Laos/Thailand" and "Laos/Vietnam", which take up 65%, should be understood as mainly Thailand and Vietnam respectively. This is because the Government of Laos has a requirement that 10% of the electricity produced should be used domestically, while the rest can be exported (GoL 2011c). In the case of the Nam Theun 2 dam, for example, 1000 MW is exported to Thailand, while only 80 MW is used domestically. Keeping this in mind, over three-quarters of all current and future electricity generated in Laos is and will be exported to its neighbouring countries.

Figure 8.4: Markets for all project realised, under construction, planned and in feasibility stage (MW).



Source: The Government of Laos (2011a)

STAKEHOLDERS IN LARGE HYDROPOWER AND THEIR ROLES

World Bank and Asian Development Bank (ADB)

The World Bank and the ADB continue to play an important role in the development of hydropower projects in Laos, although it has changed over time. From the 1960s to 2000, the World Bank and Western donors were actively involved in the construction of infrastructure (not only dams, but also roads, irrigation systems, etc.) in the region. Nowadays, their role has shifted in the face of criticism from NGOs and governments funding these organisations, because of the large social and environmental impacts often associated with these infrastructure projects. Therefore, the World Bank and ADB are now more active in setting standards, providing technical assistance, and facilitating the building of infrastructure through plans and regional forums. The Nam Theun 2 dam in Laos is a good example here, as the World Bank was actively involved in promoting this project as a “model” for future hydropower development in the region (Middleton, Garcia and Foran 2009).

Mekong River Commission (MRC)

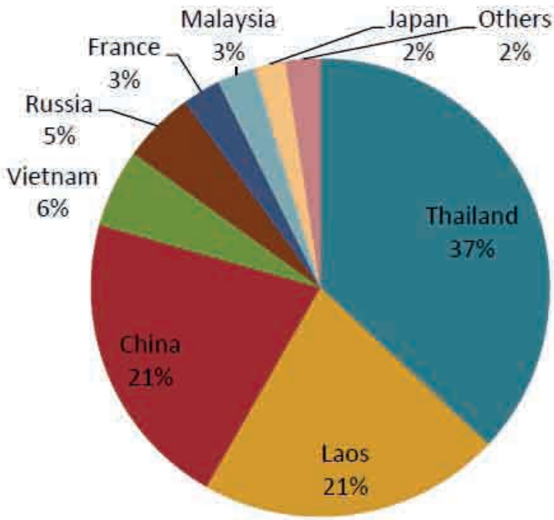
The Mekong River Commission (MRC) has an important role to play in hydropower development, in particular for those dams with transboundary impacts. The MRC was established with the signing of the 1995 Mekong Agreement by four countries: Cambodia, Laos, Thailand and Vietnam, with the objective to promote sustainable development and management of the river basin. This agreement commits the four countries to this objective. One of the tasks of the MRC is administering a consultative mechanism[4] about dams in the Mekong mainstream, which are likely to significantly alter the ecology of the entire river system. A recent test case is the plan for the Xayaburi dam, which would be the first one to be built on the lower Mekong River. While both Vietnam and Cambodia advocated postponing the project, there are indications that the Lao government and the Thai investors will try to go ahead with building the dam. This is just one example of the problematic role of the MRC in deeply political issues around hydropower and development in the Mekong region (Käkönen and Hirsch 2009; Lee and Scurrah 2009).

Regional investors and financiers

Regional investors (companies) and financiers (notably Thai and Chinese banks) are the main owners and investors of Independent Power Producer (IPP) hydropower projects in Laos (Middleton 2009). As mentioned before, this is an important change from the time when the World Bank and the ADB were the main investors. As these organisations have largely stopped funding hydropower projects directly, new forms of finance were sought in the form of Build-Own-Operate-Transfer (BOOT) projects. Figure 8.5 shows that Thai owners have the largest weighted share of ownership in all power projects (excluding those in feasibility stage) with 37%, followed by Lao (21%), Chinese (21%), Vietnamese (6%) and Russian (5%) owners. In most of the hydropower dams currently operational, Electricité du Lao, the national utility, is 100% owner. However, for all projects realised in the future, the Government of Laos or the Lao Holding State Enterprise (LHSE) own between 10 and 25% of the shares.

[4] Procedures for Notification, Prior Consultation and Agreement (PNPCA).

Figure 8.5: Weighted origin of shareholders in all projects realised, under construction and planned[5]



Consultancy companies

Consultancy companies also play an important role in the hydropower sector of Laos. The large numbers of projects, their complexity, and the large amounts of money involved have created a highly specialised consultancy scene around hydropower projects in Laos. However, for these reasons, the consultancy scene is also comprised of a limited number of foreign companies. In the case of Nam Theun 2, for example, "[m]ost of the consultants are commercial consultancy firms from Thailand, Australia and the US, but CARE, IUCN and WCS ... have served as consultants on the social and environmental studies" (Hirsch 2002, 162) This example also shows that NGOs are sometimes used as consultants. This has the double benefit of regulating potential criticism from NGOs and buying legitimacy for dam developers. Because of the close relations of consultancy companies and dam developers and to keep getting new assignments, there is pressure to provide favourable recommendations and keep the size of compensation and mitigation programs small (Goldman 2001; Lawrence 2009).

[5] The weighted shareholding is calculated by multiplying the size of the dam by the percentage of shareholding. The reason to exclude projects in feasibility stage is that the shareholding structure is not yet clear.

The Government of Laos

The Government of Laos (GoL) is supposed to play a facilitating role in the development of large hydropower projects in Laos and is also a minority shareholder. The government is overseeing the IPP process, which involves a series of requirements and formalities: from Memorandum of Understanding (MOU), Project Development Agreement (PDA), Power Purchase Agreement (PPA), Concession Agreement (CA), and finally construction and operation. It is also responsible for setting and monitoring standards, environmental and social regulations and various other tasks. Therefore, on paper, the GoL plays an important role in hydropower development. However, both the description of the stakeholders in the previous section and a closer look at some of the key policies in the next section shows that this is not always the case and that hydropower in Laos is highly dependent on regional electricity markets and the current global political economy.

OFFICIAL GOALS AND POLICIES OF LARGE HYDROPOWER

The official goals of the GoL for the power sector are (1) to expand the electricity grid to provide electricity to 90% of households by 2020, (2) to increase government revenue from IPP investments, and (3) to "promote" an integrated 500 kV grid in the Greater Mekong Sub-region (GoL 2011b). In this section, these key energy policies are discussed to see how these goals can be achieved and how they are related.

Grid expansion and access to electricity

Electricité du Lao (EdL), the national utility, is the key player to achieve the goal of access to electricity through the Power Development Plan (PDP). However, EdL does not have the funding to realise its ambitious plans and is thus dependent on outside sources of funding. Much of the funding for grid expansion comes from soft loans from the World Bank (in the South) and the ADB (in the North). Some of the key rural electrification projects are the World Bank-funded Southern Provinces Rural Electrification Project (SPRE) and the Rural Electrification Project (REP) phase 1 and 2, which have been running since 1988 (World Bank 2011). Increasingly funding for grid extension is being sought from bilateral loans from China, India and other countries in the region. As discussed in section 2.1, there is also an off-grid component to these projects, which is supposed to contribute around 10% of the target of 90% electrified households by 2020.

Increasing revenues through IPP

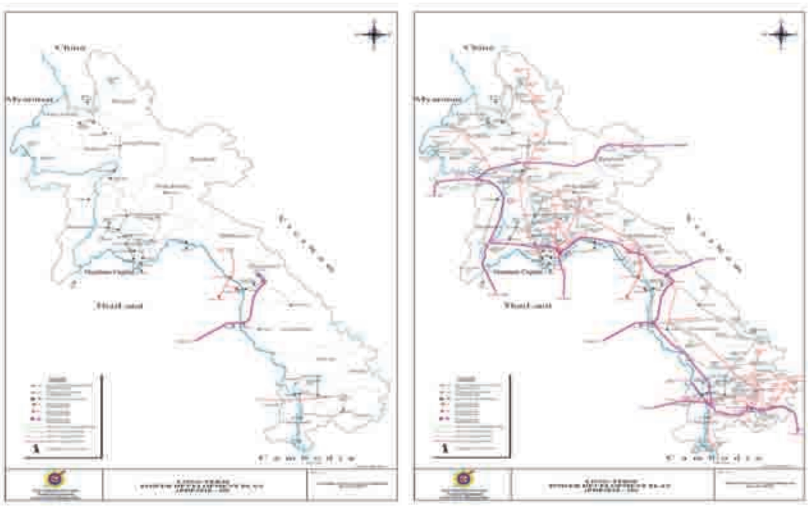
The second goal, increasing government revenue from private investment power projects, is achieved through the IPP strategy of Laos. Because of the sheer amount of projects currently in various stages of development in Laos, the government has been forced to improve its policies for individual projects, in terms of the requirements for feasibility studies, resettlement plans, compensation, environmental impacts, etc. These improvements have been driven by multilateral banks and international NGOs who are concerned with the potential negative impacts from hydropower development. There are still questions of whether the many new regional players involved in the hydropower business will follow these policies and requirements in practice (Middleton et al. 2009).

Moreover, there has been no systematic planning of the location of the projects. As soon as a company gets the green light to start the process of developing a project, there are no clear dates associated with it. In other words, the IPP strategy is led by developers and MoUs rather than by the plans of the government. As a result, the projects currently underway do not necessarily correspond to the rural electrification plans, nor does the government have much control over when they start producing electricity.

The Mekong and ASEAN power grid

The third goal, constructing a 500 kiloVolt (kV) Mekong Power Grid (part of a wider ASEAN power grid), has the potential to transform the landscape in Laos. This policy is driven by the ADB's Regional Power Interconnection and Power Trade Arrangements (ADB 2005) with the rationale that countries can produce and trade electric power more efficiently if they are interconnected. It is also part of the ADB's wider plans for the GMS to *"achieve the Millennium Development Goals (MDGs) through increased connectivity, improved competitiveness, and a greater sense of community"* (ADB 2011). Figure 8.6 shows the current power system map (2010) and the planned map for 2020. At the moment, the only 500 kV transmission line is the one connecting the Nam Theun 2 dam to the Thai power grid, without any link to the grid in Laos. The plan for 2020 includes five 500 kV substations and more than 1700 km of 500 kV transmission line (the purple lines on the map). However, how much of this plan will be realised is highly dependent on the amount of funding that can be raised in this period. The total investment costs for the PDP 2010-2020 are estimated at 11.40 billion US dollars (EdL 2010a, appendix 4-17). This is more than ten times as much as the 0.98 billion US dollars of total investment in the previous PDP 2007-2016 (EdL 2008, iv-4). It is obvious that it will be a major challenge to raise this amount of funding and realising the plan would lead to large levels of debt.

Figure 8.6: Existing Power System Diagram in year 2010 (left) and Planned Power System Diagram in year 2020 (right).



Attachments to PDP 2010-2020 (EdL, 2010a)

DISCUSSION: HYDROPOWER AND THE GREEN ECONOMY

The benefits, costs and equity aspects of hydropower in Laos

Hydropower developments cannot simply be classified as green or renewable. The International Energy Agency notes that "[h]ydro developments are environmentally and socially controversial" (IEA 2010, 299). The World Commission on Dams (WCD), probably the most detailed and comprehensive study on hydropower, finds that while there have been *"substantial benefits"* from hydropower, *"in too many cases an unacceptable and often unnecessary price has been paid to secure those benefits especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment"*. Furthermore, it states that *"[l]ack of equity in the distribution of benefits has called into question the value of many dams in meeting water and energy development needs when compared with the alternatives"* (WCD 2000, xxviii). These three issues, the benefits, the social and environmental costs, and the distribution of benefits of hydropower, will be discussed for the case of Laos.

The benefits of hydropower for Laos in monetary terms are large. For example, the Nam Theun 2 hydropower project is expected to generate average annual revenues of 80 million US dollars and more than 2 billion US dollars over its lifetime (NTPC 2011). Other hydropower projects are expected to provide similar (proportional) benefits in the form of royalties, taxes and development projects in the area. According to a government official quoted in the *Guardian* (Watts 24 September 2010), the share of hydropower and mining to Laos's GDP will increase from 4% in 2010 to 20% by 2020.

However, dams have caused substantial social and environmental impact in Laos, such as involuntary resettlement, flooding of reservoirs, changing of flood regimes, loss of fisheries, emission of greenhouse gasses from reservoirs, and disruption of livelihoods and ecosystems in general (Baran and Myschowoda 2009; Lawrence 2008). The impact of the proposed mainstream dams in particular have been widely discussed as the Mekong river is the most productive inland fishery in the world (Bakker 1999; Friend and Blake 2009; Lee and Scurrah 2009; Molle, Foran and Floch 2009). In addition, both *Science* and *Nature* have published articles on the issues about the potential negative impacts of mainstream dams in the Mekong recently (Grumbine and Xu, 2011; Vaidyanathan 2011). Many Environmental Impacts Assessments, executed by consultancy companies on behalf of project developers, have been heavily criticised for being overly optimistic about these impacts.

In addition, the sharing of costs and benefits is a major issue in Laos, as many of the benefits are likely to be accumulated by the urban elite and middle class, while the majority of the social and environmental costs will be carried by people in dam-affected rural areas (Hirsch 2007). In some cases, efforts are undertaken to provide compensation for people in affected areas. Claimed benefits from the Nam Theun 2 include for example: improved living conditions for resettled people, a development program for 200 villages in the area, protection of 4,000 km^2 of biodiversity area, generation of employment, and development of new infrastructure (World Bank and ADB 2010). However, the costs of the Nam Theun 2 social development projects are only a fraction of the total revenues which will be generated.

Another concern regarding equity is that hydropower development will reinforce the existing power structures in Laos because of corruption. According to Stuart-Fox, corruption is deeply engrained in Lao culture (Stuart-Fox 2006, 2007). Hydropower projects, with its concessions, construction contracts and large streams of revenues are a relatively easy target for corruption practices. A Wikileaks cable from the US Embassy in Vientiane (2007) states that *"a large and increasing portion of GDP is derived from resource extraction industries, which are especially vulnerable to corruption because the national government lacks adequate means to effectively regulate them and their products are difficult to trace."* As such, hydropower projects tend to benefit a small elite rather than lead to levelling of wealth in Laos.

The evidence of the costs, benefits and equity aspects of hydropower in Laos suggests that it is based on a narrow interpretation of the green economy. The key reason for the construction of hydropower dams is the need to generate electricity and this is based on neoliberal economic thinking. This version of the green economy does not challenge the problems associated with these models, as suggested by Jacobs (Jacobs 1991), but rather covers them in "green" and development rhetoric. This is in line with Molle et al., who argue that *“one finds no shortage of easy rhetoric about how export-oriented hydro-power will help ‘kickstart development’, help ‘eradicate poverty’ or ‘power progress’, but far fewer examples of tangible links between investor-owned dams and rural electrification or improved livelihoods.”* (Molle et al. 2009, 11-12). Indeed, large hydropower might actually negatively impact poor people, because hydropower can jeopardise their current land use, fisheries and other forms of livelihood.

Alternative ‘green economies’?

This paper raises question marks about hydropower in Laos as a green economy activity. This section discusses two ways forward when thinking about energy and the green economy in Laos. Given that stopping hydropower projects in the short term is not a realistic option, one of the ways forward is to improve current and future hydropower practices in Laos. There are some global initiatives aimed at improving hydropower practices, such as the guidelines from the World Commission on Dams (WCD 2000), and the Hydropower Sustainability Assessment Protocol (HSAF) from the International Hydropower Association. The latter has already been experimented with in the Mekong region, although it is too early to see any clear results (Foran 2010). These initiatives and increased capacity and political will from the hydropower developers, the government, donors, and NGOs can hopefully lead to better hydropower practices and the abandonment of projects with too high social and environmental costs. However, these initiatives should go beyond “green” rhetoric and neoliberal environmental economics to achieve more socially and environmentally equitable outcomes.

Another way forward is to give priority to issues of economic, social and environmental equity in the development of the green economy. This means focusing on the development of local capacity and jobs, balancing the flows of capital and resources from rural to urban areas, and protecting local environments and resources on which people depend. This goes well beyond putting a green label on hydropower simply because it doesn’t involve the burning of fossil fuels. Large hydropower projects are not very suitable for this kind of development, as much of the expertise for such large and complex projects has to be brought in from outside. Moreover, the social and environmental impacts are often difficult to establish because of the sheer size of the projects. Smaller projects with strong local roots and capacity building aspects might provide a much better basis for a Lao “green economy”. In the energy sector, some examples include pico, micro and small hydropower, as well as various sizes of solar PV projects and some forms of bio-energy.

Figure 8.7: Map with key existing and proposed dams in Laos in 2008.

Source: International Rivers (2011)

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References

ADB. 2005. GMS Flagship Initiative: Regional Power Interconnection and Power Trade Arrangements - Summary: Asian Development Bank.

ADB. 2011. Greater Mekong Subregion Retrieved 24 October, 2011, from http://www.adb.org/gms/

Bakker, K. 1999. The politics of hydropower: developing the Mekong. *Political Geography, 18*(2), 209-232.

Baran, E., and Myschowoda, C. 2009. Dams and fisheries in the Mekong Basin. *Aquatic Ecosystem Health & Management, 12*(3), 227-234. doi: 10.1080/14634980903149902

CIA. 2011. Lao PDR. *World Factbook* Retrieved 24 October, 2011, from https://www.cia.gov/library/publications/the-world-factbook/geos/la.html

EdL. 2008. Power Development Plan 2007-16. Vientiane: System Planning Office, Electricité du Laos.

EdL. 2010a. Power Development Plan (PDP 2010-2020). Vientiane: System Planning Office, Technical Department, Electricité du Laos.

EdL. 2010b. Statistic Report for EDL 50 year old. Vientiane: System Planning Office, Electricité du Laos.

Foran, T. 2010. Making Hydropower More Sustainable? A sustainability measurement approach led by the Hydropower Sustainability Assessment Forum. Chiang Mai: M-POWER, Unit for Social and Environmental Research, Faculty of Social Sciences, Chiang Mai University.

Friend, R., and Blake, D. J. H. 2009. Negotiating trade-offs in water resources development in the Mekong Basin: implications for fisheries and fishery-based livelihoods. *Water Policy, 11*(1), 13-30.

GoL. 2011a. Electric Power Plants in Laos July 2011 Retrieved 18 October, 2011, from http://www.poweringprogress.com//download//Electric_Power_Plants_in_Laos_July_2011.pdf

GoL. 2011b. Government Plans and Policies Retrieved 20 October, 2011, from http://www.poweringprogress.com/index.php?option=com_content&view=article&id=49&Itemid=53

GoL. 2011c. History of hydropower in Lao PDR Retrieved 20 October, 2011, from http://www.poweringprogress.com/index.php?option=com_content&view=article&id=88&Itemid=126

GoL. 2011d. Lao PDR Power Exports and Imports Retrieved 18 October, 2011, from http://www.poweringprogress.com/index.php?option=com_content&view=article&id=157&Itemid=69

Goldman, M. 2001. The birth of a discipline. *Ethnography, 2*(2), 191.

Grumbine, R. E., and Xu, J. 2011. Mekong Hydropower Development. *Science, 332*(6026), 178-179. doi: 10.1126/science.1200990

Hirsch, P. 2002. Global Norms, Local Compliance and the Human Rights-Environment Nexus: A Case Study of the Nam Theun II Dam in Laos. In L. Zarsky (Ed.), *Human Rights and the Environment: Conflicts and Norms in a Globalizing World* (pp. 147–171). London: Earthscan/James & James.

Hirsch, P. 2007. Civil society and interdependencies: Towards a regional political ecology of Mekong development. In J. Connell & E. Waddell (Eds.), *Environment, development and change in rural Asia-Pacific: between local and global* (pp. 226). New York: Routledge.

IEA. 2010. World Energy Outlook 2010. Paris: International Energy Agency.

International Rivers. 2011. Map of Key Existing and Proposed Dams in Laos Retrieved 24 October, 2011, from http://www.internationalrivers.org/files/Lao%20map%20final.JPG

Jacobs, M. 1991. *Green Economy: Environment, Sustainable Development and the Politics of the Future*. London: Pluto Press.

Käkönen, M., and Hirsch, P. 2009. The Anti-Politics of Mekong Knowledge Production. In F. Molle, T. Foran & M. Kakonen (Eds.), *Contested waterscapes in the Mekong Region : hydropower, livelihoods and governance* (pp. xxii, 426 p.). London ; Sterling, VA: Earthscan.

Lawrence, S. 2008. Power surge: the impacts of rapid dam development in Laos. Berkeley: International Rivers.

Lawrence, S. 2009. The Nam Theun 2 Controversy and Its Lessons for Laos. In F. o. Molle, T. Foran & M. Kakonen (Eds.), *Contested waterscapes in the Mekong Region : hydropower, livelihoods and governance* (pp. 81-114). London: Earthscan.

Lee, G., & Scurrah, N. 2009. Power and responsibility: The Mekong River Commission and Lower Mekong mainstream dams. Sydney: Australian Mekong Resource Centre and Oxfam Australia.

MEM. 2008. Electricity Statistics Yearbook of Lao PDR 2008. Vientiane: Department of Electricity, Ministry of Energy and Mines.

Middleton, C. 2009. Thailand's Commercial Banks' Role in Financing Dams in Laos and the Case for Sustainable Banking. Bangkok: International Rivers, Mekong Program.

Middleton, C., Garcia, J., & Foran, T. 2009. Old and New Hydropower Players in the Mekong Region: Agendas and Strategies. In F. o. Molle, T. Foran & M. Kakonen (Eds.), *Contested waterscapes in the Mekong Region : hydropower, livelihoods and governance* (pp. 23-54). London: Earthscan.

Molle, F., Foran, T., and Floch, P. 2009. Introduction: Changing Waterscapes in the Mekong Region – Historical Background and Context. In F. Molle, T. Foran &

M. Kakonen (Eds.), *Contested waterscapes in the Mekong Region : hydropower, livelihoods and governance* (pp. xxii, 426 p.). London ; Sterling, VA: Earthscan.

NTPC. 2011. Project Benefits Retrieved 21 October, 2011, from http://www.namtheun2.com/index.php?option=com_content&view=category&id=44&Itemid=62

Pholsena, V., & Banomyong, R. 2006. *Laos: from buffer state to crossroads?* Chiang Mai: Mekong Press/Silkworm Books.

Phomsoupha, X. 2009. Hydropower Development Plans and Progress in Lao PDR. *Hydro Nepal, 2009*(4).

Smits, M., and Bush, S. R. 2010. A light left in the dark: The practice and politics of pico-hydropower in the Lao PDR. *Energy Policy, 38*(1), 116-127.

Stuart-Fox, M. 2006. The political culture of corruption in the Lao PDR. *Asian Studies Review, 30*(1), 59-75.

Stuart-Fox, M. 2007. Laos: Politics in a Single-party state. *Southeast Asian Affairs, 2007*, 159-180.

Susanto, J., and Smits, M. 2010. *Towards a Locally Adapted Rural Electrification Assessment Framework: A Case Study of the Lao PDR* Paper presented at the GMSTEC 2010: International Conference for a Sustainable Greater Mekong Subregion, Bangkok, Thailand.

UNCSD and UNCTAD. 2011. Rio+20 Issues Briefs: Trade and Green Economy: United Nations Conference on Sustainable Development and United Nations Conference on Trade and Development.

UNDP. 2011. Lao People's Democratic Republic: Country profile of human development indicators. Retrieved 24 October 2011, from United Nations Development Program

US Embassy VTE (Wikileaks). 2007. *Corruption in Laos: the closer you look, the worse it appears (Cable 07VIENTIANE139)*. Wikileaks. Retrieved from http://wikileaks.org/cable/2007/02/07VIENTIANE139.html

Vaidyanathan, G. 2011. Dam controversy: Remaking the Mekong. [News Feature]. *Nature, 2011*(478), 305-307.

Watts, J. 2010. Laos sees big fish as small price to pay for hydropower, *The Guardian*. 24 September.

WCD. 2000. *Dams and development : a new framework for decision-making, report by the World Commission on Dams*. London: Earthscan.

World Bank. 2011. Lao PDR and Energy Retrieved 11 October, 2011, from http://go.worldbank.org/TJ2O7347B0

World Bank, & ADB. 2010. Update on the Lao PDR Nam Theun 2 (NT2) Hydroelectric Project: World Bank and Asian Development Bank.

Chapter 9

French Energy Policies: Challenges, Policy Innovation and Major Stakes at Hand

Marie-Helene Schwoob

ABSTRACT

Today, the energy challenge surely remains, more than ever, a central piece in puzzled political agendas worldwide. For France, as compared to most of today's developing countries that are driving the rise of the global energy demand, consumption patterns have not been raising much for the past decade – and will most probably not evolve toward a dramatic rise that would threaten the country's energy security. Nevertheless, the country still has to face numerous challenges. In spite of a political activism aimed at developing national energy resources like nuclear power, the country remains highly dependent on imported energy resources. For oil and gas, France's resources are very poor, but demand is still high – and even increasing for gas. This challenge calls for a change of paradigm, particularly in the transport sector. The country will have to envision these changes by keeping in mind that the path taken will also have to take into account environmental issues. Profound and effective institutional reforms as well as innovative ways of policy making have been driving energy policies for the past few years, but the task surely remains challenging, especially since the debate on nuclear power has recently been revived.

An impressive number of major political crises recently shook oil-producing countries. Diplomatic relations between producing and importing countries are encountering interesting developments – with western countries threatening Iran to withdraw from its buyers' list. Energy issues have been put back on the forefront of today's political priorities.

As if the quest for energy security was not enough to cope with, countries are now faced with additional new challenges. The "energy" question does not only consist of securing one's access to resources anymore: the challenge now also includes reducing one's energy consumption. Growing concerns about the rise in temperatures highly encourage countries to reduce their greenhouse gas emissions by moderating their energy consumption. Moreover, it is becoming more and more difficult to secure one's access to energy resources without raising concerns among the international community. Contemporary governments thus do not only think of conquering resources anymore: they also include reduction of their needs in their strategy. Besides, the "recent" global acknowledgment that these resources were limited urged countries to start thinking of other ways. Governments have now to choose between the unappealing solution of slowing down their economic activity and the challenging one where they have to face the technical question of improving energy efficiency and educating their population. The energy challenge surely remains, more than ever, a central piece in today's puzzled political agendas.

This paper aims to throw some light on France's energy policy. Although challenges remain, some innovations deserve to be pointed out and may encourage other countries to move towards greener economy at an acceptable price.

OVERVIEW OF THE FRENCH ENERGY SECTOR

First and foremost, and in order to deeply understand the major stakes at hand for energy politicians in France, it is crucial to explore the patterns of the French energy sector in terms of production and consumption.

Consumption patterns – a stabilized energy consumption

France can surely not be considered as a model in terms of energy savings. The country indeed ranks among the three most consuming members of the European Union, with a TFC (total final consumption) of about 160 million tonnes of oil equivalent. The transport and industry sectors are the largest final energy users and the main drivers for France's energy consumption, with a share of more than 50% of France's TFC.

The main positive aspect of France's consumption and production patterns is that its energy demand has not been evolving much in the last decades. From the beginning of the 1960s to the end of the 1990s, France has faced an important increase of its energy consumption that was driven by its economic growth. Since the beginning of the 1990s, the annual growth rate of France's TFC has been gradually decreasing. From an average annual rate of about 1% in the 1990s, the rate fell to 0.5% per year in the first decade of the 21st century. Effective energy policies that have been implemented – mostly in the industrial sector – even made France's total consumption decrease in 2009, thus making energy demand fall back to below its 2000 level.

Table 9.1: Total Final Consumption, France, 1973-2010

Million toe	1973	1979	1985	1990	2000	2005	2008	2009	2010
Coal	28	32	24	19	14	13	12	11	11
Oil	121	114	82	88	95	91	88	85	82
Gas	13	21	23	26	37	41	40	39	40
Primary electricity	8	17	62	83	109	117	117	111	115
RE and waste	9	9	10	11	12	12	15	16	17
Total	**180**	**193**	**202**	**228**	**267**	**275**	**273**	**261**	**266**

Source: Commissariat général du développement durable, décembre 2011

France, as compared to most of today's developing countries that are driving the rise of the global energy demand, is not faced with a dramatic growth of its energy consumption. Challenges do remain, although they lie in other places.

Production and import patterns – a challenging dependency on oil and gas imports

In the last few decades, France's total primary energy production has been rising slowly to meet the growth rate of energy consumption. Although consumption patterns have been undergoing a slower and slower growth since 1973, France still has to import more than half of its energy needs.

Table 9.2: Primary Energy Production, France, 1973-2010

Million toe	1973	1979	1985	1990	2000	2005	2008	2009	2010
Coal	17,3	13,3	10,9	7,7	2,3	0,3	0,1	0,1	0,1
Oil	2,2	2,2	3,3	3,5	1,7	1,5	1,8	1,6	1,8
Gas	6,3	6,5	4,5	2,5	1,5	0,9	0,8	0,8	0,6
Primary electricity	8,0	16,2	63,9	86,8	114,4	122,7	120,9	112,8	118,4
– Nuclear	3,8	10,4	58,4	81,7	108,2	117,7	114,5	106,8	111,7
– Hydro and Wind	4,1	5,8	5,5	5,0	6,2	5,0	6,4	6,1	6,7
RE and Waste	9,8	9,5	11,1	10,7	11,1	12,4	14,8	15,9	17,6
Total	**43,5**	**47,7**	**93,8**	**111,2**	**131,1**	**137,7**	**138,4**	**131,2**	**138,6**

Source: Commissariat général du développement durable, décembre 2011

France's resources in oil and gas are very poor. The country thus needs to import almost all of its oil and gas demand. Since the government decided to cease its coalmining activities in 2004, the country also has to import all of its coal demand.

However, for electricity patterns, the French balance of trade is positive. France is the world's largest net exporter of electricity, with flows mostly directed to its southeastern neighbours. Nevertheless, exported volumes can encounter significant variations from one year to another. Differences in volumes are generally influenced by weather conditions, mostly because of the country's reliance on electricity for space heating. However, political decisions can also make trade balances shift. As an example, Germany's choice to cease its nuclear activities made the country go from net exporter to net importer vis-a-vis France.

Table 9.3: Primary Energy Resources for France, 2010

	Coal	Oil	Gas	Electricity	RE & waste	**Total**
Total supply	11,5	83	42,3	115,7	17,9	**270,4**
Primary Energy production	0,1	1,8	0,6	121,0	17,6	**138,6**
Imports	11,8	104,5	41,9	1,7	0,4	**160,2**
Exports	-0,2	-21,4	-2,5	4,3	-	**-28,5**

Source: Commissariat général du développement durable, décembre 2011

France was not always the world's largest exporter of electricity. The government has been making a great deal of efforts to gain this status, particularly by developing an ambitious nuclear program. The oil crises of the 1970s made importing countries face the challenge of rising prices, even though they desperately needed energy to develop their economy. In 1973, France decided to adopt a comprehensive policy to develop its nuclear industry, with the aim of reducing its dependence on energy imports.

The results of this policy were impressive. From 1973 to 2010, the share of electricity in France's total consumption was multiplied by ten, thus allowing the share of oil to plunge from 68% to 31%, and the share of coal to drop from 15% to 4%. Nuclear power, which now accounts for about 78% of the total electricity production (and for 40% of France's total primary energy supply), has become a key resource for France over the years. Nuclear electricity production is relatively affordable, thus placing France among the largest countries in terms of electricity exports.

Nevertheless, France remains highly dependent on imported energy resources. The percentage share of natural gas doubled between 1973 and 2000 (from 7% to 15%). Moreover, in spite of the dramatic rise of nuclear power in France's energy production, oil is still a dominant energy source. The country indeed greatly relies on oil for the transport sector and for the agricultural sector. In the past few years, although the government did put a lot of effort into looking for ways of reducing its oil dependency, the percentage shares of energy sources in France's total consumption have not changed substantially. According to IEA forecasts, the dependency on imported resources like gas may even increase in the future.

FRANCE'S ENERGY POLICY INNOVATIONS

Answering the "traditional" issue of securing energy supply

France's main issues at hand, according to production and consumption patterns, is twofold: first, to secure the country's energy supply; and second – as much as it is possible – to reduce its dependence on energy imports, by promoting the use of local energy resources that are affordable and sustainable.

In order to secure energy imports, France has been developing strategies aimed at diversifying its suppliers. For gas imports, France established long-term contracts with more than ten producing countries – the most important ones being Norway, the Netherlands, Russia and Germany. For oil imports, France's suppliers are equally distributed among four producing areas (ex-USSR, Africa, Middle-East, Africa and the North Sea). Fossil fuel imports are thus well diversified, which significantly contributes to improving the security of France's energy supply.

In addition to trade approaches, France has also been working on more technical strategies, by developing a vast network of infrastructures with supplying countries, as well as by implementing emergency plans in case of potential disruption.

Another way of improving one's energy security is either to focus on reducing the use of imported resources, or to reduce the global consumption of the country. For years, the accelerated development of nuclear power was an important factor that made France's oil and gas needs drop, by substituting targeted energy sources with other sources. Today, France seems to have reoriented its focus towards policies aiming at reducing its total consumption of energy, and is actively working on implementing energy efficiency measures. In April 2006, the government issued a directive that set a 9% target for energy savings by 2016. In addition, two years later, France also committed to the European Union's target of 20% energy efficiency improvement by 2020. More detailed measures and programs focus on the building sector – which will have to meet a 38% energy consumption reduction target by 2020 – and on the transport sector – which actively promotes non-road and non-air means of transportation.

Facing the "new" challenge of sustainable energy development

Nowadays, countries are faced with an additional challenge of developing energy resources that do not threaten the global environment – and more specifically, that do not aggravate the climate change issue. Since the beginning of the 21st century, France has been placing the fight against climate change at the top of its energy policy agenda.

France took several commitments to reduce greenhouse gases emissions. In 2005, the government released the "POPE law" ("Loi de programme fixant les orientations de la politique énergétique"), which sets the country's first commitment to reduce its CO2 emissions by 75% for the year 2050. The government also took commitments in international debates, whether they were in UNFCCC's or in European Union's discussions.

Many policies have been developed since, in order to fulfil commitments that were taken. In 2004, France adopted the "2006-2012 Climate Plan" that was then revised in 2006 and again in 2009. The plan develops financial, juridical and technical solutions for several sectors that are responsible for GHG emissions, such as transport, housing, industry, energy and waste, agriculture and cooling. The program also focuses on ways of improving research and development's outputs.

For the gas and electricity sector and for heat production from renewable resources, developers are required to submit pluri-annual investment plans (PPIs). Plans are then carefully reviewed, ensuring that they are in line with France's objectives towards the future development of its energy sector.

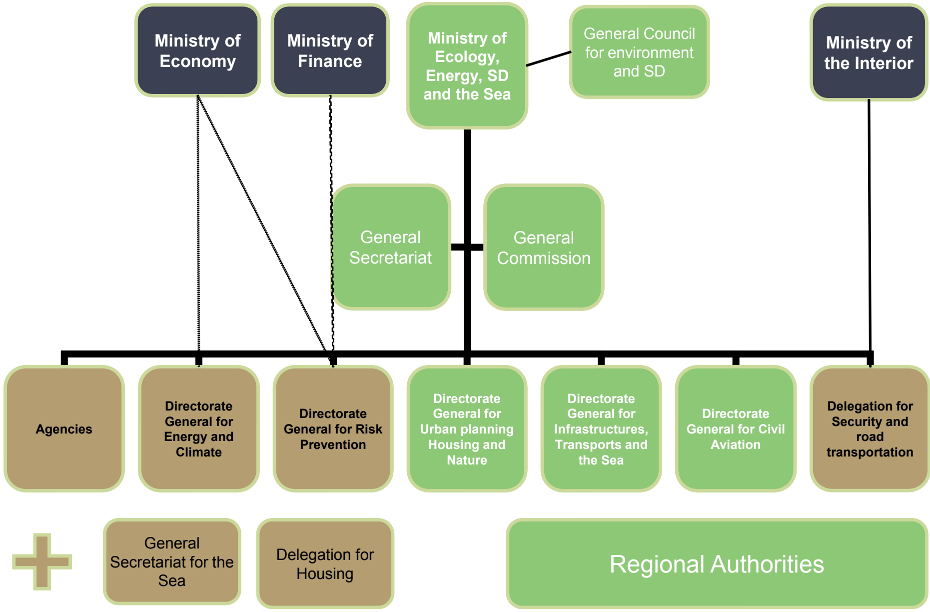
France's main innovation in terms of policy making maybe remains the "Grenelle de l'Environnement", a comprehensive public consultation that was launched in 2007-2008. The "Environment Round Table" gathered stakeholders from the state, local governments and NGOs, as well as employers and employees. People were divided into 6 working groups ("tackling climate change and controlling energy demand"; "preserving biodiversity and natural resources"; "preserving health and environment"; "adopting sustainable producing and consuming habits"; "building an ecological democracy"; "promoting ecological development paths favourable to employment and competitivity"), and submitted their propositions to the government. A vast public consultation was also conducted through public meetings as well as through internet forums. More than 300,000 Internet users participated in the process and more than 15,000 people gathered in the 19 regional meetings. The propositions submitted during the Grenelle Round Table resulted in the development of an impressive environmental program, that sets policies, measures and good practices on environmental issues that apply to numerous sectors (building; biofuels; waste treatment; …).

In June 2007, France also launched a profound institutional reform. The separate institutions working on transport, urban development, climate change and energy were combined in a new ministry: The Ministry of Ecology, Energy, Sustainable Development and Town and Country Planning. Today's Ministry of Ecology, Energy, Sustainable and the Sea is a unique structure among the European Union countries. The rationale behind this merger was to improve coherence in policy formulation, to reduce costs of policy implementation and to increase the efficiency of the policy process. The ministry formulates policies related to energy, environment, land and transport, while ensuring that these policies enable France to meet its commitments in terms of sustainable development. The structure now ranks first in size and importance, after the President's and the Prime Minister's offices.

The structure has five general directorates and one delegation, each focusing on a particular sector. Some entities are under its exclusive supervision, while others are also under the supervision of other ministries. The MEEDDM is assisted by local authorities that are also in charge of developing agricultural policies.

The ministry is supported by the assistance of experts from research and training centres and specialized technical agencies – like the Agency for Energy Control and the Environment (ADEME), a government institution under the supervision of both the MEEDDM and the Ministry of Higher Education and Research (MESR) that focuses on developing energy and environment policies.

Figure 9.1: Institutional structure of French sustainable development governance



National programs, measures issued from the Grenelle Round Table and the comprehensive institutional reform that was conducted in 2007 had significant impacts on France's consumption patterns, and have been driving GHG emissions as well as energy intensity down.

Table 9.4: EU-27 CO_2 emissions related to energy production and transformation

gCO2/kWh	1990	2000	2005	2006	2007	2008	Change 2007-2008 (%)	Change 1990-2008 (%)
UE-15	430	349	326	328	336	319	–5,1	nd
Germany	553	494	405	404	470	441	–6,1	-20,2
Austria	245	180	219	215	196	183	–6,6	-25,3
Belgium	344	284	271	260	253	249	–1,5	-27,7
Spain	427	430	397	369	387	326	–15,8	-23,7
Finland	227	211	193	241	229	187	–18,2	-17,6
France	109	84	93	87	90	83	–8,1	-24,2
Italy	575	498	413	424	388	398	+2,8	-30,6
Netherlands	588	400	387	394	399	392	–1,8	-33,4
United Kingdom	672	461	484	506	497	487	–2,1	-27,5
Sweden	48	42	44	48	40	40	–0,3	-17,3
Others EU-27	nd	517	495	501	521	503	–3,4	nd

Source : Commissariat Général au Développement Durable, 2011

Joining a more competitive environment

In the current globalisation context, it is crucial that European industries have access to energy at the same price as their competitors. With this aim in mind, decision makers have been designing policies to drive the energy sector towards a more integrated, more liberalized and more competitive market. Institutions of the European Union have been particularly active in implementing measures along the lines of market liberalization.

Some decades ago, the energy sectors of most of the European Union countries were characterized by the strong involvement of their governments. France was no exception to the rule. The rationale behind its strong governmental involvement in the energy sector was twofold: first, energy security strongly relied on an energy quest that could only be conducted by governments that could use their diplomatic relationships with producing countries to buy energy fields abroad; second, investment needs to develop energy sectors were tremendous, whether investments were dedicated to build dams or nuclear plants.

For some years, France has been transposing the EU Liberalisation directives to its own regulations. Significant progress has been made on electricity and gas market liberalization: the major gas and electricity companies are now privatised, and both markets are fully open to competition. The markets run under the supervision of an independent regulatory board, the French Energy Regulatory Commission (Commission de Régulation de l'Energie). The CRE was created in March 2000 with the aim of ensuring that the opening of energy markets takes a smooth and effective path. The responsibility of the CRE expanded from dealing only with the electricity market to supervising the gas and the electricity markets starting from 2003. The CRE has to ensure that electricity and gas suppliers have open access to all transmission and distribution networks.

However, market shares of new incomers remain insignificant, as consumer switching is rare. The former state actors – EDF and GDF Suez – are still taking the lion's share of the electricity and gas markets. Furthermore, the French government has been keeping a strong involvement in these sectors, as it still has significant stakes in GDF Suez (35.6%) and EDF (84.6%).

EVOLUTION PERSPECTIVES AND CHALLENGES

Towards a European smarter grid

The European willingness of building an interregional electricity grid faces technical issues. Connection points are currently saturated. Further research has to be conducted in order to figure out solutions for a smarter grid that could integrate all energy sources – geographically and technically – and cope with wider fluctuations in supply and demand.

For both the electricity and gas markets, France could benefit from its situation of a large country in the centre of Europe. However, growing interconnections pose many technical issues. France's grid will also have to become more flexible to cope with its integration into a more competitive market, challenged by more complex trends of energy consumption and production.

The remaining issue of regulated tariffs

The government also needs to figure out how to deal with the persistent existence of regulated tariffs on the electricity retail market. The government considers that increasing regional integration will impact domestic electricity markets and cause a rise in wholesale prices. The government thus chose to keep regulated tariffs in order to maintain stable and low prices, in such a way that consumers do not have to endure price increases.

However, the coexistence of regulated tariffs and market prices in the electricity retail market may impede investment in new capacity and poses a threat to market liberalisation. Some argue that the current tariff structure is not sustainable. Last November, GDF and other gas suppliers even attacked governmental measures related to regulated tariffs in front of court. In addition, low regulated electricity prices also carry the risk of insufficient incentives for energy savings among consumers. In the coming years, France will definitively have to deal with the compatibility of its tariff structure with the European trend of market opening and integration.

The debate of nuclear power

Although the debate of nuclear power has been taking place for decades, Fukushima's disaster made it become even more intense. The rise of concerns was not France's prerogative and spread all over the world, among producing countries as well as their more or less close neighbours. However, the discussion was particularly passionate in France, which so strongly relies on nuclear power for its electricity production.

People in favour of this energy resource argue that nuclear power accounts for 78% of the electricity production; thus the cost of a shift to other resources would be tremendous. Nuclear power, for its defendants, remains a cheap, clean and self-sufficient energy source. Moreover, the uncertainty of renewable electricity prices raises concerns among consumers – households and companies. Finally, a withdrawal from the nuclear sector would have a huge impact on French nuclear giants and on their international expertise and competitiveness.

Six months before the elections, the debate took a real political turn. Last November, in order to establish the ground basis of a political coalition, the socialist party and the green party signed an agreement which settles a roadmap for the progressive reduction of the nuclear power in France's energy mix. The agreement includes, among other measures:

- a commitment to reduce the share of nuclear power in France's electricity production from 75% to 50% by 2025, by progressively closing 24 nuclear plants;
- a readiness to definitely suspend the Penly EPR project;
- a promise to abandon the idea of initiating other nuclear plant projects.

In order to compensate for the loss of competitiveness of France's nuclear giants, the agreement proposes to build France's expertise on a sector that would specialize in the dismantling of nuclear plants.

However, in spite of this agreement, the debate is still intense between the green party and the socialist party. In December, the leader of the socialist party, François Hollande, declared that he intends to implement only the essential measures of the agreement. It is still not clear whether or not he will respect the agreement if he is elected in 2012. Whether it be him or one of his opponents elected as Head of State in a few months, the debate promises to remain passionate.

CONCLUSION

In the light of recent events and of the current economic crisis, we cannot help but wonder if France's willingness to focus on environmental protection is sustainable. Developing renewable energy indeed needs huge investments, whether it be for developing research or for implementing financial instruments like credits, loans or tax incentives.

Does France need a change of scale for its energy policy? The European Union has proven to be a key stakeholder in establishing integrated, competitive and open energy markets. The European scale can also help promoting a European competitiveness for the implementation of large smart grids. Moreover, in Durban in particular, the European Union has also proven to be a more effective structure for international negotiations. The very first treaties that brought European countries together were related to energy (coal and steel treaty in 1951, Euratom Treaty in 1957, …), and the role of the European institutions has greatly been increasing in the past few years, as well as the one of the private sector.

Will we witness a further limitation of the governments' ability to take decisions in terms of energy policy? Will we witness the formulation of a unified European energy policy that could also provide countries with a technical and financial help to face both crisis – the environmental one and the economic one?

When looking at the heterogeneity of European energy choices, it seems rather unlikely that such an evolution will occur in the coming years. Europe's divisions over nuclear power have deepened since Fukushima: while Britain and France remain committed supporters, Italy decided to build new plants, whereas Germany chose to step out of the nuclear power community.

In addition, the rules of the European Union clearly state that the EU's role is to "ensure the functioning of the energy market; ensure security of energy supply in the Union; promote energy efficiency and energy saving and the development of new and renewable forms of energy; promote the interconnection of energy networks". The general acknowledgement that all the member states keep their sovereignty over their energy resources is strongly established in the EU. According to the Treaty on the Functioning of the European Union, "European measures shall not affect a member state's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply". France has been taking, by itself, heavy commitment both for energy security and for energy efficiency. However, we can reasonably expect that European structures will provide France with some help to achieve its commitments in line with an integrated and rational European strategy.

ACKNOWLEDGMENT

Since 2005, the Asia Centre has been conducting research on contemporary Asia, and particularly on research areas that define and influence international relations strategically, politically, and in social and economic terms. Its Energy program thus has been decisive in identifying issues that were conclusive

in the evolution of Euro-Asian relationships, and more particularly of Sino-French relationships. The program has been organizing a framework for debate on energy and environment issues that brought together members of the Association, qualified French and foreign experts, as well as organizations promoting research, brainstorming and professional exchanges both in France and abroad, with a two-pronged focus aiming at enhancing the discussion: first, on the major political and strategic trends regarding energy security, and second, on the intense debate surrounding the issue of energy efficiency. Our present goal is to analyse both structural and current trends associated with local energy concerns in Europe and in Asia; to maintain our scrutiny of major technological advances and to decode the web of relations between the different players in economic and political circles affected by these issues. More information on: www.centreasia.eu

Chapter 10

Paradigm Shift in German Energy Policy: Towards an Era of Renewable Energies

Hartmut Grewe

ABSTRACT

Germany has the ambition to become the most efficient and most ecologic energy consuming economy of the world, while securing its industrial base. Its leaders see specific advantages of being a frontrunner. The new Energy Strategy of the German Government was announced in September 2010 with a vision to replace fossil and nuclear energies until 2050 step by step through renewable energies (basically by wind and solar but also implies the energetic use of biomass). This will results in Germany becoming less dependent on energy imports and GHG emissions will be significantly reduced (40% until 2020 and 80% until 2050, as compared to 1990). Besides renewable energy transition will create new jobs: in 2010 more than 360.000 were employed in the new industry. With this, conventional energies (fossil and nuclear) will play a different role in the future energy mix of all energy consuming sectors. However, the growth of renewables requires an integral strategy in the electricity and building sectors in order to transform the existing energy system.

DRIVING FORCES FOR A COMBINED ENERGY AND CLIMATE POLICY IN GERMANY (AND EUROPE)

For two decades already, since the Rio Conference of 1992 when an international climate regime under UN-auspices was inaugurated, Germany and other EU-countries have been on the forefront of fighting the trend of global warming. These countries signed the Kyoto Protocol of 1995 committing to reduce CO2-emissions. Germany so far has made the greatest progress in this respect, achieving a reduction of 20% as compared to 1990. Other industrial countries (USA, Canada, Australia) are lagging behind or have not committed themselves to mitigation measures; nor have large emitters like China or India.

The negative impacts of climate change are visible worldwide with some regional differences. Southeast Asia is one particularly affected area where some of the poorest countries suffer the most in terms of human and material losses. They have little or no financial means to invest in costly adaptation measures. Even parts of Europe and Germany witness more severe weather conditions attributed to global warming. These produce damages to buildings, infrastructures and farming due to strong winds, heavy rains, forest fires and severe droughts. Thus, an active climate policy with a strong commitment to reduce CO2-emissions has been pursued by Germany and the European Union, as an integral part of national energy policies.

Another important motive of German and European policy is the target of energy security, which is a basic concern of most states. It implies that countries which have to import fossil and nuclear energy resources (oil, gas, coal and uranium) on a large scale must take precautionary measures to secure their supplies or develop other energy sources, especially renewables. EU countries together have to import 84% of their oil consumption and 63% of their gas demand from foreign countries, like Russia. Supply lines such as oil and gas pipelines may be shut down for political reasons (for example, in the gas disputes in 2007 and 2009 between Russia and Ukraine) leading to shortages, economic slowdown and higher energy prices. Since most of the oil and gas resources are concentrated in a few, often politically unstable countries and regions, the security and costs of supply become a major concern to consumer countries. High and rising prices for oil, gas, coal, uranium and electricity can impede economic growth and create social conflicts. Therefore it becomes imperative to look for alternative sources of energy which are less costly and less risky.

The risks of using nuclear energy for electricity generation has in the past been borne and accepted by some 30 nations worldwide. The first setback in popular acceptance occurred in Germany and a few other countries (Austria, Belgium, Italy) in 1989 after the nuclear accident in Tschernobyl (formerly Soviet Union, now Ukraine). It led to the emergence of a strong anti-nuclear movement in Germany impeding the construction of new nuclear plants and installations for recycling and depositing of nuclear wastes. In the following two decades no new nuclear facilities were built in Europe; and in 2001 a first official exit decision from nuclear energy was taken by a German government coalition of Social Democrats and the Green Party. This exit was politically contested and in September 2010 revised by a new government coalition of Christian Democrats and the Liberal Party which allowed major utilities to operate their nuclear plants for a prolonged period until 2040. Then the nuclear disaster of Fukushima/Japan occurred in March 2011 in the aftermath of an earthquake and a tsunami.

This changed the German approach altogether: the risk analysis undertaken by the Federal Government concluded to shut down eight of the oldest operating plants, first temporarily, later permanently. The unilateral phasing-out decision until 2022 meant that steps had to be taken to accelerate the construction of new electricity-generating capacities, especially with renewable energy sources, and to implement efficiency measures for saving energy not only in the building and industrial sectors, but also in the transport sector.

However, an equally strong political motivation was to bury a long-lasting social and political issue which has divided the German society and to achieve some form of national consensus with regard to energy matters. Renewable energies are generally well esteemed and their promotion has been very successful, although fairly costly. However, they need to become more innovative and more competitive in order to secure green markets for the future. Germany is still a technology leader in many fields and exporting technology, but China and other competitors are catching up and are winning sizeable market shares, especially in the production and sale of PV solar modules.

GOALS AND STRATEGIES OF GERMAN ENERGY AND CLIMATE POLICY

German energy and climate policy has been increasingly embedded into the EU context. This means that many decisions taken at the community level allowing competition in a free common energy market for electricity and gas and stiffer environmental regulations are legally binding for member states. Pertinent for a common energy and climate policy has been the European Council Summit decision of March 2007 which sets ambitious political targets for 2020:

- Reducing GHG-emissions by 20% as compared to 1990
- Reducing primary energy use by 20% as compared to 1990
- Raising the share of renewable energies up to 20% of prime energy use
- Improving energy efficiency by 20% as compared to 1990

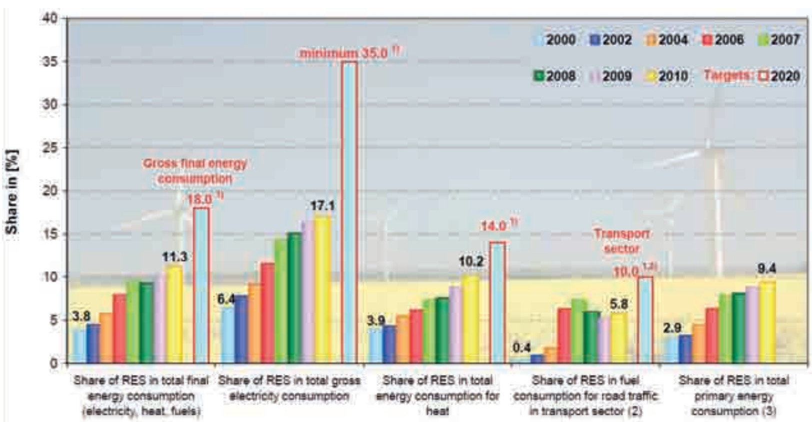
These EU target marks have been put into a package labelled the "20-20-20 strategy". The figures represent a minimum average standard which can be surpassed by individual nations, depending on political will or specific conditions. Some countries (for instance, Austria and Sweden, because of their large hydropower potentials) have already reached a share of renewables in terms of primary energy use which exceeds the 20% target, while other countries are just beginning to develop renewables. Therefore specific national goals were passed to take account of the historic differences. Germany has unilaterally declared its political will to reduce GHG-emissions by 40% by 2020, having reached the 20% mark already in 2010. Also it belongs to a small group of frontrunners who want the EU to raise its common reduction target to at least 30%. So far Europe has conditioned this concession to an active support of climate protection measures from major industrial countries and large emitters, especially the United States of America and China.

The new Lisbon Treaty has given the European Union even more authority in regulating energy and climate issues on a common basis. However, one important restriction remains with regard to the mix of energy sources and technologies which each country applies. This important issue is to remain a sovereign national decision. Thus, Germany was free to opt out of nuclear energy for electricity generation, without consideration of what impacts this decision might have on its neighbours which were relying on electricity imports from Germany. Now with eight nuclear reactors being shut down, the picture has been reversed and Germany has to import a certain amount of electricity from them (possibly even from nuclear reactors in France and the Czech Republic), although not to the extent as had been feared.

GROWTH OF RENEWABLE ENERGIES IN GERMANY: EMPIRICAL EVIDENCE

Germany has been very successful in promoting the growth of *renewable energy markets*. In 2010 its share in total final energy consumption added up to 11.3%; but in the electricity sector the contribution of renewable energy sources was truly significant and very dynamic: tripling within a decade to almost 20% in 2011. Year by year, renewable energy is gaining market share in the German electricity market. For 2020 the national target has been set with a minimum of 35%.

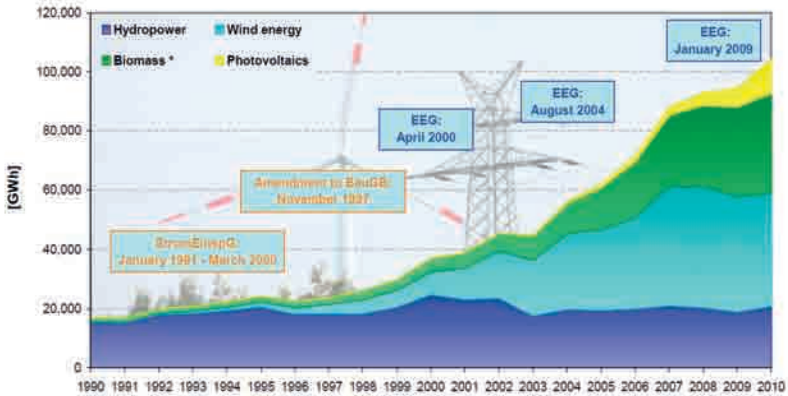
Figure 10.1: Renewable energy sources as a share of energy consumption in Germany



1) Sources: Targets of the German Government, Renewable Energy Sources Act (EEG); Renewable Energy Sources Heat Act (EEWärmeG), EU-Directive 2009/28/EC;
2) Total consumption of engine fuels, excluding fuel in air traffic
3) Calculated using efficiency method; Source: Working Group on Energy Balances e.V. (AGEB); RES: Renewable Energy Sources; Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Brigitte Hiss; as at: December 2011; all figures provisional

The country started in the early 1990s to promote electricity generation by wind power with a feed-in tariff (FIT), but the real breakthrough came in 2000 with the Renewable Energies Law (EEG) passed by the German Parliament. It gives priority to renewable electricity generation and guarantees specific revenues (depending on technology and scale) to private producers for a period of up to 20 years.

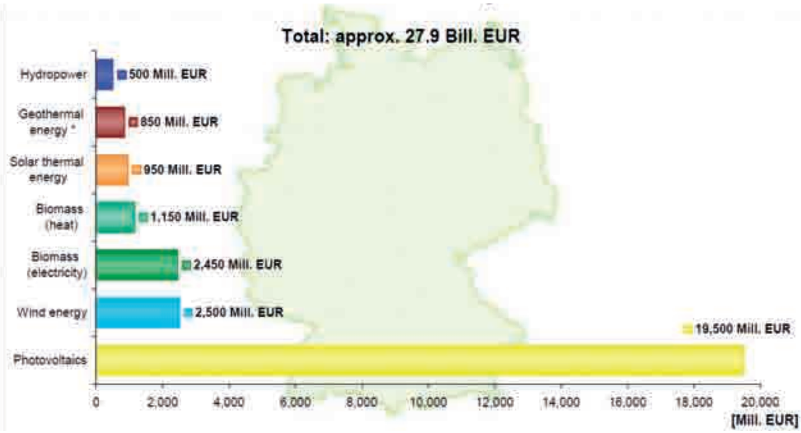
Figure 10.2: Contribution of renewable energy sources to electricity supply in Germany



Note: Solid and liquid biomass, biogas, sewage and landfill gas, biogenic share of waste; electricity from geothermal energy not presented due to negligible quantities produced; 1 GWh = 1 Mill. kWh; StromEinspG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act
Source: BMU-KI III 1 according to Working Group on Renewable Energy-Statistics (AGEE-Stat); image: BMU / Christoph Edelhoff as at: December 2011; all figures provisional

This approach has helped to fuel technology development of and investments in wind and solar power and the energetic use of biomass and geothermal sources in Germany. Total investments in RE technologies amounted to 28 billion euros in 2010, of which almost 20 billion were spent in the photovoltaic business alone.

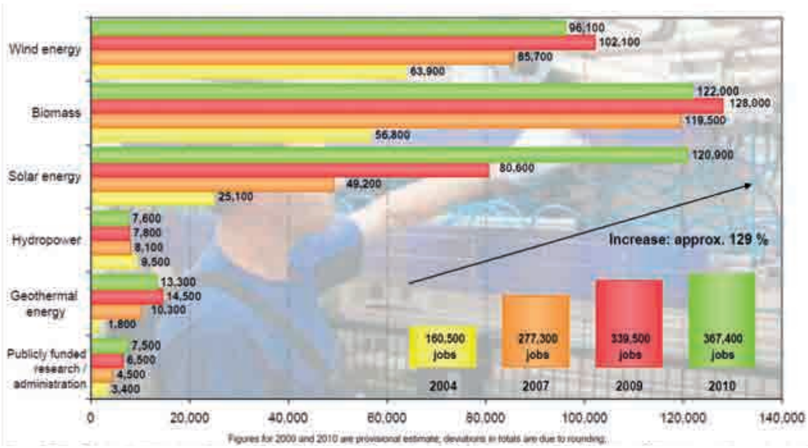
Figure 10.3: Investments in the construction of renewable energy installations in Germany 2010



Note: Large plants and heat pumps; deviations in the totals are due to rounding
Source: BMU-KI III 1 according to the Centre for Solar Energy and Hydrogen Research Baden-Wuerttemberg (ZSW); as at: December 2011; all figures provisional

The emerging renewables industry in Germany has been a true job engine with a growth rate of 129%, more than doubling the number of employed within five years. In 2010 almost 370,000 jobs were listed, and with a clear upward trend forecasted.

Figure 10.4: Jobs in the renewable energy sources sector in Germany



Source: O'Sullivan/Edler/van Mark/Nieder/Lehr: "Bruttobeschäftigung durch erneuerbare Energien im Jahr 20010 – eine erste Abschätzung", as at: March 2011; interim report of research project, Kurzund langfristige Auswirkungen des Ausbaus emeuerbarer Energien auf den deutschen Arbeitsmarkt; image: BMU / Christoph Busse / transit

The FIT incentive model of the EEG was replicated in some 50 countries worldwide to help fuel RE growth. Other countries apply diverse quota or portfolio obligations for renewables which utility companies have to meet. But the latter approach kicks out the more expensive technology options, such as photovoltaic and off-shore wind power. Experts claim that differing national promotion schemes need to be replaced by a coordinated European (EU-wide) approach because it would be more cost-effective using best locations for specific RE-technologies.

Equally (or even more) important as the growth of renewable energies is the question of energy saving or *energy efficiency* in all sectors: energy production, energy transport and energy consumption of electricity, heat and mobility or transport services.

The *strategic instruments* for energy efficiency are multidimensional and comprise:

1. Efficient conversion of energy resources (supply side)
2. Cost-effective use of energy services (demand side)
3. Promoting renewable energy resources and energy efficiency (policy side)

Keeping in mind to look at both the supply and the demand side of the energy equation, the policy lesson to be learned is that *energy efficiency and renewable energies are like two sides of a coin*. Their combination is very relevant for research and development as well as for practical applications.

THE NEW ENERGY CONCEPT AND ITS ACCELERATED IMPLEMENTATION

On 28 September 2010 the German government adopted an ambitious energy concept which is unparalleled in Europe and throughout the world. It lays down the main strategic targets of Germany's energy and climate policy for the long term – until 2050. However, the original decision adopted by a slim majority of the German Parliament included the permission to extend the lifetime of nuclear power plants. This controversial revision of a previous exit decision taken by a forerunner German Government in 2001 incited new public protests and rekindled the strong anti-nuclear movement in the country. Only six months later, the German chancellor Angela Merkel made a political U-turn by abandoning her support for the nuclear option. Why? Basically for political reasons, claim many observers, in order to pacify a long-lasting political conflict and to devalue anti-nuclear sentiment as a "green" identity in German politics.

As a response to the nuclear disaster in Fukushima, Germany adopted decisions in the summer of 2011 on the gradual phase-out of nuclear power by 2022, greater energy efficiency and an accelerated switch to renewable energies. To this end, the German government drew up a package of concrete measures and a sound financing plan for its implementation. The German Parliament passed a new atomic law in which the permanent closure of eight nuclear reactors and a timetable for the rest until 2022 was laid down. Also a special climate fund was created into which revenues gained from the auctioning of emission rights will flow to finance efficiency measures and to compensate energy-intensive industrial companies. Other items on the legislative agenda were incentives for the modernization of buildings and for investments in building new transmission lines (so-called super and smart grids) and technologies for electricity storage (including electric cars).

ROADMAP FOR A NEW ERA OF SUSTAINABLE ENERGY SUPPLY AND DEMAND (WITH THE HELP OF RENEWABLE ENERGIES AND ENERGY EFFICIENCY)

The paradigm shift of German energy policy can be characterized as accelerating the nuclear exit *and* walking the path towards an era of renewable energies and energy efficiency even faster. RE growth promises to make a significant contribution to climate protection and energy security; also their economic and job potentials are highly regarded. Energy saving through better efficiency in energy production, energy transport and energy consumption in all sectors (electricity, buildings, transport and mobility) is a clear requisite of sustainability.

Growth and market penetration of energy (basically electricity) from renewable sources is to be promoted even stronger, targeted at 35% for 2020. The bulk of this new energy production is to come from offshore wind parks located in the North and Baltic Sea. Their electricity must be transported over long distances to the consumers (industry, business and private households) in the western and southern regions of Germany. In addition, for the task of securing transmission stability under conditions when there is a growing non-continuous input of electricity from wind and solar power, new enhanced grids are needed. In order to allow for peak loads, new power plants (gas or coal-fired) need more efficiency and flexibility. This combines with the challenge to provide better and larger energy storage facilities, especially for electricity. Pump-storage capacities are limited and possible construction sites are publicly contested. More efficient batteries and other storage technologies are still in research and development.

For the construction of a new technological infrastructure required to support RE growth we need support from all citizens. The construction of transmission lines is frequently opposed by local environmental and civic groups. But new enlarged and smart grids are needed for electricity transport, especially with growing amounts of electricity from RE sources. The "not-in-my-backyard" argument also serves individuals and civic groups to oppose planning and construction of pump storage reservoirs, of large wind parks or

PV-solar fields. Transparency and information can help to initiate a fruitful dialogue between officials, experts and citizens in order to allow for necessary corrections and a speedier planning and implementation process.

There are still many challenges to be met on the way to a safer, more equitable and largely carbon-free energy future. Germany is determined to walk this path and there appears to be a consensus with regard to the goal, but the different steps to be taken towards that goal are far from clear and often contested. Much research and development should be promoted as a guide into this still uncertain future, not only in new technologies and practical applications but also in market and consumer behavior and citizens' involvement. Public acceptance, especially of the costs entailed in this transformation project, is important to heed for the decision makers in business, science and politics.

OPEN QUESTIONS – AND AN ATTEMPT TO ANSWER THEM

Will Germany face the risk of unintended de-industrialization due to rising energy prices; or will the country profit from leading the way to green innovations and new jobs in RE-industries?

- "Carbon leakage" – the fear that energy-intensive industries (steel, aluminium, glass, cement, etc.) will shift their production sites from Germany to other countries not bound by environmental or climate restrictions and offering lower energy prices – cannot be observed. The German economy is already profiting from its leading role in developing and exporting green technologies worldwide.

Can the national energy mix in the medium term exclude oil (in the transport sector) and coal (for electricity generation) and substitute them with renewable energies and a flexible use of natural gas?

- To some extent there will be progress seen in reducing the amount of oil used in the transport sector, for instance by higher fuel efficiency and alternative traction systems, such as hybrid and electric cars. Coal will become less competitive as a fuel for electricity generation due to higher operating costs from buying emissions allowances and/or utilizing CCS-technologies.

- Will civic groups and environmental lobbies continue to oppose large-scale infrastructure projects in their neighbourhood which are needed to incorporate renewables into the German energy system?This depends on progress being made in fostering a transparent and fruitful civic dialogue with protest groups. Willingness to listen to and learn from one another is a precondition for a renewed and genuine democratic culture of political compromise at all levels.

Will Germany lose its political influence in the international community (especially within EU), or will it demonstrate to the rest of the world that sustainable energy production and consumption (without nuclear power) is possible?

- Germany is far from losing its exposed position in European and international politics, as long as her economic and financial system is not suffering a setback. Members of the international community, especially her European neighbours, are looking with great interest and sympathy at the German experiment of transforming the energy system and de-carbonizing the economy. Renewables and energy efficiency are uncontested on a global scale. The future of nuclear power remains an open question, dependent on reactor safety and nuclear waste treatment.

Chapter 11

Carbon Trading and the Future of Energy Policies in Australia

Hugh Saddler

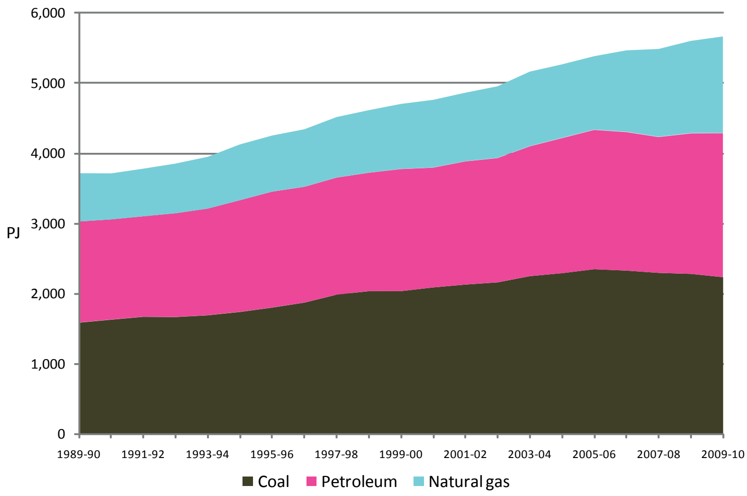
ABSTRACT

In November 2011 the Australian Parliament passed the Clean Energy Act 2011 and associated legislation, the principal effect of which will be to impose a price on greenhouse gas emissions. Pricing will start in July 2012 at a level of A$23 per tonne CO_2-e, rising gradually over the next two years and then transitioning to an emissions trading scheme in 2015. The price will be imposed on electricity generation, all other use of natural gas for energy, fugitive energy emissions and industrial process emissions. Most use of petroleum fuels will be effectively exempt. Notwithstanding the price on emissions, official projections of Australia's energy future suggest that consumption of fossil fuels, and associated emissions, will continue to increase until 2025 and will not fall back to current levels until after 2040. It is difficult to describe such expectations as a clean energy future. The reason that Australian energy policy is not expected to deliver a more decisive break with past patterns of energy use is that emissions pricing is being imposed as a perturbation from outside a well established energy policy framework. If Australia is to take seriously the importance of moving towards a green economy, energy policy will have to be decisively changed, to incorporate the urgency of reducing greenhouse gas emissions as a central objective of a new policy framework.

AUSTRALIAN ENERGY SUPPLY AND CONSUMPTION

Australian consumption of fossil fuels has been growing for many decades (Figure 11.1). In 2009-10, the respective shares of total primary energy consumption of the three fossil fuels were: coal 37%, petroleum 35%, gas 23%. Until about five years ago there was little change in the shares of the three fuel types, but since then consumption of coal has declined slowly, and consumption of gas has increased rapidly.

Figure 11.1: Australian fossil fuel primary energy consumption, 1990 to 2010

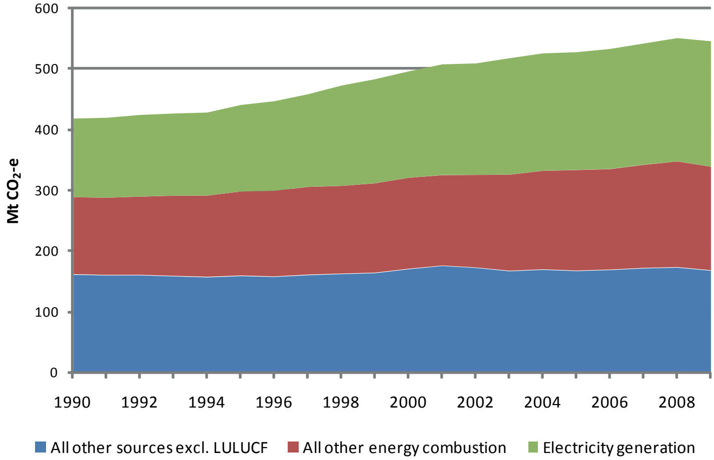


Source: Calculated from data in Australian Bureau of Agricultural and Resource Economics and Science (2011)

Unsurprisingly, steady growth in fossil fuel consumption has led to steady growth in greenhouse gas emissions (Figure 11.2). Energy combustion emissions have been the source of virtually all of the increase in Australia's net emissions since 1990, and emissions from combustion of fossil fuel for electricity generation have been responsible for the great majority of this increase. In 2008-09 (the most recent available inventory year) electricity generation contributed 38% of Australia's total emissions (exclusive of emissions associated with land use, land use change and forestry) and other energy combustion 31%. The respective shares in 1989-90 were 31% and 30%. The absolute increases in annual emissions from these two sources over this period were 77 Mt CO_2-e and 44 Mt CO_2-e respectively (Department of Climate Change and Energy Efficiency 2012).

These trends are readily explained by the fact that consumption of electricity has been growing faster than consumption of other sources of final energy consumption, and that coal fired power stations supply the great majority of electricity. This is shown in Table 11.1, as is the fact that electricity generation accounts for the great majority of coal consumption. Note that brown coal (lignite) is a low quality fuel with very high moisture content, as a consequence of which power stations which use brown coal have very high emissions intensity – in the range 1.2 to 1.5 t CO_2-e per MWh generated, depending on the size and vintage of the power station.

Figure 11.2: Australian greenhouse gas emissions (excluding emissions from land use, land use change and forestry), 1990 to 2009



Source: Calculated from data in Australian Department of Climate Change and Energy Efficiency (2011)

Table 11.1: Relationship between electricity generation and primary fuel consumption

Primary fuel	Share of electricity generation	Electricity generation as share of total consumption of fuel
Black coal	52%	84%
Brown coal (lignite)	23%	100%
Petroleum	1%	2%
Gas	16%	29%
Hydro	5%	100%
“New” renewables	3%	100%

Source: Calculated from data in Australian Bureau of Agricultural and Resource Economics and Science (2011)

The end uses of the various fuels by major economic activity in 2009-10 are shown in Table 11.2. Key points to note are as follows.

- More than half of all electricity is consumed in the residential and commercial/services sectors, i.e., in buildings and appliances.
- The other major use of electricity is in the production of primary metals, mainly aluminium.
- Almost 80% of total petroleum product consumption is for transport and much of the remainder is used in agriculture, mining and construction, where petroleum products are mainly used in mobile equipment.

- Very large quantities of gas are used to process raw gas to pipeline gas and LNG; the former would be better defined as an energy transformation industry, rather than final consumption, but the data are not reported in a way which would make this distinction possible.
- Gas is the main source of heat energy for the energy intensive process industries, which include primary metals, chemicals, pulp and paper, ceramics, glass and cement.
- The steel industry is a major user of coal; it is also used in the production of other primary metals and cement.

Table 11.2: Consumption of major fuel categories by end use sector, 2009-2010 (PJ)

Economic sector/activity	Electricity	Petroleum products	Gas	Coal & coal products
Residential	217	12	144	0
Commercial and services	206	28	48	1
Mining, agriculture, construction (1)	72	228	314	1
Primary metals	147	46	149	188
Other process industries (2)	58	71 (3)	222 (3)	38
Transport	14	1,406	20 (4)	0
All other industries	46	26	74	0

NOTES
(1) Includes substantial quantities of gas and electricity used to process raw gas to pipeline quality gas and LNG.
(2) Excludes petroleum and other forms of energy used in oil refineries.
(3) A significant fraction of the petroleum and natural gas consumption is used as petrochemical feedstock, mainly for the production of ammonia, polyethylene and polypropylene.
(4) Mostly gas used for compression along gas pipelines.
Source: Calculated from data in Australian Bureau of Agricultural and Resource Economics and Science (2011)

TRENDS AND PROJECTIONS

In November 2011 the Australian Parliament passed a package of legislation, called the Clean Energy Future package, which will have the effect of imposing a price on greenhouse gas emissions from most energy combustion activities and some other emission source categories (the new policy is discussed further below). Prior to the passage of the legislation, the government released details of comprehensive economic modelling of the effects of the carbon price policy, undertaken by the Australian Treasury Department (2011). This modelling provides projections of expected future Australian energy supply and demand, both with and without a carbon price. Shortly afterwards, a second set of projections, based on the same assumptions about national income and population growth, was published by the Bureau of Resource and Energy Economics (Syed and Penney 2011), an agency of the Department of Resources, Energy and Tourism.

Without a carbon price, over the next decade, real national income per person is projected to grow at an average annual rate of about 1.5%. This is associated with relatively little change in the structure of the economy: services remain close to their current share of 72% of national income, oil, gas and coal extraction and processing increase their share, but energy intensive manufacturing decreases. Over the whole period to 2050, the average annual rate of population growth is projected to be about 1.2%.

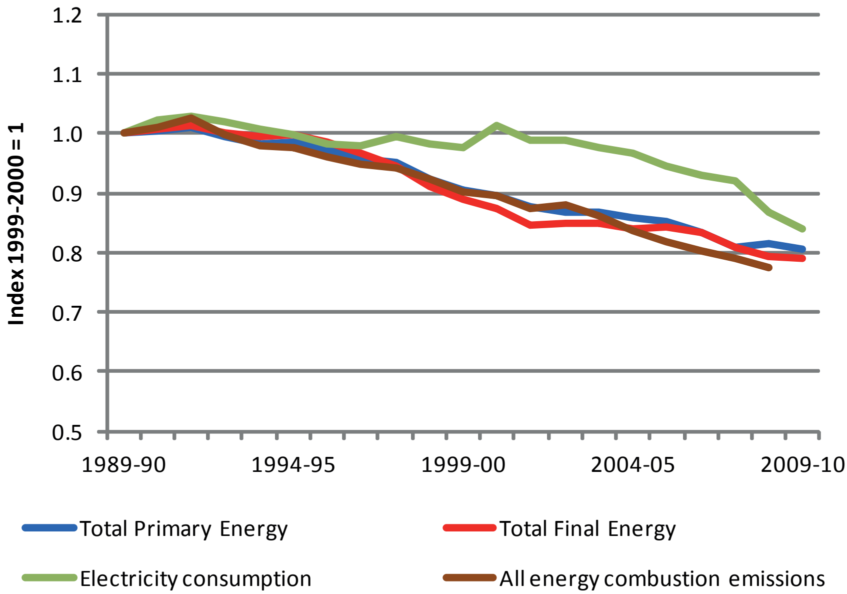
Electricity generation is projected to grow at an average annual rate of about 1.4% until 2025, and somewhat faster thereafter, i.e., slightly faster than population. However, associated emissions are projected to grow at 0.4% annually until 2020. The difference between these two rates of growth reflects the impact of various policies, currently in place, to encourage a shift from coal to lower emission generation technologies. After 2020, however, there is little further reduction in the emissions intensity of electricity, indicating that coal is projected to continue as the principal fuel for electricity generation.

Transport emissions are projected to grow at an average annual rate of 1.7% until 2020, but more slowly thereafter (data on energy consumption for transport are not published). Other direct combustion emissions, arising from use of fossil fuels for stationary energy uses, are projected to grow very rapidly, at an average annual rate of 3.1% until 2020, which is slightly higher than the rate of growth of real national income. This is despite that fact that the energy intensive sectors of the economy (mining, fuels processing and process industries) are projected, after 2012, to grow no faster than the economy as a whole. This implies no further reduction in the emissions or the energy intensity of these industries. At the most detailed level, there is a very large increase in emissions from oil, gas and coal extraction; this is undoubtedly attributable to a large increase in gas consumption for the production of export LNG.

These projections are broadly consistent with continuation of the trends seen in recent years, though in all cases indicate slightly faster growth. Over the past decade, electricity consumption has grown no faster than population, and may now be growing more slowly (see Figure 11.3). More recently, both total primary energy and total final energy consumption also appear to be growing more slowly than population. Over the past decade, emissions from transport have grown at an average annual rate of about 1.5%, which is slower than projected for the next decade.

In summary therefore, the official base case projection is that, in the absence of a price on emissions, Australian energy consumption would grow at a faster rate than it has over the past decade.

Figure 11.3: Trends in Australian energy consumption, electricity consumption, and emissions from energy consumption per $ of real GDP, 1990 to 2010



Source: Calculated from data in Schultz, and Petchey (2011) and Australian Bureau of Statistics (2011).

EXISTING EMISSIONS ABATEMENT MEASURES

In common with most other developed countries, Australia has a diverse array of policies and programs intended to reduce greenhouse gas emissions from the energy system by means other than use of a direct price on emissions. They include:

- national policies, applied across the country by the Australian government,
- federal policies, also applied across the country, but by cooperative arrangements between the national government and the eight state and territory governments, which mean that in some cases the timing and extent of implementation varies between states, and
- policies and programs developed and implemented by individual states and territories.

There are policies and programs directed at both the demand side, i.e., energy efficiency, and at the supply side, mainly providing support for low emission electricity generation. A brief account of a small number of the programs which appear, on the basis of limited evaluation data, to be having the largest impact, follows.

The Renewable Energy Target is a generation portfolio mandate program which requires all electricity retailers to source a specified quantity of their total wholesale electricity purchases from accredited renewable energy generators. The total mandate increases each year to 2020, when it nominally reaches 41 TWh, in addition to a baseline level of hydro generation of around 15 TWh. This would bring total renewables to well over 20% of projected total electricity consumption in 2020, and nearly a trebling of the current renewable share of about 8%. However, because of various complex defects in the detailed design of the scheme, mandated renewable electricity in 2020 will probably be significantly less than 41 TWh. The major effect of this program has been to allow the market to discover that southern Australia has a very large high quality wind energy resource and to support the installation of wind generation capacity which had reached about 2.1 GW by mid-2011 (Clean Energy Council 2011).

Feed in tariffs to support small-scale (mainly residential) installation of photovoltaics have been introduced by many states and territories and the Australian government also provides what is in effect a cash rebate. Some of the tariffs were initially excessively generous and there was a boom in PV installation. Capacity is estimated to have increased more than 30-fold, to about 1.03 GW, from early 2009 to mid-2011 (Clean Energy Council 2011).

The Equipment Energy Efficiency (E3) program is a cooperative federal program which has been in place for about 25 years. Its main activity is to regulate Minimum Energy Performance Standards (MEPS) on a wide and growing range of domestic, commercial and industrial appliances and equipment. A study in early 2009 estimated that the program would reduce electricity consumption in 2010 by about 10 TWh below the level which would have been obtained in the absence of the program and that savings would rise to over 30 TWh by 2020 (George Wilkenfeld and Associates 2009). While savings measured in this way against a counterfactual always involve an element of judgement, these are large numbers, relative to Australia's current total annual electricity consumption of about 211 TWh.

The Energy Efficiency Opportunities program was introduced in 2006 to encourage large energy users (corporate entities using more than 0.5 PJ annually) to improve their energy use efficiency. They are required to undertake professional assessments of their energy use, with the aim of identifying all opportunities to increase efficiency which are estimated to have a payback period of four years or less. Summary results of assessments must be publicly reported annually. The number of corporations with a reporting obligation under the scheme in 2010 was 207. The total energy used by these corporations in 2010 was over 1,400 PJ, equivalent to 38% of Australia's total final energy consumption in 2010. Identified annual savings opportunities totalled 142 PJ (10% of total energy consumption), of which 76 PJ had been or were being implemented, equal to almost 2% of Australian total final energy consumption (Australian Department of Resources, Energy and Tourism 2011).

Although each of these programs has been in place for some years it is only in the last couple of years that their impact, as estimated in the various program documents referenced here, is expected to be appreciable. Rapid growth from now on is projected. There are some data which suggest that demand for both electricity and gas, particularly in the residential sector, may not be growing as fast as in the past, but the most recent comprehensive data for the year ending June 2010, and the trends, are as yet by no means clear. In addition, there have been large increases in consumer prices for electricity and, to a lesser extent, gas over the past three years. It is therefore very difficult to determine if there is a trend towards slower growth in demand, and which causal factors are the most important.

THE CLEAN ENERGY FUTURE PACKAGE

The main features of the carbon pricing legislative package are as follows.

- Coverage of the scheme, in formal legal terms, will be emissions from energy combustion, fugitive energy, industrial processes and waste.
- However, some important emissions source categories within this coverage will be exempted from paying a carbon price; these are all road transport fuels and off-road use of petroleum fuels in the agriculture, forestry and fishing industries. In 2009, the covered source categories accounted for 83% of Australia's total emissions, excluding emissions from forestry and land use change, and the sources subject to a carbon price for 68%.
- Extending a carbon price to fuel used by heavy road transport vehicles will be reviewed in 2015. If the extension occurs, 72% of emissions (in terms of 2009 emissions) will be subject to a price. Passenger cars and light commercial vehicles will remain outside the scheme.
- Permits will have to be held against all emissions of greenhouse gases from these source categories.
- The scheme will start in July 2012, and for the first three years permits will be issued at a fixed price, set at $23 per tonne CO_2-e, in 2012-13 A$, rising at 2.5% per annum in real terms in each of the next two years, and will not be tradeable.
- Thereafter, new permits will be sold through government auctions and permits will be tradeable. Auction prices will be subject to both a floor and a ceiling.

- All entities with annual emissions of more than 25 kt CO_2-e will be required to acquit permits against their emissions each year.
- Suppliers of gas and petroleum products (to non-excluded activities) will be required to hold and acquit permits to cover their sales to smaller consumers which do not themselves have direct liability.
- Permits relating to sales of petroleum products will in general not become tradeable after three years. However, large users, e.g., airlines and rail operators, will be able to opt in to the trading scheme if they wish. In practice, since most of the petroleum-using activities of small users are excluded, this is likely to mean that, to the extent that use of petroleum fuels is covered, most of the permits relating to this use will be tradeable.
- Cash payments will be made through the taxation system to low and middle income households, as compensation for the higher costs of electricity, gas and other goods and services resulting from the carbon price.
- A wide range of emissions intensive trade exposed (EITE) industries will receive free allocations of permits to cover the majority of their emissions. These allocations will extend for some years but be subject to periodic review. In the initial years it can be calculated, from government figures, that one third of permits are expected to be allocated free.
- When permit trading starts, liabilities to acquit may be met by purchases of UN-approved categories of international instruments, including CERs. Domestic offsets from approved activities in non-covered sectors, including agriculture and forestry, may also be allowed.
- The total cap on emissions from covered sources in 2020 will be set at a level "consistent with the trajectory implied by Australia's unconditional target of reducing national emissions to 5 per cent below 2000 levels by 2020". This is specified in the legislation as a total emissions reduction by 2020 of 86 Mt CO_2-e below the level of emissions in 2013.

The Treasury modelling of the with carbon price case projected how much of the emissions reduction required to stay within the legislated cap would come from domestic emissions abatement, and how much from purchased international permits. The modelling assumed that the supply of international permits would be sufficient to meet any foreseeable demand from Australia, and that the average international price would be A$29/t CO_2-e. On that basis, it was projected that the required emissions abatement would be 58 Mt from domestic abatement and 94 Mt from international permits. This means that domestic emissions will be higher in 2020 than today.

Table 11.3 shows the projected changes in emissions from consumption of fossil fuel energy, relative to both the without carbon price case and to emissions in 2010.

Table 11.3: Projected changes in domestic emissions by 2020 with carbon price

Economic sector/activity	Emissions change relative to Base Case 2020		Emissions change relative to 2010	
	Mt CO2-e	Percent	Mt CO2-e	Percent
Electricity generation	- 20.0	- 10%	- 12.0	- 6%
Other stationary energy	- 6.3	- 5%	+26.8	+ 28%
Transport	- 1.0	- 1%	+ 14.3	+18%
Total energy	- 27.3	- 7%	+ 29.1	+ 18%

Source: Calculated from data in Australian Treasury Department (2011).

Different factors are at work in the three major sectors listed.

For electricity, emissions reductions induced by a carbon price may occur on the supply side, as a result of changes in the mix of supply technologies and fuel, and on the demand side, as a result of action to increase the efficiency with which electricity is used. The published modelling results indicate that both supply and demand changes are expected.

On the electricity demand side, a sharp fall in demand is projected in the three years following the introduction of the carbon price. Demand growth then resumes, so that by 2020 demand for electricity is at much the same level as in 2010. Hence demand reduction makes no contribution to the reduction in electricity emissions, relative to 2010, shown in Table 11.3. Growth in demand is projected to continue to grow steadily after 2020, though at a somewhat lower rate than without a carbon price.

On the electricity supply side, a modest reduction of 6% in the emissions intensity of electricity generation, additional to the 9% reduction in the base case, is projected to occur by 2020. This reduction is caused by a reduction in coal fired generation and an offsetting increase in renewable generation. There is a very small increase in gas fired generation.

The projections by the Bureau of Resource and Energy Economics (Syed and Penney 2011), which are for the with carbon price case only, show significantly faster growth in demand for electricity, supplied by a similar mix of generation technologies. This report does not include an estimate of the resultant emissions but, clearly, with higher demand, they would be higher than in the Treasury projections.

For other stationary energy use, the main driver of growth in energy demand and emissions is undoubtedly the large growth expected in the production of LNG for export. Depending on what assumptions are made about projects on line by 2020, this industry could account for as much as 20 Mt

CO_2-e, of the projected 26.8 Mt CO_2-e increase above 2010 levels, shown in Table 11.3. The contribution to national emissions growth of the LNG industry is in fact larger than can be estimated from Table 11.3, because the table does not include fugitive emissions, arising mainly from venting of stripped CO_2. One of the major projects currently under development is proposing to limit its fugitive emissions by geosequestration, but no such plans have been announced for other projects expected to be operational by 2020, and it is not clear what, if any, effect of the carbon price on these projects is suggested by the modelling.

Energy use in other mining activity is likely to account for much of the remaining increase. The modelling indicates almost no increase in output from the major emissions intensive process industries. Given the additional incentive for increased energy efficiency provided by the carbon price, emissions from these industries should actually decrease if output stays constant, but it is not clear whether the modelling includes this effect.

Finally, for transport, imposition of a carbon price is projected to have almost no effect on emissions, which continue to grow strongly. This is no surprise, since most transport emissions will be exempted from paying the price. While there are obvious political reasons for exempting road transport fuel use, and the low price elasticity of demand for road transport fuels may provide a policy reason, this leaves open the question of how to curb growth in transport emissions. This is a large and obvious lacuna in Australian policies for dealing with energy-related emissions.

The projections by the Bureau of Resource and Energy Economics imply a somewhat slower, but still significant, growth in emissions from other stationary energy use, and a somewhat faster growth in transport emissions.

TRANSFORMING THE ENERGY SYSTEM?

It will be obvious that the reductions in energy-related emissions described above fall far short of Australia bearing a proportionate share in achieving the sorts of emissions reductions which science suggests will be required if dangerous climate change is to be avoided. So far as the energy system is concerned, the modelled changes amount to little more than marginal adjustments. These certainly do not amount to a clean energy future for Australia, notwithstanding the government's choice of this phrase as the title for its policy package.

There is no room for doubt that a truly clean energy future is what will be needed if Australia is to make deep cuts in its emissions. Nor is there any uncertainty about the broad outline of what this will be like or the direction of the physical changes in the energy system which will be required. On the supply side, the emissions intensity of electricity must be reduced, by shifting electricity generation away from coal and towards much greater use of Australia's diverse and abundant renewable energy resources, supported by greater use of gas, at least over the medium term. Transport must move away from petroleum, towards a lower emission energy source, which now looks increasingly likely to be low emission electricity. On the demand side, energy efficiency must be increased in all areas of energy use, including road passenger transport, where there is immense scope for greater use of smaller, more fuel-efficient conventional vehicles in the short term.

The reason that carbon pricing alone, which is what the government has modelled, does not achieve more far-reaching changes to the energy system is that it is being imposed, as it were, from the outside, on a strongly entrenched energy policy framework, which was established with objectives quite other than emissions reduction.

The most important part of energy policy is the Australian Energy Market Agreement, to which the Australian government and all eight state and territory governments are parties. This establishes the policy framework for both the electricity and the gas industries. The objectives of the policy, as embodied in the National Electricity Market objective:

> "... to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to — (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system."[1]

The National Electricity Market was established in the early 1990s, based on ideas from the 1980s, and on the assumption that the physical structures and technologies used in the industry at that time would for the foreseeable future change only incrementally and very slowly. Environmental objectives were consciously and deliberately excluded at the time and governments have consistently rejected proposals for their inclusion ever since.

A second set of policies are those concerned with transport. These implicitly, if not explicitly, assume continued, more or less indefinite use of petroleum fuels and have no significant elements directed at reducing vehicle fuel consumption.

A third set of policies, better considered as policies for mineral exploitation rather than mining, are those which support the extraction of coal, (conventional) natural gas and coal seam gas, as well as a diverse array of non-energy minerals. The main thrust of these policies is to support short-term revenue maximisation by extracting and exporting all resources for which there is no immediate domestic market, with little concern as to how this might interact

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[1] The National Electricity Market was established by legislation of the Australian government and each of the eight state and territory governments, and this definition appears in each separate Act, e.g., National Electricity (South Australia) Act 1996.

with emissions policy. In the case of gas, specifically, little consideration has been given to either the additional emissions arising from LNG production or the availability of gas for use in the domestic economy over the longer term.

In conclusion, if Australia is to move towards a genuinely clean energy future, a price on carbon will by itself be insufficient. Fundamental changes to Australia's energy policy framework will also be required.

References

Australian Bureau of Statistics, 2011. *Australian System of National Accounts, 2010-11*, Cat. No. 5204.0.

Australian Department of Climate Change and Energy Efficiency, 2011. *National Greenhouse Gas Inventory 2009.*

Australian Department of Resources, Energy and Tourism, 2011. *Continuing Opportunities Energy Efficiency Opportunities (EEO) Program – 2010 Report, A look at results for the Energy Efficiency Opportunities Program 2006-2010.*

Australian Treasury Department, 2011. *Strong growth, low pollution: Modelling a carbon price.*

Clean Energy Council, 2011. *Clean energy Australia Report, 2011*.

George Wilkenfeld and Associates, 2009. *Prevention is Cheaper than Cure - Avoiding Carbon Emissions through Energy Efficiency: Projected impacts of the Equipment Energy Efficiency Program to 2020.* Department of Climate Change and Energy Efficiency.

Schultz, A. and Petchey, R., 2011. *Australian Energy Statistics - Energy update 2011 – Data tables*. Australian Bureau of Agricultural and Resource Economics and Sciences.

Syed, A. and Penney, K., 2011. *Australian energy projections to 2034–35.* Bureau of Resource and Energy Economics.

Chapter 12

Best Practices of Environmental Clusters in Germany: The Case of Environmental Technology Cluster of State Baden-Württemberg

Joachim Elsäesser

ABSTRACT

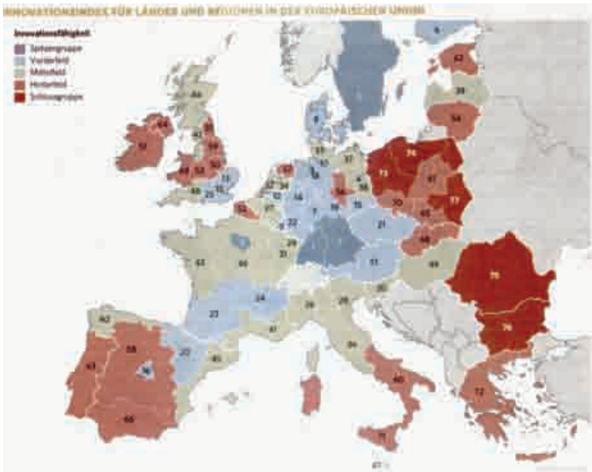
The German State of Baden-Württemberg and its industrial cluster of environmental technologies show that the courageous implementation of a Green Economy policy can lead to a win-win situation between Economy and Ecology and generate added value for the industry. Today Baden-Württemberg is the most innovative region of the European Union. The environmental sector became the fastest growing sector of this economy. Stimulated by this policy model the industry and private households in B-W have acquired consciousness for environmental issues and have reduced their greenhouse gas emissions considerably. Given this case of B-W, fight against climate change is a shared responsibility of the industry, the civil society and governments, which means that Green Economy has to be understood as a corporate social responsibility of the private sector. Governments have to consider this. The Industry Association of Baden Württemberg (LVI) demands international knowledge cooperation between stakeholders of the private sectors, putting a value dialog about sustainable entrepreneurship on the top of the agenda.

The reduction of greenhouse gas emissions and the fight against climate change is an obligation of everybody on our planet. We cannot leave this vital challenge for the future of mankind in the hands of politicians only. It is also a shared responsibility of stakeholders of the economy and of the civil society.

The Industry Association for German State of Baden-Wuerttemberg (LVI) regards actions against climate change as part of its mission. LVI sees the role of business associations from a holistic point of view, which means, that both economic and environmental issues are part of the corporate social responsibility (CSR) of the private sector and have to be addressed by entrepreneurs.

Baden-Wuerttemberg (B-W) is today considered to be the most innovative region of the European Union (Innovationsindex 2010, Stat.LA B-W). With 4.38% of GDP (2010) B-W and its industry spend more money in research and development (R&D) than any other state of Germany (Germany 2.54%) and has more patents per capita. This is the result of decades of a consistent and innovative technology policy putting the environmental sector in the focus of attention.

Figure 12.1: Baden-Wurttemberg Innovative-Region Number 1 in Europe



Population:
10.7 millions

GDP:
364,3 bil. €

Expenditure in
R&D in % of
GDP: 4,4%

No. of patents
per inhabitants:
121 / 100,000

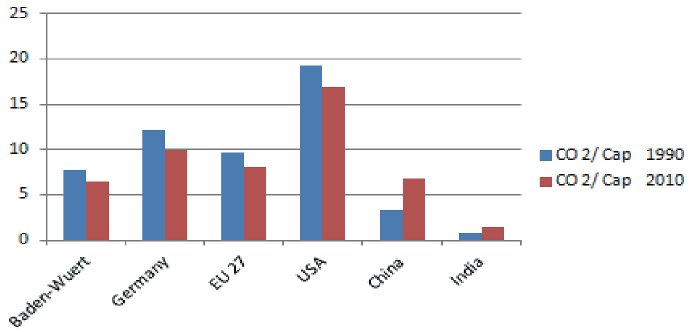
Export share:
48.2%

B-W has the ambition to provide a case for best practices in environmental policy. B-W stands for a policy model that claims that there is no contradiction between Economy and Ecology. On the contrary, combining economy and ecology in the model of a Green Economy will create a win-win-situation and generate added value.

From an early stage the government of B-W gave incentives to companies, research, education and technology institutions to develop competences in environmental technologies and to deal with the challenges of environment protection and climate change. This innovation policy also included the establishment of the first regional environmental technology cluster in Germany. The Environmental Technology Platform of Baden-Wuerttemberg (PU), which was founded in 1997 and is today the largest cluster of this kind in Germany and Europe. The PU is managed by the Industry Association LVI and has its office in the premises of LVI.

Stimulated by this policy the industry and private households in B-W have acquired consciousness for environmental issues and have reduced their greenhouse gas emissions considerably. The results are worthwhile of being mentioned. According to the Statistical Office of Baden-Wuerttemberg, in 2009 nearly 14 million less tons of greenhouse gases were emitted than in the international reference year 1990. In 2009 alone, compared to the previous year, 6.8 million fewer tons of greenhouse gases were emitted. With 7 tons of greenhouse gas emissions per capita, Baden-Wuerttemberg lies nearly a quarter (23.7%) lower than in 1990 and about 35% below the German national average of about 11 tons of greenhouse gas emissions per capita per year. The proportion of B-W in the world's greenhouse gas emissions is 0.3%, in comparison to its 0.6% share of the world's GDP.

Figure 12.2: Comparative CO_2 emissions per capita 1990-2010



Source: EU-Commission Gemeinsame Forschungsstelle + Stat LA. B-W

The expansion of renewable energies and the introduction of energy saving technologies in production, housing and logistics in B-W led to a significant replacement of fossil fuels and thus led to a marked reduction of CO2 emissions. The continuing expansion of renewable energies will lead to further significant and lasting reduction in CO2 emissions in the years to come.

But there is no reason to lose effort. Unfortunately a binding agreement worldwide for CO2 reduction is still not in sight – the outcomes of the Durban Summit 2011 were rather poor in this respect. As the CO2 reduction efforts of B-W are almost insignificant relative to the solution of this global problem, there is no other option than to step forward unilaterally and to motivate other nations to take the necessary policy measures against global climate change.

Today B-W has one of the most diversified manufacturing bases in environmental technologies in Germany and counts for almost one quarter of all German exports in environmental products and services. The environmental industry is now the third largest industrial sector of the economy with the highest growth rates. Approximately 900 mainly medium-sized companies, but also big companies, with a 16,000-strong workforce, generate a total turnover of more than 3.6 billion € with environmental products and services. In 2030 the environmental sector is likely to become the strongest industrial sector, passing the important automotive sector – with famous companies like Daimler, Porsche and Bosch which have their headquarters in Stuttgart.

In the German GDP the volume of environmental technologies had a share of 8% in 2007. In 2020 it is estimated that this percentage will increase to 14%. The number of employees in this sector has risen by a remarkable

19% just from the year 2008 to 2009. It is expected that the total sales volume in environmental technologies will double in the next 10 years. In 2020 the turnover of this sector worldwide will be above 32,000 billion Euros (Source: GreenTech Atlas 2.0).

TRILATERAL DIALOG BETWEEN GOVERNMENT, ECONOMY AND CIVIL SOCIETY

In order to maintain stakes in this fast growing and promising new global market B-W makes strong efforts to foster the trilateral dialog between government, economy and civil society. Only with the acceptance of its citizens – and their willingness to pay higher prices for goods that consume our natural resources – can a sustainable Green Economy be achieved. The new amendment of the Renewable Heat Act of the Ministry of Environment, Climate and Energy of B-W is just one example for the dedication of B-W to conduct a comprehensive environmental policy. This Act settles the requirement that from the year 2013 on, for private non-residential buildings such as office buildings, it will be obligatory to increase the share of renewable energy in the heating system from today's 10% to 15%. By the year 2020, the percentage of electricity coming from renewable energy sources should reach 35%.

The Minister for Environment of B-W said on a press conference on November 11, 2011: "We want to rebuild Baden-Wuerttemberg, in the next 40 years to the leading energy and climate region [in Europe and in the world]." The core of this ambitious plan is the Environmental Plan of B-W, which is part of the government's Sustainable Energy and Climate Policy, and which includes – among others – the following actions and set-up of institutions:

- "State Energy Regulatory Authority" and "State Energy and Competition Authority"
- "Training and Qualification Campaign Renewable Energies"
- "Information Centre Energy"
- "Wind Atlas of Baden-Wuerttemberg"
- "Energy Efficiency Round-Tables"
- "Initiative Local Climate Protection on Municipal Level" and state competition contest "Climate Neutral Municipalities"
- "Initiative Electro-Mobility"
- Expansion plan for "small hydro power stations in the catchment area of river Neckar"

- Expert hearing "Geothermal power stations" and "induced seismicity by geothermal power plan" and use of "geothermal heat pumps with ground water"
- "Renewable Heat Act B-W" for old buildings (EWärmeG)
- "Renewable Heat Act B-W" for new buildings (EEWärmeG)
- "Climate protection concept 2020PLUS Baden-Wuerttemberg"
- "Online Map for Renewable Energy on Site" giving space for participatory action and information about the use of renewable energies by the citizens of B-W. The citizens can make their individual energy balance visible and show their energy data and efforts to the public. The final goal is to create an energy saving culture among citizen.

Joint actions of government, industry and civil society are mandatory to create the necessary awareness in the public and in the media. In 2007 the government of B-W launched the Sustainability Strategy as a general policy guideline to influence decision making in almost all kinds of policy and in the ministries. This strategy enhances sustainable solutions to the challenges to the future of B-W coming from global climate change, scarce resources and also demographic change.

The Sustainable Strategy relies on the cooperation of more than 470 organizations and many dedicated people, especially the young generation. Entrepreneurs, business associations, chambers as well as universities and research and technology institutions are part of this strategy. They play a crucial role as opinion leaders and stakeholders have a particular responsibility to sustain this strategy towards a Green Economy.

A BALANCED ENVIRONMENTAL DECISION MAKING PROCESS

Environmental decision making has to be balanced and has to take into consideration the transformation-capacity of the industry. Unmeasured regulations can easily harm the competitiveness of companies and can even lead to a collapse of the whole industrial base which might then destroy the acceptance of a Sustainable Strategy entirely.

The LVI has a significant importance in this strategy by guiding and hosting the management unit of the Environmental Technology Cluster of B-W (PU). The cluster PU is a voluntary union of more than 130 individual companies, research and technology institutions, universities and service providers dealing with environment-related products and services. The cluster PU was founded with the initial financial support of the government of B-W and is today the largest regional technology cluster in Germany. The cluster PU is legally independent and financially self-sustaining.

The PU is also part of the government's new economic policy strategy encouraging the development of innovative fields of technology and clusters. The so-called Cluster Dialog of the Ministry of Economy of B-W provides financial incentives to support technology- and knowledge-networking between industrial companies and for investment in new technologies. During the last decade the PU and its member-companies have developed strong competences in new fields of technology and as a whole have built up a well diversified landscape and value chain of green industrial technologies in B-W, embracing the following competences:

Energy Efficiency

- energy efficient production processes, energy efficient buildings – zero energy houses, energy efficient machines, cross-sector technology, e.g., instrumentation and control technologies (I&C), process control technology, pump and ventilation systems, hydraulics and compressed air systems, cooling and heating systems, heat recycling, using waste heat, heating and cooling systems

Renewable Energy

- solar panels and solar thermal energy, geothermal energy (shallow and deep), wind energy (offshore and onshore), hydropower, biomass utilisation, electricity generation from purification plants, energy storage technologies (mechanical, e.g., pumped storage, flywheel; electro-chemical, e.g., batteries, hydrogen; electrical, e.g., capacitors, magnets, geothermal energy)

Air

- air pollution control, dust removal, e.g., fine particle filters, filtration, exhaust air treatment, noise reduction, shock prevention

Sustainable Water Management

- water supply and treatment, rainwater treatment, waste water collection and transport, centralized and decentralized waste water treatment, sludge treatment, eliminating and recycling of trace elements, recycling heat from waste water, instrumentation and control technologies for more efficient water use, water efficiency technology

Waste Recycling Management / Contaminated Sites

- waste treatment and disposal, landfill (e.g., construction, safeguarding, reducing landfill gas), dismantling sites and material separation, processing and recycling raw materials, energy utilization (e.g., waste incineration, maximum yield technology), recycling raw materials from landfill (urban mining), redeveloping contaminated sites (e.g., soil decontamination, re-vegetation, erosion control)

The services of the PU management and its network partners cover the following fields:

- planning and conceptualization (e.g., brand and viability assessment)
- product development, system customization and process technology
- general business operation
- contracting models and financing
- internationalization and international knowledge-networking
- building and industrial site service management systems
- instrumentation and control technologies (I&C)
- remote surveillance and control

PU and its companies are strongly engaged in international projects to foster global entrepreneurial and technological cooperation. To keep pace with environmental technological innovation international networking is mandatory. International projects provide important information about trends, requirements, demands and dynamics in the global markets for environmental products and services.

LVI and PU are currently engaged in the following international projects:

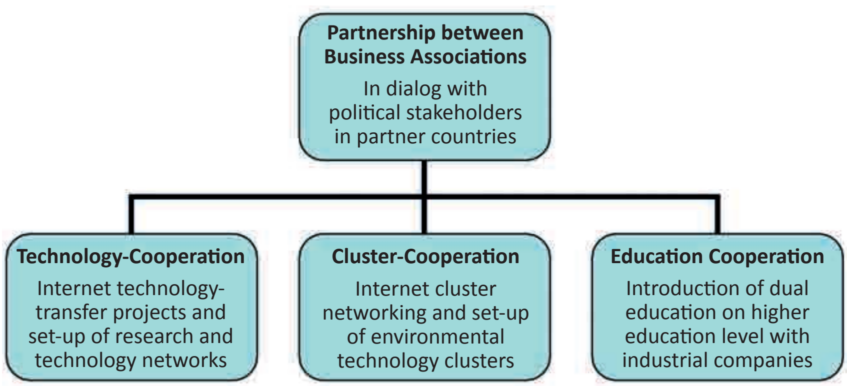
- "Ecofit" network for efficient use of resources in Suzhou, Jiangsu province, China
- Environmental Technology Information Centre in Suzhou, Jiangsu province, China
- Implementation of the environmental concept in German Danube Region Strategy
- Energy Efficiency and Resources Efficiency Network (REEF) in Santa Catarina and Paraná, Brazil
- Set-up of an environmental technology network in Kazakhstan
- Set-up of an environmental technology network in Turkey as part of European Union EPESUS project
- Set-up of environmental technology cluster in the region Bajio, Central Mexico, in cooperation with Mexican entrepreneur associations Coparmex and USEM

LESSONS FROM INTERNATIONAL PROJECT COOPERATION OF THE ENVIRONMENTAL SECTOR OF BADEN-WÜRTTEMBERG TO FOSTER GLOBAL ENTREPRENEURIAL AND TECHNOLOGICAL COOPERATION

The lessons learnt from these projects tell that the introduction of environmental technology networks have to be sustained by a policy dialog between political stakeholders and entrepreneurs– a purely policy or science-based environmental approach will lack sustainability. Usually business associations and technology clusters provide the most suitable platforms for knowledge cooperation on entrepreneurial level, given their strong legitimacy through direct and voluntary membership of opinion leading companies.

LVI is one of the most experienced business associations of German Federation of Industries (BDI) in terms of cluster management and international cooperation and has developed a holistic approach to enhance international knowledge networking in environmental technologies. This tri-lateral approach is based on the concept that cluster building has to be integrated with technology-focused education programs (based on the German concept of dual education) and applied research (German models of Steinbeis and Fraunhofer). Governments have the responsibility to be a facilitator of a policy dialog with the private sector in order to create the necessary frame conditions for the development of a environmental industrial sector. LVI supports this approach by establishing partnerships with corresponding business associations in key partner countries.

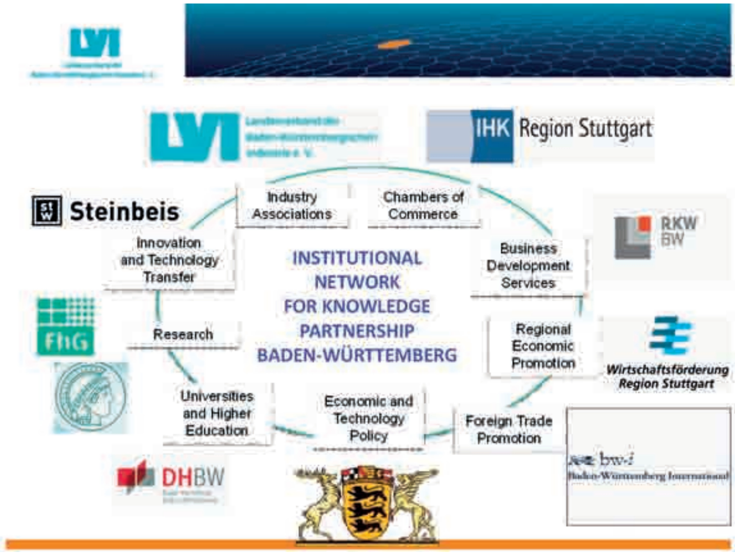
Figure 12.3: LVI partnership structure



LVI has initiated this kind of knowledge-partnership worldwide with countries like Brazil, Turkey, Mexico, Russia, South Africa etc. to support the development of a national environmental industrial sector. Through this knowledge-partnerships, incentives and signals are given to the partner countries to create the necessary legal frame-conditions and support structures for the well functioning of a competitive and environmental responsible economy.

For the conduct of these partnerships LVI relies on its cooperation with network partners in B-W, which provide core-competences in different areas and facilitate knowledge-access to 50 years of innovative environmental policy in B-W. The knowledge-network of Baden-Wuerttemberg provides the compiled know-how of the private sector, and draws on the expertise from business associations, chambers of commerce, universities, technology and research institutions, and business service providers, but also from public agencies and the government.

Figure 12.4: Institutional networks for knowledge partnership, Baden-Wurttemberg



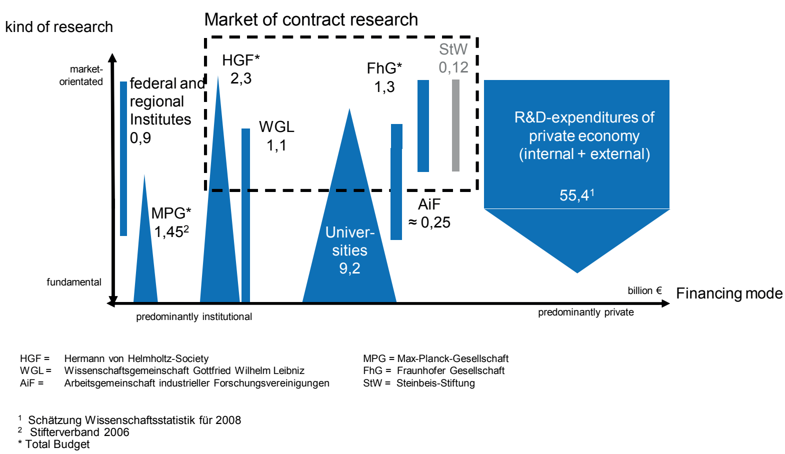
Among these network partners, Steinbeis Foundation is a key partner of LVI for technology-transfer. Complementary to the mission of larger German and European fundamental research institutes Steinbeis Foundation has a distinct focus on applied research and technological services. Technology transfers centers of Steinbeis participate in cluster networks and play a significant role in shaping the technological profile of companies.

STEINBEIS FOUNDATION

Steinbeis Foundation was established in the early 80s, with the support of the government of B-W in order to meet the growing demand of medium-sized enterprises for technology services. Technological innovation was stimulated by introducing a simple and efficient new system of industry-university cooperation. University professors were incentivized to dedicate part of their time and capacity to technology projects with the industry – which then vice versa led to more practical experience from the industry in lectures in university. Due to the services of Steinbeis Foundation a diversified commercial market for new technology services emerged, also in the field of energy efficiency and resource management. This market allows Steinbeis, as of today, to work almost entirely without any governmental subsidies (as opposed to many research establishments in the world, which receive direct or indirect governmental support in varying quantities).

Steinbeis Foundation stands for a unique policy-model and for the consequent application of the principles of subsidiarity within the system of German Social Market Economy. Today Steinbeis Foundation represents one of the largest private sector borne technology networks in Europe and became a trademark for efficient technology services. For the success of Baden-Württemberg's economy and its frontrunner-role to develop a competitive and SME-based environmental sector, Steinbeis Foundation has a significant share. Diversified technology services proved to play a key role in strengthening a competitive industrial base. In the German research and technology landscape, Steinbeis Foundation holds the position of being the technology network with the closest proximity to the industry.

Figure 12.5: Scope of Research and Technology Transfer in Germany



Another key factor for the competitiveness of the environmental sector of B-W is the availability of skilled labour. Under the former Prime Minister of B-W L. Späth a new education model in Germany was created, the so-called Dual University of Corporative Education (previously Berufsakademie). As a third pillar of the higher education system in B-W, besides the models of classical Universities and Universities of Applied Science (Fachhochschule), the model of Dual University addresses in particular the needs of technology-driven medium-sized industrial companies. It combines working and learning in industry with practical-oriented lectures in university. The Dual University system became an efficient instrument to educate a new generation of experts, also in the new skills of environment-related technologies. This model of dual higher education is copied by other countries and became a worldwide acknowledged success story made in B-W. The most recent step in this dual education model is the Steinbeis University in Berlin (SHB). In less than 15 years SHB became the largest private business school in Germany..Its unique dual and job-integrated education system of "Project-Competence-Study" brings together technology-oriented academic learning and practical work in industry.Students usually have a (part time) employment contract with a "mentor"-company where they conduct their specific project case study – related to business and/or technology opportunities of the mentor-company – and in parallel attend lectures at university.

As a conclusion, the success of B-W's environmental sector has a lot to do with the efficient interaction between well-organized technology-clusters, innovative education institutions and an industry-based technology transfer system. The economy of B-W has the interest to share this experience with partner countries worldwide. To implement similar environmental competence networks actions have to be undertaken on three different levels.

Political level (macro-level):
Policy dialog and know-how exchange concerning the application of environmental technology policy tools

Intermediary level (meso-level):
Capacity building of environmental technology related, research and education institutions

Company-level (micro-level):
Bilateral business and technological cooperation between companies and technology-clusters

THE ROLE OF SMALL AND MEDIUM-SIZED COMPANIES

As mentioned above B-W is one of the leading regions in manufacturing and providing environment- related products and services. The whole economy is involved in a profound industrial transformation process towards a Green Economy. Originally purely automotive companies are diversifying into new fields of technology and adopt more and more environmental technologies competence. There are big companies like the automotive supplier Bosch, a company that is presently transforming from an automotive-based company to an environmental technology-based company, generating an increasing number of its patents from environmental technologies, for example in the dynamic field of energy-saving electro-mobility. Thelarge car-manufacturer Daimler is about to gain a leadership position in the innovative energy technology of fuel cells.

But besides these big players, it is mainly due to the multitude of innovative medium-sized companies which are pushing forward the competence in environmental technologies in B-W. The "humus" on which this expertise grows, is the unique structure of the economy, with its high density of medium-sized technology companies, their strong integration in value chains, the excellent research and education institutions and a distinct culture of corporate relation between industry and government. Since the days of the former charismatic Prime Minister L. Späth the country's government understands its role first and foremost as a subsidiary partner of the industrial middle class.

This is probably the major reason why B-W succeeded to achieve a leadership position in the innovative sector of environmental technologies. A clearly visible result of the application of the government's principle of subsidiarity is the environmental technology cluster PU. The government of B-W encouraged the mainly medium sized environmental companies to organize themselves in a cluster-structure and encouraged the regional entrepreneur association LVI to provide the necessary service function. Economic development, like the promotion of technology-clusters, is understood as a participatory action, which means that the management has to be in the hands of entrepreneurs and stakeholders of the private sector. A government's action to direct such clusters would meant a violation of this principle of subsidiarity.

THE INDUSTRY ASSOCIATION FOR GERMAN FEDERAL STATE OF BADEN-WUERTTEMBERG (LVI)

The LVI is the legitimate platform to represent the interests of the industry of state B-W. The members companies of LVI are frequently owner-managed enterprises, some of them with a worldwide technology and market leadership position, so-called hidden champions. The personal commitment of outstanding entrepreneurs from the industrial middle class and their guiding role in the board and commissions of LVI is the fundamental backbone of the organization (presently LVI has 150 companies with direct membership and 36 member associations, representing in total ca 3000 companies in state B-W).

The economy of B-W is strongly export oriented. Member companies of LVI are increasingly expanding to the emerging markets, where they nowadays realize the highest growth rates. LVI and PU are asked by its members to strengthen cooperation with emerging markets in Latin-America, Southeast Asia, Gulf-Region, Central Asia and especially with China, India and Russia. But market conditions for environmental products and services in these countries are much more complex and less transparent than in traditional markets. In particular for small and medium enterprises (SME) this matter of fact represents a new challenge, to operate more than ever in networks and clusters. SMEs vitally depend on co-lateral support in new markets whereas larger companies can bridge most of these barriers alone. LVI and PU intend to mitigate the risks for business cooperation between its SME member companies and companies in partner countries.

In the last years the international partnerships of LVI and PU grew strongly. They are geared by the common spirit that sustainable development has to be based on shared values and ethical principles. International cooperation between entrepreneurs is a promising means to disseminate fundamental values of global environmental and social responsibility. For the entrepreneurs of LVI, Green Economy ultimately means a win-win situation for all parties involved.

Germany has a worldwide reputation of being a reliable partner for sustainable economic development. This is a shared reputation of the German government, the German civil society and the German private sector. The fight against climate change requires a strong commitment of the industry in terms of Corporate Social Responsibility (CSR). From an entrepreneur's perspective CSR actions ought to be seen from a twofold perspective. First of all to obtain tangible results to reduce greenhouse gas emissions. But also from a PR point of view. Credible involvement in climate protection has lasting influence on the image and branding of companies and their products. Actions against climate change are increasingly becoming a factor of competitiveness on global markets.

A global environmental policy has to set the global regulatory guidelines to incentivize companies in their struggle to gain shares in the expanding new markets for environmental and energy saving products and services – or even more to stimulate the invention of new technologies in order to create new markets for new sustainable goods.

Experts worldwide are advocating that in the long run it will be cheaper to develop new market-mechanisms for environmental goods now (like CDM), than to pay higher costs for repairing the damages done to nature later. Germany, since the G8 summit in Heiligendamm in 2007, is committed to finding an agreement between the key industrial nations to bring about a solution to this urgent and vital global challenge. But unfortunately some of the largest economies of this world are not yet willing to enter with the necessary enthusiasm – from an entrepreneur's perspective this is a very short-sighted point of view.

The conclusion of the CEO of the Industry Association of Baden-Württemberg, Senator E.h. Wolfgang Wolf, in this respect sounds rather simple: "If politicians and governments want to have success in fighting climate change, they simply have to have the courage to set the right incentives for the use of resources and environmental goods – the companies and the market-mechanisms then will follow this guidelines rapidly". The rapid transformation of the industrial structure of B-W is therefore a good example; though climate protection is utmost a question of willingness, courage and charisma of political decision makers.

If climate change will not be dealt with adequately, the – somehow cynical – statement of an entrepreneur of today would sound like: "Our planet will always find its equilibrium between the global factors 'natural resources' and 'mankind' – the only question remains 'What price do we have to pay for at the end' ".

Chapter 13

Moving Forward

Wan Portia Hamzah

Moving forward, sustainable energy is recognized as one of the most critical factors for the achievement of sustainable development. This year, 2012, Rio de Janeiro will be the venue for the United Nations Conference on Sustainable Development (UNCSD or Rio+20). Twenty years after the Conference on Environment and Development (UNCED or "Rio" or "Earth Summit") in Rio, the world has witnessed a development path that has been far from sustainable. Consuming energy resources the way we have, the evidence of climate change, and the persistent poverty will only mean that the world will continue to face worsening problems of resource scarcity and ecological deterioration.

Rio+20 has identified the green economy in the context of sustainable development and poverty eradication as one of the key themes of the summit. To move towards a green economy means different things to different countries. As highlighted during the December 2011 Conference in Kuala Lumpur, for developed countries, a green economy may imply opening new economic opportunities through energy- and resource-efficiency. For developing countries, a green economy can imply an opportunity to pursue low-carbon pathway but at the same time promoting inclusive growth while managing natural assets sustainably. How a country approaches a green economy will depend very much on the political development, the socio-economic progress, the governance structure, the resource endowments, the knowledge and the skills, as well as how policies are crafted and when to be implemented. Each country is unique but, as already indicated in the introductory chapter, a green economy involves a shift from pitting "green" against "growth" to making "green" and "growth" compatible. Each country should therefore be allowed to implement green economy pathways at its own pace.

It is therefore important in this context to be reminded of the principles agreed upon at the 1992 Rio Summit, in particular, the principle of "common but differentiated responsibilities". The risk of the "one size fits all" approach whereby all countries are to be treated in the same manner must be avoided. National differences must be respected. Equally important, the green economy should be just and not be made a condition for determining aid or to create trade barriers.

That the transition to a green economy involves some kind of a structural change—one that will impact on the production and consumption patterns—cannot be denied. At the core is growth triggered by new technological knowledge. This view then raises the issue of who owns that knowledge and the implications of disseminating that knowledge. The role of governments in providing the necessary support and the role of businesses in adapting to the changes and be willing to invest and innovate will be crucial.

The December 2011 Conference provided a platform for the discussion of sustainable energy which is central to a green economy (see Appendix 1 for the synopsis of the panel discussion). A reliable, affordable and efficiently clean energy system is important particularly for developing economies to meet the wider development objectives. The need to provide access to clean and affordable energy as well as integrating and mainstreaming renewable energy into sustainable development strategies have been well elaborated and documented. Among the main ingredients to move forward are:

1. A Political Commitment and a Call for a Shared Vision—the need to shift to a greener, low-carbon, resource-efficient economy must be achieved through a greater understanding of the issues and a sustained political focus. Greening the global economy will require international, regional and national efforts.

2. Smarter Partnerships and Alliance building—Partnerships and alliances involving various sectors can be achieved through governments working together with businesses and civil society. There must be a shared responsibility to improve governance and make the action sustainable.

3. A Range of Policy Initiatives—Optimizing the current policy framework by building on existing policy initiatives as well as enhancing coherence and integration of policy and programmes would be appropriate. A challenge, for example, would be linking innovations that take place in the industry sector to the policy.

4. Technical Information Management and Communication—New technologies originate from developed countries but observed today are some new technologies generated by developing countries such as Brazil, China and India. How the technological knowledge is managed and disseminated to bring benefits to all countries will require greater understanding as well as novel forms of collaboration in terms of R&D, capacity building, financing options, risk management etc.

5. The Right Market and Regulatory Conditions—Enabling conditions such as establishing the right market and introducing appropriate regulatory conditions will help to provide a secured environment for investment as well as encourage innovation. That there must be some consistency and a level playing field must not be precluded.

6. A framework to monitor progress and deliver results—there must be some agreed goals that must be followed. In addition, the process must be monitored in a systematic manner, involving not only the current economic accounting but also the social and environmental accounting mechanism.

Appendix One

Synopsis of Panel Discussion
Future Approaches for Energy Policies in Southeast Asia

The panel discussion was moderated by H.E. Ong Keng Yong, the High Commissioner of Singapore to Malaysia. H.E. Ong stressed on the importance of future approaches for energy policies and highlighted the role of ASEAN in energy cooperation. Future approaches, according to H.E., will revolve around five Cs—consumption, complacency, conservation, connectivity and cooperation. According to H.E., national approaches must be developed and later be considered into the regional cooperative framework.

The first panelist was Datuk Loo Took Gee, Secretary-General of the Ministry of Energy, Green Technology and Water. Datuk Loo provided a brief background of the energy scenario in Malaysia. Malaysia is an energy producing country but certain measures must be taken to ensure its energy security. The country has relied on gas for power generation but some adjustment must be made in the energy-mix. Her presentation also touched on the energy price for the power and non-power sectors which was heavily subsidized by the government. But measures to remove energy subsidies have been taken.

In terms of energy efficiency, Malaysia has just finalized the Energy Efficiency Master Plan. To promote energy efficiency, tariffs are being re-designed; fiscal incentives and tax allowances are also being introduced. Moving forward, renewable energy (RE) is being promoted through feed-in-tariff (FIT). The challenge is how to get more funds to promote RE. RE make up less than 1 percent in the generation mix and the government is aiming to increase RE to 11 percent.

On the promotion of the green economy, apart from the energy sector, the building and transportation sectors will also be involved. Other moves include greening of cities where developers will be provided with incentives to promote green buildings and sustainable modes of transport.

Finally, Datuk Loo touched on the regional cooperation namely the ASEAN power grid and the trans-ASEAN gas pipeline projects. That there will be challenges must be acknowledged. For the region, the legal and institutional framework as well as the technical standards must be looked into to allow a trading system to take place. Moving ahead, a consortium may be deemed necessary so that some ASEAN member countries that are more ready will forge ahead to cooperate.

The second panelist, Dr Hartmut Grewe, from energiewaechter, Berlin, highlighted the "supposed" conflict between economy and energy which should be resolved in a "win-win" situation. Commenting on economic growth described in the quantitative dimension, he provided the green growth concept described in a qualitative dimension. In terms of green growth, some countries have advanced and put a strong case for moving into the green economy. This is triggered by the implications of climate change and unsustainable use of energy and other environmental resources.

Dr Grewe also spoke of the use of RE and the intermittent delivery of the energy. However, countries must be able to pick the right choice because there are advantages as well as disadvantages associated with RE.

In moving forward, Dr Grewe pointed out three basic ingredients: low-carbon pathways, resource efficiency and socially inclusive—in the last point he reiterated that access to reliable and modern energy services will be important for economic development.

Prof. Xu Yi-Chong from Griffith University, Australia pointed out the challenges raised by the Malaysian participants, Dr Hezri Adnan of ISIS Malaysia and Ms Endang Jati M. Sahid of UNITEN; by Ms Crafton from Vermont Law School Institute for Energy and the Environment and by Mr Nyoman Iswayaroga from WWF, Indonesia. On the challenge of the big gap, moving from fossil fuel-based economy to the green economy raised by the Malaysian participants, Prof. Xu acknowledged the difficulties. Next, commenting on the correlation between the human development index and energy consumption, Prof. Xu explained that humans need energy but the consumption is uneven. On the issue of subsidy raised by Mr Nyoman, it is important to note that only a small proportion of the subsidy would really benefit the poor and that removal is a political decision.

Prof. Xu believed that in every difficulty, there is an opportunity and reiterated the opportunities largely in terms of international awareness of meeting four objectives—sustaining energy growth, increasing energy access to the poor, enhancing energy security and protecting the environment.

She also added that in the globalised world, there are opportunities. Businesses being mobile should seek and take advantage of the opportunities to capture new markets.

Spreading of democracy is another opportunity allowing greater participation of people. This will impact on government and businesses to take sustainable action. Prof. Xu added that there are solutions but the solutions may not be easy to be implemented.

The representative from Laos, Mr Thongkoun Sengphachanh, highlighted the need for developing countries such as Laos to develop sustainable action appropriate for the country and at their own pace. Laos has moved into hydro of which 80 percent of the energy generated is exported and only 20 percent is for local consumption. Laos has attracted investors in hydropower projects because of the economic viability. However, access to energy for the Laos people is still a challenge. For Laos, Mr Thongkoun Sengphachanh acknowledged the sensitivity surrounding some of the hydro projects but the need to expand hydro and export the energy generated is crucial to meet the development objectives of the country.

Dr Mattijs Smits from the University of Sydney, Australia recognized the significance of ASEAN cooperation in the energy sector and the benefits associated with the cooperative efforts. Focusing on national interest that should be respected, he questioned the intent, the "elite" behind the interest and subsequently the influence on the government policy. He argued for a greater role for the civil society and increased democracy. Increased awareness within ASEAN, for example, has provided greater public participation.

He also highlighted that energy is not a technical issue but about making choices where politics is often involved as demonstrated with the subsidy issue. On consumption, he described the need to change the behaviour pattern to bring a more sustainable consumption.

Most of the discussion revolved around political leadership to take action, targeted energy subsidy, informed citizens to change the dynamics and the changing energy landscape involving more energy producers with the introduction of feed-in-tariff. The role of regulators and moves to facilitate the change were raised. Subsequently, the issue regarding off-grid energy options for rural areas and the need to support small-scale electricity generation was encouraged.

The discussion also addressed pricing for energy cooperation and energy supply security. Also debated was the expected increased in consumption of coal in developed and developing countries and the technology available for cleaner usage or best practices to be shared. On the issue of tackling climate change, regional arrangements and climate alliances have emerged involving several countries. The political commitment is important. Also noted was bringing business on board. One final comment was that wider consultation is required for policy formulation, for exchange of ideas as well as to fully understand the opportunities and the challenges of moving into a greener economy.

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