Powering ASEAN's Growth

A look at the trends that will impact the use of power in ASEAN to 2020 and beyond

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Foreword from Peter Snell, CEO, Ipsos Business Consulting

In a summit meeting in Malaysia in 1997, ASEAN's governments agreed on a mission statement for what the region should look like in 2020. This was dubbed the ASEAN Vision 2020 and covered many different aspects of the governance of the region including the energy program. Here, as elsewhere, the hope was that a unified economic group would be physically connected through initiatives such as the ASEAN Power Grid and a Trans-ASEAN Gas Pipeline and Water Pipeline. The idea was that the ASEAN member states would work together to promote energy efficiency and develop new renewable energy resources. With less than six years to go until the end of the decade, time will soon reveal whether the vision can become a reality and how the region is adapting to meet the energy needs to power its growth.

This paper is part of a series of thought leadership pieces on the year 2020 published by Ipsos Business Consulting to celebrate our twentieth anniversary and contribute towards the region's knowledge and understanding of some of the industries that will be driving forces for Asia's growth in the decades to come.

The paper will consider the energy challenges facing ASEAN countries up to the end of this decade and how they will shape the region in subsequent years. It'll be asking whether the 2020 vision is achievable and whether regional policies can realistically form a viable energy program. ASEAN's national governments will be viewed from the perspective of the role they have had in shaping the energy programs and the public perception of energy in the region. The ASEAN experience will be considered alongside other countries around the world to identify the sort of policies and environments that will meet the needs of the region.

At the midway point of this decade, some exciting new technologies are getting adopted around the world that are enabling both the viable uptake of alternative sources and the more efficient use of fossil fuels and legacy systems. The topic is huge, so this paper will focus on technologies that improve energy efficiency and manage different electricity formats as well as some of the drivers and barriers to the uptake of these technologies. In particular the role of the private sector will be considered and its potential to help the region to modernise and to meet the energy demands of the countries at differing stages of economic development undergoing rapid economic growth.

Executive summary

Territorial oil disputes, rising fuel prices, nuclear disasters and choking smog levels have brought energy issues sharply into focus in recent years. Opinion polls have highlighted the concerns from all countries about the safety, affordability and sustainable supply of energy. Governments around the world are responding in different ways. In the ASEAN group, there has been a lot of talk about regional energy programmes and policies, however it seems to be the individual national initiatives that will shape the future of the fledgling economic block.

There are a lot of barriers to entry for alternative energy sources to feed the national grids. These barriers, consisting of economic, social and technological issues, as well as government policies such as subsidies, are keeping consumers a captive audience to their traditional suppliers and habits. All ASEAN countries suffer from low efficiency rates to varying degrees in the production, distribution and consumption process. This adds to the cost of electricity to both the state and the consumer as well as adding to the environmental impact. As economic progress continues and new technologies are used, less wastage can be expected.

The ASEAN countries are at very different stages of economic growth. Members include a fully developed city state with nearly full national electricity coverage as well as several agrarian economies such as Cambodia and Myanmar whose citizens have limited or partial access to electricity and many of whom rely on biofuel from the surrounding countryside.

As the ASEAN economies continue to grow, it seems likely that consumption rates of energy and hence, fossil fuels will soar, creating further strains on overloaded grids and further pollution in the skies and waterways.

New technologies could help to avert this disastrous scenario. Just as a combination of oil extraction technologies known as “fracking” is helping the USA’s energy needs, other new technologies are poised to change the way the world extracts, develops, distributes and consumes electricity. The ASEAN group, as with other global economic groups, will forge its energy programs not just on a regional level but on a national, state, village and individual level in the future. The member states will be assisted in their journey by examples of best (and worst) practices of their neighbours and other suitable examples from around the world, as well as by the new technologies that will become available. ASEAN’s energy will continue to get delivered along traditional routes from the fossil fuel plant operated by the national utility companies to the end consumer. But the future will also offer alternative decentralized power sources, which will be the biggest equalizer in bringing electricity to rural communities.

Prologue: ASEAN – A partnership in dynamic development?

The ASEAN leaders of 1997 had high hopes for the region by the year 2020. Their Vision 2020 statement foresaw “interconnecting arrangements in the field of energy and utilities for electricity, natural gas and water within ASEAN through the ASEAN Power Grid and a Trans-ASEAN Gas Pipeline and Water Pipeline”. There was to be “cooperation in energy efficiency and conservation, as well as the development of new and renewable energy resources.”

The environment was to be respected with mechanisms to promote sustainable development, protect the regions natural resources and deal with problems of environmental pollution.

ASEAN has certainly achieved one of its main objectives in providing a platform for dialogue amongst the member states, which arguably has kept the region peaceful for many years. This has certainly contributed towards its growth and visibility in a region straddled by the twin giants of China and India. ASEAN has also kept a constant dialogue going amongst the member states on the topic of energy and the options, technologies and best practices available. But there are many areas where the dialogue has yet to turn into action. As with other objectives set by ASEAN, the vision of 2020 might be better viewed as a process rather than a race with a countdown clock.

From the perspective of 2014, it seems difficult now to envisage a region that is powered by a network of energy pipelines, let alone one that is managing its environment and cooperating in initiatives for energy conservation and renewable resources. Critics might argue that the ASEAN of 2020 may not look much different from the ASEAN of today, except that it will be more crowded, more polluted and probably even less unified in its approach to energy.

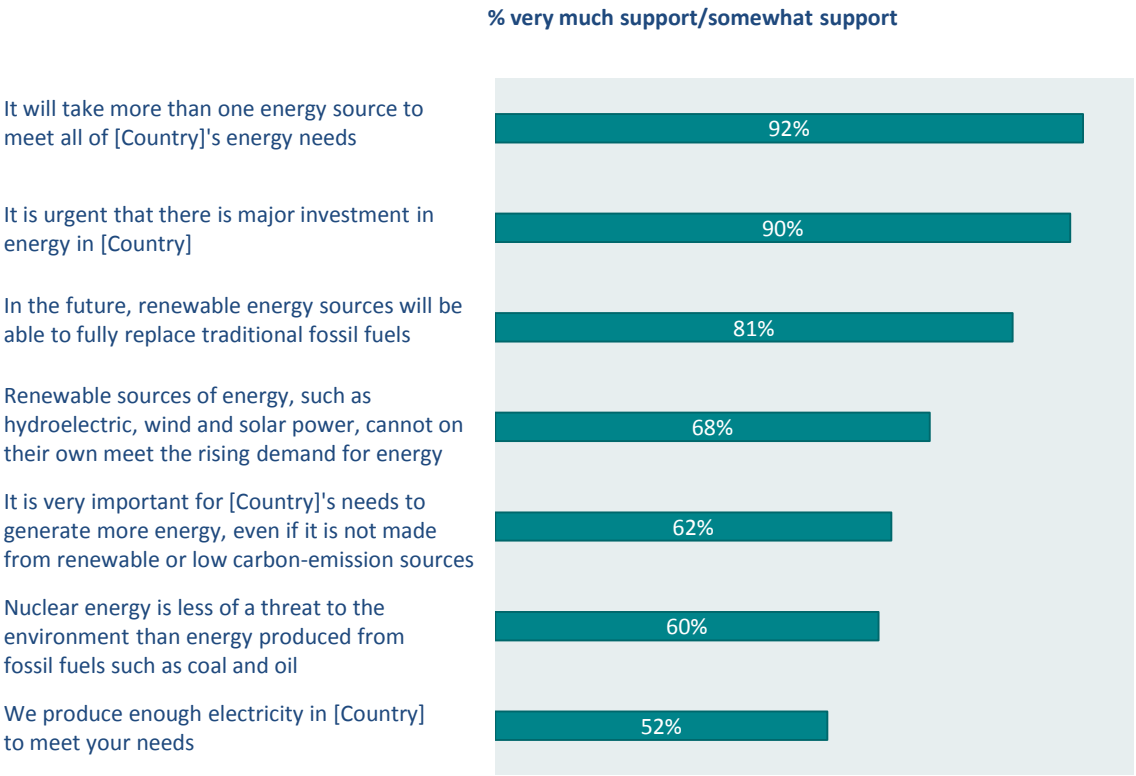
People power - Public attitudes to energy

As with most other parts of the world, the ASEAN region is largely powered through traditional fossil fuels. Whether this will continue to be the case in the future depends on a number of factors, one of them being the viewpoints of the general public both in ASEAN as well as the rest of the region and other parts of the world.

A survey from Ipsos Public Affairs in 2009 (Chart 1 below), well before Fukushima and the recent interest in renewables, indicated considerable global concern about the topic with most respondents agreeing that their countries need to invest more in energy and look at multiple sources.

Chart 1: A global consensus on mixed energy solutions

For each statement indicate whether you strongly support, somewhat support, somewhat oppose, or strongly oppose each way of producing electricity

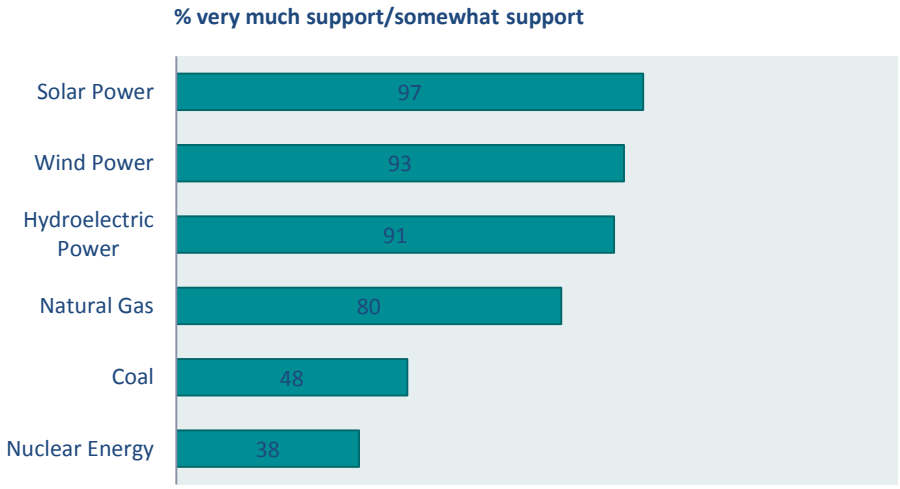


Source: Ipsos Public Affairs Global @dvisor, May 2009

A later global survey from Ipsos Energy Barometer (Chart 2 below) showed a consensus from most countries on the need for different energy sources and optimism in the potential for renewable energy sources. The survey also indicated the belief that, with the current state of technology, renewable sources have to co-exist with fossil fuels to supply the global demand for power, and hence respondents also agreed on the urgency for investment in energy in their country.

Chart 2: Support for energy sources

Please indicate whether you strongly support, somewhat support, somewhat oppose, or strongly oppose each way of producing electricity



Base: 18,787 global adults aged 16+; April 2011

Source: Ipsos Global @dvisor, Ipsos Social Research Institute, "After Fukushima, Global Opinions on Energy Policy"

If people from around the world seem to agree that energy is a pressing national issue then presumably governments should be focusing their attentions on the topic. Some are and some are not. In the ASEAN region, as with other parts of the world the governments are at different stages and using different national policies.

A later study from the Ipsos Social Research Institute which was published in a paper called "After Fukushima, Global Opinions on Energy Policy" found considerable support for renewable sources although there were clear concerns about the reliability of these sources at least in the short term. The paper[1] states: "While the public sees renewable sources such as solar, wind and water power as more environmentally friendly and more viable long-term options than fossil fuels such as coal and oil, they retain significant doubts about their reliability, and still see the traditional and less environmentally friendly power sources such as gas, oil and nuclear power as being more dependable, at least in the short-term. The public (rightly) thinks there is some way to go before renewable energy sources can replace fossil fuels."

A more recent survey conducted for this study by Ipsos in association with Toluna, an online social community voting program, found that 49% of Asia Pacific respondents agree that they would pay more for energy from renewable sources. What was surprising about the results was that respondents from developing countries (India and Thailand) indicated a much higher likelihood to pay for energy from renewable sources rather than their neighbours from the more developed countries (Singapore, Hong Kong and Japan). The graph below shows the respondents from the lowest income groups in each of the countries surveyed, although the results do not differ substantially by income groups. Higher income groups did tend to indicate a higher propensity to pay for energy from renewable sources, but developed country respondents were still not as keen as their developing country counterparts to shoulder the economic burden.

[1] "After Fukushima, Global Opinions on Energy Policy", Ipsos Social Research Institute

Table 1: "I would pay more for energy from renewable sources"

Question: "I would pay more for energy from renewable sources". 3419 respondents. Survey conducted in March 2014

	Total %	Singapore	Japan	Hong Kong	Thailand	India
Strongly agree	17	6		12	27	33
Agree	32	19	20	31	37	35
Neither agree nor disagree	32	46	52	36	22	20
Disagree	14	15	19	17	9	6
Strongly disagree	5	14	9	5	4	6

Source: Ipsos Business Consulting/Toluna

The research does show that there is concern from the general public about national energy programmes, and some sense of the different sources that they might be relying on in the future and how they might have to pay for it. Change is in the air, although no-one is clear as to what that change will be and how it will impact their pocket.

Laws of Energy: Implementing change in national energy programmes

Physics teaches us that energy can be neither created nor destroyed, but can change form. National energy policies, fortunately, have a bit more flexibility. If change is imminent, then what factors will ASEAN's governments need to consider in the implementation phase? It seems there are many complexities to consider. A country's energy supply needs cannot be entirely subcontracted out to lower cost or neighbouring countries without the risk of political bargaining. The availability and pricing of power can swing elections, and make or break companies. Power outages in developed countries are regarded as a government failure. The huge economic costs of building a new power plant and the environmental impact or society objections to the siting mean that governments have to manage the process. As a result any changes to a national energy programme can only take place with government support.

One of the problems with bringing in change is that the legacy power systems in place often make it difficult for new entries and new technologies to compete. Many renewable sources produce electricity in direct current (DC) format, whereas national power grids have long been established with alternating current (AC), which is the global established system for transmission and distribution of energy. A low-voltage DC network works well with solar panels, but it is difficult to feed this power into the AC mains grid.

Electricity does not follow the same supply chain as other commodities. This makes for difficulties in bringing new players into the system and accommodating different forms of energy. Unlike a surplus of grain which can be kept in silos, traditional power systems have offered a supply of electricity that cannot be cost effectively stored to match a later demand. The national grids have to constantly balance power generation with power consumption.

This often means that suppliers who feed power into the network have to produce the same quantity of electricity that their customers take out and are charged for any imbalances. The network operator needs to ensure a generating reserve to maintain a balance. This creates further challenges with the trading environment as the power generators have restrictions on their productivity and have to comply with the requests of the grid operators.

In nearly all ASEAN countries the state subsidises the price consumers pay for fuel or electricity. National energy programs and the infrastructure investment that plants require have been underwritten by state guarantees of pricing to the utility operator. This can discourage cross border trading as well as providing a possible barrier to entry to potential private energy investors. Consumers and industrial end-users have less incentive to look for new alternatives if their current source of energy is subsidised. Most of the ASEAN countries now have plans in place to reduce these programs (see table 2 below), which have had a long term impact on the energy policies for the region and have caused a big burden on government resources.

All of these factors make for complexity in implementing change in national energy operations. Some of these areas will be considered alongside other drivers and barriers to energy use in later parts of this paper. Before getting into the detail, it is essential to look at the projections for energy use in ASEAN to understand the size of the challenge ahead.

Table 2. Fossil fuel subsidies and efforts at reform in ASEAN countries

Country	Products subsidised	Reform efforts
Brunei Darussalam	Diesel, gasoline, LPG and electricity	Increased diesel and gasoline prices in 2008 for foreign registered vehicles to limit "fuel tourism" from Malaysia, and applied for a second increase for foreign vehicles in 2012.
Indonesia	88-octane gasoline, diesel, kerosene for households and small businesses, LPG and electricity	Increased price of gasoline by 44% and diesel by 22% in June 2013. Promoting natural gas use in transport to reduce oil subsidies. Continuing successful kerosene to LPG conversion programme, which started in 2007. Electricity tariffs are set to rise by 15% in 2013 (based on quarterly increases) for all but consumers with the lowest level of consumption.
Malaysia	95-octane gasoline, diesel, LPG and electricity	In September 2013, subsidies to gasoline and diesel were reduced in a bid to cut the budget deficit. Plans to implement in 2014 a subsidy removal programme set out in 2011 to gradually increase natural gas and electricity prices.
Myanmar	Electricity, natural gas and kerosene	As part of power sector reforms, electricity prices were increased in January 2012. Diesel and gasoline prices were indexed to Singapore spot market prices in 2011.
Thailand	LPG prices controlled. Diesel and natural gas (for vehicles) controlled to minimise effect of volatility in international prices. Electricity for poor households	From September 2013, increasing LPG prices every month for all but street vendors and consumers with the lowest level of electricity consumption. Increased electricity tariffs in September 2013, which will be revised every four months.
Vietnam	Diesel, gasoline, natural gas and electricity	Gradually moving towards market prices for oil and natural gas. Plans to introduce a roadmap for the phase-out of fossil-fuel subsidies.

Source: Southeast Asia Energy Outlook 2013 WEO special report

The stickiness of fossil fuels and ASEAN's growth

ASEAN's consumption of energy up to 2020 is expected to grow at double digit rates, with an 18% per capita increase estimated in kilotons of oil equivalent (ktoe) from the 6 largest ASEAN economies between 2013 and 2020.

Table 3: ASEAN energy consumption

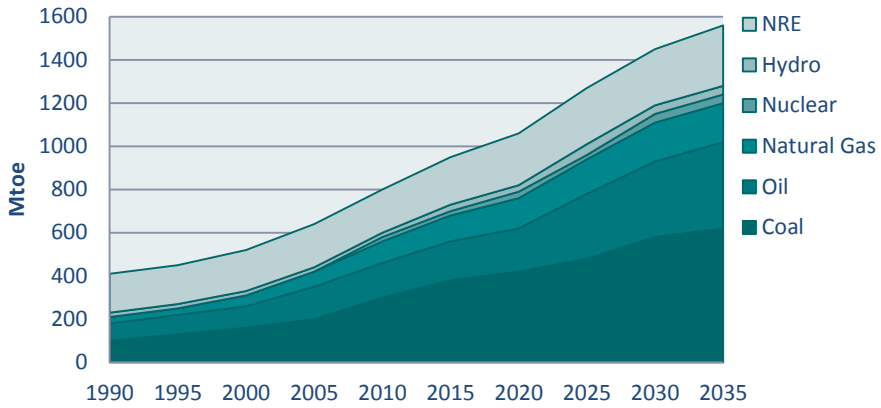
	2013 Estimates				2020 forecasts			
	Total energy consumption (Ktoe)	Population (millions)	Energy consumption per capita (Ktoe/person)	Av energy consumption	Total energy consumption (Ktoe)	Population (Millions)	Energy consumption per capita (Ktoe/person)	Av energy consumption
Indonesia	223,008	250.80	0.89		284,289	267.50	1.00	
Malaysia	78,976	29.70	2.60		100,923	32.80	3.00	
Philippines	46,004	105.70	0.43		60,767	118.70	0.50	
Singapore	37,596	5.50	6.80		48,500	6.10	8.00	
Thailand	124,398	69.30	1.80		149,670	71.70	2.10	
Vietnam	68,442	90.40	0.76		101,624	96.30	1.06	
Total	578,424	551.40	13	2.21	745,773	593.10	16	2.61

Source: EIU[2]

The Asian Development Bank (ADB)[3] expects the percentage contribution of fossil fuels to increase throughout the whole Asia Pacific region during this period and beyond from 82.4% in 2010 to 83.2% by 2035. As Chart 3 below shows, the expected contribution of new and renewable sources to Asia's energy demand seems to remain flat. Hence over time the proportional contribution of renewable sources will actually decrease as coal, oil and natural gas grow to higher levels.

[2] The Economist Intelligence Unit, Market Indicators and Forecasts 2014
[3] ADB (Oct 2013). Energy Outlook for Asia and the Pacific. (The report covers the whole region from central Asia to the Pacific Islands)

Chart 3: Primary energy demand



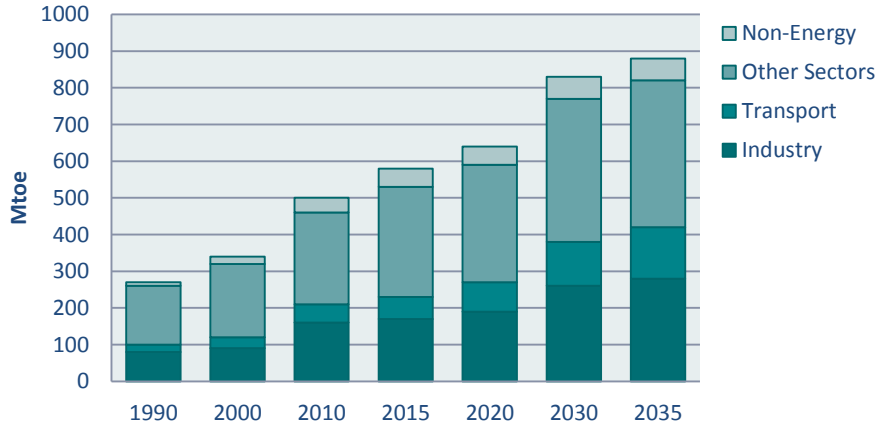
Mtoe = million tons of oil equivalent, NRE = New Renewable Energy

Note: NRE includes noncommercial biomass (such as food and animal waste) and other new and renewable energy sources (such as biomass, geothermal, wind, solar, and others)

Source: ADB

The sectors that make up the energy demand (see chart 4 below) are expected to show some changes over time as the economies of the region evolve. The industry sector is expected to show slow growth at 1.5% yearly as manufacturers increasingly adopt more energy efficient operations. The residential, commercial, agricultural and fishery sectors are expected to grow by 2.5% annually as populations increase and countries evolve from subsistence to export farming. The biggest growth apart from "others" is in the transport sector at 2.7%, which is expected through a combination of population and income growth creating a surging middle class in the region.

Chart 4: Final Energy Demand



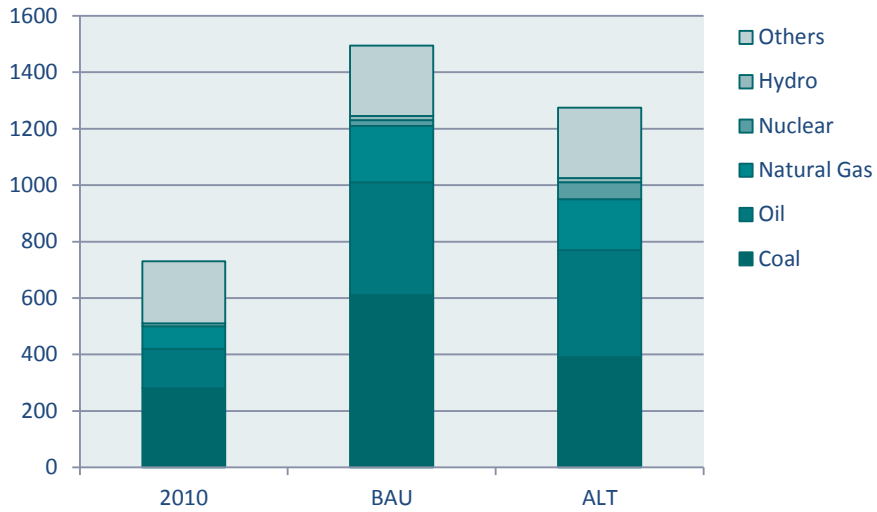
Mtoe = million tons of oil equivalent, NRE = New Renewable Energy

Note: NRE includes noncommercial biomass (such as food and animal waste) and other new and renewable energy sources (such as biomass, geothermal, wind, solar, and others)

Source: ADB

The ADB report does consider an alternative outcome with a reduced use of energy made possible through a better use of technology. In the alternative case, the projected energy demand in Asia Pacific, will be 1,295.2 Mtoe (millions of tonnes of oil equivalent) lower than that the 'business as usual' case in 2035. The ASEAN countries will likely follow a similar pattern in the alternative case. In this outcome, there will be a reduction in the share of fossil fuels, although they will still comprise the majority share of energy sources.

Chart 5: Business-as-usual and the alternative case: primary energy demand



ALT = alternative case, BAU = business-as-usual case, Mtoe = Million tons of oil equivalent
Twh = terawatt hour

Source: ADB

The forecast looks worrying in terms of the overall regional demand for energy and the implications on its governments. Energy consumption is expected to grow by 18% per capita in the ASEAN countries between 2013 and 2020, which will mean a similar growth in CO2 emissions over the same period, as well as increased government subsidies.

If the alternative case is to prevail in Asia Pacific and specifically the ASEAN region, all opportunities for more efficient use of energy and the uptake of renewable sources should be considered urgently by the national governments. Citizens in the ASEAN countries should be fully aware of what is at stake, the role they can play and the options they have as consumers to manage the demand and their pollution levels, as well as ensuring their continued economic growth and attractiveness to foreign direct investment.

New and renewable energy sources

As the graphs in the previous section show, the ASEAN countries and indeed the surrounding Asia Pacific region rely primarily on coal and oil. Fossil fuels are non-renewable as they draw on a limited supply that will eventually either run out or prove too expensive to extract using current technologies. Renewable energy sources such as wind, hydro and solar power will never (under normal climate conditions) face these limitations. However the location of the extraction point needs to be appropriate. And not all parts of the world can claim full access to a range of renewable sources.

Fortunately the ASEAN region is blessed with a climate that offers many renewable energy sources. Sunlight is a natural source for heating and lighting homes as well as for solar power. South-east Asia benefits from a year-round constant and predictable supply, unlike its neighbours to the north. The monsoon climate of the ASEAN countries produces predictable wind seasons, although much of the year is spent 'intra-monsoon' with light and inconsistent breezes. Hence part of the region is referred traditionally as the "Land Below the Wind".

The region does normally enjoy regular and consistent rain fall throughout most of the year unlike some of its water-deficient neighbours to the south and north. Hydroelectric power plants capture the energy of the water flowing back down to the sea. And the constant tides washing past the many islands that make up the region provide further opportunities for energy from ocean currents.

The tropical climate of South-east Asia is also beneficial for plant growth, which gives it the potential for the conversion of biomass to produce electricity, fuels for transportation or chemicals.

A simple assessment of the climate of the region suggests that it is probably better suited to renewable energy sources than many other parts of the world. Given the favourable climate for renewable energy it is somewhat surprising that the member states are not more advanced in this respect.

Table 4: ASEAN's suitability for renewable energy sources

	Solar	Wind	Biomass	Hydro
ASEAN				
China				
Europe				
N Am				

Source: Ipsos estimates, WEO Southeast Asia Energy Report, Energy Studies Institute, National University of Singapore[4]

Although the ASEAN region has not been regarded as having as much potential for wind power as other parts of the world, there are still some developments underway. Thailand and the Philippines will both see an upturn in operating wind farms before the end of the decade. A recent report released by the International Energy Agency and the World Bank[5] showed that Vietnam has the best capacity in the region to use wind power. Up to 8.6 percent of the country's land area was evaluated as either "good" or "very good" for building large wind power stations.

[4] Southeast Asia Energy Outlook, World Energy Outlook Special Report, International Energy Agency, ERIA, and Energy Studies Institute, National University of Singapore

[5] http://www.genewscenter.com/Press-Releases/GE-to-Partner-with-ERAV-on-development-and-integration-of-wind-power-into-the-national-grid-Agreemen-4423.aspx

GE's energy division has announced the opening of a new engineering centre in Vietnam[6] in addition to its existing wind manufacturing facility in Haiphong. GE's recent wind energy projects in Vietnam include an agreement with the Electricity Regulatory Authority of Vietnam (ERAV) in 2013 to conduct a "Renewable Energy Integration Study", which will explore developing wind power as a reliable energy source into Vietnam's national grid. Also announced in 2013 was the signing of a contract between GE Power & Water and Cong Ly Construction-Trade-Tourism Ltd in 2013 to provide 52 wind turbines for phase two of a project which started in 2011 and lead to the installation of 10 turbines which connected to the national grid in 2013.

This initiative is an indicator of how the future of ASEAN might look with the private sector developing energy initiatives combining revenue-generating projects with research and development programs that create local jobs and build engineering skills. ASEAN countries have a lot to gain from such partnerships with the private sector and it is in their best interests to ensure the regulatory requirements for foreign direct investment initiatives of this nature are suitably encouraging. The private sector will also need to make a profit from such ventures in order to be incentivised for further investment. This will mean that governments will need to consider national issues such as energy pricing and the role of the public utility. As with other aspects of the business climate, member states will need to compete with each other and aim for independent energy programs. This is perhaps at odds with the ASEAN 2020 vision of an interconnected region sharing and collaborating in the style, perhaps, of the European Energy Exchange, but it might be a more realistic roadmap than the original regional plan devised in 1997.

Trends that will impact the use of power

Efficiency in transmission and distribution

GE's investment in wind power exploration in Vietnam is a harbinger of the role that technology and engineering skills from the private sector will play in the region. Although all the member states would likely welcome such investments, there are many other ways that they could make better use of existing technologies to ensure more productivity from their energy requirements.

Better efficiency in the use of energy can come from a number of different areas. ASEAN's losses as a percentage of total net generation of electricity range from a highly efficient 4% in Malaysia to double digit figures for Indonesia, Vietnam, The Philippines, Cambodia and Myanmar. Myanmar is particularly problematic with an estimated 34% of its energy being lost in transmission and distribution. According to the International Energy Agency, a more efficient use of primary energy could reduce the region's energy use in 2035 by almost 15%, the equivalent of the current energy use of Thailand.

[6] Eco-Business: "Vietnam/US cooperate in developing renewable energy". 21 February 2014. Retrieved from: "http://www.eco-business.com/news/vietnam-us-cooperate-developing-renewable-energy/"

Table 5: Energy efficiency in ASEAN compared with other parts of the world

Energy Efficiency in ASEAN		
Country	(Billion kWh)	Losses as % of total net generation
Brunei	0.218	6%
Burma (Myanmar)	0.22	34%
Cambodia	15.36	19%
Indonesia	0.26	10%
Laos	3.99	7%
Malaysia	1.91	4%
Philippines	7.5	13%
Singapore	2.16	5%
Thailand	8.78	6%
Vietnam	7.99	10%
China	181.15	5%
United States	260.58	7%
India	219.87	6%
OECD	662.78	7%

Source: Enerdata, Energy Studies Institute, NUS

Countries that tend to be more efficient users of energy also tend to enjoy higher GDP rates. Hence as the ASEAN countries economies grow, and their technologies and infrastructures improve, their wastage rates should drop. Identifying and fixing the areas that cause the biggest energy loss need to be treated as a priority before the end of this decade.

At the global level, the energy required per unit of GDP (the energy intensity) has been decreasing by 1.3 percent per year since 1990[7]. Improvements have been achieved in all regions, with the largest reductions in the regions being the countries with the highest energy intensities (China, CIS and India). Hence there is further cause for hope that as the ASEAN countries mature and their GDPs rise, their consumption of electricity does not have to rise exponentially.

[7] Global Energy Efficiency Trends 2013, by Enerdata for ABB

The main ways of addressing energy efficiency comes from a combination of improved technology and infrastructure as well as government initiatives. As a country grows economically it has more ability to invest in the systems that create more productive power. It is also likely to generate a local knowledge base of energy engineering which in turn can create its own eco-system of supporting companies. It can also afford to rethink its whole energy program and look at alternative sources as China has done recently with hydropower. Of course, new investments in areas such as hydropower require substantial investments in infrastructure and technology.

One of the efficiency challenges in integrating renewable power is the long distance that a source (such as a hydroelectric dam) might be from a city where the demand is. High Voltage DC (HVDC) technology is needed to help this transfer to the end user. ABB, a pioneer of HVDC technology, has recently announced the world's first circuit breaker for HVDC which enables the more efficient transfer of electricity through networks. This effectively solves the problem of developing DC transmission grids, enabling integration of electricity produced from renewable sources in DC format into existing AC networks. Haider Rashid, Head of ABB in Asia describes the possibilities from this technology breakthrough. "This … will make it possible to build the grid of the future. Overlay DC grids will be able to interconnect countries and continents, balance loads and reinforce the existing AC transmission networks."

One of the other challenges of the incompatibility of AC and DC formats on grids seems to be close to a solution. Experiments being conducted in Germany by electricity transmission companies Amprion and TransnetBW, may have solved the problem of transmitting DC power on existing AC power cable infrastructure, once thought to be impossible because of the electrical interference between parallel cables. Recent experiments[8] seem to suggest that this is less problematic than previously assumed once the insulators are changed, which is a much cheaper alternative to building new DC-only power grids.

These technologies might potentially solve one of the obstacles to the ASEAN Power Grid. An EU and ASEAN conference held in Kuala Lumpur in June 2013[9] reported disappointing progress with the grid due to large national differences. Although it will be difficult to resolve these differences by 2020, at least with technologies such as HVDC and the transmission of DC on existing AC grids, the process of linking up the countries and incorporating different energy sources will be made easier. Of course, the biggest obstacle of the pricing of electricity and incentives for cross border trading will still remain at least in the short term. Hopefully in the longer term when ASEAN's infrastructure is no longer built on the promise of state-subsidised power, then the member states might start to trade energy European-style.

Improvements in energy efficiency in thermal power generation have been closely linked to the uptake of gas combined cycle plants over the last decade. The combined cycle principle puts a series of heat engines, working in sequence to drive the same shaft, passing heat from the same original source through each other to maximise the opportunity for efficient conversion to mechanical energy and hence on to electricity. As the utilities in the region adopt technologies such as combined-cycle plants they can expect to achieve similar rates of energy efficiency.

As an example of the recent uptake of this technology in the region Siemens[10] announced in July 2013 that it will supply two H-Class gas turbines, along with generators and steam turbines for a combined cycle power plant (CCPP) in Malaysia. The contractor, Samsung C&T is constructing the power plant for the Malaysian electricity utility company, Tenaga Nasional Berhad. With a generating capacity of about one gigawatt and an efficiency rating of over sixty percent, it is expected to produce the most powerful and efficient gas-fired power plant in the South-East Asian region. The plant is scheduled to go into operation in early 2016. The order value to Siemens for the components is roughly EUR150 million.

[8] The Economist, Technology Quarterly, March 8th 2014. "Can Parallel Lines Meet"
[9] 6th Power System Operators workshop, ASEAN Power Grid. Retrieved from: http://readi.asean.org/news/127-6th-power-system-operator-s-workshop-asean-power-grid-interconnection-issues-and-challenges
[10] http://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2013/energy/fossil-power-generation/efp201307049.htm

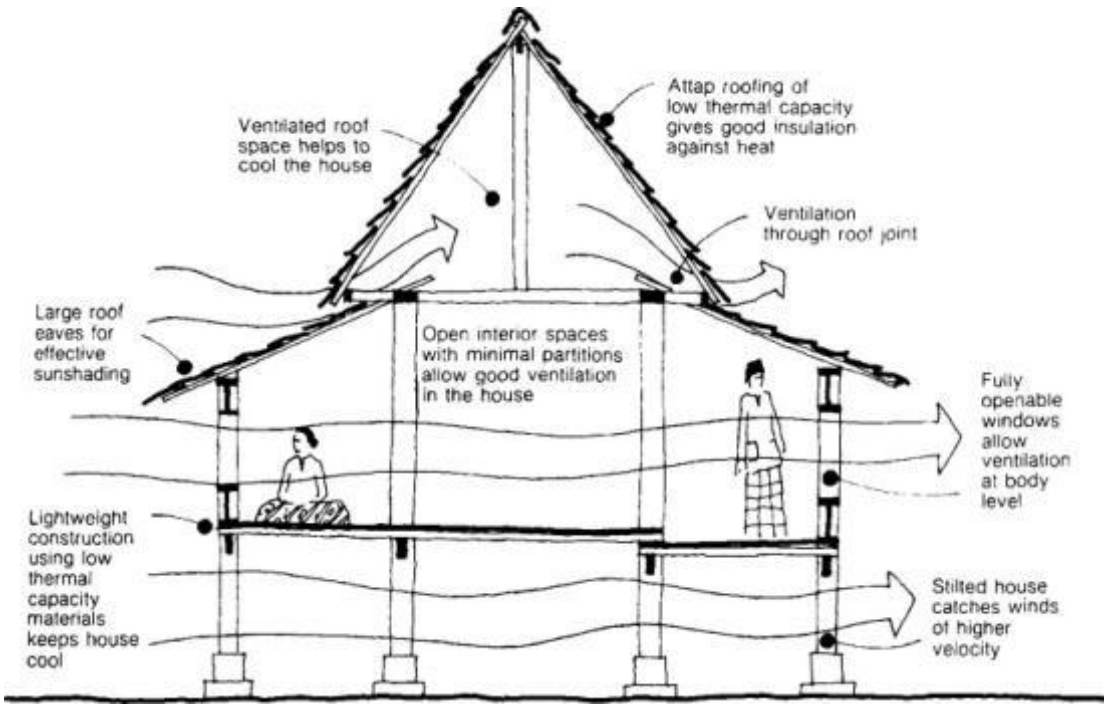
Hopefully such large investments in energy efficiency and infrastructure will allow Malaysia and the other states to produce energy more cheaply. This may in turn help the governments to reduce the subsidies to consumers, which is one of the biggest obstacles to the ASEAN Power Grid and to private sector investment in energy. Of course, not all the ASEAN countries have the same wealth, and the less affluent countries will likely struggle to afford such large upfront investments in more efficient energy infrastructure.

Efficiency in consumption: Trends with air conditioning

One of the biggest consumers of electricity in the ASEAN region is for cooling buildings. Traditional tropical buildings were designed in the past for maximum energy efficiency. Houses were often oriented along the north-east and south west axis to take advantage of the cooling monsoon winds. Low roofs and verandas provided shade for the interior from the sun. Ventilation in the roof prevented a build-up of hot air in the house. Houses were built on stilts to allow a flow of air underneath and to provide some protection from floods and the local wildlife. The building materials were sourced from nearby forests and would retain water from a tropical shower to allow for a natural cooling when the sun came out again.

Up until the latter decades of the last century, before air-conditioning became prevalent, buildings in South-east Asia continued to be designed to seek natural ways of cooling.

Illustration 1: Climate control in a traditional ASEAN house



Source: http://archfullstop.blogspot.sg/2010/11/traditional-malay-house.html

Modern condominium developers usually focus on producing iconic award winning architectural designs, rather than energy efficient buildings. Architects design enclosed apartments and elevator lobbies which cannot take advantage of the breeze for cooling. Windows that often cannot open, reach from floor to ceiling to maximise the view with no consideration for the greenhouse effect. Building materials soak up the heat. The roof space is wasted. The only balconies are designed at the back to accommodate individual air-conditioners for each unit. The air-conditioner balcony contributes to the gross floor area for each apartment, enabling the developer to sell an extra few square metres of space. The efficiencies of district cooling or centralized heating, ventilation and air conditioning (HVAC) systems are usually overlooked.

So are developers primarily responsible for wasting electricity in buildings? Facilities managers also get criticized by vendors of energy efficient systems for their supposed resistance to change. And there is often a resistance to change amongst consumers and tenants. Bosch Energy and Building Solutions estimates that the heating systems currently installed in buildings in Germany are twice as old as the national vehicle fleet. Germany is one of the more advanced global nations when it comes to attitudes towards energy and power conservation, so ASEAN countries would likely have similar or worse statistics. But there is no shortage of new technologies that are competing to reduce electricity bills.

Schneider, a power and technology company, announced a solution called “SmartStruxure Lite” in October 2013 to serve smaller commercial buildings of less than 10,000 square metres of floor space. This is a wireless system which can be retrofitted into older buildings. Saulo Spaolanse, Country President Schneider Electric for Singapore and Brunei claims it can “help make energy one of the most controllable expenses in a building.” Instead of having a constant room temperature at all times, wireless sensors in the system automatically increase temperature set-points when there is no occupancy. Schneider claims that this can create energy savings of 7% for every degree the temperature is raised. The information on energy expenditure is stored in the cloud, making it available to facility managers and unit operators to enable plans for more efficient use of the space. New technologies are increasingly coming with new data, which further help building operators to understand and plan their use of energy more effectively.

Bosch has developed a control algorithm for air-conditioning which works to achieve a constant temperature across a room by mixing the air in a room more effectively. This addresses the problems of temperature layering, cold pockets and drafts which causes the common sight in the region of office staff wearing jackets to counter the chill from air-conditioners. Bosch claims to be able to realise energy savings of between 30-70% in new and existing buildings through this system.

ASEAN countries can expect to see more energy service companies (also known as ESCOs) integrating multiple solutions and providing energy saving systems for retrofitting buildings. A common business model for ESCOs is that the payment is dependent on the energy cost savings derived from the refit, which makes it a risk-free decision for the building owner.

Sodexo, a facilities management company, claims that it is able to achieve energy cost savings in the buildings it manages in the ASEAN countries from 15-30% simply through better management of existing energy infrastructure. Organisations such as Sodexo do not have a specific interest in air-conditioning technology alone, but offer a strategic appraisal of all the functional systems that serve a building. This process will normally involve an energy audit which will look at the power consumption of the whole building and will analyse the actual space and unit requirements for heating, cooling, lighting, water, waste management etc. The use of a commercial building will often evolve over time with different tenants and uses for different rooms, hence the energy and plumbing requirements for different spaces will also change. Sodexo aims to manage both the capital and operational expenditure of a building more effectively for the building owners. It normally manages to achieve operational cost savings by focusing on the maintenance and more effective utilization of existing equipment rather than through the installation of new capital equipment.

Is energy efficiency the big idea that will help the ASEAN group to power its growth into 2020 and beyond without increasing pollution and expenditure? Clearly it will help, but energy efficiency will not be the only factor. John Browne[11], the former CEO of BP, an oil company, believes that money saved on energy, will not reduce the overall requirement for energy and may even lead to more profligate use. In developing parts of ASEAN though, cheaper costs will provide less of a burden to both rural and urban households.

A combination of social awareness, government pressure and effective communication from energy solution providers is starting to highlight the concept of energy efficient designs albeit at a very slow rate. New technologies for saving electricity expenditure and better maintenance and use of existing assets help to reduce operational costs to commercial building owners and business unit operators. Perhaps the fact that this is not as interesting a topic as the latest apps on a smartphone, means that it does not resonate with ASEAN citizens in the same way that it seems to resonate with people in other parts of the world. The 'eco-friendly' concept is starting to move beyond the recycling of hotel towels into architectural design and commercial building energy systems. The uptake of energy efficiency in the ASEAN region is surprisingly lagging other parts of the world. Fortunately, the only way is up.

Illustration 2: A modern condominium in Singapore with individual air-conditioners for each unit with their own dedicated balcony adding to the overall gross floor space

Source: The author

It's the economy…

The ASEAN website[12] is predictably bullish about the future of the region claiming that "ASEAN's economic performance continues to outpace the rest of the World …. GDP in ASEAN countries will grow 5.3% in 2013 and 5.6% in 2014. …

The introduction of a single market resulting from the introduction of the ASEAN Economic Community (AEC) planned for the end of 2015, is shaping the Region as a key investment opportunity, according to "Investing in ASEAN 2013/2014".

ASEAN's outlook for the future seems to hinge on the successful implementation of the AEC which doesn't seem likely to take shape by the end of the decade, let alone by 2015. The outlook goes on to claim "Over the next 20 years, Southeast Asia will be one of the world's fastest growing consumer markets."

[11] "Seven Elements That Changed the World" by John Browne, published by Pegasus
[12] http://www.asean.org

"The combined GDP of member nations is already significantly larger than India …. and by 2018 will exceed Japan. The AEC will unleash a new era of growth by creating a competitive market of more than 600 million people in the ten member countries comprising Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam."

The region will undoubtedly continue to grow, with or without the AEC. The only debate is the growth rates it can expect to achieve in the short term. The OECD[13] is a bit more cautious about calling the growth of ASEAN, pointing out the different stages of development of the ASEAN countries which create different challenges.

The front runner for growth is expected to be Indonesia with a projected growth rate of 6.4% between 2013-17. OECD puts this growth down to increased foreign direct investment coupled with infrastructure developments and planned economic reforms.

Singapore, Malaysia, the Philippines and Thailand have growth projection rates that are considered healthy by the OECD partly due to the comparatively high national savings rates compared with other similar economies. This assumes stable political environments which in 2014 has not been the case for Thailand causing problems for their economy. Singapore, Malaysia and Indonesia also face higher levels of political uncertainty than they did when the ASEAN 2020 vision was crafted.

The OECD predict rapid growth for the CLMV countries (Cambodia, Lao PDR, Myanmar and Vietnam) for the medium term with rates of 6-7%, Myanmar is clearly a recent succcess story enjoying a large influx of foreign investment as a result of its political reforms which started in 2010. As with other parts of the region, its continued growth is reliant on political stability.

Slower growth is predicted for Cambodia and Vietnam. The OECD expects slowing demand for Cambodia's textile exports. Weakening in Vietnam is attributed to high inflation and poor economic management.

One of the factors that might impact the economic growth rates is the poor energy infrastructure in some of the member states. High electricity prices in the Philippines, for instance are apparently deterring foreign investors[14]. The government recognizes the problem and has estimated that it needs to add around 1,000MW of new generating capacity costing perhaps US$2.25b every year between now and 2030 if it is to overcome the national energy crisis. The current generating capacity per capita in The Philippines is estimated to be roughly five times lower than Malaysia and Thailand.

The impact that the projected economic growth will have on the region's power consumption is quite substantial when considering the current low rates of uptake in many of ASEAN's less developed countries.

A study from the World Bank (see table 6 and charts 6 and 7 below)[15] shows the very high proportions of developing countries household income that go towards the basics such as energy and food. Very little additional funds are left over for the other necessities of life. Hence for the emerging markets, consumption of energy is significantly lower than in the developed markets where recreational and lifestyle pursuits can add to the demand.

[13] OECD (2013) Southeast Asian Economic Outlook 2013. Retrieved from: http://www.oecd.org/dev/asia-pacific/Pocket%20Edition%20SAEO2013.pdf

[14] Enerdata: Asia Weekly Energy News 6 Mar 2014: HIGHLIGHTS OF THE WEEK: Philippines high electricity price is keeping foreign investors away

[15] Expenditure of Low-Income Households on Energy, Evidence from Africa and Asia
Robert Bacon, Soma Bhattacharya, Masami Kojima, World Bank

That is not to say that the demand for power in developed countries has no limits. The Sustainable Energy Association of Singapore (SEAS)[16] notes that although demand for electricity rose rapidly in the city state up to 2004, the growth figures after this date can likely be attributed just to population growth. SEAS believes this is due to Singapore's consumers reaching a saturation point in the quantity and efficiency of energy drawing devices at their disposal as well as the promotion of energy efficiency by government agencies. Mature economies face different issues with energy consumption, such as managing capacity and providing for peak demand, which are problems that renewable energy sources often struggle to address.

Table 6: Shares of Urban Household Expenditure on Various Energy Sources, Food, and Transport

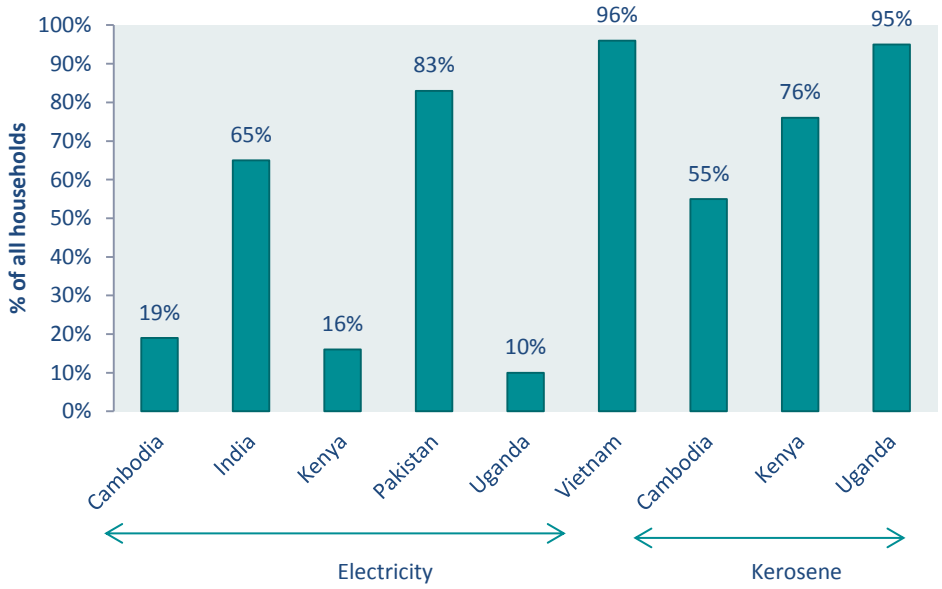
All households (%)

Expenditure items	Bangladesh	Cambodia	India	Indonesia	Kenya	Pakistan	Thailand	Uganda	Vietnam
Kerosene	0.60	0.50	1.20	2.40	2.70	0.10	0.00	1.10	0.30
LPG	ND	0.80	2.50	0.30	0.40	0.30	0.50	ND	4.60
Gasoline and Diesel	0.10	ND	1.50	1.30	0.50	1.70	5.60	0.40	4.30
Petroleum Products	0.70	1.30	5.20	4.30	3.50	2.10	6.10	1.50	9.10
Electricity	2.20	2.80	3.60	4.00	0.70	4.80	3.50	1.10	4.00
Natural Gas	1.00	N/A	N/A	0.00	N/A	1.60	0.00	N/A	N/A
Modern Energy	4.00	4.10	8.80	8.30	4.20	8.40	9.60	2.70	13.00
Biomass	3.10	3.20	1.60	0.50	1.80	1.10	0.20	3.60	1.20
Total Energy	7.10	7.30	11.00	8.80	6.00	9.60	9.80	6.30	14.00
Purchased Food	51.00	53.00	41.00	53.00	39.00	42.00	35.00	37.00	41.00
Non purchased Food	3.90	6.60	0.80	3.20	6.90	2.00	4.50	6.50	2.60
Total Food	55.00	60.00	42.00	56.00	46.00	44.00	39.00	44.00	44.00
Transport	2.80	0.10	2.50	3.10	4.90	3.10	2.50	2.50	0.50

Source: World Bank

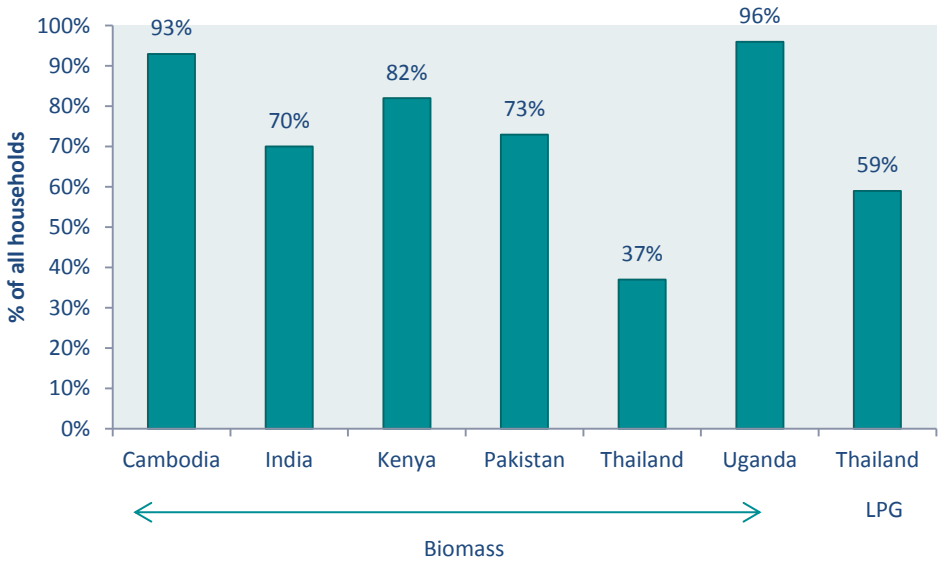
[16] "A case for sustainability: Accelerating the adoption of renewable energy in Singapore": A white paper by the Clean Energy Committee of the Sustainable Energy Association of Singapore, 20 January 2014

Chart 6: Main lighting source for all households



Source: World Bank

Chart 7: Main cooking fuel across all households



Source: World Bank

Before the developing countries of ASEAN achieve the Singapore plateau experience they will first likely go through big increases in energy. This will come about as income levels increase, giving people more money to spend on non-essentials, and as infrastructure improves giving more households access to electricity and non-biomass sources for cooking. With the expected maturity of technologies that improve efficiency and provide viable means for extracting energy from renewable sources, the more developing countries may even be able to 'leapfrog' their developed neighbours by not having to go through the learning curve of traditional power plants and inefficient transmission systems. This might enable them to more quickly catch up with and overtake neighbours that are still having to maintain and operate costly legacy systems.

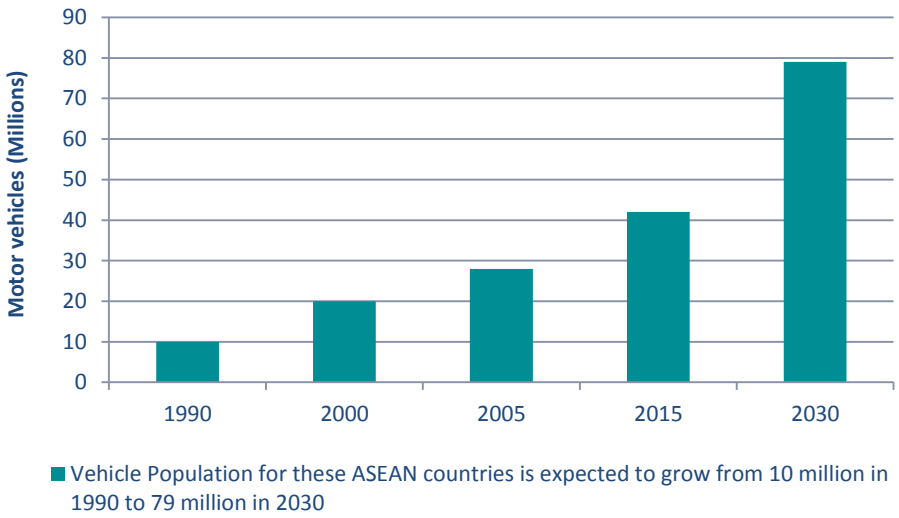
There is a long way to go to get a level playing field. According to the International Energy Agency[17], a startling 160M out of 567M total in ASEAN have no electricity at all. Electrification rates in ASEAN range from 100% in Singapore down to 10% for rural Myanmar. This lack of electrification does of course bring continued opportunities for vendors of off-grid solutions such as diesel generators, biomass power generation systems and solar power systems.

Cars and bikes

Another factor that will drive energy consumption that is linked to economic growth is the vehicle population growth in ASEAN. Malaysia and The Philippines consume 35% of their total energy in the transport sector.

Private vehicles are particularly prevalent in Malaysia as household incomes grow, vehicle prices are affordable, petrol costs are subsidized by the state and public transport alternatives are limited. Chart 9 below shows how vehicle ownership in Malaysia is expected to increase to maintain its lead to well over double the ASEAN average by 2020.

Chart 8: Vehicle population (Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam)



Source: Asia Pacific Energy Research Centre, APEC Energy Demand and Supply Outlook 4th Edition, 2009

[17] Southeast Asia Energy Outlook, World Energy Outlook Special Report, International Energy Agency, ERIA, September 2013. Retrieved from http://www.worldenergyoutlook.com

Table 8: Transport sector energy consumption

Country	Transport sector energy consumption (% of energy consumption)
Malaysia	35.1
Philippines	35
Thailand	25.1
Indonesia	21.6
Singapore	20.3
Vietnam	17.3
The transport sector in Malaysia, Philippines, Thailand, Indonesia, Singapore, and Vietnam accounted for 17-35% of total energy consumption in 2009	
Transport consumption has increased commensurately with economic growth	

Source: Energy Studies Institute Singapore

Technological advances with hybrid electric cars will help to reduce CO2 emissions and fuel consumption. One of the Singapore taxi fleets, SMRT, bought 600 Toyota Prius vehicles in October 2013 which are petrol electric hybrids, but the bulk of its fleet remains diesel powered. Plug-in hybrid vehicles (PHV) that combine conventional fuel and charging from regular household power outlets have recently entered the market in Japan[18] but will take some time before becoming mainstream due to the nascent supporting infrastructure such as batteries and charging stations etc.

Singapore's Energy Market Authority is testing out the concept of fully electric-powered cars in the city state[19]. An electric vehicle in the tests costs about S$5 in electricity per 100 kilometres compared with about S$20 in petrol costs per 100 kilometres for a normal car. Bosch Singapore, which is operating the charging infrastructure in Singapore, said there are currently 75 charging stations with 118 charging spots around the country. However, the cost of a car at around S$200,000 seems prohibitive at this stage, largely due to the cost of the battery as well as the high taxes which are unique to Singapore.

Already popular in the region, electric two-wheel vehicles are likely to experience a more rapid upsurge than their 4 wheeled counterparts by 2020[20]. Commuters in urban and sub-urban areas are leading the uptake, frustrated by the higher costs of combustion engine two-wheelers and the inefficiencies of public transport. Electric two-wheelers will likely spread into rural areas later when access to electricity becomes more readily available.

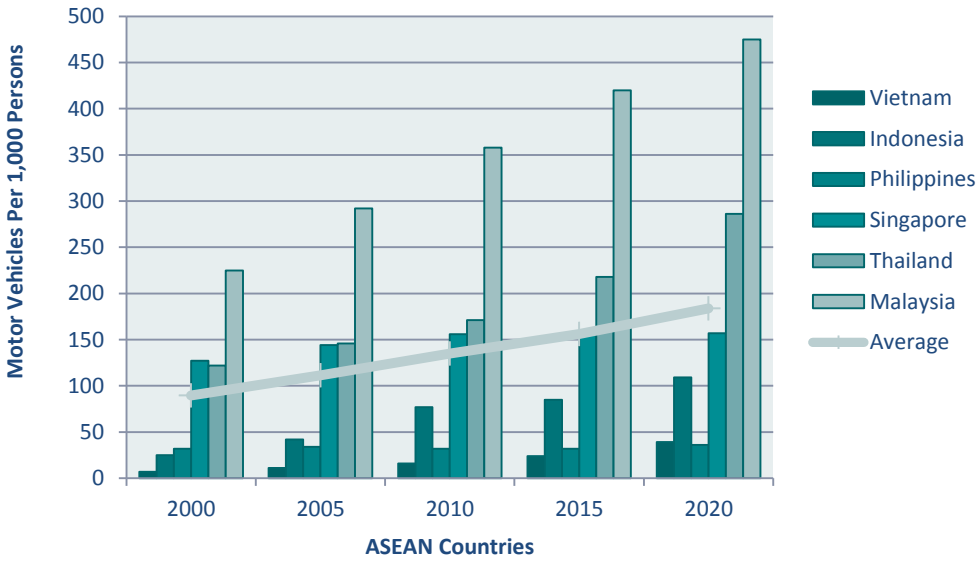
Governments in ASEAN have been slow to recognize the potential for electric two-wheelers to replace the higher polluting petrol equivalents perhaps out of a concern as to how they should be taxed or regulated.

[18] Ipsos Business Consulting: Eco-cars, and key developments within the global auto industry, by Shu Tobita and Shoko Furukawa, February 2014
[19] Green Business Singapore: "Testing of electric cars in Singapore moves into second phase"
[20] Navigant Research: Electric Scooters in Asia Pacific Will Increase Nearly Tenfold from 2012 to 2018 http://www.navigantresearch.com/newsroom/electric-scooters-in-asia-pacific-will-increase-nearly-tenfold-from-2012-to-2018

Illustration 3: Regulation for battery scooters

Source: The author

Chart 9: Vehicle population per capita



Source: APERC, APEC Energy Demand and Supply Outlook, 4thEd

Government sticks and carrots

Government policies have a huge impact on the production, distribution and use of power. Governments can encourage or nudge their citizens to be more efficient with their use of power (by adjusting the temperature of air conditioning) or use less water. Governments can also encourage businesses to be more energy efficient through infrastructure programs such as district cooling, which enables buildings to share cooling plants rather than making their own air-conditioning investments. These initiatives can be regulated to ensure that the operators are maintaining service levels and providing the planned levels of cost reductions.

Governments can also introduce taxes or other systems to encourage more efficient use of resources. Feed-in tariffs, which effectively subsidise and encourage the production of electricity from renewable sources are in their infancy in ASEAN compared with other parts of the world. Singapore's electronic road pricing which is one of the factors that is limiting vehicle growth (see chart 9 above) has recently been copied in London although without the same high taxes on car ownership that help reinforce the message.

Social awareness and consumer trends can also play a part. When the general public start to ask for more efficient power consumption or renewable alternatives for home use, then governments and developers are forced to take note.

In Australia, the recent increased uptake in solar power has led to a significant drop in demand from the grid supplied by fossil-fuel power plants. The proportion of dwellings with solar power is in double digits in nearly all states, reaching 25% in South Australia[21]. The uptake is attributed to the rising costs of grid-based electricity, as well as consumers opting for greener choices.

This has happened in other parts of the world. For instance, in Germany, there is huge support for renewable energy primarily through the program for local ownership of wind or solar power plants. According to a report from Climate Policy Initiative[22] in November 2012, "Renewable energy generation accounted for the bulk of Germany's climate investment in 2010, with EUR 26.6 billion. Small-scale renewable energy projects, such as residential solar photovoltaic installations, represented 75% of all investment in renewable energy" Hence most of the renewable energy output in Germany is owned by the general public, who have a vested interest in the spread of renewable energy to ensure their ventures succeed.

It will likely take beyond the end of this decade and probably even further for the ASEAN countries to consider the local ownership approach. Unfortunately the energy subsidies currently in place for most ASEAN countries and the wait-and-see approach to feed in tariffs will not provide any incentives for people to look for rooftop solar installations.

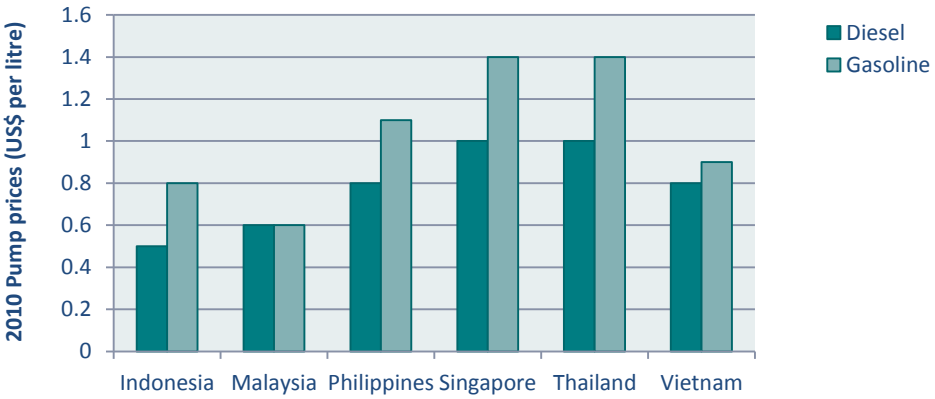
Busba Wongnapapisan, the head of renewable energy for the World Economic Forum spoke to ASEAN countries on this issue in 2012. According to a report from Energy Tribune[23]. She said: "Different countries have different regulations. How can ASEAN countries harmonize their regulations, as it makes private companies reluctant to invest? They are waiting for a clear policy."

In September 2013, ASEAN energy ministers signed a memorandum on the Trans ASEAN Gas Pipeline (TGAP) project to extend its development to 2024. The project, which consists of an ASEAN wide linking of gas pipelines and electricity supply was supposed to be in full operation by 2020. The bulk of the infrastructure is in place, but there has been no effort so far from the ASEAN countries to actually link the pipes. The Joint Ministerial Statement[24] issued after the meeting noted that: "the Ministers tasked HAPUA (Heads of ASEAN Power Utilities/Authorities) to develop an efficient and effective framework for taxation and customs tariff in order to accelerate investments in the development of ASEAN Power Grid projects". This appears to be the core of the problem. Without regional consensus on taxation and tariffs, and with the existing infrastructure in most countries underwritten by the promise of local state subsidies and guaranteed pricing for specific end users, the power grid and pipeline for trading energy will remain just wishful thinking.

[21] RenewEconomy: People Power: Rooftop solar PV reaches 3GW in Australia, 4 December 2013
[22] *Climate Policy Initiative: New Study: Germany invested EUR 37 billion, or 1.5% of GDP, to reduce the impact of climate change,* November 30, 2012. Retrieved from: *http://climatepolicyinitiative.org/press-release/new-study-germany-invested-eur-37-billion-or-1-5-of-gdp-to-reduce-the-impact-of-climate-change/*
[23] ASEAN Pipeline dream falls flat. Retrieved from: http://www.energytribune.com/11727/asean-pipeline-dream-falls-flat#sthash.uqISm2Wd.dpbs
[24] Oil, Gas & Electricity Asia, magazine, Volume 31, October 25- Nov 25 2013, p.50, "Ministers plan gas pipeline project" by Godang Sitompul

Although it is politically difficult for a government to take away or reduce subsidies, it might make more sense to offer alternatives such as loans for achieving cost savings with energy through new technologies or installing renewable energy systems, as Australia has done with solar power. Vendors of these technologies might be persuaded to offer financing schemes to prove the effectiveness of their claims, especially if governments are underwriting the costly installation phase or providing guarantees for purchasing surplus electricity. Such programs might then jump-start the process of getting industry and individuals to focus on more efficient use of technology to reduce energy consumption instead of relying on government fuel subsidies. ASEAN governments would be better off identifying the technologies and systems that can be best implemented to achieve more cost-efficient energy programs which will enable them to phase out subsidies rather than signing up to regional vision programs which their national policies prevent them from fulfilling.

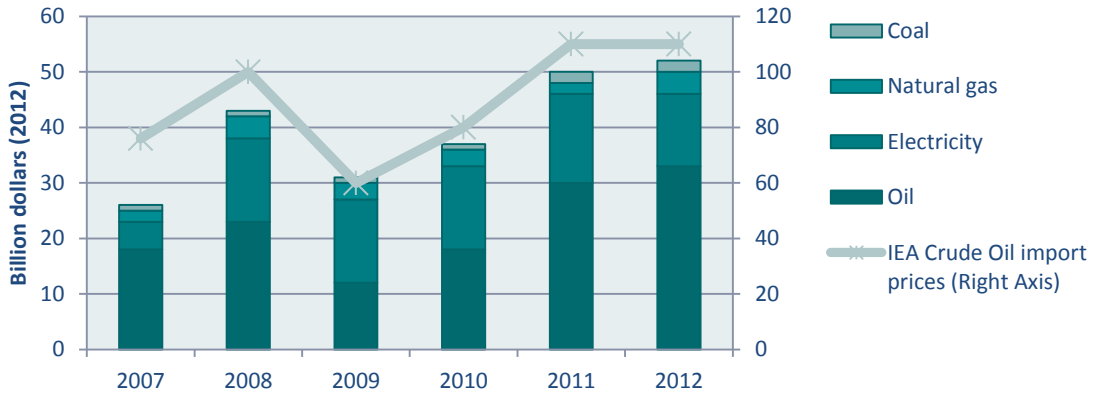
Chart 10: Pump prices



1) Malaysia and Indonesia have highest expenditure on fuel subsidies
2) Philippines and Thailand provide targeted subsidies for public transport
3) There are no fuel subsidies in Singapore

Source: World Bank, 2012

Chart 11: Value of fossil-fuel subsidies in Southeast Asia, 2007-2012



Fossil-fuel subsidies amounted to $51 billion in 2012; despite recent reforms - notably in Indonesia & Malaysia - they continue to distort energy markets

Source: South-east Asia Energy Outlook, WEO special report

ASEAN power grid or ASEAN micro-grids?

The world has recently seen the impact of the combination of two technologies, hydraulic fracturing ("fracking") and horizontal drilling to unlock natural gas and oil from shale deposits in the USA. The International Energy Agency estimates that by 2020, the USA will have replaced Saudia Arabia as the world's biggest oil producer. What other new technologies are being designed or experimented with right now that might help the ASEAN countries and others to fuel their future growth?

Solar power is starting to show the potential for more mainstream use in the region. In a recent announcement from the American Association for the Advancement of Science[25], solar cells stacked in panels have been reported to double the efficiency of the output. The German engineering company Siemens, which is a key stakeholder in the project, believes that this system will likely produce electricity that is cheaper than the supply from traditional coal-fired generators. Solar energy obviously cannot replace fossil fuels completely until the problem of banking some of what is collected during the day, for use at night, is solved. But at this sort of cost it can make a useful contribution.

In earlier sections, this paper has touched on the challenge of incorporating DC power from renewable and other sources into the AC grid and the inefficiencies of converting power between the two formats. The normal system is that AC is converted into DC through the black adapter boxes that come with the computer power supplies. The disadvantage of the adapters is that they lose a lot of power into heat, and are not capable of storing energy when the supply is at its cheapest at nighttime. A recent report[26] on the development of the USB PD (Power Delivery) standard seems to offer a solution. The idea is that low voltage electricity is required for most of the appliances that are common in offices and homes such as lights and computer equipment. The ultimate hope is that several buildings share the pooled electricity from a centralized DC smart grid, which powers itself up from a central battery at night when electricity is cheaper and can get fed from renewable sources such as solar power during the day. USB cables transmit data as well as electricity and can vary the workload according to the balanced requirements of different devices in what is referred to as machine to machine (M2M) communications. Hence a laptop that is passively charging a mobile phone and synchronizing data between the two, will interrupt this process to start the hard drive.

The advent of the DC local grid is of particular interest to some of the developing markets in ASEAN that don't have full access to electricity. Remote rural locations would have the opportunity to run low voltage DC circuits, perhaps powered by solar panels, to bring enough electricity to operate LED lights, cellphones and computers without having to get connected to the main AC grid, effectively 'leapfrogging' the legacy systems installed in the cities.

Singapore's Energy Market Authority announced the opening of a test centre for a solar and bio-diesel powered micro-grid on the rural island Pulau Ubin in October 2013[27]. The micro-grid feeds power to the main village on the island replacing the more expensive supply from diesel generators. The test centre is designed to see how similar micro-grids might be established to offer power to rural communities in the region.

[25] The Economist: http://www.economist.com/news/science-and-technology/21596924-way-double-efficiency-solar-cells-about-go-mainstream-stacking
[26] The Economist: http://www.economist.com/news/international/21588104-humble-usb-cable-part-electrical-revolution-it-will-make-power-supplies
[27] Energy Market Authority, Singapore: "Pulau Ubin Micro-grid Test Bed" October 2013. Retrieved from: http://www.ema.gov.sg/ubin-test-bed/

Might this signal the beginning of the end for the traditional national utility company in ASEAN? This seems to be a potential trend elsewhere in the world, with the experiences of renewable energy pioneers in Australia and Germany leading the way. The Rocky Mountain Institute[28] predicts the rapid demise of the monopoly of the utility company in the USA and a new dawn with multiple stakeholders working together. "The coming grid parity of solar-plus-battery systems in the foreseeable future, signals the eventual demise of legacy utility business models. … The important next question is how utilities, regulators, technology providers, and customers might work together to … build the best electricity system of the future the delivers value and affordability to customers and society."

Hence the future for ASEAN may not lie in small numbers of centralized power plants feeding national or regional grids, but from larger numbers of decentralized renewable or hybrid power units that feed surplus requirements into batteries and distribute electricity to local users through small DC networks. The challenge for the local governments will lie in how they will integrate these micro-systems into their energy programs, cope with a system of multiple suppliers and the impact this might have on the profitability of the utilities.

Fast forward

The year is 2020. It is a pivotal year in ASEAN's energy program. After spending the previous decade experimenting with different approaches, the leading ASEAN countries are now forming energy strategies that will manage demand and provide for their future growth.

The ASEAN Power Grid is connected to most member states and is now being tested for running parallel DC and AC electricity supplies. Electricity will feed from a variety of sources. There are increasing bilateral arrangements for energy trading amongst the states which will ultimately lead to the regional cooperation envisaged in 1997.

The traditional fossil fuel power plants are running at nearly optimum efficiency in the most developed ASEAN countries and providing the backbone of national power requirements, although demand from the grid seems to be leveling out. Fracking technologies are now finally being taken on board in parts of the region with the expectation of cheaper fuel in the next decade. With the memories of Fukushima now firmly in the past, nuclear options are being considered by some of the more economically advanced countries. So fossil fuels are still the major source in the region and will continue to provide the bulk of ASEAN's power until at least the end of the next decade.

Better efficiency in the operation of the existing national level plants and grids through government-led initiatives is reducing wastage, keeping electricity prices flat and power outages at bay. Government initiatives and promotions are also encouraging investment in district cooling, energy saving systems and M2M technology in the capital cities to keep electricity demand stable for air-conditioning and lighting.

Increasing numbers of small and large wind, solar and hydropower plants have started to come into operation more recently in parts of the region that are best suited to their locations. Supplies from these sources will also feed into the grid with DC voltage, encouraged by the growing trend for feed-in tariffs in each of the ASEAN countries. This will provide ever increasing supplies for the more energy efficient requirements of local consumers.

[28] The Rocky Mountain Institute: "Will the electricity grid become optional" 25 February 2014. Retrieved from: http://blog.rmi.org/blog_2014_02_25_will_the_electricity_grid_become_optional

The growth of localized power sources and micro-grids, often a hybrid combination of fossil and renewable sources is also taking the pressure from the governments to invest in expensive infrastructure to extend the grid to rural areas. Individual solar power and battery storage systems are now spreading throughout the region enabling many households to run independently from the grid, especially in the more remote rural areas. The uptake has been spurred on by government incentives which are starting to replace the legacy fuel subsidies.

Private sector financing initiatives and other public private partnerships from technology vendors are helping both remote locations and larger national scale energy infrastructure projects. Research projects and specialized power plants managed by large foreign industrial companies are starting to appear in the region. This is helping to build a small but growing pool of locally skilled energy engineers and will in turn help to provide the expertise for future growth in the sector.

Economic growth has led to an increase in cars in ASEAN, although the demand in urban areas is now starting to plateau due to the implementation of road tariffs and car ownership taxes. The money from these taxes will be used to fund more efficient public transport systems so that city dwellers in the capitals of the core ASEAN countries will choose not to own cars. Electric buses are now a commonplace sight in some of the cities. Electric and petro-electric hybrid vehicles from Japan and USA are replacing the traditional petroleum and diesel fleet of private cars and taxis in the more advanced capital cities, keeping smog levels down. In the rest of the region electric scooters, bicycles and Segway-inspired devices are replacing petrol scooters in urban areas. Motorbike ownership is no longer the rite of passage for ASEAN's urban citizens.

Many of the changes have come from consumers as well as government policies. City dwellers are campaigning for industry and governments to pollute less, regulate clean options less and provide green alternatives. The private sector is meeting this demand with technology, financing and engineering programs giving countries and individuals a stake in their energy future.

This alternative vision for ASEAN 2020 might seem a bit idealistic when seen from the perspective of 2014. It would certainly be wishful thinking to expect all the pieces to align in all countries by the end of the decade. But most of the technologies, systems and best practices that can achieve this environment are in existence and being put into practice today somewhere in the world. The core idea is that the region's energy can come from many more sources than it currently is, and can be more productively extracted, distributed and consumed. The future is definitely more complex and involves many more stakeholders than present day systems. The energy systems of the future are also likely to be disruptive to the national utilities and methods of operating. But the roadmap for where governments should be investing their energy dollars does at least have more clarity than it did in 1997.

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