

Freezing in the tropics: Asean's air-con conundrum

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Table of Contents

Executive summary	04
A looming crisis - The growth in pollution from the boom in cooling	06
Asean perspectives	12
Case study: The challenges of driving energy efficiency in Indonesia	18
Outlook for Asean	22
Appendix 1: Detailed survey results	24
Appendix 2: Bibliography	28

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Executive summary

The rapid rise in Asean's electricity demand in recent years has led to a surge in CO₂ emissions and pollutants that threaten to create an environmental crisis for a region already vulnerable to the impact of extreme weather and poor air quality.

Primary energy demand has increased by 70% in the region, collectively known as the Association of Southeast Asian Nations (Asean), from 2000 to 2016 with a further rise of 70% predicted up to 2040. Coal accounts for the largest share of the growth.

Electricity demand is expected to more than double to 2,000 tera-watt hours (TWH) up to 2040. Most of this growth comes from residential and commercial buildings, mostly for cooling, such that by 2040, air-conditioning could account for up to 40% of Asean's overall electricity demand.

This crisis can be avoided if the region adopts more efficient technologies and supports a culture change in cooling consumption.

A survey of 424 respondents from Indonesia, Malaysia, Singapore, Thailand, The Philippines and Vietnam, conducted in November and December of 2017, highlighted the problems of over-consumption and lack of awareness of the cooling challenge but also identified several opportunities.

They are:

- Manufacturers and suppliers need to focus on producing more energy-efficient AC systems and better educating their customers
- Poor energy management systems in public buildings need to be rectified by commercial operators and systems designers to avoid excessive cooling
- Public awareness campaigns should be considered to help consumers better understand the energy labelling systems as well as the financial and environmental benefits of more efficient AC systems and to build a culture of energy sustainability
- Stricter government legislation throughout the region should be used to ensure the uptake of more efficient AC products and for better design and management practices in commercial buildings
- A wider array of financial options could be used to ensure consumers install the most efficient AC systems for home use
- Consumers, businesses and governments need to work together

and regionally to manage the demand for electricity, reduce emissions and pollutants, and move away from the reliance on coal-fired power stations

The context of Asean's electricity demand and supply as well as the differing economic situations of the member states should also be considered when formulating a strategy to avert the cooling crisis.

Economic growth has risen along with fossil fuel based electricity consumption

Asean's economic success story over the first 50 years of its existence can be tracked alongside its thirst for energy. Energy demand has expanded by two and a half times from 1990 to 2013, and its rate of growth is one of the fastest in the world.

Electricity consumption to power home appliances such as air-conditioning (AC) in the tropical Southeast Asian region has increased at a rate of around 7.5% annually from 155.3 TWh in 1990 to 821.1 TWh in 2013. Over 80% of this electricity came from fossil fuels, with coal-powered stations being particularly dominant in the region. Hence overall carbon dioxide emissions for the region have grown at similar rates. Cooling consumes an increasing amount of this growth.

Energy efficient appliances can substantially reduce power demand

The upward trajectory of electricity consumption and CO₂ emissions can be significantly reduced through the adoption of better technologies. If Asean countries switch to energy efficient products and lighting, they can reduce their consumption of electricity by 100 TWh at a saving of US\$12 billion annually. This is the equivalent to the annual production of 50 power plants of 500 MW capacity, meaning that 50 power plants would not have to be commissioned.

When energy consumption for ACs in Asean countries is forecast using the best available technology for air-conditioning (BAT scenario), huge savings can be achieved.

If Malaysia and Singapore adopted the BAT scenario, for example, there would be an actual reduction in overall energy consumption

for ACs by 2030 for these two countries, compared with 2015 levels. This would be despite growth in populations and affluence.

Conversely, if there is no change to current consumption habits (the business as usual, or BAU scenario) then energy consumption in all Asean countries would increase by a compound annual growth rate (CAGR) of 5.7% by 2030.

Excessive cooling in public spaces gives the wrong message to consumers

Consumers in the region seem to have a basic awareness that more efficient technologies can result in a lower electricity bill. Yet they are not aware of quite how important this is to ensure that the region achieves its targets for CO₂ emission reductions, as reflected in Nationally Determined Contributions (NDCs) to the Paris agreement. This lack of awareness is not helped by the experience of the average city dweller in the region, who regularly encounters excessive cooling in buildings which sends the wrong message that controlling efficiency is not a major priority.

Survey respondents in Singapore seemed the most vocal about the excessive cooling of public spaces with 68% of respondents indicating that they often encounter settings that are too cold. This was also a common response across the region, with significant numbers indicating that they often encounter excessive cooling. The situation seemed to be better managed in Indonesia, where only 38% of respondents stated that they often encountered AC settings in public spaces that were too cold.

Changing consumer habits

The behavioural habits of survey respondents on air-conditioning reflect the relative affluence of the different countries in the region and the installation rate of air-conditioning units in households. Respondents from Vietnam, The Philippines and Indonesia were more likely to report the use of other cooling systems apart from air-conditioning being used in public buildings, whereas respondents from the more developed economies of Malaysia and Singapore were less likely to notice more environmentally-friendly alternatives.

Similarly, respondents from Vietnam and Indonesia were more likely

to agree that air-conditioning was a status symbol with respondents from Singapore (where the installed rate was estimated at between 76-100%) much less likely to see it as anything other than a necessity.

Government initiatives needed to manage the cooling crisis

Despite concerns about the excessive cooling of public buildings, 77% of Singapore respondents agreed or strongly agreed that their government was actively managing power demand through initiatives such as promoting energy efficiency standards in air-conditioning. At the other end of the scale, only 30% of respondents from Vietnam agreed or strongly agreed that the same was happening in their country. The most populous country in the region, Indonesia, scored 38% for this question, indicating the scope for improvement across the region through government intervention.

There was no shortage of suggestions from survey respondents as to how the region could better manage its cooling challenge. These ranged from more effective use of passive cooling methods or refrigerant-free alternatives to air-conditioning, to innovative finance and recycling programmes to promote the uptake of more energy efficient models. Respondents were also unanimous in wanting to see their countries move towards clean energy adoption.

Governments around the region have agreed on targets for AC efficiency and are at different stages of local implementation. Given the radical differences in the size, state of economic development, and political situations of the countries that make up the Asean region, the challenges for governments vary considerably. However, in all cases, there are some clear areas where governments can be focusing efforts and directing change more effectively to ensure more efficient cooling.

This paper aims to highlight both the economic and environmental benefits for driving the region towards more efficient use of ACs as well as highlighting some of the most obvious areas that governments, businesses and consumers can direct their immediate attention. Without significant efforts to make cooling efficient and clean in Asean, the region will miss out on economic and social gains while over-polluting the local and global environment.

A looming crisis - the growth in pollution from the boom in cooling

358 new coal-fired power plants have been planned in Asean countries between 2011 and 2030 and coal is projected to become the largest energy source for the region from 2040 onwards.



50 years of growth in Asean countries

Since Asean was formed in 1967, all of its member states have enjoyed over 50 years of economic growth¹. Gross Domestic Product (GDP) per capita has grown over 30 times from US\$122 in 1967 to US\$4,021 in 2016. New member states have joined the five original members. Rising birth rates and populations have more than tripled the number of Asean residents from 185 million to 634 million in the same timeframe. Poverty has declined from 47% in 1990 to 15% in 2016. Literacy, life expectancy and urbanisation rates have all gone up in tandem with rising incomes.

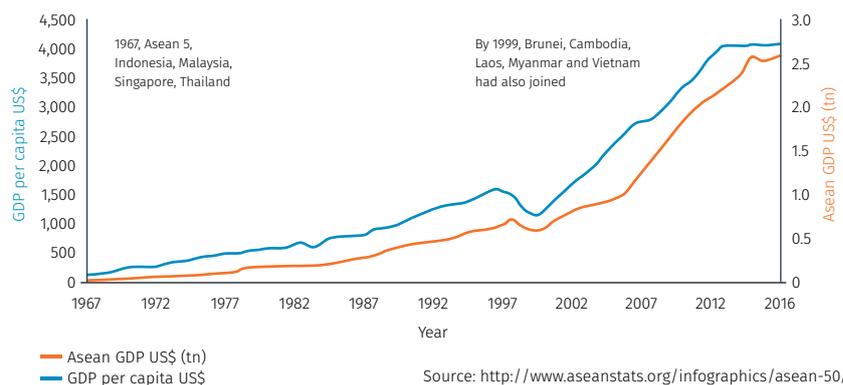
But the surge of rising, more affluent populations has taken a toll on the environment. Tree cover has decreased throughout the region with Indonesia's Sumatra alone losing nearly ¼ of its forests between 2000 and 2010². Rural villages have been replaced by suburban apartment blocks and new towns. This has led to increasing demand for grid-based electricity produced by power plants.

As the graph below shows, electricity consumption tends to rise with affluence levels. Electricity consumption to power home appliances has increased at a rate of around 7.5% annually from 155.3 TWh in 1990 to 821.1 TWh in 2013³.

About 80% of Asean's electricity supply has been generated from fossil fuels over the last decade. Coal-fired plants are still dominant in many countries with Indonesia and Vietnam operating the largest number. According to the Norwegian Institute of International Affairs (NUI)⁴, 358 new coal-fired power plants have been planned in Asean countries between 2011 and 2030, and coal is projected to become the largest energy source for the region from 2040 onwards.

With such a large reliance on fossil fuels, Asean's carbon emissions have risen over time along with the growth of affluence levels and the demand for electricity. The graph below shows that CO₂ per capita emissions for the core Asean countries excluding Singapore for 2000 to 2014 have

Evolution of Asean GDP and GDP per capita at current market prices



¹ <http://www.aseanstats.org/infographics/asean-50/> ² Rhett A. Butler, mongabay.com ³ <http://cornerstonemag.net/coal-asean-energy/>
⁴ Indra Overland et al. (2017) Impact of Climate Change on ASEAN International Affairs: Risk and Opportunity Multiplier, Norwegian Institute of International Affairs and Myanmar Institute of International and Strategic Studies

Electricity consumption per capita and GDP per capita (2016)



risen at a compound annual growth rate (CAGR) of 3.2%. Even if population levels remain unchanged, carbon emissions will continue to rise with energy demand assuming no technology changes in the appliances used.

The air pollution caused by coal combustion was estimated to cause nearly 20,000 unnecessary deaths per year in the region in 2011, a number that is expected to rise to nearly 70,000 by 2030⁵.

The risks of 'business as usual'

Asean's CO₂ emissions is forecasted to continue growing over the next decade with increasing population sizes, affluence levels, urbanisation, building construction and life expectancy. If Asean member states continue to develop under a 'business as usual scenario', this is going to result in accelerating demand for electricity and even higher rates of carbon emissions.

The benefits of energy efficiency and green AC

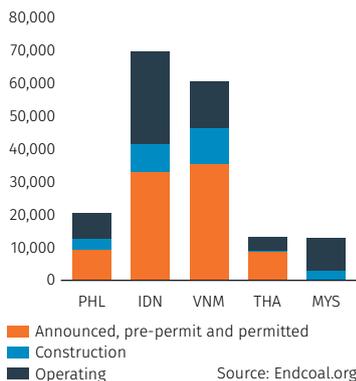
Fortunately, technological innovations and tighter regulation of standards are reducing the electricity consumption and carbon emissions of household appliances sold in the region.

Studies have found that if Asean countries switch to energy efficient products and lighting, they can reduce their consumption of electricity by 100 TWH, which equates to savings of US\$12 billion annually. This is equivalent to the annual production of 50 power plants of 500 MW capacity, meaning that 50 power plants that would not have to be commissioned.

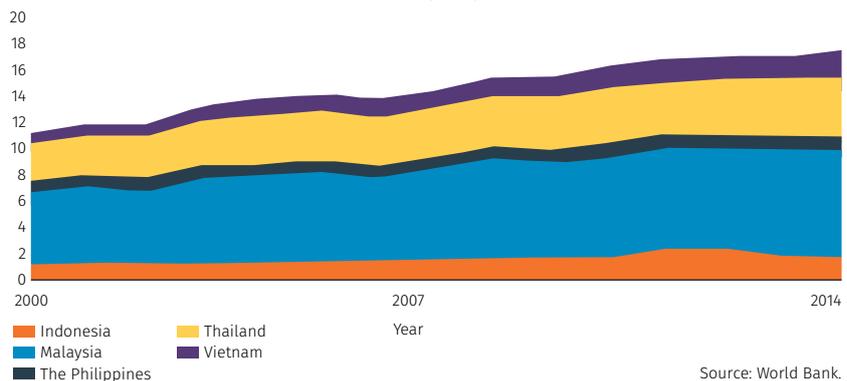
This would also result in a saving of 74 million tonnes of CO₂ emissions annually – the equivalent of taking 40 million passenger cars off the roads⁶.

Air-conditioning (AC) contributes to the bulk of Asean's electricity bill. In city

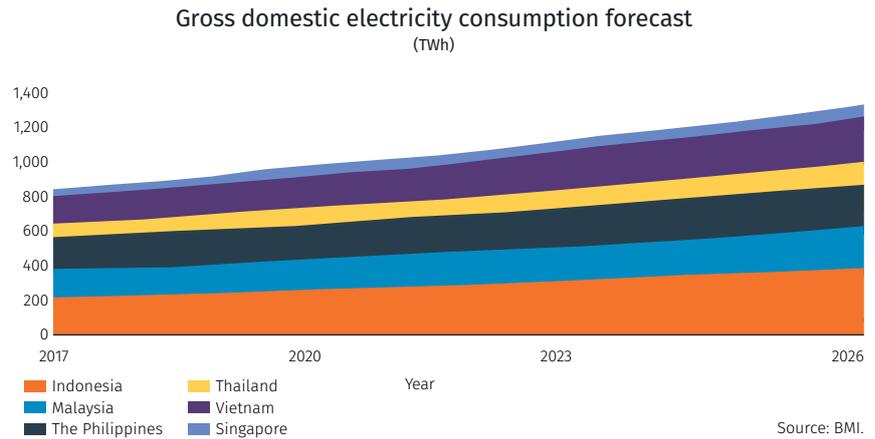
Coal plants by country (MW) (for units of 30MW and more)



CO₂ emissions (metric tons per capita)



⁵ Burden of Disease from Rising Coal-Fired Power Plant Emissions in Southeast Asia - Shannon N. Koplitz, Daniel J. Jacob, Melissa P. Sulprizio, Lauri Myllyvirta, and Colleen Reid
⁶ <http://united4efficiency.org/countries/asean/>



areas with hot climates, air-conditioning is estimated to take up as much as 60% of the overall electricity load. The majority of Asean's citizens are city dwellers; highly-dense buildings and the lack of vegetation in cities create a further heat island effect, placing further demand on cooling systems.

A study done in Singapore for example, put the share of electricity consumed by household air-conditioning at 37%⁷. And in many parts of the region, the problem is compounded by the use of less efficient AC units. The most advanced ACs are up to 30% more efficient than average products on the market⁸. Hence, tackling Asean's cooling challenge might be most effectively addressed by technology upgrades. However, there are multiple parameters and stakeholders to consider in implementing a region-wide upgrade.

The graph below considers the energy gains that could be achieved through a transition to the best available technology in 2030. Thailand and Indonesia would achieve the greatest energy savings in this scenario, although Vietnam and The Philippines also stand to make

considerable cuts in percentage terms to their current consumption.

The energy performance of ACs is measured by the Energy Efficiency Ratio (EER), which is the ratio of the total cooling capacity to the effective power input to the device. The larger the EER value, the more efficient the equipment.

The EER score for different capacity AC unit models varies significantly among Asean countries because of differences in the brands and models available as well as the regulatory and labelling systems in place in each country.

As shown in the graph below, Thailand has the largest numbers and hence the most efficient market for all AC capacity categories among the surveyed economies. (Singapore products have a higher EER score mostly due to a more stringent regulatory environment, but were not included in this survey). The Philippines has the least efficient product market, due to the large market share of less efficient window units and the lack of more efficient inverter product models.

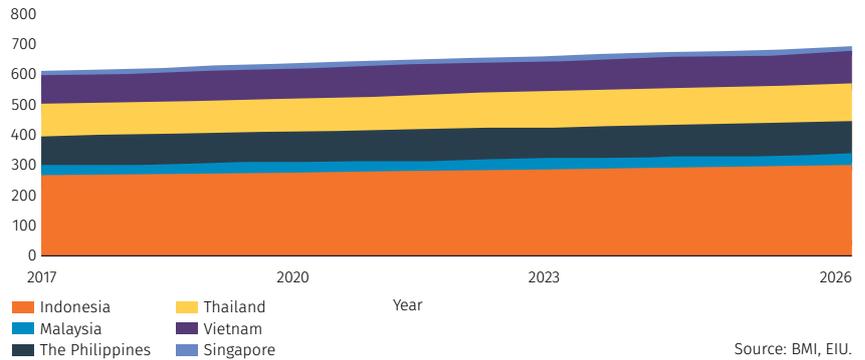
If Asean countries switch to energy efficient products and lighting, they can reduce their consumption of electricity by 100 TWh at a saving of US\$12 billion annually. This is the equivalent to the annual production of 50 power plants. This would also result in a saving of 74 million tonnes of CO₂ emissions annually – the equivalent of taking 40 million passenger cars off the roads.



⁷ <http://www.nea.gov.sg/corporate-functions/newsroom/news-releases/stricter-energy-performance-standards-for-air-conditioners-from-september-2016>

⁸ <http://www.aseanshine.org/news-activities/d/switching-markets-to-energy-efficient-and-climate-friendly-air-conditioners-brings-significant-environmental-and-economic-benefits-and-savings-for-countries-businesses-and-consumers>

Projected population growth
(2017-2030)



When energy consumption for ACs in Asean countries is forecast using the best available technology (BAT scenario) it is clear that immense savings can be gained.

In two cases, Malaysia and Singapore, the BAT scenario would actually lead to a reduction in energy consumption by 2030 compared with 2015 levels.

Conversely, if there is no change to current consumption habits (the business as usual, or BAU scenario) then energy consumption in all Asean countries would increase by a CAGR of 5.7% by 2030.

The future of minimum energy performance standards (MEPS)

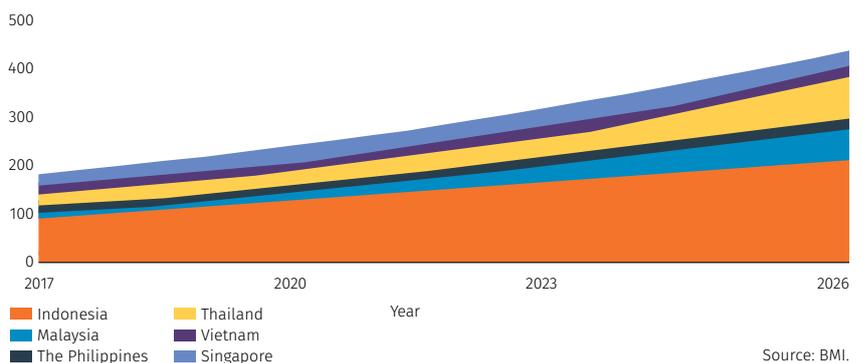
Work is underway in the region to address the need for more efficient cooling. In September 2015, the Asean Ministers of Energy Meeting (AMEM) endorsed the “Asean Regional Policy Roadmap for Harmonisation of Energy Performance Standards for Air Conditioners.”

As part of the roadmap, it was agreed that “Asean countries would adopt a minimum EER (2.9W/W or CSPF of 3.08W/W) by 2020 as mandatory MEPS (Minimum Energy Performance Standards) for all fixed and variable drive ACs below 3.52kW capacities. This would be periodically reviewed and revised at an interval of 5 years or less.”

Following the adoption of the roadmap, individual Asean countries have been adopting national policies with technical assistance from United Nations Environment and ICA. Some of the recommendations from the roadmap involved regulatory changes as well as policy suggestions.

For instance, it was noted that Malaysia, Philippines, Thailand, Singapore and Vietnam have AC markets where the average efficiency of all products is around 15% to 30% more efficient than the current MEPS. Hence, it was recommended that if those markets adopted more stringent efficiency

Construction industry value forecast
(US\$bn)



⁹ <http://www.aseanshine.org/asean-shine-task-force/d/asean-regional-policy-roadmap-for-harmonization-of-energy-performance-standards-for-air-conditioners>

Mandatory standards are essential to market transformation as they specify energy efficiency and other environmental requirements for a product to be sold in the market.



Mark Radka

Chief of UN Environment's Energy and Climate Branch

requirements, then less efficient products would be eliminated from the market and manufacturers would be forced to introduce more efficient ones.

Most of the popular brands on sale at retailers in the region interviewed for this study were from outside the region, although there was often some form of local product assembly involved. The most popular foreign multinational brands seen in the retailers across Asean countries were from Japanese and Korean manufacturers such as Daikin, Hitachi, LG, Mitsubishi, Panasonic, Samsung, Sanyo, Sharp and Toshiba. Other popular brands included Electrolux and Philips.

In most countries, the foreign brands had local offices and local assembly functions. One concern raised during interviews conducted in Indonesia was that the technology for cooling was predominantly produced by foreign brands and therefore the local markets could only perform basic assembly before sending the product to retailers.

Other brands on display included Hi-Sense and Midea from China, Pensonic from Malaysia and Trentios from Singapore. Singapore and Malaysia brands were the only ones that had a presence in some of the retail shops visited for this study that were outside their home country.

In the interviews for this study and from other surveys in the region, foreign multinational brands were seen to be dominating the regional market in terms

of retail presence and the preference of consumers.

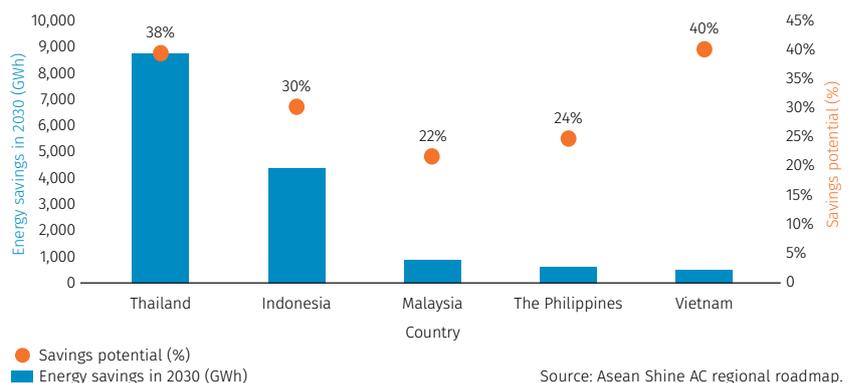
Mark Radka, chief of UN Environment's Energy and Climate Branch, warned that "inefficient polluting appliances, which are also more costly to run, may enter these markets if appropriate and effective minimum energy performance standards are not in place. Mandatory standards are essential to market transformation as they specify energy efficiency and other environmental requirements for a product to be sold in the market."

To help with the high cost of replacing or installing AC units, industry experts suggest that governments consider implementing policies that provide incentives to businesses or households. These could consist of consumer rebates, tax credits, accelerated depreciation or loan financing. As the region is at different stages of development, a tailored approach would be most effective to achieve the full adoption of the most efficient ACs.

It is clear that both the technologies and technical assistance required are available in the Asean region to address the challenges of cooling and control greenhouse gas emissions. It is up to governments to put the right policies in place, for businesses to offer the best technologies, and for consumers to demand the most efficient products.

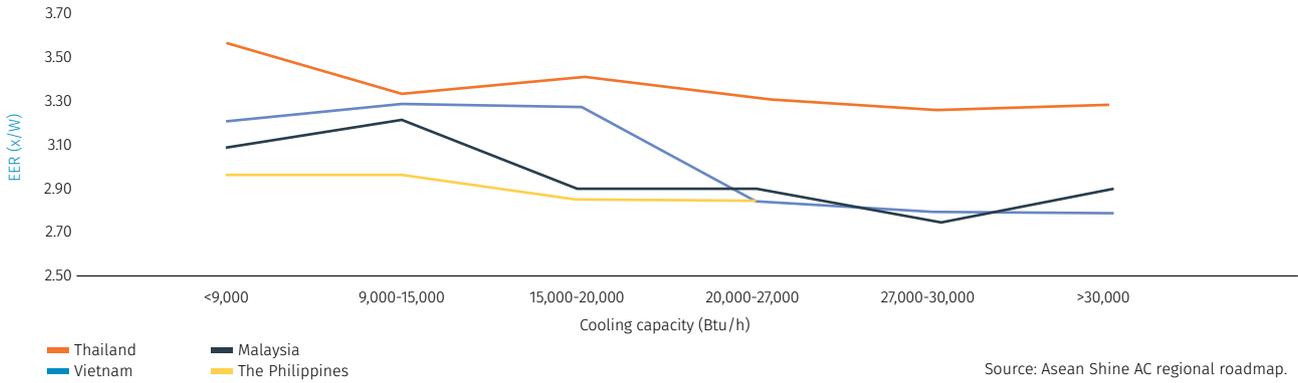
The survey results in the next chapter suggest that in most cases, there is a huge opportunity for the region to make swifter and more effective progress.

Potential energy savings in Asean as per percentage and in GWh

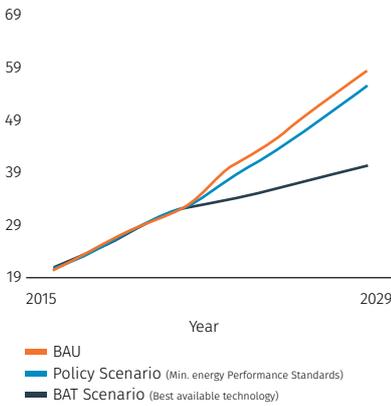


Source: Asean Shine AC regional roadmap.

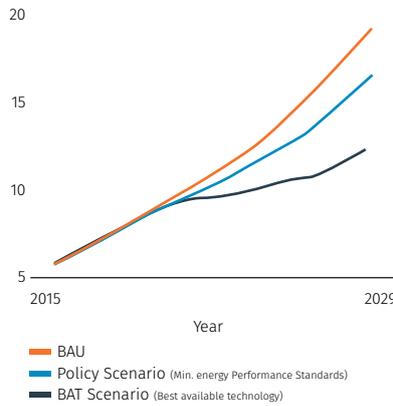
Average EER of ACs in Asean region



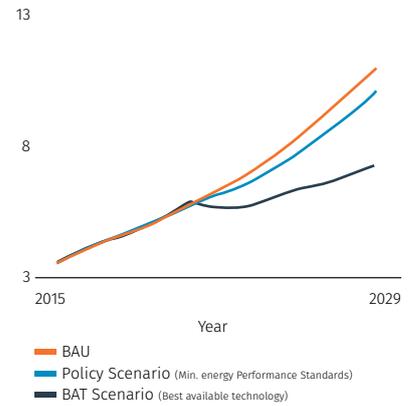
Indonesia - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (TWh)



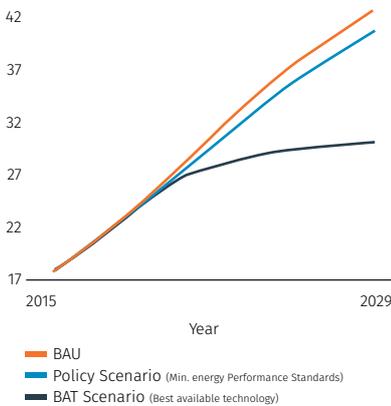
Philippines - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (TWh)



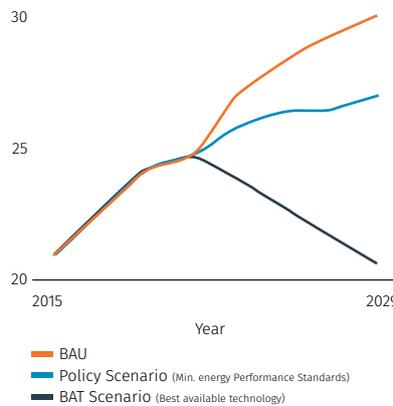
Vietnam - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (TWh)



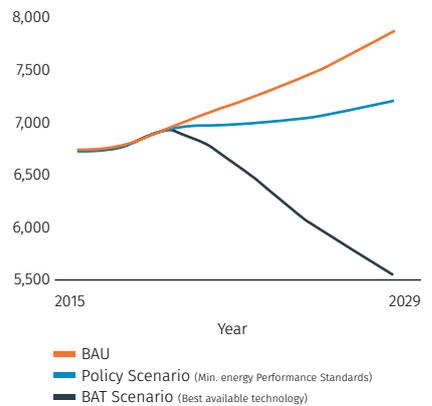
Thailand - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (TWh)



Malaysia - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (TWh)



Singapore - energy consumption of room airconditioners in three scenarios (BAU, policy scenario, BAT scenario) (GWh)



Asean perspectives

Aircon settings (should be) dependent on outside temperature and humidity. It is ridiculous that they remain unchanged during rainstorm events, turning aircon-cooled spaces into fridges.



Jair Smits
Managing Director of the Hydroinformatics Institute

A survey of 424 respondents from Indonesia, Malaysia, Singapore, Thailand, The Philippines and Vietnam conducted in November and December of 2017 showed a number of opportunities as well as some of the regional considerations and domestic issues at play. There were also a number of innovative suggestions on how these different approaches could be considered.

Poor energy controls in public buildings

Perhaps the most obvious concern affecting all countries in the region was that energy was being wasted in the excessive cooling of public buildings such as shopping malls and cinemas. This was one of the most common findings among interviewees and survey respondents.

Jeff Smith, Director of Sustainability for Six Senses Hotels, Resorts, Spas commented: "Shopping malls in Bangkok use more electricity than most provinces in Thailand".

Marc Loo, CEO of Loola Adventure Group, a resort operator in Indonesia, suggested: "We've got to get rid of this idea that public malls and hotels should resemble freezers." There were some slight differences around the region on this issue, with Singapore-based respondents showing the largest concern over this.

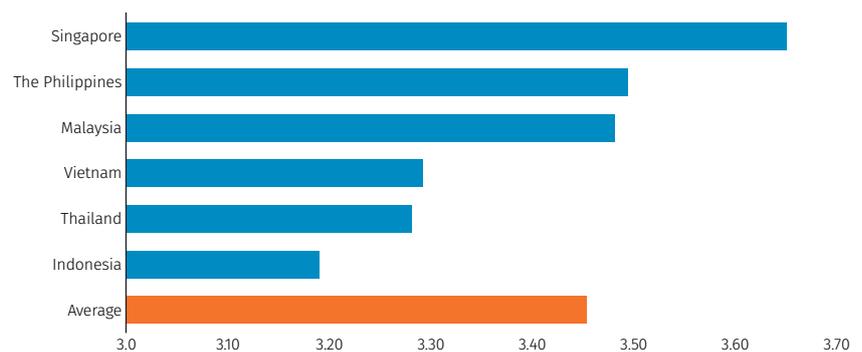
Similarly, respondents agreed that there seemed to be limited smart use of air-conditioning such as sensors to reduce AC intensity when occupants were absent, or other measures to adjust temperatures when the outside temperature dropped.

Jair Smits, Managing Director of the Hydroinformatics Institute based in Singapore, suggested that "aircon settings (should be) dependent on outside temperature and humidity. It is ridiculous that they remain unchanged during rainstorm events, turning aircon-cooled spaces into fridges."

Dave Mackerness, Director at Kaer, an airconditioning-as-a-service supplier based in Singapore, explained that the technologies used to adjust temperatures have been in place for some time. However most building operators directly manage their own cooling systems and do not usually prioritise fine-tuning the settings for maximum efficiency, even though this would result in energy savings.

He further observed: "Public buildings that we have seen in Singapore are commonly designed with an excess of peak cooling operational output of close to 40%. This is because a combination of worst case scenarios of equipment downtime, peak hot days, and maximum capacity have been factored into a

How often do you encounter AC settings in public buildings that are too cold



Source: Eco-Business Research survey, Nov-Dec 2017, 424 respondents, weighted avg. 1=never, 2=rarely, 3=sometimes, 4=often

system that might be run with minimal adjustments.

This makes sense if the designer assumes the system will be fine-tuned during operations to accommodate real-time external conditions. But this is usually not the case, resulting in the buildings becoming too cold and consuming excessive amounts of electricity.”

Respondents in countries such as Vietnam and The Philippines reported a higher adoption of non AC cooling systems in public places such as shades, fans and blinds than those in the more urban and affluent countries of Singapore and Malaysia. Hence, there is clearly an opportunity for more effective design to reduce the use of air-conditioning in public buildings.

AT Guinto, an environmental consultant in The Philippines, suggested government intervention “to require the use of more efficient air conditioners in offices, malls and cinemas right from the design stage. The same permit renewals can be enforced for existing structures, once these need to expand or be renovated.”

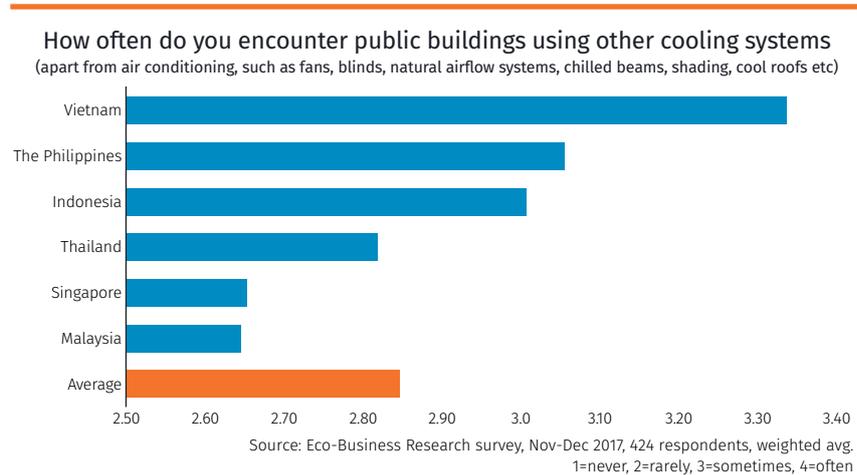
Green building codes implemented by governments around the region are addressing this to some extent. But they seem to still allow shopping malls in central locations to design fierce air

conditioning systems as the core cooling mechanism. This could be because of the association of affluence and prestige with cool indoor temperatures.

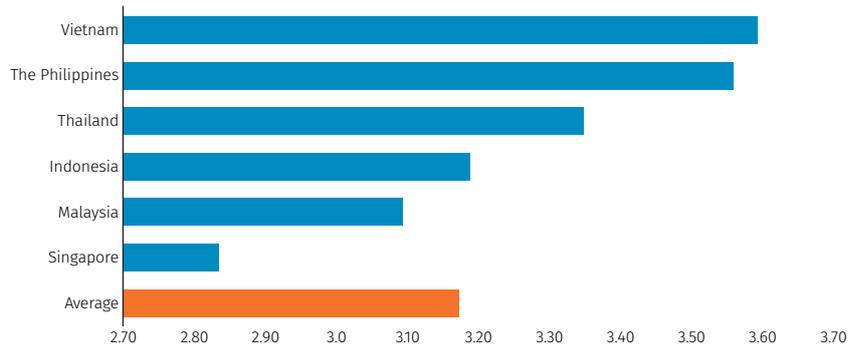
Respondents generally agreed that air-conditioning was regarded as a status symbol in their countries, although the majority also agreed that it was also a necessity. There were regional variations, with the less urbanised populations more likely to agree that it was a status symbol – and the more urbanised populations more likely to agree that it was a necessity.

One of the respondents from Singapore government research agency A*STAR commented on how cooling had become associated with blasts of cold air: “Air-conditioning has evolved into an entitlement that people feel they cannot live without. Alternative initiatives are seen as reducing the comfort level of people even if cooling capacities remain the same. For instance, some cars use diffusion AC systems that are energy efficient, and can cool the interior fast, but passengers complain about the lack of cold wind.”

For domestic use, respondents agreed that they and other citizens were also quite likely to use other or additional forms of cooling beyond air-conditioning such as fans and air coolers (which are fans that blow air chilled by ice or cold water).



Home air conditioning is regarded as a status symbol in my country



Source: Eco-Business Research survey, Nov-Dec 2017, 424 respondents, weighted avg. 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

There should be better use of product advertising to fully explain the energy consumption and cooling power to buyers.



Lany Harijanti

Development Advisor for 2030 Youth Force, an NGO based in Indonesia

Indeed, over 75% of respondents agreed or strongly agreed with this statement.

Conservative home use, but lack of awareness of energy savings with AC

Although respondents generally indicated more conservative uses of AC for home use rather than business use, there was limited understanding of the impact of air-conditioning on the environment.

About half of the respondents voted for “increasing the development of solar plants” as the most important way to reduce greenhouse gas emissions in the region, rather than increasing the efficiency of air-conditioning units. The only country that selected “efficient use of air-conditioners” as the most important way for reducing greenhouse gases was Singapore.

Over 45% of respondents disagreed or strongly disagreed with the statement ‘People in my country are aware of the harm that air-conditioning refrigerants do to the environment’. And over 30% of respondents disagreed or strongly disagreed with the statement “People in my country are familiar with the energy label and rating systems that indicate electricity savings with different brands and models of air conditioners”.

Only Singapore, Thailand and Malaysia respondents felt any degree of confidence about the consumer awareness levels of the energy label and ratings systems. And even these respondents felt that consumer awareness of the harm that refrigerants do to the environment was lacking.

Tom Tirey, CEO of Cebu Solar, said that government legislation was urgently

needed to address this in the Philippines: “Refrigerant release into the environment is rampant here. Thermostats should be required in all installations and sales of refrigerants should be regulated. Anyone can purchase gases and do (AC) servicing here,”

Limited advice from retailers

The limited understanding of the impact of AC on the environment coincided with further interviews conducted with retailers in the region in November and December 2017. In many stores, there was a lack of consistency in the energy labels and rating systems. Even in the countries where the rating system was more prevalent, not every model carried any labelling.

Shop assistants in most of the stores visited did not seem familiar with labelling systems, or the presence of inverters or refrigerants beyond the stated claims that certain models were supposed to consume less electricity.

There were one or two exceptions to this. Most of the models in the stores visited in Thailand showed a relative consistency in comparisons of specifications. One of the stores visited in Indonesia showed a model for the type of air conditioners for different sizes of rooms. And none of the stores visited offered window AC units on display, although these systems were still in common use in residential areas in all countries and still available for sale.

A significant proportion of survey respondents noted the lack of advice from sales staff as being an issue. About 14% of regional respondents selected ‘better education of sales staff to explain the

differences between models to customers' as the highest priority factor to ensure the take up of efficient AC units in the region.

Lany Harijanti, a development advisor for 2030 Youth Force, an NGO based in Indonesia, said: "There should be better use of product advertising to fully explain the energy consumption and cooling power to buyers." However, this factor was a third place in priority with 45% of regional respondents voting for stricter government legislation to ensure that stores sell only the most efficient models.

The second most popular priority was creating better consumer awareness of the efficiency of models. The option for better financing schemes so that the cost of a new air-conditioning system might be spread over a longer timeframe was the least popular option, although there were a number of suggestions from respondents as to how countries might better incorporate such choices.

Stricter government legislation needed to manage commercial and retail AC efficiency

One of the top observations that came out from survey respondents and experts interviewed for this study was the need for greater government legislation, both for commercial use of air-conditioning (so that public spaces are not excessively chilled) and for retail distribution of more efficient models.

Alan Boswell, Asia Pacific Manager for Advanced Energy Savings Solutions Company Ltd, a services company in

Thailand, commented on the problem: "AC is the biggest energy consumer in Thailand and Southeast Asia. However, most systems are over-sized and run inefficiently.

Architects, designers and mechanical and electrical system consultants often don't put in the most energy efficient systems in buildings. And owners only look for low first cost AC systems and do not look at the life-cycle costs of operating an inefficient AC system."

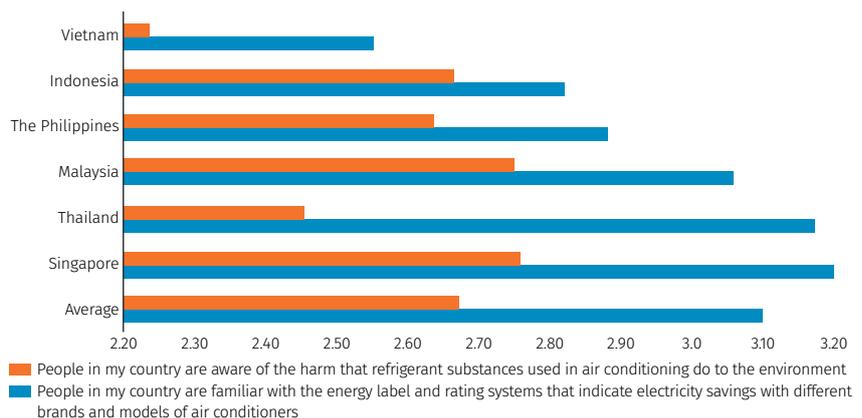
One respondent from the financial sector in Singapore suggested that the government should "mandate or encourage commercial buildings to not drop (their temperatures) below 23-25 degrees. Most buildings are too cold".

Another respondent noted that "promoting high efficiency ACs is a must. Governments need to help fund this." Singapore-based respondents had the most confidence in their government to actively manage power demand through initiatives such as promoting energy efficiency standards in air-conditioning systems. Vietnam and Malaysia-based respondents showed the least confidence for this point.

Building a culture of sustainability

Beyond government legislation, there were some interesting suggestions for how Asean countries could better build a culture of sustainability. William Kwok, General Manager for a shopping mall in Johor, South Malaysia, reflected the opinions of many with his suggestion "to have more public awareness campaigns and have more energy efficient AC units available for sale in all retailers".

Awareness of efficiency and environmental impact of ACs



Source: Eco-Business Research survey, Nov-Dec 2017, 424 respondents, weighted avg. 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

It's important to provide alternatives to AC to keep homes cooler. Most consumers are not so concerned about environmental protection, so education alone will not be effective.



Arlene Tablan
Regional Marketing Director for AkzoNobel Decorative Coatings

Eric Raymundo, Director from the Water Environment Association of the Philippines, agreed that "information education campaigns are vital".

Arlene Tablan, Regional Marketing Director for AkzoNobel Decorative Coatings, based in Singapore, suggested that governments needed to go beyond awareness campaigns. Speaking with an Asean perspective, she commented: "It's important to provide alternatives to AC to keep homes cooler. Most consumers are not so concerned about environmental protection, so education alone will not be effective."

Lou Arsenio from the Archdiocese of Manila Ecology Ministry in The Philippines suggested getting help from nature to address the cooling problem by "restoring the forests and trees even in urban areas". Any visitor to the region's rural areas can see how villages and houses are designed to maximise air flow and use trees to provide shade and natural cooling.

Similarly, any urban traveler can usually see the marked absence of trees in most cities as well as the absence of traditional construction techniques for natural cooling such as overhanging roofs, balconies and access to wind flows in most modern buildings.

A suggestion from Janya Rattanaliam, Head of International Marketing at Bangkok Hospital Pattaya, Thailand, was to have "more plants in each household (and) to have chilled beam home cooling systems". Similarly, Jed Wio from Singapore suggested designers consider greater use of "natural airflow systems like in traditional kampong houses, to avoid the heavy use of air conditioning."

Financing solutions

Although financing options were not seen as an important priority by survey respondents overall, there were some interesting suggestions involving governments, utilities, retailers and manufacturers.

"Utility companies could help finance home air conditioning by packaging equipment costs into the monthly electricity bill," said Marina Yong, Managing Director of Sustainability Momentum, an IT company in Malaysia.

Jennifer Sandiego, an interior decorator with RCHITECTS Inc based in The Philippines, suggested that retailers implement "proper recycling facilities for old and less efficient air-con units as part of sales and marketing campaigns for more efficient air-con units, as well as offering price rebates for trade-ins of old units."

Another innovative suggestion came from Shahazwan Harris, formerly an executive director for investments at the Malaysian financial institution Khazanah Nasional Berhad, that governments and the industry could introduce "energy savings bonds to finance energy savings projects (which would) promote energy savings as a business, through a guaranteed savings business model."

Consumers, governments and businesses to drive change

The interviews and survey formed a useful gauge of the awareness of the challenge of cooling the region and some of the differences between countries. At a basic level, the survey showed that people were aware that air conditioning was a big consumer of electricity, and the largest component of energy bills and that it would continue to rise with population levels and affluence levels.

Most respondents were not aware of the extent to which faster adoption rates of more efficient technologies and consistent adjustments of standards could actually lead to net decreases in energy consumption and greenhouse gas emissions.

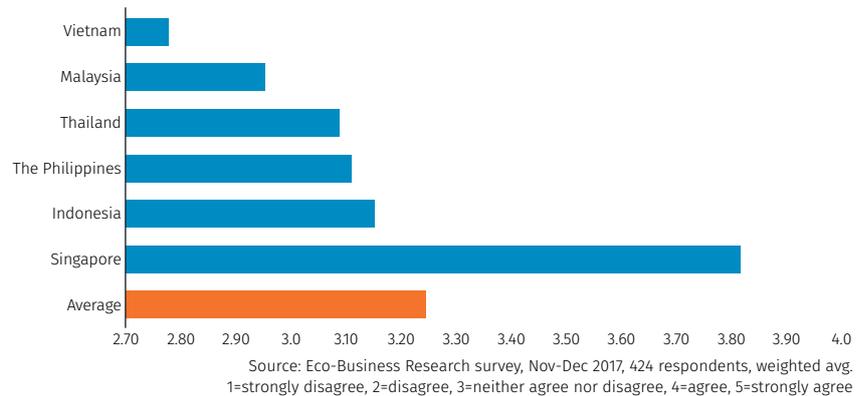
And yet most survey respondents felt that governments could play a larger part in the issue, even in countries where they were felt to be doing a good job in promoting energy efficiencies in air conditioning.

It also showed some of the most obvious targets for raising efficiency and some of the wasted energy that is a by-product of the industry. There were two clear solutions from the survey.

1. Consumers can do more to manage the power consumption of their home use systems, although they can be aided by more awareness campaigns to demonstrate the efficiencies of the more advanced models.

2. Governments can help through legislation. Legislation of the commercial sector could help to urgently address the excessive use of cooling that many respondents noted throughout the region in public buildings and the building codes that allow this. Legislation of suppliers and manufacturers could also eliminate low cost inefficient systems from the markets and drive consumers to select the most efficient systems to use in their homes. Businesses can also help drive efficiency by ensuring public buildings are best managed for optimum temperatures and that their retail customers are better educated about the most efficient brands.

My country is actively managing power demand through initiatives such as promoting energy efficiency standards in air conditions systems



Summary of key findings

	Indonesia	Malaysia	Singapore	Thailand	The Philippines	Vietnam
Current room AC use TWH	23.9	22.7	6.8	20.8	7	4.3
Projected room AC usage 2029 (BAU scenario)	59.2	30	7.8	42.6	19.4	11.1
Potential energy savings using BAT	30%	22%	Not measured	38%	24%	40%
% of respondents highlighting AC efficiency as the best way of reducing GHG emissions	16%	23%	38%	19%	7%	33%
Estimations from respondents of % of households with AC	11-25%	51-75%	76-100%	51-75%	11-25%	26-50%
Perceptions about cooling	People in my country often use other methods [than AC]	Home AC is necessary	Home AC is necessary	Home AC is necessary	People in my country often use other methods [than AC]	People in my country often use other methods [than AC]
Average response to question "My country is actively managing power demand through promoting energy efficiency standards in AC"	2.93	2.98	2.18	2.77	2.93	3.3
What action would help to ensure the uptake of more efficient AC (after consumer awareness and gov legislation)	Better labelling of models	Better labelling of models	Better labelling of models	Better education of sales staff	Better labelling of models	Better consumer awareness campaigns
Top suggested areas for improvement	Government legislation and education programmes	Innovative financing solutions that encourage efficiency	Enforced public building AC levels	Use of natural methods for cooling	Building code regulations	Public awareness campaigns

Case study:

The challenges of driving energy efficiency in Indonesia

As the graphs in the earlier chapters have shown, Indonesia has the largest population by far in the Southeast Asian region and is the largest consumer of electricity.

Any regional initiatives towards the uptake of more efficient use of air-conditioning requires a high level of participation from Indonesia.

Situated between the Indian and Pacific Oceans, consisting of more than 17,000 islands, Indonesia is also the 7th largest country in the world in terms of sea and land area. The enormities of the scale of the country have undoubtedly caused challenges in forging a cohesive programme for driving energy efficiency.

A report released in April titled World Air Conditioner Demand by Region, conducted by The Japan Air Conditioning Industry Association (JRAIA), estimates Indonesia's air conditioner demand in 2016 was the third highest in Asia, behind China and India.

According to data from Indonesia's Ministry of Energy and Mineral Resources' (MEMR) Directorate of Energy Conservation, the use of air conditioners in Indonesia per year has reached 4 million units, with an average annual growth rate of 7 percent.

The International Energy Agency's (IEA) Energy Efficiency 2017 report suggests that

significant electricity savings in Indonesia are possible by further improving the energy efficiency of air conditioning. Accelerating progress to keep pace with shared targets within Southeast Asia could save Indonesian consumers nearly USD 690 million per year by 2030.

Regulatory framework

In Indonesia, the ministry responsible for policy and regulations concerning energy efficiency of air conditioners is the Ministry of Energy and Mineral Resources (MEMR). The government agency responsible for implementing the regulations is the Directorate of Energy Conservation, under the Directorate General of New and Renewable Energy and Energy Conservation.

In 2015, the latest set of regulations from MEMR (Permen No. 7 2015) was introduced, which puts a framework in place to regulate new air conditioners being sold in the country. It came into effect in August 2016. The aim of the regulations is to encourage producers of air conditioners to compete in the market by using labels which certify the energy efficiency of their models. This





At a Glance

Third highest AC use in Asia

According to The Japan Air Conditioning Industry Association (JRAIA), estimates put Indonesia's 2016 air conditioner demand at third highest, behind China and India

Low public and consumer understanding

"There is still low public and consumer understanding of the benefits of using energy-efficient air conditioners,"

Farida Zed,
Former MEMR Director of Conservation of Energy

Campaigns lack Government involvement

The Indonesian government has authorised manufacturers to do their own campaigns without government intervention. "The only intervention is that all air con products must comply with the SKEM rating system,"

Michael Adisuhanto, Digital Appliances Product Marketing Head,
Samsung Electronics Indonesia

Need for higher EER limits

"Indonesia has been left behind when compared to other countries." To achieve better EER ratios, producers need to be willing to improve the quality of their products.

Farida Zed,
Former MEMR Director of Conservation of Energy

There is still low public and consumer understanding of the benefits of using energy-efficient air conditioners



Farida Zed

Former MEMR Director of Conservation of Energy

enables consumers to choose units that are cheaper to run.

The regulations apply to all new units sold since 2016, both locally made and imported. Air conditioners in Indonesia must bear the SKEM (Standar Kinerja Energi Minimum) label and the Energy Saving Label (Label Tanda Hemat Energi) in accordance with the Indonesian National Standard board so that household equipment conforms with energy efficiency rules.

The Energy Saving Label uses a four-star rating – a higher energy efficiency ratio (EER) and more stars means a higher energy efficiency. Four stars is the highest and equals an EER higher than 10.41 Btu/W (3.05 W/W). One star is the lowest, with an EER of between 8.53 Btu/W (2.5 W/W) and 9.01 Btu/W (2.64 W/W). Performance levels set in the regulation are on the low side, if compared to the efficiencies of models already available in Indonesia.

The regulation also only applies to single split wall-mounted units of up to 3 horsepower (hp), which are usually used in the home. This means commercial buildings can continue to use non-energy efficient models.

Wisnu Adipurwoko is an Energy Conservation Analyser at the Directorate of Energy Conservation at MEMR. "From the supervision we've carried out, all air conditioners with a maximum power output of 3 hp now use SKEM and EER labels," he says. "If there are any found without these labels, they are goods issued by the producers before the mandatory date of implementation in August 2016."

It will be some years until older, less efficient units already in use come to the end of their useful lives and need replacing. For Indonesia to move forward quickly with energy efficient cooling, owners of old models need to understand the cost-saving benefits of replacing them with more energy efficient products.

Low levels of public awareness cause behavioural challenges

Within the 2015 regulations, there is a clause (*pasal 18 and 19*) stating that MEMR should carry out public awareness campaigns on SKEM and Energy Saving Labels through the media and at energy

exhibitions. However, it seems the public awareness campaigns run by the government have not been effective.

Farida Zed worked at MEMR for 31 years before retiring in July 2017 from the position of Director of Conservation of Energy. She agrees that one of the main obstacles to Indonesia adopting more energy friendly air conditioners is public awareness. "There is still low public and consumer understanding of the benefits of using energy-efficient air conditioners," she says.

MEMR had a public awareness campaign called 'Potong 10%' (Save 10%), which Adipurwoko says "can be seen on personal TV screens on Garuda Indonesia planes, on the Jakarta commuter line, and in several print media." The campaign hoped to share the message that by reducing day-to-day individual energy consumption by 10%, the energy savings could be directed to providing electricity to areas where the electrification ratio is limited.

Zed explains that the 'Save 10%' campaign was designed to be carried out on a large scale and over a period of five years (since 2015). "However," she says, "this activity is no longer being carried out because of reallocation of funds and limited funding."

Herbert Innah is a lecturer of Electrical Engineering at the University of Cendrawasih in Jayapura, where he has lectured for 15 years. According to Innah, Indonesia has to overcome behavioural challenges in order to save energy from air conditioning.

"Most Indonesians don't understand how to operate ACs and lack awareness of the importance of saving energy," he said. "If people want to cool the room as quickly as possible, they set the temperature as low as they can. If they want to use a meeting room the next day, they turn the AC on the day before."

Industrial sector improves, but no change in retail and hospitality sectors

Zed does believe that an improvement in public awareness can be seen, but mainly in the industrial sector, to use energy efficient air conditioners in order to improve the competitiveness of products. "Meanwhile, hotels and malls are not changing much, mainly because

of the high investment costs needed to replace existing air conditioners with energy efficient ones," she said.

Public incentives

Currently, there is no incentive mechanism in place to encourage the public to purchase new air conditioners that would compensate for the higher price of the newer, more energy efficient models. Zed believes a tax reduction could be introduced, which would assist ESCOs, a controlled environment laboratory equipment company, in helping the public choose energy efficient products.

To assist the consumer, she says several mechanisms can be put in place. These include: the provision of retail sales staff who are able to explain and guide customers to purchase energy efficient air conditioners; socialising and encouraging the public to use energy calculators; ensuring that only energy efficient products are available on the market; and encouraging and educating the public so that energy saving becomes a part of life.

There is considerable scope for improving the minimum energy performance standard for air conditioners in Indonesia.

"Introducing higher EER limits is something that needs to be continued," says Zed. "Indonesia has been left behind when compared to other countries." To achieve better EER ratios, producers need to be willing to improve the quality of their products. Zed goes on to say that imports of non-inverter air conditioners (which are not energy efficient) should not be allowed in the future.

The importance of trained sales staff and government cooperation

There is still a low sales service capacity at air conditioning retailers to explain the benefits of energy-efficient air conditioners to consumers.

Michael Adisuhanto is the Digital Appliances Product Marketing Head at Samsung Electronics Indonesia. Adisuhanto observes: "The obstacle is the consumer's low awareness of how energy efficient home appliances would benefit them."

When asked if his sales staff are incentivised to sell energy efficient models, he says: "Since most of our line are four

stars, we do not need to incentivise them." According to Adisuhanto, four out of six of Samsung's air conditioner lines are equipped with inverter technology.

For Indonesia to move forward quickly, he says that the government needs to cooperate with local as well as foreign companies. "So far, government campaigns don't involve local or foreign companies directly to increase energy efficiency. But at Samsung, we always educate consumers about the benefit of our products, and energy efficiency is one of them."

Adisuhanto says that the Indonesian government has authorised manufacturers to do their own campaigns without government intervention. "The only intervention is that all air con products must comply with the SKEM rating system," he says.

Dependence on imported components

Ditsy Aksella works at Indonesia's Ministry of Environment and Forestry (MEF) in the Directorate of Climate Change Mitigation as a data analyst of ozone destruction control. She believes Indonesia can progress quickly if global markets are able to provide access to environmentally-friendly cooling technologies.

"Developed countries and producer countries like China should take the initiative so that developing countries like Indonesia can follow, and the availability of the required product components can be guaranteed at an affordable price," Aksella says.

All sources in this article stated that in order for Indonesia to be able to move forward with energy efficient cooling, the country should no longer be reliant on importing product components from abroad. The prices of environmentally-friendly components were perceived to be too expensive for the market which is a heavy user of "Freon" cooling, a trade name for a class of chemicals known as Chlorofluorocarbons used as a refrigerant in air conditioning systems.

"Domestic air-conditioning manufacturers choose not to expand their production capacity and prefer to import components due to lower prices," states Zed. "This condition impedes the government's aim to increase the added value in the country and – at the same time – the provision of employment"

Outlook for Asean

Asean's member states have enjoyed 50 years of rapid economic growth since the founding of the regional bloc. And with that growth has come the soaring demand for electricity to power appliances.

But the equatorial region, ever prone to the impact of tropical storms and rain, is now starting to understand the implications of rising greenhouse gas emissions. Like overindulgent diners at a hotel buffet, citizens are sobering up to the catastrophic environmental costs brought about by climate change.

According to NUPI (the Norwegian Institute of International Affairs), the region's coal-based electricity generation capacity has been expanding rapidly, which suggests that member states will be unlikely to achieve the nationally determined contributions (NDCs) which they pledged under the Paris Agreement. The World Resources Institute¹⁰ further suggests that the region is downplaying its commitments, noting that climate change deliberations were absent in the agenda of the latest Asean Summit, just concluded in Manila in November 2017.

Furthermore, even though cooling is integral to the region's prosperity, there is little conversation on the link between the demand for cooling in the region and each country's commitment to the Paris Agreement.

The late Lee Kuan Yew, Singapore's first post-independence Prime Minister, regarded air conditioning as the most influential invention of the last century. His enthusiasm for the appliance seems to have spread throughout the region, where citizens, at least in the more affluent urban centres, have automatically gravitated to artificially cooled surroundings.

Air conditioning has come to be seen as a normal aspect of daily life that over cooling has become the common complaint in many cities. The traditional construction materials and methods of previous decades that offered natural and non-AC cooling systems seem to have been forgotten in the race to build ever higher and shinier skyscrapers that win architectural awards for their beauty without much consideration of their toll on the environment.

Reluctant to rein in economic growth, Asean governments have in many cases been slow to address the cooling challenge. But the 'business as usual' scenario of ever increasing demand for electricity will come at a terrible environmental cost to the region's fragile tropical eco-systems if this demand is fueled by coal.

Fortunately, technological advancements can offer a way out for Southeast Asia to ensure the comfort of its citizens even while populations and economies continue to grow. But change is not going to happen without the interaction and willingness of the main stakeholders.

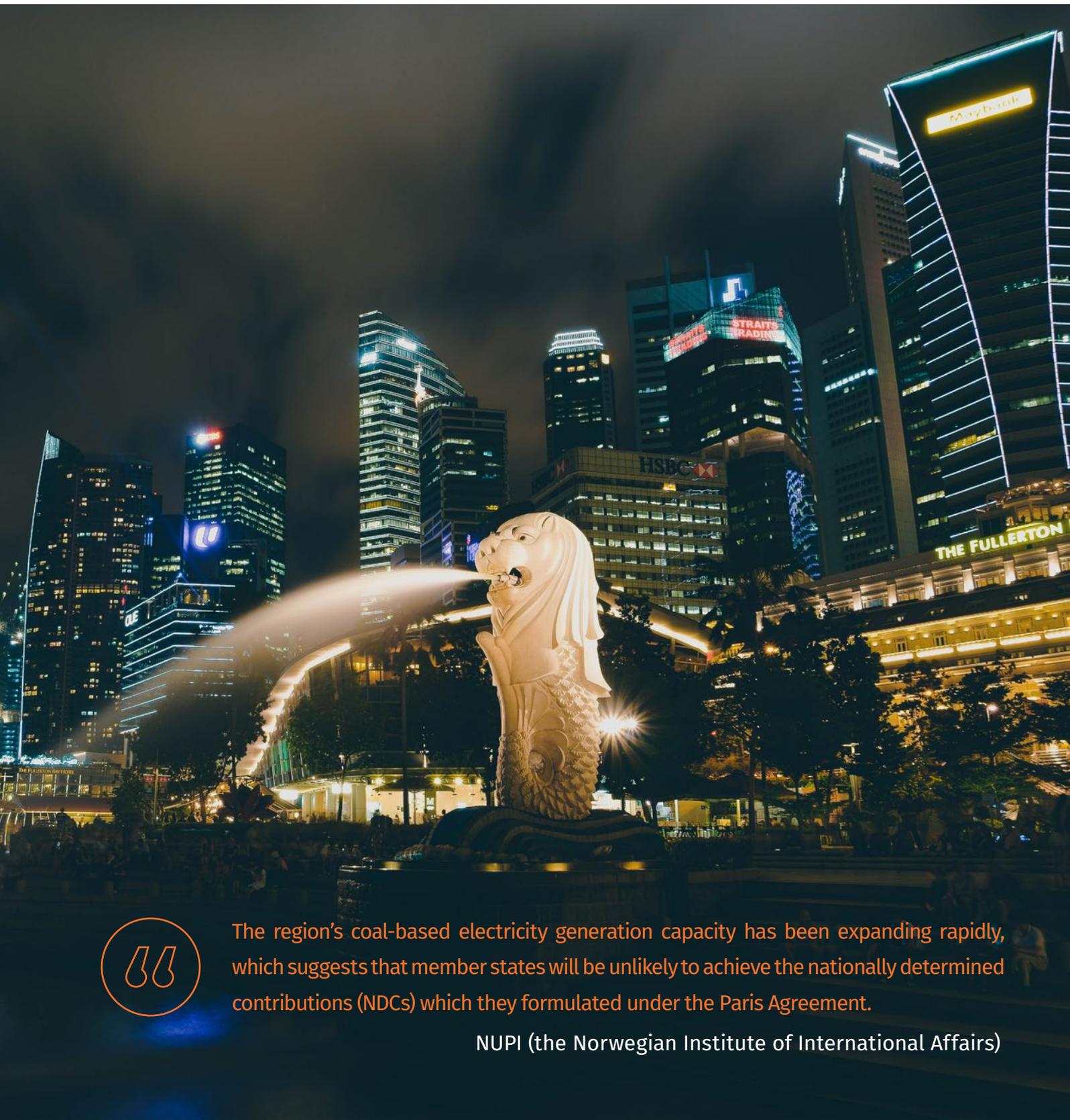
The supply side of home air conditioners is dominated by a number of multinational brands all competing for market share. Although they have some competitive business incentives to improve the efficiency of their products, they will react even more swiftly to regulatory and market demands in the region. And conversely, countries that are slow to mandate the best available technologies may risk becoming dumping grounds for old products.

Citizens can also put pressure on both manufacturers and their governments to ensure the most efficient cooling systems are available in the shops, restaurants, cinemas and offices that they visit and work in as well as the temples, mosques and churches that they frequent.

Most importantly, governments can legislate to ensure that manufacturers sell only the best available technologies and buildings are constructed using cooling systems that don't demand excessive electricity or freeze their occupants. Government agencies can also develop recycling, financing and education programmes to ensure citizens upgrade to energy efficient devices. Asean nations will discover, sooner or later, that the result of not taking any action will come at a detrimental cost to the region. 🌐



¹⁰ World Resources Institute: <http://www.wri.org/blog/2017/11/asean-countries-must-act-together-confront-climate-change>



The region's coal-based electricity generation capacity has been expanding rapidly, which suggests that member states will be unlikely to achieve the nationally determined contributions (NDCs) which they formulated under the Paris Agreement.

NUPI (the Norwegian Institute of International Affairs)

Appendix 1:

Detailed survey results

1. Which country are you based in? (Choose one)

Answer Choices	%	Responses
Indonesia	18.60%	77
Malaysia	24.76%	105
Singapore	25.00%	106
Thailand	11.32%	48
The Philippines	14.15%	60
Vietnam	5.66%	24
Other (please specify)	0.94%	4
	Answered	424

2. Which industry are you from? (Choose the one that most closely matches your sector)

Answer Choices	%	Responses
Agriculture	5.19%	22
Automotive	0.47%	2
Banking, finance, insurance	3.54%	15
Construction, engineering, architecture, real estate	15.09%	64
Consumer goods	1.18%	5
Education	6.84%	29
Energy	14.15%	60
Government or other public sector	4.72%	20
Healthcare	0.94%	4
Information technology or telecommunications	2.59%	11
Manufacturing	6.60%	28
Non-profit or NGO	13.44%	57
Services	8.25%	35
Transport or logistics	1.18%	5
Utilities	2.12%	9
Other (please specify)	13.68%	58
	Answered	424

3. What type of organisation do you work for? (Choose one)

Answer Choices	%	Responses
Multinational corporation	22.41%	95
Small or medium enterprise	40.80%	173
Government agency	12.03%	51
Other (please specify)	24.76%	105
	Answered	424

4. What is your job title? (Choose one)

Answer Choices	%	Responses
CEO, CFO, COO, CIO, President, Managing Director, Country Manager	21.23%	90
Vice President, General Manager	5.90%	25
Director	20.28%	86
Regional Manager	5.19%	22
Manager	24.06%	102
Technical, Engineer	5.90%	25
Consultant, Academic	17.45%	74
	Answered	424

5. Which of the following changes do you think would best reduce greenhouse gas emissions in your country? (Choose one)

Answer Choices	%	Responses
Consumers changing to a meat free diet	4.99%	21
Commuters using only public transport	27.08%	1114
Efficient use of air-conditioners	23.04%	97
Building more wind farms	2.14%	9
Developing more solar energy projects	38.95%	164
Developing more hydro power projects	3.80%	16
	Answered	421

6. What percentage of households in your country do you estimate own at least one air conditioning unit? (Choose one)

Answer Choices	%	Responses
0-10%	5.42	23
11-25%	18.87%	80
26-50%	21.70%	92
51-75%	24.76%	105
76-100%	29.25%	124
	Answered	424

7. What percentage of dry season/summertime peak electricity demand do you believe is due to air conditioning? (Choose one)

Answer Choices	%	Responses
0-20%	9.50%	40
21-40%	19.95%	84
41-60%	29.22%	123
61-80%	26.13%	110
81-100%	15.20%	64
	Answered	421

8. Please indicate the extent to which you agree or disagree with the following statements

Answer Choices	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly disagree	Total	Weighted average
Home air conditioning is necessary in my country	28.06% (117)	44.36% (185)	17.99% (75)	8.39% (35)	1.20% (5)	417	2.10
People in my country often use methods other than air conditioning to cool their homes, such as fans, air coolers etc	20.33% (85)	55.74% (233)	12.44% (52)	9.81% (41)	1.67% (7)	418	2.17
Home air conditioning is regarded as a status symbol in my country	9.57% (40)	33.25% (139)	29.67% (124)	23.92% (100)	3.59% (15)	418	2.79
People in my country are familiar with the energy label and rating systems that indicate electricity savings with different brands and models of air conditioners	5.02% (21)	34.21% (143)	26.32% (110)	28.47% (119)	5.98% (25)	418	2.96
People in my country are aware of the harm that refrigerant substances used in air conditioning do to the environment	2.87% (12)	18.42% (77)	31.56% (132)	36.84% (154)	10.29% (43)	418	3.33
My country is actively managing power demand through initiatives such as promoting energy efficiency standards in air conditioning systems	9.57% (40)	38.04% (159)	26.56% (111)	19.38% (81)	6.46% (27)	418	2.75
						Answered	419

9. How often do you see the following energy measures employed in offices, malls, cinemas and other public buildings in your country?

Answer Choices	Often	Sometimes	Rarely	Never	Total	Weighted average
Air conditioning settings that are adjusted for seasonal temperature variations	12.86% (54)	37.38% (157)	36.90% (155)	12.86% (54)	420	2.50
Air conditioning settings that are too cold	54.31% (227)	37.32% (156)	7.66% (32)	0.72% (3)	418	1.55
Air conditioning settings that are too warm or insufficient to cool the required area	7.43% (31)	40.77% (170)	41.73% (174)	10.07% (42)	417	2.54
Smart uses of air conditioning e.g. sensors that reduce cooling when occupants are away, thermostats that adjust air conditioning temperatures when outside temperatures change etc	7.18% (30)	27.99% (117)	45.22% (189)	19.62% (82)	418	2.77
Other cooling systems apart from air conditioning such as fans, blinds, natural airflow systems, chilled beams, shading, cool roofs etc	21.72% (91)	43.91% (184)	30.07% (126)	4.30% (18)	419	2.17
					Answered	420

10. Which of the following actions would help to ensure the uptake of more efficient air conditioners in your country? (Please rank in priority order where 1 is the most important and 5 is the least important)

Answer Choices	1	2	3	4	5	Total	Score
Stricter government legislation to ensure that only the most efficient air conditioners are available in shops	43.00% (129)	18.33% (55)	14.67% (44)	11.33% (34)	12.67% (38)	300	3.68
Better consumer awareness campaigns so that people understand the savings from more efficient air conditioners	37.66% (116)	32.79% (101)	13.96% (43)	10.71% (33)	4.87% (15)	308	3.88
More financing options so that the costs of buying air conditioners can be spread over a longer period	7.62% (25)	14.33% (47)	24.09% (79)	15.55% (51)	38.41% (126)	328	2.37
Better labelling of models so consumers can differentiate between unit costs and long term savings	10.64% (35)	21.58 (71)	31.31% (103)	25.23% (83)	11.25% (37)	329	2.95
Better education of sales staff to explain the differences between models to customers	14.25% (55)	15.54% (60)	20.73% (80)	27.98% (108)	21.50% (83)	386	2.73
						Answered	410

Appendix 2:

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World Bank

World Resources Institute



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