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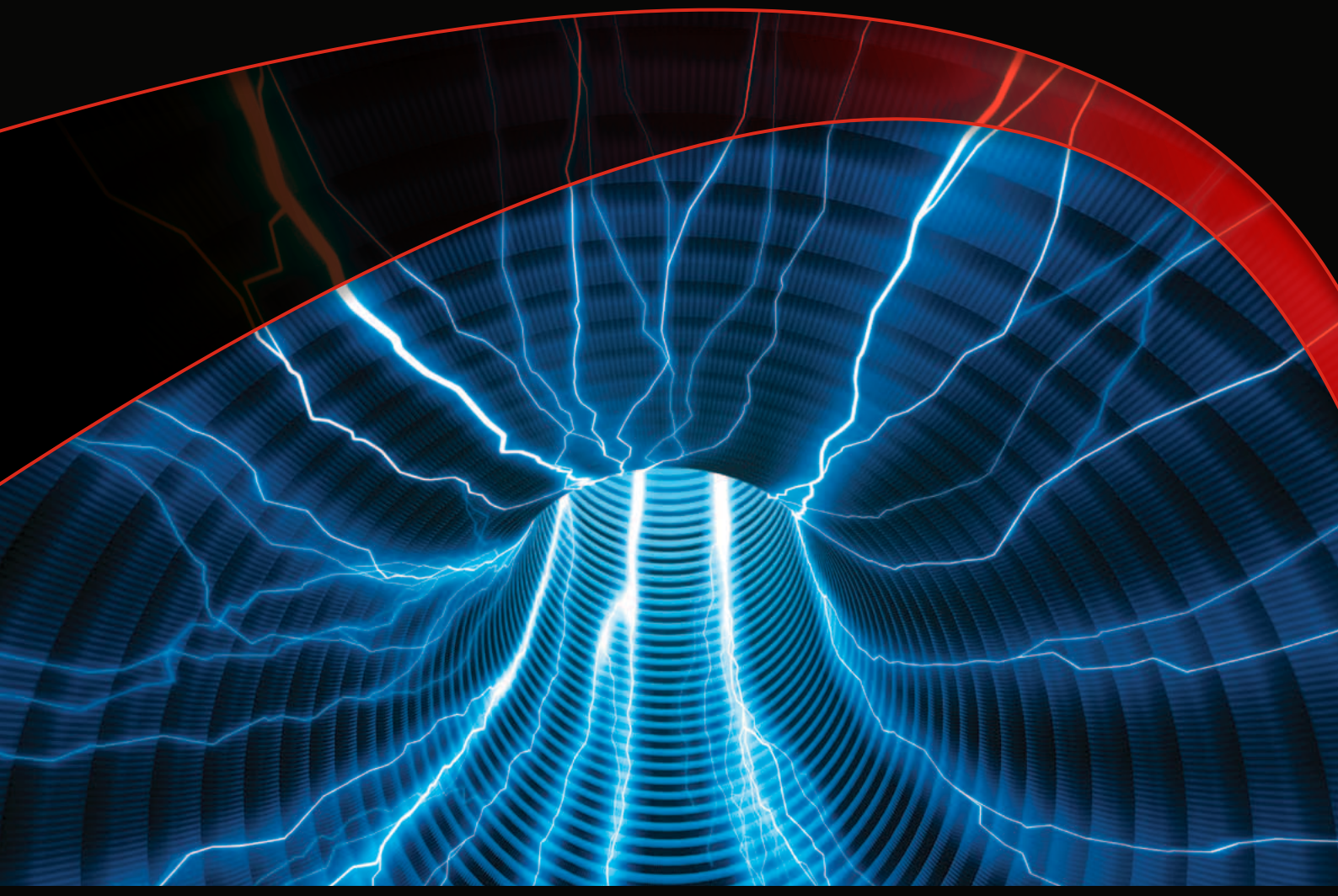
Asian Gamechangers

Powering Asia's Growth

Overview of Asia's Energy Needs



DBS

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Overview of Asia's Energy Needs

Executive Summary

Every time a person in Asia starts their car, switches on their living room light, or fires up the oven for dinner, they are helping to fuel the region's rising thirst for energy. Asia has a huge appetite for all fuels – from oil to wind – which will grow insatiably in the coming decades. It will electrify world energy markets and define the priorities of its governments as they try to sustain high levels of economic growth.

There will be plenty of energy to go around. Oil and coal remain abundant, nuclear power is making a comeback after the 2011 Fukushima disaster in Japan, and renewables of all stripes are slowly gaining a foothold.

But gaining access to this energy will come at a cost. Import bills will expand due to increasingly expensive oil, but due also to a worrying habit of subsidising the price of fuel at the pump.

Pressure will grow to wean consumers off dirty fuels and onto clean ones, or pay the environmental consequences. But even this noble endeavour entails costs, as low-carbon fuels will need huge subsidy support for a few decades just to break even.

Governments across the region face some tough choices in their quest for economic growth, and the energy they need to secure that growth. How they handle these choices will determine which parts of the region prosper – and to what degree – as the Asian century unfolds.

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Asia's Energy Boom

For decades, Asia's economic growth has been a given. Its rise from economic backwater to powerhouse has been fuelled by, and helped to fuel the world's energy markets

Asia's Growth Story

We're not surprised anymore to hear about China's voracious appetite for coal to power its booming cities. Or that it builds more houses in a year than exist in all of Spain. Or, for that matter, when Mumbai's economy is tipped to dwarf that of Portugal.

We are surprised, though, when that growth starts to tail off. China provoked widespread astonishment when it announced its economic growth had slipped to just 7.4%. That's a mile off the 12% it enjoyed a few years back. India, the region's other behemoth, has languished below 5% growth for a few quarters now. Smaller Asian economies have been decidedly earthbound for a while as well.

Asia will continue to grow strongly for a few more decades at least

The good news is that Asia will continue to grow strongly for a few more decades. Its GDP numbers are still perfectly respectable by most measures. The region is entering a more mature growth phase marked by lower but hopefully more sustainable expansion.

Led by China and India, Asia's growth averaged 7.5% for the past 25 years. With China's slower growth trajectory, it has averaged around 6% for the past three years. Going forward, a reasonable assumption might be that growth falls to 5% over the next decade and to 3.5% over the subsequent 15 years. But that would still put Asia's GDP at about $54 trillion in 2038. That's an increase of $38 trillion over today's $16 trillion GDP – equivalent to three times the current Eurozone GDP. In other words, Asia will likely add three Eurozones to the global economy in the next 25 years.

Fuelling Energy Demand

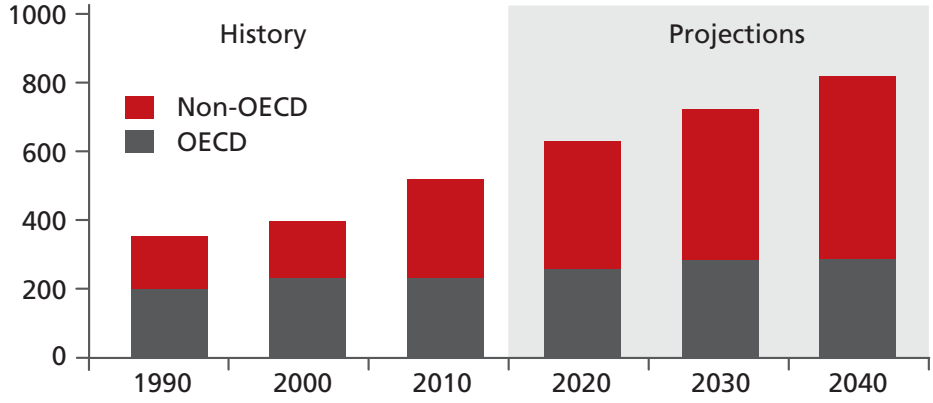
The impact of this growth on global energy flows will be nothing short of transformative.

Global energy demand will soar to new highs. Exactly how high is hard to say given the multitude of variables at play such as government policy and the impact of new extractive technologies. The International Energy Agency sees global energy demand expanding by a third between 2011 and 2035 , while the US Energy Information Agency envisages a 56% rise in consumption by 2040, spurred by long-term economic growth in the developing world.

A huge appetite for all types of fuel puts Asia at the forefront of the global energy story

Asia will be at the coalface of this boom. A huge appetite for all types of fuel puts it at

1 **World total energy consumption, 1990-2040**
quadrillion BTU

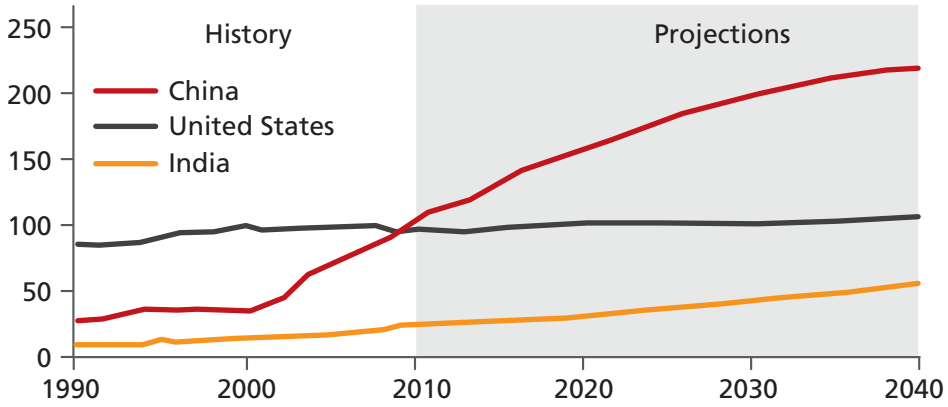


Source: US Energy Information Administration

the forefront of the global energy story. Asian oil demand has climbed by more than 40% since 2000 – or around 8 million extra barrels of oil a day. By comparison, oil demand has fallen over the same period by more than 12% in Europe and 2% in the Americas.

By 2030, China will overtake the US as the world's largest oil consumer. India becomes the largest importer of coal by the 2020s. Non-Organisation for Economic Co-operation and Development (OECD) Asia's share of global electricity consumption triples that of OECD countries. The region will account for more than a third of the world's new nuclear energy capacity by 2020. China's embrace of renewables will result in increased use of these sources – a rise greater than the combined increases of the US, Europe and Japan.

2 **Energy consumption in the US, China and India, 1990-2040**
quadrillion BTU



Source: US Energy Information Administration

Overall, Asia's energy demand is on track to rise by 2.1% a year between 2010 and 2035, more than half a point faster than the rest of the world. Developing Asia's energy use should expand by 2.3% a year through to 2035. China's energy consumption briefly intersected with the US' in 2010, but will leave it far behind in the coming decades.

Continued economic expansion of almost 6% a year among developing countries in Asia will help to sustain this appetite. In contrast, the region's developed economies – such as Japan, Australia and New Zealand – will see their overall demand share fall marginally in a reflection of their slower economic growth rates.

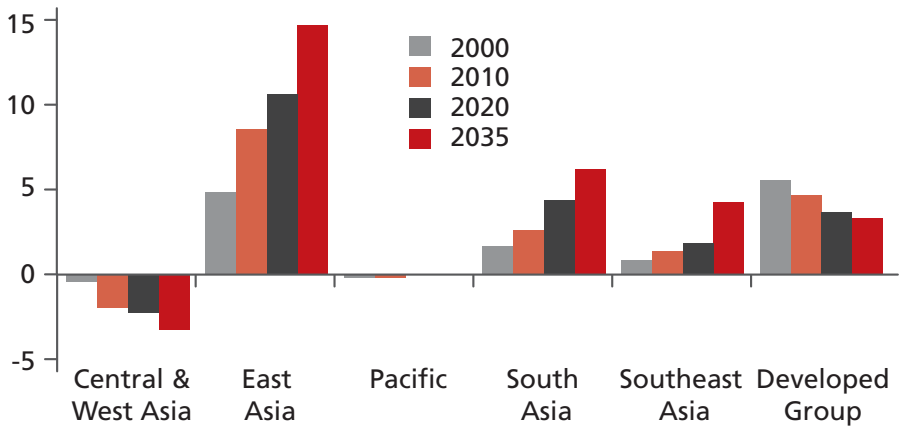
The shift in demand to emerging economies is rewiring the global energy trade

The shift in demand to emerging economies, particularly Asian ones, is rewiring the global energy trade. Countries that have long been importers are revving up their energy exports, while many exporters are becoming leading demand drivers. For Asia, the latter scenario is more often at play as they replace domestically sourced fuels with imports.

China, where energy security is the top priority as it eyes new growth targets, leads this transition. Much of its rapid industrialisation has been driven by power plants fired by coal found almost entirely at home. It still produces millions of tons of coal each year, but is now one of the largest importers of thermal coal from export markets as diverse as Columbia and Australia. The metamorphosis has taken only a few years, prompted by the global financial crisis which sent international coal prices plunging. Suddenly, cheap foreign coal was a viable option, and has remained so. Falling freight rates have added to its appeal.

China's use of coal plateaus in a decade or so, after which India takes over as the largest coal importer. Similarly, China will soon become the world's biggest oil importer as the international crude trade reorients away from the developed world and towards Asia.

3 **Net oil imports by region (2000, 2010, 2020, 2035)**
million barrels per day



Source: Asian Development Bank

As with coal, oil consumption tapers off in China as it moves to lower-carbon forms of energy. But it rises in India, which is not as far down the path towards sustainable energy use and becomes the leading single source of global oil demand by 2020. Similarly, Southeast Asia will alter the geography of global energy demand as it becomes the fourth-biggest oil importer by 2035, behind China, India and Europe.

Imports

Asia isn't producing enough of these fuels to sustain its economies, so the import bill for each is sure to rise. Fossil fuel imports are expected to double by 2035, with regional demand pushing oil imports to an amount comparable to the oil produced currently in the Middle East.

The region will become a net importer of natural gas by 2020

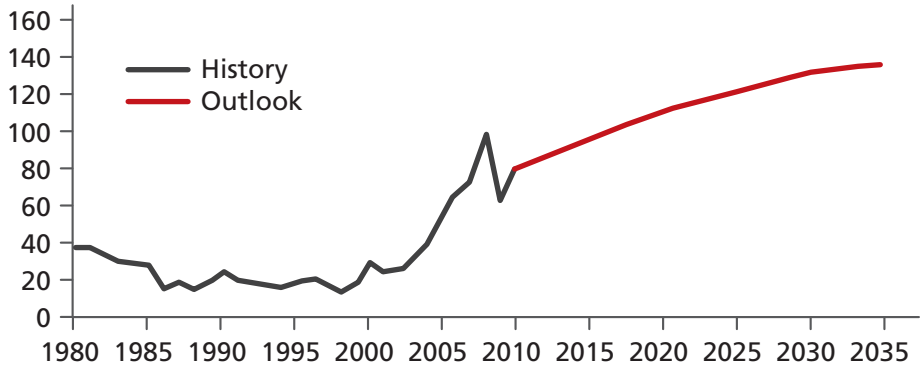
The region will become a net importer of natural gas by 2020, and by 2035 its imports may rise as much as five-fold despite increased production in some areas. India, for example, might be able to triple its domestic gas supplies. But even this would only cover around 64% of domestic demand.

The gap has to be filled from abroad, and the challenge for Asia's growing economies is to find stable and affordable supply sources. The US has emerged as a big supplier, as its recent shale oil and gas revolution – prompted by new technology that enables extraction of the fuels from previously inaccessible reserves – has turned it into a net gas exporter of supplies it no longer needs at home.

The region's oil import bill is tipped to triple within 20 years as local production dwindles and its oil dependency almost doubles

But much of the energy fuelling Asia's future growth will continue to come from the Middle East. This raises the prospect of more squabbling among Asian governments for influence and energy contracts in producer countries unless they can find a way to act cooperatively on energy security.

4 **Crude oil price assumption**
$ per barrel



Source: International Energy Agency, 2010. World Energy Outlook, Paris.

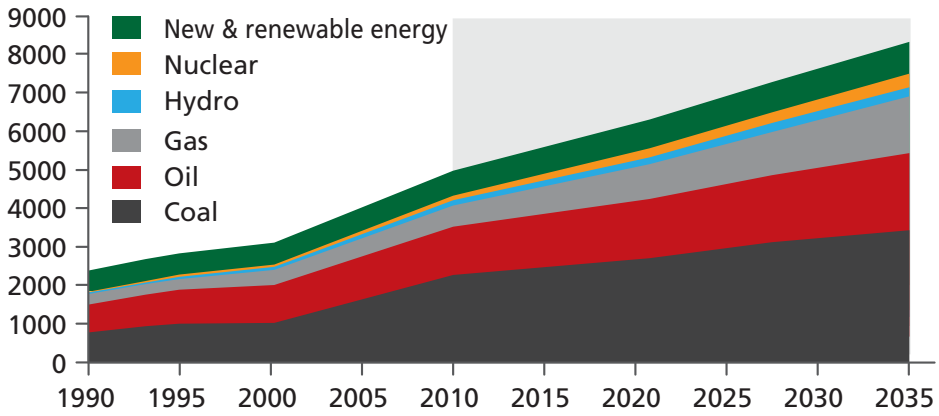
Budget

Moreover, the high import bill will stretch national budgets. This has potentially profound implications for countries in Southeast Asia, where many countries do not have the fiscal wherewithal of China or India. The region's oil import bill is tipped to triple within 20 years, as local production dwindles and its oil dependency almost doubles to 75% of demand. With the price of a barrel of oil expected to reach as high as $140 by 2035 , the challenge for these countries is to ramp up renewable forms of energy while seeking energy and money saving measures such as more efficient power plants and tough fuel economy standards.

A Fossil Fuel Future?

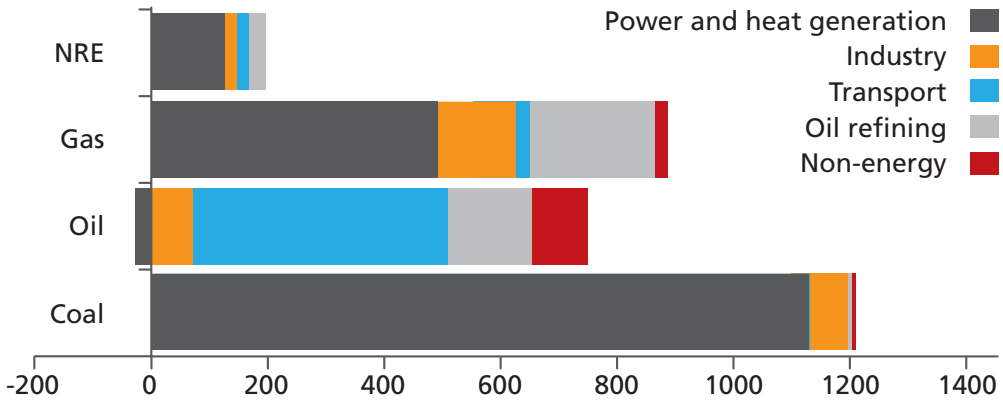
Contrary to popular belief, the world is not running out of oil. Or coal, or natural gas for that matter. In fact, fossil fuels will continue to dominate the global fuel mix.

5 **Primary energy demand by source**
Million tons of oil equivalent



Source: Asian Development Bank

6 **Incremental growth in primary energy demand by source and sector**
Million tons of oil equivalent



Source: Asian Development Bank

Oil

Of the three major fossil fuels, oil will dominate – that is until economies find cleaner fuels that will deliver power at a lower environmental impact. Globally, oil demand is expected to rise from around 86 million barrels a day to more than 100 million by 2035. The rise of oil extracted by unconventional methods such as horizontal drilling will make up the shortfall in conventional production of crude, which drops slightly to 65 million barrels a day.

Oil will continue its reign as Asia's default fuel

Oil will continue its reign as Asia's default fuel. As the region urbanises, cars are one of the first things its citizens buy both for convenience and as status symbols. That simple purchase will be responsible for a sharp spike in Asia's oil consumption over the next couple of decades.

Asia's demand for oil and its ancillary petroleum products will rise by as much as 2% through to 2035, and almost two-thirds of that increase will come from the transport sector. More than 80% of Asia's total oil demand will emanate from just six countries – China, India, Japan, Indonesia, South Korea and Thailand.

China, where cars are becoming as ubiquitous as people, again leads the trend. Its use of petroleum liquids for transport is expected to triple by 2040. A few years ago, its consumption of transport fuels was only a third that of the US. By 2040 it will be around the same.

Asia versus the developed world

These consumer patterns put Asia at odds with much of the developed world, where fossil fuels like oil are slowly falling out of favour. Globally, the share of fossil fuels in the energy mix is expected fall a few points from the current 82%, as countries find cleaner low-carbon sources of energy.

Fossil fuels like oil are slowly falling out of favour in much of the developed world

Though Asian governments are experimenting with low-carbon growth, Asia won't replace oil with renewables for quite a few decades to come. Central and West Asia will be the parts of the region to benefit most, as they will export oil to the rest of Asia.

Everyone else will have to buy oil on the best terms available, and it won't be cheap. The region's oil import bill is expected to soar as its oil imports double in volume. China alone will import more than 11 million barrels each and every day, more than doubling the 5 million it bought in 2010. That will take its import dependency beyond 70%, and South Asia won't be far behind as it doubles its purchases to more than 6 million barrels a day. By contrast, the region's developed economies will buy 1 million barrels less in 20 years time than they did in 2010.

Coal

Coal, though much maligned due to concerns over its impact on the environment, will retain a central role in Asia's economic future. However, its use will drop off – even in Asia where supplies are relatively plentiful – as governments respond to environmental concerns with new policies to encourage cleaner forms of energy.

Coal will retain a central role in Asia's economic future

China has used coal to fuel much of its economic growth, and accounts for nearly half of global consumption followed by the US and India. In fact, five of the world's top coal importing countries are in Asia. For Asian economies, the beauty of coal is its relatively easy availability

and cost effectiveness. These qualities could boost its usage by more than 50% from current levels, and ensure that coal remains the leading fuel for electricity generation globally.

7 **Top coal importers (2012e)**

	Total of which	Steam	Coking
China	289Mt	218Mt	71Mt
Japan	184Mt	132Mt	52Mt
India	160Mt	123Mt	37Mt
South Korea	125Mt	94Mt	31Mt
Taipei	64Mt	56Mt	8Mt
Germany	45Mt	36Mt	9Mt
UK	45Mt	40Mt	5Mt

Source: BP, IEA, World Steel Association, WEC
(e = estimated) (Mt = Million tonnes)
Aug 2013

For Asia, the beauty of coal is its relatively easy availability and cost effectiveness

Coal's popularity in any given country will depend partly on whether that country can afford to transition to cleaner fuels. This is already happening in OECD nations, and is likely to happen more often in Asia. Globally, coal's share of electricity generation could fall from 41% to 33% by 2035 , and while China will continue to dominate the regional coal trade with nearly two-thirds of consumption, that will level off after 2025 as cleaner fuels gain ground.

This pressure to switch to low-carbon fuels won't be so great in the region's less developed economies. India will increasingly turn to coal to fuel its economy, and will likely see demand increases exceeding 3% a year over the next couple of decades. The embrace of coal is even tighter in Southeast Asia, where large producers such as Indonesia lead demand spikes of nearly 5% a year.

Coal's convenience will be constantly weighed against its environmental costs. Once the environmental threat outweighs economic benefits, countries will feel the pressure to shift to cleaner fuels.

Natural Gas

One such fuel is natural gas, which is expected to grow the fastest of all fossil fuels in Asia.

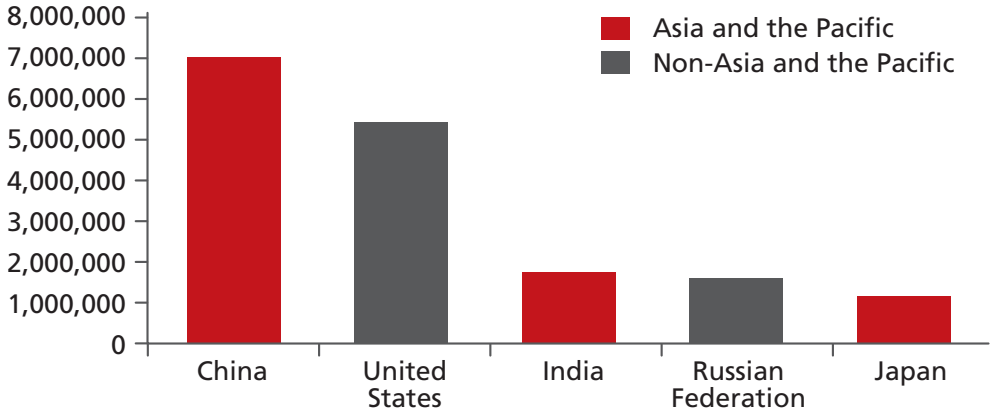
Natural gas, though a fossil fuel, has distinct advantages over its "dirtier" cousins, oil and coal. It burns less carbon which can mean less pollution and fewer greenhouse emissions.

Though drawn from fossil beds, natural gas represents a cleaner option at a time when many Asian governments are feeling the pressure to promote clean growth.

Greenhouse gas emissions

They have some work to do. Between 2000 and 2008, per capita average greenhouse gas emissions jumped by 97% in Asia, dwarfing an 18% global rise. Dependence on dirty fossil fuels like coal is the driving factor behind this discrepancy, especially in coal-dependent South Asia where greenhouse gas emissions have risen by about 3.3% annually since 1990.

8 **Top five countries in total CO2 emissions in 2008**
CO2 emissions (kiloton)



Source: World Bank

Natural gas, though not as clean as renewable forms of energy, can help reduce the region's carbon footprint. Electricity generated at gas-fired power plants can produce greenhouse gas emissions anywhere from 50% to 70% lower than at most coal-fired power plants.

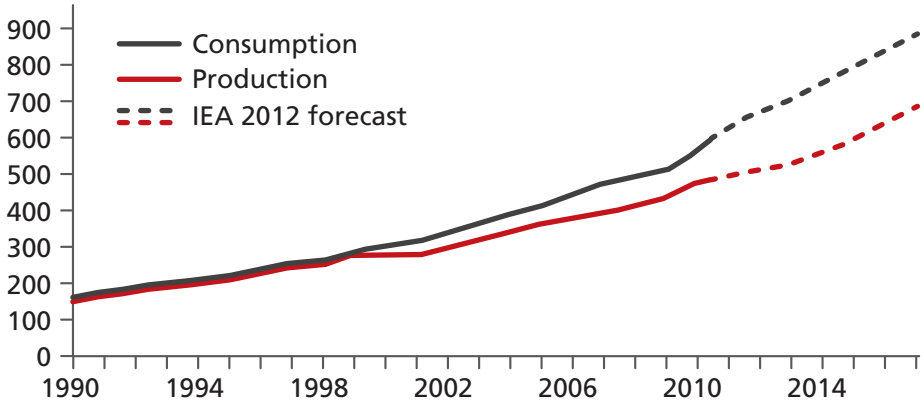
Countries tend to migrate to natural gas when their economies are developed sufficiently enough to afford to make the transition. This often coincides with political pressure to make the switch. But natural gas needs to be easily sourced and cost-effective for large-scale uptake to occur. This is what has happened over the past decade in the US, where the rise of shale gas has nudged out dirtier fuels and sent gas prices plunging.

Natural gas is seen by some as a way station on the road to renewable energy

This is a global trend that is already playing out in Asia. Globally, gas demand is expected to rise by anywhere from half to nearly two-thirds over the next couple of decades. In Asia, demand for natural gas will rise fastest of all fossil fuels at nearly 4% a year. Nearly half of that demand will come from China, followed by India with 13% and Indonesia with 6% growth.

Natural gas is seen by some as a way station on the road to renewable energy. Its suitability for Asian economies is enhanced by the existence of major suppliers within the region. Australia, Azerbaijan, Turkmenistan and Uzbekistan are all major producers, and Myanmar has large and relatively untouched reserves of natural gas.

9 **Asia Pacific natural gas consumption-production forecast, 1990-2017**



Source: International Energy Agency

Given this abundance, could natural gas be Asia's energy solution? Possibly, but consumption is tipped to outstrip production for the next few years at least.

Investment

Also, it requires huge investments in facilities such as pipelines, as well as liquefaction and regasification plants. Financing these kinds of projects is a daunting prospect for fiscally-challenged governments. Subsidies to keep gas prices low for consumers don't help matters, as they crimp the fiscal ability of governments to undertake gas infrastructure projects.

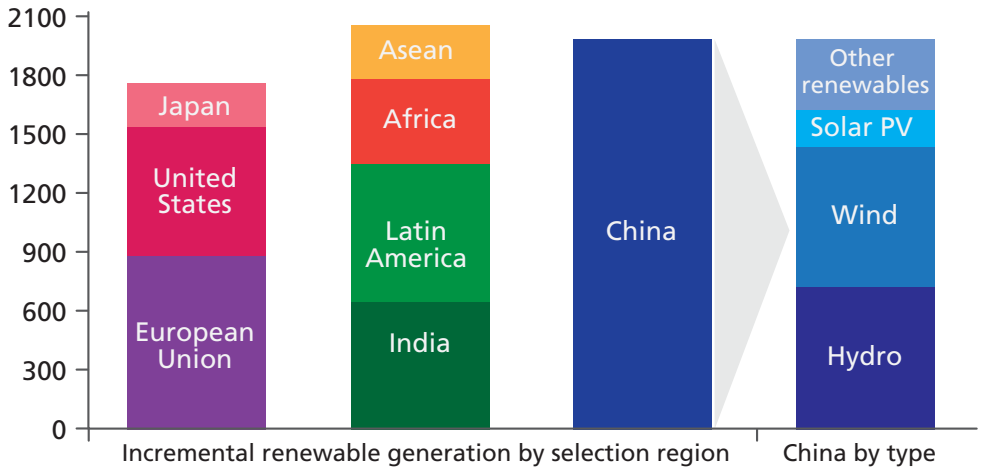
Rising Renewables

Renewable energy conjures visions of a pristine world powered by pure fuels. In fact, more than half of renewable energy consumption comprises traditional biomass – the burning of basic fuels such as wood and dried animal dung for heating and cooking. Hydro power is also a renewable form of energy, as it depends on natural water flows and gravity to generate energy.

The so-called new renewables include wind and solar, biofuels and geothermal. In widespread use around the world now, they are tipped to become more popular as the reality dawns of the potentially disastrous environmental results of excessive fossil fuel use. Overall, renewables could account for up to half the increase in global power generation up to 2035, with wind and solar accounting for nearly half of that uplift.

China, with its bigger cities shrouded in smog from coal-fired power plants, has been particularly quick to embrace renewables. Its adoption of renewable technologies is certain to escalate, reaping gains in electricity generation from renewables that outstrip the combined gains of the US, Europe and Japan.

10 **Incremental electricity generation from renewable in selected regions, 2011-2035**
terawatt hours



Source: World Energy Outlook

In a couple of decades, renewables will make up nearly a third of Asia's power generating capacity

This is a region-wide trend. In a couple of decades, renewables will make up nearly a third of Asia's power generating capacity, closing in on coal as the leading fuel for electricity generation.

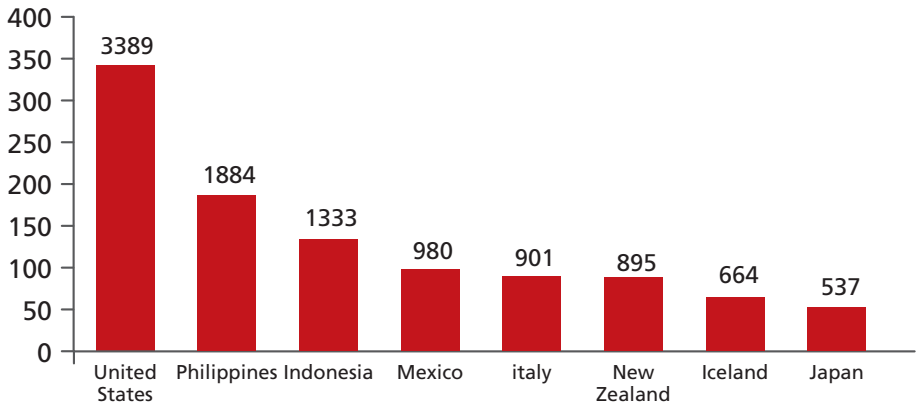
Will any of these more renewable forms of energy ever displace oil and coal in Asia?

There is no one-size-fits-all solution to Asia's energy needs. The region is so diverse economically, geographically and topographically that it will take a complex interplay of renewables and traditional fossil fuels to supply sufficient charge to its economies.

Geothermal

Different countries will pursue different energy strategies tailored to their needs and capabilities. In volcanic countries like the Philippines, geothermal energy is plentiful due to deep fractures in the earth's crust that allow steam to rise to the surface. Accordingly, geothermal energy provides 27% of electricity production at the country's power plants, second only to the US.

11 **Established geothermal market installed capacity**
megawatts



Source: Geothermal Energy Association

IIn India and other countries with large coastlines, wind farms proliferate – most of them offshore where winds are stronger. Solar energy seems particularly well suited to Asia given the preponderance of sunny days throughout much of the region. Meanwhile, hydro-electricity finds favour in mountainous areas such as northern India, Bhutan and parts of China.

Some Asian countries are taking bold approaches in efforts to put renewables at the centre of their energy mix.

Solar

China's "Golden Sun" project has used subsidies to spur the connection of solar plants to electricity grids, and has proven so successful that some of these subsidies have been reduced. By 2020, Beijing is targeting 300 gigawatts (GW) of hydropower, 150 GW of wind power, 30 GW of biomass power, and 20 GW of solar. If it hits these targets, almost a third of its total power needs will be met by renewables.

India's Jawaharlal Nehru National Solar Mission, established in 2006, calls for 200 GW of installed solar capacity by 2050. Delhi has also unveiled a national policy to promote a 20% blending of biofuels with conventional fuels for road transport. Japan's embrace of renewables began after the 2011 Tohoku earthquake and tsunami, which tainted the nuclear mainstay of its energy mix. A long-term subsidy guaranteeing producers a set return for electricity supply has been broadened from solar to take in wind, biomass, small hydro and geothermal.

But clean energies have their drawbacks, many of which resonate loudly in poorer countries.

Downsides

Renewables might not deliver the supply solutions provided by oil, coal and gas. Solar, for example, may not be suitable in less temperate North Asian countries like South Korea, while wind farms may not fit landlocked countries that aren't blessed with strong winds.

Moreover, renewables can present thorny technological problems that can dilute their benefits. Solar power requires huge amounts of space, which is at a premium throughout much of the region. Wind power is best produced at offshore wind farms, which can drive up installation and running costs. Geothermal energy isn't a favourite of tourism operators and conservationists, who have accused it of causing vegetation loss, soil erosion, landslides and water pollution.

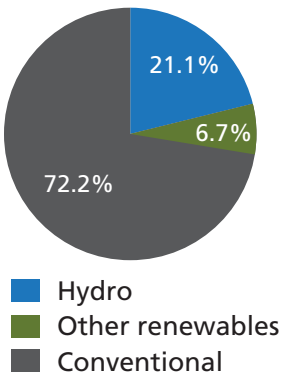
Hydro

Still, the potential for renewables to grab a bigger share of Asia's energy mix is undeniable. Hydro is an obvious case in point, with China accounting for a quarter of the global increase in power generation by 2035. Across the region, hydro demand comprises 39% of electricity currently generated, but this amounts to only 20% of the region's potential capacity.

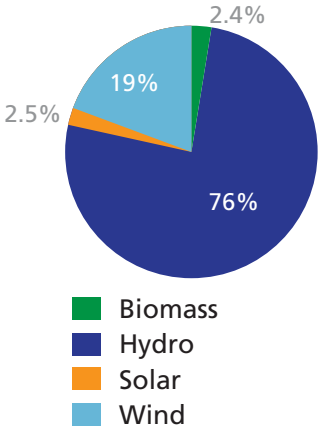
12 **The relevance of Hydroelectric power to the energy mix, 2012**

Initial hydroelectric capacity:	228,300 MW
Added hydroelectric capacity:	20,700 MW
Final installed hydroelectric capacity:	249,000 MW
Hydroelectricity as % of total installed capacity:	21.14%
Hydroelectricity as % of total renewable capacity:	76.02%

% Total installed capacity



% Installed renewable capacity



Source: renewablefacts.com

Hydro is expected to grow by 3% a year over the next 20 years , driven mainly by China but also by new projects in Southeast Asia and India, which plan to massively upgrade installed hydropower by 2017.

Biofuels

India has been keen to promote the use of renewables such as modern biomass, which uses garbage, wood, landfill gases and alcohol fuels as energy sources released usually through combustion.

Ending the reign of gas-guzzling automobiles might be even harder than displacing dirty power grids. Biofuels like ethanol, derived from fermented sugars in food crops, are expected to at least double its share of global transport fuel demand by 2035 from the current 3%. China, India, Brazil, the US and Europe are expected to account for 90% of this demand. But the sector will rely on good harvests of the necessary crops and continued subsidies, as well as sympathetic policies to loosen the hold of fossil fuels on road transport.

Subsidies

In fact, continued subsidies are crucial to the development of most renewable forms of energy. Subsidies to renewables could tally $220 billion a year worldwide by 2035, presenting a potential fiscal headache to Asian governments already saddled with large subsidy bills for fossil fuels.

The good news however, is that these subsidies should level off once renewables start to compete on an equal footing with fossil fuels. In China for example, subsidies to renewables for electricity generation are forecast to peak at $35 billion a year in 2030 due mainly to solar and bioenergy, before falling to $30 billion by 2035. Clearly, it's in the best interests of governments to promote renewables quickly, to reduce strain on the environment and on their national budgets.

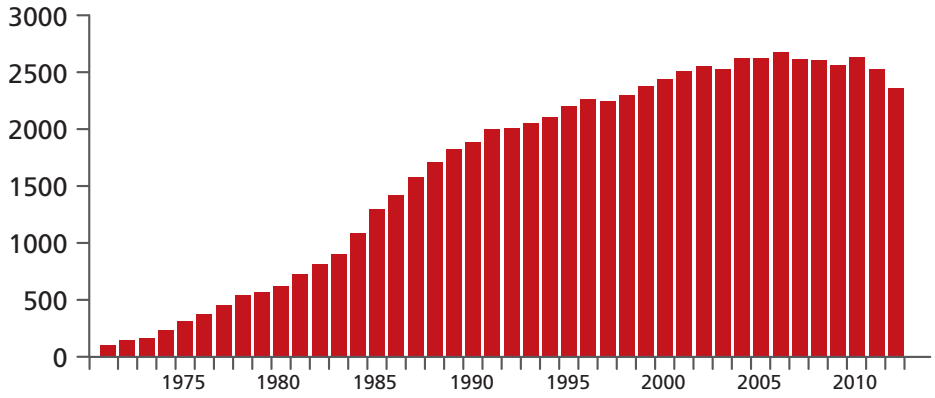
Eventually, renewables will become more than just competitive with fossil fuels. They will – hopefully – replace them to varying degrees across the region. This will happen when industrial facilities are built in areas where renewable energies are abundant. Once this happens on a massive scale, renewables can be integrated into energy supply, allowing the early retirement of conventional energy facilities.

This is already happening in Europe, where the fast growth of wind and solar power in countries like Italy and Germany has made many of those decisions relatively straightforward. The challenge for Asian policymakers is to follow suit when conventional energy plants – even when they're still profitable – begin to inhibit the growth of renewables.

The Nuclear Option

At face value, nuclear energy seems to provide the answers to Asia's thirst for energy. It is an environmentally neutral way of producing energy on a large scale since most reactors run on uranium rather than carbon fuels. For the same reason, it is not at the mercy of global oil prices, making it relatively cost-effective.

13 **Nuclear energy production**
TWh Year



Source: World Nuclear Association

Impact of the Japan Disaster

Despite these advantages, its appeal has dimmed somewhat since the 2011 earthquake and related tsunami in Japan. A meltdown at the Fukushima Daiichi nuclear reactor prompted the government to shut down scores of other reactors and veer from nuclear to other forms of energy production.

North Korea

Scruples over the efficacy of nuclear are compounded by North Korea's nuclear programme, which has been the catalyst for regional geopolitical tensions over the past two decades. Though Pyongyang insists its nuclear programme is peaceful, it is suspected to have used it to produce weapons-grade plutonium used in the manufacture of between four and eight nuclear weapons.

Global response

It's not surprising then, that uncertainly surrounds the future of nuclear power in Asia. The Tohoku disaster spooked many governments, prompting them to review plans for nuclear capacity additions. China halted approval processes for new reactors pending safety reviews. Germany and Switzerland announced plans to phase out nuclear power. Others, however, were undeterred. Turkey and Poland are moving ahead with new reactors, and France is keeping nuclear power central to its energy mix.

Simple pragmatism explains the staying power of nuclear energy. Electricity demand is likely to rise by more than two-thirds over the next two decades. Currently, nuclear energy meets around 12% of world electricity demand. Its share is expected to stay at around that mark. But as the world's energy needs surge, pressure will escalate for energy sources to be found that don't ruin the environment. That means more nuclear reactors.

The Japan accident has not swayed Asian governments from embracing nuclear energy

Asia's Nuclear Tilt

Most will be built in Asia, where the Japan accident has not swayed governments from embracing nuclear as a clean – though obviously not hazard-free – and relatively low-cost way of obtaining energy security. There are currently more than 100 operable nuclear reactors in East and South Asia, with dozens under construction and plans to build another 100 or so.

14 **Nuclear power in Asia, and involvement with the nuclear fuel cycle**

	Power reactors operable or in operation	Power reactors under construction	Power reactors planned	Research reactors	Other stages of the fuel cycle
Australia				1	UM
Bangladesh			2	1	
China	17	30	59	13	UM, C, E, FF
India	20	7	18	5	UM, FF, R, WM
Indonesia			2	3	FF
Japan	50	3	9	17 + 1	C, E, FF, R, WM
S. Korea	23	5	6	2	C, FF
N. Korea			0	1	C? FF? R
Malaysia			0	1	
Pakistan	3	2	0	1	UM, E, FF
Philippines			0	1	
Thailand			0	1 + 1	
Vietnam			4	1	
** Total	119	49	100	56*	

*54 research reactors operable, 2 under construction
** The total includes 6 reactors in operation, plus two under construction, on Taiwan. It also has four research reactors. Taiwan has no other stages of the fuel cycle.

Key: UM Uranium Mining, C Conversion, E Enrichment, FF Fuel Fabrication, R Reprocessing, WM Waste Management facilities for used fuel away from reactors.

Sources: WNA Reactor table, country papers

China, India, South Korea and Japan – safety qualms notwithstanding – are expected to be growth markets for nuclear energy, accounting for more than a third of new capacity globally.

Nuclear energy use in Asia is expected to rise by 3.5% a year as the region's governments gradually overcome scruples over its safety. Smaller countries like Malaysia, Thailand and Vietnam are expected to turn to atomic energy in the coming decades. Despite its pitfalls, the nuclear option offers extra diversity in the energy mix of smaller economies – a potentially valuable commodity with global fossil fuel prices rising and competition intensifying for access to oil and gas resources.

But nuclear energy's appeal is even greater for large economies, as once up and running, a reactor is generally a more efficient producer of energy than renewables. Additionally, using it instead of carbon-based fuels can curb greenhouse gas emissions. The use of nuclear power currently results in reduced carbon dioxide emissions to the tune of 2.5 billion tons a year.

India

That helps to make a convincing case for nuclear expansion in places like India, which has for decades supported nuclear energy albeit outside global atomic weapons controls. Its reactors run primarily on thorium – a more naturally abundant fuel source than uranium and one less suited to weapons production. India has large reserves of thorium and wants to use it to generate a quarter of its electricity – up from 3% currently – as it builds out its nuclear capacity by as much as 47 GW over the next 25 years.

China

Thorium plays a role in China's nuclear blueprint too, and Beijing hopes to fire up a thorium-fuelled nuclear reactor sometime this year. Much of China's expansion though, will use conventional uranium-fuelled reactors as it adds new capacity totalling nearly 150 GW over the next few decades. China recently commenced operations at its 19th nuclear reactor in the southern province of Fujian, taking another step towards its goal of doubling capacity by 2020 from the present 3.24 GW to 8.64 GW.

China will build almost half of all greenfield nuclear capacity over the next 20 years

Nuclear will be big in China. Its expansion plans could see as many as eight new reactors commissioned annually through to 2025, and up to double that number in subsequent years. The country has a shortage of nuclear engineers and reactor construction experts, while the post-Fukushima safety review has stalled all inland project approvals until at least 2016. Still, these hiccups aren't expected to stop China from building almost half of global greenfield nuclear capacity over the next 20 years to meet a target of 200 GW in new nuclear capacity by that time.

The Shale Revolution

Resource extraction is a cost-benefit game. Sometimes oil, gas and other fuels are easy to extract. Other fuels are locked deep underground in impermeable rock, and until recently were thought to be unreachable. Then came the so-called shale revolution in the US, which has transformed global energy markets over the past decade.

America's Energy Edge

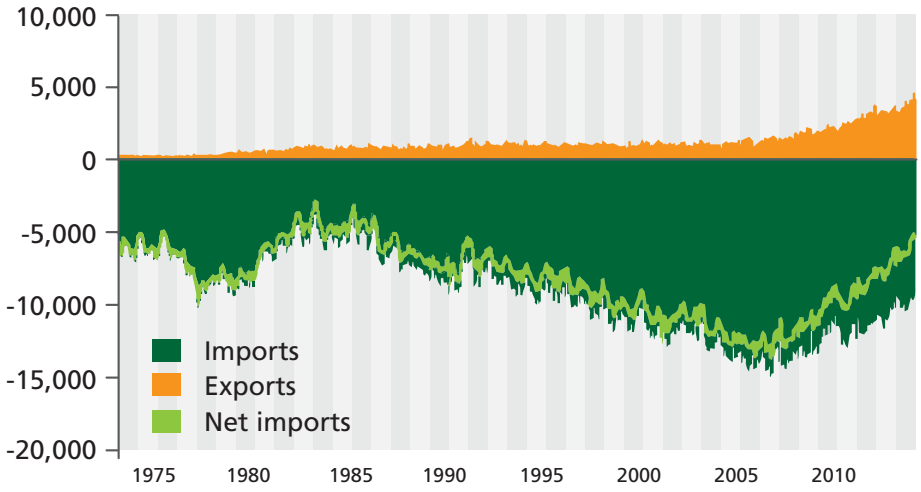
Oil and particularly gas trapped in shale rock formations can now be tapped by new techniques such as horizontal drilling and hydraulic fracturing, or "fracking", of deep rock. These technologies started to proliferate in the early 2000s, and are now well-established especially in the US.

The shale revolution in the US has transformed global energy markets

The sudden availability of once-dormant gas and oil reserves has helped make the US the world's new marginal supplier of petroleum, allowing it to replace Russia as the biggest gas producer.

US gas and oil production has soared since the early 2000s, with much of the rise attributed to shale.

15 **Shale revolution alters global energy flows**
US imports and exports of crude and petroleum products



Source: US Energy Information Administration, JKEMP

Impact on prices

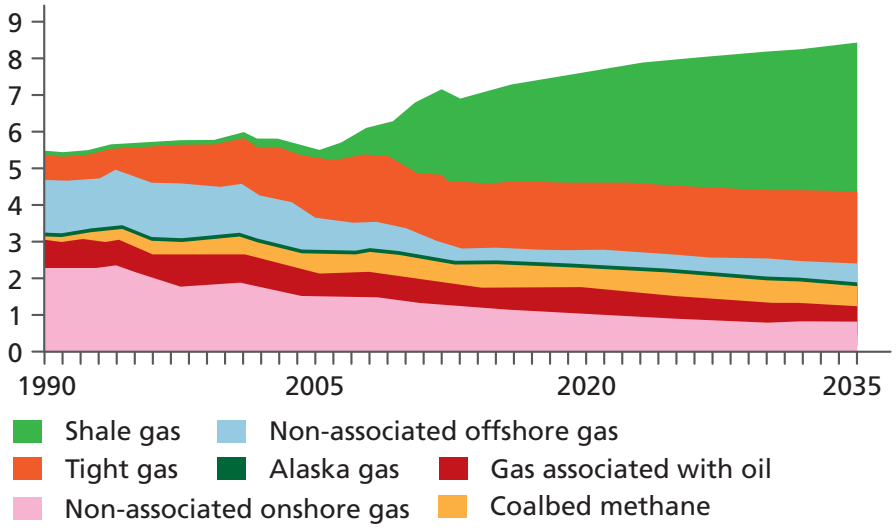
This has kept prices, particularly for gas, low in the US and also in Europe and Asia where exporters have had to find new liquefied natural gas (LNG) markets. The US shale revolution has shifted global energy supply sources to North America from traditional markets such as the Middle East and Latin America.

US imports of crude and ancillary products have halved over the past 5 years, while its exports of products like liquefied petroleum gas (LPG) and diesel have increased markedly. This has reversed the flow of global energy, which used to run east-to-west. This translates into more diversified supply which means greater energy security. As a result, global markets are better equipped to withstand potentially disruptive crises like the recent Arab Spring uprisings in the Middle East.

Asia's Shale Prospects

For Asia, shale could be a godsend. Energy security and budget impact is improved through diversity of supply, which will comfort economic planners in China and India. Asia should benefit from the massive US shale gas production, which is set to quadruple to 4.1 trillion cubic metres a year by 2035. This is more than the US will consume, which means it will become a net gas exporter. Two-thirds of its output of LNG is expected to go to Asia.

16 **Natural gas production in the US (1990-2035)**
trillion cubic metres



Source: US Energy Information Administration

This supply should help to bring down gas prices progressively in Asia as consuming countries can use their newly-diverse sourcing options to bargain for better deals. Asian consumers are currently burdened with the "Asian premium" on natural gas, a byproduct of strong regional demand, limited supply, and the linkage between the price of oil and the price of LNG. The emergence of shale and more diverse sourcing is an opportunity for Asia's importers to seek new pricing mechanisms.

Shale reserves

Even better, Asia might develop its own shale resources. So far, a lack of technology and gas transport options have hamstrung efforts to ramp up shale resource production in the

Asia's efforts to ramp up shale resource production are hindered by a lack of technology and gas transport options

region. That's a pity, as global recoverable reserves of shale oil resources alone could tally nearly 350 billion barrels.

Some of these reserves are located in China, which is enthusiastic about gaining access to them. There could be nearly 32 billion barrels of recoverable shale oil underground in China, along with 1.1 trillion cubic feet of shale gas. India recently took the first steps to gain access to its shale deposits by allowing state-owned companies to explore for deposits. Beset with electricity blackouts and budgetary stresses from oil imports, India is keen to exploit an estimated 96 trillion cubic feet of recoverable shale gas reserves – equivalent to about a quarter-century of future gas demand.

FDI limitations

Opportunities for foreign involvement in Asian shale opportunities are likely to be limited as the major markets are handing exploration and development rights to state-run resources companies. This isn't surprising as most of the gas would be used for the domestic market. But price is a key driver of this strategy. Commercialisation of shale deposits at home would give Asian importers more leverage when bargaining for the imported gas they need to fill the demand gap. Potentially, this could spell the beginning of the end for the Asian premium on gas prices.

The Price Of Power

Dismantling Asian premiums on energy will be even more important in the coming years as prices rise globally for nearly all fuels. For oil alone, Asia is forecast to meet 88% of the demand rise through to 2035, raising the prospect of huge import bills as the price of a barrel climbs.

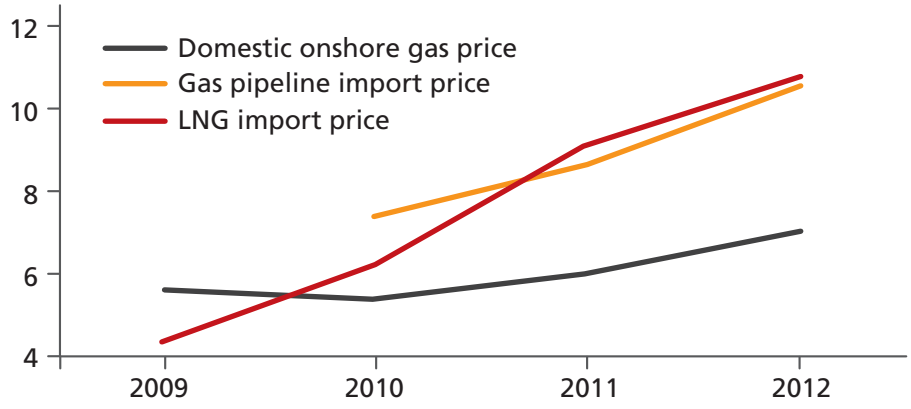
High energy costs can sting individual householders, businesses and economies. Householders pay more at the pump and economies suffer from import bills driven higher by rising oil and gas prices. Businesses are particularly vulnerable as high energy bills can hit hard at the bottom line of industries like chemicals, where they can account for around 80% of production costs.

Apart from oil, which is priced globally, there is no one global price for energy. In fact, regional differentials in pricing are wide, and are expected to remain so in decades to come. Industrial consumers in Japan, Europe and China pay twice as much for electricity as in the US. These regional variations in electricity pricing are expected to persist for some time, reflecting rising demand for power particularly in the developing world.

One factor driving the price discrepancies is natural gas production. The US shale gas revolution has resulted in sharply lower prices there for gas, much lower than in Europe, Japan and China.

But the differentials also reflect the maturing energy landscape in parts of Asia as pricing is deregulated. China, for example, is in the throes of gas price reform. Artificially low prices have led to demand spikes that have strained the balance sheets of state-controlled resources companies. Over the past few years, China has introduced new pricing formulas and raised prices for industrial and commercial users. The moves should ease the burden on state-owned companies while enticing more investment to develop complex gas fields and support infrastructure.

17 **China's average gas prices**
$/MMBtu



Source: HSBC Research, General Administration of Customs

Cutting subsidies

Subsidy slashing usually means higher prices for householders though, which explains why many countries are unwilling to experiment with it. Fuel subsidies abound in Asia, not surprisingly perhaps as they lower the cost of fuel for the poor and deliver political dividends for the government in power.

Many countries are unwilling to experiment with subsidy slashing

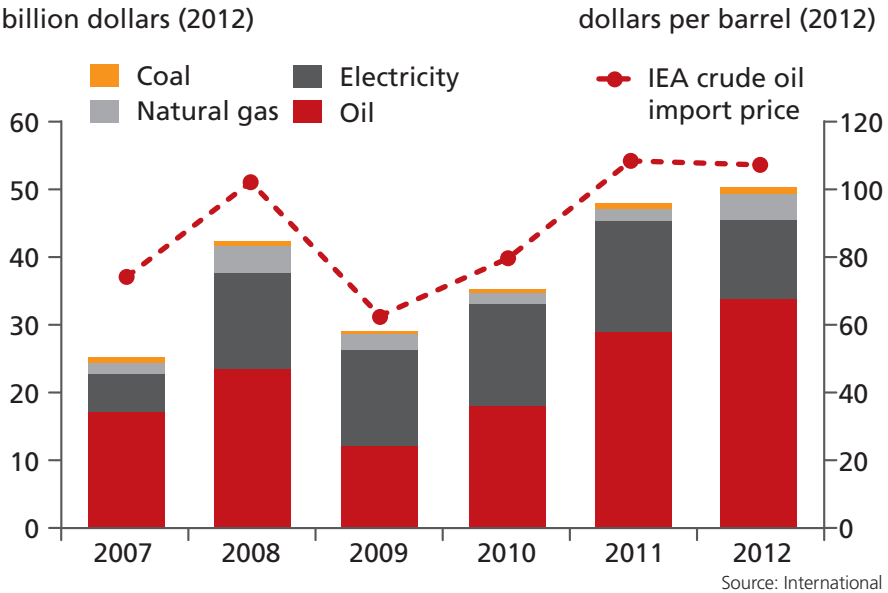
The problem is they significantly increase demand for subsidised fuels, usually fossil fuels, thereby stretching national budgets. Developed and developing countries in the Asian region were responsible for around $100 billion of the $480 billion in direct pre-tax subsidies disbursed globally in 2011 – equivalent to around 1% of regional GDP and 4% of total government revenues. That's money that could potentially be used to promote more efficient uses of energy, or improve the lives of the poor through welfare reform or better health services.

Political backlash

Dismantling subsidy programmes is a fraught endeavour for governments, however. Indonesia's attempts to cut fuel subsidies and raise the pump price in 2012 provoked violent protests that effectively shelved the plan. India tried to deregulate oil product prices in 2010, but watered down the proposals amid widespread discontent. The following year, it increased gas oil prices amid an unsustainable escalation of its fiscal deficit. Moves to reduce energy subsidies have also been announced in Thailand, Malaysia and Vietnam.

Clearly, removing subsidies causes political pain. But one of the many long-term gains could be more attention to energy efficiency as government finances are given space to explore this crucial area. These could include measures to impose stringent fuel economy standards, better building codes and energy performance standards for a wide range of

18 **Economic value of fossil-fuel subsidies by fuel in Asean**



Source: International Energy Agency

Subsidy cuts could give governments more leeway to explore energy efficiency solutions

products. In Southeast Asia alone, $350 billion in spending on energy efficiency would be more than offset by $600 billion in fuel savings over the next 20 years. Regional GDP could jump by 2% as lower energy bills translate into higher disposable income and greater economic activity.

Increasing allocation to renewables

The savings could also be used to boost the share of renewables in the region's energy mix. Most forms of renewable energy aren't yet competitive with fossil fuels and require subsidies to provide incentives for their use. Globally, subsidies for renewables hit $101 billion in 2012, but need to reach $230 billion by 2035 to support their deployment. Solar, wind and bioenergy fuels will continue to receive subsidies. But these should fall after 2030 due to rising wholesale energy prices, falling costs of renewable technologies, and the replacement of older plants with newer and cheaper capacity.

China will be doling out around $35 billion a year by 2030 to prop up renewables. But its bill is expected to start falling afterwards, and the long-term payoffs will come in the form of reduced dependence on expensive fossil fuels and greener growth. A continuing tilt to nuclear power in Asia could further balance costs with benefits. Nuclear power is less sensitive to fuel price fluctuations, and can therefore help to stabilise prices in deregulated markets.

Asia's Energy Future

Asia's economic miracle has been driven largely by dirty fuels like coal. Economies have expanded, but so too have smog-plagued cities and energy import bills. There is no silver bullet for a sustainable economic future. No one miracle fuel will power that future. Every fuel source has its downside, and often the choice of which to deploy comes down to a mundane calculation of dollars and cents.

That's understandable. The overwhelming priority for most governments is to keep economic growth ticking and provide ready access to energy for citizens and businesses. To achieve those goals, the region will continue to rely on time-honoured fuels like oil and coal.

But Asia has little choice but to embrace green growth. Demand for energy will rise regardless of how much the fuels cost on the global market. If this demand is met predominantly by dirty fuels, economic progress will come at the expense of a decent quality of life for the region's citizens.

Sustainable energy is the answer, but how to get there?

In 2012, Asia led the world's regions as a destination for clean energy investment

Each country will find its own path. But the clear trend is toward a cleaner and theoretically cheaper energy profile. In 2012, Asia led the world's regions as a destination for clean energy investment, accounting for 42% of the global total. That's encouraging, but it was driven largely by Northeast Asia, while South and Southeast Asia have been slower to respond to green growth imperatives.

For all Asians to reap the benefits of the region's growth miracle, lagging countries need to do more to diversify their energy mix. Fossil fuels, solar, wind, biofuels, nuclear and others will all have a role to play.

If Asia gets the mix right, the pain involved in that process will be easily surpassed by the long-term gains for its economies, businesses and citizens.

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