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Insight

What is the long-term outlook for energy demand in Thailand?

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6 While often used, GDP growth alone is inadequate in forecasting energy demand. Energy consumption, especially in the consumer-driven sector (comprising the residential, commercial, and transportation subsectors), does not track very well with GDP growth.

What then really drives long term energy demand? Consumer behavior; age and income levels; and urbanization. Consumer demographics make a huge difference. To illustrate this, consider two (representative) individuals. Khun Somporn is 30 years old, earns 10,000 baht a month, and lives in a rural area. Khun Somsajee is also 30, but earns 40,000 baht and lives in Bangkok. The latter spends nearly **seven** times more on energy than the former.

We develop an in-depth energy demand model using a bottom-up approach to forecast overall consumerdriven energy consumption over the next decade. Our methodology has been employed elsewhere but has not been readily applied in Thailand. Our model shows that energy demand in consumer-driven sector will grow from a compound annual growth rate (CAGR) of 3.5% in the past decade to 4% in the next one, or about 1.5 times within the next decade.

Such increasing consumption will create significant supply challenges. Power plant businesses will face challenges in developing new sources of supply to meet the growing demand, especially since resistance against new power plants is unlikely to go away any time soon. Alternative energy sources are likely to continue to be constrained by raw materials and high costs.

The best source of additional energy is to reduce waste and improve efficiency. Production and development of new energy sources require a lot of time and capital. Changing consumer behaviour can yield significant and sustainable improvements in energy outcomes. As an example, if every household used more energy efficient air conditioners (from energy label 3 to energy label 5), the annual energy savings are on the order of 800 megawatts (MW), equivalent to the output of a 20 billion baht power plant.

Because energy demand is likely to continue to outpace energy supply, business as usual may result in brownouts and blackouts, experiences which we have managed to avoid to date. We cannot continue to have it all. We cannot have more cars and more appliances, use energy in the same wasteful manner, while not allowing new power plants to be built. Something has to give. **Tough choices have to be made.**

What drives energy demand in the consumer-driven sector?

While often used, GDP growth alone is inadequate in forecasting energy demand. Energy consumption, especially in the consumer-driven sector, does not track very well with GDP growth. Figure 1 shows that GDP growth alone is not enough for explaining the trend of commercial energy consumption especially in the last few years when the GDP was declining but energy consumption in the commercial subsector was holding up. Therefore, what really drives long term energy demand?

GDP alone is not enough!



Final energy consumption can be divided into two main sectors based on sources of energy use: (1) industrial-driven sector, and (2) consumer-driven sector. This report focuses on the **consumer-driven sector,** comprising the (1) residential (2) commercial, and (3) transportation subsectors. The consumer-driven sector accounts for more than 60% of total final energy consumption and is more suited to a more in-depth, bottom-up approach.

Energy consumption in Thailand: facts and figures

,500



2,500

00 5,000 GDP per capita (USD) * Data for Vietnam is 2007 data. Source: SCB EIC analysis based on data from IMF, BP Statistical Review of World Energy

Consume natural gas and coal more

Thailand primary energy demand Unit: %



* CAGR refers to compound annual growth rate Source: SCB EIC analysis based on data from IMF, BP Statistical Review of World Energy

... and its energy efficiency remains relatively low compared with other ASEAN countries



Energy consumption in consumer-driven sector is more than half of total energy consumption

Thailand final energy demand <u>by energy type</u>

Unit: kilotonne of oil equivalent



Source: SCB EIC analysis based on data from DEDE

Drivers of energy demand in the consumer-driven sector include consumer behavior; age and income levels; and urbanization.

Higher incomes means much greater demand for electrical appliances. Our analyses based on Household Socio-Economic Surveys by the National Statistical Office, show that the demand for household appliances, both necessities and conveniences, increase sharply with income. Households with more than THB 15,000 monthly income possess air-conditioners, microwaves and computers about 4-6 times greater than those with monthly income lower than THB 15,000. (See Figure 6).

Higher income households buy more electrical appliances,
especially air conditioners and computers



Source: SCB EIC analysis based on data from Household Socio-Economic Survey in 2009 by National Statistics Office (NSO)

Urbanization matters. The proportion of electricity expenditures to total expenditures in the greater Bangkok area is about double that in rural areas. Electricity expenditures in the greater Bangkok area have also tended to increase over time, while it has remained flatter in rural areas. (See Figure 7).

7 An urban person spends twice as much on energy as a rural person



* Greater Bangkok is comprised of Nontaburi, Patumtani and Samutprakarn

** Rural figure is average energy expense of North, Central, South, and Northeast region

Source: SCB EIC analysis based on data from Household Socio-Economic Survey in 2009 by NSO

Aging also affects energy demand, especially in the transportation subsector. Thais aged 20-40 years tend to have the highest transportation energy expenditures, while those aged 30-40 years have the highest vehicle purchase expenditures. By contrast, residential energy demand does not change much with age. (See Figure 8).



To illustrate the impact of consumer demographics (age, income and location) on energy demand, we consider four representative consumers in Thailand. (See Figure 9). Khun Somporn is 30, earns 10,000 baht per month, and lives in a rural area. He spends 390 baht per month on energy expenses. Let us index this to 100 for ease of comparison. (While the names are made up, the figures are based on actual averages from household survey data, i.e., Khun Somporn represents the average of all households who share his characteristics.) Khun Sommai is also 30, but earns 40,000 baht per month, and also lives in a rural area. He spends over 4.6 times what Khun Somporn does on energy. Khun Somsajee is the same age and income level as the other two fellows, but lives in Bangkok. Her spending on energy is 6.8 times that of Khun Somporn! At the other end of the spectrum, consider Khun Sompong, who at 65 is much older than the other 30 years old. He spends only about 80% of what Khun Somporn does.

9 Income and location have a huge impact on energy consumption level



Source: SCB EIC analysis based on data from Household Socio-Economic Survey in 2009 by NSO

Temperature changes and global warming also affect energy demand in the consumerdriven sector. Electricity peak demand in Thailand is on an upward trend. In 2000-2009, electricity peak demand rose at a CAGR of 5% while the highest temperature in Thailand increased at an average of 0.1 degree Celsius annually.

Energy efficiency is key. This is particularly important for air conditioners, which consume a great amount of energy in the consumer-driven sector. **The Energy Efficiency Ratio (EER)**¹ of air-conditioner energy label No. 5 is currently 11.0, higher than that of 9.6 in 2002, resulting in a decrease in energy consumption by approximately 15%.

¹ EER figure shows energy efficiency of an air-conditioner. It is the ratio of BTU/hour to watt consumed.

$2^{\rm What \ is \ the \ long \ term \ energy \ consumption} \\ {trend \ in \ consumer-driven \ sector?}$

We develop an in-depth energy demand model using a bottom-up approach to forecast overall consumer-driven energy consumption over the next decade. Our methodology has been employed elsewhere but has not been readily applied in Thailand. Our model shows that energy demand in consumer-driven sector will grow from a compound annual growth rate (CAGR) of 3.5% in the past decade to 4% in the next one, or about 1.5 times within the next decade. The methodology and results are described in detail in Box: Methodology and the EIC energy demand model and Box: Future energy consumption in the consumer-driven sector.

2.1 Residential subsector

Increases in electrical appliances and temperature change will cause energy consumption in the residential subsector to grow at a CAGR of 3%, close to the growth rate in the past decade. We expect demand for electrical appliances to grow by 6% per year. We also take into account the improvement of energy efficiency by using the efficiency of air-conditioners (which are the most power-hungry appliances) as a proxy. We anticipate that EER in 2020 will reach 12.5, climbing up from 11.0 in 2010, i.e., an air-conditioner in 2020 would be 15% more efficient than in 2010, similar to the improvement rate in the past. The global surface temperature is projected to increase by almost 1 degree by 2020.² LPG price is expected to rise at a CAGR of 3%, close to the average figure during 2003-2010. Nevertheless, energy prices have not had as much impact on demand in the residential subsector to date as one might otherwise expect as the prices are controlled. We find that demand for electrical appliances is the major factor driving future energy consumption in residential subsector, contributing up to 2 percentage points of a total increase of 3%. (Calculation method for future energy consumption in residential subsector is shown in **Figure 10**. This method is pursued for forecasting energy consumption in other subsectors.)

D Energy consumption growth in residential subsector is driven mainly by increasing demand for electrical appliances



Source: SCB EIC analysis based on data from DEDE, Household Socio-Economic Survey in 2009 by NSO; EPPO; NESDB

² Please refer to a study by the South East Asia of the Global Change System for Analysis, Research and Training Regional Centre (SEA START RC), Chulalongkorn University which indicated that within 30 years, an average temperature in Thailand will increase around 3-4 degree Celsius.

Increasing demand on electrical appliances at a CAGR of 6% is mainly due to rising demand on electrical appliances for convenience. The number of air-conditioners, microwaves and computers will increase by about 3-4 times, resulting from households crossing over into higher income thresholds. (See Figure 11).



2.2 Commercial subsector

Office space expansion and temperature change should result in a CAGR of 5% energy demand in the commercial subsector, a slight decrease from 6% in 2000-2009. Should office spaces grow at the level close to a CAGR of 1.5% in 2001-2009 till 2020 and the global surface temperature rise around 1 degree Celsius within the next decade, electricity demand in commercial subsector will increase at a CAGR of 5% during the next 10 years. Price changes do not appear to have that much impact on energy consumption in commercial subsector. We again incorporate improving energy efficiency by including the efficiency of air-conditioners as a proxy. The 15% increase of energy efficiency will decrease energy consumption in commercial subsector by 8% as compared to a case in which the efficiency remains unchanged.

Box: Methodology and the energy demand model in consumer-driven sector by SCB EIC

Our in-depth energy demand model in consumer-driven sector is based partly on a methodology employed by the McKinsey Global Institute. Our model employs a bottom-up approach to forecast energy demand in each consumer-driven subsector—residential; commercial; and transportation—in the next decade (2020). Such an approach has not been readily applied in Thailand.

Our model considers key three dimensions: quantity; price; and energy efficiency. The quantity is driven mainly by changing consumer behavior on back of changing consumer demographics landscape. Our projection of demographic structure is built upon the latest population projection produced by the National Economic and Social Development Board (NESDB). With the projected demographic structure, we can estimate number of electrical appliances and automobile sale growth. **The price** is driven by energy price, including domestic retail price of gasoline and diesel. **For the energy efficiency,** we use improvement of energy efficiency of air-conditioner for residential and commercial subsector and use fuel consumption ratio of automobiles from a study by Laboratory for Energy and the Environment (LFEE), Massachusetts Institute of Technology (MIT) for transportation subsector. In addition to the aforementioned key three dimensions, we consider subsector-specific factors, such as, climate change, office space expansion, and number of flights to increase the rigorousness of the model.

Box: Future energy demand in the consumerdriven sector

Energy consumption in consumer-driven sector will grow 1.5 times in the next decade

Energy demand projection in consumer-driven sector Unit: kilotonne of oil equivalent 🔵 = CAGR 57,500 4.0% 38,786 ransportation 60% 3.5% 100% = 28.573 61% 63% Residential 25% 3.0% 26% 26% Commercial 2020F 2000 2009

Energy consumption in commercial subsector will grow 1.7 times, the highest of all consumer-driven subsectors

5.222

24%

76%

100 % =

3.117

23%

77%

Air transportation subsector will significantly outgrow road transportation subsector Energy demand projection in Energy demand projection in commercial subsector transportation subsector Unit: kilotonne of oil equivalent Unit: kilotonne of oil equivalent 🔵 = CAGR = CAGR 34,700 8.600 Other Petroleum products** 22% 15% NGV LPG Benzene and

100% =

18,022

27%

52%

2020F 2000 2009 2020F 2000 2009 * Transportation subsector includes road and air transportation, accounting for 96% of total transportation energy

consumption ** Petroleum products are comprised of LPG and kerosene

78%

Electricity

Source: SCB EIC analysis based on data from DEDE; Household Socio-Economic Survey in 2009 by NSO; EPPO; NESDB; Thailand Automotive Institute; Airports of ratory for Energy and the Environment, MIT; The Boeing Company



the next decade

Energy consumption in residential subsector

will continue to grow around 5% annually in

🔵 = CAGR

Fuel wood and charcoal

Petroleum products**

Electricity

Energy demand projection in

23,488

3%

48%

1.5%

2.5%

.3%

19%

17%

42%

gasoho

Jet fuel

Diesel and bio diesel

residential subsector Unit: kilotonne of oil equivalent

2.3 Transportation subsector

Energy demand in the transportation subsector is projected to grow from a CAGR of 3% in 2000-2009 to around 3.5% in the next decade, owing mainly to an expansion of automobile sales and tourism. Road transportation is driven by car sales, expected to increase at a CAGR of 5%. Demand on diesel fuel increases by about 2.5% and accounts for almost half of total energy demand in transportation subsector, resulting from intensifying commercial car sales. On the other hands, demand on gasoline (benzene and gasohol) is projected to grow moderately at a CAGR of 1.5%. This is partly on back of preference changes in using smaller-sized cars, especially those with engine smaller than 1,500 cc, accounting for more than 50% of total passenger car sales. Such preference changes are compatible with government policy to promote eco car production and also moderate demand for gasoline. However, gasoline demand growth is expected to decelerate only slightly because eco car sales tend to grow remarkably owing to its affordable price by lower-income segment. In addition, price change strongly affect the road transportation subsector. From our analysis, a 1% increase in fuel prices lowers energy consumption in the road transportation subsector by about 0.2%.

Improving energy efficiency of automobiles will lower fuel demand by approximately 6% in the next decade. Automobile manufacturing technologies have developed greatly during the past decade. For example, the fuel consumption rate of a 1,600 cc car improved by about 15% from 14 kilometers per litre in 2000 to 16 kilometers per litre in 2010. Furthermore, a study by the Laboratory for Energy and the Environment (LFEE) at the Massachusetts Institute of Technology (MIT) expects that energy efficiency in 2000-2020 will increase by 35%. If energy efficiency is improved as suggested by the study, fuel demand in the road transportation subsector will decrease by around 6%.

Energy demand in the air transportation subsector is likely to rise significantly from an increasing number of flights by 7% in the next decade on back of tourism upward trajectory trend. Based on the study of World Travel Trend 2009/2010 by the Boeing Company, it is estimated that intra-regional travel within Asia will grow by 7% in the next decade (see Figure 16). Such growth will boost jet fuel demand by 5%

16 Number of intra-Asia flights is growing



Source: SCB EIC analysis based on data from The Boeing Company

Box: Short-term outlook for energy sector

We expect short-term energy sector revenue in 2011 to grow by 10%, largely from coal, resulting from rising coal prices on the back of high electricity demand from China. Energy businesses we analyze include coal; refinery; aromatics; and olefins. For the short-term outlook, revenue of oil refinery businesses is expected to grow strongly due to an exhausted capacity surplus and the shutdown of some refineries. Such tightened supply will result in an upward trend of refinery margins. However, petrochemical businesses will also encounter additional pressure from new supply capacities especially olefins businesses. Consequently, the spread between petrochemical product prices and raw materials will narrow. Although GDP alone is inadequate to forecast the long-term energy outlook, it is an important driver affecting the energy business, especially over the short-term. Overall, improved refinery margin will result in better net earnings before interest, tax, depreciation, and amortization (EBITDA) compared to 2010.



7 Examples of drivers affecting revenue of oil refinery and petrochemical-aromatics businesses

* Weight of oil usage is comprised of (i) domestic 80% (main driver is GDP by sector: transportation 56% manufacturing 8% agriculture 9% others 7%) (ii) export 20% (main driver is GDP of Asia) Weight of aromatics usage is comprised of (i) domestic 60% (main driver is Thai GDP on manufacturing sector) (ii) Export 40% (main driver is GDP of Asia)

** refers to cost of goods sold

*** refers to selling, general and administrative expense

Source: SCB EIC analysis based on data from NESDB; Bloomberg; Reuters; Datastream

18 Energy business continues to increase, especially coal business

| | | | poor | good |
|---------------------|---|--|--|--|
| Main driver | Oil refinery and petrochemical aromatics | Petrochemical (olefins and polyolefin) | Downstream petrochemical (resins, polymers and plastic) | Production of coal and electricity generating |
| | 1 | 2 | 3 | 4 |
| Product prices | | | | |
| Sale volume | | | | |
| Cost of goods | sold 🌙 | | | |
| Impact on EBITDA | | | | |

Source: SCB EIC analysis based on data from companies' income statement; NESDB; Bloomberg; Reuters; Datastream

3 Implications to business stakeholders

Based on our analyses and interviews with industry experts, energy businesses, especially power plants, will continue to face challenges finding new energy sources to meet future demand. Power plant businesses will encounter challenges to diversify energy sources for electricity generation in line with the government's Power Development Plan (PDP) 2010-2030. At present, electricity generation using natural gas accounts for up to 70%. Coal power plants face environmental issues. Nuclear power continues to experience many roadblocks.

Because Thailand has not had the misfortune to experience widespread brownouts and blackouts, the need to build new power plants may appear to not be an urgent issue. This is not the case. Thailand has hardly experienced widespread brownouts or blackouts, thanks to the country's reserve which currently stands at about 30% of the total electricity generation. However, amidst growing demand on electricity and continuing resistance against the construction of new power plants, the PDP reserve margin is expected to drop to 15% in the next 10 years. If this persists, we face the increasing likelihood of brownouts or blackouts in some areas.

Renewable energy is only a small part of the solution. Its share is still small compared with total electricity demand. The PDP determines that not less than 5% of total electricity must be generated from renewable energy. Nonetheless, 5% is quite small, only 4,617 MW out of the peak demand which is expected to reach 52,890 MW in 2030. Electricity generation from renewable energy faces significant constraints such as high costs, volatile raw material prices, and risks from raw materials shortages. There are specific business opportunities in renewables, e.g., agricultural business whose waste can be used to supply power plants.

Petroleum businesses have to overcome challenges from government policies and changing demand. The problem of LPG and NGV prices is not a new issue. This makes petroleum businesses lack the incentive to expand their investment on infrastructure, such as, pipelines, trucks, and distributing stations.

The best source of additional energy is to reduce waste and improve efficiency. Production and development of new energy sources require a lot of time and capital. Changing consumer behaviour can yield significant and sustainable improvements in energy outcomes. As an example, if every household used more energy efficient air conditioners (from energy label 3 to energy label 5), the annual energy savings are on the order of 800 megawatts (MW), equivalent to the output of a 20 billion baht power plant. **(See Figure 19).**



19 Using more energy efficient air-conditioners can save us one 800 MW power plant worth THB 20 billion

Advanced automobile technologies can also help reduce fuel consumption. If hybrid cars increase from 0.01% in 2009 to 10% of total registered cars in 2020 with 20% lower fuel consumption (an estimate from a study by Laboratory for Energy and the Environment of MIT), fuel demand in the transportation subsector could drop by around 1% or 300 million litres of fuel, about 4% of total gasoline and gasohol sales in 2009.

Because energy demand is likely to continue to outpace energy supply, business as usual will result in an increasing chance of brownouts and blackouts in the future. We cannot continue to have it all. We cannot have more cars and more appliances, use energy in the same wasteful manner, while not allowing new power plants to be built. Something has to give. We need to make some tough choices.

| SCB EIC summary mai | in forec | asts | | | | | | | | As o | f October 2010 |
|-----------------------------------|-----------|---------------|---------|--------|-------|-------|---------|-----------|-------|--------------|----------------|
| | 2009 | | ł | \ctual | | | SCB EIC | forecasts | | Consensus | BOT |
| | Share (%) | Unit | 2009 | 10Q1 | 10Q2 | 10Q3 | 10Q4 | 2010 | 2011 | 2011 | 2011 |
| Real GDP growth | | ХО У % | -2.2% | 12.0% | 9.1% | 6.0% | 2.7% | 7.3% | 3.7% | 4.3% | 3.0-5.0% |
| Demand-side | | | | | | | | | | | |
| Private consumption | 53% | ХОУ % | -1.1% | 4.0% | 6.5% | 2.0% | 0.5% | 3.2% | 3,9% | 3.8% | 3.5-5.5% |
| Public consumption | 10% | X0Y % | 5,8% | 7.3% | 6.3% | 5.3% | 0.4% | 4.8% | 6.1% | | 2.5-4.5% |
| Investment (GFCF) | 21% | хоу % | -9,0% | 12.9% | 12.2% | 5.5% | 5.1% | 8.8% | 4,0% | 5,9% | |
| Private investment | 15% | хоу % | - 12,8% | 15.8% | 18.5% | 7.3% | 5.0% | 11.5% | 3.7% | | 8.0-10.0% |
| Public investment | 8% | X0У % | 2.7% | 3,8% | -3,4% | 2.0% | 5.5% | 1.7% | 4.7% | | 2.0-4.0% |
| Supply-side | | | | | | | | | | | |
| Agriculture | %6 | ХОУ % | -0.5% | -0'8% | -1.1% | -2.2% | 1.7% | -0,3% | 2.8% | | |
| Manufacturing | 39% | X0Y % | -5.1% | 22,9% | 18,0% | 12.7% | 5.1% | 14.3% | 5.0% | | |
| Services | 52% | ХОУ % | -0.3% | 6.6% | 4.0% | 2.1% | 1.1% | 3.4% | 2.8% | | |
| External sector | | | | | | | | | | | |
| Export growth excl. gold (USD)* | | ХОУ % | -16% | 44% | 34% | 25% | 10% | 27% | 11% | %6 | 11.0-14.0% |
| Import growth excl. gold (USD)* | | X0Y % | -25% | 52% | 49% | 27% | %6 | 33% | 15% | 11% | 13.5-16.5% |
| Current account* | | USD bln | 20.3 | 5.7 | 1.7 | 2.0 | 4.3 | 13.7 | 10.9 | 11.4 | 5.0-8.0 |
| Key rates | | | | | | | | | | | |
| Headline inflation* | | ХОУ % | -0,9% | 3.8% | 3.2% | 3.3% | 2.8% | 3.3% | 3,0% | 3.1% | 3.0-5.0% |
| Core inflation* | | ХОУ % | 0.3% | 0,4% | 0,9% | 1.1% | 1.2% | 0.9% | 1.3% | | 2.0-3.0% |
| Policy rate (RP-1D) (end period)* | | % p.a. | 1.25% | 1.25% | 1.25% | 1.75% | 1.75% | 1.75% | 2.25% | | |
| THB/USD (period average)* | | THB/USD | 34.3 | 32.9 | 32.4 | 31.6 | 29.4 | 31.6 | 28.2 | | |
| THB/USD (end period)* | | THB/USD | 33.2 | 32.5 | 32.5 | 30.8 | 29.0 | 29.0 | 27.5 | | |
| THB/EUR (end period)* | | THB/EUR | 47.5 | 44.1 | 39'6 | 40.3 | 40.7 | 40.7 | 37.4 | | |
| THB/JPY (end period)* | | THB/JPY | 37.1 | 35.8 | 37.1 | 35.0 | 34.2 | 34.2 | 33.5 | | |
| THB/CNY (end period)* | | THB/CNY | 4.9 | 4.8 | 4.8 | 4.6 | 4.4 | 4,4 | 4.2 | | |
| Oil prices –WTI (period average)* | | USD/bbl | 61.7 | 78.6 | 77.8 | 76.1 | 79.3 | 78.0 | 83.0 | | |
| Oil prices –WTI (end period)* | | USD/bbl | 74.5 | 81.2 | 75.3 | 75.2 | 79.0 | 79,0 | 85.0 | | |
| International tourists* | | КОУ | -3% | 28% | -4% | 12% | -3% | 8% | 5% | as of Oct-10 | as of Oct-10 |
| | | | | | | | | | | | |

* 2010Q3 figures are actual Source: Consensus Economic, Bank of Thailand; SCB EIC forecasts

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