New regulations in Thailand provide a significant boost to small CHP and distributed renewable energy generation. The prognosis for viable, small-scale generation is good but, as Chris Greacen writes, new distributed generation schemes may have to compete with plans for new centralized plants.

An emerging light

Thailand gives the go-ahead to distributed energy

Thanks to regulations launched on 7 December last year, decentralized electricity (DE) generation in Thailand promises to be considerably more profitable than it has in the past. The regulations lay the framework for the development of many smaller-scale CHP opportunities that had not previously been considered commercially viable. The new regulations have two key features:

- streamlined interconnection and 'net metering' for efficient fossil-fuel fired combined heat and power (CHP) generation and renewable energy up to 10 MW per installation
- attractive feed-in tariffs for electricity from renewable sources.

The regulations may well mean that shrewd investors find that smaller, cleaner projects are better investments offering lower risk, fewer headaches and higher returns than large-scale centralized generators.

This article takes a chronological approach, starting with Thailand's past DE regulations and their results to date. This provides the context for interpreting of the new regulations and their implications. It ends with a discussion of the barriers to large and small private power production in Thailand.

SMALL POWER PRODUCER (SPP) PROGRAMME

Thailand's first foray into private sector decentralized energy began in 1992 with the passage of the Small Power Producer (SPP) regulations. Modelled on the US Public Utilities Regulatory Policies Act (PURPA) regulations, the SPP programme is a power-purchasing programme set up by the National Energy Policy Council (NEPC) and the Electricity Generating Authority of Thailand (EGAT) (the state-owned utility in charge of generation and transmission) to promote power generation from renewable fuels or in cogeneration facilities in the private sector.

The SPP programme applies to both CHP (generally using natural gas or coal) and renewable energy. Under the

Thailand's new regulations will favour the development of small-scale renewable and distributed generation, such as this combined cooling, heating and power plant at the new Suvarnabhumi International Airport in Bangkok (Palang Thai)

Table 1. Average tariffs paid to firm and non-firm SPP generators, 1995–2006

Year	Average price (baht/kWh) [a]	
	Non-firm	Firm
1995	1.05	1.30
1996	1.14	1.32
1997	1.36	1.51
1998	1.30	1.84
1999	1.24	1.72
2000	2.00	1.87
2001	2.01	2.23
2002	1.73	2.20
2003	1.59	2.21
2004	1.74	2.27
2005	1.84	2.39
2006 (Jan–Sept)	2.10	2.56

[a] 1 Baht = 2.98 US cents or 2.27 Eurocents (23 February 2007)

Source: Energy Planning and Policy Office (EPPO), Thailand; http://www.eppo.go.th/power/data/data-website.xls

regulations, each generator could export up to 90 MW of power. Generators were divided into 'firm' and 'non-firm' based on their ability to guarantee availability. Firm projects received both a capacity payment and an energy payment indexed to natural gas prices, while non-firm generators received only the energy payment. These tariffs were based on the long-run avoided capacity and energy cost for electricity generated by EGAT. As of September 2006, firm SPP generators received 2.56 baht/kWh (5.4 Eurocents/kWh) and non-firm generators received, on average, 2.10 baht/kWh (4.4 Eurocents/kWh) – see Table 1.

Under the SPP programme, 78 generators are now selling power to the grid, with installed capacity of 4145 MW (Table 2). The generators are under contract to sell 2333 MW to the grid (the difference is used for self-consumption). Of this, 989 MW of installed capacity (430 MW sales to grid) are renewable energy. The remainder are fossil-fuel-fired – mostly natural gas (2277 MW) and coal (392 MW).

But after only six years, the SPP programme hit a major snag. In 1998 and citing the power generation capacity glut that followed the Asian financial crisis, the Thai Cabinet granted a ruling that EGAT no longer had to accept any new applications from fossil fuel CHP. News of the Cabinet ruling led to a last-minute rush to sign fossil-fuel fired CHP contracts (Figure 1). Since 1998, all new SPP contracts have been for renewable energy generators.

The Cabinet was influenced, in part, by EGAT's complaints about the SPP programme; EGAT – and even some SPP generators – felt that the regulations are too lax and were not fulfilling the government's goal of supporting clean, efficient CHP. In order to qualify, generators had to:

- utilize 10% of waste steam energy
- achieve a combined overall average efficiency (electrical plus thermal) of at least 45%.

Fulfilling these conditions, EGAT argued, was too easy, leading overall to little or no efficiency gain over the status quo of combined-cycle gas turbine (CCGT) generation.

To compound the problem, the projected steam customers for a number of the initial fossil-fuel SPP plants failed to materialize after they were built. In 1997, the Government stepped in to waive the 10% steam requirement for three years. In 2000,

Under the regulations, each generator could export up to 90 MW of power

the steam requirement waive was extended, this time until 2003, after which a penalty system was put in place for failing to meet steam usage. In practice, though, the regulations were light on the specifics of steam measurement, opening the door for abuses in reporting compliance with efficiency and steam requirements.

Since 2004, the Thai government has approved – and EGAT has started building – 2800 MW of new centralized fossil fuel power plants – an indication that the capacity glut argument no longer holds. Moreover, EGAT has built its own joint-venture CHP facility while the private sector has so far not been allowed to build more fossil fuel CHP. The Government, utilities, private

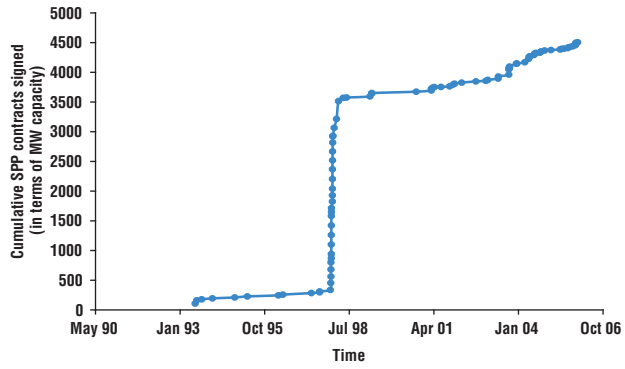


Figure 1. Cumulative SPP contracts signed, measured in MW of generating capacity. Source: EPPO, http://www.eppo.go.th/power/data/data-website.xls

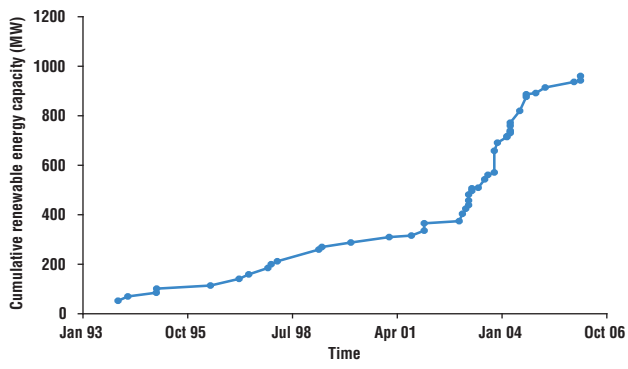


Figure 2. Cumulative renewable energy SPP contracts signed, measured in MW generating capacity. Source: EEPO, http://www.eppo.go.th/power/data/data-website.xls

Table 2. SPP generators supplying power to the grid, August 2006

Fuel	Number of projects	Generating capacity (MW)	Sale to EGAT (MW)
Non-conventional energy			
Bagasse	31	605.40	181.80
Paddy husk	5	53.40	41.80
Paddy husk, wood chips	2	57.80	49.00
Black liquor	1	32.90	25.00
Municipal waste	1	2.50	1.00
Waste gas from carbon black manufacturing	1	19.00	6.00
Bagasse, wood bark, paddy husk	3	114.90	64.00
Palm residue, cassava root	–	–	–
Paddy husk, bagasse, eucalyptus	1	3.00	1.80
Wood bark, wood chips, black liquor	1	87.20	50.00
Rubber wood chips	–	–	–
Bagasse, paddy husk, biomass	2	–	–
Natural gas by-product of crude oil	–	–	–
Corncobs, cassava rhizome, paddy husk	–	–	–
Total	*48*	*988.60*	*429.90*
Commercial energy			
Natural gas	21	2277.61	1465.20
Coal	4	392.20	196.00
Oil	1	10.40	9.00
Total	*26*	*2680.21*	*1670.20*
Mixed fuel			
Waste gas from production process/oil/coal	1	108.00	45.00
Black liquor/coal	1	40.00	8.00
Coal/eucalyptus bark	2	328.00	180.00
Total	*4*	*476.00*	*233.00*
Total	**78**	**4145**	**2333**

Source: EPPO. http://www.eppo.go.th/power/data/data-website.xls

sector and public interest organizations must now work together to reform the SPP regulations so that a new, better programme rises from its ashes, with stipulations that incentivize higher overall energy saving gains.

Renewable energy SPP generators were not restricted by the 1998 Cabinet ruling and the cumulative capacity from signed contracts has grown over the years (Figure 2). Renewable energy projects developed under the SPP programme so far have been exclusively biomass-fuelled, with the majority (31 projects) using bagasse from sugar mills (Table 2). Wind, solar and small hydro have not proved viable under the tariffs offered in the SPP programme.

VSPP PROGRAMME

The SPP programme led to a significant increase in renewable energy capacity, but the complexity of regulations and the low tariff produced only fairly large biomass projects. The average SPP renewable energy project size is 18 MW, and virtually none were built of less than 6 MW.

The Very Small Power Producer (VSPP) regulations were drawn up to provide streamlined interconnection arrangements for smaller renewable energy generation. Approved by Thai Cabinet in May 2002, the original VSPP regulations were modelled on net metering laws in the US and other countries. The regulations allow customers with renewable energy generators (solar, wind, micro-hydro, biomass, biogas, etc.) up to 1 MW (power export) to connect their generators to the grid and offset their consumption at retail rates. (Note that if the customer's load is significant, this means that their renewable energy generator could actually be larger than 1 MW as long as the net maximum outflow to the grid remained 1 MW or less.)

If a net surplus of electricity is generated, the VSPP regulations stipulate that Thai distribution utilities – Metropolitan Electricity Authority (MEA) in Bangkok and Provincial Electricity Authority (PEA) in the rest of the country – must purchase this electricity at the same tariff as they purchase electricity from EGAT. This is typically about 80% of the retail rate. An important feature of the tariff structure is that there is no firm versus non-firm distinction as for the SPP programme. Instead, generators receive higher tariffs during peak times.

The rate is adjusted every three months in response to changes in natural gas prices. In autumn 2006, VSPP plants received 3.8 baht (8.0 Eurocents) per kWh for on-peak hours (weekdays 9 am to 10 pm) and about 2.0 baht (4.2 Eurocents) per kWh for off-peak hours (weekends, holidays and night time).

In just over four years, 97 generators came on line under the VSPP regulations (Table 3), with a total of 16.8 MW generating capacity. Compared with SPP generators, the VSPP programme involves a much wider range of fuels from solar photovoltaic (PV) (66 installations) through biogas (16 installations) to various types of biomass (total of 15 installations). Because the VSPP programme was capped at 1 MW (power export) per

Table 3. VSPP electricity by fuel type, September 2006

Fuel	MEA		PEA		Total	
	No.	Maximum capacity to grid (kW)	No.	Maximum capacity to grid (kW)	No.	Maximum capacity to grid (kW)
Solar cell	44	6.5	22	59.8	66	66.3
Biogas	1	950.	15	8180	16	9130.0
Paddy husk	–	–	5	3235.0	5	3235.0
Wood chips	–	–	1	400.0	1	400.0
Palm oil bunch	–	–	3	3000.0	3	3000.0
Rice straw	–	–	6	1030.0	6	1030.0
Total	**45**	**956.5**	**52**	**15,904.8**	**97**	**16,861.3**

Source: EPPO http://www.eppo.go.th/power/data/data-website.xls

installation, the generators are much smaller and cumulative installed capacities under the VSPP programme have been modest compared with the SPP programme. However, this may be about to change.

VSPP EXPANDED TO 10 MW CHP

In December 2006, the Thai government launched an important upgrade to the VSPP regulations. The upgrade has several important features.

First, eligibility was expanded to clean fossil-fuel-fired CHP plants. Compared with the SPP programme, the requirements regarding use of waste heat are more stringent. Thailand adopted criteria similar to those used in Germany's CHP programme: fossil-fuel-fired CHP generators that connect under the VSPP programme must prove primary energy savings (PES) of at least 10% to avoid penalties. PES refers to the energy savings from CHP compared with a reference case in which an equivalent amount of electricity and heat are produced by conventional means (conventional non-CHP power plant and boiler).

The second feature of the new regulations is that the net export threshold is expanded tenfold to 10 MW. This opens up significant opportunities for generators that would not have been cost-competitive at the 1 MW level.

Under the new regulations, the net export threshold is expanded tenfold to 10 MW

Accompanying the expansion is a requirement that generators must meet Thai air quality standards; for example, a 10 MW biomass plant using an inefficient boiler could have a significant local environmental impact.

The third key commitment launched in December is that Thailand will provide a per kWh subsidy addition for renewable energy from VSPPs (Table 4). The tariff, which depends on the type of renewable energy, is additional to rates previously paid to VSPP generators and will be paid for the first seven years after each generator's commissioning date.

CHP POTENTIAL IN THAILAND

In 2006, the Thai Ministry of Energy's Energy Planning and Policy Office (EPPO) commissioned a study[1] to estimate the quantity of commercially viable new CHP in 817 existing factories and 966 existing commercial buildings located in areas that will be served by planned Thai natural gas pipeline expansion. The study concluded that commercially viable CHP new potential capacity is about 3300 MW.

In factories, the study considered natural gas combustion engines and gas turbines with waste steam used to offset natural gas, heavy fuel oil or coal in steam boilers. In commercial buildings, the study considered small (< 5 MW) combined cooling heating and power (CCHP) units using gas engines together with absorption chillers. MW and GWh reductions thus come from two sources:

Table 4. Subsidy addition for renewable VSPP

Fuel	Baht/kWh	Eurocents/kWh (approx.)
Biomass and biogas	0.3	0.65
Hydropower (<50 kW)	0.8	1.73
Hydropower (>50 kW but <200 kW)	0.4	0.86
Wind and municipal waste	2.5	5.39
Solar	8	17.25

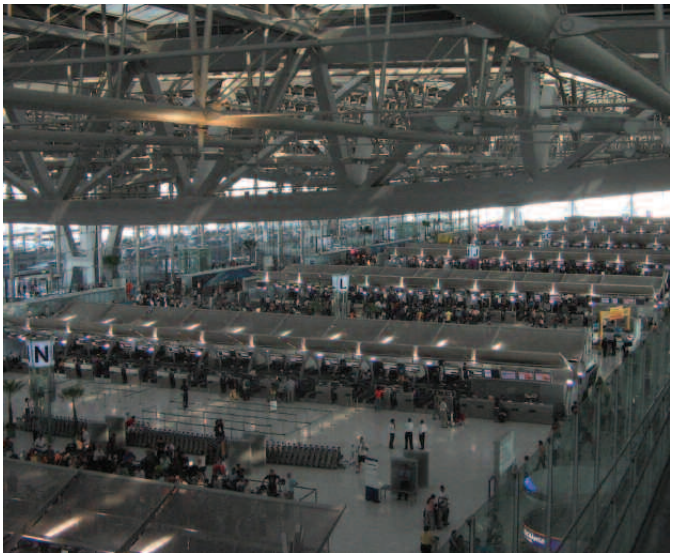
- electricity is directly produced by the CHP unit, offsetting local loads and contributing excess electricity to the grid
- waste heat is used to drive absorption chillers that substitute for electrically powered air conditioning.

CCHP plants are particularly appropriate for Thailand because the country's peak electricity consumption is driven by air conditioning. Instead of drawing from the grid during the peak load time, CCHP plants put the most energy into the grid during these periods. In addition, they provide electricity near load centres, reducing the burden on the transmission network.

An impressive example, which predates the VSPP upgrade, is the CCHP plant that cools Thailand's new flagship Suvarnabhumi International Airport. Low-pressure steam from the 55 MW CCGT is used to chill water that provides all the cooling needs for the world's second largest airport terminal (563,000 m²) and surrounding facilities. The CCHP project is a joint venture between EGAT, MEA and the Petroleum Authority of Thailand (PTT).

LARGE CENTRALIZED GENERATORS – BIG FUTURE OR BIG MISTAKE?

As Thailand's post-Asia power generation capacity crisis slowly evaporates, the Government is considering inviting bids for 3000–4000 MW of large-scale centralized independent power producers (IPPs). Due to concerns about the diversity of the country's fuel supply (natural gas accounts for 70% of



All cooling at the Suvarnabhumi International Airport and surrounding buildings is provided by CCHP (Palang Thai)

SPP CHP PROFILE
Bangkok Cogeneration Company Limited

Location: Map Ta Phut Industrial Estate, Rayong, Thailand
PPA signed: July 1996
Total electrical capacity: 113 MW
Sales to EGAT: 90 MW
Sales to Bangkok Industrial Gas Company Ltd: 16 MW
Electrical efficiency: 48%
Waste steam: accounts for 11% of total fuel energy input to power absorption chillers for air products industry
Joint venture partners: Air Products and Chemicals Inc (USA), Natsteel Ltd (Singapore), Hua Kee Company Ltd (Thailand), Chatri Sophon Company Ltd (Thailand), Bangkok Industrial Gas Company Ltd (Thailand)

The project began in the middle of 1995 in response to the Government's policy to promote power generation by private sector under the SPP programme. BCC submitted an application to EGAT in April 1996 to build a 113 MW cogeneration power plant and to sell 90 MW of power to EGAT. EGAT approved the proposal and the Power Purchase Agreement (PPA) between BCC and EGAT was signed in July 1996.

A 113 MW CHP plant sells power to EGAT, the state-owned utility (Bangkok Cogeneration)

Thailand's electricity), the Government has stated a preference for coal-fired generation. But coal is also the fuel most opposed by local communities and the most problematic from a global warming perspective.

In the past, large centralized IPPs have proved risky for investors and ratepayers alike. Thailand launched its IPP programme in December 1994. The one-time bidding process attracted 88 bids from 50 participants. Of these, only seven were selected – four natural gas plants and three large coal-fired plants totalling 6677 MW. Most of these projects would have been killed by the dramatic devaluation of the Thai baht that occurred in 1998, but survived when the government stepped in to re-negotiate contracts so that payments were indexed to the US dollar.

Nevertheless, five of the seven plants were delayed due to a combination of factors (a glut of generating capacity and difficulty raising finance) arising from the Asian financial crisis. Two of the three coal projects (Gulf Electric/Bo Nok and Union Power) were derailed by community opposition and were ultimately re-sited and changed to gas-fired generation. In the ensuing dispute, a community leader was gunned down by assassins, hardening the bitter feelings harboured by villagers against developers of large fossil-fuel power plants. The third coal fired power plant (BLCP) managed to overcome community opposition and will come on line, albeit several years late.

Consumers were upset that, even when projects turn out to be superfluous to electricity demand for a number of years, they were ultimately forced to pay for the unused capacity through 'take or pay' contracts that left the key risks on their shoulders.

In the current round under consideration, the long lead time for big projects poses heightened risks. A local newspaper quoted an energy executive's concerns about the limited tenure of the current post-coup Thai government compared with the time required for the project cycle: 'The [IPP] bidding could be annulled as the power-purchase agreement will be signed by the next government.'[2] Situations like these can have implications for the cost of finance, raising interest rates for loans.

Risks arising from community opposition and from the uncertain policy environment surrounding these large projects conspire with the increasingly clear – and frightening – reality of human-induced global climate change. Thailand is a non-

Large centralized independent power projects have proved risky for investors and ratepayers alike

Annex I country under the Kyoto Protocol and therefore is not required to curtail emissions. But many believe that building centralized coal-fired generation sends the wrong message to countries like the US and Australia that refuse to ratify Kyoto if non-Annex I countries are allowed to pollute. And more future coal combustion, whatever country it occurs in, increases the risks of catastrophic climate change.

VSPP PROFILE
SPM Farm biogas

Location: Ratchaburi, Thailand
Fuel: Methane from pig manure
Commissioning date: September 2003
Total electrical capacity: 500 kW
Sales to PEA: 150 kW

Biogas digestor at SPM farms produces enough gas for 500 kW of generation (EPPO)

Modified truck engines and induction generators burn biogas to generate electricity at SPM farms (EPPO)

BARRIERS, YET OPPORTUNITIES

Considerable, but surmountable, barriers continue to slow down deployment of decentralized energy in Thailand. One major barrier to natural-gas-fired CHP is the pipeline system, which is owned and operated by PTT. The monopoly system is limited in scope and has been slow to expand. Discussions are underway to allow third-party pipeline developers to speed up the process, but so far progress has been slow.

Another key barrier is that decentralized energy is at present virtually ignored in the power sector planning process. Thailand's Power Development Plan (PDP) developed by EGAT includes only centralized fossil fuel, hydropower and nuclear power as options. Past PDPs have all significantly overestimated demand, resulting in over-building of conventional power plants. Another future glut of conventional generation is likely to reduce markets for DE.

A third key barrier is that Thailand has yet to establish a competent, fair and independent regulatory authority whose core mandate is to ensure that decisions made in the energy sector are in the public interest, and which has sufficient legal authority to enforce compliance.

Despite these barriers, the economic prognosis for viable and profitable SPP and VSPP projects is positive. Work is underway by government and civil society groups to address these challenges through:

- reforms to the power sector planning process
- amendments to existing electricity sector legislation that will establish an independent regulatory authority.

With the likelihood that tariffs paid to SPPs will continue to increase year-over-year (they have doubled since 1995), there is more reason for optimism that this will lead to increased investment in efficient decentralized electricity. In addition, for VSPPs, the good news is that the net-metering programme now accommodates sales to the grid of up to 10 MW per installation. Furthermore, the Suvarnabhumi International Airport CCHP project exemplifies the tremendous benefits that can be achieved by utilizing this more energy-efficient technology.

Already in the pipeline are hundreds of megawatts of new private sector biomass and biogas

The market is now ripe for prudent investors and project developers. EGAT is considering installing 198 MW of fossil-fuel CCHP under the VSPP programme. The CHP units will employ absorption chillers to cool inlet temperatures in 13 existing centralized combined-cycle power plants, raising their capacity by 951 MW. Already in the pipeline are hundreds of megawatts of new private sector biomass and biogas, a minimum of 30 MW of wind power, and (at least) dozens of megawatts of new fossil-fuel fired CHP for installation in shopping malls and other commercial buildings. Based on the growing momentum for such projects in Thailand, it is likely that DE will become a major player in the Thai power sector within the next few years.

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Palang Thai helped draft the initial VSPP regulations and worked with the Thai Government on the regulation upgrade. Funding from the Mekong Programme on Water Environment and Resilience (MPOWER), Global Green Grants and Oxfam Australia support this work.

NOTES

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