SMART START

OPPORTUNITIES FOR MODERNIZING THE POWER BUSINESS IN ASIA

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EXECUTIVE SUMMARY

The power sector, and especially that of developing Asia, is in the midst of challenging and exciting times. Efficiency and clean technologies are now being emphasized in an industry which has traditionally been the provider of inexpensive power for burgeoning urban centers and industrials that contribute significantly to employment and GDP. Power providers are under pressure from technologies that are potentially disruptive, and in conjunction with environmental policy may result in some of their assets being 'stranded' or no longer viable. Developing Asia's power industry now has to meet aggressive CO2 targets, but still accommodate economically sensitive areas; it has to continue to be financially sound and avoid unnecessary risks, but also modernize its portfolio and invest to mitigate potential disruption.

The risk/reward profile of the power industry is significantly higher than it was a decade ago and power companies are attempting to adjust their internal processes to navigate this new environment. Both the power industry and regulators see potential for scaling-up clean energy solutions, but are grappling with risks associated with technical maturity, and complex issues around standardization and interoperability. While there has been significant progress in creating solutions for improving energy efficiency and decreasing humankind's impact on the environment, we are constantly reminded that all proposed solutions have their own technical and non-technical barriers to implementation, and different impacts to various stakeholders.

Crafting and implementing plans to power bolster systems, and deliver affordable, clean energy, isn't easy.

From our work throughout Asia, we have seen common threads in terms of opportunities for improving the power sector for both regulators and power companies. Below we highlight four areas for Asia's regulators and power companies that we believe are relevant to their current challenges, that are technically and economically feasible, and that have relatively low stakeholder resistance.

1. **Valuing storage, and validating it as a billable service.** Crucial to meeting CO2 targets is recognizing and rewarding the importance of power storage in integrating intermittent renewable energy. Especially in developing countries where weaker grids struggle to integrate intermittent renewable energy, storage in conjunction with demand side management (DSM) needs to be recognized as a crucial enabler of renewable energy integration. Power companies need to work with regulators in developing transparent and effective storage markets which maximize the potential of renewable energy. Rather than expect cash-strapped grids to install storage, or let third-parties seize the opportunity, power companies need to educate regulators on how to develop a storage market, and expand their own planning capabilities to profit and manage risks in power storage.

2. **Re-wiring the approach to opportunity screening.** Given new dynamics in the power industry, reactively entering new businesses when its fully delineated may not be an option for IPPs and utilities – there is a strong first mover advantage in many new businesses which impedes or excludes late entrants. The risks of centralized, thermal generation plants becoming 'stranded assets', and of being locked out by first movers from new markets such as distributed generation, storage, and behind the meter activities, are very real. Power companies need to iteratively go through the difficult task of quantifying and mapping where they want to take their portfolio, and must be open to accommodating unconventional opportunities. Combinations of physical assets in conjunction with software, data, and communications are enabling companies to act as 'market makers' and profit from augmenting and connecting supply and demand. Significant opportunity lies in being a market maker; but how to screen, plan and execute such strategies requires re-wiring traditional corporate planning.

3. **Piloting projects and services needs to be encouraged by regulators, and systematically de-risked by power companies.** Piloting projects and new ideas carries risk and financial challenges which can hamper innovation and benefits to broader society. Regulators need to realize that power companies are in a strong position to commercialize and bring scale to clean energy technologies from smaller companies that without their support, may not materialize. Regulators have access to simple tools such as tax reductions and forward weighted depreciation which can go a long way in recovering capital from pilots, and easing the burden of commercializing a technology. Power companies need to realize that the industry is now a higher risk / reward industry than it was in the past, and that they will have to get involved in business, technologies and counterparts outside of their traditional core capabilities. Having methods and a corporate culture which supports planning, executing, and de-risking pilot programs and new businesses is critical for modernizing one's portfolio in an environment of disruption and shifting industry dynamics.

4. **Regulators need to standardize and make available renewable energy (RE) resource measurement.** In several countries in Asia, accuracy of RE resource data is a problem. Where no centralized or government authority collects and makes available RE resource data, it is commonplace for manufacturers of wind turbines and solar panels to produce estimates of wind speeds and irradiance. These estimates often lack quantity of historic data or standardization of measurement, and can be inaccurate. This has been problematic for several IPPs who have invested in projects with inflated estimates of RE resource availability, as well as for grids who are struggling with inaccurate estimates of station availability. There is also a lack of an overarching policy effort to connect RE resource availability to proximity to load centers, which determines associated transmission and distribution needs, total available power to load centers, and the total delivered cost of power. Some progress is being made – National Renewable Energy Laboratory (NREL) of India publishes solar resource estimates, as an example. However, many geographies in Asia lack standardized, reliable data on resource availability. Regulators need to undertake the standardization of RE resource measurement, make this data available to all, and connect resource availability to tariffs and system planning.

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STORAGE ADDRESSES A FUNDAMENTAL ISSUE IN RENEWABLE ENERGY

RE is clean, but intermittent by nature, while power systems require that supply must be steady and reliable. RE's volatility is problematic for system operators who have to carefully match power supply, demand, and meet power quality specifications. It is especially problematic for grids with a lack of flexible ramping in the generation fleet – which is commonplace in developing countries which have historically relied on large coal fired stations for power supply. Storing power to smoothen this volatility and balance the system is critical as RE is mandated to take an increasingly large portion of the generation mix. Creating a storage market will decrease curtailment and increase RE penetration. A critical issue is how to value storage and make it a billable power service.

PUTTING A VALUE ON STORAGE

In valuing and making a market for storage, an easy place to start is simply with the costs that storage helps the system avoid. What is the cost of power during peak demand that storage could potentially reduce or replace? What are the costs of stress on the system (operations and maintenance, equipment replacement) in ramping up and down during periods of high and low demand? Are more expensive fuels such as natural gas, fuel oil and diesel used in peak power? What large capital programs could storage potentially delay, such as transformer upgrades?

Wind power curtailment (or rejection from the grid) is very common in many parts of Asia. For example, in several parts of China curtailment of wind power occurs at night when wind speeds are often stronger but demand is lower, or during winter when coal fired combined heat and power facilities operate and take precedence over wind and other power supply. In parts of India wind power operators are not being paid for available power due to ineffective grid management and tariff policies which could be in part be addressed by storage. Throughout Asia, and due to issues that can be addressed by storage, many RE stations are selling power to the grid well under their capacity and their operators are reticent to expand to build new stations.

Regulators could require that the grid purchase a set quantity of power from a renewable energy installation, if it installs storage capacity at a prescribed ratio to generation capacity. The operator would pay additional capex for storage but would get more output, and guaranteed sales from its stations. The grid company would get more guarantees on power availability, power quality, and stability from these stations, making its job much easier. In a market where RE operators are guaranteed sales in exchange for meeting a storage requirement at a prescribed ratio to their capacity, one can quantify:

1. The capital cost of RE equipment that would be underutilized without the storage (i.e. based on current conditions, the amount of RE generation that would be potentially curtailed in a station due to the grid's lack of ability to accommodate volatility).
2. The full lifecycle costs of replacing that curtailed power (i.e. generating that curtailed power from another source).
3. From these, the capital and CO2 value of storage.

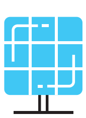
Storage as a service for market balancing, coupled with time of use (TOU) pricing (charging more for power during peak times and less off peak) can flatten the load curve or soften demand over the course of a day, thus reducing standby power. A TOU system or other price differential enables storage companies to charge storage facilities when power is inexpensive, discharge when it is expensive, and balance intermittent power or any unforeseen supply / demand events on an as needed basis. This would ease the burden on system operators in countries such as Malaysia and Indonesia who are struggling to meet peak power with domestic gas supplies. This can be effective from both the perspective of large scale grid connected storage units, as well as a collection of end user level units. Waste from both standby power and peak load spikes can be reduced tremendously by a combination of TOU and storage, the combined benefits of which can be quantified at the station and broader system levels.

Selectively installing storage may enable the system operator to delay costly upgrades to transformers, distribution lines, and other high capex items by several years.

Storage can also be valued by its ability to delay costly system upgrades in transmission, distribution, and other key long-life equipment. This is common in megacities from Shanghai to Mumbai where equipment that was installed in the previous decades is often undersized relative to current consumption. Urbanization in Asia's large cities drives the need for additional distribution equipment to be installed in city centers, which can be difficult to manage from a safety and cost perspective. Storage can delay or reduce large capex programs in difficult to implement places (dense urban centers) which can tremendously ease the cost and difficulty of system upgrades to the system operator. This is yet another means to quantify the value of storage.

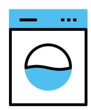
STORAGE + DSM = LOW COST SMART GRID

Smart grids have a somewhat expansive and vague definition, depending on who you ask. One can argue that the simplest and most 'bare bones' smart grid can be achieved by installing storage in the existing power system and coupling a data and communications program, and demand side management (DSM). DSM involves reducing, delaying or eliminating power demand by communicating power supply and pricing programs with consumers (or with smart devices in buildings and homes).

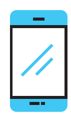


A factory can receive a message from a power company informing it that due to unanticipated overcast weather a solar power facility will have reduced output and that there is a pricing incentive for the factory to shift its power use to a later time.

A reduction in available wind power in conjunction with high demand during midday could result in the manager of an office being notified that their company will receive a discount in its power bill if it can raise the office air conditioning from 23C to 25C for the next 2 hours.



A 'set it and forget it' washer and dryer can communicate directly with the grid while you are at work and clean and dry your clothes at the most ideal time in terms of power availability and price.



People can receive an SMS message that there will be power shortages over the next day due to a plant outage and, if they reduce their consumption, they will receive and incentive.

Many of these communications can be delivered via or coupled with social media platforms in a user-friendly format. Mobile phone penetration is high in China, India and broader Asia. At a very low cost, telecom and two way data can significantly bolster DSM and smart grid solutions.

STORAGE PROVIDES SEVERAL OTHER POWER SYSTEM BENEFITS AS WELL

Storage can play a role in the quality of power provided. Frequency regulation and power factor correction (PFC) are needed in several countries (especially those with increasingly high air con loads) and can be addressed via storage.

Building energy management is a significant source of waste. Storage coupled with simple systems to manage heating, cooling, ventilation and air conditioning is a potentially major source of CO2 reduction.

The Philippines and Indonesia feature many remote or isolated communities which can be served by a combination of RE plus storage, reducing or eliminating their current reliance on diesel generators.

RENEWABLE ENERGY GENERATION ALONE WILL NOT ACHIEVE OUR CO2 TARGETS

It is important to realize that we cannot reach our environmental goals through generation alone – improvements need to be made across all areas of the power value chain. Reducing RE curtailment and energy efficiency are key steps toward these CO2 reduction goals.

The benefits of future investments in renewable energy generation will diminish with time if not coupled with other businesses.

We don't advocate regulators or power companies making aggressive commitments to developing storage technologies themselves. Instead, regulators should make storage a billable service, or enable it through TOU pricing or similar mechanisms. Power companies should define investment criteria for storage projects, and utilize mature, standardized technologies many of which have dramatically declined in price. Enabling a greater presence of storage in power systems is a low-risk first step to smartening the grid and increasing RE integration. goals.

RE-WIRE THE APPROACH TO OPPORTUNITY SCREENING

The challenge for conventional power companies is not in finding a sufficient quantity of items to feed their opportunity funnel, but in how to modernize the funnel itself. What has made a best in class generation company in the past may share no common DNA with what will determine success in the coming decade as new technologies, many of which are disruptive, come to market.

SOME ISSUES FOR MODERNIZING OPPORTUNITY SCREENING

1. Conduct a thorough managerial and human resources assessment. Are current commercial practices, risk management practices and human resources sufficient to drive change? A best in class operator of large, centralized power plants may not have the organizational structure and decision making processes in place to engage in distributed generation, or digitization of customer interaction. Rather than reject such opportunities in the mapping process, focus on structural requirements to be successful. Should an opportunity be handled via a partner, an 'incubator' investment vehicle, or within the main company but with a prescribed amount of autonomy? There is no blanket structure or single means of resolving how to structure and organize possible new businesses – this needs to be assessed on an ad-hoc basis. An important first step, however, is an objective assessment of where one's strengths lie against the required agility and competencies needed to succeed in an increasingly dynamic environment.

2. 'Go local' when identifying gaps and needs. Consumer behavior and disposable income, local regulations, incumbent players and assets in the power system and a variety of other factors impact the feasibility of new businesses. Second teams to markets to obtain and leverage local information sources to identify the needs of various stakeholders – ratepayers, industrials, the system operator, and other new participants in energy.

> Identify what local businesses are doing that may create solutions for energy needs, or which may potentially disrupt the traditional power sector.

3. Recognize the downfalls of typical organizational behavior in new business development. Resources typically flow to where our investors and current customers tell us they should. Our investors want us to defend our ground and be the best at what we do, and our customers want us to make current products more effective and cheaper. While mastery of the current business is crucial, the accompanying organizational behavior won't allow resources to flow to areas of potential innovation. Management needs to be cognizant of the fact that business opportunities will often be dismissed if their staff lacks the incentives to promote new ideas against ideas which maintain current market position. Power companies should consider regular staff rotations to share knowledge, slightly shifting the composition of staff to include people from different backgrounds, and supporting a culture where unconventional ideas can be promoted.

4. Markets that don't exist can't be quantified. Disruption by nature involves making decisions on opportunities that may not be mature or may not exist at all. In many cases, if sufficient data on the market was available to thoroughly map the opportunity, it would be too late to enter. There is no blanket solution for this, but diverse teams, unconventional thinking, and realizing the fallibility in traditional decision making methods is crucial.

5. First mover advantage or a belated jump on the bandwagon? First mover advantage is critical in many new businesses in the power sector, particularly where asset installations in the load center (batteries, distributed generation projects, combined hardware and software for energy management) are a key feature. While a low probability of users changing from one installation provider to another potentially locking out non first movers, there is typically a customer acceptance period where the first mover has deployed capital and resources, but has not yet generated significant returns. This can be contentious internally. However, a belated jump on the bandwagon can be very costly – looking at the tech sector, most companies attempting a late entry to a growing disruptive technology have failed, and destroyed significant capital and brand reputation in the process.

6. Invest in new businesses with the right expectations. Invest with the intention to learn, with the knowledge that failure rates in new businesses are high, and with pre-determined risk parameters. Don't fall into the 'margin trap'. Innovation often occurs via disrupting in high volume mainstream businesses with a simpler, lower margin solution. Use a variety of financial metrics to assess new businesses, but don't confuse higher margin with better.

7. Conventional companies need to encourage unconventional strategic thinking. In a strategy mapping exercise, it's important to remain open about sources of new opportunities – electric vehicles, building management, digital customer interface and other areas may present unconventional opportunities to conventional power companies. As an example, we would advise the power sector to consider real estate companies and owners of urban infrastructure as possible partners. Developing Asia has seen dramatic increases in urbanization over the past two decades and now is home to some of the world's largest mega-cities. Buildings in many parts of the world, especially those in developing countries with high air conditioning loads, can be major sources of energy consumption and waste. Real estate companies have competencies that are useful to power companies including permitting and construction, and providing a physical platform for connecting to end-users. Urban real estate could be fitted to have power storage (gaining efficiencies from being embedded in a load center), electric vehicle charging stations (perhaps coupled with capacitor banks), and building energy management which provides system balancing and DSM through digital end user interface. Urban real estate is one of many examples of an unconventional avenue that could provide new profit streams for conventional power companies.

Telecom is another example of a sector with infrastructure and competencies (data collection, handling, customer interface) which could prove to be highly valuable to a traditional power company seeking new avenues of growth. This also provides platforms for social media, marketing, connecting to customers, and digitizing energy services.

Manufacturers of equipment who now face a glut of supply relative to demand may be forced into partnering with and / or financing installation companies, project developers, or infrastructure owners. While financials are unattractive, manufacturers are seeking new means of monetizing their fixed assets, and this may lead to unconventional partnerships and business models that others in the value chain should monitor.

Companies that traditionally own power generation stations may enter areas like distributed generation purely as a financial player. For example, amalgamating ten small photovoltaic (PV) installation companies in Malaysia may mean quickly and inexpensively accumulating scale in the distributed generation market. This could be financed via a special purpose vehicle and operated through a franchising arrangement. Hardly a conventional generation model but this may lead to a rapid scale up of generation.

It's important for companies to encourage this thinking and recognize where traditional culture and practices may be a barrier to growth.

8. New products will grow and change with time. New business development strategies need to not only fill the gaps identified, but also utilize this position to drive new demand. Any business line should be treated as a standalone driver of cash flow as well as a platform to be leveraged for developing new avenues of customer interaction and new product / service lines. Also, new product development often involves initially targeting a specific market, but later discovering that other (sometimes more attractive) functions or needs can be fulfilled with the same application. Electric Vehicle (EV) charging stations could be rolled out targeting motorists, but later be found to have a more attractive tie-in with smart cards to be used in a combination of metro/bus, EV charging, and small goods purchases from convenience stores. What started as targeting electrically driven mobility may end up developing into a smart card or electronic billing business. Develop products with specific goals in mind but have the flexibility to allow them to serve as platforms for fulfilling other needs.

9. Map contingencies. In screening new business opportunities clearly map areas that success is contingent upon and communicate this to relevant parties. Project success may be contingent upon a policy, tariff adjustment, cost control, consumer participation, or equipment efficiency. The best means of determining if a contingency will materialize is often to directly map its parameters with those with the closest involvement. It may be appropriate to show a regulator, for example, one's analysis of a particular contingency, and negotiate with them directly solutions for managing risks.

10. Stakeholder mapping and risk analysis. People and the environment must be considered as key stakeholders – their involvement and support can make or break a variety of energy projects. Motives and risks for all stakeholders must be identified, and a stakeholder communication program should be created. Analyze what dialogue is required with regulators and other stakeholders in order to be successful and articulate this clearly and directly no matter how new or unconventional the proposed business.

11. There is no blanket commercial or financial structure. We don't believe that there is a one size fits all structure for new ventures, especially given the changes in power industry dynamics that we now face. Business model components including financing, structuring, and commercial issues will likely need to be crafted on an ad-hoc basis. Avoid applying 'one size fits all' or blanket structures, and encourage business development managers to tailor-make new structures for new opportunities.

ENCOURAGE & DE-RISK PILOT PROJECTS

Pilot projects play a key role in proving economic or technical concepts, testing the ability of markets to evolve, and commercializing high potential technologies.

Pilots are key first steps for regulators and companies to gain familiarity with new opportunities which can positively impact the power system.

Pilot projects need to be encouraged by regulators – while risk is inherent in new business development, softening potential losses or supporting an accelerated payback structure for successful projects will help bring new technologies to scale. As the energy landscape goes through large changes and brings about new technologies, creative and systematic methods for de-risking pilot projects will be an increasingly crucial component of the power business.

From our work throughout the sector, we have highlighted below some key issues to keep in mind when piloting new energy projects.

UTILIZE THE BUILT ENVIRONMENT

Existing infrastructure is a great starting point for piloting new power products and services. Consider train stations, ports, shopping malls and commercial buildings when rolling out pilots. This can ease site development and permitting constraints, increase exposure to power consumers, raise public awareness of the pilot, and open up partnership opportunities.

DEVELOP CLEAR YET FLEXIBLE SUCCESS/FAILURE CRITERIA

Success / failure criteria should include economic, technical and customer goals measured over a predetermined amount of time. Set pre-determined goals prior to piloting but be willing to edit or adjust these as the project is executed. Also, have adequate systems in place to decipher between operational and technical limits. When under-performance is encountered it's important to systematically determine if this was a technical limit or related to operating conditions or experience.

TAILOR FINANCIAL STRUCTURES

Work with regulators to make financial structures that de-risk a project. Commercializing new energy products and services is in the interest of both power companies and regulators. Accelerated depreciation and forward weighted payback structures for successful performance can be negotiated with regulators and can drastically improve the economics of pilots.

SCALING UP OR EXITING READINESS

Based on your success criteria, have resources ready to decommission and exit (and close all avenues of potential risk), or scale up and seize the market. In the case of a decision to scale up, human resources will likely be a key constraint, and remember that once a concept is proven, it may be vulnerable to competition.

ENSURING THAT STANDARDS AND REGULATIONS KEEP PACE

The current regulatory environment may not yet address certain aspects of a proposed pilot. Home battery storage businesses will require adequate policy on installation and fire prevention. Distributed generation will require policies on net metering and system interoperability. Make sure that regulators are educated on the areas you are exploring and actively support the development of policies that pertain to your pilot.

CHALLENGES WITH TIMING

Pilot programs require time to select sites, tailor make location specific plans, execute a project that one doesn't have experience in, and measure outcomes to support a scale-up / exit decision. A common problem is underestimating time required to execute pilots from start to finish.

PILOT-SPECIFIC STAFFING

Pilots require adequate staff for installations, data collection and analysis, and may require specialized skills at a specific locations for operations and maintenance. Adequately map staffing plans ahead of execution.

PILOT SCALE

Most operators will seek to keep costs and risks low but it's important to keep in mind that a pilot needs to be large enough to prove the concept and demonstrate an ability to operate at meaningful scale.

MANAGING STAKEHOLDERS

Local communities and are a critical stakeholder and communication programs need to be increased to garner their support and participation. Power companies need to increase the frequency of dialogue with regulators and should expect to more actively educate them on how to update policy. It is important to engage with stakeholders prior to launching pilots, sound them out on key issues, and openly discuss how you want to cooperate towards success. Stakeholder management should be an integral part of pilot planning.

BLACK & VEATCH HEADQUARTERS MICROGRID

Overland Park, KS

Built and implemented by Black & Veatch in 2015, the microgrid features photovoltaic solar panels, microturbines with heat recovery and an advanced lithium-ion battery energy storage system (BESS).

CENTRALIZE & STANDARDIZE RENEWABLE ENERGY RESOURCE DATA COLLECTION

Data standardization, availability and transparency are critical to building energy systems.

A key enabler of successful renewable energy programs is standardizing renewable energy resource measurements – irradiation per m2 of land, meters per second of wind speed, etc. – throughout the year. Regulators should ensure that this data is as accurate as possible and widely available. Also, RE resources and their proximity to load centers is important to understand as this impacts the total cost of delivered power and should be reflected in feed-in tariff structures.

NREL of India and Malaysia's Sustainable Energy Development Authority (SEDA) are examples of entities collecting and making publicly available data on RE resources. In other countries in Asia, however, there is no single body standardizing data and making it available to all. Ideally, this should be implemented under one government body, which makes data transparent and available to all.

In these cases where data isn't standardized under one central body, we typically find that manufacturers or design companies provide RE resources estimates. Under these circumstances, the quality of data can vary significantly, however. This often results in sub-optimal site design, equipment selection, and economic and technical forecasts of RE installations. This has negative implications for both RE operators and the system operator.

Another strong reason for centralizing RE resource forecasts is to better craft feed-in-tariffs (FITs) and other incentive mechanisms. In China, strong support for RE and robust FITs from the government were responded to by several operators installing wind and solar PV facilities – many of which ended up with extremely poor output. Developers chose sites not by available grid connectivity, or proximity to load centers, but by resource availability. This meant that many projects were installed in China's hinterland rather than near its coastal load centers.

Curtailment (rejecting or not utilizing available power) of wind power remains common throughout China. Reasons include:

- lack of grid connections / infrastructure in place;
- local hinterland grids being weak and unable to accommodate intermittent power;
- lack of proximity to load centers or high T&D costs associated with bringing power to load centers; and
- poor hinterland populations with subsidized utilities rejecting higher cost power and disputing the validity of the FIT.

FITs and other incentives need to match resource availability, required infrastructure, and load center characteristics in order to be sustainable. Standardizing the collection of RE resource data and making it publicly available enables higher penetration of RE, encourages competition, supports more accurate economic forecasts as well as more accurate technical forecasts which is key for system stability.

Governments need not heavily invest or take technology risk to do this. Installing standard anemometers (wind), and pyranometers (irradiance) in select places, logging data, and making it publicly available is a low risk approach which will support development of the RE sector. This is feasible for governments to implement from a technical and cost perspective, and will positively impact RE policy, RE production, and power system planning.

SUMMARY

The world cannot meet its CO_2 goals by renewable energy generation alone – full system planning and balancing a number of challenging technical and economic issues needs to take place.

As partners in the energy industry, we advocate attention to first steps which are low barrier and serve as enablers to further improvements. We believe that the four actions described are feasible first steps for regulators and operators in Asia to consider.

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