How do you persuade an existing market to move to a new technology?

Sarah Fairhurst

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This is an exciting time for the power industry. The concerns about global warming have resulted in significant pressures to find low carbon solutions, and with that, many new technologies have been developed and continue to develop. However, to be effective in actually reducing emissions, these new low carbon technologies must actually be chosen by generators and be deployed in the market to actually make a difference.

But even in the "conventional" space, players that have been discounted in the past have improved so much that they are now almost a "new" technology. This includes technologies such as reciprocating engines, which have been used for small off-grid solutions for years, but which are now being developed as commercial, feasible options for larger applications.

Similarly, as smart grids start to be explored, alternative options for ensuring security of supply, from demand side approaches to grid storage may be sensible strategies.

This presentation explores some of the barriers to entry that new technology faces, and gives some ideas about how these barriers can be managed. Obviously, in just a few minutes we cannot cover all technologies, all barriers or all solutions. So I have chosen a few examples to make some key points.

Firstly, what are the barriers to entry? These include:

- **Costs** – new technology may be more expensive than existing technology to build and more expensive to maintain due to different parts or lack of experienced staff.

  "When various inherent risks are ignored, usual econometric methods tend to favour the power generation from traditional sources rather than renewable alternatives. This is so due to the fact that solutions with the lowest costs are singled out as a basis for generating capacity additions." *(US Congress Paper)*

- Reliability – new technology may be less reliable due to lack of time to bed down a new system.
- Regulatory – there may be no regulations that encourage the use of cleaner equipment, or the Grid Code may not accept the characteristics of a new kind of plant; licensing processes may struggle with a new option and sometimes even carbon abatement schemes take time to come up to speed on new developments.

"One of the issues I get a lot, here in HK specifically, is unlike the US there is no strict regulatory laws forcing power companies to adopt new technologies to be cleaner. While the EPA has set emission guidelines, it's nowhere near as rigorous as what the US is now facing. Lack of a defined and enforced regulatory environment will limit the number of companies that are willing go that extra mile." Seller of new emissions technology

- Transmission requirements – new plant may need to be in a different location away from other plants (for example, wind and solar) where there are no grid connections meaning that new infrastructure is needed to cope with new technologies.
- Perceptions – new technology may be neither more expensive nor less reliable nor harder to permit, but the lack of experience or prejudice may result in perceptions of these that are as much a barrier to entry as a real issue resulting in difficulties financing new plants. This builds from the human experience of resisting change.

"Centophobia is the fear of new ideas. It is the persistent and abnormal fear of anything new, and can also be present in a milder form, as the unwillingness to try new things or break from routine." http://www.centophobia.com/

- Sorting the wheat from the chaff – sometimes, when there are so many new options, it is hard to figure out which ones are worth deploying.

(Infinite Energy) *"One of the most difficult problems in the new energy field is funding for good ideas. This is because of the very long time to market by conventional investment standards and because of the great difficulty of evaluation of the potential of the technology. A significant part of the evaluation problem is caused by the fact that most new energy concepts are either pure bunk or just on the wrong path."*

We can see from the above list that many of these barriers could be overcome by information. Not just the existence of information but also the communication and acceptance of that information in a manner that people can use to make good decisions.

For example:

- Cost differentials between renewable technologies and existing technologies exist, but if you take into account the cost of externalities, such as the costs of pollution, we may find that actually the renewables are the cheaper option in the long run. This requires a complete dataset of all the costs of pollution and a regulatory framework that takes these into account.
- Reliability becomes much less of a concern if you have plenty of data about how a unit operates under different conditions and can understand and plan for its characteristics.
- Regulatory barriers are eased if regulators (and others such as grid operators who input to procedural documents) are well informed about new technologies; understand the characteristics and how to manage any new features so that they can update laws and procedures to cover new technology. Similarly, were policy makers aware of solutions to environmental problems that were cheap, they may be more willing to impose a greater regulatory burden on the industry.
- Likewise, those planning infrastructure, such as gas pipelines and transmission lines, need to know what new technologies might be coming and what infrastructure they will need.
- The most important information is obviously about what new technologies actually do and how well they perform.
- But perhaps perceptions are the hardest of all to combat – as even with good information sometimes it's not enough to get over the barriers of inertia and "sticking with what I know works".

People who choose which plants to build, or choose which technologies to deploy are comfortable with their existing choices. They understand the engineering, the risks, the costs and the performance of existing technologies. They may be wary of changing to something they believe to be unproven, or may worry about supporting a different technology. They may not even realise the benefits that could be gained from a move.

In order to move, these people need good analysis on the actual differences between options and how they might operate in the market.

In the example of the firm selling emissions control equipment above, he states that:

"What we've found is that finding valid commercial reasons goes a long way in convincing potential customers. For example one of the factories we are currently in talks with is about 30 years old and inefficient. They told us a 2-3% improvement in efficiency will save them millions, therefore, that is how we are approaching it."

However, not all developers of the new technology know the markets that they operate in well either or how to approach key players, or what information will help to convince users to choose something new. Indeed, the developer of a new technology may not even realise some of the potential uses to which this new technology can be put.

In order to penetrate these markets, a clear strategy is needed.

Firstly, the developer of the new technology needs to decide what objectives they have in entering a new market. Are they just trying to sell the product, for example, or are they developing entire projects. In the power sector this is particularly relevant: Are you selling a generation kit or selling power? The former means targeting purchasers of power station technology (generation companies perhaps) while the latter means finding power development opportunities (that is, becoming an IPP). It's important to be clear at the start of any process what type of opportunities to seek.

Secondly the developer needs to undertake a strategic review of the new market to see who might benefit from purchasing its technology/how the technology might be used in the market in a way that adds value.

We use a case study from a project undertaken by TLG to explain this.

Background

An existing provider of power station equipment has improved its technology and wanted to review the Australian electricity market to see where there might be markets for the new kit.

The technology has a number of impressive features compared to existing power station kits:

- Starts faster than a GT.
- Ramps up faster than a GT.
- Heat rate not affected by temperature, loading or degradation over time.
- High efficiency, comparable (but slightly less than) CCGT or GT (depending on the configurations used).
- Extremely reliable – almost zero start-up failure rate.

Taking these features, we reviewed the technology and identified a number of value propositions for the kit.

These included:

- Ancillary services - given the fast start and ability to load and unload without affecting heat rate.
- Mid-merit and peaking generation – fast start and higher start reliability than GT makes ideal for peaking operation (simple cycle); high overall efficiency due to less degradation compared with existing plants, even if the starting efficiency is slightly lower than a conventional plant, makes ideal for mid-merit plant (combined cycle configuration).
- Wind chasing – to firm up wind generation due to the very fast start-up and loading.
- Transmission support – as a non-network transmission alternative at edge of grid or within grid, due to the fast and reliable start-up that are capable of comparison with network alternatives.

Having identified the potential value of the technology, we needed to see where this value might be applied in the Australian market.

In doing this, we needed to review separately the Australian National Electricity Market (NEM) and the Western Australian Electricity Market (WEM). As the client already has a client base in the non-market sectors of Australia, we did not review these.

Some attributes of the market became clear.

Wind-chasing is not an option in Australia. There are no obligations on wind farms to manage the intermittency of their output, unlike in some markets in the USA for example, and so there are no incentives for wind farms to buy this technology.

The impact of wind farms is mainly to raise ancillary service requirements where wind has penetrated. However, in the NEM there is an existing ancillary services market and a review of the prices in that market did not suggest that ancillary services alone could support new plant entry, because many plants in the NEM can provide small quantities of ancillary services, while the Snowy scheme can provide a large quantity, leading to a highly competitive ancillary services market in the NEM.

In the WEM, on the other hand, it became clear that there was a high need for new plants to supply ancillary services and that increasing wind penetration was causing significant system issues, however the market design did not give sufficient signal (no ancillary services market, or even a real short term balancing market) to new entry.

On the other hand, transmission support was a high potential activity, as the regulatory tests in Australia require network services providers to compare non-network options as part of the regulatory processes governing the build of new transmission. The operation of these tests is relatively new and the stringency of the tests is increasing. However, while potential value was clear, a path to the market was less clear.

The option that made most sense was to work with a power developer who was capable of capitalizing on a mix of these value propositions, as well as the basic generation options.

But how can this equipment supplier convince such an IPP to move to a new technology?

An overview of the value propositions as outlined above is obviously a useful first step. But the next step is hard analysis, and sometimes the "traditional analysis" can miss the very benefits being espoused.

For example, a traditional electricity market model may work on an annual basis, using a load duration curve split into a number of load blocks, to model the market and forecast market prices, generation by plant and the most economic type of new entry to build.

We have one of these models, and inputting our client data into the model results in no difference in output compared to a run without the clients plants available to be chosen as new entry.

Why is this?

Well, traditional models make many simplifying assumptions in order to make the problem of modelling something as large as an electricity system with potentially many hundred units tractable.

Assumptions typically include:

- A single heat rate per unit, to show the heat rate at full load. Ignores changes in heat rates at different loading levels and impact of ambient temperature.
- Ignore start-up costs and loading times.
- Stack plants in merit order based on fuel and variable operating costs, with a unit either on or off depending on the position in the stack.

Such models are excellent approximations of the market for existing technologies, and compare well to more sophisticated "hourly sequential" models that do take into account start-ups and loading. However even the more "sophisticated" models typically only run on an hourly basis, meaning that differences in loading rates and start-ups within an hour are ignored; while differences in heat rates at loading levels are also rarely incorporated.

This means that if a new technology has a cost slightly higher than the cost of an existing plant, or efficiency slightly worse than an existing plant at steady state conditions, the model will always choose the slightly cheaper or slightly more efficient plant.

The benefits of a heat rate that does not fall during hot summers (common in Australia) are ignored; as are the benefits of higher efficiency at lower loading levels because a single "point estimate at full load" of heat rate is used.

If we amend our models to include these features we see the following. ***[Please see conference presentation]***

Another outcome of our research for our client was that convincing the buyers may not be sufficient.

As noted above, there are more stakeholders involved in the ESI than just the buyers.

Regulators can decide whether a choice by a buyer is allowed or not: Regulatory tests for transmission, for example; and in some markets where there is no competitive generation market, a single buyer may need to convince a regulator that they are buying / building or signing a PPA with the "right type" of plant.

Policy makers decide on the legislation and often the structure of markets and rules, which may encourage technologies or deny them access to markets.

System operators and market operators may propagate rules and procedures that are based on the "old way" of running a grid that may lock out new options.

In approaching a new market, a new technology needs to market not only to the buyers but also to all these interested stakeholders. Again, hard analysis can be used to show benefits, which help to sway regulatory and policy processes.

Summary

In order to convince buyers to move to a new technology, a large amount of analysis is required.

It is important to show them not only what areas of opportunity exist, but to model the actual value to the buyer of what the technology might achieve.

As noted by the emissions control equipment seller earlier, "They told us a 2-3% improvement in efficiency will save them millions, therefore, that is how we are approaching it".

This is not a new phenomenon in marketing – certainly during my MBA course it was made clear that in order to sell you needed to be selling the benefits of the product to a buyer and not the characteristics of the product per se.

Sometimes these simple lessons, which make so much sense when discussing consumer goods, are lost in large transactions such as power.

This paper gives some insights into how to bring back the analysis that is needed to show a buyer, a regulator and other stakeholders the value – both qualitative and quantitative – that a product has in the electricity market.