Energy Futures

It's a no brainer.

The conversation over what the energy mix of the future should look like always culminates with a resounding call for renewable energy (solar, wind, geothermic etc.) Taking it further, the calls for carbon dioxide (CO_2) emission reduction all make it clear that the energy mix driving the current global economic advancement is unsustainable. The world will have to cut its dependence on fossil fuel-powered energy significantly over the next fifteen to twenty years to avoid disturbing potential consequences. However, consensus scenarios on what the future of energy could look like in twenty years describe essentially a 'more of the same' situation.

Why is this so?

With rapid economic development in emerging economies going through the path of least resistance (using readily accessible and cheap fossil fuels with minimal energy generation and transmission infrastructure changes), and the pace of development of renewable and large-scale energy efficient technologies like smart grids faltering or slowing down because of policy uncertainties, it is easy to see why the consensus is not so optimistic. To achieve a renewable energy future there will need to be significant changes in our energy transmission and energy generation infrastructure.

Take, for instance, changes to the energy generation infrastructure. Large-scale investments in renewable energy generation in Denmark and Germany have shown that a rollout of clean energy technology is not cheap. Denmark has been more successful at rolling out renewable technology because it is a relatively small and wealthy country with a flat terrain. It is also the world's largest wind turbine manufacturer and has few problems by way of conflicts with inter-connecting national grids. Germany on the other hand, though its Die Energiewende initiative has also felt the pinch , the initiative is being hampered not only by the ever-mounting bill and changing levels of public support for expenditures, but more recently by challenges to the initiative from other EU partners to which the country is connected.

Investments in smarter grids and energy efficient technologies that improve transmission and energy savings are ongoing and much more will be required to improve the chances of a transition to renewables that require efficient and targeted use of energy. The investments in these areas are growing but not at a revolutionary pace, and there is much more yet to be done.

Rethinking progress

An attempt to re-think the future, paying attention to trends already in motion, reveals that many non-traditional participants in the energy supply chain, if given sufficient incentives, could significantly alter the trajectory of our energy future and prove to be the winners in the long run. In particular, the two trends we have observed that could be game changers are:

- Biofuel technology
- Grid decentralization

Second-best is still pretty good.

A 100% renewable energy scenario is ideal and would mean maximum societal value in terms of the environment, energy access, energy security and energy affordability. The changes required to get to this scenario are dependent on advances in renewable technology, system adaptations (transmission infrastructure, generation) as well as societal advancement. For instance the world would need to run on 100% electric automobiles, shipping vessels, airliners etc. to totally eliminate the transportation fossil fuel burden on the environment. Progress in all areas will take considerable societal advancement and may not entirely occur in the foreseeable future. What we see happening in the near future (at best) is the transition of just the electricity portion of the energy mix to a renewables scenario. That leaves about 80% of the world energy needs still dependent on fossil fuel energy. Biofuels have the potential to replace fossil fuels in virtually all parts of the energy supply chain that are currently occupied by fossil fuels and should be considered and invested in as a viable alternative because they are more environmentally friendly and sustainable to produce.

Currently biofuels are also in competition with food regarding the choice of crops planted by farmers and usage of the plant after harvest. As

such, the competitiveness of biofuels may vary year on year and the issue is more about competition with highly volatile substitution products, such as food and oil, rather than cost. While biofuels are highly attractive in terms of energy security, this hardly counter-balances their drawbacks. They are not affordable due to their impact on food prices and the stability of their competitiveness with products from crude oil. Those two reasons are at the root of the lack of attractiveness of biofuels for all market players. To secure a steady growth for biofuels, both sustainability and affordability issues have to be overcome.

Real promise or pipe dream?

The current technology of biofuels or the so-called 'first generation' biofuels' are based on plants competing with food usage, such as sugar cane and corn for ethanol or palm oil for biodiesel. By contrast, second-generation or advanced biofuels are fuels that can be manufactured from non-food plants or parts of plants. A recent attempt to improve on this performance has been seen through so-called third generation biofuels, which are produced from algae. Both second and third generation biofuels aim to eliminate the competition between with food for agricultural land. As such, they become more 'affordable' as they do not directly impact the price of food, and are more 'sustainable' as they do not grow on agricultural land. Both new generations of biofuel are still under development and are highly promising for the following reasons:

- The raw material which second generation biofuels build on, is extremely cost competitive (by-products of existing agricultural production or plants growing in otherwise unused lands)
- The third generation allows for a widespread replacement of all oil usage, rather than only ethanol and biodiesel and appears to be the best opportunity for fuel substitution

However, both second and third generations have technical limitations that make their widespread implementation quite challenging:

- The yield of the second generation of biofuels is generally lower than for the first generation variety and crop cultivation is more energy intensive. This affects its cost competitiveness
- Third generation biofuels are still at a relatively early development stage, with pilot-scale plants being built around the world. The possibility to scale-up production, maintain high yields and remain environmentally sustainable has been called into question

What's in it for whom?

It is yet unclear how the market for biofuels will be organized and whether this organization will foster the right conditions for growth. Among the biggest uncertainties is the behavior of incumbents toward new generations of biofuels.

At the head of one of the most powerful lobbies in the world, the question remains as to whether oil and gas companies will strongly oppose the development of advanced biofuels, by what means and to what extent? Or will they on the contrary invest in the technologies as 'real options' against changes in the main oil market? We believe that taking out real options would be the winning move.

The third generation of biofuels acts as a substitute to oil, i.e. as a substitute to the current suppliers for refining companies, perhaps at much more attractive input costs. As such, refineries have an incentive to seek the development of biofuels. For example, we have seen Neste Oil investing in the sector through its 'Biofuel 2050' initiative.

The development of biofuels, whatever the generation, drives the need for strain selection and modification, for crop protection and for fertilization - all aspects that companies like Monsanto, Syngenta or DuPont could find attractive. All of these companies have already invested in joint ventures and research projects for the development of second and third generation biofuel solutions. There is an obvious opportunity for crop science and biotechnology companies, and the quickest player with a real and credible solution could stand to reap significant rewards as a result.

All in all we see the landscape for energy changing significantly for the better if, on the pathway to an all-renewables future, a significant investment push is given to biofuels as a credible replacement to fossil fuel energy

sources.

How about 'them' renewables?

Longer term, the shift towards 100% renewable energy still remains the ideal scenario as discussed above and this shift will require a boost in infrastructure and power generation developments. We believe that these changes are not too far off in the future and one major trend driving this move is the decentralization of power grids. Historically, power transmission and distribution has followed a centralized model, mostly due to the highly polluting nature of coal power generation and the need to move generating plants as far away from cities as possible. With increases in technological abilities to generate less polluting power, this decentralization trend is slowly happening. We see this as a positive trend that will lead to a change in the business system and encourage further investments in renewable energy from new participants that seek to capitalize on these changes and we will discuss how below.

Decentralization muddies the waters

As grid decentralization becomes a more present phenomenon, a wide range of sources has become available to the end user, bringing relevant energy mix flexibility. Conventional generation is more and more being complemented with renewable sources such as wind, biomass, and solar, all in the form of co-generation, independent production, and non-utility production.

As the decentralization occurs, the former straightforward end-to-end utility presence-based business system for power generation, distribution and use becomes a lot more complex. The power flow is extended to the distributed sources. As a consequence, information becomes a crucial element within the chain. Indeed, a new value-web fosters collaboration among players, and consumers' relevance increases significantly.

New players, consumers and utilities benefit from change

In the end, to deal with the changes, the industry will have to adapt its business model. Consumers will become producers (or 'prosumers') producing, consuming, and selling the energy surplus. The focus of utilities will shift from selling watts to selling capacity, and energy will be offered as a service (EaaS).

The new business model will make room for new players. Generation of power, storage, metering, and data mining for example, can represent entry opportunities into the industry (as we've seen with Google's recent acquisition of Nest). Real estate companies might rent rooftops for solar panel installation purposes. Tesla's moves to boost battery technology might promote the emergence of new key suppliers of storage systems. Companies like Google can provide essential data regarding consumption patterns through its facilities' automation solutions. Last, but not least, IT and software firms like IBM can use their big data competence to translate data collected into strategic business information.

Will this disruptive challenge affect the utilities industry the same way deregulation disrupted airlines and telecommunications industries in the 1970s? What should current incumbents do in order to survive? Should they fight for regulation protection or evolve to new roles? We believe that utilities will eventually be forced to leave the power generation business and focus on buying power and selling capacity. In the end, these shifts will serve the greater good.