The 21st century will be the century of electrification. Here in Europe, over the last 30 years energy use for generating electricity has almost tripled. Today 40% of energy use, including all primary and renewable sources in OECD economies, is going into electricity generation.

This growth in Europe and OECD countries is just a taste of what is to come globally: the IEA has no scenario in which global electricity demand does not grow rapidly.

However, despite the vast importance of electricity for our future, the industry is struggling to pull itself out of the 20th century.

The principle behind the technology hasn’t progressed much over a century: burn a fuel, boil some water and spin a turbine. The same can be said for the underlying business models: buy a fuel, use it in a power plant and sell the electricity. This model has worked for several generations. But change is upon us, whether we choose to acknowledge it or not.

Emerging markets are well positioned to champion this change. They have the opportunity to leap-frog straight into clean, flexible and modern electricity systems and markets. However, the established, stable markets, such as here in Europe, see weak demand growth and the slow collapse of what was once a dominant business model. A new type of utility will have to emerge.

Taking advantage of this transition and building modern, efficient and flexible electricity systems is the challenge for all of you in this room. As electricity is poised to play such a bigger role in our future, it’s time to get it right – and stable markets are a long way from getting it right.

One key player shaking up the system is renewable energy.

Within the OECD, the growth of renewables has been driven by strong policy support for decarbonisation, a desire for diversification and retirements of conventional power plants. In many cases in these countries, due to the combination of slow demand growth and of an
ambitious decarbonisation agenda, the rapid deployment of renewables often requires scaling down part of the existing energy system, which can put incumbent utilities under severe pressure.

As a consequence, even if renewables can be competitive with other forms of electricity, all power generators are struggling in OECD markets where there is oversupply and low wholesale prices. These trends are particularly marked in Europe. This is something I will return to shortly.

By contrast, non-OECD countries, with faster-growing demand, will comprise around 70% of new renewable generation to 2020. In China, renewables are forecast to provide 45% of new generation to 2020, ahead of coal. Combined with a rise in nuclear power, low-carbon generation will account for the majority of growth in China over the next five years.

Simply speaking, these two groups of countries feature two types of electricity systems: the stable and the dynamic. Europe, and particularly Southern Europe, is characterised by stable systems. In a stable system, the market is not expanding. Emerging economies, on the other hand, are characterised by dynamic systems that require rapid growth of capacity.

Both of these systems should aspire to the same goal: a clean, sustainable, efficient and flexible power system. The roads they must take, however, are different.

Dynamic systems include India, China, Brazil and other emerging economies. Here the situation is characterised by high demand growth, meaning great opportunity for investors and challenges for policy makers. This is where we expect the majority of new wind and solar plants to actually be built in the coming years.

In these dynamic markets where new capacity is needed, renewables are becoming competitive in an increasing number of circumstances and offer other advantages in terms of reduced local pollution and diversification of supply.

In these markets, with smart investments, a flexible system can be built from the very beginning. Growing capacity needs mean that renewables coming online can be streamlined into the system more easily. This is a significant opportunity for emerging economies. They can avoid the difficult choices being made here in Europe and move directly to a 21st century power system.

Those difficult choices in Europe are the result of a stable system. In a stable system, demand growth has stagnated, meaning that additional renewables will take part of the pie from incumbents with established capacity, potentially meaning economic pressure for traditional players.
In these systems – and this is the case here in Europe – decarbonisation ambitions are more radical than the natural turnover of capital stock.

This means not only building a new system, by integrating renewables and increasing efficiencies, but also scaling down the old system.

This is a difficult process, but it’s a challenge that must be addressed directly if OECD countries want to maintain their energy security and work towards climate goals.

**Integrating renewables**

One of the first questions is how to efficiently integrate variable renewables, such as wind and solar.

There has been significant technological progress in the integration of variable renewables into both dynamic and stable systems, but the lesser acknowledged developments have been in understanding their operation and management. Some electricity systems in Europe are operating in a fashion which 10 years ago would have been considered impossible. This includes the systematic application of big data, with the potential to further improve renewable forecasting.

Frankly speaking, renewables have grown up. Priority dispatch, where renewables are the first to come online when power is needed, may be appropriate for an infant industry, but it is time for renewables to be treated as market participants and be exposed to price signals. This way, we create incentives for renewables to facilitate their own integration. However, this needs to be balanced with providing sufficient certainty to attract investments.

But regardless of how it comes about, cost-effective grid integration calls for a transformation of the system as a whole.

In addition to renewable forecasting, such a transformed system will:

- Have more flexible power plants, such as flexible gas and reservoir hydro plants
- Feature a robust, smart grid with more interconnections
- Use storage, where cost-effective
- And most importantly, have better integrated and more responsive demand.

In this kind of transformed system, variable renewables become part of the solution thanks to system-friendly power plant design and better deployment strategies. Integration is about a transformation of the power system as we know it.
Of course this is a challenge.

**Changing role of utilities**

For utilities, confronting that challenge means either finding a new role, or giving way to the emergence of a new type of utility.

The renewables train is picking up speed, and utilities have missed to opportunity to get on board. Only 7% of the investment in renewables in Europe has come from utilities, with the remaining 93% coming from banks, private equity funds and middle-class households.

Utilities will no longer be solely in the business of simply buying fuel and selling electricity. The paradigm has changed to one of rapid response and flexibility.

Of course there are other opportunities:

- While there is no going back in Europe, there is still life in emerging markets and there are opportunities to invest elsewhere, including in upgrades to existing low-efficiency power plants
- A number of renewable energy investments – including offshore wind and concentrating solar power – are all utility-style investments that will have a role to play in modern, efficient, flexible power systems.
- Growth of distributed renewables does not make transmission redundant, and in fact investments in electricity networks should increase so as to enable sustainable operations and management.
- Last but not least, nuclear generation is still three times larger than wind and solar. We do not think that climate targets will be possible to reach without nuclear.

Regardless of what route utilities choose to take, the old model of selling kilowatt-hours will have to give way. The new model will revolve around selling energy services.

**Investing in efficiency**

One of those energy services will be dealing in energy efficiency.

Energy efficiency measures implemented by energy utilities can reduce operating costs and improve profit margins. They can also lead to the deferral of new infrastructure investments.

Transmission and distribution costs range from USD 50 to USD 100 per kilowatt-year, but new investments in transmission and distribution can be deferred or, in one out of three cases,
completely avoided. This can be accomplished by targeted demand-side action. This means energy efficiency.

Energy efficiency can enable utilities to offer better service to their customers, and it is opening up important new avenues of business for energy providers in addition to unit sales of energy.

However, incumbent utilities will not be able to entirely finance the transition of the system from within, but ultimately the money must keep flowing. Energy regulation must be made investor-friendly to mobilise the amounts that will be necessary to build a 21st century electricity system. These can clearly be profitable investments.

In fact the market as a whole will need to evolve.

Electricity is difficult to transport, so when it comes to pricing, location matters. Transmission will never be perfect, and thus transmission remains a scarce asset. In this regard restructured market regimes of the United States are doing a better job, and this orients incentives.

Similarly, electricity is relatively difficult to store cost-effectively at utility scale – at least based on current technologies. So this means that time also matters. Markets that close the door to trading already a day ahead of delivery will not make sense in a 21st century electricity system with high shares of renewables. However, for an hour ahead, wind, for example, can be forecast. With big data and modern IT, close-to-real-time markets are possible. Simply speaking, markets must adapt to renewables.

Additionally, flexibility itself should be valued. In the right context, dispatchable plants that can provide power within seconds or minutes are more valuable than plants that take hours to ramp up. Why should their power be priced the same?

Finally, a word on interconnections. National self-sufficiency will be difficult and expensive in a low-carbon world. For a true 21st century electricity system, European nations will need to build a shared understanding of electricity security, and this will include ensuring that capacity is tradable and policies are compatible.

The 21st century system

The eventual payoff is the 21st century electricity system.

In our *Energy Technology Perspectives 2014: Harnessing Electricity’s Potential*, we sketched out what this integrated and intelligent electricity system could look like under a scenario that limits global average temperature rise to 2 degrees Celsius.
It’s a system that features distributed power generation, both fossil-based and renewable; increased consumer engagement and demand side management; utility-scale storage technologies; electrified transport; and centralised power and heat generation.

It’s a system where all of the elements are integrated to optimise investment and operation. While this increases complexity, the gains in efficiency and resilience are tremendous.

It’s a system that optimises the use of energy resources.

Finally, it’s a system that incumbent utilities can either take part in, or watch being built by new players, as the traditional business model fades away.

Conclusion

Clearly we all have a role to play in this transformation, from investors and regulators to utilities and homeowners. Electricity is vital to all of us.

But an electricity system and market from the 20th century cannot survive long in the modern world, and we are already starting to see winners and losers as the old system is broken down and the new one is built.

With the world working toward climate targets and pushing for renewables, and millions of people ready to turn on their lights and plug in their air conditioners, electricity and how it is generated will define energy in the 21st century. Countries with stable systems in places like Europe or North America, and dynamic systems as in much of Asia, will need to chart their own paths to a clean, efficient, and flexible power system.

The only thing we can be sure of in the future is that change is coming. With the right choices, that future can be bright.