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Lessons from market reform for renewable integration in the European Union

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Abstract The European Union (EU) has the most advanced, mature, and liberal energy markets that gave rise to the most dramatic drop in wholesale energy prices, whose fallen, however, has not been translated into a reduction in retail energy prices. Instead, energy prices in Europe rose above inflation year-in-year-out, and are considerably higher compared with major economic partners. This paper highlights the key limitations in the EU market designs and network access toward renewable integration, and the wide range of reforms that the EU is currently undertaken across the Member States to achieve two goals: to make the market fit for renewable, and to set a practical example of how a competitive economy can be built on a sustainable and affordable energy system. This paper concludes with key recommendations to developing nations, particularly in addressing heavy renewable curtailment.

Keywords wholesale energy market, retail energy market, market for renewables

1 Introduction

2016 set the new world record for low carbon technology installation [1]. For instance, "...at least 75 GW of solar PV capacity was added worldwide—equivalent to the installation of more than 31000 solar panels every hour." Deployment in wind power is equally impressive. Electric vehicles are expected to rise very substantially with major manufacturers' commitment such as Volvo to make the switch to electric for all models by 2019.

However, the commercial development is significantly

lagging behind the technological progress, which has led to a series of detrimental consequences: failing to deliver returns to low carbon technologies without governmental subsidies, failing to deliver true value to flexibility, and failing to deliver economic value to energy customers. These consequences, posing major threats to the future of low carbon development, have created huge wastes in clean energy as experienced in China as low carbon development is still going strong¹⁾, and slowed down low carbon development in the UK as the government largely removed subsidies from 2017 [2].

Europe has the longest, the most mature, and the most advanced energy markets in the world. The wholesale energy markets are converging and wholesale energy prices are decreasing against declining energy demand, leading to a dramatic drop in recent years. This can be linked to the energy policies of the European Union (EU): the increase in competition following market coupling, the unbundling of electricity generation from system operation, the fall in EU Emissions Trading System (ETS) carbon prices and the growth of power generation capacity with low operating costs (such as wind and solar power, in addition to existing nuclear and hydro power).

However, the dramatic fall in wholesale energy prices has not been translated into the major reduction in consumer energy bills. Instead, consumer gas and electricity bills are rising fast. Further, the cost of integrating renewables is expressed in the significant rise in taxes and levies for renewable energy.

This highlighted a number of key limitations in EU market designs: markets, both wholesale and retail, are not sufficiently flexible to integrate renewables economically; loose link between wholesale and retail markets give rise to weak retail competition, allowing suppliers to avoid passing on wholesale price reductions to retail prices; and interconnection between the Member States are still limited, which hedges pan-European competition and limits cross-border trades and flows.

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1) <http://english.ccc.org.cn/>

Against this backdrop, the EU is currently undertaking major reforms of its energy markets to promote flexible energy systems and responsive consumers, making market work for renewables. As there is an increasing move to decentralised supply systems and energy resources, the reform allows the EU to adapt the market structure, design, and operation to ensure that the Member States will capitalize on the new technologies and opportunities, better equip the EU to contain price rises, pay for investments, and minimize cost increases. The ambition is to set a practical example of how a competitive economy can be built on a sustainable and affordable energy system.

This paper details the key components in consumer electricity prices and their make-ups, explains policy drivers for the reform, expounds the key reforms that are currently undertaking, and proposes implications and recommendation to developing countries from the EU experience.

2 Wholesale and retail energy prices in the EU

This section describes the key components in retail electricity prices—energy, network, and tax/levy, each being followed by an analysis of its contribution to retail energy prices. Figure 1 demonstrates the cost elements of energy bills, reflecting both market forces and governmental policies.

2.1 Rise and fall of European electricity demand and prices

Since the economic downturn of 2008, the overall energy demand of Europe experiences a slight fall as shown in Fig. 2. However, consumer energy prices in Europe rose above inflation year-in-year-out, and are considerably higher compared with the major economic partners: 12% more than that in China; three to four times more expensive than comparable US, Indian and Russian prices. Both

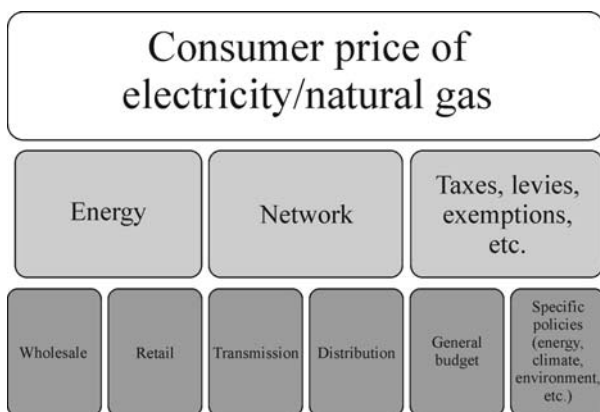


Fig. 1 Cost elements of energy bills, reflecting both market forces and governmental policies

electricity and gas prices have increased significantly in recent years despite falling consumptions in the EU, particularly from the economic downturn of 2008. This is largely due to a significant increase in network cost and governmental taxes and subsidies to low carbon generation, demand and energy efficiency [3].

Retail electricity price has a significant rise as illustrated in Figs. 3 and 4 [4].

The relative share of the energy element in the retail price of electricity had the smallest increase, and it was the tax/levy component which had seen the greatest increase. A number of the Member States provide significant tax and levy exemptions for some energy intensive industries which substantially mitigate the tax/levy price rises. On average, there was an annual rise of 4% in household electricity prices from 2008 to 2012, which was an increase above inflation, and there was an annual rise of approximately 3.5% in industrial retail prices in the same period—above inflation in half of the Member States. Figure 5 depicts the evolution of electricity price by component from 2008 to 2012 [5].

2.2 Energy networks

The relative share of transmission and distribution costs, as well as the absolute levels, vary greatly across the EU Member States.

As shown in Fig. 6, there have been great variations in the network element of prices across areas, particularly the distribution costs which are driven by differing practices regarding network tariff regulation and cost allocation practices, as well as by physical differences in the networks and the efficiency of their operations. The difference on network costs can cause the retail energy price differentials across the Member States.

This suggests that further work is needed on benchmark network costs and practices to ensure that the convergence in network practices improves the efficiency of the distribution and retail markets and so reduces the network cost element of prices.

2.3 Tax and levy

Taxes and levies for financing energy and climate policies are generally the smallest element but levies, in particular, have increase significantly more than others. In most Member States, taxation and levies are generally for promotion of energy efficiency and renewable energy production. Indeed, the cost of renewable energy added to retail prices constitutes 6% of the average EU household electricity price and approximately 8% of the industrial electricity price before taking exemptions into account. It is important that government interventions in the energy sector (financing infrastructure or generation, e.g. renewables, nuclear costs or flexible fossil fuel capacity) be as cost effective as possible.

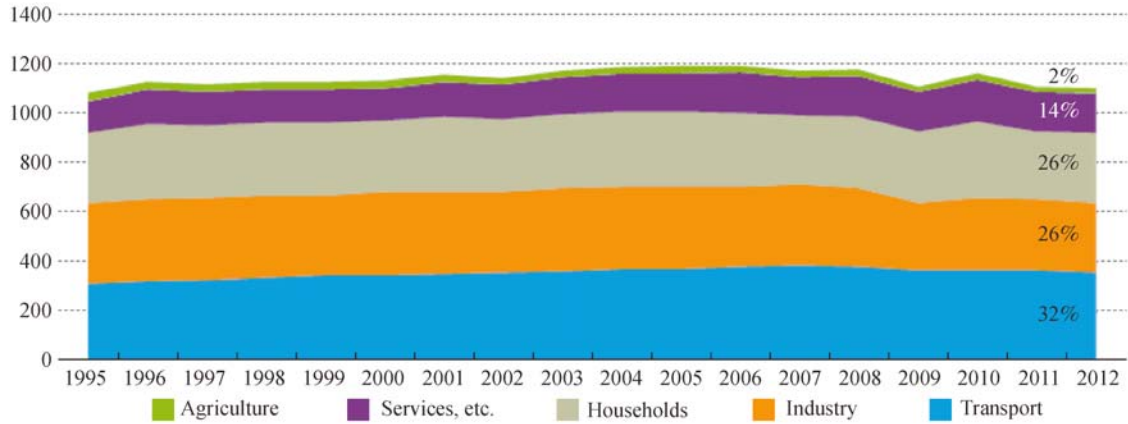


Fig. 2 Rise and fall of EU energy demand from 1995 to 2012 [3]

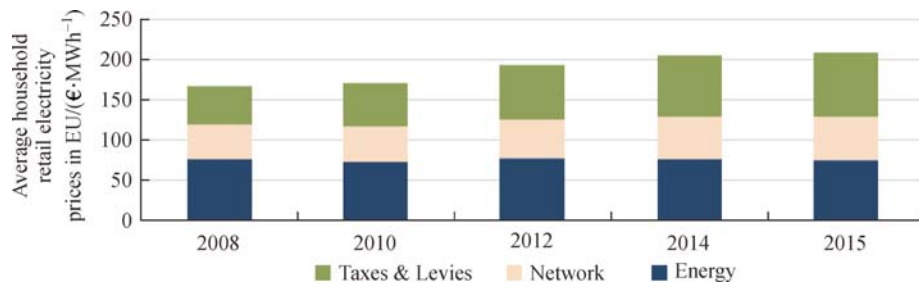


Fig. 3 Average household retail electricity prices in EU [4]

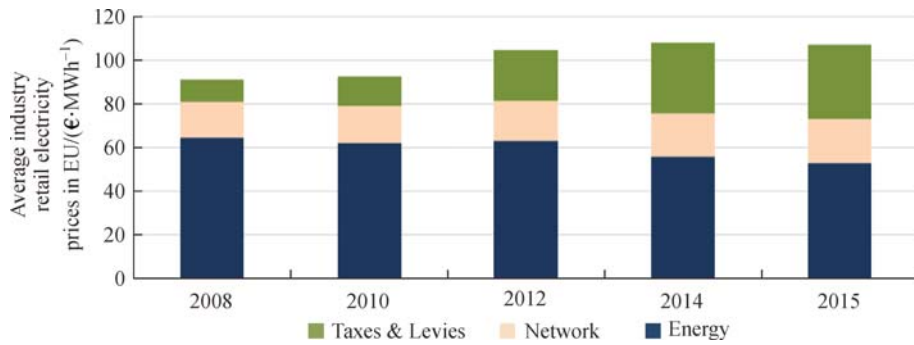


Fig. 4 Average industry retail electricity prices in EU [4]

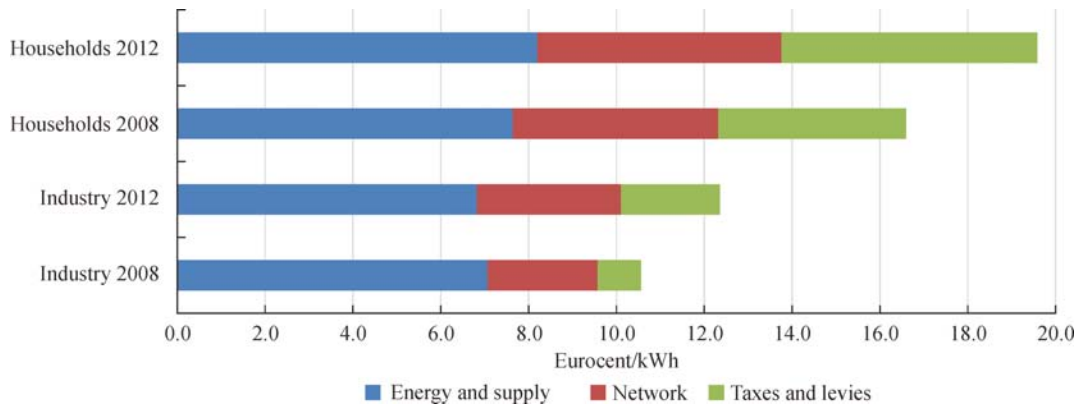


Fig. 5 Electricity price evolution by component 2008–2012 [5]

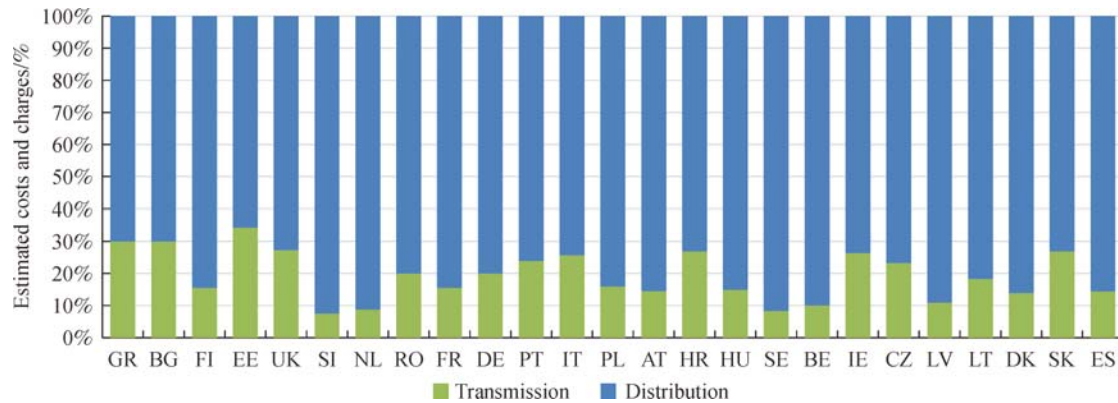


Fig. 6 Estimated costs and charges at transmission and distribution level: relative share

Moreover, the data on the tax exemptions and other subsidies, are particularly significant to keep a consistency across different industries. For this reason, the EU Commission should gather consistent and complete data on the full costs and subsidies of the various technologies in the electricity sector.

Against the backdrop of major fall in wholesale energy prices, significant rise in retail energy prices implies that the competition in retail markets is weak, allowing suppliers to avoid passing on wholesale price reductions to retail prices.

In electricity markets, the relationship between wholesale and retail prices can be cut by high levels of market concentration. Moreover, universal retail price regulation applied in some Member States tends to be detrimental to competition in the retail markets. It, therefore, contributes to reducing the responsiveness of retail prices. In addition, the Member States should explore other policy measures to address the concerns for vulnerable households or industries.

3 Policy drivers for energy market reform

The EU is committed to develop “a Resilient Energy Union with a Forward-Looking Climate Change Policy” [6], making the EU the world leader in renewable energy. The ambition is to set a practical example of how a competitive economy can be built on a sustainable and affordable energy system.

A key step in reforming a market that fits for renewables is to spread the uncertainty, or hedge against uncertainty across wider EU areas and spread over more energy vectors. This is expected to be achieved through a number of complementary instruments: constructing market working for renewables and spreading uncertainties/intermittencies over wider EU States and other energy vectors; constructing market coupling across the Member States to increase competition and reduce EU-wide wholesale energy prices; linking wholesale and retail markets to

allow suppliers to pass on market information to reward flexible and responsive consumers; and increasing interconnections between the Member States to facilitate effective competition: increasing cross-border trade/flow, controlling price rise and reducing price differences between the Member States.

These instruments are designed to overcome a number of key barriers in the current energy markets that prevent energy systems from moving to a flexible and efficient low carbon system: the markets are not sufficiently flexible to integrate renewables, as they are designed to reflect the availability of largely fossil generation that is controllable and predictable, not intermittent renewables with little opportunities/rewards for demand responses; the markets do not recognize and reward the contribution from small-scale distributed energy resources at the regional level, such as distributed generation, energy storage and demand side response; wholesale and retail markets are disconnected, consumers are not incentivized to participate in markets, leading demand side response as a largely untapped resource; and interconnections between the Member States are still limited, creating large price differences across the Europe. Figure 7 illustrates the significant differences.

4 Key reforms in EU energy markets

The key aim of the EU market reform is to integrate renewables fully into the electricity system by ensuring markets being fit for renewables, and promote their participation in electricity markets on an equal footing with conventional generation [7].

The EU proposed the following key reforms to deliver a harmonious and well-functioning EU market to support the low carbon transition at minimum cost:

4.1 Efficient short-term electricity markets

As the percentage of intermittent renewable generation

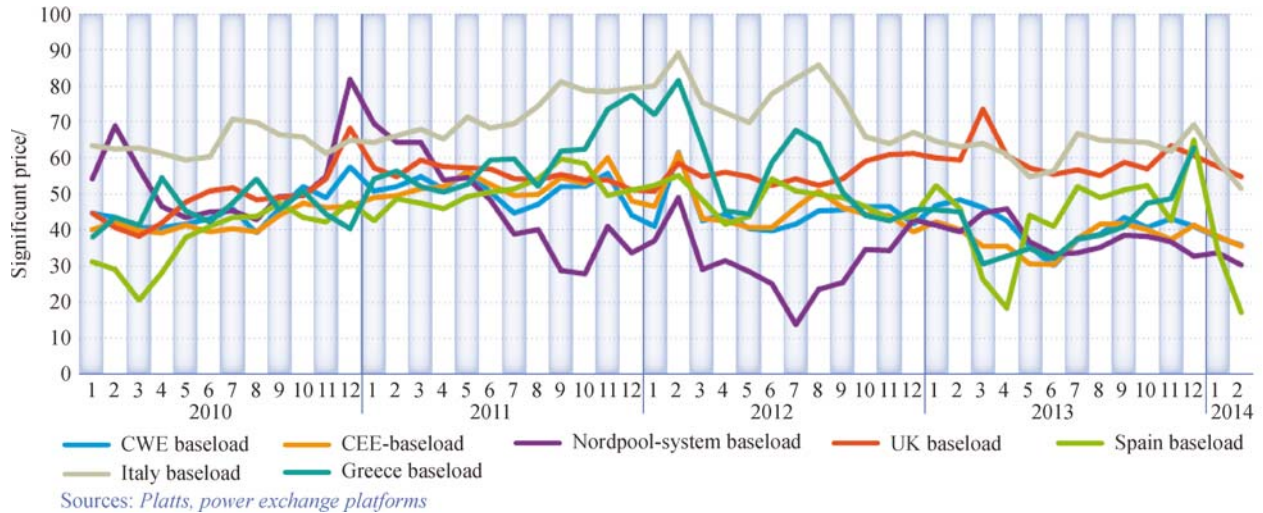


Fig. 7 Significant price differences between Member States

increases, the difference of energy cost between locations and over-time will increase very substantially. A well-functioned short-term market should deliver efficient prices to signal the surplus or shortage. There is a greater desire to run markets from the day-ahead, intra-day, right up to real-time, which will allow the dynamic nature of intermittent generation fully expressed in the market signals, and allow full access to flexible technologies.

As intermittent renewable generation increases, the security of supply will be challenged. Flexible demand such as electric vehicle, heat pump, conventional generation, energy storage, and interconnection must be incentivized to respond to rapid energy changes in the system. Hence, an efficient short-term market must reflect increasing market players, generation, and demand technologies.

At present, there are significant market coupling in Europe, for day-ahead, intra-day, and balancing markets are still operated within each EU Member States. An extending the coupling right down to balancing market, coupled with common congestion management methods will be needed to spread the uncertainty across wider areas and thus reduce the need for back-up generation.

4.2 Efficient long-term markets to incentivize right investment

Well-functioning longer-term markets should provide certainty to investors and suppliers against price-swings in short-term markets, while ensuring that customers are not unduly exposed to higher or more volatile prices. This can be achieved by long-term contracts/insurances to suppliers and consumers against price volatility, and critically, improve the long-term investment signals. Thus, it is critical to link price fluctuations in short-term markets with long-term market signals and promote appropriate long-term products. Long-term contracts

between market participants can help mitigating the investment risk for the capital-intensive investments required in the electricity sector, facilitating access to capital in particular for low-carbon technologies at reasonable costs.

4.3 Efficient infrastructure development for an efficient and functioning market

A well-functioning market requires the support of a well interconnected European energy grid, allowing energy to flow to the most needed and valued places, which is also critical to the energy security of Europe. It is, therefore, vital for a market to provide right signals to drive right investments, allowing the Member States to access diverse energy resources, reduce the overall energy costs, and minimize the price differences between the Member States.

A key priority in the energy strategy of the Energy Union is thus to enable the necessary investment to achieve the goal. To this end, the Commission devised a number of financial and advisory instruments: European Fund for Strategic Investment, Europe Facility Connection, and Investment Advisory Hub to provide expertise and technical assistance for potential investment projects.

4.4 Making market fit for renewables

An efficient short-term market that integrates from day-ahead to intra-day and up to real-time will reward flexibility in generation, demand, energy storage, and interconnection. Critically, it will encourage renewable energy to play in the markets and thus to be at the level-play field with its conventional counterparts. This would also mean that other instrument, such as risk management, become a necessity in the future market with a high level of volatility, allowing parties who excels in risk management

to develop risk mitigation strategies instead of leaving all the risks to renewable developer or the grid operator.

4.5 Linking wholesale and retail markets to deliver a better deal for consumers

The current markets have very limited consumer participation, because of lack of information and understanding both on consumer energy behaviors and their impacts on the wholesale and network costs. This led to limited energy products available to consumers, who have little incentives and capability to respond to changing energy prices, and the potential for demand response is thus largely untapped. This is particularly detrimental to the supply efficiency and security, and will ultimately compromise the cost and the speed of renewable development.

Linking wholesale and retail markets to deliver efficient price signals and energy products is needed to ensure that consumers would be active in improving overall system efficiency and, at the same time, financially beneficial from being active and responsible energy users. Common approach to the development of DER markets is desirable to ensure they could be in the level play field with generations in short-time and long-term markets.

4.6 Increasing cooperation/integration between transmission and distribution system operators

There has already been a close coordination between transmission system operators through the European network of transmission system operators for electricity (ENTSO-E), who play an important role in coordinating transmission system operators (TSOs) and developing network access and use of system codes.

Given the growth in distributed energy resources, the EU has set up Regional Security Cooperation Initiatives (RSCIs) to integrate regional system operator such that operational planning and decision-making are consistent at every point in time and every point in space.

Distribution grids are the backbone of the supply system and critical for integrating locally produced renewable energies. It is critical that new procedures and incentives are introduced to incentivize distribution system operators (DSOs) in using local flexibility to respond to new requirements in addition to traditional network upgrading. The combined development between TSO and DSOs will pave the way for pan-European coordination of system operation.

5 Implications to developing nations

As technologies become more mature, greater efforts are made across the developed and developing nations to make markets fit for low carbon development. High level

principles for an efficient and integrated market should be:

(1) An efficient market should ensure that the energy needs are met by the cheapest supply media that can be accessed through electrical interconnections and energy integration.

(2) An efficient market should promote short-term flexibility, efficiency and long-term investment certainty, and deliver customized energy products and services.

(3) An efficient market should promote innovation in technologies and services, and job creation, promoting a competitive economy based on innovation rather than expensive capital investment.

In the EU, major reform is underway to create the condition for a reliable and affordable energy for all, and for renewables to be in the level play field with its conventional counter parts. The European reform in electricity market will create harmonious/integrated short-term markets across the Member States, from day-ahead through intra-day to real-time. The key intention is to promote flexibility and cross-border trades/flows of electricity, link wholesale and retail to incentivize demand response through efficient short-term energy products, and promote right infrastructure investment through innovative long-term energy products.

The EU has many Member States with a variety of system developments, efficiency and markets, similar to the system in most developing nations. Developing countries can draw lessons from the current market reform of Europe, particularly for improving the supply efficiency and providing instruments to substantially reduce clean energy curtailments:

(1) Efficient short-term cross-border cooperation and trade, so that cheaper energy from distant generation could compete with expensive, and often high carbon based local generation. Cross-border trading will thus be incentivized to buy-in cheap distant energy instead of relying on internal energy generation. This will tackle the biggest issue in renewable curtailment, by burning expensive local coal while clean energy from remote areas has to be curtailed. This needs to be complemented by cross-border long-term energy products to ensure its long-term certainty in energy provision from distant generation.

(2) Efficient cross-border long-term energy markets/energy products that are linked to short-term energy markets, long-term energy products can hedge against short-term price volatility to consumers. The long-term contracts will act as an insurance should distant energy fail to materialise, and would give the regional network sufficient compensation to buy in from elsewhere. The long-term contract will also support efficient long-term investment signals.

(3) Efficient short-term energy markets/energy products that are linked to retail markets to allow price fluctuation, reflecting energy surplus and deficit in time and space, and incentivizing energy to flow to “where it is most wanted and valued.” Critically, it allows suppliers to pass on

whole-sale energy variations to consumer to promote/reward demand flexibility.

(4) Efficient transmission and distribution network charges have to be based on sound assessment of network expenditure. The challenge is particularly high in developing nations where there are major differences in development speed, approach and aspiration.

(5) Interconnection development needs to serve the purpose of increasing competition, spreading the uncertainty/intermittency to wider areas and reducing the overall supply cost. If the investment has not led to the reduction in energy price or the reduction in energy curtailment, especially clean energy, the investment is poor or poorly operated.

(6) Integrating energy markets serve similar purposes as interconnection. As there require many interconnections between energy vectors, energy integration essentially allows renewable to be utilized to the full, and spread uncertainty and intermittency to other energy vectors at all levels, from transmission, distribution to consumption.

6 Conclusions

Europe has the longest, the most mature, and the most advanced energy markets in the world. Although whole-sale energy markets are converging and wholesale energy prices are decreasing against declining energy demand, consumer gas and electricity bills are rising fast. Furthermore, the cost of integrating renewables is expressed in the significant rise in taxes and levies for renewable energy. It is against this backdrop that the EU is undergoing a major reform to allow the EU to develop “a Resilient Energy Union with a Forward-Looking Climate Change Policy,” and make the EU the world leader in renewable energy.

This paper analyzes the changes in energy demand and prices in Europe in recent years, highlights the key limitations of the current markets in facilitating renewable

integration and the range of reform that the EU is taking to ensure that the EU continues to lead the world in renewable development and set a practical example of how a competitive economy can be built on a sustainable and affordable energy system overcome.

Based on the EU experience and current reform, this paper proposed a range of market development that is critical for low carbon development in developing nations, including short and long-term energy markets and products for cross-region trading, integration between wholesale and retail markets, transmission and distribution network charges, and energy interconnection between different regions and integration between different energy vectors.

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