ENERGY REGULATORS
REGIONAL ASSOCIATION

Energy Crisis and Regulatory Considerations for the future market model

Final report

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Study on:

Energy Crisis and Regulatory Considerations for the future market model

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[1] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

Abbreviations and acronyms

ACER	Agency for the Cooperation of Energy Regulators (European Union)
BESS	Battery Energy Storage System
BM	Balancing Market
BRP	Balance Responsible Party
CACM	Capacity Allocation and Congestion Management
CCGT	Combined Cycle Gas Turbine
CEGB	Central Electricity Generating Board
CfD	Contracts for Difference
DAM	Day-ahead market
EB	Electricity Balancing
EC	European Commission
ECA	Economic Consulting Associates
EEA	European Economic Area
EGAT	Electricity Generating Authority of Thailand
EPP	Energy Pool Price
ERC	Energy Regulatory Committee (Thailand)
ERRA	Energy Regulators Regional Association
ESMA	European Securities and Markets Authority
FCA	Forward Capacity Allocation
FERC	Federal Energy Regulatory Commission (United States)
FG	Framework Guidelines
FTR	Financial transmission right
IDM	Intra-Day Market
IEA	International Energy Agency
IMF	International Monetary Fund
IPP	Independent Power Producer
ISO	Independent System Operator
LMP	Locational Marginal Prices
LNG	Liquefied natural gas
LOLP	Loss of Load Probability
MSC	Market Stabilisation Charge
NC	Network Codes
NEMO	Nominated Electricity Market Operator (European Union)
NETA	New Electricity Trading Arrangements (Great Britain)
NGC	National Grid Company (Great Britain)

NTC	Net Transmission Capacity
OFFER	Office of Electricity Regulation (Great Britain)
PJM	Pennsylvania - New Jersey - Maryland
PPA	Power Purchase Agreements
PPP	Pool Purchase Price
REC	Regional Electricity Company (Great Britain)
RTO	Regional Transmission Organisation (United States)
SAPP	Southern African Power Pool
SMP	System Marginal Price
SO	System Operator
SoLR	Supplier of Last Resort
TSO	Transmission System Operator
TTF	Title Transfer Facility
UIOSI	Use-it-or-sell-it
VAT	Value Added Tax
VOLL	Value of Lost Load
VRE	Variable Renewable Energy

Executive summary

This report highlights experiences from the recent energy crisis that can serve as a guide for Energy Regulators Regional Association (ERRA) member countries' preparation for and responses to future crises. Drawing on examples from a wide range of countries, with different energy markets and systems, the report provides: (a) an overview of short-term policy and regulatory measures adopted to address the crisis (mostly to support access to affordable energy) and lessons that emerge from these; and (b) in the context of evolving energy supply and market paradigms, consideration of longer-term policies and measures, including for electricity market design.

The energy crisis generated unprecedented price increases in many countries …

The energy crisis started developing in 2021, as the easing of COVID-19 restrictions released pent-up demand against a backdrop of supply side constraints, including tight LNG markets. Russia's invasion of Ukraine on 24 February 2022 then resulted in severe energy supply disruptions and significant uncertainty. Coupled with other factors, including extreme weather events, this pushed global energy markets deeper into crisis. Europe's dependency on Russian energy placed it at the centre of the crisis, but the effects were global.

Prices of gas reached unprecedented levels in, for example, Europe and NE Asia. With gas generators being the marginal price setters in many electricity markets, this, in turn, drove unprecedented increases in wholesale electricity prices. This left many countries facing the urgent issue of how to ensure their citizens and businesses could access energy at affordable prices.

… requiring governments (and regulators) to intervene …

Addressing this affordability challenge, had sizeable fiscal implications, and required governments to lead the response. The role for regulators was, inevitably, more limited but still important, not least in providing advice to governments during the crisis as well as in supporting implementation and monitoring of some measures.

… through a range of short-term measures, primarily to support affordability …

Many and varied short-term interventions were made, mainly to address affordability. These included direct subsidies to consumers, retail price caps, demand reduction measures, and interventions in wholesale markets. The need to act urgently, as well as the uncertain and relatively complex environment, made it inevitable that some of the short-term measures implemented will have been better than others. Lessons include:

- The development of interventions needs to consider secondary effects, including on competition. Demand reduction, direct financial support to consumers, and reduced taxation are examples of short-term interventions which support affordability but do not materially interfere with competition and have lower risks of unintended or distortionary consequences than some others. In general,

interventions in wholesale electricity pricing run a greater risk of unintended consequences, than interventions in the retail market, although the details matter.

- Interventions should be targeted. This relates both to targeting the root cause of the problem (rather than the symptoms) and, more broadly, to targeting affordability measures at those who most need the support (e.g. to the energy vulnerable), rather than all consumers.

- Given the large windfall profits earned by some market participants, taxes on these profits provides a means to fund, at least in part, some of the short-term interventions. To minimise potential distortionary effects or perceptions of increased investment risk such taxes should be short-term and clearly linked to the exceptional nature of events.

… whilst also prompting consideration of longer-term measures to mitigate the effects of future crises.

Short-term interventions helped mitigate some of the worst of the recent energy crisis but other, longer-term, measures could help reduce the consequences of any future shocks. For example, increasing diversity of generation technologies will increase resilience of electricity markets. With increasing deployment of variable renewable energy (VRE) generation, contributing to diversity as well as decarbonisation goals, additional flexibility is needed, ideally from non-fossil fuel sources, such as storage and demand response. These longer-term policy measures are, again, primarily the domain of governments, with a role for regulators to support and advise.

Longer-term measures for *regulators* to consider in preparing for and mitigating the effects of future shocks include:

- **Development of markets and market design.** There is a general consensus that, whilst not a 'magic bullet', competition in electricity can deliver benefits and that marginal system pricing remains the appropriate price formation mechanism in wholesale electricity markets. In the case of the European Union (EU), both Agency for the Cooperation of Energy Regulators (ACER) and the European Commission recently reached the same conclusion that the core of the existing electricity market design (including price formation by the most expensive generator needed to meet demand) remains fit for purpose. However, the Commission identified some changes, focusing on promoting a greater role for longer-term markets to create a buffer between short term changes in wholesale prices and consumers' bills.

- **Acceleration of transmission development.** Decarbonisation goals require increased connections of renewable generation. Whilst their powers vary across jurisdictions, regulators have a role in setting obligations and the right regulatory environment to encourage the acceleration in transmission development needed.

- **Protection against market failures or problems.** There are a few areas in which markets in some jurisdictions could be deemed to have failed, or at least performed poorly, during the extreme stress placed on them by the energy crisis and which provide lessons for the future. This was particularly the case in retail markets, with potential merit in regulators setting requirements (or expectations)

on suppliers' financial robustness and hedging of wholesale prices, as well as ensuring that Supplier of Last Resort (SoLR) provisions are appropriate. Wider considerations that could provide resilience against future shocks include requirements on participants to hold strategic reserves (e.g. of gas).

Introducing electricity competition is not a 'magic bullet' for responding to crisis and price shocks.

Emerging markets have looked to introduce competition in order encourage additional investment from the private sector. This needs a framework for the investor to assume some of the risk and markets are a place where this risk can be managed. If commercial interests do not share the risk, then sovereign debt could become unmanageable. Markets are also about sending efficient price signals, which ultimately inform what should be invested in.

Successful markets can emerge in many different forms, but some common factors are needed:

- **A robust regulatory framework** which gives the investor confidence that its legitimate interests will be protected and it will be allowed to control its risk.
- **Low or reducing tariff subsidies** which give confidence that the investor should be able to recover costs even without government support.
- **Robust consumer payment rates**. If consumers are not paying what they owe for energy, then investors will see risks to future payments. This also suggests that infrastructure and generation adequacy are important because frequent blackouts undermine consumers' willingness to pay.
- **Strong price signals**. These come either through long-term contracts that underwrite capacity investments or in short-term markets setting prices that reflect short-term capacity scarcity as well as variable costs. Competitions for long-term contracts are an initial way of encouraging investments but, while the auctions should bring lower cost investment, they do not pass the investment risk fully onto the investor in terms of what to build and how it should be operated; this is why short-term markets emerge to deliver the marginal value and incidence of scarcity.

This focus on investment is also relevant for new trends in development of renewables to increase national exploitation of domestic energy sources, such as wind and solar, as well as to improve the environment. Increased VRE penetration increases the need for better system management and, often, the deployment of electricity storage, which increases the importance of robust short-term markets setting scarcity prices because the resulting marginal prices are central to valuing energy arbitrage, which is what storage relies on to make money.

1 Introduction

This report has been prepared by Economic Consulting Associates (ECA) for ERRA and is a key deliverable of the project *Energy Crisis and Regulatory Considerations for the future market model*. ERRA commissioned this project following the recent energy crisis that led to unprecedented increases in electricity prices in the past two years and in response to which governments and regulators enacted a variety of measures to protect consumers.

1.1 Objectives and scope

The objective of this study is to highlight experiences from the recent energy crisis that can serve as a guide for responses to future crises affecting ERRA members' electricity sectors.

This report is intended to benefit all ERRA members (both those who are EU members, and those who are outside the EU and undergoing the energy reform process) by providing information and analysis to enhance understanding of the challenges posed by the energy crisis. As well as summarising the causes and evolution of the crisis, the report:

- Presents an overview of measures taken and considered to address the crisis, with specific examples from amongst ERRA's membership base, but also more widely. Across ERRA members there are different regulatory and market models, with differing roles and powers for those members. This means responses by a regulator that are possible and suitable in one jurisdiction may be neither possible nor suitable in another. Given these differences in models, the report considers a wide range of responses, from policy, through regulatory to issues of electricity market design, as well as the circumstances in which the response may be appropriate. These measures include not just from actions taken in response, but also consideration of potential other actions that could have been taken.

- Reflects on lessons learned from the measures implemented and presents possible future policy options.

Although the focus of the report is on electricity, given the important interaction between gas and electricity, gas market interventions are considered where relevant to the electricity market.

1.2 Approach

This work was primarily informed by desk-based research conducted by ECA across a range of countries (including ERRA members, but also more widely).[2] In addition, the research included reviews of summaries and recordings of interviews conducted by the ERRA

[2] Examples from across 20 countries are provided in text boxes throughout the report (in addition to the EU) with other countries referenced in the main text of the report.

Secretariat in late 2022[3] with representatives of ten ERRA member regulatory agencies from the following regions and countries:

- **Europe and Central Asia**: Hungary, Latvia, Poland, France, Austria, Türkiye.
- **Asia**: Thailand, Pakistan
- **Africa**: Nigeria
- **America**: USA

1.3 Report structure

The remainder of this report is structured as follows:

- Chapter 2 **describes the introduction of competition into electricity markets** and some of the wholesale market models applied internationally.
- Chapter 3 **summarises the factors behind the 2022 energy crisis and its consequences**.
- Chapter 4 provides **an overview of energy crisis response measures** and characterises the role of regulators.
- Chapter 5 **details some of the retail market interventions**, including direct support to consumers in those markets, to address problems arising from the crisis.
- Chapter 6 considers **wholesale market interventions** in response to the energy crisis, covering both short-term measures (such as price caps) and potentially longer terms measures, including the design of wholesale markets.
- Chapter 7 concludes with **lessons regarding short-term and longer-term interventions**, as well as specific considerations for jurisdictions seeking to progress or develop market opening.
- Annex A1 is a **timeline of key European Commission responses** to the energy crisis, along with brief summaries of key measures.

[3] ERRA's Interim Review on Policy Responses to the Ongoing Energy Crisis was officially concluded during an internal ERRA High-Level Consultation on Energy Crises that took place in Istanbul, Türkiye on December 5, 2022.

2 Background to power market developments

In this chapter, we briefly describe the introduction of competition into electricity markets and summarise some of the models applied internationally. This is not intended to be exhaustive but provides context to the discussion on electricity markets that follows later in the report.

2.1 Introducing competition and early liberalisations

Until the 1990s, the vast majority of countries had vertically integrated electricity systems, most of which were state-owned. This slowly changed from the 1990s as competition was introduced, particularly into electricity generation, with the intention to drive efficiency.[4] For example, generators competing to sell their power provides incentives to reduce costs and for prices to reflect costs, putting downward pressure on wholesale prices. Competitive markets also provide price signals that better inform new generation investment decisions, facilitating entry of efficient plant. Most larger economies have now introduced, or are planning to introduce, some form of competition.[5]

Competition in electricity can be introduced in different ways and to different extents but all options involve some degree of reform. A common first step is the single buyer model in which the existing vertically integrated entity purchases all power requirements, including through electricity generation that is competitively procured under long-term contracts from Independent Power Producers (IPPs). A subsequent step can then be the introduction of wholesale competition in which there are multiple buyers of power, as well as sellers. To be effective this form of competition requires more changes than the single buyer model, including unbundling, as some of the following examples illustrate.

Chile was the first country to comprehensively reform its electricity sector, moving from a state-owned vertically integrated monopoly to a competitive market. The concept was first considered by Chile's newly formed National Energy Commission in 1978 and was implemented with the enactment of the Electricity Law in 1982.[6] Two existing, vertically integrated, state-owned companies were unbundled into several generation and distribution companies, which were later privatised. Power plants were dispatched centrally, in ascending order of generation cost (regardless of any supply contracts with large customers) and energy was exchanged at the system marginal cost.

Subsequently, competitive electricity market arrangements were introduced in several jurisdictions, notably:

- the England and Wales power Pool, through which trading commenced in 1990. In summary, this was an energy-only cost-based wholesale auction where

[4] In some cases, and certainly for GB, the introduction of competition and market design were intended to increase cost-reflective pricing for large industrial customers, making their daytime baseload-type demand tariffs cheaper so they could be more competitive internationally.
[5] Some form of electricity competition has been introduced in 56 countries. Source: *Wholesale Electricity Market Design: Rationale and Choices*, ESMAP and the World Bank, November 2022.
[6] The Law distinguished between the activities of generation, transmission, and distribution, and introduced: (a) free negotiation of energy supply contracts among power generation companies and large customers, and (b) regulated prices for smaller customers.

privatised generation portfolios offered bid curves for each unit into a clearing auction that set a system marginal price reflecting the short run marginal cost of supply in each half-hour of the day-ahead. This covered variable cost but there was also a security of supply capacity payment to cover fixed costs.

- the Nordic power market, a regional electricity market operating in Sweden and Norway since 1996, and expanded to also cover Finland and Denmark by 2000. This was based more on the current bilateral contract model but with payment adjustments for the different constrained bidding zones.

- PJM (Pennsylvania - New Jersey - Maryland), emerged as a variant of the England & Wales Pool, with centralised dispatch but nodal pricing providing stronger locational price signals. This electricity market has been operating since 1997, and covers 13 States and one District.

Summary descriptions of the above electricity market arrangements are provided below.

2.1.1 England & Wales and the Electricity Pool

In the UK, ahead of electricity market liberalisation, the CEGB held an effective monopoly in electricity generation and transmission. Under the process outlined in a White Paper on "Privatising Electricity" (1988), and the subsequent Electricity Act (1989), the electricity industry was restructured, through:

- the separation of CEGB assets into separate, competing generation companies (horizontal unbundling)[7, 8]

- the setup of twelve Regional Electricity Companies (RECs), from the existing twelve regional electricity boards, competing for electricity supply to customers[9]

- the setup of National Grid Company (NGC), as an independent transmission grid company, fully owned by the RECs, aimed at providing new entrant generators fair access to transmission (vertical unbundling)

- ring fencing monopoly activities (ie transmission and distribution) from competitive activities

- the obligation for all licenced generators and suppliers to trade through the wholesale electricity Pool

- rules for NGC to dispatch power plants in cost of operation-based merit order.

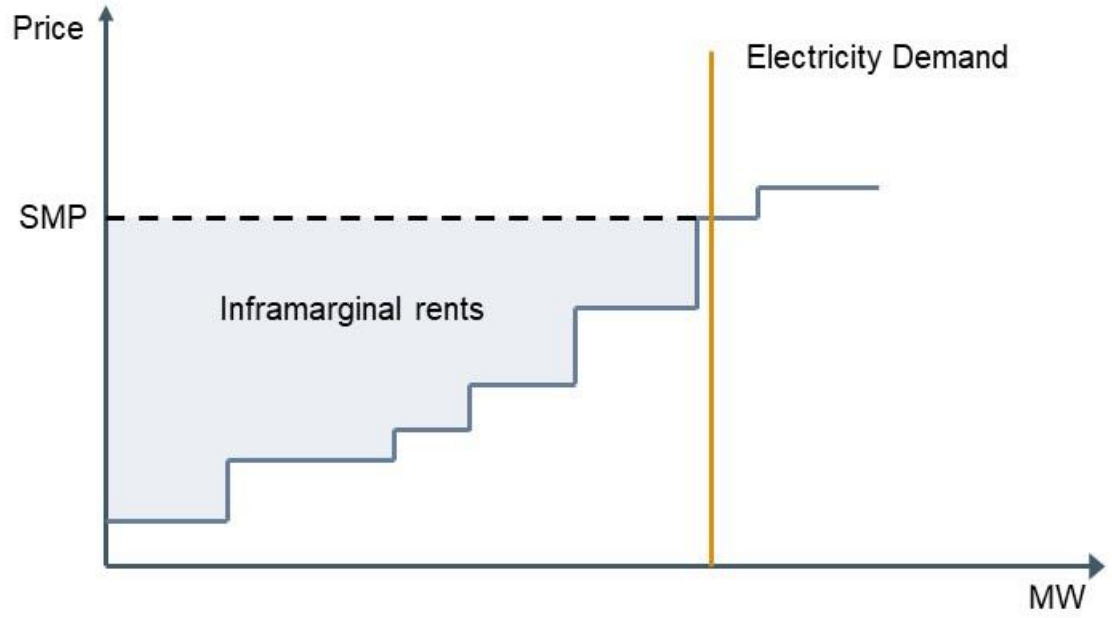
[7] Three generation companies were formed (National Power, PowerGen, and Nuclear Electric) accounting for 91% of total generation, with the remainder provided by Independent Power Producers (IPPs). Despite the initial horizontal unbundling, and some new entry, it required further horizontal unbundling for competition to take hold and prices to reduce.
[8] All of CEGB's successor entities, as well as the 12 RECs, were eventually privatised.
[9] The RECs were initially both distribution and supply companies, but retail competition was introduced later and in stages (depending on load), with full retail competition from June 1999.

The creation of the new companies (known as “vesting”) occurred on 31 March 1990 and trading through the Pool commenced on 1 April 1990.

The wholesale electricity Pool, operated by NGC, managed the coordination of generation, transmission, and distribution. The Pool was the trading mechanism through which RECs could collectively purchase electricity from generators at a common Power Purchase Price (see below) set through a bidding system, whereby generators submitted bids for each half-hour of the next day, comprising a start-up price, a no-load price, and up to 3 incremental prices. NGC produced the demand forecast (plus needed reserves), and scheduled generators’ bids to meet demand at any time of the day, by establishing a merit order of generators, according to their offer price. The price of the most expensive unit required to operate in order to meet demand in each half-hour set the price of energy at that half-hour in the system (the System Marginal Price - SMP).

The difference between the bid price of generating units and the SMP meant generators earned inframarginal rents, which were used towards coverage of their fixed cost.

Figure 1 SMP and inframarginal rents in the Pool



Source: ECA

To incentivise generators to maintain generation capacity above the level of the expected demand for electricity, so that unexpected demand and generator failures may be covered, a Capacity Payment was added to the SMP. The Capacity Payment was the product of the LOLP and the Value of Lost Load (VOLL), the latter reflecting the cost to consumers of an electricity outage (VOLL was set at 2000£/MWh in 1990, it increased to 2599£/MWh in 1997/98, and further increased each year by the RPI inflation rate).

The sum of the SMP and the Capacity Payment was the Power Purchase Price (PPP), received by Generators for their deemed output until February 1998, thereafter it was for their actual output.[10]

Due to actual system constraints generation units might have to be re-scheduled downwards ("constrained-off"), or upwards ("constrained-on"), and the relevant cost was recovered by NGC through the Pool. Constrained-off units were paid the difference between the PPP they would have received and their bid price, while constrained-on units were paid their bid price plus an Unscheduled Availability Payment, paid to available units not included in the unconstrained schedule.

Other costs of NGC for the operation of the system, and a regulated return on cost of network were also added as an uplift to the price paid by suppliers for energy offtaken by the Pool (the Pool Selling Price).

The electricity market was regulated by the Office of Electricity Regulation (OFFER), a non-ministerial government department established under the Electricity Act of 1989.[11] The Office monitored the activities of all licenced electricity generators, transmission companies, and suppliers, aiming to promote competition in the generation and supply of electricity while ensuring that all reasonable demand for electricity were satisfied. OFFER was also responsible to protect consumer interests regarding prices, security of supply, and quality of service, and to promote the efficient use of electricity.

A Pooling and Settlement Agreement, entered into by all market participants to the electricity Pool, set the precise, yet complex, rules required for the operation of the pool and financial settlement of transactions among parties. Complexity of the Pool arrangements was the reason leading to the abolishment of the Pool.

On 27 April 2001, the Pool (effectively a multilateral contract model) was replaced by a bilateral contract model (i.e. allowing exchange of electricity on a bilateral basis), known, initially, as NETA (New Electricity Trading Arrangements). A bilateral contract model was already in place in the Nordic power market.

2.1.2 The Nordic model (and some others)

The Nordic power market was developed following deregulation of the Norwegian (in 1991) and Swedish (in 1996) electricity industries, and the subsequent unification of the two markets. Finland and Denmark also joined the market, between 1998 and 2000.

In contrast to England & Wales's mandatory electricity Pool, the market was based on a "bilateral contracts" model (i.e., an arrangement allowing and promoting the exchange of electricity on a bilateral basis), which was complemented by an organised pool-type spot market. Participation in the spot market was not mandatory, and only about 25% of all electricity traded in Norway-Sweden was done through the spot market, with the rest traded through bilateral contracts. The importance of the spot market was that it provided a reference price for determination of prices in bilateral contracts.

[10] Under the Pool, some 80-90% of traded electricity was hedged through Contract for Differences (CfDs).
[11] In 1999 the offices of the electricity and gas industries regulators were merged to form the Office of Gas and Electricity Markets (OFGEM).

The Nordic model consisted of four distinctive parts: financial market, day-ahead market, intraday market and balancing market (see Figure 2).

Figure 2 The Nordic power market trading timelines

Source: ECA

Each of the four markets (as shown in Figure 2) are briefly described below:

- **The financial market** was managed by NASDAQ, and was used mainly for market participants' risk managing purposes allowing longer-term price hedging through financial derivative contracts. A weekly organised physical forward market operated in the early stage of the Nordic market, which was replaced by financial trading in the mid-1990s. Physical bilateral contracts were still allowed after the introduction of financial trading, but normally such contracts were done with the Day-ahead market price as a reference price.

- **The Day-ahead market** (DAM - ELSPOT) and Intraday market (IDM - ELBAS) were operated by Nord Pool, a power exchange jointly owned by the transmission system operators (TSOs) of the participant countries. The primary role of the DAM was to establish equilibrium between demand and supply across the whole region.

  In another difference compared to the England & Wales Pool, to handle physical transmission constraints, the market was divided into several bidding areas. When transmission constraints were binding, prices differed in the bidding areas, with higher prices in deficit areas and lower prices in surplus areas. Sweden and Finland always consisted of only one area each, whereas Norway could be divided into as many as five. Congestion in the grids of Sweden, Finland and Denmark were handled by counter trade. Nord Pool distributed information to all market participants regarding which bidding areas would apply during the following week. The overall system price and system turnover were the theoretical price and quantity that would have prevailed had there been no limitations in the grid. During most times of the year there were no, or very small, transmission constraints, so that deviations from the system price were usually small.

  Actual bidding was done by participants submitting their bid curves to Nord Pool showing how much they would be willing to buy or sell at different prices, and in what bidding area. All bids and offers were grouped in supply and demand curves, representing Nord Pool's aggregated supply and demand, and the market clearing system price was calculated at their intersection. In the absence of any transmission constraints, all bidding areas would be treated as one, and the system price would be its area price. If there were transmission constraints, however, then market clearing would occur in each of the constrained areas, yielding separate area prices.

Transmission capacity between bidding areas was managed by Nord Pool through “implicit auctions”, i.e., using the capacity for feeding power out of low price areas to high price areas, thus reducing the price in high price areas and increasing the price in low price areas. This ensured the capacity of the constraints was utilised in accordance with current price signals at all times.

- **The Intra-Day Market** was a continuous market operating up to 1 hour ahead of physical delivery. It complemented the DAM by allowing participants to balance their actual positions compared to the positions contracted through the DAM. In addition, after the DAM results were published and physical power transfers between countries were defined through the implicit auction, the remaining cross-border capacity could be allocated to the IDM for cross-border trading.

- **The Balancing Market** (BM) was operated by the national TSOs. In the BM market participants could submit up-regulation or down-regulation offers, which the TSO would activate in order to balance the system, so as to regulate the frequency in the transmission network within acceptable tolerance levels. The BM was open each day after the DAM closed and DAM prices and schedules had been published to market participants. At that time market participants would know the energy schedules of their facilities for the next day, and could determine the capacity that could be offered to the BM.

The key concept behind the Nordic market design was the concept of balance responsibility, i.e., exposure of all generation and eligible customers to the concept of hourly electricity balanced schedules. According to that concept, in each hour the Balance Responsible Party (BRP) should balance forecasted demand plus sold electricity with planned generation and bought electricity, including both bilateral trade and electricity traded through the DAM and IDM.

At the settlement phase the actual demand and generation would be controlled through balance settlement, whereby any imbalance of the BRP would be settled based on the TSO’s cost of balancing. Accordingly, the difference between planned and metered result would result in a cost attributable to the party responsible for that difference. Exposure to this unknown cost would incentivise BRPs to trade themselves in balance through a combination of bilateral contracts, and trades in the DAM and IDM.

The price applied for the settlement of imbalances differed depending on whether the imbalance was caused at the generation or the consumption part of the market.

A “two-price” system was applied for imbalances relative to the generation schedule. In such cases, separate prices were calculated for the purchase and sale of imbalance power. The price was coupled to the BM. For the sale of imbalance power, the price was set equal to the up-regulation price of the concerning hour. If the concerning hour was a down-regulation hour, then Nord Pool’s spot price for the concerning hour was used as the sales price of the imbalance power. Reversely, for the purchase of imbalance power the down-regulation price for the concerning hour was used, and if the concerning hour was an up-regulation hour, then Nord Pool’s spot price for the concerning hour was used for imbalance power purchases.

If the imbalance concerned the consumption schedule, a “one-price” system was applied, whereby the purchase and sales prices of imbalance power were identical. During an up-regulating hour, the price of imbalance power was the up-regulating price, and during a down-

regulating hour, the price of imbalance power was the down-regulating price. If no regulations had been carried out during an hour, the price of imbalance power would be the spot price.

2.1.3 USA – the PJM market

In the United States a variety of approaches initially developed, but a variant of the England & Wales Pool emerged. The deregulated PJM electricity market was setup following Order No. 888 (1996) by the Federal Energy Regulatory Commission (FERC), the independent agency regulating the interstate transmission of electricity, natural gas, and oil in the US. The order required all public utilities owning, controlling and operating electricity facilities to provide open access to third parties, under non-discriminatory tariffs, and led to functional unbundling of wholesale generation and transmission services in all public utilities.

In 1997 PJM started operation as a bid-based energy market, and was approved by FERC as a fully functioning independent system operator (ISO). In 2002 it was approved as a Regional Transmission Organisation (RTO).

PJM operates several interrelated competitive wholesale markets, each of which carries out different functions, as briefly discussed below.

Energy market

The Energy Market is the largest of the PJM markets, and accounts for most of the wholesale electricity cost. It operates as a power stock exchange, matching the demand for electricity with offers to supply it. The Energy Market comprises the Day-Ahead and Real-Time markets.

- In the Day-Ahead Market prices are calculated for each hour of the next day, based on generator offers, bids from offtakers, and bilateral transaction schedules submitted into the market, in a manner similar to the derivation of the SMP discussed above. The Day-Ahead schedule is developed using least cost security constrained unit commitment and security constrained economic dispatch programs. The objective is to minimise total production cost subject to certain constraints.

  Day-ahead settlement is based on day-ahead hourly Locational Marginal Prices (LMPs). On each hour of the Day-Ahead Market, each scheduled demand buys energy at that hour's day-ahead LMP, and each scheduled generator is paid its day-ahead LMP for the hour. Any deviations from cleared quantities in the Day-Ahead Market are settled in the Real-Time Market.

- The Real-Time Market is a balancing market serving electricity needs in real-time. Prices are calculated every five minutes for more than 10,000 different pricing points according to actual grid operating conditions.

Generators are paid the day-ahead LMP for their scheduled output and the real-time LMP for energy in excess of PJM's scheduled amount. If a generator deviates from PJM's instructions, it may be charged with a portion of the cost associated with that deviation.

Load serving entities pay real-time LMP for energy in excess of their day-ahead scheduled quantities, and receive revenue for demand deviations below their scheduled quantities.

Other PJM markets

PJM's Capacity Reliability Market ensures that there will be sufficient capacity to meet peak demand in the next three years. PJM holds annual competitive auctions to secure the needed future capacity at the lowest reasonable price, including both, generation capacity as well as flexibility to reduce consumption on demand, especially in cases of emergency.

The Ancillary Services Markets ensure that PJM has access to the ancillary services (regulation and synchronised reserve) needed to operate the system within the quality and safety standards required.

PJM also operates a market for financial transmission rights (FTRs) to assist market participants in hedging price risk when delivering energy to the grid. They are financial instruments that entitle the holder to a stream of revenues (or charges) based on the hourly congestion price differences across a transmission path in the Day-Ahead Market. FTRs may be obtained through long-term, annual, and monthly auctions, or traded with other market participants.

2.2 The European Target Model

The EU has sought to liberalise and harmonise Member States' energy markets, primarily through a series of 'Energy Packages'. The first package was adopted between 1996 and 1998 and the second in 2003. In 2009, the Third Energy Package was adopted, resulting in the current design of the European Union's electricity markets, known as the EU target model. Two further Energy Packages followed in 2019 (the Clean Energy Package) and in 2021 ('Fit for 55').

Key aspects of the Third Energy Package (and determining factors for the implementation of the target model) were:

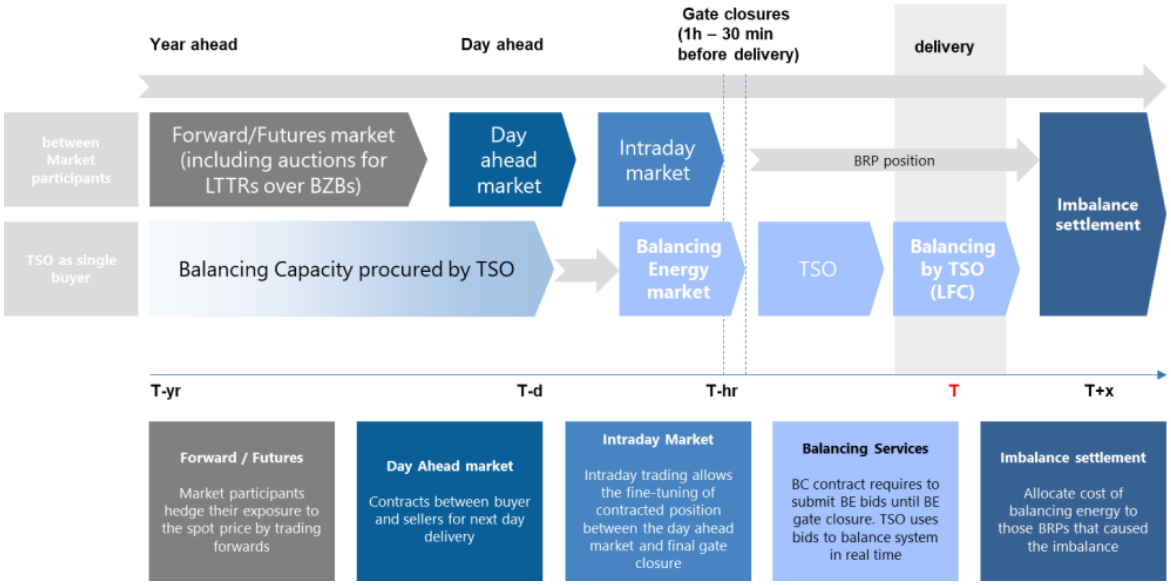
- mandatory unbundling of energy suppliers from network operators
- strengthening the independence of national regulatory authorities (NRAs)
- establishment of ACER - operational since March 2011 – to support cooperation between NRAs
- cross-border cooperation between TSOs and creation of ENTSO-E, and
- increased transparency in retail markets.

Similar to the Nordic electricity market model discussed above, the EU target model operates across different timeframes (starting from a year before real-time and finishing immediately prior to delivery of energy). Figure 3 illustrates the markets engaged in each timeframe of the target model - a corresponding set of regulations are relevant to each, specifically:

- The forward market - Forward Capacity Allocation (FCA) Regulation.

- The day-ahead and intra-day markets - Capacity Allocation and Congestion Management (CACM) Regulation
- The balancing market - Electricity Balancing (EB) Regulation.

Figure 3 Timeframes of the European Union electricity market



Source: ACER

2.2.1 The forward market

In the forward time frame, the target model mandates the development of cross-border markets based on increasingly harmonised long-term rights to access capacity on interconnectors. The objective is to give market participants the possibility to hedge themselves against price risk between bidding zones by entering into financial contracts up to several years before physical delivery.

To achieve this, the FCA Regulation, sets out:

- Harmonised allocation rules for long-term cross-border transmission rights: the target model provides a choice of long-term financial or physical transmission rights. A participant with a physical right has the right to trade across a border. The right is subject to use-it-or-sell-it (UIOSI) provisions such that a holder who decides not to nominate the capacity it holds may be compensated through the day-ahead auction. Many TSOs have now moved from physical to FTRs. In contrast to a physical right, an FTR does not give the holder a right to nominate the capacity it holds but does give them the right to collect any difference in price between interconnected zones.
- Single allocation platform: facilitated, in part, by the harmonised allocation rules. The single allocation platform, operated by the Joint Allocation Office (JAO), auctions cross-border transmission capacity rights.

- Harmonised nomination procedures: Previously disparate procedures for nomination of capacity (e.g. of nomination rules, deadlines and processes) may have been a barrier for some participants, which greater harmonisation would help lift. (These procedures relate to nomination of physical capacity and are not relevant to FTRs.)

2.2.2 The day-ahead (and intraday) market

The target model operates in accordance with the CACM Regulation includes rules for the implementation of 'market coupling' in the day-ahead and intraday timeframes. Under the market coupling approach, cross-zonal capacity is implicitly auctioned alongside the clearing of the day-ahead and intraday markets, rather than being separately (i.e. explicitly) auctioned. This implicit auctioning 'couples' the markets across zones as, subject to the cross-zonal capacity, the cheapest generators are dispatched regardless of location.

In broad terms, the day-ahead market works as follows:

- National TSOs calculate the level of available firm capacity for the next day and submit this to the Market Coupling Operator (MCO)
- Market participants then submit offers to their national Nominated Electricity Market Operators (NEMOs) and the NEMOs send the offers to the MCO
- The MCO then operates an algorithm, using the available capacities and offers, to determine prices (as above, this algorithm is intended to ensure that, given available interconnection capacity, the cheapest generators are dispatched regardless of location)
- Results are published.

In addition to the above, the CACM Regulation covers the management of residual physical congestion, and the optimal definition of bidding zones. Regarding the latter, bidding zones ought to be defined to avoid structural congestion. The CACM Regulation provides the framework for a regular assessment of the efficiency of the configuration of bidding zones and the process to follow if changes are required.

2.2.3 Balancing market

The Electricity Balancing Regulation governs the balancing markets. As in the Nordic market model, when demand and supply of market participants do not match, TSOs correct the imbalance. Balancing services (including some ancillary services) are procured in the same timeframes as the rest of the market shown in Figure 3. For example, balancing capacity, which is used to ensure markets can be balanced when needed, may be procured up to around the intraday market. Procurement of balancing energy then takes place during or after the intraday market timeframe. After delivery, imbalances are settled under national mechanisms, but with harmonised rules across member states.

2.2.4 Capacity markets

The European Target Model remains very much an energy-only market design. The model assumes that self-scheduled systems would price in the risk of loss of load to increase peaking prices sufficiently to incentivise new build generation and ensure security of supply.

However, capacity markets have been introduced into national markets. This could be in response to the belief that in an energy-only market design there is a problem with 'missing money' (i.e. that energy prices alone are insufficient to cover both the fixed and variable costs of generators). The increasing penetration of renewables (with low / zero marginal cost) may have, in part, contributed to this.

In practice, the emergence of capacity markets in the EU may be a response to other factors, including that commercial pricing may not value security of supply as much as regulators and governments would wish, or that the guarantees that VRE have been reliant on has deterred investment in new conventional generation through reducing capacity factors and increasing surpluses.

Capacity mechanisms within one national market may distort competition within that market (e.g. between different technologies and players) as well as between markets. In this regard the Clean Energy Package introduced two relevant processes. First, is the requirement for an EU-wide assessment of generation capacity adequacy – i.e. is there a concern to address in the first place? Second, where there is a concern for a particular member state, a national implementation plan is required setting out how the root causes can be addressed though market reforms (i.e. ahead of capacity mechanisms being introduced). Capacity mechanisms are then only used, in effect, as a last resort to address residual concerns.

2.3 Emerging markets and regional power pools

The introduction of competitive electricity markets has mainly been in larger and more developed economies in Europe, the Americas, Australia and New Zealand, and, increasingly, in Asia (India, Japan, the Philippines, Singapore and the Republic of Korea).[12] However, 1 in 5 developing markets have also introduced competition, and many more are actively considering it.[13]

The appropriate approach and form of electricity competition will depend on the specific objectives and circumstances of each case. However, there are conditions which make the introduction of competition more likely to succeed,[14] including the adequacy of revenues (including bill collection), the legal and regulatory environment, and the size of the market. Regarding the latter, if there is to be effective competition at the wholesale level then the market needs to be of an adequate size to support a reasonable number of competing generators (as evident from the experience in England & Wales, noted above), e.g. four to five.

[12] *Wholesale Electricity Market Design: Rationale and Choices*, ESMAP and the World Bank, November 2022.
[13] *Ibid.*
[14] For example, see *Rethinking Power Sector Reform in the Developing World*, World Bank, 2020.

The European approach of regional trading markets is one approach that, even short of introducing full competition, can help deliver benefits, including for smaller markets. Greater cooperation and trade between national markets can help security of supply (through some sharing of resources) and bring economies of scale by expanding the size of the energy sector. Regional pools have been adopted in several places, including Africa and Central America (through the Central American Electrical Interconnection System (SIEPAC)).

In the case of Africa, there has been a degree of reform and liberalisation in some countries, but the full-scale adoption of wholesale competition is relatively scarce. However, there are five regional power pools at different stages of development (i.e. the Southern African Power Pool, West African Power Pool, Eastern African Power Pool, Central African Power Pool, and North African Power Pool). As well as being the first, the Southern African Power Pool (SAPP) is also, arguably, the most developed of the African power pools and we briefly consider its development and features.

2.3.1 Southern African Power Pool

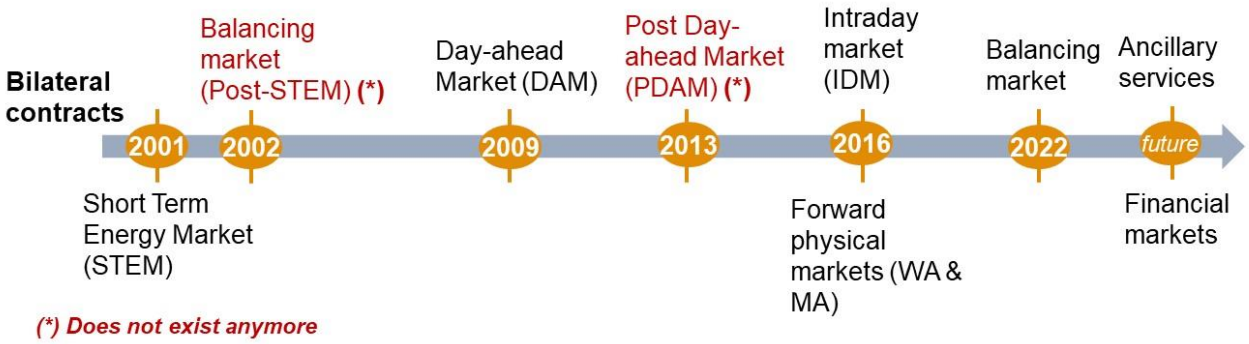
The 12 SADC (Southern African Development Community) countries formed SAPP in 1995. Three types of memberships were created:

- "Non-Operating Members" - a member not interconnected on the SAPP grid: Angola, Tanzania and Malawi are not yet electrically interconnected[15].
- "Operating Members" of SAPP - a member interconnected on the SAPP grid. The remaining nine member states which are electrically interconnected.
- Observer – a member that could attend and participate in SAPP proceedings but could not vote. They were included due to their potential technical impact on the power system.

SAPP introduced its first power trading platform in 2001 as the Short-Term Energy Market (STEM). The progressive evolution of the platform is illustrated in Figure 4. The current situation is one in which there is a DAM, backed by an Intra-Day Market. There are also two forward physical markets (week ahead and month ahead). Most recently, a balancing market operation was introduced in April 2022.

[15] While not yet interconnected, all of these countries are implementing projects to interconnect within the next 10 years. With Malawi expected to be interconnected by the end of 2023, at the completion of the Mozambique-Malawi Regional Interconnector Project (400 kV, ~130km)

Figure 4 Evolution of the SAPP trading platforms



Source: based on SAPP information

Trading operations in SAPP

The table below lists the types of products traded on SAPP's competitive markets. Most of the volumes traded through the competitive markets are traded as hourly volumes in the DAM market, but market participants can also buy and sell baseload, peak, and off-peak products at the month ahead and week ahead stage, and continuous trade of hourly volumes takes place after gate closure in the DAM market, through the IDM.

Members can trade in United States Dollars (USD) or South African Rand (ZAR). The market operator provides the daily exchange rate applicable to transactions.

Table 1 SAPP Trading timelines

Product	Description	Trading day
FPM-Monthly	Hourly contracts are concluded for a month ahead. Delivery of volume for a month, normally baseload, but can be peak/off-peak	Every Thursday in the week prior to the delivery week
FPM-Weekly	Hourly contracts are concluded for a week ahead. Delivery of volume for a week, normally baseload, but can be peak/off-peak	Every Thursday in the week prior to the delivery week
Day-ahead market	Hourly contracts are concluded for each hour of the following day or a future day. Delivery of volume in each individual hour	Day before delivery day – gate closure is at 12 noon
Intra-day market	A continuous market where trades are concluded up to one hour before delivery. Prices are based on a first come, first served basis. Delivery of volume in each individual hour	Continuous trading

Source: SAPP

Regional wholesale market vision

SAPP intends to continue developing and extending its market platform, adding Ancillary Services Market and Financial Market to enhance trade opportunities. The relatively recent introduction of the physical week and month ahead markets, and later possibility of even longer period markets, is seen by SAPP as providing a viable alternative for utilities to bilateral contracts. The SAPP vision is one in which, for example, a country whose peaking power is more expensive than regional alternatives could be met in a typical day on the basis of a larger competitive market than the bilateral market:

- **Base load** capacity would be met by a combination of own supply, bilateral contracts, and monthly forward contracts;
- **Intermediate and peak demand** would be met from a combination of the weekly forward contracts, **DAM, and IDM**
- Shortfalls and surpluses over positions on the other trading platforms covered through the **balancing market**.
- **Ancillary services** (reserves and reactive power) potentially provided through SAPP markets.

Large electricity customers can also be designated as being eligible to participate in the wholesale market. The introduction of direct trading between eligible customers and IPPs in other SAPP countries would provide a major stimulus to market development.

Some countries will clearly be more open than others to specifying which customers are to be allowed to participate in national and regional wholesale markets, but once the principle is established and regional transmission pricing regulation is assured, there would be a significant incentive for IPP investment to take place.

SAPP's vision is to have a competitive regional electricity market that will ultimately give the end-user a choice of electricity supplier. SAPP also aims to provide least cost, sustainable and competitively priced power that makes Southern Africa attractive for investment by energy-intensive users and increase electricity access to remote and low-income customers, such as those in rural communities.

3 Overview of the 2022 energy crisis

This chapter provides an overview of the energy crisis that started to develop over the summer of 2021 but rapidly escalated following Russia's invasion of Ukraine in February 2022. The impacts of the crisis have been felt globally but, as succinctly put by the IEA as the crisis was reaching its peak in October 2022, "*Europe is the main theatre in which it is playing out, and natural gas is centre stage.*"[16]

3.1 Initial signs of strain

The COVID-19 pandemic and the lockdowns enacted to limit spread of the infection and loss of life had profound worldwide impacts. In 2020, global GDP shrank by 2.8%[17] and total primary energy consumption by 3.6%[18].

In 2021, with the easing of COVID-19 restrictions, pent-up demand increased economic activity, with global GDP increasing by 6.3% and energy demand by 5.5% from 2020 levels. This increasing demand occurred against a backdrop of a range of supply side constraints, at least some of which were lingering effects of the pandemic on global supply chains. A consequence was increasing inflationary pressures, including in commodity prices. In the case of energy, exceptional weather events and supply outages (planned and unplanned) put further upward pressure on prices in some jurisdictions.

Compounding the pressures in European energy markets in 2021 were low levels of gas storage and a (lack of) supply response from Russia. Instead, the supply response to higher prices came from liquefied natural gas (LNG).

In the earlier part of 2021, some of the tightness in the European gas market was attributed to increased demand for LNG elsewhere, with a year-on-year reduction in EU LNG imports of 20% up to September 2021.[19] However, this rapidly reversed and, up to December 2021, there was a 110% year on year increase,[20] with supply of LNG being diverted to Europe, mostly from Asia.

In Europe, the result was gas and electricity prices reaching unprecedented levels; with a four-fold increase in gas prices and a doubling of electricity prices from April 2021 to October 2021.[21] In response to these increases, in October 2021, the European Commission published a communication[22] setting out the measures countries could take to mitigate energy price rises, as well as requesting Agency for the Cooperation of Energy Regulators (ACER) to review the current wholesale electricity market design (for some details see Annex A1) amidst questions as to whether it remained fit for purpose.

[16] Pg 29, World Energy Outlook 2022, IEA.
[17] IMF World Economic Outlook database, April 2023
[18] Calculated from 2023 Statistical Review of World Energy, Energy Institute.
[19] High Energy Prices, ACER, October 2021.
[20] Final Assessment of the EU Wholesale Electricity Market Design, ACER, April 2022.
[21] High Energy Prices, ACER, October 2021.
[22] Tackling rising energy prices: a toolbox for action and support, 13 October 2021, COM(2021) 660.

3.2 The energy crisis intensifies

Against this backdrop of increased demand and supply side challenges, on 24 February 2022, Russia invaded Ukraine. The resulting severe supply disruptions and significant uncertainty pushed already strained global energy markets deeper into crisis.

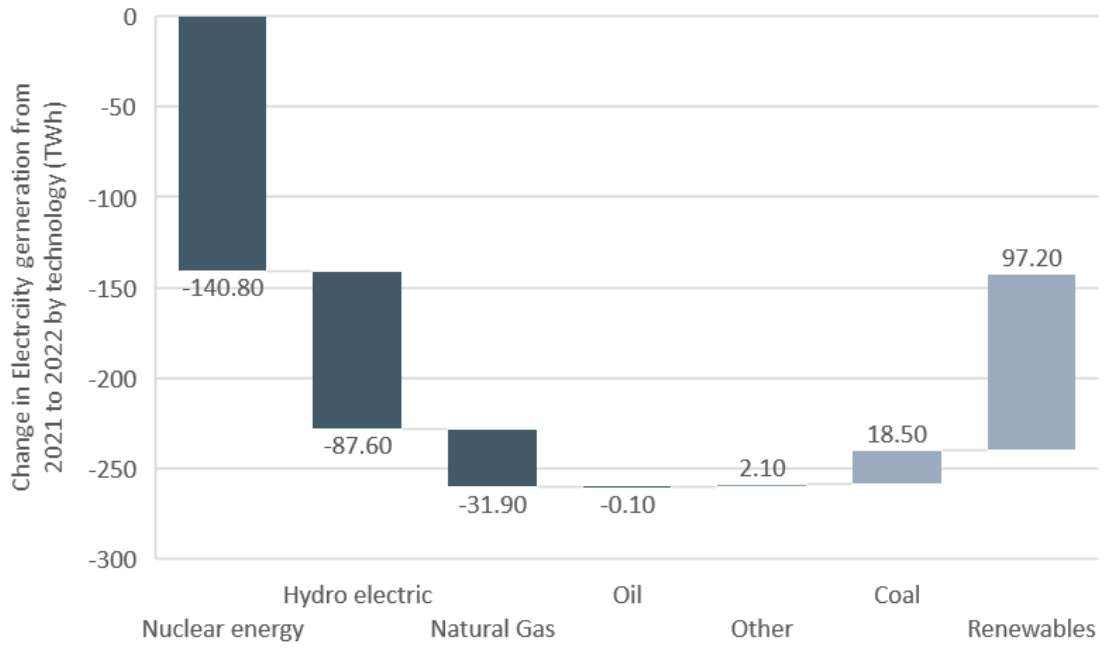
Given the extent of its prior reliance on Russia for energy supplies the effects were felt most directly and acutely in Europe. The shortfall in gas in Europe triggered significant increases in European gas prices (see section 3.3), resulting in diversions of LNG to Europe from other markets, most notably Asia. Whilst partially mitigating security of supply problems in Europe, this led to problems in some of those other markets, including power cuts.

The increases in gas (and coal) prices were the most material factors behind the increase in electricity prices (see section 3.3).[23] However, other factors, including extreme weather events in 2022 (most notably heatwaves and droughts) added to the upward pressure on electricity prices.

To illustrate the effect of some of these factors, Figure 5 shows the change from 2021 to 2022 in electricity generation by technology in Europe. The largest year-on-year change was a reduction in nuclear generation, arising from the closure of a record number of reactors in France for maintenance. Next, the exceptionally dry conditions meant a notable reduction in hydropower across Europe,[24] as well as reducing water available to cool some power plants (including some of France's nuclear fleet on the Rhone and Garonne rivers). Although this chart shows a reduction in gas fired generation in Europe, gas fired generation in the EU actually increased, despite the exceptionally high gas prices.[25]

[23] In World Energy Outlook 2022, the IEA attributed 90% of the increase in electricity prices globally to higher gas and coal prices.
[24] IEA's Electricity Market Report 2023, reports that Europe's drought in 2022 was the worst in 500 years: "*Italy's hydro use was down more than 30% compared to 2017-2021 averages, followed closely by Spain at 29% and France at 20%. Norway had the driest spell in 26 years, with hydro reservoir levels in September* [2022] *declining to the lowest monthly output in the last decade.*" (pg 23)
[25] Excluding Türkiye and Ukraine, the increase in gas fired generation across the other European countries increased by around 10.5TWh.

Figure 5 Change in electricity generation by technology – 2021 to 2022



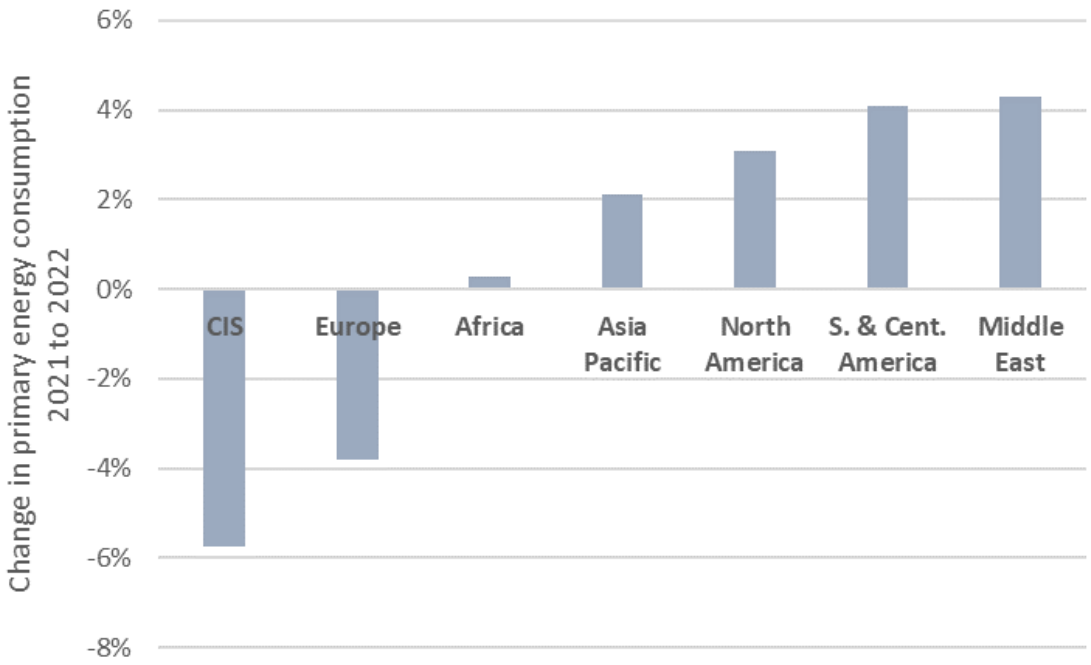
Source: ECA calculations from 2023 Statistical Review of World Energy, Energy Institute data.

Figure 5 also makes clear the significant reduction in electricity consumption from 2021 to 2022. Despite this reduction, there was a notable increase in coal-fired generation in Europe, but with the main increase in generation coming from renewable sources.

There were material concerns over the security of supply situation in Europe heading into the 2022/23 Winter. By October 2022 EU gas storage was in a much-improved position, at around 90% of capacity. This coupled with a relatively mild winter and subdued demand from China helped temper the effects of the crisis on prices over this period.

Globally, the effect of the crisis was to slow the rate of growth in primary energy consumption from 5.5% in 2021 to 1.1% in 2022. However, there was a very mixed effect by region, as shown in Figure 6.

Figure 6 Change in primary energy consumption by region – 2021 to 2022



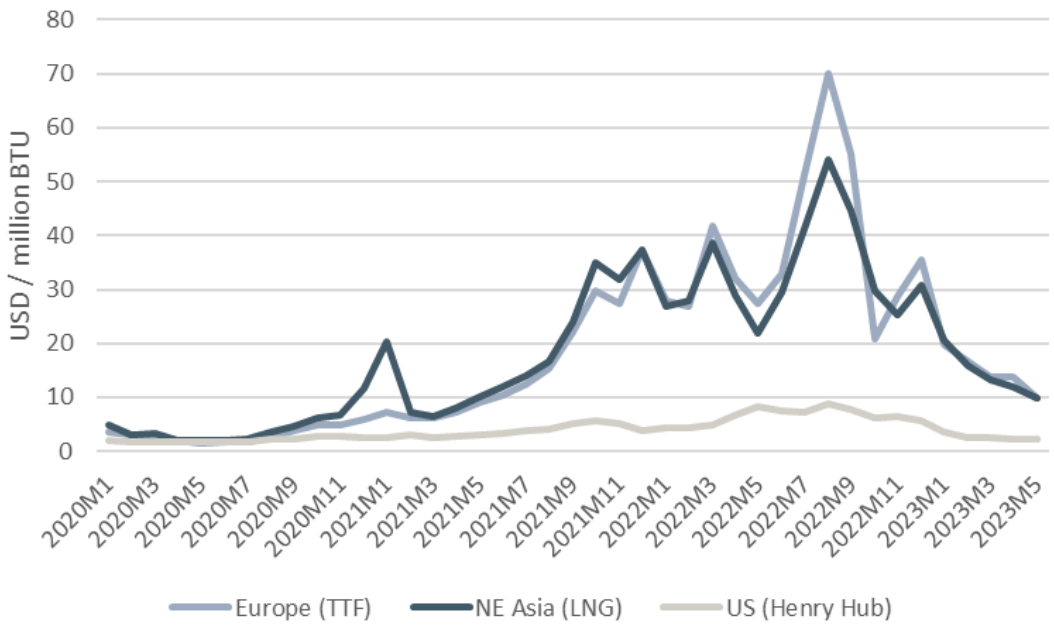
Source: ECA calculations from 2023 Statistical Review of World Energy, Energy Institute data.

3.3 Energy prices

Figure 7 shows monthly average gas prices in three key markets (Europe, NE Asia and the US) from 2020, driven by the above events.[26] While there were relatively significant increases in US natural gas prices over the period (a four-fold increases from January 2020 to August 2022), these are dwarfed by the magnitude of increases in Europe and NE Asia. The increases in both series can be seen building through 2021, with spikes both as the war in Ukraine broke out and (more materially) later in the year as preparations were made for the 2022/23 Winter. Since then, prices have declined significantly, approaching levels last seen in early 2021.

[26] These prices are monthly averages and, therefore, do not reflect the extent of the shorter volatility and prices spikes occurring through the crisis.

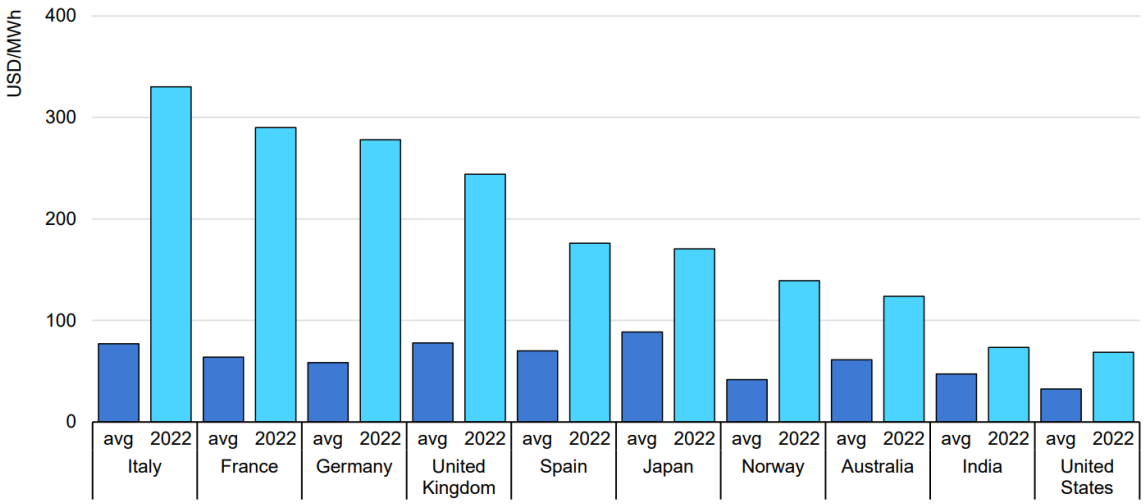
Figure 7 Evolution of key regional (monthly average) gas prices from 2020



Source: IMF Primary Commodity Prices database.

As already noted, the crisis had different impacts across jurisdictions, as is evident from Figure 8, which shows wholesale prices across a range of jurisdictions in 2022 compared to the averages across the previous five years (i.e. 2017-2021). Again, this shows the impact to be most acute in Europe, with the largest increases in Italy, France, Germany and the UK, whilst the US, India and Australia show smaller (but still significant) increases. It is also evident that the effect on prices *within* Europe differed significantly. This was for a range of reasons - for example, wholesale prices in Spain (and Portugal) were kept lower by a cap on gas prices to generators (see Box 26, section 6.1.1), whilst in Norway, despite the drought, hydropower helped in keeping prices lower than some other European countries.

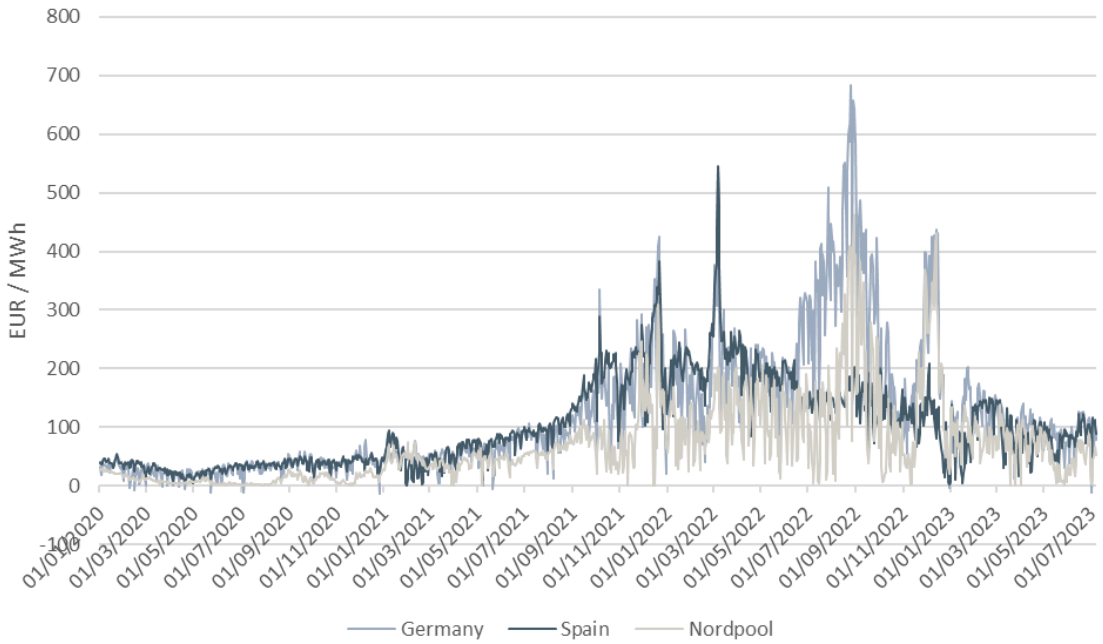
Figure 8 Electricity wholesale prices in selected countries, 2022 and 2017-2021 averages



Source: IEA (2023). Electricity Market Report.

Figure 9 shows daily electricity wholesale prices in three European markets: Germany, Spain and Nordpool. The broad pattern of prices in Germany and Nordpool follow that of gas prices shown in Figure 7, but the daily granularity also shows the extent of volatility in prices through the crisis. However, for the reason noted above, prices in Norway were generally lower than those in Germany (the most liquid EU electricity market). In the case of Spain, the effect of the cap on gas prices is also evident, with much lower wholesale prices than Germany across the Summer and Autumn of 2022.

Figure 9 Daily electricity wholesale prices in European markets from 2020 (EUR/MWh)



Source: Bloomberg

4 Overview of energy crisis measures and the role of regulators

The energy crisis resulted in unprecedented increases in gas and electricity prices in many countries, and raised concerns as to security of supply. This left those countries with the issue of how to protect citizens and businesses by ensuring access to energy at affordable prices.

In this chapter, we first provide an overview of the types of measures adopted (or considered) to address these issues, before considering the role of energy regulators.

4.1 Overview of energy crisis measures

A huge number of measures have been taken in response to the energy crisis in those countries most effected. For example, in the period from September 2021 to February 2023, ACER's inventory of energy emergency measures, covering only EU Member States and Norway, lists 439.[27] Globally, many more were taken. In this section we provide a broad overview of the most common types of measurers taken.

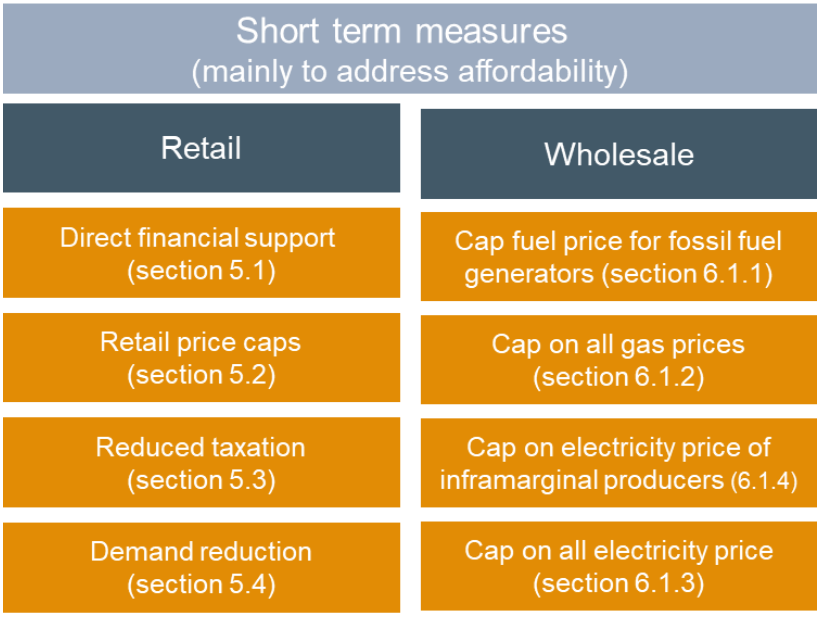
4.1.1 Short term measures to address affordability

As described in the last chapter, the energy crisis resulted in material increases and spikes in electricity prices. Many of the measures taken in response to the crisis were intended to either provide relief to consumers from these increases, or to avoid them altogether. For example, 64% of the 439 measures in ACER's inventory were aimed at tackling affordability for end-consumers, of which around half were direct support to final consumers.

Figure 10 shows a broad grouping of options for addressing high electricity prices. These include interventions in both retail markets (discussed further in chapters 5) and wholesale markets (discussed further in chapter 6). These are short-term options in the sense that most can be implemented relatively quickly and (in most cases) are best treated as temporary, emergency measures. By contrast, there maybe some other options, such as redesign of electricity markets (included as an option in Figure 11), changes to which persist over the longer-term and which are, therefore, best considered carefully, rather than introduced as an emergency measure.

[27] https://www.acer.europa.eu/media/charts/wholesale-electricity-market-monitoring-2022-emergency-measures-0

Figure 10 Overview of short-term energy crisis response measures to address affordability



Source: ECA

The cost of measures

The scale of the crisis means the short-term interventions to address affordability come at significant fiscal cost. Targeting measures (e.g. providing support to energy poor or vulnerable consumers only, rather than to all customers) is one means of limiting the costs and increasing their effectiveness. Another was to make the measures temporary (i.e. time limited).

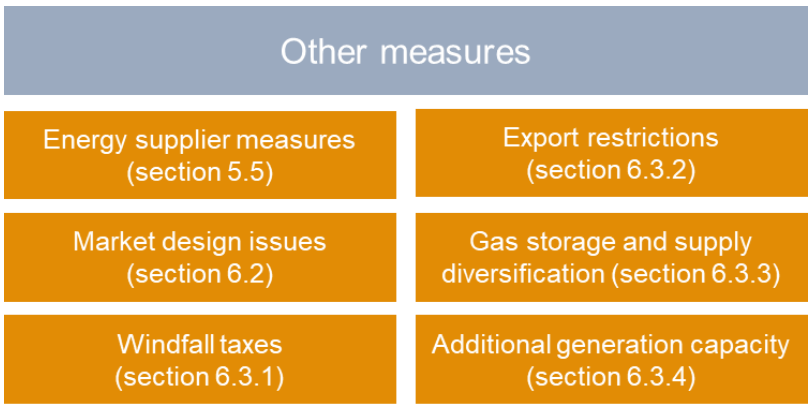
Notwithstanding, the costs are significant. In the case of the EU, UK and Norway, the estimated costs since the start of the energy crisis in 2021 have been put at €758 billion.[28] Separately, and for 2022 alone, the IEA identified an additional $500 billion of spending to reduce energy bills globally, of which $350 billion was in Europe.[29]

4.1.2 Other measures

To finance short-term affordability measures, at least partially, windfall taxes on profits of fossil fuel generators and companies have been levied in some jurisdictions. This is one of the "other" measures, which are not necessarily directly related to improving affordability in the short term. Other measures included relate to energy suppliers, export restrictions, and options for market (re)design. See Figure 11.

[28] *National fiscal policy response to the energy crisis*, Sgaravatti, G., Tagliapietra, S., Trasi, C., and Zachmann, G., June 2023 update.
[29] *Fossil Fuels Consumption Subsidies 2022*, IEA, February 2023.

Figure 11 Overview of some other energy crisis response proposals or measures



Source: ECA

4.1.3 The policy context

Although the crisis had emerged gradually, from 2021, it rapidly accelerated in the early part of 2022. This put significant pressure on governments to respond quickly to support consumers and business. The need to act urgently, as well as the uncertain and relatively complex environment, represents a significant challenge to policy makers in designing measures. Whilst, in some cases, the direct effects of an option maybe identified relatively easily, the indirect (or secondary) effects can be both harder to identify and predict. In this context, it is inevitable that some of the measures implemented will have been better than others. In further discussing the measures in chapters 5 and 6, this report considers some of the advantages and disadvantages of the measures pursued (or considered).

More broadly, the energy crisis is, in large part, a gas price crisis that has spilled into electricity, given the role of gas generators as the marginal price setter in most European power markets. To this extent, many of the above short-term measures aimed at electricity prices could be considered as treating the symptoms of the crisis, rather than the root cause (gas supply and prices). Only the minority of the implemented measures (i.e., the remaining 36% of measures in ACER's inventory) were aimed at security of supply, including some measures aimed at addressing root causes, such as increasing gas storage, reducing reliance on gas and introducing gas demand reduction targets.

4.2 Role of regulators

The precise objectives, roles, and powers of an energy regulator will typically be set down in legislation, with details varying between jurisdiction, not least depending on the stage of development of liberalisation and competition.

With the energy crisis, the paramount issue to address in most jurisdictions was that of affordability. Whilst regulators typically have the power to set price caps (e.g. at a network and retail level) doing so below cost would run counter to the typical obligation regulators have to ensure financeability and would likely jeopardize the viability of those entities. Clearly, the need to address affordability, and the sizeable fiscal implications, required governments to

lead the response. The role for regulators in such a crisis is important but, inevitably, more limited.

Across the interviews ERRA previously conducted with a cross-section of its members (see section 1.2), a common theme was the regulator acting as an expert advisory body to government. Energy markets are complex, and regulators often have deep knowledge that they can use to support governments make better informed decisions. This might include, for example, the regulator assessing and analysing the impacts of proposed emergency response measures. As an illustration, some actions taken Pakistan's regulator (NEPRA) are shown in Box 1.

Box 1 Pakistan: Supporting government decisions

The Pakistan government had decided to fast-track, through an emergency procedure, the addition of new solar capacity. The government consulted NEPRA in making this decision and NEPRA conducted the related tariff modelling. NEPRA was also to assist the policy through review of the Request for Proposals, implementation of the competitive bidding and related tasks. Ultimately, however, no bids were received, although the government intends to pursue its solar initiatives once economic conditions improve.

Source: ECA based on ERRA interview

This advisory role was not necessarily restricted to advising government. For example, in **Hungary**, the energy regulator (MEKH) was in contact with the financial regulator to help it understand some of the details of the energy sector and the magnitude of collateral requirements that had increased in the wake of the crisis (see section 5.5).

As well as an advisory role on potential emergency measures, regulators may have had a role in the detailed implementation of some of the measures, as well as in their subsequent administration and monitoring.

Again, recognising that powers vary across jurisdictions, there are other potential actions that may have been available to some regulators to support in addressing the crisis. For example, ensuring smooth procedures for the transfer of customers from suppliers who have gone bankrupt, assessment of the financial viability of suppliers and the extent to which they should be hedging prices, and regarding the appropriate processes before customers are disconnected for non-payment (see section 5.5).

There may also be scope for regulators to either advise on, or develop changes to, electricity market design, although consideration of these should be seen in the longer-term context of the objectives of energy policy, and not as a short-term measure to address temporary issues. Other longer-term measures include accelerating transmission connections of renewable generation to support decarbonisation.

More broadly, there is a potential role for regulators in preparing for future crises and in using the experience of the current crisis (which was, perhaps, beyond that foreseen) to make such

preparations. ACER's recent review identified 'risk preparedness' as one of only two 'no-regret' options for emergency responses (alongside demand reduction).[30]

[30] *Assessment of emergency measures in electricity markets: 2023 Market Monitoring Report*, ACER, 14 July 2023. The risk preparedness measures in ACER's database related to emergency plans for load shedding.

5 Retail market and consumer support interventions

This chapter provides further details on the (mostly) short-term intervention options to support affordability, either through retail market interventions or direct support to consumers, as illustrated in Figure 10. In general terms, one of the benefits of most of these retail measures is that the risks of unintended consequences, or of undermining investment incentives, is lower than with some of the wholesale market interventions.

5.1 Direct financial support

Governments providing direct support to electricity consumers, in the form of, say, cash transfers, is one of the least distortionary measures to improve affordability in the face of increased energy costs. With support being provided directly to consumers, it leaves both the retail and wholesale market to operate largely unchanged, with price signals unaffected. This is important as, for example, it means consumers still have an incentive to reduce usage as well as continuing to send appropriate price signals for generation investment. This measure also benefits from being relatively straightforward to implement.

Direct support of this form can either be targeted or un-targeted, with targeted support lowering the cost (although targeting is more complex to administer and may, therefore, take longer to implement). Support can be targeted at lower income groups, but this will always be 'imperfect', as it does not account for consumption (i.e. two households with the same income can have different consumption, e.g. from different energy efficiency, and different needs for support arising from price increases, but this will not be recognised even in most direct targeted support).

Box 2 and Box 3 provide examples of support measures targeted (depending on income) at consumers in **Netherlands** and **Latvia** respectively, and Box 4 an example of a non-targeted measure from **Great Britain**.

Box 2 Netherlands: Targeted one-off support

In the Netherlands, the government has provided a one-off energy allowance to consumers in order to help with their higher energy bills, which has been increased at various times throughout the energy crisis.

In 2023, the one-off *energietoeslag* (energy allowance) stands at around €1300, which can be claimed by one's municipality if the earnings are less than €1310.05 (for a single person) or €1871.50 (for a cohabiting couple) per month.

Source: https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices and https://www.government.nl/topics/energy-crisis/how-do-i-apply-for-the-energy-allowance-in-nl

Box 3 Latvia: Targeted support to vulnerable households

In addition to subsidies that applied to all households (for consumption of electricity, gas, district hearting, firewood, liquified petroleum gas, diesel fuel, and wooden pellets or

briquettes for heating purposes) additional state support was provided to low-income households in the heating season 2022/2023 (November 2022 - May 2023), in the form of direct financial support **tied to their income levels**. More specifically, vulnerable households received between 10 and 30 EUR per month depending on the level of pension, compensation or state social security benefit they received. In addition, for families who receive a supplement to the state family benefit for a child with a disability, support of 30 EUR per month was provided.

Source: ACER database of emergency measures

Box 4 Great Britain: Non-targeted one-off support

Support for **households** was introduced in September 2022, through the Energy Bills Support Scheme, which provides a £400 non-repayable discount to households to help with their energy bills over 6 months (i.e. the winter of 2022/23). This support measure was given to every GB household and was applied automatically to household bills. The measure ended in March 2023.

Support was extended to **businesses**, through the Energy Bill Relief Scheme, which introduced a government supported price for firms and organisations for six months, in October 2022.

Source: https://www.gov.uk/get-help-energy-bills/getting-discount-energy-bill

Another form of direct support was targeted at energy-intensive industries, which were heavily affected by the high energy prices. Measures to prevent closures of energy-intensive industries (and, in turn, productivity and employment) were implemented in a number of countries, with examples from the **Czech Republic** and **Portugal** provided in boxes below.

Box 5 Czech Republic: "Energy Guarantee" Programme

The "Energy Guarantee" programme operates within the framework of the "Expansion-Guarantee" programme for small and medium sized enterprises financed by the European Structural and Investment Funds. Companies with energy costs that exceed 10 percent of the total operating costs will be able to obtain a loan of 1 to 10 million CZK and a state guarantee of up to 80 percent of the principal sum.

Source: ACER database of emergency measures

Box 6 Portugal: Grants to gas-intensive companies

In 2022, as part of its 'Programme to support gas-intensive industries', the Portuguese government established a system of incentives for gas-intensive companies that were particularly affected by the increased natural gas prices. The programme aimed to support economic activity and preserve employment of these industries.

The support was provided in the form of a **non-repayable grant, which covered 30% of the eligible cost**. The eligible cost was determined by multiplying the units of natural gas purchased by the company during the eligible period (February – December 2022), by the difference between the price the company paid per unit consumed in a given month and the unit price paid by the company, on average, between January and December 2021.

Source: ACER database of emergency measures

5.2 Retail price caps

One broad set of measures to limiting electricity price rises to consumers is to cap their final electricity charges. There are a range of ways in this could be implemented. However, regardless of the precise detail, any shortfall between the capped charge and the costs of the supplier would need to be compensated for, e.g. by the government, resulting in a fiscal cost. The extent of the cost would depend on the detail, i.e. the level of the cap and how it may vary by, for example, consumer groups and consumption level.

Potential drawbacks from this option, depending on how it is implemented, are that it could adversely affect retail competition and may reduce the incentive for consumers to reduce consumption.

The following boxes provide examples of some of the retail price controls put in place in response to the energy crisis, with a range of different features (e.g. some capping unit prices for all or part of consumption, others capping the percentage increase, some applying to households and other to industry).

In terms of how details matter, the incentive properties of the **Germany** measure are quite different from those of the measures in **France** or **Great Britain**. In the case of Germany, the discount applies to the first 80% of consumption (for households), meaning that consumers still face the market price for their remaining 20%. This approach reduces the average price but retains strong price signals (with marginal consumption being at a marginal price). The Netherlands adopted a similar approach, with a block of consumption (in kWh) at the reduced price and a market price for the remainder. This contrasts with the measures in France and Britain which, compared to the measures in Germany and Netherlands, weakened price signals and the incentive for consumers to reduce demand. Of course, all addressed, to varying degrees, the primary aim of supporting affordability.

Box 7 France: Tariff shield

France introduced a measure in 2021 to protect small customers from the soaring energy prices, known as the bouclier tarifaire (tariff shield), whereby gas and electricity price rises were capped.

In November 2021, retail gas tariffs were frozen until the end of the 2022. In February 2022, the retail electricity tariffs rise was capped at 4% for a year.

At the beginning of 2023, the government decided on a 15% increase in the cost of gas and electricity, and a new 10% increase will occur for electricity retail tariffs on the 1st of August 2023.

According to the regulator's calculations, without the shields:

- French electricity bills would have risen by 99% in February 2023 and, as of July 2023, would still cost 75% more than what small consumers pay.
- French households' gas bills would have been 61% higher in February 2023.

While the cap on gas supply can still be activated until the end of 2023, it is not enforced anymore since the 1st of July 2023, as gas prices have decreased in recent months with countries being able to find alternatives to Russian gas. There is a plan for the electricity tariff shield to be phased out over a two-year period, and ideally by the end of 2024.

Source: https://www.theguardian.com/world/2022/sep/26/france-budget-shield-energy-price-shocks, https://www.power-technology.com/news/france-to-keep-electricity-price-cap-2025/, Fin « progressive » du bouclier tarifaire pour la fin de 2024 sur les prix de l'énergie.

Box 8 Germany: A brake on electricity and gas prices

In September 2022, (following a package of measures in June 2022) the government announced €65 billion of support to households struggling with energy prices, including a brake in the price for electricity used in basic consumption. This was to be funded by a windfall profit tax for wind, solar, biomass, coal and nuclear energy generators.

A price cap for gas was also implemented, whereby:

- for households, gas prices were capped at 12 cents/kWh for 80% of consumption, based on last year's usage levels
- for industrial consumers, gas prices were capped at 40 cents/kWh for 70% of consumption.

The caps will be in place through April 2024.

Source: https://www.bloomberg.com/news/articles/2022-11-22/germany-moves-to-rein-in-surging-gas-power-costs-from-january

Box 9 Netherlands: Retail price caps on electricity, gas and district heating

In 2022, the Netherlands introduced price caps to protect all small energy users, in particular SMEs. For 2023, the following maximum tariffs (including taxes) apply for usage up to the following usage ceilings (for both variable and fixed-tariff energy contracts):

- €0.40 per kWh for 2,900kWh of electricity used
- €1.45 per m^3 for 1,200m3 of natural gas used
- €47.38 per GJ for 37GJ of district heating used.

Source: https://www.government.nl/topics/energy-crisis/cabinet-plans-price-cap-for-gas-and-electricity

As with the direct financial support, price caps can be targeted at consumer groups, and examples of price reductions for non-household consumers in Bulgaria and industrial consumers in Türkiye are shown in Box 10 and Box 11, respectively.

Box 10 Bulgaria: Price reductions for non-household consumers

On 30 June 2022, the Bulgarian National Assembly, adopted a measure for the period from 1 July to 31 December 2022, aimed at compensating electricity non-household final customers with 100% of the difference between the fixed base price of 250 BGN/MWh (around €128/MWh) and the actual average monthly exchange price of the "day-ahead" segment. The fixed base price has been updated to 200 BGN/MWh (€102/MWh) since Oct 2022 for large industrial consumers, if they have invested in energy efficiency improvements and the development of renewable energy sources for their own use.

Source: ACER database of emergency measures

Box 11 Türkiye: Price discount for industrial consumers[31]

The Energy Market Regulatory Authority (EPDK) of Türkiye announced a 16% discount on regulated electricity price for industrial users in December 2022. The end-user prices on the free market also reduced significantly owing to descending market clearing prices in wholesale markets.

Source: ECA

Amongst its recent measures to improve the electricity market design[32], the European Commission proposed that in defined circumstances, Member States could apply to temporarily set prices for a limited volume of electricity to households and SMEs below cost. This measure may be more readily implemented where there is no retail competition and / or where the electricity retail sector is still under state ownership.

In many jurisdictions outside the EU, retail prices are set below costs. In these cases, the increase in energy prices arising from the crisis increased the size of subsidies and burden on governments where previous regulated prices were maintained. In some cases tariff increases that had been planned, either before or during the crisis, were postponed given the potential impact on consumers. For example, in the case of **Egypt**, anticipated unwinding of subsidies in 2022/23 was postponed (see Box 12), whilst in **Albania**, proposed increases in tariffs to certain household consumers were halted, whilst those to businesses were increased (see Box 13).

As noted above, in Germany and the Netherlands, measures were introduced with different household tariffs applied depending on consumption levels (i.e. block tariffs). In some jurisdictions where household tariffs were below cost prior to the crisis, including several countries in the Western Balkans, block tariffs were re-introduced. With a lower price set for the first block (or blocks) of consumption, this allows for the provision of a 'minimum' level of electricity at affordable prices whilst reducing (or potentially removing) the subsidy on household consumption at higher levels. Block tariffs are in place, for example, in **Albania**, **Bosnia and Herzegovina**, **North Macedonia** and **Kosovo**[33] (see Box 14 for further details on the response in Kosovo[34]).

Box 12 Egypt: Postponement of electricity subsidy reduction

Egypt's economic and social development plan for 2022/23 had included increases in electricity prices as part of a programme to reduce electricity subsidies to consumers. However, against the backdrop of the global energy crisis and domestic inflationary pressures,[35] in June 2022, it was announced that the planned increase was to be postponed for 6 months (i.e. until the end of 2022). The decision was taken to not add new burdens on citizens, with the government continuing to bear the cost of the subsidy.

[31] Source: https://gmk.center/en/news/turkiye-announced-a-16-discount-on-electricity-for-industry/
[32] Electricity Market Design revision: Proposal to amend the Electricity Market Design rules, March 2023, European Commission, COM(2023) 148.
[33] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.
[34] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.
[35] Annual headline inflation was 13.2% in June 2022, rising to 21.3% in December.

Source: https://www.egypttoday.com/Article/3/116833/Egypt-postpones-electricity-prices-increase-for-6-months-state-to

Box 13 Albania: Postponement of household electricity price increases

Electricity prices to Albanian households are regulated and subsidized. During the energy crisis (and amidst concerns over levels of hydropower generation likely to be available in the country) the Albanian energy regulatory authority, announced its intention to significantly increase electricity tariffs to households with consumption above 800 kWh per month for 3 months from 1 October 2022.[36] This was reported to affect somewhere between 40,000 and 90,000 households.[37] Just ahead of the increase taking effect, the government announced that the increase was to be postponed given the ongoing crisis,[38] and it was not subsequently implemented.

Source: ECA

Box 14 Kosovo[39]: (Re-)introduction of block tariffs for households

To address issues arising from the electricity crisis, Kosovo's[40] government and regulatory authority adopted measures intended to protect households, all of whom are supplied at regulated prices. This included allocation of €20m to subsidise the cost of imported electricity, an extraordinary review of regulated electricity tariffs, and allocation of €90m to subsidise final customers entitled to universal supply.

In addition, the regulator decided to introduce a two-part block tariff for household customers. For the first block (up to 800kWh/month) there was no price increase. Consumption above that threshold was priced at 12.52 cents/kWh (peak hours) and 5.9 cents/kWh (off-peak).

Source: Adapted from *Protection of vulnerable households in the Western Balkans Contracting Parties*, Energy Community Secretariat, July 2023.

An option mooted earlier by the European Commission for limiting retail prices was the aggregator / single buyer model,[41] which envisaged a state-controlled entity purchasing electricity and then selling it – either directly or through existing suppliers – at below "market" prices to certain customers categories.

Box 15 France: Nationalisation of EDF

[36] Source: https://www.ere.gov.al/sq/publikime/deklarata-per-shtyp/njoftim-per-shtyp-date-23-09-2022
[37] Source: https://www.euractiv.com/section/energy/news/energy-body-agrees-to-higher-energy-tariffs-for-big-albanian-consumers/
[38] Source: https://www.ere.gov.al/sq/publikime/deklarata-per-shtyp/njoftim-per-shtyp-date-30-09-2022
[39] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.
[40] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.
[41] For example, in *Security of supply and affordable energy prices: Options for immediate measures and preparing for next winter*, Communication from the Commission, 23 March 2022, COM(2022) 138.

France faced significant security of supply concerns during the energy crisis, given its nuclear dependence and the large reduction in nuclear power output due to outages and summer droughts (which meant that little water was available for cooling). It is worth noting that France became a net importer of electricity in 2022 for the first time since 1980. In this context, the French government embarked on an effort to nationalise EDF, which is facing financial difficulties, partly due to the electricity tariff shield that forced EDF to sell at a loss.[42] Although the French state already controlled 84% of EDF, the government started a process to fully nationalise the company in 2022 and on 8 June 2023 acquired 100% of the company.

The French government's view is that EDF's nationalisation will secure the development of new nuclear reactors and increase the security of its low-carbon energy reserves.[43]

Source: ECA

5.3 Reduced taxation

In many jurisdictions, energy prices to final consumers include taxes, such as Value Added Tax (VAT). One way to reduce costs to consumers is, therefore, to reduce the taxes on the electricity charges they pay. This offers a relatively distortion-free approach to providing support that is also relatively easy to implement. However, it is not typically a very targeted measure (i.e. whilst it may be feasible to levy different rates to, say, businesses and households, levying different rates on different types of households is more challenging).

The **Netherlands** introduced such measures in March-April 2022, namely lowering the rate of VAT on energy from 21% to 9% and cutting the excise duty on petrol and diesel by 21% from 1 April 2022 until the end of the year.[44] As other examples, Box 16 lists some measures taken in **Poland**, and Box 17 in the **US**.

Box 16 Poland: Tax reduction measures

A number of tax reduction measures were introduced, including:

- Temporary VAT reductions (2022 only) on different products, including gas, electricity, motor fuels and heat;
- Possibility of refunding the VAT paid on gas used for 2023, depending on household income;
- Temporary (2022 only) exemptions from excise duty on electricity for households, for other consumers exercise duty on electricity was decreased.

Source: ACER database of emergency measures

Box 17 United States: Gas tax reduction (and petroleum reserve release)

In the US, measures to **reduce gas taxes** were introduced on the federal and state level. On the federal level, in September 2022, two Democratic Senators introduced legislation

[42] https://www.bbc.com/news/world-europe-64674131
[43] https://www.gouvernement.fr/actualite/edf-bientot-detenue-a-100-par-letat-mode-demploi
[44] https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices

that would seek to eliminate 18 cents per gallon of federal gas taxes until January 2023[45]. On the state level, as of July 2022, Connecticut, Florida, Georgia, Maryland, and New York enacted **gas tax suspensions**; Illinois delayed a two-cent gas tax increase; states such as Connecticut, Florida, New Jersey, and Tennessee enacted new sales tax holidays, while 11 states (California, Colorado, Delaware, Georgia, Hawaii, Idaho, Illinois, Maine, New Mexico, South Carolina, and Virginia) chose to **issue rebates to eligible taxpayers**[46].

More broadly, the Biden administration responded to high gas prices in 2022 by releasing 165 million barrels from the **strategic petroleum reserves**. This supply increase helped bring gas prices down in the second half of the year.[47]

Source: ECA

In other cases, the reduction of VAT on electricity was tied to the wholesale price of electricity. For instance, in **Spain**, VAT on electricity was reduced only if the monthly average price in the wholesale market is above 45€/MWh. However, for the very vulnerable consumers, this reduction was applied without applying the wholesale market threshold.[48]

5.4 Demand reduction measures

One clear way to reduce energy bills is to reduce demand. To the extent that demand is reduced, then this may also have the secondary effect of reducing the wholesale electricity price.

There are a range of ways in which demand reduction can be either encouraged or required, covering both **short-term** but also **longer-term** options (such as energy efficiency measures).

- Measures to encourage consumers to reduce demand in the short run include communication campaigns (e.g. adverts, or information provided alongside bills) and publication of peak hours. Requirements for demand reduction could also be imposed, e.g. through setting limits on consumption, particularly at peak hours.

- Alongside these, measures that are likely to take longer to have an effect are also available. For example, energy efficiency measures (such as tighter building regulations, removal/reduction of VAT on energy efficient products) and the introduction of competitive bidding schemes can lead to reduced demand.

The EU introduced a number of measures that have to be adopted by Member States to reduce both electricity and gas demand, and encourage longer-term measures for demand reduction, such as energy efficiency investments. Details of the measures are presented in Box 18 below.

Box 18 European Union: Demand reduction measures

[45] https://www.hassan.senate.gov/news/press-releases/senators-hassan-and-kelly-introduce-bill-to-lower-high-gas-pricesat-the-pump
[46] https://taxfoundation.org/state-tax-reform-relief-enacted-2022/
[47] https://www.forbes.com/sites/qai/2022/12/02/gas-prices-december-2022-latest-winners-and-losers-from-recent-gas-price-trends/?sh=1040c3b876ad
[48] ACER database of emergency measures

Electricity demand reduction

The European Union, through Regulation 2022/1854 of 6 October 2022 *'on an emergency intervention to address high energy prices'* introduced, among other measures, binding demand reduction targets, in terms of gross electricity consumption (Article 3) and consumption during peak hours (Article 4):

- In terms of gross electricity consumption, the Regulation requires Member States to reduce it by **10%** compared to the average of gross electricity consumption in the corresponding months of the reference period.[49]
- In terms of gross electricity consumption during peak hours, the Regulation requires Member States to identify peak hours[50] and reduce consumption by at least **5% on average per hour** compared to consumption forecasted by the transmission system operators (without the demand reduction measures). Demand reduction during peak hours is particularly important given that it's during those hours that gas fired power generation has the most significant impact on the marginal price.

The Regulation allows Member States to choose the appropriate measures to meet the targets (Article 5), as long as they are '*clearly defined, transparent, proportionate, targeted, non-discriminatory and verifiable*'. Such measures could include awareness-raising campaigns, regulatory measures that limit non-essential energy consumption, as well as financial incentives to reduce electricity consumption in addition to the expected reduction. The Regulation includes a recommendation to use market-based mechanisms such as auctions or tenders in order to achieve the reduction in an efficient way.

Gas demand reduction

In order to boost the EU's security of supply, Regulation 2022/1369 of 5 August 2022 '*on coordinated demand reduction measures for gas*' established provisions for a **voluntary** gas demand reduction from 1 August 2022 to 31 March 2023 at least by **15%** compared to their average gas consumption in the reference period.[51] The Regulation allows Member States to choose the appropriate measures to achieve the target, as long as they do not '*unduly distort competition*' in the internal gas market and do not '*endanger the security of gas supply of other Member States or of the Union*'. Potential measures include encouraging fuel switching in the industry or targeted obligations to reduce heating and cooling.

The Regulation also granted the Council the possibility to declare a **Union alert** on the security of the gas supply, triggering a **mandatory** EU-wide gas demand reduction.

The objective of these gas demand reduction measures is to contribute to the filling of storage capacities (thus ensuring adequate levels of supply for winter 2023/24) and drive overall energy prices down (thus benefiting consumers across the EU).

Energy efficiency

The emergency measures introduced at the EU level promote energy efficiency investments by Member States:

[49] Reference period in the context of this Regulation is the period from 1 November to 31 March in the five consecutive years preceding the date of entry into force of the Regulation, starting with the period from 1 November 2017 to 31 March 2018.
[50] Corresponding in total to a minimum of 10% of all hours of the period between 1 December 2022 and 31 March 2023.
[51] Reference period in the context of this Regulation is the period from 1 August to 31 March during the five consecutive years preceding the date of entry into force of the Regulation.

- Firstly, the relevant Regulation recommends energy efficiency investments as one of the ways to utilise the surplus revenues from the application of the cap on producers' market revenues (see Section 6.1.4).
- Secondly, energy efficiency investments are recommended as a way to utilise the solidarity contribution, ie the surplus profits generated by companies in the crude petroleum, natural gas, coal and refinery sectors (see Section 6.3.1).

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R1854 and https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R1369

In **Serbia**, with household consumers mostly subject to regulated retail prices, and partially protected against the increases in wholesale prices, the Government recommended a discount on electricity charges for reduced consumption (see Box 19).

Box 19 Serbia: Demand reduction with regulated retail prices

The vast majority of Serbia's household customers were entitled to electricity supply at regulated prices in 2022. Whilst regulated retail prices set below costs impede the development of competition, they insulate households from the direct effect of increases in the wholesale prices during the energy crisis. However, this situation will increase electricity subsidies which are typically borne by government.

Amongst a number of other interventions to address the energy crisis, the Serbian government recommended the adoption of a discount scheme for households' electricity charges depending on consumption. Running from October 2022 to March 2023, the following discounts applied depending on the reduction in consumption in a month, compared to the same month in the prior year:

- 15% discount for a reduction of between 5% and 20%
- 20% discount for a reduction of between 20% and 30%
- 30% discount for a reduction above 30%

Across the six months, the average reduction in consumption was 8%.

Source: Adapted from *Protection of vulnerable households in the Western Balkans Contracting Parties*, Energy Community Secretariat, July 2023.

When it comes to short-term measures, a number of countries have implemented public awareness campaigns in order to induce energy saving behaviour in the residential sector. In **Malta**, the campaign (launched in October 2022) used a variety of tools to reach a wide audience, including an interactive website, booklets, and advertisements on social media providing energy savings tips.[52]

Other short-term measures have included encouraging fuel switching and fuel consumption reduction obligations for various customer categories (such as large commercial entities – see Box 20). For instance, **Poland** imposed an obligation to entities financed from the state budget for achieving 10% energy consumption savings from 2023. This obligation is monitored by the Energy Regulatory Office (URE), which also penalises the ones who do not comply.[53]

Sweden provided financial incentives to achieve the consumption reduction target set by Regulation 2022/1854 (explained in Box 18), applicable to all technologies that delivered a

[52] ACER database of emergency measures
[53] Based on interviews conducted by ERRA.

reduction in electricity consumption. The financial aid is allocated through a competitive bidding process, while there are safeguards in place to ensure the proper functioning of the electricity market.[54]

In **Thailand**, energy conservation measures were devised to encourage the use of public transport and reduce travelling costs by placing an emphasis on rail transport. Other than demand side management, Thailand also encouraged fuel switching from gas to oil in combined cycle power plants.[55]

In **Pakistan**, some demand reductions measures were applied to commercial entities, as summarised in Box 20 below. In **Hungary** support was provided to industrial companies for investments in energy efficiency measures, renewable energy production or storage (Box 21).

Box 20 Pakistan: Demand reduction from commercial entities

With soaring energy prices in 2022, Pakistan faced a balance of payment crisis with forex reserves falling below $10 billion, enough for around 45 days of total imports, as well as double-digit inflation.[56] With dwindling funds and increasing costs, the country struggled to meet the rising demand for electricity. This situation prompted the government to take the following measures:

- **Limiting operating hours** of large commercial establishments with the flexibility to work six-days a week or five-days a week;
- Ordering all markets to close by 8:30 pm and restaurants by 10pm;
- **Cutting the official fuel allowance** given to ministers and government officials by 40% and ordering all federal departments to reduce their overall expenditure by 30%;
- Implementing **load shedding** for up to 7 to 8 hours in urban areas and up to 15 to 16 hours in rural areas, and (in the face of rampant electricity theft) reducing load shedding in the areas where consumers pay bills regularly.

Source: ECA

Box 21 Hungary: Factory rescue program

The Hungarian Government initiated this measure to support large industrial companies of strategic importance for the Hungarian economy. Each entitled industrial company receives aid ranging from 0.5 million to 15 million EUR for energy efficiency and energy production investments. Using these sources, energy efficiency, renewable energy production and storage investments can be implemented, with the obligation to retain staff. The total budget of the program is 375 million EUR and it is scheduled for 12 months, having started in October 2022. Target groups are large and medium sized enterprises - in accordance with the general block exemption regulation and CEEAG - whose production and processing activities are related to the investment. The execution of the measure is coordinated by the Hungarian Investment Promotion Agency (HIPA). During the design phase of this measure MEKH also provided its expertise in energy regulation for the program developers.

[54] https://energy.ec.europa.eu/news/state-aid-commission-approves-swedish-scheme-reduce-electricity-consumption-context-russias-war-2023-02-07_en
[55] Based on interviews conducted by ERRA.
[56] Note: this was the situation prior to the IMF's approval of a support programme with Pakistan on 12 July 2023. *IMF Executive Board Approves US$3 billion Stand-By Arrangement for Pakistan*, 12 July 2023.

Source: MEKH

In addition, energy efficiency programmes were launched across Europe, in order to reduce demand in the longer-term. Some states, such as Cyprus, provided **grants** to vulnerable consumers to replace energy-intensive domestic appliances with new efficient appliances.[57]

5.5 Energy supplier measures

There are a range of measures relating to energy suppliers that could be taken to protect consumers. Some of these are not directly related to energy crises *per se*, but the recent crisis has drawn attention to them as potential examples of good practice. For example, during the crisis, the availability of fixed price energy contracts to consumers in EU Member States reduced, making it harder for consumers to protect themselves from price volatility. In a recent set of proposals,[58] the European Commission included a requirement that suppliers with more than 200,000 customers be required to offer a fixed price contract of at least one-year duration (with the supplier free to set the price).

The measures outlined below include those which have either been implemented, or have been proposed or considered, in the wake of the energy crisis.

Hedging obligations

Often, electricity suppliers will offer customers fixed prices. To the extent that the supplier has its own generation or has hedged the risk of changes in wholesale prices, it is able to support such offers. However, it was apparent during the energy crisis and resulting wholesale electricity price increases and volatility, that this was not the case with all suppliers, with many going bankrupt. This creates disruption for consumers and greater costs both for the customers of the supplier but also others, as some of the costs of the bankruptcy (e.g. unpaid network charges) may be socialised.

Whilst prudent suppliers may already have hedging in place, it could be an option to require that suppliers have appropriate arrangements in place, such that they are robust to shocks. A requirement of this form would likely require some upfront specification of what is appropriate, as well as some form of monitoring. The requirements would need to recognise specific circumstances including, for example, the supplier's ability to access hedging products (which may be more challenging for smaller entities who may struggle to provide the necessary collateral or guarantees). As Box 22 and Box 23 show, governments and regulators can have a role in understanding and supporting meeting collateral requirements.

Box 22 Great Britain: Suppliers' hedging

Suppliers often choose to protect themselves and their customers against the risk of price increases in wholesale markets by **buying energy forward in accordance with the**

[57] ACER database of emergency measures
[58] Electricity Market Design revision: Proposal to amend the Electricity Market Design rules, March 2023, European Commission, COM(2023) 148.

indexation in the price cap[59] ("hedging"). In autumn 2021, many suppliers that had failed to hedge appropriately went out of business.

However, hedging itself carries a risk in case of wholesale prices falling back sharply, given that, in the current market conditions, hedging implies buying energy at high prices. If the forward price falls, consumers might switch to take advantage of these lower prices before the energy that had been bought for them has been supplied; this would force suppliers to sell the surplus energy at a loss, thus facing financial stress.

To mitigate this wholesale market risk in the context of hedging, Ofgem introduced a **Market Stabilisation Charge** (MSC), whereby if the forward market price over the price cap indexation period is more than 10% (the threshold parameter) below the value indexed under the price cap, 85% (the de-rating parameter) of the difference has to be paid when a customer switches by the gaining supplier to the losing supplier. This reduces the benefits that customers incur when switching.

Source: https://www.ofgem.gov.uk/publications/decision-extend-msc-and-bat-beyond-31-march-2023

Box 23 Germany: Hedging instrument (margining)

Margin (collateral) requirements for energy companies trading natural gas, electricity and emission allowances on futures exchanges have created liquidity challenges in the context of the energy crisis, given that the higher the prices, the higher these margins are. Even well-positioned companies have been unable to provide the required high margins, which created the need for provision of assistance to companies experiencing temporary financing difficulties due to the extreme volatility on the energy markets.

KfW has provided a margining instrument, namely **credit lines backed by a Federal Guarantee to assist with liquidity for such collateral requirements**. This is essentially a hedging instrument that ensures companies trading on futures exchanges with electricity, natural gas and emission allowances have access to sufficient liquidity in case of further price rises and volatility.

Source: https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/06/20220617-new-hedging-instrument-margining-launched-by-the-german-federal-government-to-protect-companies-affected-by-war.html

Protection from disconnection

A further group of measures to protect consumers facing increased energy bills is to limit the ability of suppliers to disconnect them for non-payment and / or to require suppliers to support them (e.g. through spreading late payments over time), without necessarily reducing their charges. Much like the retail price caps, these measures impose costs on suppliers for which they ought to be compensated (although the magnitude of these costs will likely be much less than a retail price cap).

Box 24 Poland: Protection from disconnection

In Poland, an obligation was placed on electricity suppliers to introduce support programs for vulnerable consumers which may include agreements on overdue and current receivables for electricity or services (e.g. postponement of payments, possibility of payment by instalments, late-payment interest write-off.)

[59] The default tariff cap administered by Ofgem includes an allowance for the cost of wholesale energy which is indexed to wholesale market prices.

Source: ACER database of emergency measures

Supplier of last resort

Rising and volatile electricity prices, as witnessed during the crisis, increase the likelihood of supplier bankruptcy and the consequent risk that customers' access to electricity is lost. SoLR provisions are intended to guard against the risk that customers are left unserved by assigning the customers of failed suppliers to a new supplier (or Distribution System Operator, DSO).[60]

SoLR provisions could be considered good practice and are often in place, but the recent crisis tested existing procedures and provided opportunities to see how they could be improved. The European Commission made recent proposals for SoLR provisions including that the process is transparent, requiring clarity in the role of the SoLR and strengthening information provision to customers of failed suppliers who undergo the process.

Box 25 Great Britain: Supplier of last resort

Increased wholesale market volatility contributed to a **large number of supplier failures towards the end of 2021**, which led to Ofgem appointing a SoLR for customers whose energy supplier had failed between September and December 2021.

SoLRs incur additional costs due to purchasing gas and electricity at short notice to supply the extra customers, which cannot be recovered through normal cost recovery processes. These costs are taken into account in the Last Resort Supply Payment process, which establishes a 'levy' for SoLRs.

Under normal market conditions, Ofgem expects the SoLRs to absorb the costs of acting as a SoLR, or in case levy claims are made, to minimise the costs. However, the exceptionally difficult circumstances faced by suppliers during winter 2021/22 led to substantially higher costs, and a number of changes to the levy process were introduced by Ofgem to allow suppliers to recover them, whilst still expecting them to make 'reasonable efforts' to minimise these costs, considering the large impact on consumers' already increased energy bills.

In particular, a **faster, multiple-claims levy process** was introduced temporarily, which allowed SoLRs to submit an initial claim for the costs incurred (typically wholesale commodity costs) in the period immediately after appointment. An additional claim ('true-up' claim) could then be submitted once the 6-month appointment of SoLRs is over.

By December 2021, Ofgem had consented to covering initial levy claims totalling £1.83 billion. In June 2022, Ofgem issued a consultation in an effort to establish a fair approach for covering subsequent claims. A decision was made by Ofgem that the temporary, multiple-claim, levy process would end as early as possible after winter 2022/23 in order to lessen the short-term impact of levy claims on consumers' energy bills. However, this would depend on the prior assessment of the market conditions, in light of the potential uncertainty in 2023.

Source: https://www.ofgem.gov.uk/publications/decision-last-resort-levy-claims-true-process

[60] In practice, SOLR provisions may be wider, extending into issues such as protection from disconnection.

6 Wholesale market (and other) interventions

This chapter focuses on wholesale market interventions in response to the energy crisis. First, it considers short-term measures in electricity wholesale markets (such as price caps), then potentially longer terms measures, including the design of wholesale markets. Finally, some other (non-wholesale market) interventions are outlined.

6.1 Wholesale price caps

There are a number of ways in which (otherwise high) electricity wholesale prices could be reduced, with three options outlined below in which either wholesale electricity prices are directly capped for some (i.e. "inframarginal") generators or all generators, or the prices of fossil fuels used in generation (e.g. gas) are capped thereby indirectly reducing wholesale electricity prices. These are outlined in broad terms as significant detail is involved to implement each, which would depend on context in the country.

6.1.1 Cap on prices of fossil fuels used for electricity generation

As previously noted, in the energy crisis, the increase in electricity prices largely resulted from the increase in gas prices (with gas generators often being the price-setters in electricity markets).

In these circumstances, one option to curb electricity prices is to cap the gas price paid by gas generators; decoupling, at least in part, the price of electricity from that of gas. For these generators to still participate in the market, they would need recompense for the difference between the price they pay for their gas and the cap imposed. If this is done, then, depending on the details of the design of the arrangements, this is likely to encourage their bidding into the market at lower cost, lowering the marginal price and the electricity costs included in retail bills.

Whilst likely reducing electricity prices and guarding against the knock-on effect from gas price spikes, there are potentially significant downsides to this measure. In particular, by lowering its price, greater use of gas generation may be encouraged (contrary to the drive for carbon emission reductions) and electricity trade may be distorted between countries if the same measures aren't applied in each (see Box 26).

This broad approach was adopted in **Spain and Portugal**, as described in Box 26, and in **Thailand** (Box 27).

Box 26 Spain and Portugal: Decoupling electricity prices from gas prices

Spain and Portugal established a cap ("tope") on the cost that gas power plants may pay for the purchase of natural gas needed for electricity generation.

Generators are compensated for the difference between the level of the cap and the wholesale gas price they face. This subsidy is financed by:

- buyers on wholesale markets in proportion to the volumes purchased;

- end customers who continue to buy electricity at regulated prices;
- the higher revenues from the increased electricity exports to France as a result of the reduced Spanish electricity prices after the introduction of the cap.

This temporary measure was introduced in the Iberian market in June 2022 for a year to ensure gas generators submit lower bids into the power market, thus depressing prices.

The cap was set at €40/MWh for the first six months of application of the measure. From the seventh month, the cap increased by €5/MWh every month until reaching the maximum value of €70/MWh.

The mechanism is **managing to contain the rise in electricity prices**. However, it is also generating **negative externalities** that are driving the Iberian market to generate more energy from gas and more inefficiently, in particular:

- the mechanism has driven a large portion of gas fired Combined Heat and Power (CHP) plants out of the market
- exports of electricity to France have surged because of the price cap – this results in income being transferred to the France electricity system since the price at which that system is purchasing the energy is subsidized by consumers on the Iberian peninsula.

Electricity prices in Spain are shown in Figure 8 and Figure 9 in section 3.3.

Source: ECA

Box 27 Thailand: Levelling the playing field for power generators[61]

Thailand generates around 60% of its electricity from gas. The gas price spike in 2022 had a huge impact on electricity prices.

To reduce power producers' burden of higher gas costs, in April 2022, the Energy Regulatory Committee (ERC) of Thailand announced the criteria for calculating the Energy Pool Price (EPP), which is the weighted average prices of energy used to generate power, including PTT's pool gas, New Shipper's LNG, diesel, fuel oil, LPG and other fuels as specified by the ERC. The aim of the initiative was to reduce the electricity price by using alternative fuels on a non-discrimination basis.

Before the implementation of EPP, the gas pricing scheme in Thailand was solely managed by PTT. With the gas price spike in 2022 (spot LNG prices had sometimes reached $50/mmbtu), ERC decided to change its gas pricing scheme by introducing EPP. The prices of spot LNG and diesel/bunker oil were compared and the decisions were made which fuel should be used to generate power. ERC designated the Electricity Generating Authority of Thailand (EGAT) to collect, calculate, and deliver EPP data to PTT. PTT counter parties (power generators) then receive invoices at the EPP price instead of the gas pool price.

Source: ECA

[61] Sources: https://www.pttplc.com/uploads/Sustainability/2023/EN/08.Sustainability%20Disclosure%20and%20Benchmarking/20230315-ptt-one-report-2022-en.pdf, https://www.egat.co.th/home/en/wp-content/uploads/2023/06/EGAT-Annual-Report-2022-EN_2023-06-23.pdf

6.1.2 Capping all gas prices

Whereas the measure described above is to limit the gas prices paid by gas powered electricity generators, a wider reaching measure would be to cap the price at which gas can be traded. As with other broad measures described herein, the effects of such a measure will depend on the detail of its implementation, but it is likely such a measure would reduce the wholesale price of electricity and, ultimately, the price of electricity (and gas) to consumers. However, a significant drawback to this measure is that where the cap is binding and has an effect, it would likely result in gas being exported to jurisdictions without the cap, thereby jeopardizing security of supply.

In the case of the **European Union**, a temporary gas price price correction mechanism was introduced, as described in Box 28.

Box 28 European Union: Gas market correction mechanism

In November 2022, the European Commission (EC) proposed a "market correction mechanism" to protect consumers against excessively high gas prices,[62] with political agreement reached on 19 December 2022[63] as to the mechanism, which took effect from 15 February 2023.

Intended to reduce volatility of gas prices in European markets, the mechanism applied a price ceiling of €275 to month ahead Title Transfer Facility (TTF) derivatives only (and not to the spot market or over-the-counter trades). The ceiling triggers automatically when two conditions are met:

- "*the front-month TTF derivate settlement price exceeds €275 for two weeks;*
- *TTF prices are €58 higher than the LNG reference price for 10 consecutive trading days within the two weeks.*"[64]

Provision was made for the mechanism to be immediately suspended should there be unintended negative consequences.

In a review of the mechanism, neither ACER nor the European Securities and Markets Authority (ESMA) were able to identify any "*significant impacts (positive or negative) that could be unequivocally and directly attributed to the adoption of the MCM*" but that "*one should not infer from this outcome that the MCM might not have any impacts on financial and energy markets or on security of supply in the future.*"[65]

Professor Pollitt[66] observes that "*the inevitable result*" of the mechanism was the market operator (ICE) launching another market in London which would not be subject to the mechanism, as Britain is now outside the EU.[67]

At the end of March 2023, the scope of the market correction mechanism was extended to cover three months-ahead and a year-ahead derivates, as well as month-ahead, taking

[62] Establishing a market correction mechanism to protect citizens and the economy against excessively high prices, 22 November 2022, COM(2022) 668.
[63] Council agrees on temporary mechanism to limit excessive gas prices, Council press release, 19 December 2022.
[64] Commission proposes a new EU instrument to limit excessive gas price spikes, press release, 22 November 2022.
[65] Pg 5, Market Correction Mechanism: Effects Assessment Report, 1 March 2023, ACER.
[66] Energy Markets Under Stress: Some Reflections on Lessons From the Energy Crisis in Europe, EPRG Working Paper 2317, Michael G. Pollitt.
[67] ICE to open London gas hub, creating route around EU price cap | Reuters

effect for one-year from 15 February 2023. The mechanism is triggered automatically when the month-ahead TTF:

- exceeds €180/MWh for three working days; and
- is €35 higher than the LNG reference price for the same three working days.[68]

Source: ECA

6.1.3 Cap on electricity wholesale market prices

Under this option, wholesale electricity market prices are capped at a specific level. To ensure that generators keep producing, and security of supply is maintained, they would need to be compensated for differences between the market price and the cap. Such a cap should result in lower retail prices for consumers and may also reduce the rents earned by inframarginal producers. However, there would be challenges in implementing the cap and potentially unwelcome outcomes. In practice, depending on arrangements, it could distort bidding behaviour in the market (e.g. encouraging bidding above the cap to receive compensation), and detailed information on costs of generation technologies may be needed to counter this as well as to set the cap. This measure also undermines price signals.

Box 29 Romania: Wholesale power price regulation

Based on extraordinary ordinance GEO no. 27/2022, a single purchaser of electricity from the wholesale market was established (OPCOM SA) that has the obligation to acquire electricity from certain producers and provide this to the electricity suppliers and to transmission and distribution system operators. The price paid by OPCOM to producers is set at 450 lei/MWh. In other words, the production prices of power plants are regulated.

Source: ACER database of emergency measures

6.1.4 Cap on electricity prices of inframarginal producers

Wholesale electricity prices are typically set by the bids of the marginal generator. As already noted, for this reason, the increase in gas prices also increased wholesale electricity prices, as gas generators are often the marginal generation technology. However, the operating costs of some other generation technologies (such as nuclear and renewables) were largely unaffected by the crisis. Given this, the returns to those (inframarginal) generators increased significantly during the crisis.

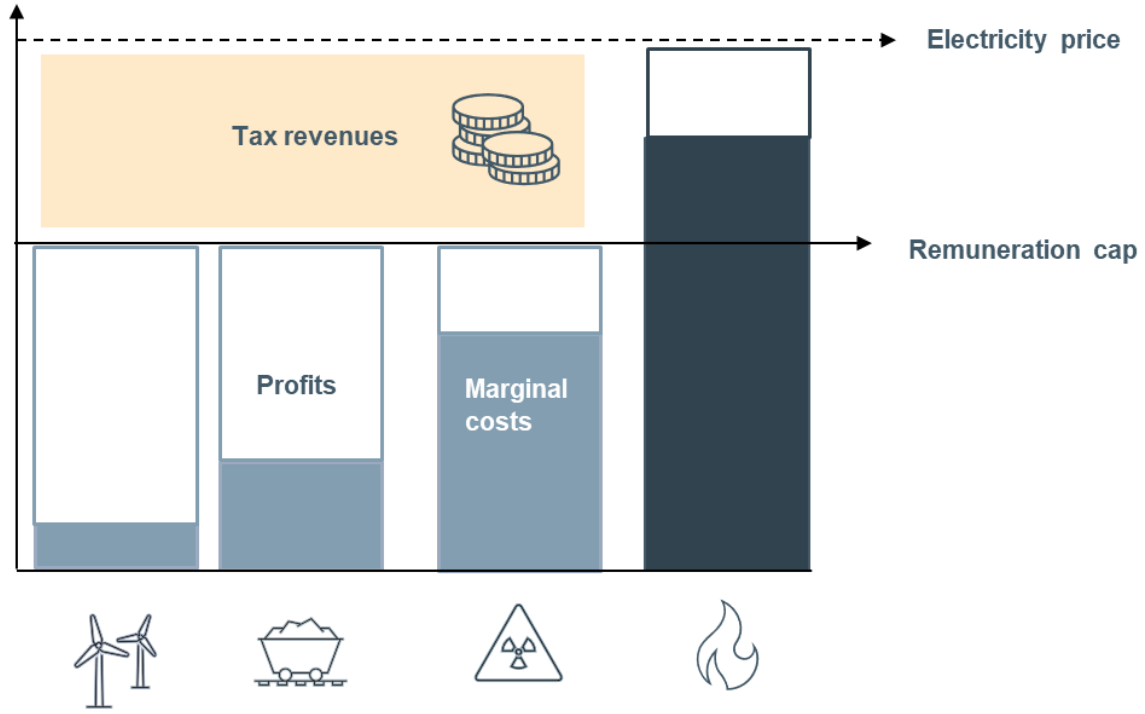
One potential way to limit the revenues of those generators not setting the marginal price is capping the unit price they can retain or are remunerated for. This approach has the benefit of leaving the fundamental functioning of the market unchanged, meaning the dispatch of power plants will continue to take place based on their level of efficiency, with those with lower marginal costs being dispatched first, and the cross-border trade of electricity will not be affected. The operation of such a revenue cap on inframarginal producers is illustrated in Figure 12.

As the wholesale price continues to be determined by the marginal generators, under this intervention, electricity wholesale prices are not reduced. However, rents are transferred from

[68] Infographic – A market mechanism to limit excessive gas price spikes.

the inframarginal generators to the government who can choose to use the additional revenue to provide support to consumers (e.g. through measures discussed above – in this chapter and the previous). The setting of the cap is a potentially challenging issue (as setting it too low could jeopardize the viability of the inframarginal generators) and such a measure could undermine investors' certainty in a regime.

Figure 12 Illustration of a remuneration cap on inframarginal producers



Source: ECA

Under proposals from the European Commission, EU Member States were required to impose a cap on the revenue inframarginal generators could earn from each MWh sold (see Box 30). Other examples are provided from Türkiye (Box 31) and Poland (Box 32).

Box 30 European Union: Cap on revenues of inframarginal generators

In October 2022, a new Council Regulation was adopted (based on Commission proposals) that included several temporary measures intended to address the exceptional increases in the level and volatility of electricity prices arising from the energy crisis.[69] Among these measures was a mandatory cap on the revenue of inframarginal producers (i.e., technologies with lower costs, such as renewables, nuclear and lignite) to apply from 1 December 2022 to 30 June 2023.

The Regulation set a *maximum* cap of €180/MWh. The Commission deemed this level sufficient to allow producers to cover investment and operational costs without impairing investment.[70] Member States had flexibility in deciding how to implement the cap. As

[69] Council Regulation (EU) 2022/1854 of 6 October 2022 on an emergency intervention to address high energy prices.
[70] The average market price expectations for peak hours were consistently and significantly below 180 EUR/MWh during the past decades, despite price differences across regions in the Union.

described in the main text, this measure does not reduce electricity prices, but the revenues above the cap were collected by Member State governments with the intention they be used to help reduce energy consumers' bills.

In June 2023, the Commission published a review of the inframarginal revenue cap (along with some of the other emergency measures).[71] The Commission noted that Member States had implemented the cap quite differently. For example, 17 countries set the cap at levels below the maximum of €180/MWh; the Netherlands opted for a lower income ceiling (130 euros/MWh), taking into account the market income based on monthly averages and including prices during off-peak hours, while the EU regulation is based on prices during peak hours.[72] Also, whilst the Regulation had the measure applying from 1 December 2022 to 30 June 2023, seven countries applied it retroactively, and 11 applied it beyond the Commission's proposed end date.

Several Member States had reported difficulties in its implementation, including both the short timescale to enact it, and conflicts with relevant national tax authorities and other applicable regulations. Furthermore, the Commission was made aware that the cap had affected existing Power Purchase Agreements (PPAs) and may have deterred the conclusion of new ones.

In its conclusions, the Commission did not recommend the extension of the temporary cap, not least given its potential adverse impact on PPAs which its market design proposals seek to promote.

Source: ECA

Box 31 Türkiye: Support fee charged to generators with low costs[73]

With the energy crisis and exchange rate fluctuations in 2022, the powers of the Energy Market Supervisory Board (EMRA) of Türkiye were expanded with an amendment made in the Energy Market Law. EMRA was authorized to determine a "**support fee**" to support supply security, costly generation, and consumers due to "unreasonable" increases in the prices of commodities that enter electrical energy generation in national or international markets. **Generators with low generation costs** were charged the support fee from April 2022 to October 2022, essentially imposing a revenue cap on some of the inframarginal generators. The support fee is calculated as the difference between the **market exchange price** or a fixed price determined by bilateral agreements and the **maximum settlement price**, where the maximum settlement price is determined by EMRA by taking into account one or more of the following parameters:

- Commodity prices input to energy generation
- Inflation
- Exchange rate
- Other parameters deemed appropriate by the EMRA

Moreover, simulations based on observed prices over January through August 2022 show that a cap set at 180 EUR/MWh would have resulted in stabilising the average revenue around 150 EUR/MWh which was consistently higher than the current levelised cost of energy (LCOE) for the inframarginal technologies targeted by the cap.

[71] COM(2023) 302, A Report … on the review of emergency interventions to address high energy prices, 5 June 2023.

[72] https://www.pwc.nl/en/insights-and-publications/tax-news/other/electricity-generation-income-capped-at-130-euro-per-mwh.html

[73] Source: https://www.mondaq.com/turkey/oil-gas-electricity/1184738/invisible-hand-of-emra-recent-regulatory-developments-in-turkish-electricity-prices

The support fee levied by EMRA can be used to support either high-cost generators, ensuring generation facilities with costs above market prices can continue to provide electricity output, or vulnerable consumers.

Source: ECA

Box 32 Poland: Revenue cap for all market participants

The Polish government, following consultation with URE, decided to implement a revenue cap, starting in October 2022 until the end of 2023. The mechanism applies to all market participants, i.e. generators of >1MW and traders (applicable to coal, gas and renewables) and traders, and requires them to transfer their inframarginal revenue to a special fund (for redistribution to final customers). It is worth noting that the final measure diverged to an extent from URE's recommendations of applying the cap only to some market participants (such as biggest generators and excluding renewables).

In addition, a retail price cap for electricity was established for households, SMEs and other vulnerable entities (such as public utilities). In the case of households, a price cap is applied if their electricity consumption exceeds particular limits (up to those limits electricity price is set at the level of 2022 regulated tariff). At the same time, there is also a compensating mechanism for retailers in case they have higher costs compared to the capped price. This measure is applied until the end of 2023.

Source: ECA based on ERRA interview

6.2 Market design changes

The debate as to the appropriate price formation mechanism in wholesale markets is far from new and, prior to the energy crisis, both the rising share of renewables and the need to decarbonise energy systems had intensified it in recent years. For example, as the share of renewable technologies in the energy mix increases, greater volatility in prices is likely to result which creates challenges for consumers (and producers).[74] The energy crisis then placed a spotlight on this debate as governments sought to address the rising challenges of affordability and energy security.

The remainder of this sub-section is structured around three areas:

- Is there a case for moving away from paying all dispatched generators the system marginal price?
- What electricity market design measures has the European Commission proposed to take in the wake of the energy crisis?
- What other potential measures might be taken?

[74] These technologies are generally characterised by high fixed cost and low (or zero) marginal cost. As their share in the energy mix increases, there will be more times when prices are low (zero, or even negative), but also very high peaks in prices at other times, which allows for recovery of fixed costs.

6.2.1 Pay-as-bid

The dominant approach to price formation in wholesale electricity market is that all dispatched generators are paid the price bid by the marginal generator which balances supply and demand – i.e. a single price is paid for all electricity. This is variously referred to as the 'system marginal price' or 'pay-as-cleared' approach. As already described (section 6.1.4), this means some generation technologies will receive a price that is more than their (marginal cost) bid.

An alternative that is sometimes mooted is to pay each generator the price they bid (i.e. a 'pay-as-bid' approach). There are two main problems with this approach. First, generators need prices (at times) to be over their marginal cost so that their fixed costs can be covered. Second, under pay-as-bid, generators bidding behaviour would change. Under a system marginal price approach, generators have an incentive to bid their marginal cost, but this is not the case for pay-as-bid. With pay-as-bid price formation, generators would seek to bid at (or just below) the price they expect to clear the market. This would involve additional resource and effort on the part of the generators (as well as more risk), and the price outcome would be broadly the same as in a system marginal price approach.

A common reaction in periods of stress in electricity markets is to question whether it is appropriate for generators to receive a price that is greater than their bid, and the same has been true of the recent energy crisis. However, the answer tends to be the same, which is that marginal cost pricing will result in the most efficient outcomes (i.e. that demand is met at least cost).

6.2.2 European Commission proposals

ACER's review of the EU's electricity market design

In October 2021, amidst rising prices in the early stages of the energy crisis, the European Commission asked ACER to review the current wholesale electricity market design and whether it remained fit for purpose.[75] ACER reported in April 2022[76], shortly after the energy crisis intensified. ACER concluded that the existing electricity market design, which has a marginal pricing system, remains the most appropriate and was not to blame for the (then ongoing) crisis. Indeed, ACER warned that "*ill-designed emergency measures or distorting price signals by interfering in market price formation may roll back EU market integration and overall competition, thereby endangering the benefits achieved up until now and possibly increasing the overall cost of the energy transition up ahead*".[77]

Whilst supporting retention of the existing market design, ACER also made 13 recommendations intended to support delivery of decarbonisation objectives (at least cost) whilst ensuring security of supply. Five of these related to developing long-term markets, specifically:

- Improving access to renewable PPAs

[75] Tackling rising energy prices: a toolbox for action and support, 13 October 2021, COM(2021) 660.
[76] Final Assessment of the EU Wholesale Electricity Market Design, April 2022, ACER.
[77] Pg 3, *ibid*.

- Improving the efficiency of renewable investment support schemes
- Stimulating 'market-making' to increase liquidity in long-term markets
- Better integration of forward markets
- Reviewing (and reducing, if warranted) collateral requirements.

Other recommendations related to: speeding up market integration; increasing flexibility; protecting consumers from price volatility; tackling non-market barriers and political stumbling blocks; and preparing for future price volatility in 'peace time'.

Despite ACER's conclusions, the ongoing energy crisis kept the question of whether the current electricity market design, with marginal pricing at its centre, was fit for purpose. For example, the European Commission president (Ursula von der Leyen) said in her 2022 State of the Union address (Sep '22): *"As we deal with this immediate crisis, we must also look forward. The current electricity market design – based on merit order – is not doing justice to consumers anymore. They should reap the benefits of low-cost renewables. So, we have to decouple the dominant influence of gas on the price of electricity. This is why we will do a deep and comprehensive reform of the electricity market."*

The European Commission's proposals

In January 2023, the European Commission initiated a public consultation on the design of the EU's electricity market and how it may be developed to better protect consumers from price volatility. In March 2023, the European Commission published its proposals.[78,79]

The EC proposals first clarified that "*the merit-order approach remains fit for purpose for these markets. The EU electricity market is based on a model that keeps the overall cost of the electricity system as low as possible for consumer …. This model supports decarbonisation because renewables are cheap to run and therefore always dispatched by the market. … When considering any reforms to the market design, it is important to bear these elements in mind …*"[80]

In broad terms, the Commission's proposals aim to optimise the EU electricity market design by complementing the short-term markets with a greater role for longer-term instruments, allowing consumers to benefit from more fixed price contracts, and facilitating investments in clean technologies. Key elements of the proposals relevant to this section of the report are as follows:[81]

- Measures to make electricity bills less dependent on short-term fossil fuel prices:

[78] Electricity Market Design revision: Proposal to amend the Electricity Market Design rules, March 2023, European Commission, COM(2023) 148.
[79] The Commission published amendments to the Wholesale Energy Market Integrity and Transparency (REMIT) Regulation at the same time, but this is not considered herein.
[80] Pg 7-8, *ibid*.
[81] Note: this is not intended as a complete summary of the measures proposed. For example, it excludes various measures proposed to protect and empower consumers (aspects of which are reflected in Chapter 5).

- *Supporting PPAs*: PPAs are long-term contracts between a generator and buyer for the provision of electricity at a pre-defined price, thereby providing price certainty for both parties. Whilst increasingly used in the EU,[82] there remain barriers to their adoption, including lack of standardisation, credit risk of counterparties, limitations in liquidity, and limited variety as to size and duration. Measures proposed to address these include requiring instruments, such as government guarantee schemes, to mitigate buyer default risk, and the reservation of some generation in State Aid supported schemes to be available for PPAs.

- *Contracts for Difference (CfD) for new decarbonised investments*: CfDs are a financial instrument (i.e. they do not involve the actual delivery of electricity) that ensures a generator receives a pre-defined 'strike' price from a counter party who carries the risk on the difference between the strike price and a 'reference' price (typically the Day-ahead market (DAM) price). The Commission notes that public support schemes (including CfDs, if a state entity is the counter party) should not crowd out private investment. Where additional support is needed from CfDs, the Commission proposes it be limited "*to low carbon and renewable energy technologies with low and stable operational costs and to low-carbon technologies which cannot provide flexibility to the electricity system*". Where CfDs are employed, the Commission proposes a range of design features, including that any revenues collected by the state (i.e. when the reference price is above the strike price) be returned to consumers.

- *Improving forward markets*: Liquid forward markets help parties to efficiently hedge price risk (and thereby reduce the impact of short-term price changes). However, several problems have been identified with Europe's forward markets, including a lack of liquidity (particularly in smaller bidding zones).[83] To address this, the Commission has proposed the establishment of virtual hubs (building on the experience in the Nordic market) in which several bidding zones are aggregated (with a single reference price) to increase liquidity of in forward hedging markets. These virtual hubs would be complemented by long-term (zone-to-hub) transmission rights.

- Facilitate and incentivise non-fossil fuel flexibility services:

  - *Supporting the development of demand response:* The Commission considers that in the regulatory frameworks of most Member States there is a bias towards capex over opex solutions, which may deter SOs from pursuing flexibility options (which are opex based). Without giving specifics, the Commission proposes to develop regulatory frameworks to ensure the right balance between opex and capex solutions. Further, the Commission is proposing to work with ACER on new rules to support demand response.

  - *Incentives for non-fossil fuel flexibility (e.g. demand response, storage, and remuneration schemes):* The Commission has made a number of proposals,

[82] Until 2022, the volume of electricity sold under PPAs had been increasing rapidly. In 2022, it fell, with reasons including increased price volatility, investor uncertainty due to political/regulatory initiatives to curb high prices, and inflation. Pg 19, *ibid*.
[83] Further Development of the EU Electricity Forward Market, ACER Policy Paper, February 2023.

starting with a request that Member States' regulatory authorities periodically assess the need for flexibility. In addition, the Commission proposes to clarify how existing provisions allow for the creation of a low-carbon capacity mechanism, as well as proposing to make it possible to design capacity payments for non-fossil fuel flexibility support schemes (via a competitive bidding process). Finally, the Commission has proposed the introduction of a peak-shaving product.

- *Improving the efficiency of short-term markets:* The Commission proposed to "set the cross-border intraday gate closure time closer to real-time, in order to allow market participants to trade as close as possible to the time of delivery of the electricity."[84]

- Generation and system adequacy:

  - *Generation adequacy and capacity mechanisms:* The existing regulatory framework for the introduction of capacity mechanisms in the EU has strict pre-requisites and is considered by many to be cumbersome and lengthy.[85] The existing process involves identifying adequacy concerns (that maybe used to justify a capacity mechanism) under a single (central reference) scenario. To simplify the process, the Commission has said it will work with ENTSO-E and ACER on the methodology and introduce more than one scenario in assessing adequacy concerns.

  - *Locational signals:* In the current EU market design, prices are for a bidding zone, without reflecting any congestion that may exist on the grid in that zone. An alternative is to have a more granular market design that reflects physical transmission constraints, thereby providing stronger (locational) price signals. The Commission has not proposed changes to this effect but has stated it will look at what level of granularity is of greatest benefit.[86]

6.2.3 Other market design options

Split market – moving to a form of average price

Prior to the Commission's above proposals, a range of options were mooted by various parties to change the EU market design. One such example, was a proposal from Greece, made during the EU Council of Energy Ministers in July 2022. The Greek proposal envisaged the establishment of two distinct and consecutive sessions of exchanges on the day-ahead market:

- A first session would involve only power plants whose cost structure is characterised by high fixed costs and low variable costs, i.e. inframarginal generating technologies, such as nuclear, renewables and hydro investment. Remuneration of power plants in the first session would come from CfDs with

[84] Pg 54, Electricity Market Design revision: Proposal to amend the Electricity Market Design rules, March 2023, European Commission, COM(2023) 148.
[85] Pg 103, Reform of Electricity Market Design, Commission Staff Working Document, March 2023, SWD(2023) 58.
[86] Pg 109, *ibid*.

public or private counterparties (such as final consumers, traders or aggregators), with prices reflecting total levelized cost. For power plants unable to find a CfD counterparty in the market, voluntary participation in a newly set up market was envisaged. Such a market, referred to as the 'green power pool' would be managed by a public entity operating as a single buyer.

- A second session would include programmable generating technologies characterised by positive marginal costs, such as coal and gas power plants. Power plants participating in the second session of the market would continue to value their production according to the System Marginal Price mechanism (i.e., remuneration for resources deployed on-demand to balance the system and provide ancillary services reflects scarcity and marginal costs).

The equilibrium price for the electricity purchased and sold would be determined by the weighted average of three values: 1) the average price paid for the contracts for difference in the first trading session; 2) the clearing price of the second trading session; and 3) the weighted average price, for the quantities traded on the green power pool.

In essence, this proposal seems to be a move away from marginal pricing (and the price signals it provides) and transition towards average pricing (i.e. a pricing mechanism based on average generation costs, including both variable and fixed costs).

6.3 Other interventions

As noted in section 4.1, a huge number and range of interventions were taken in response to the crisis and this report has provided a framework of some of the main types of responses, structured (broadly) around retail and wholesale markets. A couple of other notable responses that do not fit this categorisation are below.

6.3.1 Windfall taxes

A windfall tax is a tax on large, unexpected profits typically earned for something companies were not responsible for. The cap on the revenue of inframarginal producers (section 6.1.4) is a form of windfall tax. However, windfalls from the energy crisis were not restricted to inframarginal producers. Rising energy prices resulted in huge transfers of money from consumers to the oil, gas, coal and refinery sectors as well. In many jurisdictions windfall taxes on these sectors were introduced to support funding of some of the other interventions.

In the case of the **EU**, the Commission introduced a temporary, mandatory measure to tax excess profits generated from activities in the oil, gas, coal and refinery sectors, not covered by the inframarginal revenue cap.[87] Referred to as a 'solidarity contribution', the tax was to be collected by Member States on 2022 profits which are above a 20% increase on the average profits of the previous three years. For example, **Slovenia** applies this 20% solidarity contribution on companies that produce and process crude oil and natural gas.[88]

[87] This measure was introduced in October 2022 as part of the Commission's temporary emergency interventions to address high prices (see Annex A1).
[88] Slovenia imposes windfall tax on energy companies – EURACTIV.com

In the **UK**, a windfall tax was introduced on oil and gas extraction (but not on refining). Introduced in May 2022, the levy was initially set at 25% and was due to stay in place until 2025. The levy rate was increased to 35% from January 2023 and its duration extended to March 2028. In June 2023, the government announced that the levy would end if prices fell below a threshold for six months (£0.54 / therm in the case of gas, and $71.40 / barrel of oil).[89]

6.3.2 Export restrictions

Market coupling and cross-border trade in the EU is considered to have helped mitigate the effects of the crisis (e.g. see Box 33 and Box 34, further below). However, the effects on individual countries, particularly in the shorter term, can be different, with some potentially benefiting at the expense of others. In section 3.3, it was noted how wholesale prices in **Norway** had been somewhat lower in Germany, partly as a result of the country's hydropower (despite a drought, which saw reservoir levels at 20-year lows in autumn 2022).A study conducted for the Norwegian government identified interconnectors as having increased prices and reduced security of supply in Norway.[90] Subsequently, the Norwegian government sought to introduce new measures to protect security of supply, which could, ultimately, limit exports. The incremental measures were:

- "*legislating the producers' responsibility to contribute to the security of supply for power*
- *a formalization of the reporting scheme for hydropower producers from summer 2022*
- *requirement that producers draw up strategies to ensure security of supply and access for the energy authorities to supervise and control these, including sanctions*
- *access for the energy authorities to intervene in situations where there is a real danger of energy shortages*
- *clarification that, for reasons of security of supply, restrictions can be set on foreign connections in situations where there is a real risk of energy shortages.*"[91]

Although export restrictions are generally prohibited under European Economic Area (EEA) law, they may be justified when on security of supply grounds. The Minister of Petroleum and Energy stated "*there is room for manoeuvre within EEA law which we wish to use. I would therefore like to make it clear that, for reasons of security of supply, restrictions can be set on foreign connections if there is a risk of energy shortages, also before we get into a rationing situation for Norwegian households and businesses*".[92]

In the **United States**, the Biden administration had considered banning US oil exports to insulate American consumers from price volatility. However, industry experts warned such a

[89] https://www.bbc.co.uk/news/business-60295177
[90] Norway acts to restrict electricity exports and protect security of supply, Watt-Logic Blog, 30/1/23.
[91] Norwegian control mechanism to improve security of electricity supply, Norwegian Ministry of Petroleum and Energy Press Release, 27/1/23.
[92] *Ibid*.

move would likely backfire on US consumers because taking US barrels off the world market would drive up prices, and prices at the pump would take their cues from world prices.

Box 33 European Union: Security of supply through cross-border interconnections

Given the importance of cross-border flows for security of supply, the EU's Regulation 2022/869 '*on guidelines for trans-European energy infrastructure*' puts in place a framework for Member States to work together with the aim of strengthening existing and promoting new cross-border interconnections.

Improved integration of networks and increased cross-border interconnection capacity is especially important in the context of the gas supply disruption during the energy crisis, as it contributes to the smooth functioning of the internal energy market, as well as the distribution of gas among Member States, 'in a spirit of solidarity'.

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0869&qid=1689343609941

Box 34 Latvia: Improving cross-border flows

The regulator in Latvia made efforts to surpass the technical hurdles that were hindering cross-border flows (such as limited capacities of LNG terminal entry points and lack of synchronisation with the transmission system). In this context, cooperation between the Latvian and the Lithuanian regulator was crucial in order to achieve efficiency of cross-border flows.

Source: ECA based on ERRA interview

6.3.3 Gas storage and diversification of supplies

As observed in chapter 3, going into the crisis, gas storage levels (at least in Europe) had been relatively low and for much of 2022, there were material concerns over supply security for the 2022/23 Winter. In recognition of this, in June 2022, the European Commission introduced a gas storage regulation (see Annex A1) requiring Member States to fill gas storage facilities to 80% by 1 November 2022.

Also, the European Commission, through its REPowerEU Plan (see Annex A1), envisaged actions to diversify gas supplies. Measures were taken in several countries to expand the potential for increased use of LNG. For example, through bringing into operation previously mothballed facilities (**Spain**), increasing the capacity of existing LNG regasification facilities (**Greece**), and procurement of floating LNG facilities (**Finland, Estonia**).[93]

Other things equal, higher levels of storage and greater diversity of supply will help in (at least partially) mitigating the effects of a supply crisis.

6.3.4 Additional generation capacity

Another longer-term response to the energy crisis is to expand and diversify sources of electricity generation. Whilst not immediately successful, this was the intent behind the

[93] Source: ACER database of emergency measures.

Pakistan government's response to the crisis of seeking to procure new solar capacity, noted in Box 1, with support from NEPRA.

In the EU, one element of the European Commission's REPowerEU Plan were actions to accelerate the green energy transition – including a focus on solar, given its relatively quick roll-out potential. Some 25 of the 439 measures in ACER's database of emergency measures (see section 4.1) related to accelerated deployment of renewables.

Development of renewables increases diversity and resilience (not least by making use of domestic energy sources, such as wind and solar), as well improving the environment, but, as discussed in the conclusions (chapter 7), gives rise to the need for better management of the system, e.g. with greater need for flexibility services.

7 Conclusions

This final chapter provides our conclusions. Short-term interventions and then longer-term measures are outlined, with lessons considered for each. Whilst the focus is on the role of the regulator, the role of government is also recognised, particularly given its primacy in the short-term responses to the crisis and in setting policy for the longer-term. The chapter concludes with the lessons that arise specifically for jurisdictions seeking to progress or develop market opening.

7.1 Short-term interventions

A range of short-term interventions (described in chapter 5 and section 6.1) to address, in particular, rising and volatile electricity prices were considered and implemented in response to the energy crisis. Amongst others these included direct subsidies to consumers, retail price caps, demand reduction measures, and interventions in wholesale markets. These short-term responses were reactions to events and often implemented as a matter of urgency.

The need to act urgently, as well as the uncertain and relatively complex environment, means it is inevitable that some of the measures implemented will have been better than others. Some general lessons to note on these short-term interventions are as follows:

- First, to the extent that there is wholesale and / or retail competition in place, then the potential impact of interventions on these need to be considered. For example, in many jurisdictions, a significant amount of new (renewable) generation is required but interfering with market price signals may deter such investment and even increase its costs (if the interventions are seen as increasing risk over revenue certainty). Accordingly, there is merit in focusing on measures that either do not distort competition (where it is present) or which minimise such distortionary effects:
    - Demand reduction, direct financial support to consumers, and reduced taxation are examples of interventions (outlined in Chapter 5) which do not interfere with competition.
    - A retail price cap intervention may affect retail market competition (if it exists) but would leave any wholesale markets unaffected. As noted in section 5.2 the design of these retail price caps matters – with the approach in Germany reducing average prices while still retaining marginal pricing at the marginal consumption (thereby providing better price signals than the schemes in, e.g., France and Britain).
    - In general, interventions in wholesale electricity pricing run a greater risk of unintended consequences, although it depends on the nature of the intervention. The introduction in Spain and Portugal of a cap on the price that gas power plants can pay for the purchase of gas illustrates the risks of unintended consequences, as discussed in Box 26.

- The energy crisis resulted in large windfall profits for some (e.g. infra-marginal generators, and hydrocarbon producers). In many jurisdictions windfall taxes have been levied on these profits and used to support affordability measures. Whilst a legitimate response, such taxes can distort price signals and give rise to an increased perception of risk, deterring investment. To minimise these risks, such taxes should be short-term and linked to the exceptional nature of events.

- Second, interventions should be targeted. There are at least two elements to this:
  - First, in the case of interventions to support financeability, these should be targeted to where it is most needed, e.g. the energy vulnerable. Some financial support interventions, perhaps for expediency, were not targeted and will have resulted in support being given to parties that could have afforded the increases in prices.
  - Second, to the extent possible, interventions should be targeted at addressing root causes. In the case of the energy crisis, the problems experienced in electricity largely originated from problems in the supply (and associated price) of gas. Targeting measures at root causes, rather than symptoms, is likely to be more effective and have fewer unintended consequences.

- Third, intervention measures should be time limited. Given that measures in a crisis are introduced in haste, and many may have secondary (or unintended) consequences, adding a time limit on their application helps to minimise these negative consequences, as well as providing an opportunity to reevaluate a measure, should there be a continued need for intervention.

Most of the short-term measures introduced in response to the crisis were the jurisdiction of governments, given the associated fiscal implications (both direct costs, but also taxes to fund interventions). Nonetheless, regulators still have an important, if more limited, role, not least in supporting and advising government in the time of crisis as well as, potentially, implementing certain measures.

Depending on arrangements and responsibilities in specific jurisdictions, there are some short-term actions and measures that regulators may be able to take, including in relation to preventing disconnection for non-payment and SoLR provisions. Whilst regulators typically have the power to set price caps (e.g. at a network and retail level) doing so below cost would run counter to the typical obligation regulators have to ensure financeability.

7.2 Longer-term measures

The energy crisis brought renewed attention on whether energy markets were functioning as well as they could. This debate was already ongoing, partly due to the need to attract significant new investment in the coming years to decarbonise electricity generation, including accommodating renewable generation.

The need for increased resilience

Wholesale electricity markets in the EU could be seen to have functioned as intended during the crisis, and both ACER and the European Commission have concluded that the core market design remains fit for purpose, whilst proposing some changes (see Box 35, further below). Retail markets, however, experienced greater challenges in some countries, including Great Britain.

Regardless of how well these markets may be deemed to have coped, there were clear and significant negative consequences, most obviously in terms of affordability for consumers. The above short-term responses were reactions to the crisis to address this issue. The question that also arises is whether there are other longer-term interventions that could mitigate the effects if a similar crisis were to occur in future. In large part, this is about measures to develop the resilience of energy markets to shocks.

Greater diversity of generation sources increases resilience to shocks. Some of the shocks underlying the recent energy crisis are evident from chapter 3, and include the disruption of gas supplies to Europe, outages in the French nuclear fleet, and the effect of drought on hydropower resources. Policy measures to increase diversity of generation resource (and feedstock, including gas storage measures) will increase resilience.

Increased deployment of different forms of VRE may contribute to diversity and support increased resilience, as well as decarbonisation goals, but create other issues that need to be managed, in particular, the need for flexibility. In the near term, the integration of VRE has put pressure on the phase out of thermal generation, which is often well-placed to meet the need for greater flexibility. Going forward, other sources of flexibility, such as electricity storage, need to be developed. In the case of storage, this provides a greener solution to flexibility than thermal generation, but the duration of the storage needs to be considered.

Role of the regulator in the longer-term measures

Longer-term policy measures to address issues such as those above are primarily the domain of government, albeit with a role for regulators to support and advise in development and implementation. However, there are also longer-term measures that are more likely the domain of regulators as we now consider, covering three broad areas: supporting transmission network development; addressing market failures; and electricity market design.

The transition to net zero, will require increased connections of renewable generation to transmission networks. Again, whilst powers vary across jurisdictions, regulators are likely to have a role in setting obligations and the right regulatory environment to encourage the acceleration in transmission development needed. This may involve, for example, obligations on transmission system owners to provide the infrastructure, or on market parties to develop it quickly.

There are a few areas in which markets in some jurisdictions could be deemed to have failed during the extreme stress placed on them by the energy crisis. These may provide lessons for regulators (and other relevant parties) in preparing for and mitigating effects of future crises:

- **Supplier of Last Resort**. The energy crisis provided a stress test to SoLR arrangements. Reviewing and, where necessary, strengthening SoLR provisions (e.g. transparency, clarity in roles, clear and robust processes) in jurisdictions with

retail competition can help in minimising disruption to consumers. There is also merit in planning for the contingency that widespread crises affecting all suppliers occur in future. Not least this could be used to establish options for how to address situations where the additional costs cannot be borne by the supplier picking up new customers or socialised through increasing bills of remaining energy suppliers without comprising affordability. This latter aspect may require support from government.

- **Supplier hedging obligations**. Requiring suppliers to hedge wholesale prices could afford protection to their customers (and themselves) from changing prices, at least for a period of time. Such a requirement would likely require some upfront specification of what is appropriate (e.g. guidance and recognition of what hedging is possible in the jurisdiction and for specific suppliers), as well as some form of monitoring.

- **Financial robustness of suppliers**. Related to the prior two points, the energy crisis placed stress on suppliers' finances in some jurisdictions. This was the case in GB, where the lack of financial robustness resulted in numerous bankruptcies. Given the costs and disruptions these create there may be merit in regulators stipulating certain standards (e.g. in relation to hedging) and / or requiring suppliers to conduct stress tests as to their financial resilience.

- **Strategic reserve obligations**. Heading into the energy crisis, gas storage levels in the EU had been relatively low. Higher levels of storge and / or strategic reserves would have been beneficial. Placing requirements on participants to hold strategic reserves may help in mitigating the effects of future crises. Such obligations sit most obviously with generators through them either holding physical reserves, or through robust contractual arrangements. However, obligations could also potentially be placed on suppliers or shippers.

The energy crisis brought renewed attention on a pre-existing debate as to whether existing energy market designs would support decarbonisation goals. As already noted, in the context of the EU wholesale electricity markets, ACER and the European Commission both concluded that the core market design remains fit for purpose. However, they also proposed some changes that, in large part, were about promoting a greater role for longer-term markets to create a buffer between wholesale prices and consumers' bills (see Box 35 and section 6.2.2 for more details). The Commission also left open the option to look at what level of pricing granularity in the EU market design is most appropriate (i.e. more location specific pricing).

Box 35 European Union: Electricity market design considerations

ACER published a review (requested by the European Commission) of the EU electricity market design in April 2022 and, following a public consultation in early 2023, the Commission published its proposals in March 2023:

- Both ACER and the Commission reached the same conclusion that the core of the existing EU electricity market design, including price formation based on the system marginal price (i.e., the price bid by the most expensive generator needed to meet demand) remains fit for purpose. The existing regime was assessed to have delivered significant benefits and no fundamental change was needed. Indeed, both parties emphasised the importance of Member States fully implementing existing provisions to maximise benefits.

- The Commission proposed measures which are intended to create a buffer between (short-term) electricity wholesale prices and consumers' bills, whilst still supporting security of supply and decarbonisation objectives. In this regard, its proposals focused on a greater role for longer-term markets, to complement short-term markets, allowing consumers to benefit from more fixed price contracts. Specific measures (outlined in section 6.2.2) were intended to support increased use of PPAs (including government guarantee schemes), CfDs for new decarbonised investment, and measure to promote liquidity in forward markets (through establishment of virtual hubs).
- The Commission recognised the importance of flexibility in responding to the greater variation in electricity generation arising from the increasing share of renewables in the generation mix. Demand response and storage, in particular, have the potential to reduce reliance on gas. The Commission's proposals included ensuring that regulatory frameworks are not biased towards capex solutions (i.e., more network investment) in preference to flexibility solutions, to work on new rules to support demand response, clarifying (and simplifying) provisions for capacity mechanisms and introducing a peak-shaving product.
- The Commission also proposes to clarify how existing provisions allow for the creation of a low-carbon capacity mechanism, and to make it possible to design capacity payments for non-fossil fuel flexibility support schemes (via a competitive bidding process).
- More broadly, without making a specific proposal, the Commission intended to look at the level of granularity in the EU market design that would deliver the most benefits.

Source: ECA

7.3 Lessons for new markets developing market opening

Competitive electricity markets have been introduced in many larger, developed countries, but some developing economies have also introduced competition, and many more are actively considering it.

There are potentially significant benefits to be realised from competition, but it is important to recognise that competition is not a 'magic bullet' solution for developing economies. There are conditions that make it more likely competition will be successful, such as adequacy of revenues, including bill collection, and the legal and regulatory environment (as noted in section 2.3). In addition, there is not a single prognosis as to the approach to introducing competition or for the right form of market design, as circumstances and objectives vary across jurisdictions, and these need to be recognised in the development of any program of electricity market reform.

Wholesale competition

Whilst acknowledging that circumstances vary, there are several typical reasons for introducing wholesale electricity markets, including:

- **Attracting new generation investment** without (or with limited) government guarantees – thereby improving generation adequacy without increasing, or

putting pressure on, government expenditure and debt. Introduction of a wholesale electricity market is a usual starting point. This may start with a long-term contract model before the add-on of spot markets as a later development.

- **Improved local resilience**. More generation investment, particularly in renewables and at a local level, can help improve the resilience of electricity supplies to final consumers (which can have the additional benefit of supporting payments, as discussed further below).

- **Efficiency gains**. This was a key reason for introducing electricity competition for the early adopters, as discussed in chapter 2, for at least some of whom generation adequacy was less of a concern. For developing economies, this may be more of a later objective, particularly where competition is introduced gradually, e.g. through a long-term contract model, to spot markets, to retail competition.

As just noted, there are two forms of competition that might be introduced into wholesale markets, which can operate side-by-side:

- **Long-term contracts**. These are commonly introduced in centrally planned systems. A competitive tender is introduced either for specific sites or for contracts to deliver at lowest cost. A major element of these competitions is a payment for development of generating capacity and a separate payment for delivered electricity. The tenders need to be evaluated on the net cost to the system of both payments and so some form of modelled evaluation of the tenders will need to be performed to determine which has the lowest net present value.

  The resulting plants, once built, will then need to be optimised in short-term dispatch (either through a short-term market or else through optimisation software).

  These contracts become less useful when VRE is also part of the contract mix because such plants have negligible variable costs and so will seek to be dispatched as must-run price-takers in the market. Received wisdom is that VRE should be fully incentivised to maximise output through all payments being for energy.

  Another aspect of VRE penetration is that it disrupts the operational patterns of conventional generation with capacity factors typically falling. This is inevitable, regardless of the contracts made with the conventional generators, but it may be preferred that the conventional generators take on the dispatch risk rather than the central planner.

- **Energy-only contracts**. These are the most common contracts for VRE competing in auctions or offered through support schemes, but similar contracts can be made with conventional generators such as Combined Cycle Gas Turbines (CCGTs). These contracts can only be made once a liquid day-ahead spot market is in place. This adds another dimension to generation procurement as forward contract risk is passed from the central body (single buyer) to the generators – if the plant becomes redundant due to higher costs, then the central authorities do not have to continue making availability payments.

A more important aspect of energy-only contracts is that merit order dispatch can be applied, again with risk of not being dispatched left with the generator. This is part of allocative efficiency as observed, for example, in the development of a spot market by the SAPP. It should also be noted that the development of a bilateral contract market in the EU emerged as a preferred model with the same requirement for optimised dispatch being encouraged through generators taking dispatch risk, rather than centrally carried dispatch risk.

Retail competition

This has emerged in European markets more extensively than in most other regions. Its purpose is to use competition to share the benefits of wholesale competition with consumers by forcing suppliers to compete to supply. In emerging markets, retail tariffs tend to be price controlled. This works reasonably until there is an input price increase and pressure is put on the regulator to not allow price increases to be passed through. This was tested in the recent energy crisis and the tactic of passing responsibility for consumer price increases onto suppliers did not work well, with political intervention still being applied to subsidise retail tariffs in various ways as described in this report.

Suppliers in a market need to be paid. In the case of electricity generation, this means that charges are adequate to cover costs and that those charges are paid, i.e. customers pay suppliers and suppliers pay generators (either directly or through a market). In situations where generation adequacy falls significantly short and basic service delivery is compromised by continuous interruptions, then customers may choose not to pay. In the case of wealthy (and reliable customers) they may withdraw in favour of relying on their own generation arrangements. In the case of poorer customers, they may simply not pay in the first place (but may reconnect illegally when they need to). Whatever the root cause, generation investors (e.g. IPPs) may be deterred from entering the market.

Renewables and ancillary services

Developed and developing markets have seen big increases in renewables generation. The incentives for this are obvious. Renewables offer a usually free source of indigenous primary energy, increasing national self-reliance as well as meeting climate goals. This is further supported by the reduction in costs of deployment of new VRE generation. However, there are drawbacks in system operation with a need for increases in ancillary services to cover the intermittency of output of the main renewables technologies currently being deployed (wind and solar PV); development of markets can play a role in controlling the cost of this.

Two sorts of market are useful in supporting renewables development:

- **Spot markets**. These provide a reference price for valuing the energy element of a renewables contract. The renewable generator is guaranteed a market for the energy it sells without having to make a bilateral contract with a particular supplier in order to guarantee revenue. Very often, a financial contract is added to this to either give the generator a guaranteed price for the added environmental benefit of the renewable generation or to give the generator price certainty; these Contract for Difference financial contracts are common in developed markets but may not necessarily be supportable if the retail market is weak.

- **Ancillary services market**. Ancillary services are required to cover variations in frequency in any power system due to demand fluctuations or unplanned generation outages. With increased VRE, a new source of generation output fluctuation is introduced and an increase in ancillary services becomes a requirement. This coincides with the development of new electricity storage technologies which can supplement the delivery of ancillary services – currently Battery Energy Storage System (BESS) is the main technology being deployed.

  Ancillary services can be procured through long-term contracts where providers are paid to hold capacity available for rapid delivery (or withdrawal) of energy when called on to do so. In Europe, a trend towards shorter-term contracts has emerged, following the principles used in Australia and New Zealand towards co-optimisation between delivery of energy in the spot market or holding the capacity in reserve but this is probably not necessary for emerging markets where a longer-term contract is more likely.

  For BESS and other ancillary service providers, the valuation of capacity held for reserve is its opportunity cost – what could that capacity be sold for if not held to provide flexibility for system operation. This is where markets can provide robust prices for the short-term valuation of the capacity. The following points can therefore be made:

  - Spot market price signals aid the case for development of generation and, in particular for the valuation of ancillary services.
  - Storage, in particular, is reliant on spot markets revealing short run marginal costs including the value of scarcity so that the storage operator can value the energy needed for charging the storage device and the price for discharging the device. This is known as arbitrage and the resulting revenue stream can also be used to value the capacity withheld to provide ancillary service availability.
  - This all means that a robust market will need to pay marginal prices to provide signals for investment as well as for ancillary service valuation. The valuation rules apply to a TSO's business case for buying a storage device to support frequency stability.

Investors value sound governance

A robust and independent regulator will also make it more likely that competition will be successful. Independence from government and vested interests in the sector, increase the confidence of new entrants (e.g. IPPs) of receiving fair and equal treatment and, therefore, the confidence with which they make investments.

Annexes

A1 Timeline of key European Commission responses to the energy crisis

The following provides a timeline and brief summaries of key measures taken by the EC in response to the energy crisis.

October 2021

Energy Price Toolbox

In response to rising energy prices, the Commission published a communication setting out measures that Member States could consider adopting to mitigate temporary energy price rises.[94] The communication covered measures such as:

- Emergency income support (time-limited compensation and direct support, e.g. vouchers) and avoiding disconnection
- Taxation (e.g. reducing rates for vulnerable and / or shifting taxes from electricity bills)
- State Aid (e.g. taking measures within the state aid framework to reduce energy costs for end-users (companies and industries), facilitating access to PPAs - e.g. through demand aggregation)
- Stepping up market surveillance (i.e. identifying and investigating any anti-competitive behaviour).

The Commission also tasked ACER with assessing the current wholesale electricity market design.

March 2022

Security of supply and affordable energy prices: Options for immediate measures and preparing for next winter[95]

Subsequent to Russia's invasion of Ukraine and an escalation of the energy crisis, the Commission issued a Communication in response to a request of EU leaders outlining the pros and cons of various short term measures (see Figure 10) to address high energy prices (with no single easy answer given the diversity across Member States) along with collective action that could address root causes of the problems and secure supply for the next winter.

[94] Tackling rising energy prices: a toolbox for action and support, 13 October 2021, COM(2021) 660.
[95] Security of supply and affordable energy prices: Options for immediate measures and preparing for next winter, 23 March 2022, COM(2022) 138.

March & May 2022

REPowerEU Plan

On 8 March 2022, the EC outlined measures to reduce dependency on Russia's fossil fuels.[96] The EC, upon request of the European Council, provided further detail on 18 May 2022.[97] In addition to existing provisions[98] and measures, the REPowerEU Plan set out actions to:

- Save energy (including making use of measures such as reduced VAT on building insulation and high efficiency heating systems)
- Diversify supplies (including a voluntary platform for the common purchase of gas, LNG and hydrogen)
- Accelerate Europe's clean energy transition (including a focus on solar, given quick roll-out potential) by substituting fossil fuels out
- Smartly combine investments and reforms (including speeding up permitting).

The Plan also called on Member States to reinforce their preparedness for severe supply disruptions (including updating of contingency plans).

At the same time (in May 2022), the Commission set out a course for action on short term energy market interventions and long-term improvements to the electricity market design.[99] The Commission considered that the existing market design was efficient and delivered significant benefits. It called on Member States to ensure the full implementation of electricity market legislation but also identified areas for adjustment, including measures to improve liquidity in forward power markets, capacity mechanisms and reliability options, requirements for suppliers to hedge and assessment of the robustness of suppliers to future shocks, role for two-way CfDs, more flexibility (e.g. demand response and storage), development of digital tools to support customers in responding flexibly, locational pricing, removing barriers to innovation, maintenance of market monitoring, etc.

June 2022

Gas storage regulation[100]

Agreed on the 29 June 2022, this required Member States to fill their gas storage facilities to 80% by 1 November 2022 and to 90% by 1 November in subsequent years.

[96] REPower EU: Joint European Action for more affordable, secure and sustainable energy, 8 March 2022, COM(2022) 108.
[97] REPowerEU Plan, 18 May 2022, COM(2022) 230.
[98] E.g. solidarity measures that, in extreme gas shortages, are intended to ensure supply to households, district heating systems, etc.
[99] Short-Term Energy Market Interventions and Long Term Improvements to the Electricity Market Design – a course for action, 18 May 2022, COM(2022) 236.
[100] REGULATION (EU) 2022/1032 of 29 June 2022 amending Regulations (EU) 2017/1938 and (EC) No 715/2009 with regard to gas storage.

August 2022 *Gas and electricity demand reduction measures*[101]

With a view to safeguarding gas supplies, this established rules including for improved coordination, monitoring of gas demand reduction measures, and the possibility for the Council to mandate demand reductions.

October 2022 *Emergency intervention to address high prices*[102]

To address the substantial increases in, and volatility of, electricity prices, the EU adopted several temporary, emergency measures to provide for a coordinated response across Member States. Measures, starting from 1 December 2022, were:

- **Demand reduction:** A mandatory 5% reduction in demand at peak hours (covering a minimum of 10% of all hours from 1 Dec 2022 to 31 March 2023). In addition, an indicative target for a 10% reduction in total monthly gross electricity consumption was set. Member States were free to choose how to achieve these targets.
- **Retail measures / support for final consumers:** Temporary provision was made to allow Member States, under certain conditions, to apply public interventions in setting the price of electricity supplied to SMEs, and to set price for SMEs and households below cost. This measure applies from 8 Oct 2022 to 31 Dec 2023.
- **Revenue cap for inframarginal producers**: The Regulation mandates the introduction of a cap on the revenues of inframarginal generators at a maximum of €180/MWh to apply from 1 Dec 2022 to 30 June 2023. Member States have flexibility in deciding how to implement the cap. The intention was that revenues above the cap will be collected by Member State governments and used to help reduce energy consumers bills.
- **Solidarity contributions**: a mandatory measure to tax excess profits generated from activities in the oil, gas, coal and refinery sectors which are not covered by the inframarginal revenue cap. Collected by Member States on 2022 profits which are above a 20% increase on the average profits of the previous three years.

November 2022 *Market correction mechanism*

In November 2022, the EC proposed a “market correction mechanism” to protect consumers against excessively high gas prices.[103] See Box 28.

[101] COUNCIL REGULATION (EU) 2022/1369 of 5 August 2022 on coordinated demand-reduction measures for gas.
[102] COUNCIL REGULATION (EU) 2022/1854 of 6 October 2022 on an emergency intervention to address high energy prices.
[103] Establishing a market correction mechanism to protect citizens and the economy against excessively high prices, 22 November 2022, COM(2022) 668.

November 2022 ***Faster renewable energy and grid permitting***[104]

In November 2022, the EC proposed temporary measures (valid for 18 months) to accelerate deployment of renewables,[105] with political agreement reached in December 2022.

March 2023 ***Gas demand reduction***[106]

A proposed extension of 12 months to the emergency legislation to reduce gas demand by 15%.

March 2023 ***Extension of market correction mechanism***[107]

The scope of the market correction mechanism was extended. See Box 28.

March 2023 ***Market design proposals***[108]

Moving beyond emergency measures, the Commission, responding to an earlier request of the European Council, proposed reforms to the functioning of the EU's electricity market, as well as some measures to protect vulnerable consumers.

Market reform proposals include support for longer-term contracting (e.g. PPAs, and two-way CfDs for non-fossil fuel producers), and to improve flexibility (specifically requiring Member States to assess flexibility needs, define indicative objectives for demand side response and storage, and the possibility of introducing new flexibility support schemes).

Arrangements to protect consumers include the potential for targeted interventions in future price crises, protection from disconnection, supplier risk management (e.g. requirement for hedging strategies), and supplier of last resort arrangements.

June 2023 ***Review of emergency energy measures***

The Commission reviewed three of the (time-limited) emergency interventions to address high prices (demand reduction, cap on

[104] Proposal for a Council Regulation laying down a framework to accelerate the deployment of renewable energy, 9 November 2022, COM(2022) 591.
[105] E.g. obligation that permit granting takes no longer than 1 month for heat pump installations below 50MW, 3 months for solar and ground source heat pumps, and 6 months for repowering of renewable energy power plants
[106] Proposal for a COUNCIL REGULATION amending Regulation (EU) 2022/1369 as regards prolonging the demand reduction period for reduction measures for gas and reinforcing the reporting and monitoring of their implementation, 20 March 2023, COM(2023) 174.
[107] COMMISSION IMPLEMENTING REGULATION (EU) …/... of 31.3.2023 on the definition of the technical details of the application of the market correction mechanism to derivatives linked to virtual trading points in the Union other than the TTF, 31 March 2023, C(2023) 2194.
[108] *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design*, COM(2023) 148 final,

infraMarginal revenues, support for final customers)[109] to propose whether they should be extended:

- **Demand reduction:** Member States had met the binding 5% reduction target at peak hours, but had found the 10% indicative reduction target for overall monthly demand challenging. Nonetheless, given the changed market circumstances, the Commission did not see a need to extend the measure given that demand response is addressed both in the existing electricity market legislation and in the proposed market design changes.
- **Inframarginal revenue cap:** Member States implemented this measure in different ways: 17 set the cap below the Commission's proposal of €180/MWh, seven applied it retroactively, and 11 applied it beyond the Commission's proposed end date. Member States reported difficulties in its implementation, with potentially adverse impacts on existing PPA agreements (and in concluding new ones). The Commission did not recommend the continuation of the cap, not least given its potential adverse impact on PPAs which its market design proposals seek to promote.
- **Support for final consumers:** 12 Member States reported adopting measures under the Council Regulation (i.e., setting regulated prices for SMEs and / or setting prices for SMEs and households below cost). The Commission does not see a need to prolong these temporary measures, noting that similar provisions for targeted price interventions for households and SMEs during crises are included in the market design proposals.

[109] The solidarity contribution (proposed at the same time, October 2022) is to be separately reviewed by the Commission.