



Harnessing Energy Demand Restraint in Ukraine: A Roadmap

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Executive summary

Energy demand restraint is broadly defined to include policies and practices that help increase energy efficiency, reduce energy imports and improve operational flexibility and resilience throughout a country's energy sector, particularly in the short term.

Instituting demand restraint measures could considerably improve Ukraine's energy system flexibility and resilience while also reducing energy imports, exerting downward pressure on energy prices and delivering a range of socioeconomic and environmental benefits. Ukraine's energy policy framework recognises this potential and gives high priority to promoting energy demand restraint to help improve energy security. Analysis of recent trends in Ukrainian energy consumption suggests that the greatest opportunities for applying demand restraint are likely to be found in the residential, road transport, energy-intensive industry and energy utility sectors.

A comprehensive and integrated policy approach will be needed to help realise these benefits in a timely, efficient and cost-effective manner. This roadmap outlines a way forward, built on an integrated set of strategic goals and mutually reinforcing policy measures that could be deployed to increase demand restraint across the energy sector over an initial five-year period.

Forming the basis of this roadmap are three key strategic policy goals:

- **Improve energy efficiency**, by broadening and deepening energy efficiency in a few key high-consumption areas for which the potential to quickly realise substantial and ongoing energy savings is greatest.
- **Reduce fuel imports**, by rapidly diversifying energy consumption away from energy imports and towards domestic energy sources.
- **Harness emergency demand restraint**, by using demand restraint measures more effectively to help improve energy sector resilience and flexibility during emergency events and tight supply-demand conditions, especially in the electricity sector.

This combination of goals provides a complementary and mutually reinforcing foundation to pursue demand restraint, consistent with Ukraine's wider socioeconomic policy priorities. The goals are also compatible with the various energy policies Ukraine has committed to under its 2014 Association Agreement with the European Union and the related *acquis communautaire*.

The integrated set of policy measures to help achieve these goals focuses on improving energy efficiency in residential space heating, road transport, energy-intensive industries, and power and district heating utilities. Measures to reduce fuel imports target the road transport, power and district heating sectors, while those to harness demand restraint during periods of scarcity or emergency events target the transport and power sectors. These measures were developed with reference to international best practices, in consultation with key stakeholders including representatives of the Ukrainian government, the Ukrainian energy industry, the European Commission, international financial institutions and the international donor community.

This roadmap provides a comprehensive approach to apply demand restraint across Ukraine's energy sector. It incorporates all the major energy end-users and key intermediate consumers throughout the value chain and addresses the import-related dimensions of demand restraint, which are particularly relevant to Ukraine's circumstances and energy security goals. At the same time, this roadmap addresses the emergency management aspect of demand restraint, proposing a range of practical measures for the consumption areas that pose the greatest future energy security risks.

This framework also offers an integrated approach to address demand restraint, recognising the interrelatedness of challenges across energy-consuming sectors and throughout the energy value chain. Given that this holistic approach could aid the development of complementary and mutually reinforcing policies that address cross-sectoral issues more effectively, the roadmap is likely to be durable and adaptable to changing circumstances and policy priorities over time.

Introduction

The EU4Energy programme is a four-year initiative led and funded by the European Union. One of its key goals is to enable greater application of evidence-based energy policy and decision-making in participating countries in Eastern Europe and Central Asia.¹ The International Energy Agency (IEA), the Energy Community and the Energy Charter support the project, with the IEA taking lead responsibility for the policy development dimensions. As part of this programme, the IEA has prepared this high-level policy roadmap to help inform and guide policy practitioners as they seek to develop and implement policies to promote energy demand restraint in Ukraine.

The analysis and proposals advanced in this document form an adaptable and integrated strategic policy framework that reflects international experience and best practices. It avoids detailed prescription, recognising that Ukrainian policy practitioners are better placed to draw on their local knowledge and experience to address practical details as they emerge. Accordingly, the roadmap's proposed pathways are intended to inform and guide the development of effective policies and programmes that would help realise the untapped potential of demand restraint, enhancing Ukraine's energy security, economic competitiveness and environmental performance.

This paper begins by discussing demand restraint concepts and principles, focusing on the nature and scope of demand restraint, its potential benefits, and factors likely to affect development and implementation. A description of the policy context governing demand restraint development and implementation in Ukraine follows. It provides an overview of recent energy consumption trends, policies affecting demand restraint and the current roles and responsibilities of key institutions and stakeholders in developing and implementing demand restraint-related policies and programmes. Finally, the integrated policy roadmap to advance demand restraint includes proposed strategic policy goals and a range of policy measures to pursue demand restraint in Ukraine over the next five years.

¹ Countries participating in the EU4Energy programme are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

Demand restraint concepts and principles

What is demand restraint?

Traditionally, energy demand restraint has been realised through a range of regulatory measures and interventions to reduce energy demand in the short term to help manage energy system imbalances.

Utilities typically deploy demand restraint measures along with supply-side measures to help address unanticipated and pervasive imbalances in energy production and consumption caused by chronic supply shortages or emergency events. Demand restraint has also been deployed in regulated energy systems to help manage daily, weekly and seasonal periods of peak consumption that create tight supply-demand conditions that could threaten energy system security.

Key methods for harnessing energy demand restraint include:

- **Peak shaving**, which seeks to reduce power demand during emergency events or peak consumption periods within a day, over a week or across seasons, depending on the nature and duration of the event.
- **Load shifting**, which involves taking pressure off energy systems by moving a portion of load to an off-peak period of the day, week or season.
- **Conservation and energy efficiency**, which aims to reduce the overall level of energy consumption on a permanent basis over time.

Demand restraint measures have proven effective in helping to raise the operational flexibility and resilience of energy systems in response to emergency events or short periods of tight supply-demand balances.

Opportunities exist to apply the principles and practices of demand restraint in a broader policy context to help achieve strategic energy policy goals. In Ukraine, for example, the notion of energy demand restraint could be expanded to include policies to reduce energy imports by diversifying energy consumption away from energy imports and towards domestic energy sources.

Combining traditional forms of demand restraint and import diversification would encourage a more integrated and holistic approach to demand restraint policy in

Ukraine, incorporating the entire energy value chain. This would increase the coverage and effectiveness of demand restraint policies to improve energy sector flexibility and resilience while also making their contribution to energy security broader and deeper.

Box 1. A policy-relevant definition of energy demand restraint

For the purposes of this project, energy demand restraint includes policies and practices to increase energy efficiency, reduce energy imports and improve operational flexibility and resilience throughout Ukraine's energy sector, particularly in the short term.

Why pursue demand restraint?

International experience suggests that implementing a comprehensive demand restraint policy can deliver a range of potential benefits, including:

- **Energy security.** Demand restraint can substantially improve energy system flexibility and resilience, with the potential to greatly increase overall energy sector reliability and energy security at least cost. At the same time, ongoing energy savings resulting from demand restraint can reduce reliance on energy imports, helping to minimise exposure to external energy security supply risks.² Demand restraint measures that support switching consumption from imports to domestic energy sources can strengthen energy security by further reducing reliance on energy imports.
- **Better economic performance.** Energy savings associated with ongoing demand restraint generally have positive macroeconomic effects, including greater economic activity, productivity and employment. Other indirect benefits may also accrue from lower energy expenditures. For instance, when energy efficiency improvements reduce energy demand and costs, the increased disposable income for individuals and the higher profits for businesses can be used to boost consumption, fund investments and reduce output prices, together

² The IEA reports that energy savings resulting from improved energy efficiency reduced the energy imports of major energy-consuming countries by over 11 EJ between 2000 and 2017 – a reduction of around 20% over the period. Similarly, the IEA reports gas import reductions of 11% in Germany and 29% in the United Kingdom between 2000 and 2015 owing to energy efficiency-related savings. See IEA (2019a), pp. 1-3 for details.

driving additional economic growth. Lower energy costs also improve competitiveness, especially for energy-intensive export industries.³

- **Environmental sustainability.** More efficient energy consumption can help reduce waste, improve energy resource management and reduce carbon emissions, which together can substantially improve environmental sustainability and provide strong support for the decarbonisation transition.⁴
- **Community wellbeing.** Demand restraint leads to lower energy consumption, which can result in lower energy costs and higher household disposable income. At the same time, cleaner and more efficient energy use can deliver benefits such as better air quality, which can improve health and wellbeing.⁵

Not only could implementing an energy demand restraint programme greatly improve the flexibility and resilience of Ukraine's energy sector, it could also reduce its energy imports, exert downward pressure on energy prices and offer a range of socioeconomic and environmental benefits.

What are the key challenges for delivering demand restraint?

Stakeholders identified several potential barriers during the course of consultations:⁶

- The financial incentives created by the combination of regulated prices set below production costs and cross-subsidies are insufficient to encourage demand restraint.
- Low awareness of energy-saving opportunities and benefits can limit support for demand restraint among some stakeholders and consumers.
- Access to accurate, timely and comprehensive data to inform demand restraint decision-making and effective policy development, implementation and evaluation is limited.

³ See IEA (2019a) and IEA (2014) for further discussion of the economic benefits associated with energy efficiency and saving.

⁴ According to the IEA, energy savings achieved since 2000 had effectively reduced carbon emissions by nearly 4 Gt CO₂-eq in 2017, equivalent to a 12% reduction in emissions in that year. The IEA projects that energy efficiency and energy savings could reduce energy-related emissions by up to 3.5 GT CO₂-eq per year compared with 2017 levels, delivering up to 40% of the carbon abatement required to achieve the Paris Agreement goals. See IEA (2019a) and IEA (2018a) for further details.

⁵ See IEA (2019a) and IEA (2014) for further discussion of the health, wellbeing, income and access benefits associated with energy efficiency.

⁶ Consultations to support this project were undertaken during October-December 2020 with a range of stakeholders, including representatives of the Ukrainian government, Ukrainian energy industry, European Commission, international financial institutions and international donor organisations.

- Existing infrastructure imposes restrictions: its fragility reduces service reliability; bottlenecks restrict service access; incomplete metering and end-user control weakens potential demand responsiveness; while the nature of existing infrastructure may limit the deployment of innovative technologies to improve demand restraint.
- High upfront costs, extended payback periods due to price distortions, and underdeveloped supply chains limit access to key demand restraint technologies.
- Access to affordable financing is constrained by perceptions of risk and uncertainty among potential financiers, regulatory and market distortions, and the limited capacity of some energy consumers to fund and pay.
- Regulatory uncertainty and risks reflecting a lack of transparency in administrative and regulatory decision-making; inadequate resourcing; inadequate monitoring, verification and enforcement; insufficient institutional capacity and knowledge; and a lack of predictability and accountability in administration and decision-making, exacerbated by frequent changes to institutional and governance arrangements.

Most of these challenges are not unique to Ukraine. International experience suggests that the combination of these barriers can create considerable risk and uncertainty from a financing perspective, which is often reflected in reluctance on the part of lenders to finance energy-saving activities. This reticence can substantially reduce access to financing and raise the cost of borrowing considerably, potentially delaying and deferring timely, cost-effective actions to reduce energy consumption.

Significant transaction costs are incurred to overcome these barriers, either through direct payments or indirectly through time spent gathering information. When these costs are included, the payback period for energy-saving measures can increase to the point where options that would otherwise be cost-effective become unattractive. Transaction costs for households are typically higher than for industry, reflecting the additional costs they incur to acquire relevant information. Such costs can be another important obstacle to behavioural changes that favour energy-saving and demand restraint.

What are the key enablers of demand restraint?

An integrated and comprehensive policy response incorporating a portfolio of measures tailored to specific development and deployment challenges will be needed to overcome barriers and constraints. International experience suggests

several key principles to develop and implement effective policy responses to advance demand restraint and energy-saving.⁷

Energy performance needs to be made visible so that all decision makers can make well-informed decisions relating to energy-saving and purchasing options. This will require greater transparency, based on easy access to comprehensive, reliable, accurate and timely information presented in a way that facilitates comparison of various energy products and services.

Economic measures to overcome financial, commercial and investment barriers to demand restraint may be required, at least initially, to improve affordability and help kick-start deployment. For instance, the options proven to address financing-access challenges include utility-operated or funded energy efficiency finance schemes, typically tied to demand-side management or utility energy efficiency obligations; pay-as-you-save schemes; supportive frameworks for the energy services industry; soft loans; grants; and loan guarantees.

Perceptions of financial risk can also be addressed through measures to lower the risk premiums applied to lending for energy efficiency projects. These may include risk guarantees; credit lines; mechanisms to standardise and bundle energy efficiency projects; and awareness- and capacity-building efforts among the finance community.

Price distortions associated with cross-subsidies in the energy sector are a key barrier to efficient and timely demand restraint deployment. Removing energy subsidies would not only encourage more efficient energy use but can also improve the viability of energy businesses and reduce energy security risks.

Deployment costs and risks can be further reduced once the benefits from lessons learnt and economies of scale begin to drive widespread adoption. Policies can provide a crucial catalyst for this process: for instance, policies mandating minimum energy performance standards for equipment, vehicles, buildings and power plants have proven particularly effective. In some cases, regulatory mandates have also required industry to develop, implement, monitor and report on effective energy-saving programmes.

All these measures need to be underpinned by effective monitoring, verification and enforcement. Verification builds confidence in policy performance and outcomes, while enforcement is necessary to secure compliance. Monitoring

⁷ See IEA (2018a), UNECE (2017) and IEA (2012a) for further discussion of policy enablers for demand restraint and energy-saving.

provides a foundation for evaluation, which is essential to ensure the ongoing relevance and effectiveness of demand restraint and energy-saving programmes.

Implementation also needs to be supported by a skilled body of government and industry practitioners. Capacity-building may be required for a range of issues: policy development and implementation; product and service development; supervision and regulation, especially in relation to monitoring, verification and enforcement; the fostering of innovative business models; and the implementation of quality assurance.

A supportive policy, legal, regulatory, institutional and economic environment is necessary to realise the benefits of demand restraint and energy-saving. Any significant gaps or limitations in these foundational arrangements could fundamentally restrict the nature and scope of the demand restraint policies that can be implemented. Key governance and structural enablers to successfully develop and deliver demand restraint policies and programmes include:

- **An effective policy framework** that establishes the goals, priorities and incentives to address the various challenges of promoting demand restraint. Policies need to set clear objectives; address key challenges in an integrated, holistic way; and be flexible enough to adapt to rapid technological development, market innovation and changing community expectations. Demand restraint policy implementation in Ukraine is likely to face a range of evolving risks and challenges that will require ongoing flexibility and adaptability to resolve. International experience suggests that the most effective way to respond is to adopt an incremental and evolving approach to policy development and implementation, reflecting the principles of continual improvement.
- **Legal arrangements** that establish a framework of laws, regulations and rules that help create appropriate behavioural incentives and penalties to promote demand restraint. Ideally, the legal regime should clearly identify the rights, responsibilities and accountabilities of the various parties involved in delivering demand restraint policies and programmes, and it should provide a means to codify those responsibilities and accountabilities. Legal regimes should also clearly delineate the nature and scope of each stakeholder's authority. Furthermore, they need to provide an effective monitoring, verification and enforcement mechanism, especially when other incentives for appropriate action may be relatively weak.
- **Regulatory arrangements** that provide clarity and predictability through consistent interpretation and application of policy and legislation, consistent with achieving the government's demand restraint goals. Ideally, regulatory decision-making should be independent, transparent, objective and consistent to ensure effective monitoring, verification and enforcement of demand restraint and energy-

saving activities, building credibility and confidence in the regulatory framework among stakeholders and the community.

- **Institutional arrangements** that reinforce and complement legal and regulatory provisions by lending a high degree of certainty to the roles and functions of policy institutions, regulators and stakeholders in relation to demand restraint policy development and implementation. Responsibility and accountability for policy development and implementation must be aligned with each institution's roles and functions so that the institution best suited to undertake a particular function has clear responsibility to do so and is transparently held accountable for delivery. Institutions need to possess the appropriate policy and legal authority, resources, coverage and enforcement capacity for timely and effective administration of their duties.
- **Well-functioning energy markets** that respond to cost-reflective prices in a way that delivers more efficient energy consumption and offers opportunities for innovative arrangements to harness demand restraint. Effective markets can especially help harness the power of independent, decentralised decision-making to stimulate experimentation, learning, innovation and the timely development and deployment of initiatives to harness demand restraint at least cost. Furthermore, well-functioning markets provide clear, cost-reflective price signals for efficient energy investment, operation and end use, which are essential to promote ongoing demand restraint and more efficient energy consumption.

Overview of Ukraine's policy context for demand restraint

Decades of regional insecurity and economic upheaval have left Ukraine's energy sector in a precarious position. Much of the existing energy infrastructure is old, fragile and in need of major refurbishment or replacement, so operating efficiency is low and technical losses are relatively high, especially in the district heating and power distribution systems.

A combination of continuing policy uncertainty and ongoing disruptions have also constrained upstream energy production and discouraged sufficient, timely investment, particularly in the hydrocarbon sector. As a result, Ukraine's energy reserves remain underdeveloped, which will progressively reduce the sector's capacity to meet domestic demand. As domestic production stagnates, the energy system is becoming increasingly dependent on energy imports.

Energy sector resilience to disruptions is low, and the combination of deteriorating energy infrastructure and growing fuel import dependence is raising the risk of further major energy disruptions in the future. Maintaining access to reliable and affordable energy services is likely to become increasingly problematic in these circumstances.

Recent energy consumption trends

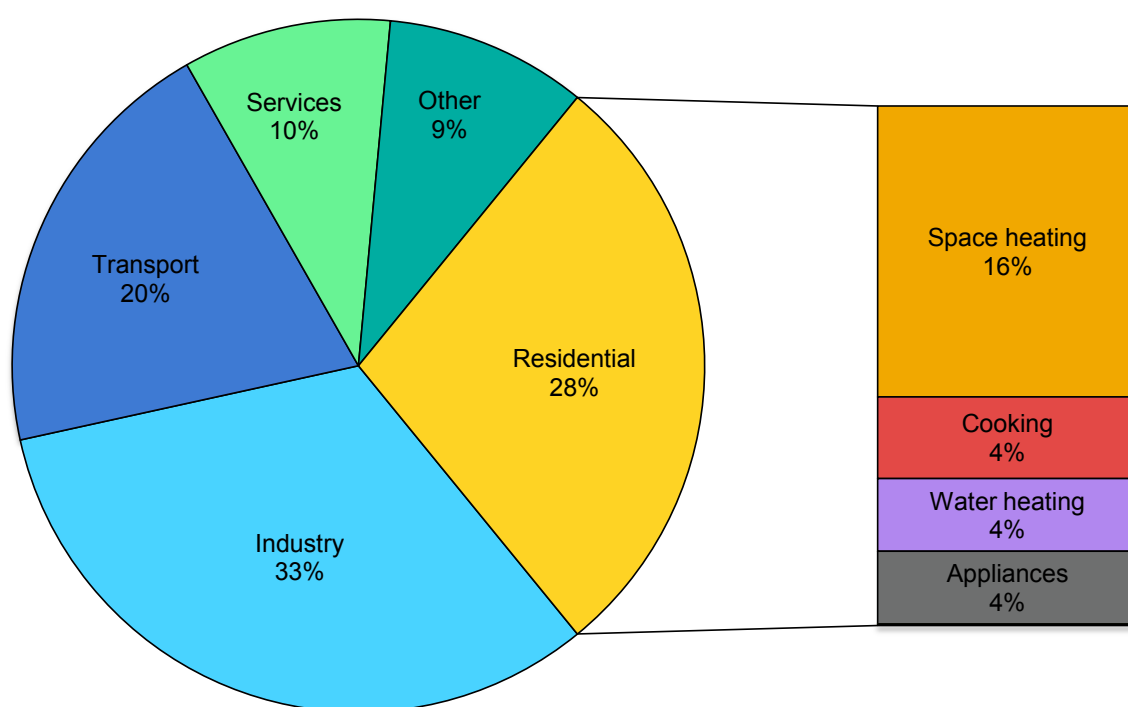
Ukraine's energy use is concentrated in the residential, industry and transport sectors, which were responsible for over 80% of total final energy consumption in 2019. The industry and residential sectors accounted for over 60%, with iron and steel production alone representing over half of all industrial use and around 17% of total final consumption. Transport accounted for a further 20% of total final consumption in 2019. Efforts to maximise energy demand restraint are therefore likely to be most successful if they target these highest-consuming sectors.

Furthermore, a breakdown of energy consumption by end use suggests that a few well-targeted demand restraint measures may be able to deliver the majority of potential savings. For instance, space heating, water heating and household appliances accounted for over 85% of Ukraine's total residential energy consumption in 2019. Space heating alone represented over half of residential

end use and around 16% of total final consumption (Figure 1). Measures targeting these end uses therefore have considerable potential to improve demand restraint.

At the same time, adding district heating consumption to household total final energy use puts residential natural gas consumption at around 15.4 bcm in 2018, which was over 140% of Ukraine's annual gas import requirements.⁸ This suggests that demand restraint measures targeting residential consumption could also support ongoing efforts to reduce exposure to energy imports. Other key consumption sectors may present similar opportunities.

Figure 1. Ukraine total final energy consumption by sector (with residential breakdown), 2019



Sources: IEA (2020d), *World Energy Balances* (database); residential breakdown based on IEA (2019b), *Energy Efficiency Indicators Highlights*, p. 148.

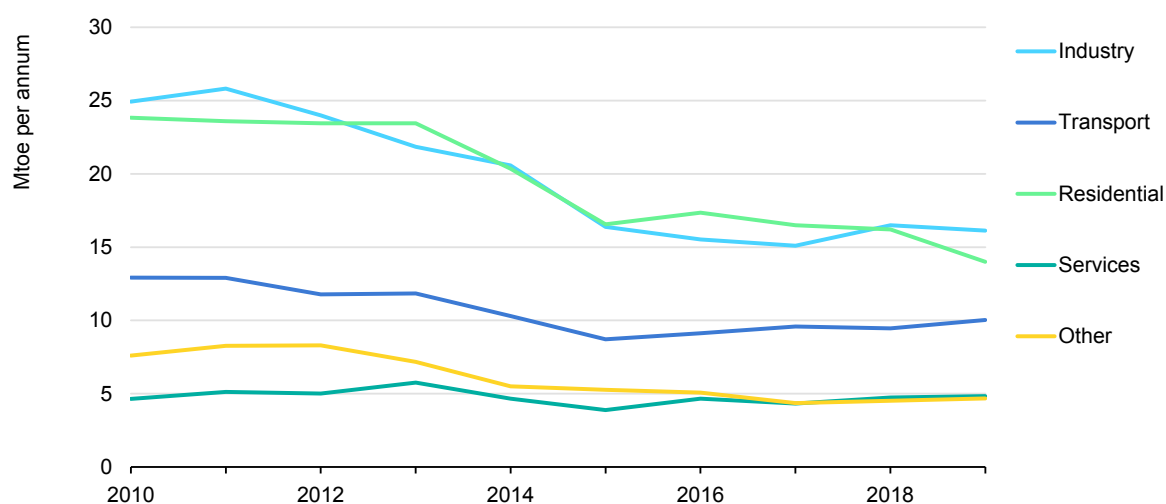
Trends in total final energy consumption by sector since 2010 indicate that consumption growth has begun to stabilise, since the economic crisis and conflict in the first half of the decade cut energy demand substantially in all sectors,

⁸ See NEURC (2019), pp. 82-83 for details.

especially residential and industry (Figure 2). The more moderate energy consumption of recent years likely stems from a combination of cyclical and structural factors.⁹

However, some signs of growth in industry demand since 2017 reflect improving economic conditions. Energy-intensive sectors such as iron and steel dominate industrial energy consumption. As this kind of industrial energy consumption in Ukraine is likely to be relatively energy-intensive,¹⁰ greater industrial activity may indicate an increase in relatively inefficient energy consumption. These emerging conditions suggest that it may be an opportune moment to pursue demand restraint, especially among energy-intensive industrial consumers.

Figure 2. Ukraine trends in total final energy consumption by sector, 2010-2019



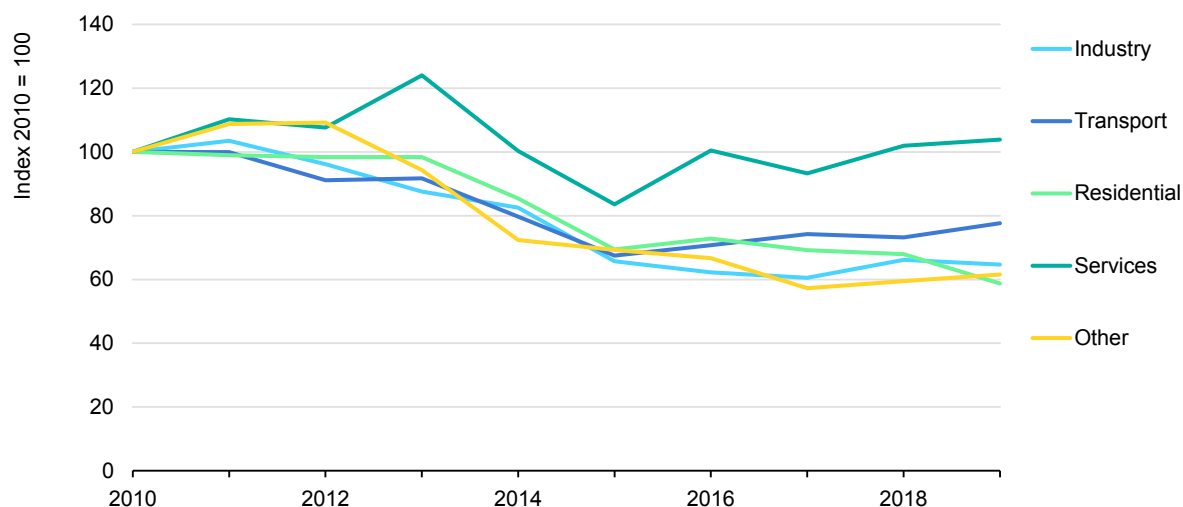
Source: IEA (2020d), *World Energy Balances* (database).

The rate of change in energy consumption by sector since 2010 displays these trends more clearly (Figure 3). The significant drop in the first half of the period is evident, as is the relative stability since 2015. Interestingly, this analysis more clearly reveals a return to sustained growth in transport sector energy consumption in recent years.

⁹ See SAE (2020), pp. 5-8 for further discussion of recent energy consumption trends.

¹⁰ SAE (2020), p. 6.

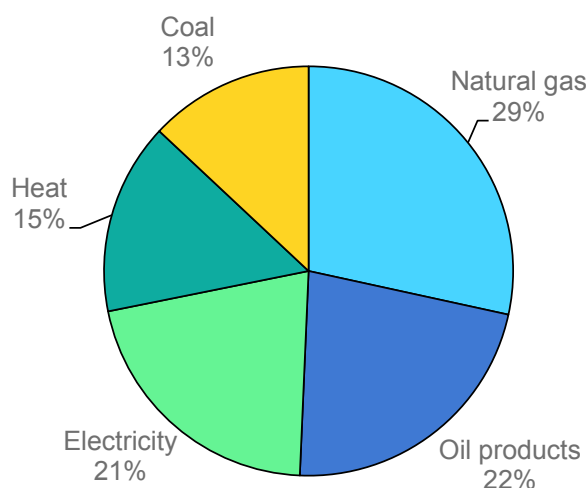
Figure 3. Ukraine rate of change in total final energy consumption by sector, 2010-2019



Source: IEA (2020d), *World Energy Balances* (database).

Natural gas continues to dominate domestic energy consumption, especially when heat production is added, as it is largely generated from natural gas (Figure 4). With the addition of heat, the natural gas share of total consumption rises to around 40%. Oil products and electricity were Ukraine's next-largest energy sources in 2019, each accounting for over 20% of domestic energy use.

Figure 4. Ukraine total final consumption by energy source, 2019

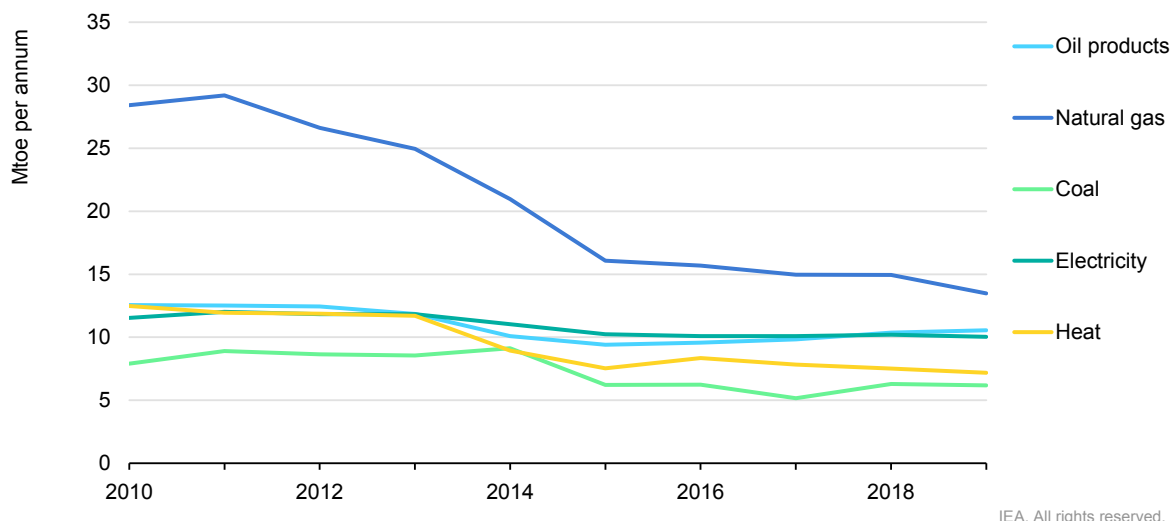


Source: IEA (2020d), *World Energy Balances* (database).

However, natural gas consumption had fallen considerably during the first half of the previous decade, with more moderate reductions among the other

major energy sources (Figure 5). Energy consumption appears to have stabilised at more moderate levels since 2015.

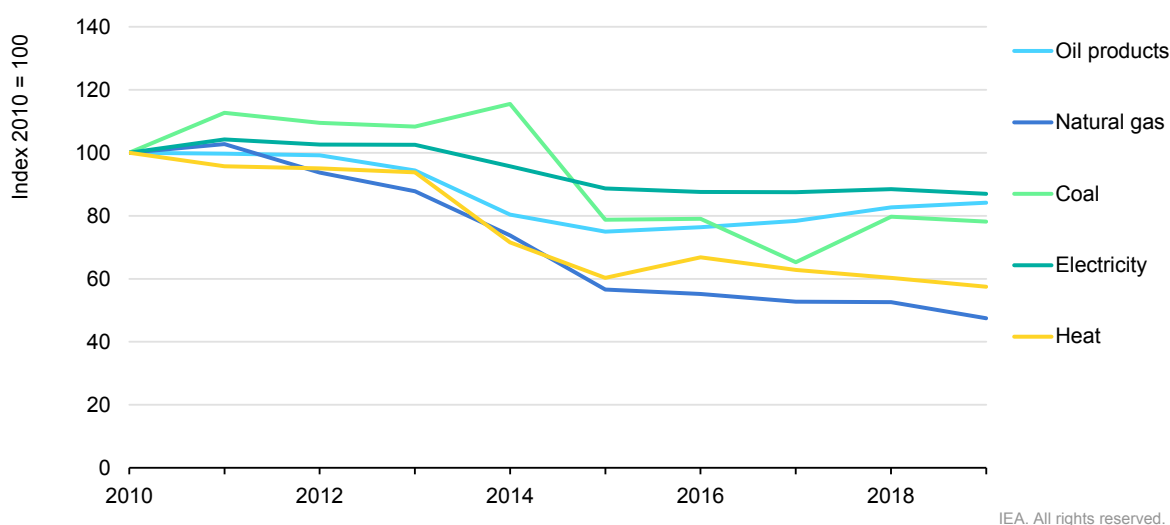
Figure 5. Ukraine trends in total final consumption by energy source, 2010-2019



Source: IEA (2020d), *World Energy Balances* (database).

These trends are revealed more clearly in Figure 6, which illustrates significant reductions in the consumption of all energy sources, particularly during the first half of the previous decade. In recent years, domestic fuel consumption has continued to fall or is levelling off for most energy sources. The exception is oil products, for which consumption has grown steadily since 2015.

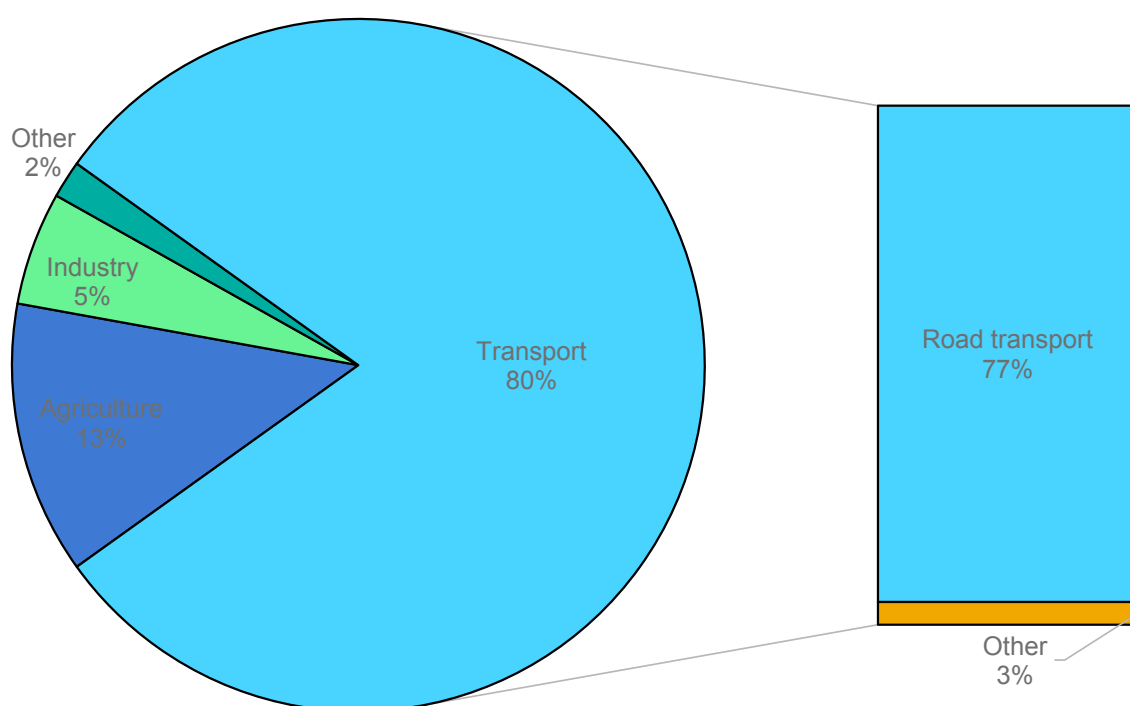
Figure 6. Ukraine total final consumption rate of change by energy source, 2010-2019



Source: IEA (2020d), *World Energy Balances* (database).

Recent growth in oil product consumption suggests that it may merit closer examination from a demand restraint perspective. The transport sector clearly dominated consumption of oil products in 2019, accounting for 80% (Figure 7). Road transport accounted for nearly all the sector's consumption and was alone responsible for 77% of Ukraine's total oil product use in 2019.

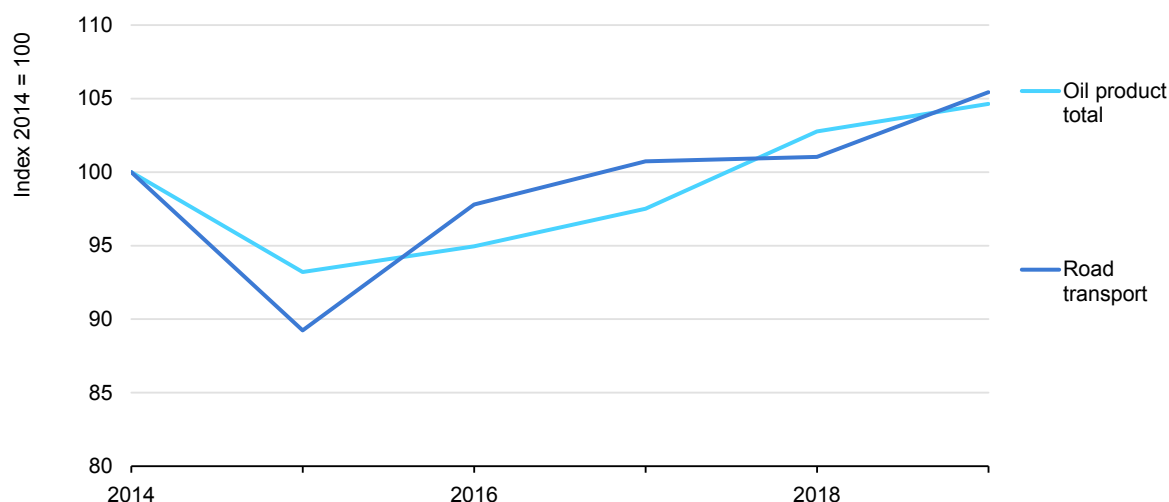
Figure 7. Ukraine oil product consumption by sector (with transport breakdown), 2019



IEA. All rights reserved.

Source: IEA (2020d), *World Energy Balances* (database).

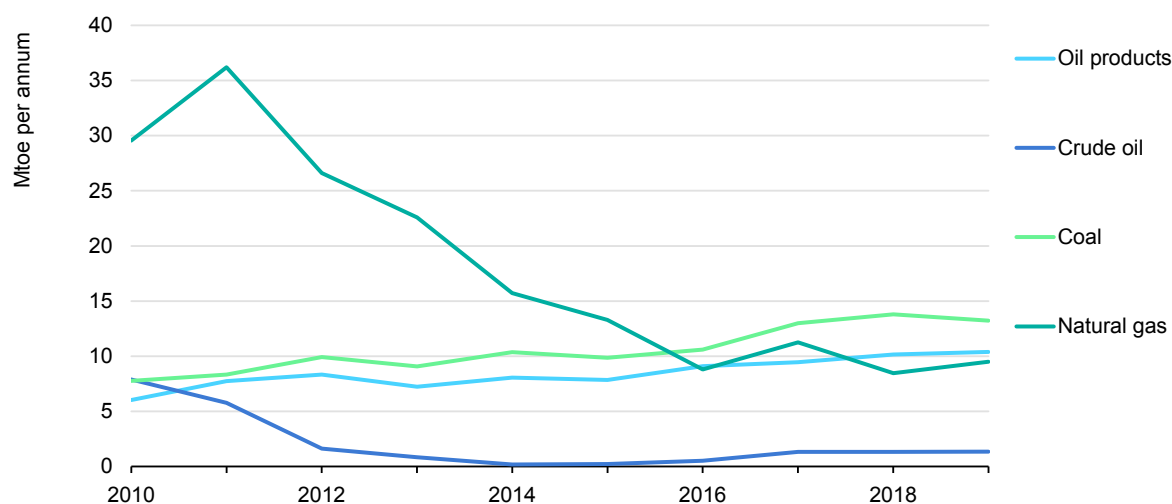
Figure 8 shows the rate of change in total oil product consumption overall compared with the road transport sector in the past few years. The relatively close correlation between growth in road transport consumption and overall domestic consumption is not surprising given the extent to which road transport dominates oil product use. These trends suggest that it could be fruitful to target demand restraint measures towards road transport oil product consumption.

Figure 8. Ukraine rate of change in oil product consumption, 2014-2019


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Source: IEA (2020d), *World Energy Balances* (database).

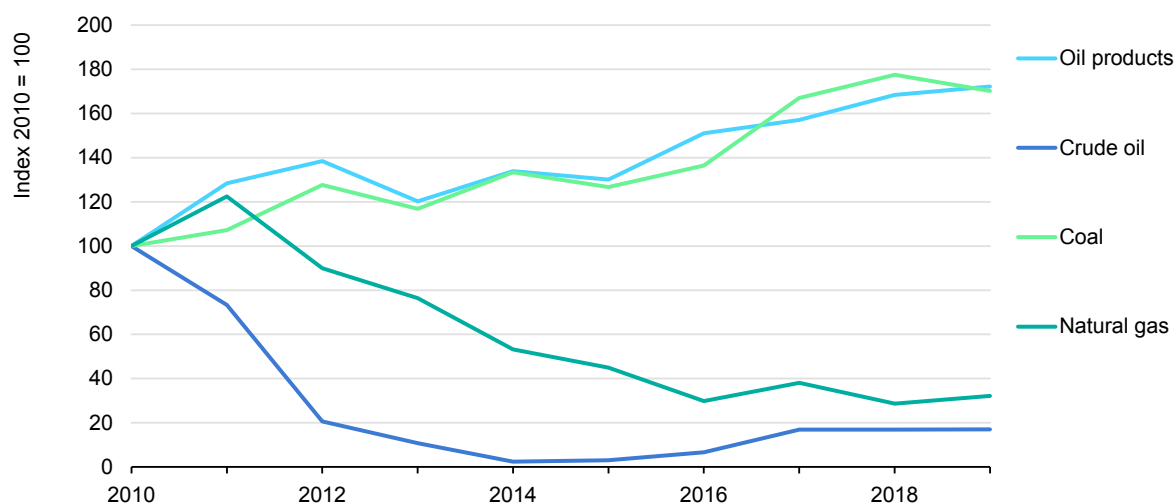
Recent energy import trends largely mirror those of domestic fuel consumption (Figure 9). The substantial drop in natural gas consumption is clearly reflected in declining natural gas imports over the period and, to a lesser extent, in declining imports of crude oil, natural gas liquids and feedstocks. However, a trend towards higher oil product and coal imports has appeared more recently.

Figure 9. Ukraine energy import trends, 2010-2019


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Source: IEA (2020d), *World Energy Balances* (database).

Figure 10 more clearly illustrates the divergences among the different energy imports. While substantial declines are evident for natural gas and crude oil, oil product and coal imports have generally been rising, especially over the last few years.

Figure 10. Ukraine rate of change in energy imports, 2010-2019


Source: IEA (2020d), *World Energy Balances* (database).

While Ukraine's rise in coal imports may reflect an increase in domestic coal demand, it may equally result from the need to replace lost domestic production. However, rising oil product demand may be more concerning from an energy security perspective, given that the majority of imported oil products cannot be domestically produced in large quantities at present. These trends suggest that demand restraint, particularly in the road transport sector, has the potential to reduce liquid fuel import dependence, consistent with the government's energy security goals.

Overall, Ukraine's recent energy consumption trends suggest several potential demand restraint priorities:

- As Ukrainian energy consumption is concentrated in the residential, transport, industry and energy utility sectors, an effective demand restraint programme should target these areas for maximum impact.
- Space heating is a key driver of residential energy consumption and may therefore provide substantial demand restraint opportunities.
- Similarly, road transport dominates energy consumption in the transport sector and may hold prime energy-saving opportunities. Applying demand restraint measures to road transport would have the added advantage of exerting downward pressure on oil product import growth.
- Energy-intensive subsectors such as iron and steel dominate industry energy consumption. Their relatively high levels of energy intensity per unit of production suggests potential for further energy-saving.

- The power and district heating sectors may also offer considerable demand restraint potential, given that they are major intermediate energy consumers and suppliers of energy to final consumers in the residential, industry and services sectors.

Policies influencing demand restraint

Ukraine's strategic energy policy framework emphasises its ongoing commitment to promote energy demand restraint to help improve energy security and self-sufficiency.¹¹ Policy priorities include improving energy efficiency; increasing renewable energy production; and reducing reliance on imported fuel through diversification.¹² This policy framework also reflects EU strategic goals and principles, consistent with Ukraine's commitments under its 2014 Association Agreement with the European Union.¹³

Ukraine is in the process of transposing the EU legislative framework, which could provide a strong and stable foundation to pursue demand restraint if the relevant provisions are fully implemented.¹⁴ Key framework legislation required to implement energy-related policy initiatives is largely in place, along with a significant proportion of the secondary legislation required to give effect to the operative provisions.¹⁵ However, several stakeholders consulted during preparation of this roadmap raised concerns about remaining gaps in the secondary legislation, which have the potential to introduce uncertainty, risk and additional costs that may delay or distort demand restraint responses.¹⁶

Translating these policy principles into effective actions that can deliver lasting outcomes remains a fundamental challenge. Several policies and programmes within the strategic policy framework that could encourage demand restraint include initiatives for energy efficiency; energy diversification; and energy-emergency management.

¹¹ See Government of Ukraine (2017) for details.

¹² See Government of Ukraine (2014; 2015) and the National Targeted Economic Programme on Energy Efficiency and Development of the Sphere of Energy Production from Renewable Energy Sources and Alternative Fuels for 2010-2020 for details.

¹³ See EU (2014) for further details.

¹⁴ The legislative framework Ukraine has undertaken to implement under its 2014 Association Agreement with the European Union and the related Energy Community *acquis communautaire* includes legislation on electricity, gas, oil, infrastructure, renewable energy, energy efficiency, competition and state aid, the environment, statistics, the climate and cybersecurity. Adoption of the EU Clean Energy Package, together with the 2030 targets, will be tabled for 2021 Ministerial Council consideration. See ECS (2020), EU Commission (2020), EU Commission (2019) and EU (2014) for further details.

¹⁵ See ECS (2020) and UNECE (2019) for details.

¹⁶ The Energy Community Secretariat expressed similar concerns in its 2020 Annual Report, noting that energy efficiency implementation suffers from an insufficient legal foundation. See ECS (2020), p. 183.

Energy efficiency

Ukraine's progress in developing and implementing policy measures to improve the energy efficiency of buildings and appliances has been considerable, consistent with its 2014 Association Agreement to implement the standards of the EU Energy Efficiency Directive.¹⁷

Key laws and regulations provide a foundation for monitoring and enforcing mandatory certification of energy efficiency in buildings, which was introduced in August 2020.¹⁸ A long-term building renovation strategy to 2050 is also being considered, and procedures for introducing energy management systems for public buildings are being developed.¹⁹

Several important programmes have been established to help fund and drive improvements in the energy efficiency of residential buildings and appliances:

- The Energy Efficiency Fund, established in 2017 in close co-operation with the European Union in accordance with the Law on the Energy Efficiency Fund of 8 June 2017 (No. 2095-VIII). The Fund has so far focused on financing energy efficiency retrofits of apartment buildings, but it is expected to be extended to retrofits of privately owned detached housing.
- The Warm Loans programme, established in 2014 to provide households with financial assistance to improve the energy efficiency of their residences through insulation, weatherisation and upgrading of major appliances such as space and water heaters. The programme has assisted 838 000 households to date, and supported investments of more than UAH 8.5 billion, including around UAH 3.2 billion in reimbursements to households.
- 23 technical regulations covering eco-design, and 11 covering energy labelling for a range of appliances. In 2020, the Ministry of Energy approved additional energy labelling regulations for decentralised heating; commercial refrigerators; residential ventilation systems; solid-fuel boilers; temperature controllers; and solar energy installations.

In addition, substantial resources have been provided to support training and capacity-building in relation to energy efficiency certification for buildings, energy efficiency auditing and energy management systems.

In the transport sector, Ukraine pledged to introduce EU standards for fuel quality, fuel efficiency and fuel emissions under its 2014 Association Agreement. A key

¹⁷ See Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 for details.

¹⁸ Energy efficiency certificates have been issued for over 4 500 buildings to date. See SAEE (2020), p. 13 for details.

¹⁹ Advice provided by the Government of Ukraine in its written submission to the IEA's 2021 review of Ukrainian energy policies (unpublished).

achievement has been implementation of the Euro 5 fuel quality standard,²⁰ which has been obligatory for fuels marketed in Ukraine since the beginning of 2018. European fuel economy standards for light- and heavy-duty vehicles are set to increase significantly in the next decade, which suggests that the EU policy framework will continue to provide a sound foundation for Ukraine to gradually increase demand restraint and energy efficiency in the transport sector.²¹

Ukraine has also supported the development and implementation of several industry-led initiatives to broaden and deepen demand restraint in the industry sector, including:

- Two Learning Energy Efficiency Networks, in which 24 companies co-operate and share information to reduce their collective energy consumption by 10 500 MWh and CO₂ emissions by 61 010 tonnes by the end of 2020.
- Various awareness-raising and capacity-building projects, particularly to implement the International Organisation for Standardisation (ISO) 50001 energy management system standard.
- Enterprise monitoring and reporting of energy efficiency trends.
- Emerging contractual arrangements for compliance with voluntary energy efficiency undertakings.²²

In relation to energy utilities, ongoing investments in the electricity and district heating sectors are being used to modernise generation and network infrastructure, including through installing metering and other technologies that allow consumers to more effectively control their consumption.²³ However, progress has been slow to date due to financial constraints and inadequate commercial incentives, largely because the regulatory framework does not provide sufficient cashflow to justify investments to modernise plant and network infrastructure.²⁴

Ukraine is in the process of implementing incentive regulation for the electricity sector, with similar reforms planned for natural gas.²⁵ They have the potential to address current deficiencies by adjusting revenues on regulated assets to offer commercial rates of return. In principle, previously implicit community service

²⁰ The Euro 5 fuel quality standard introduced a maximum sulphur content of 10 ppm in gasoline and diesel.

²¹ See IEA (2020a), p. 2 and IEA (2020b), pp. 1-2 for details.

²² See SAE (2020), pp. 11-13 and pp. 15-16, and advice received during stakeholder consultations for this project.

²³ See NEURC (2019), p. 54, p. 58 and pp. 141-144; and SAE (2020), p. 15, for further details.

²⁴ Several stakeholders suggested during the consultations that timely and efficient investments to modernise the power and district heating systems are unlikely to be forthcoming until regulated revenues provide the commercial rates of return required to justify those investment decisions.

²⁵ See ECS (2020) and NEURC (2019) for further discussion.

obligations, such as universal rights of access and price subsidies for residential consumers, are made transparent and fully funded by the government under this form of regulation. Full implementation of these arrangements, consistent with the approach commonly applied across the European Union, would help to address the fundamental financial and commercial constraints that currently hamper power sector modernisation.

Energy import diversification

The 2017 National Energy Strategy to 2035 reaffirmed the government's commitment to pursue import replacement and increase energy self-sufficiency, with a focus on reducing natural gas imports. It also reaffirmed support for developing domestic conventional, non-conventional and offshore hydrocarbon reserves, and committed to substantially expand renewable energy production to further strengthen energy security.

The government has recognised the need to diversify liquid fuel use and has therefore adopted several policies to promote the development and deployment of alternative fuels. The National Energy Strategy to 2035 envisages a growing role for alternative fuels in meeting domestic transport sector fuel demand. This plan reflects Ukraine's commitment under the 2014 Association Agreement to adopt various policies related to the development and deployment of alternative fuels for transportation, potentially hydrogen, electricity, biofuels, compressed natural gas, liquefied natural gas and various synthetic fuels.

Similarly, Ukraine has adopted a range of policies and programmes to promote the development and deployment of renewable energy, consistent with the 2035 National Energy Strategy and the National Renewable Energy Action Plan to 2020.²⁶ The most prominent of these has been the Green Tariff programme, which offered generous feed-in-tariffs to encourage investment in renewable generation capacity and the production of renewable energy.²⁷

By 2019, this programme had supported investments in approximately 4.7 GW of new renewable capacity, which represented over 40% of all renewable energy capacity serving the power sector. Production from new renewable generators approached 10.9 GWh in 2020, representing around 7.3% of total electricity production. New renewable generation helped significantly raise the renewable

²⁶ See Government of Ukraine (2014) for details.

²⁷ Under the Green Tariff programme, which operated between 2009 and 2019, NEURC determined eligibility and tariffs for each project separately. Feed-in tariff rates were determined following completion of construction. See ECS (2020), pp 190-191; NEURC (2019), pp. 58-60; and UNECE (2019), p. 19 for further details.

energy share of overall electricity production from around 4% in 2014 to 11.3% in 2020.²⁸ Although programme performance was mixed overall, it did boost capacity and production substantially, albeit from a low base.

Energy-emergency management

Ukraine's initial energy-emergency management aim to reduce exposure to natural gas import disruptions has largely been achieved through policies promoting import diversification and domestic fuel switching. The success of these policies is evidenced in a near 40% reduction in annual natural gas imports between 2014 and 2019 and a shift towards more reliable gas suppliers in recent years.²⁹ These policies were supported by a range of emergency measures designed to manage gas rationing more effectively during emergency events.

Ukraine's policy response was complemented and reinforced by its 2014 Association Agreement, which incorporated an early-warning mechanism and procedures to support Ukraine in the event of an energy emergency caused by an external supply shock affecting imports of natural gas, oil or electricity.³⁰ Co-operation includes ongoing technical assistance and research projects to improve legal and regulatory frameworks governing natural gas emergency management and stocks.³¹

Ukraine has built up considerable experience managing major energy supply disruptions caused by the unexpected loss of natural gas supplies in the past two decades. Policies developed and implemented over this period have delivered more flexible and responsive emergency reserves, which leverage the considerable natural gas storage infrastructure in place to support trade and transit; more effective emergency management co-ordination mechanisms; and more refined protocols for implementing emergency rationing arrangements. These practices have been applied successfully to help moderate the worst impacts of natural gas supply disruptions, most recently during the natural gas emergency event of March 2018.³² Overall, these measures, combined with Ukraine's substantial natural gas production and storage infrastructure, provide a solid foundation for managing shortages resulting from natural gas import disruptions.

²⁸ Figures were provided in correspondence with SAEF.

²⁹ See IEA (2020d), natural gas tables. NEURC (2019, p. 84) and ECS (2020, p. 187) report that 100% of Ukraine's natural gas imports have been sourced from EU suppliers since 2016.

³⁰ See EU (2014), Chapter 1, articles 337-338 and 340, and Annex 26 for details.

³¹ Comments provided by Naftogaz in a written submission to the consultation programme.

³² See IEA (2018b), pp. 34-36, for further discussion of the event and Ukraine's emergency response.

However, Ukraine's dependence on liquid fuel imports, especially of diesel and liquefied petroleum gas (LPG), expose it to the risks of unanticipated liquid fuel disruptions. In general, liquid fuel emergency management arrangements tend to rely heavily on supply-side measures based on the deployment of emergency stocks of crude oil and key liquid fuel products, supported by administrative interventions such as rationing.

Under its 2014 Association Agreement, Ukraine is required to apply the EU Energy Security Directive, which requires that member states develop crisis management plans and maintain emergency stocks of no less than 90 days of fuels imports.³³ However, implementation is progressing slowly and the Energy Community Secretariat's 2020 implementation report notes that although a draft law on minimum stocks of crude oil and petroleum products has been pending approval, no emergency oil stocks policy is yet in place. Similarly, a draft law proposing an Oil and Petroleum Products Market Crisis Plan has been prepared, but it has yet to be adopted. As a result, Ukraine currently has no liquid fuel emergency management procedures that comply with the Energy Security Directive.³⁴

Institutions and stakeholders

In Ukraine, the Cabinet of Ministers is the ultimate decision-making body for energy-related matters. It is responsible for policy co-ordination and the oversight of state energy companies. Energy policy is high on its political agenda, with the Parliament and the President also involved in the decision-making process. The main national-level institutions with energy policy responsibilities that could influence demand restraint policy development and implementation are:

- The Ministry of Energy, responsible for most energy supply policies and sustainable energy policy, and for co-ordinating energy policy across the government and providing advice to the Parliament.
- The Ministry of Finance, in charge of taxation policies relating to the energy sector.
- The Ministry for Communities and Territorial Development (Minregion), which develops policies and programmes affecting demand restraint at the local government level.
- The Ministry of Environment Protection and Natural Resources, responsible for a range of matters that could affect the development of demand restraint policies and programmes, including environmental protection; climate policy; ecological,

³³ See EU (2009) for details.

³⁴ ECS (2020), p. 189.

biological, radiation and genetic safety and protection; and sustainable fisheries, forestry and hunting management.

- The State Agency on Energy Efficiency and Energy Saving (SAEE), the central government body responsible for advancing and promoting energy efficiency and renewable energy development and technologies.
- The National Energy and Utilities Regulatory Commission (NEURC), which supervises and regulates the natural gas, electricity and district heating sectors. NEURC is subordinated to the President and accountable to the Parliament.
- The Anti-Monopoly Committee, tasked with preventing excessive concentration of market power in the energy sector.
- The State Nuclear Regulatory Inspectorate, which has regulatory responsibility for the operation of nuclear facilities, including uranium mining, radioactive waste storage and decommissioning at Chernobyl.

Ukraine's energy governance and institutional arrangements are relatively fluid and have changed considerably in recent years. Notably, SAEE has been incorporated into the Ministry of Energy. Consolidation of their policy functions and other related activities could improve the consistency and co-ordination of policymaking related to demand restraint, which may raise its effectiveness over time. Similarly, consolidation of a range of regulatory functions within NEURC since 2014 may improve the administration of energy-related regulation. The Energy Community Secretariat's most recent annual assessment of Ukraine's national authorities is generally positive.

Developing a demand restraint policy roadmap for Ukraine

Demand restraint could improve Ukraine's energy system flexibility and resilience considerably while also reducing energy imports, exerting downward pressure on energy prices and providing a range of socioeconomic and environmental benefits. A comprehensive and integrated policy approach will be needed to help realise these benefits in a timely, efficient and cost-effective manner. The following discussion outlines a way forward, built on an integrated set of strategic goals and mutually reinforcing policy measures that could be deployed to advance demand restraint across the energy sector over an initial five-year period.

Strategic goals

Forming the basis of this roadmap are three key strategic goals:

- **Improve energy efficiency**, by broadening and deepening energy efficiency in a few key high-consumption areas for which the potential to quickly realise substantial and ongoing energy savings is greatest.
- **Reduce fuel imports**, by rapidly diversifying energy consumption away from energy imports and towards domestic energy sources.
- **Harness emergency demand restraint**, by using demand restraint measures more effectively to help improve energy sector resilience and flexibility during emergency events and tight supply-demand conditions, especially in the electricity sector.

This combination of goals provides a complementary and mutually reinforcing foundation to pursue demand restraint, consistent with Ukraine's wider socioeconomic policy priorities. The goals are also compatible with the various energy policies Ukraine has committed to under its 2014 Association Agreement with the EU and the related *acquis communautaire*. Gradual application of the EU energy policy framework could further strengthen the wider policy, legal and regulatory foundation for Ukraine to pursue proposed demand restraint goals.

The nature and scope of these goals reflect a broad, policy-relevant understanding of demand restraint and how it could be applied in Ukraine. The goals provide a strong foundation for pursuing demand restraint across the energy sector,

reflecting the links between energy imports, intermediate consumption and energy end use, and how energy use throughout the value chain helps shape energy security and socioeconomic outcomes. Consequently, these goals can help accelerate roadmap development, simplify its implementation and maximise its effectiveness.

Residential sector measures

As space heating is a key source of household energy consumption in Ukraine, it is likely to offer the greatest opportunities for demand restraint in the residential sector. However, pursuing demand restraint in space heating could be challenging, as much of Ukraine's residential space heating is provided through a fragile and obsolete district heating system, with average technical losses estimated at around 18.5% in 2018.³⁵ Furthermore, stakeholder consultations revealed that Ukraine's residential building stock is old, with insulation and weatherisation relatively limited. Stakeholders also noted that residential consumer responses to demand restraint incentives may also be restricted in some cases by insufficient ability to control temperature levels and by market distortions such as ongoing energy price subsidies.

A suite of policy measures will be needed to help address these challenges. International experience has proven several measures effective in advancing demand restraint and energy-saving in the residential sector.³⁶

Insulating and weatherising existing buildings can considerably advance demand restraint and energy-saving, particularly by improving space heating efficiency. A variety of technologies are available, including double glazing; draught sealing; insulation; heating and cooling options; shading; low-emissivity coatings for “cool roofs”; and lighting and appliance replacement and disposal.

Building codes remain a key vehicle to promote energy efficiency, but it is difficult to transpose them directly from another jurisdiction because they need to reflect local conditions. Codes need to be reviewed and updated regularly to incorporate changes in building materials and practices, and resources must also be committed to ensure ongoing compliance through effective verification and enforcement.

³⁵ See NEURC (2019), p. 145, p. 288 and Annex 4.2.6 for further details.

³⁶ See the Annex for some leading-practice examples of building and appliance energy efficiency measures.

Current policies have taken an integrated approach to address demand restraint in this area, reflecting the interrelatedness of the challenges associated with improving the energy efficiency of space heating and building envelopes.

Nevertheless, there is still scope to build on this foundation. Funding for thermal modernisation activities could be increased to boost their effectiveness and accelerate their deployment, potentially supported through the Energy Efficiency Fund. This could be combined with measures to introduce more efficient residential space and water heating on a new and replacement basis. An expanded thermal modernisation programme that builds on the successes and lessons learnt through schemes such as the Warm Loans programme could provide a practical and effective way forward.

These efforts could be supported by complementary education and awareness-raising programmes targeting residential consumers. For instance, local weatherisation initiatives could be established offering in-home advice about managing energy consumption, potentially providing some low-cost consumable items (e.g. LED lightbulbs and door sealers) to demonstrate what can be done practically to save energy immediately. Such programmes are typically delivered in partnership with local utility service providers, retailers or energy service companies (ESCOs), and have successfully reinforced understanding and interest in reducing energy consumption.

At the same time, measures to strengthen energy efficiency standards governing new residential building construction could also be implemented, supported by more effective monitoring and enforcement, along with wider adoption of energy performance certificates for all residential buildings. Particular priority could be given to developing and implementing metrics and mechanisms to measure building energy efficiency improvements, which would address current deficiencies.³⁷ Importance could also be placed on installing energy controls, including individual heating and temperature regulators in buildings that currently do not have them. Opportunities to install energy management and monitoring systems in government buildings could be explored, to demonstrate the benefits of more effective building energy management and to test the potential to expand deployment in the future.

³⁷ See SAEF (2020), p. 7.

Box 2. Proposed policy measures to improve residential sector energy efficiency

- Extend and expand energy efficiency programmes for existing buildings, and possibly introduce building energy monitoring and management systems, drawing on successes and lessons learnt from established programmes and funding mechanisms.
- Expand building energy performance certification coverage.
- Strengthen energy efficiency standards governing new residential construction.
- Strengthen monitoring and enforcement of building energy efficiency codes.
- Strengthen financial incentives to encourage installation of more efficient residential heating appliances.
- Complete metering rollouts for all residential consumers, including installing energy controls to enable all users to directly regulate their space heating.
- Offer complementary education and activities to raise awareness of related energy-saving options, possibly including low-cost weatherisation initiatives.

Transport sector measures

Road transportation dominates energy consumption in this sector and therefore offers significant demand restraint opportunities. More efficient energy use in road transport may also significantly reduce fuel imports. However, demand restraint measures are unlikely to deliver substantial savings quickly in Ukraine given the dominance of the used-vehicle market and the relatively slow rate of vehicle replacement. This should not deter action now, especially to strengthen emergency management, as the potential for savings is considerable and the strategic importance of the sector to Ukraine's energy security is growing.

Improving energy efficiency

Ukraine's vehicle fleet is relatively old. One stakeholder noted that the average vehicle age is more than 20 years,³⁸ roughly double the EU average, and that it is

³⁸ Comments provided by Naftogaz in a written submission to the consultation program.

rising due to the popularity of used vehicles. Such vehicles are likely to be relatively inefficient from a fuel economy and emissions perspective and, furthermore, most of them run on diesel and LPG, raising Ukraine's liquid fuel import dependency (the majority of these fuels are imported from the Russian Federation and Belarus). Given that road transport usage is one of the few energy consumption areas that appear to be growing, maintaining the status quo may prove untenable from an energy security, economic performance and environmental sustainability perspective.³⁹

International experience offers several examples of leading-practice measures that could encourage demand restraint in the transport sector.⁴⁰ Mandatory measures such as fuel economy standards, which are increasingly being used to raise transport energy efficiency, are an effective way to gradually reduce transport sector fuel consumption, with the potential to deliver substantial savings and reinforce demand restraint over time.

However, given the relatively high capital cost of new vehicles in Ukraine and the slow rate of vehicle turnover, fuel economy standards are unlikely to deliver substantial demand restraint overnight. Instead, savings can be expected to accrue on a new and replacement basis at the prevailing rate of vehicle turnover. Dominance of the used-vehicle market in Ukraine is expected to further retard the speed of improvement.

Increasing the vehicle turnover rate could be encouraged through measures to address high turnover costs. Examples include subsidies to reduce the upfront purchase price, such as differential sales taxes and import duties favouring newer vehicles, and operating-cost subsidies, such as registration discounts for vehicles meeting certain age or fuel efficiency requirements. These measures may have limited effectiveness in practice, however, especially if programme funding is so constrained that it has only a marginal influence on the timing of vehicle turnovers.

Alternatively, the government could adopt various incentives for people to drive less, for instance road-user charges; schemes to encourage the use of alternative modes of transport such as public transit; the development of park-and-ride systems; higher parking fees; congestion rules restricting access to city centres on particular days; and the replacement of roads with pedestrian thoroughfares and bicycle lanes in urban planning and projects. These kinds of policies have been adopted in various jurisdictions with some degree of success.

³⁹ See SAE (2020), p. 7 for further discussion of recent trends in transport sector energy consumption.

⁴⁰ See the Annex for some leading-practice examples of transport sector energy efficiency measures.

Furthermore, a range of complementary measures could be applied to increase consumer awareness of ways to improve vehicle fuel efficiency. Mandatory fuel economy and emissions labelling schemes used in several jurisdictions for decades have proven particularly effective in informing and influencing consumers' vehicle purchase decisions. Other measures could include public education on ways to save fuel, such as through eco-driving, carpooling and regular vehicle maintenance; or promoting alternative modes of transport such as public transit and cycling. Such initiatives have been deployed elsewhere to complement mandatory and incentive-based schemes, encouraging more efficient vehicle operation and the eventual purchase of more energy-efficient vehicles.

Therefore, an effective strategy is likely to be based on primary motivators created by mandatory and incentive-based schemes, supported by complementary information and education programmes.⁴¹ For instance, an integrated strategy could be developed incorporating a range of measures such as upgraded fuel efficiency standards, user fees and pricing to promote more energy-efficient transportation options such as public transit or fuel-efficient vehicles. Incentive-based measures could be delivered either through the taxation system, such as excise waivers for new and more recent imported vehicles or in the form of grants and subsidies. An information and education programme could also be introduced to support these measures.

⁴¹ Mandatory policies typically establish legally enforceable standards, restrictions or other obligations that entities must meet over a specified period. Compliance is monitored and enforced, and non-compliance is penalised. Incentive-based policies seek to induce behavioural change to deliver desired policy outcomes, either by rewarding or penalising particular behaviours and outcomes. They can be delivered through various mechanisms, including pricing, taxation, charges, grants, licensing, and contractual arrangements. Compliance is typically monitored to help verify performance. Information and education policies incorporate a range of activities that seek to build stakeholder and community awareness, understanding, capability, engagement and support for policies and related behavioural changes. They are typically deployed to support and complement mandatory and incentive-based policies to improve overall effectiveness and outcomes.

Box 3. Proposed policy measures to improve road transport energy efficiency

- Upgrade fuel economy standards for all new and used vehicle imports, possibly starting with heavy-duty vehicles.
- Implement vehicle fuel efficiency labelling for all domestic vehicle sales.
- Develop financial assistance packages to encourage the purchase of more fuel-efficient new and used vehicles, possibly through sales tax or import duty exemptions.
- Introduce user charges to encourage greater use of more fuel-efficient transportation options, such as public transport.
- Adopt complementary measures to inform and educate road users about ways to improve and maintain vehicle fuel efficiency.

Reducing fuel imports

As road transport is a major consumer of imported liquid fuels, considerable potential for demand restraint could be realised through switching consumption from imported to domestic energy sources. However, several stakeholders report that considerable barriers continue to impede the replacement of imported fuel with domestic sources.

New and recent fuel-efficient vehicle models are 20-40% more expensive than the used vehicles that currently dominate Ukrainian sales. Consumer preference for more affordable used vehicles that are typically imported from the European Union, no longer meet EU fuel efficiency or environmental standards and run on diesel or LPG, is adding to the challenge of reducing liquid fuel imports. Overall, stakeholders consider this price differential to be a major barrier to the uptake of more fuel-efficient vehicles in Ukraine.

In addition, several stakeholders noted that current fuel excise arrangements favouring imported LPG and diesel fuel products were discouraging production and consumption of domestically refined fuels and helping to reinforce import dependence. Stakeholders reported that LPG consumption has more than doubled in recent years, which they suggest is largely because the highly favourable excise rate differential translates into substantially lower prices at the pump.

At the same time, some stakeholders raised concerns about subsidies that currently favour electric vehicles over those that run on alternative low-emission fuels. They noted that although the National Energy Policy to 2035 provides support for all alternative fuels in principle, the more recent 2018 National Transport Strategy to 2030 incorporates a taxation measure favouring electric vehicles. It was suggested that this policy could unduly limit the wider adoption of alternative-fuel vehicles by effectively restricting support to only one kind of alternative fuel and technology.

Several policy options could be explored to address these and other obstacles to diversifying liquid fuel consumption away from imports and towards domestic sources. As some of these measures are closely related to the energy efficiency schemes discussed above, they also have the potential to improve energy efficiency in the road transport sector.

Some form of capital subsidy assistance could be considered to help address the cost disadvantage and encourage greater uptake of more fuel-efficient and alternative-fuel vehicles. Examples include direct grants of up to a certain amount for the purchase of a new or used vehicle that meets minimum fuel efficiency and/or environmental emission standards; lifting of sales taxes on vehicles meeting the standards; import excise and customs duty exemptions for vehicles meeting the standards; or some combination of these allowances. Stakeholders suggested that priority could be given to vehicles that offer the greatest potential for fuel consumption savings including heavy-duty freight, commercial and public transport vehicles.

Reforming fuel excise rates to encourage switching to domestic fuel sources, especially lower-emission alternative fuels, could also be considered. Excise rates on LPG and diesel especially could be raised to bring them in line with current EU minimums. Stakeholders suggested that reforms of fuel excise arrangements could provide a substantial price incentive to consume domestic refined products and encourage much-needed investment in local refineries. Discounting or eliminating excise taxes applied to these products could also further encourage switching to domestically produced alternative fuels. According to some stakeholders, modifying the excise rates would likely be a practical and effective means of encouraging a switch from diesel to alternative fuels while also ensuring the demand required to underpin domestic production in the longer term.

Some stakeholders also suggested that current taxation arrangements for electric vehicles be extended to cover all other forms of low-emission alternative transportation fuels to help increase and accelerate demand restraint in the

transport sector. They consider that public passenger transportation and heavy-duty freight vehicles would be the most practical and feasible targets for policies to increase alternative fuel consumption. As policies promoting alternative fuels have the potential to complement and reinforce incentives for import fuel switching created by mandatory and financial measures, they may have a role in an integrated strategy to promote demand restraint in the transport sector.

Complementary policies could also be adopted to promote alternative fuel use, such as a public vehicle fleet policy favouring alternative fuels. Such schemes could provide a practical way to pilot-test the potential of alternative fuels and of extending alternative fuel arrangements, while also providing a low-risk demonstration of their potential for key stakeholders.

Similarly, the potential for fuel-saving and import substitution through upgrading and extending public transport options in more densely populated urban areas could be explored. From a demand restraint perspective, benefits derive primarily from reducing the amount of fuel consumed per passenger-kilometre, but the potential for import substitution may increase significantly when public transport vehicles consume mainly alternative fuels or are fuelled primarily by domestic energy sources.

Box 4. Proposed policy measures to reduce road transport consumption of imported fuel

- Encourage the purchase of more fuel-efficient, low-emission vehicles through some form of capital subsidy, possibly offered through direct payments or sales tax or import excise exemptions. Initial priority could be given to funding new or used public passenger, freight and commercial vehicles meeting specific fuel efficiency and/or emissions standards.
- Reform fuel excise taxation to encourage switching away from imported fuels, especially diesel and LPG, and towards low and zero-emission domestic alternatives.
- Consider extending the current taxation arrangements for electric vehicles to other cost-effective alternative fuels and technologies to help accelerate import fuel switching.
- Develop measures to support faster deployment of heavy freight and public passenger vehicles using domestically sourced alternative fuels.
- Develop measures to upgrade and extend public transport infrastructure and increase usage in more densely populated urban areas, especially where these vehicles run on domestically sourced alternative fuels.

Harnessing emergency demand restraint

Ukraine's growing dependence on liquid fuel imports, especially of diesel and LPG, expose it to the risk of unanticipated liquid fuel disruptions. Current liquid fuel emergency management relies on administrative and supply-side measures, including rationing and emergency stocks. However, concerns persist about the likely effectiveness of current measures. Development of some practical, readily deployable and cost-effective demand restraint measures could complement and reinforce supply-side initiatives and reinforce the flexibility and resilience of the sector during periods of scarcity or emergency events.

International experience has demonstrated a range of potential measures to harness demand restraint during a liquid fuel emergency, including various forms of rationing, regulation, scarcity pricing and voluntary measures. The IEA has identified several key ways to encourage emergency demand restraint in the road transport sector (Box 5).

Box 5. Measures to harness demand restraint during a liquid fuel emergency

- **Public transport:** As utilisation rates for public transport are typically low, considerable capacity could be mobilised during emergency events. Schemes to improve public transport use could be very helpful when applied in concert with measures to restrain private vehicle mobility, especially in urban areas with good public transit systems.
- **Corporate measures:** Employers or institutions could offer more flexible work schedules involving less travel and allowing more frequent teleworking. Businesses can also help through voluntary measures such as establishing ride-matching systems for their employees to commute to work.
- **Carpooling:** As passenger vehicle occupancy is typically low, considerable capacity could be mobilised during a fuel emergency. Higher passenger occupancy rates, along with fewer vehicle trips, make carpooling an efficient option to reduce fuel consumption, especially where systems to enable and motivate ride-sharing are already in place.
- **Vehicle efficiency:** Many simple, voluntary measures such as eco-driving, proper tyre inflation and the removal of unnecessary (especially heavy) items from vehicles can be deployed at short notice to reduce fuel consumption. Campaigns calling on motorists to drive more efficiently are estimated to have great fuel-savings potential during a crisis.
- **Pricing strategies:** Dynamic pricing strategies, such as electronic systems for charging road-user fees or pricing schemes for parking, are effective tools to manage vehicle use and help decrease fuel-wasting congestion. Systems that use real-time pricing and clearly advertise the cost to drivers can be an especially effective rapid-response tool to reduce congestion during peak periods.
- **Driving restrictions:** Schemes that limit vehicle circulation on certain days or at certain times can save substantial fuel (for example, odd-even licence plate restrictions can be an effective way to mitigate panic-buying at filling stations). However, enforcement is required to make such measures effective. Systems to implement driving restrictions already exist in some countries for non-emergency purposes, typically to reduce traffic congestion and particulate emissions in urban areas. These could also be used to restrain demand during a supply crisis.
- **Multi-fuel vehicles:** The ability for drivers to switch from oil products to alternative fuels (e.g. biofuels, LPG and natural gas) during periods of oil product scarcity could be a viable and effective short-term emergency response measure where the capacity to make this switch already exists. For example, in cars enabled to use either LPG or gasoline, drivers could readily switch to LPG during an emergency event.
- **Freight trucking:** Encouraging trucking companies to combine trips and keep trucks full could be included in a general information campaign. Similarly, encouraging eco-driving, proper tyre inflation, speed reduction and fuel switching with higher-biodiesel blends could be beneficial.

Source: IEA (2018c), *Saving Oil in a Hurry*.

According to IEA analysis, the most effective of these options are driving restrictions, such as driving bans and speed limit reductions; substantially reduced public transport fares, possibly including free transit at specific times; flexible working arrangements; and public information campaigns promoting practical fuel-saving measures.

As advance preparation and planning are crucial to successfully implement demand restraint measures during an emergency event, a practical first step is to develop a demand restraint policy that identifies the key measures to be used. The Lithuanian Energy Agency has recently published a liquid fuel emergency demand restraint strategy that provides a good example of how to tailor best-practice principals to local circumstances.

Box 6. Key features of Lithuania's liquid fuel emergency demand restraint strategy

In 2020, the Lithuanian Energy Agency published *Demand Restraint Measures for Liquid Fuels*, establishing a framework for restraining liquid fuel demand during an emergency. The framework's primary measures involve:

- Promoting **public transport** use through fare discounts and increased service frequency.
- Promoting **remote working** and other flexible working arrangements.
- Reducing **speed limits**, including lowering maximum limits on motorways from 110 km/h to 90 km/h, and reducing all other speed limits to no more than 80 km/h.
- Introducing **fuel rationing** for transit freight transport by imposing a refuelling limit of 150 litres per service station visit.
- Introducing **driving bans**, using either the last licence plate digit or an "odds and evens" system.

To create a more favourable environment for implementing these key actions, the strategy also proposes several indirect measures: promoting eco-driving; restricting the movement of passenger and freight vehicles in urban areas; and raising parking fees. In addition, a communications campaign aims to build community support, keep the community informed about developments and provide practical advice to help consumers cope during emergencies.

The Lithuanian Energy Agency estimates that enacting these measures could save over 590 ktoe annually, representing one-quarter of Lithuania's annual transport fuel consumption. Most of these savings (70%) are expected to result from the combined effects of fuel rationing for freight transit and speed limit reductions.

Source: Lithuanian Energy Agency (2020), *Demand Restraint Measures for Liquid Fuels*.

The Government of Ukraine could consider preparing a similar document outlining objectives, strategies and operational practices to be deployed during an emergency event. The operational plan should address activation triggers and clearly identify the various stakeholders' respective roles in delivering elements of the plan, and it should also draw on international experience to identify the best-practice principles and measures to employ, suited to Ukraine's circumstances and requirements.

Box 7. Proposed policy measures to harness emergency demand restraint in road transport

- Develop an integrated range of primary demand restraint measures to be deployed during an emergency event, possibly including targeted fuel rationing; targeted driving restrictions such as limitations on the movement of passenger and freight vehicles in urban areas; speed limit reductions; more efficient freight logistics to reduce trips; reduced public transport fares to encourage greater usage; and various road-user pricing strategies.
- Formulate a range of complementary measures to support more effective deployment of primary demand restraint measures, such as encouraging more flexible working arrangements; promoting eco-driving and other actions to improve vehicle efficiency; and encouraging various forms of carpooling.
- Draw up a comprehensive communications strategy to engage the community more effectively and promote fuel-saving through compliance with mandatory measures; participation in voluntary measures; and ongoing support during the emergency response.
- Prepare an integrated liquid fuel demand restraint strategy that incorporates primary and complementary measures tailored to Ukraine's circumstances, ready to be deployed during liquid fuel emergencies. Test implementation procedures regularly with all key stakeholders to ensure it can be rolled out quickly and efficiently during an emergency event.

Industry sector measures

Considerable progress has been made towards improving energy demand restraint in Ukraine's industry sector. For instance, with the support of donor organisations, most of Ukraine's energy-intensive industries have introduced energy management systems compliant with the ISO 50001 standard.⁴² Despite these positive developments, recent trends show that high levels of energy intensity accompany growth in final energy consumption across the industry

⁴² The ISO 50001 standard gives organisations a recognised framework to develop an effective energy management system. Like other ISO management system standards, it follows the "plan-do-check-act" process for continual improvement. The ISO 50001 requirements enable organisations to: develop a policy for more efficient energy use; fix targets and objectives to meet that policy; gather data to better understand and make decisions concerning energy use; measure the results obtained; review the policy's effectiveness; and continually improve energy management. See ISO (2018) for further details.

sector.⁴³ This suggests that there is scope for further demand restraint, particularly among energy-intensive industrial consumers.

International experience has proven several key measures that have the potential to increase demand restraint and energy-saving in the industry sector.⁴⁴ In particular, application of a comprehensive energy management system, combined with an independently verifiable regime of energy efficiency auditing, can identify areas for energy efficiency savings and help establish a virtuous cycle of continual improvement in industry energy efficiency. Highly motivated industry “ownership” of energy efficiency processes and outcomes has prompted active engagement with industry-driven energy efficiency networks, promoting targeted education, learning and information-sharing. In several cases, voluntary contracts have been a practical incentive for enterprises to deliver energy savings through greater efficiency.

Governments have supported the development and implementation of energy management systems through a range of measures, including enterprise-level energy audit programmes to identify initial energy-saving opportunities and establish operational baselines to monitor performance and implementation progress, and independent systems of monitoring, reporting and verification. These arrangements have been supported by a combination of policy measures such as tax relief; technical assistance; grants and various forms of concessions; and help for industries to establish networking arrangements.

Opportunities exist to build on Ukraine’s progress so far: policy measures in particular could complement and reinforce industry initiatives to increase their effectiveness, expand coverage and accelerate deployment. For instance, a more rigorous and comprehensive framework could be developed to help identify and implement substantial energy-saving opportunities, possibly drawing from best-practice examples such as Australia’s energy efficiency opportunities scheme. Such an approach could incorporate a regime of regular, independent auditing to improve measurement and verification, a voluntary contractual framework to support more effective implementation of energy efficiency initiatives, and a mechanism to facilitate more transparent information exchange and dissemination of best practices and lessons learnt.

Industry-driven development and deployment of energy-saving measures could be further enhanced by more effective partnerships among energy efficiency practitioners and experts. Ukraine’s developing energy services sector could

⁴³ See SAE (2020), p. 6 for further analysis of industrial energy consumption trends.

⁴⁴ See the Annex for some leading-practice examples of industry sector energy efficiency measures.

make a valuable contribution by drawing on its knowledge and experience of energy performance contracting, project development and related financing arrangements. Partnerships of this kind could help catalyse energy efficiency projects in the industrial sector, especially among smaller industrial and commercial enterprises.

Some stakeholders also noted that the high cost of more energy-efficient equipment and insufficient access to capital could delay or defer implementation of energy efficiency-related investments or process improvements in some cases. Various incentives could therefore be developed to address impediments to necessary capital equipment replacements and process improvements when the potential energy savings are substantial. Such programmes could link technical and financial assistance to implementation, possibly through a system of independent auditing and voluntary contracts as previously discussed.

Box 8. Proposed policy measures to improve industry sector energy efficiency

- Develop a more rigorous and comprehensive framework to identify and implement demand restraint options, which could include improving the application and coverage of energy management systems; supporting a regime of regular, independent energy auditing; and reporting results more transparently.
- Support the development and deployment of voluntary contractual mechanisms to facilitate implementation of energy efficiency initiatives as well as more effective verification and compliance.
- Expand support for industry-led efforts to improve education, capabilities and information exchange, incorporating training and capacity-building and the sharing of best-practice lessons among industry participants.
- Develop incentives to address potential barriers to the deployment of energy-efficient capital equipment and process improvements that have the potential to deliver substantial energy savings.
- Facilitate the development of more effective partnerships between smaller commercial and industrial energy consumers and energy efficiency practitioners and experts, possibly by leveraging the knowledge and experience of the emerging energy services sector.

Energy utility sector measures

Power and district heating utilities are major consumers of imported fuels and key suppliers of energy to residential, commercial, public and industrial consumers. As a result, they hold a strategic position in Ukraine's energy sector, with considerable potential to shape and drive demand restraint outcomes.

Improving energy efficiency

Ukraine's power and district heating utilities are typically operating old infrastructure, resulting in low levels of technical efficiency and high losses, especially in the electricity and district heating distribution systems.⁴⁵ As a result, a considerable amount of the system's energy potential is being lost, leading to substantial fuel over-consumption and wasted energy production.

International experience suggests there may be considerable potential for demand restraint to help reduce energy consumption and waste in the energy utility sector. Targeted application of a combination of mandatory, regulatory and financial incentives could help accelerate modernisation in this sector to reduce network losses and improve the efficiency of power generation and heat production.

Regulatory mandates, such as generator efficiency standards and network loss limitations, have been applied gradually in other countries to improve the technical and operational efficiency of power and district heating utilities, producing more efficient energy consumption and reducing energy waste. Mandates provide a verifiable and enforceable mechanism for extending coverage and delivering substantial savings in regulated network industries. However, costs could be an issue when mandates are poorly calibrated.

Similarly, various regulatory incentives have also been used to encourage energy efficiency and reduce losses. These have included financial rewards for meeting and exceeding energy efficiency targets or benchmarks and penalties for underperformance. Regulatory incentives have proven effective in driving behavioural change among energy utilities, especially when they complement other regulatory initiatives to deliver demand restraint and energy savings. For example, international experience has shown that appropriately incentivised utilities operating within an environment of cost-reflective pricing can use their technical, financial, managerial and marketing capabilities to develop and deliver

⁴⁵ See NEURC (2019), p. 145, p. 288 and Annex 4.2.6, for further details.

a range of timely, innovative and cost-effective energy efficiency measures.⁴⁶ However, this potential can be realised only if the regulatory framework permits utilities to provide such products and services.

Financial stimulus has also been used to strengthen mandatory and regulatory incentives to improve energy efficiency and reduce losses. Examples include investment incentives in the form of grants, loans, tax breaks and risk-sharing mechanisms. Although financial incentives have proven effective, their cost may limit their coverage and impact in practice.

Utilities could also be key enablers of demand restraint among their customers. Various programmes have been deployed offering advice to customers on relevant energy efficiency measures, or assistance accessing financial incentives; aiding with bulk procurement, distribution and installation of energy-efficient products; providing information and communication technology tools to support more efficient energy use; and enabling consumers to more actively control their energy use and energy providers to better monitor, aggregate and control loads.⁴⁷

Opportunities to apply mandatory, regulatory or financial incentives could be explored to modernise the power and district heating sectors to speed the reduction of network losses and improve power generation and heat production efficiency. Targeted application of a combination of these measures could restrain energy demand considerably and also encourage more efficient investment, operation and end use in the power and district heating sectors, which can have a critical bearing on Ukraine's energy security, economic competitiveness and environmental outcomes. Extending incentive regulation to the district heating and natural gas sectors could also be considered, to make the economic regulation of energy sector utilities more comprehensive and integrated.

An additional option is to expand the roles and functions of power and district heating utilities to enable them to offer their customers a range of energy efficiency services. In principle, utilities are well placed to leverage their detailed knowledge and understanding of their customer base to identify energy efficiency opportunities and to readily realise them through a range of energy-efficient products and services. They therefore have considerable potential to help accelerate demand restraint and energy-saving and may provide effective programme delivery for some demand restraint measures in Ukraine.

⁴⁶ See the Annex for some leading-practice examples of measures that could be deployed to encourage demand restraint in the utilities sector and among utility customers.

⁴⁷ See IEA (2019a) for further discussion.

Power and district heating utilities could also be given the authority to more effectively engage with ESCOs to help develop and deploy targeted energy efficiency and energy-saving products and services. Such arrangements may initially focus on building-retrofit opportunities in the residential, public and commercial sectors, enabling ESCOs to leverage their greater knowledge and experience in these areas and their growing regional coverage.

Box 9. Proposed policy measures to improve energy efficiency in power and district heating

- Develop mandatory measures to improve energy efficiency, possibly including generator efficiency standards and penalties for excessive network losses.
- Formulate regulatory incentives, such as financial rewards for meeting energy efficiency targets or benchmarks, to encourage greater energy-saving and lower technical losses.
- Develop financial incentives to complement and reinforce mandatory and regulatory measures, potentially focusing on critical investments to help accelerate sector modernisation.
- Explore ways that power and district heating utilities can encourage energy efficiency and energy-saving among their customers, including by informing and educating them, possibly in partnership with ESCOs.
- Examine ways to hasten the extension of incentive regulation and cost-reflective pricing arrangements to the district heating sector.

Reducing fuel imports

Renewable energy is now one of the most affordable sources of energy for power and heat generation⁴⁸ and has considerable potential to displace energy imports in the power and district heating sectors. Ukraine's policies to date have considerably advanced the production and consumption of renewables in the stationary energy sector in recent years. However, emerging policy uncertainty is

⁴⁸ For instance, in the power sector the levelised lifecycle cost of renewable energy has fallen to a level that makes onshore wind and photovoltaic solar energy production less costly than new baseload generation from fossil fuels in many cases. See IRENA (2020) and IEA (2020c) for details.

raising concerns about the future of renewables, which could greatly reduce their potential to support import fuel diversification in power and district heating.

As international experience suggests that investment certainty is a fundamental prerequisite for renewable energy development and deployment, the current instability of Ukraine's renewable energy framework needs to be resolved as soon as possible. Accordingly, consideration could be given to reviewing, and revising when necessary, the key elements of support mechanisms to minimise any undue administrative or regulatory uncertainty that could reduce programme effectiveness.

For instance, Ukraine's original Green Tariff programme incorporated ex-post regulatory decision-making in relation to eligibility and the rate of assistance provided. Introducing clear and predictable arrangements to determine and deliver assistance, established in advance of any investment decision, could greatly reduce investor uncertainty and help accelerate renewable energy deployment. Furthermore, publishing clear target trajectories for new renewable investment and production, possibly expressed in GWh per annum over a rolling three- to five-year horizon, would facilitate more efficient planning, procurement and development.

At the same time, opportunities to deepen and expand support programmes could be explored to encourage greater renewables-based electricity and heat consumption. Extending renewable energy consumption mandates could also help reduce production risks; provide a stable market for renewable energy; and establish a more predictable trajectory for growth in renewable energy consumption. Various mechanisms could be deployed to this end, including purchasing quotas, consumption guarantees and various forms of price support.

Initiatives could also be considered to address network constraints that may unduly restrict access to domestic renewable energy. Introducing increasing volumes of intermittent renewable energy into a power system can create energy flows that networks were not designed to accommodate, creating new points of congestion and other technical issues that may limit access to reliable supplies. New network investment may be required to address these challenges.

International experience indicates that reviewing network planning and development arrangements, including network management and system operating practices, is an effective way to develop more integrated approaches to network development that support growing deployment of domestic energy sources, especially renewable energy. Effective longer-term planning can help identify emerging infrastructure bottlenecks and set more effective investment

priorities. Consideration could be given to reviewing network development plans and related investment regulations to ensure that network constraints do not become an undue hindrance to renewable energy development and deployment, and to wider power sector development. In addition, power system operating protocols and practices could be reviewed to ensure that increasing volatility and new energy flow paths do not unduly constrain or disrupt access to domestic energy sources.

More effectively incorporating renewable energy into modernisation programmes for the power and district heating sectors could also facilitate its development and deployment.

Box 10. Proposed policy measures to reduce the imported fuel consumption in power and district heating

- Expand measures to encourage greater renewable energy use in the power and district heating sectors, possibly by extending consumption mandates through quotas, guarantees or various forms of financial incentive.
- Review and upgrade the rules governing eligibility and access to the main measures supporting renewable energy development, to eliminate any undue regulatory or administrative uncertainty, risk and additional costs.
- Resolve any remaining uncertainty surrounding Ukraine's renewable energy support programmes.
- Review and update power network planning and development frameworks to support more efficient and timely renewable energy development and consumption.
- Examine opportunities to incorporate the development and deployment of renewable energy more effectively into modernisation plans for the power and district heating sectors.

Harnessing emergency demand restraint

Ukraine's power infrastructure is old and fragile, increasing the risk of outages that may result in cascading system-wide failures.⁴⁹ This risk may be magnified by

⁴⁹ NEURC (2019), p. 31.

growing volumes of variable renewable energy entering the grid, which is likely to place the power system under greater operational stress. Ukraine currently relies exclusively on supply-side reserves and administrative responses to maintain power system security.⁵⁰

However, international experience has shown that even a relatively small degree of demand restraint can greatly increase power system flexibility, reliability and resilience, especially when systems are under stress or during emergency events. These benefits were particularly evident in the aftermath of the 2011 Great East Japan Earthquake event.

⁵⁰ See NEURC (2019), pp. 37-38 for an overview of the key emergency management reserves maintained by Ukrenergo, Ukraine's power system operator (among its other functions).

Box 11. Demand restraint in Japan's power sector following the 2011 Great East Japan Earthquake

The potential for demand restraint to help improve power sector flexibility and resilience during an emergency event was illustrated after the 2011 Great East Japan Earthquake.

In the wake of this event, Tokyo Electricity Power – which provided electricity to around 42 million individual consumers and corporations responsible for 40% of Japan's GDP – lost around 40% of its generating capacity.

The Japanese government implemented a series of mandatory and voluntary savings measures to help address the shortfall, including:

- Ten days of rotating load-shedding immediately after the incident.
- Mandatory requirements for large industrial consumers to reduce electricity use by 15% (compared with the previous year) during July-September 2011.
- Measures encouraging small businesses to take voluntary power-saving actions.
- Measures encouraging households to take voluntary power-saving measures, including using electric fans instead of air conditioners, using blinds to reduce heat from sunlight, and disconnecting electric appliances when not in use.
- A range of public sector energy-saving actions, including the dimming/switching off of lights, the raising of air conditioning temperatures, and less frequent running of trains and metros.

Applying these measures caused summer peak power demand to fall by around 15%, which helped eastern Japan avoid unscheduled power restrictions.

Sources: IEA (2019a), *Multiple Benefits of Energy Efficiency*; Kimura, O. and K. Nishio (2013) *Saving Electricity in a Hurry: A Japanese Experience After the Great East Japan Earthquake in 2011*; IEA (2012a), *World Energy Outlook 2012*.

There may also be opportunities to fine-tune established regulatory mechanisms and protocols to manage demand during power sector emergency events to more effectively harness emergency demand restraint. International experience suggests some key preconditions to successfully develop and deploy regulatory forms of emergency demand restraint in the power sector:

- **Capacity to monitor and analyse power flows in real time**, which depends on the ability of system operators to monitor, understand and respond to changing

power system conditions as they happen, based on the availability and coverage of accurate, timely information on power flows and equipment performance.

- **Capability to manage power flows in real time**, based on the nature, coverage and resilience of key system monitoring, diagnosis and control technologies.
- **Effective co-ordination** focused on the ability of all parties responsible for implementing demand restraint to work together in a way that maximises efforts to harness energy-saving potential.
- **Effective communication** focused on the ability of parties responsible for co-ordinating and implementing demand restraint measures to keep each other informed, and to keep other stakeholders and the community apprised of developments and actions they can take to support demand restraint initiatives.
- **Effective ongoing training and capacity-building** to support the development and deployment of emergency demand restraint measures, including processes to test, review and develop procedures to implement these measures.

Current emergency management protocols and mechanisms could be reviewed to ensure that they will deliver the expected outcomes, and to verify that all the key preconditions for developing and implementing regulatory forms of emergency demand restraint align with current best practice.

Opportunities to develop emergency demand restraint resources could also be explored. For instance, emergency demand restraint could be achieved through voluntary measures, innovative contracting or scarcity pricing.

International experience shows that calls for voluntary energy savings can substantially reduce demand for short periods during emergency events, creating greater system flexibility and resilience in the wake of an energy system disruption. To date, most efforts to induce voluntary demand restraint during power shortages or emergency events have focused on media campaigns to inform consumers and encourage them to adopt behaviours that reduce power consumption.

However, realising this potential during a crisis can be challenging. The government could therefore consider developing a framework and mechanisms in advance to harness voluntary demand restraint during an emergency, and have it ready to be rolled out quickly when required.

Furthermore, introducing energy market and regulatory reforms consistent with those applied in the European Union would offer new opportunities to harness demand restraint through various forms of innovative contracting. For example, a

range of incentive-based contractual arrangements have been deployed internationally to help harness demand restraint during periods when power systems are under stress or experiencing emergency conditions.

Box 12. Contractual mechanisms to harness demand restraint in the power sector

- **Direct load control programmes** permit operators to enter into contracts with customers, enabling them to remotely shut down or cycle a customer's electrical equipment (e.g. air conditioners, water heaters, space heating) at short notice. Direct load control programmes are offered primarily to residential and small commercial customers.
- **Interruptible supply contracts** incorporate curtailment options and provide a rate discount for agreeing to reduce load during predefined events. Penalties may be incurred for failure to curtail. Interruptible programmes have traditionally been offered to large industrial and commercial customers.
- **Demand bidding and buyback programmes** enable customers to make bids to curtail, based on wholesale electricity market prices or an equivalent benchmark. Such products are usually made available to large customers only, with metering equipment that permits real-time monitoring and verification of compliance.
- **Emergency demand response programmes** provide incentive payments to customers for load reductions during periods of reserve shortfalls.
- **Capacity market programmes** accept bids from customers to curtail load as an alternative to procuring conventional generation or network resources. Customers typically receive same-day notice of events. Incentives usually consist of upfront reservation payments, and penalties for failure to curtail when required.
- **Ancillary services programmes** permit customers to bilaterally contract to deliver curtailment, or to offer load curtailment in ancillary service markets as an alternative source of reserves for system operators. Where available, system operators pay customers the contract price (or market price in the case of an ancillary services market) for committing to curtail loads according to contract or dispatch requirements.

Source: IEA (2011b), *Empowering Customer Choice in Electricity Markets*.

Technologies to monitor, verify and enforce demand response in real time, such as smart metering and controllable devices, are generally deployed to enforce these contractual arrangements. The contracting party, usually a retailer, system operator, aggregator or other load-serving entity, makes the decision to activate

these forms of demand restraint. Payments to customers are usually agreed in advance of any event that may trigger activation.

Consideration could be given to developing innovative contractual arrangements such as these to help turn demand restraint into a potential emergency management resource that could be procured by system operators, or other responsible parties, to complement and reinforce their traditional supply-side resources.

Alternatively, raising power prices to “scarcity” levels could provide a clear and effective incentive to reduce power consumption during periods when power systems are under stress or experiencing emergency conditions. The effectiveness of price signals in moderating demand during an emergency event depends very much on whether consumers are exposed to the price rise in real time and whether they have the capacity to respond.

If consumers are not aware that scarcity pricing is in effect, they will have no incentive to respond and their consumption is unlikely to change. In this situation, dramatic power cost increases can create unintended financial hardship. Similarly, when consumption is highly price-inelastic,⁵¹ exposure to scarcity pricing may simply result in a wealth transfer from consumers to producers without achieving the desired reduction in consumption. Care needs to be taken to ensure that any scarcity price mechanism is deployed appropriately and sends an effective signal to reduce, delay or defer consumption.

⁵¹ Consumption is said to be price-inelastic when the rate of change in consumption is relatively unresponsive to the rate of change in price.

Box 13. Proposed policy measures to harness emergency demand restraint in the power sector

- To minimise unintended economic or social impacts and to improve the effectiveness of measures, fine-tune current regulatory mechanisms and protocols for load management, including emergency power flow monitoring and management capability; co-ordination; communications; and training and capacity-building.
- Devise targeted voluntary mechanisms to harness demand restraint during emergencies.
- Develop a range of contractual mechanisms to help harness demand restraint during periods of scarcity and emergency events.
- Explore the potential to apply various forms of scarcity pricing to help moderate demand during scarcity and emergency events.
- Establish a comprehensive communications strategy to engage with communities more effectively to inform them about power-saving opportunities; to encourage them to participate in voluntary power-saving activities; and to garner ongoing community support during an emergency response.
- Prepare an emergency demand restraint strategy for the power sector that is ready to deploy during periods of scarcity or emergency events. The strategy should provide an integrated framework for deploying emergency demand restraint, incorporating regulatory mechanisms, contractual mechanisms, voluntary mechanisms, and (potentially) pricing mechanisms. Implementation procedures should be tested regularly with all key stakeholders to ensure it can be rolled out quickly and efficiently during an emergency event.

Demand restraint policy development and implementation pathways

Table 1, which presents some indicative pathways and time frames to develop and implement this roadmap, groups measures by target sector and strategic goal. It outlines an indicative five-year policy development and implementation pathway for each measure proposed.













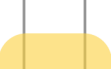









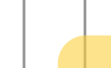











Within each timeline, periods notionally allocated for policy development are identified by yellow cells. Detailed policy and programme formulation and related

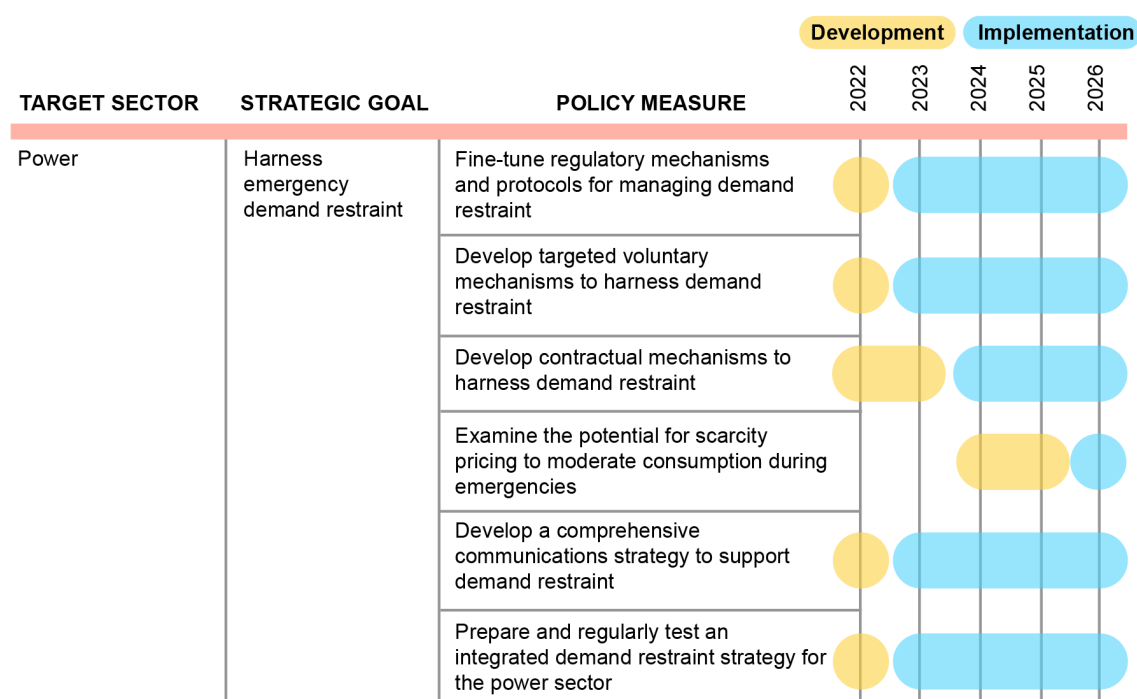
implementation arrangements would be developed and finalised during this period, including related policy, legal, regulatory, funding and programme delivery elements.

Blue cells pertain to implementation periods in which the practical delivery of measures would commence, including potential preliminary implementation arrangements such as pilot or demonstration programmes. Preliminary implementation programmes are typically undertaken to support incremental learning and risk management, especially when measures introduce new processes, are potentially sensitive, or are in some other way ground-breaking.

Table 1. Potential pathways to pursue demand restraint in Ukraine over the next five years

TARGET SECTOR	STRATEGIC GOAL	POLICY MEASURE	Development		Implementation		
			2022	2023	2024	2025	2026
Residential	Improve energy efficiency	Expand energy efficiency programmes for existing buildings					
		Expand building energy performance certification coverage					
		Strengthen energy efficiency standards for new construction					
		Strengthen energy efficient building code monitoring and enforcement					
		Consider financial incentives for efficient heating appliances					
		Complete metering and energy control technology rollouts					
		Offer complementary information and education programmes					
Transport	Improve energy efficiency	Upgrade fuel economy standards for all new and used vehicles					
		Implement fuel efficiency labelling for all vehicle sales					
		Develop financial incentives for more fuel-efficient vehicle purchases					
		Introduce user charges to encourage greater use of more efficient transport options					
		Offer complementary information and education programmes					
	Reduce fuel imports	Develop financial incentives for low-emissions vehicles that use alternative fuels					
		Accelerate deployment of freight and public transport vehicles using alternative fuels					
		Reform fuel excise arrangements that currently support diesel and LPG product imports					
		Consider extending electric vehicle tax breaks to other alternative fuels and technologies					
		Offer incentives to increase public transport usage and extend networks in urban areas					
	Harness emergency demand restraint	Develop primary demand restraint measures to deploy during emergency events					
		Develop complementary measures to increase demand restraint effectiveness					

TARGET SECTOR	STRATEGIC GOAL	POLICY MEASURE	Development		Implementation		
			2022	2023	2024	2025	2026
Transport	Harness emergency demand restraint	Develop a comprehensive communications strategy to support demand restraint					
		Prepare and regularly test an integrated liquid fuel demand restraint strategy					
Industry	Improve energy efficiency	Support efforts to improve energy efficiency auditing and management systems					
		Support the establishment of voluntary contractual mechanisms to encourage energy efficiency					
		Support the establishment of industry networks to improve education and information exchange					
		Develop financial incentives to accelerate the deployment of energy-efficient equipment					
		Support partnerships between smaller businesses and energy services companies					
Power and district heating	Improve energy efficiency	Develop mandatory measures to improve energy efficiency					
		Develop regulatory measures to improve generator efficiency and reduce network losses					
		Offer financial incentives to address critical investment constraints on sector modernisation					
		Consider options for utilities to encourage energy-saving among their customers					
		Extend incentive regulation and cost-reflective pricing to the district heating sector					
	Reduce fuel imports	Extend consumption mandates for renewable energy					
		Review and improve the rules governing renewable energy support					
		Resolve remaining uncertainty concerning renewable energy support programmes					
		Review and update power network planning and development frameworks					
		Incorporate renewables into modernisation programmes					



An earlier proposed implementation date for a particular measure generally reflects higher priority. Indicative priorities for policy development and implementation for each measure were determined according to the following criteria:

- **Effectiveness:** in terms of the potential contribution to demand restraint, including energy savings, system resilience and flexibility, and import fuel diversification. Measures that are likely to deliver the greatest demand restraint score more highly under this criterion.
- **Urgency:** the degree to which a measure addresses a pressing policy need. Measures that resolve clear gaps or deficiencies in current arrangements gain a higher score for this criterion.
- **Timeliness:** how quickly a measure can be developed, implemented and begin to deliver results. Measures that are likely to be developed, deployed and begin to deliver demand restraint more quickly score higher.
- **Deployment:** the ease with which a particular measure can be developed and implemented, given the existing policy, legal and regulatory framework; likely resource requirements; level of complexity; institutional capability; and likely level of stakeholder and community support. Measures that are relatively simple to develop and administer, require fewer additional resources, and build on knowledge and experience developed through existing arrangements obtain a higher score.

For example, measures proposed to harness emergency demand restraint have the potential to deliver immediate benefits from a flexibility and resilience perspective. Some would also address gaps in current arrangements and should be relatively simple and quick to develop – and in the case of the power sector, they would largely build on existing frameworks. As a result, these measures are considered high priorities for development and implementation.

Similarly, measures proposed to improve energy efficiency in the residential and industry sectors offer substantial demand restraint benefits, and the potential to leverage existing resources and programmes to help broaden and accelerate their deployment. These measures are also generally rated as high priorities for development and implementation.

Conversely, several of the measures proposed for the transport and utilities sectors may be ground-breaking; prove complex to develop and implement; require significant resources; raise various sensitivities; and be slower to deliver material levels of demand restraint. As a result, they may take longer to develop and implement and are likely to deliver benefits over a longer period. The related pathway proposals therefore indicate delayed commencement, lengthier development time frames, and implementation later in the initial five-year period.

This combination of measures provides a comprehensive approach for pursuing demand restraint across Ukraine's energy sector. They cover all the major energy end-users and the key intermediate energy consumers throughout the value chain and include the import-related dimensions of demand restraint, which are particularly relevant given Ukraine's circumstances and energy security goals. At the same time, the proposals address emergency management with a range of practical measures focused on the areas of consumption likely to pose the greatest risk to future energy security.

This integrated approach to demand restraint also recognises the interrelatedness of the challenges across all energy-consuming sectors and throughout the energy value chain, and can support the development of mutually reinforcing policies and programmes that address cross-sectoral issues more effectively. Consequently, the proposed pathways are likely to be more durable and adaptable to changing circumstances and policy priorities.

Nevertheless, these proposed pathways are indicative suggestions only, as there are many ways to proceed with policy development and implementation. Irrespective of the course it chooses to develop and implement demand restraint policy, Ukraine is likely to encounter a range of evolving risks and challenges that will require ongoing flexibility and adaptability to resolve. International experience

suggests that the most effective way to respond to these challenges is to adopt an incremental and innovative approach to policy development and implementation, reflecting the principles of continual improvement.

Under this approach, policies are typically implemented in stages, initially involving demonstration projects or some other targeted activity, with the lessons drawn from experience fed into the next iteration of policy development. Policies are developed and refined gradually in a co-ordinated manner as these implementation cycles proceed. With increasing maturity comes greater confidence and the wider stakeholder support needed to progressively roll out policies to a larger target group, increasing the policy's effectiveness while drawing on practical experience to reduce subsequent implementation risks and costs.

The Government of Ukraine could therefore consider adopting this type of approach, supported by effective management arrangements and appropriate whole-of-government co-ordination, to ensure that demand restraint policies and measures are developed and implemented in a timely and effective manner.

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Annex: Leading-practice examples of energy efficiency measures

International experience suggests that a wide range of potentially suitable energy efficiency measures could be deployed to pursue energy demand restraint in Ukraine. The following tables identify some leading international practices applied in the residential, transport, industry and energy utilities sectors, some of which may merit consideration for development and deployment in Ukraine.

Table 2. International examples of energy efficiency policy measures applied in the residential sector

Policy	Example
Insulation and weatherisation of existing residences	<p>The Netherlands. The government has committed EUR 150 million to a EUR 600 million revolving fund, EUR 400 million in grants for rental houses and funds for local government implementation of housing energy efficiency. The Voluntary Energy Saving agreement for the rental housing sector targets 1 million retrofits by 2020 with energy savings of 21 PJ. Energiesprong is a related market development programme working with owners, financiers and industry to refurbish 111 000 social housing units to near-zero energy levels with a 30-year energy performance contract funded from long-term energy savings.</p> <p>China. The Heat Reform and Building Energy Efficiency Project for China aims to increase energy efficiency in urban residential buildings and central heating systems in China's cold-climate regions by integrating three components: 1) operational demonstrations showing that the greatest energy efficiency gains and cost savings in residential space heating can be achieved by simultaneously addressing the thermal integrity of buildings, the operational efficiency of heat supply systems, the provision of means for heat control by consumers, and the implementation of heat metering, cost-based heat pricing and consumption-based heat billing; 2) co-operation with central government; and 3) promoting simultaneous development of heating sector reforms and building energy efficiency improvements in Chinese municipalities.</p> <p>United Kingdom. The Energy Company Obligation (ECO) is the main measure for facilitating retrofit household energy efficiency measures. Specifically, the largest element of the ECO, the Carbon Emissions Reduction Obligation, targets wall insulation. The ECO contains special elements to alleviate fuel poverty (Affordable Warmth), open to qualifying households.</p>

Policy	Example
Minimum energy performance standards (MEPS) for new and existing buildings	<p>European Union. The Energy Performance of Buildings Directive aims to establish binding standards to deliver “nearly zero energy buildings” through a combination of MEPS for buildings and certification of building energy performance.</p> <p>Denmark. MEPS for buildings have been applied for a long time and are now at relatively high levels. They are regularly tightened to reflect the evolution of building materials and practices. Changes in standards are defined well in advance to make transitions smoother. These measures are generally complemented by stricter voluntary standards.</p>
Energy efficiency building certification	<p>United Kingdom. Energy Performance Certificates (EPCs) use a coloured chart, similar to those used on household electrical appliances, to indicate the relative energy efficiency of a particular building. Buildings are rated from A to G with appropriate colour coding ranging from green (for A-rated buildings) to red (for G-rated buildings). The EPC contains information on potential energy costs and carbon dioxide emissions. Each EPC is valid for 10 years and can be used multiple times during that period. An EPC can be produced only by an accredited energy assessor who will visit the property to carry out an assessment.</p>
MEPS standards and labelling for household appliances	<p>European Union. Under the Eco-design Directive, 16 of the most energy-intensive household products are regulated to minimise energy costs and environmental impacts during their respective lifecycles.</p> <p>Republic of Korea. Over 30 appliances are regulated for minimum energy performance. The E-Standby low-standby power programme complements this measure with its “energy boy” endorsement label and a certification programme for high-efficiency appliances. Together, these generate strong market push-pull for energy-efficient appliances.</p> <p>Australia and New Zealand. The Energy Rating Label allows consumers to compare the energy efficiency and running costs of appliances before purchase. The star rating shows how efficient a model is relative to other models of the same size. More stars mean more efficiency compared with other models of the same size. The Energy Rating Label also indicates an appliance’s energy consumption or how much electricity a model uses. It is based on standardised testing conducted in line with the official Australian and New Zealand Standard. The lower the number, the less the model’s running costs.</p>

Policy	Example
Endorsement of highest-efficiency appliances	United States. The ENERGY STAR programme was introduced by the Environmental Protection Agency and is currently used in several jurisdictions including the European Union, Canada, Australia, the European Free Trade Association (EFTA), Japan, New Zealand, Switzerland and Taiwan. It has broad global impact, as ENERGY STAR products are freely traded to many other countries. ENERGY STAR specifications draw on international standardisation processes and maintain a threshold whereby only the most efficient 25% of each assessed product category may carry the label. The use of third-party certification ensures governments and consumers can have confidence in the brand.

Sources: Adapted from UNECE (2017), *Best Policy Practices for Promoting Energy Efficiency Second Edition*; various websites.

Table 3. International examples of energy efficiency policy measures applied in the transport sector

Policy	Example
Fiscal policies (including taxation and user charges)	<p>France. The “bonus–malus” scheme offers an incentive to purchase efficient vehicles and a disincentive for inefficient vehicles, with a view to skewing purchases towards high-efficiency vehicles. This is an example of a “feebate” (i.e. fee and rebate) scheme. Measures of this kind can be designed to be fiscally neutral, balancing the discounted lifecycle costs to consumers of inefficient vehicles against the benefits of efficient vehicles, with little or no costs to government.</p> <p>Spain. The Efficient Vehicle Incentives programme facilitates the replacement of older, fuel-intensive vehicles with high-efficiency models that have lower consumption and CO₂ emissions. A direct government subsidy of EUR 1 500 per vehicle is given for efficient vehicles whose before-VAT cost is up to EUR 25 000 or for electric, plug-in hybrids whose before-VAT cost is up to EUR 30 000. The seller of the vehicle is required to match the government subsidy.</p>
Light-duty passenger vehicle fuel economy standards and labelling	European Union. New CO ₂ emissions standards for light-duty passenger and commercial vehicles were approved in 2019. The new targets are defined as percentage reductions in CO ₂ emissions per km from the baseline year 2021. The targeted reduction for 2030 is 37.5% for cars and 31% for light commercial vehicles. This new goal builds on the previous requirement for a maximum 95 gCO ₂ /km of emissions for newly registered light-duty vehicles in 2020, corresponding to 4.1 L/100 km for gasoline-powered vehicles and 3.6 L/100 km for diesel vehicles.

Policy	Example
Heavy-duty vehicle fuel economy standards and labelling	<p>Japan. The Top Runner programme sets fuel economy standards indexed to manufacturer average curb weight. The 2020 targets represent a 19.7% reduction in fuel consumption compared with 2009. The programme includes tax breaks for early compliance that have resulted in manufacturers meeting previous fuel economy targets well ahead of schedule.</p>
	<p>European Union. Since 2019, trucks with a gross vehicle weight of more than 7.5 tonnes have been subject to mandatory monitoring and reporting of fuel consumption and CO₂ emissions. A regulation mandating average specific CO₂ emission reductions for regulated classes of new trucks of 15% by 2025 and 30% by 2030 (compared with the July 2019–June 2020 reference period) was also introduced in 2019. The 2030 target is binding but subject to review in 2022.</p> <p>United States. In 2012, the Environmental Protection Agency and the National Highway Traffic Safety Administration issued revised standards for vehicle fuel economy labels. The updated labels provide vehicle purchasers with information about fuel economy, fuel costs and environmental impacts such as smog and carbon emission ratings. Labels are required for all vehicles sold, both new and used.</p>
Public transport, eco-driving and low-energy modes	<p>Canada. The Eco Driver programme informs drivers about buying, maintaining and driving efficient vehicles. Energy cost savings of up to 15% have been achieved.</p>
	<p>Finland. A comprehensive policy package for energy efficiency in the transport sector has been implemented to make public transport, walking and cycling more attractive compared with driving. The measures are regulatory as well as informational. They include vehicle tax rates determined according to vehicle emissions and expansion of the public transport system. Information campaigns include energy-efficient driving as part of the driver education curriculum. Experts have identified the transport and public sector elements of this package to be among the most effective in Europe.</p> <p>European Union. A revised Clean Vehicles Directive sets national targets for public procurement of low- and zero-emission vehicles to help accelerate their deployment. It applies to different forms of public procurement, including purchase, lease, rent and relevant services contracts. Member states are required to transpose the directive into law by August 2021.</p>

Sources: Adapted from IEA (2020a), *Tracking Transport 2020: Fuel Consumption of Cars and Vans*; UNECE (2017), *Best Policy Practices for Promoting Energy Efficiency Second Edition*; various websites.

Table 4. International examples of energy efficiency policy measures applied in the industrial sector

Policy	Example
Industrial energy efficiency auditing	<p>Australia. The Energy Efficiency Opportunities (EEO) programme required all corporations using more than 0.5 PJ of energy per year to undertake rigorous energy efficiency audits every five years and to report publicly on the outcomes. Subsequent application of audit findings was voluntary. EEO covered approximately 450 businesses across all sectors that accounted for 65% of total end-use energy consumption, stimulating them to take a more rigorous approach to energy use and energy efficiency by addressing the informational failures and organisational barriers to identifying and implementing cost-effective energy efficiency improvements. EEO provided advice, produced guidance materials and case studies, and held annual workshops. At its peak, participating corporations reported estimated energy savings totalling 88.8 PJ per year, or 1.5% of Australia's total annual energy consumption.</p>
Energy management systems	<p>United States. 3M expanded its ISO 50001 expertise and certification from two initial plants in 2011 (pilot study) to 30 sites in seven countries as part of its global enterprise model. Over three years, the 30 sites improved their collective energy performance by 4.5% – reducing energy use by more than 1.9 million GJ, cutting emissions by 330 000 tonnes (CO₂ equivalent) and lowering energy costs by USD 13.5 million.</p> <p>India. JK Tyre & Industries Ltd. of India saved nearly USD 1.8 million over a six-year period as its Chennai Plant gained certification and recertification to ISO 50001. By identifying the pieces of equipment that use the most energy, the plant prioritised opportunities for energy savings. In addition to using more renewable energy, the plant installed devices that alert staff to even slight increases in energy use and upgraded multiple systems to reduce both energy and water demand.</p> <p>Russia. PJSC Magnitogorsk Iron & Steel Works (PJSC MMK), a steel producer and metallurgical company, established an ISO 50001 energy management system that delivers USD 20.5 million in annual savings with no financial investment. Overall site savings over three years totalled USD 38.6 million, with CO₂-eq emissions reductions of 698 186 metric tonnes.</p>
MEPS for industrial equipment	<p>European Union. Under the Eco-design Directive, four of the most energy-intensive industrial products (electric motors, circulator pumps, fans and water pumps) are regulated to minimise energy costs and environmental impacts over their respective lifecycles. Energy savings of 195 TWh across the European Union were forecast by 2020. The policy has been accompanied by significant technology development and has initiated EU and global standardisation processes.</p>

Policy	Example
Energy management capacity-building	European Union. European Energy Manager (EUREM) is a standardised training and development programme that enhances the skills of technical experts in the field of energy efficiency. The EUREM programme is offered in 30 countries and covers most energy efficiency-related issues likely to arise in an industrial setting. EUREM targets technical experts, company executives and energy service providers, with training usually held externally and consisting of formal training and a major project.
Enterprise networks	Germany. Learning Energy Efficiency Networks (LEEN) supports energy efficiency innovation among participating companies to improve their competitiveness. By learning from each other, member companies co-operate to save energy in the most cost-effective way. The primary starting point is to improve the efficiency of cross-cutting technologies (e.g. compressed air systems, combined heat and power systems, electrical drives). Evaluation of 30 networks in Germany identified 4 000 profitable measures, with an average internal rate of return of 35%. Companies co-operating in LEEN networks increase their efficiency twice as quickly as the German industrial average.
Voluntary agreements	Denmark. Under the Agreement on Industrial Energy Efficiency (DAIEE), participants are required to implement an ISO 50001-compliant energy management system and have it certified by an external accredited certification body. If companies opt into and comply with this voluntary agreement, they receive a carbon tax reduction. The Netherlands. The Long-Term Agreement (LTA) is a voluntary arrangement that requires participants to achieve negotiated energy efficiency targets and to adopt an energy management system as agreed by the parties. Participating companies must also implement a broader and more strategic energy efficiency plan. Companies that opt into and comply with the LTA receive partial exemptions from the energy/carbon tax and are awarded automatic compliance with the energy-saving requirements under the Environmental Management Act.

Sources: IEA (2021), *Policies and Measures* (database); CEM (2019), “Announcing winners of the 2019 Global Leadership Awards in Energy Management”; ISO (2018), ISO 50001 Energy Management Systems; UNECE (2017), *Best Policy Practices for Promoting Energy Efficiency Second Edition*; IEA (2012c), *Energy Management Programmes for Industry*.

Table 5. International examples of energy efficiency policy measures applied in the energy utilities sector

Policy	Example
Cost-reflective pricing and energy price subsidy reform	<p>Various countries. A number of countries have established liberalised electricity markets with dynamic, cost-reflective pricing. Exemplars include Australia, some Canadian provinces, New Zealand, Norway, some US states, the United Kingdom and the European Union. These reforms are undertaken for a wide variety of economic security and resource management reasons. They typically involve removing energy subsidies to motivate more rational investment, operational and end-use decision-making, while also reducing demand on public budgets. While not specifically energy efficiency policies, these energy market and pricing reforms have the potential to encourage implementation of a wide range of sustainable energy options, including energy efficiency.</p>
Energy efficiency regulatory mandates	<p>United States. Natural gas and electricity utilities in Massachusetts offer the Mass Save programme, which provides energy efficiency services and incentives to help residential and commercial clients identify energy efficiency opportunities. In California, the Public Utilities Commission has published policy rules and related reference documents outlining the administration, oversight and evaluation of energy efficiency programmes funded by ratepayers in California.</p> <p>European Union. Article 14 of the EU Energy Efficiency Directive provides comprehensive guidance on: identifying and implementing adequate measures for efficient district heating and cooling infrastructure; the development of high-efficiency cogeneration; and the use of heating and cooling from waste heat and renewable energy sources. Procedures require that operators of electricity generation installations, industrial installations and district heating and cooling installations carry out installation-level cost-benefit analyses when they plan to build or refurbish capacities, or construct a new district heating and cooling network.</p> <p>China. Under the Electricity Demand-Side Management Implementation Measures regulation, all grid companies must deliver energy savings of at least 0.3% of the previous year's sales, and peak demand reductions of at least 0.3% of the previous year's peak demand.</p>
White certificates	<p>Denmark. The Danish energy efficiency obligation (EEO) white certificate scheme incorporates a verification and measurement system with a mechanism for enabling third parties to help finance cost-effective energy savings. The scheme has proven effective in encouraging energy efficiency initiatives in the trade and industry sectors.</p>

Policy	Example
Voluntary energy efficiency programmes	<p>Portugal. The Demand-Side Energy Efficiency Plan (PPEC) consists of a tender mechanism by which eligible promoters submit measures to improve the energy efficiency of electricity utilities. Measures are selected based on technical and economical evaluation criteria. An evaluation of the PPEC identified benefit-cost ratios of 8:1 in the residential segment; 9:1 in the services segment and 7:1 in the industry segment.</p> <p>South Africa. ESKOM (the national electricity utility) has deployed a suite of measures to promote demand restraint, including a large-scale National Efficient Lighting programme and targeted demand management efforts for various industrial customers. Electricity demand reductions of over 7 TWh per year have been achieved, along with the development of around 2 GW of flexible demand response.</p>

Source: Adapted from UNECE (2017), *Best Policy Practices for Promoting Energy Efficiency Second Edition*

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