

[illegible]The cover features a photograph of three people: a woman in the foreground wearing a black hijab and a yellow-orange garment, smiling; another woman behind her wearing a patterned headscarf; and a young child in the foreground looking off-camera. A solid blue rectangle occupies the top right corner.

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**TECHNICAL
REPORT**

ENERGY SUBSIDY REFORM IN ACTION

DISTRIBUTIONAL
ANALYSIS FOR
INFORMING ENERGY
SUBSIDY REFORMS

Review of Recent Approaches

ESMAP
Energy Sector Management Assistance Program

THE WORLD BANK
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Anne Olivier, Mikhail Matytsin, and Defne Gencer

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The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and [over 20 partners](#) to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the WB, ESMAP works to accelerate the energy transition required to achieve [Sustainable Development Goal 7](#) (SDG7), which ensures access to affordable, reliable, sustainable, and modern energy for all. It helps shape WB strategies and programs to achieve the [WB Climate Change Action Plan](#) targets. Learn more at: <https://www.esmap.org>.

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ABOUT THIS SERIES

This report is part of the “Energy Subsidy Reform in Action” series produced by the ESMAP Energy Subsidy Reform Facility, with the objective of drawing insights from recent experiences and emerging approaches related to reform of energy subsidies in developing countries. The series includes issue-specific reports from various relevant domains such as energy sector reform, macroeconomic and fiscal policy, carbon pricing, poverty and distributional analysis, social protection, political economy, and communications.

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Executive Summary

With limited fiscal space for poverty reduction and social protection, countries are exploring ways to provide support to poor and vulnerable people in an efficient and effective way. In recent years, governments have increasingly been considering the replacement of energy subsidies delivered through energy prices with targeted cash transfers to select end users. Globally, energy subsidies were estimated at US\$531 billion in 2021, and exceeded US\$1 trillion in 2022,¹ with country-level spending on energy subsidies often exceeding allocations for social assistance. Energy subsidies are very costly—government spending to subsidize fossil fuels, heating, or electricity can put significant pressure on a country’s fiscal balance, consuming scarce fiscal resources that could otherwise be used for pro-poor public spending. By distorting price signals, subsidies lead to overuse of the subsidized fuels and reduce incentives for energy conservation and investment in energy efficiency and cleaner energy alternatives, and thereby undermine climate change mitigation efforts. Much evidence indicates that energy subsidies tend to be regressive, often disproportionately benefiting higher-income households.² As countries explore ways to address the fiscal burden, opportunity costs, and regressive incidence of energy subsidies, they are increasingly focusing on creating, strengthening, or expanding social protection mechanisms to support people most in need. However, developing the ability to make such transitions and deliver solutions that meet key government objectives involves significant effort and requires key steps such as understanding subsidies and their reform; planning, financing, and implementing social protection measures; and at the same time being mindful of political economy constraints.

Any effort to reform energy subsidies or design new mechanisms should begin with a careful assessment of the distributional impacts of energy subsidies, their reform, and potential mitigation mechanisms. The specific role of distributional analysis in a comprehensive approach to subsidy reform is to identify the reform’s potential impact on different segments of the population, especially the poor and vulnerable. Indeed, the removal of energy subsidies can have significant impacts on low-income households that rely on these subsidies to access and consume energy services, even though these subsidies may disproportionately benefit higher-income households. Distributional analysis helps

¹ According to the International Energy Agency (IEA) Database (2022), fossil fuel consumption subsidies in 2021 were rising back to 2018 levels as energy prices rose with the rebound of the global economy. (See appendix A for the evolution of global fossil fuel subsidies as well as for selected countries from 2010 to 2021.) Preliminary estimates for 2022 indicate that they doubled between 2021 and 2022 (<https://www.iea.org/commentaries/the-global-energy-crisis-pushed-fossil-fuel-consumption-subsidies-to-an-all-time-high-in-2022>). Following the war in Ukraine and growing political conflicts with the Russian Federation, oil and gas prices increased significantly in 2022 (World Bank 2022).

² Arze del Granado, Coady, and Gillingham (2012) show that, among 20 developing countries, the richest 20 percent of households in low- and middle-income countries capture six times more in total fuel product subsidies than the poorest 20 percent of households, with gasoline being the most regressive (that is, subsidy benefits increase as income increases) and kerosene being progressive. IEA data show that subsidies to natural gas and electricity have also been found to be badly targeted, with the poorest 20 percent of households receiving 10 percent of natural gas subsidies and 9 percent of electricity subsidies (IEA 2011).

policy makers design targeted mitigation measures to protect the poor and vulnerable from the impacts of the reform. In addition to enabling a comprehensive understanding of the way in which the current arrangements benefit different households, and how households stand to be affected by different reform options, better understanding distributional impacts through distributional analysis assessments can help decision-makers evaluate and address political economy constraints that may affect implementation of the reform (Inchauste and Victor 2017; Inchauste, Victor, and Schiffer 2018).

Various approaches can be used to assess poverty and the distributional impacts of energy subsidies and their reform. These include quantitative approaches assessing the direct and indirect effects of the subsidies in contexts in which the reform leads to higher prices paid by energy consumers and qualitative approaches that enhance the findings of the quantitative analysis by focusing on the vulnerability of specific groups. The quantitative approaches rely on household budget and expenditure surveys and compare the welfare of various groups of households before and after the reform using simulations and modeling tools. They can also be part of a broader assessment of fiscal and social transfers. The qualitative approaches rely on feedback from households on energy services and related transfers or subsidies, and use surveys, questionnaires, focus group discussions, and in-depth interviews to explore attitudes and mitigation issues.

Each analytical approach to assessing the distributional impacts of energy subsidy reforms has different strengths, weaknesses, and resource requirements, and carefully considering the approach that fits the objectives of the specific analytical exercise is important. This report reviews the main analytical approaches for poverty and distributional analyses and explores how different methods have been used to support real-world energy subsidy reform efforts, drawing on the body of technical assistance funded by the Energy Sector Management Assistance Program's (ESMAP's) Energy Subsidy Reform Facility since 2014. A detailed review of the main methodologies and analytical approaches, followed by an examination of their application to actual reform efforts—from those focusing on electricity tariffs in Guinea and petroleum products in Indonesia to gas and heating in Ukraine and Uzbekistan—illustrates how various approaches can help identify, assess, and develop ways to address the potential impacts of reforms on poverty, affordability, and inequality.

Country and sector context, reform objectives, and systemic factors play critical roles in influencing the feasibility and usefulness of approaches to distributional analysis. As a first critical step, practitioners considering distributional analysis in relation to energy subsidy reforms need to invest time to understand the context within which the reform is being developed, assess its objectives, evaluate availability of data and resources, and accordingly choose the analytical tool that best fits their needs. Once that choice is made, the analytical approach can be customized to the context. Developing an understanding of the potential impacts of reforms may require combining diverse sources of information and methods. The assumptions of the analysis should be guided by the type of energy source and market conditions.



A review of recent real-world examples illustrates the design, approach, and data and methodological challenges that will be relevant when seeking to understand the distributional impacts and policy implications of reforms. The country cases reviewed for this report, each of which involves a different analytical approach, shed light on the main elements that guide the choice of analytical approach, model design, and implementation arrangements for the analysis.

- *Distributional analysis of energy tariff reform using limited modeling in a data-constrained environment.* The Guinea case study reviews a situation in which ad hoc modeling was needed to simulate the alternative reform scenarios to be considered in a context with serious data availability and quality challenges. In this case, electricity subsidies had been publicly funded for years, providing benefits to a limited share of the population, mostly urban and better-off, that was already connected to the grid. Affordability issues for several price increase scenarios were at the center of the analysis given the national focus on expansion of electricity access to lower-income households in a country with prevalent poverty.

- *Distributional analysis of energy subsidies as part of broader fiscal analysis using the Commitment to Equity (CEQ) framework.* The Indonesia case study demonstrates how the analysis of electricity and fuel subsidies may be part of a broader approach to assessing the distributional impact of fiscal policies using the fiscal incidence analysis under the CEQ framework (Lustig 2018). This approach was especially useful in highlighting the fiscal magnitude and distributional impact of energy subsidies relative to other, more effective, social programs. Under this framework, various programs can be compared with each other in multiple dimensions—efficiency, marginal contribution, progressivity, and so on. Given the substantial indirect effects of fuel subsidies on the prices of all other goods and services, this case also demonstrates the usefulness of a limited general equilibrium approach to account for indirect effects of fuel subsidies in addition to the direct effects coming from households' fuel consumption. A critical point to recognize is that some energy subsidies cannot directly be converted into fiscal revenue or savings to the government once eliminated because some subsidies don't involve explicit fiscal transfers.³ In such cases, their elimination does not immediately lead to fiscal resources being freed up and can be redeployed for other purposes (Kojima 2017).
- *Standard distributional analysis of targeted and untargeted energy subsidies with relatively high complexity and data requirements.* The Ukraine case study covers the energy subsidy reform initiated in 2014 involving unprecedented increases in gas and heating tariffs, along with targeted subsidies and social assistance delivered through energy bills, which quickly became the key component of the social safety net program in Ukraine. The analytical activity supporting this reform effort used the standard distributional analysis approach. The complexity of the energy system and the intricacies of the reform program required detailed modeling, posing several data challenges despite access to extensive quantitative data. The challenges imposed by the seasonality of residential heating are shared by most countries of the Europe and Central Asia region.
- *Qualitative methods to complement quantitative work.* The Uzbekistan case study is a case in which energy subsidies were also high and qualitative methods and data were used to guide the reform because service quality issues and energy inefficiencies were prevalent. This case highlights the use of complementary approaches to assess the potential impact of reforms, including methods that allow policy makers to gauge the population's readiness for the reform.

Even when well-developed methodologies are available, the quality and completeness of a distributional analysis for energy subsidy reform are highly dependent on data availability and underlying assumptions. Results are sensitive to the design, assumptions, and limitations of the simulation models. The modeling effort must be fully transparent to allow practitioners and decision-makers to be aware of its limitations so they can avoid overinterpreting results when assumptions or data are not reliable or may have changed. When interpreting the results of qualitative surveys, recognizing the

³ This is true, for example, in the case of an inefficient state-owned enterprise, or oil-producing country that sells the commodity domestically at a lower price than the export parity price, with significant opportunity cost to the economy.

context, design, and limitations of the approach is critical, given that the objective of the study is to understand the perspectives of specific groups. Qualitative analysis can contribute to the government's toolbox of options for understanding, assessing, and evaluating potential distributional impacts and household perspectives, ideally in combination with quantitative methods to address the potential distributional impacts that may result from the reforms.

Well-designed and context-appropriate distributional analysis can strengthen reform efforts by helping identify mitigation options that can be built into the reform design.

The choice of analytical tools should be guided by country context, reform objectives, and the strengths and weaknesses of different modeling approaches, as well as by the availability of data and resources. Having the right skill set on board and fostering collaboration among experts with diverse technical expertise is critical to a sound distributional assessment of a reform initiative under consideration. Going forward, distributional analyses can be further strengthened by incorporating indicators to assess the distributive impact of the reform on households, especially where energy affordability and poverty are significant issues, in addition to the resulting distributional *incidence*.



ONE Introduction and Overview



The pervasiveness and magnitude of energy subsidies have prompted energy subsidy reforms aimed at reducing the substantial amount of government spending while gaining an understanding of and managing the distributional impact of reforms.

Because most energy subsidies tend to accrue to the wealthiest households, which consume more energy on average, energy price subsidies are often an inefficient way of protecting the poor and reducing poverty or inequality. In contexts without universal household access to energy services, whether gas, district heating, or electricity, the benefits of the price subsidies do not reach those without access to those services, which can be as high as 70 percent of the population in some countries in Sub-Saharan Africa.

Energy subsidies also take up significant government resources and leave little fiscal space for other critical priorities.

The magnitude of energy price subsidies varies across countries and regions and by energy source and end use, as well as over time, but in many cases governments direct substantial spending to cover their cost, sometimes more than what they spend on social assistance, health, and education. In the Europe and Central Asia region, where substantial amounts of energy are used for heating, energy subsidies for heating fuels, gas, and district heating tend to be significant and have been the focus of reforms in many countries. Uzbekistan stood out with energy subsidies, mainly for natural gas, that amounted to 25 percent of the country's GDP in 2012, and in Ukraine, energy subsidies, mostly for residential gas use and district heating, reached 6.6 percent of GDP before the reform.¹ To put this in perspective, in the Middle East and North Africa region, energy subsidies focus mainly on petroleum products, and can reach 2 or 3 percent of GDP or even higher as in Algeria, the Arab Republic of Egypt, the Islamic Republic of Iran, or Libya according to International Energy Agency (IEA) calculations.² In Guinea, the government subsidy for electricity topped 1.7 percent of GDP in 2019 (IMF 2020), which is in the same range as government expenditures for education, even though electricity coverage is limited and despite the fact that the electricity subsidy is an actual expenditure outflow for the government in the form of a transfer to the electricity utility. In Latin America, energy subsidies cover mostly petroleum products and electricity.³ In Asia, subsidies are also provided for fuels and electricity, and vary significantly based on country context, with estimates ranging from 0.6 percent of GDP in China, to 2.6 percent in India, 2.7 percent in Indonesia, and 5.6 percent in Bangladesh (IEA Energy Subsidy Database 2022).

Most of the key questions concerning the distributional analysis of energy reforms can be tackled through a framework that starts with assessing the pre-reform distribution of existing energy subsidies, followed by the simulation of price increase options under consideration as part of the reform. This analysis can be supplemented by simulation of mitigation mechanisms. Figure 1.1 presents the standard framework for the

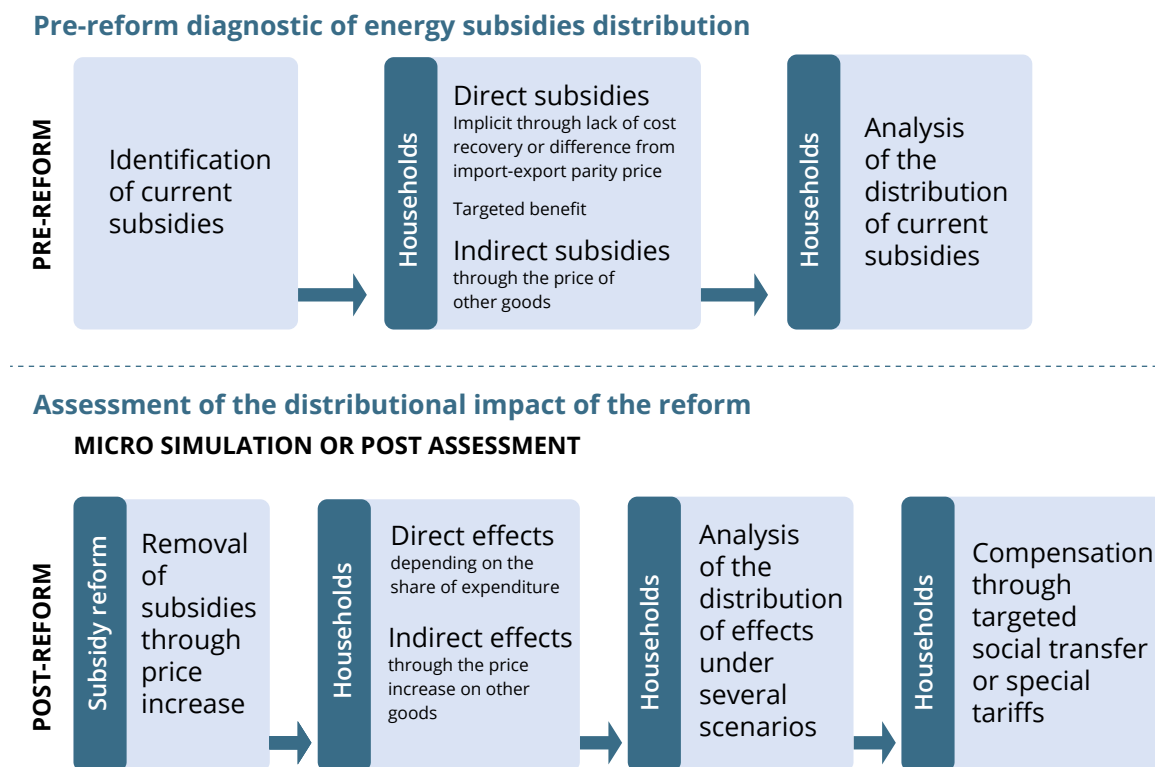
¹ In both instances, subsidy reforms led to a significant reduction of energy subsidies, as detailed in the case studies; however, subsidies rebounded with the 2021 energy crisis, nearing pre-reform levels and tripling from 2020 to 2021 in both countries.

² The IEA, using a price-gap approach to quantify subsidies using export parity prices as reference prices, estimates high levels of petroleum product subsidies in exporting countries. Expressed in terms of opportunity cost, these subsidies estimated for exporting countries do not imply actual fiscal costs incurred by the government.

³ Between 2011 and 2014, Central American countries spent a combined US\$1.3 billion per year on electricity subsidies, or 1 percent of the region's aggregate GDP, and less than 40 percent of the subsidies go to the poorest 40 percent of the population (Hernandez Ore et al. 2017).

FIGURE 1.1

Conceptual Framework for Distributional Analysis of Energy Subsidy Reforms



Source: Authors' illustration based on original work.

distributional analysis of energy subsidy reforms, with a pre-reform diagnostic followed by an assessment of the distributional impact of the reform.

A critical element in the pre-reform analysis is the assessment of the magnitude and distribution of existing energy subsidies, which differ between households according to the energy source, the way energy is consumed, and the availability of alternatives. For example, in Ukraine and other countries in the Europe and Central Asia region, where most residential energy consumption is for heating during the winter, gas consumption has been increasing with wealth as well as access to district heating; consequently, subsidies benefit wealthier households more, whether through gas used for heating or through district heating. In Sub-Saharan Africa, and in particular in Guinea, which is one of the case studies in this report, access to grid electricity has been more intensive around the capital and other urban centers; therefore, the benefits of subsidies accrue to the better-off portions of the population. With regard to refined petroleum products, the type of fuel consumed varies with household income in most regions of the world. For example, gasoline is commonly consumed in greater amounts by wealthier households owning cars,

as illustrated by the Indonesia case study in this report. For network-supplied energy, households may face different average prices depending on the consumption volume (in the case of block tariffs) or consumer category (metered versus unmetered consumption or specific social categories). In other contexts, shortages or rationing may alter the prices faced by poorer households, which may need to rely on informal alternatives. One fundamental difference between energy delivered through networks (such as electricity, natural gas, or district heating) and liquid fuels (such as gasoline, diesel, and liquefied petroleum gas) stems from the ability to transport and store liquid fuels, enabling black markets to develop and smuggling to occur. In such cases, the price paid by consumers may be different than the official price and would alter the results of the assessment.⁴

At the core of the distributional analysis of the reform is the assessment of how the removal of subsidies translates into various options for price increase pathways and what they mean for households across the distribution. The impacts of energy price increases are rarely uniform across households, either because of pre-reform price heterogeneity or because of the design of the reform itself. Because energy price increases can have large impacts across sectors and the broader economy, an important consideration is the extent to which those indirect effects should be considered in the distributional analysis.⁵ In many cases, whether to consider indirect effects will depend on the magnitude of the price increase and the known channels of impact, as with the reforms in Indonesia discussed later in this report.

A subsequent priority is to identify options for mitigating impacts on the welfare of vulnerable groups. This kind of analysis typically focuses on how to compensate the poorest households or citizens for any welfare loss either directly (through better-targeted energy subsidies) or by redirecting government spending for previously untargeted energy subsidies into pro-poor social programs. The Ukraine Housing and Utility Subsidy (HUS) program is an example of how an existing social protection program was leveraged to support households during the reform and eventually made the transition to being a fully targeted program. According to World Bank team estimates, without the HUS program, the average energy expenditures of the bottom 30th percentile of households could have equaled as much as 20 percent of total household expenditures after the 2015 energy tariff increases, whereas with the mitigation measures delivered through the HUS, this share could be contained to 10 percent, on average.

In addition to quantitative assessments to improve the reform's design, other constraints to reform may be present that might not be visible in a standard quantitative analysis. In that context, it is important to understand consumer attitudes, perceptions, and readiness for energy reforms, which may point to issues beyond the potential distributional impacts, such as coping mechanisms in the face of high energy prices. These attitudes are best assessed through qualitative studies, as detailed in the Energy Subsidy Reform Assessment Framework (ESRAF) Guidance Note 4 (Canpolat and

⁴ This data issue may also occur with network utilities where informal connections are widespread and the official utility tariff does not apply to all users.

⁵ Direct and indirect impacts of energy subsidy reform are explored in ESRAF Good Practice Note 3, "Analyzing the Incidence of Consumer Price Subsidies and the Impact of Reform on Households—Quantitative Analysis" (Olivier and Ruggeri Laderchi 2018).

Georgieva 2018). For instance, in Uzbekistan, the qualitative assessment revealed important concerns about the quality of energy services among the most vulnerable households and the reliance on alternative sources of energy, which are often costly. Such qualitative issues can be largely missed by quantitative surveys; therefore, qualitative assessments involving approaches such as focus group discussions, key informant interviews, or mobile surveys can provide valuable insights into the expected effects of an energy subsidy reform initiative.

This report aims to contribute to the global knowledge base on energy subsidy reform by exploring how poverty and distributional analyses have been used to support energy subsidy reform efforts. To this end, this report reviews select country-specific activities supported by the Energy Sector Management Assistance Program (ESMAP) and its Energy Subsidy Reform Facility (ESRF).⁶ The report begins by providing an overview of key distributional issues related to energy subsidy reforms and emerging lessons from a global stocktaking of practices, as well as country-specific insights from case studies. The report then discusses different approaches to the use of distributional analysis for gaining an understanding of the impacts of energy subsidy reforms in select country contexts, specifically in Guinea, Indonesia, Ukraine, and Uzbekistan.

The cases reviewed in this report provide a sense of the breadth of possible analytical approaches and cover a wide range of energy subsidy reforms and issues in different contexts. The report explores the analytical approaches in countries with different sector challenges and for reforms involving several types of energy, from electricity in Guinea and petroleum fuels in Indonesia to gas and heating in Ukraine and Uzbekistan. The report discusses the impacts of reforms on poverty, affordability, and inequality and the role of systemic factors such as access. The review also highlights the data and methodological challenges faced by teams when undertaking distributional analyses and the policy implications of these reforms.

The report is aimed at practitioners and policymakers. While certain technical material in the report, in particular Chapter 2, is intended mainly for poverty economists and specialists in this field, the practical application of these methodologies and approaches in the context of real-world energy subsidy reforms is relevant for both practitioners and policy makers. Thus, the conclusions and findings have policy significance, and as such are intended to be useful to both poverty economists and less specialized practitioners.

This report is organized into four chapters. After a general overview and introduction of key concepts in chapter 1, the report introduces main approaches and methodologies for distributional analysis in the context of energy subsidy reform in chapter 2. With its technical focus, this chapter is intended mainly for poverty economists and specialists in this field. Chapter 3 focuses on practical implementation of these methodologies and approaches by applying them to analyses of real-world energy subsidy reforms carried out in Guinea, Indonesia, Ukraine, and Uzbekistan. Each country presents unique sector

⁶ The report complements the Good Practice Notes issued by ESRF, particularly Note 3, “Analyzing the Incidence of Consumer Price Subsidies and the Impact of Reform on Households—Quantitative Analysis” (Olivier and Ruggeri Laderchi 2018).

contexts, reform challenges, and distributional analysis approaches. This chapter is intended to be relevant for practitioners and policy makers seeking to understand how distributional analysis was used to inform and refine the design of real-world energy subsidy reforms. As such, the chapter offers practical insights for those embarking on reform efforts, or supporting governments in doing so, by providing an understanding of how distributional analyses can be designed, how different methodologies can be adapted to specific country contexts and data availability, and how implementation challenges can be addressed. Chapter 4 draws insights and conclusions based on the review of methodologies, approaches, and case studies.



TWO

Approaches for Assessing Distributional Impacts of Energy Subsidy Reforms



This chapter reviews the main methodological approaches used to assess the distributional and poverty impacts of energy subsidies and their reforms. In this review, the chapter draws from and expands on the approaches covered in ESRAF Good Practice Notes 3 (Olivier and Ruggeri Laderchi 2018) and 4 (Canpolat and Georgieva 2018) and in recent analytical work carried out by World Bank technical teams in support of their government counterparts, with funding from the ESMAP ESRF. It also draws from a set of studies applying the Commitment to Equity (CEQ) methodology, assessing subsidies in a broader fiscal analysis context. While reviewing the different methodologies, the chapter discusses key design considerations and the main challenges for quantitative approaches to distributional impact assessments.

2.1 General versus Partial Equilibrium

The simplest quantitative assessment relies on estimating the partial equilibrium effects of an energy price increase, at least as an intermediate step, and does not take into account the effect of the price increase on other goods consumed by households. Such direct impacts can be limited to the purchasing power loss for households following the energy price increase or broadened to include the welfare loss incurred. The purchasing power loss is the simplest measure, measuring the impact on households' real incomes and expenditures, and is proportional to the share spent on the item in household expenditures. For example, if a household devotes 2 percent of its total expenditure to a given energy source, the price of which is expected to double (increase by 100 percent), and it makes no adjustment to the amount it consumes, its purchasing power loss will be 2 percent. This can be thought of as the real income or expenditure of the household contracting by 2 percent.⁷ This approach lends itself to estimating impacts (in partial equilibrium) that incorporate the purchasing power loss that households can experience into the welfare indicator of interest (for example, household per capita income or consumption). However, the assumption that households do not change their behavior in the face of an increase in prices is simplistic or focused on the short term. If households reduce their consumption or substitute an alternative good, the welfare loss would be smaller than these estimates imply.

A more comprehensive approach consists of measuring the impact on households as measured by their welfare loss. Following Hicks (1942), the welfare impact on households of a price change for a purchased good can be understood as the additional expenditure required following a price increase to reach the same level of utility as with the initial price. This measure, based on the utility from the consumption and not the consumption

⁷ This loss of purchasing power, assuming constant consumption, is expressed as a share of total income and corresponds in nominal terms to the Laspeyres variation—the amount of money required for the household to maintain its initial level of consumption.

itself, is called the compensating variation.⁸ Such a measure would require prior knowledge of the preferences of consumers. Various methodologies have been presented in the theoretical and empirical literature to approximate this welfare measure with limited assumptions. Among the simplest approximation of the welfare measure is the Laspeyres variation, that is, the change in income required to purchase the original quantities of the good after the price has changed (equivalent to the loss of purchasing power in the first approach presented earlier). This measure would be an upper bound⁹ of the actual welfare change in the absence of energy shortages before the price increase.¹⁰ Another widely used measure to approximate the welfare loss is the loss of consumer surplus, which requires information on the demand function, but not on preferences. For nonnegligible price elasticities,¹¹ where consumption is adjusted following a price variation, this measure underestimates the true welfare effect of a price increase because it does not assume constant utility and is thus smaller than the compensating variation. The Laspeyres variation and the consumer surplus loss can therefore be used as the lower and upper bounds of the true value of the welfare change for an energy price increase when the welfare reference period is the period prior to the price increase. The lower the price elasticity, the closer these measures will be. When price elasticity is low and close to zero, the Laspeyres variation is a good measure of the compensating variation (see Cory and others [1981], as well as Araar and Verme [2016] for a comprehensive review of these measures).

To account for the effect of the energy price increase on other economic sectors based on their energy intensity, general equilibrium approaches are required.

Increases in the prices of the goods produced in each sector may feed through to other sectors, so that the process is iterative and sensitive to the possibility of switching away from fuels and away from goods and services that are intensive in energy, which will have relatively high price increases, toward those with relatively low increases. As consumers switch to consuming goods that are less energy intensive, the structure of production would shift toward less-energy-intensive goods. This would, in turn, have impacts on employment and wages, potentially leaving workers in energy-intensive industries behind. The longer-term effects that would account for these adjustments would require the use of a general equilibrium model, such as a computable general equilibrium (CGE) model, which allows the behavior of firms and consumers to be fully flexible, as detailed in Burns,

⁸ This report does not retain the notions of equivalent variation or Paasche variation, given that these variations use as a reference the welfare or consumption level after the price increase, and thus do not take into account the loss of welfare incurred by the reduction in consumption. These two measures are commonly used in the fiscal literature where the reference period is the one following the change in price (the post-tax period).

⁹ Because the utility level for constant consumption with a higher price would increase, such an estimation would then overestimate the welfare impact compared with a utility level that remains constant. The Laspeyres variation can thus be viewed as an upper bound of the true welfare change.

¹⁰ If energy rationing were preventing households from purchasing more energy, should shortages be significantly reduced following the price increase, some or many households may purchase greater quantities despite the price increase.

¹¹ The qualitative literature on Eastern Europe reports that poorer households have lower price elasticity because they are closer to a subsistence level; these findings are confirmed by Zhang (2011) in Turkey, where the electricity own price elasticity is estimated at -0.08 for the poorest quintile and -0.5 for the wealthiest in 2008. Assumptions of quasi-inelastic energy consumption for the estimation of the impact on poverty is thus reasonable for electricity in richer countries, though it seems likely that other energy sources (such as cooking fuels) in other contexts (such as Sub-Saharan Africa or South Asia) would require different assumptions. In the upper part of the distribution, as well as for most petroleum products, price elasticities are likely to be significant. In cases of acute shortages, the price elasticity may even become positive. A review by Dahl (2012) reports estimates of between -0.11 and -0.33 for gasoline, and of between -0.13 and -0.38 for diesel. The price elasticity for gasoline appears to be higher in richer countries. Vagliasindi (2013) reports that long-run elasticities are significantly higher than short-run elasticities.

Djiofack, and Prihardini (2018). CGE models are also required to assess further impacts, such as the potential reduction of competitiveness of energy-intensive industries following the removal of energy subsidies, as shown by Burniaux and Chateau (2011). CGE models require additional assumptions, including the idea that the economy is in equilibrium in the baseline period. The model then assesses the impact of the proposed energy subsidy reform in a new equilibrium, but the models do not systematically describe the transition process to the new steady state. Although CGE models are outside the scope of this report, they are an increasingly used and useful component of the analytical toolkit available to policy makers and practitioners considering energy subsidy reform initiatives. In this context, it is important to point out that a key determinant of acceptability and feasibility of a proposed energy subsidy reform initiative is precisely what happens to vulnerable groups in the short term and the mitigation measures that may be incorporated into the design of the reform to address some of the most critical impacts. Nevertheless, it is possible to enable the inclusion of some behavioral responses as well as indirect effects in limited equilibrium approaches, as described later in this report.

2.2 Direct versus Indirect Effects

For energy primarily used for heating (usually gas or district heating) and subsidies concentrated among residential consumers, typically only the direct effects are estimated because the likelihood of having impacts on other markets is small.

In these cases, the magnitude of the welfare effect will depend on the magnitude of the price gap, the share of total expenditure devoted to energy, and price elasticities of demand. For petroleum products, as well as for electricity in some instances—which are important inputs to production—partial or full removal of subsidies can have impacts on production technologies and the prices of other goods. In these cases, both direct and indirect effects must be evaluated because the magnitude of indirect effects can be substantial. For instance, in their review of 32 countries, Coady, Flamini, and Sears (2015) estimate that indirect effects account for about 55 percent of the potential impact of the increase in fuel prices, with significant differences by region depending on the energy intensity of household consumption.¹² Jellema and Inchauste (2018) find that, among 20 countries covering regions across the globe, indirect effects of higher fuel prices on welfare accounted for nearly 60 percent of the total impact.

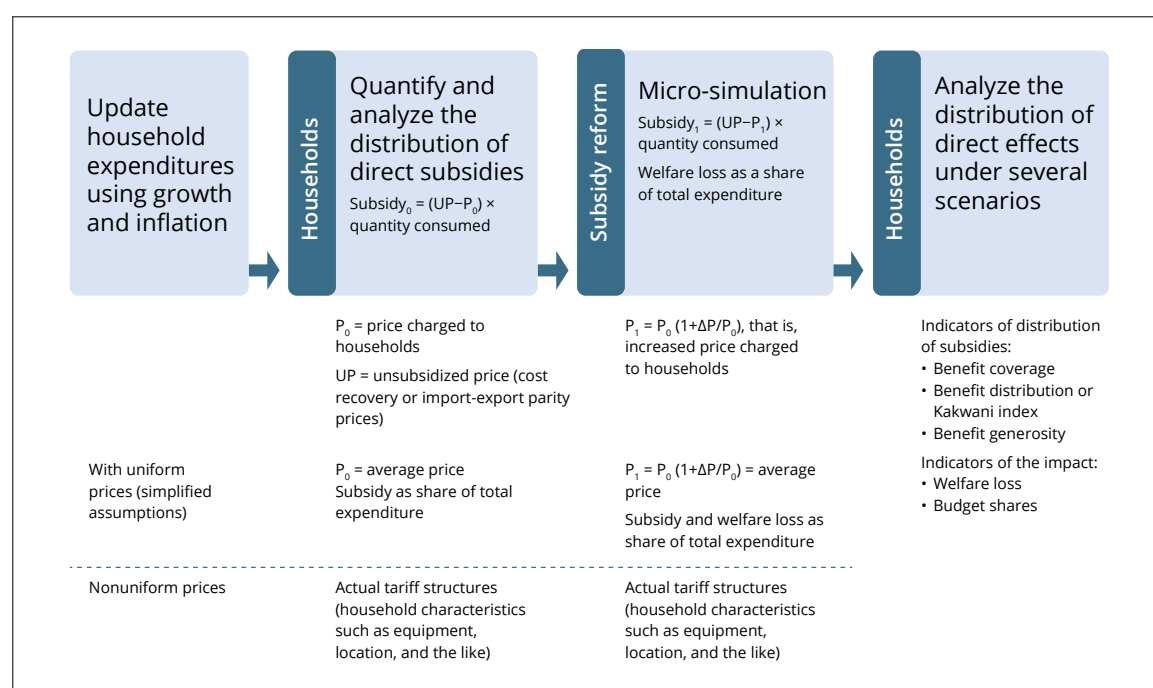
Estimation of the direct effects of gas or electricity price increases permits the analysis of complex tariff structures with nonuniform prices (varying with consumption) and prices that are differentiated depending on consumer category or

¹² Note that the findings on the magnitude of indirect effects are likely to be significantly overstated because of the use of input-output analysis, which is based on fixed coefficients (that is, there is no scope for substitution), as recognized by Coady, Flamini, and Sears (2015). Estimates should therefore be considered to be short-term effects or upper bounds of the long-term effects.

energy-consuming equipment in the household. The quantification and analysis of the direct effect of subsidies requires that the gap between the unsubsidized price (usually the cost recovery price for electricity or the import-export parity price for gas or refined petroleum products) and the price actually charged to households be identified.¹³ When prices are uniform or almost uniform across households, the analysis can simply use the difference between the unsubsidized price and the average price and calculate the current and the revised subsidies as shares of total expenditure. When prices are not uniform across households and these differences are significant across the distribution, then the subsidy at the household level using actual tariff structures needs to be calculated, based on household characteristics, equipment, location, and any other relevant variables provided in household budget surveys. Figure 2.1 shows a typical sequence of analysis for the evaluation of the direct effects in practice, with a prior estimation of the pre-reform subsidy (based on household expenditures updated to the period of reference) and a simulation of the post-reform subsidy.

FIGURE 2.1

Evaluation of the Direct Effects of Price Increases in Practice



Source: Authors' illustration.

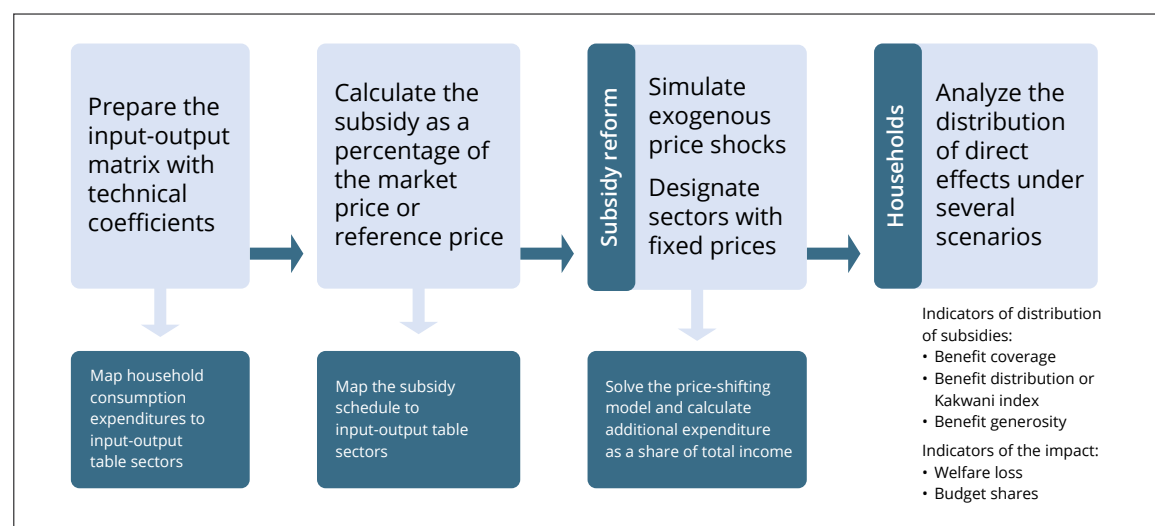
¹³ For a systematic review of approaches to quantification of subsidies, see ESRF Guidance Note 1 (Kojima 2017).

Estimating the indirect effects of price increases may require the use of general equilibrium approaches that include estimates of the effects of the energy price increase on other goods consumed by households in addition to the direct effects from their energy consumption. Depending on the energy carrier under consideration and the availability of an input-output matrix or a social accounting matrix, a simpler approach can be used to incorporate only some indirect effects that, a priori, are considered most relevant. This approach, which can be referred to as using “limited general equilibrium,” would involve identifying and quantifying effects based on some assumptions about which channels are likely to matter the most in a given context. As shown in figure 2.2, the first step is to prepare an input-output matrix with the technical coefficients between sectors, and map all the items that make up household consumption expenditure in the household survey to the relevant sectors in the input-output matrix. The main issue here is often the requirement for data given that the input-output table should be sufficiently disaggregated and up to date.

Thereafter, the subsidy as a percentage of the market or reference price can be calculated for each energy item included in the reform under consideration. This subsidy schedule would then be mapped to the input-output table sectors. The simulation

FIGURE 2.2

Evaluating the Indirect Effects of Energy Price Increases in Practice



Source: Authors' illustration based on Jellema and Inchauste (2018).

of the required price increase would then be applied to each relevant sector. Because nearly all goods and services use energy as an input, this process will affect the cost structure of nearly all goods except goods for which prices are regulated. The change in energy prices is applied using the technical coefficients from input-output tables, which remain fixed over the analysis (Jellema and Inchauste 2018). The difference in prices of other goods and services resulting from this channel is interpreted as indirect effects. These indirect effects can be evaluated separately or in addition to the direct effects, using the same welfare indicators as for the direct effects.

The indicators for both direct and indirect impacts are of two kinds: indicators for the distributional performance of the subsidy on the one hand (share of population receiving benefits; relative contribution to post-fiscal income; and various measures of progressivity including the Kakwani index¹⁴) and indicators of the impact on households on the other hand (welfare loss and budget shares). The welfare loss measure can be simply approximated by the increase in expenditure if consumption remains constant, or by the consumer surplus if behavioral responses are included, so that the reduction of welfare through the reduction of consumption is accounted for.

Prepackaged simulation models such as the World Bank tool SUBSIM (SUBsidy SIMulation Stata Package) are available to facilitate rapid distributional analyses of energy subsidies and simulations of subsidy and price reforms (Araar and Verme 2012). The model, initially developed for the Middle East and North Africa region with a focus on oil prices, can also be applied to energy, food, or water subsidies and accommodates linear and nonlinear pricing for the direct effects, with some simplifying assumptions. For estimation of the indirect effects, the SUBSIM software automatically creates a technical coefficient matrix from the input-output matrix. The price-shifting model presented above is simulated under a “permanent price shock” option with a long-term price adjustment. The model estimates the impact of subsidy reforms on household welfare, poverty and inequality, and the government budget with or without compensatory cash transfers. It either estimates an upper bound of the household welfare effect of the price increase, assuming that the loss in welfare is approximated by the total expenditures required to maintain the same level of consumption as before the price increase (thus the Laspeyres variation) or a lower bound (the equivalent variation) using as a reference the welfare level after the price increase, with an assumption about preferences based on a Cobb-Douglas utility function as well as price elasticity. The IMF has also developed a set of publicly accessible Stata dofiles that estimate the direct and indirect effects of indirect taxes or subsidies using the price-shifting model described previously. Both tools provide a rapid analysis that includes the indirect effect of price increases on household welfare. In the case of a networked utility with complex tariff structures, such as when different tariffs apply to specific customer categories or specific equipment holders (as is quite common in gas tariffs in the Europe and Central Asia region), ready-made products that lend

¹⁴ The Kakwani index is a measure of the progressivity of a social intervention based on the difference between Gini indicators (Son and Kakwani 2006).

themselves to rapid analysis might disregard some of the specificities of the tariffs that apply to the most vulnerable households and thus provide an inaccurate approximation of the impacts that would matter the most to the analyst.

2.3 Subsidy Analysis as Part of a Broader Fiscal Incidence Assessment

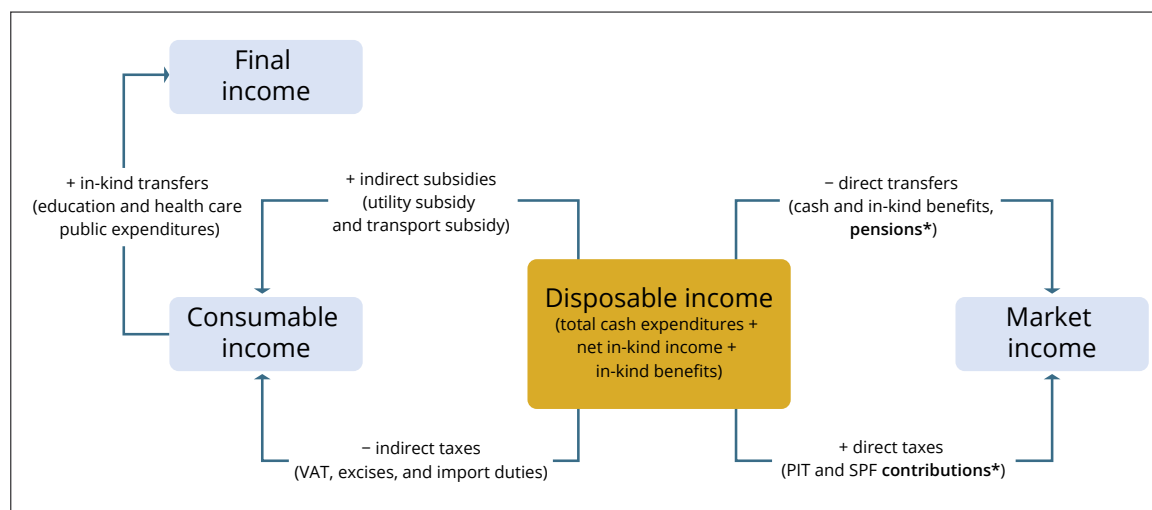
The CEQ methodology¹⁵ provides a way to assess the direct and indirect effects of subsidies in a broader context of fiscal incidence analysis of tax and social interventions. Energy subsidies in this approach are differentiated from social in-kind transfers (such as education and health expenditures) and are considered to be government-funded “indirect subsidies” to be added to the disposable income of households and form part of “consumable income.” The assessment of the welfare impacts of each fiscal intervention is based on indicators of coverage; relative and absolute incidence;¹⁶ the Kakwani index; and the intervention’s marginal contribution to poverty and inequality. The case study on Indonesia details how this methodology was used to assess the direct and indirect distributional impacts of fiscal and social policies, including electricity and petroleum product subsidies, using an input-output table for the economy. This broad-based assessment provided the analytical basis for a series of government actions, which included the elimination of most subsidies for fuel and electricity (a reduction from 3.7 percent of GDP in 2012 to 1.7 percent in 2019, according to IEA data), in favor of expanding the social transfer program to 10 million beneficiaries in 2017 (Tiwari et al. 2020).

The CEQ methodology uses a household survey and allocates taxes and benefits, both cash and in-kind, to individuals to allow comparison of incomes before and after taxes and transfers (Lustig and Higgins 2018). The methodology relies on four main income concepts, from market income to final income, as illustrated in figure 2.3: the point of departure is *market income*, that is, household income before any tax or benefit, comprising income from all forms of employment, capital income (rent and dividends), and private transfers. The next income concept comprises market income plus pensions (which include contributory pensions and exclude the respective pension contributions), then subtracts direct taxes and social insurance contributions other than those for pensions and adds direct cash transfers (and other social benefits except pensions) to generate disposable income. Disposable income is typically the key income concept in standard analyses of poverty and inequality, and as such, fiscal incidence analysis typically stops here. CEQ analysis computes two further income concepts by subtracting indirect taxes (VAT and

¹⁵ See *Commitment to Equity Handbook* (Lustig 2018).

¹⁶ Relative incidence refers to the size of the subsidy relative to household income, a measure similar to benefit generosity. Absolute incidence refers to the size of the subsidy that is directed to each decile, also called benefits incidence or targeting accuracy.

FIGURE 2.3
Construction of Income Concepts



Source: Bornukova, Leshchenko, and Matytsin 2019.

Note: PIT = personal income tax; SPF = social pension fund; VAT = value added tax.

* Pensions and SPF contributions are included in direct transfers and taxes, respectively, only within the approach using pensions as government transfers.

excises) and adding energy and fuel subsidies¹⁷ to generate consumable income, which reflects the actual amount of market goods and services consumed by households. Eventually, final income is defined as the income aggregate that includes the cash equivalent of in-kind benefits, that is, the cost of public health and education services consumed by households (Lustig 2018).

Because it is possible to compute statistics such as the poverty rate or inequality indexes for each separate income concept, comparisons across different income concepts allow an assessment to be made of the marginal contributions of individual taxes and expenditure programs to poverty and inequality alleviation. In addition, each fiscal intervention is allocated to households in the survey sample, which provides insight into the incidence of various taxes and programs across different population groups; in other words, a profile of contributors and beneficiaries of different programs can be constructed (Jellema and Inchauste 2018), including breaking down each type of energy subsidy.

¹⁷ Note that in the CEQ assessments, energy subsidies are usually identified as “indirect subsidies,” which include energy subsidies but also other government subsidies such as those for agriculture, but that term is avoided here. They are specifically called “energy subsidies” instead to be more consistent with other sections of the report and avoid confusion with direct and indirect effects.

2.4 Data and Inputs Needed for the Analysis

There are two main kinds of data required for energy subsidy reform analysis: the household expenditures typically reported in household budget surveys (expenditure on energy but also on other goods for indirect effects), and the price gap, based on the actual price applied to households and the reference price for the relevant energy source.¹⁸ Information on the price gap requires the existing pricing or tariff structure, as well as information on what a cost-recovery or fair market price would be. If the analysis assumes that the reform eliminates the price gap in one go, the impact of the price increase can be assessed using the available information. In most cases, the price reform is actually a gradual process with successive price increases, up to full cost recovery. If the reform initiative being assessed follows the gradual approach, then data on the anticipated schedule of price increases is required. The level of detail for both types of data requirements depends on the complexity of the context and the credibility of the simplifying assumptions. Moreover, where indirect effects of the energy price increase on other goods are expected to be significant, as for most petroleum products, additional data are required in the form of an input-output matrix describing the current structure of the economy.

At the household level, the level of detail needed depends on the heterogeneity of energy use and the price structure. When tariffs are not uniform, nominal expenditures on energy from budget surveys are required without regional or temporal adjustments because price or tariff structures applied to households to derive the quantities consumed are in nominal terms, as are the price increases in the reform scenario. In addition, data often need to be updated for the year of the analysis to account for nominal or real income growth (either uniformly or, better, adjusted by quintile to take into account differentiated economic growth), and further assumptions might be required to disaggregate data between fuels (refined fuels might be aggregated or some utility expenditures might be aggregated).

It is important to highlight that expenditure, not units of energy consumed, is reported by households in the budget survey. Energy expenditure does not necessarily strongly correlate with consumption for multiple reasons: households with unmetered consumption might be charged a fixed amount; the tariff structure might depend on the location, type of equipment, volume, or season; fuels might be sold on the black market; shortages and rationing might limit consumption; infrequent billing (and missing expenditure for the period) might affect the reporting of expenditures; and arrears or regularization fees might be included. An additional challenge for the analysis involving energy consumption is the price elasticity of consumption, given that average price elasticities known from the literature are typically relevant for small changes, and in any case, only for households able to adapt their consumption to price, which excludes unmetered ones and households facing shortages or rationing, who are often the poorest. Sensitivity of the

¹⁸ The total price gap is required to assess the distribution of the existing subsidies before the reform.



analysis to elasticities (including differentiated elasticities with zero or lower price elasticity for lower incomes) might be conducted for a more comprehensive analysis.

In cases with direct energy benefits, such as the in-kind subsidies in Ukraine, for example, or cash transfers, benefits provided to households are also affected by the price increase, and thus the formula used for calculation of eligibility and benefits by the social protection program is required for the simulation. A significant challenge is that theoretical eligibility is not the same as actual take-up by households. Benefits simulated at the household level, using eligibility thresholds, will typically assume perfect targeting and full uptake, where all eligible households receive benefits. In Ukraine, for instance, a large share of households became eligible to receive energy benefits as they reached the eligibility threshold, and simulations were conducted for both the coverage at the time of the survey and for coverage extended to all eligible households (discussed further in the Ukraine case study).

In addition, a welfare indicator is also required for the assessment of the distribution of impact among households. For consistency with poverty assessments, this indicator is usually total expenditures or income adjusted for time and location, and further adjusted by household size or adult-equivalent. The CEQ methodology requires additional data from households for a broader fiscal analysis, given that it measures poverty and inequality before and after different fiscal interventions based on the four income concepts described in figure 2.3, starting from market income to final income.

Along with household-reported information, data on energy prices are required to quantify the subsidies. Because electricity tariffs or fuel prices might not always be uniform, but rather will vary by category of consumers, knowledge of the actual price increase applied to each category is critical to be able to assess the distributional impact of the reforms. Prices used to quantify subsidies can be provided either as a percentage of the unsubsidized price or the actual unsubsidized price (often the import or export parity prices) and actual prices charged to households. Where detailed tariff schedules are not available for the analysis, a key challenge is related to average prices, which do not provide adequate information on actual prices charged to different household categories. Because the focus of the analysis is on the distribution of effects between income groups, differences in prices paid by households are critical for the analysis, and hence applying average prices can be misleading. For example, in Guinea, because of affordability concerns, the 2018 reform involved larger price increases applied to higher consumption tariff blocks. Looking at only average price increases would have overestimated the effects on lower-income consumers. Inversely, the reduction of the size of the first consumption block in 2019 affected mostly users just above the new threshold, and effects on this category of households could be underestimated by using an average price increase. More generally, moves from block tariffs to uniform cost-reflective tariffs stand to have greater impacts on users previously benefiting from lower tariffs (often the most vulnerable). In such an analysis, the use of actual tariff-increase data by category would avoid underestimating the impacts on households in each category. Regarding indirect effects, utilities generally apply different tariffs to residential and nonresidential users.



THREE Case Studies

This chapter reviews energy subsidy reform support activities in four specific country engagements which benefited from ESMAP funding. These case studies show how different analytical approaches to poverty and distributional analyses were applied in specific country contexts and highlight select findings from those activities.

3.1 Analysis of Direct and Indirect Effects: 2018–19 Electricity Tariff Reforms in Guinea

This case study is an example of the use of distributional analysis in a situation in which the benefits of pre-reform electricity subsidies accrued to a limited portion of the population, mostly urban and better-off, that was already connected to the grid. To simulate alternative reform scenarios, a specific model was developed, and analysis was carried out amid serious data availability and quality challenges.

The distributional analysis focused on tariff increase scenarios that would take place over a relatively long period in an evolving sector where access to electricity service continued to be expanded. The distributional analysis focused not only on the direct effects of an electricity price increase, but also on indirect effects because the scenarios were balancing tariff increases between residential and nonresidential users. Although tariffs were far from cost-recovery levels, the affordability of price increase scenarios was at the center of the analysis given the national focus on expansion of electricity access to lower-income households in a country with prevalent poverty.

3.1.1 Background and Context

By 2018, Electricité de Guinée (EDG), the state-owned electricity company, had been facing financial deficits for several years. Tariffs were inadequate to cover the costs of service, which were high as a result of heavy reliance on thermal generation, operational inefficiencies, and commercial losses, among other reasons. Electricity tariffs had been constant in nominal terms between 2008 and 2018 despite high inflation rates, and covered less than 50 percent of all of EDG's costs in 2018. Technical and commercial losses accounted for more than half of the hidden costs (Trimble et al. 2016). At that time, only 29 percent of the population had access to electricity, and most households connected to the grid were not poor. The majority of households with access to grid electricity were urban households, mainly in the capital, Conakry (71 percent of households connected), where electricity access stood at 84 percent of the city's households, versus 39 percent in secondary cities and 1 percent in rural areas. Electricity tariffs for residential customers were cross-subsidized by other customers, and ultimately, the sector was being subsidized by the government, which had been providing significant transfers to support EDG's

day-to-day operations. The fiscal cost of the support to EDG increased from 0.8 percent of GDP in 2018 to 1.7 percent in 2019, placing a heavy burden on public finances and limiting the fiscal space available for other sectors, notably health and education (IMF 2020).

In view of the challenges, the government of Guinea initiated an effort to strengthen the sector's financial sustainability, starting with tariff increases to bring them closer to cost-recovery levels by 2025/26, as part of a comprehensive Recovery Plan for the Energy Sector (Government of Guinea 2020). In May 2018, electricity tariffs increased by 10 percent for all residential users, except for those consuming less than 60 kWh/month, and by 25 percent for nonresidential users.¹⁹ The reform strategy aimed to progressively increase tariffs over the 2019–25 period, including a moderation of these increases for the “social” bracket (the consumption bracket benefiting from the lower tariff) to protect the poorest.²⁰

3.1.2 Analytical Approach and Methodology

To prepare for the recovery plan, the government, with support from the World Bank and funding from ESMAP, carried out successive distributional analyses to assess the potential impacts of different electricity tariff scenarios. The final scenarios considered in these analyses, conducted in 2018 and 2019, are detailed in table 3.1.

TABLE 3.1

Guinea: Price Increase Scenarios for Residential and Nonresidential Customers, 2018–25

Scenarios ^a	Average cumulative nominal price increase (%) for the period, compared with 2018 tariffs ^b	
	Residential	Nonresidential ^c
Scenario 1	95 (32 for 0–40 kWh/month bracket)	82
Scenario 2	166 (50 for 0–40 kWh/month bracket)	60
Scenario 3	219 (63 for 0–40 kWh/month bracket)	45

Source: Authors' elaboration based on Government of Guinea (2020) and World Bank financial scenario documents for the Recovery Plan for the Energy Sector.

Note: kWh = kilowatt-hour.

a. Price increase scenarios according to the modulation between residential and nonresidential customers.

b. Note that expected inflation (average consumer price inflation) was about 8 percent per year, thus a cumulative 72 percent for the period 2018–25 (according to the October 2019 World Economic Outlook database), and it should be revised to a cumulative amount of 103 percent by 2025 according to the April 2022 World Economic Outlook database.

c. Electricity tariffs for Mines and Export are expected to provide new revenues for the utility.

¹⁹ This case study uses the Guinean franc (GF) because the analysis focused on tariffs and their local affordability. For context, the official exchange rate was GF 9,011 per US\$ in 2018 and GF 9,565.08 per US\$ in 2020 (World Bank, World Development Indicators).

²⁰ A consumer with monthly consumption of 40 kWh was billed GF 211/kWh in 2018 (about US\$0.022/kWh) and 357 GF/kWh in 2021 (about US\$0.039/kWh).

Several tariff increase scenarios were analyzed, and their distributional impact on households was assessed, modulating the price increase by consumer category according to the existing tariff structure. Instead of actual household electricity consumption, for which accurate data were not available in 2018, the affordability of selected electricity consumption bundles was estimated. This estimation was made for households with access to grid electricity as well as for a hypothetical scenario with universal access (to account for socioeconomic changes in the customer base if and when all households receive electricity access). The analysis considered two different spending thresholds according to which affordability of electricity consumption could be assessed (that is, spending thresholds for electricity of 3 percent and 5 percent of total expenditures²¹) as well as two different growth scenarios for estimating the increase in household income (a uniform increase in line with expected inflation and a more conservative scenario to avoid underestimating the impact on the poor).

In parallel to the analysis of the total price increase on affordability, analysis of the impact of the 2018 and 2019 actual nominal price increases on poverty was conducted, including the indirect impacts on households through the electricity price increase to nonresidential users. Although the 2019 price increase for commercial and industrial users was limited to a nominal 5 percent, on average (which was less than the average inflation rate of 9 percent at the time), it followed a 25 percent price increase for nonresidential users in 2018 for which the indirect effects were assessed to have been more significant because they affected all households (compared with the direct effects affecting only the households connected to the grid, which are the wealthiest part of the population).²² To take into account the indirect effects, technical coefficients between sectors were prepared using a social accounting matrix from 2014, later disaggregated and updated to 2016, and mapped to household consumption expenditure. Then, using data from the household survey, the additional expenditures due to these indirect effects were calculated for each household as a share of total expenditure under a price-shifting model. The increase in poverty due to both direct and indirect effects was estimated.

Ultimately, the Government of Guinea decided on an intermediate tariff increase scenario between scenarios 2 and 3, with a cumulative increase of 182–195 percent for residential consumers (15.5–16.3 percent per year, limited to 6.2 percent for the social bracket), and 45 percent for nonresidential consumers (4.8–5.4 percent per year). In the meantime, because scenarios were still being assessed, electricity tariffs for residential users were increased by 15 percent in May 2019, except for tariffs for the social bracket, for which the upper bound was reduced from 60 kWh/month to 40 kWh/month, and this social tariff became available only to domestic users consuming less than the threshold.²³

²¹ The Sustainable Energy for All framework defines 5 percent of total expenditure as an affordability threshold (Bhatia and Angelou 2015); however, because of the simultaneous burden of coal and wood expenditures for cooking, a 3 percent threshold for electricity affordability is also considered for this analysis, as per Briceno-Garmendia and Shkaratan (2011), who compare both thresholds for their affordability study in 27 Sub-Saharan African countries.

²² See also Batana (2019) for a broader fiscal analysis, subject to the same data limitations.

²³ Although these increases are nominal for residential consumers in each bracket, the change in the usage threshold from 60 kWh/month to 40 kWh/month for the social bracket and the availability of the tariff only for those below the threshold since 2019 has more significant consequences on consumers above the newly revised threshold. In particular, the price increase for households consuming between 40 kWh/month and 80 kWh/month is much higher than the nominal increase estimated in the analysis.

TABLE 3.2

Guinea: Tariff Schedule for Residential and Nonresidential Low-Voltage Customers, 2008–21

Tariff regular	2008 to April 2018						May 2019			October 2021				
	Consumption Blocks	Fixed Charge, Single-phase	Fixed Charge, Three-phase	Tariff 2008	Tariff 2018	Variation in variable tariff 2018/2008	Consumption blocks ^a	Tariff 2019	Variation in variable tariff 2019/2018 ^a	Fixed Charge, Single-phase	Fixed Charge, Three-phase	Tariff 2021 ^b	Variation in fixed charge 2021/2019	Variation in variable tariff 2021/2019 ^b
	kWh/month	GF/month	GF/kWh	GF/kWh	GF/kWh	%	kWh/month	GF/kWh	%	GF/month	GF/month	GF/kWh	%	%
Residential clients, LV / Single-phase	T1	1 to 60	4,850	90	90	0	1 to 40	90	0	10,000		107	206	19
	T2	61 to 330	4,850	232	255	10	41 to 330	293	15	10,000		387	206	32
	T3	Above 330	4,850	265	292	10	Above 330	336	15	10,000		453	206	35
Residential clients, LV / Three-phase	T1	1 to 60		14,550	90	0	1 to 40	90	0		20,000	107	137	19
	T2	61 to 330		14,550	232	10	41 to 330	293	15		20,000	387	137	32
	T3	Above 330		14,550	265	10	Above 330	336	15		20,000	453	137	35
Commercial, LV (Single and Three-phase)		1 to 330	5,240	15,720	802	1,000	1 to 330	1,050	5	10,000		1,169	191	11
		Above 330	5,240	15,720	1,243	1,560	Above 330	1,638	5		20,000	1,823	127	11
Tariff prepayment							Registered Power	Tariff 2019				Tariff 2021		Variation in tariff 2021/2019
								May 2019				October 2021		
							kVA	GF/kWh				GF/kWh		%
Residential clients, LV / Single-phase							1.1 to 3.3	255				387		52
							4.4 to 9.9	347				453		31
Residential clients, LV / Three-phase								359				453		26
Commercial, LV / Single-phase								1,430				1,728		21
Commercial, LV / Three-phase								1,486				1,823		23

Source: Authors' elaboration using Government Decrees for 2008, 2018, 2019, and 2021.

Note: GF =Guinean Franc; kVA =kilovolt-ampere; kWh = kilowatt-hour; LV =Low Voltage; T1 = 1st block; T2 = 2nd block; T3 = 3rd block.

a. Reduction of T1 from 60 to 40 kWh/month.

b. Tariff switched to volumetric: the tariff for the block corresponding to the final month of consumption is applied to all consumption.

In 2021, after a period in which low-consumption households²⁴ received free electricity as part of pandemic-related support measures, electricity tariffs were increased by another 32 percent for residential consumption (limited to 19 percent for those in the social bracket), and fixed monthly charges increased for all user categories (from 4,850 to 10,000 GF/month for low-voltage single-phase users).²⁵ Detailed tariff schedules are presented in table 3.2.

3.1.3 Data Availability, Constraints, and Solutions

A key challenge for the distributional analysis was related to data. Significant adjustments of the household survey data used in the analysis were required across various parts of the analysis. The latest data available at the time of the analysis was from the 2012 household survey, *Enquete Legere pour l'Evaluation de la Pauvrete*, which was not fully representative of the electricity situation in 2018. Major changes to electricity access rates and sales by the utility had occurred between 2015 and 2018. In 2012, only 21 percent of households were connected to the grid, but by 2018 coverage was estimated to have reached 29 percent, largely thanks to regularization of illegal connections and metering of shared connections. This survey did not provide data on households that had been connected to the grid after 2012. EDG data indicated that average electricity consumption per residential user in Conakry also increased by 80 percent between 2014 and 2018 (a 16 percent increase per year), reaching 255 kWh/month, on average.²⁶ The increase in billed consumption reflected increased power generation (by 270 percent between 2013 and 2017 according to data available from the utility) allowing electricity rationing, which had been a major issue, to be reduced. Improved metering and billing also helped: EDG increased the number of formal connections (mostly by reducing informal connections), expanded metering, and adjusted the methodology for billing unmetered consumers (incorporating hours of use). Therefore, to better estimate the impact of a tariff increase on expenditures, expenditures recorded in the 2012 survey had to be adjusted to 2018 levels to reflect changes in electricity access rates and consumption.

The analysis based on 2012 data was sensitive to the assumptions used to adjust these data to 2018, the base year, on the one hand, and to 2025 for the various tariff increase scenarios, on the other hand. Total household expenditure figures were adjusted for inflation for the period 2012–18 to construct the baseline, then two scenarios were considered for the period 2018: a homogeneous growth assumption and a more conservative assumption according to which the expenses of the poorest increase by only half compared with the rest of the population, to take into account nonuniform variations

²⁴ Households consuming less than 330 kWh/month were provided electricity free of charge as part of the pandemic measures; the threshold was later decreased to 250 kWh/month to limit coverage of the measure (IMF 2020).

²⁵ The doubling of the fixed charge can also have a larger impact on lower consumers, although this was not part of any of the scenarios analyzed. For a household consuming 40 kWh/month, the planned consumption tariff increase was 19 percent in 2021; however, the total bill would increase by about 70 percent because of the fixed charge increase. For a household consuming 60 kWh/month (the previous lower bound of the first block), the monthly bill would increase from 22,430 GF (about US\$2.4) to 33,220 GF (about US\$3.6), thus about a 50 percent increase.

²⁶ Note that this average consumption comes from the total amount of electricity supplied by EDG to domestic users divided by the number of official domestic connections and strongly overestimates the actual average consumption at the household level (because of theft and multiple connections).



across time according to the standard of living.²⁷ At the same time, household electricity expenses increased substantially between 2012 and 2018, as documented by EDG data, and electricity expenditure recorded in the 2012 household survey was adjusted to approximate EDG's data, as noted earlier.

Census and utility data were used to update electricity access rates. In *Enquete Legere pour l'Evaluation de la Pauvrete 2012*, 85 percent of the households in Conakry stated that they had access to electricity through an EDG connection, 8 percent through a neighbor, and 2 percent otherwise (only 6 percent reported no access at all); and 70 percent stated that they used grid electricity for lighting. In the 2014 census, there was no direct question on access, but 76 percent of Conakry households reported using electricity from the EDG grid for lighting, which was far more than indicated by EDG customer data at that time. Because of the mismatch between census and EDG data (mainly resulting from

²⁷ As evidenced in the Systematic Country Diagnostic for Guinea, consumption growth was not pro-poor between 2007 and 2012: the consumption growth rate declined from the poorest to the wealthiest decile, showing negative numbers for most households. The poor living in urban areas had the largest drop in consumption during this period (World Bank 2018).

informal connections and shared billing), household electricity expenditure data did not correctly reflect consumption at the household level. Electricity access, and hence consumption data, was also limited for rural households outside Conakry, where access was rare. The 2014 census indicated that only 20 percent of all electricity users outside Conakry were in rural areas (based on the proxy of using electricity for lighting)

In addition to the data challenge resulting from households sharing connections, which misrepresents the relationship between recorded expenditure and actual electricity consumption per household, another limitation was imposed by the lack of metering, which is a very common issue in Sub-Saharan Africa, as demonstrated by Kojima et al. (2016). In 2012, most residential electricity users in Guinea were unmetered, and households were billed a fixed amount based on capacity and electrical appliances used by the household. Under the 2015–19 management contract with Veolia, meters have been installed in Conakry and about a third of residential users were metered in 2017.

In view of constraints in connection and consumption data available from the household survey, the affordability analysis was conducted for selected electricity consumption thresholds (40, 60, and 80 kWh/month). It was assumed that, following the large-scale metering campaign, the tariff would apply to each household and connections would not be shared by multiple others,²⁸ even though the fixed charge would represent a significant part of electricity bills (about 50 percent of the bill for a metered household consuming 60 kWh/month in 2018).

3.1.4 Main Findings and Lessons Learned

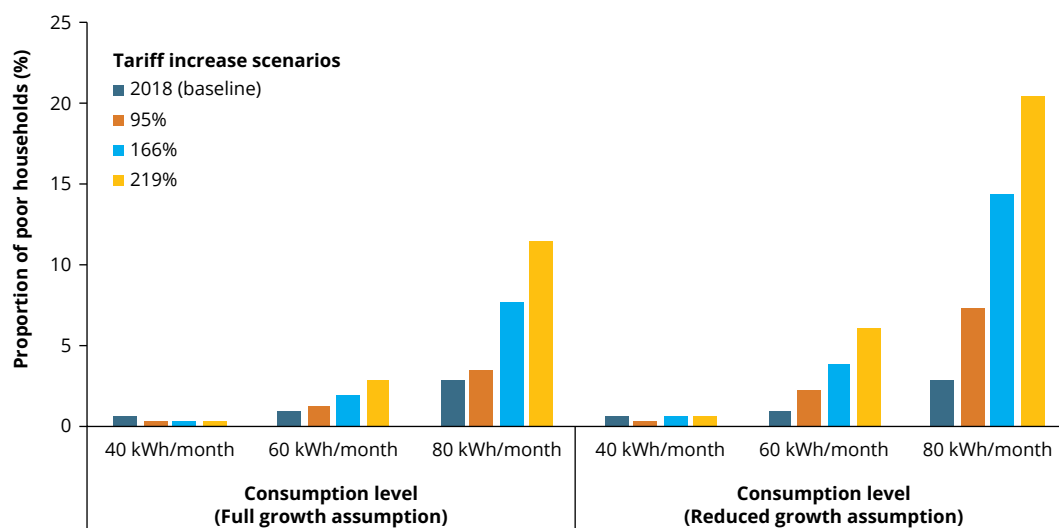
The distributional analysis indicated that electricity consumption would remain affordable for households already connected to the electricity grid (mainly households in the capital, Conakry) for all tariff increase scenarios, and for all the basic electricity consumption bundles considered.

For poor rural households and households in secondary cities, which were mostly unconnected at the time of the analysis, affordability of electricity, assessed at the threshold of 3 percent of total household expenditures, had the possibility of becoming an issue in the higher price increase scenario, as shown in figure 3.1. According to the analysis, when lower growth rates were assumed, up to 20 percent of households would spend more than 3 percent of their household budget to pay for a consumption level of 80 kWh/month. If incomes were to grow in line with inflation, the proportion of poor households whose consumption would be above the affordability threshold would be reduced to 11 percent.

²⁸ The assumption of individual metering remains a simplifying assumption for a context such as the Guinean one, where shared connections are common among the poor. The 2021 increase of the fixed charge from 4,850 GF to 10,000 GF per month will provide even more incentives for households to share a meter.

FIGURE 3.1

Guinea: Poor Households above Affordability Threshold, by Consumption and Tariff Scenario



Source: Authors' calculations based on updated Enquete Legere pour l'Evaluation de la Pauvrete 2012.

Note: Affordability threshold is 3 percent of total household expenditure. The full growth assumption assumes uniform income growth in line with expected inflation; the reduced growth assumption is more conservative, with poor households' income increasing by half the expected inflation growth rate. kWh = kilowatt-hour.

A lower consumption level of 60 kWh/month would remain affordable for most poor households. Because the first 40 kWh consumption block has been protected from higher increases (the price increase in this bracket is lower than inflation), this consumption level would remain affordable for all poor households under all increase scenarios conducted.

Alternatively, considering a 5 percent affordability threshold as used in the Sustainable Energy for All Framework (Bhatia and Angelou 2015),²⁹ consumption of up to 80 kWh/month (the estimated average consumption) would remain affordable for all poor households under all tariff increase scenarios assessed. The analysis indicated that regardless of which tariff increase scenario is chosen to bring tariffs closer to cost-reflective levels, a subsistence consumption level could benefit from being spared from significant tariff increases, and it is critical for poor households to have the ability to control their billed consumption through actual metering or a specific fixed fee based on household equipment or electric features. It is worth noting that the scenarios assessed at

²⁹ Bhatia and Angelou (2015, 75), in their work *Beyond Connections: Energy Access Redefined*, define affordability as follows: "To be affordable, a stipulated [electricity] consumption of 365 kWh per year [about 30 kWh/month] should cost less than 5 percent of the household income." A 3 percent threshold is also commonly used for Sub-Saharan Africa (Briceno-Garmendia and Shkaratan, 2011).

the time did not include a switch to a volumetric tariff (where the social tariff is available only to consumers below the threshold), which would have a high impact on households consuming just above this usage threshold, whether large households or households sharing meters, nor did the assessments include any increase in the fixed charge.

The actual 2019 price increase for residential users was limited to 5 percent, on average; thus, the total estimated impact remained insignificant, even after including indirect effects on poverty incidence through the impact on the prices of other goods as estimated through an additional analysis that was part of a Poverty and Social Impact Analysis. Because this increase followed a 25 percent price increase for nonresidential users in 2018, the combined direct and indirect effects of the 2018 and 2019 increases on poverty were estimated at 0.15 percentage point. There is also an effect on the poorest (households that were already poor before the price increase) through the increased expenditures, thus on poverty severity: the poverty gap increased by 0.11 percentage point.

The analysis indicated that investing in social safety nets could prove very important in channeling direct support to low-income households facing issues of electricity affordability as electricity access is expanded. Indeed, the expansion of the country's social assistance programs was one of the government's priorities under a three-year IMF Extended Credit Facility signed in December 2017, along with a commitment to gradually reduce untargeted electricity subsidies to create fiscal space for public investments in infrastructure and to strengthen social safety nets. The government expressed its intention to use part of the savings from the electricity tariff reform to scale up social assistance programs in 2019 and mitigate the impact of the increase in petroleum product prices (through targeted cash transfers to poor households in urban and peri-urban areas, the most affected by the increase in petroleum product prices) as well as for labor-intensive public works (IMF 2019).

The case study for Guinea highlights a situation in which modeling was needed to simulate alternative reform scenarios in a context with substantial data challenges. In this case, publicly funded indirect electricity tariff subsidies, representing about 1.7 percent of GDP—about the size of public spending for education—were providing benefits to a limited share of the population already connected to the grid, while at the same time expansion of electricity access to poorer households remained a national priority. The methodological approach chosen was useful for understanding the distributional impacts of price reform in a data-constrained setting by adjusting household data to the time frame of the reform. The detailed analyses carried out as part of this exercise contributed to the government's own analysis and decision-making by limiting the price increase for low electricity consumers in the path to cost recovery.

3.2 Analysis of Electricity and Fuel Subsidies as Part of a Broader Fiscal Incidence Assessment: Indonesia, 2014–18

This case study was selected to illustrate a broad distributional analysis of fiscal policy using a CEQ approach to assess direct and indirect effects of fiscal policy tools, including consumption taxes and energy subsidies.

This approach was especially useful in highlighting the fiscal magnitude and distributional impact of energy subsidies relative to other, more effective and pro-poor social programs. Given the substantial indirect effects of fuel subsidies on prices of all other goods and services, this case also demonstrates the usefulness of a limited general equilibrium approach to account for those indirect effects in addition to the direct effects from households' fuel consumption.

3.2.1 Background and Context

Energy subsidies in Indonesia were estimated to be equivalent to 3.7 percent of GDP in 2012 at the time of the analysis, corresponding to about 23 percent of total government expenditure.³⁰ These subsidies were almost as much as total social spending on priorities such as education, health, direct cash transfers, and contributory pensions, which amounted to 25 percent of total expenditure. In the 2014–15 period, the government of Indonesia introduced ambitious reforms to reduce untargeted energy subsidies and reallocate expenditures to programs that reduce inequality and foster balanced economic growth (Jellema, Wai-Poi, and Afkar 2017). Among measures taken were the removal of subsidies for low-octane gasoline, the reduction of the subsidy on diesel, and approval of electricity tariff increases for several consumer categories. In 2017, the conditional cash transfer program increased to 10 million beneficiaries (Tiwari et al. 2020). With all these measures, the aggregate energy subsidy figure decreased from 3.7 percent of GDP in 2012 to 1 percent in 2018. This section summarizes the approach and key findings from the two analyses carried out in the context of World Bank support to the government of Indonesia. The most noteworthy findings of the analysis were related to the regressivity of untargeted energy subsidies and the inefficiency with which it supports the bottom of the income distribution.

³⁰ In 2021, energy subsidies in Indonesia bounced back to 2.7 percent of GDP (see appendix A for the fossil fuel subsidy variation in US dollars between 2010 and 2021 using IEA data).

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